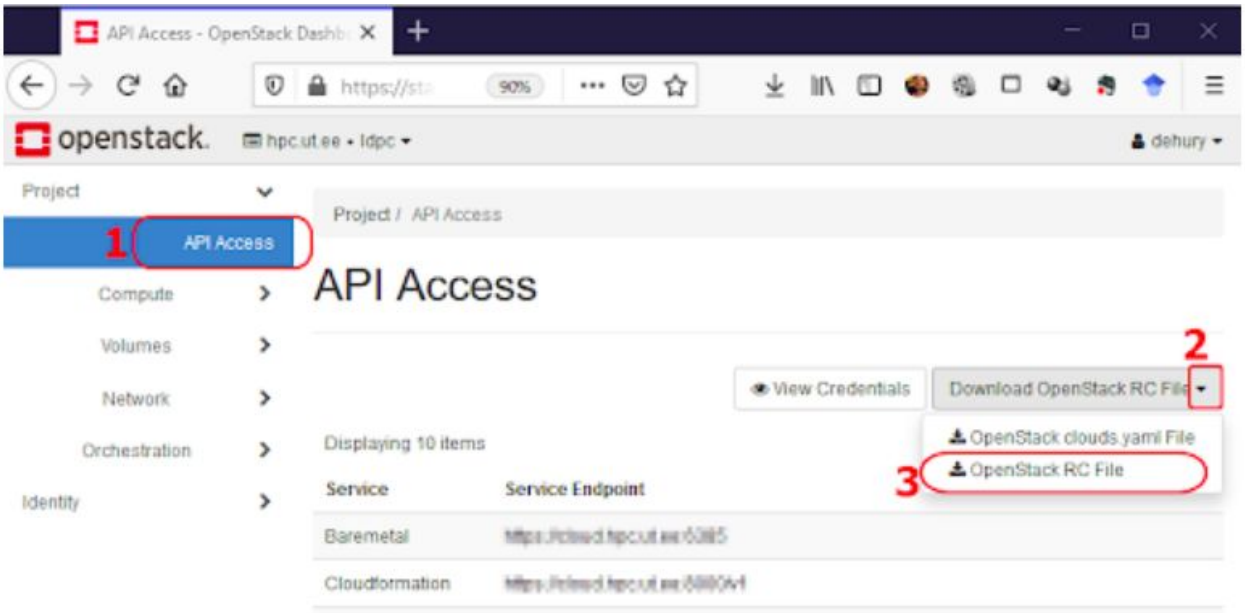
1. Create a Ubuntu VM in https://stack.cloud.hpc.ut.ee/ with size m1.xsmall
2. Installing xOpera orchestrator:
    - Connect to the vm and update the apt sudo apt update
    - Install the python virtual environment sudo apt install -y python3-venv python3-wheel python-wheel-common
    - Create a directory mkdir opera && cd opera, Download the opera wget https://github.com/xlab-si/xopera-opera/archive/0.5.1.tar.gz and untar it tar -xvf 0.5.1.tar.gz
    - Create a python virtual environment python3 -m venv .venv
    - activate it. .venv/bin/activate,Now you should see (.venv) $
    - Now change the dircd xopera-opera-0.5.1,
    - Install opera with required openstack libraries to use opera to connect openstack pip install -U opera[openstack] and sudo apt install python3-openstackclient
3. Download the OpenStack credentials. For this go to API *Access -> Download OpenStack RC file -> OpenStack RC file* (ldpc-openrc.sh).A sample screenshot is also given in the below figure



4. In linux terminal use the command to copy the file to vm: scp -i path-to-private-of-vm/yourkey-name.pem ldpc-openrc.sh username@your-ip:

5. Copy your open stack private key from your host machine to VM using gitbash in windows and in Ubuntu directly from the terminal. scp -i C:/Users/xxx/Desktop/xxx.pem C:/Users/xxx/Desktop/xxx.pem ubuntu@your-ip:
6. Add your ssh key to the SSH agent. First activate SSH agent service: eval `ssh-agent` then add the key ssh-add PATH_TO_YOUR_SSH_KEY.
7. Now run source ldpc-openrc.sh and it will ask for a password, please provide your openstack login password and test it using nova list to list all vms from openstack.
8. git clone https://github.com/Afsana2910/webApp-loadbalancer-node_exporter-TOSCA
9. Now move to project cd webApp-loadbalancer-node_exporter-TOSCA. Do ls -l, Now you should see the service template service.yaml.
10. Now to modify the following in nano service.yaml . Change the key_name and name in the load balancer and three vm.

```
topology_template:
  node_templates:
    vm_loadBalancer:
      type: my.nodes.VM.OpenStack
      properties:
        name: nginxRadon_loadBalancer
        image: centos7
        flavor: m1.xsmall
        network: provider_64_net
        key_name: key_khan


    vm1:
      type: my.nodes.VM.OpenStack
      properties:
        name: nginxRadon_Host1
        image: centos7
        flavor: m1.xsmall
        network: provider_64_net
        key_name: key_khan

    node1:
      type: my.nodes.NodeExporter
      requirements:
        - host: vm1


    vm2:
      type: my.nodes.VM.OpenStack
      properties:
        name: nginxRadon_Host2
        image: centos7
        flavor: m1.xsmall
        network: provider_64_net
        key_name: key_khan

    node2:
      type: my.nodes.NodeExporter
      requirements:
        - host: vm2


    vm3:
      type: my.nodes.VM.OpenStack
      properties:
        name: nginxRadon_Host3
        image: centos7
        flavor: m1.xsmall
        network: provider_64_net
        key_name: key_khan
```

11. Run the command opera deploy service.yaml to deploy the service file
12. Run the command opera undeploy to undeploy.

Monitoring by Prometheus and Node Exporter Locally

1. Install Prometheus and Node Exporter from Link1, Link2
2. Create a folder and put the vm instance key and openstack api access key in that folder.
3. Copy the parser.py script in the same folder
4. Run the following commands inside the folder

```
eval `ssh-agent`

ssh-add YOUR_KEY

source ldpc-openrc.sh

nova list --status ACTIVE | grep -v '\-\-\-\-' | sed 's/^[^|]\+|//g' | sed 's/|\(.\)/,\1/g' | tr '|' '\n' > servers.txt

python parser.py

sudo cp prometheus.yml /etc/prometheus/prometheus.yml

sudo systemctl start prometheus

sudo systemctl restart prometheus
```