MySQL Cluster on Centos 7

Content:

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Percona XtraDB Cluster on CentOS 7

Content:

How to Install and Configure MySQL Cluster on CentOS 7

MySQL Cluster is designed to provide a MySQL compatible database with high availability and low latency. The MySQL Cluster technology is implemented through the NDB (Network Database) and NDBCLUSTER storage engines and provides shared-nothing clustering and auto-sharing for MySQL database systems. In the shared-nothing architecture, each of nodes has its own memory and disk, the use of shared storage such as NFS, SANs are not recommended and supported.
To implement a MySQL Cluster, we have to install three types of nodes. Each node type will be installed on its own server. The components are:

1. **Management Node - NDB_MGMD/MGM**
   The Cluster management server is used to manage the other node of the cluster. We can create and configure new nodes, restart, delete, or backup nodes on the cluster from the management node.

2. **Data Nodes - NDBD/NDB**
   This is the layer where the process of synchronizing and data replication between nodes happens.

3. **SQL Nodes - MySQLD/API**
   The interface servers that are used by the applications to connect to the database cluster.

In this tutorial, I will guide you through the installation and configuration of a MySQL Cluster with CentOS 7. We will configure the management node, two data nodes, and two SQL nodes.

Prerequisites

5 CentOS servers or virtual machines. I will use the hostnames and IP addresses as shown below:

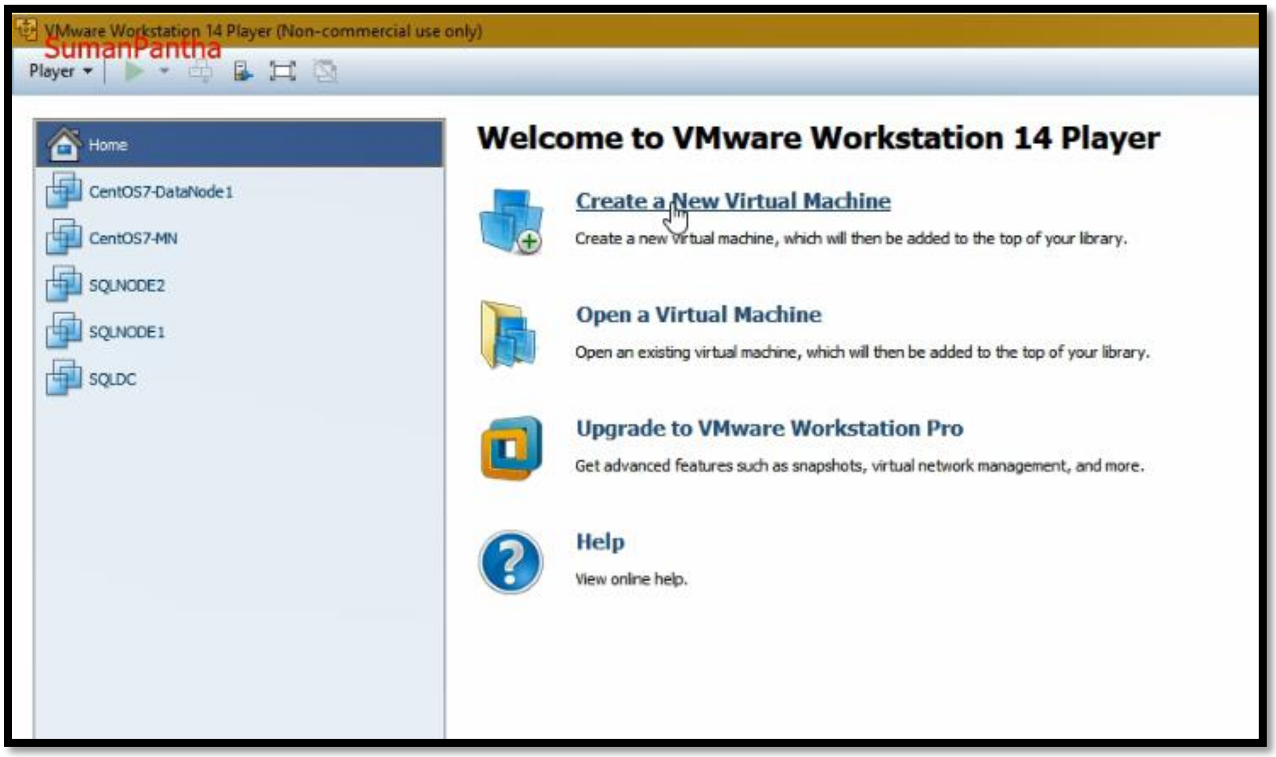
- **Management Node**
  centosmn = 192.168.19.130
- **Data Nodes**
  datanode1 = 192.168.19.129
  datanode2 = 192.168.19.131
- **SQL Nodes**
  sqlnode1 = 192.168.19.132
  sqlnode2 = 192.168.19.133

- The OS is CentOS 7 - 64bit.

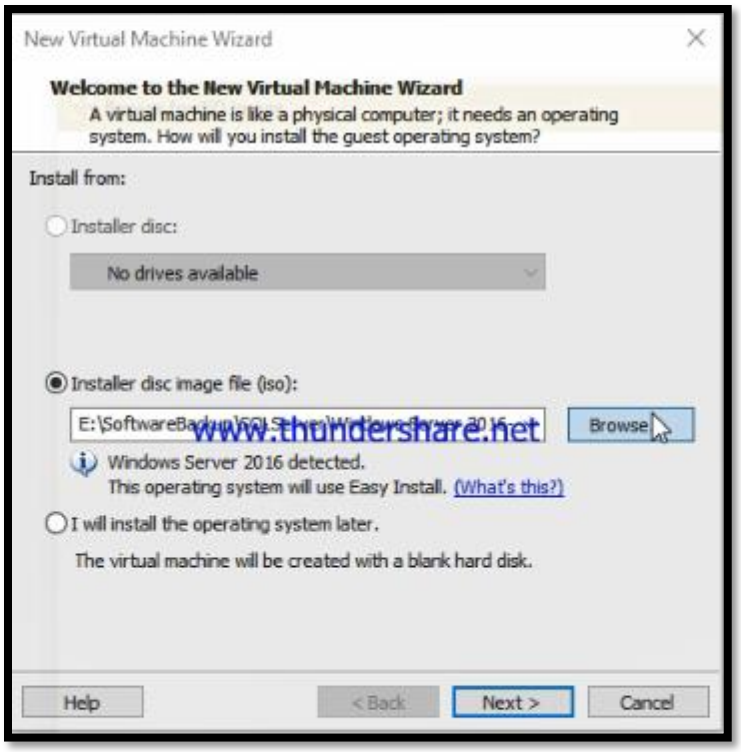
Installation of CentOS 7 (64X) Minimal in VMWare

As we need 5 Virtual Machine to implement the MySQL Clustering so we need to first install Operation System (CentOS 7). The steps to install CentOS in VMWare is represented by the screenshot below. We need to install CentOS in five different VM. So, repeat the steps to install the OS on five different VM.

For the very first time we need to create the Virtual Machine for the OS.


VMware Workstation 14 Player (Non-commercial use only)
SumanPantha
Player
Home
CentOS7-DataNode1
CentOS7-MN
SQLNODE2
SQLNODE1
SQLDC
Welcome to VMware Workstation 14 Player
Create a New Virtual Machine
Create a new virtual machine, which will then be added to the top of your library.
Open a Virtual Machine
Open an existing virtual machine, which will then be added to the top of your library.
Upgrade to VMware Workstation Pro
Get advanced features such as snapshots, virtual network management, and more.
Help
View online help.

Browse the OS file and click Next to continue the installation.



New Virtual Machine Wizard

Welcome to the New Virtual Machine Wizard

A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?

Install from:

( ) Installer disc:

No drives available

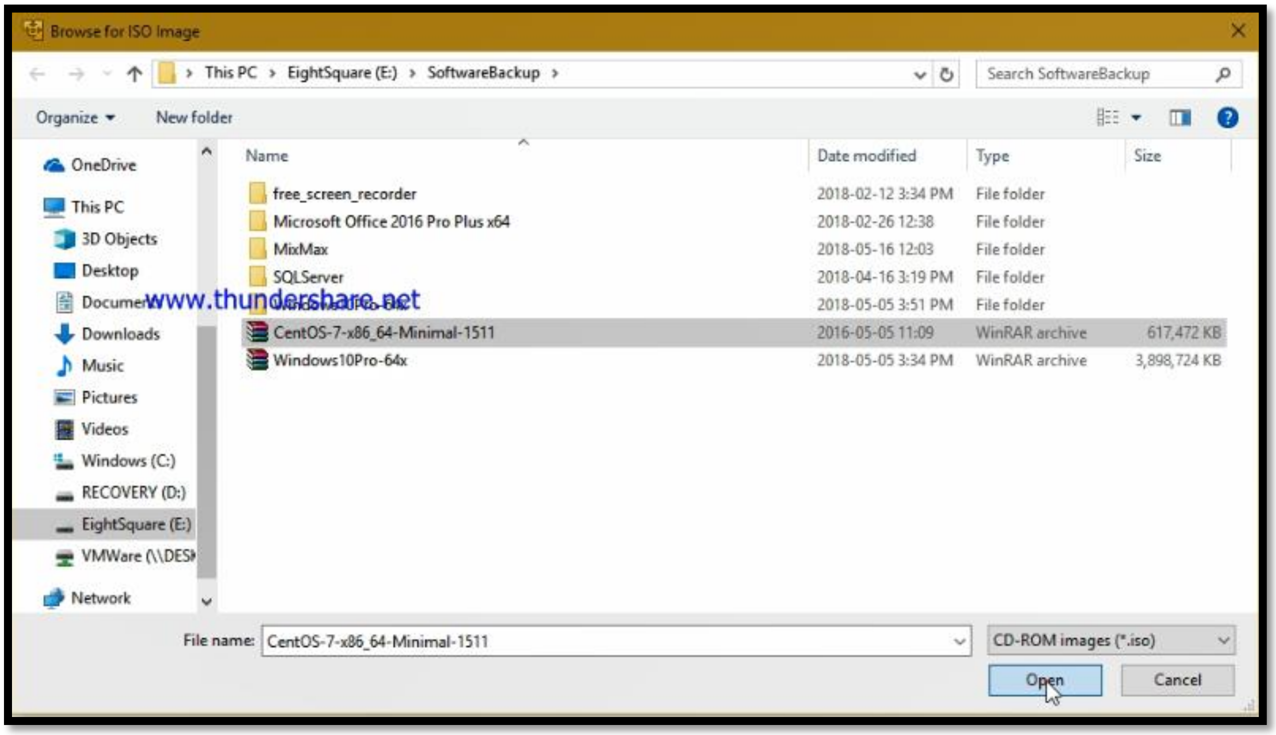
(●) Installer disc image file (iso):

E:\SoftwareBackup\SQLServer\Windows Server 2016...

Windows Server 2016 detected.
This operating system will use Easy Install. (What's this?)

( ) I will install the operating system later.

The virtual machine will be created with a blank hard disk.



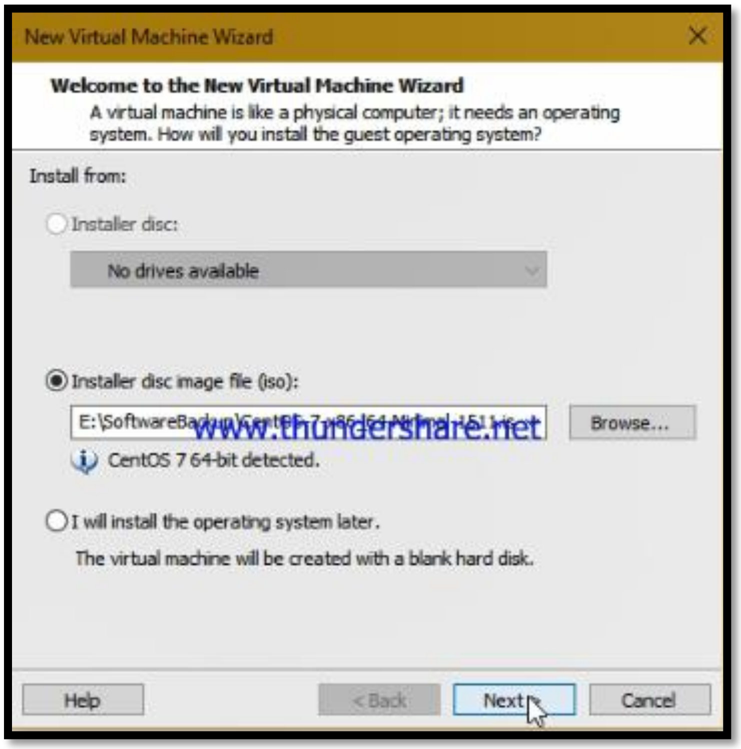
Browse for ISO Image

This PC > EightSquare (E:) > SoftwareBackup >

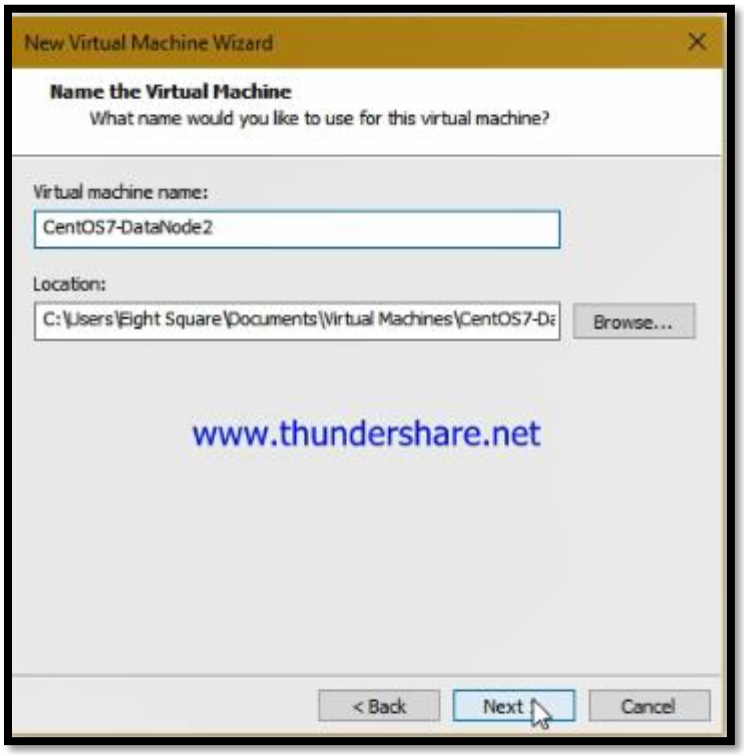
Name	Date modified	Type	Size
free_screen_recorder	2018-02-12 3:34 PM	File folder	
Microsoft Office 2016 Pro Plus x64	2018-02-26 12:38	File folder	
MixMax	2018-05-16 12:03	File folder	
SQLServer	2018-04-16 3:19 PM	File folder	
Windows10Pro-64x	2018-05-05 3:51 PM	File folder	
CentOS-7-x86_64-Minimal-1511	2016-05-05 11:09	WinRAR archive	617,472 KB
Windows10Pro-64x	2018-05-05 3:34 PM	WinRAR archive	3,898,724 KB

File name: CentOS-7-x86_64-Minimal-1511

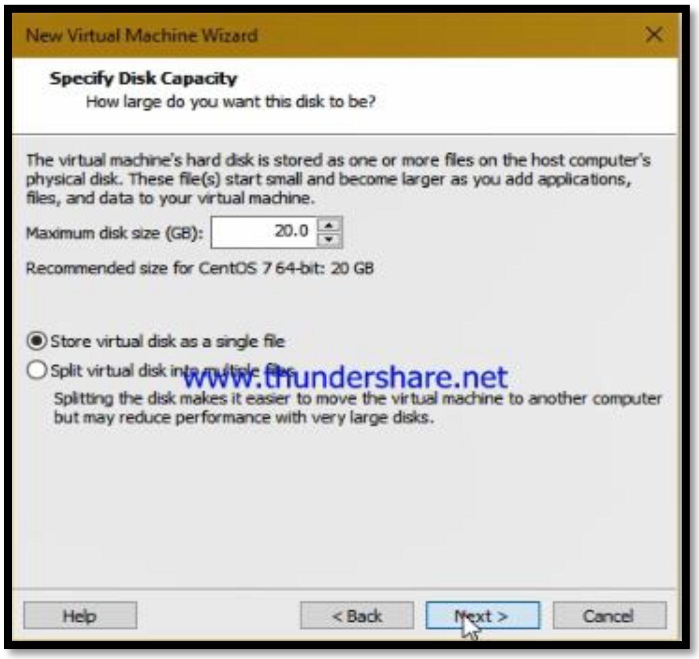
CD-ROM images (*.iso)


New Virtual Machine Wizard
Welcome to the New Virtual Machine Wizard
A virtual machine is like a physical computer; it needs an operating system. How will you install the guest operating system?
Install from:
Installer disc:
No drives available
Installer disc image file (iso):
E:\SoftwareBackup\CentOS-7-x86_64-Minimal-1511.iso
Browse...
CentOS 7 64-bit detected.
I will install the operating system later.
The virtual machine will be created with a blank hard disk.
Help
< Back
Next
Cancel

Give the Virtual Machine a Identical name and click Next


New Virtual Machine Wizard
Name the Virtual Machine
What name would you like to use for this virtual machine?
Virtual machine name:
CentOS7-DataNode2
Location:
C:\Users\Eight Square\Documents\Virtual Machines\CentOS7-Da
Browse...
< Back
Next
Cancel

Instead of splitting the virtual disk files select to store in a single file and click Next to continue.


New Virtual Machine Wizard

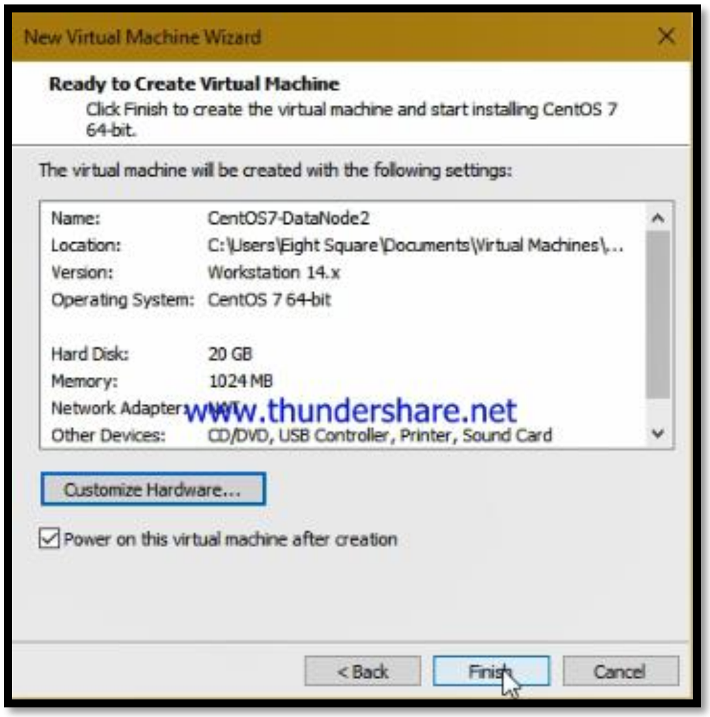
Specify Disk Capacity
How large do you want this disk to be?

The virtual machine's hard disk is stored as one or more files on the host computer's physical disk. These file(s) start small and become larger as you add applications, files, and data to your virtual machine.

Maximum disk size (GB): 20.0

Recommended size for CentOS 7 64-bit: 20 GB

[✓ Store virtual disk as a single file]
Split virtual disk into multiple files
Splitting the disk makes it easier to move the virtual machine to another computer but may reduce performance with very large disks.


New Virtual Machine Wizard

Ready to Create Virtual Machine
Click Finish to create the virtual machine and start installing CentOS 7 64-bit.

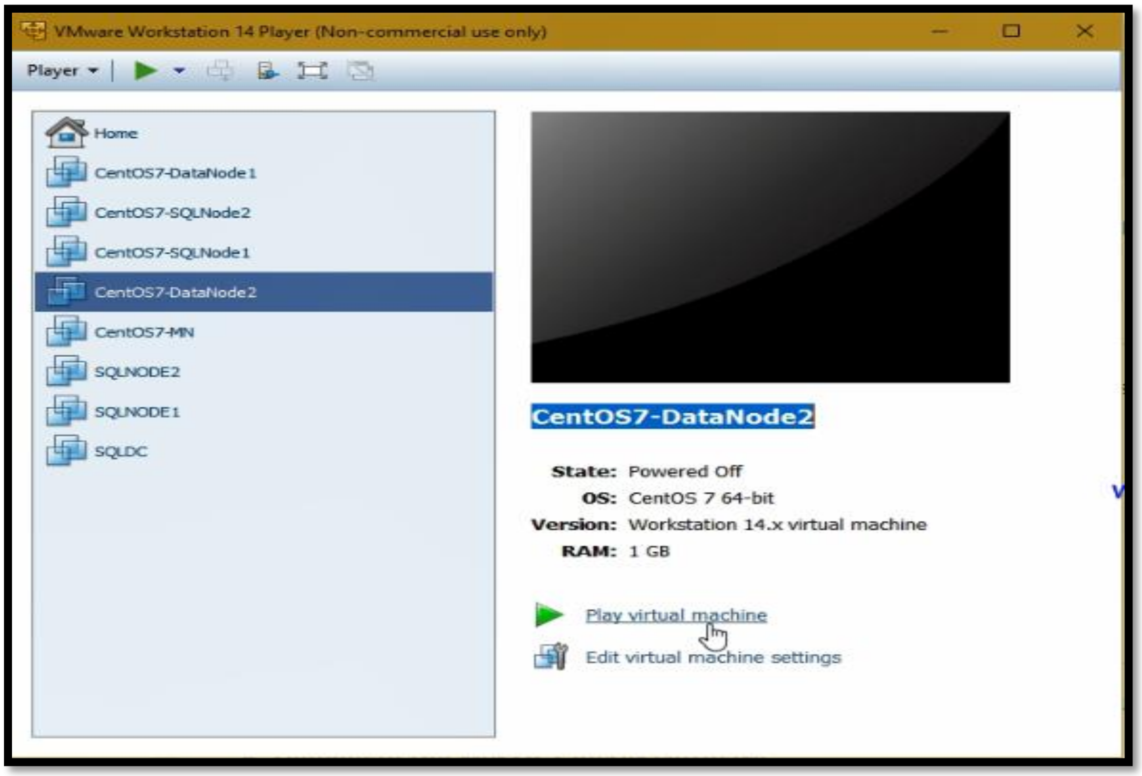
The virtual machine will be created with the following settings:

Name:	CentOS7-DataNode2
Location:	C:\Users\Eight Square\Documents\Virtual Machines\...
Version:	Workstation 14.x
Operating System:	CentOS 7 64-bit
Hard Disk:	20 GB
Memory:	1024 MB
Network Adapter:	NAT
Other Devices:	CD/DVD, USB Controller, Printer, Sound Card

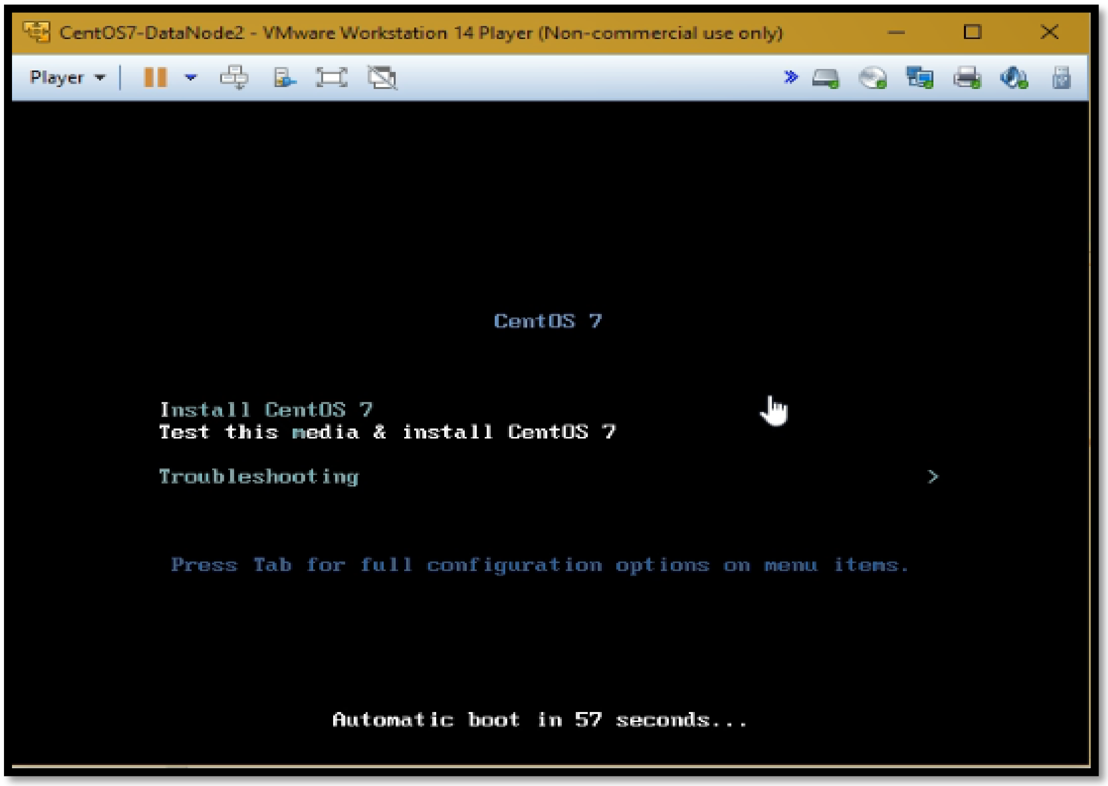
[✓] Power on this virtual machine after creation

Click Finish to complete the creation of the Virtual Machine.

Select the Virtual Machine and Click on Play virtual machine

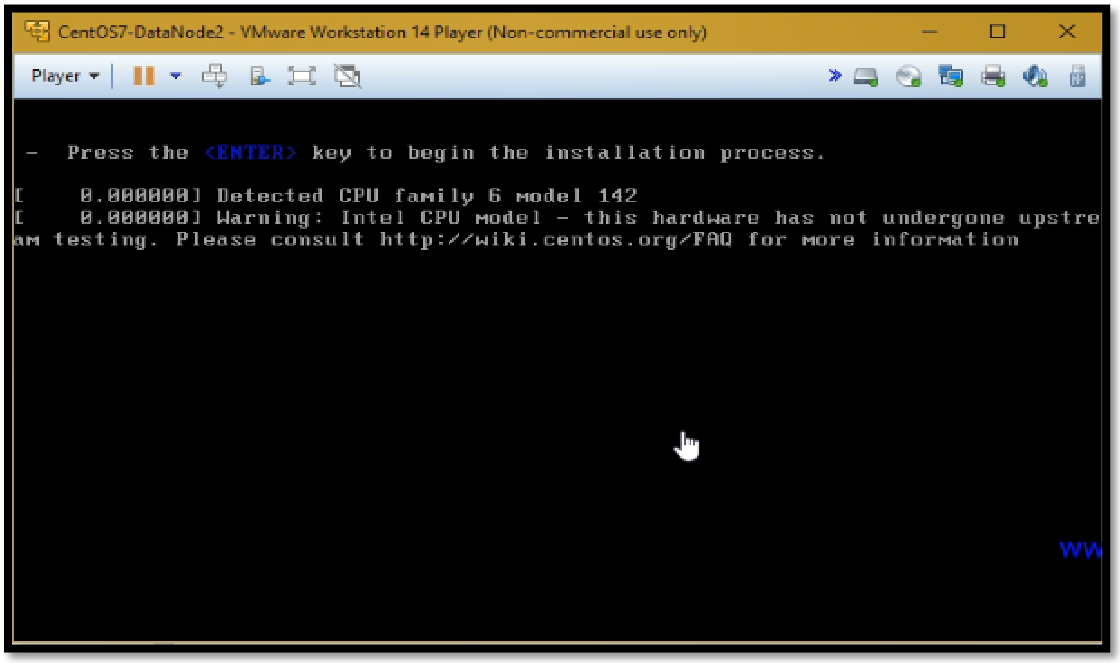


State: Powered Off
OS: CentOS 7 64-bit
Version: Workstation 14.x virtual machine
RAM: 1 GB

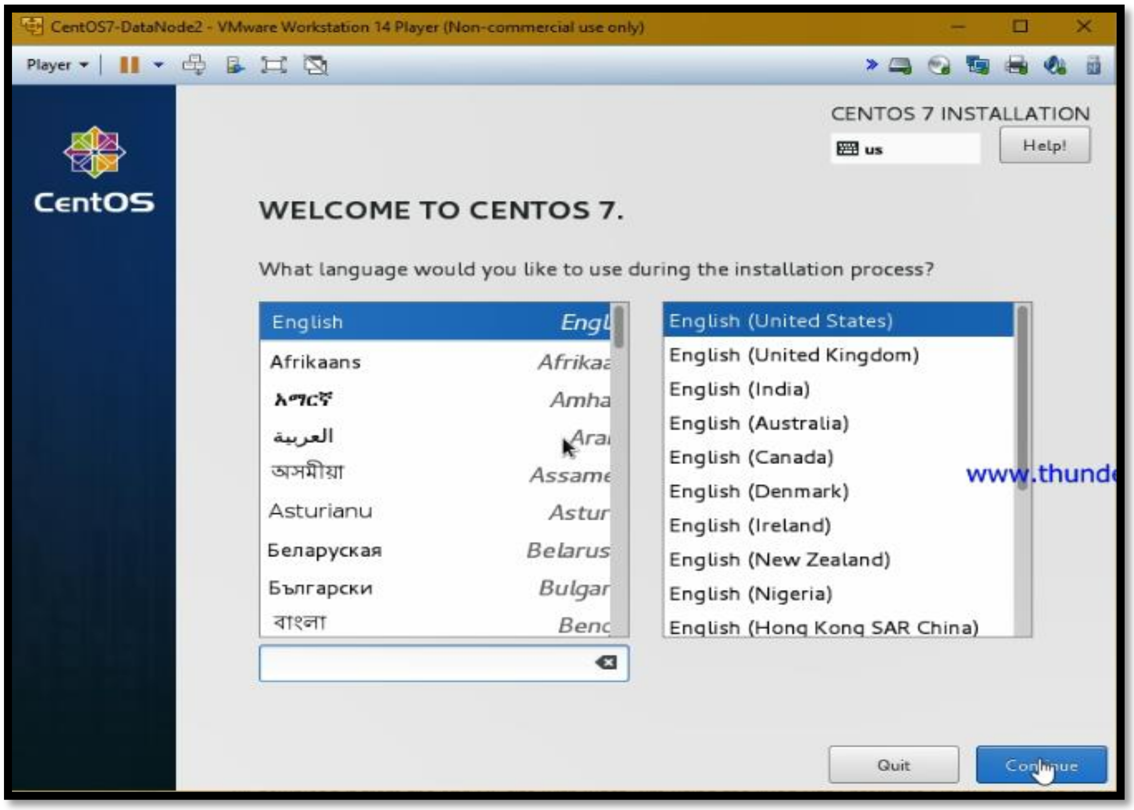

CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player

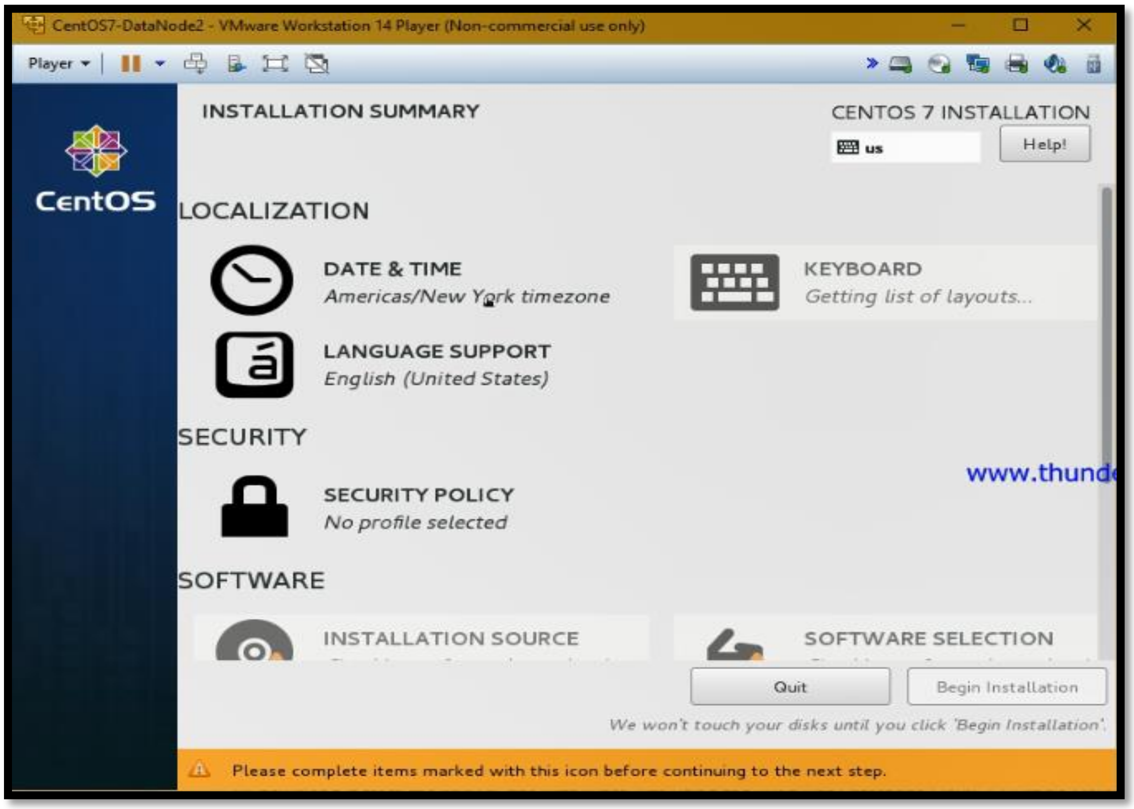
```
CentOS 7

Install CentOS 7
Test this media & install CentOS 7

Troubleshooting                                    >

Press Tab for full configuration options on menu items.

Automatic boot in 57 seconds...
```

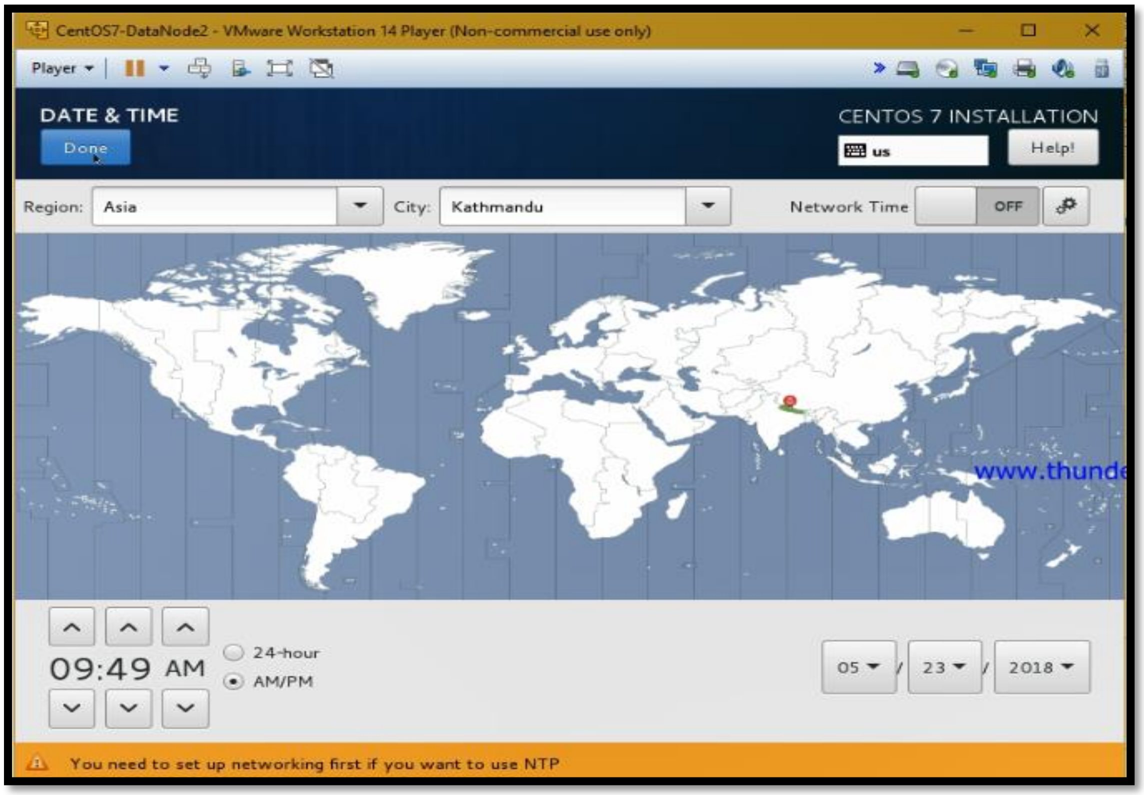
Press Enter key to continue.


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player

```
- Press the <ENTER> key to begin the installation process.
[    0.000000] Detected CPU family 6 model 142
[    0.000000] Warning: Intel CPU model - this hardware has not undergone upstre
am testing. Please consult http://wiki.centos.org/FAQ for more information
```


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player
CentOS
CENTOS 7 INSTALLATION
us
Help!
WELCOME TO CENTOS 7.
What language would you like to use during the installation process?
English Engl
Afrikaans Afrikaa
አማርኛ Amha
العربية Arai
অসমীয়া Assame
Asturianu Astur
Беларуская Belarus
Български Bulgar
বাংলা Benc
English (United States)
English (United Kingdom)
English (India)
English (Australia)
English (Canada)
English (Denmark)
English (Ireland)
English (New Zealand)
English (Nigeria)
English (Hong Kong SAR China)
www.thund
Quit
Continue


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player
CentOS
INSTALLATION SUMMARY
CENTOS 7 INSTALLATION
us
Help!
LOCALIZATION
DATE & TIME
Americas/New York timezone
KEYBOARD
Getting list of layouts...
LANGUAGE SUPPORT
English (United States)
SECURITY
SECURITY POLICY
No profile selected
www.thund
SOFTWARE
INSTALLATION SOURCE
SOFTWARE SELECTION
Quit
Begin Installation
We won't touch your disks until you click 'Begin Installation'.
Please complete items marked with this icon before continuing to the next step.


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

DATE & TIME

CENTOS 7 INSTALLATION

Region: Asia

City: Kathmandu

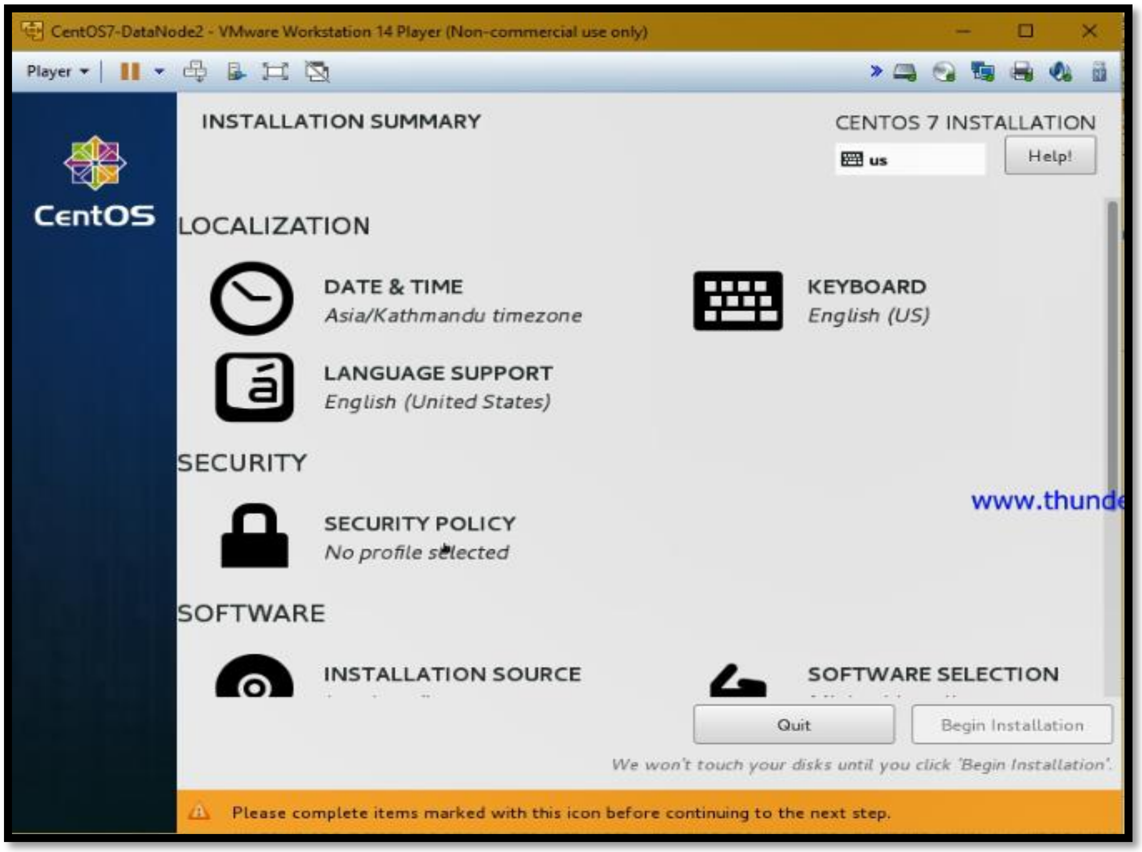
Network Time OFF

09:49 AM

24-hour [✓ AM/PM]

05 / 23 / 2018

You need to set up networking first if you want to use NTP


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION SUMMARY

CENTOS 7 INSTALLATION

LOCALIZATION

DATE & TIME
Asia/Kathmandu timezone

KEYBOARD
English (US)

LANGUAGE SUPPORT
English (United States)

SECURITY

SECURITY POLICY
No profile selected

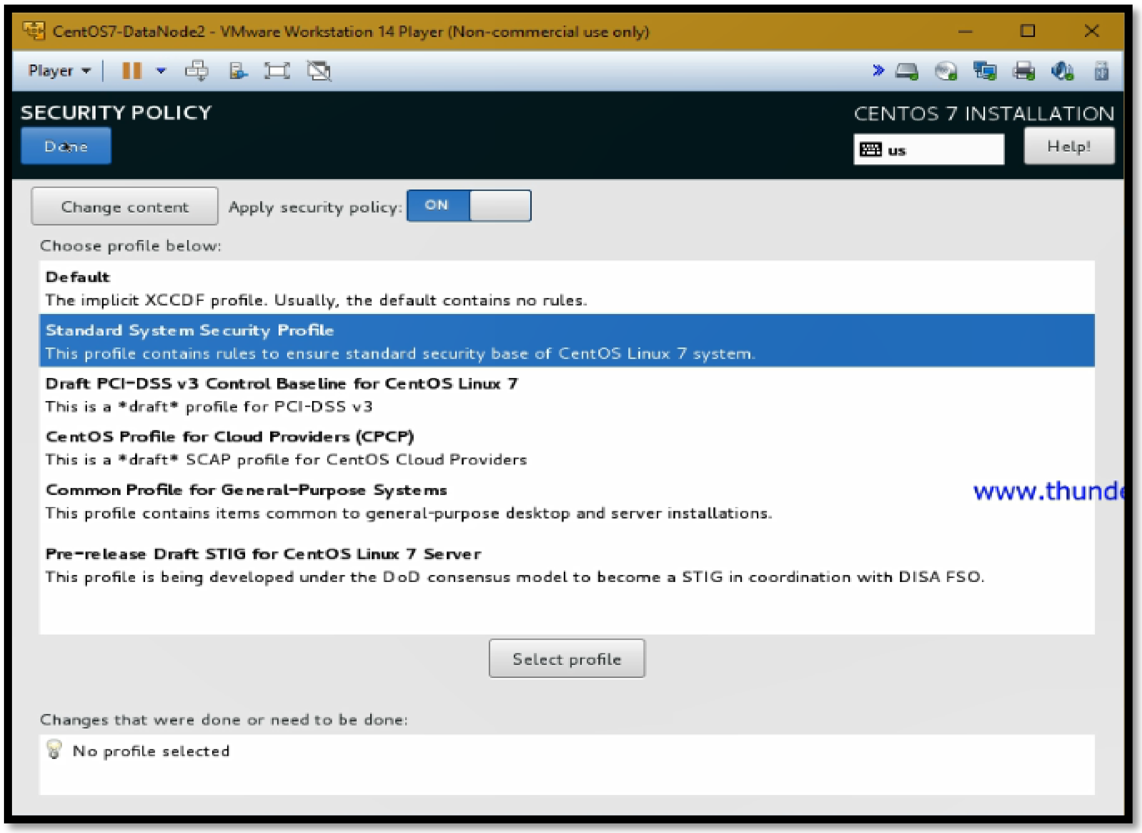
SOFTWARE

INSTALLATION SOURCE

SOFTWARE SELECTION

We won't touch your disks until you click 'Begin Installation'.

Please complete items marked with this icon before continuing to the next step.



Apply security policy: ON

Choose profile below:

Default
The implicit XCCDF profile. Usually, the default contains no rules.

Standard System Security Profile
This profile contains rules to ensure standard security base of CentOS Linux 7 system.

Draft PCI-DSS v3 Control Baseline for CentOS Linux 7
This is a *draft* profile for PCI-DSS v3

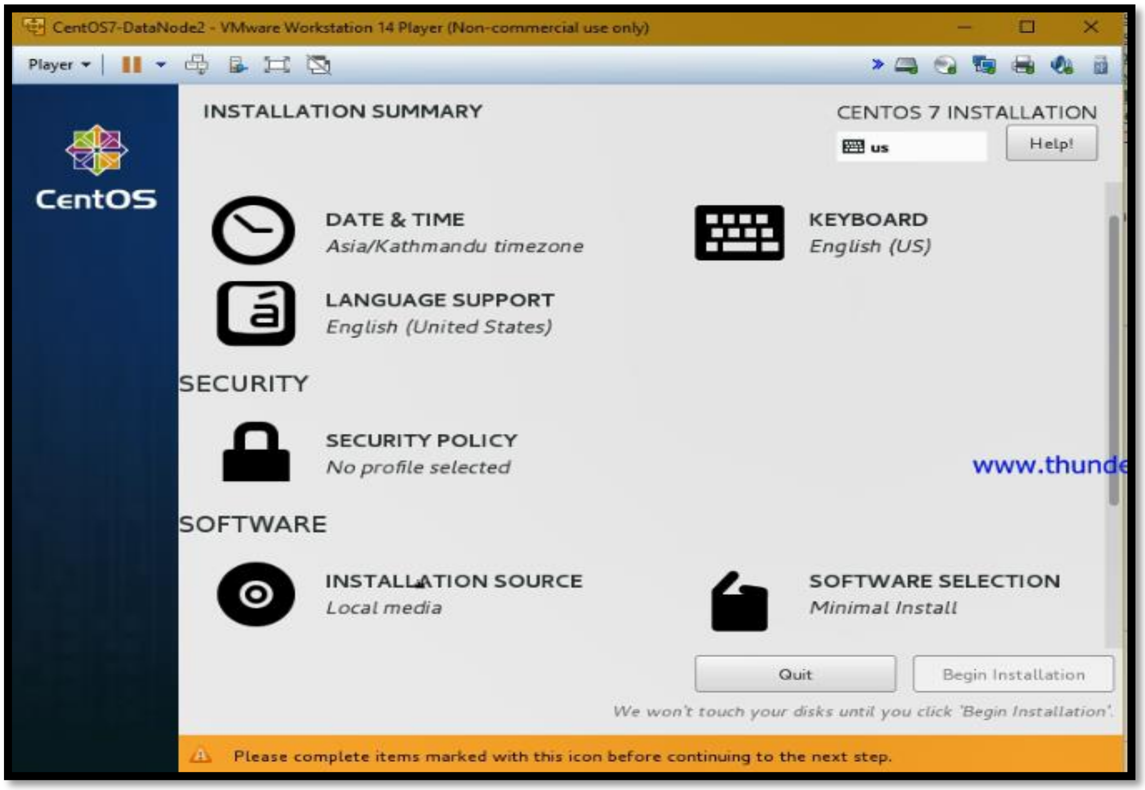
CentOS Profile for Cloud Providers (CPCP)
This is a *draft* SCAP profile for CentOS Cloud Providers

Common Profile for General-Purpose Systems
This profile contains items common to general-purpose desktop and server installations.

Pre-release Draft STIG for CentOS Linux 7 Server
This profile is being developed under the DoD consensus model to become a STIG in coordination with DISA FSO.

Changes that were done or need to be done:

No profile selected



DATE & TIME: *Asia/Kathmandu timezone*

KEYBOARD: *English (US)*

LANGUAGE SUPPORT: *English (United States)*

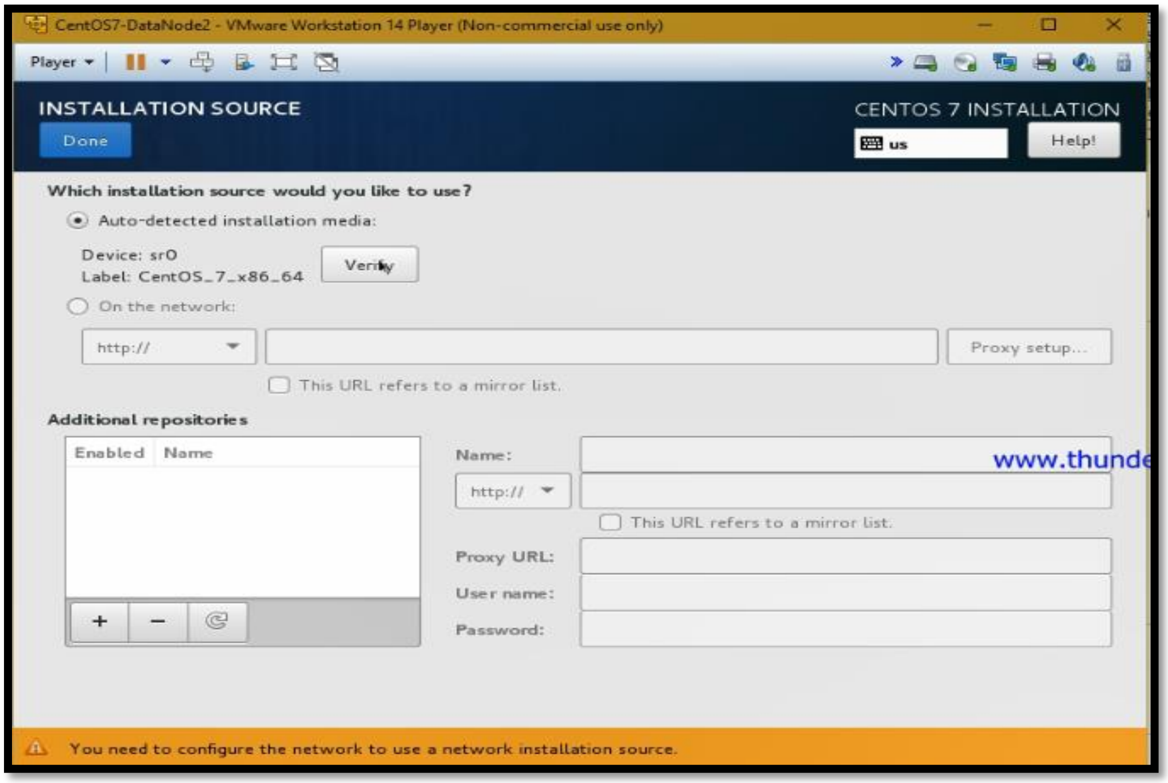
SECURITY POLICY: *No profile selected*

INSTALLATION SOURCE: *Local media*

SOFTWARE SELECTION: *Minimal Install*

We won't touch your disks until you click 'Begin Installation'.

Please complete items marked with this icon before continuing to the next step.


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION SOURCE

CENTOS 7 INSTALLATION

Which installation source would you like to use?

(●) Auto-detected installation media:

Device: sr0
Label: CentOS_7_x86_64

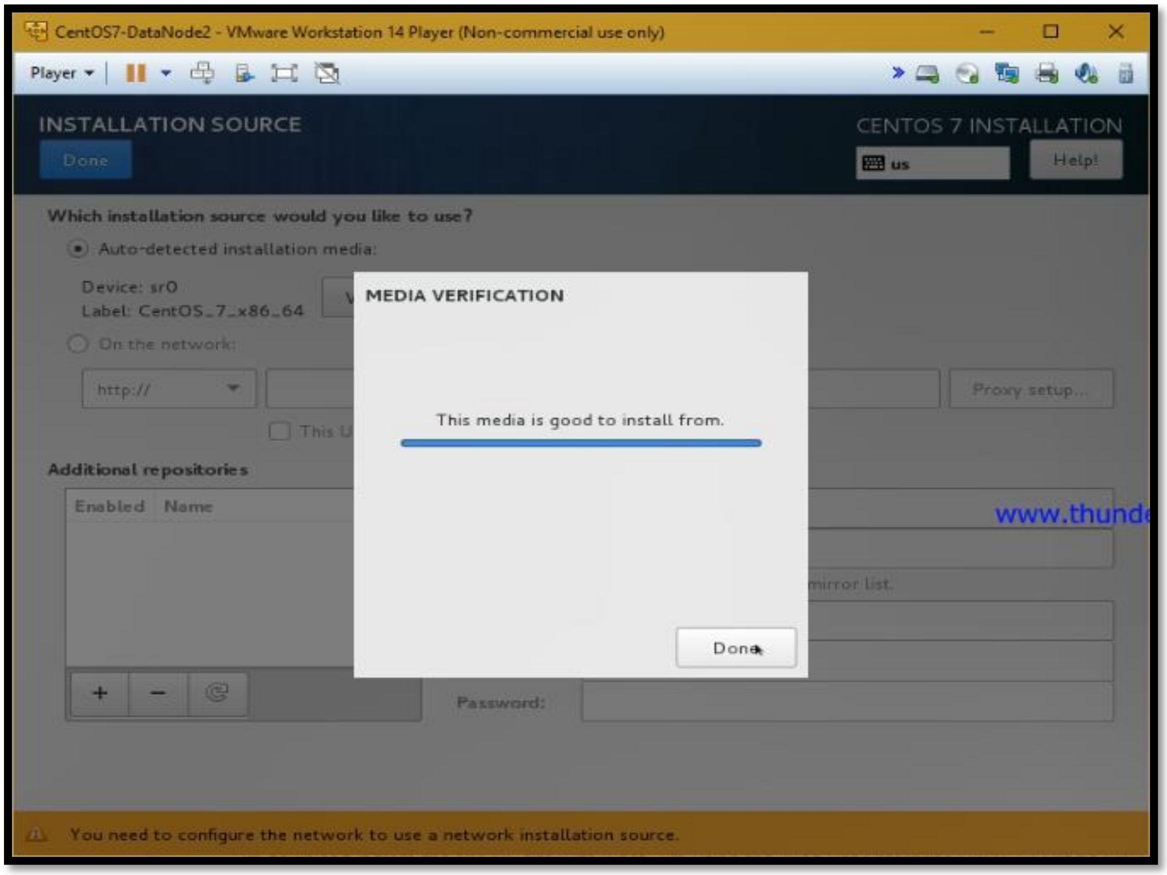
( ) On the network:

☐ This URL refers to a mirror list.

Additional repositories

Name:
Proxy URL:
User name:
Password:

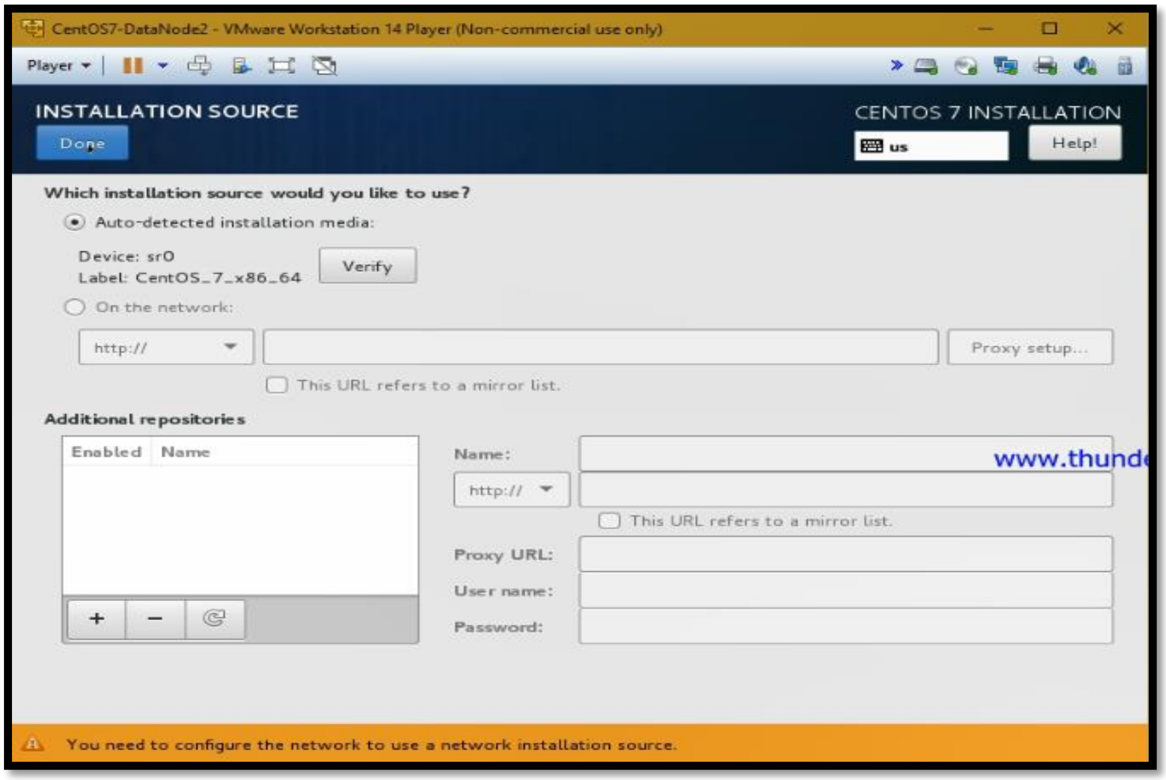
You need to configure the network to use a network installation source.


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

MEDIA VERIFICATION

This media is good to install from.

You need to configure the network to use a network installation source.



CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION SOURCE

CENTOS 7 INSTALLATION

Which installation source would you like to use?

(●) Auto-detected installation media:

Device: sr0
Label: CentOS_7_x86_64

( ) On the network:

http://

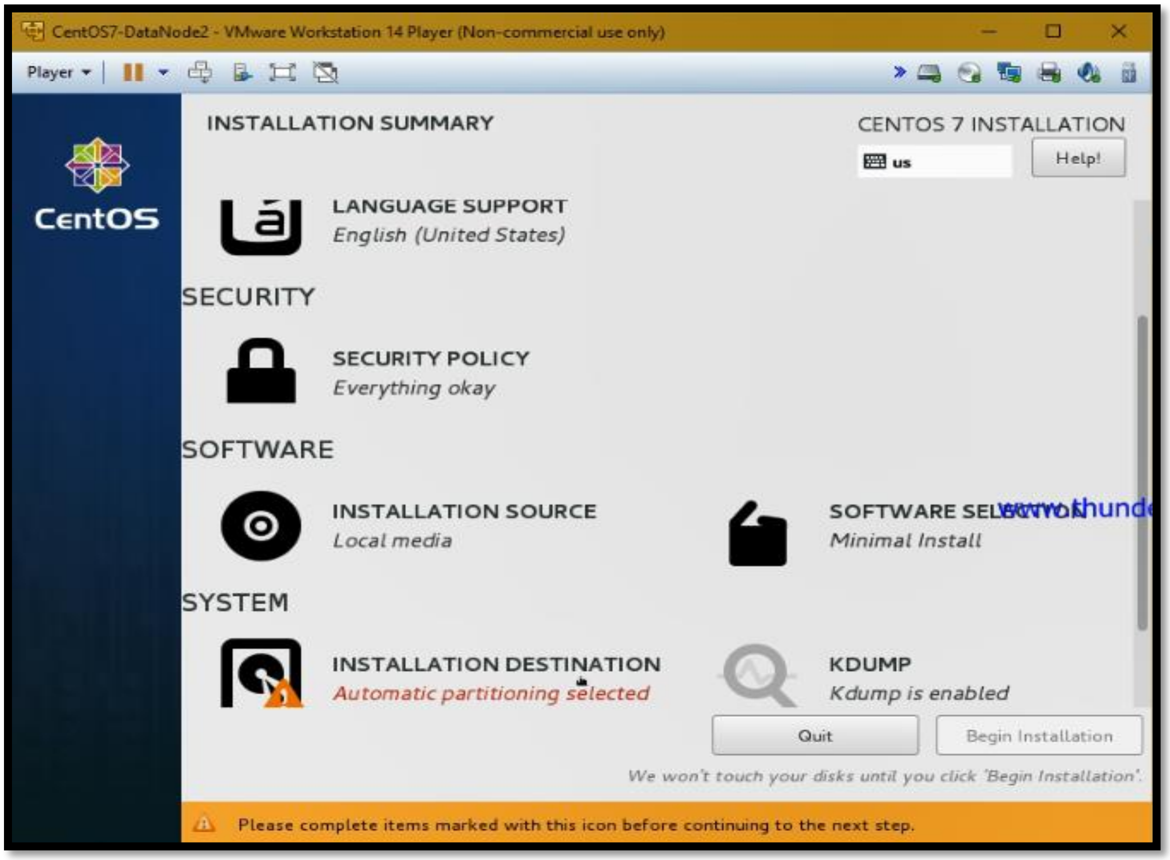
☐ This URL refers to a mirror list.

Additional repositories

Enabled	Name

Name:
http://
☐ This URL refers to a mirror list.
Proxy URL:
User name:
Password:

You need to configure the network to use a network installation source.



CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION SUMMARY

CENTOS 7 INSTALLATION

LOCALIZATION

LANGUAGE SUPPORT
English (United States)

SECURITY

SECURITY POLICY
Everything okay

SOFTWARE

INSTALLATION SOURCE
Local media

SOFTWARE SELECTION
Minimal Install

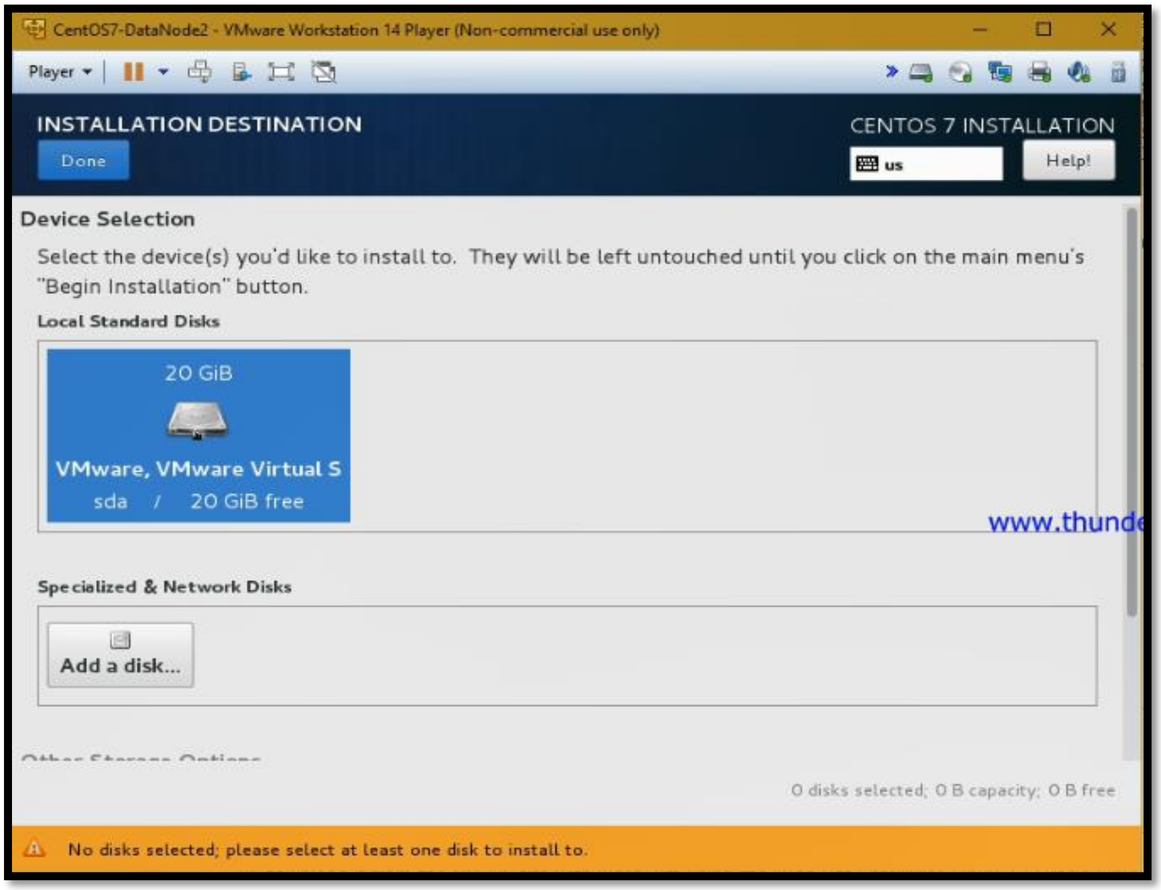
SYSTEM

INSTALLATION DESTINATION
Automatic partitioning selected

KDUMP
Kdump is enabled

We won't touch your disks until you click 'Begin Installation'.

Please complete items marked with this icon before continuing to the next step.



CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION DESTINATION

CENTOS 7 INSTALLATION

Device Selection

Select the device(s) you'd like to install to. They will be left untouched until you click on the main menu's "Begin Installation" button.

Local Standard Disks

20 GiB

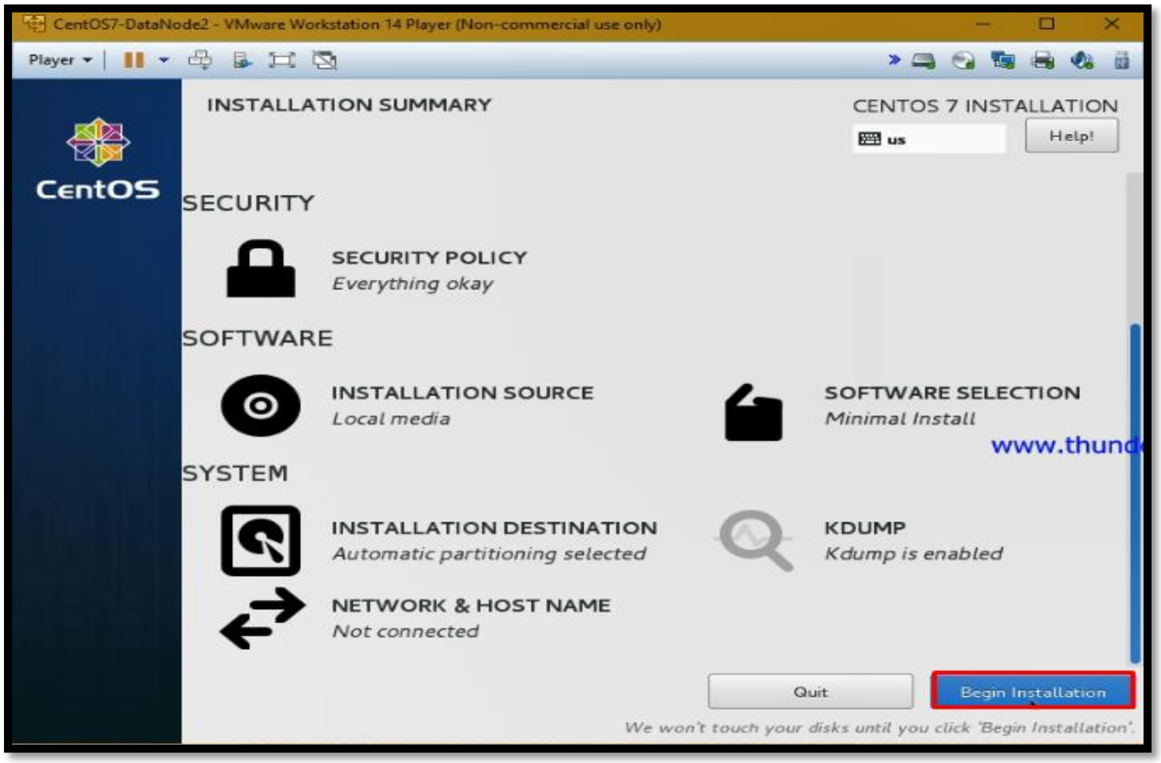
VMware, VMware Virtual S

sda / 20 GiB free

Specialized & Network Disks

0 disks selected; 0 B capacity; 0 B free

No disks selected; please select at least one disk to install to.



CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)

INSTALLATION SUMMARY

CENTOS 7 INSTALLATION

SECURITY

SECURITY POLICY
Everything okay

SOFTWARE

INSTALLATION SOURCE
Local media

SOFTWARE SELECTION
Minimal Install

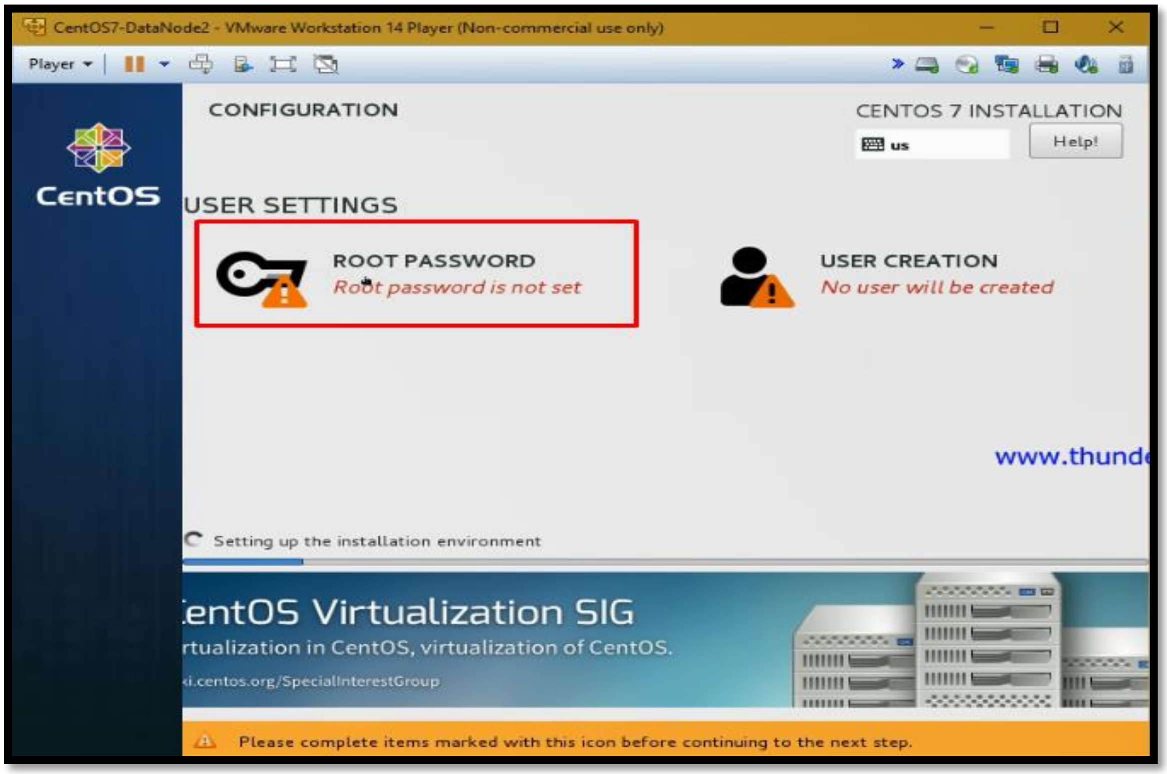
SYSTEM

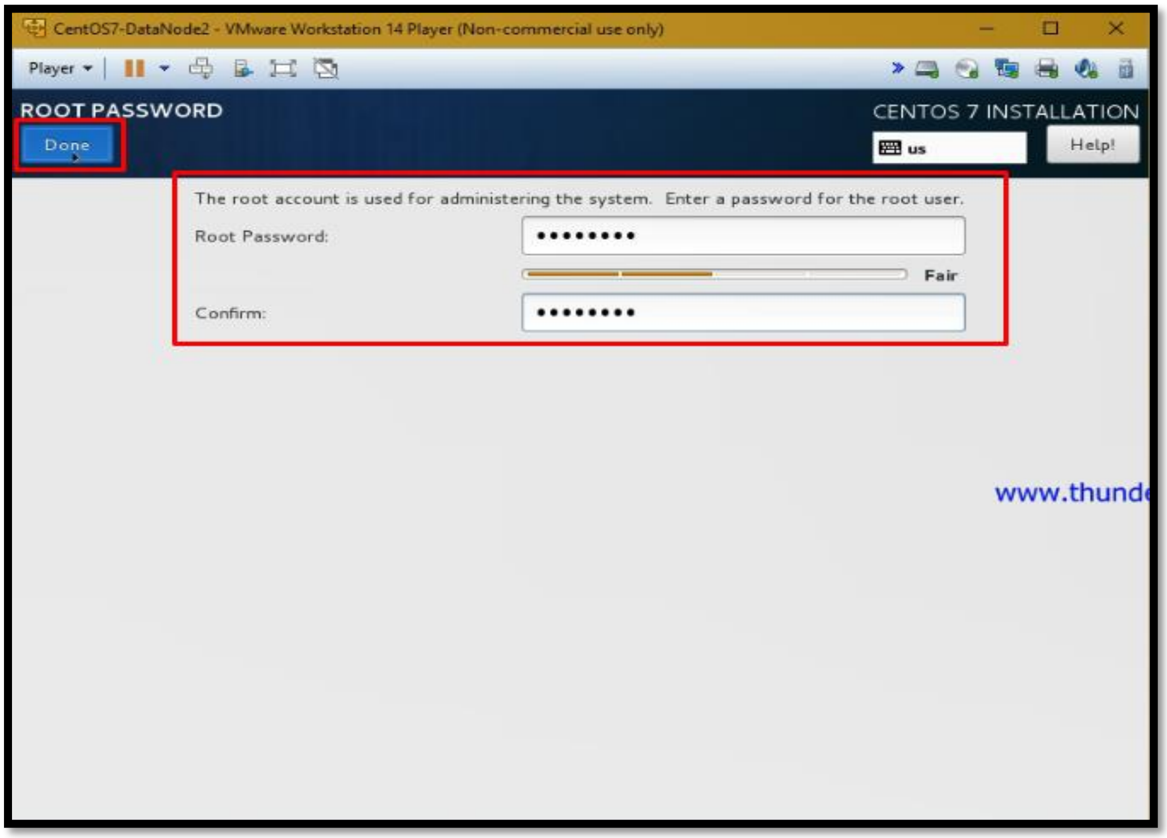
INSTALLATION DESTINATION
Automatic partitioning selected

KDUMP
Kdump is enabled

NETWORK & HOST NAME
Not connected

We won't touch your disks until you click 'Begin Installation'.


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player
CentOS
CONFIGURATION
CENTOS 7 INSTALLATION
us
Help!
USER SETTINGS
ROOT PASSWORD
Root password is not set
USER CREATION
No user will be created
www.thunde
Setting up the installation environment
entOS Virtualization SIG
rtualization in CentOS, virtualization of CentOS.
i.centos.org/SpecialInterestGroup
Please complete items marked with this icon before continuing to the next step.

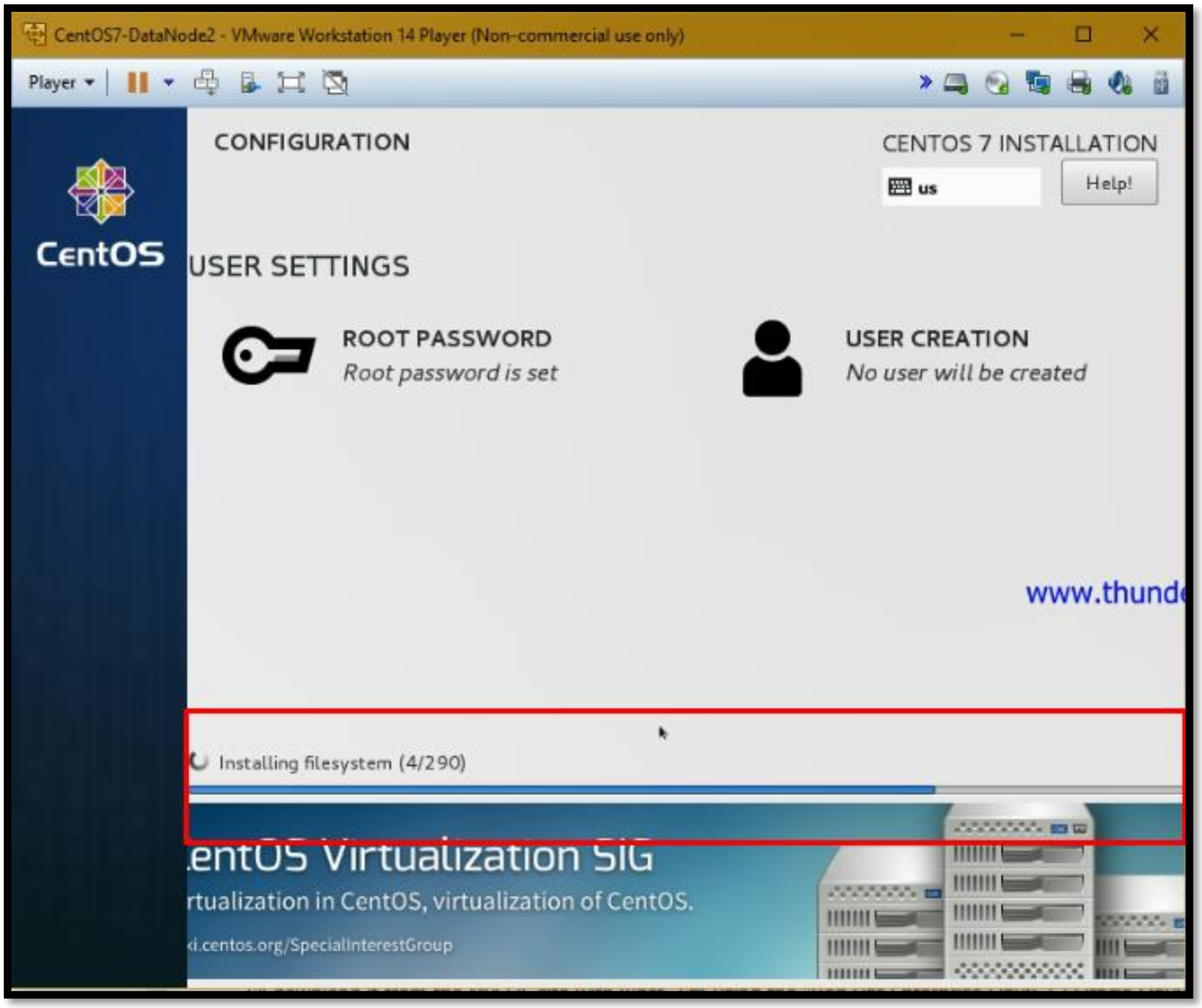

CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player
ROOT PASSWORD
Done
CENTOS 7 INSTALLATION
us
Help!
www.thunde

The root account is used for administering the system. Enter a password for the root user.

Root Password: ••••••••

Fair

Confirm: ••••••••


CentOS7-DataNode2 - VMware Workstation 14 Player (Non-commercial use only)
Player
CentOS
CONFIGURATION
CENTOS 7 INSTALLATION
us
Help!
USER SETTINGS
ROOT PASSWORD
Root password is set
USER CREATION
No user will be created
www.thund
Installing filesystem (4/290)
entOS Virtualization SIG
rtualization in CentOS, virtualization of CentOS.
i.centos.org/SpecialInterestGroup

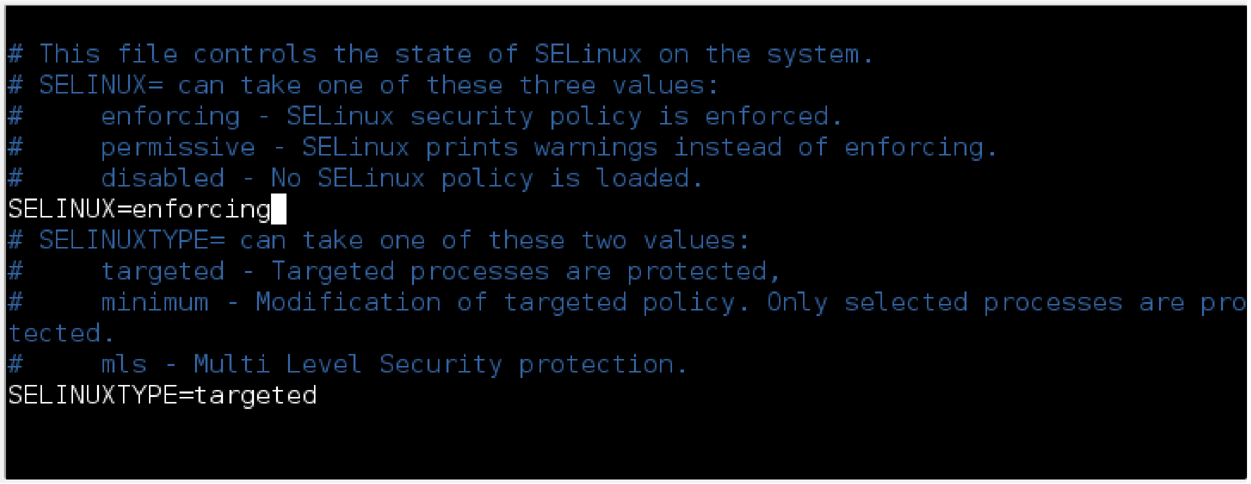
Change the host name before you start the process as readable hostname helps to identify the server easily. To change the hostname as per the desired name follow the link below for more info: https://github.com/sumanpantha/Linux-Research/blob/master/Change%20HostName
Also update all the OS with command: yum update.

```
Syntax To change hostname:
(root@localhost ~] # hostnamectl set-hostname your-new-hostname)
```

```
For Management Nodes:
[root@localhost ~] # hostnamectl set-hostname centosmn
For Data Nodes:
[root@localhost ~] # hostnamectl set-hostname datanode1
[root@localhost ~] # hostnamectl set-hostname datanode2
For SQL Nodes:
[root@localhost ~] # hostnamectl set-hostname sqlnode1
[root@localhost ~] # hostnamectl set-hostname sqlnode2
```

- Need to Disable SELinux in all the nodes:
  To Disable SELinux

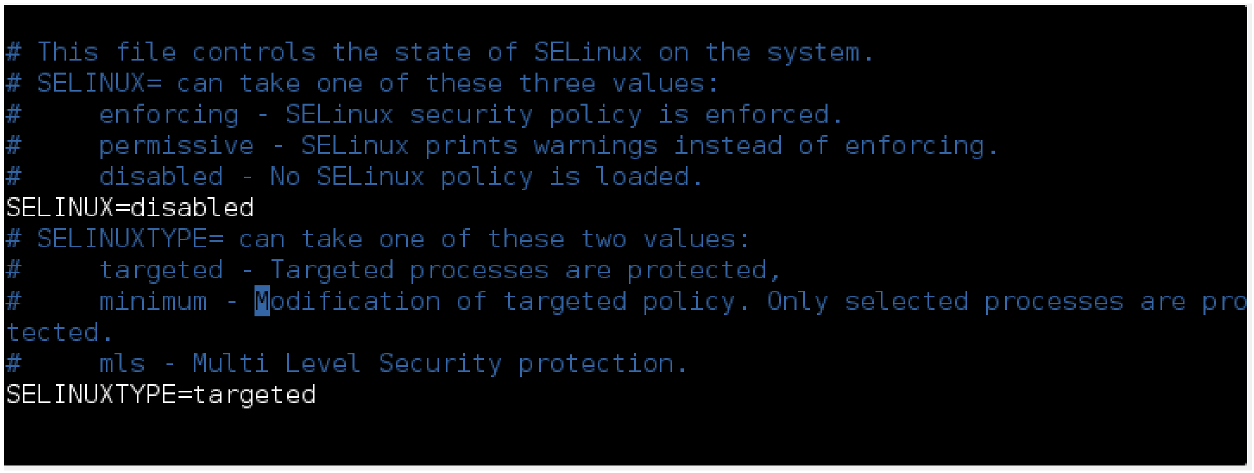
```
[root@centos-mn ~] # vi /etc/sysconfig/selinux
```



```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=enforcing
# SELINUXTYPE= can take one of these two values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are pro
tected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```

Then change the directive `SELinux=enforcing` to `SELinux=disabled` as shown in the below

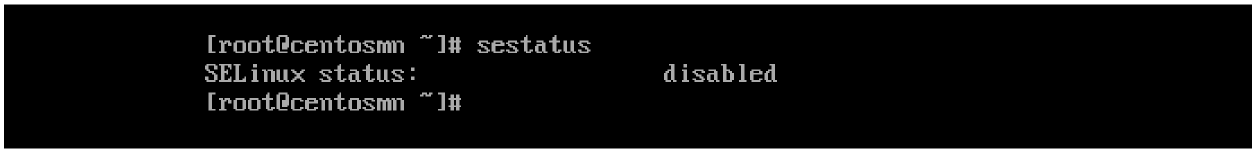
```
SELINUX=disabled
```



```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=disabled
# SELINUXTYPE= can take one of these two values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are pro
tected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```

Then, save and exit the file, for the changes to take effect, you need to reboot your system and then check the status of SELinux using **sestatus** command as shown:

```
[root@centos-mn ~] # sestatus
```



```
[root@centosmn ~]# sestatus
SELinux status:                 disabled
[root@centosmn ~]#
```

Step 1 - Setup Management Node

The first step is to create the **Management Node** with CentOS 7 **centosms** and IP*192.168.19.130*. Make sure you are logged into the **datanode1** server as root user.

A. Download the MySQL Cluster software

I'll download it from the MySQL site with wget before download we need to install wget. I'm using the "CentOS Linux 7 (x86, 64-bit), RPM Bundle " here. Then extract the tar file.

```
[root@centos-mn ~] # yum install wget

[root@centos-mn ~] # wget http://dev.mysql.com/get/Downloads/MySQL-
Cluster-7.4/MySQL-Cluster-gpl-7.4.10-1.el7.x86_64.rpm-bundle.tar


[root@centos-mn ~] # tar -xvf MySQL-Cluster-gpl-7.4.10-
1.el7.x86_64.rpm-bundle.tar
```

B. Install and Remove Packages

Before you install the rpm package for MySQL Cluster, you need to install *perl-Data-Dumper* that is required by the MySQL-Cluster server. And you need to remove *MariaDB-libs* before we can install MySQL Cluster.

```
[root@centos-mn ~] # yum install perl-Data-Dumper

[root@centos-mn ~] # yum remove mariadb-libs

[root@centos-mn ~] # yum install net-tools
```

C. Install MySQL Cluster

Install MySQL Cluster package with these rpm commands:

```
[root@centos-mn ~] # rpm -Uvh MySQL-Cluster-client-gpl-7.4.10-1.el7.x86_64.rpm

[root@centos-mn ~] # rpm -Uvh MySQL-Cluster-server-gpl-7.4.10-1.el7.x86_64.rpm

[root@centos-mn ~] # rpm -Uvh MySQL-Cluster-shared-gpl-7.4.10-1.el7.x86_64.rpm
```

Make sure there is no error.

D. Configure MySQL Cluster

Create a new directory for the configuration files. I will use the /var/lib/mysql-cluster directory.

```
[root@centos-mn ~] # mkdir -p /var/lib/mysql-cluster
```

Then create new configuration file for the cluster management named config.ini in the mysql-cluster directory.

```
[root@centos-mn ~] # cd /var/lib/mysql-cluster
[root@centos-mn ~] # vi config.ini
```

Paste the configuration below:

```
[ndb_mgmd default]
# Directory for MGM node log files
DataDir=/var/lib/mysql-cluster

[ndb_mgmd]
#Management Node centosmn
HostName=192.168.19.130

[ndbd default]
NoOfReplicas=2      # Number of replicas
DataMemory=256M     # Memory allocate for data storage
IndexMemory=128M    # Memory allocate for index storage
#Directory for Data Node
DataDir=/var/lib/mysql-cluster

[ndbd]
#Data Node datanode1
HostName=192.168.19.129

[ndbd]
#Data Node datanode2
HostName=192.168.19.131

[mysqld]
#SQL Node sqlnode1
HostName=192.168.19.132

[mysqld]
#SQL Node sqlnode2
HostName=192.168.19.133
```

Save the file and exit.

E. Start the Management Node

Next start the management node with the command below:

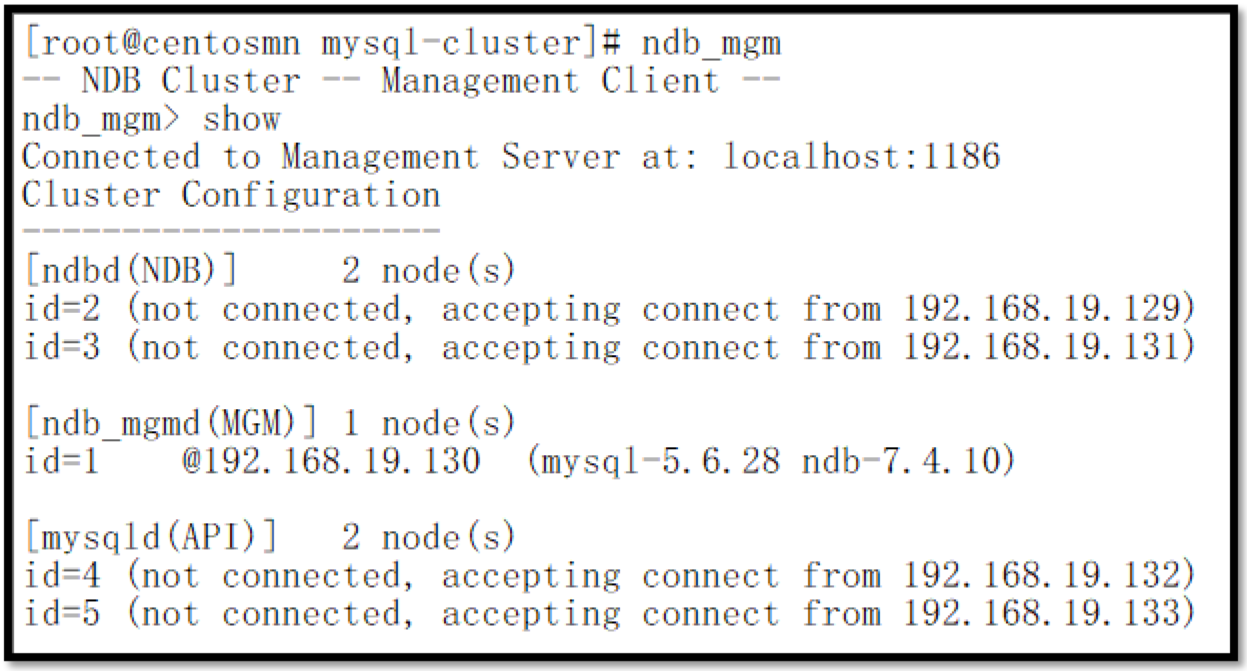
```
[root@centos-mn ~] # ndb_mgmd --config-file=/var/lib/mysql-cluster/config.ini
```

The result should be similar to this:

```
MySQL Cluster Management Server mysql-5.6.28 ndb-7.4.10
2018-05-24 19:26:08 [MgmtSrvr] INFO     -- The default config directory
'/usr/mysql-cluster' does not exist. Trying to create it...
2018-05-24 19:26:08 [MgmtSrvr] INFO     -- Successfully created config
directory
```

The management node is started, now you can use command ndb_mgm to monitor the node:

```
[root@centos-mn ~] # ndb_mgm
ndb_mgm> show
```



```
[root@centosmn mysql-cluster]# ndb_mgm
-- NDB Cluster -- Management Client --
ndb_mgm> show
Connected to Management Server at: localhost:1186
Cluster Configuration
---------------------
[ndbd(NDB)]     2 node(s)
id=2 (not connected, accepting connect from 192.168.19.129)
id=3 (not connected, accepting connect from 192.168.19.131)

[ndb_mgmd(MGM)] 1 node(s)
id=1    @192.168.19.130  (mysql-5.6.28 ndb-7.4.10)

[mysqld(API)]   2 node(s)
id=4 (not connected, accepting connect from 192.168.19.132)
id=5 (not connected, accepting connect from 192.168.19.133)
```

You can see the management node has been started with: mysql-5.6 and ndb-7.4.

Step 2 - Setup the MySQL Cluster Data Nodes

We will use 2 CentOS servers for the Data Nodes.

1. datanode1 = 192.168.19.129
2. datanode2 = 192.168.19.131

A. Login as root user and download the MySQL Cluster software

Login to the datanode1 server with ssh:

```
[root@centos-mn ~] # ssh root@192.168.19.129
```

Then download the MySQL Cluster package and extract it:

```
[root@datanode1 ~] # yum install wget

[root@datanode1 ~] # wget http://dev.mysql.com/get/Downloads/MySQL-Cluster-7.4/MySQL-
Cluster-gpl-7.4.10-1.el7.x86_64.rpm-bundle.tar

[root@datanode1 ~] # tar -xvf MySQL-Cluster-gpl-7.4.10-1.el7.x86_64.rpm-bundle.tar
```

B. Install and Remove Packages

Install perl-Data-Dumper and remove the mariadb-libs also need to install net-tools for the connection between the nodes:

```
[root@datanode1 ~] # yum install perl-Data-Dumper

[root@datanode1 ~] # yum remove mariadb-libs

[root@centos-mn ~] # yum install net-tools
```

C. Install MySQL Cluster

Now we can install the MySQL Cluster packages for the Data Nodes with these rpm commands:

```
[root@datanode1 ~] # rpm -Uvh MySQL-Cluster-client-gpl-7.4.10-1.el7.x86_64.rpm

[root@datanode1 ~] # rpm -Uvh MySQL-Cluster-server-gpl-7.4.10-1.el7.x86_64.rpm

[root@datanode1 ~] # rpm -Uvh MySQL-Cluster-shared-gpl-7.4.10-1.el7.x86_64.rpm
```

Make sure there is no error.

D. Configure Data Node

Create a new configuration file in the /etc directory with the vi editor:

```
[root@datanode1 ~] # vi /etc/my.cnf
```

Paste configuration below:

```
[mysqld]
ndbcluster
ndb-connectstring=192.168.19.130     # IP address of Management Node

[mysql_cluster]
ndb-connectstring=192.168.19.130     # IP address of Management Node
```

Save the file and exit.

Then create the new directory for the database data that we defined in the management node config file config.ini.

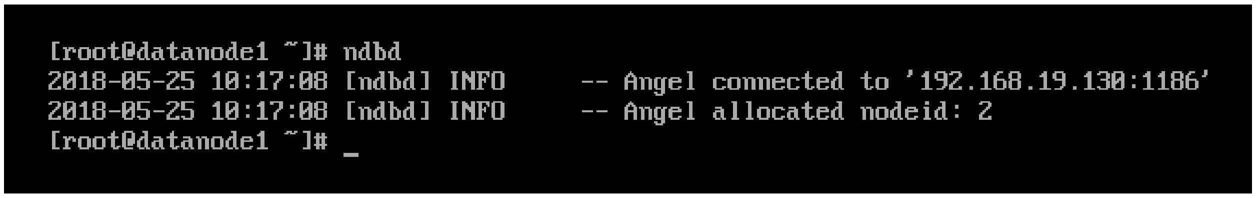
```
[root@datanode1 ~] # mkdir -p /var/lib/mysql-cluster
```

Now start the data node/ndbd:

```
[root@datanode1 ~] # ndbd
```

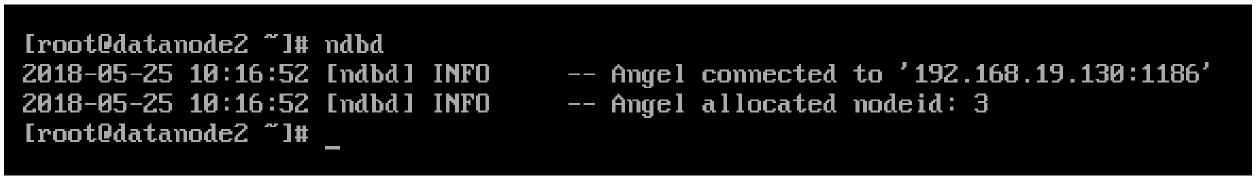
Results:

datanode1



```
[root@datanode1 ~]# ndbd
2018-05-25 10:17:08 [ndbd] INFO     -- Angel connected to '192.168.19.130:1186'
2018-05-25 10:17:08 [ndbd] INFO     -- Angel allocated nodeid: 2
[root@datanode1 ~]# _
```

datanode2



```
[root@datanode2 ~]# ndbd
2018-05-25 10:16:52 [ndbd] INFO     -- Angel connected to '192.168.19.130:1186'
2018-05-25 10:16:52 [ndbd] INFO     -- Angel allocated nodeid: 3
[root@datanode2 ~]# _
```

Data Node datanode1 connected to the management node IP 192.168.19.130.

E. Redo step 2.A - 2.D on db3 server.

As we have 2 data nodes, please redo the steps 2.A - 2.D on our second data node.

Step 3 - Setup SQL Node

This is step contains the setup for the SQL Node that provides the application access to the database. We use 2 CentOS servers for the SQL Nodes:

1. sqlnode1 = 192.168.19.132
2. sqlnode2 = 192.168.19.133

A. Log in and Download MySQL Cluster

Login to the sqlnode1 server as root user:

```
[root@centosmn ~] # ssh root@192.168.19.132
```

And download MySQL Cluster package:

```
[root@sqlnode1 ~] # yum install wget

[root@sqlnode1 ~] # wget http://dev.mysql.com/get/Downloads/MySQL-Cluster-7.4/MySQL-
Cluster-gpl-7.4.10-1.el7.x86_64.rpm-bundle.tar

[root@sqlnode1 ~] # tar -xvf MySQL-Cluster-gpl-7.4.10-1.el7.x86_64.rpm-bundle.tar
```

B. Install and Remove Packages

Install perl-Data-Dumper and remove the mariadb-libs that conflict with MySQL Cluster.

```
[root@sqlnode1 ~] # yum install perl-Data-Dumper

[root@sqlnode1 ~] # yum remove mariadb-libs

[root@sqlnode1 ~] # yum install net-tools
```

C. Install MySQL Cluster

Install the MySQL Cluster server, client and shared package with the rpm commands below:

```
[root@sqlnode1 ~] # rpm -Uvh MySQL-Cluster-client-gpl-7.4.10-1.el7.x86_64.rpm
[root@sqlnode1 ~] # rpm -Uvh MySQL-Cluster-server-gpl-7.4.10-1.el7.x86_64.rpm
[root@sqlnode1 ~] # rpm -Uvh MySQL-Cluster-shared-gpl-7.4.10-1.el7.x86_64.rpm
```

D. Configure the SQL Node

Create a new my.cnf file in the /etc directory:

```
[root@sqlnode1 ~] # vi /etc/my.cnf
```

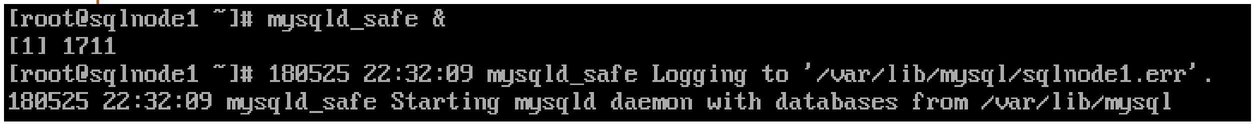
And paste configuration below:

```
[mysqld]
ndbcluster
ndb-connectstring=192.168.19.130    # IP address for server management node
default_storage_engine=ndbcluster   # Define default Storage Engine used by MySQL

[mysql_cluster]
ndb-connectstring=192.168.19.130    # IP address for server management node
```

Save the file and exit the editor.
Start the SQL Node by starting the MySQL server:

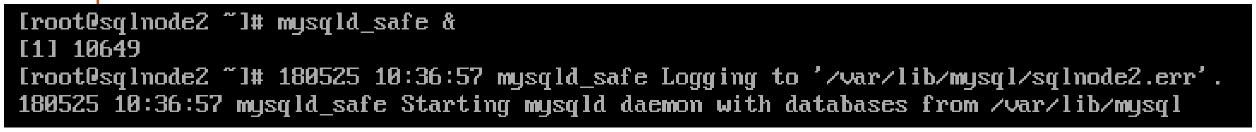
```
[root@sqlnode1 ~] # service mysql start
```

Start sqlnode1



```
[root@sqlnode1 ~]# mysqld_safe &
[1] 1711
[root@sqlnode1 ~]# 180525 22:32:09 mysqld_safe Logging to '/var/lib/mysql/sqlnode1.err'.
180525 22:32:09 mysqld_safe Starting mysqld daemon with databases from /var/lib/mysql
```

Start sqlnode2



```
[root@sqlnode2 ~]# mysqld_safe &
[1] 10649
[root@sqlnode2 ~]# 180525 10:36:57 mysqld_safe Logging to '/var/lib/mysql/sqlnode2.err'.
180525 10:36:57 mysqld_safe Starting mysqld daemon with databases from /var/lib/mysql
```

Disable Firewall or allow the port used for MySQL database (3306) and cluster port (https://bytefreaks.net/gnulinux/how-to-startstop-or-enabledisable-firewalld-on-centos-7)
Allow mysql port on both the SQL Nodes sqlnode1 and sqlnode2.

```
[root@sqlnode1 ~] # firewall-cmd --permanent --add-port=3306/tcp

[root@sqlnode1 ~] # firewall-cmd --reload
```

E. Redo step 3.A - 3.D on db5 server.

Please redo the steps 3.A - 3.D on the second SQL server (sqlnode2).

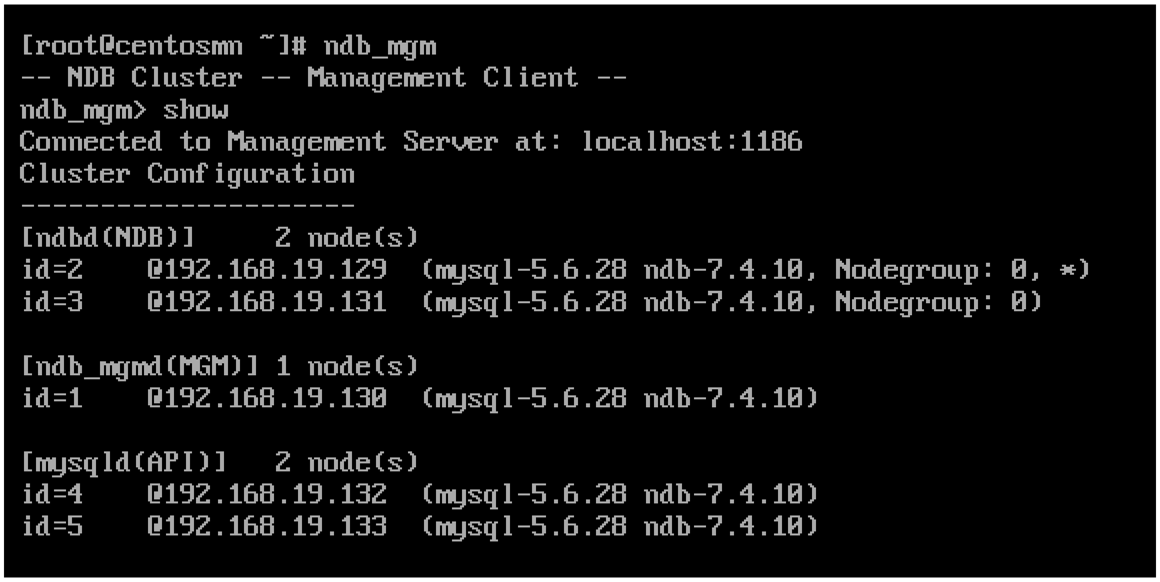
Step 4 - Monitor the Cluster

To see the cluster status, we have to log into the management node centosmn.

```
ssh root@192.168.19.130
```

We can use the ndb_mgm command to see the cluster status:

```
[root@centos-mn ~] # ndb_mgm
 ndb_mgm> show
```



```
[root@centosmn ~]# ndb_mgm
-- NDB Cluster -- Management Client --
ndb_mgm> show
Connected to Management Server at: localhost:1186
Cluster Configuration
---------------------
[ndbd(NDB)]     2 node(s)
id=2    @192.168.19.129  (mysql-5.6.28 ndb-7.4.10, Nodegroup: 0, *)
id=3    @192.168.19.131  (mysql-5.6.28 ndb-7.4.10, Nodegroup: 0)

[ndb_mgmd(MGM)] 1 node(s)
id=1    @192.168.19.130  (mysql-5.6.28 ndb-7.4.10)

[mysqld(API)]   2 node(s)
id=4    @192.168.19.132  (mysql-5.6.28 ndb-7.4.10)
id=5    @192.168.19.133  (mysql-5.6.28 ndb-7.4.10)
```

Another useful command is:

```
ndb_mgm -e "all status"
ndb_mgm -e "all report memory"
```

Step 5 - Testing the Cluster

To perform a test on our new MySQL Cluster, we have to login to the SQL Nodes **sqlnode1** or **sqlnode2** servers.
Login to the sqlnode1 server:

```
ssh root@192.168.19.132
```

Change the default MySQL password that stored in .mysql_secret file in root directory:

```
[root@sqlnode1 ~] # cat .mysql_secret
```

This is my sample:

```
# The random password set for the root user at Tue Mar 22 19:44:07 2016
(local time): qna3AwbJMuOnw23T
```

Now change the password with command below:

```
[root@sqlnode1 ~] # mysql_secure_installation
```

Type your old MySQL password and then type the new one, press enter to confirm all.
If all is done, you can login to the MySQL shell with your password:

```
[root@sqlnode1 ~] # mysql -u root -p
```

After you logged in, create a new root user with host "*@*", so we will be able to access the MySQL from outside.

```
mysql> CREATE USER 'root'@'%' IDENTIFIED BY 'admin123';
```

Replace *admin123* with your own secure password! Now you can see the new root user with host "@" on the MySQL user list:

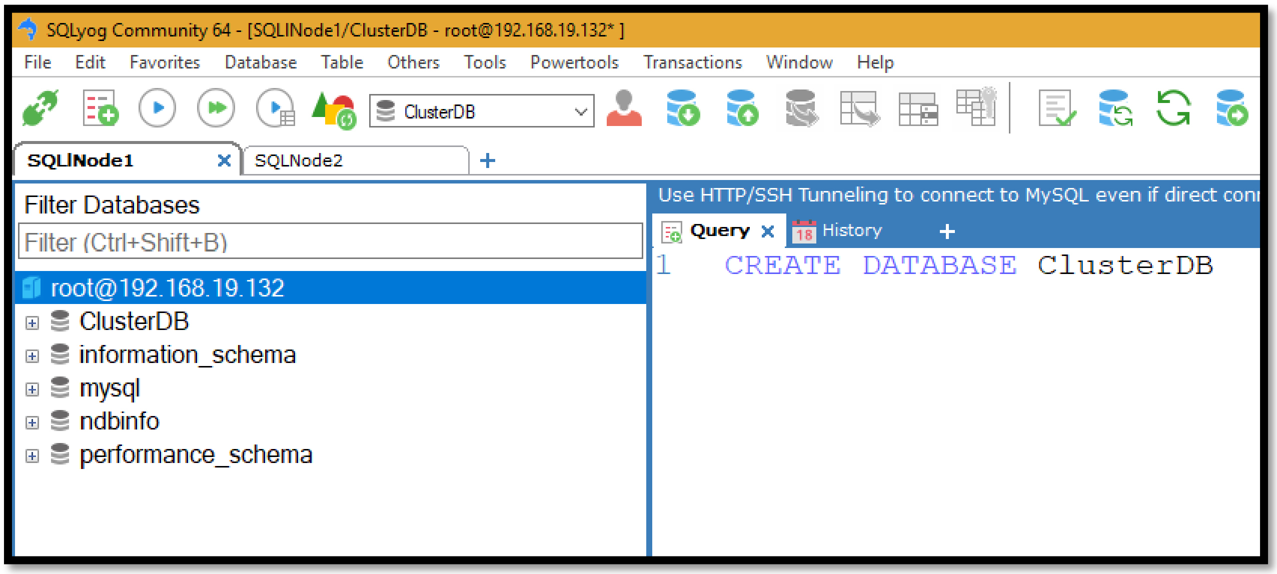
```
mysql> select user, host, password from mysql.user;
```

And grant the new root user read and write access from the remote node:

```
GRANT ALL PRIVILEGES ON *.* TO 'root'@'%' IDENTIFIED BY PASSWORD
'*94CC7BF027327993D738E11...(Encrypted PASSWORD)' WITH GRANT OPTION;
```

Now try to create a new database(ClusterDB) from sqlnode1 server and you will see the database on sqlnode2 too. This is just a sample result for testing the cluster data replication.

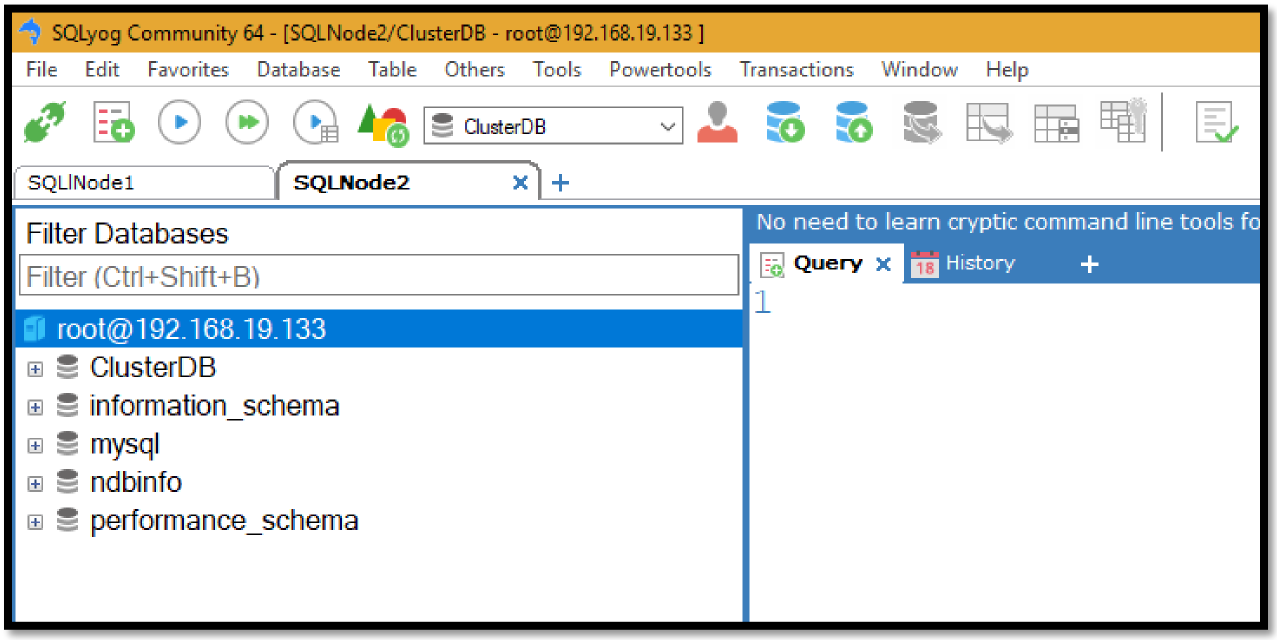
SQLNODE1


SQLyog Community 64 - [SQLNode1/ClusterDB - root@192.168.19.132*]
File Edit Favorites Database Table Others Tools Powertools Transactions Window Help
ClusterDB
SQLNode1
SQLNode2
Filter Databases
Filter (Ctrl+Shift+B)
Use HTTP/SSH Tunneling to connect to MySQL even if direct con
Query
History

```
CREATE DATABASE ClusterDB
```

```
root@192.168.19.132
  ClusterDB
  information_schema
  mysql
  ndbinfo
  performance_schema
```

SQLNODE2


SQLyog Community 64 - [SQLNode2/ClusterDB - root@192.168.19.133]
File Edit Favorites Database Table Others Tools Powertools Transactions Window Help
ClusterDB
SQLNode1
SQLNode2
Filter Databases
Filter (Ctrl+Shift+B)
No need to learn cryptic command line tools fo
Query
History

```
root@192.168.19.133
  ClusterDB
  information_schema
  mysql
  ndbinfo
  performance_schema
```

The MySQL Cluster has been setup successfully on CentOS 7 with 5 server nodes.

Conclusion

MySQL Cluster is a technology that provides High Availability and Redundancy for MySQL databases. It uses NDB or NDBCLUSTER as the storage engine and provides shared-nothing clustering and auto-sharing for MySQL databases. To implement the cluster, we need 3 components: Management Node(MGM), Data Nodes (NDB) and SQL Nodes (API). Each of node must have its own memory and disk. It is not recommended to use network storage such as NFS. To install MySQL Cluster on a CentOS 7 minimal system, we have to remove the mariadb-libs package, mariadb-libs conflict with MySQL-Cluster-server and you have to install the perl-Data-Dumper package, it's needed by MySQL-Cluster-server. A MySQL Cluster is easy to install and configure on multiple CentOS servers.

Percona XtraDB Cluster on CentOS 7

Installation of CentOS 7 (64X) Minimal in VMWare

As we plan to cluster 3 node Cluster need 3 Virtual Machine to implement the MySQL Clustering so we need to first install Operation System (CentOS 7). The steps to install CentOS in VMWare is represented by the screenshot on MySQL Cluster on CentOS 7. We need to install CentOS in five different VM. So, repeat the steps to install the OS on three different VM.

For the very first time we need to create the Virtual Machine for the OS. And install OS on all three machine and continue the process then after.

How to Install Percona XtraDB Cluster on CentOS 7

This tutorial is all about installing and configuring Percona XtraDB Cluster on a CentOS 7 server. We will use Percona XtraDB Cluster 5.6 that is fully compatible to MySQL and the Percona Server. Percona is a company of MySQL and MongoDB database experts founded in 2006. Percona builds and maintains open source software for MySQL and MongoDB: the Percona Server (database server for MySQL with high availability performance enhancements), Percona XtraDB Cluster (high availability solution for MySQL cluster), Percona Server for MongoDB and other tools for managing the databases such as the Percona toolkit, Percona monitoring tools and Percona XtraBackup.

Prerequisite

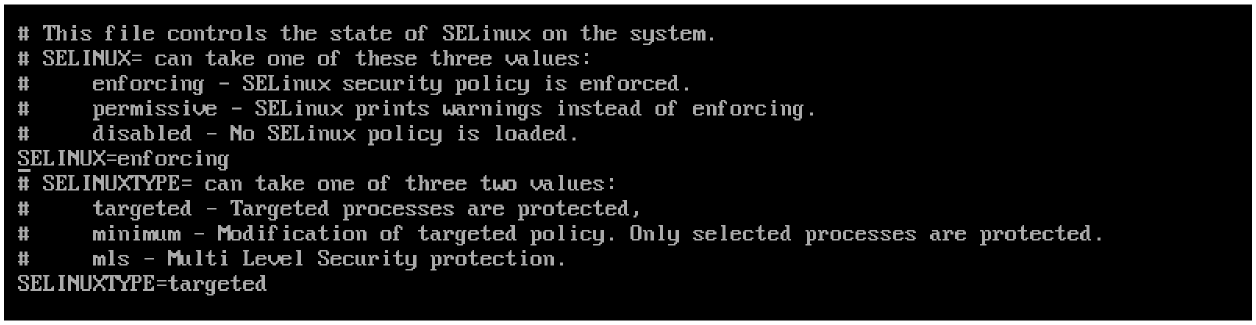
- 3 CentOS 7 server nodes.
  Percona1: 192.168.19.129
  Percona2: 192.168.19.135
  Percona3: 192.168.19.138
- Root privileges.
- Basic CentOS 7 knowledge.
- Change the host name before you start the process as readable hostname helps to identify the server easily. To change the hostname as per the desired name, follow the link below for more info: https://github.com/sumanpantha/Linux-Research/blob/master/Change%20HostName
  Also update all the OS with command: yum update.

```
Syntax To change hostname:
(root@localhost ~] # hostnamectl set-hostname your-new-hostname)
```

```
[root@localhost ~] # hostnamectl set-hostname parcona1
[root@localhost ~] # hostnamectl set-hostname parcona2
[root@localhost ~] # hostnamectl set-hostname parcona3
```

- Need to Disable SELinux in all the nodes:
  To Disable SELinux

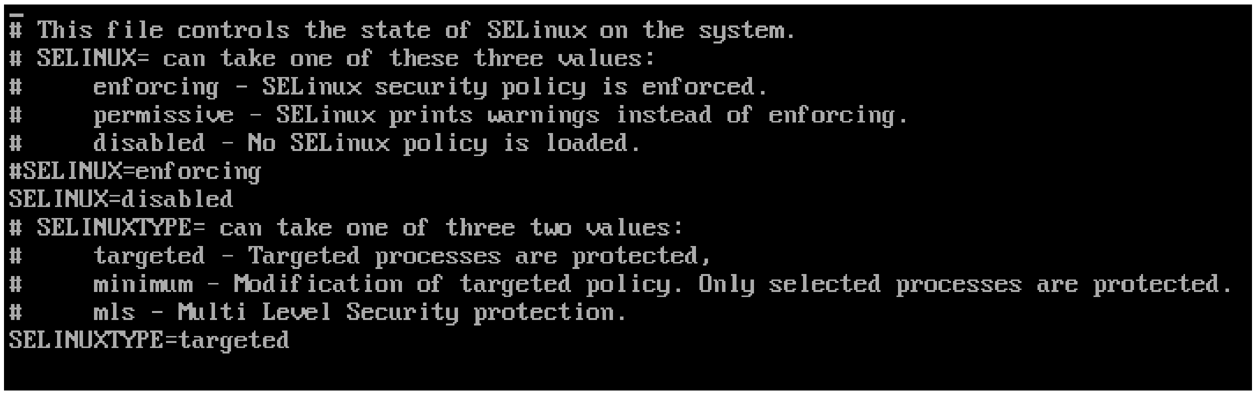
```
[root@parcona1 ~] # vi /etc/sysconfig/selinux
```



```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=enforcing
# SELINUXTYPE= can take one of three two values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are protected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```

Then change the directive `SELinux=enforcing` to `SELinux=disabled` as shown in the below

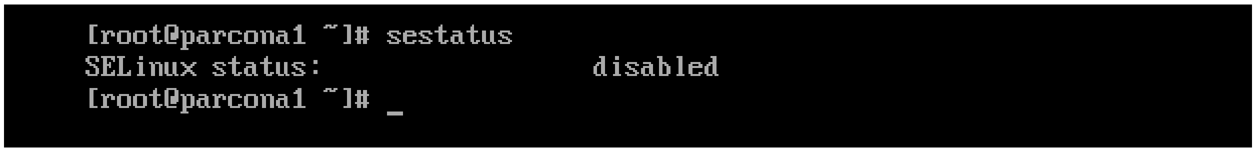
```
SELINUX=disabled
```



```
# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
#SELINUX=enforcing
SELINUX=disabled
# SELINUXTYPE= can take one of three two values:
#     targeted - Targeted processes are protected,
#     minimum - Modification of targeted policy. Only selected processes are protected.
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```

Then, save and exit the file, for the changes to take effect, you need to **reboot** your system and then check the status of SELinux using **sestatus** command as shown:

```
[root@parcona1 ~] # sestatus
```



```
[root@parcona1 ~]# sestatus
SELinux status:                 disabled
[root@parcona1 ~]# _
```

Step 1 - Setup the hosts file

The first thing to do is to configure the hostnames of all servers. I've 3 servers with CentOS 7 as listed below:

```
Node            Server IP       Hostname

Node1    -    192.168.19.129     percona1
Node2    -    192.168.19.135     percona2
Node3    -    192.168.19.138     percona3
```

Connect to all servers by using your terminal:

```
ssh root@serverip
```

If you have logged into all server, edit the *'/etc/hosts'* file on each server with vim:

```
vim /etc/hosts
```

Paste the hosts configuration below:

```
192.168.19.129 percona1
192.168.19.135 percona2
192.168.19.138 percona3
```

Replace the IP addresses with the ones that match your local network configuration. Save and exit.

Step 2 - Configure Firewalld

Firewalld is the new default firewall interface on CentOS 7. The `firewall-cmd` command is used to configure the firewall. We can define and configure specific groups or zones, or we can configure a firewall for services like ssh, MySQL databases etc.
In this step, we will use firewalld for the firewall configuration. We will use the *'firewall-cmd'* command to open the percona server port and other ports that are needed for the cluster.
Start firewalld with this systemctl command:

```
systemctl start firewalld
```

Then run the command below to open the port used by the MySQL/percona server:

```
firewall-cmd --zone=public --add-service=mysql --permanent
```

Next, add the other ports for the cluster with command below:

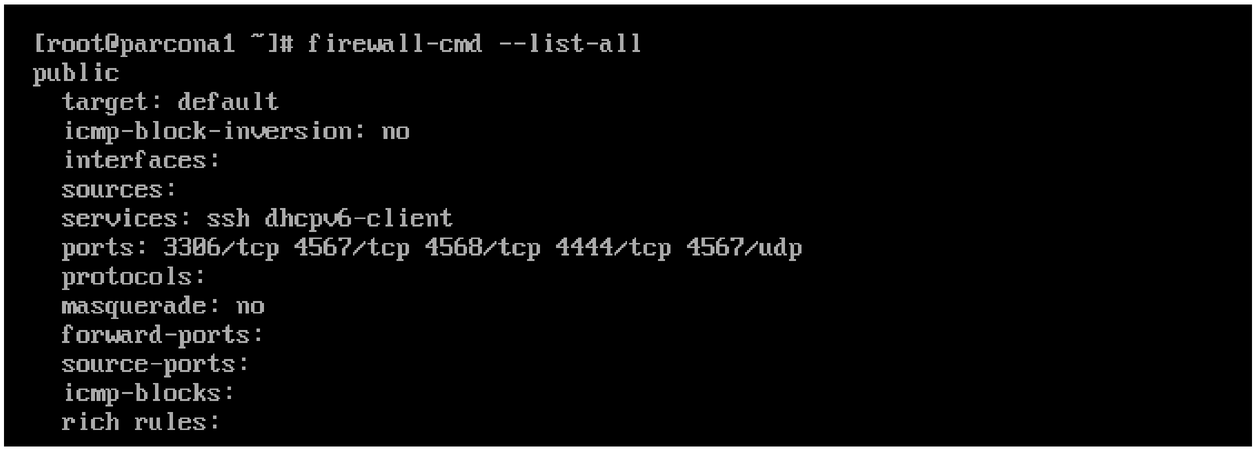
```
firewall-cmd --zone=public --add-port=3306/tcp --permanent
firewall-cmd --zone=public --add-port=4567/tcp --permanent
firewall-cmd --zone=public --add-port=4568/tcp --permanent
firewall-cmd --zone=public --add-port=4444/tcp --permanent
firewall-cmd --zone=public --add-port=4567/udp --permanent
```

Reload the firewall rules:

```
firewall-cmd --reload
```

To see the list of all the firewall rules, use the option *'--list-all'*:

```
firewall-cm --list-all
```


```
[root@parcona1 ~]# firewall-cmd --list-all
public
  target: default
  icmp-block-inversion: no
  interfaces:
  sources:
  services: ssh dhcpv6-client
  ports: 3306/tcp 4567/tcp 4568/tcp 4444/tcp 4567/udp
  protocols:
  masquerade: no
  forward-ports:
  source-ports:
  icmp-blocks:
  rich rules:
```

Step 3 - Install the Epel Repository and Socat

To get Percona XtraDB Cluster running on the server, we need to install socat, and it's available in the epel-repository. So, we need to install the Epel repository first and then install socat. Further we have to remove the mariadb-libs from the server because they conflict with the Percona XtraDB Cluster.
Install epel-repository and socat:

```
yum -y install epel-release
yum -y install socat
```

Remove the mariadb-libs to avoid the package conflict between mariadb-libs and Percona XtraDB Cluster:

```
yum -y remove mariadb-libs
```

The Epel repository and socat are installed.

Step 4 - Install Percona XtraDB Cluster

In this step, we will install the Percona xtradb cluster with all package dependencies. We need to add the Percona repository for the installation and then we start the Percona server and configure the root user and password for the database server.
Install the Percona repository with yum:

```
yum -y install http://www.percona.com/downloads/percona-
release/redhat/0.1-3/percona-release-0.1-3.noarch.rpm
```

Now install Percona XtraDB cluster and the other packages required for this tutorial:

```
yum install Percona-XtraDB-Cluster-server-56 Percona-XtraDB-Cluster-
client-56 Percona-XtraDB-Cluster-shared-56 percona-toolkit percona-
xtrabackup Percona-XtraDB-Cluster-galera-3 rsync nc
```

Percona XtraDB Cluster is installed, start the Percona server with this systemctl command:

```
Systemctl start mysql.service

OR

systemctl start mysql
```

Next, configure the root password for all percona/mysql servers:

```
mysql_secure_installation
```

Set the percona/mysql password:

```
Enter current password for root (enter for none): PRESS ENTER
Set root password? [Y/n] Y
New password: TYPE YOUR PASSWORD
Re-enter new password: REPEAT PASSWORD
Remove anonymous users? [Y/n] Y
Disallow root login remotely? [Y/n] Y
Reload privilege tables now? [Y/n] Y
```

Note:

Run step 1 - 4 on all 3 CentOS servers.

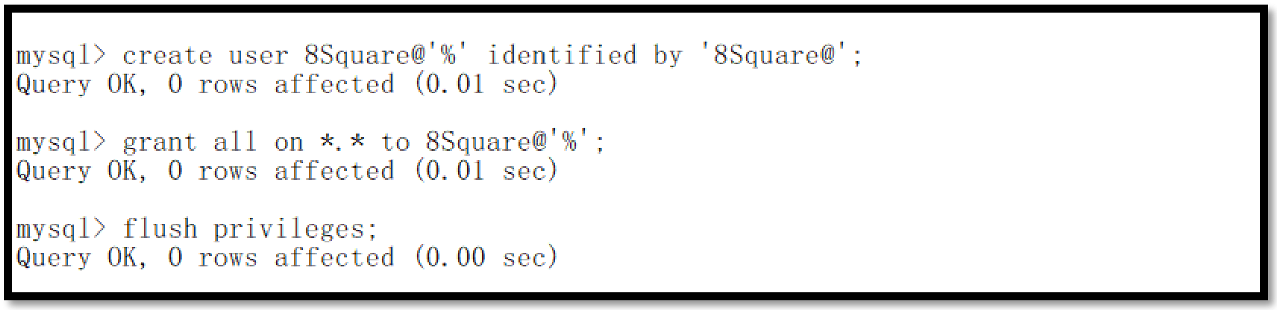
Step 5 - Configure Percona XtraDB Cluster

In step 4 we've already installed Percona XtraDB Cluster and configured the root password for all Percona/Mysql server nodes. In this step, we will create a new user for SST authentication and edit the MySQL configuration my.cnf on each of server.
SST (State Snapshot Transfer) is a full data copy from one server as a donor to another server as the joiner. For the SST authentication, we need to create a new user called *'8Square'* with password *'8Square@'*. And for the SST method, we will use xtrabackup-v2 instead of rsync. Please use a different and secure password for your cluster!
Login to the percona/mysql shell on each server:

```
mysql -u root -p
TYPE YOUR PASSWORD
```

And create the new *'8Square'* with password *'8Square@'*:

```
create user '8square'@'%' identified by '8Square@';
grant all on *.* to 8square@'%';
flush privileges;
```



```
mysql> create user 8Square@'%' identified by '8Square@';
Query OK, 0 rows affected (0.01 sec)

mysql> grant all on *.* to 8Square@'%';
Query OK, 0 rows affected (0.01 sec)

mysql> flush privileges;
Query OK, 0 rows affected (0.00 sec)
```

Then stop the MySQL service on each server before editing the config file:

```
systemctl stop mysql
```

Next, edit the mysql configuration file my.cnf on each server with the vi editor.

On **Percona1** server:

```
vi /etc/my.cnf
```

For the very first-time table the backup of default my.cnf file and replace my.cnf file with below my.cnf file.

```
# Template my.cnf for PXC
# Edit to your requirements.

[mysqld]

datadir=/var/lib/mysql

server_id =1

# Path to Galera library
wsrep_provider=/usr/lib64/libgalera_smm.so

# For the first node of the cluster we don't use wsrep cluster address.
wsrep_cluster_address=gcomm://

# In order for Galera to work correctly binlog format should be ROW
binlog_format=ROW

# MyISAM storage engine has only experimental support
default_storage_engine=InnoDB

# This InnoDB autoincrement locking mode is a requirement for Galera
innodb_autoinc_lock_mode=2

# Node 1 address
wsrep_node_address=192.168.19.129

# SST method
wsrep_sst_method=xtrabackup

# Cluster name
wsrep_cluster_name=my_centos_cluster

# Authentication for SST method
wsrep_sst_auth=8square:8Square@
```

Save and exit.

On **Percona2** server:

```
vim /etc/my.cnf
```

For the very first-time table the backup of default my.cnf file and replace my.cnf file with below my.cnf file.

```
# Template my.cnf for PXC
# Edit to your requirements.

[mysqld]

server_id =2

datadir=/var/lib/mysql

# Path to Galera library
wsrep_provider=/usr/lib64/galera3/libgalera_smm.so

# Cluster connection URL contains IPs of node#1
wsrep_cluster_address=gcomm://192.168.19.129:4567

# In order for Galera to work correctly binlog format should be ROW
binlog_format=ROW

# MyISAM storage engine has only experimental support
default_storage_engine=InnoDB

# This InnoDB autoincrement locking mode is a requirement for Galera
innodb_autoinc_lock_mode=2

# Node 2 address
wsrep_node_address=percona2

# Cluster name
wsrep_cluster_name=my_centos_cluster

# SST method
wsrep_sst_method=xtrabackup

#Authentication for SST method
wsrep_sst_auth=8square:8Square@
```

Save and exit.

On **Percona3** server:

```
vim /etc/my.cnf
```

For the very first-time table the backup of default my.cnf file and replace my.cnf file with below my.cnf file.

```
# Template my.cnf for PXC
# Edit to your requirements.

[mysqld]

server_id = 3

datadir=/var/lib/mysql

# Path to Galera library
wsrep_provider=/usr/lib64/libgalera_smm.so

# Cluster connection URL contains IPs of node#1
wsrep_cluster_address=gcomm://192.168.19.129:4567

# In order for Galera to work correctly binlog format should be ROW
binlog_format=ROW

# MyISAM storage engine has only experimental support
default_storage_engine=InnoDB

# This InnoDB autoincrement locking mode is a requirement for Galera
innodb_autoinc_lock_mode=2

# Node 3 address
wsrep_node_address=192.168.19.138

# Cluster name
wsrep_cluster_name=my_centos_cluster

# SST method
wsrep_sst_method=xtrabackup

#Authentication for SST method
wsrep_sst_auth=8square:8Square@
```

Save and exit.

Step 6 - Start the Percona XtraDB Cluster Server

We've configured Percona XtraDB cluster on all servers, and now we can start the server.
On Percona1 server, bootstraping or getting the cluster up and running:

```
systemctl start mysql@bootstrap
```

Next, start Percona/MySQL server on percona2 and percona3 server with the command below:

```
systemctl start mysql
```

make sure there are no error messages. If there is an error after typing to start MySQL, check the log file `'/var/log/messages'`.

Step 7 - Testing

We must log in to the percona/mysql shell on each server for testing the Percona XtraDB cluster.
Login to the Percona/MySQL shell on all servers/nodes:

```
mysql -u root -p
TYPE YOUR PASSWORD
```

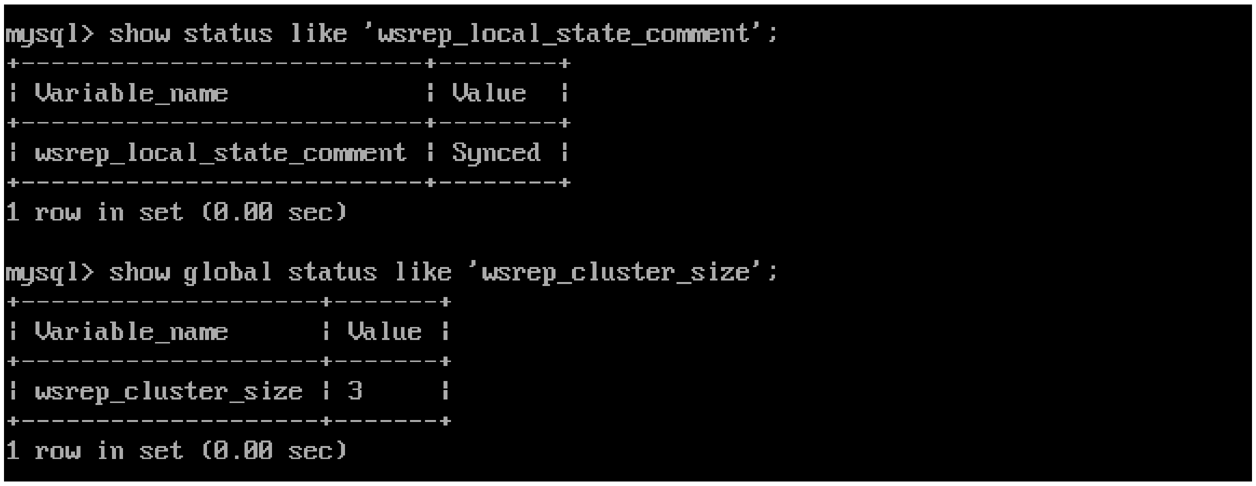
Testing the High Availability with mysql command:

```
SHOW STATUS LIKE 'wsrep_local_state_comment';
```

Try that command on every node, if you see **"Synced"** as the result, then that node is ready to handle traffic.
Testing available nodes of the cluster:

```
show global status like 'wsrep_cluster_size';
```

You will get the current number of nodes in the Percona cluster.



```
mysql> show status like 'wsrep_local_state_comment';
+---------------------------+--------+
| Variable_name             | Value  |
+---------------------------+--------+
| wsrep_local_state_comment | Synced |
+---------------------------+--------+
1 row in set (0.00 sec)

mysql> show global status like 'wsrep_cluster_size';
+--------------------+-------+
| Variable_name      | Value |
+--------------------+-------+
| wsrep_cluster_size | 3     |
+--------------------+-------+
1 row in set (0.00 sec)
```

For the full results, you can use the command below:

```
show global status like 'wsrep%';
```