

# An Integrator's Guide to MicroTCA

## Part I – Platform management overview

By Paul Stevens, Advantech

*In this first of a series of three Articles written by Tom Kastner, Peter Marek and Paul Stevens of Advantech, we take a deeper look at MicroTCA technology and provide some insight for potential System Integrators into the functionality of the MicroTCA Carrier Hub (MCH).*

*Part 2 will focus on the startup sequence of a typical system in order to explain the importance of E-keying and Power budgeting. Finally in Part 3 we will discuss each of the various management software options available.*

In the July issue of Boards and Solutions, we published an introductory article outlining the main concepts behind MicroTCA. In this follow-up series of articles we hope to address the needs of users and system integrators who may not be so familiar with the advanced platform management aspects of MicroTCA. Indeed, for those of us migrating from a VME, Compact-PCI or Industrial PC base, it will become clear that life may never be the same without a MicroTCA Controller Hub (MCH). The platform management aspects of MicroTCA definitely make up for the shortfalls of MicroTCA's "predecessor" peers and the maxim of "who can do the most can do the least" is certainly true. As MicroTCA interoperability testing among manufacturers progresses the industry will certainly reap the rewards from the hard work of its PICMG members.

With that said let's start with a recap of what's in a MicroTCA Shelf. A MicroTCA Shelf consists of at least one MicroTCA Carrier. Up to sixteen MicroTCA Carriers can be grouped together to form a single MicroTCA Shelf. MicroTCA Carrier management functions are fulfilled by the Carrier Manager, a logical function that manages each MicroTCA Carrier, possibly with redundant instances. The Carrier Manager function resides physically with a MicroTCA Carrier Management Controller (MCMC) along with the Fabric switches and clock distribution on the MicroTCA Carrier Hub (MCH). A MicroTCA Carrier can be implemented with either single or redundant MCHs.

Additional MicroTCA Carrier architectural elements include:

- Module Management Controllers (MMCs) present in AdvancedMCs,

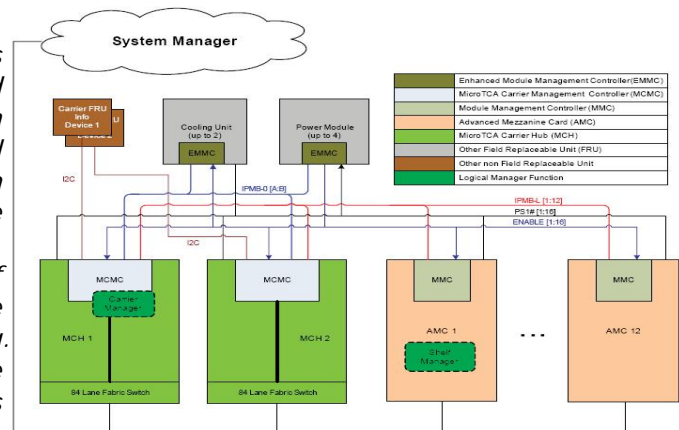


Fig 1. Management Aspects of a MicroTCA Shelf

- Enhanced Module Management Controllers (EMMCs) present in Power Modules (PMs), Cooling Units (CUs) and OEM Modules,
- Carrier FRU Information devices,
- Management hardware interfaces
- Management commands

The Carrier Manager, representing the entire MicroTCA Carrier, exists on only one MCH at a time, even if a redundant MCH is available. The Shelf Manager manages up to sixteen MicroTCA Carriers that comprise a MicroTCA Shelf. Each Carrier Manager interfaces to the Shelf Manager using a logical Shelf-Carrier Manager Interface, which can be an IP-based interface. From a hierarchical perspective, the highest level of management is given to the System Manager which is responsible for managing one or more MicroTCA Shelves and possibly other Shelf types.

Figure 1 shows a System Manager external to the Shelf. Note that because the System Manager is a logical entity, in some systems (such as single Shelf systems), it can be integrated within the Shelf.

MicroTCA Shelves have one or more (possibly redundant) transports capable of supporting the Internet Protocol and connecting a System Manager to a Shelf Manager, MCH(s) and possibly to AdvancedMCs. These connections may be Ethernet and/or other IP-capable transport connections and are used for communication between

- System Manager and Shelf Manager
- Shelf Manager and Carrier Manager

as well as support for other IP-based management services for Modules that need them.

The MicroTCA management subsystem consists of four types of management-oriented connections within the Shelf:

#### AdvancedMCs <-> Carrier Manager

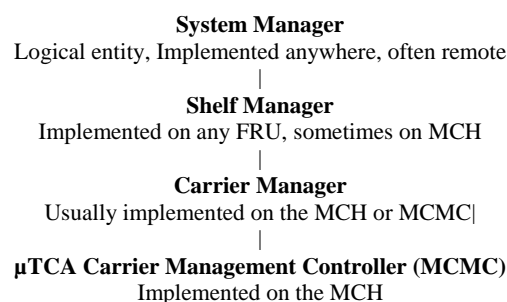
These connections are a non-redundant implementation of the Intelligent Platform Management Bus (IPMB), which is implemented in a radial topology. The IPMB from the Carrier Manager to the AdvancedMCs is called IPMB-L. Each AdvancedMC connecting to IPMB-L does so via a Module Management Controller (MMC).

#### Carrier Manager <-> PMs, CUs, OEM Modules

In MicroTCA Shelves, the PMs, OEM Modules, and CUs have EMMCs on them. Since these Modules are critical to the operation of the Shelf, the EMMCs on these Modules connect to IPMB-0. IPMB-0 is implemented as a dual redundant bus in MicroTCA

function that provides management interfaces to managed entities within a Carrier. The Carrier Manager manages the AdvancedMCs, MCHs, PMs, CUs and OEM Modules, and represents these entities in a MicroTCA Carrier to the Shelf Manager.

The overall management hierarchy can be summarised as:



#### MCMC <-> Carrier FRU Information device

The MicroTCA specification allows up to two MCHs per MicroTCA Carrier. Each MCH contains an MCMC with connectivity to a Carrier FRU Information device found in the MicroTCA Carrier. Each MCMC accesses Carrier FRU Information over a dedicated I2C interface between the MCMC and its associated Carrier FRU Information device.

#### Shelf Manager <-> Carrier Manager

MicroTCA requires an IP-based communication interface between the Shelf Manager function and remote Carrier Managers, but allows an implementation-defined Shelf-Carrier Manager Interface where both Shelf and Carrier Manager are located together.

The Shelf Manager can be implemented on any FRU. It centralizes hardware management information from one or more Carriers. The Shelf Manager watches over AdvancedMCs, MCHs, PMs, CUs, and OEM Modules and reports anomalous conditions to the System Manager whilst taking corrective actions where appropriate. It can also provide the collective hardware status of all the Carriers in the shelf and indicate with telco alarms on the status of the shelf that it monitors.

In Figure 1, the Shelf Manager is located on an AdvancedMC. However it can also be implemented with the Carrier Manager on a MCH or any external hardware. In a MicroTCA Shelf with multiple Carriers, the Shelf Manager is also located on an AdvancedMC. It is possible that redundant Shelf Managers are located across different Carriers that are part of the same MicroTCA Shelf. The MCMC communicates with the Carrier Manager, a logical management

Another important function of the Carrier Manager is to ensure that AdvancedMCs only enable compatible interfaces over the MicroTCA Backplane interconnects, so that incompatible devices don't harm each other or disrupt communication. This function is called Electronic Keying (E-Keying) and assures compatibility of all enabled interfaces within the shelf. Each AdvancedMC contains an MMC, whose FRU Information indicates the capabilities of each Port implemented on the AdvancedMC. Additionally, the Carrier FRU Information, which is accessible by the Carrier Manager, indicates the connectivity of the Backplane. MCMC FRU Information indicates the capabilities of the Ports implemented on the MCH. By coordinating the information from these sources, the Carrier Manager decides which Ports on each AdvancedMC or MCH Fabric to enable or disable. The Carrier Manager communicates this information to each MCH via the MCH's MCMC and to each AdvancedMC via the AdvancedMC's MMC. The AdvancedMC MMCs and MCH MCMCs ensure that only compatible interfaces are enabled.

Access to each MicroTCA Carrier's resources (i.e. Managed FRUs and associated sensors) is controlled by Sensor Data Records (SDRs) accessible via Carrier Manager Device SDR commands. The Shelf Manager accesses MicroTCA Carrier SDRs over the Shelf-Carrier Manager Interface. Any FRU device or sensor that is not described by an SDR is not directly known to the System Manager or Shelf Manager.

The Power Modules provide power to the AdvancedMCs, MCHs, CUs, and OEM Modules. However, MCMCs, MMCs, EMMCs and Carrier FRU Information devices draw Management Power from PMs in the Shelf so they are



**Fig 2. UTCA-5503**

#### MicroTCA Carrier Hub MCH

*In Advantech's MicroTCA Carrier Hub implementation the MCMC is based on a Renesas H8 design running firmware based on PigeonPoint Systems code. In addition to full carrier management functionality, the UTCA-5503 also provides a primary gigabit ethernet fabric on Common Options Fabric A for up to 12 AdvancedMC's*

operational before any other components. The Carrier Manager controls Payload Power to the Modules in a MicroTCA Carrier with commands to the PMs, giving it the ability to shut off any Module deemed to be failing or needing to be powered off as required by the Carrier Manager, Shelf Manager, or System Manager. Given the data about the MicroTCA Shelf power capability, the Carrier Manager negotiates power budgets with AdvancedMCs and other FRUs so that the MicroTCA Carrier operates within its power capacities.

The Shelf Manager manages the cooling of the Shelf via the Cooling Units and FRU temperature sensors. Sensors on FRUs monitor temperatures and issue event messages when temperatures go outside the prescribed bounds. In response to such events, the Shelf Manager can initiate changes in cooling levels for the Shelf.

The MCHs, PMs, CUs, and AdvancedMCs shown in Figure 1, are Field Replaceable Units (FRUs). Notice that the Carrier FRU Information device is not necessarily implemented as a distinct FRU, but is implemented directly on the MicroTCA Carrier Backplane or as re-movable card connected to the Backplane. In MicroTCA, all entities except the Carrier FRU Information device are implemented as Intelligent FRUs and

are IPMI-capable. Each FRU that connects to either IPMB-L or IPMB-0 must be an Intelligent FRU with a management controller.

A Carrier FRU Information device is an I2C serial EEPROM on the MicroTCA Backplane which stores the attributes of a MicroTCA Carrier, including Backplane connectivity and the power-up sequence of AdvancedMCs. The capability to store the attributes of a MicroTCA Carrier external to the MCMC, coupled with access to the Carrier FRU Information, enables a Carrier Manager to interoperate across various modular MicroTCA Carrier implementations.

The MicroTCA Shelf Manager itself does not participate in power budgeting or E-Keying. The Carrier Manager handles those responsibilities. After the Carrier Manager has established an interface with the Shelf Manager, the Shelf Manager discovers the already activated MicroTCA FRUs and synchronizes its internally tracked FRU states with the MicroTCA Carrier FRU states.

In next month's article we will discuss in more detail the power budgeting and E-keying mechanisms and use a typical system configuration to describe a carrier power-up and initialisation sequence.