

TELECOM

Management building blocks speed AdvancedTCA product development

By Mark Overgaard

The IPM Sentry Intelligent Platform Management products provide off-the-shelf building blocks for the management subsystems of AdvancedTCA products that enable developers of those products to focus on their unique added values rather than developing and validating the management subsystems on their own.

The IPM Sentry products are Intelligent Platform Management building blocks designed from the ground up for modular platforms like AdvancedTCA, CompactPCI, and CompactTCA, in which there is a strong focus on a dynamic population of Field Replaceable Units (FRUs) and maximum service availability. The Intelligent Platform Management Interface (IPMI) specification provides a solid foundation for the management of such platforms, but requires significant extensions to support them well. See "Design considerations for PICMG 3.0 AdvancedTCA backplanes" (on page 62) and "CompactTCA unifies platform architecture" (on page 30) in this issue for additional background.

IPMI defines a management infrastructure that is widely used across the PC and server industry. PICMG 2.9, the CompactPCI System Management specification, maps IPMI to the CompactPCI architecture, but does not address the necessary extensions. As a result, there are competing and incompatible sets of OEM-specific extensions in the CompactPCI space.

PICMG 3.0, the AdvancedTCA specification, defines the necessary extensions to IPMI. In fact, more than 30 percent of the 430 pages of PICMG 3.0 R1.0 are devoted to shelf management, including the definition of 24 new commands, five new FRU Information data structures – several quite complex – and two new sensor types.

The strategy in the IPM Sentry product line is to leverage the AdvancedTCA extensions for use in other modular architectures such as CompactPCI and CompactTCA. This current article, however, focuses primarily on AdvancedTCA.

Overview of Intelligent Platform Management in AdvancedTCA

Figure 1 shows the logical elements of an example AdvancedTCA shelf, identified in terms of the ATCA specification and potential sites for incorporation of IPM Sentry products. Note that AdvancedTCA has adopted the term shelf for alignment with typical practice in telecommunications applications. Traditionally, for instance, in the CompactPCI specifications, the term chassis has been used with essentially the same meaning.

An AdvancedTCA Shelf Manager communicates inside the shelf with IPM Controllers, each of which is responsible for local management of one or more Field Replaceable Units (FRUs), such as

boards, fan trays or power entry modules. Management communication within a shelf occurs primarily over the Intelligent Platform Management Bus (IPMB), which is implemented on a dual-redundant basis as IPMB-0 in AdvancedTCA.

An overall system manager (typically external to the shelf) can coordinate the activities of multiple shelves. A system manager typically communicates with each Shelf Manager over Ethernet or possibly another transport that supports the Internet Protocol (IP), such as InfiniBand.

Figure 1 shows three levels of management:

1) Board 2) Shelf 3) System

The next two sections address the board and shelf levels in turn, highlighting the following IPM Sentry products and their capabilities as well as the relevant AdvancedTCA functionality:

- IPM Sentry Board Manager software and BMR-100 hardware reference design, which together implement an AdvancedTCA-compliant IPM Controller.
- IPM Sentry Shelf Manager software and ShMM-300 mezzanine module, which together with an appropriate ShMM-300 carrier board, implement an AdvancedTCA-compliant Shelf Manager and Shelf Management Controller (ShMC).

A subsequent section addresses the IPM Sentry BTC-100 bench top carrier for the ShMM-300 that allows immediate lab and prototype experimentation with the IPM Sentry products.

Board management (IPM Sentry Board Manager and BMR-100)

This level includes the local management of full-size 8U AdvancedTCA boards as well as other auxiliary FRUs, such as fan trays or power entry modules. The IPM Sentry BMR-100 reference design can be implemented as part of any board or other FRU, and executes the IPM Sentry Board Manager software, thereby realizing an AdvancedTCA-compliant IPM Controller. The IPM Sentry Board Manager represents one or more FRUs (via IPMB) to the Shelf Manager, including:

- Providing inventory information identifying each such FRU, including its manufacturer and other data.
- Describing and implementing a set of logical sensors (such as for temperature, state of IPMB-0, and operational state for each FRU – activated, deactivated, etc.).
- Generating events (typically directed to the Shelf Manager) for exceptional conditions detected by any sensor, based on its configured event generation settings.
- Negotiating with the Shelf Manager for resources needed by the FRU(s), including power and interconnects.

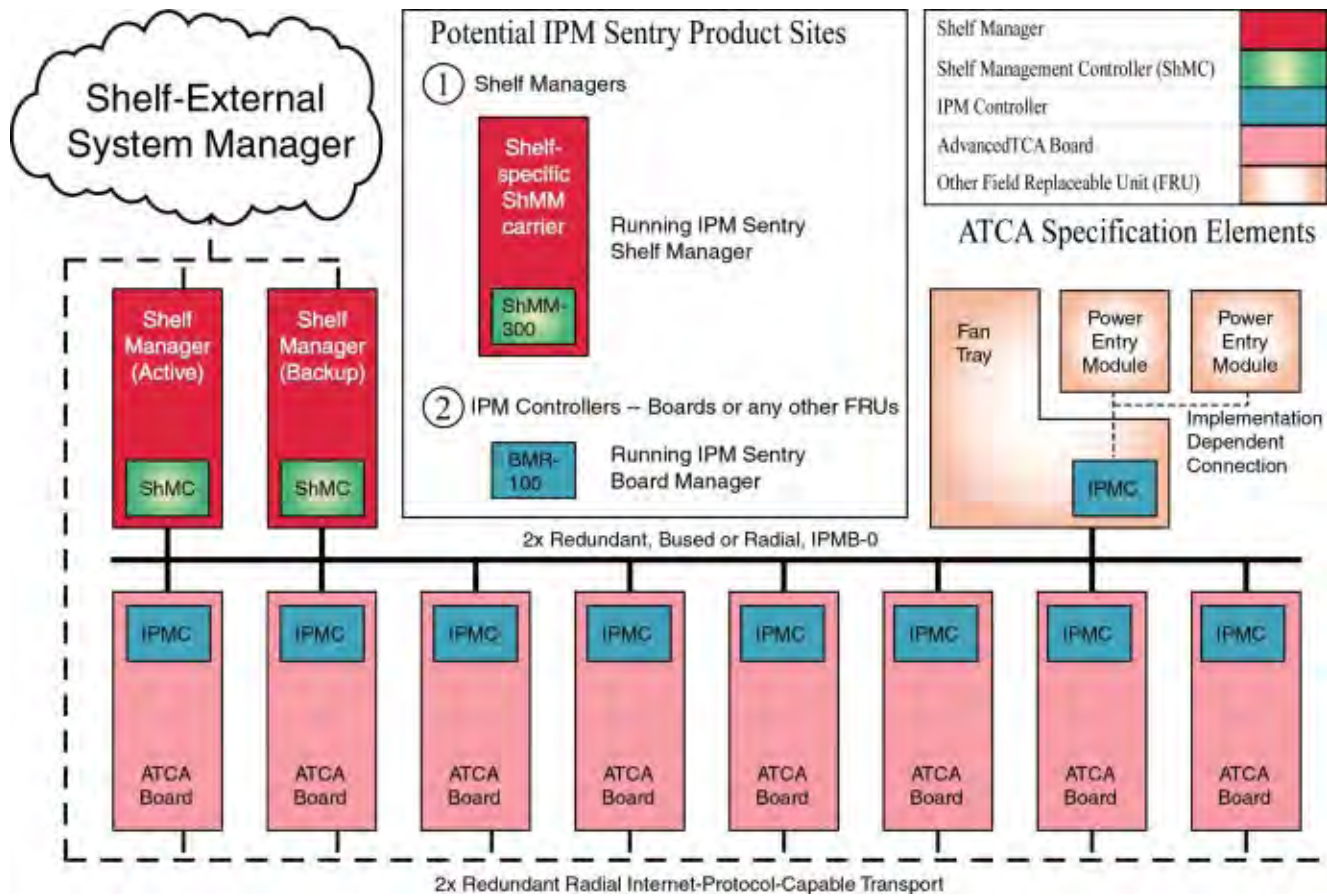


Figure 1

The BMR-100 reference design is the first of a family of such designs. It is based on a very cost-effective single-chip, dual-core processor from Texas Instruments, the TMS320VC5470 (C5470). The board manager executes on the 32-bit, 47.5 MHz ARM7 core, with the 100 MHz C54x Digital Signal Processor (DSP) core dedicated to implementing the dual redundant IPMB interface that is required by AdvancedTCA. The C5470 integrates a rich complement of interfaces, including two UARTs, many general purpose I/Os and a master-only I2C interface for access to on-board sensors and I/O expansion. As a consequence of this high integration, an IPM Controller based on the C5470 can be compact and economical, but fully capable of handling the ATCA extensions to IPMI.

The BMR-100 product includes all the materials necessary (documentation, schematics, bill of materials, etc.) for AdvancedTCA Intelligent FRU developers to integrate the reference design directly into their boards and take immediate advantage of the fully validated Board Manager executing on the C5470.

Shelf management (IPM Sentry Shelf Manager and ShMM-300)

The IPM Sentry Shelf Manager (consistent with AdvancedTCA Shelf Manager requirements) has two main responsibilities:

- Manage/track the FRU population and common infrastructure of a shelf, especially the power, cooling, and interconnect resources and their usage. Within the shelf, this management/tracking primarily occurs through interactions between the Shelf Manager and the IPM Controllers over IPMB-0.
- Enable the overall system manager to join in that management/tracking through the system manager Interface, which is typically implemented over Ethernet.

Much of the IPM Sentry Shelf Manager is devoted to routine missions such as powering a shelf up or down and handling the arrival or departure of FRUs including negotiating assignments of power and interconnect resources. In addition, the Shelf Manager can take direct action when exceptions are raised in the shelf. For instance, in response to temperature exceptions the Shelf Manager can raise the fan levels or, if that step is not sufficient, even start powering down FRUs to reduce the heat load in the shelf.

Support for dual redundant operation

The IPM Sentry Shelf Manager can be configured with active/backup instances to maximize availability. Figure 2 shows how both instances are accessible to the System Manager, with only the active instance interacting at any given time. Similarly, only the active instance communicates over IPMB-0 with the IPM Controller population in the shelf. The two instances communicate over TCP/IP, with the active instance posting incremental state updates to the backup. As a result, the backup can quickly step into the active role if necessary.

Three cross-connected signals between the two Shelf Manager instances enhance their coordination:

- Presence. Each Shelf Manager instance knows whether the other instance is present in the shelf.
- Health. Each instance knows whether the other instance considers itself healthy.
- Switchover. The backup instance can force a switchover if necessary.

System manager interface

Another major subsystem of the IPM Sentry Shelf Manager implements the system manager Interface. System Manager is a

logical concept that may include software as well as human operators in the swivel chairs of an operations center. The IPM Sentry Shelf Manager provides a rich set of system manager interface options, which provide different mechanisms of access to similar kinds of information and control regarding a shelf.

One such mechanism is IPMI LAN Interface. To maximize interoperability among independently implemented shelf products, this interface is required by the AdvancedTCA specification and supports IPMI messaging with the Shelf Manager via the Remote Management Control Protocol (RMCP). A system manager that uses RMCP to communicate with shelves should be able to interact with any ATCA-compliant Shelf Manager. This relatively low level interface provides essentially complete access to the IPMI aspects of a shelf, including the ability for the system manager to issue IPMI commands to IPM Controllers in the shelf, using the Shelf Manager as a proxy.

In addition, the IPM Sentry Shelf Manager provides two interfaces oriented towards human users rather than programmatic ones:

- **Command Line Interface (CLI):** This interface provides a comprehensive set of textual commands that can be issued to the Shelf Manager via either a physical serial connection or Telnet.
- **Web-based Interface:** This interface enables essentially the same functionality as the CLI, with access to the Shelf Manager via a Web browser.

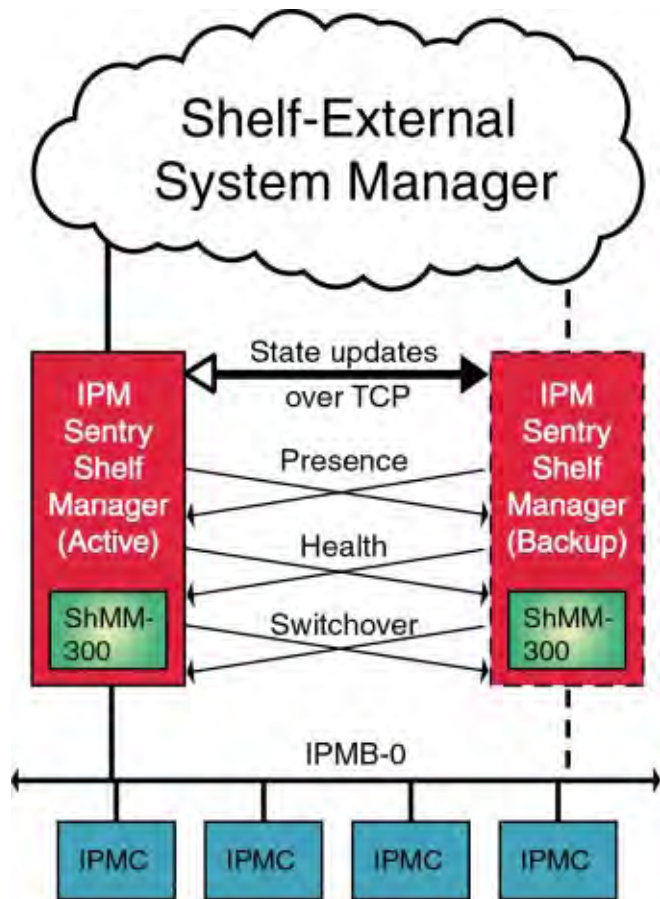


Figure 2

Using either of these mechanisms, the system manager can access information about the current state of the shelf, including current FRU population, sensor values, threshold settings, recent events, and overall shelf health.

Finally, the IPM Sentry Shelf Manager supports Simple Network Management Protocol (SNMP) access to the shelf. This popular management protocol is supported with a custom Management Information Base (MIB) providing Get and Set access to a wide range of information and controls regarding the shelf.

ShMM-300 Shelf Management Mezzanine

The IPM Sentry Shelf Manager executes on the ShMM-300 hardware, a small (67.60 mm x 50.80 mm) Shelf Management Mezzanine (ShMM) that conforms to the Small-Outline Dual Inline Memory Module (SO-DIMM) specification. Figure 3 shows a ShMM-300, highlighting its small size.



Figure 3

Despite its small size, the ShMM-300 packs a substantial set of capabilities:

- 47.5 MHz ARM7 RISC core and 100 MHz C54x DSP core in a single chip: the Texas Instruments TMS320VC5471
- 4, 16, or 32 Mbytes of SDRAM
- 1 to 16 Mbytes of Flash for program, data, and FRU information storage
- Real-time clock to time-stamp System Event Log entries, backed by on-carrier battery
- Watchdog timer external to C5471 for protection

The following correspond to features that are accessible to the ShMM carrier via the socket:

- Two 10/100 Mbit Ethernet controllers with LED indicator controls
- Two serial interfaces, one with modem control, CMOS & RS-232/RS-485 levels
- Master-only I2C bus for access to on-carrier devices, such as hardware monitors
- High speed Serial Peripheral Interface (SPI) for access to PLDs or specialized peripherals on-carrier
- General Purpose I/O signals
- Dual redundant & buffered IPMB, implemented by the C54x DSP core
- Shelf Manager redundancy and hot-swap interfaces with on-board CPLD assist
- JTAG interface for processor debug, plus Flash, and CPLD programming

Flexibility of the mezzanine form factor

The compact mezzanine form factor of ShMM-300 enables great flexibility in how it is integrated into a shelf. The ShMM-300 and its integrated Shelf Manager can be applied as product building blocks in many contexts:

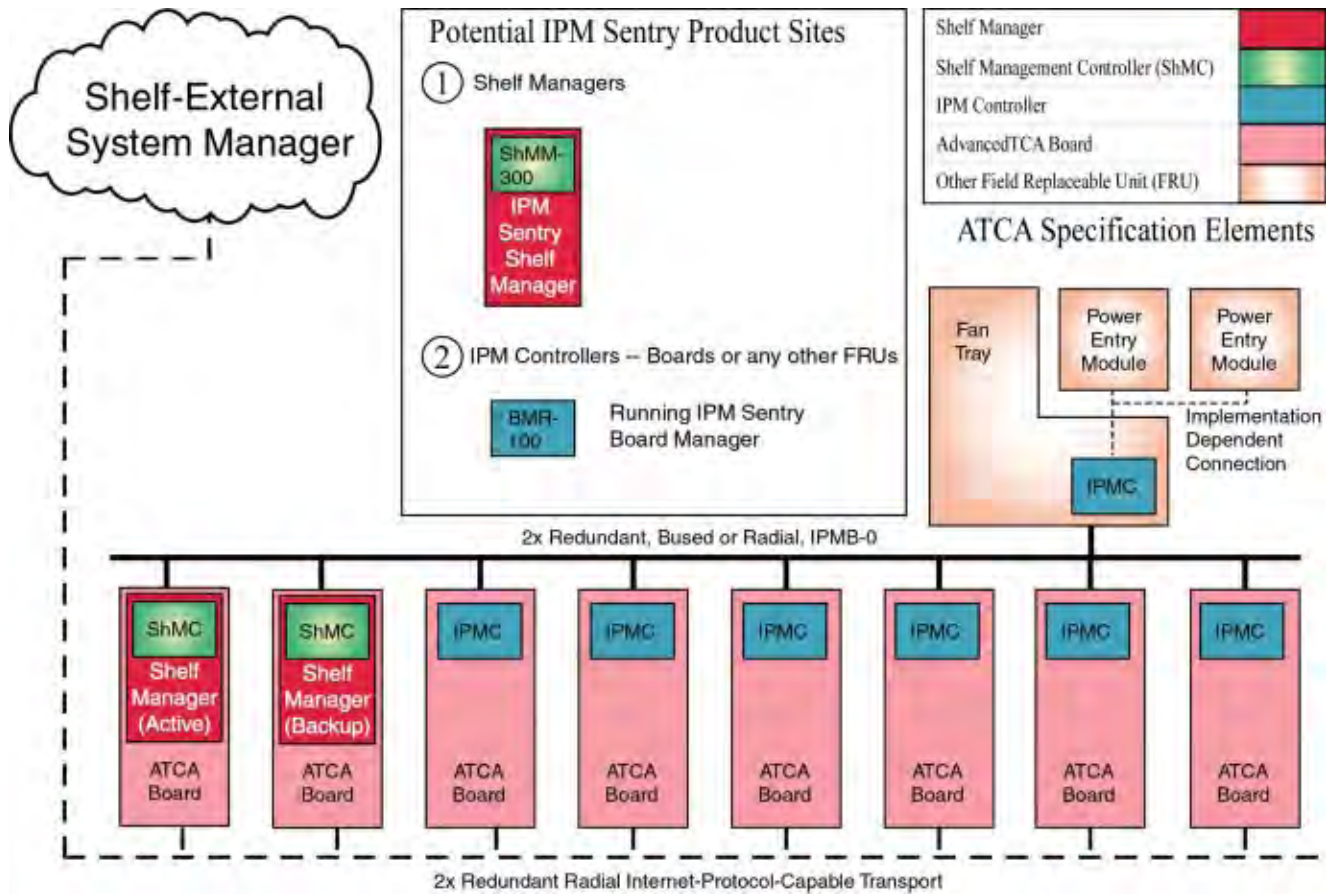


Figure 4

- In dedicated management slots across a range of shelf designs for a given modular architecture (such as AdvancedTCA), each of which can have a unique form factor for the ShMM carrier board if necessary. In these configurations, the ShMM carrier board could optionally also include shelf-specific functionality such as fan or power entry controls/sensors, possibly eliminating those functions as separate FRUs in the shelf.
- In similar dedicated slots across multiple modular architectures (including CompactPCI and CompactTCA for instance). Again, the ShMM carriers may need to be respun, but the ShMM-based Shelf Manager can be directly reused.
- Integrated with AdvancedTCA boards, rather than in dedicated management slots. A pair of such boards could potentially house the dual redundant Shelf Manager function in addition to their other functionality. Figure 4 shows an example of this approach, where shelf-specific facilities such as fan control would typically be delegated to one or more separate IPM Controllers accessed over IPMB-0 from the Shelf Manager.

The ShMM-300 can run the IPM Sentry Board Manager as well. In fact, a prototype AdvancedTCA board could incorporate a ShMM socket instead of an integrated implementation of the BMR-100 reference design to accelerate early development. The C5471 processor on the ShMM-300 is equivalent to the C5470 processor used in the BMR-100 reference design, except for the integrated Ethernet port that augments the C5471.

BTC-100 bench top carrier for ShMM

The IPM Sentry BTC-100 + ShMM-300 can be instantly useful in a laboratory or prototyping/development environment focused on AdvancedTCA. Figure 5 shows the BTC-100 with a ShMM-300 installed.



Figure 5

One immediate use of the BTC-100 is in familiarization with IPM Sentry facilities and Intelligent Platform Management in general. Engineers can set up one or two BTC-100s running the IPM Sentry Shelf Manager and one or more other BTC-100s, each executing the IPM Sentry Board Manager. A 10-conductor ribbon cable implements IPMB-0 and links the BTCs together. With such a configuration, the management aspects of AdvancedTCA can be thoroughly explored – all without creating any new hardware! The BTC-100 is richly populated with test headers, jumpers, and status LEDs for maximum prototyping access and flexibility.

The BTC-100 comes with a design specification and complete schematics and is ideally suited as a reference design for custom ShMM carrier boards. If the custom carrier is a shelf-specific dedicated management card, the form factor and detailed connections to the backplane and other shelf resources can be adapted to optimize to the product goals for that shelf.

SPECIAL FEATURE

Functionally, the BTC-100 provides access to all the external I/O interfaces implemented on the ShMM-300, including dual Ethernet, dual serial ports (one with modem control), dual redundant IPMB, and Shelf Manager redundancy signals (which are connected between two redundant BTC-300s).

In addition, the BTC-100 adds the following functionality, most of which would typically be included on shelf-specific ShMM carriers:

- Voltage and temperature monitoring
- Telco alarm interface that is compatible with PICMG 3.0 requirements, including relays, LEDs, and an alarm cutoff push-button
- Fan control via tachometer inputs and Pulse Width Modulated outputs, buffered so that only the active BTC-100 attempts to control the fans
- User configurable hardware address with parity
- FRU LEDs
- Battery backup for the ShMM-300 real-time clock
- JTAG interface for debugging and manufacturing

Finally, the BTC-100 also supports a set of radial physical IPMB-0 segments as a reference design for shelves that choose to implement IPMB-0 as a dual redundant star rather than as a bus. In this design, each of IPMB-A and IPMB-B (the redundant buses that combine to form IPMB-0) remain a single logical bus with multiple physical segments in that bus.

Conclusion

The IPM Sentry products are the first Intelligent Platform Management building blocks designed from the ground up for modular platforms like AdvancedTCA, CompactPCI, and CompactTCA, in which there is a strong focus on a dynamic FRU population and maximum service availability.

The IPM Sentry products (Shelf Manager, ShMM-300, BTC-100, Board Manager, and BMR-100) are:

- Off-the-shelf management building blocks for AdvancedTCA board and shelf products that allow product developers to focus on their unique added values, not on creating and validating the management aspects.
- Purposely architected to allow those developers to customize the building blocks on both the hardware and software levels for differentiation.
- Already in use by leading AdvancedTCA product developers for early products and interoperability testing.
- Leveraging the significant extensions defined by PICMG 3.0 to support compatible implementations for CompactPCI and CompactTCA.
- Built by leaders in the creation and refinement of the shelf management aspects of PICMG 3.0R1.0 with many years of experience with management aspects of advanced CompactPCI platforms.



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