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White Paper

Upgrading your Legacy VME and CompactPCI Systems to MicroTCA

Many design engineers are looking to upgrade from their legacy parallel bus systems to a new architecture. Legacy VME and CompactPCI simply do not have the bandwidth and performance for most embedded computing applications. They can still have a niche in specific designs where a bus-based approach is acceptable – less reliability and significantly lower throughput. However, most board vendors are investing their resources in the newer, more powerful architectures.

MicroTCA was developed by the PICMG® group, the same organization that created CompactPCI in the 1990's (and many of the same companies that created VME in the VITA® group), and is a good fit for a wide range of applications because of its high performance-to-size ratio and versatility. The architecture has benefits over other form factors due to its robust system management, inter-processor bandwidth, and high-reliability features. In addition, the open-standard COTS architecture is typically more interoperable and lower cost than competing standards.

Applications

MicroTCA has some primary markets that drive the bleeding edge performance and innovation. These are MIL/Aero, Communications, and High Energy Particle Physics. In the Mil/Aero market, Electronic Warfare (EW) applications drive powerful DAQ, A/D & D/A converters. The Physics community needs the highest performance digitizers, with more channel options, and various RF boards for Low Level RF, beam position monitoring, and other requirements. In Communications applications, the push for faster networking has driven 100G processors and FPGAs. MicroTCA also offers a wealth of high-end storage, graphics, I/O, FPGA and other boards which make the ecosystem rich and diverse. The result is a highly versatile, compact COTS architecture that is well-suited to a wide range of applications.

Figure 1 shows the various markets where MicroTCA is a good fit and some of the key products/features for those industries. Note that for simplicity sake, not every single market or product type is listed. This list is meant to be a simple, but comprehensive representation.

Figure 1

	MARKETS	PRODUCTS & FEATURES
MIL/AERO	• RADAR/Jamming • Comm/Network • Security/LTE • SONAR • Video (EO) Processing • Recorders • Simulators • SDR	• High GSPS A/D & D/A Modules • Storage Modules • Video/Image Processing Modules • Graphics Modules • Networking/Processor Modules • RF Modules • DAQ Modules • FPGAs • Hardened Rugged Chassis Platforms
COMMUNICATIONS	• LTE/4G/5G • Access/Edge • Networking • Network Security • Communications Test	• 100G/40G/10G Processing Modules • 100G/40G/10G FPGA Modules • Network Interface Modules • 40GbE Chassis Platforms • Packet Processor Modules
TRANSPORTATION	• Railway • Traffic Mgmt Systems • Transport Mgmt Systems • Comm/Network	• Rugged Chassis Platforms • Networking Modules • Remote System Mgmt • Carrier Locators • Processor Modules • Storage Modules
PHYSICS/LAB	• Beam Position Monitoring • LLRF • Research • Nuclear Test Systems • Telescope Control Systems	• A/D & D/A Converters • High Speed Processors • 40G MCH with Signal Conditioning • Specialty RTMs • DAQ Modules
ENERGY	• Oil Platforms • Power Distribution Systems • Turbine Control Systems • Geographic & Meteorological Mapping	• Rugged Chassis • Video/Image Processing Modules • Graphics Modules • Networking Modules • High-end Processing Modules • Remote System Mgmt
HIGH PERFORMANCE INDUSTRIAL	• Industrial Control • Fabrication/Lithography • Semiconductor Test • 3D X-ray/Non Destructive Test • Geographic & Meteorological Mapping	• Networking Modules • Remote System Mgmt • Carrier Locators • Processor Modules

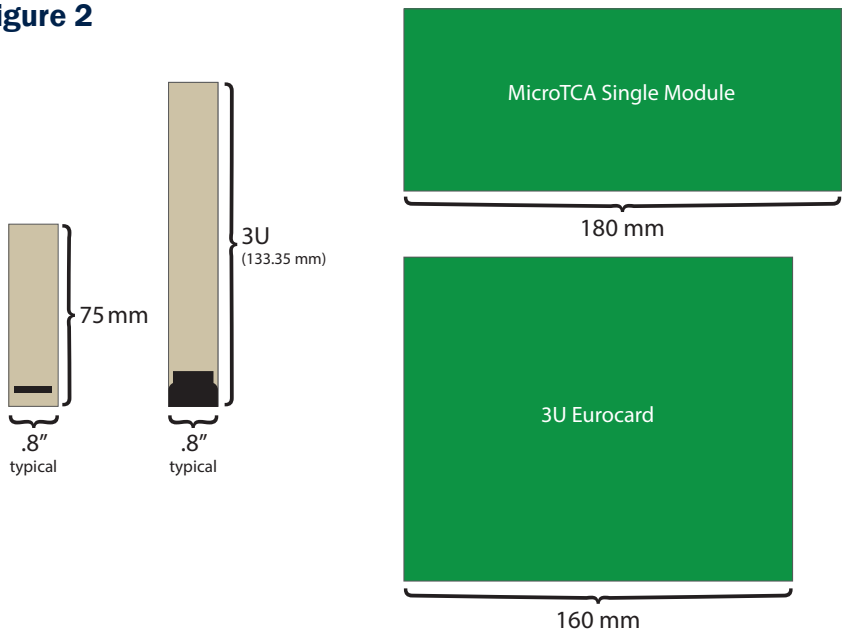
Figure 1 (con't)

MARKETS	PRODUCTS & FEATURES
BROADCAST • Video Processing • Media Transport	• Chassis Platforms with Rear I/O • Video Processing Modules • A/D & D/A Converters • High Speed Processing Modules • 40G MCH with Signal Conditioning • RF Modules
MEDICAL • PETScan • CATScan/tomography • MRI • Computational Analysis Systems	• GPGPU/graphics Modules • High-speed Processing Modules • 1U Chassis Platforms • Storage Modules • Video/image Processing Modules • A/D & D/A Converters
IOT/ NETWORKING • Network Aggregator • Network Security	• Network Interface Modules • Storage Modules • Carrier Locators & Mgmt • Remote System Mgmt

Eurocard vs MicroTCA

VME and CompactPCI are based on the 3U and 6U Eurocard form factor. A 3U (5.25" or 133.35mm) x 160mm or board takes up much more real-estate than a 75mm by 180mm MicroTCA single module. The same goes for the 6U size, it is 6U (10.50" or 266.70mm) x 160mm, much larger than 150mm x 180mm double module. See Figure 2 below.

Figure 2



As shown in the chart in Figure 2, the VME and CompactPCI architectures require a much larger form factor to provide far less bandwidth. The serial fabric approach of MicroTCA provides more inherent reliability. In the serial approach, if one serial lane has a problem it does not affect the other traffic lanes. In a parallel bus approach (VME and CompactPCI), the data goes across a shared bus so if there is a problem, it can affect ALL of the traffic on the bus.

Figure 3

	VME	VME64x	CPCI	MTCA
Board Height	133.25mm (3U) or 266.70mm (6U)	266.70mm (6U)	133.25mm (3U) or 266.70mm (6U)	75mm or 150mm
Board Depth	160mm	160mm	160mm	180mm
Pitch	.8″	.8″	.8″	.6″, .8″ (most common) & 1.2″
Bus/Fabric	Asynchronous parallel bus, 32 or 64-bit	Asynchronous parallel bus, 64-bit	Synchronous parallel bus, 32 or 64-bit	Serial fabric, 21 lanes at 10 Gbps each
Routing	Bus - single point of failure	Bus - single point of failure	Bus - single point of failure	Serial Fabric, Redundancy
Rugged	Yes	Yes	Yes, (concerns of bent pins)	MTCA.2, MCTA.3 specifications
Rear I/O	Yes	Yes	Yes	MTCA.4 specification
System/Health Management & Failover	No	No	No	Yes
Keying	Mechanical	Mechanical	Mechanical	Electronic
JTAG Integrated	No	No	No	Yes
Geographical Addressing	No	Yes	Yes	Yes
Advanced Clocking with Redundancy	No	No	No	Yes
High Availability (99.99999% uptime)	No	No	No	Yes

MicroTCA has defined ports for various signal types across the backplane to ensure interoperability. Serial fabrics such as PCIe (up to Gen 3), Ethernet (GbE to 40GbE), and Serial RapidIO (SRIO) can be routed across the fat pipes (ports 4-7) and extended fat pipe region (ports 8-11). There are also defined ports for GbE update channel (ports 0, 1) and SAS/SATA storage (ports 2, 3). Finally, there are other ports from 12-15 and 17-20 (extended region for user defined I/O, clocking, etc.), as well as other signals.

See our MicroTCA Overview Guide for more details on the MicroTCA Specification.

Less Known Features of MicroTCA

MicroTCA has several features that are not widely understood, but highly valuable for many applications.

- Hardware Platform Management (HPM) with E-Keying: Using IPMI-based HPM software, the MicroTCA Carrier Hub (MCH) goes through a specific process when booting. First, the MCH identifies all boards in the system (manufacturer, serial number, etc) and gets their power budget, including preventing an unknown/ wrong board from powering up. It will power up/ initialize the PSUs and fans, then turn on boards sequentially. If one board is eating up more power than its defined budget, the MCH has the ability to shut down that board and send a remote signal to be serviced.

- Redundancy/Failover: Redundant Power Modules (PMs) are mapped to the chassis power channels. In the event of PM failure the power to the chassis is not interrupted. Cooling redundancy allows the chassis to operate with a single Cooling Unit (CU) and still meet the cooling requirement. The redundant MCHs provide management failover capability with a primary MCH managing the chassis.

- Carrier Locator: MicroTCA offers a carrier locator option which is particularly useful where multiple chassis are located a network. The locator identifies the exact location of a chassis needing service. Imagine a remote location (like an oil platform) or data center with multiple chassis, the locator can help pinpoint the location, even in the dark.

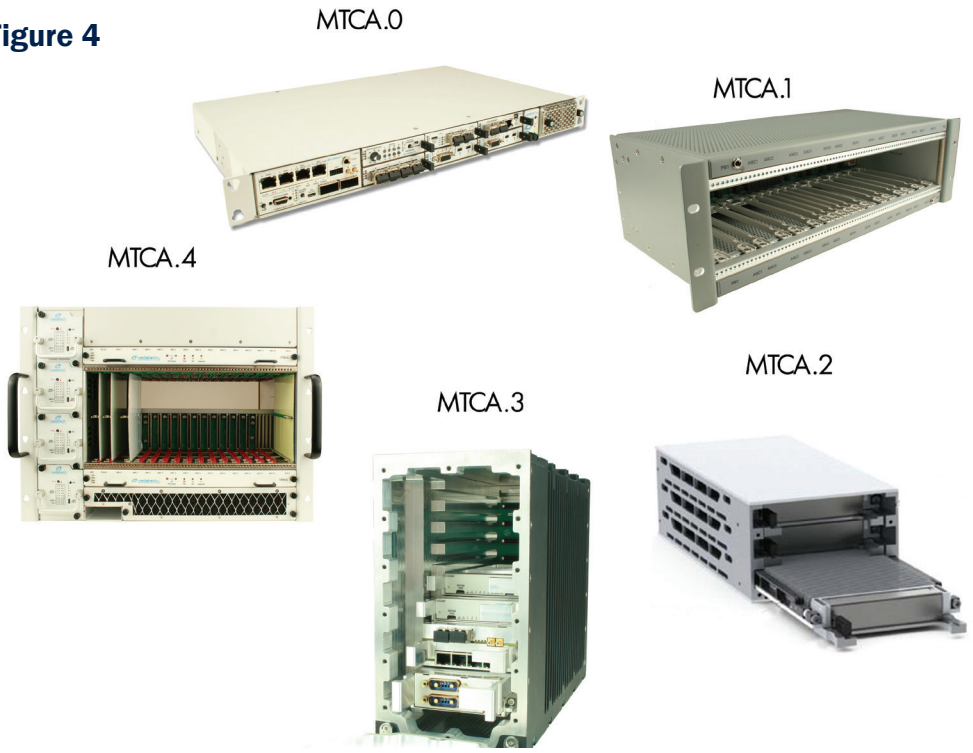
- JTAG: The JTAG Switch Module (JSM) allows dongles to be plugged for easy test and debug of all of the boards in the chassis. Since all slots/FRUs are managed and identified by the MCH, the JTAG allows the test and de-bug from one slot (instead of plugging to each individually). Further, de-bugging and software updates can be loaded via the JSM. There are also virtual JTAGs, where software and firmware updates can be done remotely. This is a significant benefit for applications where the physical chassis location is not easily accessible (satellite, oil platform, vehicle/craft, etc.).

Large COTS Ecosystem

The MicroTCA ecosystem is vast with hundreds of AMCs available in the market and dozens of standard chassis configurations. This includes horizontal-mount, vertical-mount and low profile. MicroTCA also provides multiple ruggedization levels including MTCA.0 (Core specification), MTCA.1 (Rugged Air Cooled), MTCA.2

Hardened Air/Conduction Cooled Hybrid, MTCA.3 (Hardened Conduction Cooled) and MTCA.4 (With RTMs for Physics, other applications)

Figure 4



The same AMCs can be used in all of these chassis types, including the hardened versions by adding clamshells to the standard modules. As MicroTCA is used in so many different markets, it is truly a COTS architecture. The resulting economies of scale help to keep costs significantly lower than competing high-performance architectures.

Cutting Edge Performance

As the MicroTCA architecture is also a key form factor of many Communications, MIL/Aero, and High Energy Physics applications, the push for cutting-edge design is prevalent. For example, there are currently solutions in the market for 40GbE (the specification is in draft). The industry's first 100G line cards (via the front panel) were introduced by VadaTech in the MicroTCA form factor. Other products of interest include:

- Tilera processor, 72 core
- Multi-GSPS A/D and D/A Converters
- 100G Altera™ FPGA and Cavium™ Processor
- Chassis platforms with 12 AMCs in 1U height
- Storage modules with SAS-3/SATA III with Host Bus Adapter and Integrated RAID
- FPGA Carriers with high GSPS FMCs & networking FMC
- MCH with 40G/PCIe Gen 3/SRIO Gen 2 plus IEEE1588/GPS/SyncE (See Figure 5)

Figure 5

CONCLUSION

When comparing MicroTCA to legacy architectures, the form factor is superior in nearly every category. When it comes to performance density, versatility, reliability/high availability, and performance, MicroTCA is the best upgrade path from legacy VME and CompactPCI. As the specification was developed by many of the same people as the legacy architectures, the lessons learned were very valuable in creating MicroTCA. The result is a powerful, versatile architecture that suits a wide range of configurations.

VadaTech offers the industry's largest selection of MicroTCA products and the only complete ecosystem from chassis platforms, MCHs, JSMs, power modules, to over 250 AMCs. Contact VadaTech to learn more about our application-ready platforms or to discuss upgrading your legacy bus application to MicroTCA.