

Advanced Mezzanine Cards: More important than you think



By *Rubin Dhillon*

If you think the new Advanced Mezzanine Card (AMC) standard is “just another mezzanine card” or if you think it’s just a subset of the AdvancedTCA specification and it will arrive sometime in the future, then you may have completely missed the boat.

AMC boards and chassis are here today. They are being adopted in platforms ranging from custom designs and blade servers to AdvancedTCA products and beyond. They are being considered by companies in the military and commercial markets as well as those in the enterprise and telecommunications space. Why? Because AMC modules bring a truly modular approach to systems design that no other mezzanine form factor has offered.

The PCI Industrial Computer Manufacturers Group (PICMG) consortium of more than 450 companies published the AMC base specification, AMC.0, in January of this year.

Since then, there have been a number of product pre-announcements and a small number of real product announcements that suggest the ecosystem for AMC modules is in the early stages of development. However, the market demand for this technology is now, and customers are anxious to build platforms using the scalability and modularity of AMCs today.

It seems that there has been a gap between what the market wants and what the ecosystem is ready to provide. Why is this? Most telecommunication equipment companies have been focused on developing AdvancedTCA components (mostly dual-Xeon processors) and positioning themselves as the *integrator of choice* for major Telecom Equipment Manufacturers (TEMs). Some companies have chosen to sit back and wait, positioning their existing PCI Mezzanine Cards (PMCs) for

AdvancedTCA. As a subset of the overall AdvancedTCA specification, AMC has taken a back seat to AdvancedTCA for some time. Plus – what’s all the excitement – AMC is just another mezzanine card isn’t it?

What is an AMC?

In many ways AMC is to AdvancedTCA what PMC is to CompactPCI. The original goal was to define a mezzanine card for the AdvancedTCA platform that would allow modularity and scalability. Therefore the AMC standard is designed with telecom applications in mind. Some highlights:

Form factor, power, and thermals

The AMC form factor has been designed to be as flexible as possible for a wide range of computing and I/O applications. The AMC specification supports a range of single-wide, double-wide, half-height, and full-height configurations. One advantage of the AMC form factor is its larger surface area, approximately 14 percent larger than the PMC form factor, resulting in more room for components (Figure 1).

The AMC specification supports up to 60 W of power in all configurations, however it is unlikely that a system will

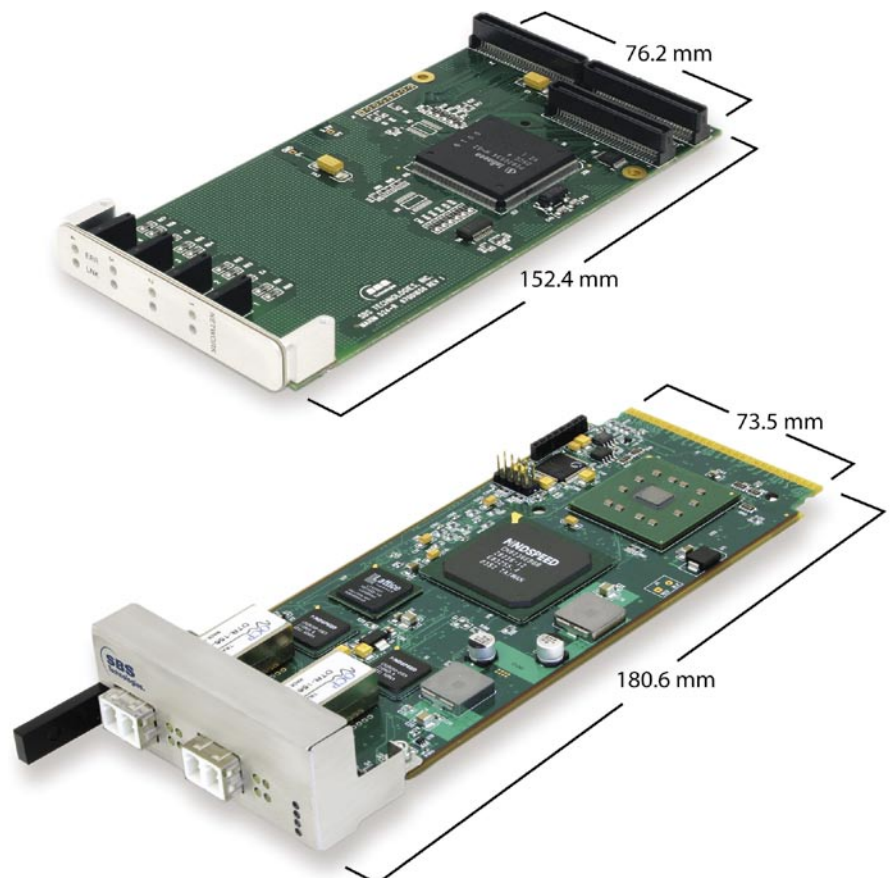


Figure 1

be capable of cooling a single-wide, half-height module running at 60 W (especially if there is another 60 W module in the adjacent half-height slot). Table 1 lists the recommended power requirements for the various form factors.

Designed for high-speed applications – the serial interconnect

With telecom networks moving towards IP, 10 Gigabit Ethernet, and talk of 40 Gigabit interfaces, older parallel or PCI-based solutions such as PMC cannot keep up. The PCI PICMG standards committees have addressed this by adopting a serial interconnect strategy for the AMC that supports up to 12.5 Gbps. AMC has been designed with flexibility in mind and is capable of supporting a range of protocols including PCI Express and Advanced Switching (AMC.1), Gigabit Ethernet (AMC.2), and Serial RapidIO (AMC.4). Others have been proposed (such as InfiniBand). At the time this is being written, AMC.1 and AMC.2 seem to have the most interest, with AMC.4 gaining attention in DSP-centric applications.

Hot swap capability

The hot swap capability of AMC modules gives this mezzanine card format its true modularity. Unlike its PMC predecessor, the AMC module is front-loadable, sliding into a chassis, rather than being installed piggyback style in the internals of a carrier. The module is field-replaceable and upgradeable and does not require the entire system or blade to be removed. In this fashion, an AdvancedTCA blade consisting of multiple AMCs is flexible, scalable, and highly available.

Manageability

The AMC specification supports the Intelligent Platform Management Interface (IPMI) as standard and Electronic Keying (E-Keying). This allows dynamic configuration of AMCs as well as giving them a monitoring and alerting subsystem.

The characteristics just noted are a clear indication of how designers created the AMC architecture to address the telecom applications of today and tomorrow. Sure, first generation AdvancedTCA systems have been deployed using the PMC mezzanine architecture, but this is temporary, since PMCs cannot deliver the perfor-

Description	Length	Width	Height	Recommended power
Single-wide, half-height	181.5 mm	73.5 mm	8.18 mm comp.	20 W
Single-wide, full-height	181.5 mm	73.5 mm	13.88 mm I/O	40 W
Double-wide, half-height	181.5 mm	148.5 mm		60 W
Double-wide, full-height	181.5 mm	148.5 mm		60 W

Table 1

mance and modularity that today's system designers demand.

Winds of change in the market

We all know what happened to the telecommunications market several years back, and many companies are still recovering from that pain. The challenges are not behind us. The tremendous amount of activity in the market includes continued cost reductions and downsizing as well as consolidations at all levels including traditional board and chip vendors, TEMs, and end users. The move to all-IP networks has picked up momentum. What's more, new services and companies are delivering those services. Cable companies have gotten into the voice business, and telecom companies are looking at the video business.

The current telecommunications environment is driving the industry to adopt an open standard modular computing architecture to build scalable platforms. The TEMs are seeing less and less value in hardware and are looking more like software companies. Because of their lack of hardware resources, TEMs are focusing more of their energy and corporate resources into their core competencies in software applications such as softswitches and leaving the building of telecommunication hardware-to-hardware companies.

Competition is stiff, time to market is key, and cost to market is getting even more emphasis all across the telecom board. All of these factors are affecting the traditional embedded equipment companies that provide the boards and software that go into telecommunications systems.

The whole idea behind the modular computing architecture concept is to encourage a rich ecosystem of suppliers all competing to supply innovative products at the best price possible. Companies building modular systems want to have multiple

suppliers for each component in their systems (second and third sourcing as much as possible) so they can take advantage of market efficiencies.

Supply chain issues such as lead times, inventories, quality, and yearly cost reduction commitments are becoming more prominent factors in the buying decisions TEMs are making. The whole environment is starting to look more like the IT industry than the traditional embedded industry.

This is not as strange as it sounds, though. There are companies that supply major IT systems that are very good with supply chain issues, companies such as IBM, HP, and Sun Microsystems, Inc. All three companies have announced strategies to compete effectively in the telecommunications market. Major TEMs see this as a welcome sign.

AMC steps out of the AdvancedTCA shadow

We are still in the early days of market development for AMC, however. Initial market data projects AMC sales as a small percentage of AdvancedTCA sales. It has become very clear that the opportunity of marketing AMC products extends way beyond its use in AdvancedTCA systems. Some TEMs are not moving aggressively in the AdvancedTCA direction because they have invested way too much in their own proprietary platforms.

These companies have recognized the advantages of the open standard modular computing concept, and are adapting their platforms to support AMC modules. This adaption essentially gives them the best of both worlds, which is leveraging a rich ecosystem of open standard modular AMCs and extending the life of their investment in proprietary equipment. For example, IBM has announced a joint partnership with SBS Technologies to develop

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AMC support for its eServer BladeCenter platform, thereby enabling another (potentially large) channel for AMCs. Figure 2 shows a prototype of an AMC carrier blade for an IBM BladeCenter eServer system.



Figure 2

MicroTCA: AMC gets its own system platform

If you consider the architecture of the AMC standard – hot swappable, serial interconnect, and manageability – it lends itself nicely to a standalone system. This is exactly what many companies are working towards.

The MicroTCA system architecture consists of AMC modules, all connected together by a common backplane. AMC microblades can provide I/O and processing power to a standalone MicroTCA system without needing a carrier card, just as AdvancedTCA blades provide those same features to an AdvancedTCA system. The concept of a standalone AMC-based system will strengthen the acceptance of this architecture in application areas outside of the telecommunication market.

There is a lot of excitement around the MicroTCA specification as it has the potential of addressing applications not particularly suited for AdvancedTCA, but requiring a similar level of system performance and features. For example, while the AdvancedTCA architecture is aimed at core telecommunication network operations, the MicroTCA architecture is better suited for lower-cost network edge and enterprise applications.

The first MicroTCA demonstration systems were on display at SUPERCOMM in June of this year and the MicroTCA

Committee projects final specification is to be ratified by the PICMG Committee sometime in early 2006.

What does MicroTCA look like so far?

At the time of this article the PICMG Committee is still working through the details of MicroTCA. The goal is to build a platform specification that has the cost, size, and modularity to meet applications not addressed by AdvancedTCA. These applications could vary widely, including telecommunications network applications, enterprise network applications, or even consumer applications.

Some MicroTCA specifications

Mechanicals, size, and power

The size and configuration of a chassis of AMCs connected by a serial interconnect fabric could vary from a small box of two single-height, single-wide AMCs, to a large, standalone chassis with multiple-sized AMC micro-blades. Of the many possible types of chassis configurations possible, there are at least two configurations the MicroTCA Committee is considering. Figure 3 shows a proposed MicroTCA chassis (top) and an SBS AMC chassis (bottom), each populated with AMC modules. Figure 3 shows a possible 4U 19" rack-mount chassis, which can support up to 10 full-height AMC modules and could also support a mixture of the other form factor AMCs and a possible 8" cube chassis configuration that could hold up to 12 half-height AMCs.

A MicroTCA system might also support either 48 V nominal or AC main power allowing it to support applications beyond central office telecom networks (AdvancedTCA specification provides for 48 V only).

Virtual Carrier Manager (VCM)

The VCM is the heart of a MicroTCA chassis and probably will be present in most MicroTCA configurations, as well as high-end systems. The VCM will most likely be the size of a full-height, double-wide AMC module and responsible for powering, managing, and connecting up to 12 AMC cards in the MicroTCA chassis.

The VCM will provide IPMI system management and a fabric switch with



Figure 3

up to 60 lanes of connectivity with various configurations supporting Ethernet, PCI Express, and other protocols. It is expected that there will be two virtual carriers to provide redundancy in a high availability configuration.

Interconnect fabric

The MicroTCA specification will be as flexible as AdvancedTCA, supporting a range of possible protocols across a serial backplane. The first systems on display at SUPERCOMM 2005 supported a Gigabit Ethernet backplane. Future systems are projected to support PCI Express and Advanced Switching, Serial RapidIO, and 10 Gigabit Ethernet.

Cost

Cost is an important part of any specification and will be pivotal for MicroTCA architecture gaining acceptance in many of the applications it targets. The current target cost for a low-end bare bones MicroTCA system, including chassis, backplane, and virtual carrier is \$500. At this early point in the market development, \$500 seems like a very challenging number to achieve, however, MicroTCA proponents point to potential volumes of both AMCs and MicroTCA systems driving the cost down.

As mentioned, MicroTCA is aimed at those applications not currently addressed by AdvancedTCA. AdvancedTCA is positioned very well for core network applications where the size and cost of the architecture is acceptable. For telecom and datacom applications such as wireless base stations, router/gateways, Multiservice Provisioning Platforms (MSPPs), and other applications requiring a smaller form factor and lower cost, MicroTCA is much better suited.

The concept of a standalone AMC-based system will strengthen the acceptance of this architecture in application areas outside of the telecommunication market.

Perhaps the most surprising aspect of MicroTCA is the interest the architecture is receiving beyond the traditional telecom applications. There is interest in using the platform to address data center and IT applications, therefore bringing MicroTCA and AMC to the enterprise market.

Also, there has been some discussion with companies building military systems where the concept of a *ruggedized* architecture is being explored. A ruggedized, conduction-cooled, bullet-proof military communications system using low-cost, high-volume MicroTCA components could soon be explored by companies, such as SBS Technologies, which build military systems using Commercial Off-The-Shelf (COTS) components. This is a significant challenge, but if realized, could open up a rich ecosystem of high-performance, low-cost building blocks unlike anything the military system integrators have seen in the past.


The MicroTCA architecture still has some way to go before the specification is finalized. There are challenges creating rugged, low-cost backplane connectors. There is still work to be done to address the reliability, availability, cooling, and cost aspects of the overall MicroTCA specification.

However, the enthusiasm behind the proposed specification, particularly from those vendors looking to get the most out of their AMC investments, looks to keep it on the fast track toward early deployment.

Conclusion

Developing the underlying technology for AMC modules is daunting. Everything from designing for a challenging thermal environment to getting the correct tools to implement complex high-speed interconnect fabrics, all while keeping costs as low as possible, is a significant challenge to those companies looking to supply AMC products.

The development of standards such as AMC and MicroTCA is changing the technology and market dynamics of the telecommunications industry in exciting and challenging ways. Over the next few years we will see AMC modules deployed in a variety of architectures and various markets. We will see a few major system integrators emerge as the suppliers to the world's leading TEM and enterprise companies. The face of the embedded industry

will change dramatically. These are indeed challenging, but exciting times. 

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