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

Getting Started Guide

007-5875-001

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Contents

About This Guide vii
Audience vii
Related Publications viii
Product Support ix
Reader Comments x

1 Overview 1
The GigE Implementation 2
Hardware—GigE 3
Servers 3
Network Hardware 5
Configurations—GigE 6
Half-Rack 7
Full-Rack (42U) 8
Multi-Rack (Second Rack And Beyond) 9
Network Topology—GigE 10
Node Level 11
Rack Level for Single-Rack Configuration 12
Rack Level for Rack 1 in Multi-Rack Configuration 13
Rack Level for Rack 2 (And Beyond) in Multi-Rack Configuration 14
Inter-Rack Level 15
The 10GigE Implementation 16
Hardware—10GigE 16
Servers 16
Network Hardware 18
Configurations—10GigE 19
Half-Rack 20
Full-Rack (46U) 21

Multi-Rack (Second Rack and Beyond) 22
Network Topology—10GigE 23
Node Level 23
Rack Level for Single-Rack Configuration 24
Inter-Rack Level 25
Software 26

2 Cluster Startup 27

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

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.

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)

You can obtain SGI documentation in the following ways:

- 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.

Product Support

SGI provides a comprehensive product support and maintenance program for its products. SGI also offers services to implement and integrate Linux applications in your environment.

- 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

Reader Comments

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

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Overview

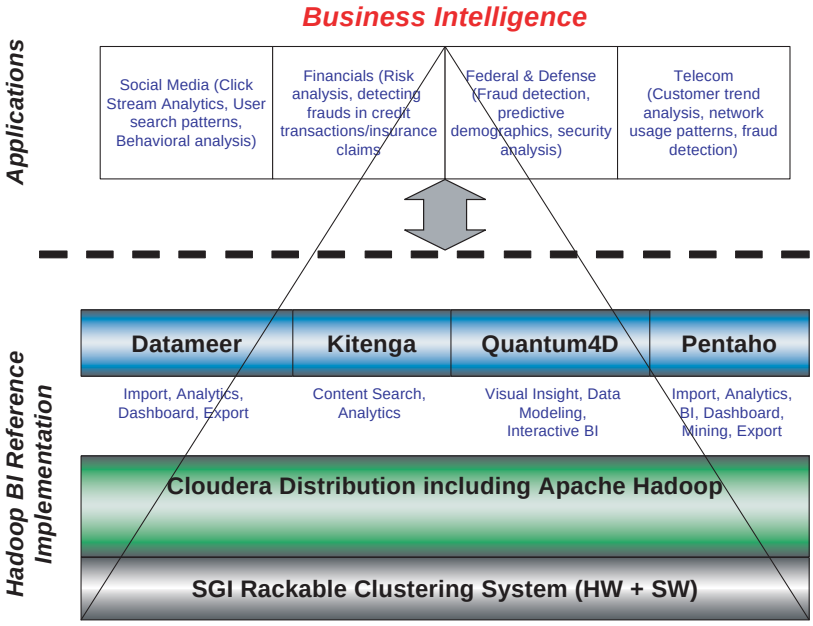


Figure 1-1 SGI Hadoop Business Intelligence Ecosystem

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” 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” 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” 1TB 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” 1TB 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

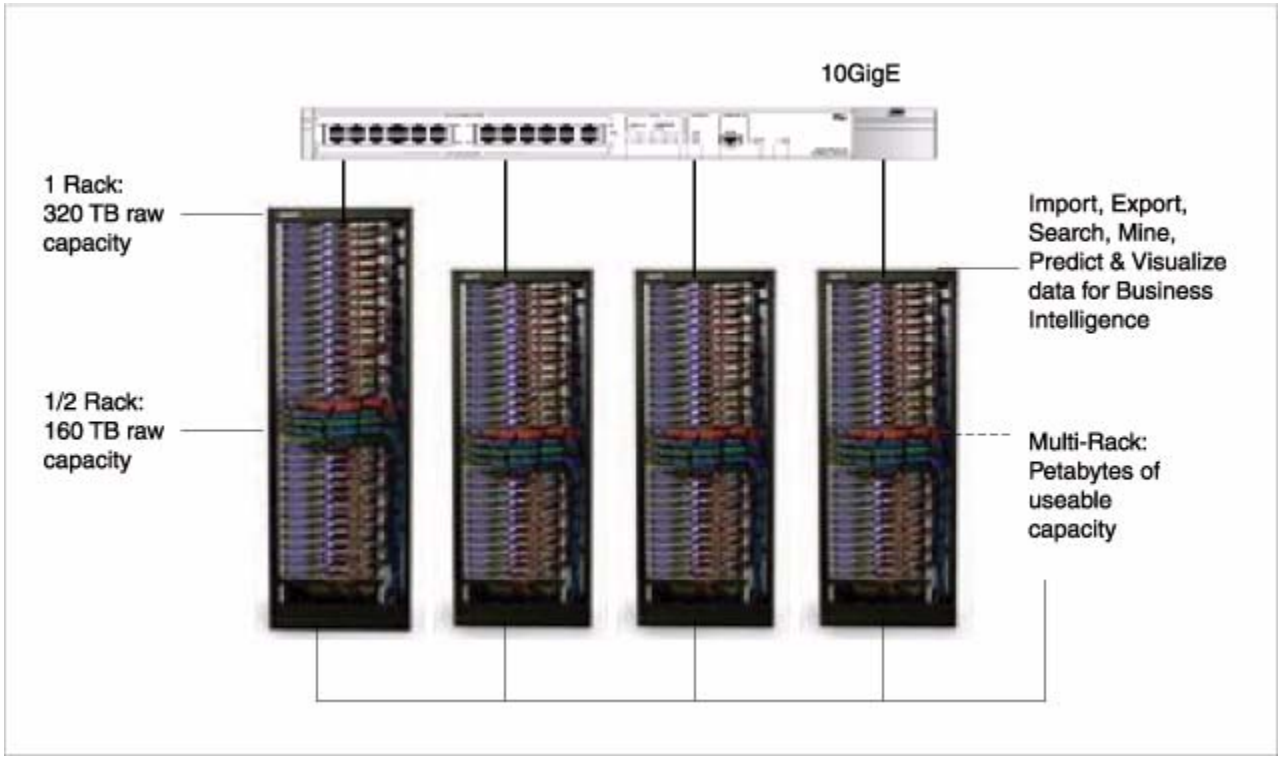
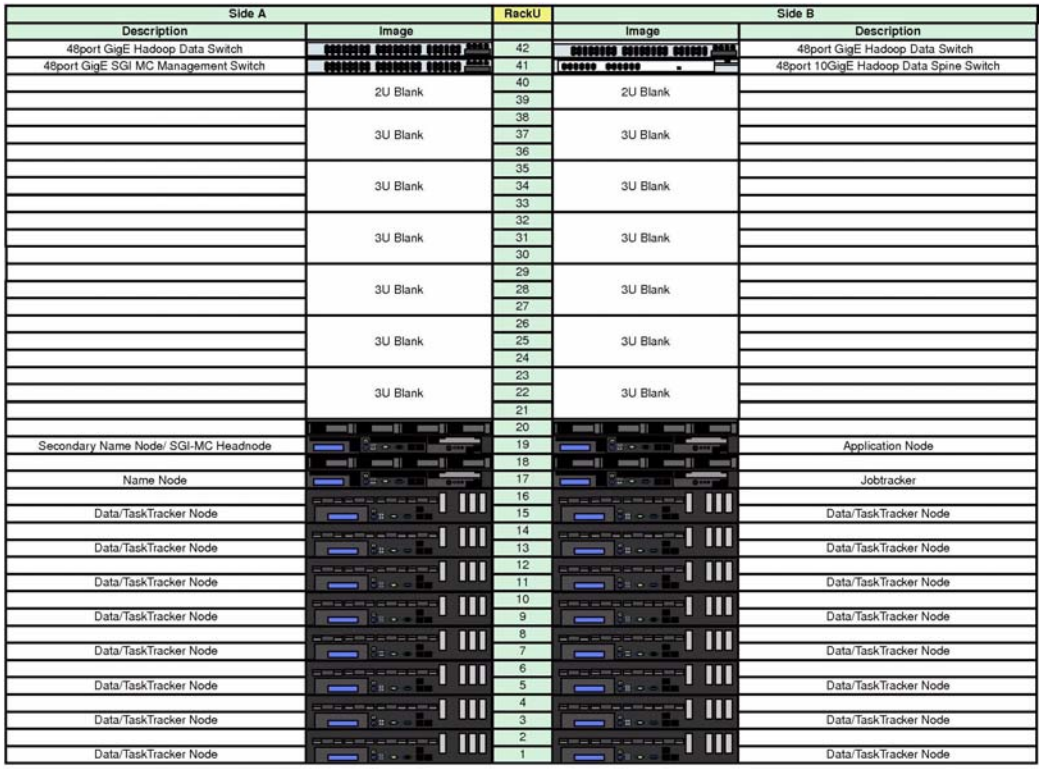


Figure 1-4 Data Capacity for Various Rack Configurations

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


Side A
RackU
Side B
Description
Image
Image
Description
48port GigE Hadoop Data Switch
48port GigE SGI MC Management Switch
48port GigE Hadoop Data Switch
48port 10GigE Hadoop Data Spine Switch
2U Blank
2U Blank
3U Blank
3U Blank
3U Blank
3U Blank
3U Blank
3U Blank
3U Blank
3U Blank
Secondary Name Node/ SGI-MC Headnode
Application Node
Name Node
Jobtracker
Data/TaskTracker Node
Data/TaskTracker Node
Data/TaskTracker Node

Full-Rack (42U)

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)

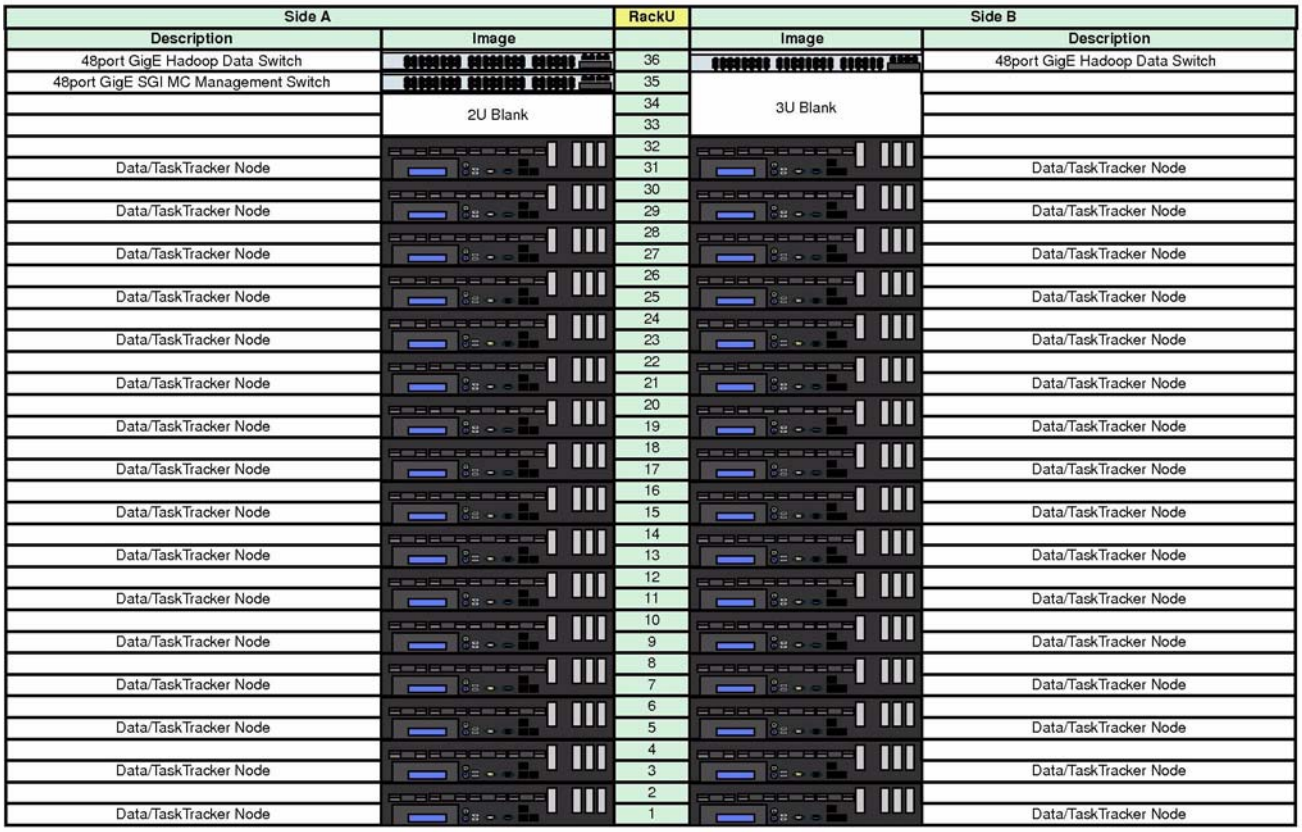


Figure 1-7 Multi-Rack—Second Rack And Beyond

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 1-3 Network 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

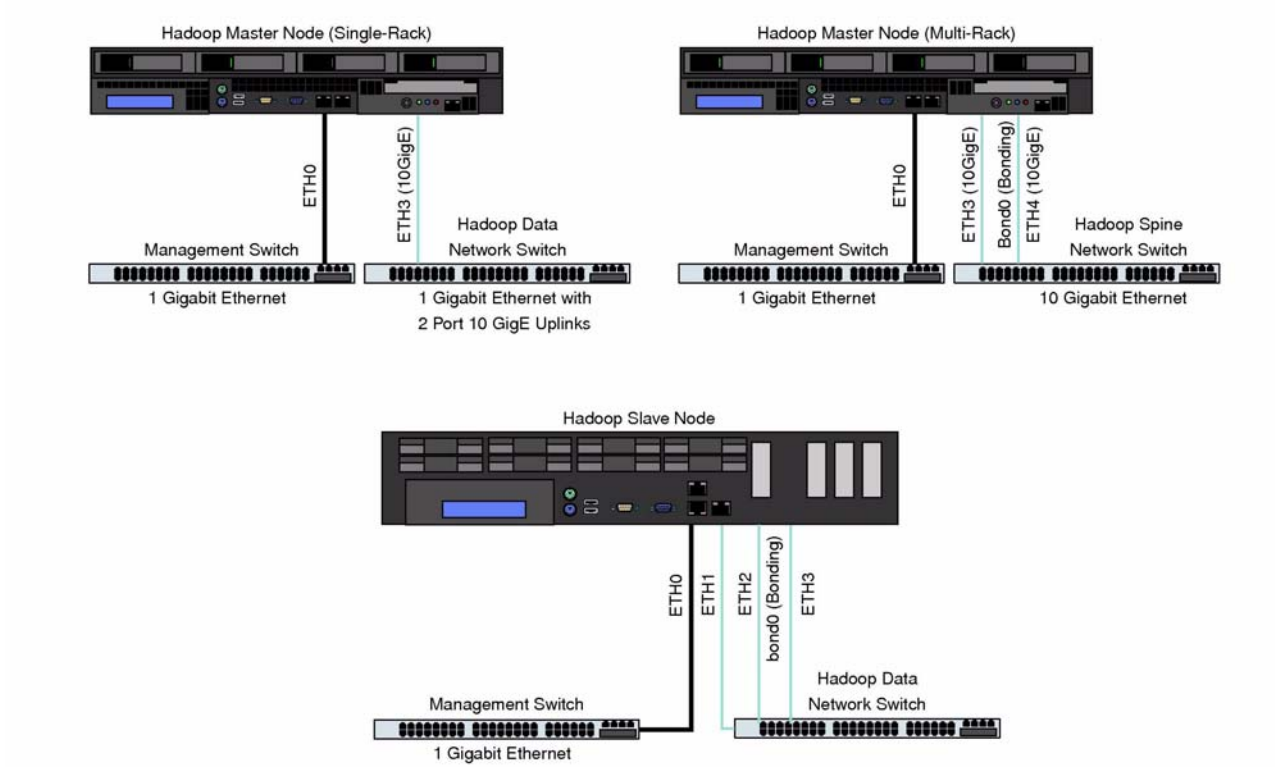


Figure 1-8 Network Topology—Node Level

Rack Level for Single-Rack Configuration

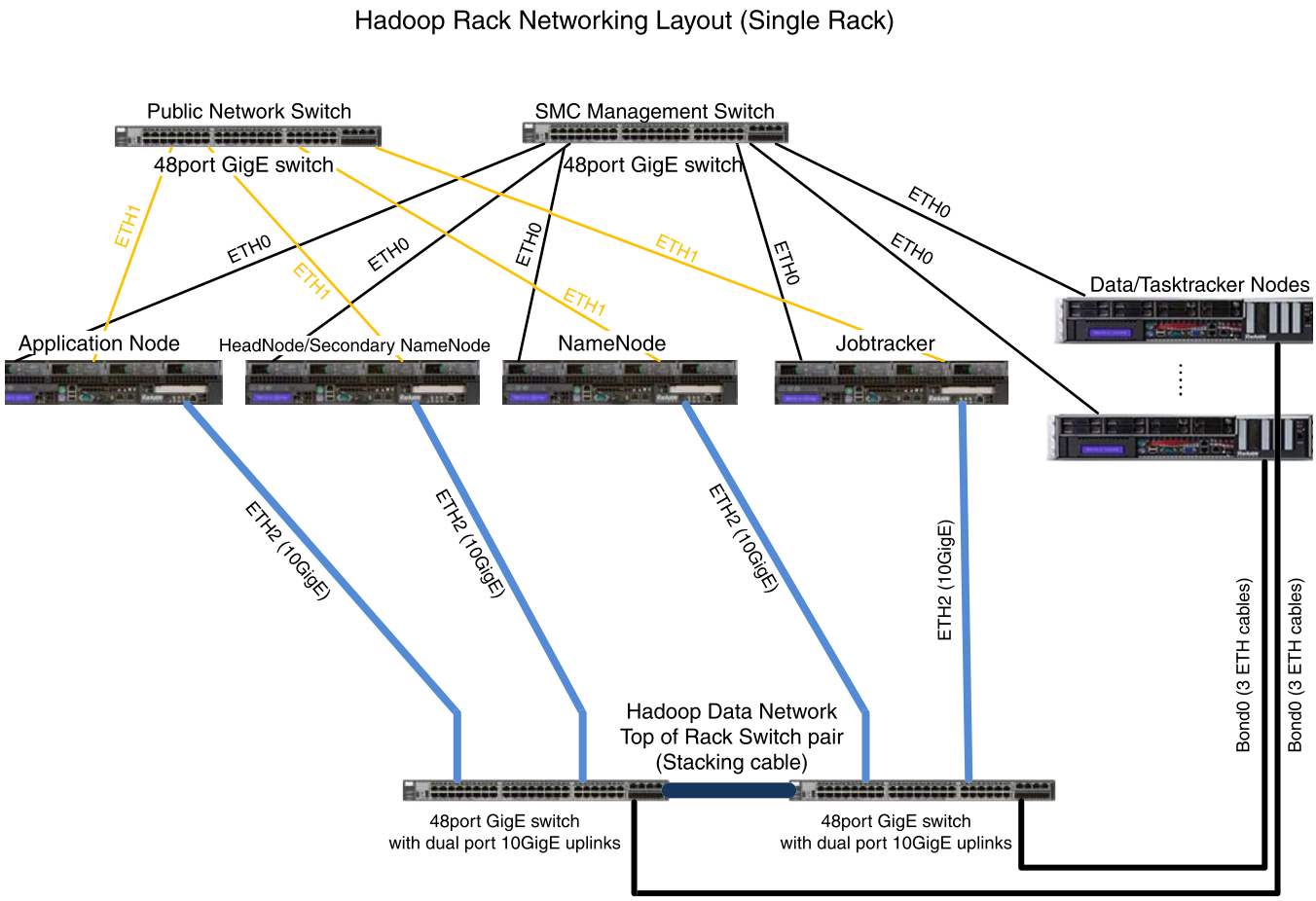


Figure 1-9 Network Topology—Rack Level for Single Rack

Rack Level for Rack 1 in Multi-Rack Configuration

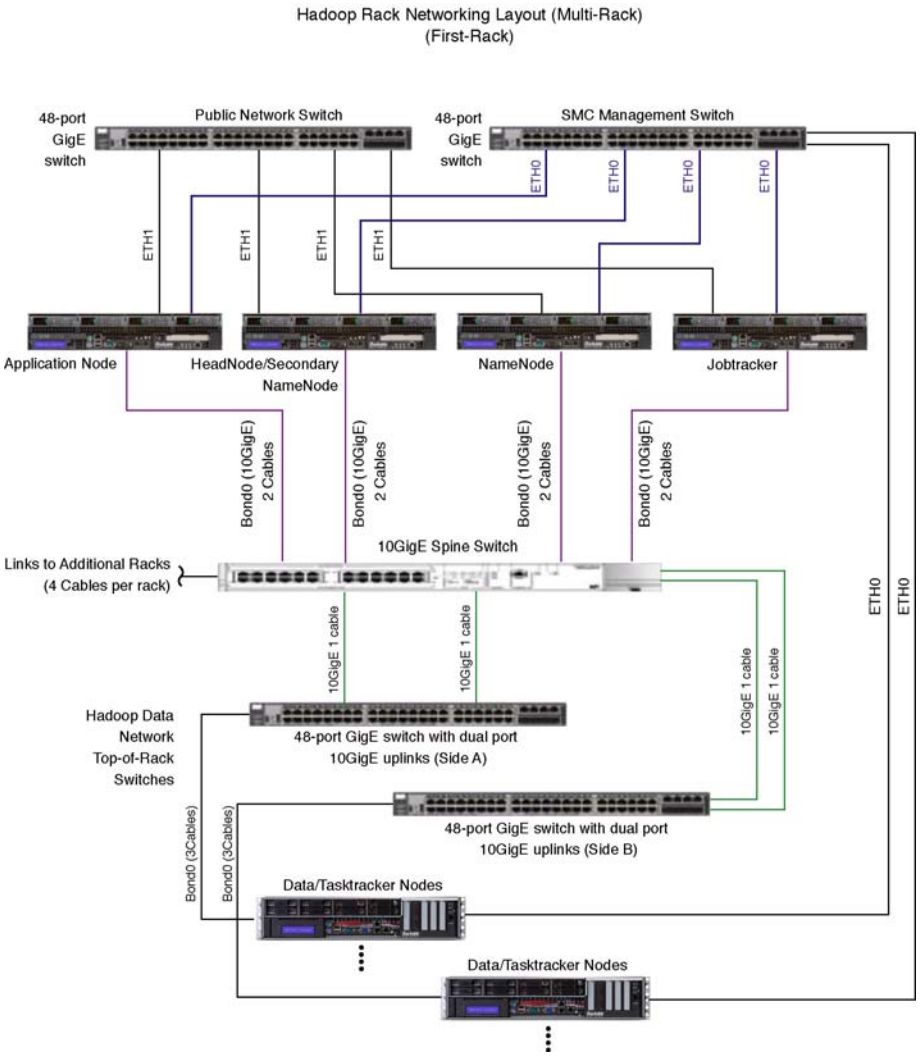


Figure 1-10 Network Topology—Rack Level for Rack 1 of Multi-Rack

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

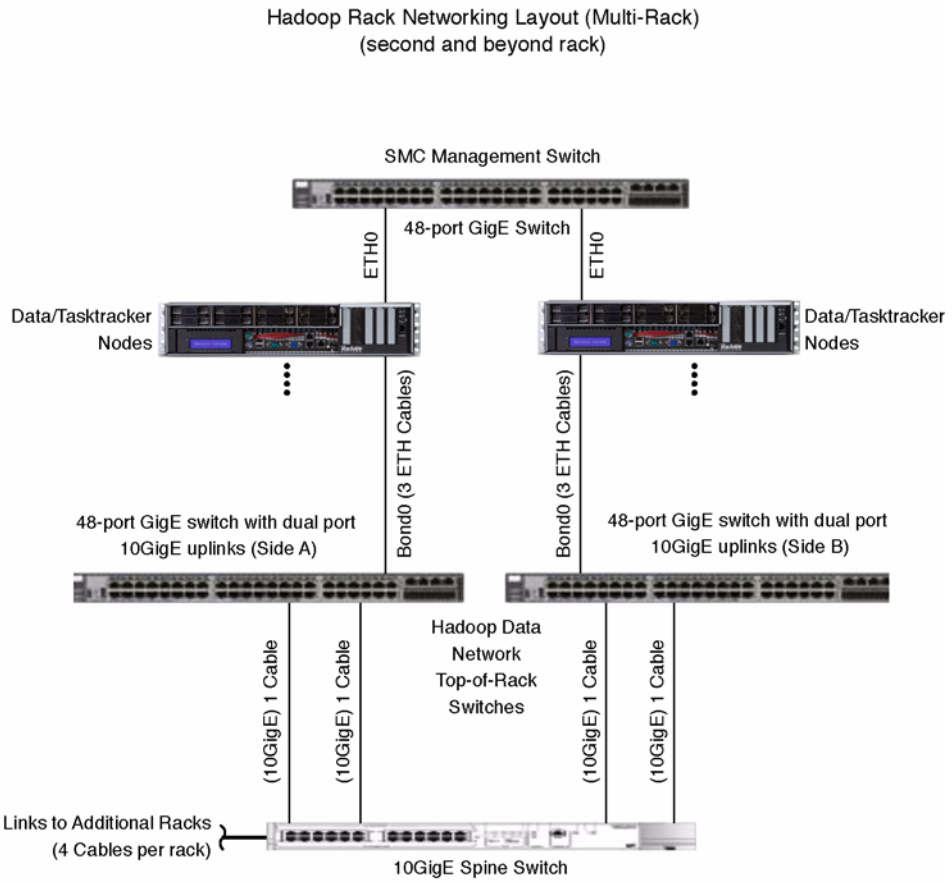


Figure 1-11 Network Topology—Rack Level for Rack 2 (And Beyond) of Multi-Rack

Inter-Rack Level

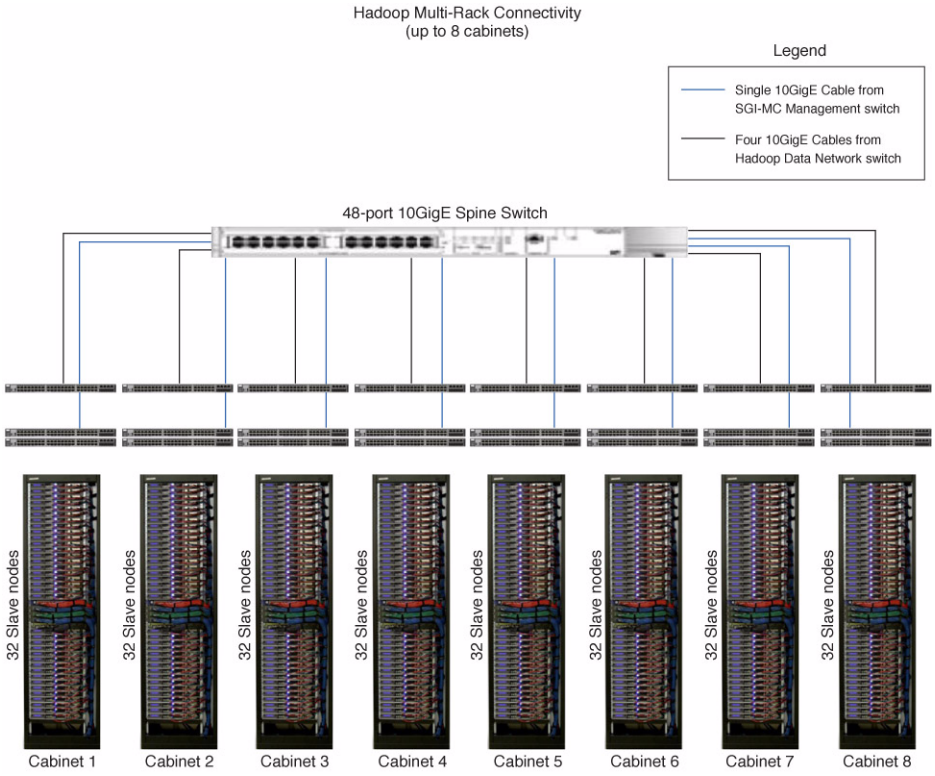


Figure 1-12 Network Topology—Inter-Rack Level

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” 1TB 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” 1TB 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” 1TB 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

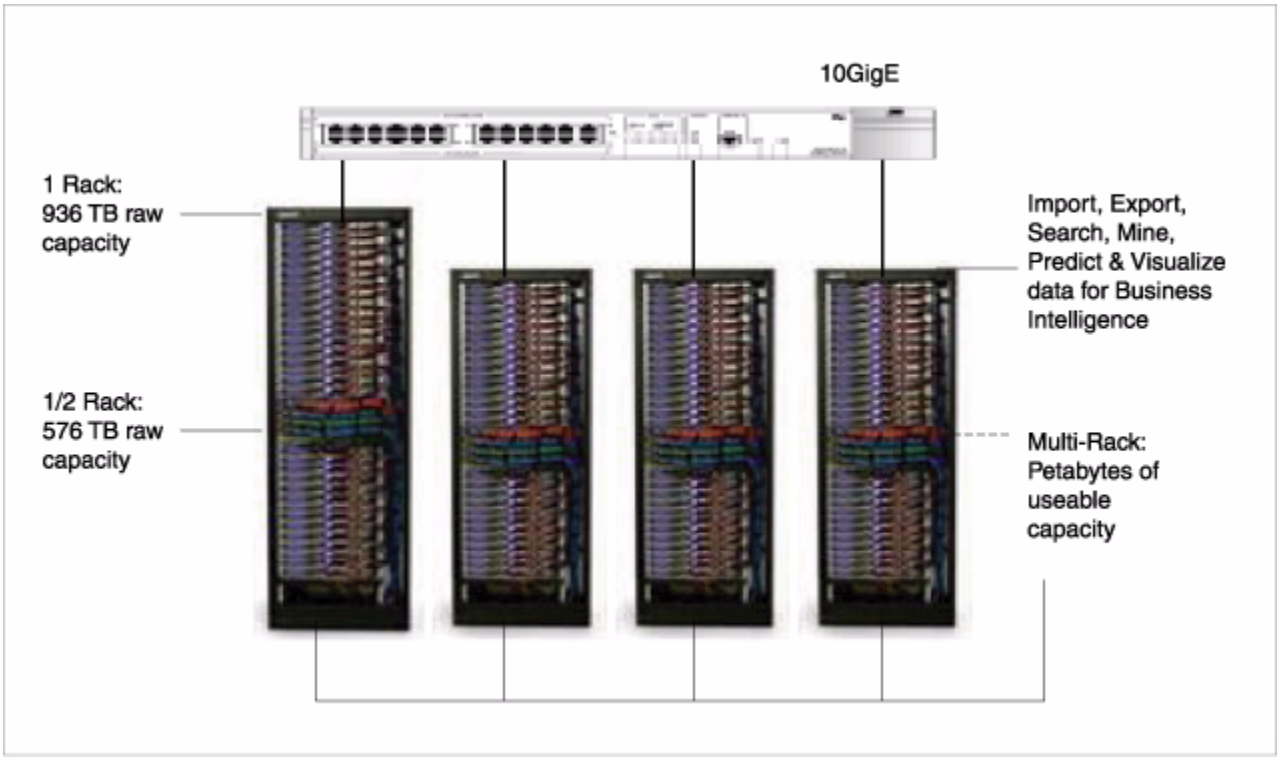


Figure 1-15 Data Capacity for Various Rack Configurations

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

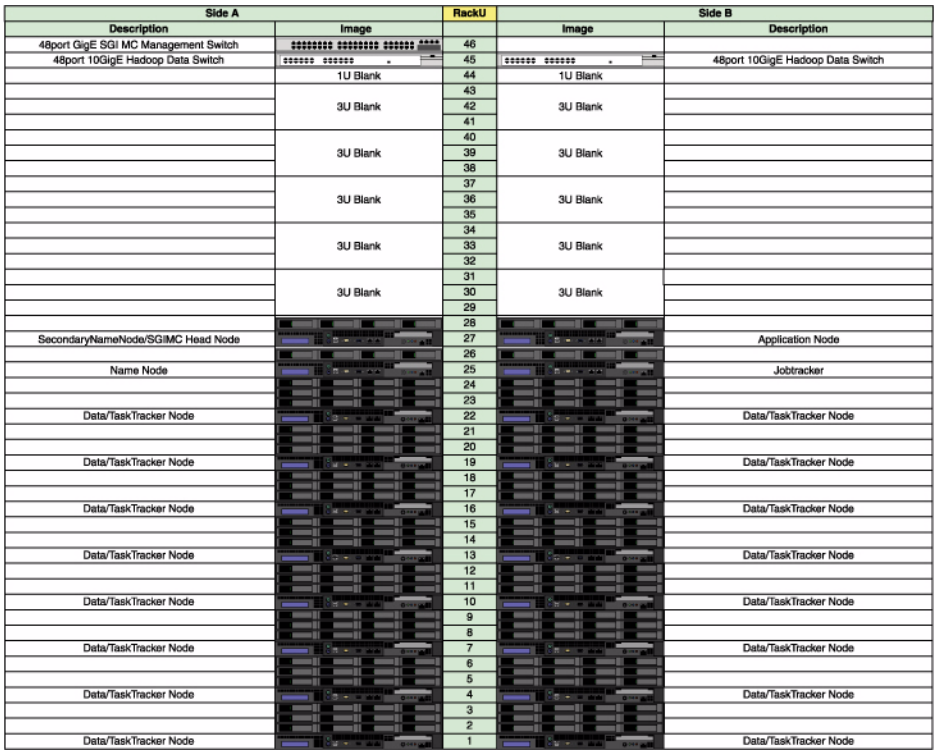


Figure 1-16 Half-Rack Configuration

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)

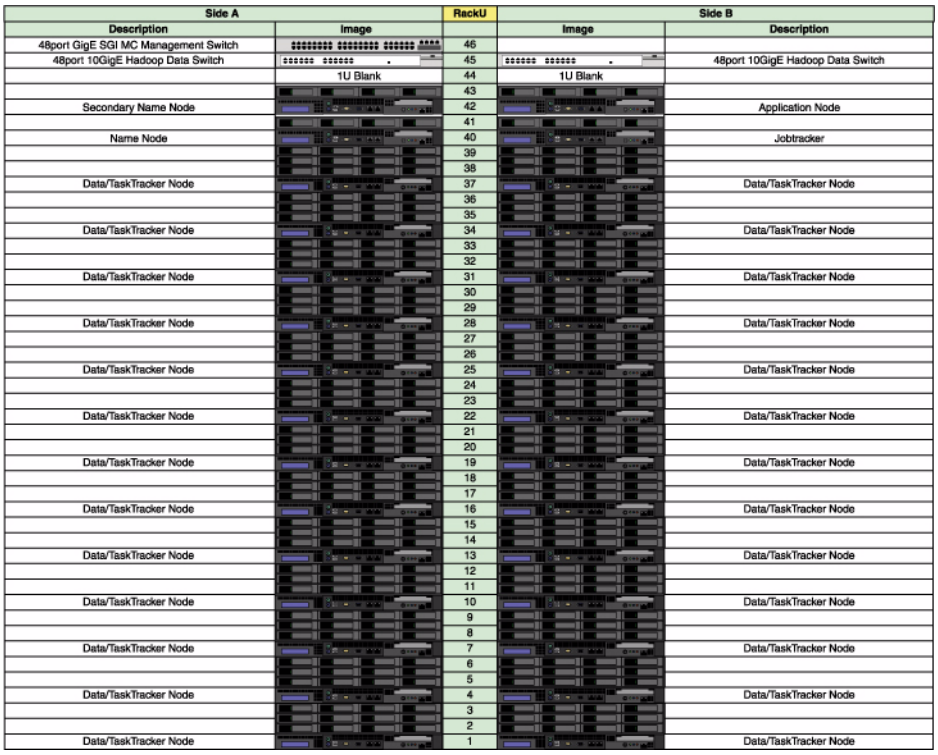


Figure 1-17 Full-Rack Configuration

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)

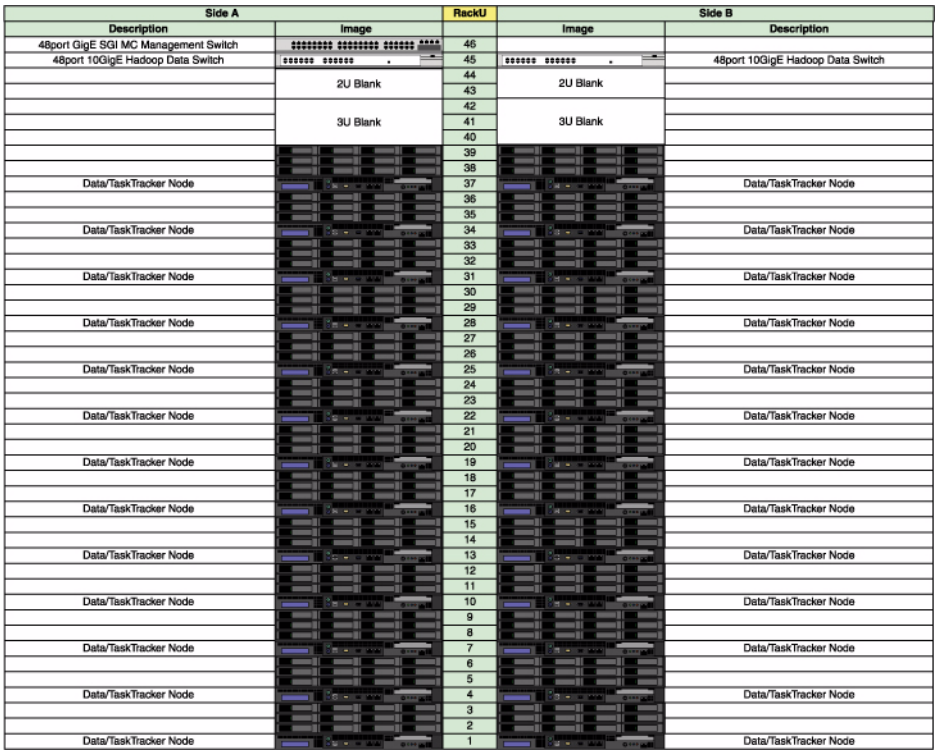


Figure 1-18 Multi-Rack—Second Rack and Beyond

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

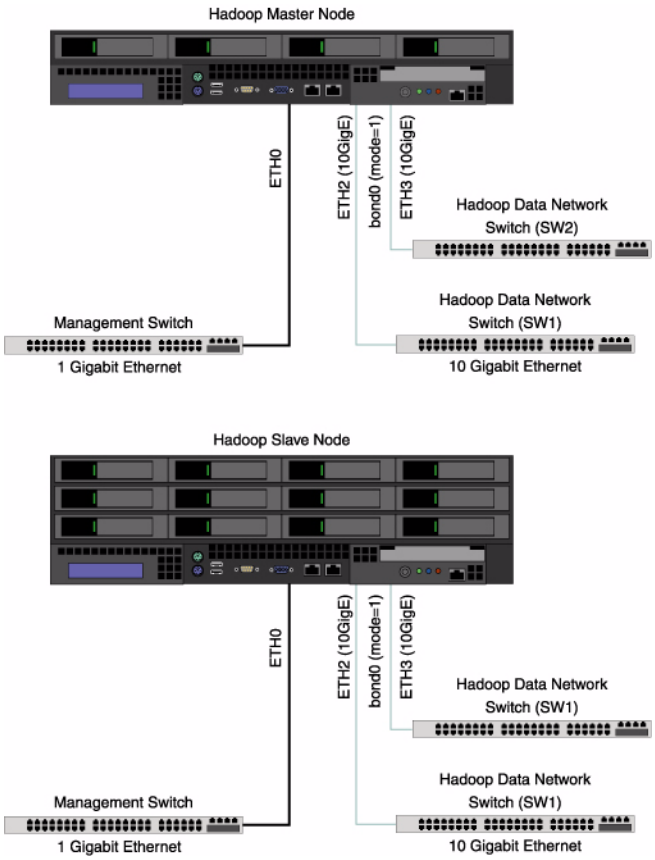


Figure 1-19 Network Topology—Node Level

Rack Level for Single-Rack Configuration

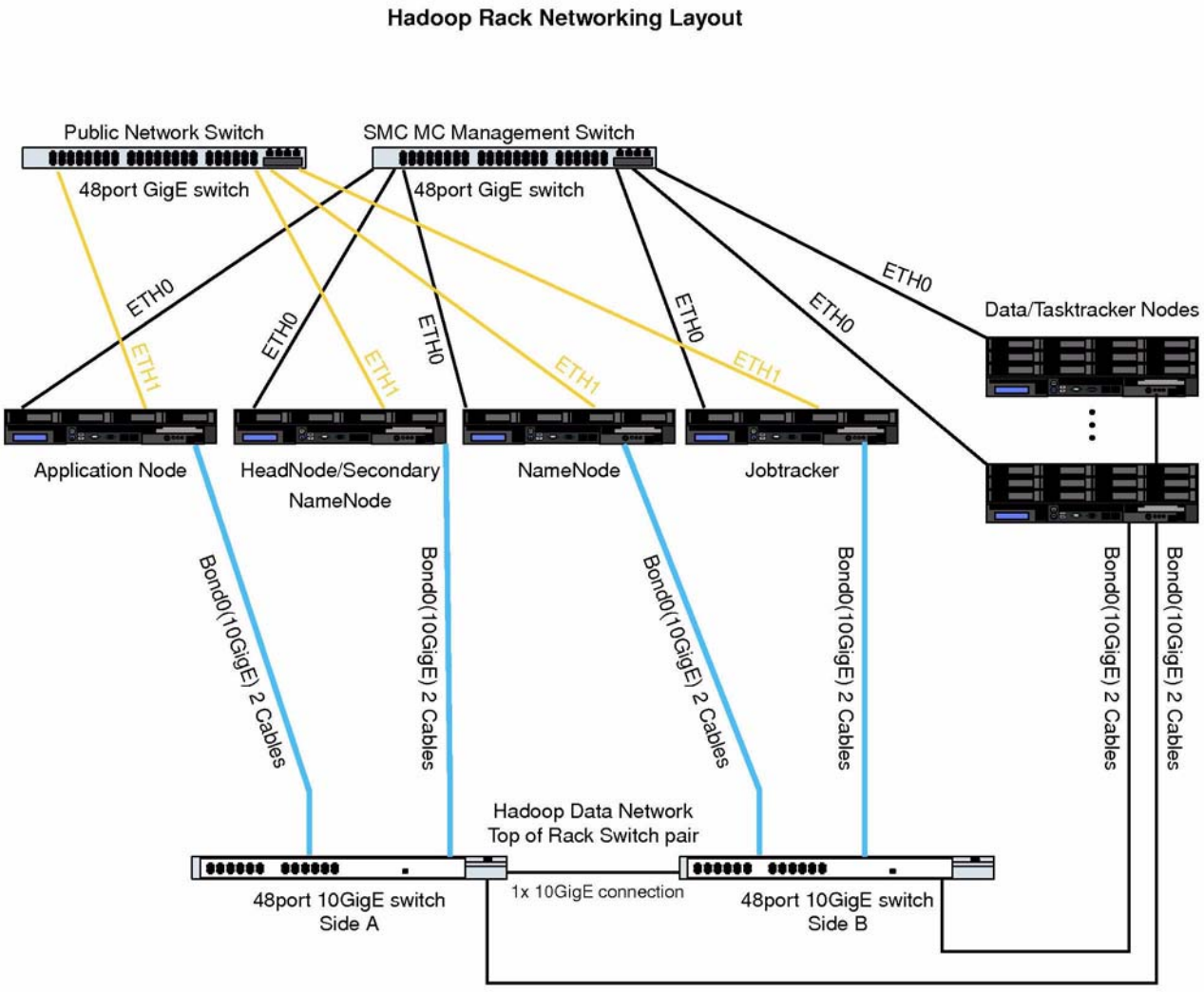


Figure 1-20 Network Topology—Rack Level for Single Rack

Inter-Rack Level

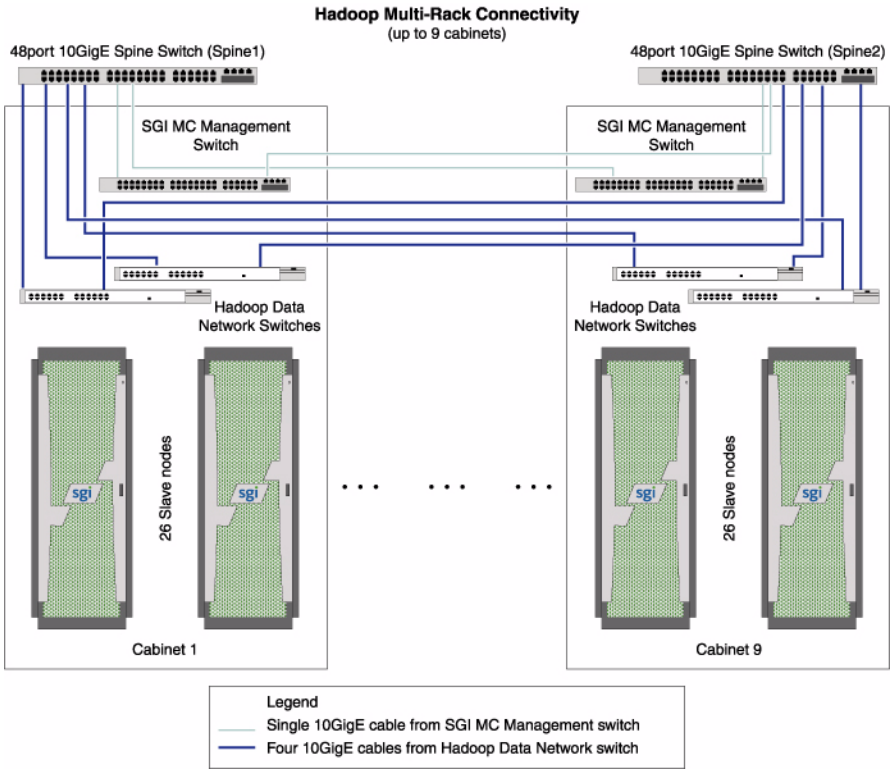


Figure 1-21 Network Topology—Inter-Rack Level

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)
- Cloudera™ 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®, Datameer™, Pentaho® and Quantum 4D® (See Figure 1-1 on page 1and Figure 1-22.)

Figure 1-22 shows the SGI Hadoop software stack.

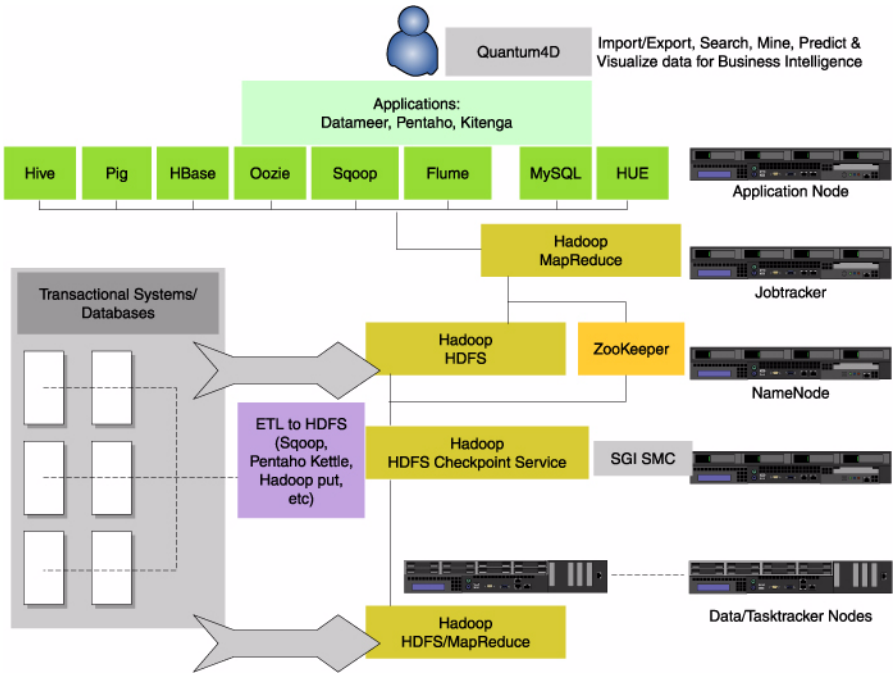


Figure 1-22 SGI Hadoop Software Stack

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 Managment 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.*