Advancements in Connector Technology for MicroTCA™ Applications

The Micro Telecommunications Computing Architecture (MicroTCA™) specification defines the requirements for a system that uses Advanced Mezzanine Card (AMC™) modules directly on a backplane. The PCI Industrial Computer Manufacturers group (PICMG®) developed the MicroTCA™ platform as a more compact and cost-effective alternative to a high-capacity, high-performance Advanced Telecommunications Computing Architecture (ATCA®) system implementation. While the MicroTCA™ system architecture initially targeted telecom and datacom applications - such as wireless base stations, access equipment, routers, and customer premise equipment - manufacturers of industrial control, instrumentation, medical electronics, and military systems have also shown interest in MicroTCA™ implementations.

The MicroTCA™ specification complements the ATCA® specification developed for "big box" applications. The specification leverages elements from the ATCA® and AMC™ (AdvancedMC™) specifications to establish a physically small but very powerful system that fits a shelf measuring 4U high by 300mm deep. Although AMC™-compliant modules were originally intended as plug-in cards to add functionality and features to carrier boards in ATCA® systems, it was realized that the same modules could also be used as standalone cards that plug directly to a backplane, providing an opportunity to reduce overall system size. The MicroTCA™ system architecture reduces size and cost by eliminating the ATCA® carrier board and providing a chassis that accepts AdvancedMC™ modules directly. A MicroTCA™ Carrier Hub (MCH) emulates the requirements of the carrier board defined in the AMC™ specification to properly host the modules. MicroTCA™ shelves will also support hot-pluggable modules, which increase system availability by allowing individual modules to be serviced or upgraded without taking the shelf offline.

MicroTCA™ designs employ a modular approach where standardized elements, such as AMC™s, MCHs and power entry modules (PEMs), are configured to build actual products. Equipment designers' capability to use and re-use off-the-shelf backplanes and modules in their designs lowers design costs and accelerates time to market. Customers can buy the functionality they need, plug it into their systems, and it works. Aggregated customer demand for standardized "building blocks" will drive manufacturing economies leading to lower component and system costs.

Standardized connector interfaces are critical to the success of this modular approach. The MicroTCA™ specification defines four connector types: a backplane connector to accept AMC™s and MCHs, a MCH connector (sometimes referred to as the "tongue" connector), a power module input connector and a power module output connector.

The next focus of this article is the backplane connector, which is expected to see the most use in a typical MicroTCA™ system.

The requirement that the backplane connector accept any AMC™ modules that conform to the AdvancedMC™ specification without modification dictated a card edge connector design utilizing cantilever beams to interface with the gold-plated edge fingers on the AMC™. Compatibility with existing AMC™s also defined the pin count and contact pitch - 170 total contacts spaced on 0.75mm pitch - and the need to be able to scale differential signals to data rates in excess of 12 Gb/s. While the industry specification necessarily limited connector makers' creativity at the interface to the AMC™ module, other design considerations led to different techniques for connector termination to the backplane.

As the MicroTCA™ standard was being developed within PICMG®, participating connector members offered proposals to the workgroup. While all connector designs needed to accommodate the same mating interface—namely, the previously-standardized AMC™ card edge—each could use a different technology to attach the connector to the backplane. The organization specified three mounting styles in the document: a compression design, a press-fit design, and a surface-mount design (an approach proposed by FCI). These options give system designers the opportunity to optimize their backplane designs for performance, cost and manufacturability.

Surface-mount and press-fit MicroTCA™ backplane connectors. (Photo courtesy FCI)

The surface-mount (SMT) version, for example, offers advantages in meeting the biggest challenge faced by system designers and connector manufacturers: achieving bandwidth of up to 12.5 Gb/s across the backplane. Not long after the optimized SMT footprint proposal was accepted into the specification, FCI demonstrated, for the first time, a live 12.5 Gb/s link using surface-mount MicroTCA™ connectors on a backplane demonstrator. In comparison to conventional press-fit backplane termination, additional benefits derive from the surface-mount footprint, which significantly reduces the required number of drilled through holes for a connector.

With a typical MicroTCA™ backplane using up to twenty connectors to provide slots for up to twelve AMC™s and redundant MCHs, reducing the overall number of through holes can greatly simplify routing complexity and potentially reduce the layer count and backplane cost.

While a compression-style connector can offer high-Speed electrical performance that is similar to that offered by a surface-mount connector, the SMT connector offers advantages during backplane assembly. Capability for connector installation using conventional surface-mount reflow soldering processes - combined with a connector design that require no costly hardware, compensating board stiffeners, and secondary assembly operations - results in lower total applied cost.

Press-fit backplane connector designs play an effective role in extending the MicroTCA™ architecture to thicker backplanes where proven press-fit technology is often preferred. Capability to install the connectors using flat-rock insertion tooling simplifies backplane assembly. Press-fit termination may also be preferred in harsh environments that demand "ruggedized" systems. These connector versions can accommodate data rates in the range of 6.25 to 10 Gb/s.

As previously noted, the MicroTCA™ specification also comprehends the connectors used to bring input power to the power modules. PICMG® members chose to leverage proven D-subminiature connector technology in the standard. Different connector configurations enable 48V or 24V DC cable connections to the power module. The shielded connectors are designed to fit the power module faceplate on the front side of a MicroTCA™-compliant power module. Connector manufacturers have developed various connector options to facilitate system designs.

The board mounted versions are available as a single port or as a dual-stacked configuration for redundant input feeds. Available Pin-in-Paste (PIP) connector options incorporate design features, such as counterweights that shift a connector's center of gravity, to enable PIP application methods for through-hole termination using reflow-soldering processes to reduce the cost of board assembly. FCI's MicroTCA™ power input connectors also offer the most compact footprint in the market to date, providing more space on the board for routing traces or additional components.

Although the MicroTCA™ specification is well-defined, the industry is experimenting within the practice. Adaptation for use in products targeting more demanding market segments, such as military systems and industrial equipment used in uncontrolled environments, present the connector industry with opportunities to enhance mechanical and environmental performance.
Future developments are focused on the ruggedness of the connectors.

Single-port and dual-stacked board-mount connectors and cable connector for 48V input to MicroTCA™ power entry modules. (Photo courtesy FCI)

Designated "Rugged MicroTCA™," these products will be ideal for use in MicroTCA™ systems that operate in outdoor, remote, high-shock, high-vibration and extreme temperature environments.

The current challenge facing the MicroTCA™ specification is widespread adoption, which has not occurred as fast as was initially anticipated. While the industry targeted an overall system cost of around $500, the current cost level is unfortunately around $1000. The slower rate of adoption has contributed to the higher cost.

As compliant components and systems reach higher production volumes, manufacturers will begin to realize benefits from improving manufacturing economies of scale. The resulting lower costs will make the standardized architecture more attractive to equipment manufacturers, service providers and end-users that have traditionally relied on proprietary system implementations. Continued profitable growth will attract additional suppliers, increasing competition and further contributing to cost improvements.

The MicroTCA ™ standard is in the very early stages of adoption by the market. The various building blocks are available, the performance of these building blocks is promising, which can only lead one to the conclusion that increasing volume requirements will ultimately drive costs and prices in the targeted and required direction.

FCI, a leading developer of connectors and interconnect systems has developed and made available a wide range of backpanel, power, board-to-board and I/O connectors and cable assemblies that are in full compliance with the MicroTCA™ specification issued by PICMG®.

For more product details, please visit www.fci.com where a full productline catalogue (Products for µTCA™ shelves and AdvancedMC™ modules) can be downloaded.