

AMCs in the Wireless Infrastructure

The Advanced Mezzanine Card is the next generation mezzanine card optimized for AdvancedTCA. It is designed to enhance the modularity value proposition of AdvancedTCA and extend performance scalability beyond today's PMC architecture.

By René Torres and Mark Summers

The use of PMCs has traditionally enabled telecommunications equipment manufacturers to implement a large variety of embedded processors, digital signal processors, network processors, and other components into modular system designs for telecommunication infrastructure. The ATCA (PICMG 3) family of specifications defines the next generation, high-performance blade architecture for carrier-grade telecom applications. PICMG AdvancedMC.0 is the next generation mezzanine card optimized for ATCA. It is designed to enhance the modularity value proposition of ATCA and extend performance scalability beyond today's PMC architecture. AdvancedMC offers benefits for 3G networks' wireless infrastructure applications, such as RNCs that require higher compute and I/O performance scalability to support the rapid growth and convergence of wireless data and voice traffic.

As the next generation mezzanine extension to ATCA, AdvancedMC is well positioned to become the next high-volume, mezzanine FRU in telecommunications. This article focuses on the benefits of AdvancedMC in wireless infrastructure networks and uses a 3G RNC as an example candidate for AdvancedMC use.

RNC Role and Requirements

In a 3G UMTS network, a single RNC can often control between 100 and 250 Node B base transceiver stations, each of which in turn can serve hundreds of UE devices. The primary function of the RNC is to route voice and data traffic over ATM or IP interfaces among the Node B stations it manages and the backend core network. The RNC incorporates both high-performance data plane and control plane functionality. The data plane typically includes line cards that process the OSI layer 2 and 3 transport protocols of the voice and data traffic during active sessions. The control plane in comparison typically manages three functions:

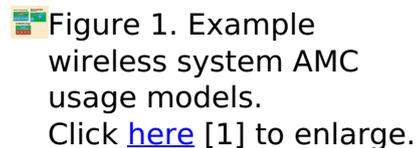
- Shelf management including shelf, chassis, rack, and system management and management of high availability, software provisioning, and the collation of billing and performances statistics:

- Signaling handling of call setup and teardown protocols in addition to control soft handovers of voice and data traffic among Node B stations:

Applications and services In this capacity, the RNC is the heart of the Radio Access Network. As new wireless standards continue to emerge for 3G and 4G wireless networks and beyond, TEMs are looking more than ever to move their designs into a standardized modular architecture flexible and robust enough to support multiple aggressive upgrade paths for their RNC into the next decade. This requirement extends to the smallest field replaceable unit.

Maximum Flexibility and Density

The AdvancedMC specification allows the use of half-height or full-height modules that enable ultra-dense stacking of mezzanine cards, permitting four full-height or eight half-height cards on a single ATCA carrier card. The result is the ability for TEMs to increase their services and applications density per cabinet. AdvancedMC also supports a much wider range of I/O options than the current PMC standard and provides the flexibility to employ multiple processor configurations to support a variety of services and capacities. Figure 1 shows examples of possible uses for the RNC.

 Figure 1. Example wireless system AMC usage models. Click [here](#) [1] to enlarge.

Added Bandwidth

TEMs need a hardware architecture for increased 3G voice and data traffic while also providing the flexibility to implement multiple future network upgrades needed to deliver increased I/O and compute performance in the future. Today's PMCs rely primarily on the parallel PCI bus architecture for control and management. Routing considerations with parallel bus architectures can have drawbacks. For example, parallel bus routing may require substantial board real estate for the fan-out of the signal traces. In addition, I/O scalability over a standard PMC 64-bit/66 MHz bus is limited to 4 Gb/s in bursts. This can quickly become a bottleneck for the RNC. By comparison, AdvancedMC supports high-speed serial interconnects, including Ethernet and PCI Express architecture, that simplify board routing constraints and provide a higher sustainable throughput. AdvancedMC incorporates highly pin-efficient interconnects with a differential signaling physical layer that supports the transmission of full-duplex signals. In fact, the AdvancedMC transport layer supports 21 duplex lanes (42 differential pairs). With throughputs as high as 12.5 Gb/s per lane, serial interconnects help maximize bandwidth on a point-to-point basis. AdvancedMC has sufficient lane scalability to handle multiple 10 Gb/s interfaces such as Ethernet, Fiber Channel, OC-192, and SPI-4. Although AdvancedMC was specified primarily for LVDS, the AdvancedMC.0 base specification now allows for non-LVDS applications.

Using AdvancedMC in the Distributed Control Plane

Many first-generation RNC designs employed a centralized control plane processing card shared by multiple line cards and communicated with the line cards over a

backplane or a switching fabric (see Figure 2). One possible concern with this approach is providing sufficient processing power to shake hands with the protocol traffic load generated by multiple line cards. In some instances, CPU performance can impose a throughput bottleneck. As line card rates in the radio access networks increase up to 10 Gb/s speeds, many wireless equipment manufacturers are now exploring ways to partition their Control Plane stacks to place some lower layer protocol processing on adjunct mezzanine cards down on the line card, closer to the wire.

 Figure 2. Centralized control plane model.

Click [here](#) [2] to enlarge.

One of the significant advantages of AdvancedMC is that it provides a higher power and thermal envelope than PMC and PrPMC. This distributed control plane architecture benefits from the higher compute range and I/O potential of AdvancedMC. Today's PMC specification is limited to only 7.5 W of power dissipation per card and the PrPMC mezzanine at 12 W. By comparison, a 1X-wide AdvancedMC mezzanine has an approximate 30 W thermal envelope (depending on placement of the AdvancedMC), and the connector can deliver 60 W to the card, which would enable a 2X-wide card to be powered from a single connector.

In the RNC example, a high-performance OTC computer-type processor can be added onto a line card via an adjunct AdvancedMC module where it can perform distributed control plane computations in sync with a network processor that performs the data plane processing function. In conjunction, a system designer can partition separate compute blades using dual low-voltage processors to process multi-threaded, higher-level RNC applications and services that can directly leverage symmetric multiprocessing. Figure 3 shows an example of this type of partitioning.

 Figure 3. Using AdvancedMCs for distributed control plane over the line card. Click [here](#) [3] to enlarge.

A Common Platform for CapEx and OpEx Reduction

In many locations, CapEx is expected to stay flat or slightly over the next four years. Under such a challenging environment, TEMs are looking for ways to simplify product offerings across a common architecture to leverage economies of scale and reduce time-to-market.

Many wireless TEMs have adopted or are seriously exploring ATCA as commercial off-the-shelf architecture that they can use to develop a common, reusable compute and line card platform for use in multiple network elements. AdvancedMC extends this value proposition at the mezzanine level, enabling TEMs to expand their common platform designs down to the lowest FRU level. Figure 4 shows a UMTS network diagram and indicates where a common platform based on ATCA and AdvancedMC could be reused across multiple wireless network elements ranging across the Radio Access Network back into the Core Network.

Figure 4.
UMTS

network element targets for sharing a common ATCA and AdvancedMC platform. Click [here](#) [4] to enlarge.

From a service provider perspective, a common platform based on ATCA and AdvancedMC would enable them to purchase common replacements for upgrade boards and mezzanine cards within multiple wireless network elements, while minimizing the variety of FRUs maintained in inventory. From an OEM perspective, they can design to a standard. By simplifying maintenance and training, standardizing on modular systems can also help wireless network operators significantly reduce their operating expenditures. This, in combination with a standard IPMI-based fault detection trigger and native hot swap capability, greatly improves manageability while helping to reduce regular maintenance costs.

Table 1. Connectors that Fit Half-Height and Full-Height Modules

Connectors	Full-Height	Extended Full Height	Half-Height
XPAK (low-profile)	Yes (1 on a 1x; 3 on a 2x)	Yes	Yes (1 on a 1x; 3 on a 2x)
XPAK2 (X2 MSA)	Yes (1 on a 1x; 3 on a 2x)	Yes	Yes (1 on a 1x; 3 on a 2x) (Subject to manufacturer specified pin length)
XENPAK	Yes (1 on a 1x; 3 on a 2x)	Yes	No
SFP (MiniGBIC)	Yes (4 max. -1x)	Yes (8 max; 1x)	Yes (4 max. -1x)
RJ-45	Yes (4 max. -1x)	Yes (8 max; 1x)	Yes (4 max. -1x)

Conclusion

AdvancedMC provides TEMs with a flexible, standards-based, cost-effective means to meet RAS requirements above and beyond what PMC offers today. By offering

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increased compute and I/O performance potential together with improved system manageability, AdvancedMC mezzanines enable TEMs to maximize the flexibility and density of their next generation RNC designs to support more services per system. In parallel, service providers will now potentially be able to save time and costs on truck roll maintenance and upgrades as well as further consolidate future inventory across one common platform throughout the network.

About the Authors

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Glossary of Acronyms

3G - Third-Generation

AdvancedTCA - Advanced Telecom Computing Architecture

ATCA - AdvancedTCA

ATM - Asynchronous Transfer Mode

BTS - Base Transceiver Station

CapEx - Capital Expense

FRU - Field-Replaceable Unit

I/O - Input/Output

IP - Internet Protocol

IPMI - Intelligent Platform Management Interface

LVDS - Low Voltage Differential Signal

NOC - Network Operations Center

OC - Optical Carrier

OpEx - Operating Expense

OTC - Over the Counter

OSI - Open System Interconnection

PCI - Peripheral Component Interconnect

PICMG - PCI Industrial Computer Manufacturers Group

PMC - PCI Mezzanine Card

PrPMC - Processor PMC

RAS - Reliability, Availability, and Serviceability

RNC - Radio Network Controllers

SPI - System Packet Interface

TEM - Telecommunications Equipment Manufacturer

UE - User Equipment

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UMTS - Universal Mobile Telecommunications

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