Optimized Infrastructure for Big Data Analytics with Hortonworks from Hitachi Vantara

Reference Architecture Guide

By David Pascuzzi

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Feedback

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Revision History

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<thead>
<tr>
<th>Revision</th>
<th>Changes</th>
<th>Date</th>
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<tr>
<td>MK-SL-040-00</td>
<td>Initial release</td>
<td>February 27, 2018</td>
</tr>
<tr>
<td>MK-SL-040-01</td>
<td>Add support for Hitachi Advanced Server DS220</td>
<td>August 29, 2018</td>
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Optimized Infrastructure for Big Data Analytics with Hortonworks from Hitachi Vantara

Reference Architecture Guide

Use this reference architecture guide to configure an optimized infrastructure for big data analytics with Hortonworks from Hitachi Vantara. This has an example environment that can be deployed for a big data infrastructure for advanced analytics.

This integrated big data infrastructure uses the following:

- **Hitachi Advanced Server DS120** — This is a flexible 1U server designed for optimal performance across multiple applications.
- **Hitachi Advanced Server DS220** — This is a flexible 2U server designed for optimal performance across multiple applications.
- **Hortonworks Data Platform** — This is the industry's only true secure, enterprise-ready open source Apache Hadoop distribution based on a centralized architecture (YARN). Hortonworks Data Processing addresses the complete needs of data-at-rest, powers real-time customer applications and delivers robust big data analytics that accelerate decision making and innovation.
- **Cisco Nexus 3048** — This 48-port 1 GbE switch provides a management network. It is used both as a leaf switch and a spine switch.
- **Cisco Nexus 93180YC-E/FX** — This 48-port switch provides 10 GbE connectivity for intra-rack networks. It is used as the leaf switch for the data network. Designed with Cisco Cloud Scale technology, it supports highly scalable cloud architectures.
- **Cisco Nexus 93180LC-EX** — This 24-port switch provides 40 GbE connectivity for inter-rack networks. It is used as the spine switch for the data network, and it supports flexible migration options. It is ideal for highly scalable cloud architectures and enterprise data centers.

**Note** — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

**Key Solution Elements**

These are the key hardware and software components used for this optimized infrastructure for big data analytics with Hortonworks from Hitachi Vantara.

**Hardware Elements**

These are the key hardware elements to power this big data solution. It is possible to create a scale-out configuration to power your Hortonworks Data Platform environment. This solution supports using either the 1U Hitachi Advanced Server DS120 or the 2U Advanced Server DS220.
**Hitachi Advanced Server DS120**

Optimized for performance, high density, and power efficiency in a dual-processor server, Hitachi Advanced Server DS120 delivers a balance of compute and storage capacity. This rack mounted server has the flexibility to power a wide range of solutions and applications.

The highly-scalable memory supports up to 3 TB RAM using 24 slots of 2666 MHz DDR4 RDMM. DS120 is powered by the Intel Xeon scalable processor family for complex and demanding workloads. There are flexible OCP and PCIe I/O expansion card options available. This server supports up to 12 small form factor storage devices with up to 4 NVMe.

This 1U solution allows you to have a high CPU to storage ratio. This is ideal for balanced and compute heavy workloads.

Figure 1 shows the front and back of this server.

**Hitachi Advanced Server DS220**

With a combination of two Intel Xeon Scalable processors and high storage capacity in a 2U rack-space package, Hitachi Advanced Server DS220 delivers the storage and I/O to meet the needs of converged solutions and high-performance applications in the data center.

The Intel Xeon Scalable processor family is optimized to address the growing demands on today's IT infrastructure. The server provides 24 slots for high-speed DDR4 memory, allowing up to 3 TB of memory per node when 238 GB DIMMs are used. This server supports up to 12 large form factor storage devices and an additional 2 small form factor storage devices.

This 2U solution using large form factor storage allows you to have a dense storage solution with lower power consumption. This is ideal where the maximum storage per rack is your largest concern. This larger form factor also provides you with more expansion options.

Figure 2 shows front and back views of this server.
Cisco Switches

These solutions reduce complexity and cost, as well as enable virtualization and cloud computing to increase business agility.

This solution includes the following Cisco switches to provide Ethernet connectivity:

- **Cisco Nexus 3048**
- **Cisco Nexus 93180YC-E/FX**
- **Cisco Nexus 93180LC-EX**

This solution uses a leaf-spine network architecture. This network architecture can be replaced to match the rest of the network configuration.

This reference architecture uses Hitachi Advanced Server DS120 for a compute intensive solution and very high I/O intensive solutions. Designs that support a storage intensive solution are available, also.

Hortonworks Data Platform

Hortonworks Data Platform is the industry's only true secure, enterprise-ready open source Apache Hadoop distribution based on a centralized architecture. Hortonworks addresses the complete needs of data-at-rest, powers real-time customer applications, and delivers robust big data analytics that accelerate decision making and innovation. Some key features are the following:

- 100% open approach
- Enterprise ready
- Apache Hadoop software
- Centralized Hadoop cluster management and monitoring
- Based upon YARN
- Enable enterprises to deploy, integrate and work with volumes of data
- Built in governance and integration tools
- Provisioning, management, and monitoring tools
- Multiple levels of support
**Big Data** is a generic term to cover a set of components that are used with very large data sets to provide advanced data analytics. Big data usually refers to large volumes or high velocity of unstructured or semi-structured data.

Usually, a big data solution is part of an [Apache Hadoop](https://hadoop.apache.org) project. However, big data can include components from many different software companies.

This reference architecture uses [Red Hat Enterprise Linux](https://www.redhat.com) and [Hortonworks Data Platform](https://hortonworks.com). The following is a partial list of the software components and modules that can be used in a HDP deployment:

- **Apache Ambari**
  
  Apache Ambari is aimed at making Hadoop management simpler by developing software for provisioning, managing, and monitoring Apache Hadoop clusters.

- **Apache Atlas**
  
  Apache Atlas is a scalable and extensible set of core foundational governance services – enabling enterprises to effectively and efficiently meet their compliance requirements within Hadoop and allowing integration with the whole enterprise data ecosystem.

- **Apache Falcon**
  
  Apache Falcon is a feed processing and feed management system aimed at making it easier for end consumers to onboard their feed processing and feed management on Hadoop clusters.

- **Apache Flume**
  
  Apache Flume is a distributed, reliable, and available service for efficiently collecting, aggregating, and moving large amounts of log data.

- **Apache Hadoop Distributed File System**
  
  Hadoop Distributed File System (HDFS) is a distributed high-performance file system designed to run on commodity hardware.
Apache Hadoop Common
These common utilities support the other Hadoop modules. This programming framework supports the distributive processing of large data sets.

Apache Hadoop YARN
Apache Hadoop YARN is a framework for job scheduling and cluster resource management. This splits the functionalities of the following into separate daemons:
- ResourceManager interfaces with the client to track tasks and assign tasks to NodeManagers management
- NodeManager launches and tracks execution on the worker nodes

Apache HBase
Apache HBase is a datastore built on top of HDFS.

Apache Hive
Apache Hive is data warehouse software that facilitates reading, writing, and managing large datasets residing in distributed storage using SQL.

Apache Kafka
Apache Kafka is a distributed streaming platform.

Apache Oozie
Apache Oozie is a workflow scheduler system to manage Apache Hadoop jobs.

Apache Pig
Apache Pig is a platform for analyzing large data sets that consists of coupling the following:
- A high-level language for expressing data analysis programs
- An infrastructure for evaluating these data analysis programs

Apache Spark
Apache Spark is a fast general engine for large-scale data processing.
- Spark Master Node
  In a Spark cluster, the master node oversees assigning tasks for the worker nodes to execute. It checks the status of those tasks and retrieves the results.
  Also, the master node can be used as a worker node, if necessary. In this solution, the master node will assign tasks to itself, as well as to worker nodes. This can be useful if there are few overall nodes in the cluster.

  Spark Worker Node or Nodes
  The worker node or nodes in a Spark cluster do the work assigned to them by the master node. They connect to the master node, are assigned tasks, and execute those tasks. These nodes use the CPU and available storage.

Apache Sqoop
Apache Sqoop is a tool designed for efficiently transferring bulk data between Apache Hadoop and structured data stores, such as relational databases.
• **Apache Storm**

  *Apache Storm* is a distributed realtime computation system. It can process unbounded streams of data in realtime.

• **Apache Tez**

  *Apache Tez* is used to build an application framework which allows for a complex directed-acyclic-graph of tasks for processing data.

• **Apache Zeppelin**

  *Apache Zeppelin* is a web-based notebook that enables data-driven, interactive data analytics and collaborative documents with SQL, Scala and more.

• **Apache ZooKeeper**

  *Apache ZooKeeper* is a centralized service for maintaining configuration information, naming, providing distributed synchronization, and providing group services.

  • **ZooKeeper Master Node**

    ZooKeeper is a high-availability system, whereby two or more nodes can connect to a ZooKeeper master node. The ZooKeeper master node controls the nodes to provide high availability.

  • **ZooKeeper Standby Master Node**

    When ZooKeeper runs in a highly-available setup, there can be several nodes configured as ZooKeeper master nodes. Only one of these configured nodes is active as a master node at any time. The others are standby active nodes.

    If the currently-active master node fails, then the ZooKeeper cluster itself promotes one of the standby master nodes to the active master node.

**Solution Design**

This is the detailed design for an integrated infrastructure for Hitachi Vantara to implement big data and business analytics.

• “Server Architecture” on page 7

  • “Master Node” on page 7

  • “Worker Node” on page 8

  • “Edge Node” on page 10

  • “Hardware Management Server (Optional)” on page 10

• “Network Architecture” on page 11

• “Deployment Options” on page 13

• “Rack Configurations” on page 14

  • “Single Rack Configuration” on page 14

  • “Multiple Rack Configuration” on page 16

This design does not limit the maximum number of nodes. The size of your solution depends on your specific deployment needs.

For a large deployment, the recommendation is to validate that your network meets your requirements.
**Server Architecture**

This solution uses multiple types of server nodes using Hitachi Advanced Server DS120 (1U) or Hitachi Advanced Server DS220 (2U). This architecture supports using servers in multiple configurations. Not all workable options are shown.

There are these types of nodes:

- “Master Node” on page 7
- “Worker Node” on page 8
- “Edge Node” on page 10
- “Hardware Management Server (Optional)” on page 10

**Master Node**

A master node is a node that controls other processes on the network. The following are types of master nodes:

- Ambria node
- Name node
- ZooKeeper node

Table 1, “Hitachi Advanced Server DS120 Master Node Configuration,” on page 7 lists the hardware used for an Advanced Server DS1’20 master node. Table 2, “Hitachi Advanced Server DS220 Master Node Configuration,” on page 8 lists the hardware used for an Advanced Server DS220 master node.

**TABLE 1. HITACHI ADVANCED SERVER DS120 MASTER NODE CONFIGURATION**

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Hitachi Advanced Server DS120</td>
</tr>
<tr>
<td>CPU</td>
<td>2 Intel 4110 processor, 8-core, 2.1 GHz</td>
</tr>
<tr>
<td>Memory Options</td>
<td>128 GB — 4 × 32 GB DDR4 R-DIMM, 2666 MHz RAM</td>
</tr>
<tr>
<td>Network Connections</td>
<td>2 Intel XXV710 10 GbE dual port SFP28 (LP-MD2)</td>
</tr>
<tr>
<td></td>
<td>1 GbE LOM management port</td>
</tr>
<tr>
<td>Disk Controllers</td>
<td>LSI 3516 RAID controller</td>
</tr>
<tr>
<td>Disk</td>
<td>Storage Disks:</td>
</tr>
<tr>
<td></td>
<td>8 × 1.8 TB SAS</td>
</tr>
<tr>
<td></td>
<td>2 × 128 GB MLC SATADOM for operating system</td>
</tr>
<tr>
<td>Racks</td>
<td>42 U rack</td>
</tr>
<tr>
<td>Number of Master Nodes</td>
<td>Depends on the implementation. Minimum of 3 master nodes for up to 100 worker nodes. Increment by 2 master nodes for every 100 worker nodes</td>
</tr>
</tbody>
</table>
Configure a master node storage as the following:

- 2 × RAID-1 — Operating system (root disk)
- 4 × RAID-10 — DB file systems
- 2 × RAID-1 — HDFS NameNode metadata
- 1 × JBOD — Apache ZooKeeper
- 1 × JBOD — Quorum journal node

Unlike data nodes, master nodes can be connected to the data network and the client network. Provide a second NIC to isolate the data network and the client network traffic.

If other software needs a master node, review the requirements for that software before designing that node.

**Worker Node**

Worker nodes process the data. These nodes have very diverse needs with many different configurations and software products running on the nodes.

Table 3, "Hitachi Advanced Server DS120 Worker Node Configuration Options," on page 9 shows the Hitachi Advanced Server DS120 worker node configuration options. Table 4, "Hitachi Advanced Server DS220 Worker Node Configuration Options," on page 9 shows the Advanced Server DS220 worker node configuration.

### TABLE 2. HITACHI ADVANCED SERVER DS220 MASTER NODE CONFIGURATION

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Hitachi Advanced Server DS220</td>
</tr>
<tr>
<td>CPU</td>
<td>2 Intel 4110 processors, 8-core, 2.1 GHz</td>
</tr>
<tr>
<td>Memory Options</td>
<td>128 GB: 4 × 32 GB DDR4 R-DIMM, 2666 MHz RAM</td>
</tr>
<tr>
<td>Network Connections</td>
<td>2 Intel XXV710 10 GbE dual port SFP28 (LP-MD2)</td>
</tr>
<tr>
<td></td>
<td>1 GbE LOM management port</td>
</tr>
<tr>
<td>Disk Controllers</td>
<td>LSI 3516 RAID controller</td>
</tr>
<tr>
<td>Disk</td>
<td>Storage disks:</td>
</tr>
<tr>
<td></td>
<td>▪ 8 × 1.8 TB SAS</td>
</tr>
<tr>
<td></td>
<td>▪ 2 × 128 GB MLC SATADOM for operating system</td>
</tr>
<tr>
<td>Racks</td>
<td>42 U rack</td>
</tr>
<tr>
<td>Number of Master Nodes</td>
<td>Depends on the implementation. Minimum of 3 master nodes for up to 100 worker nodes. Increment by 2 master nodes for every 100 worker nodes</td>
</tr>
</tbody>
</table>

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- 4 × RAID-10 — DB file systems
- 2 × RAID-1 — HDFS NameNode metadata
- 1 × JBOD — Apache ZooKeeper
- 1 × JBOD — Quorum journal node

Unlike data nodes, master nodes can be connected to the data network and the client network. Provide a second NIC to isolate the data network and the client network traffic.

If other software needs a master node, review the requirements for that software before designing that node.

**Worker Node**

Worker nodes process the data. These nodes have very diverse needs with many different configurations and software products running on the nodes.

Table 3, "Hitachi Advanced Server DS120 Worker Node Configuration Options," on page 9 shows the Hitachi Advanced Server DS120 worker node configuration options. Table 4, "Hitachi Advanced Server DS220 Worker Node Configuration Options," on page 9 shows the Advanced Server DS220 worker node configuration.
### TABLE 3. HITACHI ADVANCED SERVER DS120 WORKER NODE CONFIGURATION OPTIONS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Model</td>
<td>Hitachi Advanced Server DS120</td>
</tr>
<tr>
<td>CPU</td>
<td>2 Intel 4110 processors, 8-core, 2.1 GHz</td>
</tr>
<tr>
<td>Memory Options</td>
<td>256 GB: 8 × 32 GB DDR4 R-DIMM, 2666 MHz RAM</td>
</tr>
<tr>
<td>Network Connections</td>
<td>Intel XXV710 10 GbE, dual port SFP28 (LP-MD2)</td>
</tr>
<tr>
<td></td>
<td>1 GbE LOM management port</td>
</tr>
<tr>
<td>Disk Controllers</td>
<td>LSI 3516 RAID controller</td>
</tr>
<tr>
<td>Disks</td>
<td>12 × 1.8 TB SAS</td>
</tr>
<tr>
<td></td>
<td>2 × 128 GB MLC SATADOM for operating system</td>
</tr>
<tr>
<td>Racks</td>
<td>42 U rack</td>
</tr>
<tr>
<td>Number of Servers</td>
<td>Up to 36 Servers per rack</td>
</tr>
</tbody>
</table>

### TABLE 4. HITACHI ADVANCED SERVER DS220 WORKER NODE CONFIGURATION OPTIONS

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>Hitachi Advanced Server DS220</td>
</tr>
<tr>
<td>CPU</td>
<td>2 Intel 4110 processors, 8-core, 2.1 GHz</td>
</tr>
<tr>
<td>Memory Options</td>
<td>256 GB: 8 × 32 GB DDR4 R-DIMM, 2666 MHz RAM</td>
</tr>
<tr>
<td>Network Connections</td>
<td>Intel XXV710 10 GbE dual port SFP28 (LP-MD2)</td>
</tr>
<tr>
<td></td>
<td>1 GbE LOM management port</td>
</tr>
<tr>
<td>Disk Controllers</td>
<td>LSI 3516 RAID controller</td>
</tr>
<tr>
<td>Disks</td>
<td>Storage disks:</td>
</tr>
<tr>
<td></td>
<td>12 × 1.8 TB SAS</td>
</tr>
<tr>
<td></td>
<td>12 × 6 TB SATA</td>
</tr>
<tr>
<td></td>
<td>12 × 8TB SATA</td>
</tr>
<tr>
<td></td>
<td>DFP operating system</td>
</tr>
<tr>
<td>Racks</td>
<td>42 U rack</td>
</tr>
<tr>
<td>Number of Servers</td>
<td>Up to 18 servers per rack</td>
</tr>
</tbody>
</table>
Configure the storage for the worker node as the following:

- 2 × RAID-1 — Operating system (boot disk)
- 12 × JBOD

**Edge Node**

An edge node resides on both the client network and the data network and initiates processing to Hortonworks Data Platform. This multi-homed node acts either as a gateway or runs software that needs access to the Hortonworks environment and client systems. Master nodes connected to both networks are a type of edge node.

Depending on the work being performed and what other software is running on the edge node, the configuration can vary significantly. In this reference architecture, an edge node uses either a master or worker node configuration. These nodes are usually multi-homed, connecting to the client network and data network. Add a second Intel XXV710 NIC to this node configuration.

The number and type of edge nodes depends on the software you need when you implement this solution. The following are possible example edge nodes:

- **Gateway node**
  - Allows for access to both client and data network
  - Runs Hadoop client processes
  - Place data transfer nodes, such as Sqoop on edge nodes.

- **Pentaho node**
  - Transfer data from existing sources into Hadoop
  - Execute Hadoop data reports

Other possibilities include edge nodes for SAP HANA or Oracle. This architecture does not limit you.

**Hardware Management Server (Optional)**

You can include an optional hardware management server in your solution implementation. This server provides access to the out-of-band management network.

Table 5 lists the hardware used for the optional management server.

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chassis</td>
<td>Hitachi Advanced Server DS120</td>
</tr>
<tr>
<td>CPU</td>
<td>1 Intel 4110 processor, 8-core; 2.1 GHz;</td>
</tr>
<tr>
<td>Memory Options</td>
<td>64 GB: 2 × 32 GB DIMMs</td>
</tr>
<tr>
<td>Network Connections</td>
<td>2 Intel XXV710 10 GbE dual port</td>
</tr>
<tr>
<td></td>
<td>1 GbE LOM management port</td>
</tr>
</tbody>
</table>
Network Architecture

This solution uses three logical networks. There can be multiple network configurations, depending on the Apache Hadoop deployment.

Figure 4 shows one of the possible configurations.

- **Client Network** — Client access to edge nodes
- **Data Network** — Communication between nodes
- **Management Network** — Management of hardware

### TABLE 5. HARDWARE MANAGEMENT SERVER (CONTINUED)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disk Controllers</td>
<td>Intel RTEs on mother board</td>
</tr>
<tr>
<td>OS</td>
<td>2 × 128 GB SATADOM configured as RAID-1</td>
</tr>
<tr>
<td>Storage</td>
<td>No separate storage is needed.</td>
</tr>
</tbody>
</table>
The network architecture has these components:

- “Switches” on page 12
- “Data Network” on page 13
- “Client Network (Optional)” on page 13
- “Management Network” on page 13

**Switches**

This solution requires the following three types of switches:

- **Leaf Data Switches — Cisco Nexus 93180YC-E/FX**

  These leaf data switches connect all nodes in a rack together. Then, uplink the leaf switches to the spine data switches.

  Connect two switches together using stacking. This lets both switches act as one single logical switch. If one switch fails, there still is a path to the hosts.
**Spine Data Switches — Cisco Nexus 93180LC-EX**

These spine data switches interconnect leaf switches from different racks.

Connect two switches together using an inter-switch link (ISL). This lets both switches act together as a single logical switch. If one switch fails, there still is a path to the hosts. Used in multi-rack configurations. Leaf data switches are connected to the spine using a redundant 100 GbE link.

One set of spine switches supports 12 racks of 36 Hitachi Advanced Server DS120 nodes or 18 Advanced Server DS220 nodes.

**Leaf and Spine Management Switches — Cisco Nexus 3048**

These leaf and spine switches connect the management ports of the hardware to the management server. When there is more than one rack, use a spine switch to connect all the management leaf switches together. The management network is uplinked to the inhouse management network.

**Data Network**

Use the data network for communication between the nodes.

Provide redundancy with two network interfaces configured at the operating system level to use the active-active network-bonding mode.

The standard configuration has up to 36 Hitachi Advanced Server DS120 nodes on the data network for each rack. This provides an oversubscription ratio of 2.25:1.

The standard configuration has up to 18 Hitachi Advanced Server DS220 nodes on the data network for each rack. This provides an oversubscription ratio of 1.175:1.

For systems with heavy network usage, dropping the number of nodes per rack to 16 provides a ratio of 1:1.

**Client Network (Optional)**

The client network is an optional network that could be multi-homed, used on edge nodes. Data nodes are not multi-homed, so they do not connect to the client network.

Depending on the components being installed, master nodes may be multi-homed, connecting to the data network and client network. This separates the Hadoop internode traffic from the rest of the client network traffic.

**Management Network**

The management network allows for access to the nodes using the 1 GbE LAN on motherboard (LOM) interface. This network provides out of band monitoring and management of the servers. You can uplink this network to the client network.

**Deployment Options**

There are many types of workloads that all have different hardware and software requirements. Even though there are different workloads and deployment options, for enterprise solutions there may be a slight difference in the hardware used for the different Hitachi Data Platform components.

**Storage Intensive Workload**

A storage-intensive workload is when the number one concern is the amount of storage for each rack. In this type of solution, the total storage outweighs the other considerations. Solutions using very large disks are suited for this workload.
- **Balanced Workload**
  A balanced workload is a good default to use in planning your solutions. It assumes that there is no one item that will always be the bottleneck. And, it is a good starting point when the workload is not known.

- **Compute Intensive**
  These solutions usually need a higher number of CPUs and memory-to-storage ratio. This is a good fit for using Hitachi Advanced Server DS120. By using smaller storage devices, larger amounts of memory, and by having more nodes, this will have more CPUs available.

- **I/O Intensive**
  A I/O-intensive solution stores less data per disk and node. It is also a good fit for using Hitachi Advanced Server DS120. This solution allows for more nodes in a rack.

**Rack Configurations**
This optimized infrastructure for big data analytics with Hortonworks from Hitachi Vantara comes in these different rack configurations:

- “Three-rack Configuration with Hitachi Advanced Server DS120” on page 16
- “Three-rack Configuration with Hitachi Advanced Server DS220” on page 18

**Single Rack Configuration**
Figure 5 on page 15 shows a single rack configuration using Hitachi Advanced Server DS120 or Advanced Server DS220 with the following components:

- Top-of-rack data and management switches
- 3 master nodes
- 1 edge node
- 9 worker nodes
  - Advanced Server DS120 worker node configuration
    - 2 Intel 4110 processors
    - 368 GB RAM
    - 12 × 1.8 TB SAS drives
  - Advanced Server DS220 worker node configuration
    - 2 Intel 4110 processors
    - 368 GB RAM
    - 12 × 8 TB SATA drives
**Multiple Rack Configuration**

There are two multiple rack configurations shown:

- “Three-rack Configuration with Hitachi Advanced Server DS120” on page 16
- “Three-rack Configuration with Hitachi Advanced Server DS220” on page 18

**Three-rack Configuration with Hitachi Advanced Server DS120**

Figure 6 on page 17 shows a sample three-rack configuration using Hitachi Advanced Server DS120.

- **Rack 1**
  - Top-of-rack data and management switches
  - 1 hardware management node
  - 5 master nodes
  - 4 edge nodes
  - 27 worker nodes

- **Rack 2:**
  - Top-of-rack data and management switches
  - Spine data and management switches
  - 36 worker nodes

- **Rack 3**
  - Top-of-rack data and management switches
  - 36 worker nodes

The Advanced Server DS120 worker node configuration for this example is the following:

- 2 Intel 4110 processors
- 368 GB RAM
- 12 × 1.8 TB SAS drives

This sample environment has the following total resources:

- 99 worker nodes
- 198 CPUs
- 36432 GB RAM
- 2138.4 TB raw data storage

Spine switches will often be placed in separate or existing network racks. When doing so, the recommendation is to have each pair of spine data switch in separate racks to protect from stack failure. For completeness sake, the spine switches are shown in these racks.
This design has the master node and edge nodes in the same rack, co-existing with data node. Other implementations could have dedicated racks for master nodes and edge nodes, or have master nodes and edge nodes spread across multiple racks.

Figure 6
Three-rack Configuration with Hitachi Advanced Server DS220

Figure 7 on page 19 shows a sample three-rack configuration using Hitachi Advanced Server DS220.

- Rack 1
  - Top-of-rack data and management switches
  - 5 master nodes
  - 4 edge nodes
  - 9 worker nodes
- Rack 2
  - Top-of-rack data and management switches
  - 18 worker nodes
- Rack 3
  - Top-of-rack data and management switches
  - 18 worker nodes

This is the Advanced Server DS220 worker node configuration:

- 2 Intel 4110 processors
- 368 GB RAM
- 12 × 8 TB SATA drives

This sample environment has the following total resources:

- 45 worker nodes
- 90 CPUs
- 16560 GB RAM
- 4320 TB raw data storage
Validation

There are many different configurations of both hardware and software that can be used in this solution. A basic validation of this solution was done in Hitachi Vantara's lab environment. This was tested with Hortonworks Data Platform v2.6.4. The operating system for this test is Red Hat Enterprise Linux v7.3. Ambria was installed on a master node, using it to deploy a basic HDFS configuration in a small cluster. The standard map reduce word count example was run to verify functionality.
For More Information

Hitachi Vantara Global Services offers experienced storage consultants, proven methodologies and a comprehensive services portfolio to assist you in implementing Hitachi products and solutions in your environment. For more information, see the Services website.

Demonstrations and other resources are available for many Hitachi products. To schedule a live demonstration, contact a sales representative or partner. To view on-line informational resources, see the Resources website.

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