

## PRODUCT BRIEF

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# Pigeon Point ShMM-700R and Shelf Manager

## Shelf Management Mezzanine & Shelf Manager Core

For AdvancedTCA® and Custom Derivative Architectures

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The Pigeon Point ShMM-700R, and the Pigeon Point Shelf Manager that comes pre-loaded on it, are part of a series of Pigeon Point off-the-shelf management components.

(The term “shelf,” as used in AdvancedTCA and some industries, is essentially equivalent to the widely used term “chassis.”)

This member of the series provides the core of an AdvancedTCA Shelf Manager. The ShMM-700R mezzanine complies with the 67.60mm x 41.75mm DDR3 204-pin SO-DIMM form factor. It is installed in the SO-DIMM socket of a ShMM carrier board to produce a complete Shelf Manager. The carrier board can be customized to the form factor and feature requirements of the shelf products it supports.

For shelf developers, the ShMM-700R is available in a Pigeon Point Shelf Management Starter Kit (which is detailed in a separate product brief). The kit includes:

- Schematics for a ShMM carrier board, ready for adaptation to the needs of your shelf
- Bench top hardware, including a Shelf Manager and IPM Controller (IPMC), allowing your ramp up on AdvancedTCA style management to start immediately
- One-stop support for hardware, firmware and software used in developing and delivering your Pigeon Point ShMM-700R based AdvancedTCA Shelf Manager



#### Small size and low power mezzanine form factor

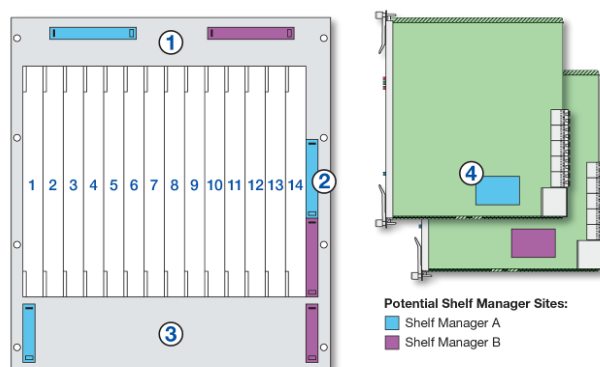
Despite its small size, with high integration, the RoHS-compliant ShMM-700R includes a capable compute core, while still remaining low power:

- 297 MHz ARM processor: the Freescale i.MX287
- Microsemi SmartFusion FPGA
- 128 MB of SDRAM
- 64 MB of Flash for program, data storage (two copies to support reliable upgrades)
- Maximum power: 3.0W at 3.3V/5.0V.

#### Outstanding placement flexibility

This combination of small mezzanine form factor and low power allows a broad range of mechanical options for dual ShMM-700R carriers. Here are some alternatives for a 19-inch shelf with a 14-slot subrack (as shown in the figure below, which assumes ATCA form factors):

1. Horizontal in upper or lower air plenum
2. Vertical next to a slot
3. Vertical in upper or lower air plenum
4. Integrated with appropriate board types (likely switch or hub boards)



#### Overall tracking/management of shelf

One overall responsibility of the Pigeon Point Shelf Manager is to manage and monitor the overall operation of a shelf, including the FRU population and the power, cooling and interconnect resources and their usage, as well as events that may be generated by exception conditions in the shelf. Within the shelf, this management/tracking primarily occurs through interactions between the Shelf Manager and the IPMCs over IPMB-0. The figure below shows these key management subsystems and the IPMB-0 connection with the IPMCs in the shelf.

This mission includes negotiating assignments for power and interconnect resources when a shelf is powered up or down or when a FRU arrives or departs. This mission also includes taking 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.

### Specification-compliant and interoperability-tested

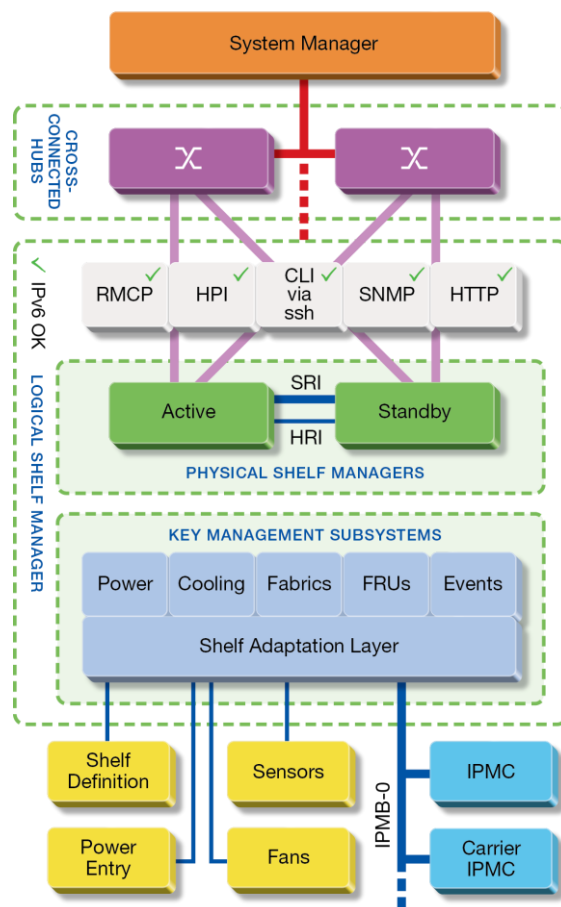
When integrated with a suitable carrier, the ShMM-700R complies with PICMG 3.0 R3.0 as amended by ECN 3.0-3.0-001 (which includes IPv6 support) and IPMI v2.0, document revision 1.0 (as well as for the IPv6 aspects of document revision 1.1), plus relevant errata. It has been thoroughly tested with other independently implemented management components at PICMG TCA-IWs (Interoperability Workshops).

Pigeon Point ShMMs manage tens of thousands of ATCA shelves throughout the world and have been intensively and successfully tested by major Network Equipment Providers.

### Highly adaptable, including for custom management architectures

The Pigeon Point Shelf Manager is already being used in custom management architectures to take advantage of the well defined management infrastructure within ATCA. It can be used for blades in bladed systems or for main system boards in non-bladed systems, such as appliances. The management framework is independent of physical form factor choices, including number and size of boards or blades. Hot swapping of boards in live shelves is supported, but need not be used.

Custom architectures can mix standards-based boards with proprietary-architecture boards. Such mixtures enable system developers to leverage standards-based ecosystem products and integrate proprietary form factors or extensions with their “special sauce,” as well.



### Support for redundant Shelf Managers

The Pigeon Point Shelf Manager is usually configured with active/backup instances to maximize availability. The above diagram shows how both instances are accessible to the System Manager, with only the active instance interacting at any given time. Similarly, the active instance is the primary communicator over IPMB-0 with the IPMC population in the shelf. The two instances communicate over the TCP/IP based Software Redundancy Interface (SRI) which is implemented via a pair of USB links between the ShMM-700Rs. The active instance posts incremental state updates to the backup via this interface. As a result, the backup can quickly step into the active role if necessary.

The Hardware Redundancy Interface between the two Shelf Manager instances enables the exchange of hardware level ShMM-700R state information, including the following:

- 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.

### **ShMC cross-communication links further improve availability**

In typical shelves that support Shelf Manager redundancy, the Pigeon Point Shelf Manager running on the ShMM-700R supports ShMC cross-communication links so that each dedicated<sup>1</sup> Shelf Manager can communicate with both Ethernet hubs (switches) in the shelf, using the two 10/100 Mbit Ethernet links built into the ShMM-700R.

As a result, either a hub board or a Shelf Manager can switch over to its redundant peer, independently. The above figure shows these cross-connects.

### **Flexible Shelf Adaptation Layer supports wide range of shelf variants**

The key technology in this layer is the Pigeon Point Hardware Platform Description Language (HPDL). HPDL enables a textual definition of management aspects of the ShMM carrier board architecture and shelf architecture, including the IPMB-0 topology, the access methods and implementations of auxiliary FRUs such as fan trays and power entry modules, plus information on shelf level IPMI sensors and IPMI sensors on the ShMM carrier board.

Textual HPDL descriptions are easy for shelf developers to maintain, including for numerous shelf architecture variants. HPDL text is compiled to a binary format and interpreted during shelf operation. Binary HPDL modules can apply to an

entire shelf or locally describe a specific FRU, facilitating modular maintenance.

Shelf adaptations via HPDL can be done by shelf development engineers without any C language programming skills. HPDL is a key enabler for the wide range of standards-based and custom management architectures that can be supported by the Pigeon Point Shelf Manager.

### **Rich System Manager Interface**

Another overall responsibility of the Pigeon Point Shelf Manager is to enable an overall System Manager to join in the Shelf Manager’s management and tracking activities through the System Manager Interface, which is implemented over Ethernet on the Pigeon Point ShMM.

“System Manager” is a logical concept that may include software as well as human operators in the “swivel chairs” of an operations center. As shown in the figure, the Pigeon Point Shelf Manager provides a rich set of built-in System Manager Interface options, which provide different mechanisms of access to similar kinds of information and control regarding a shelf. Some of the interface options are specification-governed, while others are specific to the Pigeon Point Shelf Manager.

One such mechanism is the Remote Management Control Protocol (RMCP) 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. RMCP+, the advanced variant of RMCP specified in IPMI v2.0, is supported as well, though not mandated by ATCA. 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 IPMCs in the shelf, using the Shelf Manager as a proxy.

<sup>1</sup> *Dedicated* Shelf Managers are implemented in specific positions in the shelf designed for that particular purpose, versus *integrated* with boards in full size slots, such as the hub boards implementing a dual star Ethernet or other fabric.

The Pigeon Point Shelf Manager supports several configuration options when both of the ShMM-700R Ethernet ports on each of a redundant pair of ShMMs are connected to the System Manager. Those configurations support one, two or all four Ethernet ports being actively used or monitored at any given time.

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

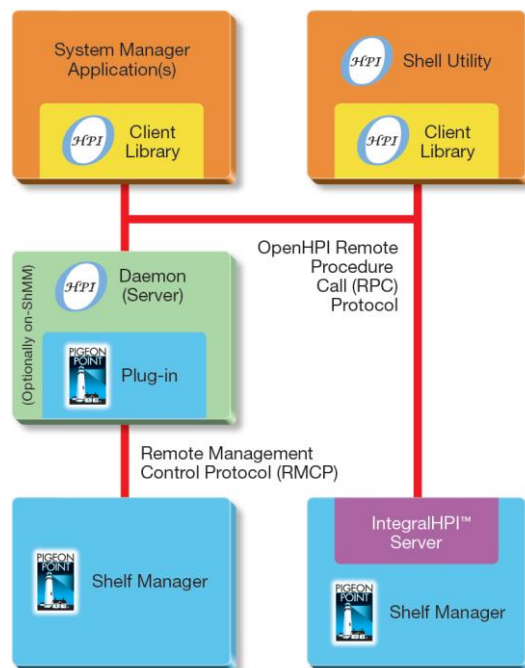
- **Command Line Interface (CLI):** This interface provides a comprehensive set of textual commands that can be issued to the Shelf Manager via either a physical serial connection or via a remote shell interface, such as ssh.
- **Web-based Interface (implemented via HTTP):** This interface enables a subset of the CLI functionality, with access to the Shelf Manager via a web browser.

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.

The Pigeon Point Shelf Manager also 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.

Finally, Pigeon Point offers optional implementations of the Hardware Platform Interface (HPI), a standard set of application programming interfaces defined by the Service Availability Forum, which provides implementation-independent access to a managed compute platform for upper layer management applications. HPI is widely used for this purpose with ATCA shelves and with custom shelves, as well. Pigeon Point IntegralHPI™ is an advanced implementation of HPI as a subsystem within the Pigeon Point Shelf Manager, including full redundancy support and optimized performance. Pigeon Point OpenHPI is a distribution of the open source OpenHPI project that includes the Pigeon Point plug-in and has been improved by

thoroughly testing and optimizing it for use with the Pigeon Point Shelf Manager. IntegralHPI implements the same client library protocol as the OpenHPI daemon, so System Manager applications can access either style of HPI service interchangeably.



### Fan geography support enables fine granularity cooling management

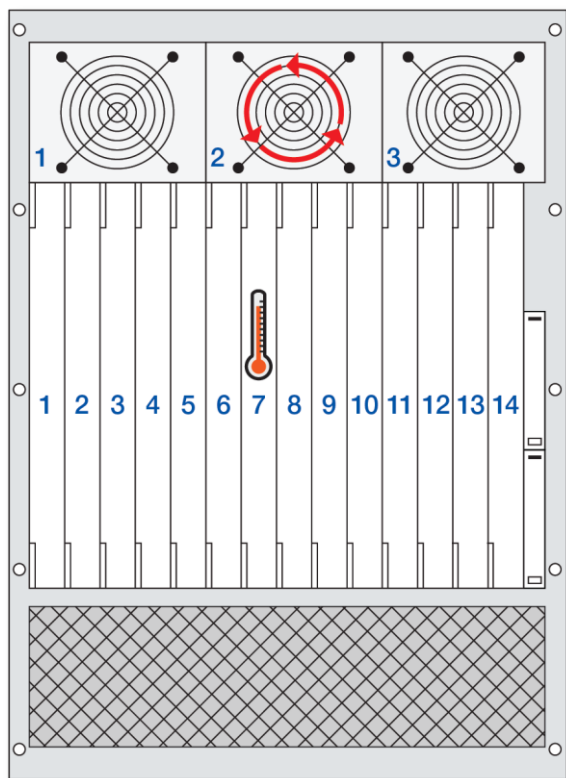
Consistent with ATCA, the Shelf Manager supports shelves that self-describe their *fan geography* – the mapping between the FRUs in the shelf (such as the boards) and the fan devices that cool them. This mapping allows the Shelf Manager to adjust fan speeds for just the fans that cool a particular FRU that is raising a temperature exception. Since increased fan speeds translate to increased acoustic noise, this type of focused response to a temperature exception can be very important for some customers.

In the example shown in the figure below, a temperature exception raised by the board in slot 7 results in a fan speed increase only in the second fan tray, which has cooling responsibility for slots 6-10.

Since the fan geography description is included in the Shelf FRU Information, the Pigeon Point Shelf Manager can automatically adjust its management to fit the cooling zones actually implemented in



any given shelf, even in a custom shelf that substantially extends or diverges from the ATCA physical architecture.



The remainder of this product brief provides a summary of key features of the ShMM-700R hardware and software. The focus is on features that have software support and the initial feature descriptions elaborate on the System Manager Interface options.

#### IPMI LAN interface

- Complies with IPMI v2.0, document revision 1.0, and relevant subsequent errata, as well as with the IPv6 aspects of document revision 1.1.
- Includes required support for Remote Management Control Protocol (RMCP), as well as RMCP+, as specified by IPMI v2.0
- Privilege levels: user, administrator, operator
- Authentication types: none, MD5, straight password/key

#### Support for IPv6

- Supports RMCP sessions with a System Manager over IPv6 protocol

- Supports IPMI-defined IPv6 LAN Configuration Parameters, including get and set operations from CLI
- Allows each network interface to have both IPv4 and IPv6 enabled, or just IPv4
- Supports the IPv6 facilities defined in PICMG 3.0 R3.0 amendment ECN 3.0-3.0-001, which adds IPv6 awareness to the ATCA hardware platform management architecture, including provisions for:
  - Defining default IPv6 addresses in Shelf FRU Information
  - Automatically transferring IPv6 addresses to the newly active Shelf Manager of a redundant pair during a switchover
  - Support for the extended version of the “Get Shelf Manager IP Addresses” command, which can retrieve IPv6 addresses as well as IPv4 addresses from the Shelf Manager

#### ATCA-defined and broadly useful extensions to IPMI in System Manager interface

- Get Shelf Manager IP Addresses command allows System Manager to monitor all IP addresses offered by a Shelf Manager, with automatic follow-up if any of the addresses stop responding
- Get/Set Fan Policy commands make it easy for System Manager to retrieve fan geography; additionally, System Manager can temporarily disable Shelf Manager autonomous control of particular fan devices, perhaps for diagnostic operations
- Get Shelf Power Allocation command provides System Manager visibility on power allocations done by Shelf Manager
- FRU Inventory Device Lock Control/Write commands ensure that concurrent attempts to change shelf configuration information do not cause corruption of that data.

### Simple Network Management Protocol interface

- Complies with IETF-defined SNMP v2c and v3 protocols
- Supports several groups of SNMP variables for configuration and control, including: IPMCs, FRU information devices, sensors, boards, shelf/shelves, System Event Log, LAN configuration parameters, PEF configuration parameters

### Command Line Interface (CLI)

- Accessible via Telnet/SSH or ShMM-700R serial console
- Comprehensive status and control access to:
  - Shelf Manager state and parameters
  - Boards and other specialized FRUs, such as fans
  - Management controllers on intelligent FRUs
  - Sensors
  - System Event Log
  - FRU inventory information, including shelf and board data

### Web interface

- Accessible via any web browser at the URL: <http://<Shelf-Manager-IP-Address>>
- Implements simple front end to the command line interface; supports most important CLI commands

### Support for AXIe, ATCA-based instrumentation

- Compliant with AXIe-1 Base Architecture specification, revision 2.0
- Supports AXIe extensions for ATCA-style electronic keying, including:
  - AXIe formats for Backplane and Board Point-to-Point Connectivity records
  - AXIe algorithms for electronic keying
  - AXIe variants of commands Get Port State and Set Port State
- Supports special power sequencing for AXIe modules:
  - At shelf power-up, retrieves the version of each AXIe module using the command “Get AXIe version”
  - During chassis power-up and power-down, performs special power sequencing procedures as defined in the AXIe-1 specification

- Supports AXIe Root Channel Preference record

### Based on PPMM-700R hardware platform

- Pigeon Point Management Mezzanine (PPMM-700R) physical module delivered as ShMM-700R for the ATCA Shelf Manager application
- Delivered and sold separately as a ChMM-700R Chassis Manager module for VPX chassis complying with VITA 46.11; see separate ChMM-700R product briefs for details
- Adaptable to custom architectures, as well

### RoHS compliant

- Complies with the Restriction of Hazardous Substances (RoHS) Directive, which became effective July 1, 2006

### JEDEC-specified SO-DIMM mezzanine format

- JEDEC 204-pin DDR3 SO-DIMM
- Example socket: TE Connectivity 2013289-1
- Mounting hole on free edge of SO-DIMM enables supplementary mechanical support for NEBS vibration and earthquake requirements

### Robust ShMM-700R peripheral complement

- Dual redundant IPMB
- Shelf Manager redundancy and hot swap interfaces with on-board SmartFusion FPGA assistance
- Two 10/100 Mbit Ethernet controllers with LED indicator controls
- The ShMM carrier reference design optionally supports a GbE Switch (Micrel KSZ9563R) which allows the carrier board Ethernet interface(s) to be connected to an external GbE device (e.g. a switch)
- Two serial interfaces to the i.MX287 and one serial interface to the SmartFusion FPGA
- Four external master-only I<sup>2</sup>C ports, and one local master-only I<sup>2</sup>C bus for carrier devices
- Real-time clock to time-stamp System Event Log entries, backed by on-carrier battery or supercap
- Watchdog timer external to i.MX287 that automatically disconnects from IPMB-0 and reboots i.MX287 if software hangs
- USB 2.0 host and device ports
- General Purpose IO signals

### Hardware support for reliable firmware upgrade

- Leverages redundant firmware instances in Flash
- Each instance includes a separate copy of U-Boot, FPGA image, Linux kernel and Flash-based Linux root file system
- Confirmed firmware executes during normal operation
- During reliable upgrade, new firmware is loaded as the candidate image
- If the candidate firmware does not start and validate successfully, hardware automatically reboots back to the confirmed firmware

### Shelf Manager redundancy interfaces<sup>§</sup>

- Software redundancy interface (typically routed on the backplane between Shelf Manager instances) supports state updates from active to backup Shelf Manager, so that backup can take over quickly
- Software redundancy interface is implemented with dual USB links
- Hardware redundancy interface is implemented on a two-wire serial interface between Shelf Managers
- FPGA-assisted management of hardware redundancy interface ensures that only one Shelf Manager is active

### System Manager Interface implemented over 10/100 Mbit Ethernet link(s)<sup>§</sup>

- Usually implemented to include both Ethernets
- Activity and status LEDs
- Supports IPMI LAN, SNMP, HPI, and web interfaces via ATCA-defined Shelf Manager IPv4 address, which automatically fails over between active and backup Shelf Managers on switchovers
  - Corresponding support for IPMI LAN, HPI, SNMP and web interfaces over IPv6
- Also supports command line interface over ssh and telnet via both IPv4 and IPv6

- Optionally, uses external DHCPv4 server to acquire Internet Protocol v4 addresses for use on System Manager Ethernet interfaces and to be applied, under PICMG HPM.3, to Intelligent FRUs in a shelf

### Centralized fan management support<sup>§</sup>

- Optionally makes the active Shelf Manager directly responsible for fan speed control and measurement
- Implemented on the ShMM carrier reference design via On Semiconductor ADT7490 controller with up to 3 PWM outputs and up to 4 tachometer inputs
- Provision for carrier-specific parameterization

### Distributed fan management support<sup>§</sup>

- Optionally defers to intelligent (IPMC equipped) fan trays to handle local fan speed control and measurement
- AdvancedTCA-defined fan tray support allows interoperability and automatic discovery
- Provision for carrier-specific parameterization

### Flexible temperature monitoring<sup>§</sup>

- On-carrier digital or analog temperature monitors
- Off-carrier digital temperature monitors (I<sup>2</sup>C-accessed), possibly placed at key monitor points in shelf, for instance to measure air ingress and/or egress temperatures
- Provision for carrier-specific parameterization

### Telco alarms<sup>§</sup>

- DB15-compatible connector interface with major and minor alarm reset, plus relay connections for critical, major, minor and power alarms
- LEDs for critical, major and minor alarms indicate: no alarm (off), alarm triggered (on) or alarm cut-off activated (blinking)
- Alarm cutoff push button

<sup>§</sup> Features that are marked with the “§” symbol are dependent on suitable support in the ShMM-700R carrier.



### Remote time management

- Configurable so that Shelf Manager time is set from network-accessed time servers
- Supports operation without battery backup of the ShMM-700R's real-time clock; two protocol options:
  - RFC 868 as implemented in Linux `rdate` command
  - Network Time Protocol as implemented in Linux `ntpd` command

### ShMM-managed Shelf FRU Information support<sup>§</sup>

- Provision for dual redundant SEEPROM storage of shelf description data structures, accessed via I<sup>2</sup>C from active Shelf Manager
- Shelf FRU Info SEEPROMs typically attached to backplane
- Supports Atmel AT24C128 and compatible SEEPROM devices

### IPMC-managed Shelf FRU Information support<sup>§</sup>

- Optionally accesses Shelf FRU Information via IPMCs in the shelf
- Configurable to use specific pre-defined IPMC addresses or dynamic search for Shelf FRU Information sources

### Miscellaneous features<sup>§</sup>

- Carrier slot hardware address detection
- Auto-detection of carrier configuration information
- Up to 3 bi-color LEDs, supported with ATCA-defined LED discovery and control facilities
- Optional lithium battery or supercap backup on carrier for ShMM-700R real time clock

### Comprehensive Shelf Manager foundation layer

- ShMM-700R operating system is based on the Linux 2.6.34 kernel, supporting the Freescale i.MX287
- Support for reliable remote firmware upgrade for U-Boot, FPGA, Linux kernel and Linux root file system:
  - Reliable upgrade utility handles upgrade steps, can be invoked locally at ShMM-700R console or remotely via telnet, rsh or ssh

- New firmware images acquired via highly configurable invocations of reliable upgrade utility
- Configuration options include multiple protocol choices for upgrade image retrieval (e.g., FTP, scp), arbitrary scripts for image validation and upgrade finalization
- Persistent status file records progress of upgrade steps
- Support for upgrade images in PICMG HPM.1 format

- Boot monitor based on U-Boot; key features include:
  - Serial console command-driven user interface
  - Network download via BOOTP or TFTP
  - Extensive support for Flash memory
  - Powerful environment variable facility
  - Autoboot mode
- Kernel debugging supported via KGDB

### Comprehensive user documentation

The *Pigeon Point Shelf Manager User Guide* covers installation, upgrading and overall use of the Pigeon Point Shelf Manager. The *Pigeon Point Shelf Manager External Interface Reference* covers the details of the main external interfaces, including the command line, web access, SNMP and RMCP interfaces. The *Pigeon Point HPI User Guide* covers the installation and usage of both IntegralHPI and Pigeon Point OpenHPI, including the HPI command shell that is used for both. The current version of each document is available on the library page of the Pigeon Point website at [www.pigeonpoint.com/library.html#userdocs](http://www.pigeonpoint.com/library.html#userdocs).

### Ordering Information:

ShMM-700R-CC Part #: 21990-600	297MHz, 64MB Flash (dual regions), 128MB RAM; RoHS compliant; rated for commercial temperatures
ShMM-700RI-CC Part #: 21990-601	297MHz, 64MB Flash (dual regions), 128MB RAM; RoHS compliant; rated for industrial temperatures

The following is a high level block diagram of the PPMM-700R module which is the hardware platform for the ShMM-700R:

