

SGI® Hadoop® Based on Intel® Xeon® Processor E5 Family

Getting Started Guide

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Record of Revision

Version Description

001 January 2013

Initial printing.

007-5875-001 iii

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About This Guide

This guide provides an overview of the SGI® Hadoop® Reference Implementations based on the Intel® Xeon® processor E5 family along with getting-started instructions for these implementations. This guide consists of the following chapters:

- Chapter 1, "Overview," provides an overview of the SGI Hadoop solution.
- Chapter 2, "Cluster Startup," describes licensing and Hadoop specifics for configuring cluster management and monitoring.

Audience

This guide is written for the system administrators of the Hadoop cluster and developers. The guide assumes the reader is familiar with clusters, the Hadoop technology, and business intelligence applications.

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Related Publications

The following SGI documents are relevant to your Hadoop solution:

- SGI Management Center Quick Start Guide (007-5672-xxx)
- SGI Management Center (SMC) Installation and Configuration (007-5643-xxx)
- SGI Management Center (SMC) System Administrator's Guide (007-5642-xxx)
- SGI Rackable C2005 Server Family User's Guide (007-5717-xxx)
- SGI InfiniteStorage Server 3000 (ISS3000) User's Guide (007-5721-xxx)
- SGI Rackable C1110-RP6 System User Guide (007-5843-xxx)

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- Refer to the SGI Technical Publications Library (TPL) at http://docs.sgi.com. Various formats are available. The TPL contains the most recent and most comprehensive set of online books, man pages, and other information.
 - To get the latest revision of a document on the TPL, use the core publication number as your search string. For example, use 007-1234 as your search string to get the latest version of the document with part number 007-1234-xxx.
- Refer to the SGI Supportfolio[™] webpage for documents whose access require a support contract. See "Product Support" on page ix.
- You can also view man pages by typing **man** < title> on a command line.

Note: For information about third-party system components, see the documentation provided by the manufacturer/supplier.

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Product Support

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- Refer to http://www.sgi.com/support/
- If you are in North America, contact the Technical Assistance Center at +1 800 800 4SGI or contact your authorized service provider.
- If you are outside North America, contact the SGI subsidiary or authorized distributor in your country.

Be sure to have the following information before you call Technical Support:

- Product serial number
- Product model name and number
- Applicable error messages
- · Add-on boards or hardware
- Third-party hardware or software
- Operating system type and revision level

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Reader Comments

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Overview

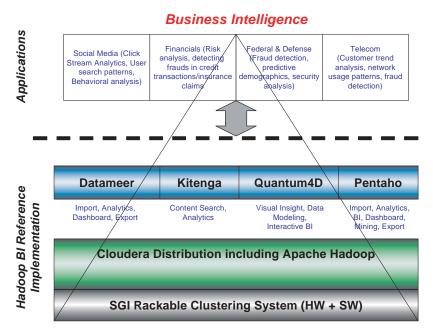


Figure 1-1 SGI Hadoop Business Intelligence Ecosystem

The SGI Hadoop Reference Implementations provide pre-defined and pre-certified Hadoop solutions with these features:

- Pre-defined and pre-certified configurations
- · High performance
- Power optimization
- Capability of running business intelligence (BI) applications directly atop Hadoop (See Figure 1-1.)

There are two primary SGI Hadoop Reference Implementations based on the Intel® Xeon® Processor E5-2600 Series: GigE-based and 10GigE-based. This chapter describes these two implementations using the following topics:

- "The GigE Implementation" on page 2
- "The 10GigE Implementation" on page 16
- "Software" on page 26

The GigE Implementation

This section describes the GigE implementation using the following topics:

- "Hardware—GigE" on page 3
- "Configurations—GigE" on page 6
- "Network Topology—GigE" on page 10

Hardware—GigE

This section describes the hardware used in the GigE-based implementation: first, the servers and then the network hardware.

Servers

The SGI Hadoop cluster employs the SGI Rackable™ C2005 and C1000 families of servers; a C2005 server and a C1110 server are shown in Figure 1-2 and Figure 1-3, respectively. This section describes the SGI servers that are used in the GigE-based SGI Hadoop cluster, their function in the Hadoop paradigm, and their specifications.



Figure 1-2 An SGI Rackable C2005 Server



Figure 1-3 An SGI Rackable C1110 Server

Table 1-1 describes the SGI Hadoop Reference Implementations with SGI GigE-based servers with the Intel Xeon Processor E5-2600 Series.

 Table 1-1
 SGI Hadoop GigE-Based Servers–Intel Xeon Processor E5-2600 Series

SGI Server	Conventional Node Type	Hadoop Node Type	Specifications
C2005-RP1 (half-depth) or C1110-RP6(full-depth)	Master nodes	NameNode, Secondary NameNode, JobTracker	- 2x Intel Xeon Processor E5-2630 (2.3 GHz, 6-core) - 8x 8GB 1.35v 1333MHz DIMMs (64GB memory) - 4x 2.5" 1TB 7200 rpm SATA 6Gb/s drives in RAID 10 configuration - 1x Dual-port 10GigE NIC - Redundant power supply
C2005-RP1 (half-depth) or C1110-RP6(full-depth)	Compute/Slave nodes	DataNodes, TaskTrackers	- 2x Intel Xeon Processor E5-2630 (2.3 GHz, 6-core) - 8x 8GB 1.35v 1333MHz DIMMs (64GB memory) - 10x 2.5" ITB 7200 rpm SATA 6Gb/s drives
C2005-RP1 (half-depth) or C1110-RP6(full-depth)		Application Node	 2x Intel Xeon Processor E5-2670 (2.6 GHz, 8-core) 16x 8GB 1.35v 1333MHz DIMMs (128GB memory) 4x 2.5" 1TB 7200 rpm SAS 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply

Table 1-2 describes the SGI Hadoop Reference Implementation with SGI GigE-based servers with the Intel Xeon Processor E5-2400 Series.

 Table 1-2
 SGI Hadoop GigE-Based Servers–Intel Xeon Processor E5-2400 Series

-			
SGI Server	Conventional Node Type	Hadoop Node Type	Specifications
C2005-RN1 (half-depth) or C1110-RN3 (full-depth)	Master nodes	NameNode, Secondary NameNode, JobTracker	 2x Intel Xeon Processor E5-2420 (1.9 GHz, 6-core) 6x 8GB 1.35v 1333MHz DIMMs (48GB memory) 4x 2.5" ITB 7200 rpm SATA 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply
C2005-RN1 (half-depth) or C1110-RN3 (full-depth)	Compute/Slave nodes	DataNodes, TaskTrackers	- 2x Intel Xeon Processor E5-2420 (1.9 GHz, 6-core) - 6x 8GB 1.35v 1333MHz DIMMs (48GB memory) - 10x 2.5" 1TB 7200 rpm SATA 6Gb/s drives
C2005-RP1 (half-depth) or C1110-RP6 (full-depth)		Application Node	 2x Intel Xeon Processor E5-2670 (2.6 GHz, 8-core) 16x 8GB 1.35v 1333MHz DIMMs (128GB memory) 4x 2.5" ITB 7200 rpm SAS 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply

Network Hardware

The network hardware consists of the following two components:

- 2 LG-Ericsson ES-4550G 48-port GigE switches per rack
- 1 LG-Ericsson ES-5048XG 10-GigE spine switch

Configurations—GigE

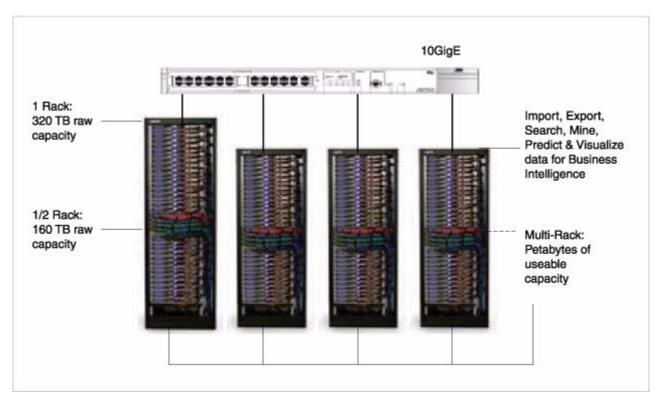


Figure 1-4 Data Capacity for Various Rack Configurations

The SGI Hadoop cluster is available in single-rack and multi-rack configurations. Figure 1-4 shows the range of data capacity for the configurations. This section describes the half-rack, full-rack, and multi-rack configurations.

Half-Rack

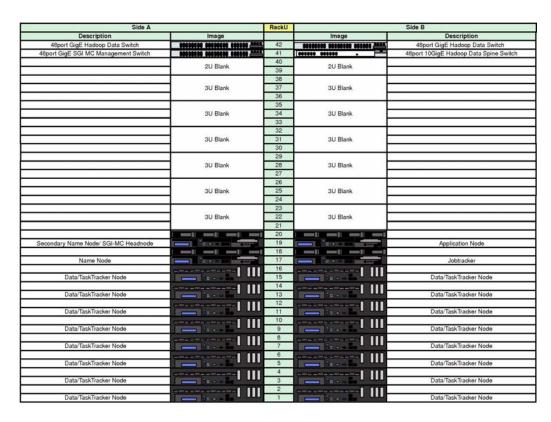


Figure 1-5 Half-Rack Configuration

Figure 1-5 describes the configuration of a half-rack configuration. The rack consists of the following:

- 1 SGI Management Center node/Secondary NameNode
- 1 NameNode
- 1 JobTracker
- 1 Application node
- 16 DataNodes/TaskTracker nodes
- 2 48-port GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Full-Rack (42U)

Side A		RackU	Side B					
Description	Image	c .	Image	Description				
48port GigE Hadoop Data Switch	CONCINCT CONTRACT CONTRACTOR	42	********** ******* ****** ******	48port GigE Hadoop Data Switch				
48port GigE SGI MC Management Switch	***************************************	41		48port 10GigE Hadoop Data Spine Switch				
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	CHERTHAN III	6						
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V200020004-00-00000		4		200000000000000000000000000000000000000				
Data/TaskTracker Node		3		Data/TaskTracker Node				
		2						
Data/TaskTracker Node	31	- 1		Data/TaskTracker Node				

Figure 1-6 Full-Rack Configuration

Figure 1-6 describes the configuration of a full-rack configuration. The rack consists of the following:

- 1 SGI Management Center node/Secondary NameNode
- 1 NameNode
- 1 JobTracker
- 1 Application node
- 32 DataNodes/TaskTracker nodes
- 2 48-port GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Multi-Rack (Second Rack And Beyond)

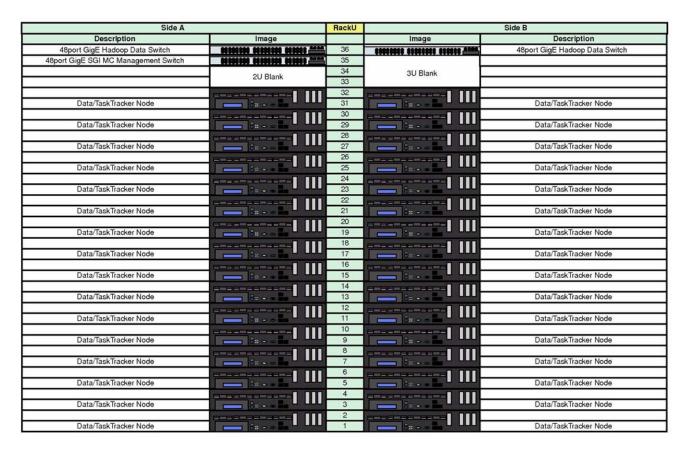


Figure 1-7 Multi-Rack—Second Rack And Beyond

Figure 1-7 describes the configuration of the second rack (and subsequent racks) of a multi-rack configuration. Each rack consists of the following:

- 32 DataNodes/TaskTracker nodes
- 2 48-port GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Network Topology—GigE

As described in Table 1-3, the network topology of the SGI Hadoop cluster depends on its rack configuration.

Table 1-3Network Topology

Rack Configuration	Network Topology
Single-rack	The Master node servers are attached to the top-of-rack switches directly via 10-Gigabit Ethernet.
Multi-rack	A 10-Gigabit Ethernet aggregate spine switch is introduced into the networking topology. The Master node servers are attached to this spine switch directly.

This section illustrates the network topology from the most granular level (node level) to the top level (inter-rack level):

- "Node Level" on page 11
- "Rack Level for Single-Rack Configuration" on page 12
- "Rack Level for Rack 1 in Multi-Rack Configuration" on page 13
- "Rack Level for Rack 2 (And Beyond) in Multi-Rack Configuration" on page 14
- "Inter-Rack Level" on page 15

Node Level

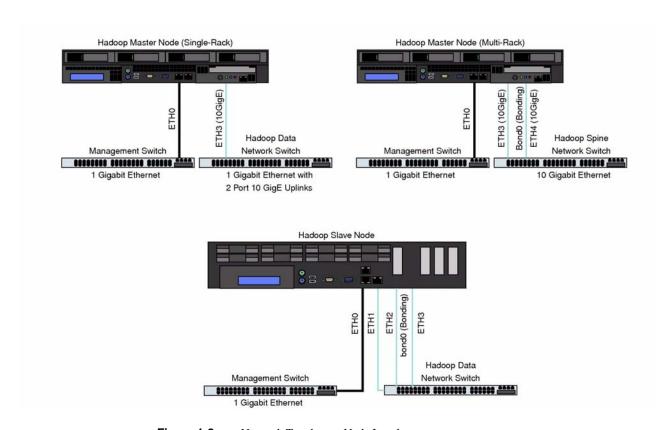


Figure 1-8 Network Topology—Node Level

Rack Level for Single-Rack Configuration

Hadoop Rack Networking Layout (Single Rack)

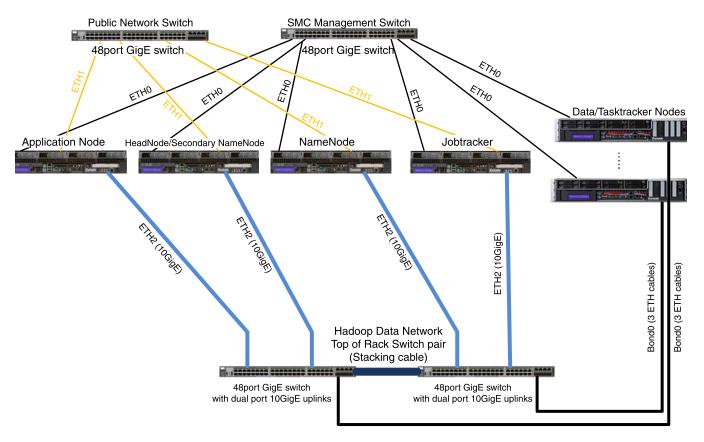


Figure 1-9 Network Topology—Rack Level for Single Rack

Rack Level for Rack 1 in Multi-Rack Configuration

Public Network Switch SMC Management Switch 48-port 48-port GigE GigE switch switch ETH1 ETH1 ETH1 ETH Application Node HeadNode/Secondary NameNode Jobtracker NameNode Bond0 (10GigE) 2 Cables Bond0 (10GigE) 2 Cables Bond0 (10GigE) 2 Cables Bond0 (10GigE) 2 Cables 10GigE Spine Switch Links to Additional Racks [000000] [000000] (4 Cables per rack) ETH0 ETH0 10GigE 1 cable 10GigE 1 cable 10GigE 1 cable 10GigE 1 cable Hadoop Data 48-port GigE switch with dual port 10GigE uplinks (Side A) Network Top-of-Rack Switches 48-port GigE switch with dual port 10GigE uplinks (Side B) Data/Tasktracker Nodes i Data/Tasktracker Nodes

Hadoop Rack Networking Layout (Multi-Rack) (First-Rack)

Figure 1-10 Network Topology—Rack Level for Rack 1 of Multi-Rack

1

Rack Level for Rack 2 (And Beyond) in Multi-Rack Configuration

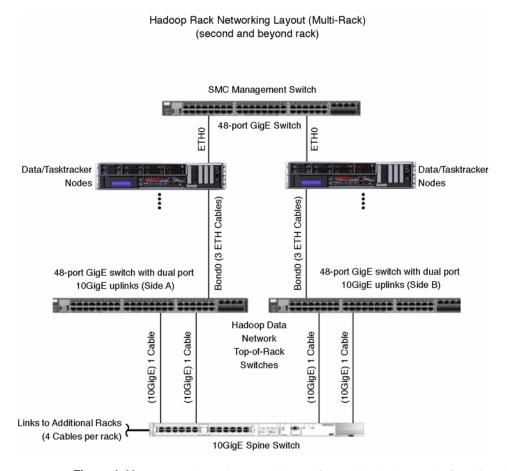


Figure 1-11 Network Topology—Rack Level for Rack 2 (And Beyond) of Multi-Rack

Inter-Rack Level

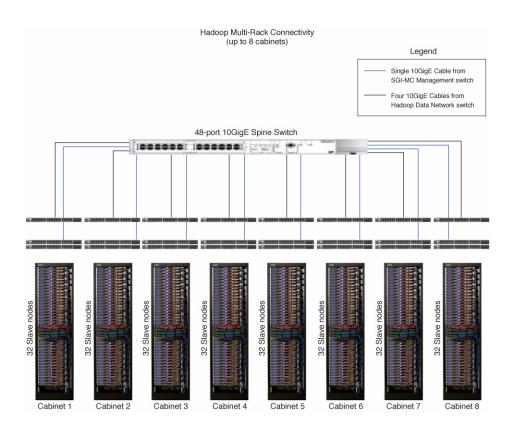


Figure 1-12 Network Topology—Inter-Rack Level

The 10GigE Implementation

This section describes the 10GigE implementation using the following topics:

- "Hardware—10GigE" on page 16
- "Configurations—10GigE" on page 19
- "Network Topology—10GigE" on page 23

Hardware—10GigE

This section describes the hardware used in the 10GigE-based implementation: first, the servers and then the network hardware.

Servers

The 10GigE-based SGI Hadoop cluster employs SGI Rackable™ C2005 and ISS3012 servers; a C2005 server and an ISS3012 server are shown in Figure 1-13 and Figure 1-14, respectively. This section describes the SGI servers that are used in the 10GigE-based SGI Hadoop cluster, their function in the Hadoop paradigm, and their specifications.



Figure 1-13 An SGI Rackable C2005 Server



Figure 1-14 An SGI ISS3012 Server

Table 1-4 describes the SGI Hadoop Reference Implementations with SGI 10GigE-based servers with the Intel Xeon Processor E5-2600 Series.

 Table 1-4
 SGI Hadoop 10GigE-Based Half-Depth Servers–Intel Xeon Processor E5-2600 Series

SGI Server	Conventional Node Type	Hadoop Node Type	Specifications
C2005-RP1	Master nodes	NameNode, Secondary NameNode, JobTracker	- 2x Intel Xeon Processor E5-2630 (2.3 GHz, 6-core) -8x 8GB 1.35v 1333MHz DIMMs (64GB memory) - 4x 2.5" ITB 7200 rpm SATA 6Gb/s drives in RAID 10 configuration - 1x Dual-port 10GigE NIC - Redundant power supply
ISS3012-RP6	Compute/Slave nodes	DataNodes, TaskTrackers	- 2x Intel Xeon Processor E5-2630 (2.3 GHz, 6-core) - 8x 8GB 1.35v 1333MHz DIMMs (64GB memory) - 12x 3.5" 3TB 7200 rpm SATA drives - 1x Dual-port 10GigE NIC
C2005-RP1		Application Node	 2x Intel Xeon Processor E5-2670 (2.6 GHz, 8-core) 16x 8GB 1.35v 1333MHz DIMMs (128GB memory) 4x 2.5" 1TB 7200 rpm SAS 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply

Table 1-5 describes the SGI Hadoop Reference Implementation with SGI 10GigE-based servers with the Intel Xeon Processor E5-2400 Series.

 Table 1-5
 SGI Hadoop 10GigE-Based Half-Depth Servers–Intel Xeon Processor E5-2400 Series

SGI Server	Conventional Node Type	Hadoop Node Type	Specifications
C2005-RN1	Master nodes	NameNode, Secondary NameNode, JobTracker	 2x Intel Xeon Processor E5-2420 (1.9 GHz, 6-core) 6x 8GB 1.35v 1333MHz DIMMs (48GB memory) 4x 2.5" ITB 7200 rpm SATA 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply
ISS3012-RN1	Compute/Slave nodes	DataNodes, TaskTrackers	 2x Intel Xeon Processor E5-2420 (1.9 GHz, 6-core) 6x 8GB 1.35v 1333MHz DIMMs (48GB memory) 12x 3.5" 3TB 7200 rpm SATA drives 1x Dual-port 10GigE NIC
C2005-RP1		Application Node	 2x Intel Xeon Processor E5-2670 (2.6 GHz, 8-core) 16x 8GB 1.35v 1333MHz DIMMs (128GB memory) 4x 2.5" ITB 7200 rpm SAS 6Gb/s drives in RAID 10 configuration 1x Dual-port 10GigE NIC Redundant power supply

Network Hardware

The network hardware consists of the following two components:

- 2 LG-Ericsson ES-4550G 48-port GigE switches per rack
- 1 LG-Ericsson ES-5048XG 10-GigE spine switch

Configurations—10GigE

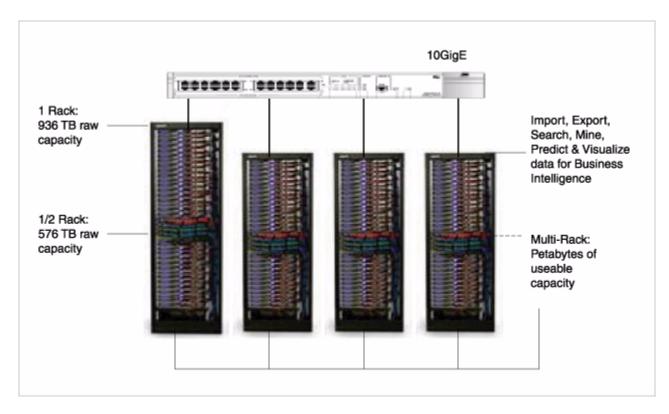


Figure 1-15 Data Capacity for Various Rack Configurations

The SGI Hadoop Cluster is available in single-rack and multi-rack configurations. Figure 1-15 shows the range of data capacity for the configurations. This section describes the half-rack, full-rack, and multi-rack configurations.

Half-Rack

Side A		RackU	Side B					
Description	Image		Image	Description				
48port GigE SGI MC Management Switch	********* ******** ****** *****	46		•				
48port 10GigE Hadoop Data Switch		45		48port 10GigE Hadoop Data Switch				
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		43						
	3U Blank	42	3U Blank					
		41	1					
		40						
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Figure 1-16 Half-Rack Configuration

Figure 1-16 describes the configuration of a half-rack configuration. The rack consists of the following:

- 1 SGI Management Center node/Secondary NameNode
- 1 NameNode
- 1 JobTracker
- 1 Application node
- 16 DataNodes/TaskTracker nodes
- 2 48-port 10GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Full-Rack (46U)

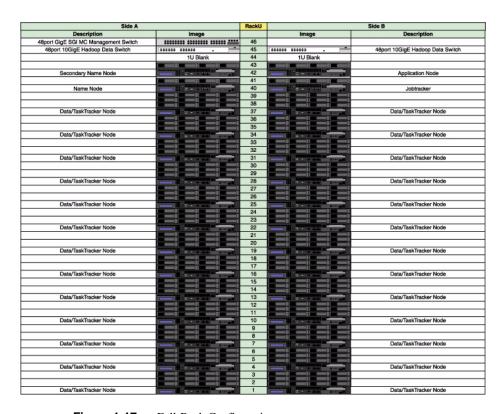


Figure 1-17 Full-Rack Configuration

Figure 1-17 describes the configuration of a full-rack configuration. The rack consists of the following:

- 1 SGI Management Center node/Secondary NameNode
- 1 NameNode
- 1 JobTracker
- 1 Application node
- 26 DataNodes/TaskTracker nodes
- 2 48-port 10GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Multi-Rack (Second Rack and Beyond)

Side A		RackU	Side B				
Description	Image		Image	Description			
Bport GigE SGI MC Management Switch	******** ******* ****** ****	46					
48port 10GigE Hadoop Data Switch		45		48port 10GigE Hadoop Data Switch			
		44					
	2U Blank	43	2U Blank				
		42					
	3U Blank	41	3U Blank				
	30 Blank	40	- SO BIATIK				
		39					
		38					
Data/TaskTracker Node		37	E CONTRACTOR OF THE PERSON NAMED IN CONT	Data/TaskTracker Node			
		36					
		35					
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		33					
		32					
Data/TaskTracker Node		31	1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0 1 0	Data/TaskTracker Node			
		30					
		29					
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		26	- تصدا تصدا تصدا				
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Data/TaskTracker Node		22	000 MM	Data/TaskTracker Node			
		21					
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		18					
		17					
Data/TaskTracker Node		16	The same of the same	Data/TaskTracker Node			
		15					
		14					
Data/TaskTracker Node		13	THE RESERVE OF THE PERSON NAMED IN	Data/TaskTracker Node			
		12					
		11					
Data/TaskTracker Node		10		Data/TaskTracker Node			
Datar lask flauket 1900e	E	9	10. 10 May 010 May 10 M	Data lask llacker 1400e			
		8					
Data/TaskTracker Node		7		Data/TaskTracker Node			
Data/TaskTracker Node	- 15			Data/ lask fracker Node			
		6					
		5					
Data/TaskTracker Node		4		Data/TaskTracker Node			
		3					
		2					
Data/TaskTracker Node		1	- WA 9111A	Data/TaskTracker Node			

Figure 1-18 Multi-Rack—Second Rack and Beyond

Figure 1-18 describes the configuration of the second rack (and subsequent racks) of a multi-rack configuration. Each rack consists of the following:

- 26 DataNodes/TaskTracker nodes
- 2 48-port GigE stacked Hadoop data network switches
- 1 SGI Management Center network switch

Network Topology—10GigE

This section illustrates the network topology from the most granular level (node level) to the top level (inter-rack level):

- "Node Level" on page 23
- "Rack Level for Single-Rack Configuration" on page 24
- "Inter-Rack Level" on page 25

Node Level

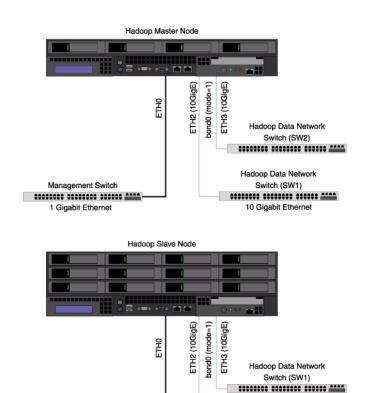


Figure 1-19 Network Topology—Node Level

Management Switch

1 Gigabit Ethernet

007-5875-001 23

Hadoop Data Network

Switch (SW1)

10 Gigabit Ethernet

Rack Level for Single-Rack Configuration

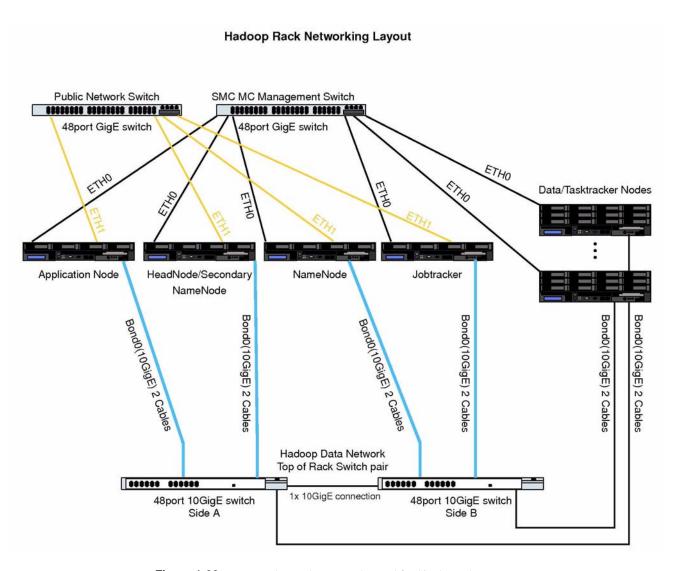


Figure 1-20 Network Topology—Rack Level for Single Rack

Inter-Rack Level

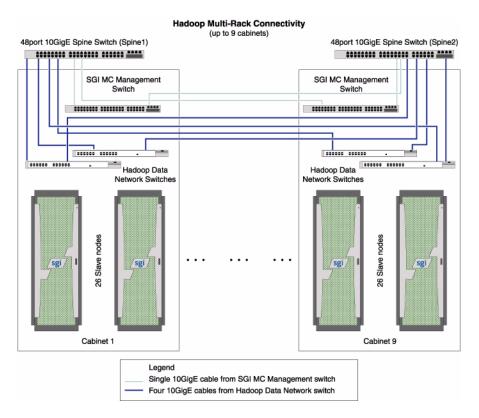


Figure 1-21 Network Topology—Inter-Rack Level

Software

The software stack for the SGI Hadoop solution consists of the following components:

- Red Hat® Enterprise Linux (RHEL) 6 .2 (2.6.32-220.el6.x86_64)
- ClouderaTM distribution Apache Hadoop 3 update 4 (Hadoop 0.20.2-cdh3u4)
- SGI Management Center 1.6.0
- An ecosystem of business intelligence applications software from ISVs like Kitenga®, DatameerTM, Pentaho® and Quantum 4D® (See Figure 1-1 on page 1 and Figure 1-22.)

Figure 1-22 shows the SGI Hadoop software stack.

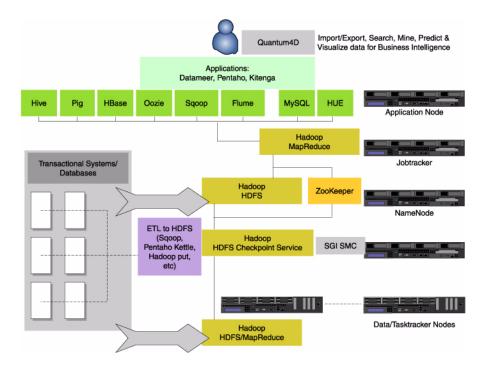


Figure 1-22 SGI Hadoop Software Stack

Cluster Startup

This chapter describes the broad steps for starting the SGI Hadoop cluster:

- "Accepting End-User License Agreements (EULAs)" on page 27
- "Configuring and Starting SGI Management Center" on page 28
- "Starting the Cluster for the First Time" on page 28
- "Re-Imaging the Server Nodes" on page 29

Accepting End-User License Agreements (EULAs)

The SGI Hadoop solution contains third-party software whose end-user license agreements you must read and accept. One such product is the Java® Distribution Kit (JDK). The JDK copyright and third-party license agreement can be found on any of the cluster nodes in directory /usr/share/doc/java-1.6.0-sun-devel-1.6.0.25. Read and accept the conditions in the license agreement.

If you get trial versions of business intelligence applications, they also will require you to accept their EULAs.

Configuring and Starting SGI Management Center

To configure and start the SGI Management Center to monitor the SGI Hadoop cluster, you will need to follow the instructions in the SGI Management Center Quick Start Guide and appropriately configure the Hadoop servers described in Table 2-1.

 Table 2-1
 Hostnames for SGI Hadoop Servers

Daemon	Hostname	Hadoop Data Network Hostname
NameNode	sgi-nn	sgi-nn-10ge
Secondary NameNode	sgi-snn	sgi-snn-10ge
JobTracker	sgi-jt	sgi-jt-10ge
Application Node	sgi-app	sgi-app-10ge
DataNodes & TaskTrackers	r[rack#]n[node#]	r[rack#]n[node#]-ge

Starting the Cluster for the First Time

Use the following steps to start the SGI Hadoop cluster the first time.

- 1. Power on the head node of the cluster.
- 2. Use SGI Management Center to start the nodes in the cluster.
 - a. Log in as root.
 - b. Start the SGI Management Center with the following command:
 - # mgrclient
 - c. Within the Management GUI, select the nodes to start, right-click, and select **Power** > **On**.
 - d. Start the nodes in the following order:
 - i. sgi-app
 - ii. sgi-nn
 - iii.sgi-jt
 - iv. Compute/Slave nodes in the Compute group

Hadoop is configured to start once the servers have booted.

- 3. Use the web browser on the head node to log into the Hadoop web interfaces:
 - NameNode: http://sgi-nn-10ge:50070
 - Secondary NameNode: http://sgi-snn-10ge:50090
 - JobTracker: http://sgi-jt-10ge:50030
- 4. Verify that the cluster powered on correctly and that all slave nodes joined the Hadoop cluster.

Run the following command to verify the number of DataNodes match the expected slave node count:

sudo -u hdfs hapoop dfsadmin -report

Re-Imaging the Server Nodes

In SGI Management Center, there are compute images for each node type. Table 2-2 shows the mapping. Re-provision the nodes with the compute images as needed.

Table 2-2 Compute Images for SGI Hadoop Servers

Node Name	Image Name		
sgi-nn	Compute-Hadoop-Namenode		
sgi-jt	Compute-Hadoop-Jobtracker		
sgi-app	Compute-Hadoop-App		
r[rack#]n[node#]	Compute-Hadoop-Slave		

To provision a node, do the following:

- 1. Select the appropriate node.
- 2. Right-click.
- 3. Select **Provision** > *compute-image-for-node*.