SuMegha Cloud Lab Kit

Version 1.3

User Manual

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System Software Development for HPC

C-DAC KP
Bangalore

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User Manual

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Authors : Sukeshini, Payal Saluja, Shivay Veer Sharma, Deepanshu Saxena,		
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Chapter 1
Introduction

1.1 CLOUD COMPUTING

Cloud Computing is the buzz word in today's technological era. The researchers, academicians and domain experts who want to build a private cloud for their applications, don't know where and how to start. The SuMegha Cloud Lab kit becomes an ideal solution to cater their requirements. SuMegha is a C-DAC's scientific cloud with various open- source and indigenously developed components installed to facilitate the users to execute their applications on cloud with ease.

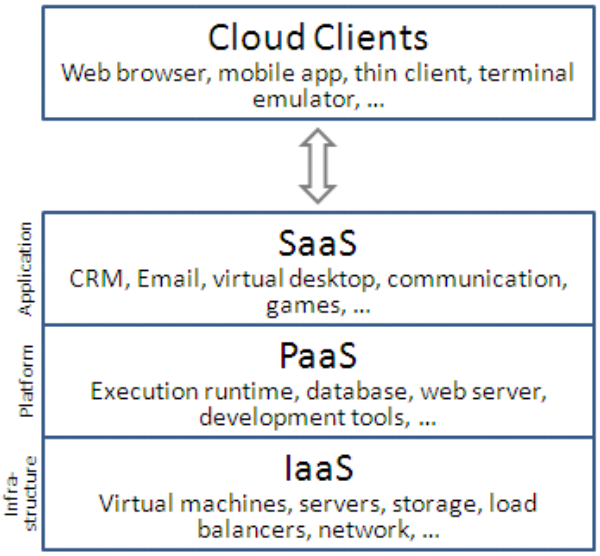


Figure 1: Cloud computing layers

Cloud Computing is delivery of *Computing as a Service* rather than a product, wherein resources, software(s) and information are provided as a utility (like the electricity) over Internet. Cloud computing use the Internet technologies for delivery of IT Enabled capabilities '*as a service*' to the required users. We can access these resources from anywhere and pay according to our usage. The services offered on cloud are:

- **SaaS (Software as a Service)** - The users are given access to software applications hosted by the cloud vendor over Internet.

  Examples: Cloud-based word processing application, Online e-mail providers like Google's Gmail, Yahoo mail and Microsoft Hotmail, Photo editing softwares, Google docs etc.

- **PaaS (Platform as a Service)** – It offers development platform on the cloud. Provider manages the cloud infrastructure for the platform and users can develop and host their applications on cloud. The entire life cycle of software can be operated on a PaaS.

Example: Google App Engine lets users run web applications on Google's infrastructure.

- **IaaS (Infrastructure as a Service)–**It is on demand provisioning of Virtual Machines, Virtual Clusters, and Storage (StaaS – storage as a service) to users. The main concept being virtualization, where the users through their virtual desktop access resources like Network, Storage, Virtualized Servers, Routers and so on, supplied by Cloud Service Provider (CSP).

  Examples: Amazon EC2 and Amazon S3 (Storage as a Service).

Following are the common deployment models of cloud:

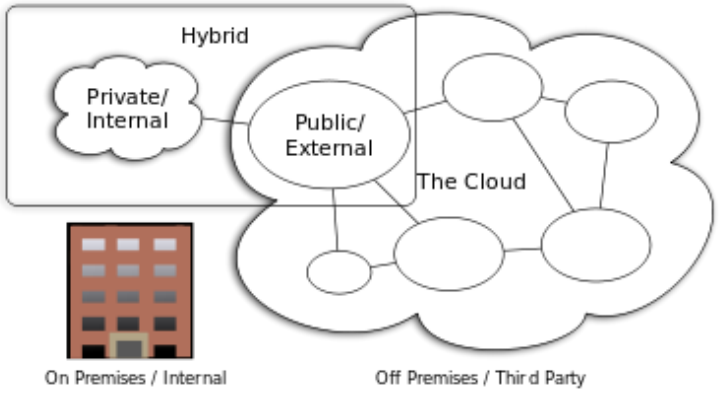


Figure 2: Cloud computing types

1. **Public clouds**: The services and infrastructure in a Public Cloud are provided off-site over the Internet that is open for public use. Usually, they are owned by the organization offering the cloud services.
2. **Private clouds**: A private cloud is one in which the services and infrastructure are maintained on a private network and is operated solely for one organization. These clouds offer the greatest level of security and control.
3. **Hybrid clouds**: A hybrid cloud is a composition of two or more clouds (private or public) and includes a variety of public and private options with multiple providers.

Scientific Clouds

Scientific computing deals with solving large-scale scientific problems in domains like astrophysics, mechanical engineering and material science by utilizing mathematical modeling and computer simulations. Running large and accurate simulations requires a significant amount of computing resources, often demanding the utilization of supercomputers, Clusters or Grids; which may not be available for the researchers and scientists**.** Scientific Clouds can meet these huge computation capabilities and storage requirements of scientific community through

infrastructure and storage services that can be shared with the scientists and researchers over Cloud. Amazon Elastic MapReduce is an example that gives processing capability for vast amounts of data stored over amazon S3 service. SuMegha is a scientific cloud, developed by C-DAC, offers High Performance Compuitng (HPC) as a service, Infrastructure as a Service and Storage as a Service.

1.2 SUMEGHA CLOUD LAB KIT

SuMegha Cloud lab kit is a sophisticated Cloud installation package comprising of various softwares to build private clouds. The Cloud software stack consists of open source components like Xen, Nimbus, Openstack swift, GlusterFS and in-house developed tools like Cloud portal, Problem Solving Environments (PSE), Cloud Vault, Job Submission portal. It also provides a set of Golden Images of different sizes like small, medium, and large; with CentOS operating systems and parallel environments with MPI libraries and Hadoop framework. This lab kit enables the automated deployment (installation and configuration) of private cloud on the recommended hardware to setup "Cloud Lab" without having expertise in system administration.

Highlights

- Builds a private cloud in an organization
- Web based tools that supports easy and quick access to the Virtual machines and Virtual HPC clusters
- Simple and quick installation of all the cloud components.
- Pre-built OS images with complex parallel environments like MPI and Map Reduce to cater the HPC needs.
- Golden images with preloaded HPC applications like Seasonal Forecast Model, Cloud Next generation pipeline with the required visualization tools and job submission portal for easy parallel job submission.

Who can use SuMegha Cloud Lab Kit?

- Entry Level Engineers
  - To get better understanding of basics, necessary functions and features of SuMegha before working on Real-time environment
- Educational/ Training Institutes
  - To setup Cloud laboratory for experimental / practical purpose.
- Research Organizations
  - To identify issues and vulnerabilities of important aspects in Cloud Computing, such as Monitoring, Security, Resource usage, Billing, etc.

Chapter 2

SuMegha Cloud Stack

2.1 SUMEGHA CLOUD STACK COMPONENTS

SuMegha Cloud Stack has been designed, keeping in mind the requirements of the scientific environments and applications. The stack comprises of the stable versions of best suited Cloud components required to build the private scientific cloud. Figure 1 depicts the complete SuMegha software stack.

The basic SuMegha Cloud lab kit consists of the following components:

- OS (CentOS) : Downloadable from SuMegha website (www.Sumegha.in)
- Hypervisor (Xen): CD
- Cloud Middleware (Nimbus):CD
- Cloud Portal
- Pre-built golden images with CentOS, MPI & HADOOP environments and tools like job submission portal for virtual HPC clusters.

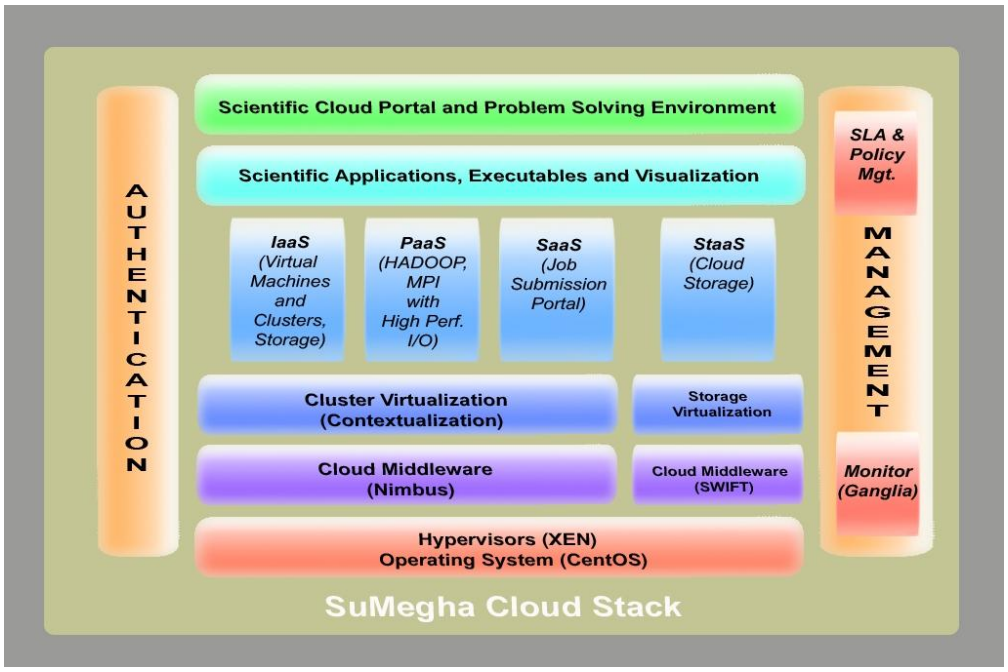


Figure 3: SuMegha Cloud Stack

Figure 4 shows the architecture of Cloud components installed using SuMegha Cloud Lab kit.

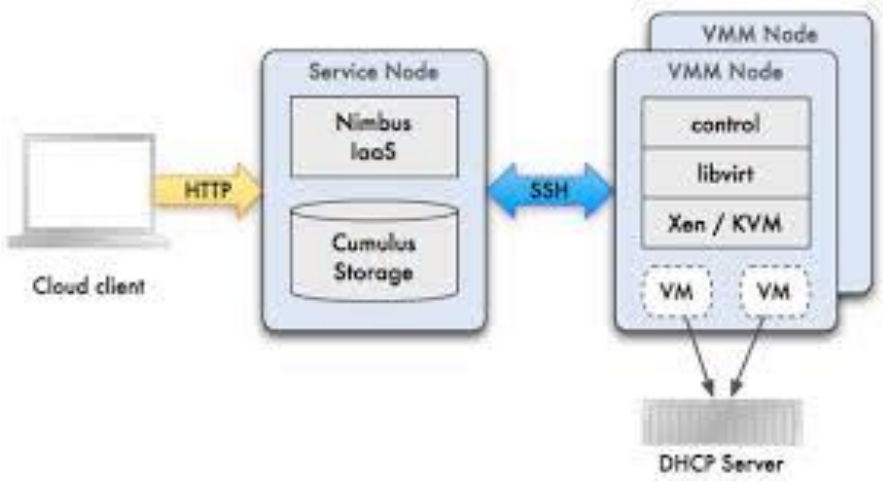


Figure 4: SuMegha Cloud Architecture

2.2 SUMEGHA LAB KIT OFFERINGS

- **Basic Cloud lab kit (Free)** --- Currently available
  a. Software stack to setup Private cloud for provisioning of Virtual Machines/ Servers i.e deployment of Infrastructure as a Service
  b. Interactive installation & configuration of cloud stack
  c. User manual for SuMegha Cloud lab kit.
  d. Distribution through CD and downloadable from SuMegha website (www.sumegha.in)

- **Basic Cloud lab kit with Cloud Storage facility** upto 2 GB **(Free)** --- In future
  a. Software stack to setup Private cloud for provisioning of Virtual Machines/ Servers i.e deployment of Infrastructure as a Service (IaaS)
  b. Interactive installation & configuration of cloud stack
  c. User manual for SuMegha Cloud lab kit
  d. Access to Cloudvault cloud storage: up to 2 GB free, beyond it chargeable per 5GB
  e. Distribution through CD

- **Advanced Cloud lab kit (Chargeable)** --- In future
  a. Software stack to setup Private cloud for provisioning of Virtual Machines/ Servers i.e deployment of Infrastructure as a Service (IaaS)
  b. Interactive installation & configuration of cloud stack
  c. Software stack to setup cloud storage (Storage as a Service – StaaS)
  d. Access to Cloudvault cloud storage: Upto 5GB
  e. User manual for SuMegha Cloud lab kit

f. 1-day hands-on training
g. Distribution through CD

- **Support Services**
  - ✓ E-mail support (free)
  - ✓ Annual maintenance through E-mail support (Chargable)
  - ✓ One day hands-on training (chargable)

Chapter 3
Installation & Configuration

3.1 PREREQUISITES FOR INSTALLATION

It is assumed that the installer possess the knowledge of basic UNIX system administration.

Following are requirements to set up the Virtual Machine Manager (VMM) node and Service Node, as part of SuMegha Cloud Lab Kit installation.

3.1.1 Virtual Machine Manager (VMM) Node

Operating System	Centos version **6.4** Downloadable from link- http://www.sumegha.in/Repository/CentOS_6.iso
CPU	One or more 64-bit x86 CPU(s), 1.5 GHz or above, 2 GHz or faster multi-core CPU recommended
RAM	Minimum 4 GB
Disk Space	Minimum 60 GB; Minimum 2GB for /boot partition

3.1.2 Service Node

Operating System	Centos 6.4
RAM	4 GB
Disk Space	Minimum 100 GB
Network	Internet Connectivity
Software	JAVA 1.6+, Python (2.6 – 3.0)

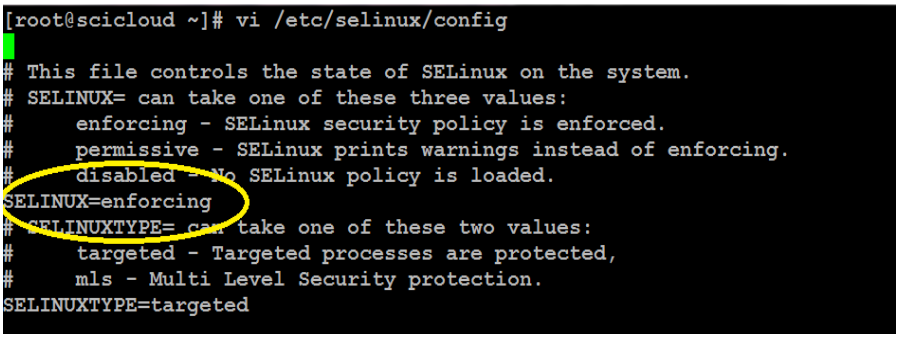
3.2 COMMON CONFIGURATIONS

Before installations, the administrator must check for three things on the both VMM node and Service node:

1. Disable the SELINUX
2. Disabling "requiretty" setting
3. Providing sudo privileges to nimbus user

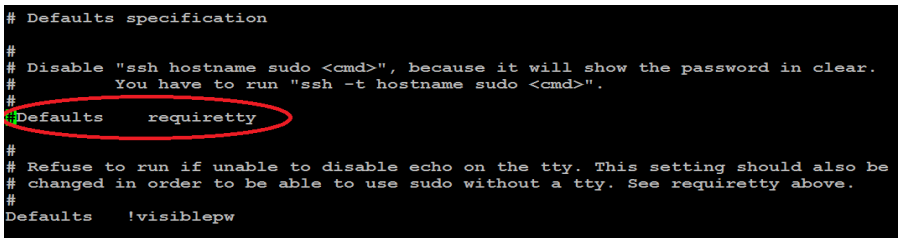
Disable the SELINUX

By default, SELINUX is enforcing. The user has to disable the SELINUX in the file: *"/etc/selinux/config*". Please remove enforcing and add the entry: **SELINUX=disabled**



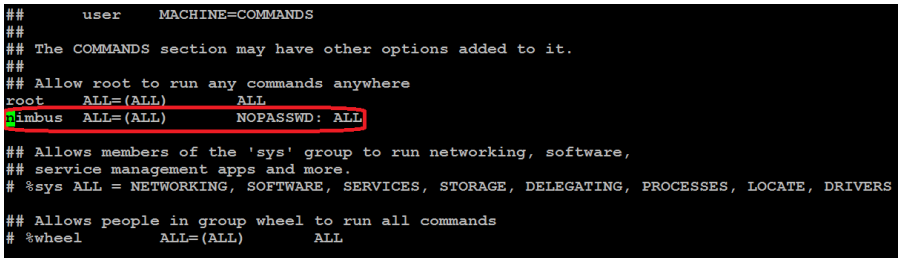
Disabling "requiretty" setting

In the file "*/etc/sudoers*", discard the *requiretty* entry. Do not comment the line, instead delete the *requiretty* entry.



Providing Sudo privileges to nimbus user

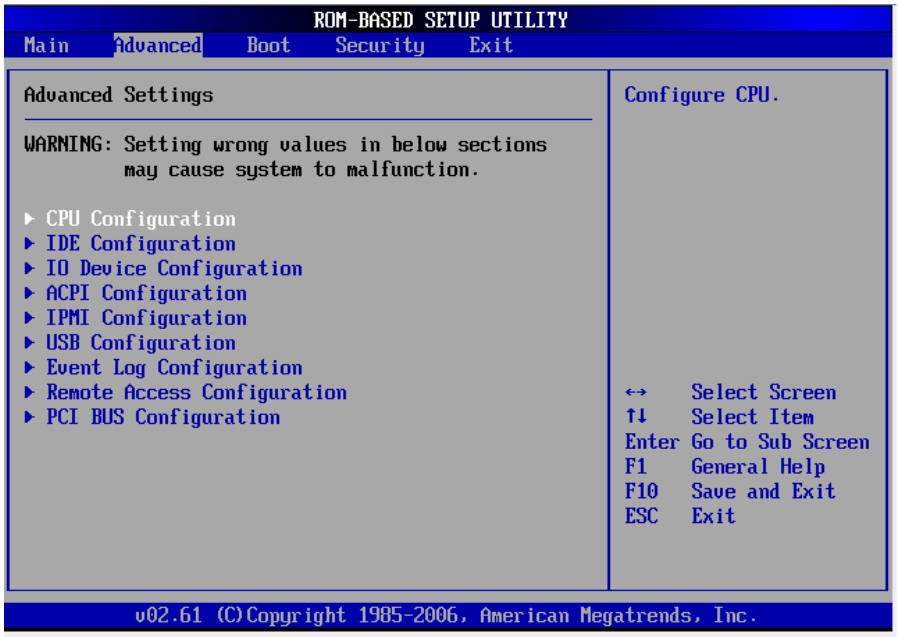
In the file "*/etc/sudoers*", please add "*nimbus*" user the sudo privileges. Add entry:
'nimbus ALL=(ALL) NOPASSWD: ALL

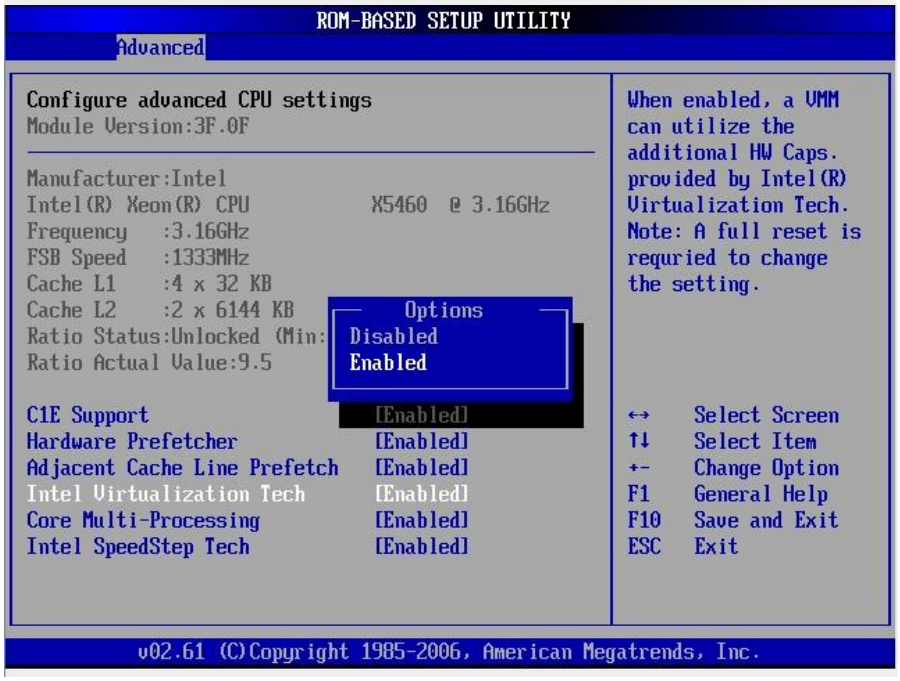


Configuration: Virtual Machine Manager (VMM) Node

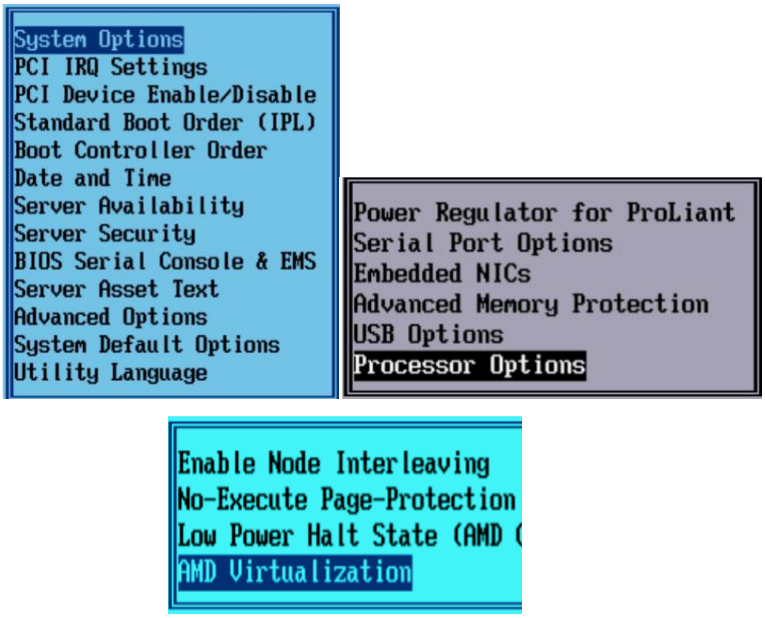
Before proceeding, please enable the virtualization in the BIOS setting.

- For Intel processors: Go To *Advanced Tab -> CPU Configuration-> Intel Virtualization -> Enabled*





- For AMD processor: Go to System options -> Processor Options -> Amd Virtualization -> Enabled



3.3 CLOUD LAB KIT SOFTWARE INSTALLATION

SuMegha installation is completely automated with minimal interactions with the user installing the software. Also, ensure if all the pre-requisites are met before installation. The installer is available in CD or can be downloaded from SuMegha website:

http://www.sumegha.in/Repository/SuMeghaLabKit.iso

If the installation is done from CD, execute the *SuMegha-Install* script present in the main CD directory, using the command:

sh SuMegha-Install

If the installation is done from downloaded .iso, follow these steps:

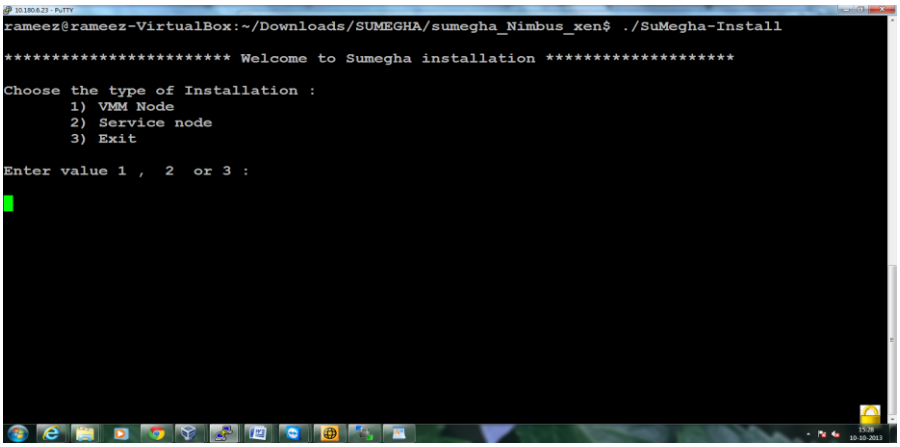
a. # mount –o loop SuMeghaLabKit.iso <mount directory>

b. # cd <mount directory>

c. SuMegha installation is invoked by executing the following script present in main the CD directory:

sh SuMegha-Install

When you invoke the main script *SuMegha-Install*, the options to install VMM node or Service Node shall be displayed.

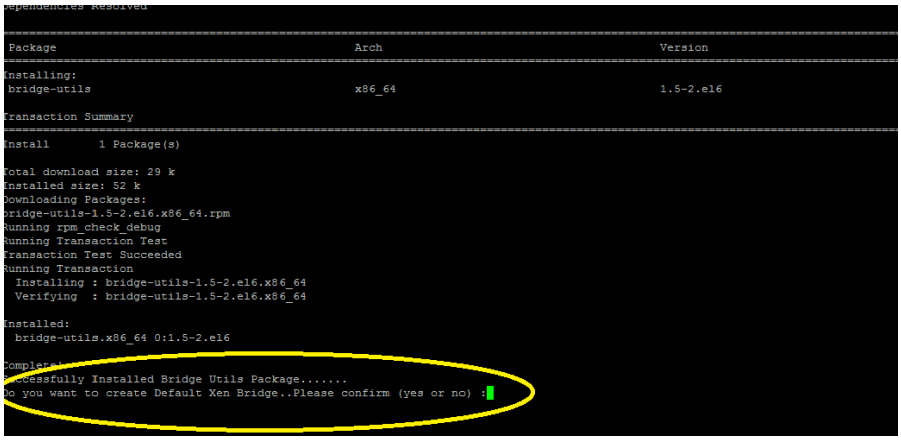


Note: VMM node should be installed & configured first, followed by the Service node.

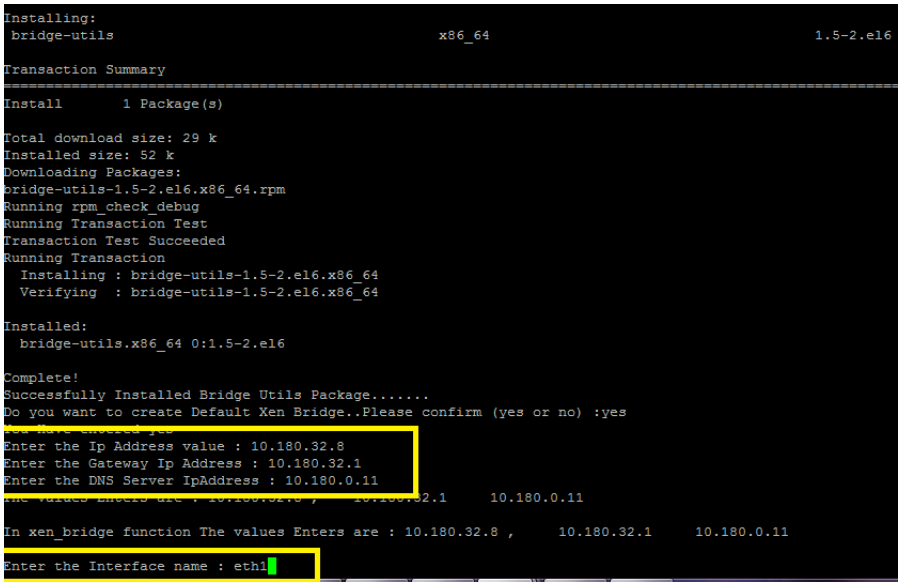
3.3.1 Virtual Machine Manager (VMM) Node Installation

When the pre-requisites are met and VMM node installation option selected, the first component of SuMegha Cloud Lab kit, Xen installation starts. The user is prompted whether to create a default Network Bridge "*xenbr0*" or not.

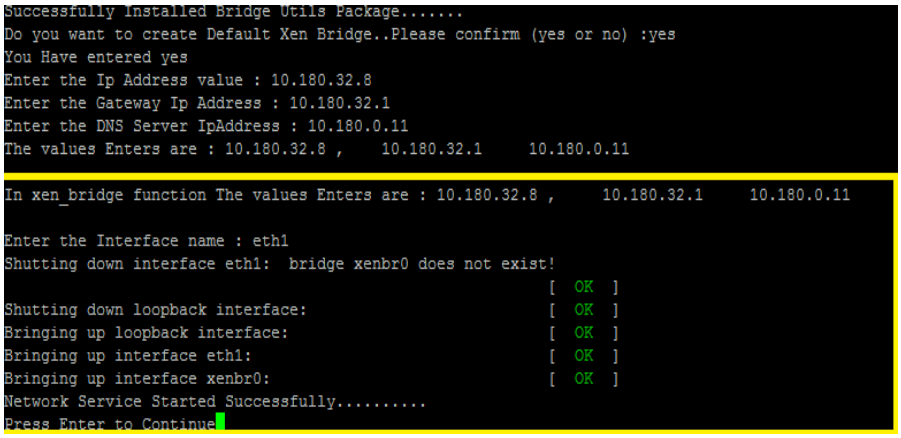
At any point, when the installation has paused, please press “Enter key” twice to continue.



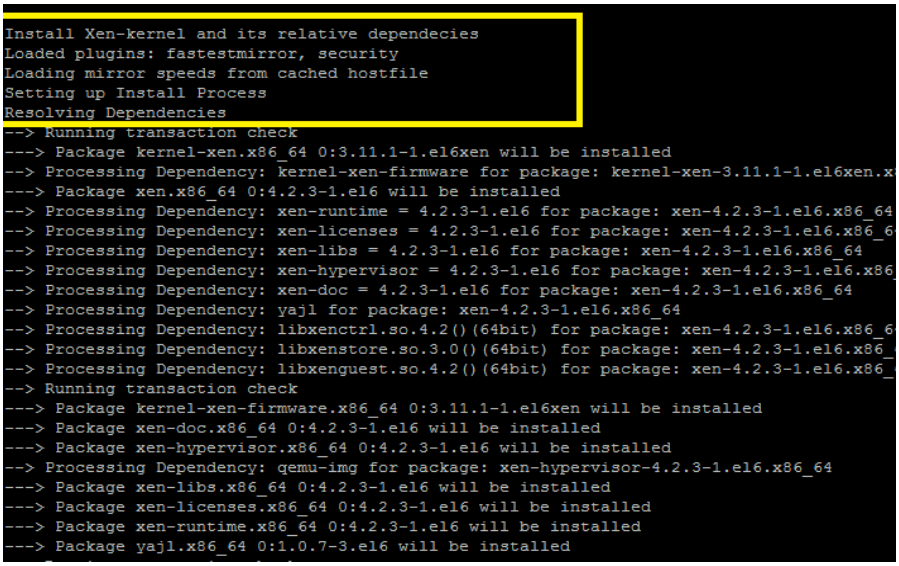
If user opts for default Xen bridge creation, then he/ she has to provide IP Address, Gateway Address, DNS Address and the name of the Interface on which network is configured.

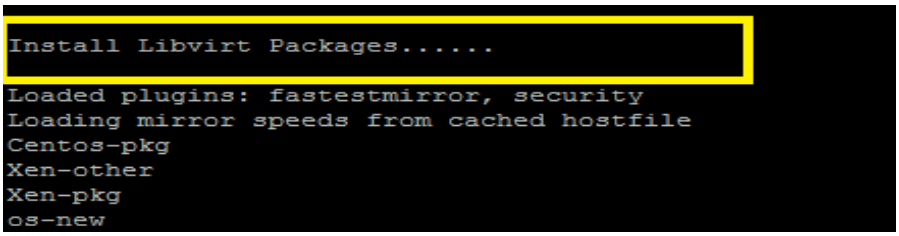


It will create *Xenbr0 Bridge* and it will restart the network

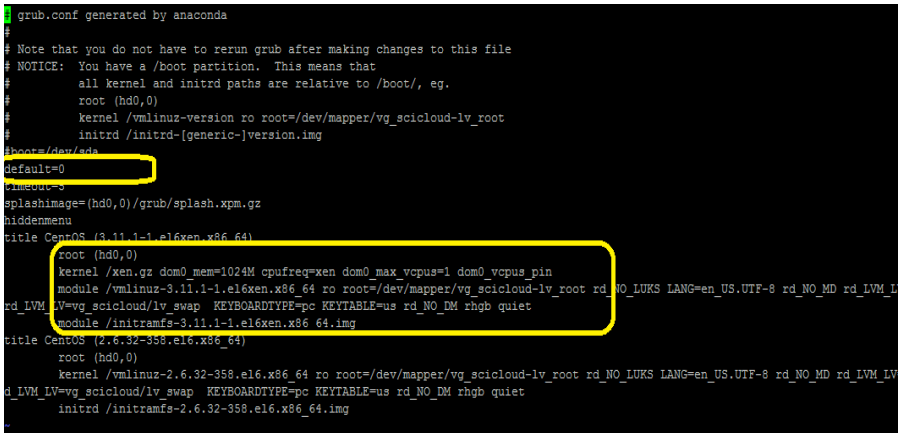


After bridge gets created, installation of Xen, its relative packages and libvirt begins.





After the Xen is installed successfully, check the default variable in the file *"/boot/grub/menu.lst*" before rebooting. Change the default kernel to Xen Kernel, by changing the value of the default variable.



Creating your own Network Bridge

If the user opts for creating his/ her own Network Bridge, he/ she has to set up a network bridge on their server for virtual machines to be accessed from other hosts, as if they were

physical systems in the network.

To do this, we install the package bridge-utils and configure a bridge.

```
yum install bridge-utils
```

Create the file */etc/sysconfig/network-scripts/ifcfg-br0*

Please use the IPADDR, PREFIX, GATEWAY, DNS1 and DNS2 values from the file: /etc/sysconfig/network-scripts/ifcfg-eth0file; Also, ensure you use TYPE=Bridge, not TYPE=Ethernet

```
vi /etc/sysconfig/network-scripts/ifcfg-br0
```

```
DEVICE="br0"
NM_CONTROLLED="yes"
ONBOOT=yes
TYPE=Bridge
BOOTPROTO=none
IPADDR=192.168.0.100
PREFIX=24
GATEWAY=192.168.0.1
DNS1=8.8.8.8
DNS2=8.8.4.4
DEFROUTE=yes
IPV4_FAILURE_FATAL=yes
IPV6INIT=no
```

Modify */etc/sysconfig/network-scripts/ifcfg-eth0* as follows (Comment BOOTPROTO, IPADDR, PREFIX, GATEWAY, DNS1, and DNS2 and add BRIDGE=br0)

```
vi /etc/sysconfig/network-scripts/ifcfg-eth0
```

```
DEVICE="eth0"
NM_CONTROLLED="yes"
```

```
ONBOOT=yes
HWADDR=00:1E:90:F3:F0:02
TYPE=Ethernet
#BOOTPROTO=none
#IPADDR=192.168.0.100
#PREFIX=24
#GATEWAY=192.168.0.1
#DNS1=8.8.8.8
#DNS2=8.8.4.4
DEFROUTE=yes
IPV4_FAILURE_FATAL=yes
IPV6INIT=no
NAME="System eth0"
UUID=5fb06bd0-0bb0-7ffb-45f1-d6edd65f3e03
BRIDGE=br0
```

Restart the network

```
/etc/init.d/network restart
```

Execute the following command:

```
ifconfig
```

It should now show the network bridge (br0):

```
br0       Link encap:Ethernet  HWaddr 00:1E:90:F3:F0:02
          inet addr:192.168.0.100  Bcast:192.168.0.255  Mask:255.255.255.0
          inet6 addr: fe80::21e:90ff:fef3:f002/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:17 errors:0 dropped:0 overruns:0 frame:0
          TX packets:29 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:1196 (1.1 KiB)  TX bytes:2794 (2.7 KiB)

eth0      Link encap:Ethernet  HWaddr 00:1E:90:F3:F0:02
          inet6 addr: fe80::21e:90ff:fef3:f002/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500 Metric:1
          RX packets:4554 errors:0 dropped:0 overruns:0 frame:0
```

TX packets:3020 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:1000
RX bytes:6249612 (5.9 MiB) TX bytes:254928 (248.9 KiB)
Interrupt:25 Base address:0x6000

lo Link encap:Local Loopback
inet addr:127.0.0.1 Mask:255.0.0.0
inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:16436 Metric:1
RX packets:3 errors:0 dropped:0 overruns:0 frame:0
TX packets:3 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:1304 (1.2 KiB) TX bytes:1304 (1.2 KiB)

Please execute command to switch off Network Manager at boot time *"Chkconfig NetworkManager off"*

The VMM installation is complete. Please reboot your system with Xen kernel and check whether installation is correct using following command: *"virsh list"*

```
[root@sumegha ~]# virsh list
 Id    Name                           State
----------------------------------------------------
0     Domain-0                       running
```

The following output implies the system has booted with Xen kernel. Also, check using "uname -r".

Please uncomment following lines in */etc/libvirt/libvirtd.conf* file:

- Uncomment the line *unix_sock_group="libvirt"* and replace *'libvirt'* with *'root'*

  unix_sock_group = "root"
- Uncomment the following lines:

  unix_sock_ro_perms = "0770"
  unix_sock_rw_perms = "0770"
  unix_sock_dir = "/var/run/libvirt"
  auth_unix_ro = "none"
  auth_unix_rw = "none"
- After editing this file run the following command

  usermod –G root nimbus
- Restart libvirt and Xen service from 'root' login

  service libvirtd restart
  service xend restart

Checking Xen and libvirt

If VMM and Service Node are installed on the same machine, execute the following command to check whether installations are correct:

virsh -c 'xen+ssh://nimbus@<service node-IP>' list

If VMM and Service Nodes are installed on different machines, execute the following command to check whether installations are correct:

virsh -c 'xen+ssh://nimbus@<vmm node-IP>' list

If you encounter any errors, whether during installations or configurations, please report to SuMegha team.

3.3.2 Service Node Installation

Select the Service Node installation option in the main script. The installations are done in */opt/nimbus* directory, by default. Ensure the output of the commands *hostname* and *hostname –f* should be same.

Following are the steps for installing Service node:

1. Set up password less login using SSH keys to connect nimbus user of VMM and the Service
   a. Generate an SSH keygen keys on the Service Node:
      nimbus@service $ *ssh-keygen –t rsa*

   b. Create .*ssh* directory on VMM node:
      nimbus@vmm1 $ *ssh nimbus@vmm1 mkdir -p .ssh*

   c. Upload the generated public keys to VMM node:
      nimbus@service $ *cat .ssh/id_rsa.pub |*
      ssh nimbus@vmm1 'cat >> .ssh/authorized_keys'

   d. Set permissions on the VMM node:
      Due to different SSH versions on servers, we need to set permissions on .ssh directory and authorized keys file.

      nimbus@vmm1 $ *ssh nimbus@vmm1 "chmod 700 .ssh; chmod 640 .ssh/authorized_keys"*

      nimbus@vmm1's password: [Enter Your Password Here]

   e. Login from Service Node to VMM Node without password
      From now onwards, you can log into VMM node as *nimbus* user from the Service Node

as *nimbus* user without password.
nimbus@service $ *ssh nimbus@vmm1*

NOTE: As you add more VMMs in future, you should ensure that SSH works in the same way for each.

2. While installing the Service node, the *nimbus* user is created. You have to press "y" to enable it.

```
Is the current account (nimbus) the one the service will run under? y/n:
y
```

3. You have to provide the hostname of the machine where you have installed the VMM node. If the VMM node is on same machine, you can provide "*localhost*" as shown below.

```
Pick a VMM to test with, enter a hostname:
localhost
```

4. You have to provide the RAM size allocated for the VMM's which shall be used for virtualization.

```
How much RAM (MB) should be allocated for VMs on the 'localhost' VMM?
2048
```

5. Press "y" if the *nimbus* user is present on both Service and VMM Node.

```
Is the current account (nimbus) also the account the privileged scripts will run under on the VMM (localhost)? y/n:
y
```

6. Does the container account (*nimbus*) need a special (non-default) ssh key to access the '*nimbus*' account on the VMM Node? Press "n"
7. All the VMMs should be able to access the Service Node by hostname. The *hostname* is detected by the installation script and is shown in console. If the hostname is incorrect, then press "no"; else provide correct hostname.

```
*** It looks like you have a hostname set up: XXXX

Would you like to manually enter a different hostname? y/n:
```

8. By default, SSH Server runs on port 22.

   If the VMM Node's SSH port number is 22, don't change the port number during installation, by pressing "n". If ssh port number is other than 22, then provide the ssh port number.

```
Is your local SSHd server on a port different than 22?  Enter 'n' or a port number:
n
```

9. If you have already installed the VMM Node, press [Enter] to continue.

```
Waiting for you to install workspace control for the account 'nimbus' on the test VMM 'localhost'

After this is accomplished, press return to continue.
```

10. For completing the installation, you need to explicitly start nimbus services when the script prompts.

```
Please optionally start the service and then hit enter.
```

To start the nimbus services, login to another terminal as "*nimbus*" user and run following command:

/home/nimbus/nimbus/bin/nimbusctl start

After these services start, press [Enter] in installation script.

11. If all the entries are correct, type "y" and press [Enter] when it prompt the message

```
OK, point of no return.  Proceed? y/n
```

12. After starting the service in other terminal, you should provide the list of IP's required for the Virtual Machines in the file:

/home/nimbus/nimbus/services/etc/nimbus/workspace-service/network-pools/public

# Hostname	IP Address	Gateway	Broadcast	Subnet Mask [MAC]
pub3.cdacb.in	10.180.36.3	10.180.36.1	10.180.36.255	255.255.255.0
pub4.cdacb.in	10.180.36.4	10.180.36.1	10.180.36.255	255.255.255.0
pub5.cdacb.in	10.180.36.5	10.180.36.1	10.180.36.255	255.255.255.0
pub6.cdacb.in	10.180.36.6	10.180.36.1	10.180.36.255	255.255.255.0
pub7.cdacb.in	10.180.36.7	10.180.36.1	10.180.36.255	255.255.255.0

After adding these entries, restart the nimbus services. Also, add these entries in your centralized DHCP server, in the file:

/home/nimbus/nimbus/services/var/nimbus/dhcpd.entries

Note:

- All the administration commands are present in the directory: */home/nimbus/nimbus/bin*
- Two additional Scripts are provided in */home/nimbus* directory for creating the user and changing password
- Cloud Portal is installed in */WebApplication* (Tomcat Server)

Building the image repository

The images are required to boot the VM instances when requested by the user from cloud portal. The steps for setting up the image repository are as follows:

1. Download the images from the following link:
   http://www.sumegha.in/Repository/Images/

2. Switch user as " *nimbus*"

   Note: All the administrative commands should be executed as "*nimbus*" user

3. Run the following command as *nimbus* user to upload each image to the Cloud image repository

   */home/nimbus/nimbus-cloud-client-021/bin/cloud-client.sh --transfer --sourcefile <**image path**> --common*

This completes the installation of Service Node.

For any issues/ errors regarding the SuMegha Cloud Lab Kit installation, please contact the SuMegha team for clarifications.

Chapter 4
Using Cloud Services

4.1 CONFIGURATIONS

Before starting the cloud services, you must ensure the following:

1. In Virtual Machine Manager (VMM) Node
   - Ensure the system is booted from the Xen Kernel
   - Check *xend* service is running
2. In Service Node
   - Providing IP addresses to Virtual Machines (VM) and centralized DHCP Server
   - Nimbus services are running
3. Configuration of Cloud Portal

   Following parameters in the file: */WebApplication/webapps/ROOT/WEB-INF/classes/config.properties* is modified as root.
   - Ipaddress = x.x.x.x
   - adminId=abc
   - adminPasswd=abc

   If you face any issues while creating VMs through portal, please look into the file */WebApplication/logs/catalina.out* or contact SuMegha team.

4.2 VIRTUAL MACHINES

Refer *Online help* available in Cloud Portal for further details.

Create a Virtual Machine

To create a Virtual Machine, provide the following three parameters in the *Run Instance block* on the Instance or Image page.

- Image File - VM Type provided to you or VM's saved by you.
- Size - RAM and CPU of your machine
- Hours - Number of hours you want the Virtual machine

The three variations in Image Sizes are:

- Small Image - 1 vCPU & 1GB RAM
- Medium Image - 2vCPU & 2GB RAM
- Large - 4vCPU & 4GB RAM

Upon clicking the RUN button, the Virtual Machine is created and listed in the Instance page.

Following are the three states that Virtual Machine can be in:

- UNPROPAGATED - your machine is in INSLALATION mode.
- PROPAGATED - your machine is in BOOTING mode.
- RUNNING - your machine is ready to use.

Save the Virtual Machine

You can save an instance of Virtual Machine by specifying the Image name and then clicking on *Save* button in the Instances/ Images page.

Note: While saving, do not destroy the Virtual Machine; else you lose both your data and VM.

Also, you cannot save a Cluster.

Destroy the Virtual Machine

Click on the Destroy Machine block in the Instances / Images page and select the Virtual Machine handle to be destroyed.

Note: You can destroy the machines at any point of time. Once you destroy the Virtual Machine, the data in that machine also get destroyed.

Run the Saved Virtual Machine

When you save a Virtual Machine, it is listed in the *Run Instances* list on the Instances/ Images page. Specify the *Image Size* and the *Number of Hours* the image is required then click RUN to start the machine using the saved image.

Delete the saved Virtual Machine

Click the Delete button next to the *Image name* in the list of saved images of the Virtual Machine.

Note: If you delete a saved image, it does not delete the Virtual Machine with which it was booted.

4.3 LOGIN TO VIRTUAL MACHINE

1. From Linux System

You can login to the Virtual Machine using the SSH key given at the home page by following these steps:

- Copy the SSH key content into a file
- Change the mode of that file using the following command:
  $chmod 0600 filename
- Now, ssh using that key:
  $ ssh -i {path of ssh key file} root@{machine IP address}

2. From Windows System

Step 1: Install putty client on your Windows desktop machine.

Step 2: Copy the ssh key from the Cloud Portal after registration and save text file on your Windows desktop machine.

Step 3: Install puttygen. Using puttygen, as shown in Figure 5, convert ssh private key to .PPK format compatible for putty. Click yes, when prompted for passphrase free ssh communication.

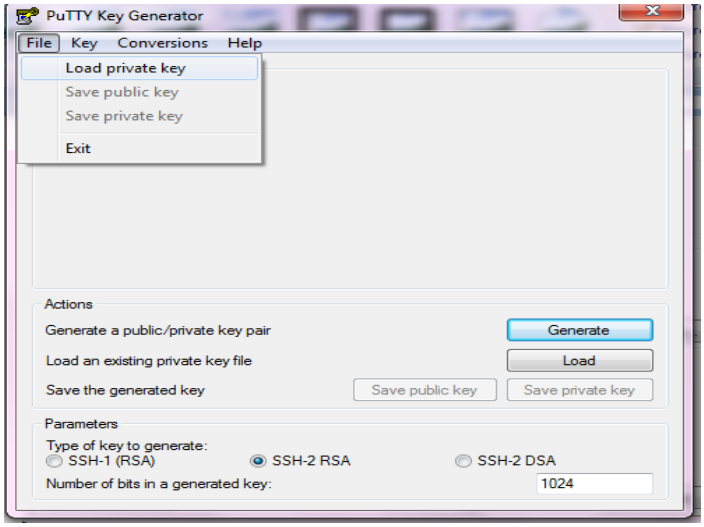


Figure 5: Puttygen - Convert ssh private key to putty compatible format

Step 4: Provide the IP address and Port number of the VM instance to be accessed.

Step 5: Load the ssh private key as shown in figure 6 to open the session.

Step 6: Login as *root* user.

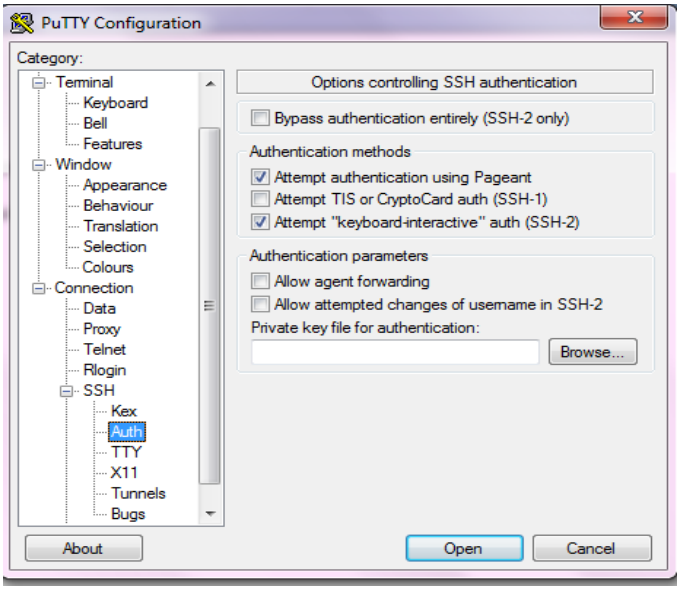


Figure 6: Putty - uploading ssh private key to login to the remote machine

4.4 VIRTUAL CLUSTERS

To create a Virtual Cluster, provide the following four parameters in the *Run Cluster block* on the Instances/ Images page.

- Type - Cluster type
- Size - RAM and CPU of your Cluster
- Node - Number of Nodes required (including Head Node)
- Hours - Number of hours you want the Virtual Cluster

The three variations in Image Sizes are:

- Small Image - 1 vCPU & 1GB RAM
- Medium Image - 2vCPU & 2GB RAM
- Large - 4vCPU & 4GB RAM

Upon clicking the RUN button, the Virtual Cluster is created and listed in the Instance page.

Following are the three states that Virtual Machine can be in:

- UNPROPAGATED - your machine is in INSLALATION mode.
- PROPAGATED - your machine is in BOOTING mode.
- RUNNING - your machine is ready to use.

Note

- Do not login to any of the Virtual Cluster nodes,
  - Until all of them are in running mode.
  - Until the Contextualization Status in LOGS [CTX_SUCCESS] is displayed before all the nodes.
- All the Cluster nodes have the same name; the first one is the head node.

The setup allows creation of two types of Clusters:

- MPI Cluster
- Hadoop Cluster

4.4.1 Creation of MPI (Message Passing Interface) Cluster

In the MPI cluster, the machine file */root/mpd.hosts* is used for running MPD, by using the following command in the Head Node, as *root* user.

$ mpdboot -n {no. of nodes} -f /root/mpd.hosts

4.4.2 Creation of Hadoop Cluster

Hadoop cluster allows users to:

- Run Hadoop MapReduce jobs on the Hadoop cluster.
- Store data on HDFS (Hadoop Distributed File System) redundantly (ie, multiple copies will be stored in the cluster to provide fault tolerance).

On Hadoop cluster:

1. Login to the Master Node and switch to *hadoop* user.

2. Hadoop is installed *in /home/hadoop/project/hadoop-0.20.0* directory. Switch to this directory before performing any operations (ie, Data storing and Running your Map-Reduce JOB).

3. Run you Hadoop-Mapreduce Job

   $ cd /home/hadoop/project/hadoop-0.20.0

   a. Copy the local directory to HDFS:

      $ ./bin/hadoop dfs -put localInput /home/hadoop/project/hadoop/hdfs/data/dfsInput

   b. List all the HDFS files in the directory to check whether the input directory is present:

      $ ./bin/hadoop dfs -ls /home/hadoop/project/hadoop/hdfs/data/

   c. Run your job (Ex: ABC.jar is the file in dfsInput directory):

$ ./bin/hadoop jar ABC.jar /home/hadoop/project/hadoop/hdfs/data/dfsInput /home/hadoop/project/hadoop/hdfs/data/dfsOutput

Note: *Output* is the name of the directory where the results of Map-Reduce job will be stored. Ensure this directory does not exist before running the job.

ABC.jar is the job that has to be transferred from your machine to Master Node of Hadoop Cluster. Hadoop Programming can be done using Hadoop plugins available for Netbeans/ Eclipse.

4. Copy these output files (in dfsOutput directory) to your local machine in the directory local Output.

Chapter 5
Getting Started

5.1 JOB SUBMISSION PORTAL

1. User can access the Job Submission Portal by typing the following URL in the browser: **http://Ip Address:8084/JSPC**

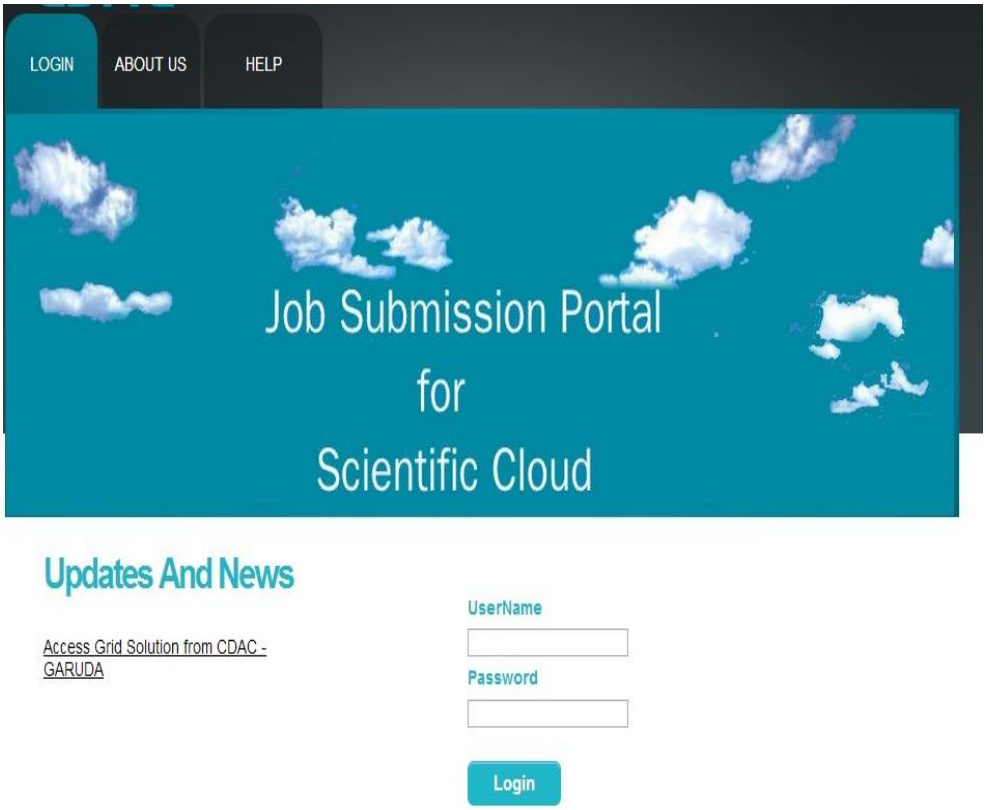


Figure 7: Login page for Job Submission Portal for Scientific Cloud

2. User can submit the Sequential and Parallel Jobs by selecting the appropriate option from the Job Submission Page. For parallel jobs, the user can select the number of process.
3. User has to provide the executables along with the following parameters like input files (if any), stdin input file, command line arguments.

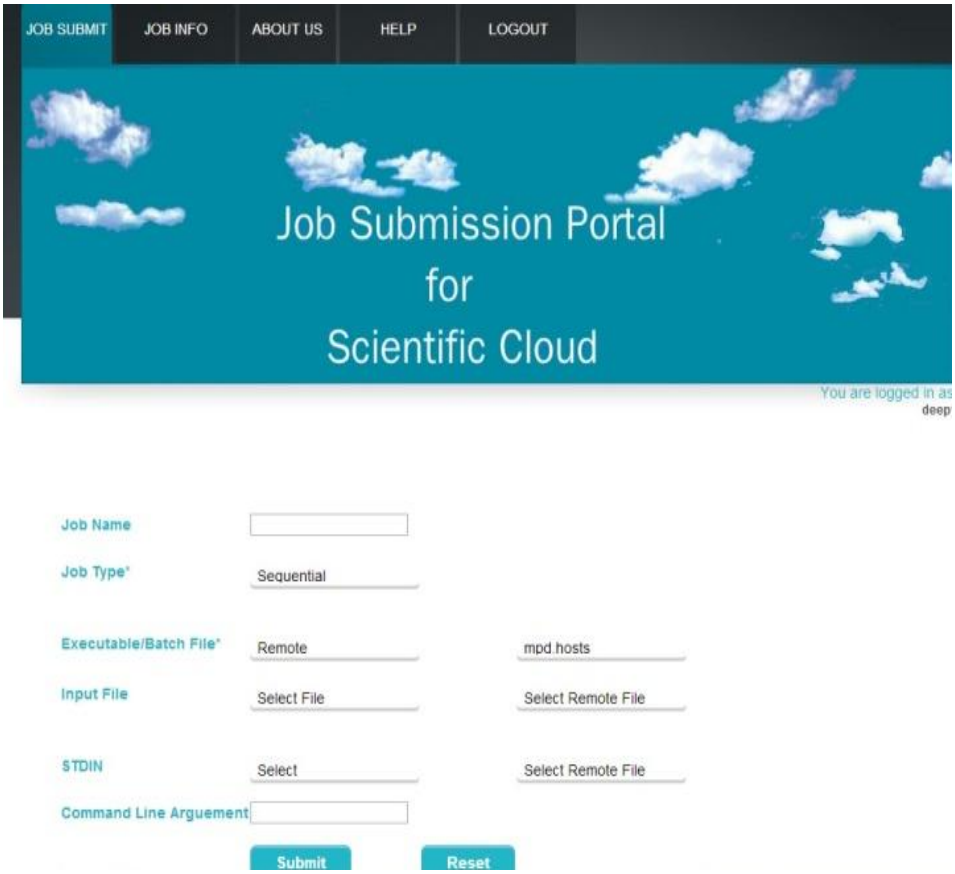


Figure 8: Job Submission Page

4. After submitting the job, the user is given a Job ID for checking the status of job in JobInfo page.
5. User can view/ download the output/error file(s), as shown in Figure 9.
6. The administrator can add a user using Add User facility in Figure 10.

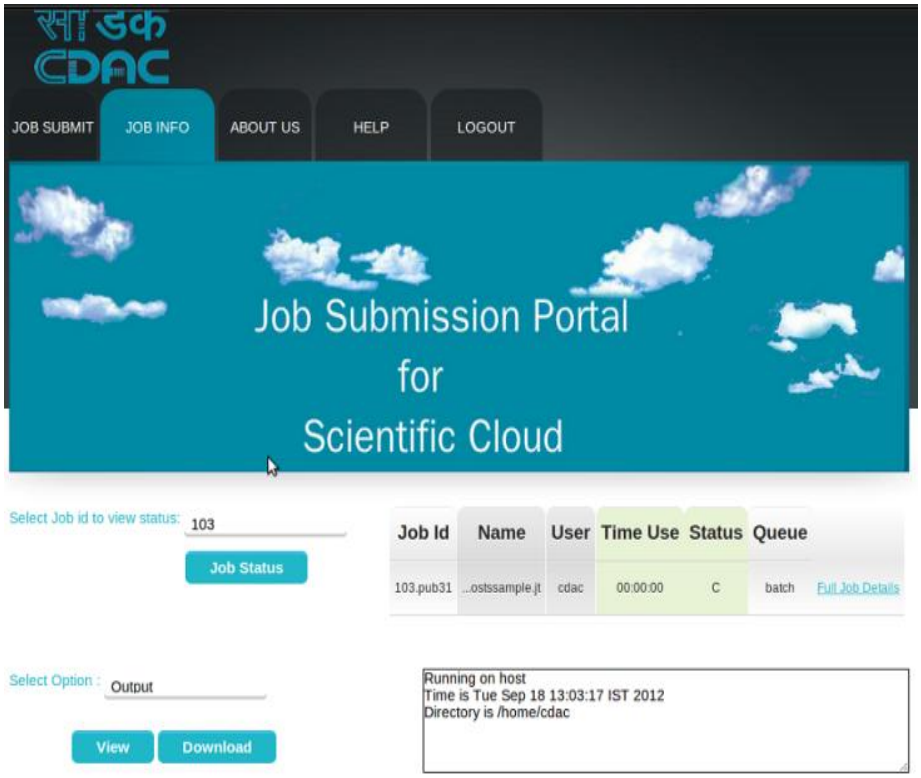


Figure 9: Job Info Page

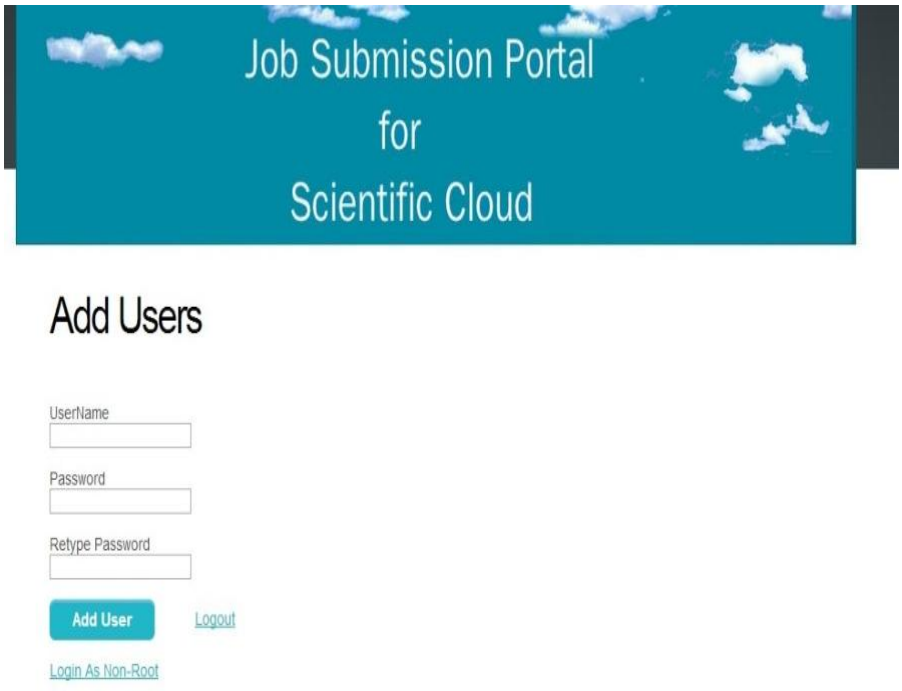


Figure 10: Adding users

5.2 PSE'S FOR SFM

The Problem Solving Environment (PSE) for Seasonal Forecast Model (SFM) is a web-interface to interact with the Virtual Clusters provided by scientific cloud to run the SFM application for weather prediction.

Hardware Requirements

- Cluster of MPICH2 with Linux OS
- A cluster of MPICH2 having Torque as a scheduler

Software Requirements

- Apache tomcat Web/Application server for communication
- Mysql Database to store information
- Torque Scheduler for Linux clusters.
- GrADS for Visualization

1. User can access the PSE for SFM Portal by typing the following URL in the browser: **http://Ip Address:8080/pse-sfm**
2. User can submit the weather forecasting job by selecting the number of process and can give the related input file having .ieee extension. Figure 12 shows the Job Submission page of PSE for SFM.
3. User can monitor the status of the job by selecting the appropriate job-id and after completion of job user can view the output/error file(s). Figure 13 shows the Job Info page.

Figure 11: Login page for PSE for SFM

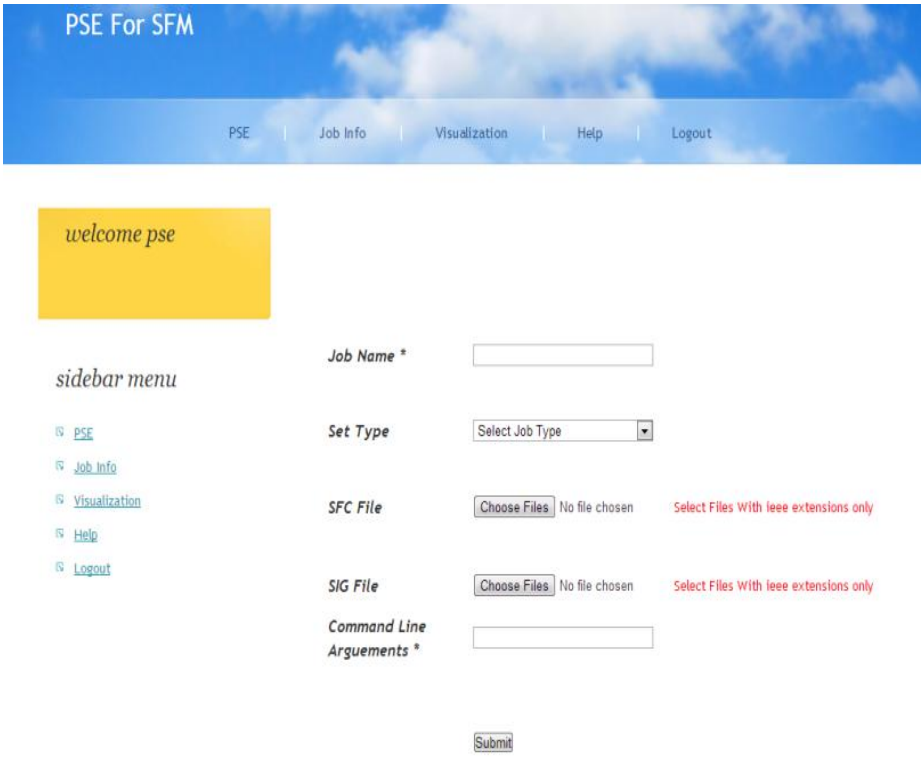


Figure 12: Job Submission page

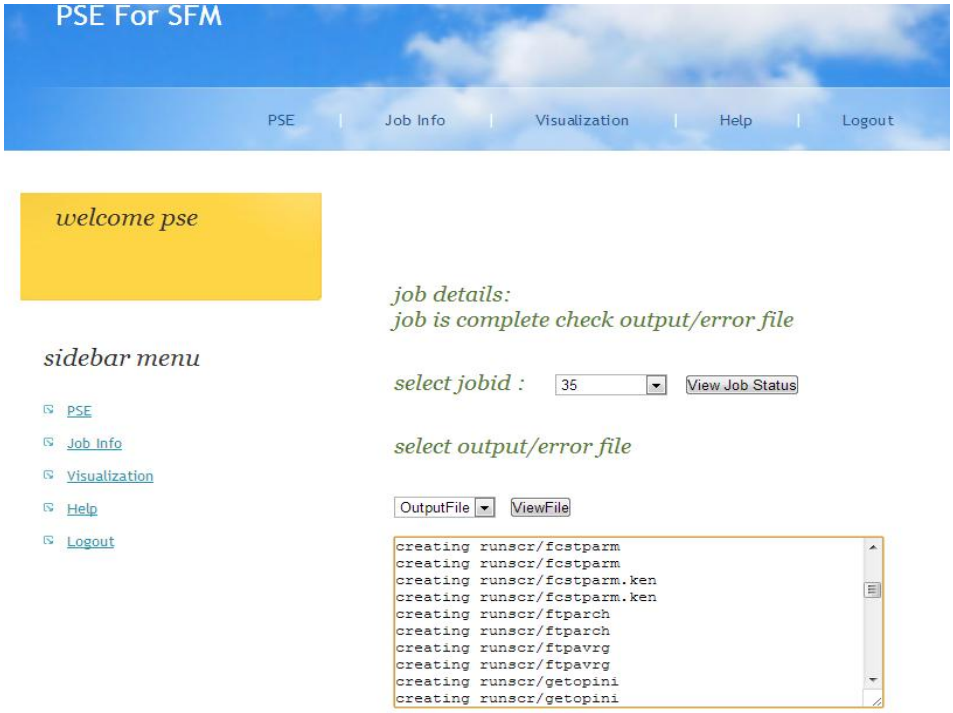


Figure 13: Job Info page

4. Web- based *File Explorer* is provided for the user to view the directories and file and to download the file.

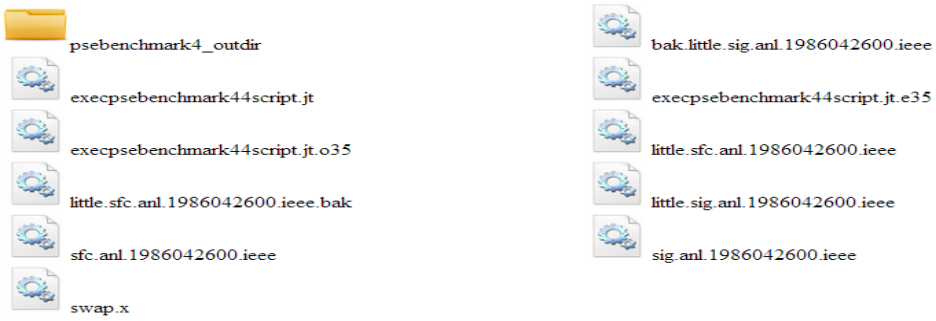


Figure 14: File Browser

5. After completion of job, the *flx.***** output file is generated. This file has to be converted into descriptor file i.e. *.ctl* file. Using this descriptor file, the user can do visualization and enter the grads commands in the text area provided, as shown in Figure 15.

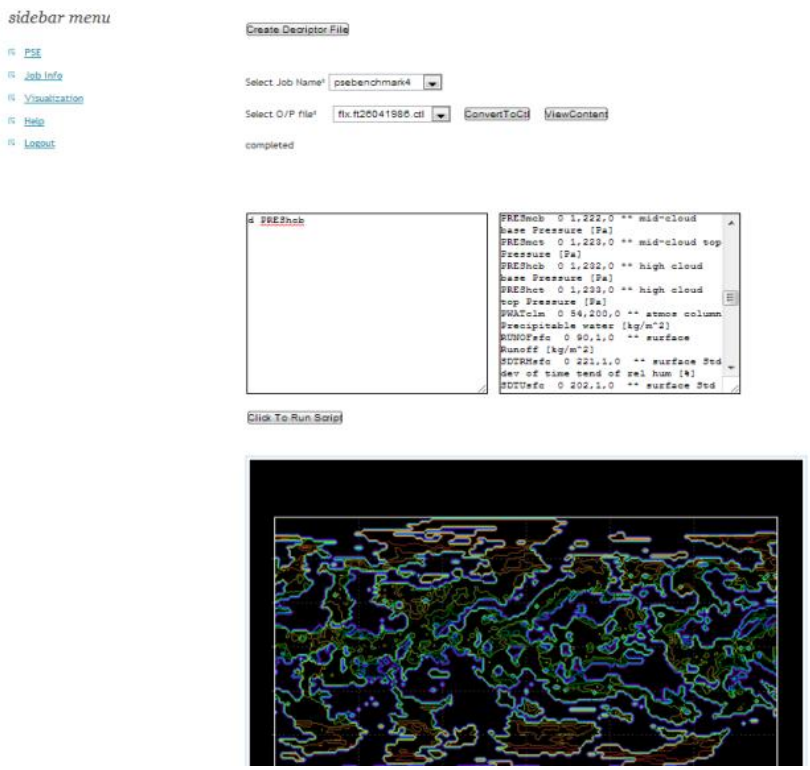


Figure 15: Visualization

LIST OF FIGURES