



SGI® Performance Suite 1.6 Start Here

007-5680-007

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Record of Revision

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003	April 2011 Updated to support the SGI Performance Suite 1.2 release.
004	November 2011 Updated to support the SGI Performance Suite 1.3 release.
005	May 2012 Updated to support the SGI Performance Suite 1.4 release.
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007	May 2013 Updated to support the SGI Performance Suite 1.6 release.

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About This Guide

This guide provides information about the SGI Performance Suite release.

The SGI Performance Suite release media includes the following in the `/docs` directory:

- A PDF version of this document, the *SGI Performance Suite Start Here*.
- A text file named `product-release-readme.txt`, which contains the release notes. The release notes contain the latest information about the software and documentation in this release.
- A text file named `product-release-rpms.txt`, which lists the RPMs distributed with SGI Performance Suite bundle.

Online Support Services

SGI offers online support resources on the Supportfolio website, on the SGI Update Server, and on the SGI licensing server. The following list provides more information about these online resources.

- Supportfolio

Supportfolio is the SGI support website. You can log into Supportfolio on the following website:

<https://support.sgi.com/login>

After you log into Supportfolio, the following resources are available to you:

- Supportfolio SGI Knowledgebase

The SGI Knowledgebase available from Supportfolio has answers to common questions, problem resolutions, how-to documents, and many other useful articles for system administrators.

<https://support.sgi.com/kb/publisher.asp>

- Supportfolio Software Updates

You can check for updates to your purchased SGI software, and you can download or order CDs all in one convenient place. Supportfolio Software Updates provide one-stop shopping to check for and get new updates for your SGI software.

<https://support.sgi.com/software?cmd=order>

- SGI Customer Support Center

You can open calls to the SGI Customer Support Center online, keep track of all your cases, and receive automatic update information when your case is updated via the Supportfolio Problem Resolution Tools.

<https://support.sgi.com/caselist>

- SGI Update Server

Software release updates are available from the SGI Update Server. You can use your operating system's tools (for example, YaST, zypper, and yum) to update your system. Refer to the product release notes for more information about the SGI Update Server.

<https://update.sgi.com/>

- SGI Software License Server

You can order SGI software licenses conveniently via email or online. When you send a blank email to license@sgi.com, SGI responds via email, and sends you a template to fill out. SGI sends you your license quickly with complete instructions for license installation.

Alternatively, go online to the SGI Key-O-Matic.

<http://www.sgi.com/support/licensing/>

Obtaining SGI Publications

You can obtain SGI documentation in the following ways:

- Visit the SGI Technical Publications Library at the following website:

<http://docs.sgi.com>

This library contains the most recent online books, release notes, man pages, and other information.

- You can view man pages by typing `man title` on a command line.

Conventions

The following conventions are used throughout this publication:

Convention	Meaning
<code>command</code>	This fixed-space font denotes literal items such as commands, files, routines, path names, signals, messages, and programming language structures.
<i>variable</i>	Italic typeface denotes variable entries and words or concepts being defined.
user input	This bold, fixed-space font denotes literal items that the user enters in interactive sessions. (Output is shown in nonbold, fixed-space font.)

Reader Comments

If you have comments about the technical accuracy, content, or organization of this publication, contact SGI. Be sure to include the title and document number of the publication with your comments. (Online, the document number is located in the front matter of the publication. In printed publications, the document number is located at the bottom of each page.)

You can contact SGI in any of the following ways:

- Send e-mail to the following address:
techpubs@sgi.com
- Contact your customer service representative and ask that an incident be filed in the SGI incident tracking system.
- Send mail to the following address:
SGI

Technical Publications
46600 Landing Parkway
Fremont, CA 94538

SGI values your comments and will respond to them promptly.

Release Features

This chapter includes following topics:

- "About SGI Performance Suite Software" on page 1
- "SGI Performance Suite Software Bundles" on page 2
- "Finding SGI Performance Suite Manuals" on page 8
- "Getting Updates" on page 8
- "SGI Open Source Information" on page 10
- "Documentation Updated for This Release" on page 11

About SGI Performance Suite Software

The SGI Performance Suite accelerates application performance on Red Hat Enterprise Linux Server (RHEL) platforms and on SUSE Linux Enterprise Server (SLES) platforms.

The following topics describe the SGI Performance Suite:

- "Platform Support" on page 1
- "SGI[®] MPI" on page 2
- "SGI[®] REACT[™]" on page 3
- "SGI[®] UPC" on page 4
- "SGI[®] Accelerate[™]" on page 6

Platform Support

SGI supports the SGI Performance Suite 1.6 release on SGI systems that host one of the following operating systems:

- The SLES 11 SP2 base distribution

- The RHEL 6.4 and RHEL 6.3 base distributions

SGI Performance Suite software (with the exception of SGI REACT) also runs on the Community ENTerprise Operating System 6 (CentOS 6) base distribution. The SGI support team answers questions relating to any of these products, but they do not provide technical support for the CentOS operating system.

For information about SGI hardware platforms and operating system configuration settings, see the following URL:

<http://www.sgi.com/servers/>

SGI Performance Suite Software Bundles

This section describes the main contents of the SGI Performance Suite release. Manuals associated with the SGI Performance Suite software can be found at the SGI Technical Publications Library, which is located at the following website:

<http://docs.sgi.com>

SGI® MPI

SGI® MPI is a scalable, high-performance message passing interface (MPI) environment. SGI MPI includes the following software packages:

- Message Passage Toolkit (MPT) software stack (`sgi-mpt`)
- PerfBoost

SGI PerfBoost uses a wrapper library to run applications compiled against other MPI implementations under the SGI Message Passing Toolkit (MPT) product on SGI platforms.

- `memacct`

Memory accounting utility. For more information, see the `memacct(3)` man page.

- `sgi-mpt-shmem`

Contains the SGI SHMEM™ library functions. The SHMEM library functions enable low-latency, high-bandwidth communication in highly parallelized, scalable programs.

- xpmem

SGI's NUMAlink technology, the XPC kernel module, and the XPMEM kernel module allow users to create a very low latency, very large, shared-memory cluster for optimized use of Message Passing Interface (MPI) software and the SHMEM programming model. The globally addressable, cache coherent, shared memory is exploited by MPI and SHMEM to deliver high performance.

- The MPInside profiling tool is a light-weight tool that analyzes communication performance within MPI applications. It provides a level of analysis that you typically find only in more intensive tools that require you to post-process large log files. When your application runs, MPInside evaluates the application, the effect of the network on the application, data transfer synchronization, and other program attributes. In addition, MPInside also pinpoints bottlenecks and load imbalance.

MPInside monitors a running program, gathers information for all threads, and writes its analysis to a file. You can import the file into a spreadsheet. Using the spreadsheet, you can plot the data or derive additional metrics.

For more information about SGI MPI, see the following:

- *Message Passing Toolkit (MPT) User Guide.*
- *MPInside reference manual.* This manual is included in the software package.
- *MPInside Reference Guide.* This manual is posted to the SGI Technical Publications Library.
- MPInside(3) man page. This man page is included in the software package.
- *Linux Application Tuning Guide for SGI X86-64 Based Systems.*
- *SGI UV Systems Linux Configuration and Operations Guide.* This guide contains information about SHMEM.

SGI® REACT™

SGI® REACT™ is a real-time performance solution for Linux. SGI REACT includes the following software packages:

- Linux REACT stack
- External interrupt driver
- REACT/Pro Frame Scheduler

The REACT/Pro Frame Scheduler is an execution manager that schedules `pthreads` or processes on one or more CPUs in a predefined cyclic order (see the `frs(3)` man page).

- Kernel barrier (`kbar`) facility

The kernel barrier (`kbar`) facility provides for the fast wakeup of many blocked user threads. When the barrier is signaled, the operating system uses a configurable number of CPUs to quickly wake all the threads blocked on it. For more information, see the `kbar(3)` man page.

- `sgi-shield` kernel module

Enables the use of the `cpu_shield` routine that controls timer interrupts on select CPUs.

- User level interrupt facility. For more information, see the `uli(3)` man page.

For more information, see the *REACT Real-Time Programmer Guide*.

SGI® UPC

SGI® UPC is an implementation of the Unified Parallel C (UPC) parallel extension to the C programming language standard. SGI UPC includes the following software packages:

- `sgi-upc`
- `sgi-upc-devel`
- `xpmem`

Cross-process memory mapping. See `xpmem` descriptions in "SGI® MPI" on page 2.

- `sgi-array-services`

SGI Array Services includes administrator commands, libraries, daemons, and kernel extensions that facilitate parallel application execution of across a number of hosts in a cluster or array.

- `sgi-mpt`

SGI MPT runtime environment. For more information, see "SGI® MPI" on page 2.

- `sgi-mpt-shmem`

Contains the SGI SHMEM™ library functions. The SHMEM library functions enable low-latency, high-bandwidth communication in highly parallelized, scalable programs. Also see `xpmem` descriptions in "SGI® MPI" on page 2.

- `libgru`

SGI UV global reference unit (GRU) libraries.

- `superpages`

Note: The `superpages` module is only supported on SGI® UV™ 2000, SGI UV 1000, and SGI UV 100 series systems. For more information on `superpages`, see "Superpages" on page 14.

- `numatools`

SGI NUMALink memory placement tools.

- `libcpuset`

The `cpuset` library provides mechanisms that create, destroy and manage `cpusets`, and mechanisms that control the placement of processes and threads within `cpusets`.

- `libbitmask`

This bitmask library supports multiword bitmask operations for applications programmed in the C programming language. It works in conjunction with Linux kernel support for processor and memory placement on multiprocessor SMP and NUMA systems. The `cpuset` library depends on this bitmask library.

For more information, see these related manuals:

- *Unified Parallel C (UPC) User Guide*
- *Message Passing Toolkit (MPT) User Guide*
- *Linux Resource Administration Guide*
- *SGI UV GRU Development Kit Programmer Guide*
- *Linux Application Tuning Guide for SGI X86-64 Based Systems*

SGI® Accelerate™

SGI® Accelerate™ includes optimized software libraries and runtime performance tools that increase application performance. It includes the following software packages:

- `cpusets`

A *cpuset* defines a list of CPUs and memory nodes. The *cpuset* facility functions primarily as a workload manager. It enables a system administrator to restrict the number of processor and memory resources that a process or set of processes can use.

- `numatools`

See the `numatools` description in "SGI® UPC" on page 4.

- `FFIO`

The `cpusets` and NUMA tools provide controls for dedicated resource use, which in turn helps optimize performance on a system shared by many users. For I/O intensive applications, `FFIO` helps improve performance without additional coding or retooling of the software logic.

- `sgi-pcp`

SGI Performance Co-Pilot UV hub performance counters.

- `libgru` development kit

The SGI UV Global Reference Unit (GRU) is part of the SGI UV Hub application-specific integrated circuit (ASIC) Library Development Kit.

- `SGISOLVE`

The PSLDLT libraries under the `SGISOLVE` umbrella contain two direct solvers, PSLDLT and PSLDU, and one iterative solver, DIterative (deprecated), for solving symmetric, general unsymmetric, double precision, double complex, 32-bit integer, 64-bit integer, and sparse linear systems of equations. These solvers are optimized and parallelized for both IN-CORE and OUT-OF-CORE execution on the SGI SMP platforms.

For more information, see these related manuals:

- *Linux Resource Administration Guide*
- *SGI UV GRU Development Kit Programmer's Guide*

- *Performance Co-Pilot Linux User's and Administrator's Guide*
- *Linux Application Tuning Guide for SGI X86-64 Based Systems*

Software Package License Information

The SGI Performance Suite contains software packages released under a variety of licenses. The licensing terms for all proprietary software packages allow you to install the software on SGI systems only. For licensing information, see the `PACKAGE_LICENSES.txt` file that resides in the `/docs` directory on the product CD.

SGI Performance Suite Distribution Methods

SGI provides the SGI Performance Suite software as a software download and on hard media.

To download software, see the SGI Performance Suite release information that is available on Supportfolio at the following URL:

https://support.sgi.com/content_request/786853/index.html

SGI issues CDs for each product individually, as follows:

- SGI® MPI CD
- SGI® REACT® CD
- SGI® UPC CD
- SGI® Accelerate™ CD

If you order CDs, you receive CDs only for the software you order. If you order the entire SGI Performance Suite, you receive all four CDs.

Release Information and Release Notes

For a complete list of RPMs included in the SGI Performance Suite 1.6 release, see the file named `product-release-rpms.txt` in the `/docs` directory on the product CD.

For the latest information about software and documentation in this release, see the release notes file named `product-release-readme.txt` in the `/docs` directory on the product CD.

Finding SGI Performance Suite Manuals

The SGI Performance Suite manuals are installed in the following location on your SGI system:

```
/usr/share/doc/packages/sgi-perfsuite-1/
```

The directory for each manual contains a PDF and an HTML copy of the manual. For example:

```
sys:/usr/share/doc/packages/sgi-perfsuite-1 # ls
figures    index.html    LX_UVConfigOps_AG  MPIinside_UG  PS_Start_Here  GRUDEV_PG  LX_86_AppTune
LX_Resource_AG  MPT_UG      UPC_UG
```

The following example shows the content of the PS_Start_Here directory:

```
/usr/share/doc/packages/sgi-perfsuite-1 # ls
pdf sgi_html
```

You can also use the Mozilla Firefox browser to access the following local URL on your SGI system:

```
# firefox -no-remote file:///usr/share/doc/packages/sgi-perfsuite-1/index.html
```

Note: The SGI documentation is available on the SGI Technical Publications Library website at the following URL:

<http://docs.sgi.com>

Getting Updates

The following topics explain how to get software updates for your system:

- "RHEL 6 Updates" on page 9
- "SLES 11 Updates" on page 9
- "SGI Performance Suite Updates" on page 9

Detailed instructions for downloading and installing updates are available from the SGI product pages on Supportfolio at the following website:

<https://support.sgi.com>

Note: You must have a Supportfolio account to access this page and the SGI update server.

RHEL 6 Updates

Red Hat, Inc. provides software updates for RHEL 6. As a Red Hat Enterprise Linux customer, you receive access to the Red Hat Network. This allows you to download updates for your system. For more information about the Red Hat Network and updates, see *Red Hat Network Overview* and the **Update** link at the following location:

<https://www.redhat.com/rhn/>

You can also use the `yum` software package manager to get updates, as follows:

```
% yum update
```

The `yum` software package manager checks for updates and then updates your system appropriately. You must be registered with RHN, for `yum` to get RHN RHEL 6 updates.

You can configure the `updatesd(8)` notifier daemon to notify you of updates and, potentially, to install the updates for you. Configuration is done via the `yum-updatesd.conf(5)` file.

SLES 11 Updates

SGI encourages SLES 11 customers to use the YaST2 Online Update tool to keep system software updated with the latest maintenance fixes.

Novell provides software updates for SLES 11. In order to configure your system to enable online updates, you must register with Novell. For more help with this, you can use the **Novell Customer Center Configuration** tool. The **Novell Customer Center Configuration** module has been moved from the **Software** to the **Support** menu in YaST2.

SGI Performance Suite Updates

Customers that received SGI Performance Suite software pre-installed on their new SGI system can log in as the root user and run a product-specific script to add the

proper update source. For example, you can run one or more of the following update scripts on RHEL 6 platforms:

- For SGI MPI:
`% /usr/sbin/sgi-mpi-update-source`
- For SGI REACT:
`% /usr/sbin/sgi-react-update-source`
- For SGI UPC:
`% /usr/sbin/sgi-upc-update-source`
- For SGI Accelerate:
`% /usr/sbin/sgi-accelerate-update-source`

Each script prompts you for your Supportfolio login and adds the proper SGI update source for the given architecture. The preceding commands apply only to systems running RHEL 6 as the base operating system.

For information about software updates, see the release notes file named *product-release-readme.txt* in the `/docs` directory on the product CD.

For information about how to download and install SGI Performance Suite 1.6 updates, log into Supportfolio and navigate to the SGI Performance Suite product page. The Supportfolio website is as follows:

<https://support.sgi.com>

The SGI Performance Suite product website is as follows:

https://support.sgi.com/content_request/786853/index.html

SGI Open Source Information

SGI maintains the following website for open source information that describes projects related to its open source efforts:

<http://oss.sgi.com>

You can also access open source information, such as Open SpeedShop, from the following website:

<http://sourceforge.net>

Documentation Updated for This Release

The following manuals have been updated for the SGI Performance Suite 1.6 release:

- *Message Passing Toolkit (MPT) User Guide*, 007-3773-022
- *Linux Resource Administration Guide*, 007-4413-017

SGI Performance Suite Software Installation

This chapter includes the following topics:

- "About Installing the SGI Performance Suite" on page 13
- "Installing or Upgrading SGI Performance Suite" on page 13
- "Systems with Multiple Ethernet Configurations" on page 14
- "XVM Volumes Access in Rescue Mode" on page 14
- "Adding the `xfst_quota` Variable to the `initrd` Boot Image (SLES Platforms Only)" on page 14
- "Superpages" on page 14
- "SLES 11 or RHEL 6 Kernels" on page 16
- "Getting the Latest Firmware for Your SGI System" on page 17
- "License Information" on page 17

About Installing the SGI Performance Suite

SGI delivers your system to you with the following software preinstalled:

- A base operating system distribution of either Red Hat Enterprise Linux (RHEL) or SUSE Linux Enterprise Server (SLES). SGI installs the most recent version of the operating system that you order.
- SGI Foundation Software
- (Optionally) SGI Performance Suite

Installing or Upgrading SGI Performance Suite

Installation instructions for the SGI Performance Suite software reside in the product release notes on the product CD. On the CD, the release notes reside in a file named `product-release-readme.txt` in the `/docs` directory. For example, for the SGI Accelerate 1.6 product, this file is `SGI-Accelerate-1.6-readme.txt`.

Upgrade instructions also reside in the release notes.

Systems with Multiple Ethernet Configurations

When doing a network installation on a system with multiple Ethernet interfaces, there is no guarantee regarding initial interface names. The first interface discovered is named `eth0`, and so on. This can make network installations confusing. If this is a problem, a workaround is to remove the Ethernet cards that are **not** used when you install software over the network. After the installation is complete, you can reinstall the Ethernet cards. A persistent naming mechanism ensures that an interface, once named, retains its name across system reboots.

XVM Volumes Access in Rescue Mode

You cannot access XVM Volumes in rescue mode. It is possible to boot into rescue mode from the operating system DVD, but that DVD does not contain the `xvm` kernel module. This makes it impossible to perform maintenance on XVM volumes from rescue mode at this time. SGI recommends that you do not migrate any system directories to XVM because there is no way to access them from rescue mode.

Adding the `xfstools` Variable to the `initrd` Boot Image (SLES Platforms Only)

You need to add `xfstools` to the `INITRD_MODULES` variable in the `/etc/sysconfig/kernel` file when `rootflags=quota` is set. If you do not, the `initrd` boot loader panics your system at boot time.

Superpages

The superpages mechanism on SGI UV systems allows you to map large areas of reserved memory into your application. `libsuperpages` is a library for allocating and mapping SGI UV superpages. For more information, see the `libsuperpages(3)` man page.

Superpages are defined in an EFI firmware variable as a kernel boot option that can only be adjusted by the superuser. When enabled, at boot time, the SGI UV reserves

the amount of specified memory to be used via superpages, and it is not available to the operating system for its regular activities. The SGI UV BIOS passes superpages addresses to the superpages driver as an Advanced Configuration and Power Interface (ACPI) device.

The `superpages_define -w` command creates the EFI variable to define superpages. You must be a superuser (**root user**) to execute this command. After execution, to enable superpages, you need to reboot the system. The system BIOS then reserves the system memory for superpages rather than providing it to the operating system. The `superpages_define` command is described in more detail in the examples that follow.

The `superpages` command allows you to test the functionality of an SGI UV system's superpages. For a usage statement, enter `superpages -h`.

The `superpages_define` command is used to configure superpages. For a usage statement, enter `superpages_define -h`.

Example 1. The `superpages_define` command's `-L` option displays valid superpage sizes, as follows:

```
uv-sys:~ # superpages_define -L
Valid superpage sizes:
[1] 0x200000 2M (2097152)
[2] 0x400000 4M (4194304)
[3] 0x1000000 16M (16777216)
[4] 0x2000000 32M (33554432)
[5] 0x8000000 128M (134217728)
[6] 0x20000000 512M (536870912)
[7] 0x40000000 1G (1073741824)
[8] 0x100000000 4G (4294967296)
[9] 0x400000000 16G (17179869184)
[10] 0x1000000000 64G (68719476736)
[11] 0x4000000000 256G (274877906944)
[12] 0x10000000000 1T (1099511627776)
```

Example 2. The `superpages_define -c` command displays the available memory ranges for superpage allocation, as follows:

```
uv-sys:~ # superpages_define -c
available memory ranges for superpage allocation:
0x100000000-0x87ffffff 0x780000000 30G
0x1000000000-0x17feffffff          0x7ff000000 31G
```

available memory: 61G (63472M)

Example 3. The following command shows the 4G areas of memory that can be used as superpages:

```
uv-sys:~ # superpages_define -p 4G

in /etc/superpages.conf format:
# for pagesize: 0x100000000 4G
size_4G 4G #node0 0x100000000:3 #node1 0x400000000:4 #node2 0x100000000:4 #node 3 0x1400000000:3
# 14 4G superpages
```

Example 4. The following command shows the 4G areas of memory that can be used as superpages, but it limits such areas to two per node:

```
uv-sys:~ # superpages_define -p 4G -n 2

in /etc/superpages.conf format:
# for pagesize: 0x100000000 4G
size_4G 4G #node0 0x100000000:2 #node1 0x400000000:2 #node2 0x100000000:2 #node3 0x1400000000:2
# 8 4G superpages
```

Example 5. After you are satisfied with your memory selection, type commands similar to the following to define superpages:

```
uv-sys:~ # superpages_define -p 4G -n 2 > /etc/superpages.conf
uv-sys:~ # superpages_define -w
```

When you reboot your SGI UV system, those chosen areas are superpages.

You can use huge pages to optimize the performance of your MPI application. For more information, see the *Message Passing Toolkit (MPT) User Guide*.

SLES 11 or RHEL 6 Kernels

For x86_64 systems, SLES 11 contains kernel-default and kernel-trace. The kernel-default variant provides multiprocessor support. The SGI Performance Suite provides kernel module packages for both the default and trace kernel variants.

For x86_64 systems, RHEL 6 has one kernel image, kernel, and kvm is the only supported virtualization.

Getting the Latest Firmware for Your SGI System

For information about the latest firmware for your SGI system, see the *SGI Foundation Software 2.8 Start Here* available at the following website:

<http://docs.sgi.com>

License Information

Remember to back up all license key files before you install operating system software and/or SGI software products. For all licensed software, you need to restore your original license key files after you complete your installation. A license key file is not included in these RPMs.

In terms of software licensing support, the operating system distributors do not ship any licensing code. Independent software vendors (ISVs) are responsible for obtaining and including software licensing components into their products. SGI products ship with SGI licensing software.

For more information, see the specific product release notes or the FAQ at the following website:

<http://www.sgi.com/support/licensing/faq.html>

If you encounter any license-related problems, contact your local support center at the following website:

<http://www.sgi.com/support/supportcenters.html>

SGI Performance Suite Overview

This chapter includes the following topics:

- "About Performance Suite Features" on page 19
- "Unsupported Elements" on page 21
- "About Performance Suite Features" on page 19
- "HPC Application Tools and Support" on page 22
- "NUMA Data Placement Tools" on page 23

About Performance Suite Features

The SGI Performance Suite provides application acceleration components for software developers and end users. SGI Accelerate, SGI MPI, SGI REACT, and SGI UPC contain libraries and tools that enable software developers to develop, profile, and tune applications for faster performance. End users benefit from running their applications with the runtime acceleration tools supplied in SGI Accelerate and SGI MPI.

The SGI Performance Suite software release consists of kernel modules for SGI software built against the kernels in Red Hat Enterprise Linux Server 6 (RHEL 6) or SUSE Linux Enterprise Server 11 SP2 (SLES 11 SP2) and additional software developed by SGI. For information about how these products are bundled, see "SGI Performance Suite Software Bundles" on page 2.

The following sections describe some key components:

- "Array Services" on page 20
- "Cpuset Support" on page 20
- "Partitioning" on page 21
- "IOC4 Serial Driver" on page 21
- "Utilities" on page 21
- "Unsupported Elements" on page 21

Array Services

The Array Services include administrator commands, libraries, daemons, and kernel extensions that support parallel applications run across several hosts in a cluster or array. The Message Passing Interface (MPI) uses Array Services to launch parallel applications. The secure version of Array Services is uses the secure sockets layer (SSL) and secure shell (SSH).

For information about MPI, see the *Message Passing Toolkit (MPT) User Guide*.

For information about standard Array Services or Secure Array Services (SAS), see the *Linux Resource Administration Guide*.

Cpuset Support

The cpuset facility's primary function is as a workload manager. The cpuset facility enables a system administrator to restrict the number of processors and memory resources that a process or set of processes can use. A cpuset defines a list of CPUs and memory nodes. A process contained in a cpuset can run only on the CPUs in that cpuset and can only allocate memory on the memory nodes in that cpuset. Essentially, cpusets provide you with a CPU and memory containers, or *soft partitions*, within which you can run sets of related tasks.

Using cpusets on an SGI system improves cache locality and memory access times and can substantially improve an application's performance and runtime repeatability. Restraining all other jobs from using any of the CPUs or memory resources assigned to a critical job minimizes interference from other jobs on the system. For example, Message Passing Interface (MPI) jobs frequently consist of a number of threads that communicate using message passing interfaces. All threads need to be active at the same time. If a single thread loses a CPU, all threads stop making forward progress and spin at a barrier. Cpusets can eliminate the need for a gang scheduler.

Cpusets are represented in a hierarchical virtual file system. Cpusets can be nested, and they have file-like permissions.

In addition to their traditional use to control the placement of jobs on the CPUs and memory nodes of a system, cpusets also provide a convenient mechanism to control the use of Hyper-Threading Technology.

For more information about cpusets, see the *Linux Resource Administration Guide* and the *Linux Application Tuning Guide for SGI X86-64 Based Systems*.

Partitioning

SGI provides the ability to divide a single SGI UV 2000, SGI UV 1000, or SGI UV 100 system into a collection of smaller system partitions. Each partition runs its own copy of the operating system kernel and has its own system console, root filesystem, IP network address, and physical memory. All partitions in the system are connected via the SGI high-performance NUMALink interconnect, just as they are when the system is not partitioned. Thus, a partitioned system can also be viewed as a cluster of nodes connected via NUMALink.

Benefits of partitioning include fault containment and the ability to use the NUMALink interconnect and global shared memory features of the SGI systems to provide high-performance clusters.

For more information about partitioning, see the *SGI UV Systems Linux Configuration and Operations Guide*.

IOC4 Serial Driver

The IOC4 serial driver supports the internal IDE CD-ROM, NVRAM, and Real-Time Clock. Serial ports are supported on the IOC4 base I/O chipset and the following device nodes are created:

```
/dev/ttyIOC4/0 /dev/ttyIOC4/1 /dev/ttyIOC4/2 /dev/ttyIOC4/3
```

Utilities

`udev_xsci` is a `udev` helper for creating XSCSI device names.

`sgtools` is a set of tools for SCSI disks that use the Linux SG driver and `lsiutil`, the LSI Fusion-MPT host adapter management utility.

Unsupported Elements

SGI does not support the following:

- Base Linux software not released by Red Hat for RHEL 6.4, RHEL 6.3, by SUSE for SLES 11 SP2, or by SGI for other SGI software.
- SGI does not provide technical support for the CentOS 6 operating system.

- Other releases, updates, or patches not released by Red Hat for RHEL 6.3, by Novell for SLES 11 SP2, or by SGI for SGI Performance Suite software.
- Software patches, drivers, or other changes obtained from the Linux community or vendors other than Red Hat, Novell, and SGI.
- Kernels recompiled or reconfigured to run with parameter settings or other modules as not specified by Red Hat, Novell, or SGI.
- Unsupported hardware configurations and devices.

HPC Application Tools and Support

SGI supports HPC libraries, tools, and software packages from on Linux. These tools provide a powerful, standards-based system that uses Linux and commodity x86_64 processor-based solutions for HPC environments. The following sections describe some of these tools, libraries, and software:

- "Message Passing Toolkit" on page 22
- "Performance Co-Pilot" on page 23

Message Passing Toolkit

The SGI Message Passing Toolkit (MPT) provides industry-standard message passing libraries that are optimized for SGI computers. MPT contains the MPI and the SHMEM APIs. The MPT software enables you to use the low-level capabilities within SGI hardware easily, effectively, and efficiently. For example, MPT enables memory mapping within and between partitions for fast memory-to-memory transfers, and MPT uses the hardware memory controller's fetch operation (fetchop) support. Fetchops and other shared memory techniques enable ultra fast communication and synchronization between MPI processes in a parallel application.

You can use the SGI Array Services software to launch, monitor, and control MPI jobs across a cluster or partitioned system. Array Services provides the notion of an array session, which is a set of processes that can be run on different cluster nodes or system partitions. Array Services is implemented using Process Aggregates (PAGGs), which is a kernel module that provides process containers. PAGGs has been open-sourced by SGI for Linux.

For more information, see the *Message Passing Toolkit (MPT) User Guide*.

Performance Co-Pilot

The SGI Performance Co-Pilot software provides performance monitoring and performance management services targeted at large, complex systems. Integrated with the low-level performance hardware counters and with MPT, Performance Co-Pilot provides the following:

- CPU, I/O, and networking statistics
- Visualization tools
- Monitoring tools

NUMA Data Placement Tools

This section describes the commands that are currently provided with the collection of NUMA data placement tools that can help you tune applications on your system.

For information about performance tuning information for single processor and multiprocessor programs, see the *Linux Application Tuning Guide for SGI X86-64 Based Systems*.

dlook Command

The `dlook(1)` command displays the memory map and CPU use for a specified process. The following information is printed for each page in the virtual address space of the process:

- The object that owns the page (file, `SYSV` shared memory, device driver, and so on)
- Type of page (RAM, `FETCHOP`, `IOSPACE`, and so on)
- If RAM memory, the following information is supplied:
 - Memory attributes (`SHARED`, `DIRTY`, and so on)
 - Node on which that the page is located
 - Physical address of page (optional)

Optionally, the amount of elapsed CPU time that the process has run on each physical CPU in the system is also printed.

dplace Command

The `dplace(1)` command binds a related set of processes to specific CPUs or nodes to prevent process migrations. In some cases, this tool improves performance because of the occurrence of a higher percentage of memory accesses to the local node.

taskset Command

The `taskset(1)` command sets or retrieves the CPU affinity of a running process, or `taskset(1)` launches a new command with a given CPU affinity. CPU affinity is a scheduler property that bonds a process to a given set of CPUs on the system. The Linux scheduler honors the given CPU affinity, and the process does not run on any other CPUs. Note that the Linux scheduler also supports natural CPU affinity; the scheduler attempts to keep processes on the same CPU as long as practical for performance reasons. Therefore, forcing a specific CPU affinity is useful only in certain applications.

For more information about NUMA tools, see the *Linux Application Tuning Guide for SGI X86-64 Based Systems*.

Documentation Resources

The following topics describe additional documentation resources available to SGI Performance Suite users:

- "SGI Documentation" on page 25
- "Red Hat Documentation" on page 30
- "SUSE Documentation" on page 30
- "Intel Documentation" on page 31

SGI Documentation

Online and postscript versions of SGI documentation are available at the SGI Technical Publications Library at the following website:

<http://docs.sgi.com>

The following topics describe the SGI documentation:

- "SGI Performance Suite Software Manuals" on page 25
- "Additional SGI Software Manuals" on page 27
- "SGI Hardware Manuals" on page 29

SGI Performance Suite Software Manuals

The following documentation describes the SGI Performance Suite software:

- *SGI Performance Suite Product Bundles Release Notes*

Provides the latest information about software and documentation in this release. Release notes are in a file in the `/docs` directory on the product CD for each SGI Performance Suite software bundle.

- *Message Passing Toolkit (MPT) User Guide*

Describes the industry-standard message passing protocol optimized for SGI computers.

- *MPIInside Reference Guide*
Documents the SGI MPIInside MPI profiling tool.
- *REACT Real-Time for Linux Programmer's Guide*
Describes the facilities of REACT real-time for Linux that support real-time programs.
- *Performance Co-Pilot Linux User's and Administrator's Guide*
Describes the Performance Co-Pilot (PCP) software package of advanced performance tools for SGI systems running the Linux operating system.
- *Unified Parallel C (UPC) User Guide*
Documents the SGI implementation of the Unified Parallel C (UPC) parallel extension to the C programming language standard.
- *SGI UV GRU Development Kit Programmer Guide*
Documents the SGI UV global reference unit (GRU) development kit. It describes the application program interface (API) that allows direct access to GRU functionality.
- *Linux Resource Administration Guide*
Provides a reference for people who manage the operation of SGI servers and contains information needed in the administration of various system resource management features such as Array Services, CPU memory sets and scheduling, and the Cpuset System.
- *Linux Application Tuning Guide for SGI X86-64 Based Systems*
Provides information about tuning application programs on SGI systems. Application programs include Fortran and C programs written on SGI Linux systems with the compilers provided by Intel.
- *SGI UV Systems Linux Configuration and Operations Guide*
Provides information on how to perform system configuration and operations under the Linux operating system for SGI UV 100, SGI UV 1000, and SGI UV 2000 series systems.

Additional SGI Software Manuals

The following documentation describes current SGI software products:

- *SGI Foundation Software X.X Start Here*

Provides information about the SGI Foundation Software X.X release that supports SGI differentiated server solutions.

- *SGI UV System Management Node Administrator Guide*

Describes the system management node (SMN) installation, configuration and operation for SGI UV 2000, SGI UV 1000 and SGI UV 100 series systems.

- *SGI Management Center for SGI ICE*

Describes how to perform general system installation, configuration, and operations on the SGI ICE 8400 and SGI 8200 systems.

For other SGI hardware platforms, see the *SGI Management Center (SMC) System Administrator Guide* and *SGI Management Center Installation and Configuration*.

- *SGI ICE X Installation and Configuration Guide*

Describes the SGI® ICE™ X system installation and configuration process.

- *SGI ICE X Administration Guide*

Describes administrative tasks for SGI ICE X systems.

- *SGI Management Center (SMC) Installation and Configuration*

This guide is intended for system administrators. It describes how to install and configure the SGI Management Center. A companion manual, the *SGI Management Center (SMC) System Administrator Guide*, describes general cluster administration.

For SGI ICE platforms, use one of the following manuals: the *SGI Management Center for SGI ICE* (for SGI ICE 8400 or SGI ICE 8200 systems) or the *SGI Management Center for SGI ICE X*.

- *SGI Management Center (SMC) System Administrator Guide*

This guide describes how to monitor and control a cluster using the SGI Management Center. A companion manual, the *SGI Management Center (SMC) Installation and Configuration Guide*, describes how to install and configure the SGI Management Center.

For SGI ICE platforms, use one of the following manuals: the *SGI Management Center for SGI ICE* (for SGI ICE 8400 or SGI ICE 8200 systems) or the *SGI Management Center for SGI ICE X*.

- *SGI Management Center Quick Start Guide*

The guide explains how to deploy your SGI Management Center software.

- *XFS for Linux Administration*

Describes XFS, an open-source, fast recovery, journaling filesystem that provides direct I/O support, space preallocation, access control lists, quotas, and other commercial file system features.

- *XVM Volume Manager Administrator Guide*

Describes the configuration and administration of XVM logical volumes using the XVM Volume Manager.

- *CXFS 7 Administration Guide for SGI InfiniteStorage*

Documents CXFS running on a storage area network (SAN). CXFS is clustered XFS, a parallel-access, shared, clustered filesystem for high-performance computing environments.

- *CXFS 7 Client-Only Guide for SGI InfiniteStorage*

Provides an overview of the installation and configuration procedures for CXFS client-only nodes running SGI CXFS clustered filesystems.

- *Guaranteed-Rate I/O Version 2 for Linux Guide*

Provides information about GRIO version 2, the second-generation guaranteed-rate I/O product from SGI.

- *High Availability Extension and SGI InfiniteStorage*

Provides information about creating resources for the high-availability (HA) SGI resource agents that SGI provides for use with the SUSE Linux Enterprise High Availability Extension (HAE) product.

- *DMF 6 Administrator Guide for SGI InfiniteStorage*

Describes how to administer the Data Migration Facility (DMF). DMF is a hierarchical storage management system for SGI environments. Its primary purpose is to preserve the economic value of storage media and stored data. This

manual describes DMF components, features, and architecture; it focuses on the tasks of configuration and ongoing administrative duties.

- *SGI InfiniteStorage Appliance Manager User Guide*

Describes the operation of SGI InfiniteStorage Appliance Manager, which is a web-based interface that lets you configure, manage, and monitor a storage server.

- *SGI UV CMC Software User Guide*

Documents the chassis manager controller (CMC) command line interface (CLI) for the SGI UV 2000, SGI UV 1000, and SGI UV 100 systems.

SGI Hardware Manuals

SGI creates hardware manuals that are specific to each product line. The hardware documentation typically includes a system architecture overview and describes the major components. It also provides the standard procedures for powering on and powering off the system, basic troubleshooting information, and important safety and regulatory specifications.

The following procedure explains how to retrieve a list of hardware manuals for your system.

Procedure 4-1 To retrieve hardware documentation

1. Type the following URL into the address bar of your browser:

`docs.sgi.com`

2. In the search box on the Technical Publications Library, narrow your search as follows:

- In the **search** field, type the model of your SGI system.

For example, type one of the following: "UV 2000", "ICE X", Rackable.

Remember to enclose hardware model names in quotation marks (" ") if the hardware model name includes a space character.

- Check **Search only titles**.
- Check **Show only 1 hit/book**.
- Click **search**.

Red Hat Documentation

Documentation for Red Hat Enterprise Linux 6.4 (RHEL 6.4) or RHEL 6.3 is located in the `/usr/share/doc` directory. It contains package-specific documentation. If you install the `zisofs` module, additional documentation in the form of READMEs can be found in `/usr/share/doc/zisofs-tools-1.x.x`.

On the RHEL 6 DVD, `README-lang` and `RELEASE-NOTES-lang` files are found in the root directory.

Note: Red Hat Enterprise Linux 6 (RHEL 6) documentation is available at the following website:

<http://www.redhat.com/docs/manuals/enterprise/RHEL-6-manual/index.html>

The following documentation is available:

- *Release Notes for x86_64 architecture*
- *Red Hat Enterprise Linux Deployment Guide*
- *Red Hat Enterprise Linux Installation Guide*
- *Red Hat Virtualization*

SUSE Documentation

Documentation for SUSE Linux Enterprise Server 11 (SLES 11) is located on your system in the `/docu/en` directory.

For SUSE Linux Enterprise Server 11 package descriptions, see the following website:

<http://www.suse.com/products/server/technical-information/#Package>

For SUSE documentation, see the following website:

<https://www.suse.com/documentation>

The following SLES11 documentation is available:

- *SUSE Linux Enterprise Server 11 Installation Quick Start*
`art_sles_installquickstart.pdf`

- *SUSE Linux Enterprise Server 11 Deployment Guide*
book_sle_deployment.pdf
- *SUSE Linux Enterprise Server 11 Administration Guide*
book_sle_admin.pdf
- *SUSE Linux Enterprise Server SLES11: Storage Administration Guide*
stor_admin.pdf

Intel Documentation

The following topics describe the documentation available from Intel Corporation:

- "Intel Compiler Documentation" on page 31
- "Intel Processor Documentation" on page 31

Intel Compiler Documentation

Documentation for the Intel compilers is located on your system in the `/docs` directory that resides within each compiler's installation directory. If you installed the Intel compilers, the following documentation is available:

- *Intel C++ Compiler User's Guide* (c_ug_lnx.pdf)
- *Intel Fortran Compiler User's Guide* (for_ug_lnx.pdf)
- *Intel Fortran Programmer's Reference* (for_prg.pdf)
- *Intel Fortran Libraries Reference* (for_lib.pdf)

Intel Processor Documentation

Intel server processor information is available online at the following website:

<http://www.intel.com/support/processors/sb/CS-029807.htm>

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