DELL POWEREDGE C6220 AND UBUNTU SERVER: A LAMP REFERENCE ARCHITECTURE

WHAT YOU WILL LEARN

- The features and advantages of the Dell PowerEdge C6220

- How to install the Ubuntu Server operating system on the Dell PowerEdge C6220

- How to install the LAMP Web-application stack on Ubuntu Server

- How to configure software RAID during Ubuntu Server installation

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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: Ubuntu Server running on the Dell PowerEdge C6220.

Organizations often use open-source Linux-based operating systems, such as Ubuntu Server, 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, Ubuntu Server, and the Linux/Apache/MySQL/PHP (LAMP) application stack on one node of the Dell PowerEdge C6220, from start to finish.

The Dell PowerEdge C6220 server

The Dell PowerEdge C6220 rack 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 onboard storage with the Intel C600 chipset.
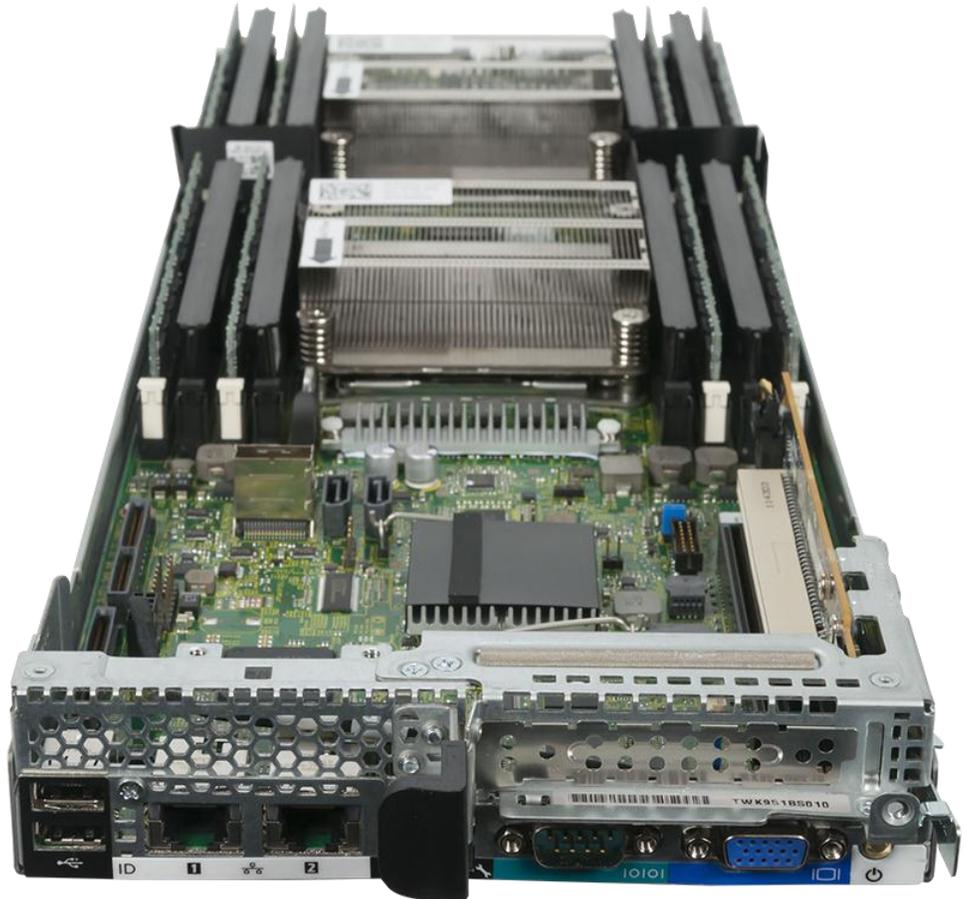

Figure 1: 1U server node of the Dell PowerEdge C6220.

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 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.

Dell PowerEdge C6220 storage and expansion specifications

The Dell PowerEdge C6220 features the following specifications:

- Hard disk
  - o SATA, SAS, and SSD options
  - o Maximum raw storage capacity of 24TB across four nodes when using SATA drives
  - o 2.5" or 3.5" drive form factor
- Available storage controllers
  - o Intel C600 chipset for onboard storage options with SATA and SSD, which we use for this guide.
  - o LSISAS2008 6Gb SAS mezzanine card
  - o LSI MegaRAID SAS 9265-8i add-in RAID controller
- Expansion slots
  - o The PowerEdge C6220 four-node configuration has one x8 expansion slot and one x16 expansion slot per node.
  - o The PowerEdge C6220 two-node (2U sled) configuration has one x8 expansion slot and two x16 expansion slots per node.

About Ubuntu Server

Ubuntu Server is an open-source Linux-based operating system designed to meet the needs of your business by providing high-volume server performance and management simplicity without the hassles and added costs of license or upgrade fees. Ubuntu is certified to work with most Dell PowerEdge series servers, and integrates easily with other operating systems and applications. With tools for rapid deployment, integration, and smart systems management features, Ubuntu can boost the efficiency

of your data center. Ubuntu Server is tailored to meet the needs of hyper-scale deployments. For more information about Ubuntu Server, visit http://www.ubuntu.com/business/server/overview.

INSTALLING UBUNTU SERVER ON THE DELL POWEREDGE C6220

Prerequisites

BIOS requirements

When installing Ubuntu Server 11.10 (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 Intel C600 chipset, which supports onboard SATA storage. Ubuntu Server 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 Ubuntu Server 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. In our lab installation, we used a Dell PowerEdge C6220 with six internal disks and no hardware RAID controller – the so-called JBOD configuration. We use software raid built into the Linux distribution to provide protection against disk failure.
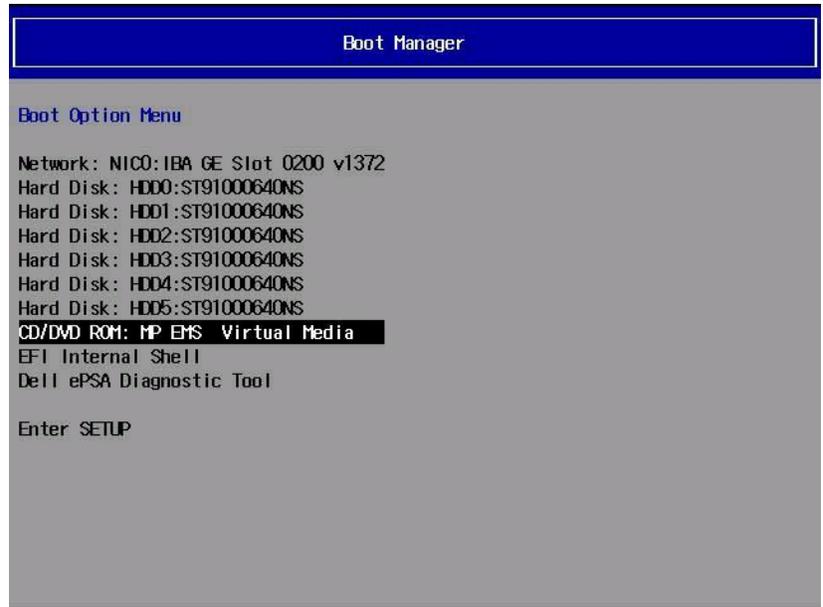
Installing the operating system

1. Using the BMC, assign the Ubuntu-11.10-server-amd64 installation DVD to the node and start the server.

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

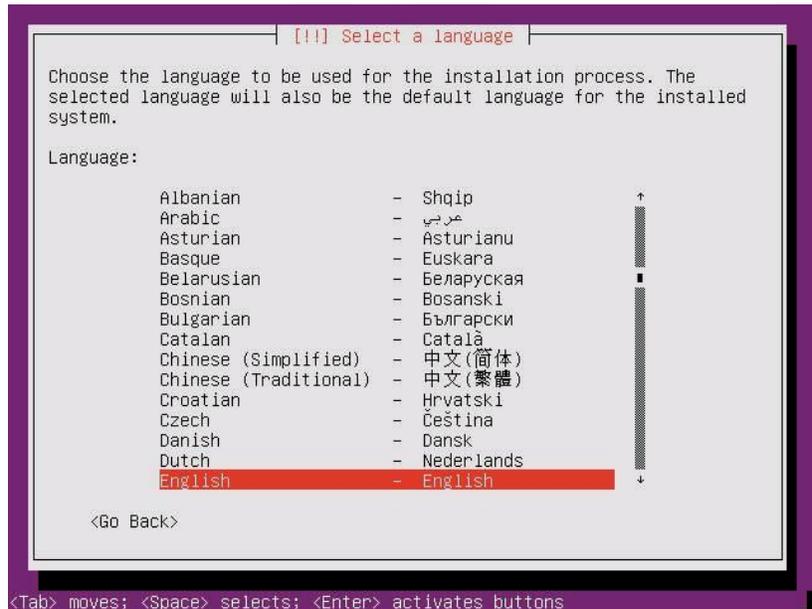3. On the Boot Manager screen, select CD/DVD ROM, and press Enter.

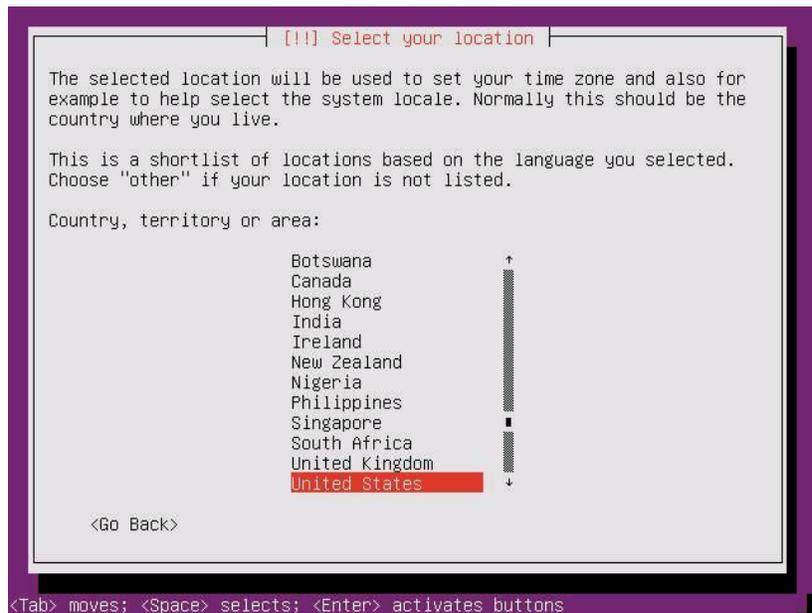4. On the Language screen, select the language for the initial installation screens, and press Enter.

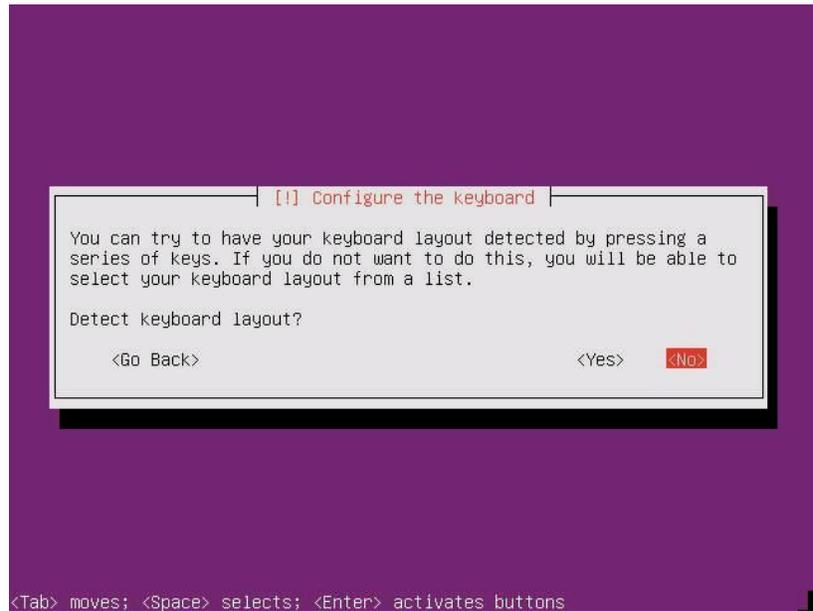5. On the Ubuntu Server boot manager screen, select Install Ubuntu Server, and press Enter.

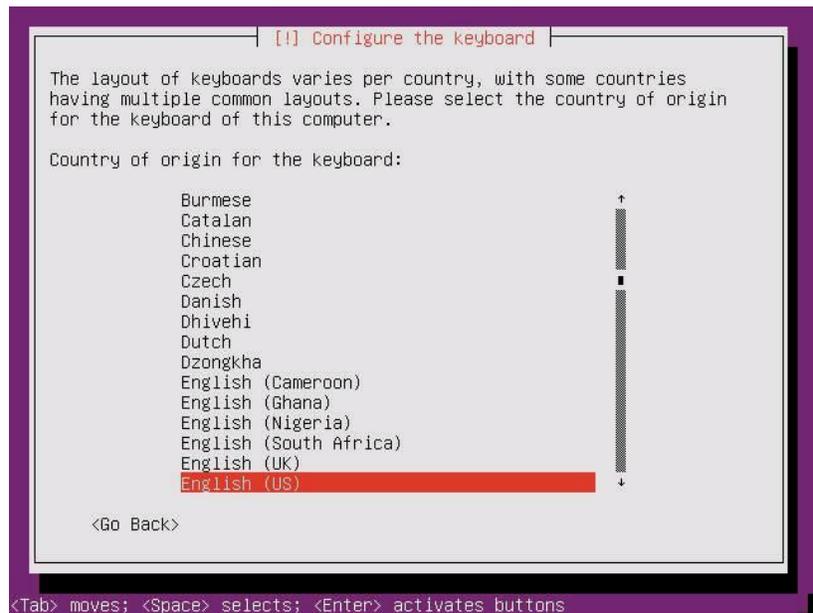6. On the Select a language screen, choose your preferred language, and press Enter.

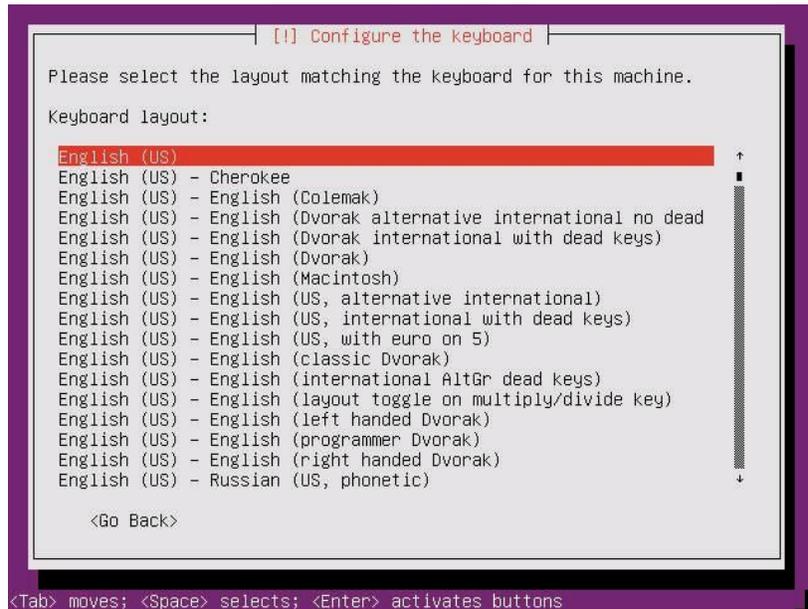

7. On the Select you location screen, select your country or region, and press Enter.

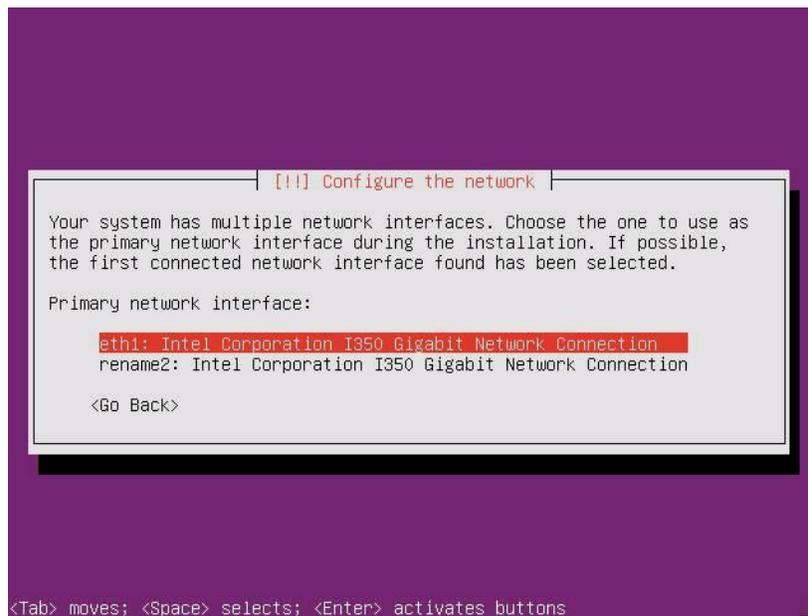8. On the Configure the keyboard (automatically) screen, select No, and press Enter.

9. On the next Configure the keyboard screen, select the country of origin, and press Enter.
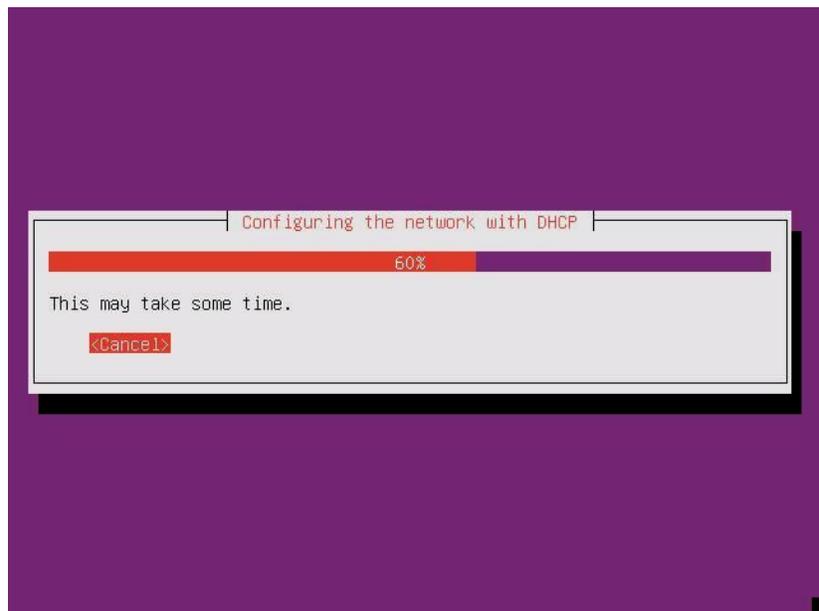
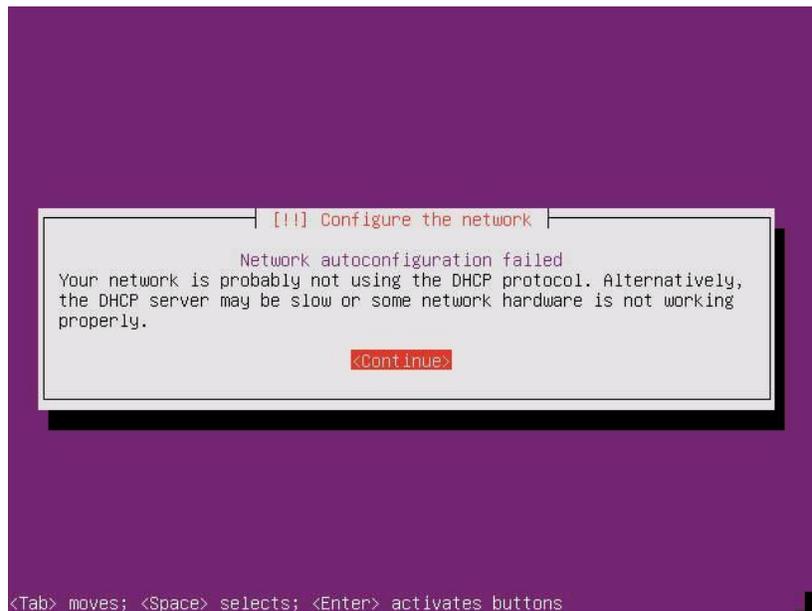10. On the third Configure the keyboard screen, select the layout you would like to use, and press Enter.

```
┌───────────────────────┤ [!] Configure the keyboard ├───────────────────────┐
│                                                                              │
│  Please select the layout matching the keyboard for this machine.            │
│                                                                              │
│  Keyboard layout:                                                            │
│                                                                              │
│      English (US)                                                        ↑   │
│      English (US) - Cherokee                                             ▪   │
│      English (US) - English (Colemak)                                        │
│      English (US) - English (Dvorak alternative international no dead         │
│      English (US) - English (Dvorak international with dead keys)            │
│      English (US) - English (Dvorak)                                         │
│      English (US) - English (Macintosh)                                      │
│      English (US) - English (US, alternative international)                  │
│      English (US) - English (US, international with dead keys)               │
│      English (US) - English (US, with euro on 5)                            │
│      English (US) - English (classic Dvorak)                                │
│      English (US) - English (international AltGr dead keys)                  │
│      English (US) - English (layout toggle on multiply/divide key)          │
│      English (US) - English (left handed Dvorak)                            │
│      English (US) - English (programmer Dvorak)                             │
│      English (US) - English (right handed Dvorak)                           │
│      English (US) - Russian (US, phonetic)                               ↓   │
│                                                                              │
│          <Go Back>                                                           │
│                                                                              │
└──────────────────────────────────────────────────────────────────────────┘
 <Tab> moves; <Space> selects; <Enter> activates buttons
```

11. On the Configure the network screen, select a network interface, and press Enter.

```
┌───────────────────────┤ [!!] Configure the network ├───────────────────────┐
│                                                                              │
│  Your system has multiple network interfaces. Choose the one to use as       │
│  the primary network interface during the installation. If possible,         │
│  the first connected network interface found has been selected.              │
│                                                                              │
│  Primary network interface:                                                  │
│                                                                              │
│          eth1: Intel Corporation I350 Gigabit Network Connection             │
│          rename2: Intel Corporation I350 Gigabit Network Connection          │
│                                                                              │
│          <Go Back>                                                           │
│                                                                              │
└──────────────────────────────────────────────────────────────────────────┘
 <Tab> moves; <Space> selects; <Enter> activates buttons
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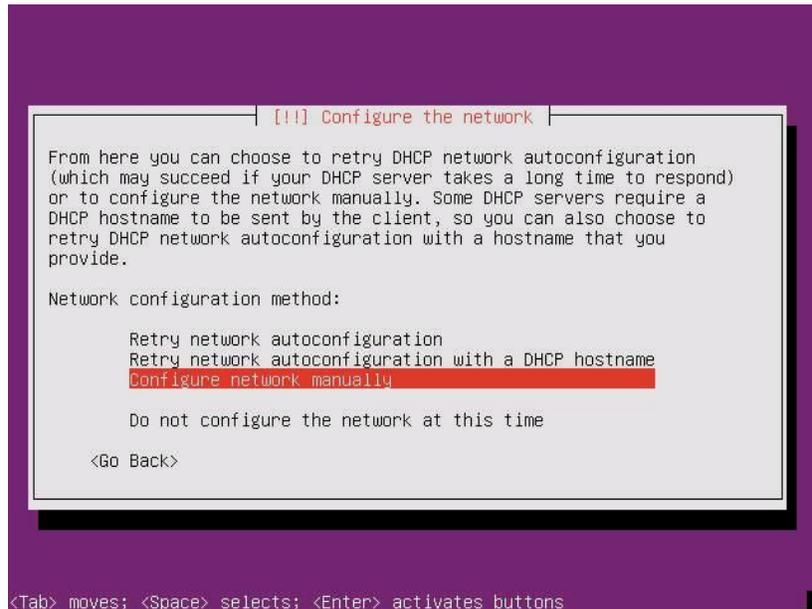
12. On the Configuring the network with DHCP screen, press Enter to cancel the scan for a DHCP server and proceed to manual configuration of the network interface.
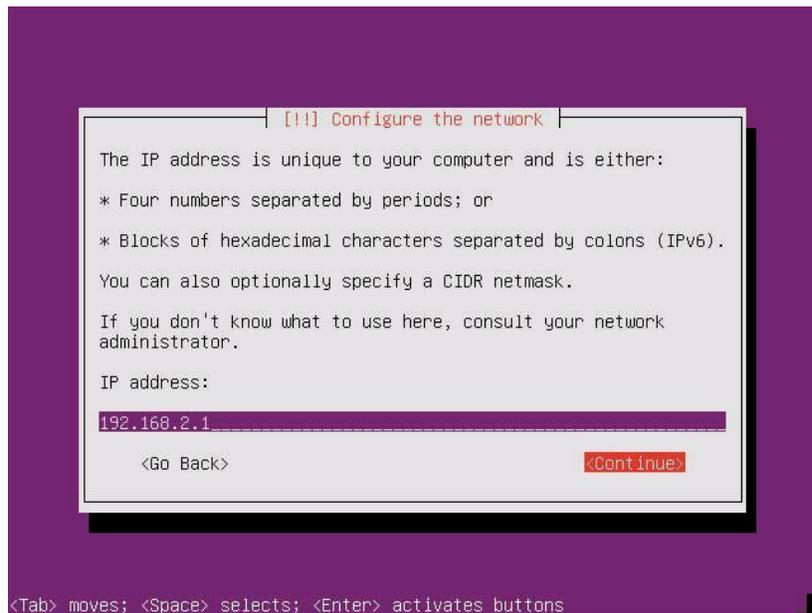

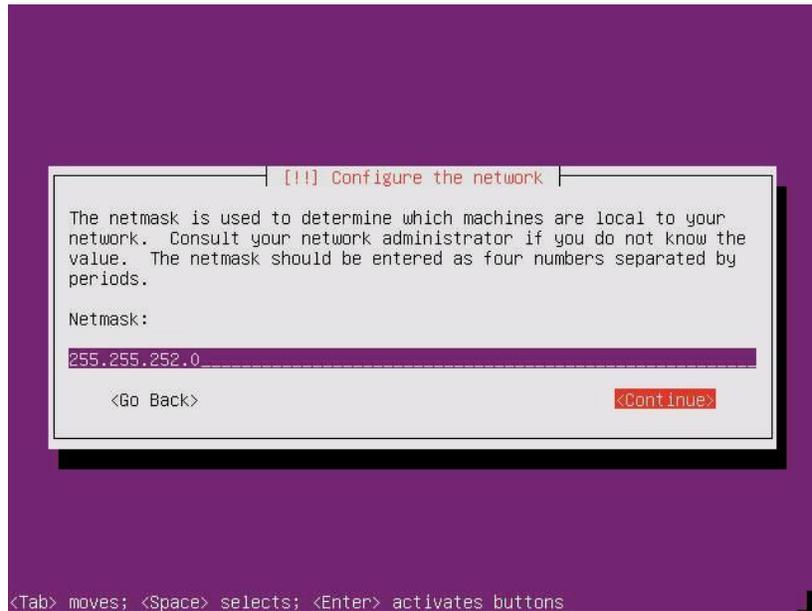13. On the second Configure the network screen, press Enter to continue.

14. On the third Configure the network screen, select Configure network manually, and press Enter.
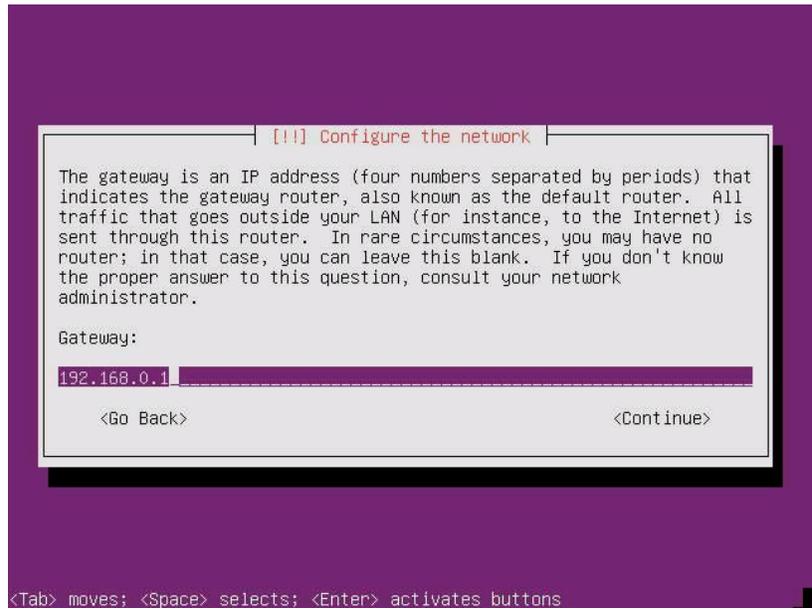

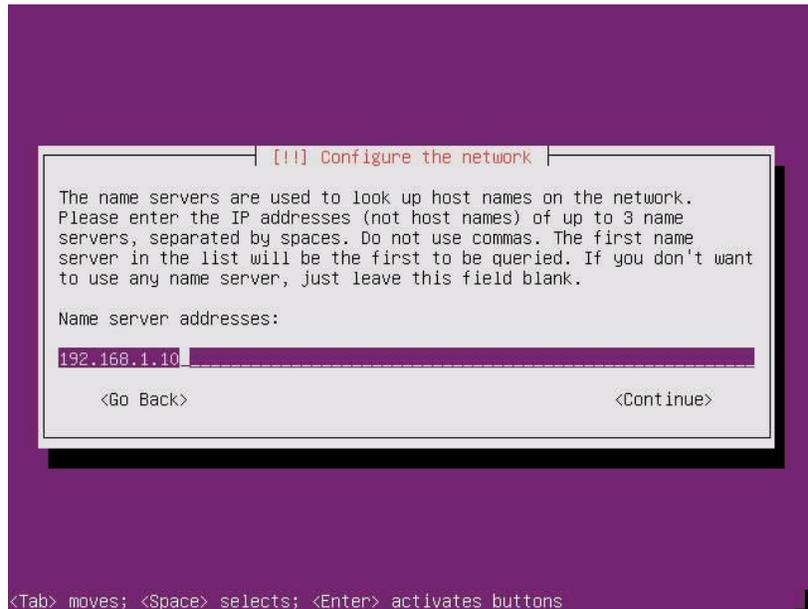15. On the fourth Configure the network screen, enter the network interface's IP address, press Enter.

16. On the fifth Configure the network screen, enter the netmask for the attached network, press Enter.

17. On the sixth Configure the network screen, enter the gateway for the attached network, press Enter.

18. On the seventh Configure the network screen, enter the IP address of a DNS server, press Enter.

19. On the eighth Configure the network screen, enter the name of the server without domain name, press Enter.
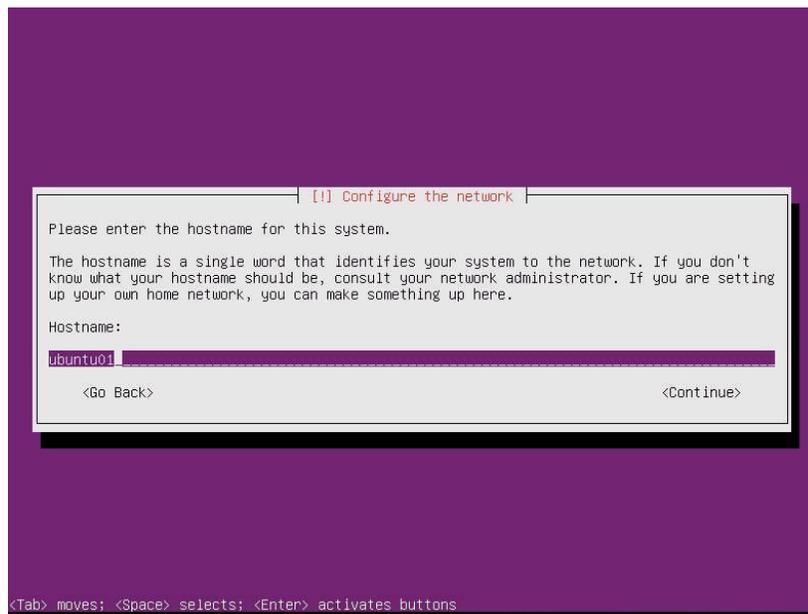
20. On the ninth Configure the network screen, enter the server's domain name, if any, press Enter.
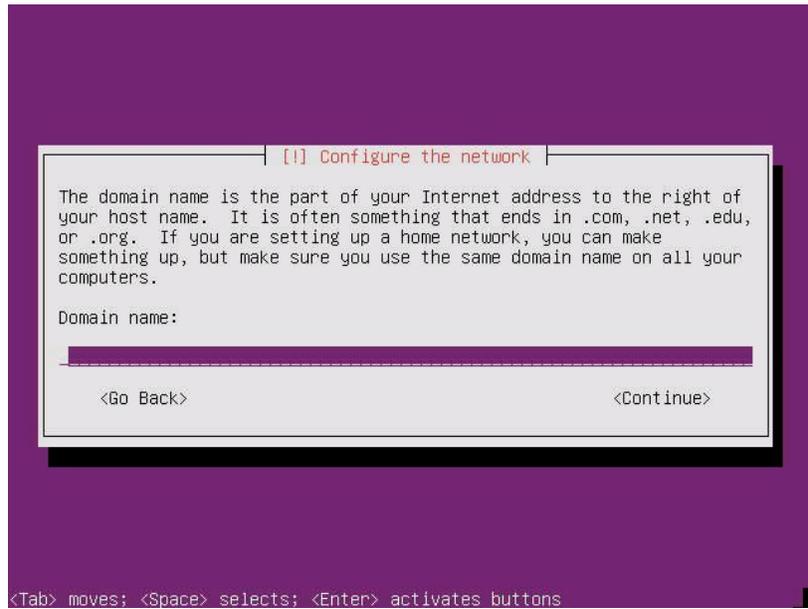
21. On the Configure the clock screen, select your time zone or UTC. And press Enter.
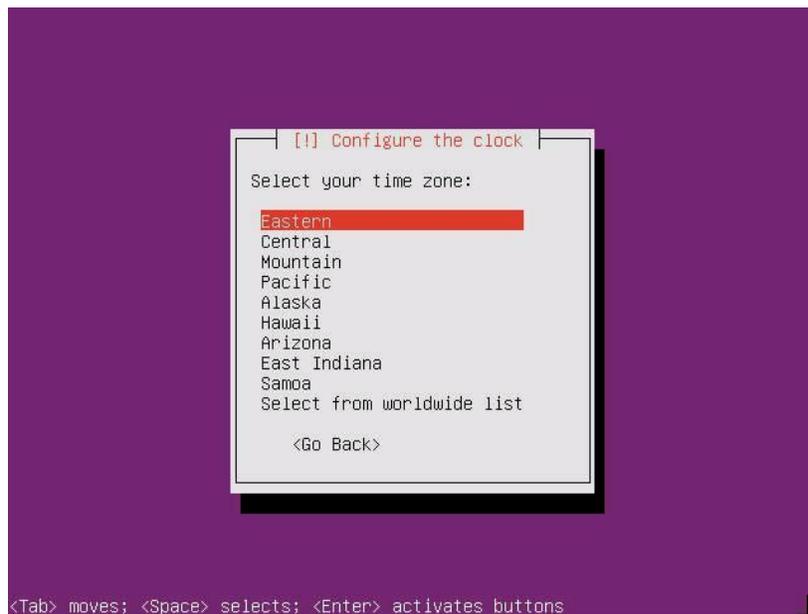
22. Next, create and mirror two pairs of disk partitions, swap and root, on the first two physical disks by using the following procedure. On the Partition disks screen, select Manual, and press Enter.
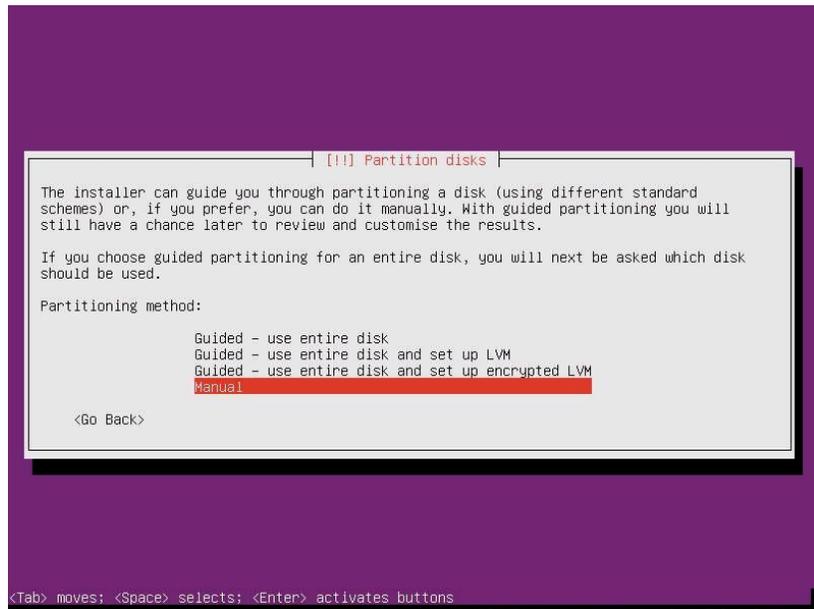
23. On the next Partition disks screen, select the first disk SCSI1, and press Enter.
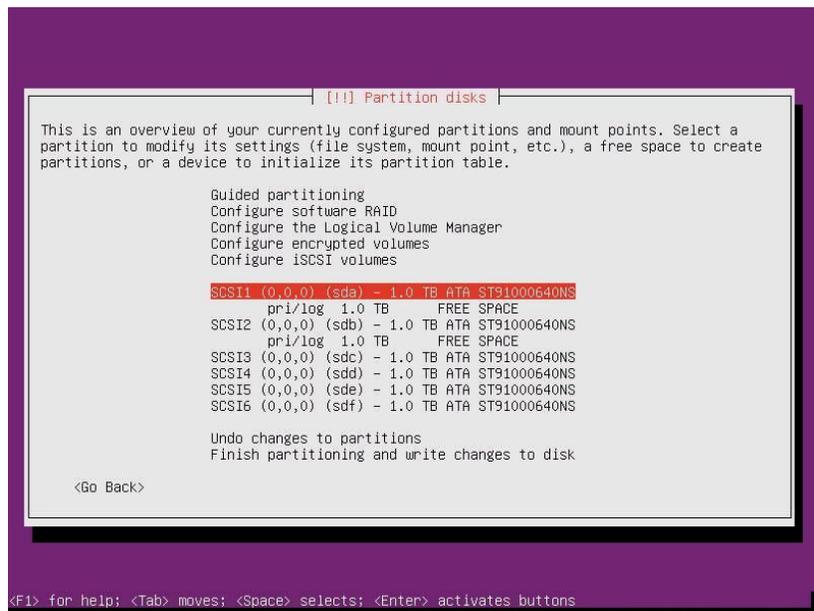
24. On the next Partition disks screen, select Yes to create a new partition table, and press Enter.
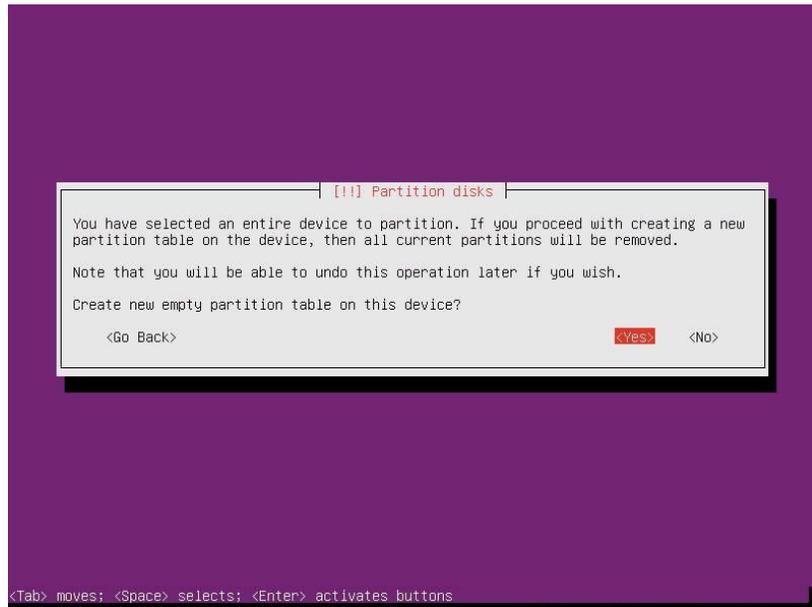
25. Repeat Steps 23 and 24 for the second disk SCSI2.

26. Back on the Partition disks screen, select FREE SPACE for Disk 1, and press Enter to create a 35GB partition for swap space.
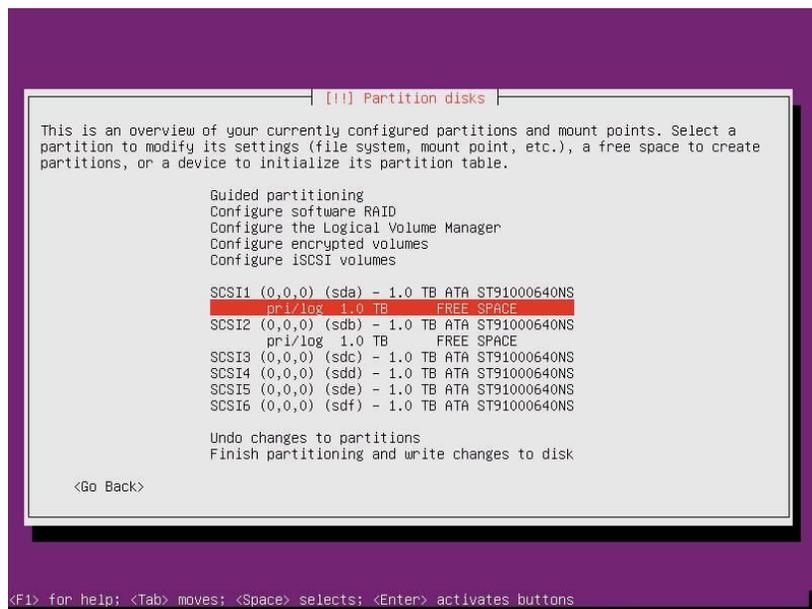
27. On the Partition disks sub-screen, select Create a new partition, and press Enter.

```
                    ┤ [!!] Partition disks ├
   How to use this free space:

   Create a new partition
   Automatically partition the free space
   Show Cylinder/Head/Sector information

        <Go Back>



<F1> for help; <Tab> moves; <Space> selects; <Enter> activates buttons
```
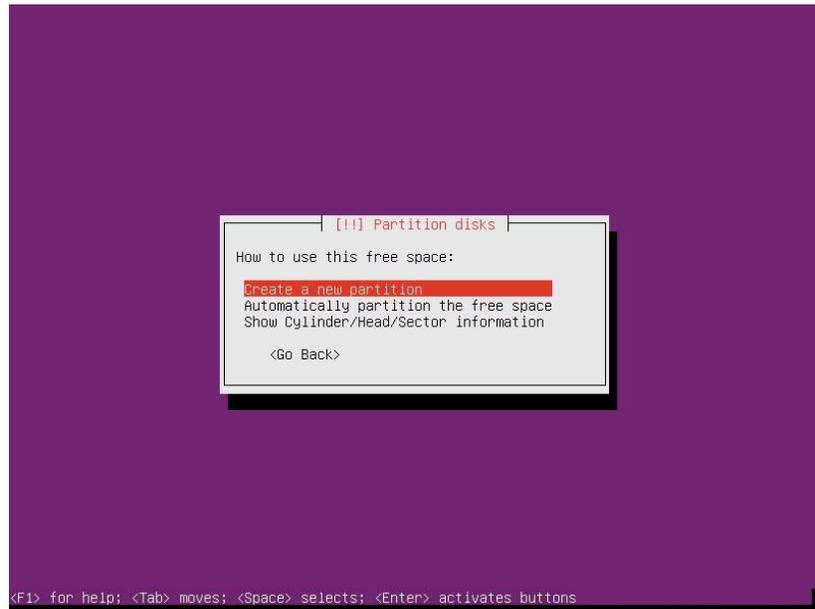
28. On the Partition disks sub-screen, enter 35 GB, press Enter.

```
                         ┤ [!!] Partition disks ├
   The maximum size for this partition is 1.0 TB.

   Hint: "max" can be used as a shortcut to specify the maximum size, or enter a percentage
   (e.g. "20%") to use that percentage of the maximum size.

   New partition size:

   35 GB_____

        <Go Back>                                              <Continue>




<Tab> moves; <Space> selects; <Enter> activates buttons
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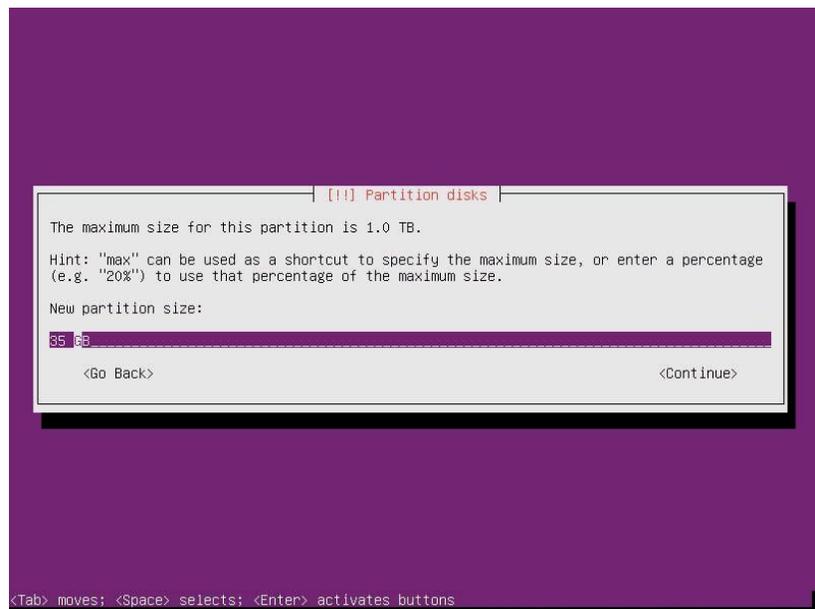
29. On the Partition disks sub-screen, select Primary, and press Enter.
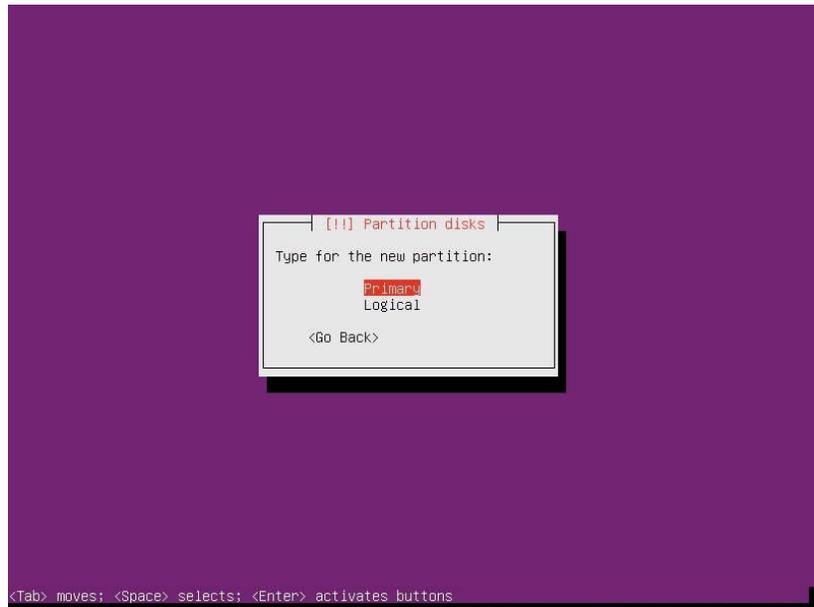
30. On the Partition disks sub-screen, select Beginning, and press Enter.
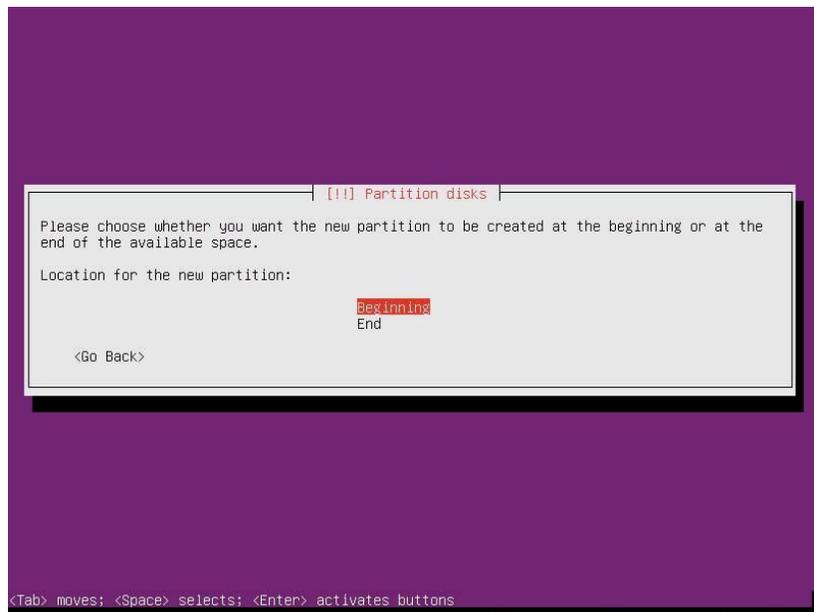
31. On the Partition disks sub-screen, Use as and Press Enter.
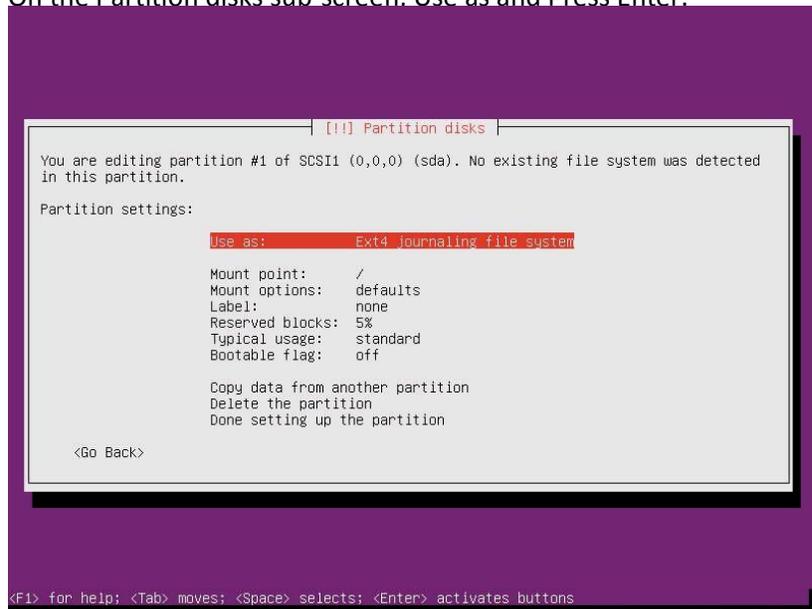
32. On the next screen, select physical volume for RAID, and press Enter.
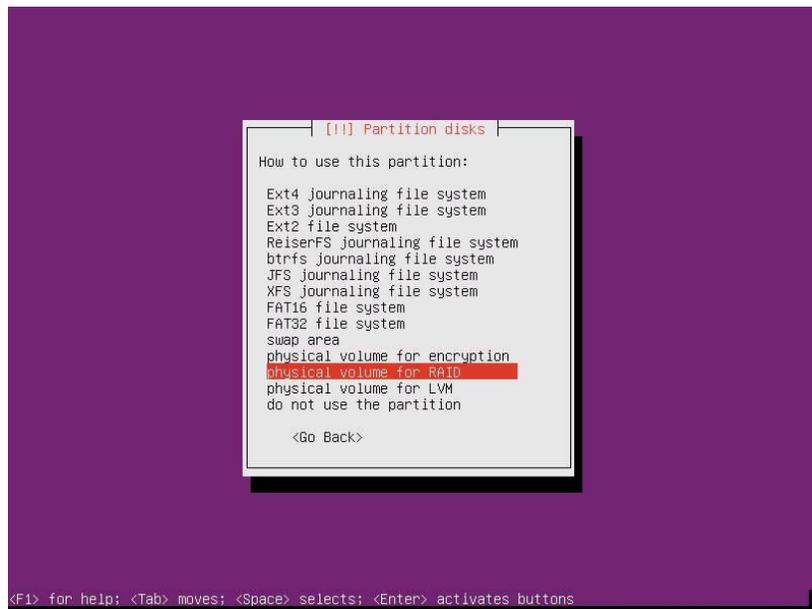
33. Back at the Partition disks sub-screen, select Done setting up the partition, and press Enter.
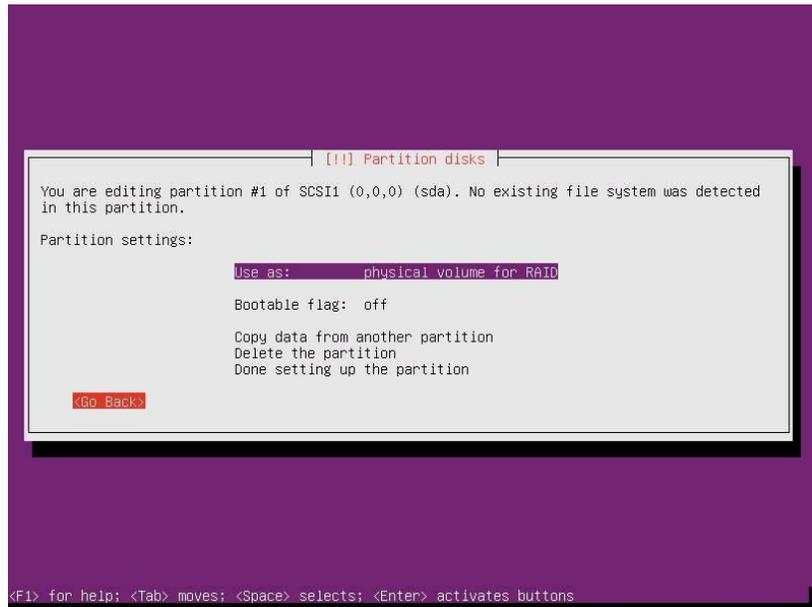
34. On the Partition disks screen, repeat steps 26 through 33 to create a 20GB root partition. Note: Change the Bootable flag for the root partition on from the Partition disks sub-screen.
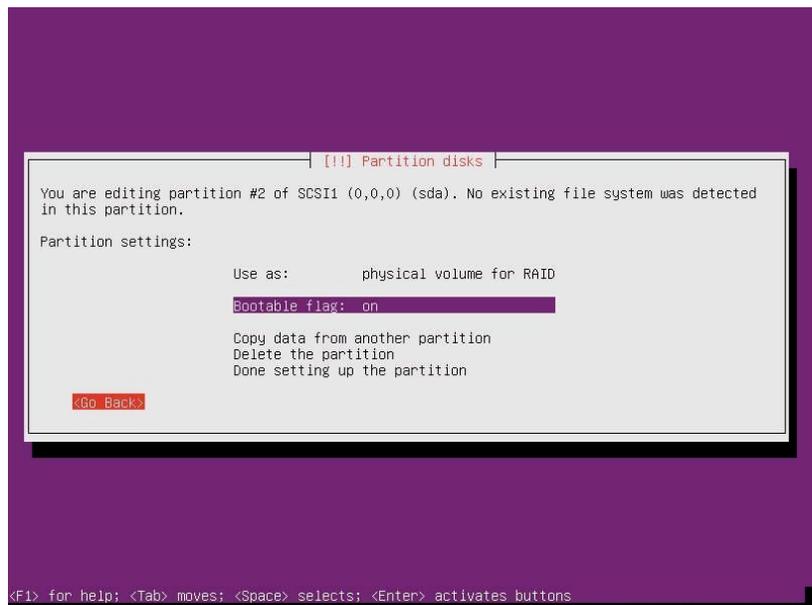
35. Repeat steps 26 through 34 for the second disk. Disks 1 and 2 will now have identical partitions.

36. On the Partition disks screen, select Configure software raid, and press Enter.
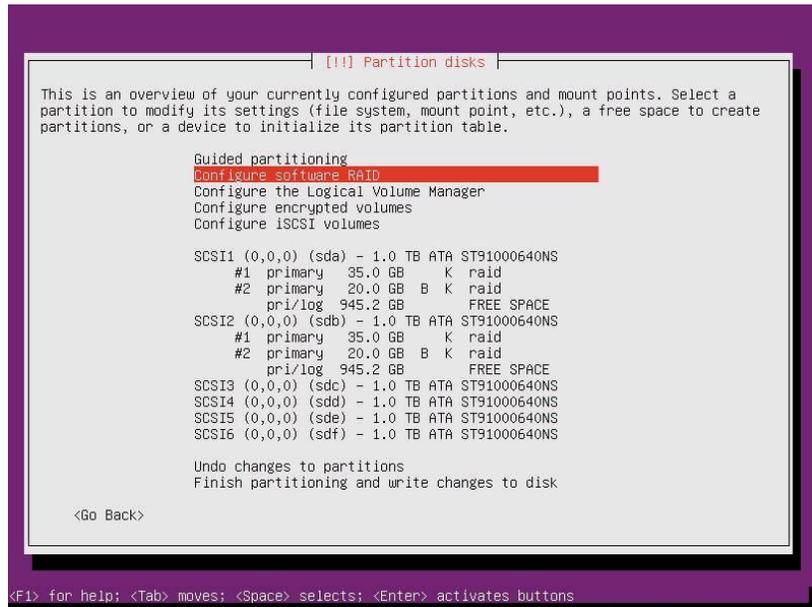
37. On the Partition disks sub-screen, select Yes to write the changes to disk, and press Enter.
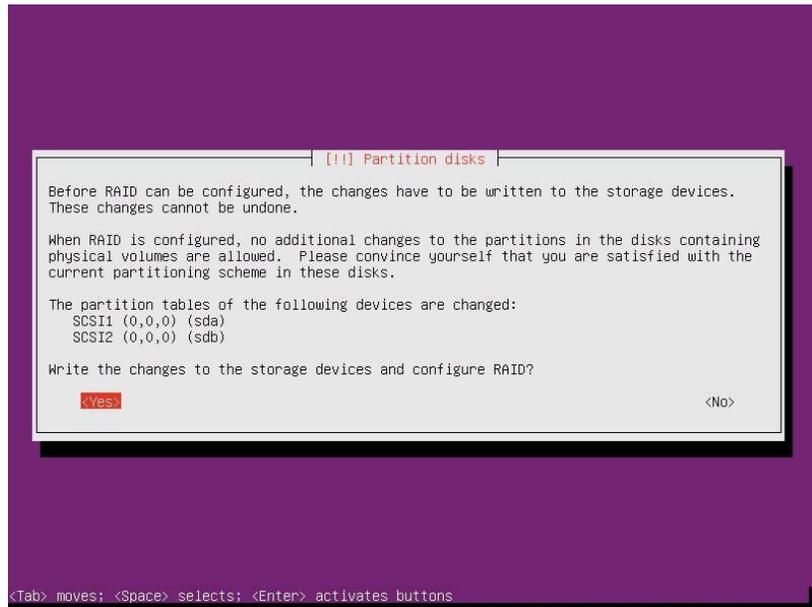
38. On this Partition disks sub-screen, select Create MD device, and press Enter.
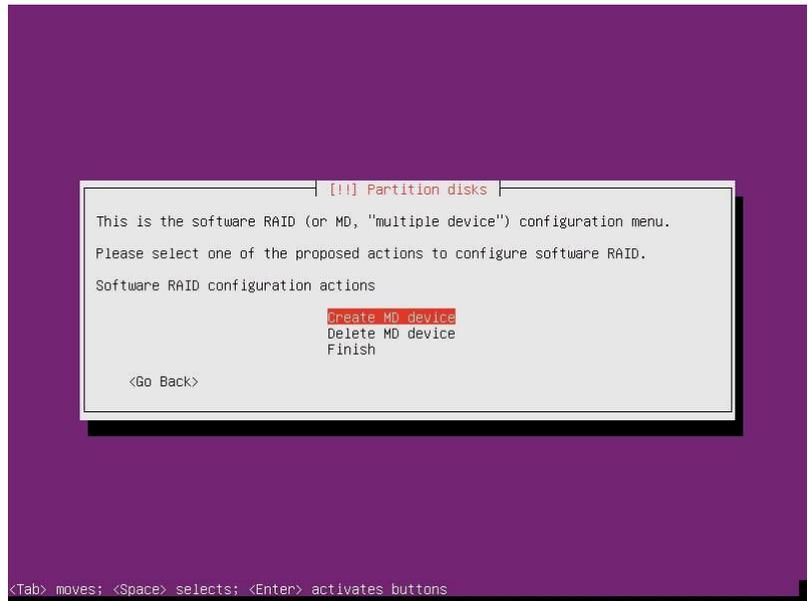
39. On the next Partition disks sub-screen, select RAID1 to mirror the partition, and press Enter.
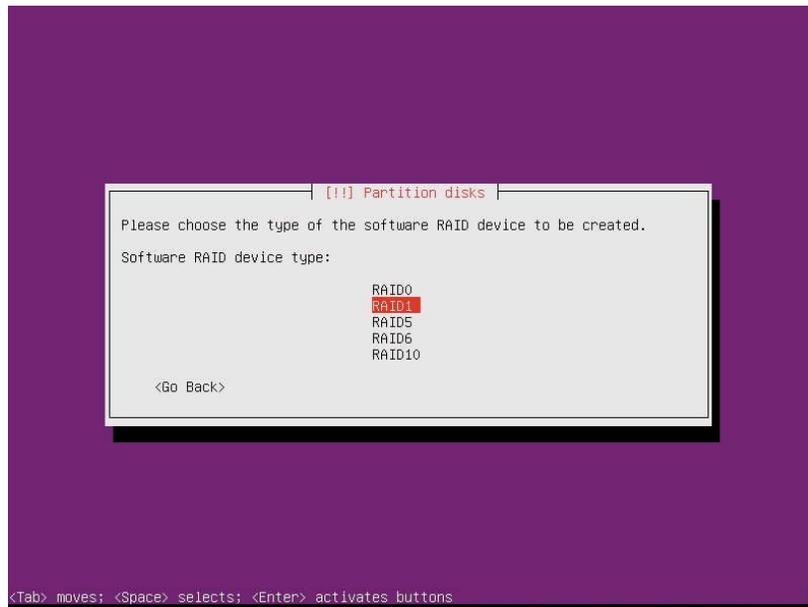
40. On the next Partition disks sub-screen, enter 2 devices, and press Enter.
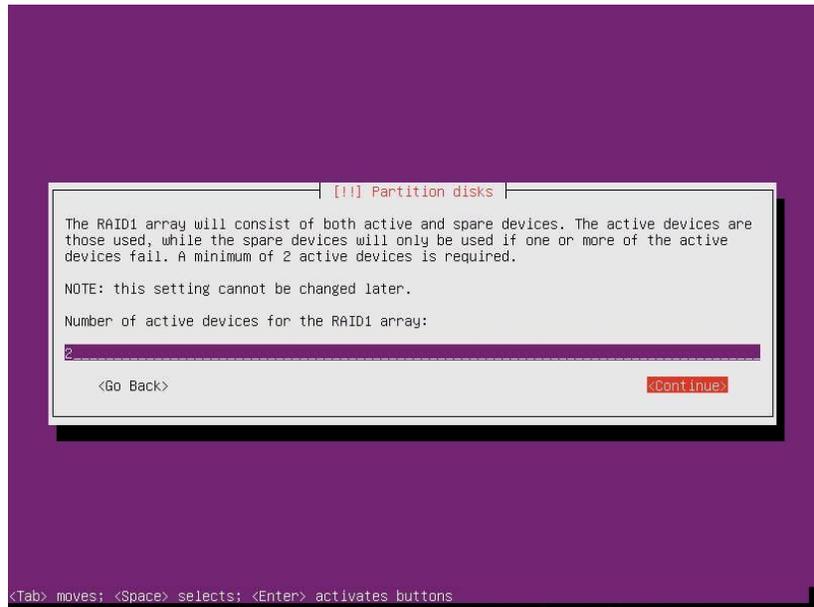
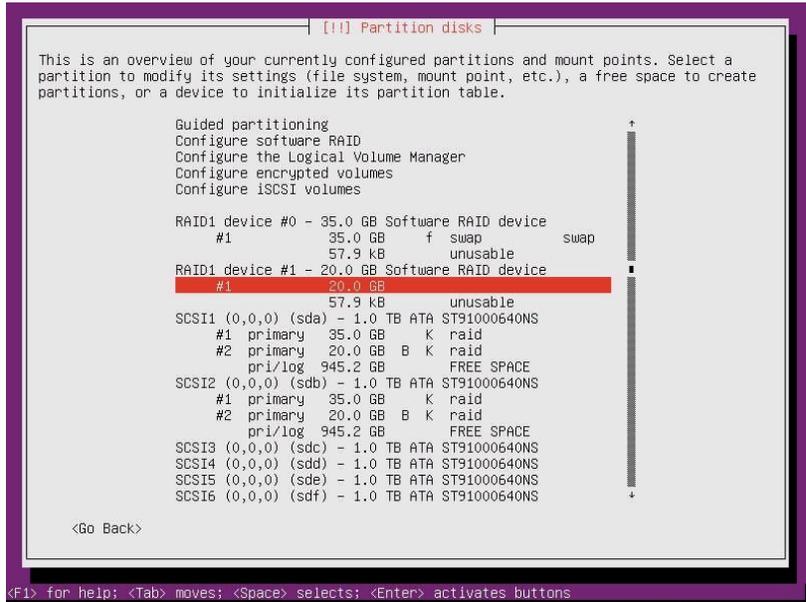41. On the next Partition disks sub-screen, enter 0 spares, and press Enter.
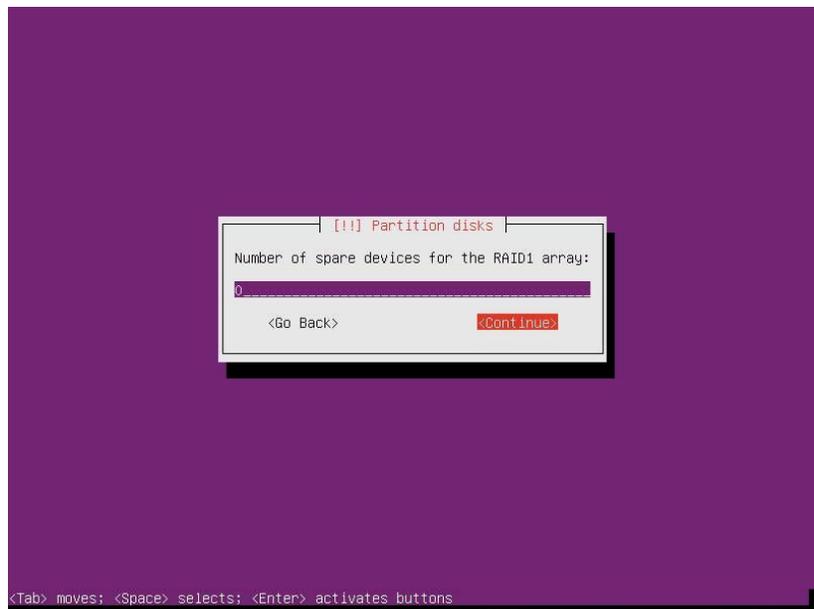
42. On the next Partition disks sub-screen, select the pair of swap partitions, /dev/sda1 and /dev/sdb1, and press Enter.
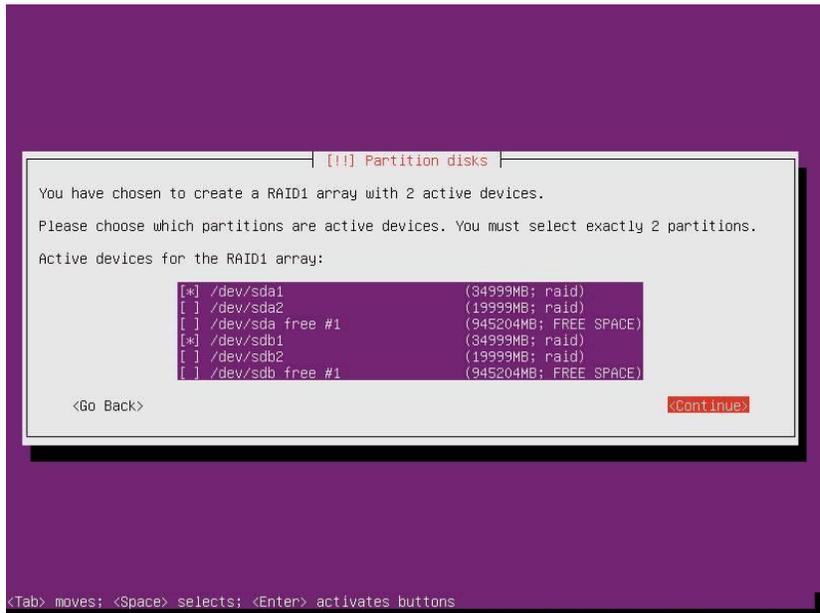
43. Repeat steps 38 through 42 for the pair of root partitions.

44. On the Partition disks sub-screen, select the pair of root partitions, /dev/sda2 and /dev/sdb2, and press Enter.
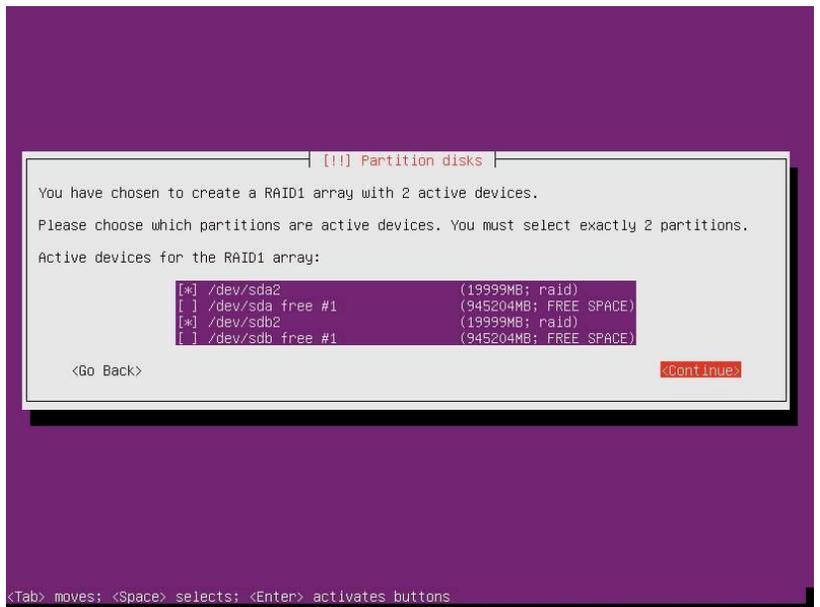
45. On the next Partition disks sub-screen, select Finish, and press Enter.
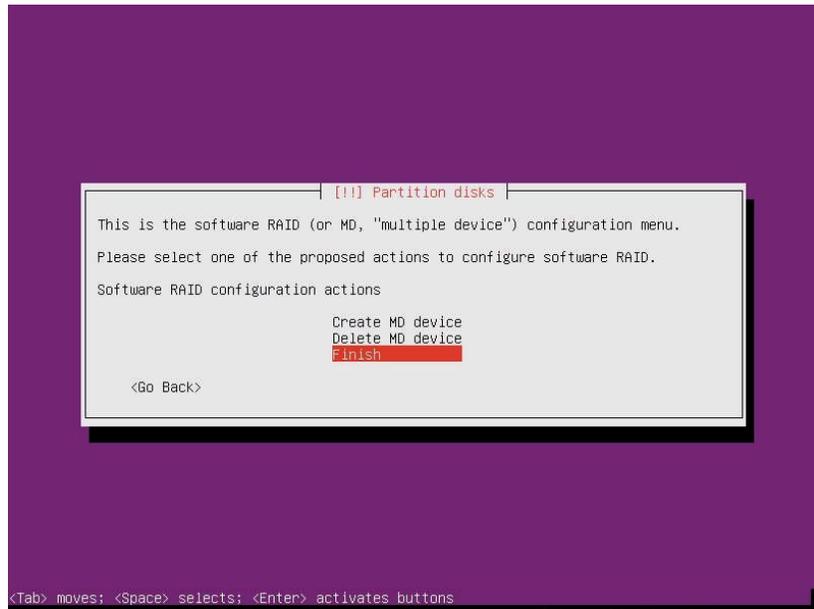
46. Back on the Partition disks screen, select the partition #1 (35GB) on RAID1 device #0, and press Enter.
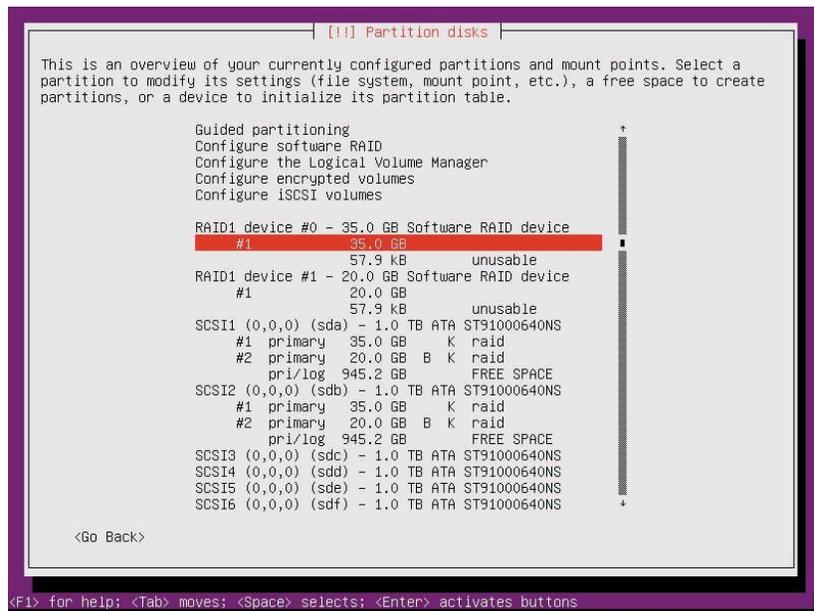
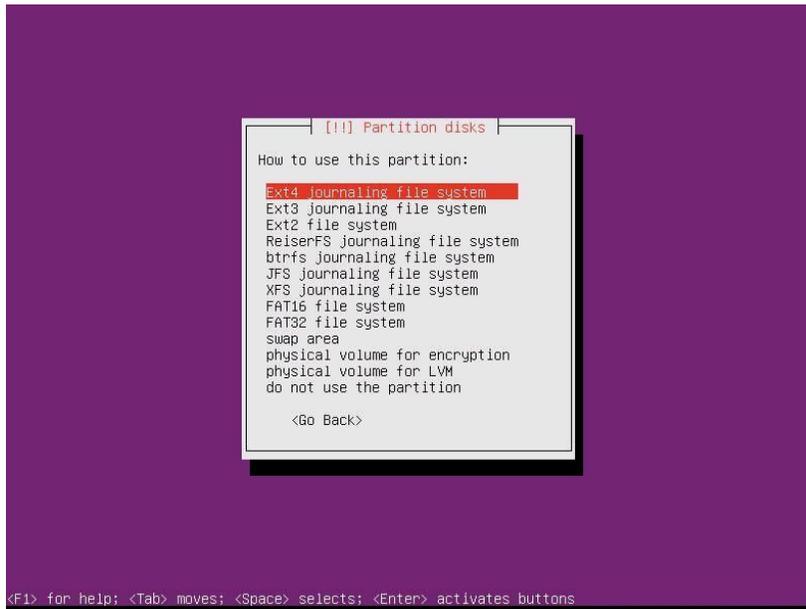47. On the Partition disks sub-screen, select swap area, and press Enter.
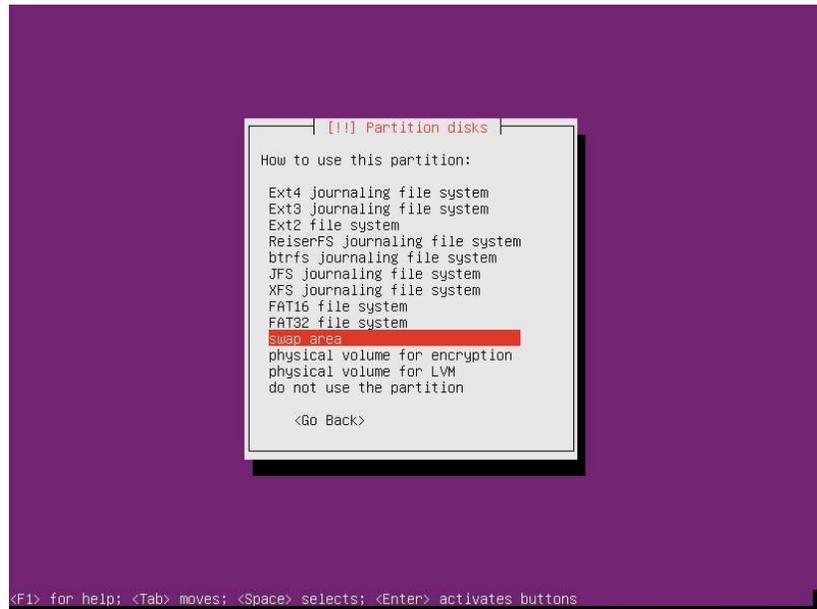
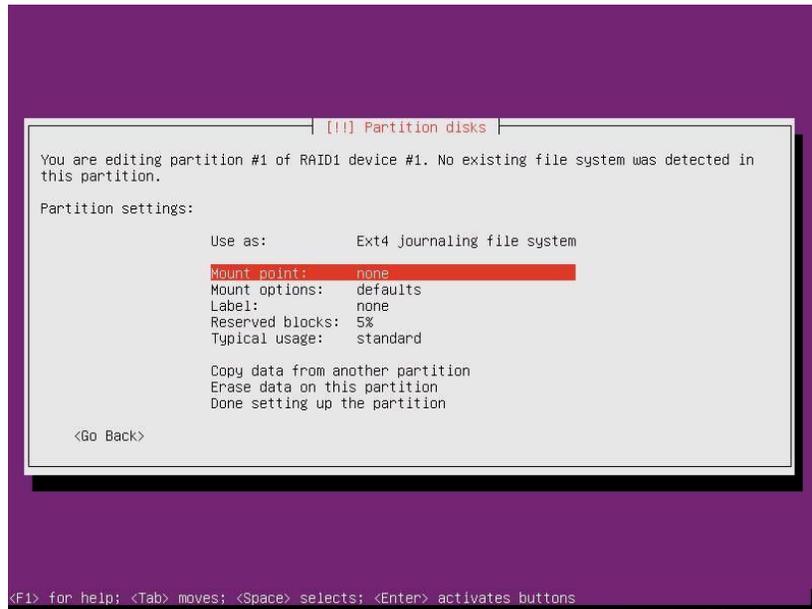48. On the next Partition disks sub-screen, select Done setting up the partition, and press Enter.
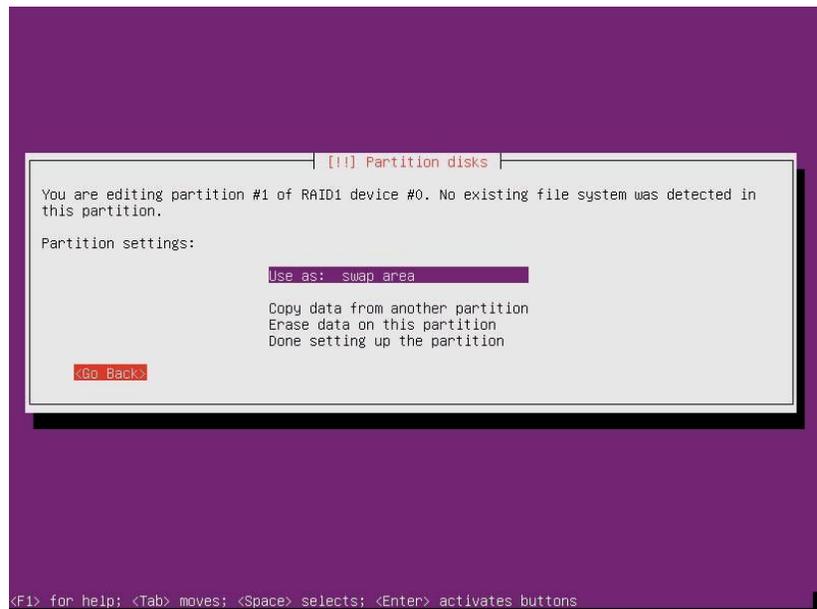
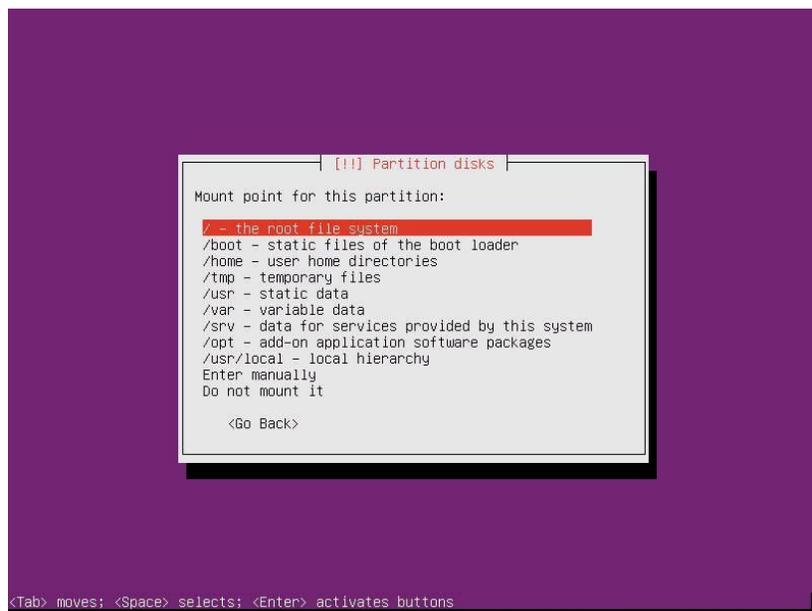49. Back on the Partition disks screen, select the partition #1 (20GB) on RAID1 device #1, and press Enter.

50. On the Partition disks sub-screen, select Ext4 journaling file system, and press Enter.
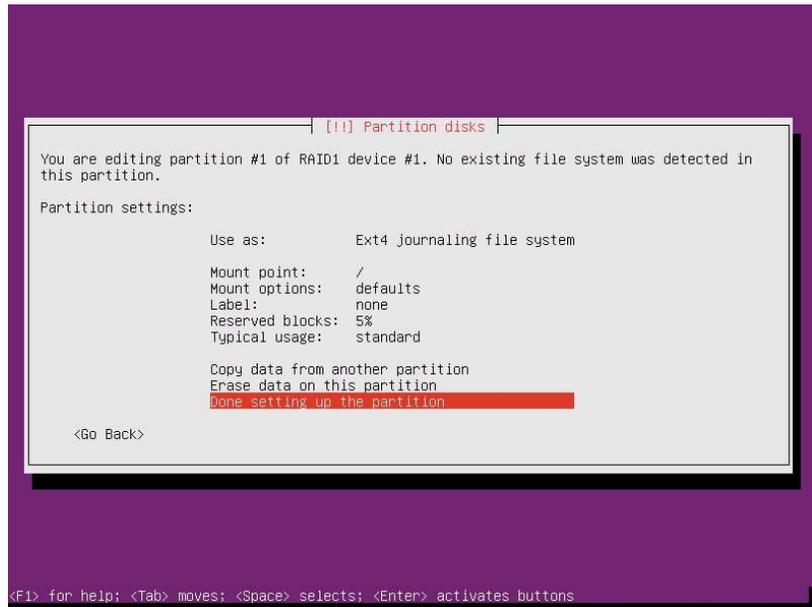
51. At the next Partition disks sub-screen, select Mount point, and press Enter.
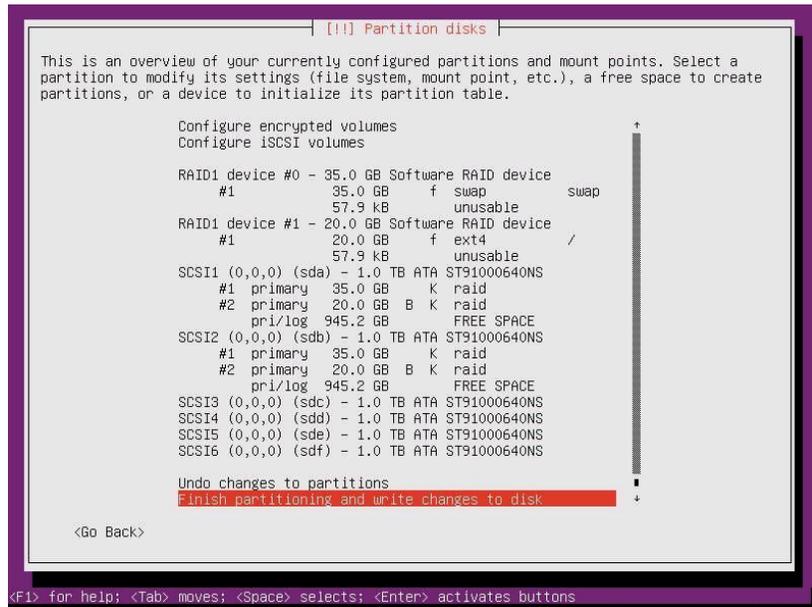

52. On the next Partition disks sub-screen, select / - the root file system, and press Enter.
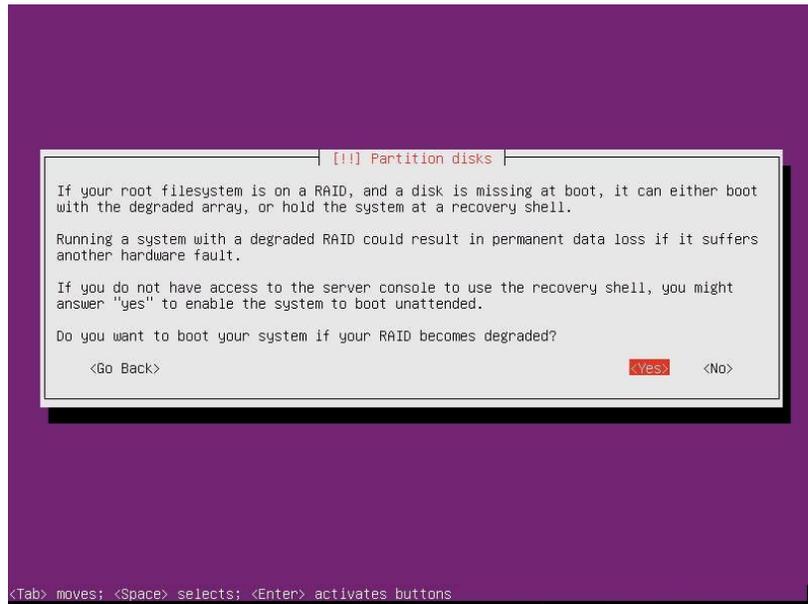
53. At the next Partition disks sub-screen, select Done setting up the partition, and press Enter.
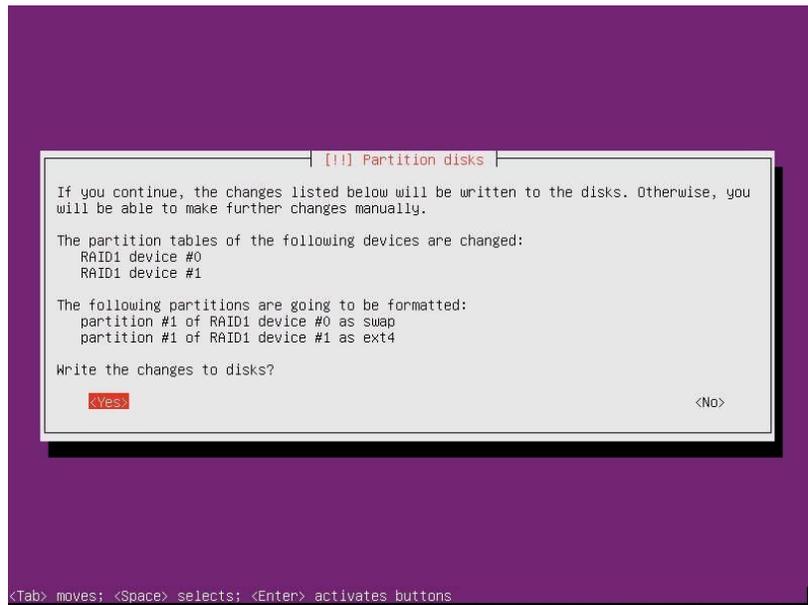

54. Back on the Partition disks screen, select Finish partitioning and write changes to disk, and press Enter.

55. On the penultimate Partition disks screen, select Yes to allow the operating system to switch to degraded RAID operation, if necessary, and press Enter.

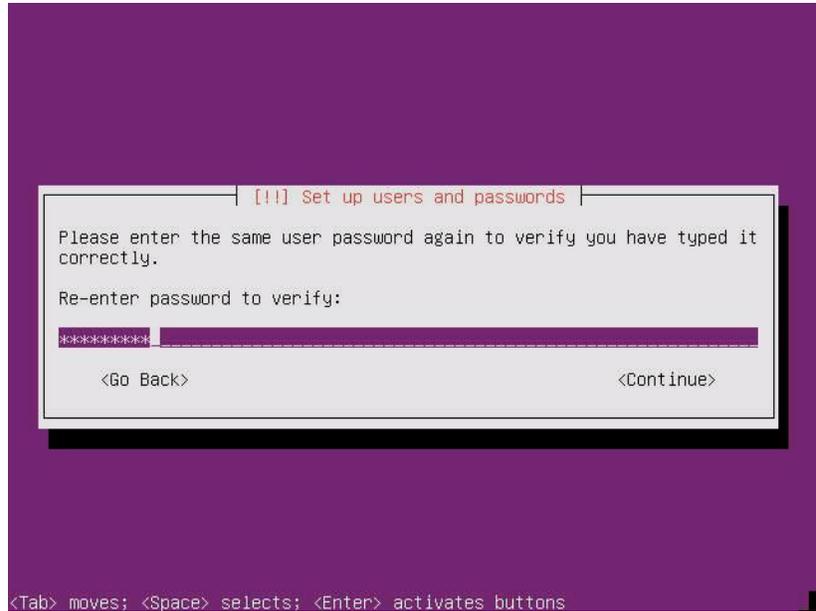56. On the final Partition disks screen, select Yes to write changes to disk, and press Enter.

57. On the Set up users and passwords screens, enter the full name, username, and password for one non-privileged account since Ubuntu does not permit root logins by default. Select Continue on each screen, and press Enter.
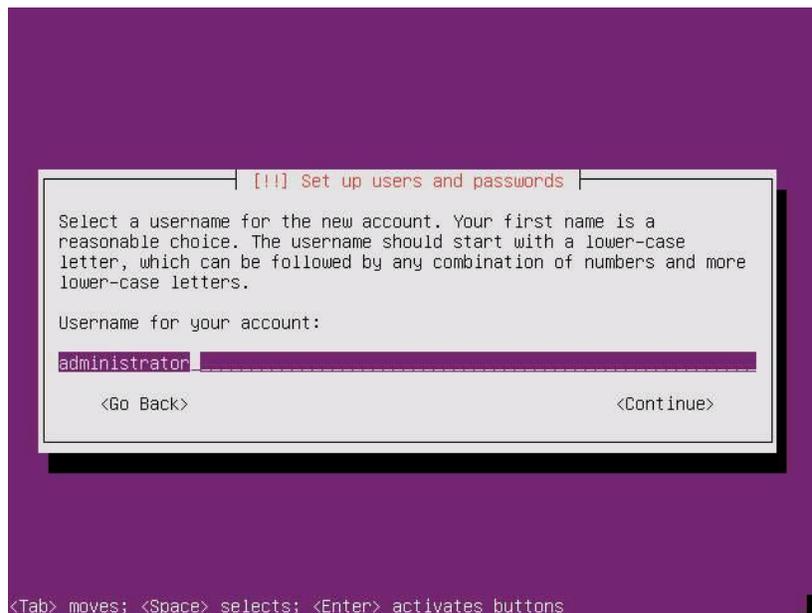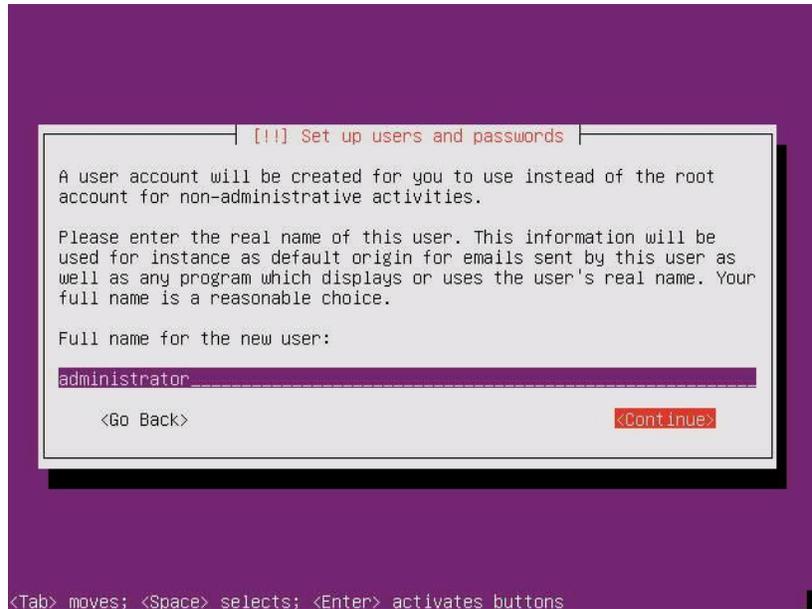
58. On the final Set up users and passwords screen, select No to skip encrypting your home directory, press Enter.
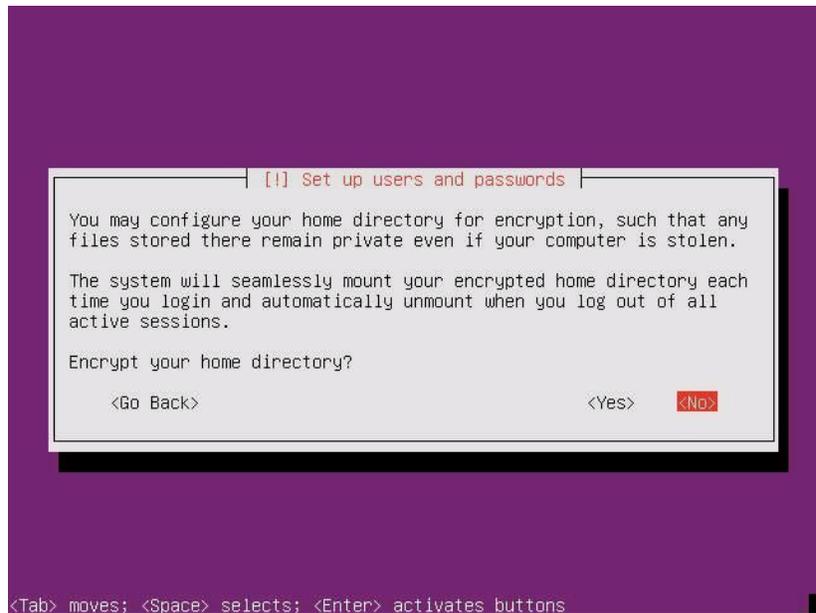
59. Ubuntu will try to install the latest updates if it can access the Internet either directly or through a HTTP proxy. On the Configure the package manager screen, enter the URL for a HTTP proxy, if needed, press Enter.
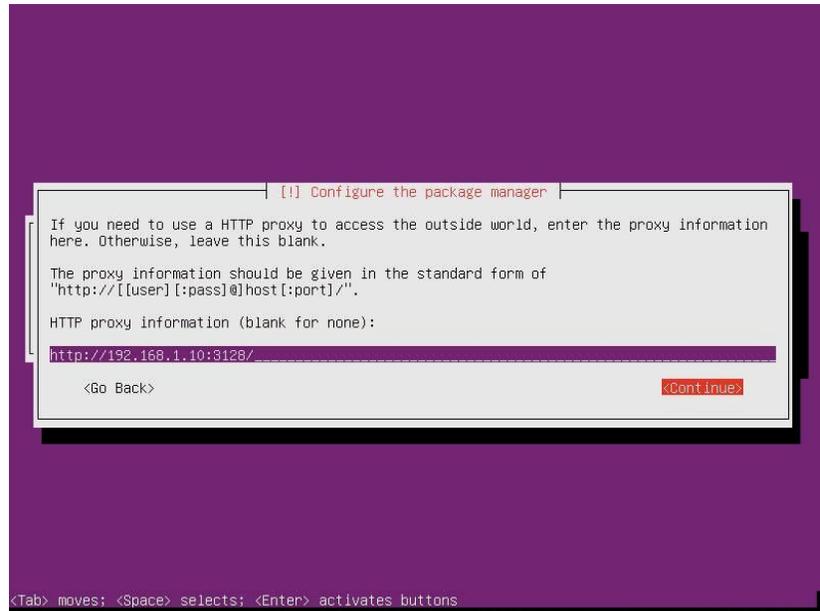
60. On the Configuring tasksel screen, select the package update method, and press Enter.
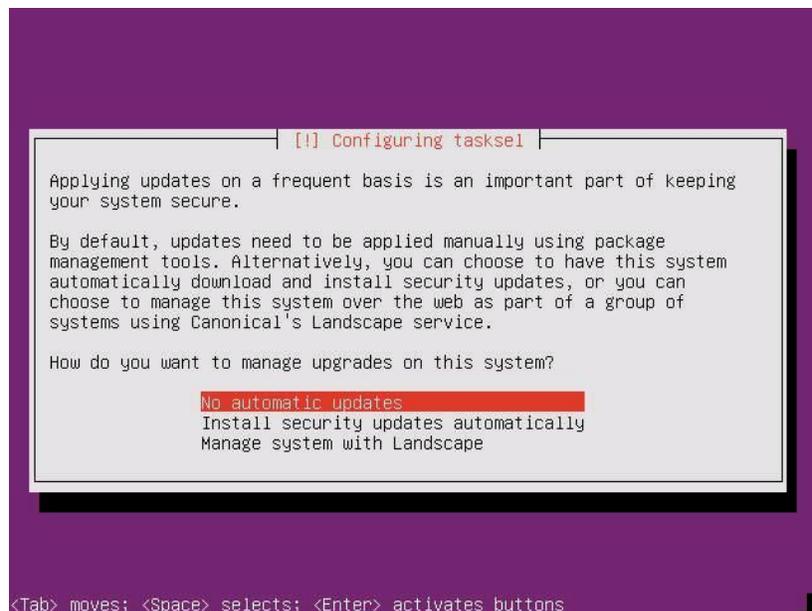
61. On the Software selection screen, use the space bar to select additional packages to install, such as an SSH server then press Enter.
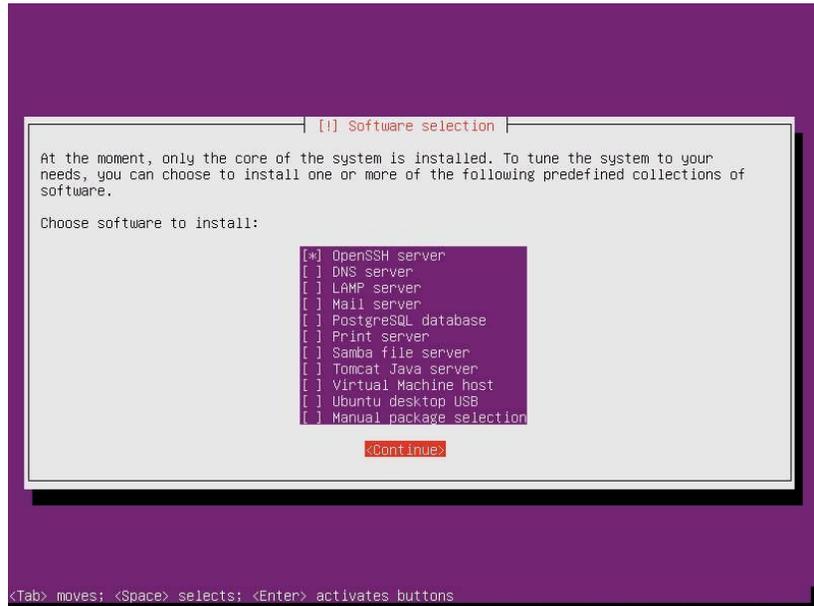
62. On the Install the GRUB boot loader on a hard disk screen, select Yes, and press Enter.

63. On the Finish the installation screen, press Enter.

64. After the server reboots, login as the user created above (e.g., administrator).

INSTALLING THE LAMP STACK ON UBUNTU SERVER AND THE DELL POWEREDGE C6220
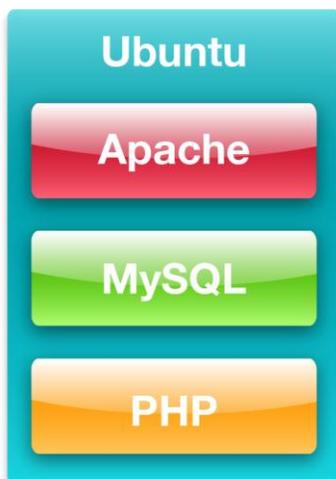
The LAMP stack – An overview

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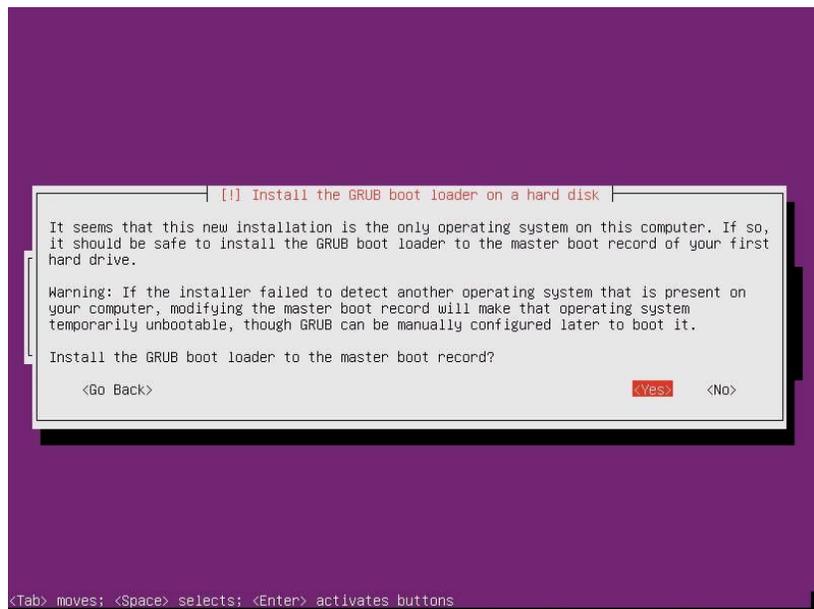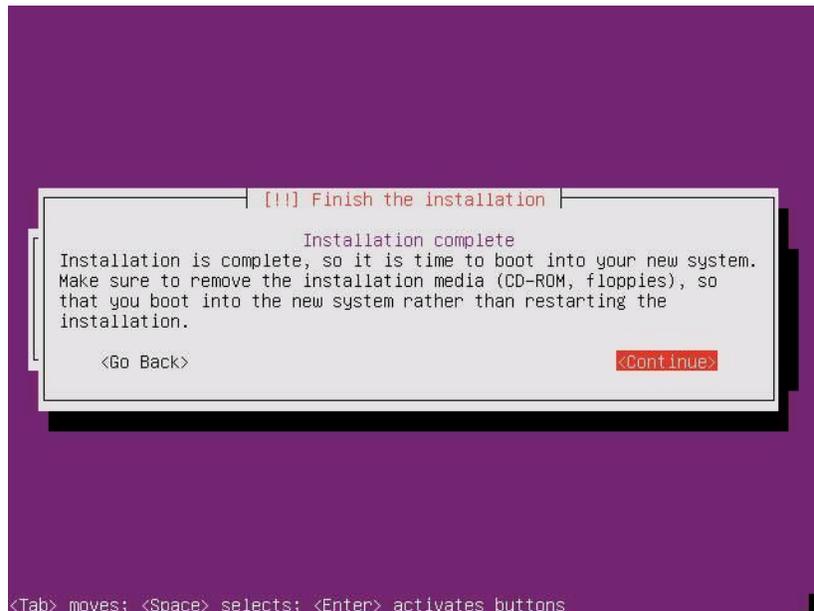language. This application stack has been used for years by service providers to provide powerful and flexible multi-tier environments for customers. Below, we briefly describe each component and then review the specific methods for setting up a single-server LAMP stack on the Dell PowerEdge C6220.

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 LAMP

1. Log onto the server as the non-privileged user.
2. Run tasksel to install the complete LAMP stack as a task:

```
sudo tasksel install lamp-server
```

3. When prompted, enter a password for the mysql root user and select OK.

Additional Apache configuration

No additional configuration steps are needed.

Additional MySQL configuration for mysql_secure_installation

1. Log onto the server at the non-privileged user.
2. Invoke the mysql_secure_installation utility

```
sudo mysql_secure_installation
```

a. Enter the mysql root password (RootPassword).
b. Enter Y to remove the ability for users to anonymously connect.
c. Enter Y to disallow root login remotely.
d. Enter Y to remove the test database and access to it.
e. Enter Y to reload the privileges table.

Additional PHP configuration

No additional configuration steps are needed.

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 into the server as the non-privileged user.

2. 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;
```

3. Exit the mysql client utility.

4. 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");
```

5. Exit the mysql client utility.

6. In the Apache Web data directory, located by default on Ubuntu Server at /var/www/, create a new file named helloworld.php that will query the database and print the results. See Appendix C for this sample PHP file contents.

7. 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 Ubuntu Server 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 Ubuntu 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 Ubuntu Server is a simple, straightforward task that can bring many benefits to your cloud environment.

APPENDIX A – REFERENCES

1. Dell Support page: http://support.dell.com

2. Ubuntu 11.10 Server Guide, https://help.ubuntu.com/11.10/serverguide/C/serverguide.pdf

APPENDIX B – DELL POWEREDGE C6220 SYSTEM DETAILS

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

System	Dell PowerEdge C6220
Power supplies	
Total number	2
Vendor and model number	Dell Model : D1200E-S1
Wattage of each (W)	1400
Cooling fans	
Total number	4
Vendor and model number	Dell FHXGY-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) #1	
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	Ubuntu 11.10 Server, 64-bit
File system	ext4
Kernel	3.0.0-17-server
Language	English
Updates	All as of 4/12/2012
Graphics	
Vendor and model number	ASPEED VGA Controller
Graphics memory (MB)	8
Storage controller	
Vendor and model number	Intel Corporation Patsburg 6-Port SATA AHCI Controller
Firmware version	06
Cache size	None
Internal hard drive	
Vendor and model number	Seagate ST91000640NS
Number of disks in system	6
Size (GB)	1,000
Buffer size (MB)	64
RPM	7.2K
Type	SATA
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 – CONFIGURATION FILES FOR LAMP ON UBUNTU SERVER

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

```php
<?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/helloworld.php.

ABOUT PRINCIPLED TECHNOLOGIES

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