Board and Box Level Systems Face SWaP Design Challenges

Reducing size, weight and power of military systems remains a challenge, especially when shrinking budgets are putting pressure on costs. The modular nature of open architecture provides a path for having the best of both worlds.

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Designing board- and box-level systems utilizing a modular open architecture addresses three of the biggest challenges facing military system designers today: time-to-deployment, SWaP (size, weight and power) and shrinking budgets. The modular nature of open architecture provides both exceptional longevity and maximum flexibility as subassemblies and even complete sub-systems can be upgraded without requiring a custom data acquisition system or a complete system redesign. Open architecture can even help engineers avoid redesigning their systems to meet changing mission requirements.

Time-to-Deployment

There are many single board computers (SBCs), I/O and communications boards and power supplies available on the market. Many of them meet demanding application requirements and deliver solid performance with adequate software support. However, problems can arise when engineers need to design a functional system around these individual boards, which often come from different suppliers. The system I/O integration part is not always so easy and often leads to delays. In fact, it usually involves making some difficult tradeoffs in terms of price, performance, footprint and time-to-deployment.

When building mil-aero systems that include complex I/O requirements, it is important and preferable to utilize COTS components that enable a smarter, faster, more efficient system design at a lower cost. A different COTS approach could be one that features pre-tested, modular sub-systems that are specifically designed for sensor-rich, mil-aero applications.

For example, a Custom-On-Standard Architecture (COSA) from North Atlantic Industries takes a unique modular approach. COSA is comprised of I/O function modules on individual standard board platforms that allow users to mix and match field-proven I/O functions to meet specific customer requirements. COSA enables customizable, highly programmable I/O and SBC boards, sub-systems and systems with off-the-shelf efficiency that significantly accelerate a customer’s time-to-mission. Utilizing multifunction modules built on standard board platforms, the modular and adaptive technology provides plug-and-play interoperability.

COSA-enabled solutions eliminate the need to design custom data acquisition systems for most sense-and-response applications by using configurable, pre-tested hardware, which facilitates faster system integration. Instead of spending months specifying, designing, building and testing the underlying data acquisition system, design engineers can immediately begin focusing their efforts at the application level. Programmable intelligent I/O modules deliver significantly more functionality and flexibility in a smaller footprint, in less time, reducing overall time-to-deployment. Figure 1 is an example of a 6U VME multifunction I/O board.
TECH RECON

Focus on SWaP

An open architecture design approach centered around distributed processing and distributed I/O can provide an extensive list of field-proven I/O offerings in small, modular packages that feature greater flexibility and higher density than conventional rugged COTS solutions. Designers do not need to compromise size, weight and/or power, as the highly configurable and modular function modules are designed to solve the specific I/O, measurement or simulation requirements encountered in demanding applications (Figure 2). These requirements can include I/O density, performance, processing speed, power considerations, bandwidth and reliability, to name a few. Design engineers can discover that they don't have to trade performance for footprint, power consumption cost or development time.

For example, on a standard rugged 6U VME SBC, instead of providing two PMC/XMC slots, a COSA approach offers customers the ability to mix and match up to six high-density, intelligent I/O and communications function modules. On a 3U board, design engineers can mix and match up to three I/O and communications function modules. COSA enables the utilization of a wide selection of function modules (40+ unique functions) so that virtually any embedded system design requirement can be met. Rugged system chassis offerings range from a one I/O function NANO to a Sensor Interface Unit (SIU) containing up to 15 high-density I/O or communication functions with or without an SBC (Figure 3). A COSA design platform also provides a proven and seamless software integration, enabling complex I/O functions to be easily integrated into an existing system.

Shrinking Budgets

Budget cuts are nothing new to the U.S. military, as the Department of Defense (DoD) continues efforts to reduce costs. The DoD funding has recently experienced a significant reduction as a result of the U.S. government’s budget restraints. During 2013, the inability to balance the national budget forced the U.S. government to impose a limit-called sequestration-on government spending and temporarily shut down government operations. Uncertainty around government spending has many program managers pulling back on important battlefield management systems (BMS), according to research firm and consultancy Frost & Sullivan.

As defense budgets tighten, research and development (R&D) on BMS improvements are expected to remain stagnant-putting U.S.-developed BMS at a disadvantage. One of the ways defense contractors cope with budget constraints is by moving from military-specification (mil-spec) components to COTS devices. Government contractors have been transitioning to COTS in an attempt to save costs associated with mil-spec devices. Companies with BMS offerings that can be easily upgraded to integrate with commercial off-the-shelf technologies and capabilities will gain firm standing within this market space, the consultancy added.

With respect to budget constraints, designing with a modular, open architecture greatly reduces engineering efforts to complete the system. The adaptive nature of a COSA platform usually only requires a quick configuration of a set of standard products to meet application specifications. Intended for complex I/O operations, COSA-enabled I/O functions support all of the different sensors required in mil-aero applications. As a result, a modular, open architecture design platform eliminates non-recurring engineering (NRE) fees to configure a system.

Managing Longevity

The rapid rate of component change-over associated with the commercial market is a concern for mil-aero companies. It forces mil-aero program managers to
constantly track the market to deal with perpetual, unanticipated product obsolescence. Utilizing COTS suppliers, the program manager offloads much of the tracking and obsolescence maintenance to the supplier. Designed to ensure long-term viability of mil/aero products, the modular nature of an open architecture approach provides both exceptional longevity and maximum flexibility as subassemblies and even complete systems can be upgraded without requiring a complete system redesign. This is an especially attractive feature to organizations faced with shrinking budgets and time constraints.

In general, the lifespan of commercial hardware and software is significantly shorter than the lifespan of most military programs. This forces military program managers to develop specific timelines for COTS insertions and upgrades to meet changing program requirements. Open architecture design platforms allow mil/aero products to be developed with insertion cycles in mind. Maintaining form, fit and function upgrade compatibility ensures that customers don’t have to design “around” their systems to meet changing mission requirements. As technologies advance, insertion cycles can be accomplished with seamless transitions in functionality, performance and support.

Compatible with proven VME, Open-VPX, PCI/PCIe, cPCI, PC/104, PMC and VXI platforms, COSA-enabled embedded solutions can be configured from more than 40 off-the-shelf modules including I/O, measurement/simulation, communication and power as well as single board computers.

**Configurable Solution**

A Custom-On-Standard Architecture design platform enables customizable and highly configurable boards, self-standing subsystems and systems to be developed with off-the-shelf efficiency. Utilizing multifunction modules built on standard board platforms, the modular and adaptive technology delivers SWaP-efficient I/O-intensive boards and systems with more processing power, under tighter timelines at a lower system cost.

This approach provides distributed I/O and processing solutions that meet demanding customer requirements, in less time, with less weight, less program risk, no special code required and no NRE. With COSA design principles and disciplines, engineers can get a completely integrated and tested solution, not just hardware, in less time at a lower cost.

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Rugged Systems - Configure to Customize

NAI's COSA™ architecture allows you to integrate multi-function I/O, SBCs, power supplies, and software into a rugged enclosure of your choice. Pre-existing, fully tested functions can be combined in an unlimited number of ways — quickly and easily.

**Functions**

**I/O**
- A/D
- D/A
- Discrete
- Isolated Discrete
- TTL
- Differential Transceiver
- Relay

**Measurement/Simulation**
- Synchro/Resolver to Digital
- LVDT/RVDT to Digital
- Digital to Synchro/Resolver
- Digital to LVDT/RVDT
- AC Reference
- RTD
- Thermocouple
- Strain Gage

**Communications**
- MIL-STD-1553
- RS-232/422/423/485
- ARINC 429/575
- CANBus
- *Ethernet Switch

**Power Supplies**
- DC Input
- AC Input

**Single Board Computers**
- Intel® Core™ i7
- Intel® Atom™
- Freescale™ QorIQ P2041
- ARM Cortex™ A9

**Memory**
- SATA 256GB

**Boards**

**Chassis**
- NIU1A: 1 function, 1 module
- SIU33: 3x3U cPCI slots, 9 functions
- SIU35: 5x3U cPCI slots, 15 functions
- SIU62: 2x6U VME slots, 12 functions

*Occupies 2 module slots*

**Operating Systems**
- Windows® Embedded 7
- Wind River® Linux
- Wind River® VxWorks®
- Altera® Linux