LOWER COST MICROTCA FOR SPECIAL APPLICATIONS

MICROTCA IS AN EXTREMELY VERSATILE TECHNOLOGY WITH MANY APPLICATIONS DRIVING MANY DIFFERENT REQUIREMENTS. SYSTEM DESIGNERS CAN REDUCE COSTS BY CONSIDERING WHAT TRADEOFFS MAKE SENSE WHEN IT COMES TO POWER, COOLING, BACKPLANE ROUTING, AND SYSTEM MONITORING/MANAGEMENT.

DESIGNERS CAN HARNESS THE POWER AND FUNCTIONALITY OF AMC MODULES WITHOUT TAKING ON THE FULL COST OF MICROTCA ARCHITECTURE BY CAREFULLY SELECTING THEIR FEATURE SET.

ADVANCED MEZZANINE CARD (AMC)

Modules were originally developed by PICMG as a modular I/O expansion device for AdvancedTCA (ATCA) systems. An ATCA board (Carrier) with one or more AMC slots is installed in the ATCA shelf. The AMC Carrier provides the AMCs with +3.3V DC Management Power (MP), +12V DC Payload Power (PP), an I2C connection to the Module Management Controller (MMC), synchronization clocks, and a switch for one of the available serial Fabrics, typically ethernet, Sata/SaS, PCIe, or SrIo.

Figure 1: AMC module in an ATCA Carrier

AAMC manufacturers quickly determined that they could build a small version of an ATCA system using just the AMC modules. In a MicroTCA (MTCA) system the AMC modules plug directly into the backplane. The support functions originally provided by the ATCA Carrier are provided by special modules in the MTCA system.

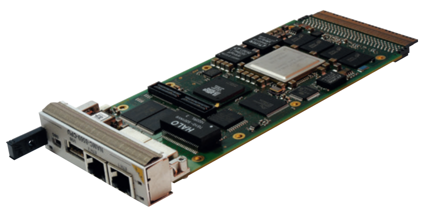

Figure 2: NAT NAMC-8569-CPU

The power supply and presence detection functions went into the MTCA Power Module (PM), the shelf management, Ethernet switch, Fabric switch, and clock distribution functions went into the MicroTCA Carrier Hub (MCH), and the ATCA fan tray became the MTCA Cooling Unit (CU). PICMG decided that a maximum of 12 AMCs would be allowed in a MTCA system, so the standard MCH and PM modules were designed to meet this requirement. Since MTCA was a derivative of ATCA, all of the high-reliability features such as hot-swap, redundancy, and shelf management were included.

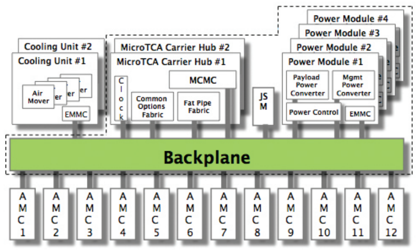

Figure 3: MTCA System Interconnections (see page 5)

MTCA SYSTEM OVERHEAD COST

The simplest implementation of an MCH performs just the system management functions for up to 12 AMCs, 2 CUs, 4 PMs, and possibly a second MCH. The system management functions include the power up/down sequence of all FRUs in the chassis, cooling management based on onboard temperature sensors, E-Keying the AMC and MCH ports, providing an external network connection to the system management functions, and providing an interface to the onboard sensors. All of these are vital to the health and reliability of the system.

By assembling the MCH with additional ICs, it also provides an Ethernet switch for each AMC's port 0/1, and an external Ethernet connection for management tools. Users can add PCBs for a SRIO, PCIe, or Ethernet Fabric switch to the MCH depending on what Fabric the AMC modules need. These Fabrics are implemented on the AMC's ports 4-7, ports 8-11, and ports 12-20. A PCB can also be added to the MCH for PCIe or Telecom clock distribution. In a redundant configuration, one MCH connects to port 0, ports 4-7, and possibly some of the ports 12-20. The second MCH connects to port 1, ports 8-12, and possibly some of the ports 12-20. The cost of the MCH varies considerably depending on the amount of features selected.

The PM can come in many varieties, with -48VDC, +12VDC, or AC inputs, and total power capacities ranging from 400W to 1000W. The PM converts the input voltage to individually controllable +12V and +3.3V outputs for each AMC, CU, PM, and MCH in the chassis.

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The PM also has voltage and current measurement for each output, as well as presence detection and an enable signal output for each output. Because of space constraints, the PM is challenging to design and cool. The CUs in a MTCA chassis are typically redundant so a failed CU can be replaced without a significant reduction in cooling capacity. The CU includes a management processor that measures voltage and current in the CU, measures the individual fans speed, and provides a mechanism for fan speed control.

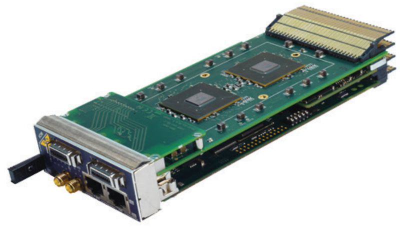

Figure 4: NAT MCH with Clock and Fabric options

In a 12-slot MTCA system, the overhead costs for the MCH(s), PM(s), and CU(s) are reasonable. In a small slot count system, the cost of the MCH and PM are a large percentage of the total cost of the system, and can make MTCA uncompetitive.

MTCA COMPLIANT COST REDUCTION

MICROTCA CARRIER HUB (MCH)

Most MCH manufacturers use a modular approach to implementing their products. The original implementations of the MCH included a Fabric B SATA/SAS switch for the disk drives on tongue 2 of the MCH. Users quickly found that they could eliminate the SAS/SATA switch on the MCH if the Common Options Port[2:3] SAS/SATA interconnections between the Processor and Storage AMC slots were directly routed through the backplane. There is some loss of flexibility with dedicated Processor and Storage AMC slots, but this generally does not cause any problems.

The Fat Pipe Port[D:G] Fabric switch, typically Ethernet or PCIe, is located on tongues 3 and 4 of the MCH. Tongue 3 connects to the first 6 AMC modules and tongue 4 connects to the last 6 AMC modules. When building a small slot count system, users can select a smaller Fabric switch on the MCH that only connects to tongue 3. If the Fat Pipe Fabric is not used at all, a lower-cost basic MCH can be used that provides just the management and Common Options Port [0:1] Ethernet switching functions. If users are not using a PCIe fabric or not building a Telecom system, they can skip the clock distribution module to again save cost.

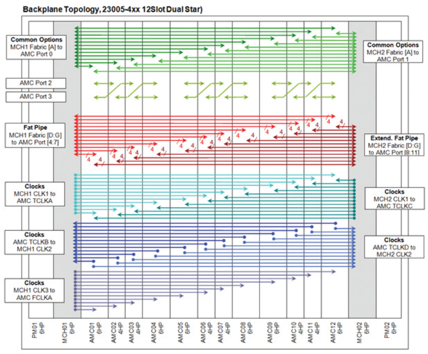

Figure 6: The nVent SCHROFF MTCA backplane topology shown in the above diagram is a Dual-Star, Dual-MCH implementation for GbE, Fat Pipe, Extended Fat Pipe and Clocks, with direct interconnects of Ports 2/3 for the storage interface. (see page 5)

POWER MODULE (PM)

MPMs typically use -48V Telecom as the input power. These PMs convert the –48V to +3.3V and +12V for the AMCs and CUs. A lower cost solution is to use a PM with a +12V input because it only needs to convert a little of the +12V to +3.3V.

Since the -48V and +12V input PMs need an external power supply, users might be able to reduce the total cost of power conversion by using an AC input PM.

Connector Region		AMC Port #	Signal convetions			Non-redundant MCH Fabric #	Redundant MCH # / Fabric #
Basic Side	Common Options	0	AMC.2 1000BASE-BX			A	1 / A
		1	AMC.2 1000BASE-BX			--	2 / A
		2	AMC.3 1SATA/SAS			B	1 / B
		3	AMC.3 1SATA/SAS			C	2 / B
	Fat Pipe	4	AMC.1 1 x4 PCI-Express	AMC.4 x4 SRIO	AMC.2 10GBASE-BX4	D	1 / D
		5				E	1 / E
		6				F	1 / F
		7				G	1 / G
Extended Side	Extended Fat Pipe	8		AMC.4 x4 SRIO	AMC.2 10GBASE-BX4		2 / D
		9					2 / E
		10					2 / F
		11					2 / G
	Extended Options	12					
		13					
		14					
		15					
		17					
		18					
		19					
		20					
		16	Tclock C,D	re-assigned with Rev. 2.0			

Figure 5: AMC-MCH Port Interconnections (see page 5)

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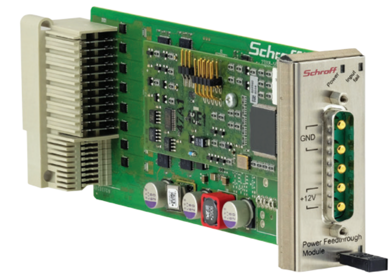

Figure 7: A nVent SCHROFF +12V input PM

Figure 8: A NAT-PM-AC600 600W AC input PM

COOLING UNIT (CU)

If the system does not need to be serviced while running, operators might be able to use just a single CU and cut the cost of cooling in half.

BENDING THE RULES TO REDUCE COST

In order to make small MTCA systems more cost-effective, manufacturers and system integrators are bending the MTCA specification's rules. For special applications, and with careful consideration of the consequences, bending the MTCA rules can result in a significant reduction in the cost of an MTCA system.

MICROTCA CARRIER HUB (MCH)

The idea behind having Ethernet and Fabric switches on the MCH was to support a large number of AMCs, and to make the AMCs independent of the slot location. If only need a few AMCs are needed in a MTCA system, users might be able to directly interconnect the Ethernet and Fabric ports between the AMCs and eliminate the cost of the Ethernet and Fabric switches on the MCH. Since the Port[A:B] Ethernet connection on the AMC is a 1000BASE-T, it is possible to connect Port[A:B] Ethernet to an RJ-45 connector and then to an external network. PCIe Fabrics need a PCIe reference clock, so if the PCIe ports are directly interconnected between the processor AMC and other AMCs,

Figure 9: A NAT eMCH is shown in the above SCHROFF chassis between the AMC slots and the fans.

the processor AMC will need to source the PCIe reference clock and sent it to the other AMCs. Most processor AMC modules can source the Fabric clock.

A low cost, reduced functionality "eMCH" has been developed by NAT.

This eMCH is implemented on a mezzanine that mounts to the backplane and provides an external Ethernet connection and service interface. It eliminates the need for a special MCH backplane slot and provides significant design flexibility. This low cost eMCH provides all of the normal management functions and switches Port[A:B] Ethernet channels, but does not provide Fabric switching or reference clocks. AMCs in a system with an eMCH cannot tell that a reduced functionality MCH is managing them.

Many AMCs can be configured so that they turn on without waiting for commands from the MCH. If all of the AMCs in a system support this feature, then it is possible to eliminate the MCH entirely. If the MCH is eliminated, a chassis is needed with CUs that support autonomously fan speed control based on intake and exhaust air temperatures. If the CU is designed well, it will listen for temperature event messages from the AMC modules and adjust the fan speed. It is possible to design a PM that will operate without an MCH. In this case when the PM sees the presence signal from the AMC it enables power to the AMC.

Figure 10: SCHROFF Low Cost MTCA PM-on-a-mezzanine

POWER MODULE (PM)

The PMs are usually installed in specials slot in the chassis. In small systems the special PM slot can be eliminated and put the PM functionality on a mezzanine on the rear of the backplane. The reduced cost PM-on-a-mezzanine provides all of the normal PM functions, but in a reduced cost implementation. The MCH cannot tell that it is not managing a normal PM. A significant part of the system's cost reduction comes from using a low cost open frame power supply to provide the 12V for the modules.

An even lower cost PM implementation can also be used. The low cost version does not support management by the MCH, and just enables power to the AMCs when their presence is detected. In this case, all of the power switching is done by components located directly on the backplane.

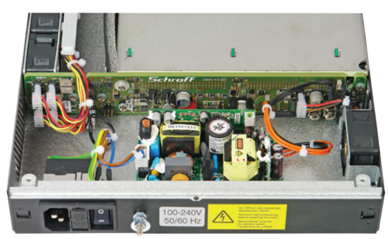

Figure 11: SCHROFF Low Cost MTCA PM-on-a-mezzanine

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COOLING UNIT (CU)

A normal CU includes a powerful IPMC management processor with dual IPMB connections to the MCH. For example, nVent uses a lower cost implementation of a CU in their small chassis. This low cost CU uses a small processor with just a private I2C connection to the MCH. In this case, the MCH includes special firmware that treats the low cost CU as if it were a normal CU. From the user's perspective there is no difference between the normal CU and the low cost CU.

The speed of the fans is normally managed by the MCH. The MCH reads temperature sensors on the AMCs and in the chassis, and then determines the optimal fan speed.

If the MCH is eliminated, the CU needs to manage the fan speed autonomously. The CUs in some small chassis will look for an MCH, and if they don't find one, they will autonomously manage the fan speed based on their own temperature sensors. Since there are often two CUs in the low cost system, one CU is elected the master CU and controls the speed of the slave CU's fans. The optimal fan speed is based on the delta-T inside the system by monitoring inlet and outlet temperature sensors. The low cost CU can also receive temperature events from the AMC modules and react by increasing the fan speed.

LOWER COST MTCA EXAMPLES

OPTION 1: LOWEST COST

This would be the simplest "MTCA" system. It holds 2 single full-size AMC modules, includes a universal AC input, 12V output, 150W power supply inside the rear of the chassis. All ports are interconnected between the two AMC modules, and the backplane supports 10 Gbps Fabric speeds. It has no management functionality at all. The 12V and 3.3V power to the AMCs is enabled when the system detects the presence of the AMC. Standard AMC modules will work in this chassis as long as they will operate without management.

Figure 12: SCHROFF 11850-023 AdvancedMC mini system for 2 single full-size AMC modules

OPTION 1: LOWER COST

This reduced cost MTCA chassis has management functionality that is MTCA compliant, but the MCH, PM, and CU are integrated into the chassis. Advanced 2-Slot AMC boxes may include a NAT eMCH and a PM-mezzanine mounted to the rear of the backplane. The power supply is an open frame switcher inside the rear of the chassis. Since this chassis has normal management functionality, there are no special considerations for the AMC modules. A larger version of this chassis can be built, but since there is no MCH switching function, all of the interconnections between the AMC modules are point-to-point through the backplane. Once the backplane is designed for this specific application, the chassis architecture is fixed.

OPTION 1: LOW COST

Another low-cost design option is a 1U MTCA chassis that holds 6 single mid-size AMC modules, and a normal full-size MCH. The PM functions are integrated into the chassis by a PM-mezzanine mounted to the rear of the backplane and an open frame switcher inside the rear of the chassis. This design reduces the cost of the PM, but still allows for the use of a normal full function MCH. No special routing is used in the backplane, and there are no special considerations for the AMC modules.

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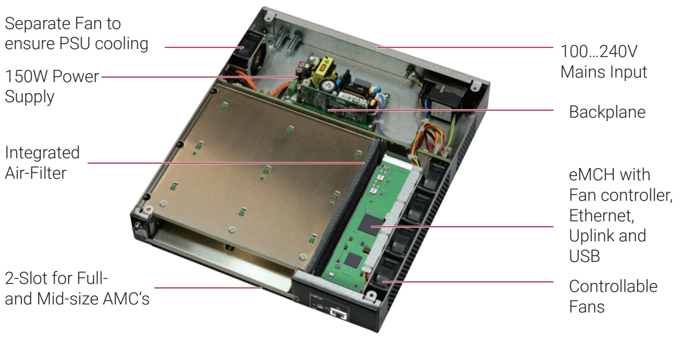

Figure 13: SCHROFF 11850-016 AdvancedMC mini system for 2 single full-size AMC modules with NAT eMCH

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DIAGRAMS

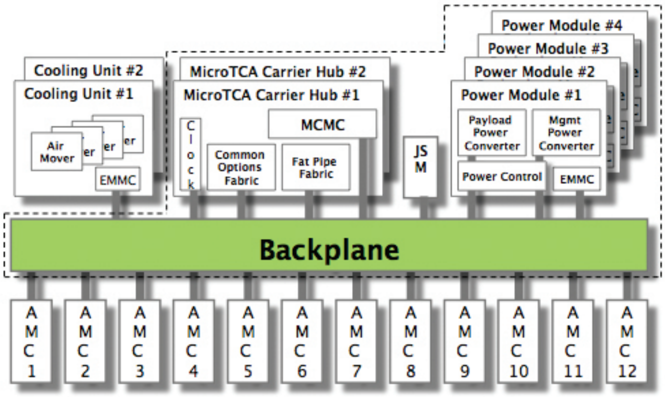

Figure 3: NAT NAMC-8569-CPU

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		1	AMC.2 1000BASE-BX			--	2 / A
		2	AMC.3 1SATA/SAS			B	1 / B
		3	AMC.3 1SATA/SAS			C	2 / B
	Fat Pipe	4	AMC.1 1 x4 PCI-Express	AMC.4 x4 SRIO	AMC.2 10GBASE-BX4	D	1 / D
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		9					2 / E
		10					2 / F
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Figure 5: MTCA System Interconnections

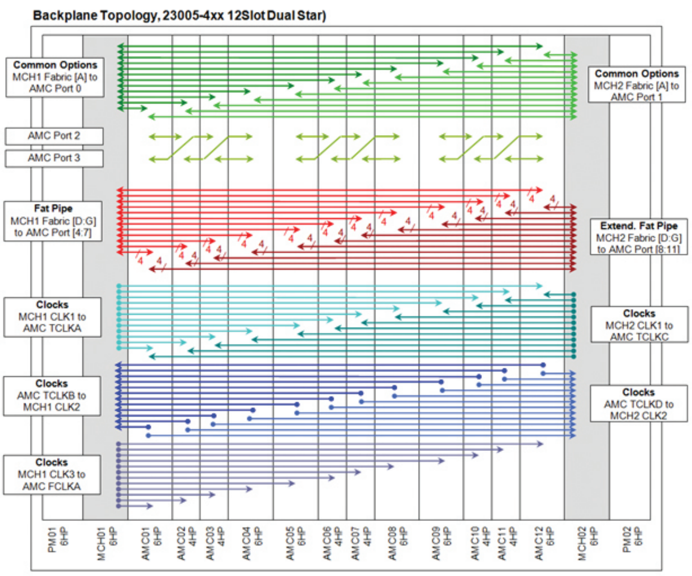

Figure 6: SCHROFF MTCA backplane topology

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