

DELL POWEREDGE C6220 AND CENTOS 6.2: A LAMP REFERENCE ARCHITECTURE



A Principled Technologies Reference Architecture commissioned by Dell Inc.

WHAT YOU WILL LEARN

- The features and advantages of the Dell PowerEdge C6220
- How to install the CentOS 6.2 operating system on the Dell PowerEdge C6220
- How to install the LAMP Web-application stack on CentOS
- How to configure the LSI MegaRAID 9265-8i storage controller

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EXECUTIVE SUMMARY

With the dominance of cloud computing in today's marketplace, companies require a reliable and powerful platform on which to deliver their cloud and application services. The massive data centers designed to provide cloud computing services require a large number of servers that are efficient, powerful, flexible, and are easy to maintain. Software must be low cost, feature laden, and easy to integrate. Using a low-cost operating system paired with the Dell PowerEdge C series servers can allow service providers and other companies to deliver high-quality and efficient applications to their customers.

Dell designed the Dell PowerEdge C series, which includes the Dell PowerEdge C6220, specifically to meet the needs of these organizations that need to deploy large-scale environments. In this reference architecture, we look at some of the many benefits that the Dell PowerEdge C6220 server can bring to large deployments and describe in detail the setup of a common configuration: CentOS running on the Dell PowerEdge C6220.

Organizations often use open-source Linux-based operating systems, such as CentOS, in these hyper-scale environments due to their price point, flexibility, ease of management, and performance capabilities. These operating systems offer many built-in application stacks, hypervisors, and other features that allow organizations to offer their customers a comprehensive set of services. In this document, we walk you through the task of deploying one such operating system, CentOS Server, and the Linux/Apache/MySQL/PHP (LAMP) application stack on one node of the PowerEdge C6220, from start to finish.

The Dell PowerEdge C6220 server

The Dell PowerEdge C6220 server features up to four independent 1U hot-swappable, two-socket server nodes that each harness the power of the Intel® Xeon® processor E5-2600 series to maximize performance for hyper-scale environments. Designed for flexibility, the multiple independent server nodes allow you to mix and match workloads on different servers within the same chassis. If your requirements demand it, configurations are available that feature just two independent 2U nodes, with greater I/O capacity. The high performance levels it delivers, coupled with a simple, modular, and easy-to-maintain design, make the Dell PowerEdge C6220 an optimal choice for large software as a service (SaaS) and cloud deployments. Figure 1 presents a 1U server node of the Dell PowerEdge C6220.

The Dell PowerEdge C6220 is available with multiple storage controller options, such as onboard storage with the Intel C600 chipset, the LSISAS2008 6Gb SAS mezzanine

card, or the LSI MegaRAID SAS 9265-8i RAID controller. For this installation guide we used the LSI MegaRAID SAS 9265-8i add-in RAID controller.

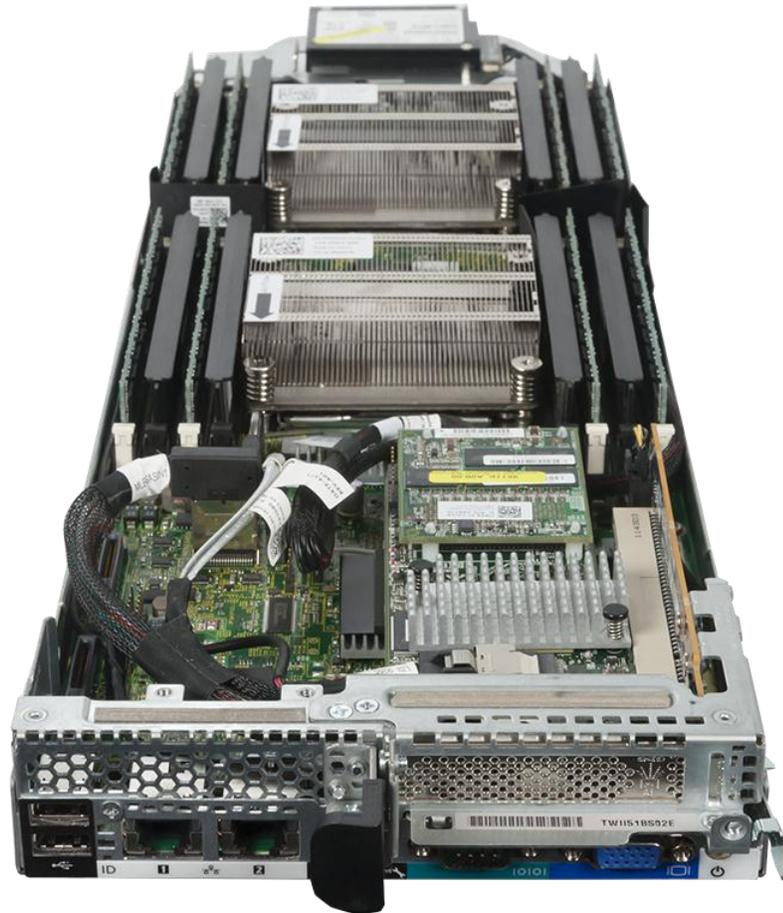


Figure 1: 1U server node of the Dell PowerEdge C6220 with the LSI MegaRAID SAS 9265-8i storage controller.

The Dell PowerEdge C6220 can deliver many benefits to your large deployment, and lets you:

- Make better use of expensive data center space by increasing the rack density with four two-socket server nodes fitting into a standard 2U rack slot.
- Configure servers to better fit application and workload needs for increased performance without reconfiguring your chassis and rack layout. You can easily use 1U nodes in a four-node configuration or 2U nodes in a two-node configuration. Additionally, an optional expandable

backplane allows for adjustable disk and assignment and storage configurations.

- Reuse or repurpose servers easily when workloads change with hot-swap server nodes – you no longer need to experience downtime by replacing the entire server chassis.

Designed with power-efficiency in mind to help reduce energy costs, the Dell PowerEdge C6220 utilizes dynamic HDD allocation for better resource utilization, and maximizes operating efficiency with a shared-infrastructure design. The Dell PowerEdge C6220 also offers different drive options, so you can allocate storage to the workloads that need it. To learn more about the Dell PowerEdge C6220 and the entire Dell PowerEdge C Series, visit

<http://www.dell.com/us/enterprise/p/poweredge-cloud-servers>.

Storage and expansion specifications

The Dell PowerEdge C6220 features the following specifications:

- Hard disk
 - SATA, SAS, and SSD options
 - Maximum raw storage capacity of 24TB across four nodes when using SATA drives
 - 2.5” or 3.5” drive form factor
- Available storage controllers
 - Intel C600 chipset for onboard storage options with SATA and SSD
 - LSI SAS2008 6Gb SAS mezzanine card
 - LSI MegaRAID SAS 9265-8i add-in RAID controller, which we used for this installation guide
- Expansion slots
 - The PowerEdge C6220 four-node configuration has one x8 expansion slot and one x16 expansion slot per node.
 - The PowerEdge C6220 two-node configuration has one x8 expansion slot and two x16 expansion slots per node.

About CentOS Server

Community ENTERprise Operating System, commonly known as CentOS, is an open-source Linux-based operating system designed to provide organizations with an enterprise-class computing platform that is free to use. CentOS incorporates numerous advanced operating system features such as virtualization capabilities, enhanced

memory management capabilities, and ext4 file system support. For more information about CentOS, visit <http://www.centos.org/>.

INSTALLING CENTOS ON THE DELL POWEREDGE C6220

Prerequisites

BIOS requirements

When installing CentOS 6.2 (64-bit), we used the default factory BIOS setting for the server. Based on your workload requirements, BIOS settings may require adjustment, but you should thoroughly test these changes prior to production implementation.

Driver prerequisites

In our lab installation, we used a Dell PowerEdge C6220 with the LSI MegaRAID SAS 9265-8i RAID controller. Using this storage controller, CentOS installs and runs without extra hardware drivers or software modules on the Dell PowerEdge C6220.

Installation

Deployment options

We recognize in mass deployment situations there are various options for OS deployment including Preboot eXecution Environment (PXE) or orchestration tools such as Puppet. For this guide, however, we wish to prepare our “gold image” for CentOS on a single Dell PowerEdge C6220 server node. To do this, we used its embedded baseboard management controller (BMC) console and virtual installation media.

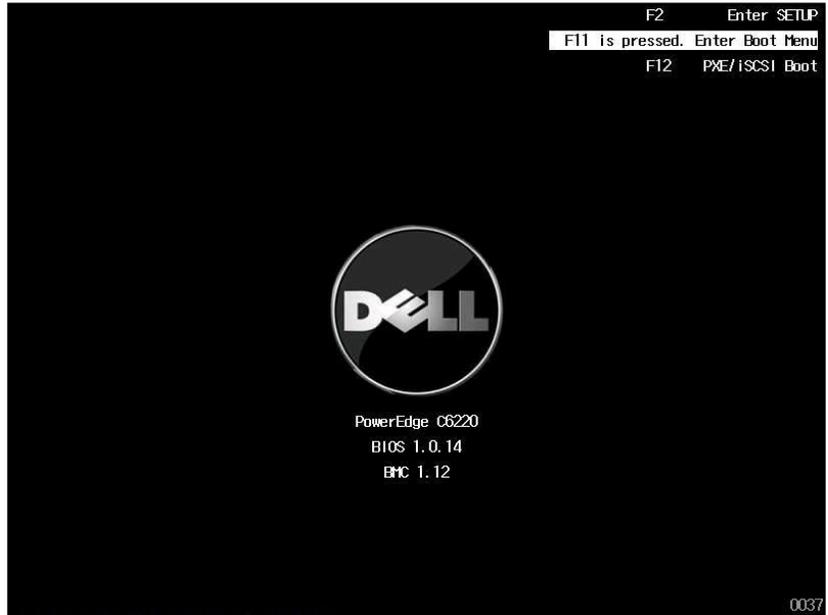
Storage configuration

The Dell PowerEdge C6220 can use several storage controllers to guard against disk failures. For this guide, we assume that we wish to change the disk configuration from the factory installation. We created one RAID6 virtual disk using the LSI MegaRAID SAS 9265-8i RAID controller and the six 900GB internal hard drives assigned to the server. We partitioned for the virtual disk for both OS and application data. Detailed instructions on how to configure the storage controller are in [Appendix C](#).

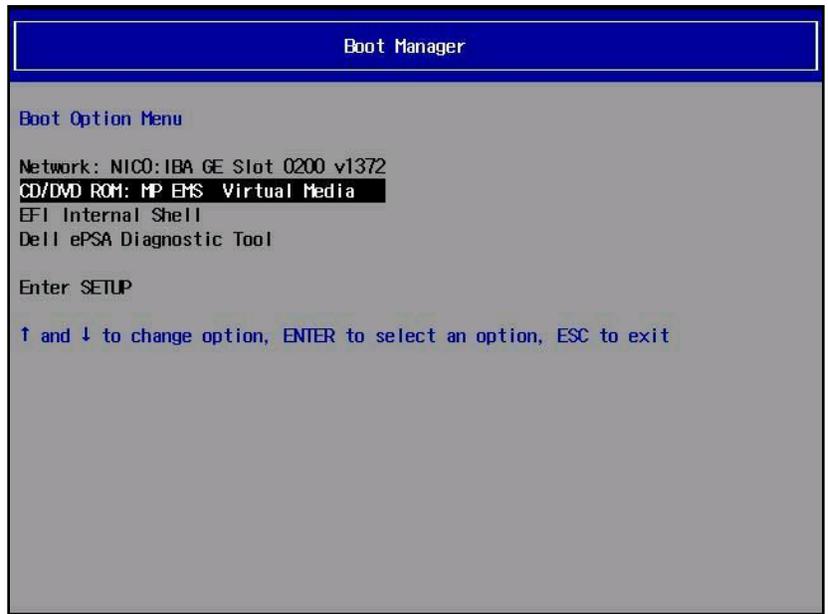
Installing the operating system

1. Using the BMC, assign the CentOS-6.2-x86_64-bin-DVD1 installation DVD to the node and start the server.

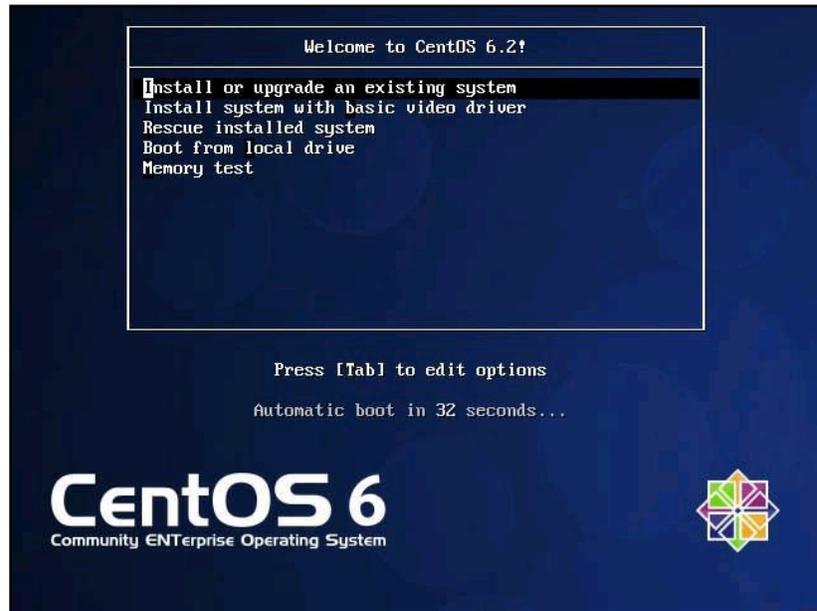
2. At the Dell PowerEdge C6220 Start Up screen, press F11 to select the boot device.



3. On the Boot Manager screen, select the device with the CentOS boot media; e.g., the CD/DVD virtual device.



4. At the CentOS 6.2 welcome screen, select Install or upgrade an existing system, and press Enter.



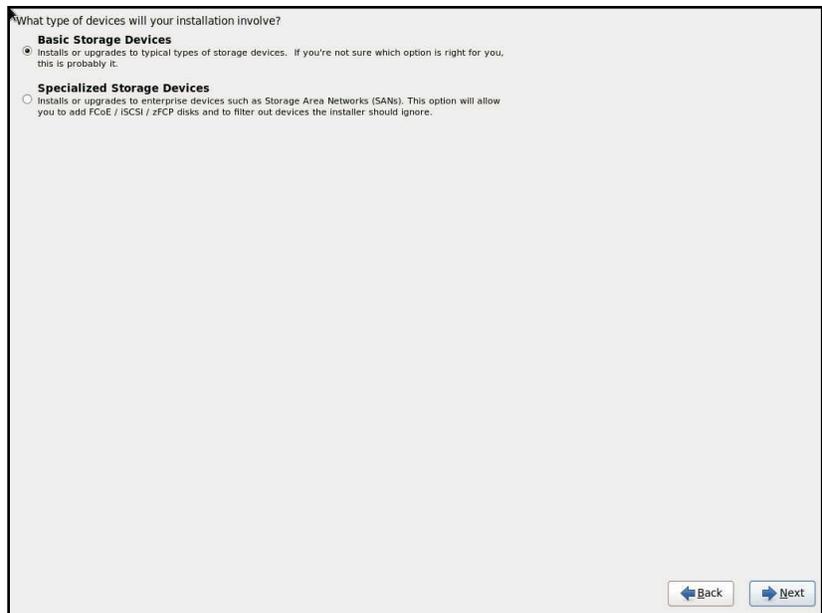
5. At the Media test screen, select Skip, and press Enter.



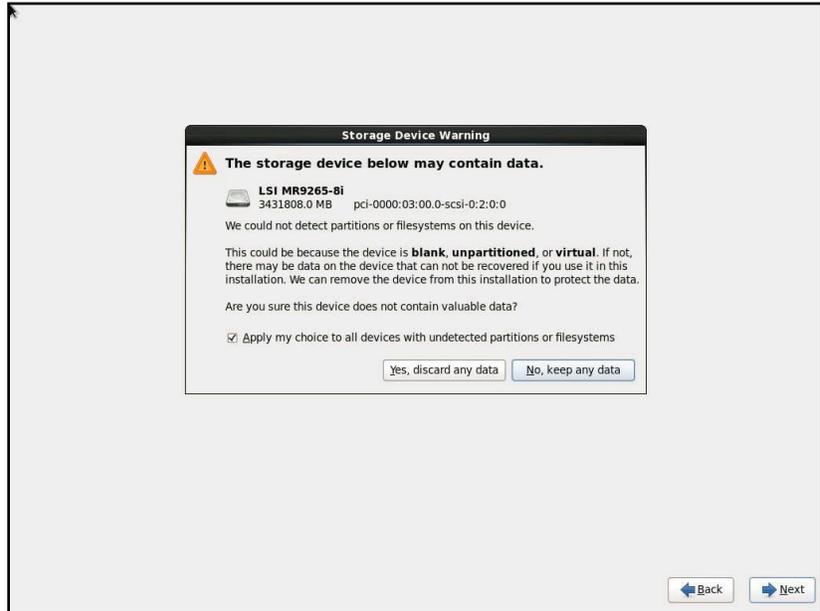
6. At the CentOS 6 title screen, click Next.



7. At the Choose an Installation Language screen, select English, and click Next.
8. At the Keyboard Type screen, select U.S. English, and click Next.
9. At the Storage Devices screen, select Basic Storage Devices, and click Next.

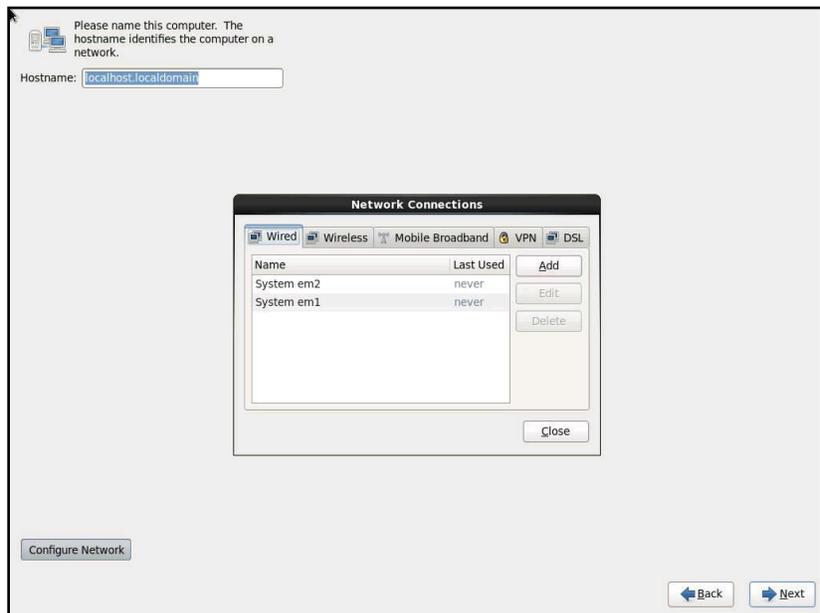


10. If a warning for device initialization appears, select Yes, discard any data.



11. At the Name the Computer screen, type the host name, and click Configure Network.

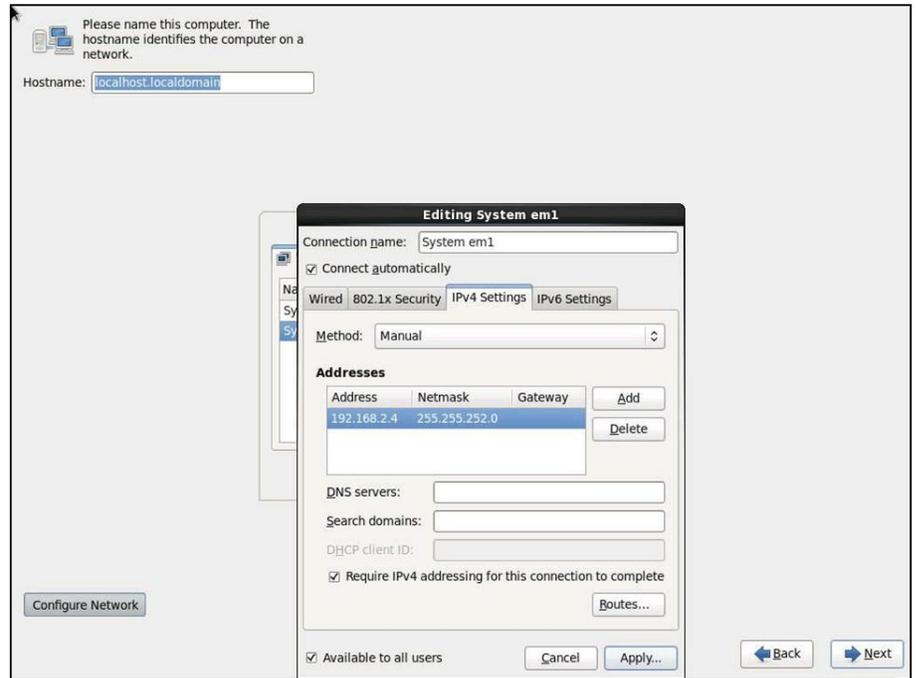
12. At the Network Connections screen, select the server's main or management network interface, and click Edit.



13. At the Editing network interface screen, check Connect Automatically.

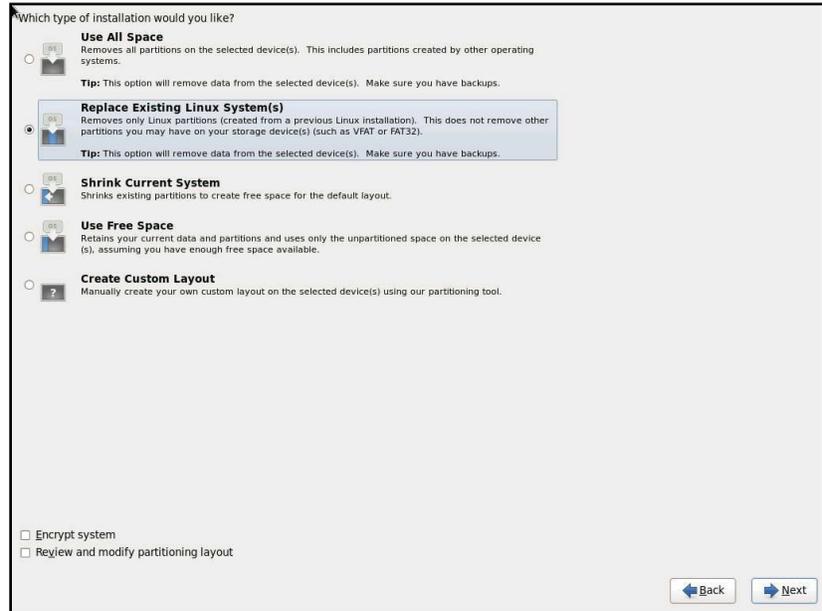
14. On the same screen, Select the IPv4 Settings tab, change the Method to Manual, and click Add.

15. On the same screen, enter the IP address, Netmask, Gateway, and DNS server. Click Apply.

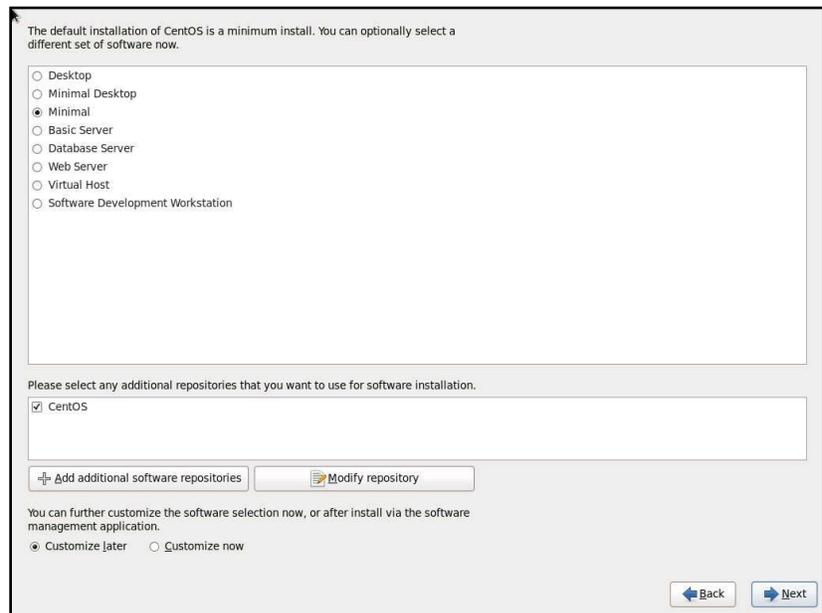


16. Click Close on the Network Connections screen, and click Next on the Name the Computer screen.
17. At the Time zone selection screen, select the appropriate time zone, and click Next.
18. Enter the root password in the Root Password and Confirm fields, and click Next.

19. At the Partition selection screen, select Replace Existing Linux System(s), and click Next.



20. If a warning appears, click Write changes to disk.
21. At the default installation screen, Select Minimal and click Next to begin the installation.



22. At the Congratulations screen, click Reboot.
23. After the system reboots, open a console window and login in as root.

24. Disable SELinux by editing the file `/etc/selinux/config`, and change the line `SELINUX=enforcing` to `SELINUX=disabled`. This change will take effect after rebooting.

25. Disable these unused services by running the following command-line script:

```
CHK_OFFs="auditd autofs cups ip6tables iptables\  
nfslock netfs portreserve postfix qpid rhnsd\  
rhsmcertd rpcgssd rpcidmapd rpcbind"  
for i in ${CHK_OFFs}; do  
    chkconfig $i off  
    service $i stop  
done > /dev/null 2>&1
```

26. Update the operating system with patches and security fixes using yum.

```
yum update
```

27. Reboot the server.

INSTALLING THE LAMP STACK ON CENTOS AND THE DELL POWEREDGE C6220

The LAMP stack – An overview

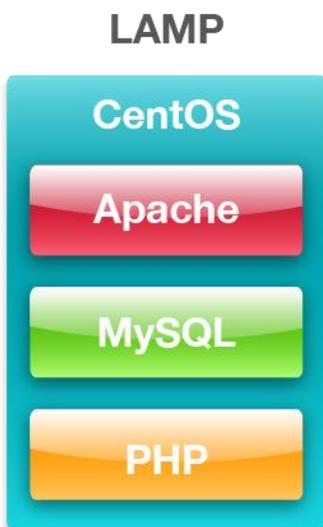
LAMP describes the components of a possible multi-tier software stack that an infrastructure may run: the Linux operating system, Apache Web server, MySQL database, and PHP scripting language. This application stack has been used for years by service providers to provide powerful and flexible multi-tier environments for customers. Below, we briefly describe each component and then review the specific methods for setting up a single-server LAMP stack on the Dell PowerEdge C6220.

Apache

Apache HTTP Server is an open-source Web server application that includes such features as Secure Sockets Layer and Transport Layer Security support, filtering support, and custom log files. For more information, visit <http://www.apache.org/>.

MySQL

MySQL is an open-source database that delivers high performance, high reliability, and is easy to use. Running on more than 20 operating system platforms and providing a range of database tools, MySQL delivers flexibility and performance to large-scale deployments. For more information about MySQL, visit <http://www.mysql.com/>.



PHP

PHP is a Web scripting language that can be embedded into HTML source documents instead of using an external file to process data. The Web server interprets the PHP code to generate a Web page. For more information about PHP, visit <http://www.php.net/>.

Installation procedure

Installing Apache Web Server

1. Log onto the CentOS server as root.
2. Install the Apache Web Server application packages and their dependencies:

```
yum install @web-server
```

Installing MySQL Database

1. Log in as root.
2. Install the MySQL application packages and their dependencies

```
yum install @mysql @mysql-client
```

Installing PHP Scripting Language

1. Install the application packages and their dependencies:

```
yum install @php php-mysql
```

Testing with a sample LAMP application

To complete the LAMP deployment, we create a sample LAMP application consisting of a test database with test data, a PHP script which creates a dynamic Web page that prints the contents of a SQL query from the database. In this case, we demonstrate using the well-known “Hello World” example.

1. Log onto the CentOS server as root.
2. Start the MySQL database instance.

```
service mysqld start  
chkconfig mysqld on
```

3. Run the `mysql_secure_installation` utility to modify MySQL’s default settings and set the instance’s root password to “RootPassword” (It is initially unset).

```
mysql_secure_installation
```

4. Using the `mysql` client, create a test database, a test application user, and set privileges:

```
mysql --user root --password=RootPassword  
mysql> USE mysql;
```

```
mysql> CREATE DATABASE helloworlddb;
mysql> CREATE USER testappuser@localhost IDENTIFIED BY
'Password1';
mysql> GRANT ALL ON helloworlddb.* TO
testappuser@localhost;
mysql> FLUSH PRIVILEGES;
```

5. Exit the mysql client utility.
6. Using the mysql client, login as the test application user to the newly created database and create a sample schema definition. In our case, this is just one table with one column.

```
mysql --user testappuser --password=Password1
mysql> USE helloworlddb;
mysql> CREATE TABLE tbl_hello_world (testcol CHAR(100));
mysql> INSERT INTO tbl_hello_world (testcol) VALUES
("Hello World");
```

7. Exit the mysql client utility.
8. In the Apache Web data directory, located by default on CentOS at `/var/www/html/`, create a new file named `helloworld.php` that will query the database and print the results. See [Appendix D](#) for this sample PHP file contents.

9. Start the Web server.

```
service httpd start
chkconfig httpd on
```

10. From another machine, verify the page is operational by visiting http://server_ip_address/helloworld.php

SUMMING IT ALL UP

The Dell PowerEdge C6220 server and the Linux-based CentOS operating system provide the power and features you need to deploy multiple, enterprise-class workloads in a large-scale cloud services environment. By increasing rack density, eliminating downtime with hot-swappable server nodes, and removing the cost of OS licenses and upgrade fees, running CentOS on the Dell PowerEdge C6220 can have a great effect on your organization's bottom line, all while delivering top-of-the-line workload performance for your cloud and SaaS users. As we have shown in this guide, deploying the Dell PowerEdge C6220 with CentOS is a simple, straightforward task that can bring many benefits to your cloud environment.

APPENDIX A – REFERENCES

1. LSI MegaRAID SAS 9265-8i product description:
<http://www.lsi.com/products/storagecomponents/Pages/MegaRAIDSAS9265-8i.aspx>
2. CentOS documentation: <http://www.centos.org/>
3. Dell Support page: <http://support.dell.com>

APPENDIX B – DELL POWEREDGE C6220 SYSTEM DETAILS

Figure 2 presents the server configuration we used for this guide.

System	Dell PowerEdge C6220
Power supplies (per chassis)	
Total number	2
Vendor and model number	Dell Model : D1200E-S1
Wattage of each (W)	1400
Cooling fans (per chassis)	
Total number	4
Vendor and model number	Dell FHXY-A00
Dimensions (h x w) of each	2.5" x 2.5"
Volts	12
Amps	3.30
General	
Number of processor packages	2
Number of cores per processor	6
Number of hardware threads per core	2
System power management policy	Balanced
CPU	
Vendor	Intel
Name	Xeon
Model number	E5-2630
Stepping	7
Socket type	LGA2011
Core frequency (GHz)	2.30
Bus frequency	7.2 GT/s
L1 cache	32 KB + 32 KB (per core)
L2 cache	256 KB (per core)
L3 cache	15 MB
Platform	
Vendor and model number	Dell PowerEdge C6220
Motherboard model number	E145483
BIOS name and version	Dell 1.0.14
BIOS settings	Defaults
Memory module(s)	
Total RAM in system (GB)	32
Vendor and model number	Hynix HMT351R7BFR8A-H9
Type	PC3-10600R
Speed (MHz)	1,333
Speed running in the system (MHz)	1,333
Timing/Latency(tCL-tRCD-tRP-tRASmin)	9-9-9-36

System	Dell PowerEdge C6220
Size (GB)	4
Number of RAM module(s)	8
Chip organization	Double-sided
Rank	Dual
Operating system	
Name	CentOS 6.2
File system	ext4
Kernel	2.6.32-220.13.1.el6.x86_64
Language	English
Updates	All as of 4/12/2012
Graphics	
Vendor and model number	ASPEED VGA Controller
Graphics memory (MB)	8
RAID controller	
Vendor and model number	LSI MegaRAID SAS 9265-8i
Firmware version	3.120.5-1169
Cache size	1 GB
Driver module and version	LSI MegaRAID SAS Driver: megaraid_sas, 00.00.05.40-rh2
Internal hard drive	
Vendor and model number	Seagate ST9900805SS
Number of disks in system	6
Size (GB)	900
Buffer size (MB)	64
RPM	10K
Type	6GB SAS
Ethernet adapters	
Vendor and model number	I350 Gigabit Network Connection
Type	Integrated
USB ports	
Number	2 external, 1 internal
Type	2.0

Figure 2: Detailed configuration information for the Dell PowerEdge C6220 we used for this guide.

APPENDIX C – LSI MEGARAID SAS 9265-8I STORAGE CONFIGURATION

Below, we provide the detailed instructions for creating one RAID6 virtual disk using the LSI MegaRAID SAS 9265-8i RAID controller and the six 900GB internal hard drives assigned to the server.

1. Connect to the server console.
2. Boot the server and press Ctrl-H on the controller screen to enter the device's graphical interface.

```
LSI MegaRAID SAS-MFI BIOS
Version 5.14.00 (Build January 19, 2011)
Copyright(c) 2011 LSI Corporation
HA -0 (Bus 3 Dev 0) LSI MegaRAID SAS 9265-8i
FW package: 21.0.1-0100

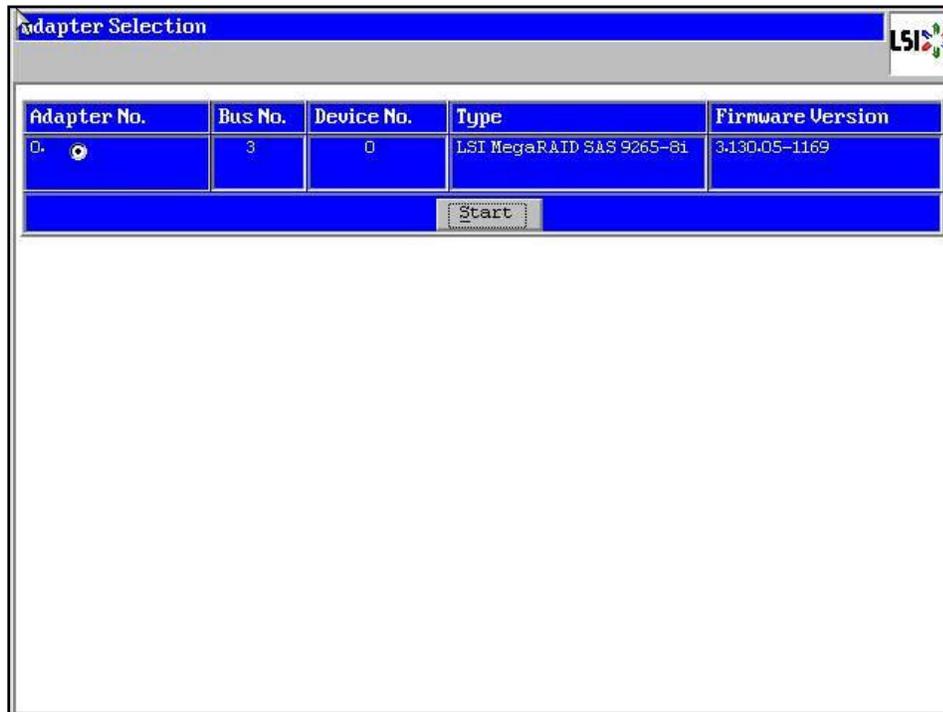
Battery Status: Fully charged

PCI SLOT ID LUN VENDOR PRODUCT REVISION CAPACITY
-----
0          0          LSI      LSI MegaRAID SAS 9265-8i 3.130.05-1024MB
0          10 0      SEAGATE ST9900005SS CS05 858483MB
0          11 0      SEAGATE ST9900005SS CS05 858483MB
0          18 0      SEAGATE ST9900005SS CS05 858483MB
0          19 0      SEAGATE ST9900005SS CS05 858483MB
0          20 0      SEAGATE ST9900005SS CS05 858483MB
0          21 0      SEAGATE ST9900005SS CS05 858483MB

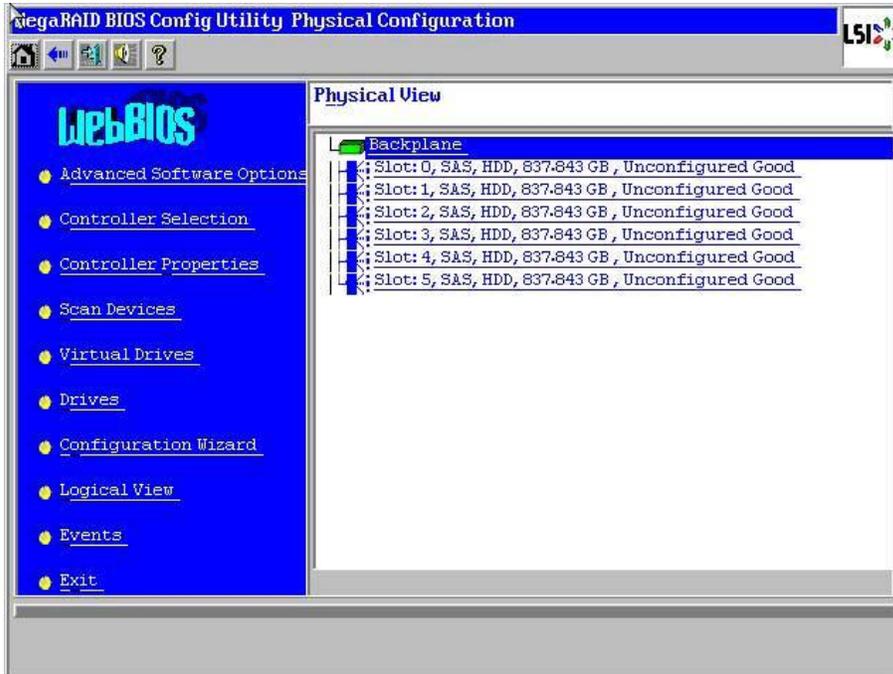
0 JBOD(s) found on the host adapter
0 JBOD(s) handled by BIOS

0 Virtual Drive(s) found on the host adapter.
0 Virtual Drive(s) handled by BIOS
Press <Ctrl><H> for WebBIOS or press <Ctrl><Y> for Preboot CLI
```

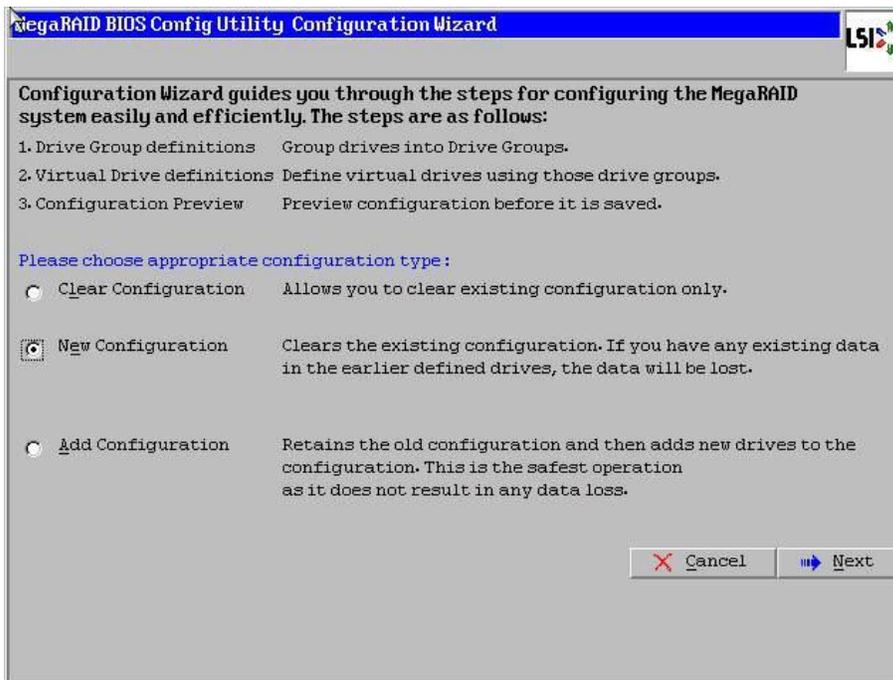
3. On the Adapter Selection screen, select the LSI MegaRAID SAS 9265-8i adaptor and click Start.



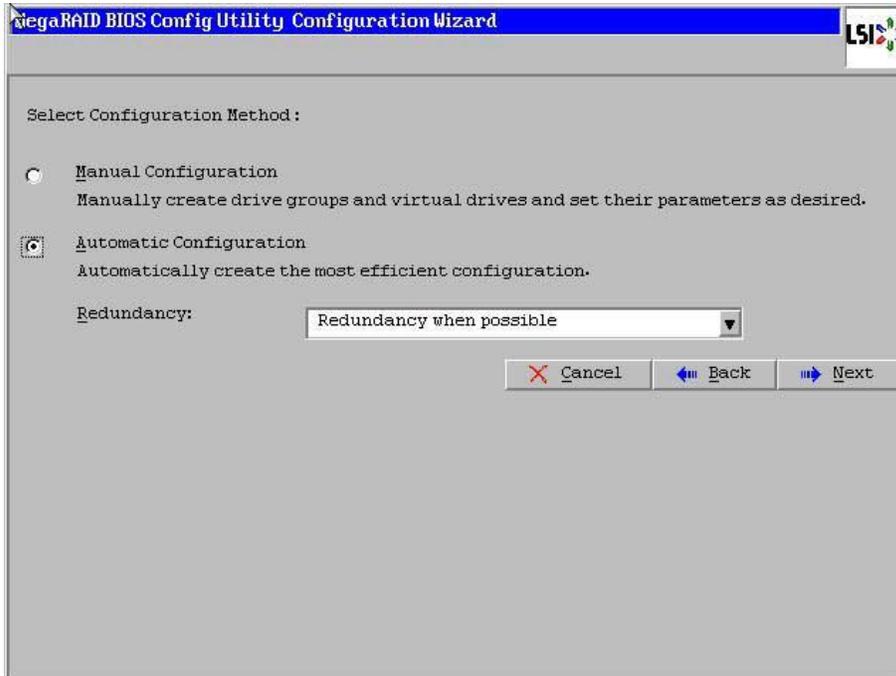
4. On the MegaRAID BIOS Home screen, click on Configuration Wizard.



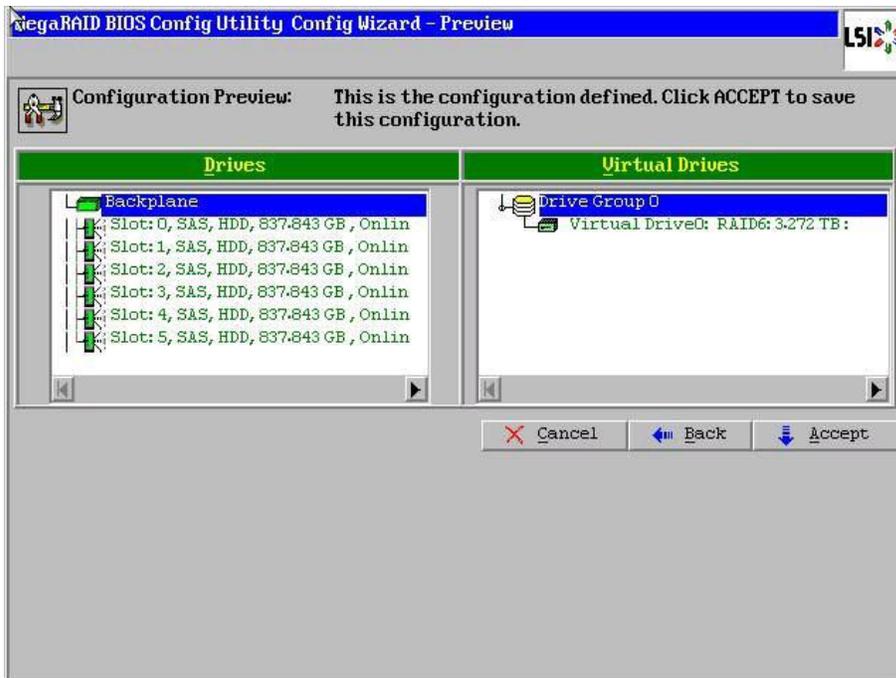
5. On the first Configuration Wizard screen, select New Configuration, and click Next.



6. On the Confirm Page, click Yes to clear the storage configuration.
7. On the Select Configuration Method screen, select Automatic Configuration and Redundancy when possible. Click Next.

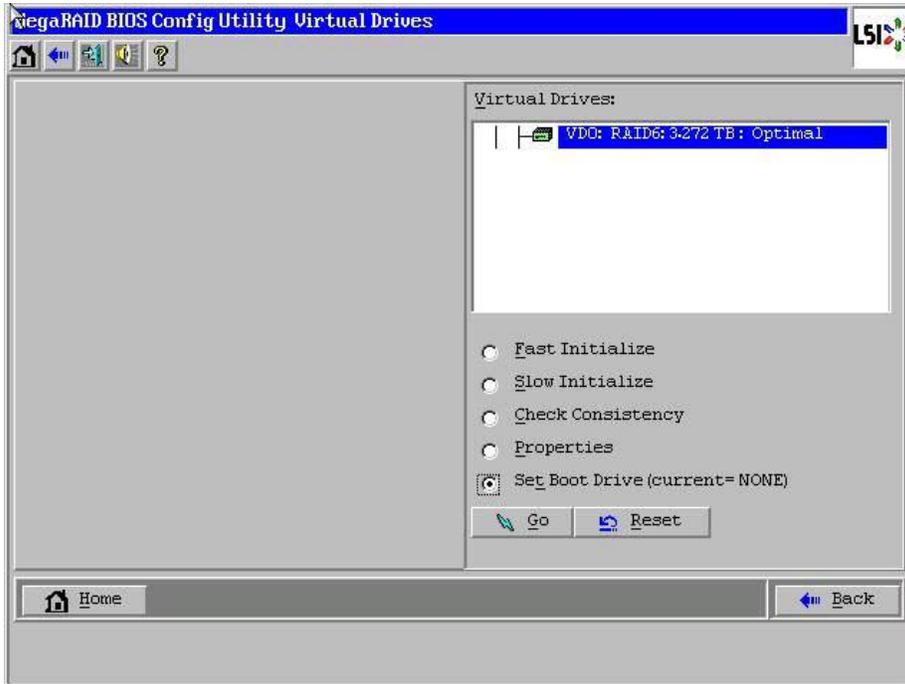


8. On the Configuration Preview screen, click Accept.

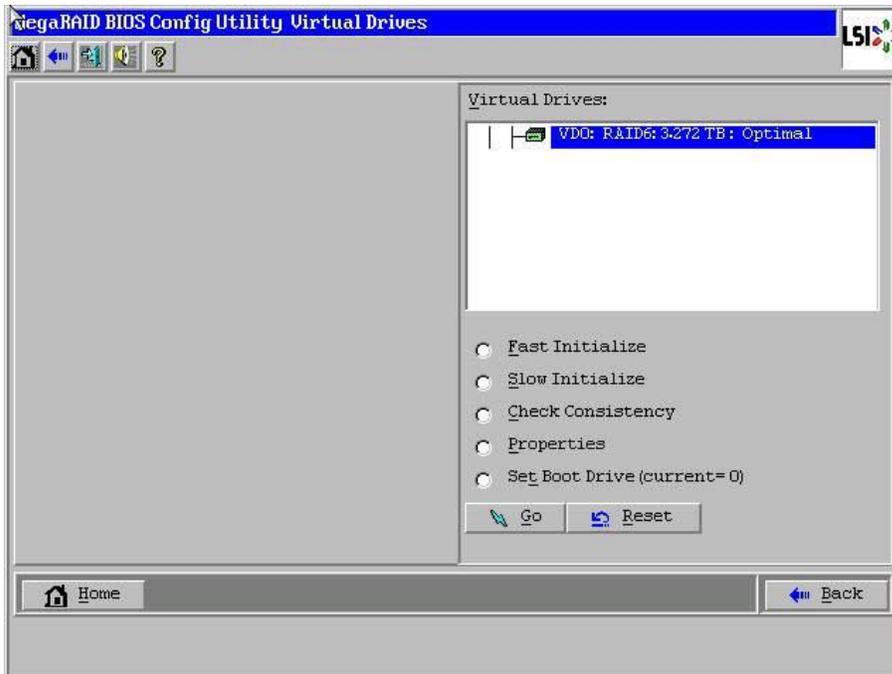


9. On the Save configuration screen, click Yes.

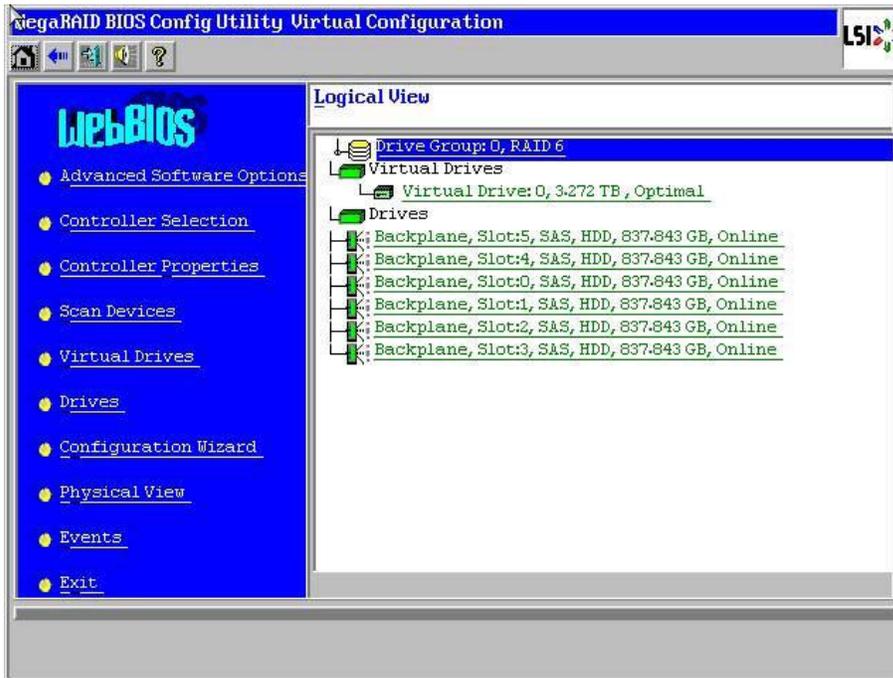
10. On the Initialize Confirm Page, click Yes.
11. The next screen will show the progress for initializing the new RAID6 drive, and refresh when completed. Select Set Boot Drive (current = NONE), and click Go.



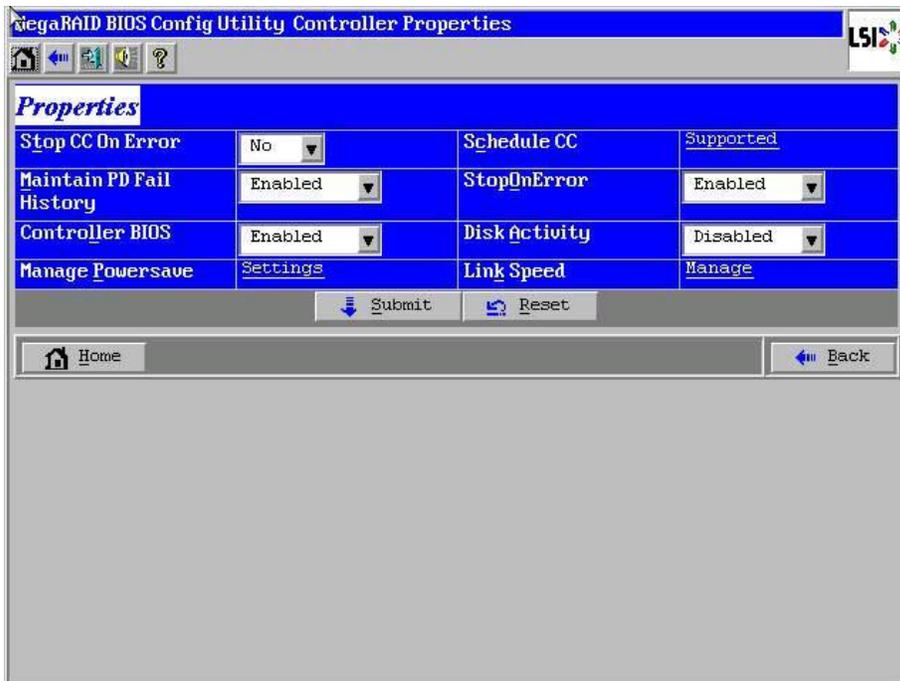
12. After the screen refreshes and the virtual drive is set as the boot drive, click Home.



- Finally, verify that the controller BIOS is enabled so that it will present the virtual drive as a bootable device. On the Home screen, click Controller Properties.



- Click Next twice to go to the third screen, Controller Properties. Set the Controller BIOS to enabled if necessary.



- Click Home to return to the Home screen, and then Exit.
- On the Exit Confirmation Screen, click Yes.

- On the Reboot System Page, select Restart System (warm boot) from the Power menu.



- As the system reboots, the storage-controller screen now displays the virtual disk.

```

LSI MegaRAID SAS-MFI BIOS
Version 5.14.00 (Build January 19, 2011)
Copyright(c) 2011 LSI Corporation
HA -0 (Bus 3 Dev 0) LSI MegaRAID SAS 9265-Bi
FW package: 21.0.1-0100

Battery Status: Fully charged

PCI SLOT ID  LUN  VENDOR  PRODUCT                                REVISION  CAPACITY
-----
0             LSI      LSI MegaRAID SAS 9265-Bi              3.130.05-1024MB
0            10 0     SEAGATE  ST9900805SS                            CS05      858483MB
0            11 0     SEAGATE  ST9900805SS                            CS05      858483MB
0            18 0     SEAGATE  ST9900805SS                            CS05      858483MB
0            19 0     SEAGATE  ST9900805SS                            CS05      858483MB
0            20 0     SEAGATE  ST9900805SS                            CS05      858483MB
0            21 0     SEAGATE  ST9900805SS                            CS05      858483MB
0             0     LSI      Virtual Drive                          RAID6     3431808MB

0 JBOD(s) found on the host adapter
0 JBOD(s) handled by BIOS

1 Virtual Drive(s) found on the host adapter.

```

APPENDIX D – SAMPLE SCRIPT FILE FOR LAMP ON CENTOS 6.2

Figure 3 presents the sample PHP file to use for testing the LAMP stack.

```
<?php
$db_username="testappuser";
$db_password="Password1";
$db_host     ="localhost";
$db_name     ="helloworlddb";
$link       = mysql_connect($db_host, $db_username, $db_password);
mysql_select_db($db_name, $link);
$result = mysql_query("SELECT testcol FROM tbl_hello_world", $link);
$row     = mysql_fetch_assoc($result);
print_r($row);
mysql_close($link);
?>
```

Figure 3: Sample PHP file to query the test database: </var/www/html/helloworld.php>.

ABOUT PRINCIPLED TECHNOLOGIES



Principled Technologies, Inc.
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Durham, NC, 27703
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