

Introduction to Internet of Things
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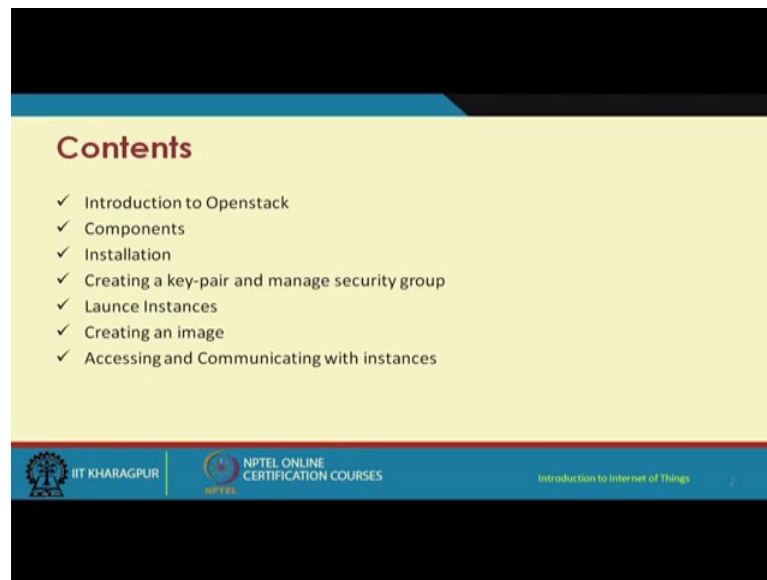
Lecture - 41
Cloud Computing: Practical

This is the fifth lecture in the series on cloud computing for internet of things. In this lecture, you will learn about some of the basics about a an open source platform for cloud which is openstack and in this lecture I will be assisted by one of the TAs, Mr. Anand Shri and he will show you how to create you know it is not possible to show you the installation of cloud or openstack specifically it is not a you know possible to show through this. Those installations are available; the instructions for installations are available you know through different links that are available publicly. Now once you have installed openstack then how to create virtual machine instances how to access those instances and so on, so, those manipulations how to do how to play around with openstack interface, so, those things we are going to show in this particular lecture.

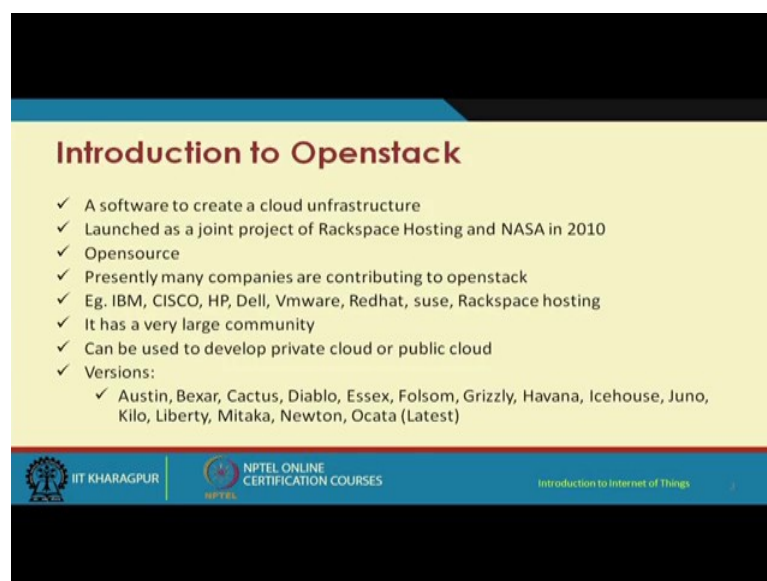
So, this basically is going to give you a practical exposure of cloud with a popular open source system openstack and so, this through this actually you can use openstack specifically with internet of things you know if you are building IoT platforms and for cloud requirements you can use openstack for it.

Hi everyone, my name Anand Shri and I am one of the TAs of this course. So, today I am going a do; I am going tell you about some basics about open stacks. So, let us get started. Here first let us start with what actually is open stack.

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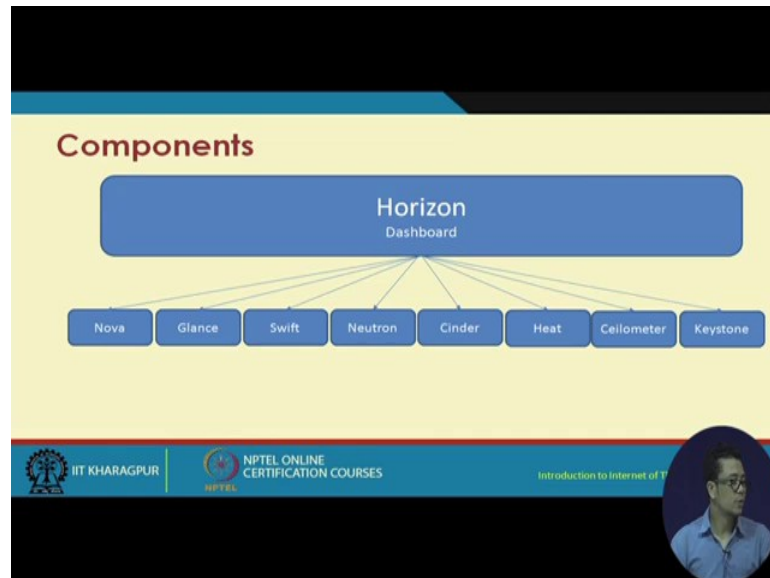
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So, openstack is software through which you can generate your own cloud and it is a joint project of the NASA and the rack space hosting and it was established in; it was first released in 2010. So, right, but right now so many companies; so many big big companies are helping in developing the helping in developing this software. So, some of the companies are CISCO, IBM, HP, Redhat and so on so; obviously, actually you can even contribute in developing the software you can even develop your code that can upgrade the present openstack also. So, it is completely free and it is the only completely free open source cloud developing software that is available in the market. So, some of

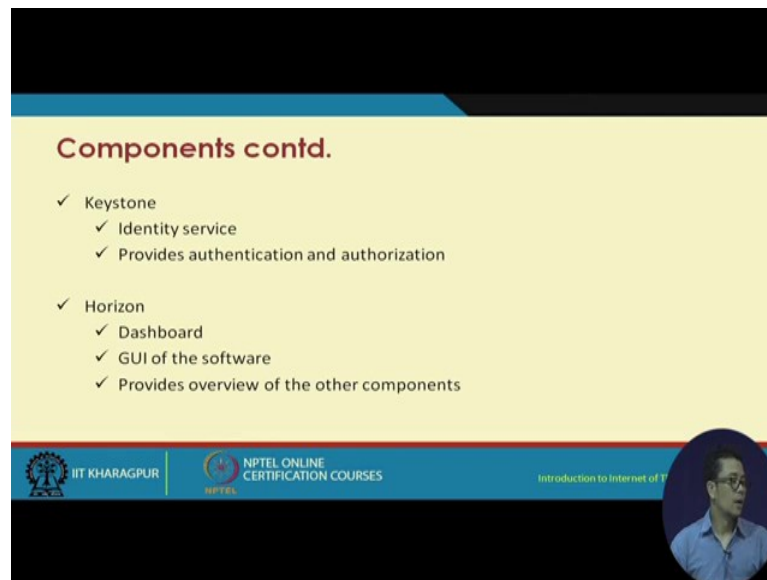
the versions of the openstacks are a listed here. So, it is a releasing order of the alphabetical orders. So, it was a first it was 2010, it was launched as the Austin, but right now the latest version is Ocata. So, let us go to the next slide.

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So, these are components of the open stack. So, in openstack there are so many components and its components are acting their own function and its component has their own specific functions. So, first here is horizon. This horizon is the dashboard section. From this horizon you can actually access other components. So, actually horizon is the GUI interface of the software. So, it provides GUI sections.

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Components contd.

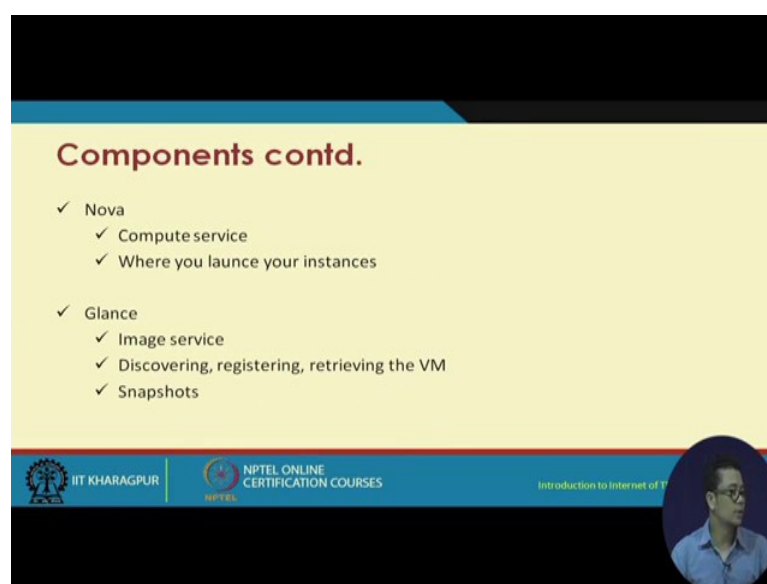
- ✓ Keystone
 - ✓ Identity service
 - ✓ Provides authentication and authorization
- ✓ Horizon
 - ✓ Dashboard
 - ✓ GUI of the software
 - ✓ Provides overview of the other components

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It also provides overview of the other components. So, when we do the practical section you will know what the horizon is.

So, next is the keystone; keystone is actually the authentication and authorizing system. So, when a user access the system or when a user access the cloud, this keystone will be able to detect if this user is authentic or if this user is authorized to use the resources that he is attempting to use.

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Components contd.

- ✓ Nova
 - ✓ Compute service
 - ✓ Where you launce your instances
- ✓ Glance
 - ✓ Image service
 - ✓ Discovering, registering, retrieving the VM
 - ✓ Snapshots

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So, next component is a Nova, Nova is the compute service actually Nova is the component where we are going to launch the instances and all. So, and the glance is the image service.

So, for installing the instances we need images. So, for this we will use Glance. So, it is also useful in discovering registering retrieving those VM ware also and through this glance we can also give the snapshots.

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The slide is titled "Components contd." in red text. It lists two main components with their functions:

- ✓ Swift
 - ✓ Object storage
 - ✓ Helps in storing data safely, cheaply and efficiently
- ✓ Neutron
 - ✓ Provides networking service
 - ✓ Enables the other services to communicate with each other
 - ✓ Make your own network

The slide footer includes the IIT Kharagpur logo, the text "NPTEL ONLINE CERTIFICATION COURSES", and a small circular video inset of a man speaking. The text "Introduction to Internet of Things" is also visible in the footer.

So, that we can use the snapshot later for the installation of the other VMs also and next is the Swift; Swift is full object storage. So, Swift helps in the storing data safely cheaply and efficiently so; obviously, it is also written on the slide also.

So, the next is the Neutron; Neutron is one of the most important part of the openstack because it is the because it is networking part of the system it provides the networking service of the softwares. So, through this we can access other components and through this we can access different-different instances and then neutron you can create your own networks you can modify your own networks and we can say it as a Neutron is providing like the network as a service.

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Components contd.

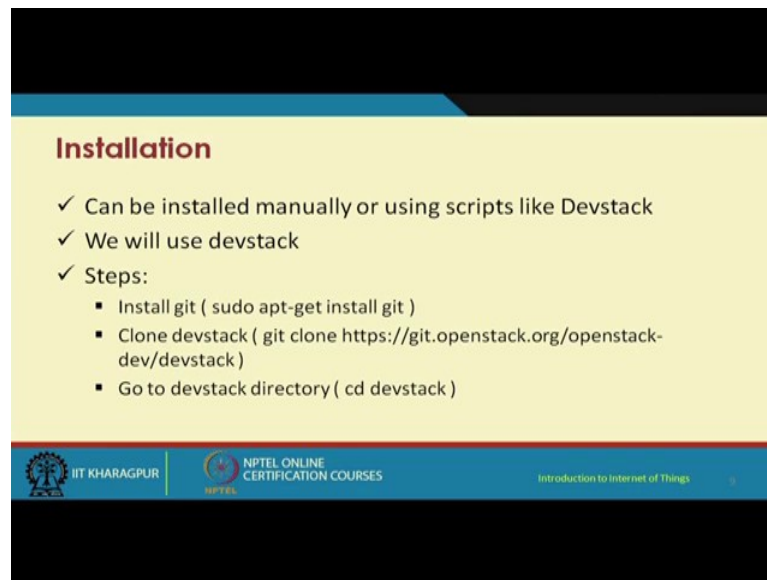
- ✓ Cinder
 - ✓ Block storage
 - ✓ Virtualizes the management of block service
- ✓ Heat
 - ✓ Orchestration
- ✓ Ceilometer
 - ✓ Billing
 - ✓ What service you are using
 - ✓ How long are you using

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So, next component is the cinder; cinder is also a storage, but it is the block storage like it is something like pluggable type of storage and then next is the Heat and the heat provide orchestration.

So, and the next is the ceilometers; ceilometer is the billing section like through the ceilometer one can monitor what resource is using and for how long the resources is using. So, billing is actually helpful in helpful for the cloud service providers like a we can monitor which user is using which resources and for how long he is using the resources and according to the time and the type of resources we can build them we can say how much resources that he is using how much costs for that.

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Installation

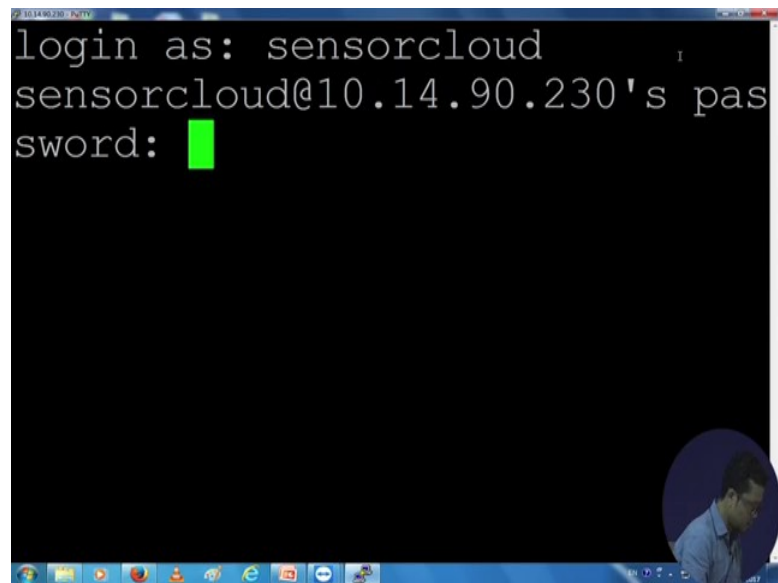
- ✓ Can be installed manually or using scripts like Devstack
- ✓ We will use devstack
- ✓ Steps:
 - Install git (`sudo apt-get install git`)
 - Clone devstack (`git clone https://git.openstack.org/openstack-dev/devstack`)
 - Go to devstack directory (`cd devstack`)

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So, next is; so let us get started the installation part. So, actually in the installation there are many steps like we can also install manually like we can make our own VMs and then install it again and it is quite difficult. So, there are script devstack through which we can easily install the install the cloud like all this openstack in this devstack the installation steps are already written in the form of the devstack file. So, we can directly run the file and everything will be run by the script itself.

So, while installing the file we may face some problems like a proxy problem then it can the solving those kind of problem is already find already available in the internet also. So, let us here also I am showing how to solve it using the devstack. So, devtacks script is found in a git.openstack.org a website. So, you can easily clone from there and you can a clone then and you can access it easily. So, in order to clone it we have to first install the git softwares.

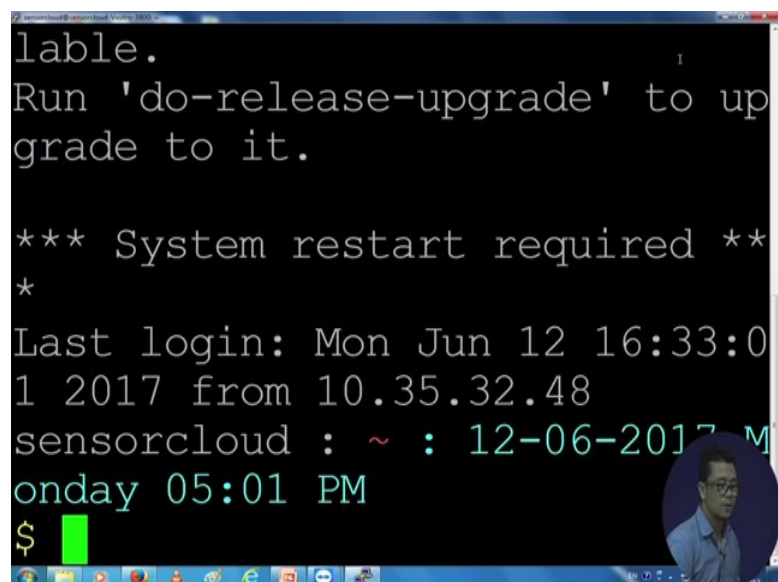
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A terminal window with a black background and white text. The text shows a login prompt 'login as: sensorcloud', followed by the user 'sensorcloud@10.14.90.230's' and a password prompt 'password:' with a redacted password. The window has a Windows taskbar at the bottom with various icons. A small circular inset in the bottom right corner shows a man speaking.

```
login as: sensorcloud
sensorcloud@10.14.90.230's pas
sword: 
```

So, in order to it just perform the steps that I have given there like installation part just go to the command and after that just clone it and after that go to the directory like this. So, let us go to the machine where the cloud is installed and see; what is it showing.

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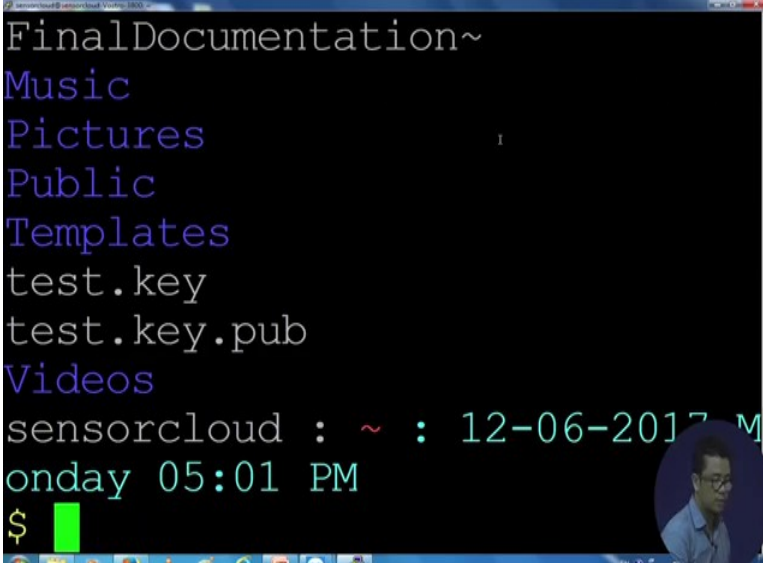
A terminal window with a black background and white text. The text shows the command 'do-release-upgrade' being run, followed by a message '*** System restart required ***'. Below this, it shows the last login time 'Mon Jun 12 16:33:01 2017 from 10.35.32.48' and the current date and time 'sensorcloud : ~ : 12-06-2017 Monday 05:01 PM'. The prompt '\$' is followed by a redacted character. The window has a Windows taskbar at the bottom with various icons. A small circular inset in the bottom right corner shows a man speaking.

```
lable.
Run 'do-release-upgrade' to up
grade to it.

*** System restart required ***
*
Last login: Mon Jun 12 16:33:0
1 2017 from 10.35.32.48
sensorcloud : ~ : 12-06-2017 M
onday 05:01 PM
$ 
```

So, let us go there. So, it is running here. So, actually this devstack folder is clone in the home directory.

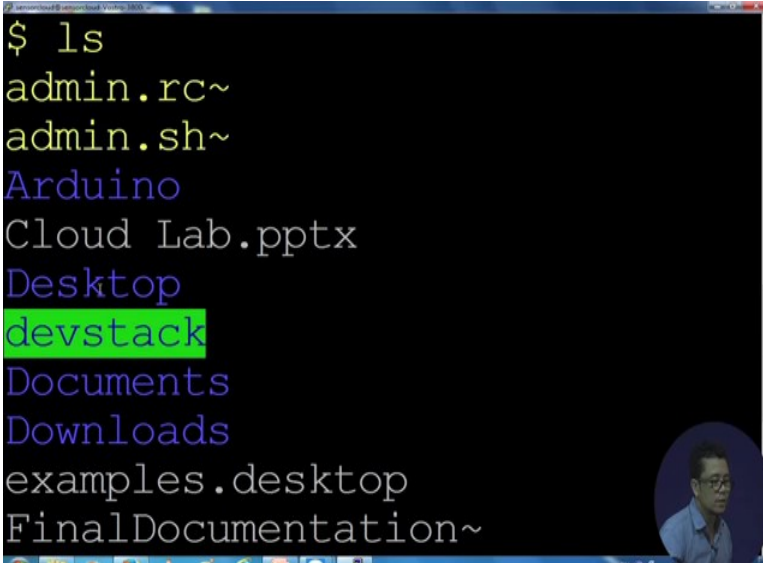
(Refer Slide Time: 09:06)

A terminal window with a black background and white text. The text lists several directories: FinalDocumentation~, Music, Pictures, Public, Templates, test.key, test.key.pub, and Videos. Below these, it shows the date and time: sensorcloud : ~ : 12-06-2017 Monday 05:01 PM. The prompt is a green dollar sign followed by a green cursor. A small circular inset in the bottom right corner shows a man's face.

```
FinalDocumentation~  
Music  
Pictures  
Public  
Templates  
test.key  
test.key.pub  
Videos  
sensorcloud : ~ : 12-06-2017 Monday 05:01 PM  
$
```

So, let us see what is in the home directory. So, we can see there is (Refer Time: 09:19).

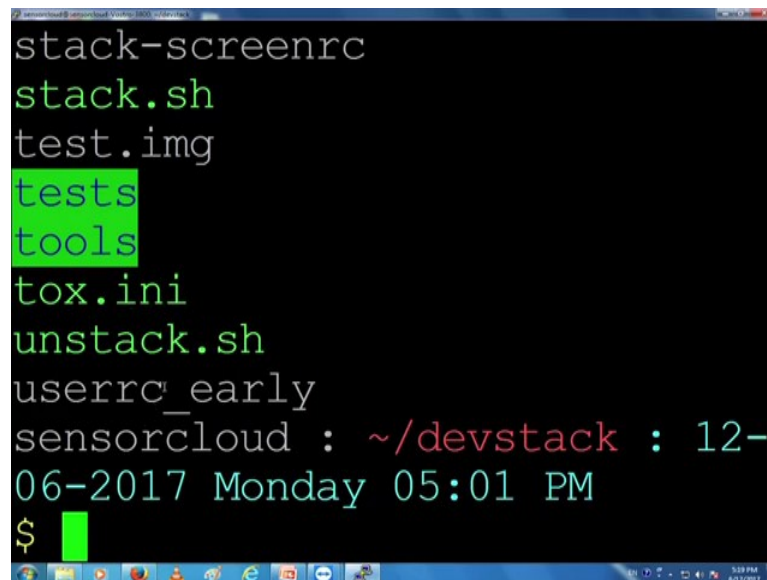
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A terminal window with a black background and white text. The text shows the output of the 'ls' command: admin.rc~, admin.sh~, Arduino, Cloud Lab.pptx, Desktop, devstack, Documents, Downloads, examples.desktop, and FinalDocumentation~. The 'devstack' entry is highlighted with a green background. The prompt is a green dollar sign. A small circular inset in the bottom right corner shows a man's face.

```
$ ls  
admin.rc~  
admin.sh~  
Arduino  
Cloud Lab.pptx  
Desktop  
devstack  
Documents  
Downloads  
examples.desktop  
FinalDocumentation~
```

Desk here devstack here So, we will go to this folder. So, inside it So, inside it there will be so many files.

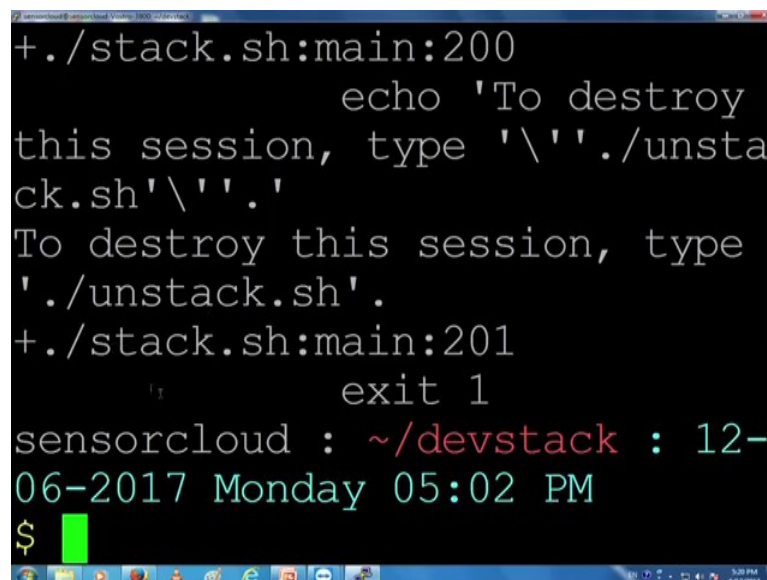
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A terminal window with a black background and green text. It lists the contents of a directory named 'stack'. The files listed are: stack-screenrc, stack.sh, test.img, tests, tools, tox.ini, unstack.sh, and userrc_early. Below the file list, the prompt 'sensorcloud : ~/devstack : 12-06-2017 Monday 05:01 PM' is shown, followed by a green cursor on a '\$' prompt.

```
stack-screenrc
stack.sh
test.img
tests
tools
tox.ini
unstack.sh
userrc_early
sensorcloud : ~/devstack : 12-
06-2017 Monday 05:01 PM
$
```

So, we just need to; we need to run this .stack.sh file. So, let us run it; right. So, it is saying that it is already installed already running there this stack.

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A terminal window with a black background and green text. It shows the execution of the script './stack.sh'. The script prints instructions on how to destroy the session using './unstack.sh'. It then prints the prompt 'sensorcloud : ~/devstack : 12-06-2017 Monday 05:02 PM' and a green cursor on a '\$' prompt.

```
+./stack.sh:main:200
        echo 'To destroy
this session, type '\''./unsta
ck.sh'\''.'
To destroy this session, type
'./unstack.sh'.
+./stack.sh:main:201
        exit 1
sensorcloud : ~/devstack : 12-
06-2017 Monday 05:02 PM
$
```

So, it means I have already the installed the cloud in my server; it means we I do not need to install it.

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```
ready running a stack.sh session.
n.'
You are already running a stack
k.sh session.
+./stack.sh:main:199
      echo 'To rejoin t
his session type '\''screen -x
stack'\''.'
To rejoin this session type 's
creen -x stack'.
+./stack.sh:main:200
```

So, for the installation part; just go to the step and you will be able to install it.


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Installation contd.

- Open local.conf file and paste the following and save the file


```
ADMIN_PASSWORD=<YOUR PASSWORD>
DATABASE_PASSWORD =<YOUR PASSWORD>
RABBIT_PASSWORD =<YOUR PASSWORD>
SERVICE_PASSWORD =<YOUR PASSWORD>
```

```
HOST_IP=<the IP of your PC>
```
- Run the stack.sh file (./stack.sh)
- For uninstallation, go to devstack directory and run unstack.sh file

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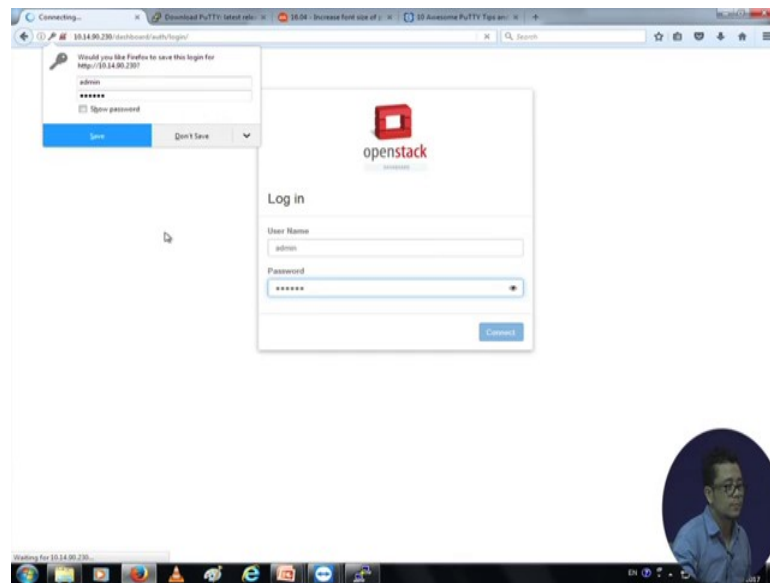
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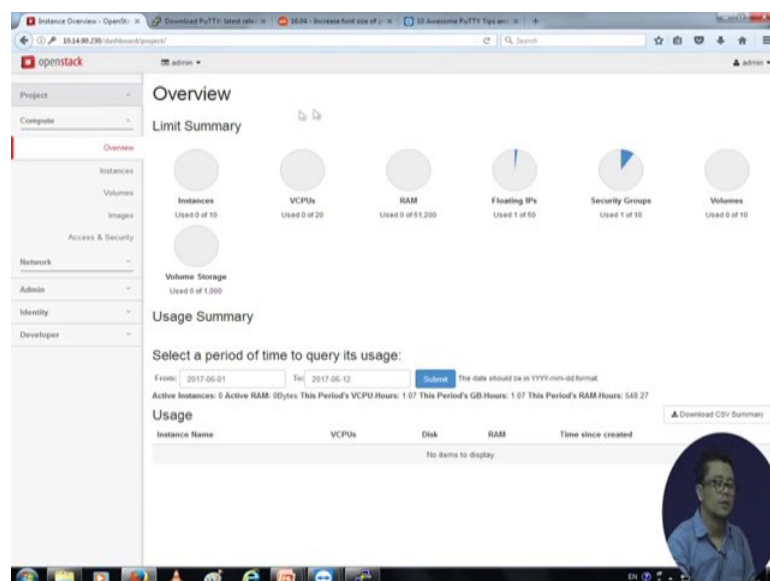
So, for the installation go to a there is some settings like a go to the local .config file and set this settings and run the .sh file stack.sh file for and for the un-installation just run the unstack.sh file.

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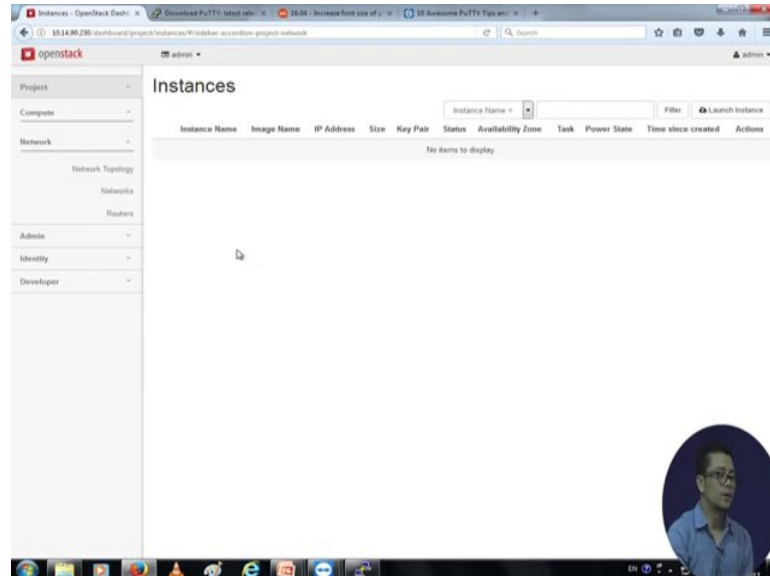
So, after that let us go to the actual cloud and see some working about how to lower the instance and how to delete it how to access the instance and all. So, let us go to the cloud go here I will be accessing as an admin this password is a password that you set during the installation part. So, you should remember the password and you should remember the username also only through the password and username you should be able to access this admin a section so successive.

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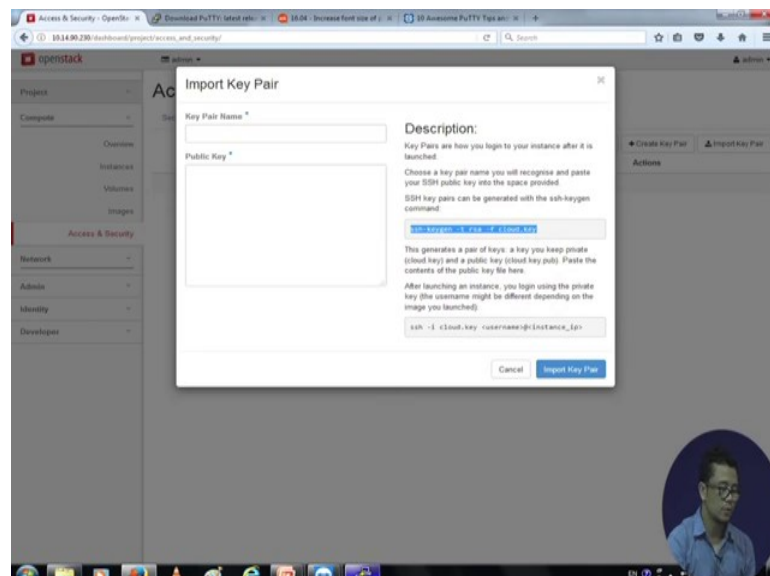
So, this is the horizon this is the horizon of the openstack means this is the GUI part of the section.

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So, through this GUI part we can access to different components like instance instances; obviously, the glance part like a network networking is; obviously, the neutron part. So, let us get started with the creation of the key keys user keys it will be required for the launching of the instance. So, first let us create the key pair. So, it should be starts with the; you just go click the input key pair and here is the command for crating a key pair.

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(Refer Slide Time: 12:20)

```
sensorcloud@sensorcloud-Virtual: 3800 ~$ echo 'To destroy
this session, type \'./unsta
ck.sh\'\'.'
To destroy this session, type
\'./unstack.sh\'.'
+./stack.sh:main:201
exit 1
sensorcloud : ~/devstack : 12-
06-2017 Monday 05:02 PM
$ ssh-keygen -t rsa -f clc
ey
```

So, just copy it and go there and yeah let us copy it and make some yeah, like this is the name of the key, you should remember this key in order to access your instance yeah, yeah test 2.

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```
sensorcloud@sensorcloud-Virtual: 3800 ~$ |
| O.OO=.
| O.+ . .
| . . S
|
|
|
|
+-----+
sensorcloud : ~/devstack : 12-
06-2017 Monday 05:05 PM
$ cat test2.key.pub
```

So, just double click it. So, key is already created. So, we want to access the key already the key should be created here after we create a key.

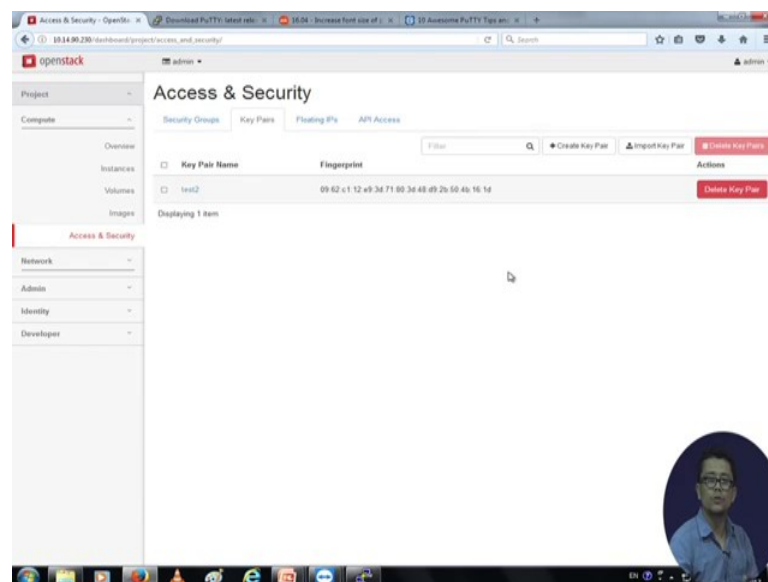
So, let us go create the key first let us access the key. So, this is the generated key actually this is the RSA generated key.

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```
sensorcloud@sensorcloud-Vostro-3800:~$ cat /dev/urandom | fold -n 64 | tr -dc 'a-z0-9' | fold -n 64 | paste -d / | tr -d '\n'
ZUcEKsxYTap/Tbt/9RSyvrlMnvjZdB
kjwt5nR8qKyivSA6SJFz5Un+15kmvBo
MO1i0Bki+BPfuhGhktCfm8GwA5ddyv
b4ikncGTRG7lhPnjKQYQG/7BI2t4+Z
P26VyDEEnUSC3paJt4H0YIHvDSBuSD
+WPKW23FX+v0pvjlzRt/dAxN2FdbNK
PDuN9E15okGG56X0pAkD sensorclo
ud@sensorcloud-Vostro-3800
sensorcloud : ~/devstack : 12-
06-2017 Monday 05:06 PM
$
```

So, copy it copy the key and go there gives some name this will be the name of your key pair. So, let us give it test2 and place your the generated RSA key here. So, after that import the key.

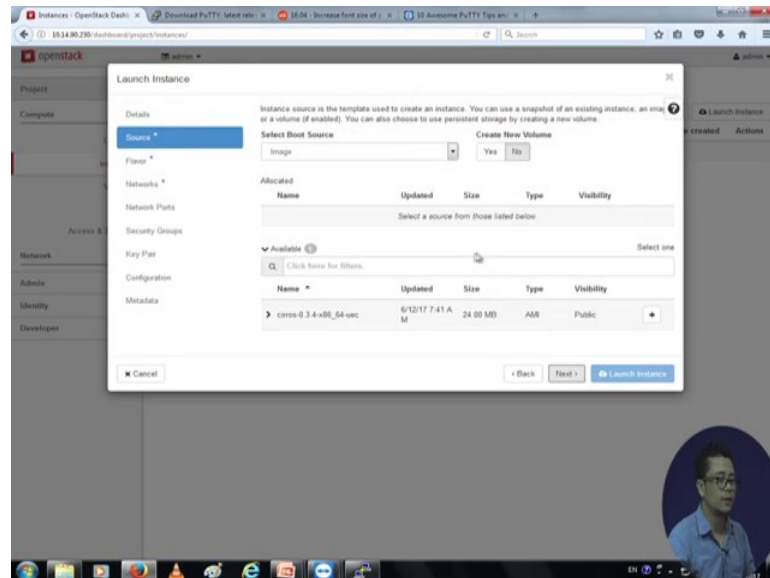
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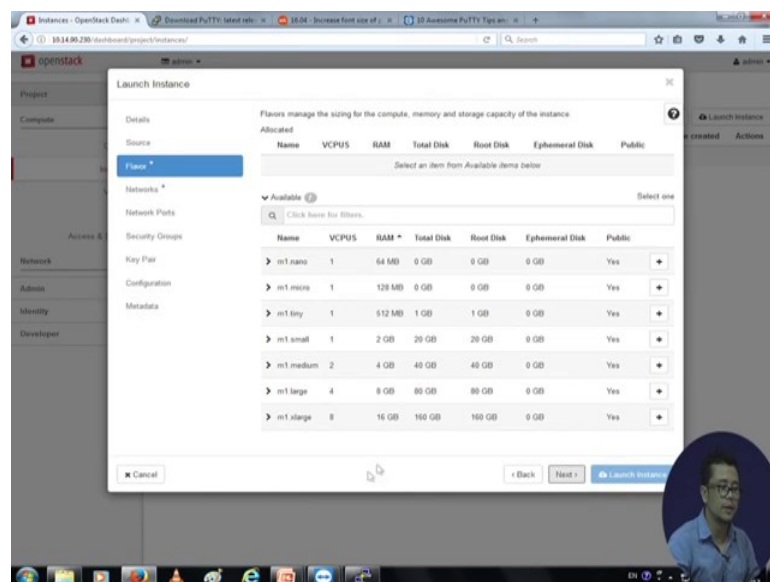
So, we can see that the key is already generated. So, through this key; this actually; this key is generated using your keystone; like this is the authentication part in authorizing part. So, this key is doing the authentication and authorization part of the cloud. So, let us go to instance and let us launch an instance. So, let us give the name of the instance

like test2. So, this is the name of the instance you should give the name of the instance anything you like and after that go to next and select image this is the Cirros image this is the only image I have right now next time in others in the sometime.

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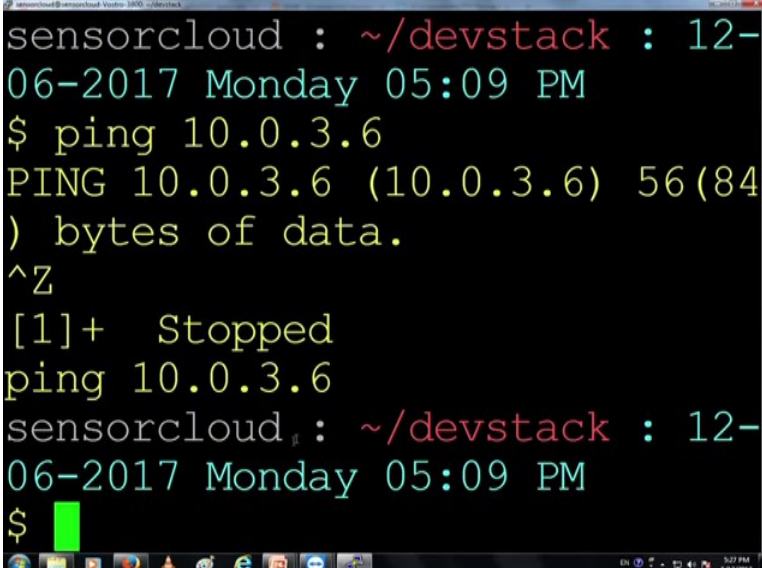
We will be discussing about the how to create the image and all. So, let us let us launch this instance first. So, you if it added then go to next and you just select one of name.

So, you should be some you should select it carefully. So, so you will not be able you. So, that you your instinctively happens you will run smoothly as well as it will not

consume the name of your server also. So, for this Cirros; this I will select this tiny and after that next and what is network this is already I have created this network already. So, let us select this one and go to the network port and this security pair security group its already default and after that security pair. So, this is the security key that we have generated just now.

So, now, we can launch the instance. So, let us see it is scheduling it is installing it will take some time it is active now it is already launched. So, let us say if we can access this let us see if we can access this instance the instance is here. So, let us say if we can ping this instance the IP of the instance is this 10.3.36 3.6.

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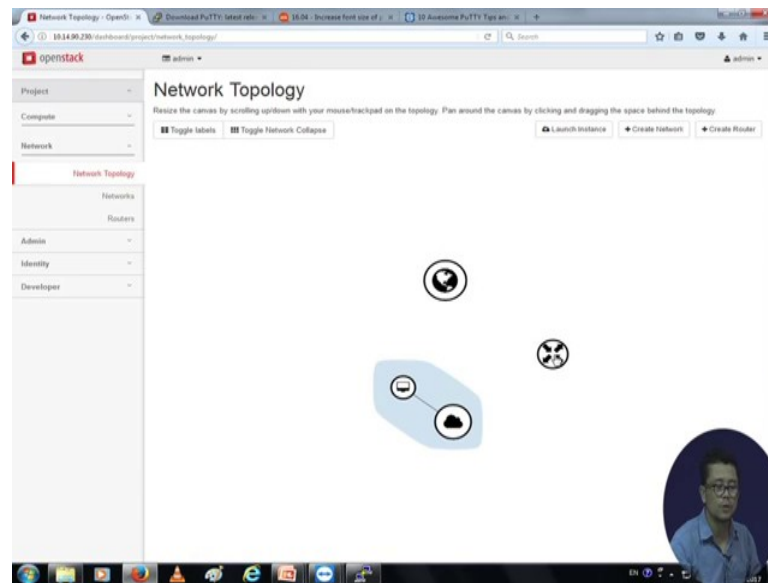
A terminal window screenshot with a black background and white text. The prompt is 'sensorcloud : ~/devstack : 12-06-2017 Monday 05:09 PM'. The user enters '\$ ping 10.0.3.6'. The output is 'PING 10.0.3.6 (10.0.3.6) 56(84) bytes of data.' followed by '^Z' and '[1]+ Stopped ping 10.0.3.6'. The prompt repeats. A green cursor is visible at the end of the second prompt line.

```
sensorcloud : ~/devstack : 12-06-2017 Monday 05:09 PM
$ ping 10.0.3.6
PING 10.0.3.6 (10.0.3.6) 56(84) bytes of data.
^Z
[1]+  Stopped
ping 10.0.3.6
sensorcloud : ~/devstack : 12-06-2017 Monday 05:09 PM
$
```

So, let us see if we can ping. So, I think it will not be able to ping I will explain you later. So, let us exit it and let us set some rules and all.

So, first we have not connect this instance to any external IP. So, if we do not connect it to external IP then we will not be able to access the other outside environment you will not be able to access it. So, let us create let us see.

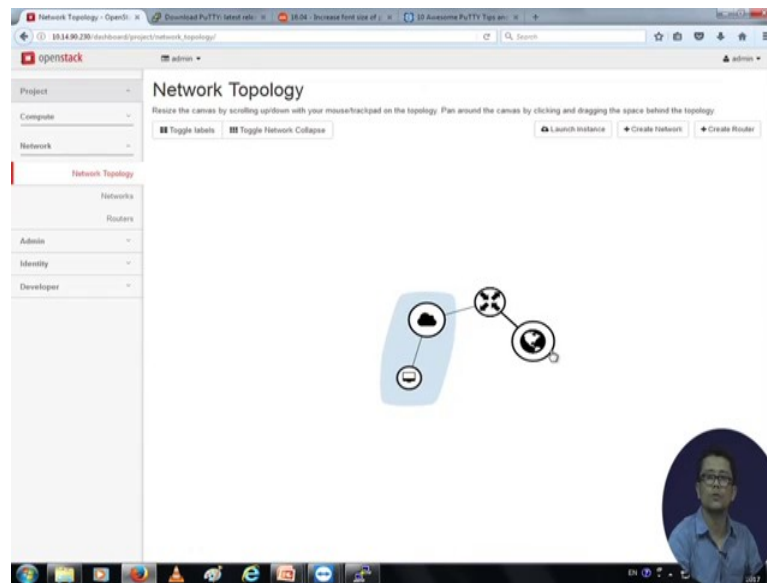
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The network topology first, so, we can see that this is our instance. So, test2 is a instance and this is our this is our network. So, and this is the public. So, until we connect this instance to the public we the outside environment or the inner environment when we inter communicate with each other.

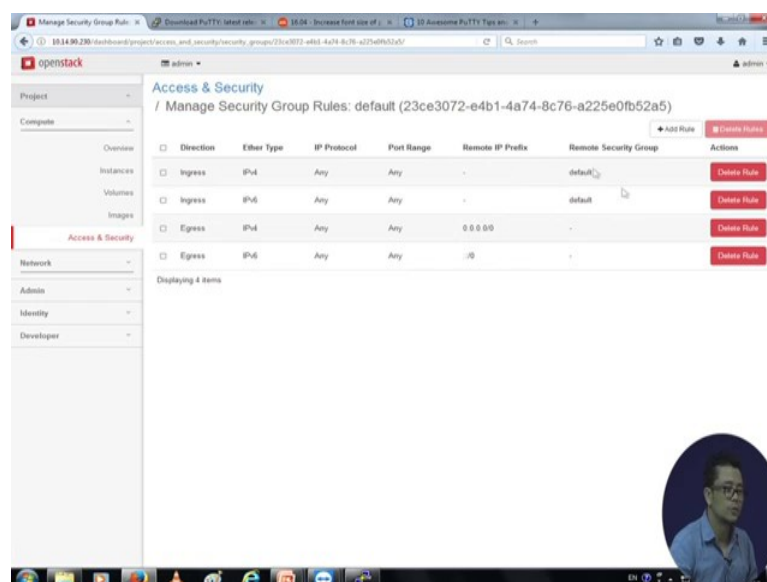
So, what we need to do is first we need to create a router. So, let us create a router create a router let us give some name like router one router one. So, it is created router and we can see that from network topology the router is already created it is created here. So, all we need to do is connect this public offset public port to the router and then connect this router to this network. So, let us do it. So, go to the router and to go to the interface and at interface select your network this is dc; this is a network. So, submitted and your network is connected to the router. So, right now what we need to do is connect the outside world to the router let us do it already done. So, let us see the network topology.

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So, we can see that the router is connected to the inner world and the outer world. Now this outer world should be able to ping to the inner world or should be able to connect with the inner world. So, let us check if it is connecting or not again it is not again it is not connecting also. So, why it is it? So, let us check it because we have not set any security rule.

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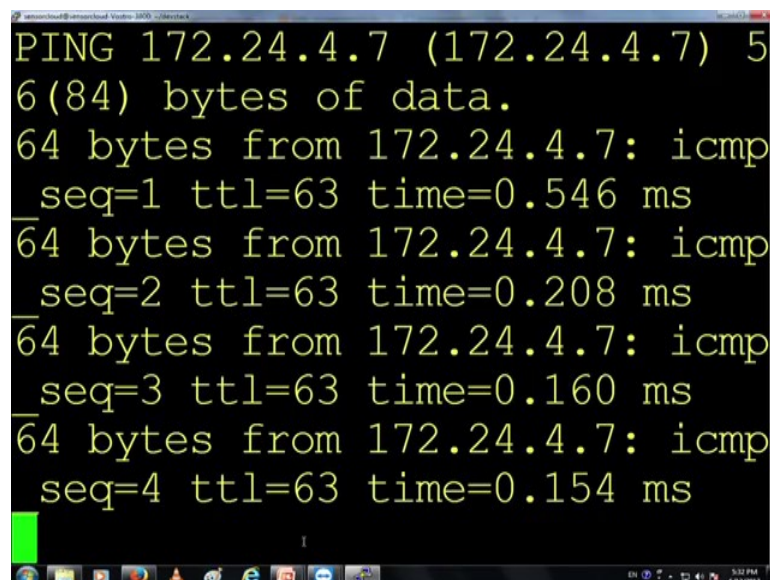


So, let us do it. So, for setting up the security rule go to the access and security and go to the security group and minus the rule. So, so we can see that there is an any role that is

related to ping for ping the rules would be ICMP right. So, let us add the rule from here select the ICMP and edit. So, or our rule is added. So, we can we let us see it whether it is accessible from the outside world again it is not. So, why because we have not set any floating IP; that means, our instance is not connected to the to the outside world unless you know we have to set the floating IP. So, let us edit go to instance go there associate floating IP and let generate one; a new one, it is generated and associated.

So, we can see that there is another IP this is the floating IP of your instance. So, through this floating IP outside world should be able to access this instance. So, let us see it if is actually accessible or not let us copy the floating IP. So, let us ping it right.

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A terminal window screenshot showing the output of a ping command. The text is as follows:

```
PING 172.24.4.7 (172.24.4.7) 56(84) bytes of data:
64 bytes from 172.24.4.7: icmp_seq=1 ttl=63 time=0.546 ms
64 bytes from 172.24.4.7: icmp_seq=2 ttl=63 time=0.208 ms
64 bytes from 172.24.4.7: icmp_seq=3 ttl=63 time=0.160 ms
64 bytes from 172.24.4.7: icmp_seq=4 ttl=63 time=0.154 ms
```

The terminal window has a title bar that reads "ssh -l ubuntu@10.0.0.100 -X -Y". The desktop environment at the bottom shows various application icons and a system clock indicating 3:32 PM on 8/13/2017.

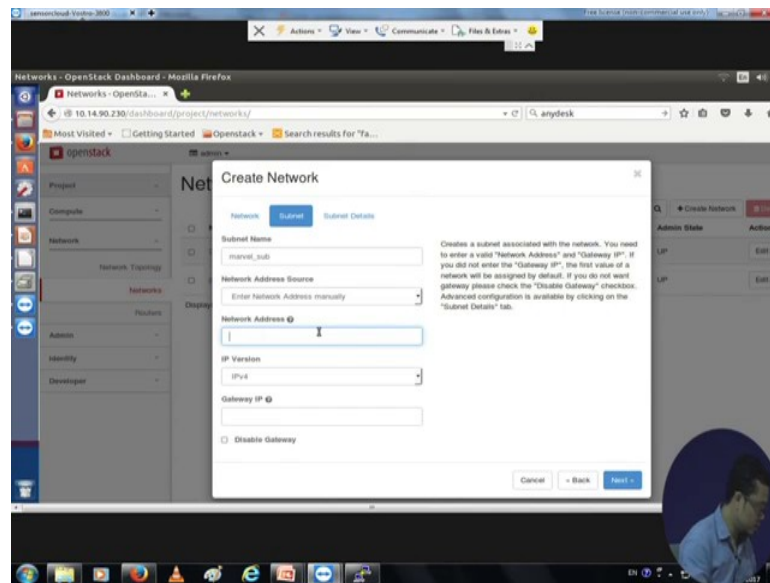
So, we can see that we can able to ping it, it means we are able to access these instance from the outside world it is a good thing. So, let us go here and this is accessible and we can check if it is let us set another rule let us add another rule like let us see if it is . So, we are not able to ssh the instance. So, for this we also need to get another rule. So, let us add it from here select the ssh rule and edit. So, we should be able to access it changed ok resolved it copy.

Now we can access the; so, yes, so, right. Now password what the key is. So, here we are able to access this from the outside world also we are able to access it from the outside world also. So, this is how we generated and how we create the instance. So, right now let us go to the neutron part let us go a bit deeper to the neutron part. So, let us delay

these instance for a time being. So, that it will not consume much name of the hosting server right let us launch dc let us launch2 instance flavor tiny see if you remove this we do not need it now.

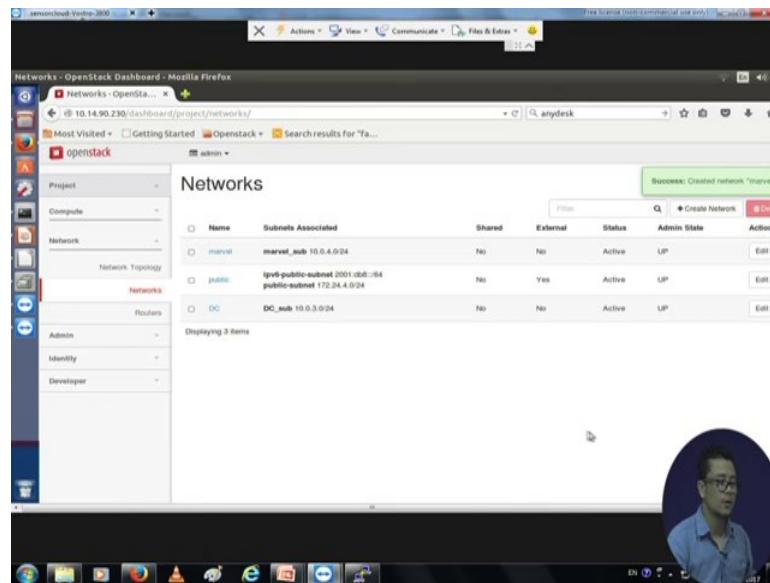
So, this launches instance and let us create another network. So, I will show you how to create a network here. So, for creating a network just click the create network and after that give a name like marvels yeah marvels and go to next.

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Yeah you should click this create sub net part and go to next and give a sub net name like marvel_sub and after that you should give a network address ten dot zero dot like four dot zero slash ten for you should give the this subnet in the form of cidr notation. So, let us go next and you should click this DHCP and after that create it should be created hence in a while it is gone a take a while.

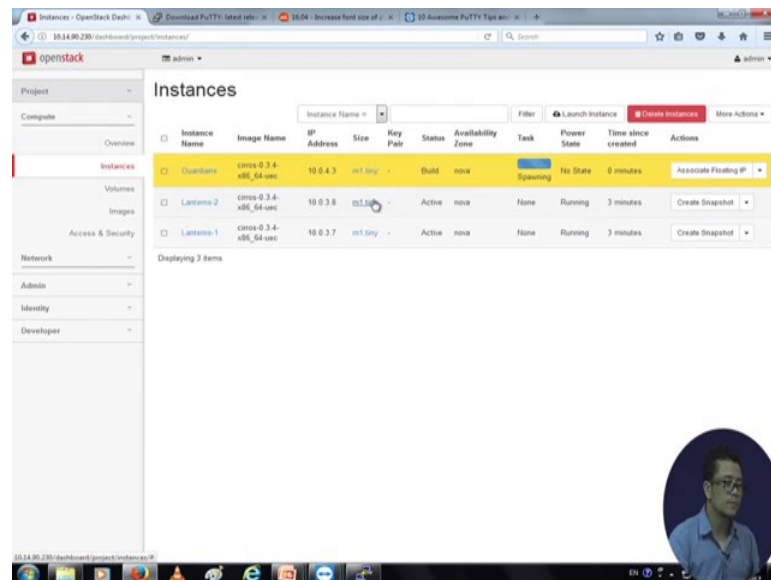
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So, we have a marvel and we have the dc. So, let us connect this network. So, let us connect the instances that are created inside this marvel part and the dc part. So, let us create another instances it is taking a bit longer than expected let us access this from here. So, so instance let us refresh it, it should not take this long its taking here also same here its coming. So, we have generated 2 instances one is the lantern one and then another is a lantern2.

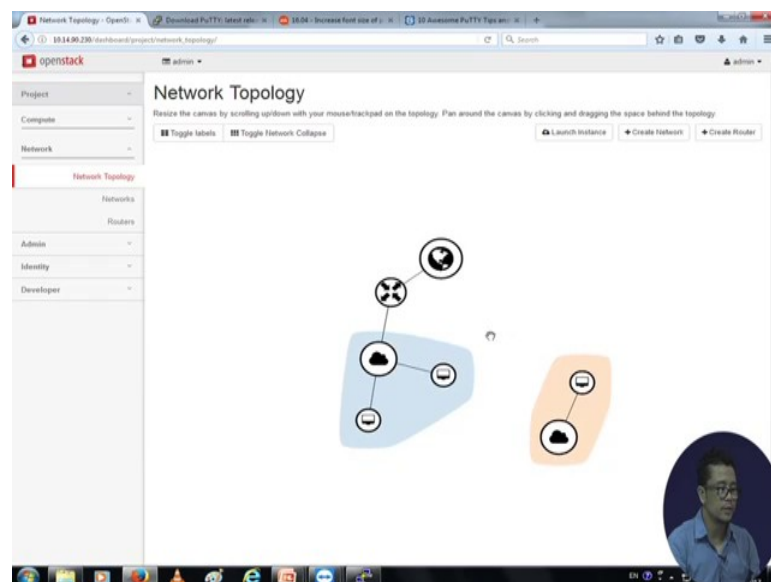
So, let us launch another 2 instances let us call it guardians. So, let us select the same and let us go to the next and select the; your flavors selected next and select the marvel next, next, next. So, we do not need this key right now. So, just launch it is gone a take a while.

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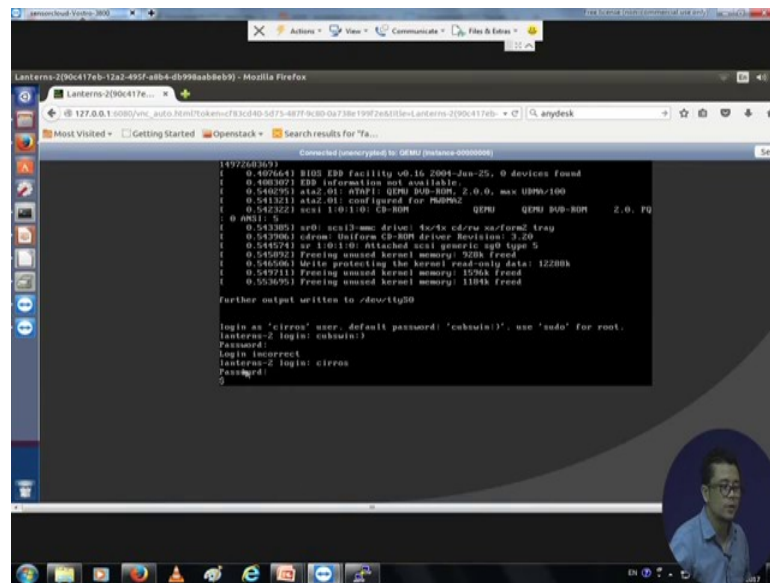
So, Yeah this is guardians and this instances under your marvel network and this lanterns is under the dc network. So, it is creating. So, let us wait for a while ok it is created. So, let us go to the network topology and check it if a check the network topology here.

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So, it is loading let us wait for a while Yeah, we can see that this is your lanterns and this is your marvels these are not connected so; that means, we will not be able to access this pc this guardians from this lanterns because they are not connected.

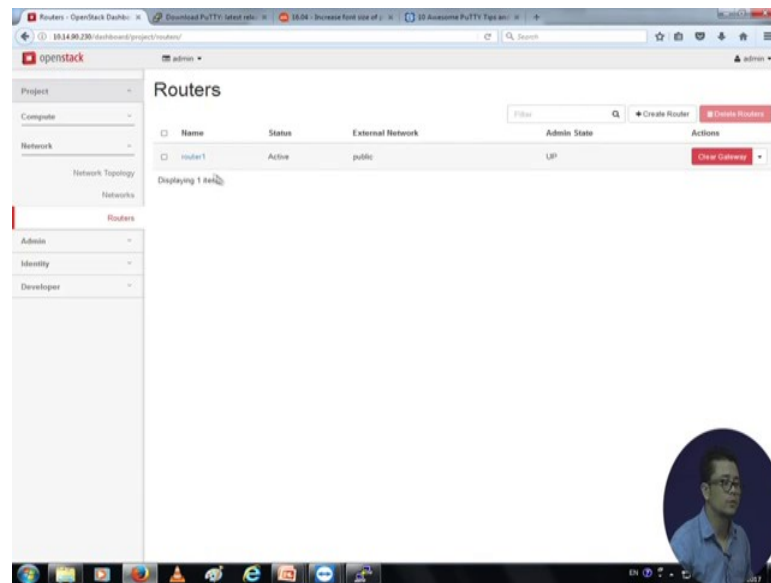
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So, let us check if it is you know accessible or not let us go from here and let us go to the lantern like go to the console go to the console here for the cirros this is the password just. So, it is sorry login as cirros and password is a cup swin. So, we are under this cirros. So, it is the lantern two. So, let us check if it is you know we can access the guardians from the lantern.

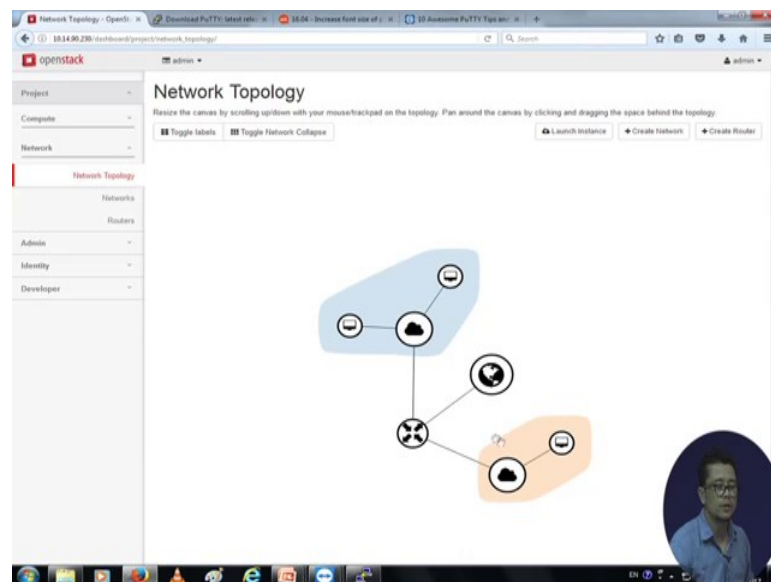
Let us check the guardians what is the IP of the guardians let us check it. So, IP of the guardian is this. So, let us copy it and let us check if it is accessible or not let us go here and ping 10.0.4.3. So, it is not accessible. So, we should set you know we should connect the 2 networks. So, let us do it let us do it. So, go to the network go to the router. So, router is already created.

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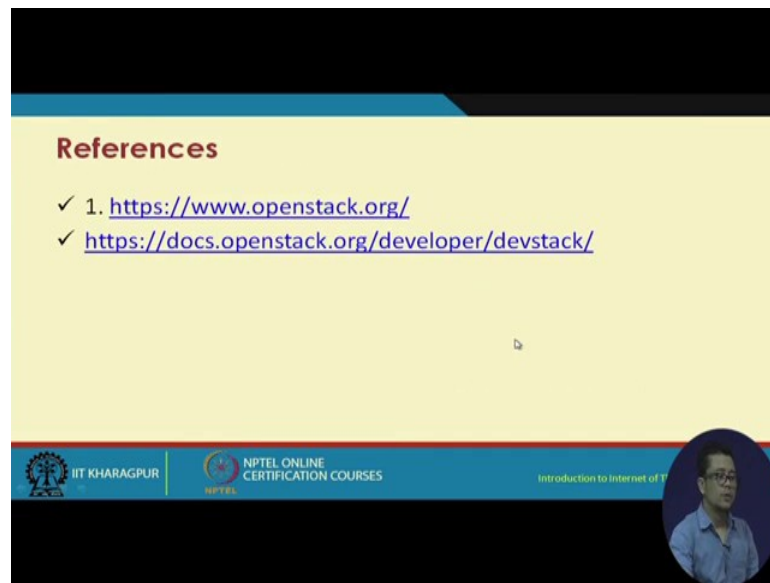
So, go to the router and add interface at the marvels here. So, here we can see that from a network topology.

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This 2 worlds are already connected. So, right now the 2 should be able to connect to each other. So, let us check if it is able to connect it or not so right.

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Now, we can see that the 2 networks are able to connect. So, this how you set your neutron is how you set up your network and this is all. So, let us end here this session. So, so these are the references.

Thank you.