BladeCenter to HPI Mapping

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1 Introduction

BladeCenter HPI support is through the open source project – OpenHPI. OpenHPI supports HPI with a common set of core infrastructure code and a series of code plugins that are hardware and/or protocol specific. One of these plugins supports the IBM BladeCenter products.

HPI applications may run multiple plugins (e.g. to support BladeCenter and ATCA systems) or multiple instances of the same plugin (e.g. to support multiple BladeCenter chassis). For details on OpenHPI, refer to http://openhpi.sourceforge.net.

The OpenHPI BladeCenter plugin code communicates with the BladeCenter's Management Module using SNMP. No matter where the HPI application resides – on a laptop, on a standalone server, or on one of the blades in the BladeCenter itself – an external network path must exist to the BladeCenter's Management Module. The OpenHPI BladeCenter plugin mines the SNMP information available in the BladeCenter's SNMP MIB and translates that information into HPI structures, states, and events.

1.1 OpenHPI BladeCenter Plugin Configuration File

The HPI BladeCenter plugin is configured with the OpenHPI file – ***openhpi.conf***. This file is installed in /etc/openhpi. To enable the BladeCenter plugin, remove the comments from the "plugin libsnmp_bc" statement and the "handler libsnmp_bc {}" section. You'll probably also want to comment out the default "plugin dummy" statement and "handler libdummy {}" section.

The variables within the "handler libsnmp_bc {}" section depend upon your BladeCenter and network configuration. If a variable doesn't apply to your configuration, either comment it out, define it to be null ("") , or define it to be "none" (case insensitive).

Here's a description of the openhpi.conf variables:

Variable	***Default Value***	***Description***
entity_root	"{SYSTEM_CHASSIS, 4}"	Defines the last part of each resource's Entity Path. {SAHPI_ENT_ROOT, 0} is assumed at the end of this definition. Applications can run multiple instances of the plugin to support multiple BladeCenters. To keep track of which BladeCenter is being addressed, change the location number (4) to a unique number for each plugin instance definition.
host	"192.168.70.125"	BladeCenter Management Module (MM) IP address.
version	"1"	SNMP version. SNMP versions 1 and 3 are supported. SNMP v3 is recommended due to its enhanced security, more flexible configuration, and performance capabilities.
community	"public"	SNMP v1 community name. Required if using SNMP v1; must match "Community Name" configured in the MM.
security_name	"snmpv3_user"	SNMP v3 user name. Required if using SNMP v3; must match one of the "Login IDs" configured in the MM.
context_name	""	SNMP v3 context name. Required if MM's "Context name" field is defined for the SNMP v3 "Login ID".
security_level	"noAuthNoPriv"	SNMP v3 security level. noAuthNoPriv, authNoPriv, and authPriv supported.
passphrase	""	SNMP v3 authentication password. Required if using SNMP v3 and security_level is authNoPriv or authPriv; must match "Password" defined in MM for the SNMP v3 "Login ID".
auth_type	""	SNMP v3 authentication password encoding type. Required if using SNMP v3 and security_level is authNoPriv or authPriv. Must match "Authentication Protocol" defined in the MM. Values of MD5, SHA, and None are supported.
privacy_passwd	""	SNMP v3 privacy password. Must match "Privacy password" defined in the MM.

Variable	Default Value	Description
privacy_protocol	""	SNMP v3 privacy protocol. Must match "Privacy protocol" defined in the MM. If security_level is authPriv, OpenHPI code defaults privacy_protocol to DES since there is currently no other privacy protocol choice supported.
count_per_getbulk	"32"	SNMP v3. Optional. SNMP_MSG_GETBULK commands can be used to increase performance. This variable sets the MAX OIDs allowable per MSG_GETBULK command. ● A value of "0" disables the use of the SNMP_MSG_GETBULK SNMP command. ● Positive values less than 16 default to "16", since values less than 16 don't necessarily increase performance. ● Too high of a value (> 40) can cause SNMP commands to BladeCenter to timeout. The maximum value depends on BladeCenter code levels but the highest value that works across all platforms and code loads is "45". ● Default is "32".

Table 1.1: OpenHPI BladeCenter Plugin Configuration Variables

1.2 BladeCenter Configuration Tips

1.2.1 BladeCenter MM Default Address and Password

BladeCenter Management Modules ship with a default IP address and password of 192.168.70.125 and PASSW0RD (with a zero).

Simplest thing is to attach a laptop configured on the same subnet (e.g. 192.168.70.100) as the active MM. There is a JS-45 connection for each MM on the back of the BladeCenter chassis. Use standard Ethernet cables. Once you've configured the MM, you can connect the MM ports to an external switch or to one of the internal BladeCenter switches to connect the MM(s) to an external network.

1.2.2 SNMP Set Capability

The OpenHPI BladeCenter plugin uses SNMP set commands to power on/off/reset blades, clear the Event Log, and support HPI controls. To allow these functions, the MM SNMP configuration must be defined with Set Capability.

1.2.3 SNMP V1 Configuration

Enable SNMP V1, from the *MM Control->Network Protocols* screen. MM supports three unique SNMP V1 community names. Each community has a defined Access Type (Set, Get, Trap) and three supported IP addresses. The MM's access types are hierarchical – Set implies Set/Get/Trap; Get implies Get/Trap; and Trap implies Trap functionality. One of the supported IP addresses must be the IP address of the system running OpenHPI.

The MM supports 0.0.0.0 (meaning everybody gets access). But this address is only for the Get Access Type and only if it is defined in the first supported IP address location. Sometimes there are problems with executing set commands if 0.0.0.0 is defined in the first location of the first community. To avoid these problems, for OpenHPI we recommend that the first community be defined for OpenHPI access. It must have an Access Type of Set and the first IP address must be the IP address of the HPI application.

After you've defined the MM and before you try OpenHPI, try issuing a net-snmp command line request from the OpenHPI host to see if the MM is properly configured: Something like:

- snmpwalk -v1 -t 10 -On -c mm_community_name mm_ip_address .1

  Reads the entire Management Module MIB information. (That's a capital “o” for -On)

- snmpset -v1 -c mm_community_name mm_ip_address .1.3.6.1.4.1.2.3.51.2.3.4.3.0 i 1

  Clears the MM Event Log.

1.2.4 SNMP V3 Configuration

Enable SNMP V3, from the *MM Control->Network Protocols* screen, then define or enable an MM Login ID for SNMP V3 on the *MM Control->Login Profiles* screen:

- Login ID – must match *security_name* in openhpi.conf.
- Login password - must match *passphrase* in openhpi.conf.
- Define Login ID for Supervisor Role; make sure all Access Scope definitions are under the Assigned column.
- Click on *Configure SNMPv3 User:*
  - Context Name – must match *context_name* in openhpi.conf. Some MM code levels cannot blank this field once defined.
  - Authentication protocol – define if *security_level* in openhpi.conf is authNoPriv or authPriv. Recommend MD5.
  - Privacy protocol – pick DES, if *security_level* in openhpi.conf is authPriv.
  - Access Type – must be Set.
  - Hostname/IP address for traps – IP address for traps – not used for OpenHPI.

After you've defined the MM and before you try OpenHPI, try issuing a net-snmp command line request from the OpenHPI host to see if the MM is properly configured: Something like:

- snmpwalk -v3 -t 10 -On -u login_id -A login_id_password -l security_level -n “context name” mm_ip_address .1

  Reads the entire Management Module MIB information. (That's a capital “o” for -On)

- snmpset -v3 -u login_id -A login_id_password -l security_level -n “context name” mm_ip_address .1.3.6.1.4.1.2.3.51.2.3.4.3.0 i 1

  Clears the MM Event Log.

1.2.5 Redundant Management Modules

An optional Management Module can be installed in the BladeCenter for redundancy. In this mode, one MM acts as the primary; the second as a standby. The two MMs checkpoint each other and keep critical information such as user configuration, event logs, and code levels synchronized. When the standby MM detects the primary has failed, it takes over. This is seamless in regards to the operations of the other BladeCenter components (e.g. blades, switches, etc). They continue to operate as usual. OpenHPI supports sensors to determine which MM is active and which is standby. The OpenHPI application can also force a MM switchover remotely.

To configure the MM for redundancy:

- Configure both MMs with the same static IP address. This is done on the Management Module's *MM Control->Network Interfaces* screen.
- Configure both MMs with the same MAC address. This is done on the Management Module's *MM Control->Network Interfaces->Advanced Ethernet Setup* screen. Set the Locally Administered MAC Address of the standby MM to be the same as the burned in MAC address of the primary. You can use this if you're using static IP address or a DHCP server.

1.3 Building OpenHPI Source

Generally there isn't any problem building OpenHPI from source if you need the latest support and features. Just follow the instructions in the *openhpi/README* file. The BladeCenter plugin builds by default. One thing that may get you is if you don't have the necessary prerequisite software on your build machine. You'll get an error message during the build but then the build goes on to build other plugins. The error message is often lost with the other build messages. To get the build to stop immediately on a prerequisite error, explicitly enable the BladeCenter plugin with the -*enable-snmp_bc* build option.

1.4 References

- In the spirit of open source, the best documentation source (and generally the most accurate) is the code. When you download the OpenHPI code, BladeCenter plugin code is located in the *openhpi/plugins/snmp_bc* directory. Two of the key files in that directory are:
  - *snmp_bc_resources.c* - describes the Resources and RDRs supported.
  - *snmp_bc_event.map* - describes which BladeCenter events are explicitly mapped to HPI sensors and resources.
- BladeCenter Management Module code can be downloaded from http://www.ibm.com. Click on “Downloads and drivers”. When you download the code, you'll also get the BladeCenter's SNMP MIB.
- http://www-03.ibm.com/systems/bladecenter contains lots of good BladeCenter information.

2 BladeCenter Resources

Table 2.1: BladeCenter Resources describes an abbreviated RPT table for supported BladeCenter resources.

Resource	*Entity Path*	*Capabilities*	*Severity*
BladeCenter Chassis	{entity_root}	SAHPI_CAPABILITY_CONTROL SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Virtual Management Module	{SAHPI_ENT_SYS_MGMNT_MODULE, 0} {entity_root}	SAHPI_CAPABILITY_CONTROL SAHPI_CAPABILITY_EVENT_LOG SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Management Module Slot x	{BLADECENTER_SYS_MGMNT_MODULE_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Management Module x	{SAHPI_ENT_SYS_MGMNT_MODULE, x} {BLADECENTER_SYS_MGMNT_MODULE_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_MANAGED_HOTSWAP SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESET SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Blade Slot x	{SAHPI_ENT_PHYSICAL_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Blade x	{SAHPI_ENT_SBC_BLADE, x} {SAHPI_ENT_PHYSICAL_SLOT, x} {entity_root}	SAHPI_CAPABILITY_CONTROL SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_MANAGED_HOTSWAP SAHPI_CAPABILITY_POWER SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESET SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Blade Expansion Module (BEM) x	{SAHPI_ENT_SYS_EXPANSION_BOARD, x} {SAHPI_ENT_SBC_BLADE, x} {SAHPI_ENT_PHYSICAL_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
I/O Module Slot x	{BLADECENTER_INTERCONNECT_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
I/O Module x	{SAHPI_ENT_INTERCONNECT, x} {BLADECENTER_INTERCONNECT_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_MANAGED_HOTSWAP SAHPI_CAPABILITY_POWER SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESET SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR

Resource	Entity Path	Capabilities	Severity
Power Module Slot x	{BLADECENTER_POWER_SUPPLY_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Power Module x	{SAHPI_ENT_POWER_SUPPLY, x} {BLADECENTER_POWER_SUPPLY_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Blower Slot x	{BLADECENTER_FAN_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Blower x	{SAHPI_ENT_FAN, x} {BLADECENTER_FAN_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Media Tray Slot x	{BLADECENTER_PERIPHERAL_BAY_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE	SAHPI_CRITICAL
Media Tray x	{SAHPI_ENT_PERIPHERAL_BAY, x} {BLADECENTER_PERIPHERAL_BAY_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR

Table 2.1: BladeCenter Resources

2.1 BladeCenter non-Standard Entity Type Definitions

Unfortunately, the HPI standard does not support entity types for different types of hardware slots. To support various slot types, the OpenHPI BladeCenter plugin supports the following entity path extensions:

BladeCenter non-Standard Entity Path Definition	Value
BLADECENTER_INTERCONNECT_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x10
BLADECENTER_POWER_SUPPLY_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x11
BLADECENTER_PERIPHERAL_BAY_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x12
BLADECENTER_SYS_MGMT_MODULE_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x13
BLADECENTER_BLOWER_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x14

Table 2.2: BladeCenter non-Standard Entity Path Definitions

These extensions are defined in the OpenHPI file ***SaHpiBladeCenter.h***.

2.2 Entity Path Examples

{entity_root} is defined in OpenHPI's ***openhpi.conf*** file. For example, if entity_root = "{SYSTEM_CHASSIS, 2}" in ***openhpi.conf***, then {entity_root} is:

{SAHPI_ENT_SYSTEM_CHASSIS, 2}
{SAHPI_ENT_ROOT, 0}

For the following examples, assume entity_root = "{SYSTEM_CHASSIS, 1}" is defined in ***openhpi.conf***.

Example 1: Blade in slot 3

{SAHPI_ENT_SBC_BLADE, 3}

{SAHPI_ENT_PHYSICAL_SLOT, 3}

{SAHPI_ENT_SYSTEM_CHASSIS, 1}

{SAHPI_ENT_ROOT, 0}

Example 2: SCSI Blade Expansion Module attached to blade in slot 3

{SAHPI_ENT_SYS_EXPANSION_BOARD, 1}

{SAHPI_ENT_SBC_BLADE, 3}

{SAHPI_ENT_PHYSICAL_SLOT, 3}

{SAHPI_ENT_SYSTEM_CHASSIS, 1}

{SAHPI_ENT_ROOT, 0}

Example 3: Management Module 2

{SAHPI_ENT_SYS_MGMNT_MODULE, 2}

{BLADECENTER_SYS_MGMNT_MODULE_SLOT, 2}

{SAHPI_ENT_SYSTEM_CHASSIS, 1}

{SAHPI_ENT_ROOT, 0}

Notes:

- All HPI location values start at 1; except for the Virtual Management Module resource, which has an HPI location value of 0.
- HPI location numbers for the slot and the entity plugged into the slot are always equal.

2.3 Virtual Management Module

BladeCenter supports two dedicated Management Modules (MMs) which serve as the management control point for the entire chassis. The Management Modules plug into their own slots (they don't take up a blade slot) and are hot swappable. There must be at least one Management Module in the chassis for proper operations. The second MM is optional.

When the second MM is installed, it behaves as an active standby. The two Management Modules ping each other over an internal bus. If the primary MM fails, the standby takes over. With the exception of a few events, the takeover is completely automatic and transparent.

To model this behavior, BladeCenter supports a Virtual Management Module resource (VMM). It

is distinguished by an HPI Entity Path location code of 0 (all physical resources have location codes starting with 1). The primary Management Module monitors the BladeCenter Event Log and several sensors. These are preserved over an MM failover and are associated with the VMM resource.

RDRs specific to an MM, like inventory, are associated with the individual physical MM resource.

2.4 BladeCenter Model Resource Differences

The OpenHPI BladeCenter plugin dynamically determines what BladeCenter model it's communicating with and creates the necessary HPI entities. There isn't anything the HPI application need do or configure for this to happen. But just for fun, here's the major resource differences between the various BladeCenter models:

Resource	*BladeCenter*	*BladeCenter H*	*BladeCenter T*
Blades	14	14	8
I/0 Modules	4	10	4
Blowers	2	2	4

Table 2.3: BladeCenter Model Resource Differences

3 Resource RDR Mappings

A couple of general BladeCenter RDR observations:

- HPI applications cannot disable individual sensors (e.g. SensorRec.EnableCtrl = SAHPI_FALSE for all sensors).
- HPI applications cannot disable individual events for a given sensor (e.g. SensorRec.EventCtrl = SAHPI_SEC_READ_ONLY for all sensors).
- HPI applications cannot set thresholds (e.g. SensorRec.ThresholdDefn.WriteThold = 0 for all threshold sensors).
- HPI applications cannot write inventory information. SA_ERR_HPI_READ_ONLY is returned for *saHpiIdrAreaAdd()*, *saHpiIdrAreaDelete()*, *saHpiIdrFieldAdd()*, and *saHpiIdrFieldDelete()* .
- To assist HPI applications in identifying individual voltage sensors, the Nominal value is defined to be the same as the voltage type (e.g. The 3.3 voltage sensor has a Nominal value of 3.3); else the HPI application needs to parse the RDR's IdString.
- Operational sensors that are readable are more accurate then those that are event-only. Readable sensors get their information directly from the MM; event-only sensors are more subject to mapping idiosyncrasies. Also events are mapped to a single sensor. So a temperature event may get mapped to a specific temperature sensor and not to the more general operational event sensor. Readable sensors reflect the MM's status independent on how OpenHPI maps the individual event.
- For a complete description of how all the RDR fields are defined, refer to the OpenHPI file ***snmp_bc_resources.c.***

3.1 Chassis RDRs

Sensor	***Type***	***Category***	***Events***	***Data Format***
Ambient Air Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
I/O Module Redundancy	SAHPI_PLATFORM_ALERT	SAHPI_EC_REDUNDANCY	SAHPI_ES_FULLY_REDUNDANCY SAHPI_ES_REDUNDANT_LOST	Event only
Power Module Redundancy	SAHPI_PLATFORM_ALERT	SAHPI_EC_REDUNDANCY	SAHPI_ES_FULLY_REDUNDANCY SAHPI_ES_REDUNDANT_LOST	Event only
Power Domain 1 Redundancy	SAHPI_PLATFORM_ALERT	SAHPI_EC_REDUNDANCY	SAHPI_ES_FULLY_REDUNDANCY SAHPI_ES_REDUNDANT_LOST	Event only
Power Domain 2 Redundancy	SAHPI_PLATFORM_ALERT	SAHPI_EC_REDUNDANCY	SAHPI_ES_FULLY_REDUNDANCY SAHPI_ES_REDUNDANT_LOST	Event only
Chassis Total Maximum Power Capability	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Chassis Total Assigned Power	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Chassis Total Minimum Power Capability	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)

Sensor	Type	Category	Events	Data Format
Chassis Filter (BCT only)	SAHPI_ENT_TEMPERATURE	SAHPI_EC_SEVERITY	SAHPI_ES_OK SAHPI_ES_INFORMATIONAL SAHPI_ES_MINOR_FROM_OK SAHPI_ES_MAJOR_FROM_LESS SAHPI_ES_CRITICAL	Event only

Table 3.1: Chassis Sensor RDR Summary

Control	Output Type	Type	Comments
Chassis Location LED (Writable Blue LED to illuminate chassis location)	SAHPI_CTRL_LED	SAHPI_CTRL_TYPE_DISCRETE	0= Off; 1= solid on; 2=blinking

Table 3.2: Chassis Control RDR Summary

Inventory	Inventory Area Type	Supported Fields
Chassis Inventory	SAHPI_IDR_AREATYPE_CHASSIS_INFO	SAHPI_IDR_FIELDTYPE_CHASSIS_TYPE SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_NAME SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.3: Chassis Inventory RDR Summary

3.2 Slot RDRs

The Slot State sensor is a presence sensor which allows the HPI application to sense if there is something plugged into a physical slot. If there is a resource in the slot, the Slot State sensor returns an event state of SAHPI_ES_PRESENT and the Resource ID (RID) of the occupying resource. The RID is returned in the least significant 32 bits of an SAHPI_SENSOR_READING_TYPE_UINT64 value. The most significant 32 bits of the UINT64 value are set to 0. If there is no resource in the slot, an event state of SAHPI_ES_ABSENT and a RID of SAHPI_UNSPECIFIED_RESOURCE_ID is returned.

The Maximum Power Capability sensor reports the maximum power that the resource plugged into the slot could consume if it was fully populated (CPUs, memory chips, expansion cards, etc). The Assigned Power Capability sensor reports the power currently being supplied to the slot for its resource. The Minimum Power Capability sensor reports the minimum power that can be allocated to the slot's resource based on the resource's maximum CPU throttling capabilities.

Sensor	Sensor Number	Type	Category	Events	Data Format
Slot State	BLADECENTER_SENSOR_NUM_SLOT_STATE	SAHPI_ENTITY_PRESENCE	SAHPI_EC_PRESENCE	None	UINT64 (RID)

Sensor	Sensor Number	Type	Category	Events	Data Format
Slot Maximum Power Capability	BLADECENTER_SENSOR_NUM_MAX_POWER	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Slot Assigned Power	BLADECENTER_SENSOR_NUM_ASSIGNED_POWER	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Slot Minimum Power Capability	BLADECENTER_SENSOR_NUM_MIN_POWER	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)

Table 3.4: Slot Sensor RDR Summary

3.2.1 Multi-slot Blades

In BladeCenter, blades may span multiple slots. In this case, each Slot State sensor in the slot span reports that the slot is occupied and returns the same RID. Blades are the only resource that span multiple slots.

For multi-slot blades, the Maximum, Assigned, and Minimum Power Capability values are spread evenly among the slots.

3.2.2 Special Sensor Numbers

The sensor numbers for Slot RDRs are hard coded and defined in the OpenHPI file ***SaHpiBladeCenter.h***. These sensor numbers are the same as those defined in the *HPI-to-*A*dvancedTCA Mapping Specification* (which defines similar sensors). The attempt is to provide the HPI application that needs to support both BladeCenter and ATCA chassis with as consistent an interface as possible.

3.2.3 Power Module Slot RDRs

Generally the Power Module Slot resource reports 0 for the Power Module's Slot Maximum, Assigned, and Minimum Power Capability Sensors. In some BladeCenter models, the power modules themselves consume power. For example, the BladeCenter H power modules contain fan packs which cool the power modules. These fan packs draw current. The amount of which is reported by the Power Module's Slot Maximum, Assigned, Minimum sensors.

3.3 Management Module RDRs

3.3.1 Virtual Management Module RDRs

The VMM Redundancy sensor is an event only sensor that notifies the HPI application that MM redundancy has been lost or recovered.

The Active MM and Standby MM sensors returns and event state of SAHPI_ES_PRESENT and the Resource ID of the physical MM that serves as the active or standby MM. The RID is returned in the least significant 32 bits of an SAHPI_SENSOR_READING_TYPE_UINT64 value. The most significant 32 bits of the UINT64 value are set to 0. If there is no standby MM, the Standby MM sensor returns SAHPI_UNSPECIFIED_RESOURCE_ID and an event state of SAHPI_ES_ABSENT.

The MM Air Temperature sensor reads the temperature as recorded at the primary MM.

A variety of sensors monitor the voltage distribution coming from the power modules and being distributed in the chassis to the various hardware components.

A variety of sensors monitor internal chassis I2C buses used to determine the presence and status of various hardware components. Events from these sensors don't always mean that the component has failed; just that the primary MM cannot access it.

A control is provided to allow the HPI application to force a MM failover. Setting a value of SAHPI_CTRL_STATE_PULSE_ON forces the failover. This control returns SA_ERR_HPI_INVALID_REQUEST if there are not redundant MMs in the chassis. SAHPI_CTRL_STATE_OFF is always returned if the control's state is read.

Sensor	***Type***	***Category***	***Events***	***Data Format***
System Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SHAPI_ES_DEGRADED SAHPI_ES_OFF_LINE	Event Only
MM Redundancy	SAHPI_OPERATIONAL	SAHPI_EC_REDUNDANCY	SAHPI_ES_FULLY_REDUNDANT SAHPI_ES_NON_REDUNDANT_SUFFICIENT_RESOURCES	Event only
Active MM	SAHPI_ENTITY_PRESENCE	SAHPI_EC_PRESENCE	None	UINT64 (RID)
Standby MM	SAHPI_ENTITY_PRESENCE	SAHPI_EC_PRESENCE	None	UINT64 (RID)
MM Air Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR	UINT64 (Degrees C)
System 1.8 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
System 2.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
System 3.3 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
System 5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
System -5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
System 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_CRIT	FLOAT64 (Volts)
Midplane Maximum Power Capability	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Midplane Assigned Power	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
Midplane Minimum Power Capability	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)

Table 3.5: VMM Sensor RDR Summary

Control	Output Type	Type	Comments
MM Failover	SAHPI_CTRL_GENERIC	SAHPI_CTRL_TYPE_DIGITAL	SAHPI_CTRL_STATE_PULSE_ON Forces MM failover

Table 3.6: VMM Control RDR Summary

3.3.2 Physical Management Module RDRs

Sensor	Type	Category	Events	Data Format
MM Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED SAHPI_ES_OFF_LINE SAHPI_ES_INSTALL_ERROR	Event Only

Table 3.7: Physical MM Sensor RDR Summary

Inventory	Inventory Area Type	Supported Fields
MM Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.8: Physical MM Inventory RDR Summary

3.4 Blade RDRs

Sensor	Type	Category	Events	Data Format
Blade Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE SAHPI_ES_DEGRADED SAHPI_ES_INSTALL_ERROR	INT64 0 = unknown 1 = good 2 = warning 3 = bad 4 = kernelmode 5 = discovering 6 = comm error 7 = no power 8 = flashing 9 = init error
Blade Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only
Blade NMI Status	SAHPI_CRITICAL_INTERRUPT	SAHPI_EC_STATE	SAHPI_ES_STATE_ASSERTED SAHPI_ES_STATE_DEASSERTED	Event Only
Blade CPU 1 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
Blade CPU 2 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)

Sensor	Type	Category	Events	Data Format
Blade CPU 3 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
Blade CPU 4 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
Blade CPU 1 Core Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade CPU 2 Core Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade CPU 3 Core Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade CPU 4 Core Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade VRM Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 0.9 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 1.2 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 1.2 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 1.25 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 1.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 1.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 1.8 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 1.8 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 2.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 2.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 3.3 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 3.3 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Standby 5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade -5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)

Sensor	Type	Category	Events	Data Format
Blade Standby 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Memory Bank 1 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Volts)
Blade Memory Bank 2 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Volts)
Blade Memory Bank 3 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Volts)
Blade Memory Bank 4 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
Blade Battery Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)

Table 3.9: Blade Sensor RDR Summary

Control	Output Type	Type	Comments
Blade Location LED (Writable Blue LED to illuminate blade location)	SAHPI_CTRL_LED	SAHPI_CTRL_TYPE_DISCRETE	0 = Off; 1 = solid on; 2 = blinking
Blade BMC Reset	SAHPI_CTRL_GENERIC	SAHPI_CTRL_TYPE_DISCRETE	1 = reset BMC

Table 3.10: Blade Control RDR Summary

Inventory	Inventory Area Type	Supported Fields
Blade Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_NAME SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.11: Blade Inventory RDR Summary

3.5 Blade Expansion Module RDRs

Sensor	Type	Category	Events	Data Format
BEM Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED SAHPI_ES_OFF_LINE	Event Only
BEM Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	Event Only
BEM Voltage	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	Event Only

Sensor	Type	Category	Events	Data Format
PEU2 Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
PEU2 1 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
PEU2 3.3 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
PEU2 5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
PEU2 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
PEU2 Standby 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
BIE Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	FLOAT64 (Degrees C)
BIE 1.5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
BIE 3.3 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
BIE2 5 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)
PEU 12 Volt	SAHPI_VOLTAGE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_LOWER_MAJOR	FLOAT64 (Volts)

Table 3.12: BEM Sensor RDR Summary

3.6 I/O Module RDRs

Sensor	Type	Category	Events	Data Format
I/O Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = unknown 1 = good 2 = warning 3 = bad
I/O Module Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only
I/O Module Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_CRIT SAHPI_ES_UPPER_MAJOR	Event Only

Table 3.13: I/O Module Sensor RDR Summary

Inventory	Inventory Area Type	Supported Fields
I/O Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.14: I/O Module Inventory RDR Summary

3.7 Power Module RDRs

Sensor	Type	Category	Events	Data Format
Power Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = unknown 1 = good 2 = warning 3 = bad
Power Module Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only
Power Module Temperature	SAHPI_TEMPERATURE	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR SAHPI_ES_UPPER_CRIT	Event Only
Power Module Fan Pack Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only
Power Module Fan Pack Average Speed (Percent of Max) (BCH only)	SAHPI_FAN	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR	PERCENTAGE
Power Module Fan Pack Average RPM Speed (BCH only)	SAHPI_FAN	SAHPI_EC_UNSPECIFIED	None	FLOAT64 (RPM)

Table 3.15: Power Module Sensor RDR Summary

Inventory	Inventory Area Type	Supported Fields
Power Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.16: Power Module Inventory RDR Summary

3.8 Blower RDRs

Sensor	Type	Category	Events	Data Format
Blower Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = unknown 1 = good 2 = warning 3 = bad
Blower Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only
Blower Speed (Percent of Max)	SAHPI_FAN	SAHPI_EC_THRESHOLD	SAHPI_ES_UPPER_MAJOR	PERCENTAGE
Blower RPM Speed (BCH only)	SAHPI_FAN	SAHPI_EC_UNSPECIFIED	None	FLOAT64 (RPM)

Table 3.17: Fan Sensor RDR Summary

3.9 Media Tray RDRs

Sensor	Type	Category	Events	Data Format
Media Tray Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED	Event Only
Media Tray Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only

Table 3.18: Media Tray Sensor RDR Summary

Inventory	Inventory Area Type	Supported Fields
Media Tray Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MFG_DATETIME SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.19: Media Tray Inventory RDR Summary

4 Hot Swap Operations

BladeCenter hardware currently supports two hot swap models.

- Simple “Not present or Active” model
- Three State “Not present, Inactive, Active” model

4.1 Simple Hot Swap

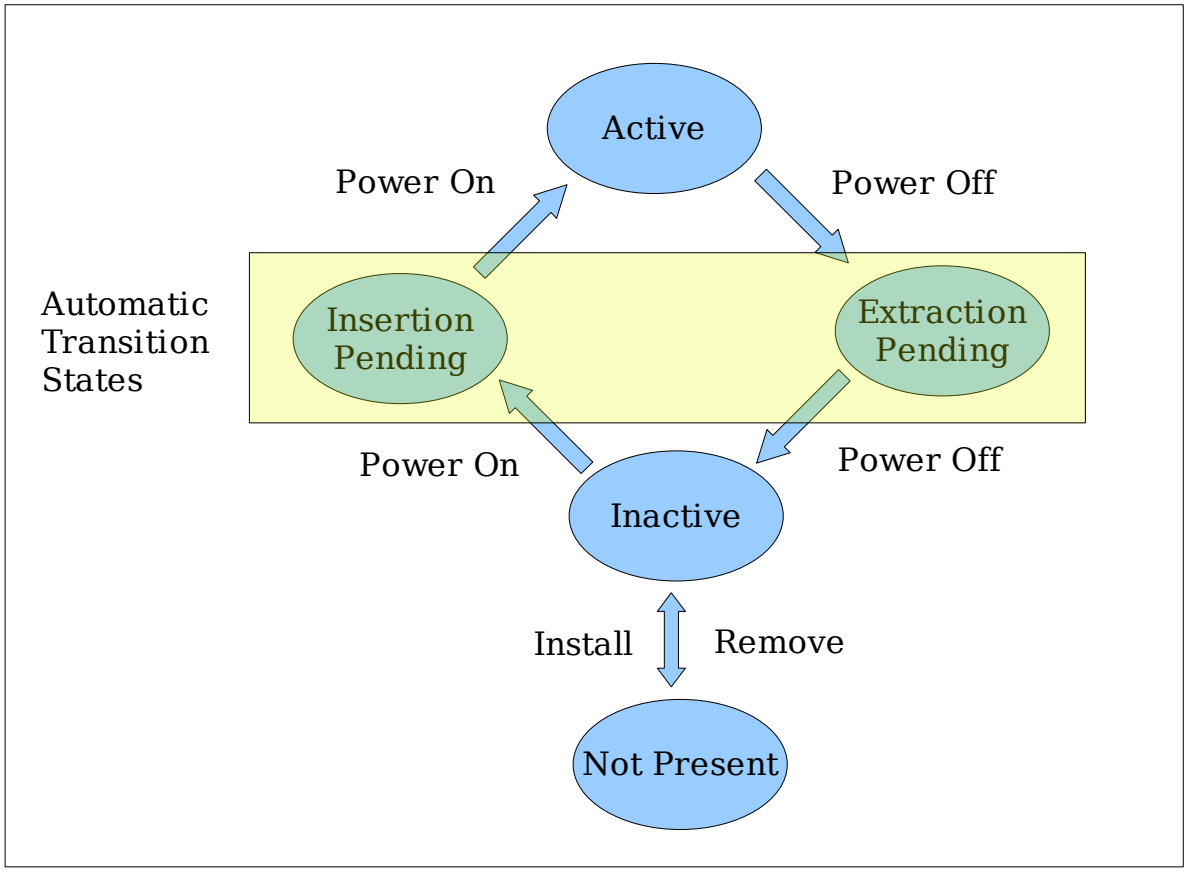
Resources such as fans, power supplies, and the media tray become active as soon as they are installed into the system. There is no HPI application action required to activate these resources. Nor is there any action required to make these resources ready to be removed. These resources are modeled using HPI's Simplified Hot Swap model. HPI hot swap events are generated whenever the resource is removed from or installed into the system.

Resources supporting HPI's Simplified Hot Swap model are distinguished in Table 2.1: BladeCenter Resources by a Capabilities definition that includes SAHPI_CAPABILITY_FRU but does **not** include SAHPI_CAPABILITY_MANAGED_HOTSWAP.

4.2 Three State Hot Swap

Resource such as blades, I/O modules, and Management Modules go through a three stage hot swap procedure – Not Present, Inactive, Active. When one of these resources is inserted into the chassis, it enters the Inactive state. In this state, the resource is in communication with the primary Management Module and has run self-tests to verify that it is ready for normal operations. It now takes an explicit action to activate the resource – either by pressing a local power-on hardware button or by issuing a remote power-on command. Likewise the resource can be power-off either locally or remotely to move the resource from the Active to the Inactive state. The resource can also be reset remotely – which acts like a power off/power on sequence.

So how to model this in HPI? HPI's Simplified Hot Swap model is too simple; while HPI's 5-state Managed Hot Swap model is too complex. To give HPI applications control over transitions between the Active and Inactive state, these resources are modeled using HPI's Managed Hot Swap model. The difference is that transitions from the Inactive state to the Active state and vice versa pass automatically through the HPI “Insertion Pending” and “Extraction Pending” states. See the figure below:



For example, when a blade is inserted into the chassis, it enters into the HPI Inactive state. An informational HPI hot swap event flows to the HPI application marking the transition from SAHPI_HS_STATE_NOT_PRESENT to SAHPI_HS_STATE_INACTIVE. If the application then issues saHpiResourcePowerStateSet() to the blade, it will receive an informational hot swap event marking the transition from SAHPI_HS_STATE_INACTIVE to SAHPI_HS_STATE_INSERTION_PENDING followed immediately by another HPI event marking the transition from SAHPI_HS_STATE_INSERTION_PENDING to SAHPI_HS_STATE_ACTIVE. The automatic transitions through HPI's Insertion Pending and Extraction Pending states means:

- saHpiHotSwapPolicyCancel() always returns SA_ERR_HPI_INVALID_REQUEST
- saHpiResourceActiveSet() always returns SA_ERR_HPI_INVALID_REQUEST
- saHpiResourceInactiveSet() always returns SA_ERR_HPI_INVALID_REQUEST
- saHpiAutoInsertTimeoutGet() always returns SAHPI_TIMEOUT_IMMEDIATE
- saHpiAutoInsertTimeoutSet() always returns SA_ERR_HPI_READ_ONLY
- saHpiAutoExtractTimeoutGet() always returns SAHPI_TIMEOUT_IMMEDIATE
- saHpiAutoExtractTimeoutSet() always returns SA_ERR_HPI_READ_ONLY

BladeCenter blades, I/O modules, and Management Modules do not possess hot swap indicator LEDs so:

- saHpiHotSwapIndicatorStateGet() always returns SA_ERR_HPI_CAPABILITY
- saHpiHotSwapIndicatorStateSet() always returns SA_ERR_HPI_CAPABILITY

The HPI application may get HPI events re-announcing a state. For example, when in ACTIVE state, BladeCenter may generate another hot swap event stating that its in the ACTIVE state. Such re-announcements are informational and carry matching values for previous and current state.

5 Event Processing

HPI defines a simple polling interface for events. Internally, however, things get a little complex. There are actually four major logs that are involved in the processing of events:

- BladeCenter Hardware Event Log
- OpenHPI BladeCenter Plugin Resource Event Log
- OpenHPI Domain Event Log
- OpenHPI Domain Alarm Table

5.1 BladeCenter Hardware Event Log

At the base, is the BladeCenter's Hardware Event Log. This log is persistent in the BladeCenter hardware and is preserved over MM failovers and failures. All the noteworthy (plus some not so noteworthy) events in the BladeCenter system are logged here. The log is accessible externally through SNMP commands.

In a simplified event flow, an HPI application issues *saHpiEventGet()* which flows through the OpenHPI Infrastructure code to the OpenHPI BladeCenter plugin code. The OpenHPI BladeCenter plugin code issues an SNMP command to the BladeCenter Management Module to retrieve an event from the BladeCenter's Hardware Event Log. The BladeCenter event is then translated into an HPI event and returned the event to the OpenHPI Infrastructure code. The OpenHPI Infrastructure code then logs the event in its Domain Event Log, so that its available to all subscribed users. If the severity is high enough, the event is also logged to the Domain Alarm Table.

All HPI Resource Event Log commands, s*aHpiEventLogxxx(),* deal with the BladeCenter Hardware Log and its characteristics and are supported by the OpenHPI BladeCenter plugin code.

All HPI Domain Event Log commands, *saHpiEventGet()* and *saHpiEventAdd();* and all HPI Domain Alarm Table commands, saHpiAlarmxxx(), are supported entirely by the OpenHPI Infrastructure code. More on these in a bit.

5.1.1 Non-Writable

The BladeCenter Hardware Event Log is not writable from external sources. SA_ERR_HPI_INVALID_CMD is returned for the command s*aHpiEventLogEntryAdd()*.

The HPI Infrastructure code, however, does support writable user-defined events to the Domain Event Log and the Domain Alert Table. So the commands *SaHpiEventAdd()* and *SaHpiAlarmAdd()* are supported.

5.1.2 Variable Length

The BladeCenter Hardware Event Log is variable in size. The size varies depending upon what specific events are logged. Some are larger than others. Typically the number of events range from around 350 to almost 800 events. HPI assumes fix length logs so the OpenHPI BladeCenter plugin fibs a bit and returns a value of 768 for the maximum length of the log. 768 is based on the smallest BladeCenter event message.

5.1.3 Wrap Characteristics

When the BladeCenter Hardware Event Log gets full, it wraps. The oldest events are replaced

with the newer ones. Generally this isn't a problem, as we'll see, since the OpenHPI BladeCenter plugin code keeps a copy of the BladeCenter Hardware Event Log in its memory – which does not wrap. So events that are replaced in the hardware event log are generally still available in the plugin's memory cache.

5.1.4 Too Much Stuff

Lots of stuff is logged in the BladeCenter's Hardware Event Log – not all of it useful to HPI applications or easily translated into HPI structures. However, no event in the hardware event log is lost or ignored. If the BladeCenter plugin code doesn't know what to do with an event (or doesn't think its useful), it translates the event into an HPI OEM event with the event's message put into the Text Buffer of the OEM event. An application could parse the Text Buffer of OEM events if desirable; but ,in general, HPI applications should simply ignore HPI OEM events.

A list of the hardware events explicitly mapped into non-OEM HPI events are listed in the OpenHPI file – s***nmp_bc_events.map***.

5.2 OpenHPI BladeCenter Resource Event Log

HPI's Resource Event Log (REL) for BladeCenter is supported in the OpenHPI's BladeCenter plugin code. The REL is associated with the Virtual Management Module resource. The plugin code keeps the REL synchronized with the BladeCenter Hardware Event Log .

To improve performance, the OpenHPI BladeCenter plugin code generally reads more than one event from the BladeCenter Hardware Event Log at a time. When an HPI application requests an event, the BladeCenter plugin determines if there are any new events to read from the hardware. If there are, the plugin reads *all* the new events in the BladeCenter Hardware Event Log at once. It stores the new events in the REL and feeds them to the OpenHPI Infrastructure code. If there are no new events to be read from the hardware but there are unprocessed events in the REL, the event is returned from the REL memory. This improves SNMP network efficiencies and reduces the chances that events are lost due to the hardware log wrapping.

5.2.1 Initial Bring-up

The first time HPI comes up, the BladeCenter plugin code reads all of the BladeCenter's Hardware Event Log to create the REL. This may take a very long time (minutes) - there can be hundreds of events to read. There are a couple of things one can do to improve bring-up performance:

- Clear the Event Log before requesting the first event
  Issuing *saHpiEventLogClear()* causes the BladeCenter Hardware Event Log to be cleared. If course, you'll lose historical data (which may be stale).
- Use SNMP v3 and configure the “count_per_getbulk” variable in ***openhpi.conf*** to be as large as possible. Using SNMP GET-BULK commands to retrieve the initial set of events can dramatically reduce bring-up time. The maximun value for “count_per_getbulk” depends on the Management Module code level. Consult ***openhpi/plugins/snmp_bc/README*** for the details.

Besides performance, the other area of concern is stale data. When the BladeCenter Hardware Event Log is first read, it can contain events for resources that are no longer in the chassis (e.g. removed blades). The OpenHPI BladeCenter plugin code won't propagate events to the OpenHPI Infrastructure code until after the initial bring-up and discovery is finished. If the HPI application wants to read historical data, it can issue ***saHpiEventLogGet()***; if it just wants events after bring-up, it can issue ***saHpiEventGet()***.

5.3 OpenHPI Domain Event Log

This is the log that the HPI application reads when issuing ***saHpiEventGet()***. Events can be added to this log using ***saHpiEventAdd()***.

Generally the OpenHPI Domain Event Log and the plugin's REL have more events then the application has read. When the application requests an event, it can usually be retrieved from memory instead of having to request the event from the hardware. This greatly improves performance. OpenHPI can also be configured to run in a threaded mode. In this mode, a separate thread polls the plugins for events every 3 seconds. The idea is to off-load the time getting and translating events directly from the hardware.

This design should also reduce concern about log wrapping. Unless the hardware event log can be overflown in 3 seconds, events will be picked up and saved in memory until the HPI application gets around to processing them. The amount of memory used to store events can be capped by the user, if desired, through the OPENHPI_EVT_QUEUE_LIMIT configuration option in ***openhpi.conf***.

5.4 OpenHPI Domain Alarm Table

For events with severities greater than or equal to SAHPI_MINOR, the OpenHPI Infrastructure code stores and tracks in the Domain Alarm Table (DAT). As events are recovered, they are removed from this table. User applications can add events to the DAT with the command – *saHpiAlarmAdd()*. The size of the DAT can be limited, if desired, by the OPENHPI_DAT_SIZE_LIMIT configuration option in ***openhpi.conf***.