

Usage models for Advanced Mezzanine Card (AdvancedMC)

CompactPCI

The PCI Industrial Computer Manufacturers Group (PICMG) AMC.x, more commonly known as Advanced Mezzanine Card (AdvancedMC), is the next-generation mezzanine standard designed to enhance modularity and serial connectivity for AdvancedTCA and other carrier-grade communications platforms. The use of mezzanine cards enables manufacturers to implement a variety of embedded processors, Digital Signal Processors (DSPs), network processors, and other components. Each AdvancedTCA board can support up to four AdvancedMC mezzanine cards, which provides new ways for manufacturers to meet their reliability, availability, serviceability, and cost requirements.

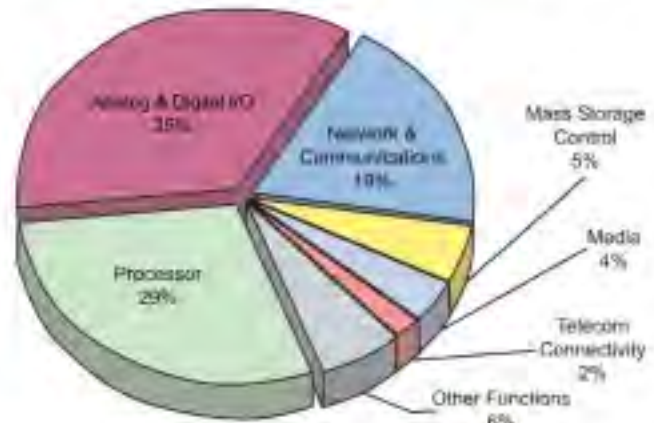
The good news is that the list of potential usage models for AdvancedMC mezzanines is practically unlimited. It includes I/O cards, processor cards, storage modules, packet processing modules, fabric conversion cards, security modules, and more. In this article, the second in a continuing series on AdvancedMC, Mark and John look at how PICMG AMC.x subsidiary specifications now under development will support traditional usage models, some not-so-obvious uses, and areas where AdvancedMC may not be the best choice.

Traditional usage models

The usage models for AdvancedMC generally extend current mezzanine usage. Figures 1 and 2 depict how mezzanine cards are used in various vertical markets, as reported by Venture Development Corp. The top three applications, in terms of dollar volume, include communications equipment, military-aerospace, and industrial applications, which altogether represent over 90 percent of total mezzanine revenue. Figure 2 breaks out the quantity of mezzanine cards shipped in 2003 by their function. I/O and processor cards makeup almost two-thirds of the total number of units shipped. Adding-in communications-oriented mezzanines raises this total to 83 percent.

Existing mezzanine specifications originated with a sharp focus on I/O, and have

2003 Mezzanine Cards Shipments Segmented by Functional Type (% of Unit Shipments)



The second largest share of unit volume shipments (29%) is attributed to processor cards (including CPUs, DSPs and FPGAs). These are offered by more than 40% of vendors, but represent only about 9.4% of current mezzanine card products.

Figure 1

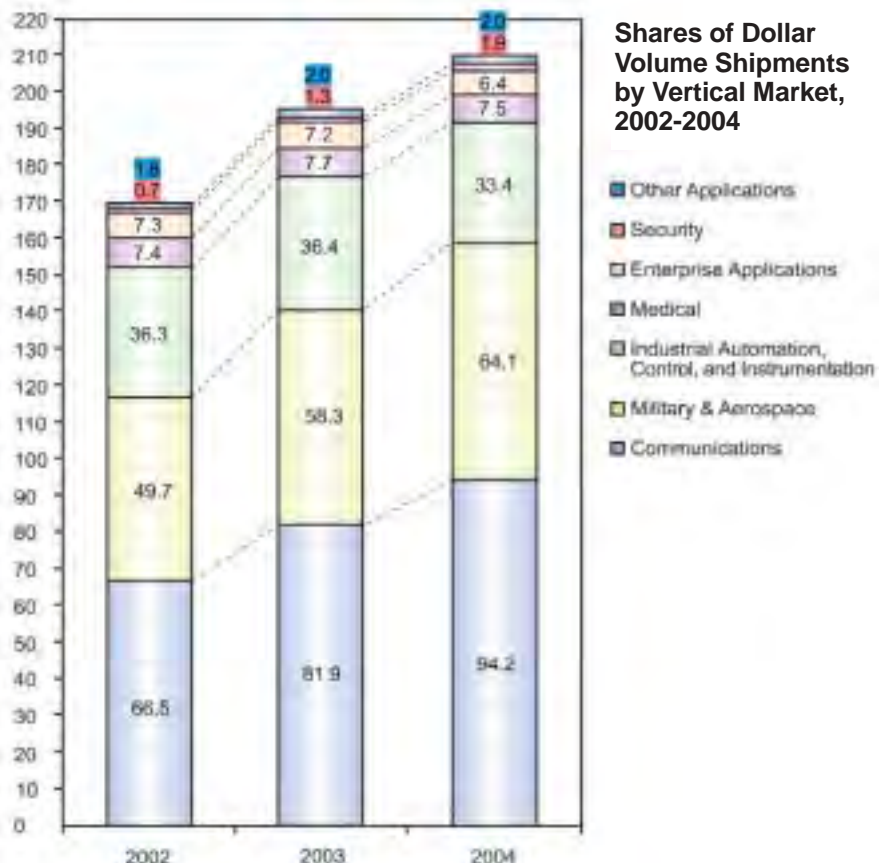


Figure 2

evolved organically to add various processor and telecom capabilities. These specifications include the following:

- PMC: PCI Mezzanine Card, IEEE1386.1.
- PrPMC: Processor PCI Mezzanine Card, VITA-32.
- PTMC: PICMG 2.15 with 10/100/1000 Ethernet.

All of these specifications are based on the CMC spec, or IEEE 1386.0, the base mechanical spec. Other mezzanine form factors are designed to fill market niches, and include Industry Pack, PC•MIP, and M-Modules.

Key determinants

The five key factors that determine valid usage models for AdvancedMC mezzanines are the same as the key design parameters for the specification:

- Bandwidth
- Real estate
- Thermal envelope
- Interconnects
- Manageability

AdvancedMC supports evolving requirements in each of these areas. The advantages are summarized in Table 1.

Bandwidth

The parallel buses of existing mezzanine cards use faster and wider Peripheral Component Interconnect (PCI) buses to provide Gbit/sec-class peak bandwidths (with much lower sustained bandwidths), but at the cost of pin count and connectivity. Even with a large number of extra

ground pins to absorb loop current, faster PCI buses are only point-to-point. Supporting multiple devices on a mezzanine card requires a bridge chip that adds complexity, dissipates more power, and uses valuable mezzanine real estate. Moving to a high-speed serial interconnect supports higher bandwidth devices, or allows multiple devices to be supported without an onboard bridge chip. Serial interconnects also provide greater pin-efficiency. High-speed serial interfaces that provide 1 Gbit/sec or more of usable bandwidth per pin minimize connector cost and size, and also minimize the mezzanine area devoted to the external connection.

Real estate

Mezzanine real-estate specs should support components on both sides and allow room on the primary component side for sufficient airflow. Previous mezzanine cards

were typically unable to handle anything but discrete components on the secondary side (Side-2). CMC allows only 1.9mm, while AdvancedMC provides a minimum of 2.6mm that provides enough room for Ball-Grid-Array (BGA) packages.

As shown in Figure 3, an analysis of 50 components most often used on mezzanine cards shows that a sweet spot of a 2.6mm minimum backside component height allows for the maximum use of real estate.

The primary component side should also be deep enough to support both active components with heat sinks and storage devices, and needs a deep mechanical envelope that extends all the way from the front panel back to the connector. Common Mezzanine Card (CMC) provides 10mm at front, but only 4.5mm at the back. By comparison, AdvancedMC pro-

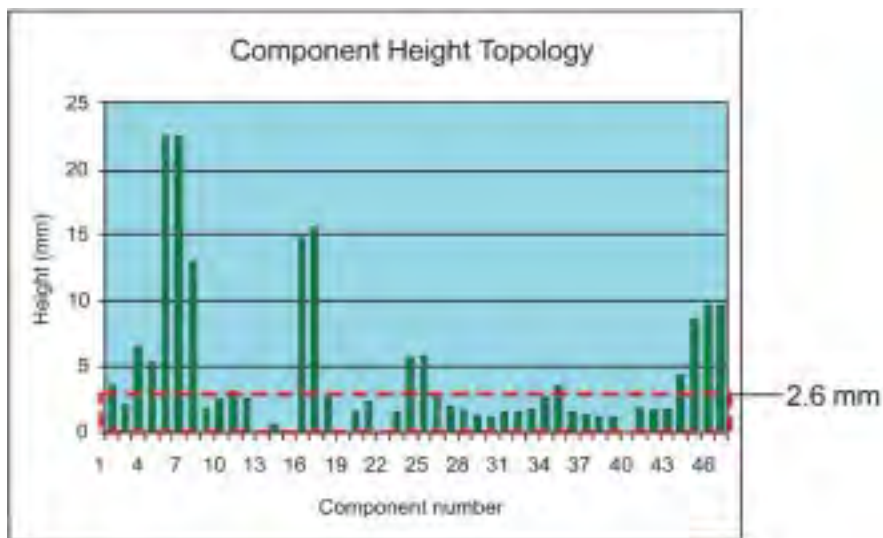


Figure 3

Features	PMC	AdvancedMC
Form factor	Single and Double-Wide	Single and Double-Wide Full Height Regular or Double Stacked Half Height
Real estate	74 mm x 149 mm 1.9 mm max. backside height	72 mm x ~190* mm (175 usable) 2.6 mm min. backside height
Connectors	Unshielded P1386	Shielded Differential Pairs (20 duplex ports)
Interconnects	PCI 32/33; 33/64; 66/32; 66/64 Ethernet	"Agnostic" 1 Gigabit Ethernet, Fibre Channel, PCI-Express, IBX, XAUI, 10 Gigabit Ethernet
Bandwidth	PCI: 1-4 Gbits/sec Ethernet: 1 Gbits/sec	1 to > Nx10 Gbits/sec
Native manageability	No	Yes IPMI (Intelligent Platform Management Interface)
Hot swap	No	Yes
Power for 1X wide	7.5/12* Watts	~35** Watts/Bay

* VITA-32 PrPMC wattage allowance

**Dimensions or values that are still in debate by the PICMG AMC.0 Subcommittee

Table 1

vides 13mm at the front, and 11mm at the back that provides enough room for high components and high air flow, and even enough for a 2.5-inch/70mm hard disk drive at the front of the card. The AdvancedMC is also longer than previous mezzanines, or 175mm deep.

Thermal envelope

The thermal envelope, both in terms of power delivery and power dissipation, is another key spec. The PMC mezzanine is rated at only 7.5W, and the PrPMC mezzanine at 12W. Since higher bandwidth translates directly into higher power, these thermal envelopes are clearly too small. A single-wide AMC mezzanine has a 30W thermal envelope, and for added flexibility the connector can deliver 60W to the card. This allows for a double line card to be powered from a single connector, and also provides an element of future-proofing on the assumption that more efficient thermal management technologies will be developed. In an effort to reduce cost and time-to-market, the AdvancedMC Side-1 height is sufficient to allow designers to reuse existing CompactPCI mezzanine solutions.

Interconnects

AdvancedMC assumes a High Speed Serial (HSS) interface to the baseboard, for greater bandwidth and pin efficiency. The AdvancedMC connector could be used for other types of interfaces, but only if pin count is not an issue. The AdvancedMC committee is currently considering PCI Express, Advanced Switching, GigE, RapidIO, InfiniBand, Serial ATA, Serial Attached SCSI, and Fibre Channel. The committee is also considering system packet interface 4.2 (SPI 4.2), the lone exception to the HSS rule. SPI 4.2 is included simply because it is a standard interface for network processors. SPI 4.1 is not being considered because it requires far too many pins and would add too much cost.

Manageability

Communications and industrial applications require hot-swap capability and a dedicated management interface. While the CMC standard has both electrical and mechanical issues that prevent it from supporting hot swap, the AdvancedMC mezzanine natively supports hot swap, both electrically and mechanically. Where the

AdvancedMC specification includes the Intelligent Platform Management Interface (IPMI), while PMC and PrPMC do not.

AdvancedMC usage models

I/O devices

The peripherals connecting to a general-purpose processor would presumably use a direct descendant of PCI, such as PCI Express. The same is true for peripheral chips used to connect to general-purpose processors. Network-oriented I/O devices that are part of the primary or fast data path, such as a framer, would presumably use SPI or a similar interface that allows direct connection to a network processor.

General-purpose processors

This covers any number of sub-categories including control processors, network service and application processors, adjunct processors, server micro-blades, and chassis/shelf management controllers. This category covers an extremely broad range of performance, bandwidth, and power dissipation characteristics.

Network processors

High-end network processors with throughput of up to 10 Gbits/sec typically require far more area and power than a mezzanine could be expected to provide. However, high-volume opportunities at data rates of OC-12 and below, coupled with the trend towards functional integration in network processors, makes AdvancedMC an interesting possibility.

Coprocessors

This category could include a wide variety of processors, including crypto, security, DSP, content processing, and transcoding. A 2X-wide AdvancedMC card could contain multiple coprocessors, or even a DSP farm. Depending on its function, the data flow in and out of a coprocessor mezzanine could use a simple batch transfer mechanism, or a more network-oriented streaming mechanism. A batch transfer requires only a single memory-mapped interconnect with Direct Memory Access (DMA) support. Streaming could require two, possibly packet-oriented interconnects. A DSP farm could allocate one HSS lane to each processor, or the AdvancedMC card could use a single, wider interface and

include a small-scale switch.

With the obvious uses for an AdvancedMC mezzanine card accounted for, it is time to look at some less-obvious uses. These more obscure uses will take advantage of the 40 differential pairs available on AdvancedMC.

Fabric cards

With 20 lanes of HSS I/O, an AdvancedMC mezzanine could function as a small-scale fabric card, since the fabric itself could easily be implemented with a single switch chip. Putting two mezzanines on a baseboard creates a redundant fabric.

RTM adapter cards

The rear transition module (RTM) on AdvancedTCA is designed to allow personalized customization for each blade, since the user-defined signals do not need to adhere to strict standards. Another mezzanine usage model of interest is the RTM Adapter Mezzanine Card, which allows an even greater level of mission-critical customization.

Power converters

The power to the AdvancedTCA carrier card is -48 VDC. Unfortunately, most electronic components require a substantial amount of power conversion from this base voltage. On AdvancedTCA carrier cards where real estate is limited, the AdvancedMC card could function as a power conversion mezzanine card.

Memory cards

Communications systems use a wide variety of memory types. Possibilities include a flash array for nonvolatile storage of configuration data or statistics, a flash hard disk drive for booting, a static random access memory (SRAM) template memory for a DSP farm, a network processor ternary content addressable memory (TCAM), assuming the AMC has sufficient pins, or that TCAMs start using HSS interfaces.

Storage cards

As mentioned earlier, an AdvancedMC mezzanine card is large enough to support a 2.5-inch/70mm hard disk drive, with enough real-estate leftover for additional silicon, such as an I/O processor or even a micro server node.

What doesn't it do?

The breadth of usage models covered by AdvancedMC raises this question. The simple answer is that AdvancedMC cards can do almost everything that makes sense to do on a mezzanine. Inappropriate uses would include circuits that require large area, high power, or that have very hot components requiring tall heatsinks or large heat pipes. These would typically be placed on a baseboard.

Conclusion

AdvancedMC opens up a far wider set of applications than historical mezzanine standards. The AdvancedMC feature set of hot swap, greater power/size, and faster/wider buses positions this standard as a flexible enabler for many more usage models than existing IEEE 1386 based mezzanine cards, while allowing developers to future-proof their designs. The next article in this series will look at AdvancedMC and PCI Express technology.

For further information, contact either John or Mark at:

John Beaton

Intel Corporation

5000 W. Chandler Blvd.

Chandler, AZ 85226

Tel: 480-554-1327 • Fax: 480-554-7674

E-mail: john.beaton@intel.com

Web site: www.intel.com

Mark Summers

Intel Corporation

5000 W. Chandler Blvd.

Chandler, AZ 85226

Tel: 480-554-1258 • Fax: 480-554-7674

E-mail: mark.d.summers@intel.com

Web site: www.intel.com