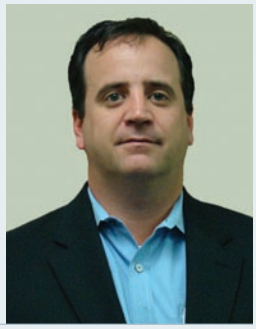
Single-source approach speeds delivery, mitigates risk for radar and signal processing systems



By Rob Hoyecki

EDITOR'S NOTE

Radar and sonar systems are hugely complex animals. They don't just rely on garden-variety single board computers; they need sensor processor front ends, intermediate signal converters, legacy military interfaces, graphics processors, and other functions. Rob Hoyecki cautions that because of the complexities involved, it's advisable to stick with a single systems integrator to pull all these bits together. – Ed.

Today's radar and signal processing customers just might find that a single-source vendor is key in solving the integration and interoperability issues that often prevail in these complex systems.

Providing radar and signal processing customers with a single-source subsystem lets embedded COTS vendors offload the system integrator and helps to ensure an optimally cohesive, tightly integrated solution. This frees the integrator from the daunting challenge of identifying the various suppliers and functional modules needed to meet the system's functional requirements – and afterwards, to make these various components work together seamlessly.

In the past, radar processing involved distinct stages. The acquisition system did its job and passed the data through a pipe to the DSP system. Once the DSP system was done, the data was then passed through another pipe to General Purpose Processors (GPPs) for pattern analysis, database management, user displays, and so on. Typically, each of those pipes was a unique, self-contained element (FPDP, Fibre Channel, and so on) likely provided by different vendors. Pipe "A" needed to be integrated into both the acquisition system and the DSP system. Then pipe "B" needed to be integrated into both the DSP and GPP systems, after which a graphics controller would be integrated into the GPP system, and so on. Fabrics such as Race/Race++, Myrinet, and SkyNet did a pretty good job at tying the various DSP processors together, but support for these was limited among the other subsystem components.

Today's radar processing systems are much more complex. There is greatly increased interaction between acquisition components, FPGA processing, DSP processing, general purpose processing, and command and control. Acquisition boards and FPGAs may be rapidly adjusted to different mission modes. Processing tasks may be redistributed among the DSP nodes, and applications running in the GPP system may be controlling these activities and monitoring the overall system for health. GbE with TCP/IP, Serial RapidIO, and PCI Express all help by providing industry-standard communications fabrics. In addition, software drivers and communications middleware are needed to quickly accomplish such complex interprocessor communications systems. A single-source provider, able to offer a range of products from individual components to complete packaged solutions, greatly eases the integrator's challenge. By delivering a broad range of products in all of the required subsystem spaces, a single-source vendor makes it much easier for the customer to mix and match components to best meet their specific needs.

Radar systems use a wider variety of functional product types compared to other embedded systems. For example, a mission computer may comprise a 1553 interface, a graphics interface, and a general purpose processor. A radar processing system, in addition to the elements of a mission computer, may also include high-speed analog-to-digital conversion, user-programmed FPGAs, and multiprocessor solutions. Radar systems also require a greater scope of software products. In addition to BSP interfaces, a radar developer will be working with FPGA IP toolkits, signal processing libraries, and multiprocessor communication packages. This means that a radar system developer selecting various functional elements from multiple vendors has a bigger integration challenge than that faced by integrators of less complex embedded systems.

Increasingly, customers seek a vendor who can both provide the system's embedded modules and define the enclosure around the boards. Packaging requires expertise in the fully qualified high-speed signals on the backplane. A single vendor can control I/O choices, making the system integration problem significantly easier from a hardware perspective. Curtiss-Wright, for example, optimizes interoperability by basing all of its new products on three high-speed interface types: GbE, PCIe, and Serial RapidIO. Providing common interfaces for the system's FPGAs, SBCs, and dense PPC processing cards helps streamline the integration process. In the past there were many different I/O types that might be used across a signal processing system backplane, for example, Myrinet, SkyNet, and Race/Race++. Much work was typically required to convert mismatched cards to enable them to support the desired I/O. Ensuring common board pinouts is another advantage that a single-source vendor can provide. When a single vendor defines and ensures correct board pinouts, data flows across the backplane can be vastly improved.

The newer high-speed fabrics such as Serial RapidIO are very flexible, which eases the addition and removal of different card types, such as FPGA boards or quad PPC processors. Unfortunately, simply selecting a Serial RapidIO backplane

doesn't solve all the integration challenges. While these advanced fabric technologies deliver breakthrough bandwidth, they also require drive and equalization tuning, as well as careful backplane design. Sourcing the system components from a single vendor ensures the integrator that the components have been tested together, mitigating interoperability issues for these high-speed interfaces.

Support also needs to be provided for functions such as insertion and removal of nodes and the enumeration algorithm used across the system. When adding advanced system-level features, such as system analysis, sourcing from a single vendor makes it much more likely that these issues have been looked at and addressed.

Even when amortized across production, software development expenses can be a big part of the cost to the end user in military systems because production rates are low. A key advantage provided by a single-vendor approach for radar processing is the minimization of software costs. Curtiss-Wright has developed a Continuum Software Architecture (CSA) approach to provide common software interfaces across disparate products. CSA enables us to support our new FPGA, DSP, and SBC products with common APIs, which speeds and simplifies system integration and later technology upgrades. Other tools, such as Continuum IPC and Continuum Insights, further ease the integration task by simplifying interprocessor communications among the various processing elements (not just the DSP nodes). These tools also give the integrator a system-level view of what's happening in their system, along with system-level debug capabilities. These all add up to an unprecedented amount of control over the system integration task.

It is common for radar imaging system processors to be loaded at nearly 100 percent capacity. This level of performance drives the need for more advanced system software development tools than the relatively simple single processor debuggers that are part of a typical development tool chain. Curtiss-Wright and other vendors offer extended software development tools to enable developers to more easily manage and debug complex multiprocessor software. These tools tend to be vendor-specific, which means that optimal performance is delivered when used with single-sourced hardware. Use of products from multiple vendors may forgo the use of such tools, or at least require the complexity of managing and learning a disparate collection of development tools.

As vendors expand their ability to provide complete signal processing products, new market opportunities that formerly required a custom solution are emerging – and can be addressed with open standard COTS products. Increasingly, the ability to scale systems, ensured by the interoperability provided by a single source, is desired and demanded by COTS customers who look to vendors to be able to add more of the solution. This trend is opening new application opportunities – such as large 3D radars and multimode radars for SIGINT – for embedded COTS vendors.

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