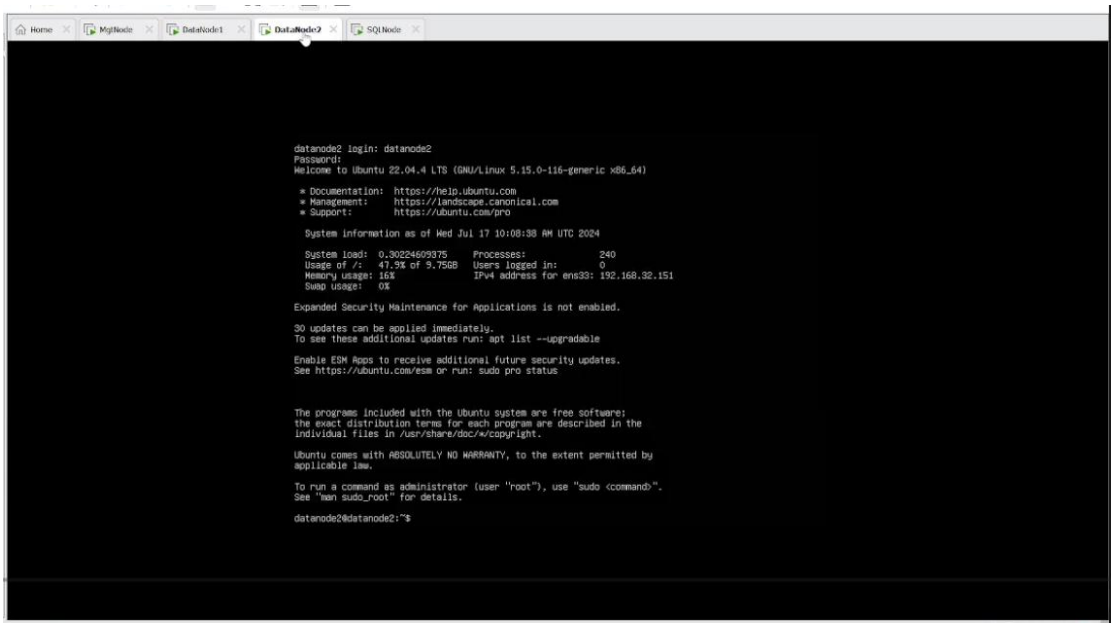
MySQL NDB Cluster Configuration in Ubuntu 22.04 LTS–Step by Step process

Prerequisites :

Server Usage Type	Public/Internet IP address	Node ID
Management node	192.168.32.149	1
Date node 1	192.168.32.150	2
Data node 2	192.168.32.151	3
SQL node	192.168.32.152	4

Configuring 4 nodes :



Step 1: Defining MySQL NDB Cluster Management Node (ndb_mgmd)

First, we will set up and configure the MySQL NDB Cluster management node. This daemon will be responsible for reading the cluster configuration file and distributing the information to all processes (nodes participating in the clustered network)..

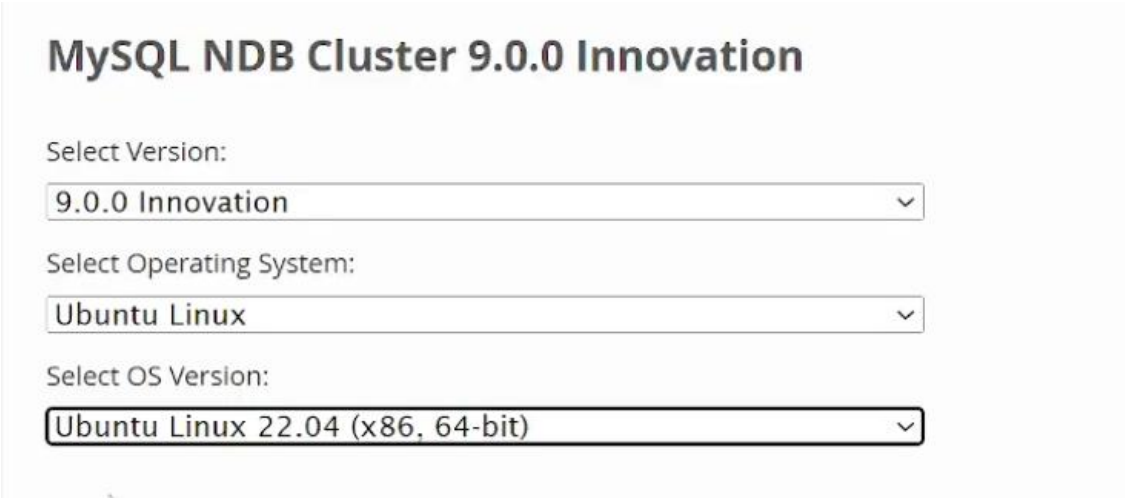
The ndb_mgmd is also responsible for maintaining a log file that details the activities of all nodes in the system.

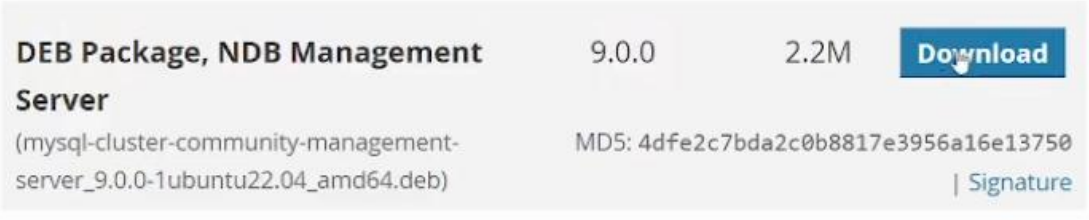
So, connect to the management node using an SSH client.

Download NDB Management Server

Then, we need grab the link of the latest NDB Management Server for our Ubuntu 22.04 server from MySQL Cluster download page. (http://dev.mysql.com/downloads/cluster/)

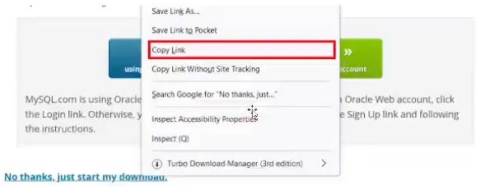
Once you enter the download link on a web browser, scroll down to Generally Available (GA) Releases. Then, select **Ubuntu Linux** as the Operating System and **Ubuntu Linux 16.04(x86, 64 Bit)** version as shown below:





On the next screen, navigate to the bottom and right-click **No thanks, just start my download** to copy the link address e.g. https://dev.mysql.com/get/Downloads/MySQL-Cluster-9.0/mysql-cluster-community-management-server_9.0.0-1ubuntu22.04_amd64.deb

Refer to the image below:



Next, ensure you are connected on the terminal window of the management server. Then cd to the **tmp** directory:

```
$ cd /tmp
```

Download the MySQL cluster management server DEB file using **wget** command and the link you have copied above:

```
$ wget https://dev.mysql.com/get/Downloads/MySQL-Cluster-9.0/mysql-cluster-community-management-server_9.0.0-1ubuntu22.04_amd64.deb
```

Installing the NDB Management Server

You can now use the Debian based **dpkg** package manager to install the **ndb_mgmd** as shown below:

```
$ sudo dpkg -i mysql-cluster-community-management-server_9.0.0-1ubuntu22.04_amd64.deb
```

Configuring the MySQL NDB Management Node

We will first create a directory for log files **/var/lib/mysql-cluster/**:

```
$ sudo mkdir /var/lib/mysql-cluster/
```

Then, we will create and open a config.ini file in the same directory. This is the global configuration file read by the management server, which in turn redistributes the information to other nodes in the cluster.

The configuration file lists all the details of the management nodes, data nodes and SQL(API) nodes. So, using a nano editor, open the file:

```
$ sudo nano  /var/lib/mysql-cluster/config.ini
```

Then, paste the below minimum configuration information and remember to change the IP addresses to match your **IP addresses** that you wish to include in the database cluster.

In below we have change ip according to server

```
  GNU nano 6.2                    /var/lib/mysql-cluster/config.ini *
# Default settings
[ndbd default]
# Options affecting ndbd processes on all data nodes:
NoOfReplicas=2                    # Number of replicas

# Management node
[ndb_mgmd]
# Management process options:
hostname=192.168.32.149           # Hostname of the manager
datadir=/var/lib/mysql-cluster    # Directory for the log files

# 1st data node
[ndbd]
hostname=192.168.32.150           # Hostname/IP of the first data node
NodeId=2                          # Node ID for this data node
datadir=/usr/local/mysql/data     # Remote directory for the data files

# 2nd data node
[ndbd]
hostname=192.168.32.151 # Hostname/IP of the second data node
NodeId=3                          # Node ID for this data node
datadir=/usr/local/mysql/data     # Remote directory for the data files

# SQL node
[mysqld]
hostname=192.168.32.152 # In our case the MySQL server/client is different server cluster manager
```

Press **CTRL +X, Y** and **Enter** to save the file.

In the above file, the NoOfReplicas=2 is a default parameter that can only be defined in the **[ndbd default]** section. The parameter defines the number of replicas each table will have on the cluster. The default, maximum and recommended value is 2 a value greater than this won't work in a production server.

This parameter is also used to specify the size of node groups in the network. So, if you have 6 data nodes and the NoOfReplicas is set to 2, then the first group is going to be formed by server 1,2 and 3 while the second one will come from server 4, 5 and 6.

In our case, we are using only two data servers and since we are setting the NoOfReplicas to 2. Each data node(server), will be taken as a group.

To avoid a single point of failure, nodes in the same group should not be setup in the same server because a hardware problem may cause the entire cluster to stop working.

On the configuration file, a management node is defined under the `[ndb_mgmd]` section while data nodes are listed under `[ndbd]`. The API/SQL or MySQL server nodes are defined under the `[mysqld]` section.

Nodes participating in the cluster are assigned a unique id with the NodeId parameter. The data nodes must define a data directory using the datadir parameter.The datadir on the management node points to the directory for the log files.

Once we have created the master MySQL cluster configuration file, we will start the **ndb_mgmd** Management daemon.

The configuration file we created must be specified when the ndb_mgmd is started for the first time using the -f option as shown below:

```
$ sudo ndb_mgmd -f /var/lib/mysql-cluster/config.ini
```

You should get the below output:

```
MySQL Cluster Management Server mysql-9.0.0 ndb-9.0.0
2024-07-17 04:06:35 [MgmtSrvr] INFO     -- The default config directory
'/usr/mysql-cluster' does not exist. Trying to create it...
2024-07-17 04:06:35 [MgmtSrvr] INFO     -- Sucessfully created config
directory
```

This shows that MySQL NDB Management server is setup and running on my VMWare Workstation.

In order for the process to start at boot, we need to run a few commands:

Before we create the service, we need to kill the running server:

```
$ sudo pkill -f ndb_mgmd
```

Then, we need to create and open a systemd unit file for the **ndb_mgmd** service:

```
$ sudo nano /etc/systemd/system/ndb_mgmd.service
```

Then, paste the code below to instruct the systemd daemon how to start, stop and restart the service:

```
[Unit]
Description=MySQL NDB Cluster Management Server
After=network.target auditd.service

[Service]
Type=forking
ExecStart=/usr/sbin/ndb_mgmd -f /var/lib/mysql-cluster/config.ini
ExecReload=/bin/kill -HUP $MAINPID
KillMode=process
Restart=on-failure

[Install]
WantedBy=multi-user.target
```

Press **CTRL +X, Y** and **Enter** to save the file.

```
  GNU nano 6.2                    /etc/systemd/system/ndb_mgmd.service *
[Unit]
Description=MySQL NDB Cluster Management Server
After=network.target auditd.service

[Service]
Type=forking
ExecStart=/usr/sbin/ndb_mgmd -f /var/lib/mysql-cluster/config.ini
ExecReload=/bin/kill -HUP $MAINPID
KillMode=process
Restart=on-failure

[Install]
WantedBy=multi-user.target
```

Reload systemd manager for the changes to take effect:

```
$ sudo systemctl daemon-reload
```

Next, enable the **ndb_mgmd** service:

```
$ sudo systemctl enable ndb_mgmd
```

Then, start the service:

```
$ sudo systemctl start ndb_mgmd
```

You can check the status of the ndb_mgmd process by running the command below:

```
$ sudo systemctl status ndb_mgmd
```

The final step for setting up the Cluster Manager is to allow incoming connections from other MySQL Cluster nodes on our private network.

If you did not configure the ufw firewall when setting up this into server, you can skip ahead to the next section.

We'll add rules to allow local incoming connections from both data nodes:

```
$ sudo ufw allow from 192.168.32.150
$ sudo ufw allow from 192.168.32.151
```

After entering these commands, you should see the following output:

```
Output
Rule added
```

The Cluster Manager should now be up and running, and able to communicate with other Cluster nodes over the private network.

Step 2: Configuring MySQL Cluster on Data Nodes

With the management node configured, we can now go ahead and configure our 2 data nodes. Please note, you must follow and repeat the below procedure for every data node on the cluster for replication to work.

The data node is responsible for storing MySQL cluster data and thus, they offer redundancy and high availability, 2 or more servers must be used.

Remember, your data nodes must be homogeneous in nature. This means you should setup the data node ECS instances with the same VCPU's, RAM , disk space and bandwidth.

A RAM of at least 1GB is recommended for the data nodes because the cluster engine uses a lot of memory.

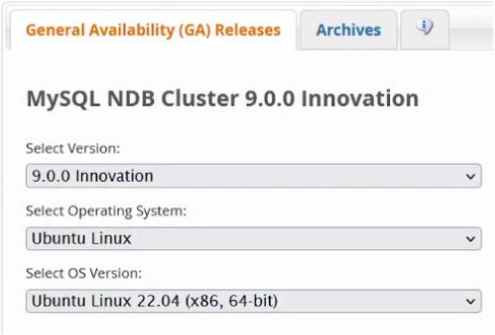
So, let start by installing and configuring the first data node. In our case, we will SSH to the server with the IP address 198.18.0.2.

Then, cd to the tmp directory:

```
$ cd /tmp
```

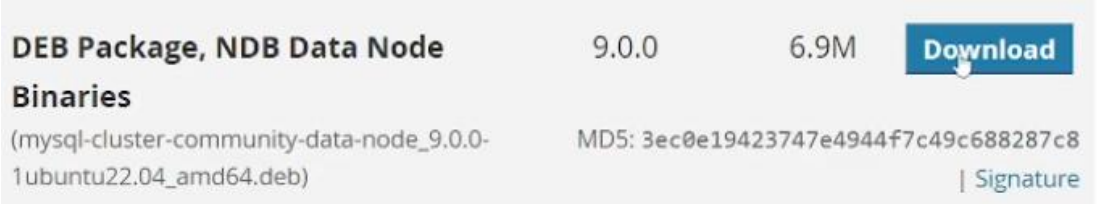
Just like we have done for the management node, we are going to pull the latest NDB cluster data node deb package from MySQL download page. Select **Ubuntu Linux** and **Ubuntu Linux (22.04(x86, 64-bit)** as the version.

Connect datanode1 and datanode2

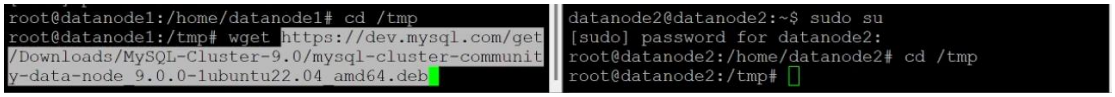


Then, scroll down on the list and select **DEB Package**, **NDB Data Node Binaries**. Then, click **Download** as shown below:

Download the package



Paste the link and download using weget



After download and install update using apt update on both datanode1 and datanode2

Then, download the deb file from the link you have copied using the **wget** command:

```
$ wget https://dev.mysql.com/get/Downloads/MySQL-Cluster-9.0/mysql-cluster-community-data-node_9.0.0-1ubuntu22.04_amd64.deb
```

The MySQL cluster community data node has known dependency requirements, so we are going to install **libclass-methodmaker-perl** package before we install the daemon.

So first, update the package list information index:

```
$ sudo apt-get update
```

Before we install the data node binary, we need to install a dependency, libclass-methodmaker-perl:

```
$ sudo apt-get install libclass-methodmaker-perl
```

Now next step to install the Mysql cluster on both datanode1 and datanode2 :

We can now go ahead and install MySQL cluster data node:

```
$ sudo dpkg -i mysql-cluster-community-data-node_9.0.0-
1ubuntu22.04_amd64.deb
```

Next, we need to instruct the data node to connect to the management cluster to retrieve the configuration file that we created. When there are changes in the data node, the events will be transferred to the management node to be written to the cluster log file.

So, open the `/etc/my.cnf` file to enter the MySQL cluster management node information. That is the IP address where the cluster management node resides, in our case **192.168.32.149**

```
$ sudo nano /etc/my.cnf
```

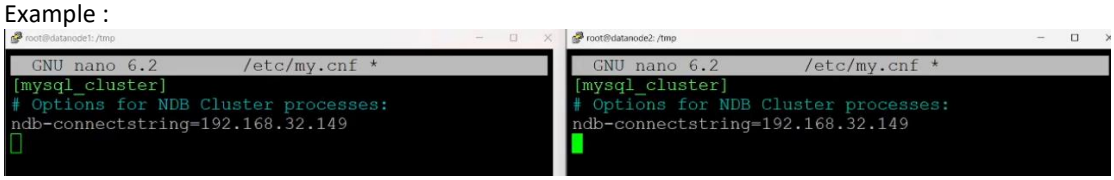
Paste the content below on the file and remember to replace **192.168.32.149** with the private IP address of your MySQL cluster management node:

```
[mysql_cluster]
# Options for NDB Cluster processes:
ndb-connectstring=192.168.32.149
```

Save the file by pressing **CTRL + X, Y** and **Enter**.

Next, create the data directory `/usr/local/mysql/data` because this is what we specified in the management node configuration file:

Example :



Next, create the data directory `/usr/local/mysql/data` because this is what we specified in the management node configuration file:

```
$ sudo mkdir -p /usr/local/mysql/data
```

Now we can start the data node using the following command:

```
$ sudo ndbd
```

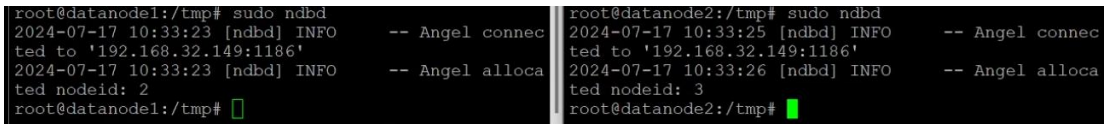
You should get the below output:

```
2023-07-22 17:59:22 [ndbd] INFO     -- Angel connected to
'192.168.32.149:1186'
2023-07-22 17:59:22 [ndbd] INFO     -- Angel allocated nodeid: 2
```

The NDB data node daemon has been successfully installed and is now running on your server.

We also need to allow incoming connections from other MySQL Cluster nodes over the private network.

Start the ndbd node in both node1 and node2 id .



If you did not configure the ufw firewall when setting up this servers, you can skip ahead to setting up the systemd service for ndbd.

We'll add rules to allow incoming connections from the Cluster Manager and other data nodes:

```
sudo ufw allow from 192.168.32.150
sudo ufw allow from 192.168.32.151
```

After entering these commands, you should see the following output:

```
Output
Rule added
```

Your MySQL data node Droplet can now communicate with both the Cluster Manager and other data node over the private network.

Finally, we'd also like the data node daemon to start up automatically when the server boots. We'll follow the same procedure used for the Cluster Manager, and create a systemd service.

To enable the ndbd service to start at boot, we will add the process in the systemd daemon. First, let's kill the process that we initialized:

```
$ sudo pkill -f ndbd
```

Then, open the **/etc/systemd/system/ndbd.service** file to instruct systemd on how to start, stop and restart the ndbd service:

```
$ sudo nano /etc/systemd/system/ndbd.service
```

```
root@datanode1:/tmp# sudo pkill -f ndbd
root@datanode1:/tmp#
```

```
ted nodeid: 3
root@datanode2:/tmp# sudo pkill -f ndbd
```

Now next open in both node file sudo nano /etc/systemd/system/ndbd.service

```
root@datanode2: /tmp
/etc/systemd/system/ndbd.service *
[Unit]
Description=MySQL NDB Data Node Daemon
After=network.target auditd.service

[Service]
Type=forking
ExecStart=/usr/sbin/ndbd
ExecReload=/bin/kill -HUP $MAINPID
KillMode=process
Restart=on-failure

[Install]
WantedBy=multi-user.target
```

Run below on both node

Press **CTRL +X, Y** and **Enter** to save the file.

Restart the systemd process for the changes to take effect:

```
$ sudo systemctl daemon-reload
```

Then, enable the **ndbd** process using the systemctl command:

```
$ sudo systemctl enable ndbd
```

Then, start the ndbd process:

```
$ sudo systemctl start ndbd
```

You can check whether the ndbd process is running by typing the command below:

```
$ sudo systemctl status ndbd
```

You should see the following output:
Output

```
● ndbd.service - MySQL NDB Data Node Daemon
   Loaded: loaded (/etc/systemd/system/ndbd.service; enabled; vendor preset:
enabled)
   Active: active (running) since Thu 2024-07-06 10:55:49 UTC; 8s ago
  Process: 11972 ExecStart=/usr/sbin/ndbd (code=exited, status=0/SUCCESS)
 Main PID: 11984 (ndbd)
    Tasks: 46 (limit: 4915)
```

```
   CGroup: /system.slice/ndbd.service
           ├─11984 /usr/sbin/ndbd
           └─11987 /usr/sbin/ndbd
```

Step 3: Configuring SQL Cluster Node

In this step, we will install a custom MySQL community server that is bundled with the NDB storage engine. This is the SQL node and will reside in our 4th server

The SQL node will be used specifically to access the clustered data through the NDBCLUSTER storage engine. It is simply a mysqld process that works as the API(Application Programming Interface) node to manipulate data on the cluster.

Your web application or website should connect to this SQL node. So, if you are designing a software or a website, use the public IP address of this node as your host.

To setup the SQL node, we will SSH to the server with the public IP address **192.168.32.152**. The MySQL cluster server applications require some dependencies, so will first update the package list index and install them.

```
$ sudo apt-get update
```

Then install `libaio1` and `libmecab2` packages:

```
$ sudo apt install libaio1 libmecab2
```

Press Y and hit enter when prompted to confirm the installation
Then , cd to the tmp directory on the server .
$ cd /tmp

Download the Mysql Cluster DEB bundle link from Mysql cluster download page select ubuntu linux as the operating system as the version .

DEB Bundle	9.0.0	454.9M	Download
(mysql-cluster_9.0.0-1ubuntu22.04_amd64.deb-bundle.tar)	MD5: bfe02de0eca0db65f7101439f90c20ba		| Signature

Select appropriate bundle and click on download and right click and copy the url link and now follow the below steps .

```
$ wget https://dev.mysql.com/get/Downloads/MySQL-Cluster-9.0/mysql-cluster_9.0.0-1ubuntu22.04_amd64.deb-bundle.tar
```

The above command will download a tar archive file e.g. **mysql-cluster_9.0.0-1ubuntu22.04_amd64.deb-bundle.tar.**

The zipped file contains several deb packages that we require for the installation. First create a working installation directory e.g. **install**:

```
$ sudo mkdir install
```

Then, unzip the **mysql-cluster_9.0.0-1ubuntu22.04_amd64.deb-bundle.tar** deb files to the installation directory:

```
$ sudo tar -xvf mysql-cluster_9.0.0-1ubuntu22.04_amd64.deb-bundle.tar -C install/
```

Once the deb files are extracted and copied in the **installation** directory, cd to the directory.

```
$ cd install
```

Then, run the commands below one by one to install all required MySQL Cluster packages. Enter a strong password for the root user of the database server when prompted to do so:

```
$ sudo dpkg -i mysql-common_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-cluster-community-client-plugins_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-cluster-community-client-core_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-cluster-community-client_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-client_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-cluster-community-server-core_9.0.0-1ubuntu22.04_amd64.deb
$ sudo dpkg -i mysql-cluster-community-server_9.0.0-1ubuntu22.04_amd64.deb
```

Next, we need to configure MySQL server to connect to the cluster. We can do this by editing the `/etc/mysql/my.cnf` file:

```
$ sudo nano /etc/mysql/my.cnf
```

Enter the values below and replace the IP address `192.168.32.149` with the private IP address of your Cluster Management Server :

```
[mysqld]
# Options for mysqld process:
ndbcluster                          # run NDB storage engine

[mysql_cluster]
# Options for NDB Cluster processes:
ndb-connectstring=192.168.32.149     # location of management server
```

Add in sqlnode my.cnf ip of ndb server

```
!includedir /etc/mysql/conf.d/
!includedir /etc/mysql/mysql.conf.d/
[mysqld]
# Options for mysqld process:
ndbcluster                                # run NDB storage engine

[mysql_cluster]
# Options for NDB Cluster processes:
ndb-connectstring=192.168.32.149          # location of management server
```

The `ndbcluster` directive enables the `ndbcluster` storage engine because it is not enabled by default to save resources. Then, the `ndb-connectstring` points to the private IP address of the mysql management server.

Restart MySQL server for the changes to take effect:

```
$ sudo systemctl restart mysql
```

Step 4: Verifying MySQL Cluster Installation

The following MySQL cluster nodes should now be up and running.

- MySQL cluster Management node
- MySQL cluster data node 1

- MySQL cluster data node 2
- SQL node

To test if the MySQL cluster is working, enter the command below on the **SQL node**:

```
$ mysql -u root -p
```

Enter your MySQL cluster password that you created when prompted and hit **Enter**. You should see the output below:

```
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 11
Server version: 9.0.0-cluster MySQL Cluster Community Server - GPL
```

Create a sample database:

```
mysql > create database test_database;
```

Now create table in this database and insert some records .
Once inside the mysql client run the following command
Mysql> SHOW ENGINE NDB STATUS \G;

And connect ndbd and perfrom activity.

Mysql> ndb_mgm

Run show command to see the ndb cluster setup status and connected node .