

# BladeCenter to HPI Mapping



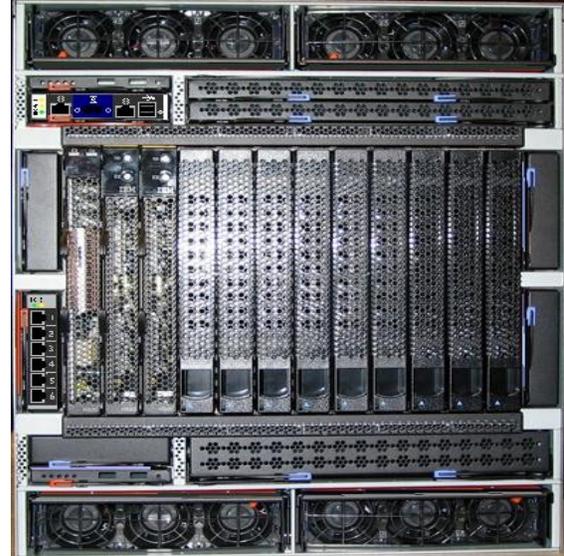
BladeCenter



BladeCenter H



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BladeCenter HT

December 7, 2006

# Table of Contents

1	Introduction.....	5
1.1	OpenHPI BladeCenter Plugin Configuration File.....	5
1.2	BladeCenter Configuration Tips.....	6
1.2.1	BladeCenter MM Default Address and Password.....	6
1.2.2	SNMP Set Capability.....	6
1.2.3	SNMP V1 Configuration.....	6
1.2.4	SNMP V3 Configuration.....	7
1.2.5	Redundant Management Modules.....	7
1.3	Building OpenHPI Source.....	8
1.4	References.....	8
2	BladeCenter Resources.....	9
2.1	BladeCenter Model Differences.....	9
2.2	RPT Mapping .....	9
2.3	BladeCenter non-Standard Entity Type Definitions.....	11
2.4	Entity Path Examples.....	13
2.5	Virtual Management Module.....	13
3	Resource RDR Mappings.....	15
3.1	Chassis RDRs.....	15
3.2	Slot RDRs.....	16
3.2.1	Multi-slot Blades.....	17
3.2.2	Special Sensor Numbers.....	17
3.2.3	Power Module Slot RDRs.....	17
3.3	Management Module RDRs .....	17
3.3.1	Virtual Management Module RDRs.....	17
3.3.2	Physical Management Module RDRs.....	19
3.4	Blade RDRs.....	19
3.5	Blade Expansion Module (BEM) RDRs.....	21
3.6	I/O Module RDRs.....	22
3.7	Power Module RDRs.....	22
3.8	Blower RDRs.....	23
3.9	Media Tray RDRs.....	23
3.10	Alarm Panel RDRs (BCHT Only).....	24
3.11	Mux Module RDRs (BCHT Only).....	24
3.12	Network Clock Module RDRs (BCHT Only).....	24
3.13	Management Module Interposer RDRs (BCHT Only).....	25
3.14	I/O Module Interposer RDRs (BCHT Only).....	25
3.15	Front Bezel RDRs (BCHT Only).....	25
4	Hot Swap Operations.....	27
4.1	Simple Hot Swap.....	27
4.2	Three State Hot Swap.....	27
5	Event Processing.....	30
5.1	BladeCenter Hardware Event Log.....	31
5.2	BladeCenter Resource Event Log.....	32
5.3	OpenHPI Domain Event Log.....	32

5.4 OpenHPI Domain Alarm Table.....33

## Index of Tables

Table 1.1: OpenHPI BladeCenter Plugin Configuration Variables.....	6
Table 2.1: BladeCenter Model Resource Differences.....	9
Table 2.2: BladeCenter Resources.....	11
Table 2.3: BladeCenter non-Standard Entity Path Definitions.....	11
Table 3.1: Chassis Sensor RDR Summary.....	16
Table 3.2: Chassis Control RDR Summary.....	16
Table 3.3: Chassis Inventory RDR Summary.....	16
Table 3.4: Slot Sensor RDR Summary.....	17
Table 3.5: VMM Sensor RDR Summary.....	18
Table 3.6: VMM Control RDR Summary.....	18
Table 3.7: Physical MM Sensor RDR Summary.....	19
Table 3.8: Physical MM Inventory RDR Summary.....	19
Table 3.9: Blade Sensor RDR Summary.....	20
Table 3.10: Blade Control RDR Summary.....	21
Table 3.11: Blade Inventory RDR Summary.....	21
Table 3.12: BEM Sensor RDR Summary.....	22
Table 3.13: I/O Module Sensor RDR Summary.....	22
Table 3.14: I/O Module Inventory RDR Summary.....	22
Table 3.15: Power Module Sensor RDR Summary.....	23
Table 3.16: Power Module Inventory RDR Summary.....	23
Table 3.17: Blower Sensor RDR Summary.....	23
Table 3.18: Media Tray Sensor RDR Summary.....	23
Table 3.19: Media Tray Inventory RDR Summary.....	24
Table 3.20: Alarm Panel Sensor RDR Summary.....	24
Table 3.21: Alarm Panel Inventory RDR Summary.....	24
Table 3.22: Mux Module Sensor RDR Summary.....	24
Table 3.23: Mux Module Inventory RDR Summary.....	24
Table 3.24: Network Clock Module Sensor RDR Summary.....	25
Table 3.25: Network Clock Module Inventory RDR Summary.....	25
Table 3.26: Management Module Interposer Inventory RDR Summary.....	25
Table 3.27: I/O Module Interposer Inventory RDR Summary.....	25
Table 3.28: Front Bezel Sensor RDR Summary.....	25

# 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://www.openhpi.org>.

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 – a 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 “`handler libsnmp_bc {}`” section. You'll probably also want to comment out the default “`handler libsimulator {}`” 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:

<b>Variable</b>	<b>Default Value</b>	<b>Description</b>
<code>entity_root</code>	<code>{SYSTEM_CHASSIS, 4}</code>	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.
<code>host</code>	<code>"192.168.70.125"</code>	BladeCenter Management Module (MM) IP address.
<code>version</code>	<code>"1"</code>	SNMP version. SNMP versions 1 and 3 are supported. SNMP v3 is recommended due to its enhanced security, more flexible configuration, and increased performance capabilities.
<code>community</code>	<code>"public"</code>	SNMP v1 community name. Required if using SNMP v1; must match “Community Name” configured in the MM.
<code>security_name</code>	<code>"snmpv3_user"</code>	SNMP v3 user name. Required if using SNMP v3; must match one of the “Login IDs” configured in the MM.
<code>context_name</code>	<code>""</code>	SNMP v3 context name. Required if MM's “Context name” field is defined for the SNMP v3 “Login ID”.
<code>security_level</code>	<code>"noAuthNoPriv"</code>	SNMP v3 security level. <code>noAuthNoPriv</code> , <code>authNoPriv</code> , and <code>authPriv</code> supported.
<code>passphrase</code>	<code>""</code>	SNMP v3 authentication password. Required if <code>security_level</code> is <code>authNoPriv</code> or <code>authPriv</code> ; must match “Password” defined in MM for the SNMP v3 “Login ID”.
<code>auth_type</code>	<code>""</code>	SNMP v3 authentication password encoding type. Required if <code>security_level</code> is <code>authNoPriv</code> or <code>authPriv</code> . Must match “Authentication Protocol” defined in the MM. Values of MD5, SHA, and None are supported.
<code>privacy_passwd</code>	<code>""</code>	SNMP v3 privacy password. Must match “Privacy password” defined in the MM.

<b>Variable</b>	<b>Default Value</b>	<b>Description</b>
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. <ul style="list-style-type: none"> <li>● A value of "0" disables the use of the SNMP_MSG_GETBULK SNMP command.</li> <li>● Positive values less than 16 default to "16", since values less than 16 don't necessarily increase performance.</li> <li>● Too high of a value (&gt; 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".</li> <li>● Default is "32".</li> </ul>

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, user ID, and password of 192.168.70.125, USERID, and PASSWORD (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 older BladeCenter chassis or on the Management Module itself on newer BladeCenter models. 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's SNMP "Access Type" must be defined for Set. In the MM, this is defined for each SNMP V1 community and/or SNMP V3 Login ID.

### **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, 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`  
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`  
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 configure step but then configure goes on to build the other OpenHPI plugins. The error message is often lost with the other configure messages. To get the build to stop immediately on a prerequisite error, explicitly enable the BladeCenter plugin with the *-enable-snmp\_bc* configure 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

### 2.1 BladeCenter Model 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:

<b>Resource</b>	<b>BladeCenter</b>	<b>BladeCenter T</b>	<b>BladeCenter H</b>	<b>BladeCenter HT</b>
Management Modules	2	2	2	2
Blades	14	8	14	12
I/O Modules (1-4Gb)	4	4	6	4
I/O Modules High-Speed (10Gb)	0	0	4	4
Media Trays	1	1	1	2
Blowers/Fans	2	4	2	4
Network Clock Modules	0	0	0	2

Table 2.1: BladeCenter Model Resource Differences

All blades and I/O modules are inter-changeable between the various BladeCenter models. In addition, high-speed I/O modules and Management Modules are inter-changeable between the BladeCenter H and BladeCenter HT.

### 2.2 RPT Mapping

Table 2.2: BladeCenter Resources describes an abbreviated RPT table for supported BladeCenter resources.

<b>Resource</b>	<b>Entity Path</b>	<b>Capabilities</b>	<b>Severity</b>
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
MM Interposer x (BCHT Only)	{SAHPI_INTERCONNECT, x} {BLADECENTER_SYS_MGMNT_MODULE_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE	SAHPI_MAJOR

<b>Resource</b>	<b>Entity Path</b>	<b>Capabilities</b>	<b>Severity</b>
Management Module x	{SAHPI_ENT_SYS_MGMNT_MODULE, x} {BLADECENTER_SYS_MGMNT_MODULE_SLOT, x} {entity_root}  For BCHT Entity Path is: {SAHPI_ENT_SYS_MGMNT_MODULE, x} {SAHPI_INTERCONNECT, 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_FRU SAHPI_CAPABILITY_MANAGED_HOTSWAP SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
I/O Module Slot x	{BLADECENTER_SWITCH_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
I/O Interposer x (BCHT Only)	{SAHPI_INTERCONNECT, x} {BLADECENTER_SWITCH_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE	SAHPI_MAJOR
I/O Module x	{SAHPI_ENT_SWITCH, x} {BLADECENTER_SWITCH_SLOT, x} {entity_root}  For BCHT, Entity Path is: {SAHPI_ENT_SWITCH, x} {SAHPI_INTERCONNECT, x} {BLADECENTER_SWITCH_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
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_CAPABILITY_SENSOR	SAHPI_CRITICAL

<b>Resource</b>	<b>Entity Path</b>	<b>Capabilities</b>	<b>Severity</b>
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
Alarm Panel Slot x (BCHT Only)	{BLADECENTER_ALARM_PANEL_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Alarm Panel x (BCHT only)	{SAHPI_ENT_DISPLAY_PANEL, x} {BLADECENTER_ALARM_PANEL_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Mux Module Slot x (BCHT Only)	{BLADECENTER_MUX_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Mux Module x (BCHT Only)	{SAHPI_ENT_OTHER_CHASSIS_BOARD, x} {BLADECENTER_MUX_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Network Clock Module Slot x (BCHT Only)	{BLADECENTER_CLOCK_SLOT, x} {entity_root}	SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_CRITICAL
Network Clock Module x (BCHT Only)	{SAHPI_ENT_BATTERY + 13} {BLADECENTER_CLOCK_SLOT, x} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_INVENTORY_DATA SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR
Front Bezel (BCHT Only)	{SAHPI_ENT_PHYSICAL_SLOT + 16} {entity_root}	SAHPI_CAPABILITY_FRU SAHPI_CAPABILITY_RDR SAHPI_CAPABILITY_RESOURCE SAHPI_CAPABILITY_SENSOR	SAHPI_MAJOR

Table 2.2: BladeCenter Resources

### 2.3 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:

<b>BladeCenter non-Standard Entity Path Definition</b>	<b>Value</b>
BLADECENTER_SWITCH_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
BLADECENTER_ALARM_PANEL_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x15
BLADECENTER_MUX_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x16
BLADECENTER_CLOCK_SLOT	SAHPI_ENT_CHASSIS_SPECIFIC + 0x17

Table 2.3: BladeCenter non-Standard Entity Path Definitions

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

## 2.4 Entity Path Examples

{entity\_root} is defined in OpenHPI's *openhpi.conf* file. For example, if entity\_root = "{SYSTEM\_CHASSIS, 4}" in *openhpi.conf*, then {entity\_root} is:

```
{SAHPI_ENT_SYSTEM_CHASSIS, 4}
{SAHPI_ENT_ROOT, 0}
```

For the following examples, assume entity\_root = "{SYSTEM\_CHASSIS, 4}" 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, 4}
{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, 4}
{SAHPI_ENT_ROOT, 0}
```

### Example 3: Management Module 2 (in a BCHT)

```
{SAHPI_ENT_SYS_MGMNT_MODULE, 2}
{SAHPI_ENT_INTERCONNECT, 2}
{BLADECENTER_SYS_MGMNT_MODULE_SLOT, 2}
{SAHPI_ENT_SYSTEM_CHASSIS, 4}
{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.

## 2.5 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.

### 3 Resource RDR Mappings

A couple of general BladeCenter RDR observations:

- Not all the sensors listed below are supported by all the various blade types or BladeCenter chassis. The BladeCenter plugin dynamically discovers which sensors are available for each blade type and chassis.
- 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 `saHpiIldrAreaAdd()`, `saHpiIldrAreaDelete()`, `saHpiIldrFieldAdd()`, and `saHpiIldrFieldDelete()`.
- 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 than 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 individual events.
- 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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Chassis Total Minimum Power Capability	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)
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

<b>Control</b>	<b>Output Type</b>	<b>Type</b>	<b>Comments</b>
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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Chassis Inventory	SAHPI_IDR_AREATYPE_CHASSIS_INFO	SAHPI_IDR_FIELDTYPE_CHASSIS_TYPE 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 (0xFFFFFFFF) 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.

<b>Sensor</b>	<b>Sensor Number</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Slot State	BLADECENTER_SENSOR_NUM_SLOT_STATE	SAHPI_ENTITY_PRESENCE	SAHPI_EC_PRESENCE	None	UINT64 (RID)
Slot Maximum Power Capability	BLADECENTER_SENSOR_NUM_MAX_POWER	SAHPI_OTHER_UNITS_BASED_SENSOR	SAHPI_EC_THRESHOLD	None	UINT64 (Watts)

<b>Sensor</b>	<b>Sensor Number</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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-AdvancedTCA 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, and 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 an 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.

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
System Management Bus Operational State	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_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

<b>Control</b>	<b>Output Type</b>	<b>Type</b>	<b>Comments</b>
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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
MM Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Blade Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED SAHPI_ES_OFF_LINE 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)
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)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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)
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

<b>Control</b>	<b>Output Type</b>	<b>Type</b>	<b>Comments</b>
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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Blade Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	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 (BEM) RDRs

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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
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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
I/O Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED SAHPI_ES_OFF_LINE SAHPI_ES_INSTALL_ERROR	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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
I/O Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Power Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_DEGRADED 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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Power Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	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

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
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: Blower Sensor RDR Summary

### 3.9 Media Tray RDRs

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Media Tray Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	Event Only (BC, BCH, BCT)  INT64 (BCHT) 0 = ok 1 = fault
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

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Media Tray Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.19: Media Tray Inventory RDR Summary

### 3.10 Alarm Panel RDRs (BCHT Only)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Alarm Panel Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = ok 1 = fault

Table 3.20: Alarm Panel Sensor RDR Summary

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Alarm Panel Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_ISR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.21: Alarm Panel Inventory RDR Summary

### 3.11 Mux Module RDRs (BCHT Only)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Mux Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = ok 1 = fault

Table 3.22: Mux Module Sensor RDR Summary

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Mux Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.23: Mux Module Inventory RDR Summary

### 3.12 Network Clock Module RDRs (BCHT Only)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Network Clock Module Operational Status	SAHPI_OPERATIONAL	SAHPI_EC_AVAILABILITY	SAHPI_ES_RUNNING SAHPI_ES_OFF_LINE	INT64 0 = ok 1 = fault

Table 3.24: Network Clock Module Sensor RDR Summary

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Network Clock Module Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.25: Network Clock Module Inventory RDR Summary

### 3.13 Management Module Interposer RDRs (BCHT Only)

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
Management Module Interposer Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SSAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.26: Management Module Interposer Inventory RDR Summary

### 3.14 I/O Module Interposer RDRs (BCHT Only)

<b>Inventory</b>	<b>Inventory Area Type</b>	<b>Supported Fields</b>
I/O Module Interposer Inventory	SAHPI_IDR_AREATYPE_BOARD_INFO	SAHPI_IDR_FIELDTYPE_MANUFACTURER SAHPI_IDR_FIELDTYPE_PRODUCT_VERSION SAHPI_IDR_FIELDTYPE_SERIAL_NUMBER SAHPI_IDR_FIELDTYPE_PART_NUMBER

Table 3.27: I/O Module Interposer Inventory RDR Summary

### 3.15 Front Bezel RDRs (BCHT Only)

<b>Sensor</b>	<b>Type</b>	<b>Category</b>	<b>Events</b>	<b>Data Format</b>
Front Bezel Filter	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 3.28: Front Bezel Sensor 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

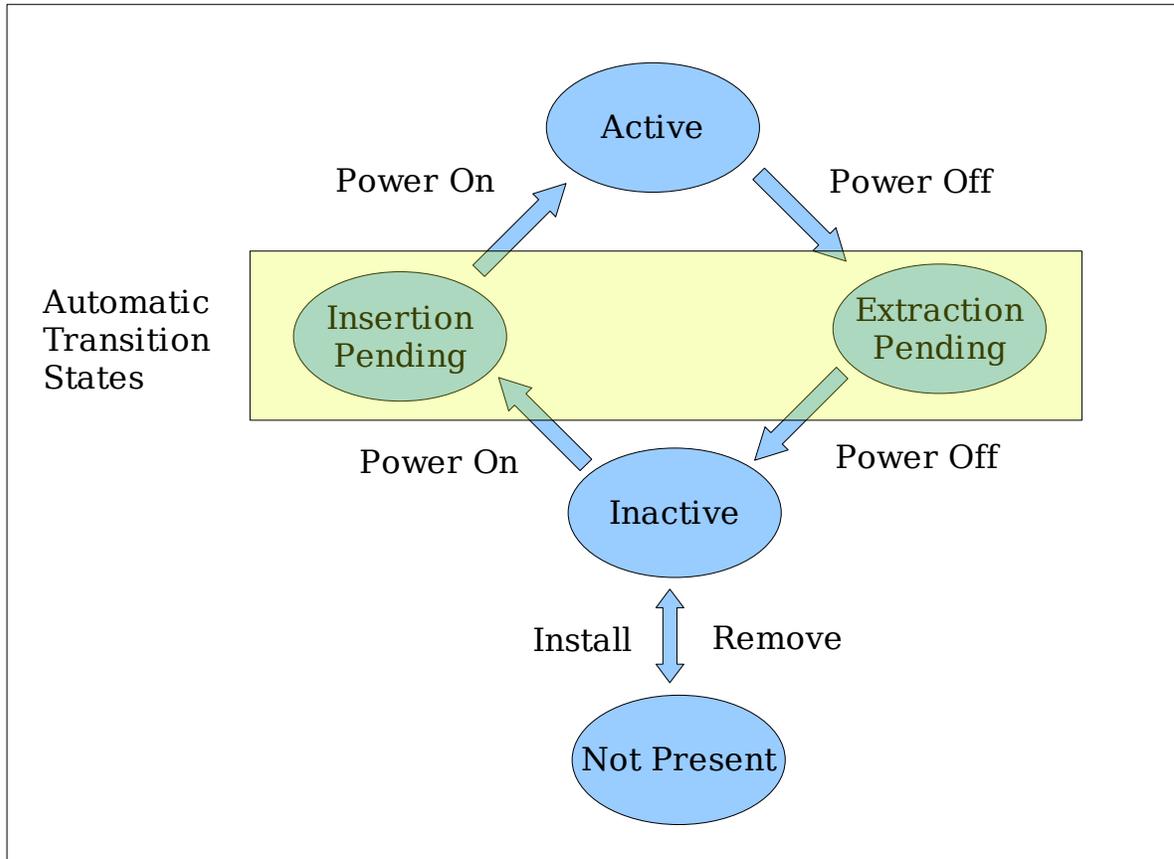
Resources such as fans, power supplies, and the media tray become active as soon as they are installed into the system. There is no HPI application action required to activate these resources. Nor is there any action required to make these resources ready to be removed. These resources are modeled using 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 2.2: 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:

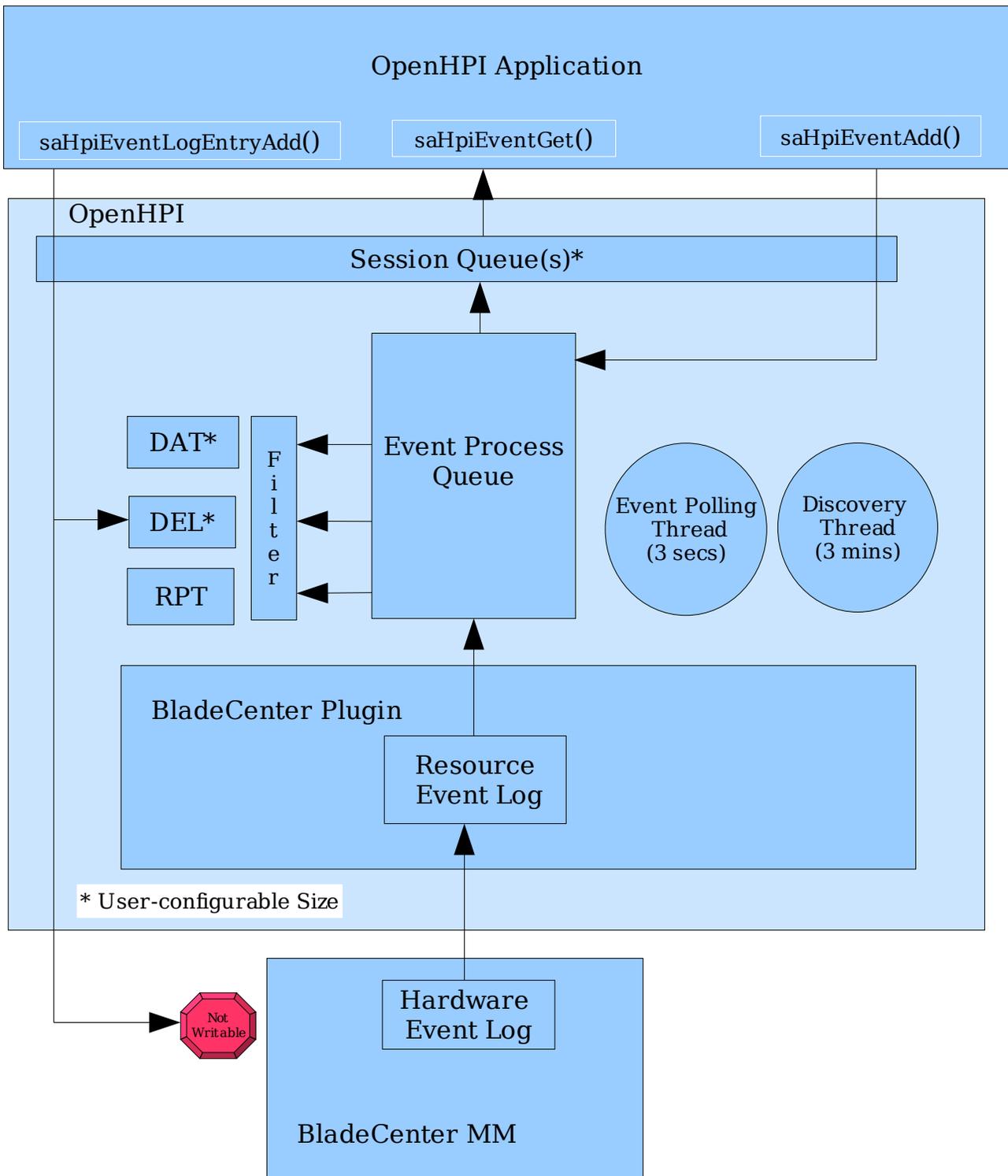
- saHpiHotSwapIndicatorStateGet() always returns SA\_ERR\_HPI\_CAPABILITY
- saHpiHotSwapIndicatorStateSet() always returns SA\_ERR\_HPI\_CAPABILITY

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.

Blade Expansion Module (BEM) resource is a special case of Managed Hotswap resource. Blade Expansion Module resource also goes through a three stage hot swap procedure – Not Present, Inactive, Active. But BEM resource is always tied to a blade resource. That is when a blade changes state, the attached BEM goes through the same state change; for example, a blade is being removed, the attached BEM is also being removed. A BEM can not change state by itself. BEM state changes are initiated by state changes at the (main) blade.

## 5 Event Processing

The figure below show a simplified view of how events are processed by OpenHPI and the BladeCenter plugin.



## 5.1 BladeCenter Hardware Event Log

At the core of the eventing system, is the BladeCenter's Hardware Event Log. All noteworthy (plus some not so noteworthy) events in the BladeCenter system are logged here. This log is persistent in the BladeCenter hardware and is preserved over MM failures and failovers.

The Hardware Event Log is accessible externally through SNMP commands. The BladeCenter plugin exposes the information in this log to the OpenHPI application as an HPI Resource Event Log, associated with the Virtual Management Module resource. The plugin keeps the Resource Event Log synchronized with the Hardware Event Log.

In a simplified event flow, the HPI application issues *saHpiEventGet()* to request an event. The OpenHPI BladeCenter plugin issues an SNMP command to the BladeCenter Management Module to retrieve the event from the BladeCenter's Hardware Event Log. The raw BladeCenter SNMP event is translated into an HPI event by the plugin code and returned to the application through an internal OpenHPI event process queue. Depending upon the event's characteristics, OpenHPI updates its Resource Presence Table (RPT) (e.g. for hot-swap events) or (depending on the event's severity) stores the event in the Domain Event Log (DEL) and/or Domain Alarm Table (DAT).

To increase performance, OpenHPI possesses two internal threads – one which harvests events from the plugins every 3 seconds and one which issues discovery to find new resources and their associated events every 3 minutes. Also when requested for an event, the BladeCenter plugin code will fetch **all** the new events from the Hardware Event Log. The result of all this is when an application requests an event, it is usually already in OpenHPI's memory. Events are retrieved quickly and SNMP network idiosyncrasies are generally smoothed over.

A couple of things to note about the physical BladeCenter Hardware Event Log:

- Non-Writable

The BladeCenter Hardware Event Log is not writable from external sources. SA\_ERR\_HPI\_INVALID\_CMD is returned for *saHpiEventLogEntryAdd()* commands that target the BladeCenter Resource Event Log.

Writable events are supported, however, for OpenHPI's DEL and DAT. So *saHpiEventLogEntryAdd()* commands that target the Domain Event Log, *SaHpiEventAdd()* commands, and *SaHpiAlarmAdd()* commands are supported.

- Variable Length

The BladeCenter Hardware Event Log is variable in size. The size varies depending upon what specific events are logged. 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.

Generally this is not a problem, since access to the Hardware Event Log is through the BladeCenter plugin's Resource Event Log, which is unlimited in size.

- Wrap Characteristics

When the BladeCenter Hardware Event Log gets full, it wraps. The oldest events are replaced with the newer ones. Events are rarely lost, however, since the OpenHPI BladeCenter plugin always requests all new events from the hardware whenever an event request is made (by the application or the internal OpenHPI event thread). Events that may be lost in the Hardware Event Log due to wrapping are usually still in memory in the BladeCenter plugin's Resource Event Log.

- Lots of Event Messages

Lots of stuff is logged in the BladeCenter's Hardware Event Log – not all of it useful to HPI applications or translatable 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 OEM Text Buffer for desired unmapped events; 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 – ***smp\_bc\_events.map***.

- Initial Startup

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. OpenHPI uses SNMP v3's SNMP GET-BULK commands to retrieve the initial set of events. This dramatically reduces bring-up time (from potentially several minutes to under a minute).
- 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 application 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()*.

## 5.2 BladeCenter Resource Event Log

Generally, OpenHPI application will use *saHpiEventxxx()* or *saHpiAlarmxxx()* commands to access the domain's DEL and DAT respectively for high severity events. For applications that wish to read the BladeCenter's Hardware Event Log more directly using *saHpiEventLogxxx()* commands, the BladeCenter plugin supports a Resource Event Log (REL).

The REL mirrors the events in the Hardware Event Log. *saHpiEventLogInfoGet()* commands targeting the REL return the characteristics of the Hardware Event Log – namely fixed length size, and overwrite on log wrap. Although these characteristics are indeed true of the actual Hardware Event Log, the REL implementation eases these restrictions. As discussed in the section above, the REL itself is unlimited in size and rarely wraps.

## 5.3 OpenHPI Domain Event Log

All events occurring in a domain, for all plugins and instances of plugins, are store in a Domain Event Log (DEL). This log defaults to a maximum of 10,000 events in size, but this can be configured with the *OPENHPI\_DEL\_SIZE\_LIMIT* option in ***openhpi.conf***. If *OPENHPI\_DEL\_SIZE\_LIMIT = 0*, the DEL is unlimited in size.

Also available in ***openhpi.conf*** are options to save the DEL to disk (*OPENHPI\_DEL\_SAVE*) and set the minimum severity level of events that are saved in the DEL (*OPENHPI\_LOG\_SEV*).

## **5.4 OpenHPI Domain Alarm Table**

Events with severities greater than or equal to SAHPI\_MINOR, are also stored in the Domain Alarm Table (DAT). By default the size of this log is unlimited. The size can be restricted, however, with the *OPENHPI\_DAT\_SIZE\_LIMIT* configuration option in ***openhpi.conf***.

Also available in ***openhpi.conf*** are options to save the DAT to disk (*OPENHPI\_DAT\_SAVE*) and restrict the number of user alarms supported (*OPENHPI\_DAT\_USER\_LIMIT*).