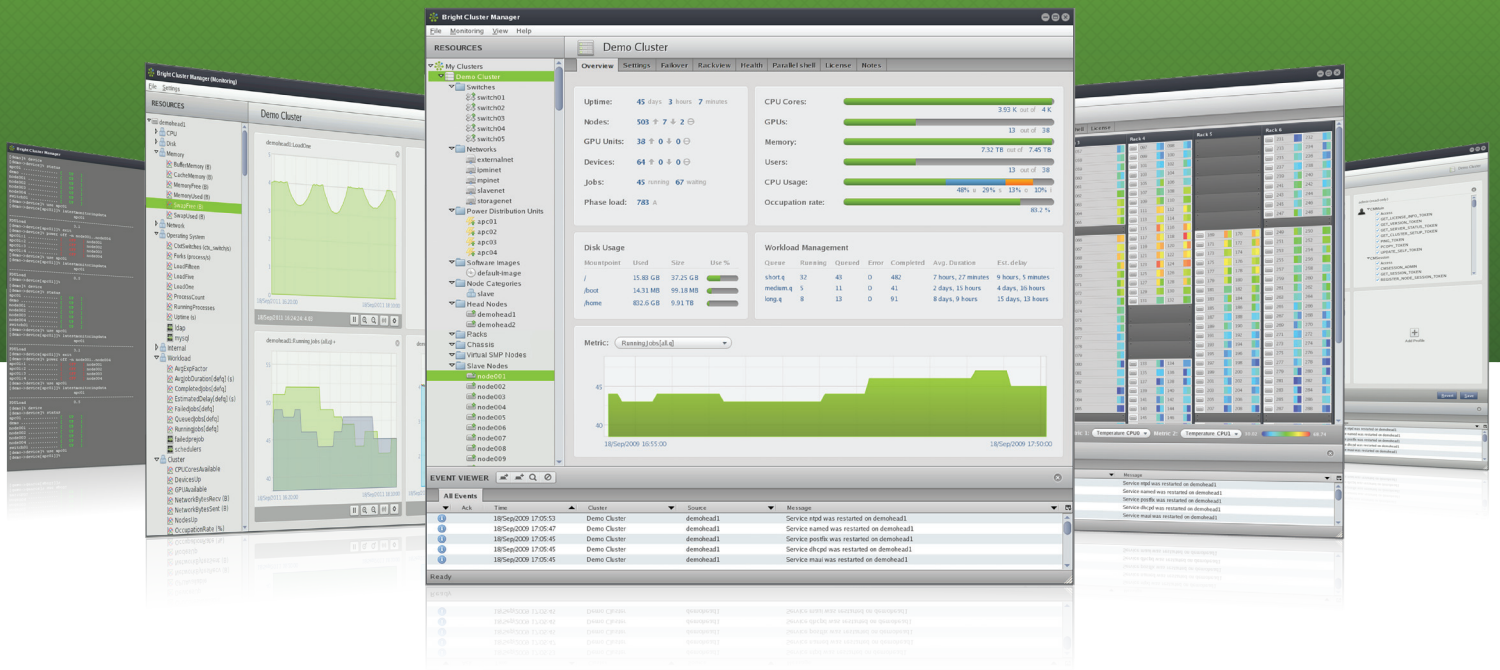
Bright Computing

Bright Cluster Manager



Advanced Cluster Management Made Easy

Bright Cluster Manager® removes the complexity from the installation, management and use of HPC clusters — on-premise or in the cloud. With Bright Cluster Manager, you can easily install, manage and use multiple clusters simultaneously, including compute, Hadoop, storage, database and workstation clusters.

The Bright Advantage

Bright Cluster Manager delivers improved productivity, increased uptime, proven scalability and security, while reducing operating cost:

Rapid Productivity Gains

- Short learning curve: intuitive GUI drives it all.
- Quick installation: one hour from bare metal to compute-ready.
- Fast, flexible provisioning: incremental, live, disk-full, disk-less, over InfiniBand, to virtual machines, auto node discovery.
- Comprehensive monitoring: on-the-fly graphs, Rackview, multiple clusters, custom metrics.
- Powerful automation: thresholds, alerts, actions.
- Complete GPU support: NVIDIA, AMD[1], CUDA, OpenCL.
- Full support for Intel Xeon Phi.
- On-demand SMP: instant ScaleMP virtual SMP deployment.
- Fast customization and task automation: powerful cluster management shell, SOAP and JSON APIs make it easy.
- Seamless integration with leading workload managers: Slurm, Open Grid Scheduler, Torque, openlava, Maui[2], PBS Professional, Univa Grid Engine, Moab[2], LSF.
- Integrated (parallel) application development environment.
- Easy maintenance: automatically update your cluster from Linux and Bright Computing repositories.
- Easily extendable, web-based User Portal.
- Cloud-readiness at no extra cost[3], supporting scenarios "Cluster-on-Demand" and "Cluster-Extension", with data-aware scheduling.
- Deploys, provisions, monitors and manages Hadoop clusters.
- Future-proof: transparent customization minimizes disruption from staffing changes.

Maximum Uptime

- Automatic head node failover: prevents system downtime.
- Powerful cluster automation: drives pre-emptive actions based on monitoring thresholds.
- Comprehensive cluster monitoring and health checking: automatic sidelining of unhealthy nodes to prevent job failure.

Scalability from Deskside to TOP500

- Off-loadable provisioning: enables maximum scalability.
- Proven: used on some of the world's largest clusters.

Minimum Overhead / Maximum Performance

- Lightweight: single daemon drives all functionality.
- Optimized: daemon has minimal impact on operating system and applications.
- Efficient: single database for all metric and configuration data.

Top Security

- Key-signed repositories: controlled, automated security and other updates.
- Encryption option: for external and internal communications.
- Safe: X509v3 certificate-based public-key authentication.
- Sensible access: role-based access control, complete audit trail.
- Protected: firewalls and LDAP.

Bright Cluster Manager

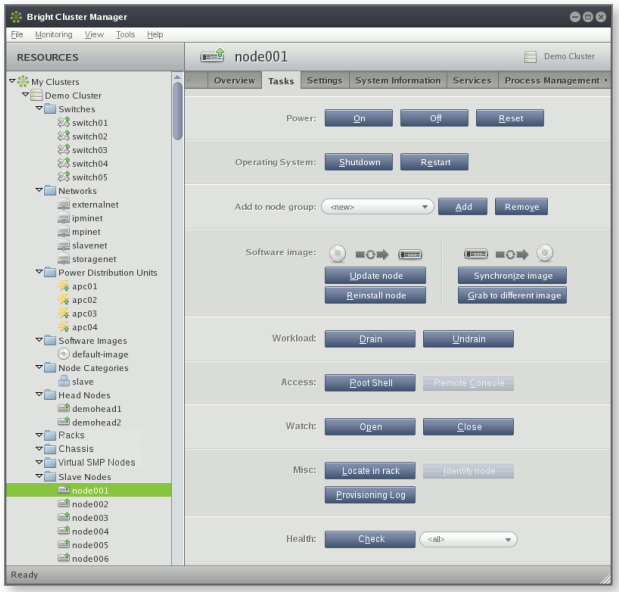
Easy-to-use, complete and scalable

Bright Cluster Manager® removes the complexity from the installation, management and use of HPC clusters, without compromising performance or capability. With Bright Cluster Manager, you can easily install, use and manage multiple clusters simultaneously, including compute, Hadoop, storage, database and workstation clusters.

A Unified Approach

Bright Cluster Manager was written from the ground up as a totally integrated and unified cluster management solution. This fundamental approach provides comprehensive cluster management that is easy to use and functionality-rich, yet has minimal impact on system performance. It has a single, light-weight daemon, a central database for all monitoring and configuration data, and a single CLI and GUI for all cluster management functionality. Bright Cluster Manager is extremely easy to use, scalable, secure and reliable. You can monitor and manage all aspects of your clusters with virtually no learning curve.

The cluster installer takes you through the installation process and offers advanced options such as "Express" and "Remote".



By selecting a cluster node in the tree on the left and the Tasks tab on the right, you can execute a number of powerful tasks on that node with just a single mouse click.

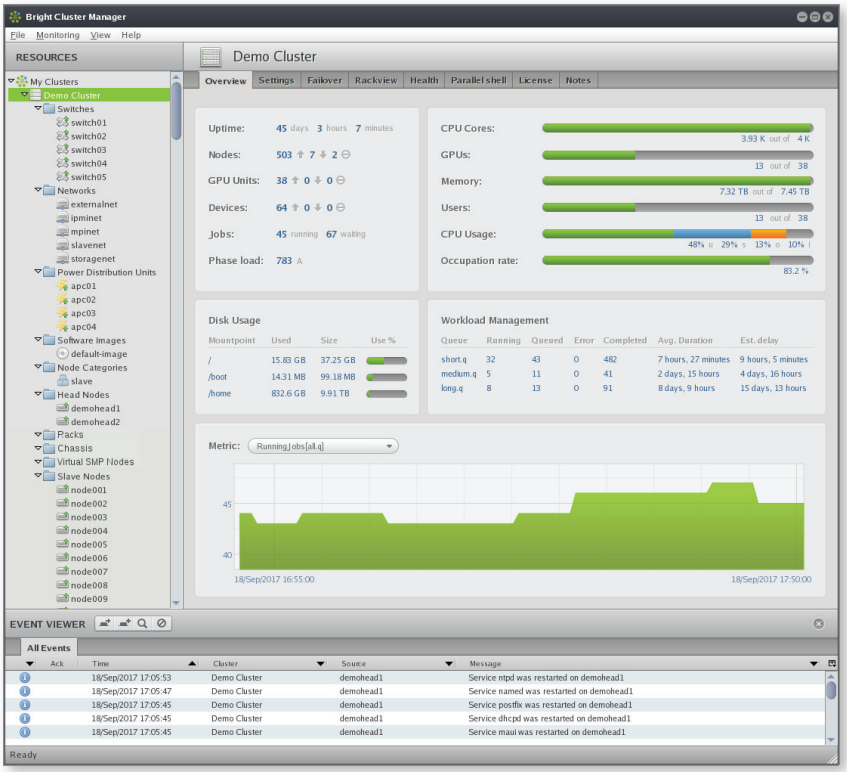
Bright's approach is in sharp contrast with other cluster management offerings, all of which take a "toolkit" approach. These toolkits combine a Linux distribution with many third-party tools for provisioning, monitoring, alerting, etc.

This approach has critical limitations: these separate tools were not designed to work together; were often not designed for HPC, nor designed to scale. Furthermore, each of the tools has its own interface (mostly command-line based), and each has its own daemon(s) and database(s).

Countless hours of scripting and testing by highly skilled people are required to get the tools to work for a specific cluster, and much of it goes undocumented. Time is wasted, and the cluster is at risk if staff changes occur, losing the "in-head" knowledge of the custom scripts.

> **"Bright met our demanding requirements straight out of the box."**
> **– Dr Tommy Minyard, Director of Advanced Computing at TACC**

"Bright Cluster Manager is a comprehensive cluster management solution that provides all the functionality that we need here at CD-adapco. Our key applications, STAR-CCM+ and STAR-CD, were easy to install and run well on the cluster." — Philip Jones, Euro IT Director at CD-adapco



Ease of Installation

Bright Cluster Manager is easy to install. Installation and testing of a fully functional cluster from "bare metal" can be completed in less than an hour. Configuration choices made during the installation can be modified afterwards. Multiple installation modes are available, including unattended and remote modes. Cluster nodes can be automatically identified based on switch ports rather than MAC addresses, improving speed and reliability of installation, as well as subsequent maintenance. All major hardware brands are supported: Dell, Cray, Cisco, DDN, IBM, HP, Supermicro, Acer, Asus and more.

Ease of Use

Bright Cluster Manager is easy to use, with two interface options: the intuitive Cluster Management Graphical User Interface (CMGUI) and the powerful Cluster Management Shell (CMSH).

The **CMGUI** is a standalone desktop application that provides a single system view for managing all hardware and software aspects of the cluster through a single point of control. Administrative functions are streamlined as all tasks are performed through one intuitive, visual interface. Multiple clusters can be managed simultaneously. The CMGUI runs on Linux, Windows and OS X, and can be extended using plugins. The **CMSH** provides practically the same functionality as the CMGUI, but via a command-line interface. The CMSH can be used both interactively and in batch mode via scripts.

Either way, you now have unprecedented flexibility and control over your clusters.

Support for Linux and Windows

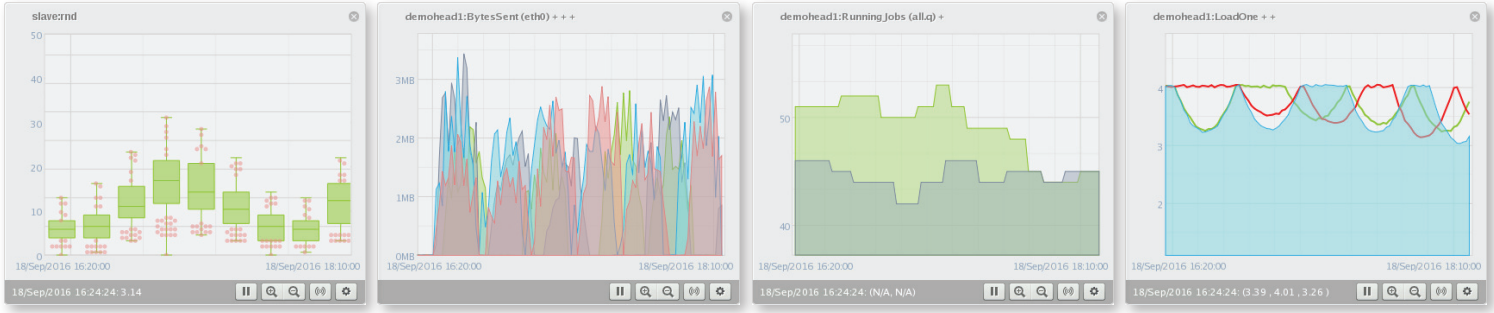
Bright Cluster Manager is based on Linux and is available with a choice of pre-integrated, pre-configured and optimized Linux distributions, including SUSE Linux Enterprise Server, Red Hat Enterprise Linux, CentOS and Scientific Linux. Dual-boot installations with Windows HPC Server are supported as well, allowing nodes to either boot from the Bright-managed Linux head node, or the Windows-managed head node.

The Overview tab provides instant, high-level insight into the status of the cluster.

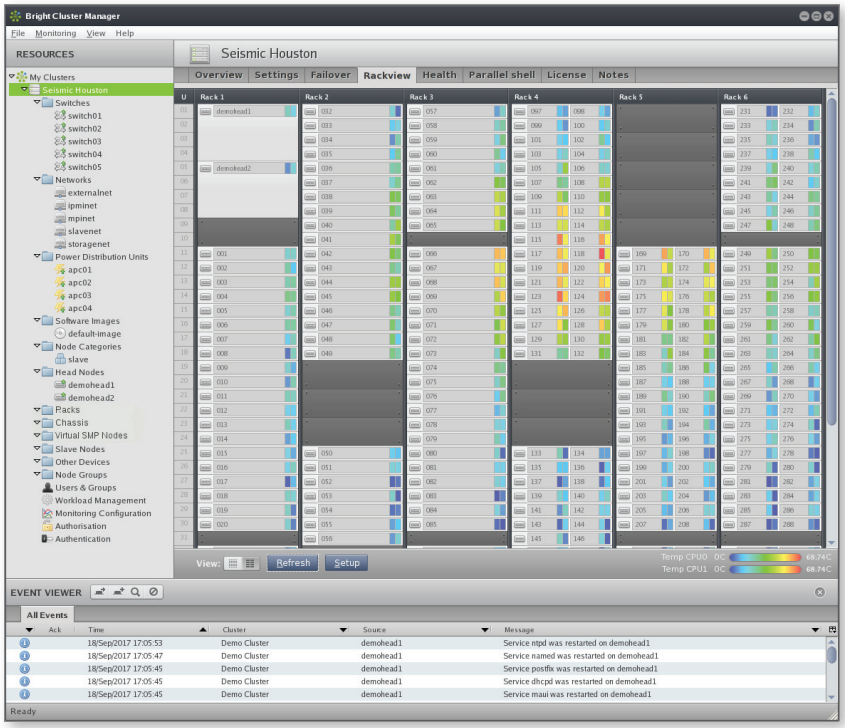
Extensive Development Environment

Bright Cluster Manager provides an extensive HPC development environment for both serial and parallel applications, including the following (some are cost options):

- Compilers, including full suites from GNU, Intel, AMD and Portland Group.
- Debuggers and profilers, including the GNU debugger and profiler, TAU, TotalView, Allinea DDT and Allinea MAP.
- GPU libraries, including CUDA and OpenCL.
- MPI libraries, including OpenMPI, MPICH, MPICH2, MPICH-MX, MPICH2-MX, MVAPICH and MVAPICH2; all cross-compiled with the compilers installed on Bright Cluster Man-



Cluster metrics, such as GPU, Xeon Phi and CPU temperatures, fan speeds and network statistics can be visualized by simply dragging and dropping them into a graphing window. Multiple metrics can be combined in one graph and graphs can be zoomed into. A Graphing wizard allows creation of all graphs for a selected combination of metrics and nodes. Graph layout and color configurations can be tailored to your requirements and stored for re-use.

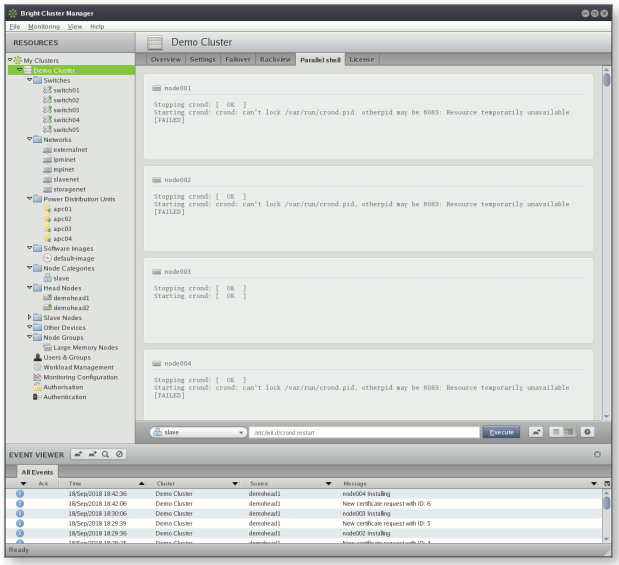


The status of cluster nodes, switches, other hardware, as well as up to six metrics can be visualized in the Rackview. A zoom-out option is available for clusters with many racks.

ager, and optimized for high-speed interconnects such as InfiniBand and 10GE.

- Mathematical libraries, including ACML, FFTW, Goto-BLAS, MKL and ScaLAPACK.
- Other libraries, including Global Arrays, HDF5, IIPP, TBB, NetCDF and PETSc.

Bright Cluster Manager also provides Environment Modules to make it easy to maintain multiple versions of compilers, libraries and applications for different users on the cluster, without creating compatibility conflicts. Each Environment Module file contains the information needed to configure the shell for an application, and automatically sets these variables correctly for the particular application when it is loaded. Bright Cluster Manager includes many preconfigured module files for many scenarios, such as combinations of compliers, mathematical and MPI libraries.



The parallel shell allows for simultaneous execution of commands or scripts across node groups or across the entire cluster.

Powerful Image Management and Provisioning

Bright Cluster Manager features sophisticated software image management and provisioning capability. A virtually unlimited number of images can be created and assigned to as many different categories of nodes as required. Default or custom Linux kernels can be assigned to individual images. Incremental changes to images can be deployed to live nodes without rebooting or re-installation.

The provisioning system only propagates changes to the images, minimizing time and impact on system performance and availability. Provisioning capability can be assigned to any number of nodes on-the-fly, for maximum flexibility and scalability. Bright Cluster Manager can also provision over InfiniBand and to ramdisk or virtual machine.

Comprehensive Monitoring

With Bright Cluster Manager, you can collect, monitor, visualize and analyze a comprehensive set of metrics. Many software and hardware metrics available to the Linux kernel, and many hardware management interface metrics (IPMI, DRAC, iLO, etc.) are sampled.

Examples include CPU, GPU and Xeon Phi temperatures, fan speeds, switches, hard disk SMART information, system load, memory utilization, network metrics, storage metrics, power systems statistics, and workload management metrics. Custom metrics can also easily be defined.

Metric sampling is done very efficiently – in one process, or out-of-band where possible. You have full flexibility over how and when metrics are sampled, and historic data can be consolidated over time to save disk space.

Cluster Management Automation

Cluster management automation takes pre-emptive actions when predetermined system thresholds are exceeded, saving time and preventing hardware damage. Thresholds can be configured on any of the available metrics. The built-in configuration wizard guides you through the steps of defining a rule: selecting metrics, defining thresholds and specifying actions.

For example, a temperature threshold for GPUs can be established that results in the system automatically shutting down an overheated GPU unit and sending a text message to your mobile phone. Several predefined actions are available, but any built-in cluster management command, Linux command or script can be used as an action.

"I am very impressed with the efficiency achieved with Bright Cluster Manager. Our cluster was up and running within a few hours, ready for integration into our HPC environment. Now it is continuing to save our system administrators valuable time."
– Prof. Lennart Johnsson, Director of the TLC² and the Advanced Computing Research Laboratory at the University of Houston

Comprehensive GPU Management

Bright Cluster Manager radically reduces the time and effort of managing GPUs, and fully integrates these devices into the single view of the overall system. Bright includes powerful GPU management and monitoring capability that leverages functionality in NVIDIA® Tesla™ and AMD[1] GPUs.

You can easily assume maximum control of the GPUs and gain instant and time-based status insight. Depending on the GPU make and model, Bright monitors a full range of GPU metrics, including:

- GPU temperature, fan speed, utilization.
- GPU exclusivity, compute, display, persistance mode.
- GPU memory utilization, ECC statistics.
- Unit fan speed, serial number, temperature, power usage, voltages and currents, LED status, firmware.
- Board serial, driver version, PCI info.

Beyond metrics, Bright Cluster Manager features built-in support for GPU computing with CUDA and OpenCL libraries. Switching between current and previous versions of CUDA and OpenCL has also been made easy.

Full Support for Intel Xeon Phi

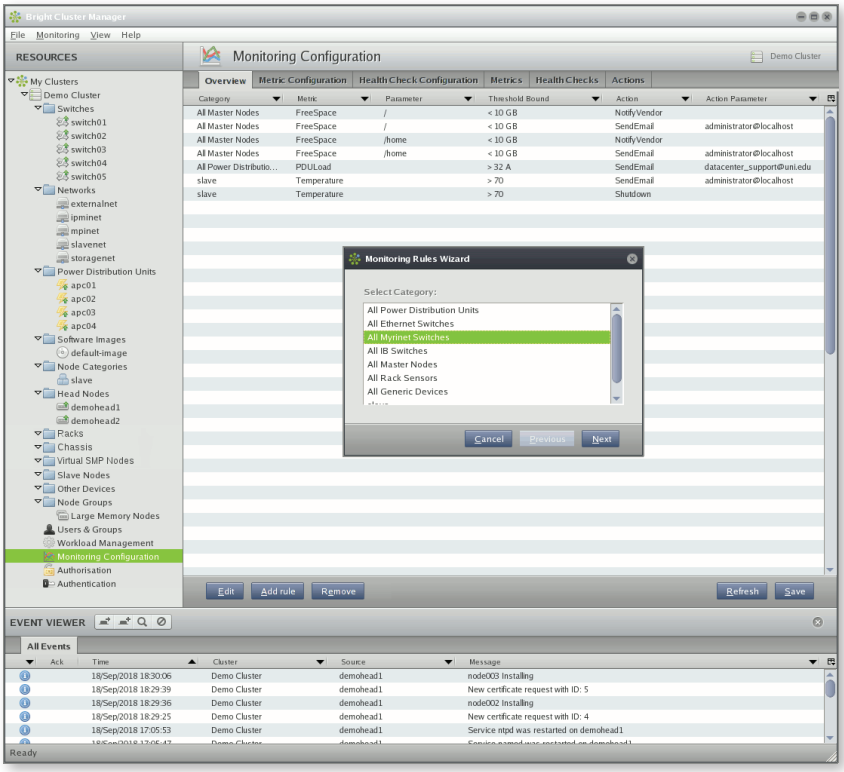
Bright Cluster Manager makes it easy to set up and use the Intel Xeon Phi coprocessor. Bright includes everything that is needed to get Phi to work, including a setup wizard in the CMGUI. Bright ensures that your software environment is set up correctly, so that the Intel Xeon Phi coprocessor is available for applications that are able to take advantage of it.

Bright collects and displays a wide range of metrics for Phi, ensuring that the coprocessor is visible and manageable as a device type, as well as including Phi as a resource in the workload management system. Bright's pre-job health checking ensures that Phi is functioning properly before directing tasks to the coprocessor.

Multi-Tasking Via Parallel Shell

The parallel shell allows simultaneous execution of multiple commands and scripts across the cluster as a whole, or across easily definable groups of nodes. Output from the executed commands is displayed in a convenient way with variable levels of verbosity. Running commands and scripts can be killed easily if necessary. The parallel shell is available through both the CMGUI and the CMSH.

"Bright Cluster Manager is a key component of Cray's External Services, offering file system, data movement and backup solutions. Bright's image management capabilities make it easy for Cray to test new images in a dynamic environment and rapidly deploy upgrades. We are able to just about eliminate system downtime."
— Barry Bolding, Vice President, Storage and Data Management at Cray

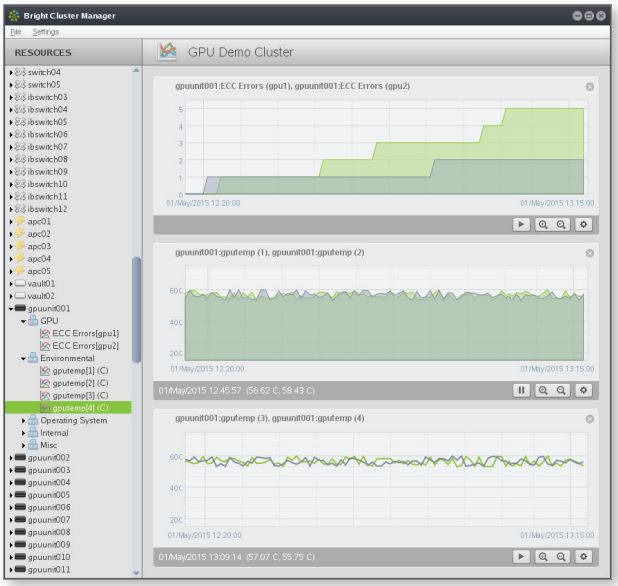


Integrated Workload Management

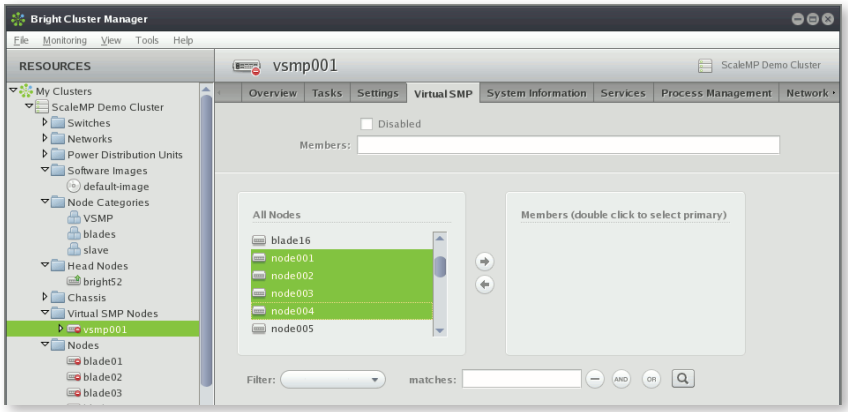
Bright Cluster Manager is integrated with a wide selection of free and commercial workload managers. This integration provides a number of benefits:

- The selected workload manager gets automatically installed and configured.
- Many workload manager metrics are monitored.
- The CMGUI and User Portal provide a user-friendly interface to the workload manager.
- The CMSH and the SOAP & JSON APIs provide direct and powerful access to a number of workload manager commands and metrics.

The automation configuration wizard guides you through the steps of defining a rule: selecting metrics, defining thresholds and specifying actions.



Example graphs that visualize metrics on a GPU cluster.



Creating and dismantling a virtual SMP node can be achieved with just a few clicks within the GUI or a single command in the cluster management shell.

- Reliable workload manager failover is properly configured.
- The workload manager is continuously made aware of the health state of nodes (see section on Health Checking).
- The workload manager is used to save power through auto-power on/off based on workload[4].
- The workload manager is used for data-aware scheduling of jobs to the cloud.

The following user-selectable workload managers are tightly integrated with Bright Cluster Manager:

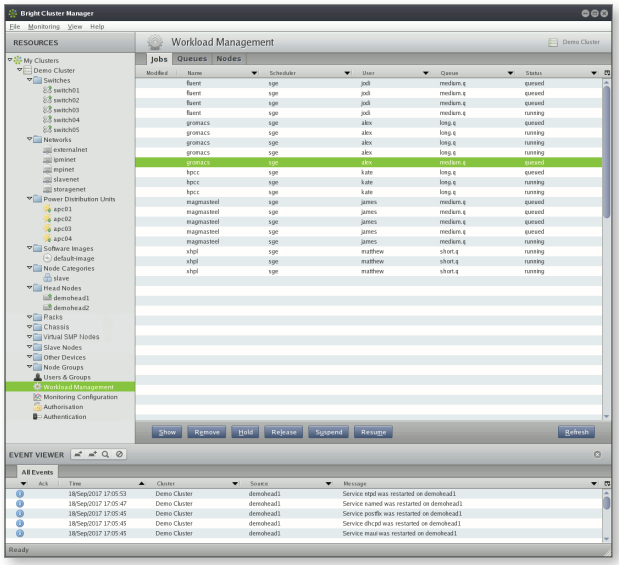
- PBS Professional, Univa Grid Engine, Moab[2], LSF.
- Slurm, openlava, Open Grid Scheduler, Torque, Maui[2].

Alternatively, other workload managers, such as LoadLeveler and Condor can be installed on top of Bright Cluster Manager.

Integrated SMP Support

Bright Cluster Manager – Advanced Edition dynamically aggregates multiple cluster nodes into a single virtual SMP node, using ScaleMP's Versatile SMP™ (vSMP) architecture. Creating and dismantling a virtual SMP node can be achieved with just a few clicks within the CMGUI. Virtual SMP nodes can also be launched and dismantled automatically using the scripting capabilities of the CMSH.

In Bright Cluster Manager a virtual SMP node behaves like any other node, enabling transparent, on-the-fly provisioning, configuration, monitoring and management of virtual SMP nodes as part of the overall system management.



Workload management queues can be viewed and configured from the GUI, without the need for workload management expertise.

> "With Bright Cluster Manager now offering full support for ScaleMP vSMP Foundation, setting up and managing an SMP cluster has never been so easy." – Shai Fultheim, CEO of ScaleMP

Maximum Uptime with Head Node Failover

Bright Cluster Manager – Advanced Edition allows two head nodes to be configured in active-active failover mode. Both head nodes are on active duty, but if one fails, the other takes over all tasks, seamlessly.

Maximum Uptime with Health Checking

Bright Cluster Manager – Advanced Edition includes a powerful cluster health checking framework that maximizes system uptime. It continually checks multiple health indicators for all hardware and software components and proactively initiates corrective actions. It can also automatically perform a series of standard and user-defined tests just before starting a new job, to ensure a successful execution, and preventing the "black hole node syndrome". Examples of corrective actions include autonomous bypass of faulty nodes, automatic job requeuing to avoid queue flushing, and process "jailing" to allocate, track, trace and flush completed user processes. The health checking framework ensures the highest job throughput, the best overall cluster efficiency and the lowest administration overhead.

Top Cluster Security

Bright Cluster Manager offers an unprecedented level of security that can easily be tailored to local requirements. Security features include:

- Automated security and other updates from key-signed Linux and Bright Computing repositories.
- Encrypted internal and external communications.
- X509v3 certificate based public-key authentication to the cluster management infrastructure.
- Role-based access control and complete audit trail.
- Firewalls, LDAP and SSH.

User and Group Management

Users can be added to the cluster through the CMGUI or the CMSH. Bright Cluster Manager comes with a pre-configured LDAP database, but an external LDAP service, or alternative authentication system, can be used instead.

Web-Based User Portal

The web-based User Portal provides read-only access to essential cluster information, including a general overview of the cluster status, node hardware and software properties, workload manager statistics and user-customizable graphs.

VIRGINIA BIOINFORMATICS INSTITUTE

"With Bright, we deliver reliable compute services rapidly, with minimal disruption. This allows us to keep our operating expenses at a minimum."
— Kevin Shinpaugh, Director of IT and HPC at VBI

The User Portal can easily be customized and expanded using PHP and the SOAP or JSON APIs.

Multi-Cluster Capability

Bright Cluster Manager — Advanced Edition is ideal for organizations that need to manage multiple clusters, either in one or in multiple locations. Capabilities include:

- All cluster management and monitoring functionality is available for all clusters through one GUI.
- Selecting any set of configurations in one cluster and exporting them to any or all other clusters with a few mouse clicks.
- Metric visualizations and summaries across clusters.
- Making node images available to other clusters.

Fundamentally API-Based

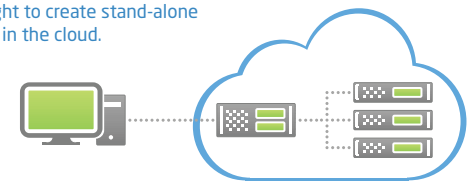
Bright Cluster Manager is fundamentally API-based, which means that any cluster management command and any piece of cluster management data — whether it is monitoring data or configuration data — is available through the API. Both a SOAP and a JSON API are available and interfaces for various programming languages, including C++, Python and PHP are provided.

Cloud Bursting

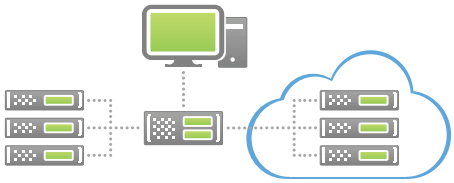
Bright Cluster Manager supports two cloud bursting scenarios: "Cluster-on-Demand" — running stand-alone clusters in the cloud; and "Cluster Extension" — adding cloud-based resources to existing, onsite clusters and managing these cloud nodes as if they were local. In addition, Bright provides data aware scheduling to ensure that data is accessible in the cloud at the start of jobs, and results are promptly transferred back. Both scenarios can be achieved in a few simple steps. Every Bright cluster is automatically cloud-ready, at no extra cost.

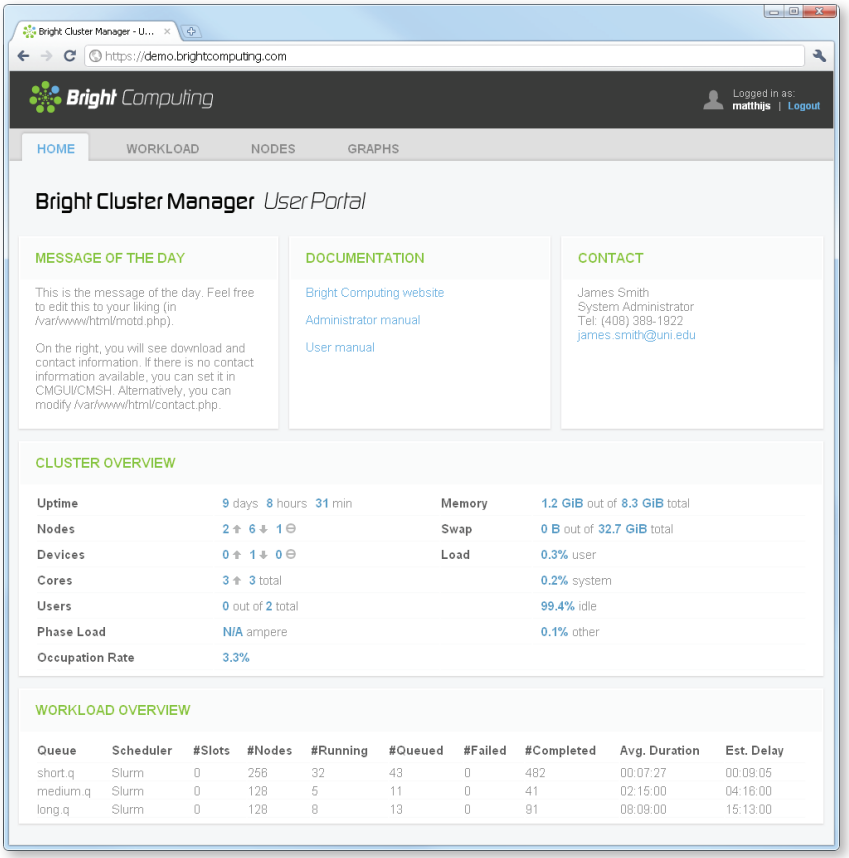
powered by amazon web services

Scenario 1: **"Cluster on Demand"**
Use Bright to create stand-alone clusters in the cloud.



Scenario 2: **"Cluster Extension"**
Use Bright to extend onsite clusters into the cloud.





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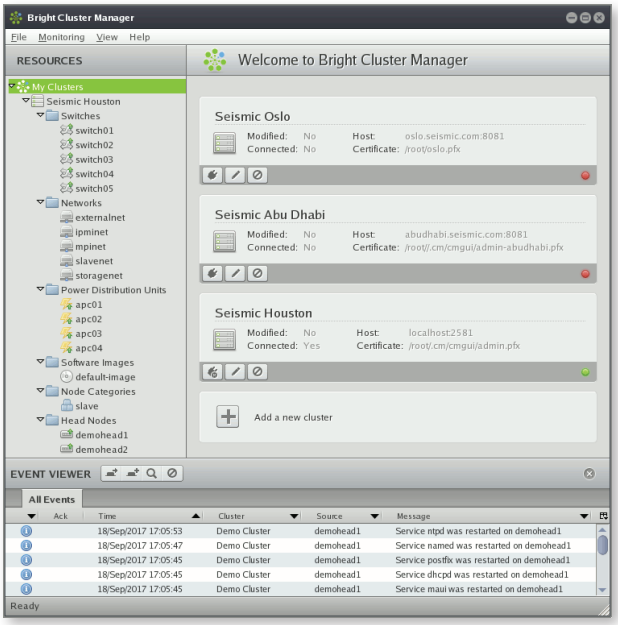
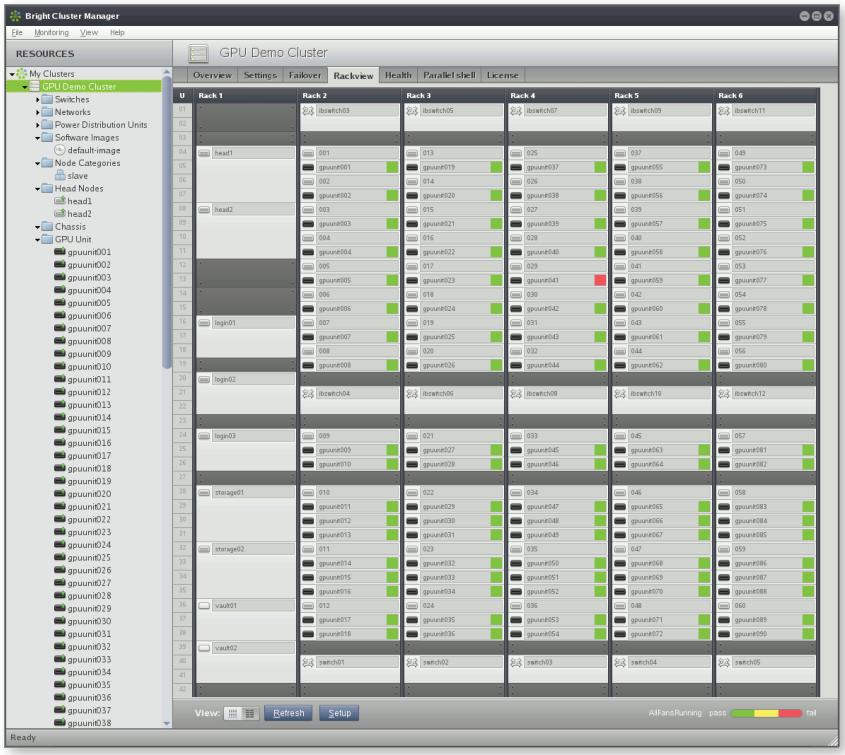


Bright Cluster Manager can manage multiple clusters simultaneously. This overview shows clusters in Oslo, Abu Dhabi and Houston, all managed through one GUI.



Cluster health checks can be visualized in the Rackview. This screenshot shows that GPU unit 41 fails a health check called "AllFansRunning".

Hadoop Cluster Management

Bright Cluster Manager is the ideal basis for Hadoop clusters. Bright installs on bare metal, configuring a fully operational Hadoop cluster in less than one hour. In the process, Bright prepares your Hadoop cluster for use by provisioning the operating system and the general cluster management and monitoring capabilities required as on any cluster.

Bright then manages and monitors your Hadoop cluster's hardware and system software throughout its life-cycle, collecting and graphically displaying a full range of Hadoop metrics from the HDFS, RPC and JVM sub-systems. Bright significantly reduces setup time for Cloudera, Hortonworks and other Hadoop stacks, and increases both uptime and MapReduce job throughput.

This functionality is scheduled to be further enhanced in upcoming releases of Bright, including dedicated management roles and profiles for name nodes, data nodes, as well as advanced Hadoop health checking and monitoring functionality.

Standard and Advanced Editions

Bright Cluster Manager is available in two editions: Standard and Advanced. The table on this page lists the differences. You can easily upgrade from the Standard to the Advanced Edition as your cluster grows in size or complexity.

Documentation and Services

A comprehensive system administrator manual and user manual are included in PDF format. Standard and tailored services are available, including various levels of support, installation, training and consultancy.

1) AMD ATI GPUs allow only limited management and monitoring functionality. 2) Moab and Maui integration is through Torque or Slurm. 3) Cloud bursting capability is included free of charge, but cloud usage may incur cost. 4) Selected workload managers only.

Feature	Standard	Advanced
Choice of Linux distributions	☑	☑
Intel Cluster Ready	☑	☑
Cluster Management GUI	☑	☑
Cluster Management Shell	☑	☑
Web-Based User Portal	☑	☑
SOAP & JSON API	☑	☑
Node Provisioning	☑	☑
Node Identification	☑	☑
Cluster Monitoring	☑	☑
Cluster Automation	☑	☑
User Management	☑	☑
Role-based Access Control	☑	☑
Parallel Shell	☑	☑
Workload Manager Integration	☑	☑
Cluster Security	☑	☑
Compilers	☑	☑
Debuggers & Profilers	☑	☑
MPI Libraries	☑	☑
Mathematical Libraries	☑	☑
Environment Modules	☑	☑
Cloud Bursting	☑	☑
Hadoop Management & Monitoring	☑	☑
NVIDIA CUDA & OpenCL	-	☑
GPU Management & Monitoring	-	☑
Xeon Phi Management & Monitoring	-	☑
ScaleMP Management & Monitoring	-	☑
Redundant Failover Head Nodes	-	☑
Cluster Health Checking	-	☑
Off-loadable Provisioning	-	☑
Multi-Cluster Management	-	☑
Suggested Number of Nodes	4 - 128	129 - 10,000+
Standard Support	☑	☑
Premium Support	Optional	Optional

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