



Where the rubber meets the road: AdvancedMC in AdvancedTCA – translating from standards to products

By *Ian D. MacMillan*

AdvancedTCA has rapidly emerged as the platform technology of choice for the delivery of innovative telecommunications infrastructure solutions. Standards enable delivery of high performance and high throughput solutions, as well as defined reliability and management architecture. The AdvancedTCA integration framework allows ease of mixing and matching functional modules, and has resulted in AdvancedTCA's adoption as the common platform framework for telecommunications equipment manufacturers to deliver advanced system solutions. AdvancedTCA is enabling developers to meet the global needs of 3G wireless and IP Multimedia Subsystems and to access broadband network deployment. AdvancedMC hot-swap capability has enabled AdvancedMCs to emerge as a key ingredient for the delivery of highly functional and robust systems. Ian discusses the status of the critical choices and issues systems developers should address as they look to deliver AdvancedTCA/AdvancedMC solutions.

Building useful telecommunications platforms for next generation networks requires a critical mass of AdvancedTCA and AdvancedMC building block products and capabilities. However, as with any new standard, issues need to be addressed in the development of new products, and AdvancedTCA and AdvancedMC are no exceptions. The standards provide a plethora of choices for implementation and design of the individual boards and modules. Hence, the system integrator has to clearly define the system architecture and the key interfaces in order to ensure ease of development and delivery of the solutions. In addition, the industry and vendors have recognized that ease of integration and interoperability is the key to enable further adoption of standards and market growth.

AdvancedMC building blocks for telecommunications

A typical AdvancedTCA platform will contain a number of base functions including the AdvancedTCA shelf, pro-

cessor blades, switch blades, and element management. Depending on the capacity of a given system, these functions may be implemented in various ways, ranging from separate AdvancedTCA blades to a single set of redundant blades.

I/O interfaces and specialized components must populate the platform depending on the application. The key AdvancedMC building blocks required are:

- Telecom Interface processing modules
 - T1/E1/J1
 - OC-3/12
- Communications processing modules for channelized OC-3/DS3/T1/E1 interfaces
- Digital Signal Processor modules
- Network Processor modules
 - General purpose
 - Security flow through and coprocessors
- Gigabit Ethernet interface modules

AdvancedTCA allows the flexibility of deploying the AdvancedMC building blocks on multipurpose blades such as Single Board Computers (SBCs) or on carrier blades designed to support typically up to four AdvancedMCs. Other special purpose blades/AdvancedMCs would include disk drive AdvancedMCs for storage.

Taming the flexibility beast

The AdvancedMC building blocks and the flexible AdvancedTCA infrastructure allow for the development of highly reliable and highly functional network platforms. However, system designers face a number of choices in the actual AdvancedMC implementation:

- Port usage
- I/O options
- Form factor (such as full-height, half-height)
- Support for TDM (voice) and multimedia data
- Port density

- Front access versus rear access
- Support for APS and EPS

Port usage

The AdvancedMCs in each of the building block groups outlined previously have different requirements to complete their functions. The AdvancedMC dot specifications were created to define AdvancedMC port usage optimized to the different AdvancedMCs' functions. However, these AdvancedMC dot specifications make conflicting use of AdvancedMC ports.

AdvancedMCs provide 21 full-duplex high speed serial ports, three clocks, and other control, test, and power connections. The AMC.0 base specification (Figure 1) provides usage guidelines, but does not make firm assignments of the ports. AdvancedMC dot specifications assign specific uses to some of the ports:

- AMC.1 PCI Express and Advanced Switching
- AMC.2 Ethernet
- AMC.3 SATA and SAS
- AMC.4 Serial RapidIO

Each dot specification defines multiple legal configurations. The dot specifications necessarily make conflicting use of some ports.

As noted, AdvancedMCs may be used on AdvancedTCA processor blades, AdvancedMC carrier blades, and other host environments. No single AdvancedMC port usage model is optimal for all environments.

The carrier and the AdvancedMC must align in their use of the AdvancedMC ports. It is not economically viable to build multiple variants of the AdvancedMCs to support all the applicable options. This requires developers to select optimized AdvancedMC port usage models for processor blade and carrier card environments in the context of the overall system architecture. Figures 2 and 3 show some AdvancedMC port usage options.

| Port No. | AdvancedMC Port Mapping Strategy |
|----------|----------------------------------|
| CLK1 | Clocks |
| CLK2 | |
| CLK3 | |
| 0 | Common Options Region |
| 1 | |
| 2 | |
| 3 | |
| 4 | Fat Pipes Region |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | Extended Options Region |
| 10 | |
| 11 | |
| 12 | |
| 13 | |
| 14 | |
| 15 | |
| 16 | |
| 17 | |
| 18 | |
| 19 | |
| 20 | |

There are some conflicts among the dot specs in the use of this region.

Each AdvancedMC dot spec makes its own use of this region.

The dot specs generally do not define the use of this region.

Figure 1

To further complicate the port usage issue, MicroTCA has some additional port configurations (Figure 4), which the AdvancedMC developers need to consider.

Internal I/O

The parallel I/O standards have reached their physical limitations and are viewed as not being capable of providing a reliable and cost-effective means for data rates greater than 1 gigabit per second (Gbps). Serial I/O appears to provide the path forward and has propagated waves of new serial interface standards development.

Serial system interfaces such as PCI Express, Advanced Switching, Serial RapidIO, InfiniBand, 1 Gb Ethernet, 10 Gb Ethernet XAUI (10 gigabit attachment unit interface), Fibre Channel, Serial ATA, SxI-5, and TFI-5 are all available today. AdvancedTCA and AdvancedMC in particular have support for PCI Express, 1 Gb Ethernet, 10 Gb Ethernet XAUI, Advanced Switching, and Serial RapidIO for internal communications.

Limits on the AdvancedMC form factor in terms of size and ports can make it difficult if not impossible to support more than one of these internal communications standards. Speculation continues on whether Ethernet will ultimately emerge as the preferred internal communications solution by adapting to meet the specific needs that drove the development of the other standards.

Form factor

The initial AdvancedMC specification defined half-height and full-height form

factors. However, early products have shown issues with both form factors. It is possible that there may be a third height defined. In addition, with implementation experience and testing there are a number of changes being considered in the standards to add improvements to such elements as mechanical robustness and front panel design. The standards committees are paying careful attention to ensure that these changes have only an incremental impact on the many existing products to prevent any further delays in adoption of AdvancedMC solutions into end products.

Support for TDM

TDM voice is not going away. In March 2005, PICMG announced final ratification of the Internal TDM specification (PICMG SFP.1), also known as iTDM.

See "Legacy telecom hits the 21st century: TDM circuits on AdvancedTCA switch fabrics" in the May, 2005 issue of this magazine for an extensive discussion of iTDM. Unfortunately, iTDM is not the only mechanism for transporting TDM in AdvancedTCA. Other options such as a proprietary TDM backplane using the undefined Zone 3 connectors or TDM over IP have also been suggested.

In addition, iTDM needs to address the larger system context. For example, if a redundant Gig E links on AdvancedMC Ports 0 and 1 used, and how does the redundancy scheme work? iTDM itself defines a number of options that may make it more difficult to achieve interoperability. Given the continuing importance of TDM traffic, it's critical that the industry coalesces around a single standard such as iTDM and incorporates iTDM in the interoperability initiatives.

Port density

Gigabit Ethernet and optical interfaces can increase their capacity by simply moving to the next throughput level and the physical interface remains the same.

However T1/E1/J1 interfaces remain ubiquitous and must also be supported in AdvancedTCA platforms. The AdvancedMC, in particular, presents challenges with the front plates' limited real estate for connectors. As the capability of AdvancedMCs increases, the fan-in problem will be exacerbated.

The most common T1/E1/J1 connector is the RJ-45 style. It's possible to fit four RJ-45s on an AdvancedMC faceplate. Also the RJ-45 has sufficient pins to sup-

| Port No. | Generic | PCIE | GigE | Alternate | Notes | |
|----------|-------------------------|----------|----------|-----------|---|--|
| CLK1 | Clocks | CLK IN | CLK IN | CLK IN | Telecom Clock Input (8 KHz or 19.44 MHz) | |
| CLK2 | | CLK OUT | CLK OUT | CLK OUT | Telecom Clock Output | |
| CLK3 | | PCIE CLK | PCIE CLK | PCIE CLK | PCIE Clock Input | |
| 0 | Common Options Region | | GbE | | Control and Data | |
| 1 | | | GbE | PCIE | Control and Data | |
| 2 | | SAS/SATA | SAS/SATA | | Interconnect between processor and disk AdvancedMC | |
| 3 | | SAS/SATA | SAS/SATA | | | |
| 4 | Fat Pipes Region | PCIE x4 | | GbE | Control and Data (Some AdvancedMCs may support only x1 or x2 PCIE) | |
| 5 | | | | | | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | Extended Options Region | | APS? | | | |
| 10 | | | Rear I/O | Rear I/O | | |
| 11 | | | | | | |
| 12 | | | | | | |
| 13 | | | | | | |
| 14 | | | | | | |
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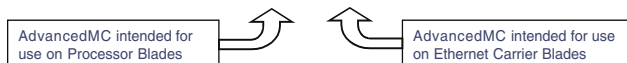


Figure 2

port two T1/E1/J1s, although this not a standard configuration. For signaling applications, this suffices. However, for media gateway applications, 16 and even 32 ports would be very desirable. Possible solutions include using a more dense front panel connector or using an RTM with more RJ-45 connectors.

The use of RTMs presents the challenge of passing RTM signals through an AdvancedTCA carrier (that is, the challenge of determining which ports are routed to the backplane). It's not clear if a standard solution will emerge. Hopefully the industry will adopt a de facto solution for this configuration.

Front access versus rear access

On systems with limited needs for port connectors, front access has been a common approach for many platforms such as CompactPCI. With optical interfaces, front access is the standard. The optical signal needs to be connected directly to the interface card, given there is no support in the standards for routing optical signals within the chassis.

However, with electrical interfaces and particularly T1/E1/J1 as noted earlier, rear access may be important in systems that have to support large numbers of ports. Alternatively, low-bandwidth signals could be muxed up in an external box in order to avoid the problem. Another approach is to use a dense connector on the front side and an external breakout panel.

Support for APS

Automatic Protection Switching (APS) is a requirement for many telecommunications network platforms. It is fairly easy to support APS on a single AdvancedTCA blade or AdvancedMC. However, to eliminate single points of failure, implementing APS over two cards helps.

AdvancedTCA and AdvancedMC standards don't address APS across cards. Therefore developers are creating their own solutions for APS. Where AdvancedMCs are used, the AdvancedMC carrier card must also support the APS solution.

Summary

AdvancedTCA and AdvancedMC products are rapidly coming to the market, representing telecommunications products' future. One clear sign of the progress that the industry is making is the identification of these types of interoperability issues as developers come closer to having real products based on AdvancedTCA and AdvancedMC.

| Port No. | Generic | iNAV31K | Notes |
|----------|-------------------------|----------|---|
| CLK1 | Clocks | CLK IN | Telecom Clock Input (8 KHz, 19.44 MHz TBD) |
| CLK2 | | CLK OUT | Telecom Clock Output |
| CLK3 | | PCIe CLK | PCIe Clock Input to AdvancedMC |
| 0 | Common Options Region | GbE | GigE connection to onboard switch |
| 1 | | GbE | GigE connection to onboard switch |
| 2 | | SAS/SATA | Interconnect between Bay B4 (PrAMC) and Bays B3, B2 (Disk AdvancedMC) |
| 3 | | SAS/SATA | |
| 4 | Fat Pipes Region | PCIe x4 | Optional PCIe x4 |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | Extended Options Region | Rear I/O | Direct connections to Carrier's Optional Zone 3 Connector (Bays B1, B2, B3, B4) |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |

Figure 3

| Port No. | Generic | MicroTCA | Notes |
|----------|-------------------------|--------------|------------------------|
| CLK1 | Clocks | Clock In/Out | VCM 1/2 - Bussed Clock |
| CLK2 | | Clock In/Out | VCM 1/2 - Radial Clock |
| CLK3 | | Clock In/Out | VCM 1/2 - Bussed Clock |
| 0 | Common Options Region | GbE 0 | VCM 1 - Fabric[A] |
| 1 | | GbE 1 | VCM 2 - Fabric[A] |
| 2 | | SAS/SATA | SAS/SATA Host/Disk |
| 3 | | SAS/SATA | SAS/SATA Host |
| 4 | Fat Pipes Region | Fabric | VCM 1 Fabric[D:G] |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | Extended Options Region | Fabric | VCM 2 Fabric[D:G] |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
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| 18 | | | |
| 19 | | | |
| 20 | | | |

Note: JTAG Interface is not shown

Figure 4

The challenge is to achieve consensus around the solutions to these issues as quickly as possible. Every new telecommunications standard has resulted in the creation of an industry forum focused on making the standard useful by driving common applications and interoperability. Look for the same to happen with AdvancedTCA and AdvancedMC.

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