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Cryptography and Cloud Security

Assignment4

The following steps are the procedures used to accomplish the networking lab:

Setup and Requirement

Setup project

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud config set project assignment1-230117
Updated property [core/project].
```

Setup Zone

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud config set compute/zone us-central1-f
Updated property [compute/zone].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Setup the environment

Creating a Network named nw102

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute networks create nw102 --subnet-mo
de=custom
API [compute.googleapis.com] not enabled on project [864761210753].
Would you like to enable and retry (this will take a few minutes)?
(y/N)?  y

Enabling service [compute.googleapis.com] on project [864761210753]...
Waiting for async operation operations/acf.61678ba5-4568-45f6-884c-9ed8f97a2054 to complete...
```

Operation is completed

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute networks create nw102 --subnet-mode=custom
API [compute.googleapis.com] not enabled on project [864761210753].
Would you like to enable and retry (this will take a few minutes)?
(y/N)?  y

Enabling service [compute.googleapis.com] on project [864761210753]...
Waiting for async operation operations/acf.61678ba5-4568-45f6-884c-9ed8f97a2054 to complete...
Operation finished successfully. The following command can describe the Operation details:
 gcloud services operations describe operations/tmo-acf.61678ba5-4568-45f6-884c-9ed8f97a2054
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/networks/nw102].
NAME    SUBNET_MODE  BGP_ROUTING_MODE  IPV4_RANGE  GATEWAY_IPV4
nw102   CUSTOM       REGIONAL

Instances on this network will not be reachable until firewall rules
are created. As an example, you can allow all internal traffic between
instances as well as SSH, RDP, and ICMP by running:

$ gcloud compute firewall-rules create <FIREWALL_NAME> --network nw102 --allow tcp,udp,icmp --source-ranges <IP_RANGE>
$ gcloud compute firewall-rules create <FIREWALL_NAME> --network nw102 --allow tcp:22,tcp:3389,icmp
```

Creating a network range

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute networks subnets create nw102-us --network nw102 --range 192.168.10.0/24 --region us-central1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/us-central1/subnetworks/nw102-us].
NAME      REGION       NETWORK  RANGE
nw102-us  us-central1  nw102    192.168.10.0/24
```

Option to subnetwork in other region

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute networks subnets create nw102-eu
--network nw102 --range 192.168.20.0/24

For the following subnetwork:
 - [nw102-eu]
choose a region:
 [1] asia-east1
 [2] asia-east2
 [3] asia-northeast1
 [4] asia-south1
 [5] asia-southeast1
 [6] australia-southeast1
 [7] europe-north1
 [8] europe-west1
 [9] europe-west2
 [10] europe-west3
 [11] europe-west4
 [12] northamerica-northeast1
 [13] southamerica-east1
 [14] us-central1
 [15] us-east1
 [16] us-east4
 [17] us-west1
 [18] us-west2
Please enter your numeric choice:  Please enter a value between 1 and 18:
```

Operation succeeded

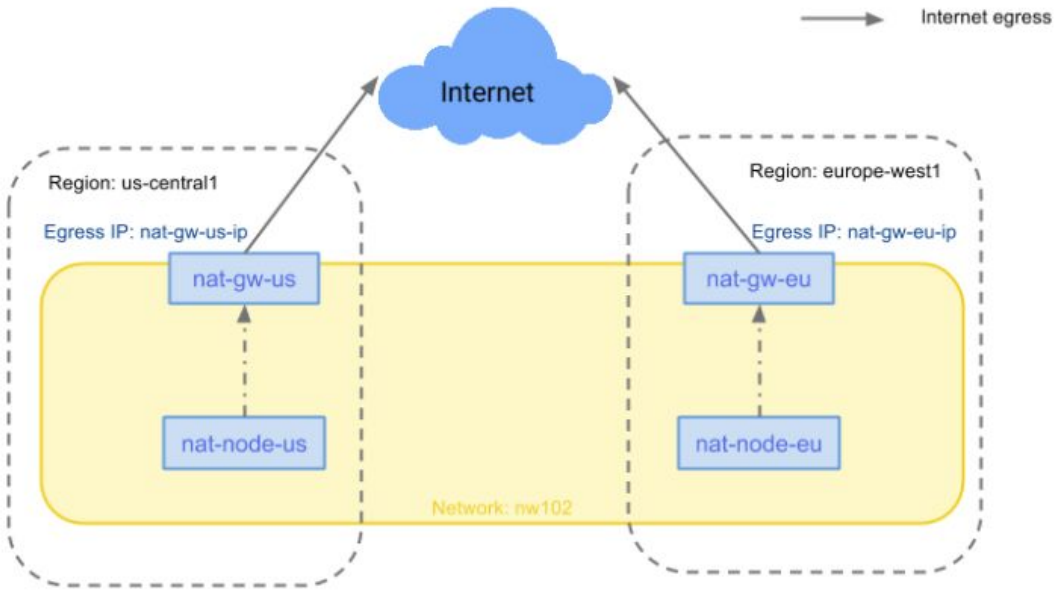
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute networks subnets create nw102-eu
--network nw102 --range 192.168.20.0/24

For the following subnetwork:
 - [nw102-eu]
choose a region:
 [1] asia-east1
 [2] asia-east2
 [3] asia-northeast1
 [4] asia-south1
 [5] asia-southeast1
 [6] australia-southeast1
 [7] europe-north1
 [8] europe-west1
 [9] europe-west2
 [10] europe-west3
 [11] europe-west4
 [12] northamerica-northeast1
 [13] southamerica-east1
 [14] us-central1
 [15] us-east1
 [16] us-east4
 [17] us-west1
 [18] us-west2
```

Creating firewalls rules:

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules  create nw102-allow-internal --network nw102 --source-ranges 192.168.10.0/24,192.168.20.0/24 --allow tcp,udp,icmp
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/firewalls/nw102-allow-internal].
Creating firewall...done.
NAME                  NETWORK  DIRECTION  PRIORITY  ALLOW         DENY  DISABLED
nw102-allow-internal  nw102    INGRESS    1000      tcp,udp,icmp        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Creating a NAT gateway

NAT architecture in both regions



Create VMs in several regions

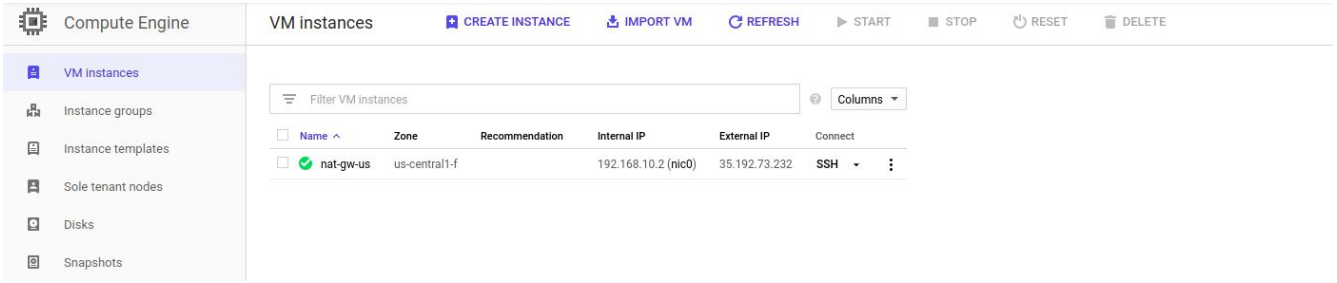
Create NAT gateways in U.S and EU

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute addresses create nat-gw-us-ip --r
egion us-central1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/us-central1
/addresses/nat-gw-us-ip].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

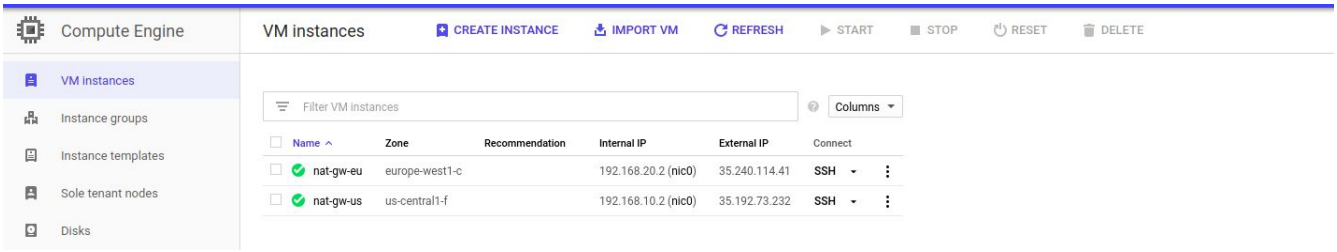
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute addresses create nat-gw-eu-ip --r
egion europe-west1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/europe-west
1/addresses/nat-gw-eu-ip].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Creating different virtual machines using different systems

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-gw-us --netw
ork nw102 --subnet nw102-us --address nat-gw-us-ip --can-ip-forward --zone us-central1-f --ima
ge-family debian-9  --image-project debian-cloud
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f
/instances/nat-gw-us].
^LNAME       ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP    STATUS
nat-gw-us  us-central1-f  n1-standard-1               192.168.10.2  35.192.73.232  RUNNING
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

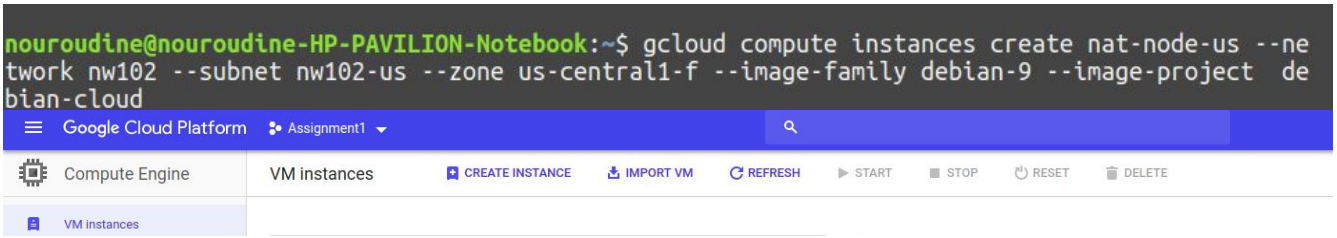



```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-gw-eu --network nw102 --subnet nw102-eu --address nat-gw-eu-ip --can-ip-forward --zone europe-west1-c --imag
e-family centos-7 --image-project centos-cloud
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-gw-eu].
NAME       ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP    STATUS
nat-gw-eu  europe-west1-c  n1-standard-1               192.168.20.2  35.240.114.41  RUNNING
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

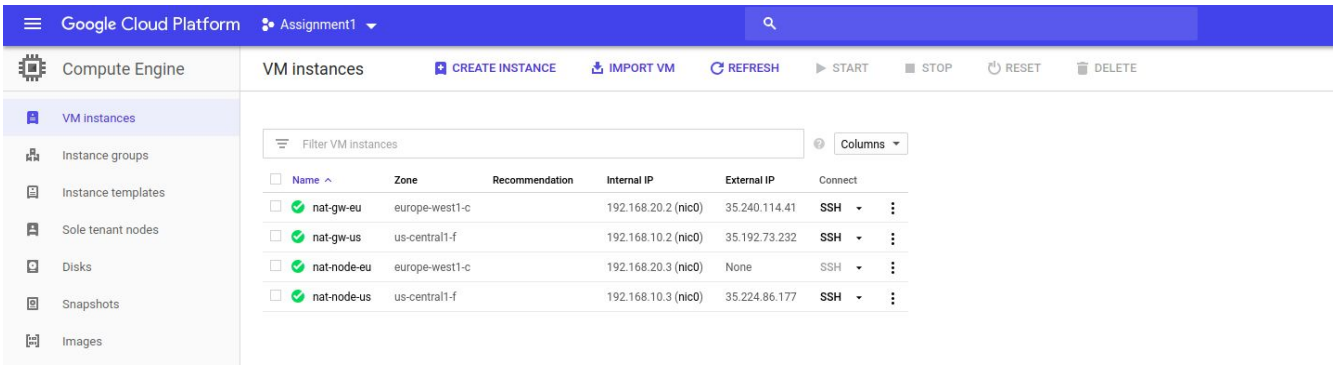


Instances without --can-ip-forward

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-node-us --ne
twork nw102 --subnet nw102-us --zone us-central1-f --image-family debian-9 --image-project  de
bian-cloud
```



```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-node-eu --network nw102 --subnet nw102-eu --zone europe-west1-c --image-family centos-7 --image-project cent
os-cloud --no-address
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-node-eu].
NAME         ZONE            MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP  STATUS
nat-node-eu  europe-west1-c  n1-standard-1               192.168.20.3                RUNNING
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```



Allowing connection by SSH

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow-ssh --network nw102 --source-ranges 0.0.0.0/0 --allow tcp:22
Creating firewall...⠶Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/firewalls/nw102-allow-ssh].
Creating firewall...done.
NAME           NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
nw102-allow-ssh  nw102    INGRESS    1000      tcp:22        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Series of SSH connections to instances

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-gw-us --zone us-central1-f
Updating project ssh metadata...⠧Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117].
Updating project ssh metadata...done.
Waiting for SSH key to propagate.
Warning: Permanently added 'compute.6878298777082202584' (ECDSA) to the list of known hosts.
Linux nat-gw-us 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh  nat-gw-eu --zone europe-west1-c
Warning: Permanently added 'compute.392086308224042779' (ECDSA) to the list of known hosts.
[nouroudine@nat-gw-eu ~]$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-node-us --zone us-central1-f
Warning: Permanently added 'compute.1211501300194049062' (ECDSA) to the list of known hosts.
Linux nat-node-us 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

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```

Deleting instance

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud  compute instances delete-access-config nat-node-us --zone  us-central1-f
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/nat-node-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

SSH failed after instance deletion

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-node-us --zone us-central
1-f
ERROR: (gcloud.compute.ssh) Instance [nat-node-us] in zone [us-central1-f] does not have an ex
ternal IP address, so you cannot SSH into it. To add an external IP address to the instance, u
se [gcloud compute instances add-access-config].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Set up NAT

Separates instances into two partitions

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-node-us --zone us-central1-f --tags nat-us
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/nat-node-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances  add-tags nat-node-eu --zone europe-west1-c --tags nat-eu
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-node-eu].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute routes create nw102-nat-us --netw
ork nw102 --tags nat-us --destination-range 0.0.0.0/0 --next-hop-instance nat-gw-us --next-hop
-instance-zone us-centra1-f --priority 800
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/routes/nw102
-nat-us].
WARNING: Some requests generated warnings:
 - Next hop instance 'https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/
us-centra1-f/instances/nat-gw-us' does not exist.

NAME          NETWORK  DEST_RANGE  NEXT_HOP                          PRIORITY
nw102-nat-us  nw102    0.0.0.0/0   us-centra1-f/instances/nat-gw-us  800
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute routes create nw102-nat-eu --netw
ork nw102 --tags nat-eu --destination-range 0.0.0.0/0 --next-hop-instance nat-gw-eu --next-hop
-instance-zone europe-west1-c --priority 800
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/routes/nw102
-nat-eu].
NAME          NETWORK  DEST_RANGE  NEXT_HOP                           PRIORITY
nw102-nat-eu  nw102    0.0.0.0/0   europe-west1-c/instances/nat-gw-eu  800
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Make sure traffic through NAT gateways gets forwarded and NATed to its owns IP

SSH in the machine in us-central1-f to do some configuration

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-gw-us --zone   us-central
1-f
Linux nat-gw-us 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

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permitted by applicable law.
Last login: Wed Jan 30 02:11:20 2019 from 47.34.9.131
nouroudine@nat-gw-us:~$
```

```
nouroudine@nat-gw-us:~$ echo 1 | sudo tee /proc/sys/net/ipv4/ip_forward
1
nouroudine@nat-gw-us:~$
```

```
nouroudine@nat-gw-us:~$ sudo iptables  -t nat -A POSTROUTING -o eth0 -j MASQUERADE
nouroudine@nat-gw-us:~$
```

SSH in the machine in europe-west1-c do achieve some configurations

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh  nat-gw-eu --zone europe-west
1-c
Last login: Wed Jan 30 02:13:40 2019 from 47.34.9.131
[nouroudine@nat-gw-eu ~]$
```

```
Last login: Wed Jan 30 02:13:40 2019 from 47.34.9.131
[nouroudine@nat-gw-eu ~]$ echo 1 |  sudo tee /proc/sys/net/ipv4/ip_forward
1
[nouroudine@nat-gw-eu ~]$
```

```
nouroudine@nat-gw-eu:~
[nouroudine@nat-gw-eu ~]$ sudo iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE
[nouroudine@nat-gw-eu ~]$
```

SSH NAted instances to verify NAT configuration

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-gw-us --zone us-central1-f
Linux nat-gw-us 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Wed Jan 30 03:40:01 2019 from 47.34.9.131
nouroudine@nat-gw-us:~$
```

SHH an instance from another instance using the NAT configuration

Permission denied at first tried

```
nouroudine@nat-gw-us:~$ ssh nat-node-us
The authenticity of host 'nat-node-us (192.168.10.6)' can't be established.
ECDSA key fingerprint is SHA256:QHu7hdIB51TOtuvLk/Y/R0wUS4ccMtnTmjzc9EBrjaY.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'nat-node-us,192.168.10.6' (ECDSA) to the list of known hosts.
Permission denied (publickey).
nouroudine@nat-gw-us:~$
```

Used the right configuration to have permission

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ ssh-add ~/.ssh/google_compute_engine
Enter passphrase for /home/nouroudine/.ssh/google_compute_engine:
Identity added: /home/nouroudine/.ssh/google_compute_engine (/home/nouroudine/.ssh/google_comp
ute_engine)
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Now the operation was successful

```
nouroudine@nat-gw-us:~$ ssh nat-node-us
Linux nat-node-us 4.9.0-8-amd64 #1 SMP Debian 4.9.130-2 (2018-10-27) x86_64

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
nouroudine@nat-node-us:~$
```

The Traceroute is not working because the packet is not installed. After installing the package on Centos-7 and debian-9, I was able to run the command on Google.com.

```
[nouroudine@nat-gw-eu ~]$ traceroute google.com
traceroute to google.com (66.102.1.100), 30 hops max, 60 byte packets
 1  * * *
 2  * * *
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  wb-in-f100.1e100.net (66.102.1.100)  0.726 ms  0.689 ms  0.796 ms
```

```
nouroudine@nat-gw-us:~$ traceroute google.com
traceroute to google.com (74.125.202.100), 30 hops max, 60 byte packets
 1  216.239.48.167 (216.239.48.167)  2.629 ms 216.239.49.123 (216.239.49.123)  2.829 ms 216.239.49.121 (216.239.49.121)  2.161 ms
 2  * * *
 3  * * *
 4  * * *
 5  * * *
 6  * * *
 7  * * *
 8  * * *
 9  * * *
10  * * *
11  io-in-f100.1e100.net (74.125.202.100)  0.906 ms  0.878 ms  0.888 ms
```

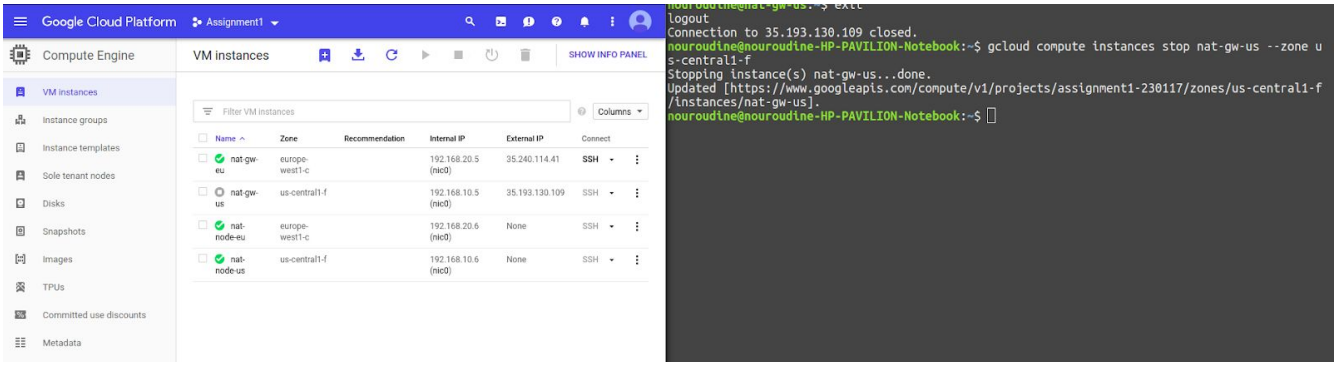
Let try the ping command by pinging another instance

```
nouroudine@nat-gw-us:~$ ping nat-node-w-us
PING nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7) 56(84) bytes of data.
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=1 ttl=64 time=0.285 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=2 ttl=64 time=0.364 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=3 ttl=64 time=0.389 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=4 ttl=64 time=0.244 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=5 ttl=64 time=0.273 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=6 ttl=64 time=0.290 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=7 ttl=64 time=0.312 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=8 ttl=64 time=0.349 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=9 ttl=64 time=0.301 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=10 ttl=64 time=0.288 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=11 ttl=64 time=0.267 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=12 ttl=64 time=0.271 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=13 ttl=64 time=0.250 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=14 ttl=64 time=0.240 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=15 ttl=64 time=0.259 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=16 ttl=64 time=0.392 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=17 ttl=64 time=0.275 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=18 ttl=64 time=0.238 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=19 ttl=64 time=0.276 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=20 ttl=64 time=0.236 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=21 ttl=64 time=0.254 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=22 ttl=64 time=0.249 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=23 ttl=64 time=0.239 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=24 ttl=64 time=0.211 ms
64 bytes from nat-node-w-us.us-central1-f.c.assignment1-230117.internal (192.168.10.7): icmp_seq=25 ttl=64 time=0.277 ms
```

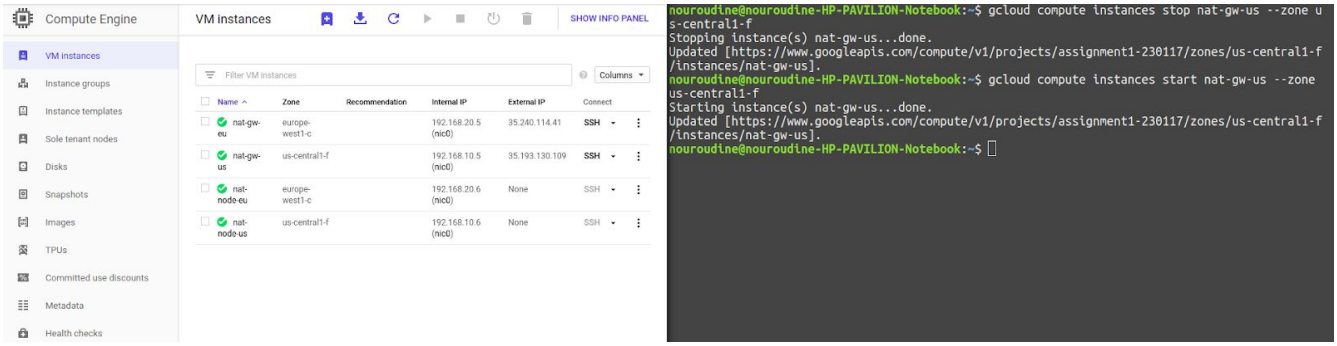
```
[nouroudine@nat-gw-eu ~]$ ping nat-node-w-edu
PING nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7) 56(84) bytes of data.
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=1 ttl=64 time=1.81 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=2 ttl=64 time=0.915 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=3 ttl=64 time=0.363 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=4 ttl=64 time=0.371 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=5 ttl=64 time=0.307 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=6 ttl=64 time=0.314 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=7 ttl=64 time=0.336 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=8 ttl=64 time=0.453 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=9 ttl=64 time=0.379 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=10 ttl=64 time=0.296 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=11 ttl=64 time=0.296 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=12 ttl=64 time=0.421 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=13 ttl=64 time=0.296 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=14 ttl=64 time=0.316 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=15 ttl=64 time=0.322 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=16 ttl=64 time=0.284 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=17 ttl=64 time=0.295 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=18 ttl=64 time=0.292 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=19 ttl=64 time=0.390 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=20 ttl=64 time=0.299 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=21 ttl=64 time=0.286 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=22 ttl=64 time=0.335 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=23 ttl=64 time=0.283 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=24 ttl=64 time=0.287 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=25 ttl=64 time=0.313 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=26 ttl=64 time=0.289 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=27 ttl=64 time=0.341 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=28 ttl=64 time=0.303 ms
64 bytes from nat-node-w-edu.europe-west1-c.c.assignment1-230117.internal (192.168.20.7): icmp_seq=29 ttl=64 time=0.292 ms
```

Restarting the NAT gateway

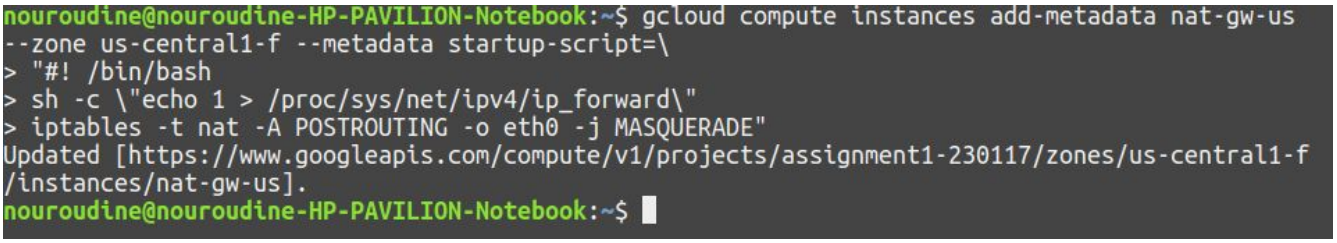
Stop the instance



Start the instance



Applying the startup scripts before restarting the NAT gateways



```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances stop nat-gw-us --zone u
s-central1-f
Stopping instance(s) nat-gw-us...done.
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f
/instances/nat-gw-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances start nat-gw-us --zone us-central1-f
Starting instance(s) nat-gw-us...done.
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/nat-gw-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-metadata nat-gw-eu --zone europe-west1-c --metadata  start-script=\
> "#! /bin/bash
> sh -c \"echo 1 > /proc/sys/net/ipv4/ip_forward\"
> iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE"
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-gw-eu].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances stop nat-gw-eu --zone   europe-west1-c
Stopping instance(s) nat-gw-eu...done.
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-gw-eu].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances start nat-gw-eu --zone europe-west1-c
Starting instance(s) nat-gw-eu...done.
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-gw-eu].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Optimal - Reduce NAT external exposure

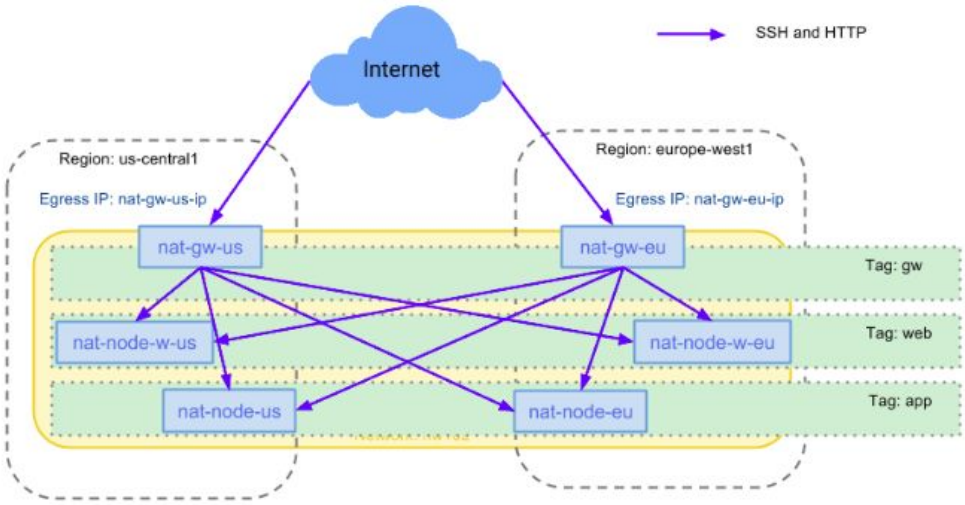
```
Deleted [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/firewalls/nw102-allow-ssh].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

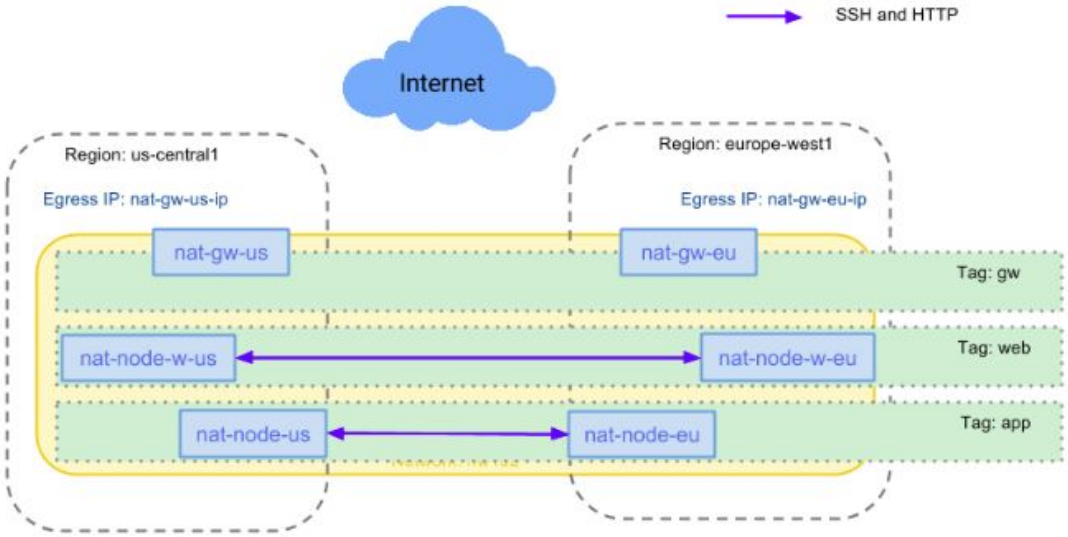
Restrict Current SSH to current machine (my machine)

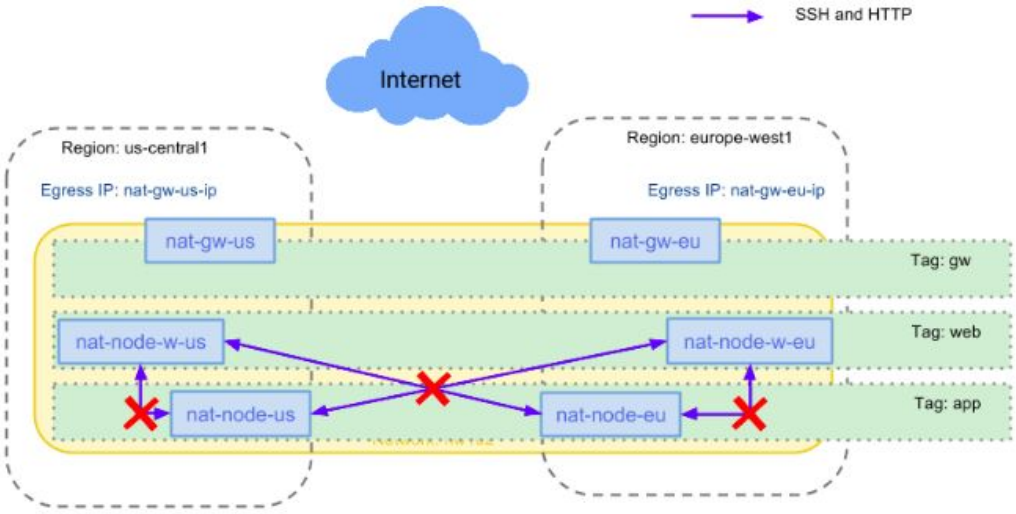
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-ssh --network nw102 --source-ranges  47.34.9.131 --allow tcp:22
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-ssh].
Creating firewall...done.
NAME            NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
nw102-allow-ssh  nw102    INGRESS    1000      tcp:22        False
```

Creating a Tiered Network

This shows the architectural relations between the web servers and applications servers. According the Networking 102 instruction the subnetworks can be used as a complement to segmenting. Logical routing and firewalls is done by tags and not subnetworks



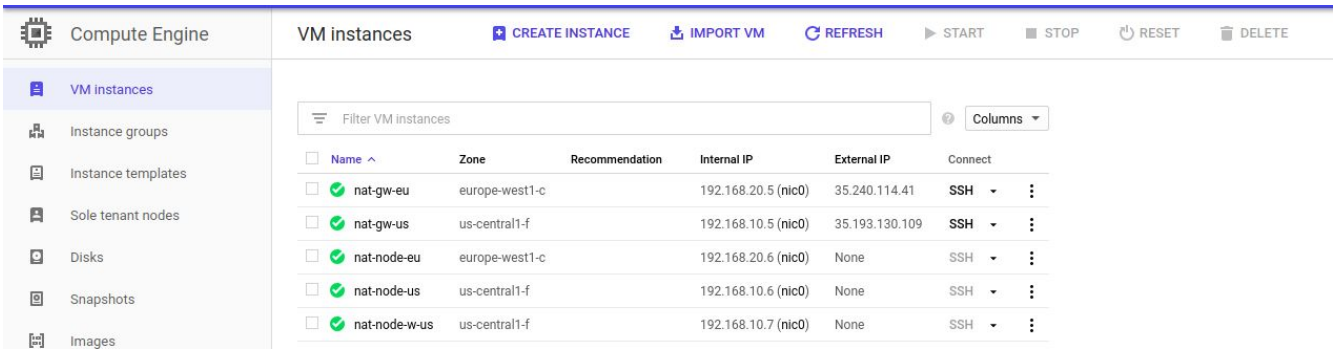




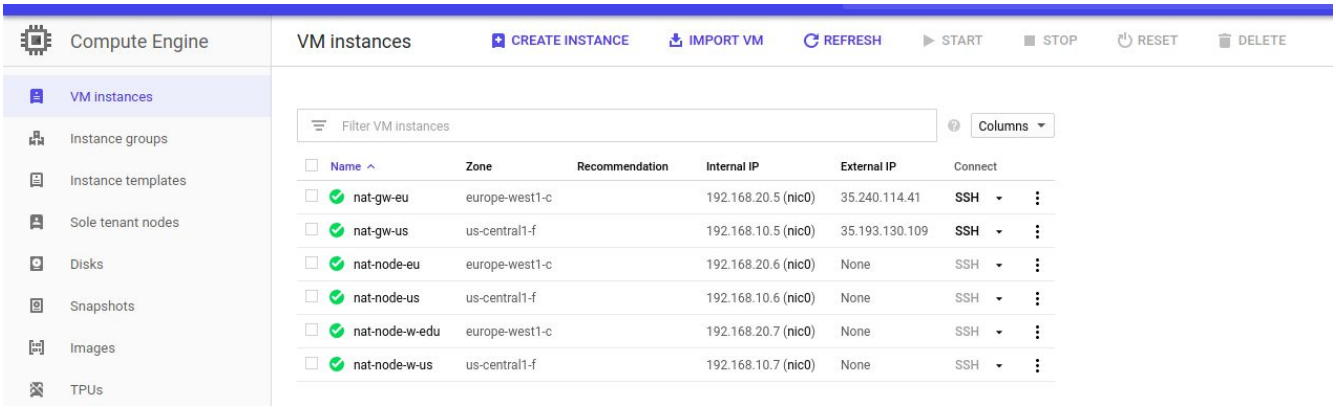
Creating web servers

the procedure will how to set up a web server in a virtual instance

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-node-w-us --network nw102 --subnet nw102-us --zone us-central1-f --image-family debian-9 --image-project deb
ian-cloud --no-address --tags nat-us
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/nat-node-w-us].
NAME          ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP  STATUS
nat-node-w-us  us-central1-f  n1-standard-1               192.168.10.7                RUNNING
```




```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-node-w-edu --network nw102 --subnet nw102-eu --zone europe-west1-c --image-family centos-7 --image-project
 centos-cloud --no-address --tags nat-eu
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/instances/nat-node-w-edu].
NAME           ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP  STATUS
nat-node-w-edu  europe-west1-c  n1-standard-1               192.168.20.7                RUNNING
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```



Apache servers installed and running

```
[nouroudine@nat-gw-eu ~]$ sudo service httpd status
Redirecting to /bin/systemctl status httpd.service
● httpd.service - The Apache HTTP Server
   Loaded: loaded (/usr/lib/systemd/system/httpd.service; disabled; vendor preset: disabled)
   Active: active (running) since Wed 2019-01-30 22:19:26 UTC; 19s ago
     Docs: man:httpd(8)
           man:apachectl(8)
 Main PID: 22711 (httpd)
   Status: "Total requests: 0; Current requests/sec: 0; Current traffic:   0 B/sec"
   CGroup: /system.slice/httpd.service
           ├─22711 /usr/sbin/httpd -DFOREGROUND
           ├─22712 /usr/sbin/httpd -DFOREGROUND
           ├─22713 /usr/sbin/httpd -DFOREGROUND
           ├─22714 /usr/sbin/httpd -DFOREGROUND
           ├─22715 /usr/sbin/httpd -DFOREGROUND
           └─22716 /usr/sbin/httpd -DFOREGROUND

Jan 30 22:19:26 nat-gw-eu systemd[1]: Starting The Apache HTTP Server...
Jan 30 22:19:26 nat-gw-eu systemd[1]: Started The Apache HTTP Server.
```

```
nouroudine@nat-gw-us:~$ sudo service apache2 status
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
   Active: active (running) since Thu 2019-01-31 02:04:28 UTC; 1min 29s ago
 Main PID: 32323 (apache2)
   CGroup: /system.slice/apache2.service
           ├─32323 /usr/sbin/apache2 -k start
           ├─32325 /usr/sbin/apache2 -k start
           └─32326 /usr/sbin/apache2 -k start

Jan 31 02:04:27 nat-gw-us systemd[1]: Starting The Apache HTTP Server...
Jan 31 02:04:28 nat-gw-us systemd[1]: Started The Apache HTTP Server.
nouroudine@nat-gw-us:~$
```

Partition network tiers with firewall rules

Lock down the network

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules  create nw102-allow-internal --network nw102 --source-ranges 192.168.10.0/24,192.168.20.0/24 --allow tcp,udp,icmp
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/firewalls/nw102-allow-internal].
Creating firewall...done.
NAME                NETWORK  DIRECTION  PRIORITY  ALLOW         DENY  DISABLED
nw102-allow-internal  nw102    INGRESS    1000      tcp,udp,icmp        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Assign tags

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-gw-us --zone us-central1-f --tags gw
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/nat-gw-us].
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-gw-eu --zo
ne europe-west1-c --tags gw
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-
c/instances/nat-gw-eu].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-node-us --
zone us-central1-f --tags app
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f
/instances/nat-node-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-node-eu --
zone europe-west1-c --tags app
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-
c/instances/nat-node-eu].
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-node-w-us
--zone us-central1-f --tags app
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f
/instances/nat-node-w-us].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances add-tags nat-node-w-us
--zone us-central1-f --tags web
Updated [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f
/instances/nat-node-w-us].
```

Permit HTTP and SSH: Create additional firewall rules to permit curl among VMs in the same tier or for the NAT gateways.

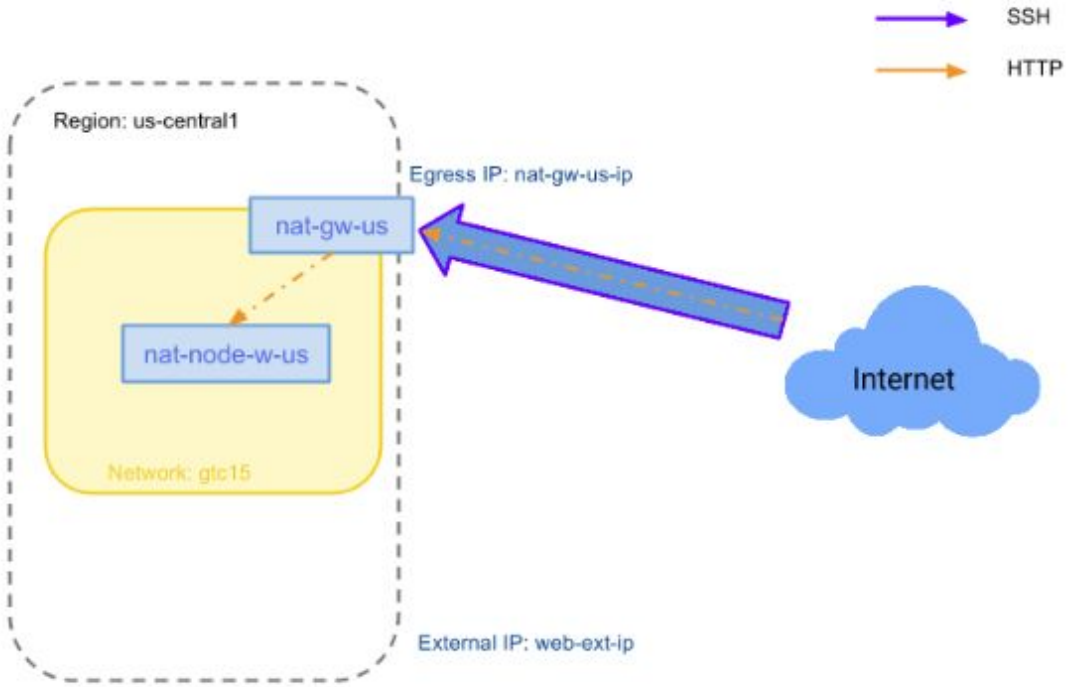
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-web --network nw102 --source-tags gw,web --target-tags web --allow tcp:22,tcp:80
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-web].
```

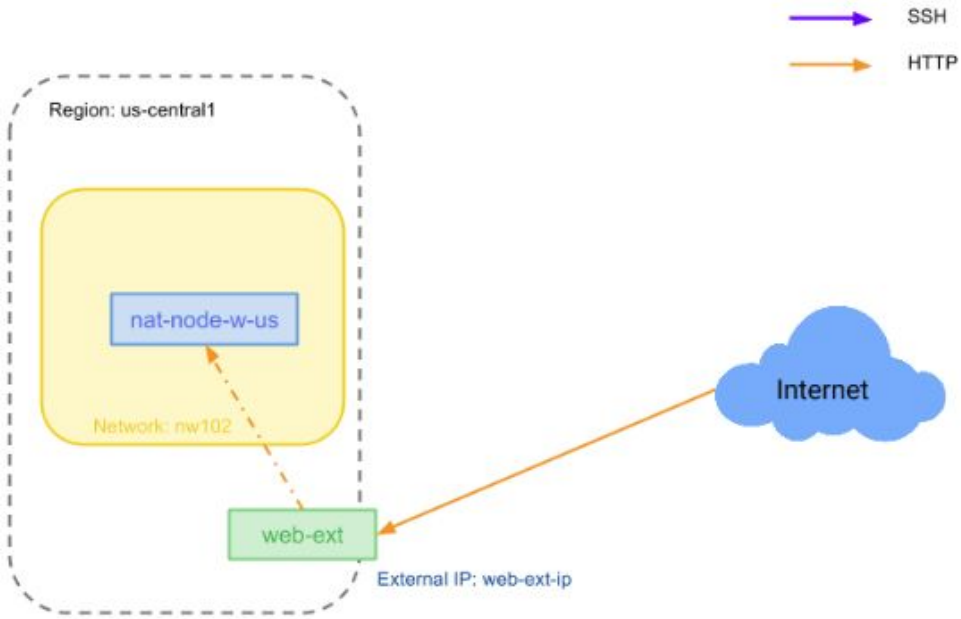
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-app --network nw102 --source-tags gw,app --target-tags app --allow tcp:22,tcp:80
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-app].
Creating firewall...done.
NAME            NETWORK  DIRECTION  PRIORITY  ALLOW         DENY  DISABLED
nw102-allow-app  nw102    INGRESS    1000      tcp:22,tcp:80       False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-egress --network nw102 --source-tags app,web --target-tags gw --allow tcp:80,tcp:443
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-egress].
Creating firewall...done.
NAME               NETWORK  DIRECTION  PRIORITY  ALLOW          DENY  DISABLED
nw102-allow-egress  nw102    INGRESS    1000      tcp:80,tcp:443       False
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-traceroute --network nw102 --source-ranges 192.168.10.0/24 --target-tags gw --allow udp:33434
-33534
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-traceroute].
Creating firewall...done.
NAME                   NETWORK  DIRECTION  PRIORITY  ALLOW           DENY  DISABLED
nw102-allow-traceroute  nw102    INGRESS    1000      udp:33434-33534       False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Alternate connectivity options





Create forwarding rule to access internal resources

Add a new firewall to allow external access to web services in tier web

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-ext --network nw102 --source-ranges 0.0.0.0/0 --target-tags web --allow tcp:80
Creating firewall...:Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-ext].
Creating firewall...done.
NAME            NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
nw102-allow-ext  nw102    INGRESS    1000      tcp:80        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Create the forwarding rule to expose web service through another external IP

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute addresses create web-ext-ip  --region us-central1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/us-central1/addresses/web-ext-ip].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute addresses create web-ext-ip  --region us-central1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/us-central1/addresses/web-ext-ip].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute target-instances create web-target --instance nat-node-w-us  --zone us-central1-f
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/targetInstances/web-target].
NAME        ZONE          INSTANCE       NAT_POLICY
web-target  us-central1-f  nat-node-w-us  NO_NAT
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute forwarding-rules create web-ext -
-address web-ext-ip --port-range 80 --region us-central1 --target-instance web-target --target
-instance-zone us-central1-f
WARNING: The --port-range flag is deprecated. Use equivalent --ports=80 flag.
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/us-central1
/forwardingRules/web-ext].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

For some reasons it is impossible to install an apache server on nat-node-us and

nat-node-eu.

```
nouroudine@nat-node-us:~$ sudo apt install apache2
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1 libaprutil1 libaprutil1-dbd-sqlite3
  libaprutil1-ldap libicu57 liblua5.2-0 libperl5.24 libxml2 perl perl-modules-5.24 rename
  sgml-base ssl-cert xml-core
Suggested packages:
  www-browser apache2-doc apache2-suexec-pristine | apache2-suexec-custom perl-doc
  libterm-readline-gnu-perl | libterm-readline-perl-perl make sgml-base-doc
  openssl-blacklist debhelper
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute ssh nat-gw-eu --ssh-flag="-A" --zone europe-west1-c
Last login: Thu Jan 31 22:48:36 2019 from 47.34.9.131
[nouroudine@nat-gw-eu ~]$ ssh nat-node-eu
The authenticity of host 'nat-node-eu (192.168.20.3)' can't be established.
ECDSA key fingerprint is SHA256:x5vt2SnU0GnB8EHG2TmuMya8VPtcIleZsQ/0zPwkL6M.
```

Therefore, it is not possible to install a web content from the browser.

Support server rotation and IP migration

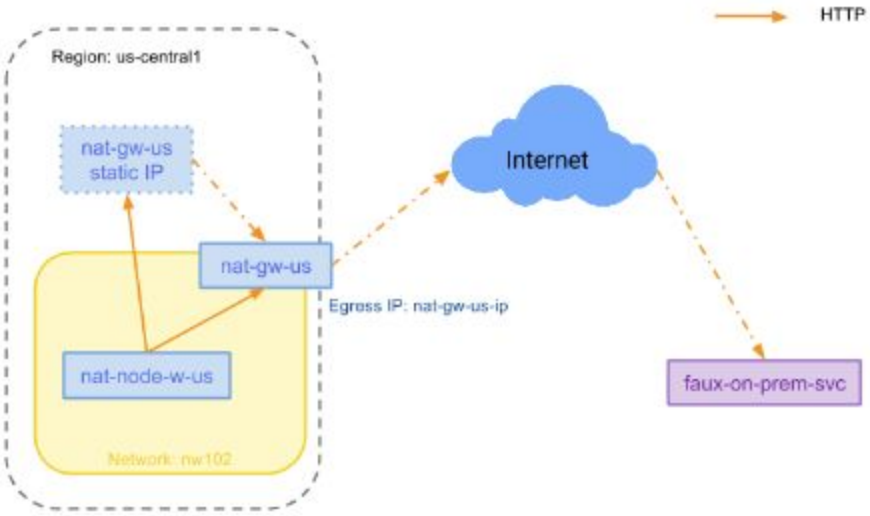
In preparation for the IP migration, create a new forwarding rule with a new IP address.

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute addresses create new-web-ext-ip --region europe-west1
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/europe-west1/addresses/new-web-ext-ip].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute target-instances create new-web-target --instance nat-node-w-eu --zone europe-west1-c
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/europe-west1-c/targetInstances/new-web-target].
NAME           ZONE           INSTANCE       NAT_POLICY
new-web-target  europe-west1-c  nat-node-w-eu  NO_NAT
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute forwarding-rules create new-web-e
xt --address new-web-ext-ip --port-range 80 --region europe-west1 --target-instance new-web-ta
rget --target-instance-zone europe-west1-c
WARNING: The --port-range flag is deprecated. Use equivalent --ports=80 flag.
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/regions/europe-west
1/forwardingRules/new-web-ext].
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

External Resource Mapping



Map an external service through an internal IP

Create a standalone VM in the default network with web serving capability and create a firewall to allow traffic to it via TCP and port 80:

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create faux-on-perm-svc --network default --zone us-central1-f --image-family debian-9 --image-project debian-cloud --tags http-server
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/zones/us-central1-f/instances/faux-on-perm-svc].
NAME           ZONE           MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP  EXTERNAL_IP     STATUS
faux-on-perm-svc  us-central1-f  n1-standard-1             10.128.0.2   35.184.237.112  RUNNING
```

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create default-allow-http-server --network default --target-tags http-server --allow tcp:80
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-230117/global/firewalls/default-allow-http-server].
Creating firewall...done.
NAME                    NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
default-allow-http-server  default  INGRESS    1000      tcp:80        False
```

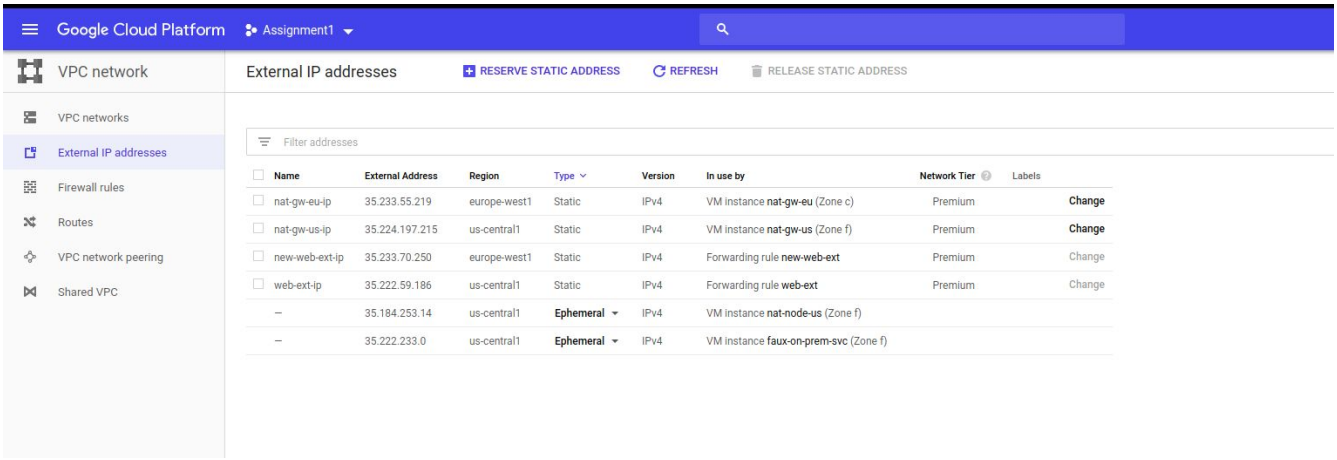
Install Apache on the standalone VM that was just created

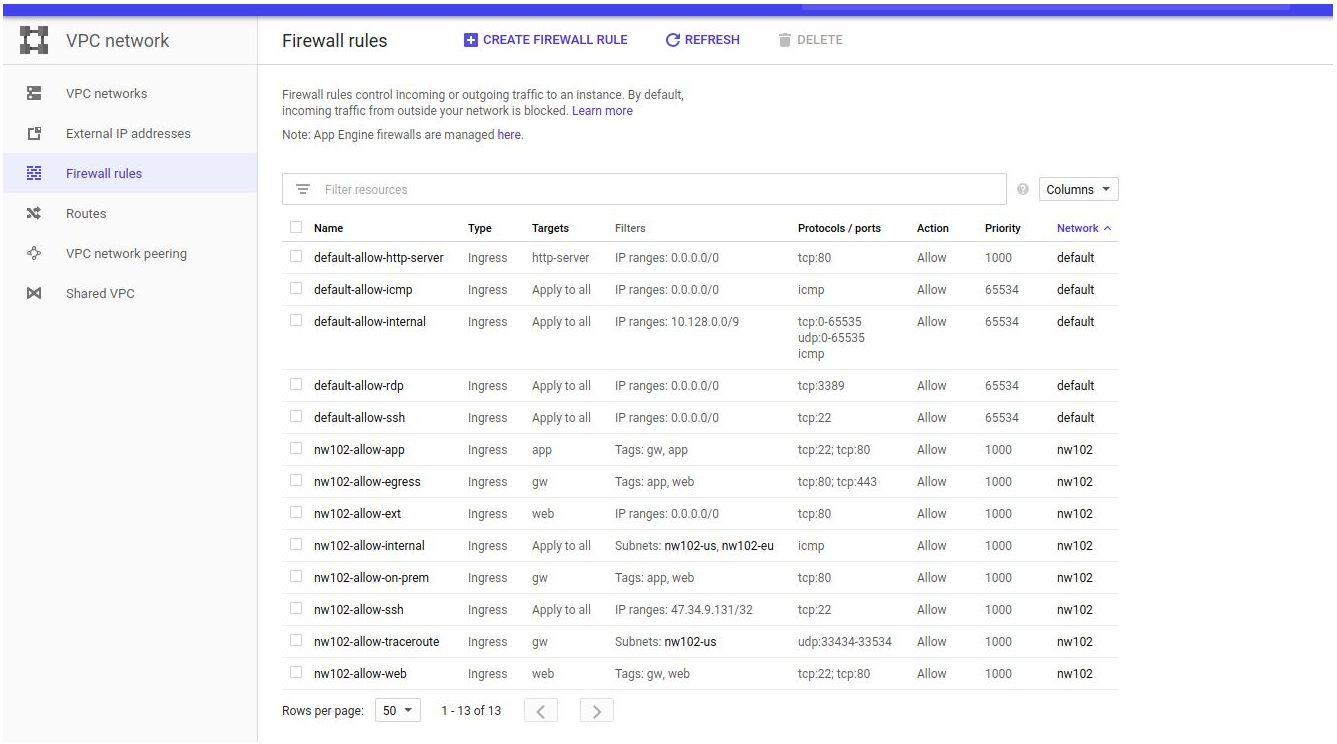
```
nouroudine@faux-on-perm-svc:~$ sudo service apache2 status
● apache2.service - The Apache HTTP Server
   Loaded: loaded (/lib/systemd/system/apache2.service; enabled; vendor preset: enabled)
   Active: active (running) since Thu 2019-01-31 09:29:46 UTC; 17s ago
 Main PID: 1709 (apache2)
   CGroup: /system.slice/apache2.service
           ├─1709 /usr/sbin/apache2 -k start
           ├─1711 /usr/sbin/apache2 -k start
           └─1712 /usr/sbin/apache2 -k start

Jan 31 09:29:46 faux-on-perm-svc systemd[1]: Starting The Apache HTTP Server...
Jan 31 09:29:46 faux-on-perm-svc systemd[1]: Started The Apache HTTP Server.
```

Mapping of web service as internal service using iptables

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-on-prem --network nw102 --source-tags app,web  --target-tags gw --allow tcp:80
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23011
7/global/firewalls/nw102-allow-on-prem].
Creating firewall...done.
NAME                NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
nw102-allow-on-prem  nw102    INGRESS    1000      tcp:80        False
```

Configurations interfaces





Float static IP for mapped service

Network interface configuration

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute routes create nw102-192-168-30-11
 --network nw102 --destination-range 192.168.30.11/32 --next-hop-instance nat-gw-us --next-hop
-instance-zone us-central1-f
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230321/global/routes/nw102
-192-168-30-11].
NAME                NETWORK  DEST_RANGE        NEXT_HOP                          PRIORITY
nw102-192-168-30-11  nw102    192.168.30.11/32  us-central1-f/instances/nat-gw-us  1000
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

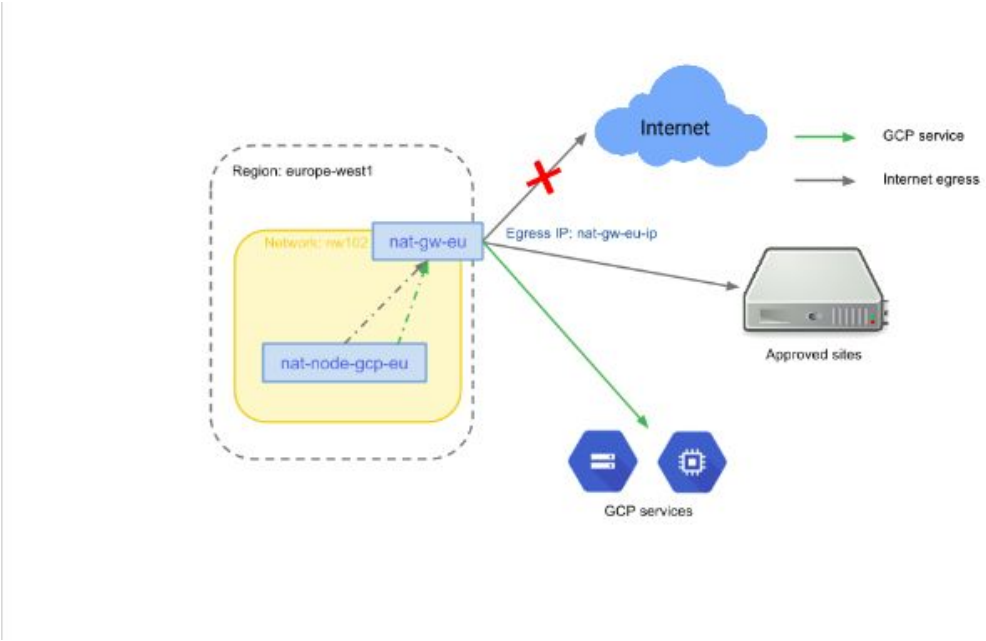
```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-on-prem-alt --network nw102 --source-ranges 192.168.0.0/19 --target-tags gw --allow tcp:80
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23032
1/global/firewalls/nw102-allow-on-prem-alt].
Creating firewall...done.
NAME                    NETWORK  DIRECTION  PRIORITY  ALLOW   DENY  DISABLED
nw102-allow-on-prem-alt  nw102    INGRESS    1000      tcp:80        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

The configuration is well done, but curl command failed to connect to the target:

```
nouroudine@nat-node-us:~$ curl  192.168.30.11
curl: (7) Failed to connect to 192.168.30.11 port 80: Connection timed out
nouroudine@nat-node-us:~$ curl  192.168.30.11
curl: (7) Failed to connect to 192.168.30.11 port 80: Connection timed out
nouroudine@nat-node-us:~$ curl  192.168.30.11
curl: (7) Failed to connect to 192.168.30.11 port 80: Connection timed out
nouroudine@nat-node-us:~$
```

Egress Proxy

Configurations of proxy using NAT gateway functionalities

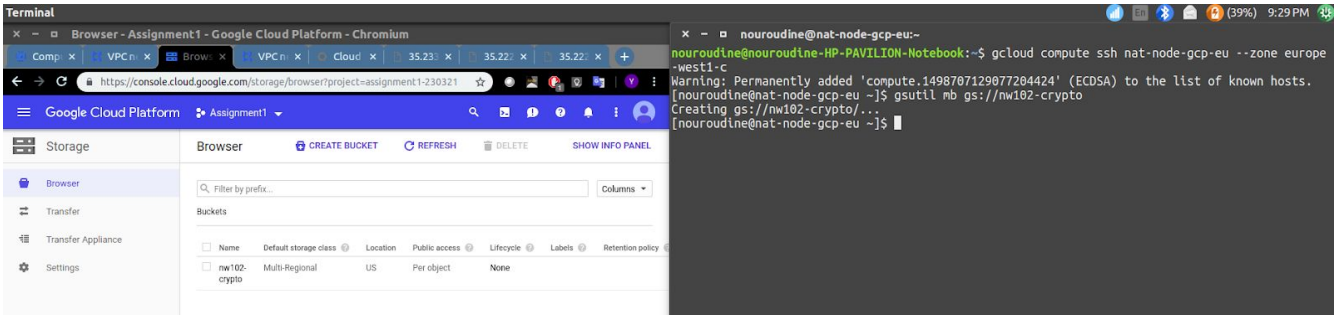


Create new VM and verify default access

The following will show the different steps of the installation and configurations

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute instances create nat-node-gcp-eu --network nw102 --subnet nw102-eu --zone europe-west1-c --image-family centos-7 --image-project
centos-cloud --scopes cloud-platform
Created [https://www.googleapis.com/compute/v1/projects/assignment1-230321/zones/europe-west1-c/instances/nat-node-gcp-eu].
NAME            ZONE            MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP     STATUS
nat-node-gcp-eu  europe-west1-c  n1-standard-1              192.168.20.5  104.155.93.227  RUNNING
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Backet created:



Curl worked like a charm

```
[nouroudine@nat-node-gcp-eu ~]$ curl -L www.google.com
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en"><head><meta content="Search the world's information, including webpages, images, videos and more. Google has many special features to help you find exactly what you're looking for." name="description"><meta content="noodp" name="robots"><meta content="text/html; charset=UTF-8" http-equiv="Content-Type"><meta content="/images/branding/googleg/1x/googleg_standard_color_128dp.png" itemprop="image"><title>Google</title><script nonce="4T7S5zwtV0VX4zRoLs2Dyg==">(function(){window.google={kEI:'s75TXK7dEcGYa7yJrpAB',kEXPI:'0,1353747,57,1957,1017,1406,698,527,730,1450,115,234,30,695,533,805,18,71,253,841,132,2334979,329520,1294,12383,4855,32692,15247,867,10761,1696,4987,1100,3335,2,2,4609,2192,369,1160,7,2147,5505,224,1017,1195,266,4204,903,575,835,284,2,1306,2431,59,2,1,3,1297,284,3586,453,3390,10,300,1267,774,2254,1403,3337,1146,5,2,2,1965,2593,182,283,3136,669,1050,1888,1129,268,103,7,1,2,3,463,620,29,983,6,406,458,1847,769,536,695,3395,1209,792,84,412,2,554,2635,380,438,516,280,1220,401,557,270,448,155,37,1180,1296,68,484,47,1080,1284,424,1028,790,8,2,259,499,1245,258,2,366,265,217,942,1403,2,4,2,140,530,44,165,169,36,564,8,828,417,187,162,167,82,98,149,1750,306,95,2190,17,12,620,464,694,256,44,227,79,25,330,110,294,360,21,317,255,2,83,340,597,1,390,357,983,695,228,186,103,11,287,327,38,372,518,3,314,417,32,208,214,2,396,36,42,348,30,390,233,90,13,248,85,332,350,5963777,2554,233,21,5997582,2799950,4,1572,549,333,444,1,2,80,1,900,575,17,305,2,6,1,2,2132,1,1,1,1,1,414,1,748,926,3,570,1,2,456,32,56,6,1,14,4,1,19,12,1,10,22306524',authuser:0,kscs:'c9c918f0_s75TXK7dEcGYa7yJrpAB',kGL:'US'};google.kHL='en';})();google.time=function(){return(new Date).getTime()};(function(){google.lc=[];google.li=0;google.getEI=function(a){for(var b;a&&(!a.getAttribute||!(b=a.getAttribute("eid")));)a=a.parentNode;return b||google.kEI};google.getLEI=function(a){for(var b=null;a&&(!a.getAttribute||!(b=a.getAttribute("leid")));)a=a.parentNode;return b};google.https=function(){return"https:"==window.location.protocol};google.ml=function(){return null};google.log=function(a,b,e,c,g){if(a=google.logUrl(a,b,e,c,g)){b=new Image;var d=google.lc,f=google.li;d[f]=b;b.onerror=b.onload=b.onabort=function(){delete d[f]};google.vel&&google.vel.lu&&google.vel.lu(a);b.src=a;google.li=f+1}};google.logUrl=function(a,b,e,c,g){var d="",f=google.ls||"";e||-1!=b.search("&ei=")||(d="&ei="+google.getEI(c),-1==b.search("&lei=")&&(c=google.getLEI(c))&&(d+="&lei="+c));c="";!e&&google.cshid&&-1==b.search("&cshid=")&&"slh"!=a&&(c="&cshid="+google.cshid);a=e||"/"+(g||"gen_204")+"?atyp=i&ct="+a
```

```
[nouroudine@nat-node-gcp-eu ~]$ curl -L www.iana.org
<!doctype html>
<html>
<head>
        <title>Internet Assigned Numbers Authority</title>

        <meta charset="utf-8" />
        <meta http-equiv="Content-type" content="text/html; charset=utf-8" />
        <meta name="viewport" content="width=device-width, initial-scale=1" />

        <link rel="stylesheet" media="screen" href="/_css/2015.1/screen.css"/>
        <link rel="stylesheet" media="print" href="/_css/2015.1/print.css"/>
        <link rel="shortcut icon" type="image/ico" href="/_img/bookmark_icon.ico"/>

        <script type="text/javascript" src="/_js/2013.1/jquery.js"></script>
        <script type="text/javascript" src="/_js/2013.1/iana.js"></script>
```

```
[nouroudine@nat-node-gcp-eu ~]$ curl 35.222.233.0

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
    <title>Apache2 Debian Default Page: It works</title>
    <style type="text/css" media="screen">
  * {
    margin: 0px 0px 0px 0px;
    padding: 0px 0px 0px 0px;
  }

  body, html {
    padding: 3px 3px 3px 3px;
```

Trying to access Google Cloud platform resources: The request is not working as they might suspected

```
[nouroudine@nat-node-gcp-eu ~]$ gsutil ls gs://
INFO 0201 04:11:36.581570 retry_util.py] Retrying request, attempt #1...
INFO 0201 04:12:38.820609 retry_util.py] Retrying request, attempt #2...
INFO 0201 04:13:42.331372 retry_util.py] Retrying request, attempt #3...
INFO 0201 04:14:49.447334 retry_util.py] Retrying request, attempt #4...
INFO 0201 04:16:03.328412 retry_util.py] Retrying request, attempt #5...
```

Deploy a proxy service for limited access

The installation of Squid is required for the configuration of an egress whitelist to include googleapis.com

```
[nouroudine@nat-gw-eu ~]$ yum install squid -y
Loaded plugins: fastestmirror
You need to be root to perform this command.
[nouroudine@nat-gw-eu ~]$ sudo yum install squid -y
Loaded plugins: fastestmirror
Loading mirror speeds from cached hostfile
 * base: mirrors.sonic.net
 * epel: d2lzkl7pfhq30w.cloudfront.net
 * extras: mirror.fileplanet.com
 * updates: mirror.fileplanet.com
Resolving Dependencies
--> Running transaction check
---> Package squid.x86_64 7:3.5.20-12.el7 will be installed
--> Processing Dependency: squid-migration-script for package: 7:squid-3.5.20-12.el7.x86_64
--> Processing Dependency: perl(Digest::MD5) for package: 7:squid-3.5.20-12.el7.x86_64
--> Processing Dependency: perl(Data::Dumper) for package: 7:squid-3.5.20-12.el7.x86_64
--> Processing Dependency: perl(DBI) for package: 7:squid-3.5.20-12.el7.x86_64
--> Processing Dependency: libltdl.so.7()(64bit) for package: 7:squid-3.5.20-12.el7.x86_64
--> Processing Dependency: libecap.so.3()(64bit) for package: 7:squid-3.5.20-12.el7.x86_64
--> Running transaction check
---> Package libecap.x86_64 0:1.0.0-1.el7 will be installed
---> Package libtool-ltdl.x86_64 0:2.4.2-22.el7_3 will be installed
---> Package perl-DBI.x86_64 0:1.627-4.el7 will be installed
--> Processing Dependency: perl(RPC::PlServer) >= 0.2001 for package: perl-DBI-1.627-4.el7.x86_64
--> Processing Dependency: perl(RPC::PlClient) >= 0.2000 for package: perl-DBI-1.627-4.el7.x86_64
---> Package perl-Data-Dumper.x86_64 0:2.145-3.el7 will be installed
---> Package perl-Digest-MD5.x86_64 0:2.52-3.el7 will be installed
--> Processing Dependency: perl(Digest::base) >= 1.00 for package: perl-Digest-MD5-2.52-3.el7.x86_64
---> Package squid-migration-script.x86_64 7:3.5.20-12.el7 will be installed
--> Running transaction check
---> Package perl-Digest.noarch 0:1.17-245.el7 will be installed
---> Package perl-PlRPC.noarch 0:0.2020-14.el7 will be installed
--> Processing Dependency: perl(Net::Daemon) >= 0.13 for package: perl-PlRPC-0.2020-14.el7.noarch
--> Processing Dependency: perl(Net::Daemon::Test) for package: perl-PlRPC-0.2020-14.el7.noarch
--> Processing Dependency: perl(Net::Daemon::Log) for package: perl-PlRPC-0.2020-14.el7.noarch
--> Processing Dependency: perl(Compress::Zlib) for package: perl-PlRPC-0.2020-14.el7.noarch
--> Running transaction check
---> Package perl-IO-Compress.noarch 0:2.061-2.el7 will be installed
--> Processing Dependency: perl(Compress::Raw::Zlib) >= 2.061 for package: perl-IO-Compress-2.061-2.el7.noarch
--> Processing Dependency: perl(Compress::Raw::Bzip2) >= 2.061 for package: perl-IO-Compress-2.061-2.el7.noarch
---> Package perl-Net-Daemon.noarch 0:0.48-5.el7 will be installed
--> Running transaction check
---> Package perl-Compress-Raw-Bzip2.x86_64 0:2.061-3.el7 will be installed
---> Package perl-Compress-Raw-Zlib.x86_64 1:2.061-4.el7 will be installed
--> Finished Dependency Resolution
```

```
Total                                                       2.2 MB/s | 4.5 MB  00:00:02
Running transaction check
Running transaction test
Transaction test succeeded
Running transaction
  Installing : perl-Data-Dumper-2.145-3.el7.x86_64                                  1/13
  Installing : perl-Net-Daemon-0.48-5.el7.noarch                                    2/13
  Installing : perl-Digest-1.17-245.el7.noarch                                      3/13
  Installing : perl-Digest-MD5-2.52-3.el7.x86_64                                    4/13
  Installing : 7:squid-migration-script-3.5.20-12.el7.x86_64                        5/13
  Installing : 1:perl-Compress-Raw-Zlib-2.061-4.el7.x86_64                          6/13
  Installing : libtool-ltdl-2.4.2-22.el7_3.x86_64                                   7/13
  Installing : libecap-1.0.0-1.el7.x86_64                                           8/13
  Installing : perl-Compress-Raw-Bzip2-2.061-3.el7.x86_64                           9/13
  Installing : perl-IO-Compress-2.061-2.el7.noarch                                 10/13
  Installing : perl-PlRPC-0.2020-14.el7.noarch                                     11/13
  Installing : perl-DBI-1.627-4.el7.x86_64                                         12/13
  Installing : 7:squid-3.5.20-12.el7.x86_64                                        13/13
  Verifying  : perl-Compress-Raw-Bzip2-2.061-3.el7.x86_64                           1/13
  Verifying  : 7:squid-3.5.20-12.el7.x86_64                                         2/13
  Verifying  : perl-Data-Dumper-2.145-3.el7.x86_64                                  3/13
  Verifying  : perl-Digest-MD5-2.52-3.el7.x86_64                                    4/13
  Verifying  : libecap-1.0.0-1.el7.x86_64                                           5/13
  Verifying  : perl-IO-Compress-2.061-2.el7.noarch                                  6/13
  Verifying  : libtool-ltdl-2.4.2-22.el7_3.x86_64                                   7/13
  Verifying  : 1:perl-Compress-Raw-Zlib-2.061-4.el7.x86_64                          8/13
  Verifying  : 7:squid-migration-script-3.5.20-12.el7.x86_64                        9/13
  Verifying  : perl-Digest-1.17-245.el7.noarch                                     10/13
  Verifying  : perl-DBI-1.627-4.el7.x86_64                                         11/13
  Verifying  : perl-Net-Daemon-0.48-5.el7.noarch                                   12/13
  Verifying  : perl-PlRPC-0.2020-14.el7.noarch                                     13/13

Installed:
  squid.x86_64 7:3.5.20-12.el7

Dependency Installed:
  libecap.x86_64 0:1.0.0-1.el7                 libtool-ltdl.x86_64 0:2.4.2-22.el7_3
  perl-Compress-Raw-Bzip2.x86_64 0:2.061-3.el7 perl-Compress-Raw-Zlib.x86_64 1:2.061-4.el7
  perl-DBI.x86_64 0:1.627-4.el7                perl-Data-Dumper.x86_64 0:2.145-3.el7
  perl-Digest.noarch 0:1.17-245.el7            perl-Digest-MD5.x86_64 0:2.52-3.el7
  perl-IO-Compress.noarch 0:2.061-2.el7        perl-Net-Daemon.noarch 0:0.48-5.el7
  perl-PlRPC.noarch 0:0.2020-14.el7            squid-migration-script.x86_64 7:3.5.20-12.el7

Complete!
[nouroudine@nat-gw-eu ~]$
[nouroudine@nat-gw-eu ~]$ sudo su -
[root@nat-gw-eu ~]# ca
```

Squid is running

```
[nouroudine@nat-gw-eu ~]$ sudo service squid restart
Redirecting to /bin/systemctl restart squid.service
[nouroudine@nat-gw-eu ~]$ sudo service squid status
Redirecting to /bin/systemctl status squid.service
● squid.service - Squid caching proxy
   Loaded: loaded (/usr/lib/systemd/system/squid.service; disabled; vendor preset: disabled)
   Active: active (running) since Fri 2019-02-01 04:34:08 UTC; 19s ago
  Process: 13363 ExecStart=/usr/sbin/squid $SQUID_OPTS -f $SQUID_CONF (code=exited, status=0/SUCCESS)
  Process: 13358 ExecStartPre=/usr/libexec/squid/cache_swap.sh (code=exited, status=0/SUCCESS)
 Main PID: 13365 (squid)
   CGroup: /system.slice/squid.service
           ├─13365 /usr/sbin/squid -f /etc/squid/squid.conf
           ├─13367 (squid-1) -f /etc/squid/squid.conf
           └─13368 (logfile-daemon) /var/log/squid/access.log

Feb 01 04:34:08 nat-gw-eu systemd[1]: Starting Squid caching proxy...
Feb 01 04:34:08 nat-gw-eu systemd[1]: Started Squid caching proxy.
Feb 01 04:34:08 nat-gw-eu squid[13365]: Squid Parent: will start 1 kids
Feb 01 04:34:08 nat-gw-eu squid[13365]: Squid Parent: (squid-1) process 13367 started
[nouroudine@nat-gw-eu ~]$
```

Firewall configuration

```
nouroudine@nouroudine-HP-PAVILION-Notebook:~$ gcloud compute firewall-rules create nw102-allow
-proxy --network nw102 --source-ranges 192.168.20.0/24 --target-tags  gw --allow tcp:3128
Creating firewall...⠹Created [https://www.googleapis.com/compute/v1/projects/assignment1-23032
1/global/firewalls/nw102-allow-proxy].
Creating firewall...done.
NAME               NETWORK  DIRECTION  PRIORITY  ALLOW     DENY  DISABLED
nw102-allow-proxy  nw102    INGRESS    1000      tcp:3128        False
nouroudine@nouroudine-HP-PAVILION-Notebook:~$
```

Testing the configuration with curl and it is working like a charm:

```
[nouroudine@nat-node-gcp-eu ~]$ curl www.google.com
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en"><head><meta content="Search the world's information, including webpages, images, videos and more. Google has
many special features to help you find exactly what you're looking for." name="description"><meta content="noodp" name="robots"><meta content="text/html; charset=UTF-8" http-equiv="Content-T
ype"><meta content="/images/branding/googleg/1x/googleg_standard_color_128dp.png" itemprop="image"><title>Google</title><script nonce="iNo/6Q45zrsf67i5gOFChQ==">(function(){window.google={kE
I:'n85TXIDeA4mOar2AutgL',kEXPI:'0,1353747,57,1958,1016,624,782,1,696,528,590,140,326,1240,233,30,1227,806,342,735,4,235,2334959,329539,1294,12383,4855,32691,15248,867,10761,1402,5281,1100,33
35,2,2,4605,2196,364,1165,7,2147,5505,224,2212,266,1028,2713,1366,575,835,284,2,1306,2432,58,2,1,3,1297,4323,3398,302,1268,291,482,2248,1409,3337,1146,5,2,2,981,982,2595,182,283,556,2580,669
,1050,1808,1129,268,81,7,1,2,25,463,620,29,983,6,406,458,1847,769,536,695,3395,1209,318,474,84,412,2,3189,380,438,796,1220,401,557,269,413,36,155,37,1180,956,408,484,47,1080,543,2193,1,47,75
4,8,2,247,499,1245,258,2,366,265,218,2185,122,37,2,4,2,572,98,44,371,1388,9,419,189,160,167,82,247,1116,635,306,95,91,34,2081,12,622,446,710,256,44,227,78,26,332,70,692,21,41,276,255,2,22,61
,47,293,989,1339,165,758,184,403,366,26,652,211,3,763,207,208,2,403,35,45,346,21,8,391,48,37,144,99,8,665,426,36,47,14,5963604,2554,223,32,8797531,4,1572,549,333,444,1,2,80,1,900,583,3,310,1
,8,1,2,2132,1,1,1,1,1,414,1,748,926,3,570,1,2,456,32,57,5,1,14,4,1,19,12,1,6,22306528',authuser:0,kscs:'c9c918f0_n85TXIDeA4mOar2AutgL',kGL:'US'};google.kHL='en';})();google.time=function(){r
eturn(new Date).getTime()};(function(){google.lc=[];google.li=0;google.getEI=function(a){for(var b;a&&(!a.getAttribute||!(b=a.getAttribute("eid")));)a=a.parentNode;return b||google.kEI};goog
le.getLEI=function(a){for(var b=null;a&&(!a.getAttribute||!(b=a.getAttribute("leid")));)a=a.parentNode;return b};google.https=function(){return"https:"==window.location.protocol};google.ml=f
unction(){return null};google.log=function(a,b,e,c,g){if(a=google.logUrl(a,b,e,c,g)){b=new Image;var d=google.lc,f=google.li;d[f]=b;b.onerror=b.onload=b.onabort=function(){delete d[f]};googl
e.vel&&google.vel.lu&&google.vel.lu(a);b.src=a;google.li=f+1}};google.logUrl=function(a,b,e,c,g){var d="",f=google.ls||"";e||-1!=b.search("&ei=")||(d="&ei="+google.getEI(c),-1==b.search("&le
i=")&&(c=google.getLEI(c))&&(d+="&lei="+c));c="";!e&&google.cshid&&-1==b.search("&cshid=")&&"slh"!=a&&(c="&cshid="+google.cshid);a=e||"/"+(g||"gen_204")+"?atyp=i&ct="+a+"&cad="+b+d+f+"&zx="+
google.time()+c;/^http:/i.test(a)&&google.https()&&(google.ml(Error("a"),!1,{src:a,glmm:1}),a="");return a};}).call(this);(function(){google.y={};google.x=function(a,b){if(a)var c=a.id;else{
do c=Math.random();while(google.y[c])google.y[c]=[a,b];return!1};google.lm=[];google.plm=function(a){google.lm.push.apply(google.lm,a)};google.lq=[];google.load=function(a,b,c){google.lq.pu
sh([[a],b,c])};google.loadAll=function(a,b){google.lq.push([a,b])};}).call(this);google.f={};</script><script nonce="iNo/6Q45zrsf67i5gOFChQ==">var a=window.location,b=a.href.indexOf("#");if(
0<=b){var c=a.href.substring(b+1);/(^|&)q=/.test(c)&&-1==c.indexOf("#")&&a.replace("/search?"+c.replace(/(^|&)fp=[^&]*/g,"")+"&cad=h")};</script><style>#gbar,#guser{font-size:13px;padding-to
p:1px !important;}#gbar{height:22px}#guser{padding-bottom:7px !important;text-align:right}.gbh,.gbd{border-top:1px solid #c9d7f1;font-size:1px}.gbh{height:0;position:absolute;top:24px;width:
100%}@media all{.gb1{height:22px;margin-right:.5em;vertical-align:top}#gbar{float:left}}a.gb1,a.gb4{text-decoration:underline !important}a.gb1,a.gb4{color:#00c !important}.gbi .gb4{color:#dd
8e27 !important}.gbf .gb4{color:#900 !important}
</style><style>body,td,a,p,.h{font-family:arial,sans-serif}body{margin:0;overflow-y:scroll}#gog{padding:3px 8px 0}td{line-height:.8em}.gac_m td{line-height:17px}form{margin-bottom:20px}.h{co
lor:#36c}.q{color:#00c}.ts td{padding:0}.ts{border-collapse:collapse}em{font-weight:bold;font-style:normal}.lst{height:25px;width:496px}.gsfi,.lst{font:18px arial,sans-serif}.gsfs{font:17px
arial,sans-serif}.ds{display:inline-box;display:inline-block;margin:3px 0 4px;margin-left:4px}input{font-family:inherit}a.gb1,a.gb2,a.gb3,a.gb4{color:#11c !important}body{background:#fff;col
or:black}a{color:#11c;text-decoration:none}a:hover,a:active{text-decoration:underline}.fl a{color:#36c}a:visited{color:#551a8b}a.gb1,a.gb4{text-decoration:underline}a.gb3:hover{text-decorati
on:none}#ghead a.gb2:hover{color:#fff !important}.sblc{padding-top:5px}.sblc a{display:block;margin:2px 0;margin-left:13px;font-size:11px}.lsbb{background:#eee;border:solid 1px;border-color:
#ccc #999 #999 #ccc;height:30px}.lsbb{display:block}.ftl,#fll a{display:inline-block;margin:0 12px}.lsb{background:url(/images/nav_logo229.png) 0 -261px repeat-x;border:none;color:#000;curso
r:pointer;height:30px;margin:0;outline:0;font:15px arial,sans-serif;vertical-align:top}.lsb:active{background:#ccc}.lst:focus{outline:none}</style><script nonce="iNo/6Q45zrsf67i5gOFChQ==">
</script></head><body bgcolor="#fff"><script nonce="iNo/6Q45zrsf67i5gOFChQ==">(function(){var src='/images/nav_logo229.png';var iesg=false;document.body.onload = function(){window.n && window.
n();if (document.images){new Image().src=src;}
if (!iesg){document.f&&document.f.q.focus();document.gbqf&&document.gbqf.q.focus();}
}
})();</script><div id="mngb"> <div id=gbar><nobr><b class=gb1>Search</b> <a class=gb1 href="http://www.google.com/imghp?hl=en&tab=wi">Images</a> <a class=gb1 href="http://maps.google.com/map
s?hl=en&tab=wl">Maps</a> <a class=gb1 href="https://play.google.com/?hl=en&tab=w8">Play</a> <a class=gb1 href="http://www.youtube.com/?gl=US&tab=w1">YouTube</a> <a class=gb1 href="http://new
s.google.com/nwshp?hl=en&tab=wn">News</a> <a class=gb1 href="https://mail.google.com/mail/?tab=wm">Gmail</a> <a class=gb1 href="https://drive.google.com/?tab=wo">Drive</a> <a class=gb1 style
="text-decoration:none" href="https://www.google.com/intl/en/about/products?tab=wh"><u>More</u> &raquo;</a></nobr></div><div id=guser width=100%><nobr><span id=gbn class=gbi></span><span id=
gbf class=gbf></span><span id=gbe></span><a href="http://www.google.com/history/optout?hl=en" class=gb4>Web History</a> | <a  href="/preferences?hl=en" class=gb4>Settings</a> | <a target=_to
p id=gb_70 href="https://accounts.google.com/ServiceLogin?hl=en&passive=true&continue=http://www.google.com/" class=gb4>Sign in</a></nobr></div><div class=gbh style=left:0></div><div class=g
bh style=right:0></div> </div><center><br clear="all" id="lgpd"><div id="lga"><img alt="Google" height="92" src="/images/branding/googlelogo/1x/googlelogo_white_background_color_272x92dp.png
" style="padding:28px 0 14px" width="272" id="hplogo" onload="window.lol&&lol()"><br><br></div><form action="/search" name="f"><table cellpadding="0" cellspacing="0"><tr valign="top"><td wid
th="25%"> </td><td align="center" nowrap=""><input name="ie" value="ISO-8859-1" type="hidden"><input value="en" name="hl" type="hidden"><input name="source" type="hidden" value="hp"><in
put name="biw" type="hidden"><input name="bih" type="hidden"><div class="ds" style="height:32px;margin:4px 0"><input style="color:#000;margin:0;padding:5px 8px 0 6px;vertical-align:top" auto
```

```
[nouroudine@nat-node-gcp-eu ~]$ curl https://www.google.com
<!doctype html><html itemscope="" itemtype="http://schema.org/WebPage" lang="en"><head><meta content="Search the world's information, including webpages, images, videos and more. Google has
many special features to help you find exactly what you're looking for." name="description"><meta content="noodp" name="robots"><meta content="text/html; charset=UTF-8" http-equiv="Content-T
ype"><meta content="/images/branding/googleg/1x/googleg_standard_color_128dp.png" itemprop="image"><title>Google</title><script nonce="trtrb7laOTK9U8YnjAURVg==">(function(){window.google={kE
I:'Ss9TXJywGNKLlwS6lbPYDw',kEXPI:'0,1353747,57,1958,1632,790,698,527,731,1449,115,234,30,696,532,805,18,324,735,3,235,2334964,329535,1294,12383,4855,32691,15248,867,10761,1402,6381,3335,2,2,
4605,2196,364,1165,7,2147,5505,224,2218,260,1027,4080,575,835,284,2,578,728,2069,362,59,2,1,3,61,1236,4323,3391,7,302,1268,773,2248,1409,3337,1146,5,2,2,1963,2595,2,180,283,556,2580,669,1045
,1,1812,1129,268,81,7,1,2,25,463,620,29,983,6,406,458,1847,769,536,695,1247,2148,47,1162,318,558,412,2,554,33,2132,469,381,436,159,639,1220,38,363,556,271,448,155,1217,1210,154,99,385,47,108
0,1283,796,657,790,8,2,259,499,1245,258,2,366,265,218,922,2,1420,2,4,2,670,44,934,8,829,416,349,167,82,247,1262,489,305,96,759,1447,632,447,17,340,354,256,44,229,77,25,330,72,332,361,16,322,
173,81,2,83,340,1344,209,775,159,12,672,80,587,325,40,437,457,3,740,19,208,207,2,404,32,45,348,29,391,48,32,153,95,5,10,39,1,201,417,12,417,23,4,6,5963665,1873,681,235,20,5997239,362,2799930
,4,1572,549,333,444,1,2,80,1,900,579,11,306,1,8,1,2,2132,1,1,1,1,1,414,1,748,926,3,570,1,2,456,32,56,6,1,14,4,1,19,12,1,12,22306522',authuser:0,kscs:'c9c918f0_Ss9TXJywGNKLlwS6lbPYDw',kGL:'US
'};google.kHL='en';})();(function(){return(new Date).getTime()};(function(){google.lc=[];google.li=0;google.getEI=function(a){for(var b;a&&(!a.getAttribute||!(b=a.getAttribute("ei
d")));)a=a.parentNode;return b||google.kEI};google.getLEI=function(a){for(var b=null;a&&(!a.getAttribute||!(b=a.getAttribute("leid")));)a=a.parentNode;return b};google.https=function(){retur
n"https:"==window.location.protocol};google.ml=function(){return null};google.log=function(a,b,e,c,g){if(a=google.logUrl(a,b,e,c,g)){b=new Image;var d=google.lc,f=google.li;d[f]=b;b.onerror=
b.onload=b.onabort=function(){delete d[f]};google.vel&&google.vel.lu&&google.vel.lu(a);b.src=a;google.li=f+1}};google.logUrl=function(a,b,e,c,g){var d="",f=google.ls||"";e||-1!=b.search("&ei
=")||(d="&ei="+google.getEI(c),-1==b.search("&lei=")&&(c=google.getLEI(c))&&(d+="&lei="+c));c="";!e&&google.cshid&&-1==b.search("&cshid=")&&"slh"!=a&&(c="&cshid="+google.cshid);a=e||"/"+(g||
"gen_204")+"?atyp=i&ct="+a+"&cad="+b+d+f+"&zx="+google.time()+c;/^http:/i.test(a)&&google.https()&&(google.ml(Error("a"),!1,{src:a,glmm:1}),a="");return a};}).call(this);(function(){google.y
={};google.x=function(a,b){if(a)var c=a.id;else{do c=Math.random();while(google.y[c])}google.y[c]=[a,b];return!1};google.lm=[];google.plm=function(a){google.lm.push.apply(google.lm,a)};googl
e.lq=[];google.load=function(a,b,c){google.lq.push([[a],b,c])};google.loadAll=function(a,b){google.lq.push([a,b])};}).call(this);google.f={};</script><script nonce="trtrb7laOTK9U8YnjAURVg==
">var a=window.location,b=a.href.indexOf("#");if(0<=b){var c=a.href.substring(b+1);/(^|&)q=/.test(c)&&-1==c.indexOf("#")&&a.replace("/search?"+c.replace(/(^|&)fp=[^&]*/g,"")+"&cad=h")};</scri
pt><style>#gbar,#guser{font-size:13px;padding-top:1px !important;}#gbar{height:22px}#guser{padding-bottom:7px !important;text-align:right}.gbh,.gbd{border-top:1px solid #c9d7f1;font-size:1px
}.gbh{height:0;position:absolute;top:24px;width:100%}@media all{.gb1{height:22px;margin-right:.5em;vertical-align:top}#gbar{float:left}}a.gb1,a.gb4{text-decoration:underline !important}a.gb1
,a.gb4{color:#00c !important}.gbi .gb4{color:#dd8e27 !important}.gbf .gb4{color:#900 !important}
</style><style>body,td,a,p,.h{font-family:arial,sans-serif}body{margin:0;overflow-y:scroll}#gog{padding:3px 8px 0}td{line-height:.8em}.gac_m td{line-height:17px}form{margin-bottom:20px}.h{co
lor:#36c}.q{color:#00c}.ts td{padding:0}.ts{border-collapse:collapse}em{font-weight:bold;font-style:normal}.lst{height:25px;width:496px}.gsfi,.lst{font:18px arial,sans-serif}.gsfs{font:17px
arial,sans-serif}.ds{display:inline-box;display:inline-block;margin:3px 0 4px;margin-left:4px}input{font-family:inherit}a.gb1,a.gb2,a.gb3,a.gb4{color:#11c !important}body{background:#fff;col
or:black}a{color:#11c;text-decoration:none}a:hover,a:active{text-decoration:underline}.fl a{color:#36c}a:visited{color:#551a8b}a.gb1,a.gb4{text-decoration:underline}a.gb3:hover{text-decorati
on:none}#ghead a.gb2:hover{color:#fff !important}.sblc{padding-top:5px}.sblc a{display:block;margin:2px 0;margin-left:13px;font-size:11px}.lsbb{background:#eee;border:solid 1px;border-color:
#ccc #999 #999 #ccc;height:30px}.lsbb{display:block}.ftl,#fll a{display:inline-block;margin:0 12px}.lsb{background:url(/images/nav_logo229.png) 0 -261px repeat-x;border:none;color:#000;curso
r:pointer;height:30px;margin:0;outline:0;font:15px arial,sans-serif;vertical-align:top}.lsb:active{background:#ccc}.lst:focus{outline:none}</style><script nonce="trtrb7laOTK9U8YnjAURVg==">
</script></head><body bgcolor="#fff"><script nonce="trtrb7laOTK9U8YnjAURVg==">(function(){var src='/images/nav_logo229.png';var iesg=false;document.body.onload = function(){window.n && window.
n();if (document.images){new Image().src=src;}
if (!iesg){document.f&&document.f.q.focus();document.gbqf&&document.gbqf.q.focus();}
}
})();</script><div id="mngb"> <div id=gbar><nobr><b class=gb1>Search</b> <a class=gb1 href="https://www.google.com/imghp?hl=en&tab=wi">Images</a> <a class=gb1 href="https://maps.google.com/m
aps?hl=en&tab=wl">Maps</a> <a class=gb1 href="https://play.google.com/?hl=en&tab=w8">Play</a> <a class=gb1 href="https://www.youtube.com/?gl=US&tab=w1">YouTube</a> <a class=gb1 href="https://
news.google.com/nwshp?hl=en&tab=wn">News</a> <a class=gb1 href="https://mail.google.com/mail/?tab=wm">Gmail</a> <a class=gb1 href="https://drive.google.com/?tab=wo">Drive</a> <a class=gb1 s
```

```
[nouroudine@nat-node-gcp-eu ~]$ curl 35.222.233.0

<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">
<html xmlns="http://www.w3.org/1999/xhtml">
  <head>
    <meta http-equiv="Content-Type" content="text/html; charset=UTF-8" />
    <title>Apache2 Debian Default Page: It works</title>
    <style type="text/css" media="screen">
  * {
    margin: 0px 0px 0px 0px;
    padding: 0px 0px 0px 0px;
  }

  body, html {
    padding: 3px 3px 3px 3px;

    background-color: #D8DBE2;

    font-family: Verdana, sans-serif;
    font-size: 11pt;
    text-align: center;
  }

  div.main_page {
    position: relative;
    display: table;

    width: 800px;

    margin-bottom: 3px;
    margin-left: auto;
    margin-right: auto;
    padding: 0px 0px 0px 0px;

    border-width: 2px;
    border-color: #212738;
    border-style: solid;

    background-color: #FFFFFF;

    text-align: center;
  }

  div.page_header {
    height: 99px;
    width: 100%;
```

Testing the configuration by accessing Google ressources and it works perfectly:

```
[nouroudine@nat-node-gcp-eu ~]$
[nouroudine@nat-node-gcp-eu ~]$ gsutil ls gs://
gs://nw102-crypto/
[nouroudine@nat-node-gcp-eu ~]$
```

```
[root@nat-node-gcp-eu ~]# cat <<EOF >>/etc/profile
> export no_proxy=".internal,localhost,127.0.0.1,metadata,169.254.169.254"
> EOF
[root@nat-node-gcp-eu ~]# exit
logout
[nouroudine@nat-node-gcp-eu ~]$ exit
logout
Connection to nat-node-gcp-eu closed.
[nouroudine@nat-gw-eu ~]$ ssh nat-node-gcp-eu
Last login: Fri Feb  1 04:43:43 2019 from nat-gw-eu.europe-west1-c.c.assignment1-230321.internal
[nouroudine@nat-node-gcp-eu ~]$ gcloud compute instances list
NAME              ZONE            MACHINE_TYPE   PREEMPTIBLE  INTERNAL_IP   EXTERNAL_IP     STATUS
nat-gw-eu         europe-west1-c  n1-standard-1               192.168.20.2  35.233.55.219   RUNNING
nat-node-eu       europe-west1-c  n1-standard-1               192.168.20.3                  RUNNING
nat-node-gcp-eu   europe-west1-c  n1-standard-1               192.168.20.5                  RUNNING
nat-node-w-eu     europe-west1-c  n1-standard-1               192.168.20.4                  RUNNING
faux-on-prem-svc  us-central1-f   n1-standard-1               10.128.0.2    35.222.233.0    RUNNING
nat-gw-us         us-central1-f   n1-standard-1               192.168.10.2  35.224.197.215  RUNNING
nat-node-us       us-central1-f   n1-standard-1               192.168.10.3  35.184.253.14   RUNNING
```