HPE System Management is about:

- Resiliency & Security
- Operational Efficiency
- HPC Scale
- System Performance

Delivers fully integrated system management for HPE HPC systems:

System Setup

- Hardware Management
- Software Updates
- Power Management
- ISV & Open Source Software Integration
- Image Management
HPE Performance Cluster Manager

Fully integrated system management for HPC clusters:

**Gain Complete Control**
- All the functionality you need to manage your cluster all day, every day
- Fine-grained central monitoring and management of all aspects of your cluster hardware (CPU, memory, GPU, networking, cooling, ...)

**Be Efficient**
- Streamline maintenance by setting up alerts and automatic reactions
- Any software image can be provisioned on all or select cluster nodes to accommodate different requirements
- Integration with most widely used 3rd party HPC tools (workload management, system management, monitoring and more)

**Grow Effortlessly**
- Manage system of any size – up to 100,000 nodes
- System log, hardware inventory, image repositories designed for scale
- No disruption to existing system with rolling hardware upgrades
- System management solution of choice for Hybrid HPC infrastructure for on-prem and cloud

Reduce time & resources spent administering your system

Increase productivity & lower your operating costs

Increase return on your investment

HPE HPC Systems: HPE SGI 8600, HPE Apollo 2000, Apollo 6x00, Apollo 4x00, Apollo 70 (Arm), Apollo 35, HPE ProLiant DL, HPE Moonshot
HPE Performance Cluster Manager

Features At-a-Glance

System Setup
- Provision thousands of cluster nodes in less than an hour
- Add new cluster nodes without shutdown of system
- Automatic hardware discovery
- Configuration information stored in a secure repository

Image Management & Software Update
- Secure software image repository supports Linux OS, middleware and applications
- Image formats: RPM, ISO, gold image
- Any software image can be provisioned on all or select cluster nodes
- Accountability built in to track changes

Hardware Management
- Collect various telemetry data and store in a secure repository
- Analyze behavior of metrics at a specific point in time or over a period of time
- View metrics and alerts via GUI, CLI, Ganglia, Nagios, ELK*
- Setup automatic reactions to alerts
- Broadcast commands to selected nodes
- FRU inventory for serviceability*
- Find differences between nodes
- Integrated firmware flashing for BIOS, BMC/iLO, CMC, network adapter/switch
- Central management is protected with secure administrative node

Power Management
- Collect and analyze power metrics (for nodes, chassis, rack, PDU, CDU)
- Topology-aware Power On/Off
- Power capping
- Assign/account power resources for jobs

ISV & Open Source Software Integration
- Altair PBS Professional, Slurm: Launch tool, manage resources, use selected tool commands from HPCM
- Mellanox UFM*: View IB switch metrics with associated cluster node metrics
- Ganglia, Nagios Core, ELK*: Integrated for system monitoring, alerts and analytics
- DCGM connector*: Integrated management of NVIDIA GPUs
- Ansible: HPCM stores hardware metrics in Ansible Playbook format

*New feature in HPCM 1.1 - December 2018
Hardware Management

All Configurations
– Alerts and notifications for all hardware events
– Secure and authenticated repositories for telemetry
– *Scalable system log repository based on ELK (Elastic Search, Logstash, Kibana) support log data analysis and visualization*
– Firmware and BIOS flashing for all nodes (iLO or non-iLO enabled)
– Supports standard protocols – Redfish, IPMI, SNMP
– No disruption to existing system with rolling hardware upgrades
– *NVIDIA DCGM integration for NVIDIA GPU management and control*
– *FRU Inventory (serial number, hostname, part number, bmc, date) for serviceability*
– Check for differences between nodes
– Broadcast commands to multiple nodes
– Hardware inventory output in Ansible playbook format

Flat Configurations
– *Integration with Mellanox UFM connects IB switch telemetry with cluster node telemetry*

Flat
HPE Apollo (x86-64, Arm64) HPE ProLiant DL

Distributed Configurations
– Automatic hardware discovery for new systems
– High Availability for Admin and Leader Nodes
– Correctable memory error handling

Distributed
HPE SGI 8600

New feature in HPCM 1.1 December 2018
## Login Node Status

<table>
<thead>
<tr>
<th>Hardware management</th>
<th>Network Attributes</th>
<th>Server Management</th>
<th>Network Addresses</th>
<th>Software Image</th>
<th>Internals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Firmware and BIOS Update

Easy firmware and BIOS update from GUI
Hardware Monitoring

Instant View of a set of nodes
Recognize changes over time

Time View shows the “flower petals” of cluster nodes over time
Ganglia Monitoring

Ganglia Open Source monitoring tool – Ganglia Web interface
Nagios Monitoring

Nagios Open Source monitoring tool
Broadcast commands to multiple nodes

Each window = cluster node

Type command once to send to 4 nodes
Identify inconsistencies

Immediately find differences
### Network Management

#### Hardware Management

**View interconnect metrics**

<table>
<thead>
<tr>
<th>Name</th>
<th>Base IP</th>
<th>Broadcast</th>
<th>Gateway</th>
<th>Type</th>
<th>Vlan</th>
<th>Subnet mask</th>
<th>Management server IP address</th>
</tr>
</thead>
<tbody>
<tr>
<td>bmc-1</td>
<td>10.169.0.0</td>
<td>10.169.0.255</td>
<td>172.212.255.254</td>
<td>bmc</td>
<td>1</td>
<td>255.255.255.255</td>
<td>192.168.127.246</td>
</tr>
<tr>
<td>bmc-2</td>
<td>10.169.0.0</td>
<td>10.169.0.255</td>
<td>172.212.255.254</td>
<td>bmc</td>
<td>1</td>
<td>255.255.255.255</td>
<td>192.168.127.246</td>
</tr>
<tr>
<td>bmc-3</td>
<td>10.169.0.0</td>
<td>10.169.0.255</td>
<td>172.212.255.254</td>
<td>bmc</td>
<td>1</td>
<td>255.255.255.255</td>
<td>192.168.127.246</td>
</tr>
<tr>
<td>bmc-4</td>
<td>10.169.0.0</td>
<td>10.169.0.255</td>
<td>172.212.255.254</td>
<td>bmc</td>
<td>1</td>
<td>255.255.255.255</td>
<td>192.168.127.246</td>
</tr>
</tbody>
</table>

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**Hewlett Packard Enterprise**

14
NVIDIA GPU Management

- NVIDIA Datacenter GPU Manager (DCGM) enables GPU diagnostics, health, configs, alerts on a single server
- DCGM features integrated in HPCM:
  - Diagnostic tests
  - Health watches
  - Set/enforce config targets
  - NVLink error counts
  - Device info
  - Topology
- HPCM makes GPU health management cluster-aware by aggregating the GPU health metrics and alerts

Example: Quick System Validation shows that 2 nodes pass all GPU validation tests

Metrics collected include: GPU load, memory use, power, temperature and more
# Image Management

<table>
<thead>
<tr>
<th>Feature</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Image Formats</strong></td>
<td>Software image repository supports RPM, ISO, remote repository (URL), Gold image (AutoYaST, Kickstart)</td>
</tr>
<tr>
<td><strong>Software Repository Actions</strong></td>
<td>Capture, backup and redeployment of images</td>
</tr>
<tr>
<td><strong>Linux OS distributions</strong></td>
<td>RHEL, SLES, CentOS multiple versions can be managed and provisioned on all or select nodes</td>
</tr>
<tr>
<td><strong>Accountability</strong></td>
<td>Track changes to the archive – who made change and when change was made</td>
</tr>
<tr>
<td><strong>Version Control</strong></td>
<td>Roll changes forward or backward as required and on-demand</td>
</tr>
<tr>
<td><strong>Distributed configuration support</strong></td>
<td>Master images on the admin node are also cached on leader nodes</td>
</tr>
<tr>
<td><strong>Security</strong></td>
<td>Secure image repository</td>
</tr>
</tbody>
</table>
## Software Updates

<table>
<thead>
<tr>
<th>Feature</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Multi-cast and BitTorrent provisioning enables fast provisioning of software across the cluster in a single provisioning session</td>
</tr>
<tr>
<td>Cluster Node Support</td>
<td>Provisions diskfull and diskless (nfs/tmpfs) nodes</td>
</tr>
<tr>
<td>Security</td>
<td>Transfer of secret information (ssh, passwords, etc) occurs before provisioning. No image corruption during provisioning because image is encrypted with key. Compute node root ssh keys kept separate from admin nodes.</td>
</tr>
<tr>
<td>Automatic retries</td>
<td>Provisioning is not disrupted by network communication interruptions</td>
</tr>
<tr>
<td>System setup</td>
<td>No reboot required after provisioning</td>
</tr>
<tr>
<td>Mixed Linux OS distributions</td>
<td>Different OS images and kernels can be provisioned on selected nodes</td>
</tr>
</tbody>
</table>
# Power Management

<table>
<thead>
<tr>
<th>Feature</th>
<th>Capability</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Topology aware power on/off control</strong></td>
<td>Sequential staging of power on/off. Power on: rack, chassis, nodes. Power off: nodes, chassis, rack. Also aware of whether node is booted with OS or not.</td>
</tr>
<tr>
<td><strong>Power monitoring</strong></td>
<td>Read and aggregate power and energy at available measurement points (rack AC, bulk DC, nodes, liquid-cooling infrastructure). Power data reported in watts.</td>
</tr>
<tr>
<td><strong>Power data reports for analyses</strong></td>
<td>Power data can be imported into spreadsheets for charting and further analyses.</td>
</tr>
<tr>
<td><strong>Power capping</strong></td>
<td>Set limits to trigger a power cap based on environmental failure (power or thermal), datacenter power capacity or for other reasons (i.e. workloads, planned brownouts, time of day).</td>
</tr>
<tr>
<td><strong>Power resource management for jobs</strong></td>
<td>Altair PBS Professional Power Awareness feature uses the power data from the cluster management tool to define per job power envelopes, contain the system global power consumption, apply per user, per group, per job class power containment and account for consumed energy.</td>
</tr>
<tr>
<td><strong>Sandia PowerAPI plug-in</strong></td>
<td>Enables power measurement and control for HPC with the PowerAPI Open Source software (powerapi.sandia.gov)</td>
</tr>
</tbody>
</table>
Power Consumption

GUI: Power for 32 nodes

CLI: Average power for SGI HPE 8600 rack

```
[root@cb10 ~]# cd /dev/shm/rrds/Power\ Stats/rack1
[root@cb10 rack1]# rrdtool fetch DC_Power.rrd AVERAGE -s 1520870160 -e 1520870460
```

Using the graph function of the rrdtool utility can produce a simple graph:
Altair PBS Professional Power Awareness

**Job Submission**

```
labtest@login0:~> qsub -l select=4:nCPUs=48:mpiprocs=48:eoe=350W,place=excl testjob.sh
```

**Power CAP applied**

```
labtest@login0:~> pbsnodes -v r1i1n1
r1i1n1

pbs_version = PBSPro_13.1.503
state = busy
pCPUs = 48
resources_available.eoe=270W,350W,800W
power_enable = True
current_eoe = 350W
```

**Energy is monitored**

```
labtest@login0:~> qstat -f
Job Id: 6.login0
resources_used.CPUpercent = 98
resources_used.CPUt = 00:58:18
resources_used.mem = 484532kb
resources_used.nCPUs = 48
resources_used.walltime = 57:15:28
resources_used.energy = 0.089
```

**Accounting logged energy used**

```
root@login0:~> cat /var/spool/pbs/server_priv/20180102 | grep 6.login0
01/02/2018 10:35:51;E;6.login0;user=labtest jobname=6.login0 queue=low Exit_status=0 resources_used.CPUpercent=97 resources_used.CPUT=03:37:12 resources_used.mem=484532kb resources_used.nCPUs=192 resources_used.energy=1.234
```

*All power awareness features will be part of the standard PBS Professional 18 Commercial Release in Q3/4 2018. Power awareness is not featured in the Community Editions.*
## ISV and Open Source Software Integration

<table>
<thead>
<tr>
<th>Software</th>
<th>Capability</th>
<th>Use Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Altair PBS Professional</strong></td>
<td>Track selected nodes’ metrics by job</td>
<td>Check on system health before job is scheduled?</td>
</tr>
<tr>
<td></td>
<td>Save metrics/job for future resource analyses</td>
<td>Find CPU load for the job</td>
</tr>
<tr>
<td></td>
<td>Access to PBS Professional commands from HPCM menus</td>
<td>Running time for the job</td>
</tr>
<tr>
<td></td>
<td>Altair required software: <a href="https://pbsworks.com/cmupbsconnector/">https://pbsworks.com/cmupbsconnector/</a></td>
<td>Identify which job is most power efficient</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Experiment with adjusting resources</td>
</tr>
<tr>
<td><strong>Slurm</strong></td>
<td>Track selected nodes’ metrics by job</td>
<td>Find CPU load for the job</td>
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<td>Save metrics/job for future resource analyses</td>
<td>Running time for the job</td>
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<td>Access to Slurm commands from HPCM menus</td>
<td>Experiment with adjusting resources</td>
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<tr>
<td></td>
<td>Integrated with HPCM</td>
<td></td>
</tr>
<tr>
<td><strong>Mellanox UFM</strong></td>
<td>View InfiniBand switch metrics with the associated cluster node metrics</td>
<td>Provide more detailed data when reporting InfiniBand issues to HPE Pointnext: “The problem with the switch is on node 15”</td>
</tr>
<tr>
<td></td>
<td>Use UFM commands from HPCM</td>
<td></td>
</tr>
<tr>
<td><strong>Ansible Playbook</strong></td>
<td>HPCM outputs hardware inventory metrics in Ansible Playbook format</td>
<td>Hardware metrics are ready to be used by Ansible</td>
</tr>
<tr>
<td></td>
<td>Feature is integrated in HPCM</td>
<td></td>
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## ISV and Open Source Software Integration

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<td><strong>Ganglia</strong></td>
<td>Open Source software for hardware monitoring</td>
<td>Plug-ins for Ganglia UI</td>
</tr>
<tr>
<td></td>
<td>Integrated in HPCM for monitoring, collecting hw metrics, visualization of hw metrics (Ganglia Web)</td>
<td>Write scripts or use other tools like Grafana to view the Ganglia database</td>
</tr>
<tr>
<td><strong>Nagios Core</strong></td>
<td>Open Source software for hardware monitoring, alerts</td>
<td>Plug-ins for Nagios UI</td>
</tr>
<tr>
<td></td>
<td>Integrated in HPCM to monitor for alerts</td>
<td>Checks for services that are running</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check for temperature on switches</td>
</tr>
<tr>
<td><strong>ELK</strong></td>
<td>Elastic Search is the database for system log data and uses REST API</td>
<td>Debug issues by reviewing log data in one UI</td>
</tr>
<tr>
<td></td>
<td>Logstash takes the system logs and converts them into Elastic Search format</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kibana is a GUI for reporting and visualization of data</td>
<td></td>
</tr>
<tr>
<td><strong>NVIDIA DCGM</strong></td>
<td>NVIDIA GPU monitoring and management</td>
<td>Multi-GPU health management across the cluster</td>
</tr>
<tr>
<td></td>
<td>Integrated in HPCM</td>
<td></td>
</tr>
</tbody>
</table>
Altair PBS Professional integration into HPCM

- Altair PBS Professional integration into HPCM enables job efficient scheduling
- Access PBS Professional commands from within HPCM
- Track selected nodes’ metrics by jobs
- Key functionalities:
  - Delete jobs
  - Suspend jobs
  - Resume jobs
  - Manage suspended jobs
  - Identify job power usage
Plan your upgrade

HPE HPC System Management solutions:

Today

- HPE Insight Cluster Management Utility
  (for HPE Apollo, ProLiant, Moonshot)

December 2018

- HPE Performance Cluster Manager
  (for HPE Apollo, SGI 8600, ProLiant, Moonshot)

- HPE SGI Management Suite
  (for HPE SGI 8600)

Comprehensive software designed for ease of operation, resiliency and serviceability of all HPE HPC systems.
Upgrade Process from HPE Insight Cluster Management Utility (CMU) and HPE SGI Management Suite (SMS):

**Customer has active Pointnext support contract for SMS or CMU**

- **Yes**: Ensure SMS 3.5 or CMU 8.2 is running on admin node

- **No**: Purchase support contract

**Tips and tricks:**
- Most of the customization can be done on the images, then applied to one node for testing and then propagated to other running nodes
- Capture image of customized running node if you are doing customization on the running node
- Discovery for switches should be done before discovering other nodes

**MIGRATE:**

1. Use tools to save DB content in configuration file
2. Save images
3. Adjust configuration file as necessary
4. Install HPCM on admin node
5. Import configuration file
6. Import images
7. Migrate / adjust site-specific customizations for admin node and images
8. Discover / provision nodes and other hardware in cluster
9. Migrate / adjust site-specific customizations on running nodes (compute nodes) and other hardware (switches etc.)
Thank You