Deployable xTCA Platforms Fuel Net-Centric Application

Together ATCA and MicroTCA are finding solid opportunities in key military applications where performance and bandwidth rank as high priorities.

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Broad new military initiatives such as the U.S. Navy's (CANES) Consolidated Afloat Networks and Enterprise Servers, Brigade Combat Team Modernization, (JTRS) Joint Tactical Radio System and (WIN-T) War fighter Information Network-Tactical (Figure 1) are bringing greater levels of networking capabilities to various deployed and ground command units. Complex network-centric systems that meet a diverse set of application requirements support these evolving programs and at the same time must meet the military's mandates for security, mobility, flexibility and ruggedness.

When weighing the options for an embedded computing solution, it is typically an application's size, weight and power (SWaP) requirements that continue to be a deciding factor in selecting an optimum platform. However, designers of network-centric applications for command and control now have expanded demands for higher computing performance, system throughput, high availability and a greater need for larger memory capacities and more sophisticated signal processing, all delivered in an open and standardized COTS form factor. While tried and true embedded computing platforms such as VME and CompactPCI remain attractive for many military communications applications, system designers have started to focus on standards-based AdvancedTCA and MicroTCA platforms that have been well proven in the communications market for these new network-oriented military programs.

Overlapping Telecom and Military Needs

The open modular computing specifications from PICMG for AdvancedTCA and MicroTCA were specifically designed for the demanding telecommunications market and are integrated with a long list of leading-edge features and server class performance that are well positioned to meet the military's broader requirements for networking applications. Both platforms are designed to provide reliable

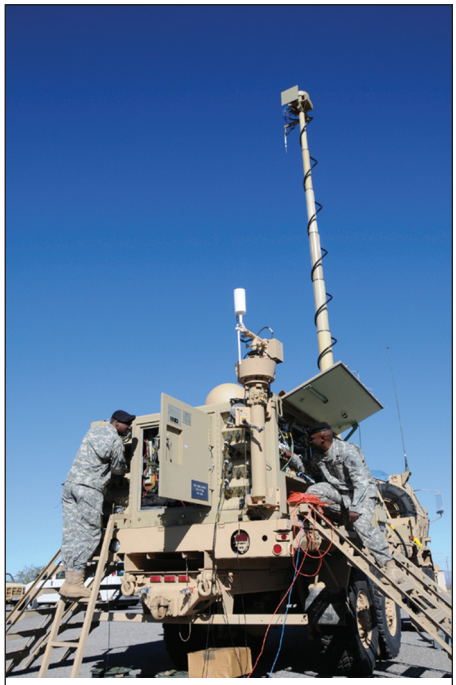

Figure 1

Soldiers from the Training and Doctrine Command (TRADOC) Capabilities Manager Networks and Services examine WIN-T equipment during the WIN-T Increment Two Engineering Field Test at Fort Huachcuca, Ariz. last December.

performance while reducing development and operational costs. This design architecture allows for the high-performance operations and expanded communication capabilities needed for the military's diverse operational needs, particularly when higher performance is required. With their proven combination of performance and reliability, each has found a place in network-centric military applications, bringing distinct advantages depending upon program specifications.

MicroTCA has a small form factor advantage over both VME and CompactPCI including their derivatives VITA 31, VITA 41, VITA 46 and PICMG 2.16. MicroTCA blades are smaller and use less power, yet they can still deliver more communication bandwidth and higher computational abilities by using multiple processors on a single backplane. VME or CompactPCI designs can match this performance in 6U, but fall short when modified to 3U. And at 2U x 3-6HP x 183.5 mm, MicroTCA may be one of the larger small form factors, but is still more compact than 3U VME or CompactPCI.

A Compelling Case for xTCA

AdvancedMCs together with AdvancedTCA and MicroTCA have been defined by market research company VDC as the xTCA architecture. All are the result of current and expanding PICMG specifications and have demonstrated their worth as more than viable solutions for next-generation systems. Of specific importance to the risk-adverse military market, xTCA platforms have been proven for more than six years in the telecommunications industry. This sustained continuity of deployed technology fits the demands of military systems. Not only is xTCA a mature, readily available architecture that touts broad industry adoption, but it offers a diverse ecosystem of hardware, software and design resources to support it. This comprehensive ecosystem ensures that innovation remains high, and the list of industry-leading suppliers that support life cycle and logistics help keep costs down.

In addition, the ability to leverage an established and modular standards-based COTS platform simplifies the design process for developers aiding design flexibility and interoperability while helping system architects meet application specifications, decrease development time and reduce operational costs. With these demands fulfilled, military suppliers are better able to satisfy tighter time-to-market schedules with less risk. AdvancedTCA, in particular, has been widely adapted due in large part to its sustainable interoperability demonstrated in more than six years of deployments.

Ongoing PICMG Work

PICMG is a consortium of companies who collaboratively develop open specifications. For the xTCA architecture, this group has combined all the best features of proprietary architectures and other standards to initially meet the high-density, reliability, availability and serviceability needs of the telecommunications industry. Military system suppliers are confronting many of the same challenges faced by Network Equipment Providers. Designed for NEBS Level 3 requirements for ruggedization, these xTCA platforms address similar military requirements for extended thermal management, fire suppression, electromagnetic compatibility and the ability to continue working during extended mechanical environmental conditions such as shock and vibration. Military designers can be assured that these platforms are rugged enough for many ground installations and wide-body airborne applications.

PICMG is also working on an extension of the base MicroTCA specification to MTCA.3. MicroTCA.3 will standardize a conduction-cooled build grade allowing AdvancedMCs to meet ANSI/VITA 47's most extreme thermal, shock and vibration profiles. This would then allow reliable performance in conduction-cooled system applications for ground mobile and other airborne environments. Independent third-party tests currently being conducted have proven MicroTCA will qualify to these environments offering systems designers another high-performance option for future military embedded designs. Already adopted ruggedized specifications for MicroTCA include rugged air-cooled MicroTCA (MTCA.1) and a hardened MicroTCA for military applications (MTCA.2). Table 1 summarizes the timeline of these PICMG spec efforts.

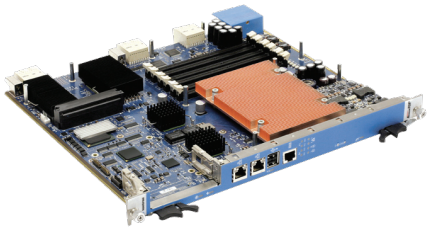

Figure 2

The AT8060 is a drop-in compatible Intel Xeon 32 nm, 6-core AdvancedTCA node Blade.

AMCs Smooth the Way

AdvancedMCs provide flexibility to AdvancedTCA platforms by giving developers the ability to add specific features or functions as mezzanines. AdvancedMC's usage has broadened, however, from its original purpose modules as a mezzanine-only building block to an AdvancedTCA Blade or system. In a more recent usage model in MicroTCA platforms, AdvancedMCs provide full-scale PCI Express, 1 and 10 Gigabit Ethernet or serial Rapid IO (s-RIO) infrastructure. This new usage model provides a lower-cost backplane and enclosure solution with the same basic features of the

Figure 3

ATCA is being evaluated for integration into airborne applications on widebody aircraft such as AWACS. The E-3 Sentry is a modified Airborne Warning and Control System (AWACS) Boeing 707/320 commercial airframe with a rotating radar dome.

MicroTCA Specification Timeline

MTCA.0	MicroTCA	R1.0	6-Jul-06	Adopted	Define a system architecture that uses AdvancedMC mezzanine cards plugged directly into a backplane without modifications
MTCA.1	Air-Cooled Rugged MicroTCA	R1.0	19-Mar-09	Adopted	Ruggedized version of MicroTCA for exterior and mobile communications applications
MTCA.2	Hardened Air-Cooled MicroTCA			Under Development	Expand the market for MicroTCA into commercial and military ruggedized applications
MTCA.3	Hardened Conduction-Cooled MicroTCA			Under Development	

Table 1

MicroTCA ruggedization efforts include independent third-party tests and work within PICMG committees.

PICMG3.x in a smaller footprint.

From a technology perspective, xTCA utilizes multicore processors for the intensive computing performance needed for networking and hosting a variety of applications. In fact, an AdvancedTCA Blades, featuring a new six-core processor can deliver up to 10 times the throughput with an Intel Xeon processor at 2.56 gigabytes per second when compared to other legacy standards and represents a threefold increase in bandwidth over previous processor generations.

For example, the WIN-T program leverages these proven xTCA telecommunication industry functions such as interconnects, high availability and software protocol stacks. AdvancedTCA and MicroTCA platforms offer ideal native support of Internet protocol-based network topologies found in the network-centric nature of WIN-T. In particular, the secure network approach to warfare is an ideal fit for the features of the AdvancedTCA and MicroTCA platforms, characterized by high processing capacity, extremely high communication bandwidth and high availability.

Cost pressures and time to deploy challenges in the defense electronics market are driving system designers to leverage commercial products and technologies for their next-generation platforms. Old stovepiped solutions are giving way to open-standard, COTS solutions, which can deliver on all the important demands requirements for next-generation military deployments. Proprietary platforms simply cannot sustain the military's crucial need for more performance, high reliability, ruggedness, interoperability and demonstrated product longevity.

Leading-Edge xTCA Platforms

Today's xTCA platforms take advantage of highly integrated processor architectures and updated chipsets to achieve higher computing density and deliver better power-to-performance ratios. This architecture advantage ensures technical leadership and the highest level of security for the continued advancement of our modernized military operations. Leveraging more I/O per slot, accelerating I/O traffic and lower CPU utilization in both native and virtualized environments are vitally important for next-generation military networks. The xTCA architecture and platform chipsets can support up to 36 lanes of PCI Express and directly assignable I/O for virtualization. Virtualization will be a key technology to boost operating system and network utilization without increasing system costs, and enable cross domain and secure applications to leverage common computing platforms.

Additional xTCA platform features are available to ensure interoperability, reliability and network functionality. These include full IPMI and supervisory remote control capabilities with power on-off, clean shutdown, warm reset/cold reset controls via any IPMI channel

including LAN even when the payload power is off. For the applications that can allow removable storage, the option exists to have a rear transition module built with a SAS controller or an AdvancedMC module that can support a hot swappable SAS/SATA storage.

Maximizing Memory

Another significant benefit of the AdvancedTCA architecture is that it allows maximum use of available memory—much more than other platforms, with today's boards supporting up to 48 Gbyte DDR3. Scalability is also enhanced with simplified upgrades that enable the exchange of existing node blades without having to upgrade the chassis platforms.

The most sophisticated AdvancedTCA boards today are PICMG 3.1 Option 9, Option 2 compliant. An example of a high-performance AdvancedTCA board is the Kontron AT8050. It features outstanding performance with 10 + 10 Gbit Ethernet on the fabric interface, plus two 10/100/1000 Mbit/s Ethernet on the base interface and two 10/100/1000 Mbit/s Ethernet via the front panel or RTM. In addition, the Kontron AT8050 (Figure 2) is a single-socket processor blade and, as opposed to a dual socket approach, enables designers to make use of the one available AdvancedMC slot for further feature extensions.

xTCA Finds a Niche in Military Applications

The case has definitely been made for the compelling advantages of integrating proven xTCA COTS platforms into defense network-centric military command, control, communications and computing systems. xTCA provides an optimal embedded computing platform able to meet the military's high-reliability, high-performance, life cycle management and sustainable technology requirements.

The flexibility of the architecture enables a wide range of applications along with helping suppliers meet strict program completion goals. Suppliers are already evaluating AdvancedTCA platforms for integration into airborne applications on widebody aircraft such as P8, AWACS (Figure 3) and AEW&C; ground deployable command and control and combat operations, as well as in shipboard network enterprise computing systems. Designers have found that xTCA's leading-edge features and server class performance are well positioned as a viable upgrade path for a growing list of evolving initiatives. ▮▮

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