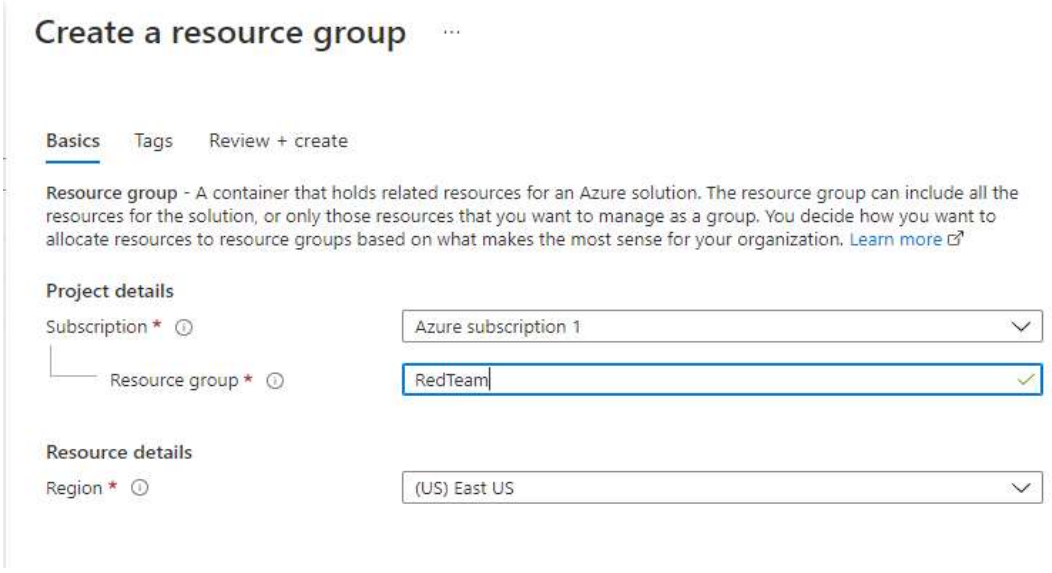
The goal of this activity is to create a highly available web server for XCorp's Red Team for training and testing purposes. We will implement IaaS to create a cloud infrastructure environment that will consist of a jump box provisioner and 2 virtual machines running DVWA that are both receiving traffic from a load a balancer. In addition, we will create a cloud monitoring system by installing and configuring an ELK stack server.

I.) Creating the Virtual Network Environment

A.) Setting up the Resource Group

1.) We will create a logical grouping of network assets in Microsoft Azure that will help incorporate automatic provisioning, network monitoring, and access control in our virtual environment by first creating a resource group. This resource group will include a logical network, firewall, virtual computer, and other network resources that will provide the Red Team with the components required to maintain a secure cloud infrastructure.

2.) Within the Azure portal, we will click on Resource Groups on the home screen, select the create resource group button, specify the name of our resource group as RedTeam, and ensure the region is selected as East US.

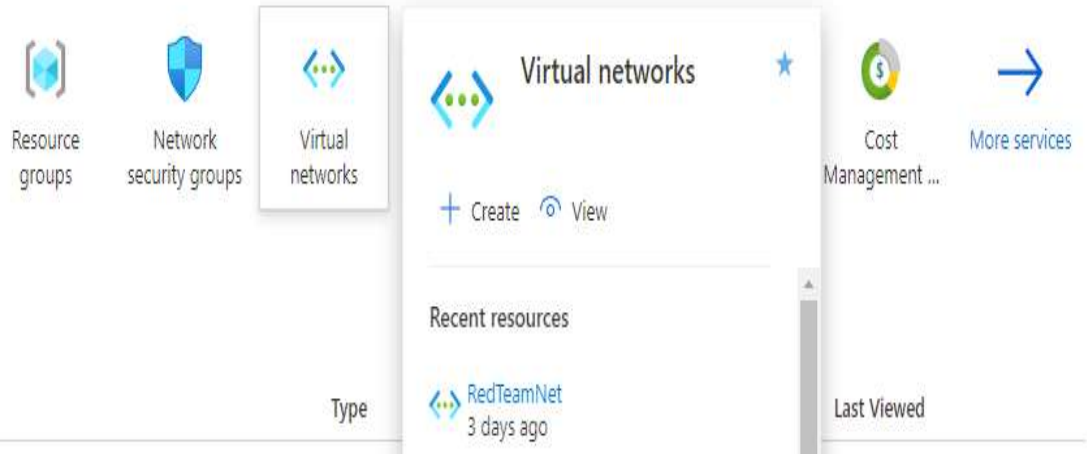


B.) Setting up the Virtual Network

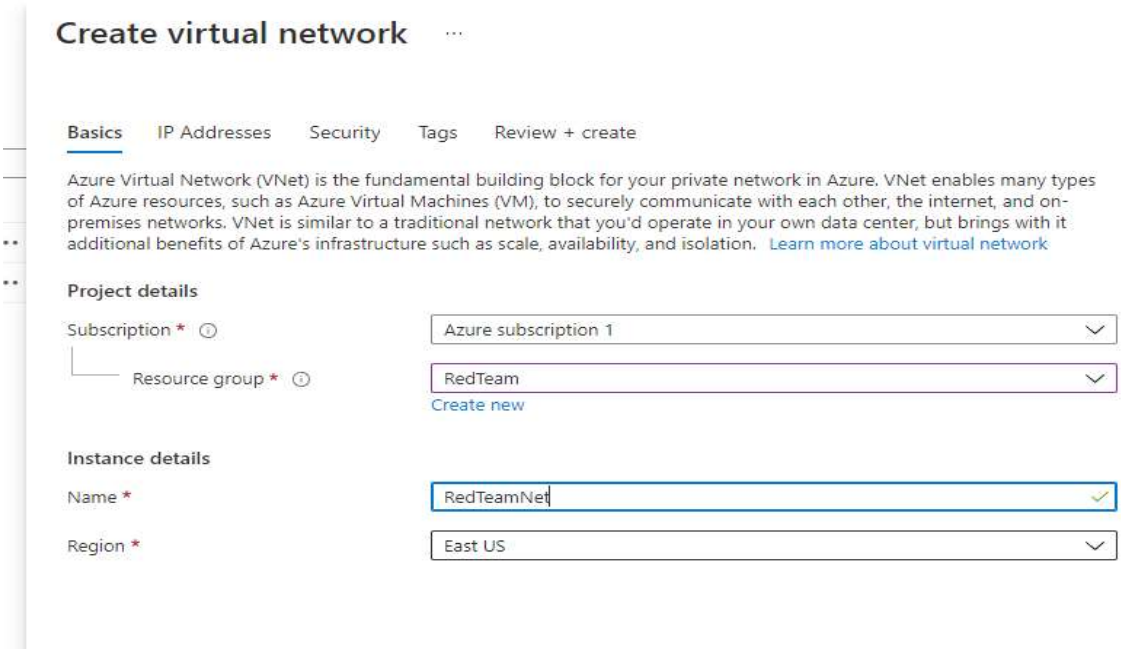
1.) We will now create a virtual network within Azure that will provide an isolated environment for our virtual machines to communicate securely with each other and outside networks. This

virtual network will allow us to deploy servers, virtual machines, and services securely from an outside network.

2.) From the home screen within the Azure portal, select the Virtual networks icon and click on the create button.



3.) Within the Basics tab of the VM creation page, we will attach our subscription to the RedTeam resource group created in the first step and ensure it is in the same East US region.



4.) Next, we will define our network and subnet within the IP Addresses tab and use the default settings provided by Azure. Our virtual network will be defined by the IP range 10.0.0.0/16. Within that network we will also have a subnet that will be defined by the IP range 10.0.0.0/24.

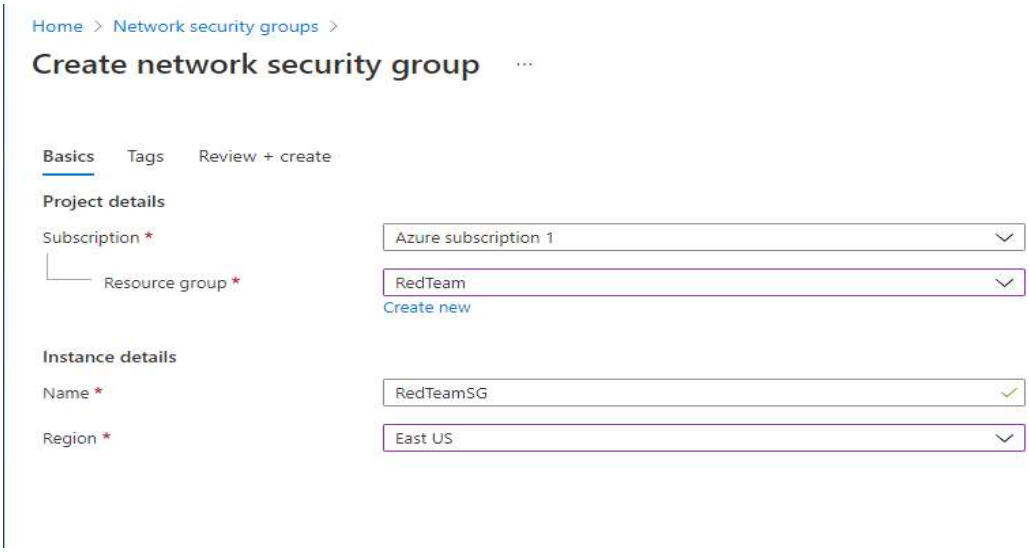
5.) The last step in creating our virtual network is to configure the security settings of the network. Based on our current subscription, we will incorporate the default settings provided by Azure and disable the BastionHost, DDoS Protection Standard, and Firewall settings. In a real-world setting, consideration should be given to enabling these settings to provide enhanced network security to the environment based on the security requirement needs of the organization.

6.) We will click on create and review to review to ensure our configuration of the virtual network is correct. Once everything looks sufficient, we will click on the create button to deploy our virtual network.

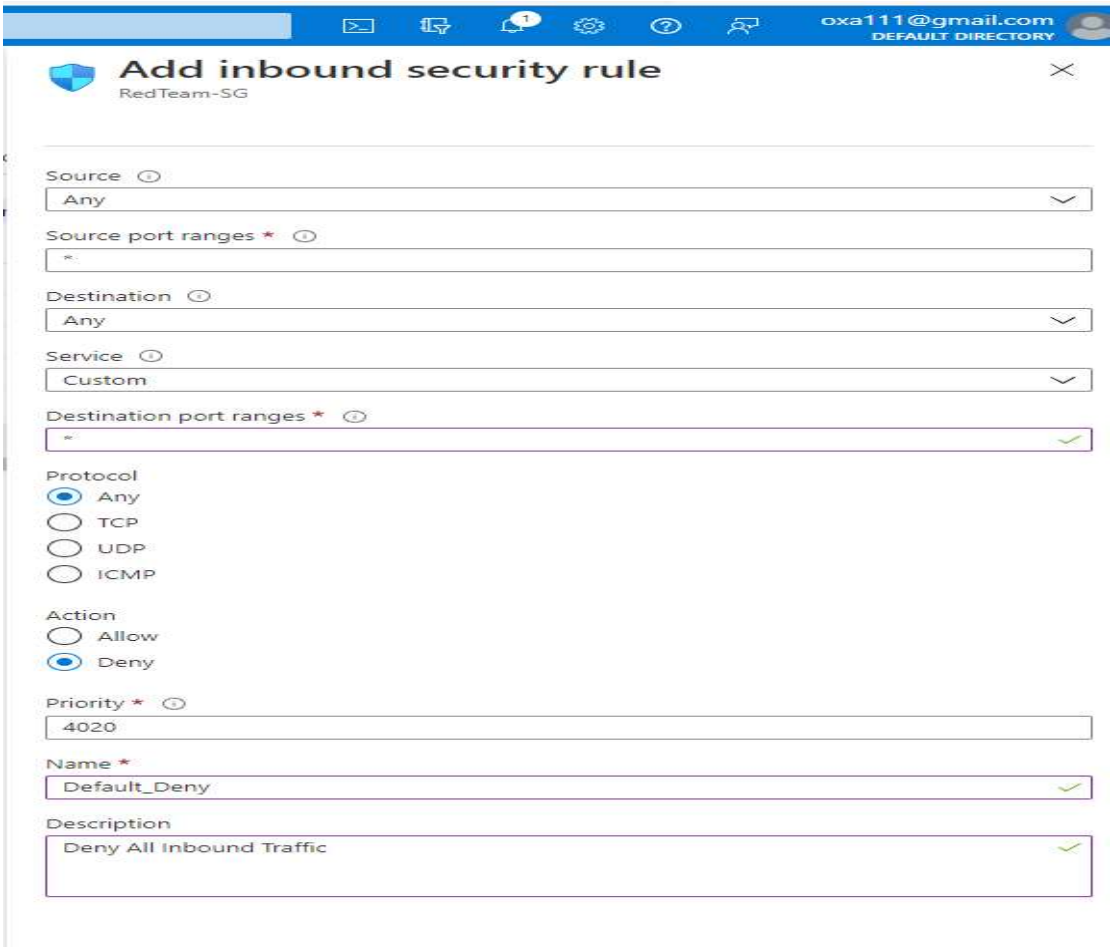
C.) Creating the Network Security Group

1.) Our goal is to have virtual machines running inside our virtual network. Before deploying any VMs in our cloud environment, we must ensure that we have a mechanism in place that will monitor the flow of inbound and outbound traffic in our newly created virtual network and the virtual machines running on that network. In Azure, a network security group (NSG) will provide the same functionality as an on-premises firewall by blocking and allowing specified traffic to our virtual network and virtual machines. The steps to follow will be used to create a NSG and configure rules to control traffic coming into the network.

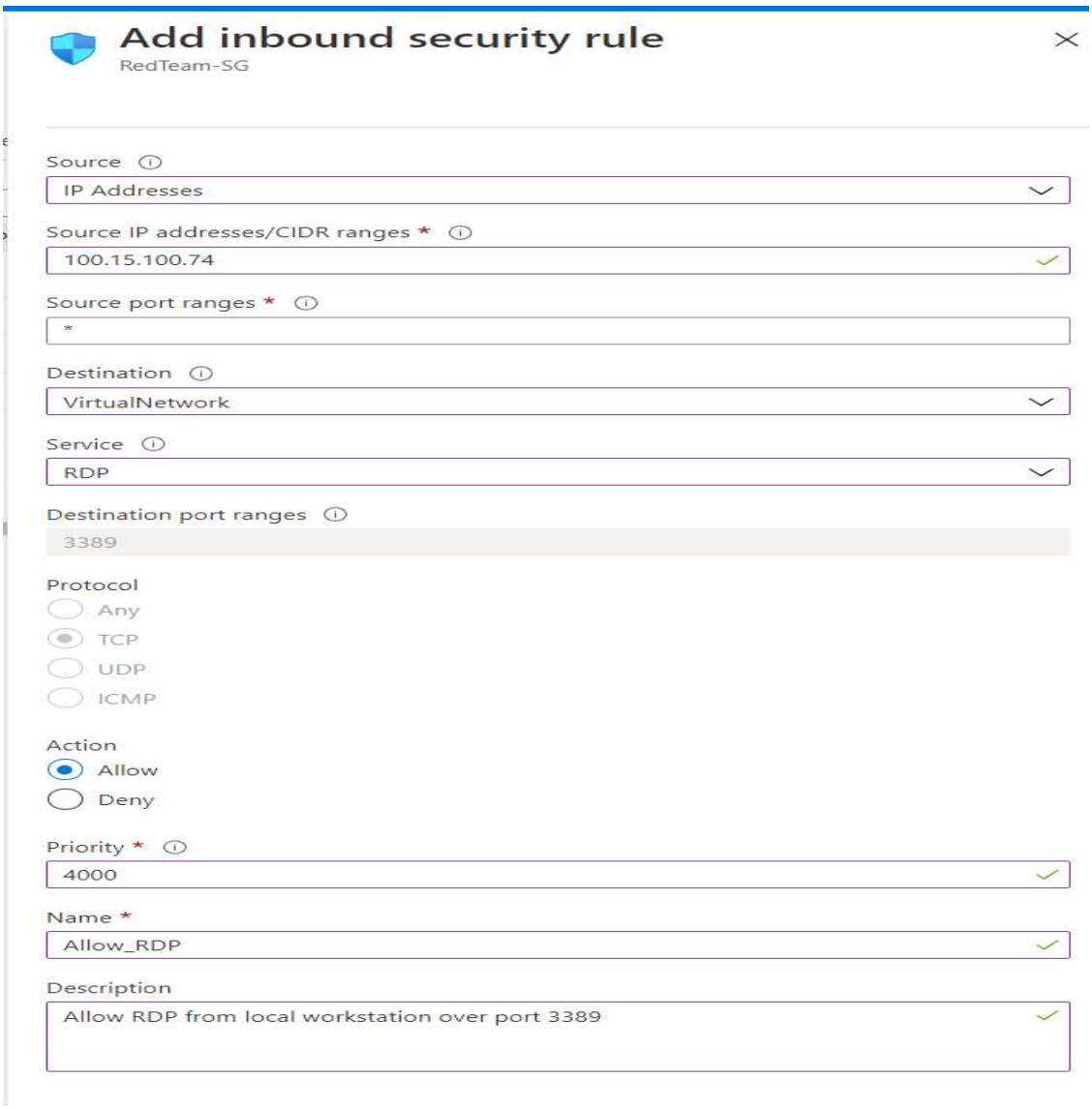
2.) We will click on the create network security group option within the Azure portal, attached the security group to our RedTeam resource group, and name our NSG RedTeamSG.



3.) The previous step helped create the NSG for our RedTeam resource group. In this step we will apply inbound security rules to restrict the flow of traffic coming into our network. We will first create a default deny inbound security rule that will block all source IP addresses and all source port ranges to any destination addresses on the network using any protocol. This default deny rule will ensure that no malicious actors can access the network while it is safely being configured to our required specifications.



4.) In the previous inbound security rule created, we denied all traffic to our virtual network. However, we will need access to our virtual network in order to configure and deploy virtual machines and services in our environment. To accomplish this, we will create a new inbound security rule that will allow traffic only from our external host workstation to connect to the virtual network via RDP. This rule will specify the source as our public IP address and allow access from any source port range. At the same time, we will specify the destination as our virtual network using port 3389 for HTTP traffic. We want this rule to be recognized before our default deny rule so we will set a lower priority number than 4020, which was our priority number for our default deny rule, to ensure it is applied first.



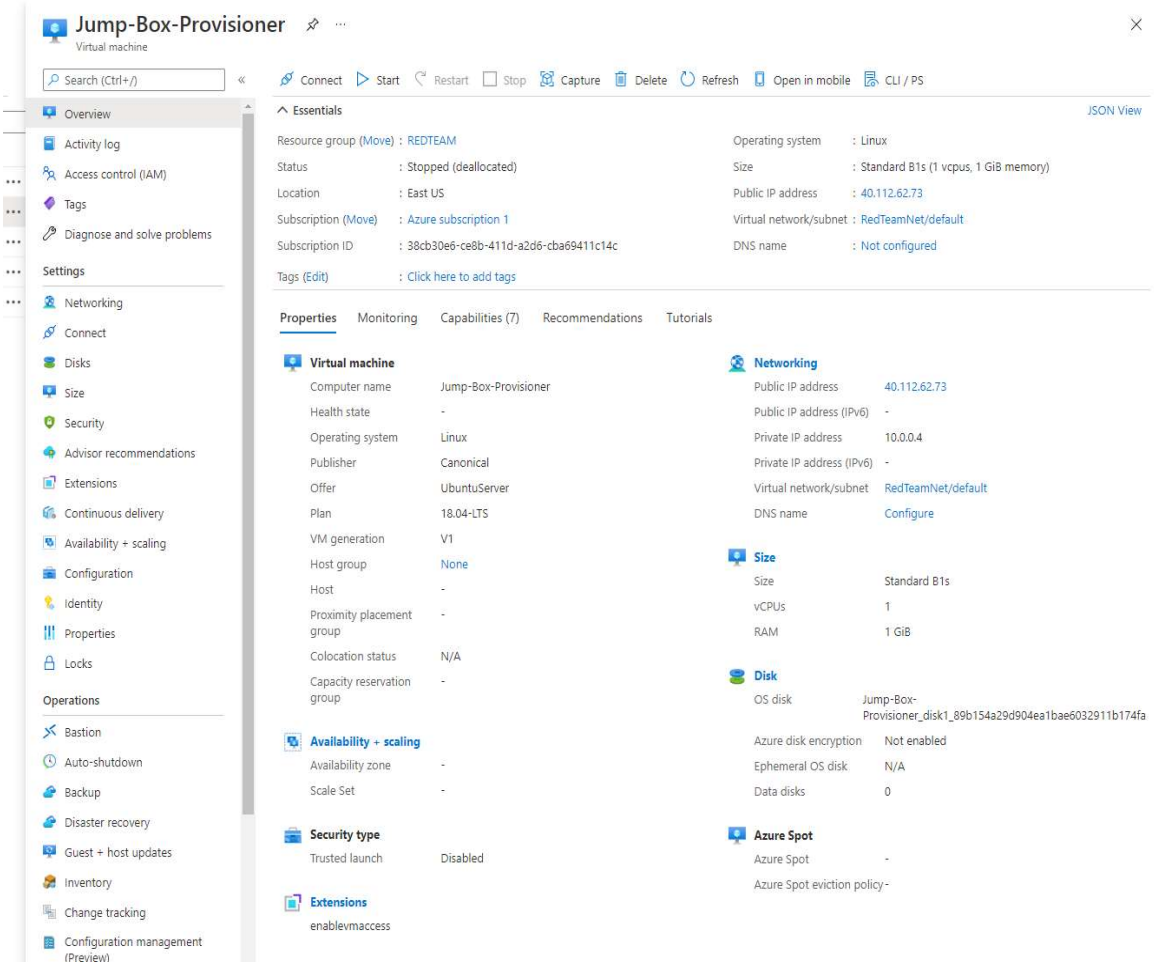
D.) Setting up the Jump Box Provisioner

1.) At this point we have created a virtual network that is protected by our NSG that allows traffic from our local workstation while blocking all other incoming traffic to the network. In the steps to follow we will create a virtual machine that will be our jump box provisioner that will allow us to configure other virtual machines in the network.

2.) We will create our jump box provisioner by allocating a software version of various components consisting of RAM, storage, OS disks, and a CPU. Within the Azure portal, we will click on the create VM button to begin the creation of our jump box provisioner and use the following settings to configure the VM.

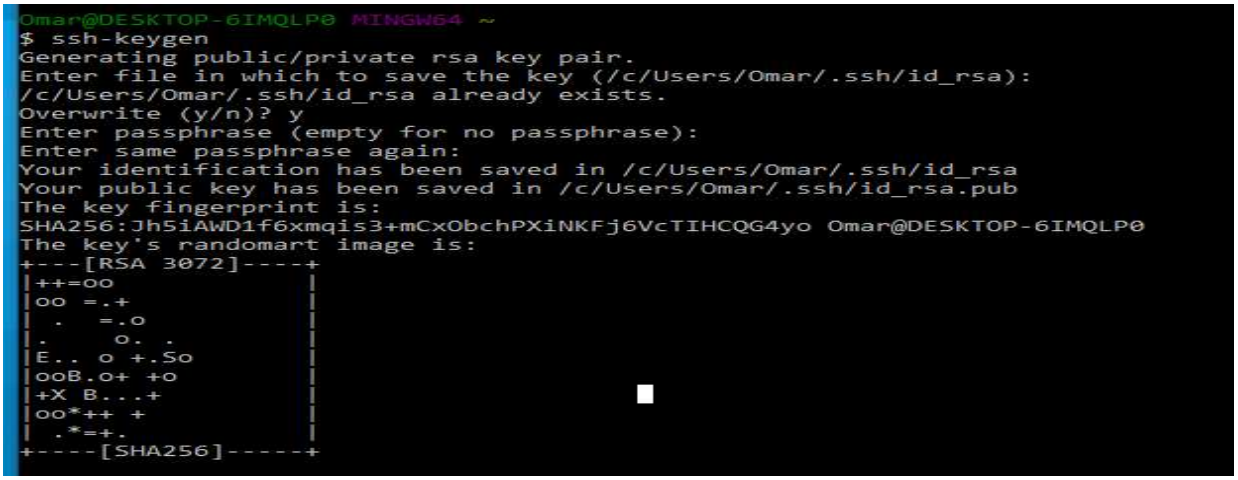
- Assign the jump box VM to our East US region
- Specify no infrastructure redundancy required
- Select theUbuntu Server 18.04 LTS image
- Allocate 1 vCPU and 1 GiB of memory to the VM
- Select SSH public key as authentication type
- Assign the VM to our RedTeam virtual network created
- Select the subnet created within the VNet created
- Use the default public IP address provided by Azure
- Choose the advanced option within the NIC network security group setting
- Assign the created RedTeam security group to the VM
- Ensure accelerated networking is kept at its default setting of off
- Confirm the load balancing selection is kept off

Once all these settings have been configured properly, the review and create option should resemble the following:

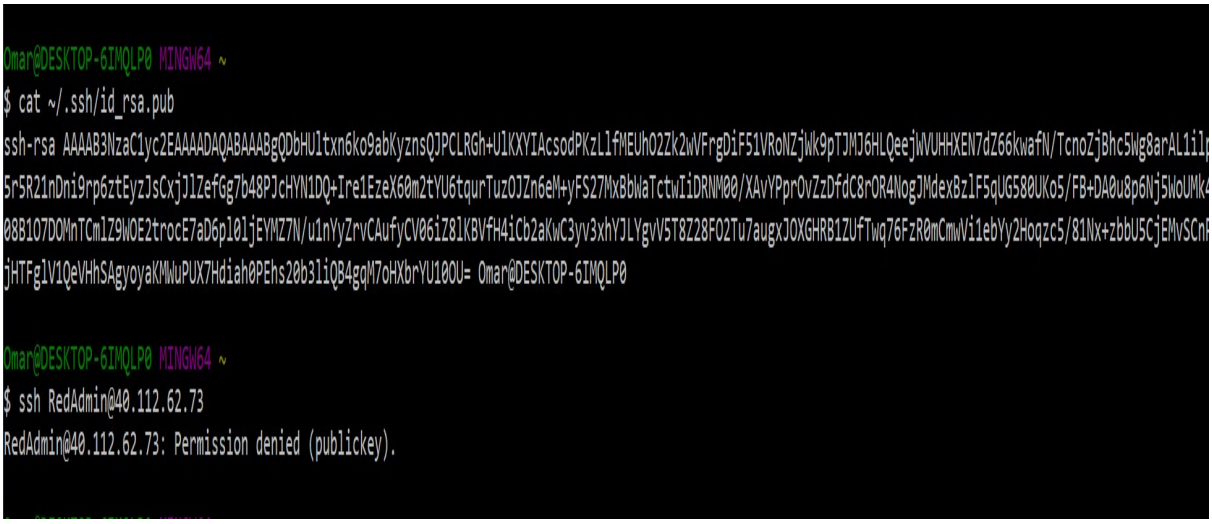


E.) Establishing an SSH Connection to the Jump Box

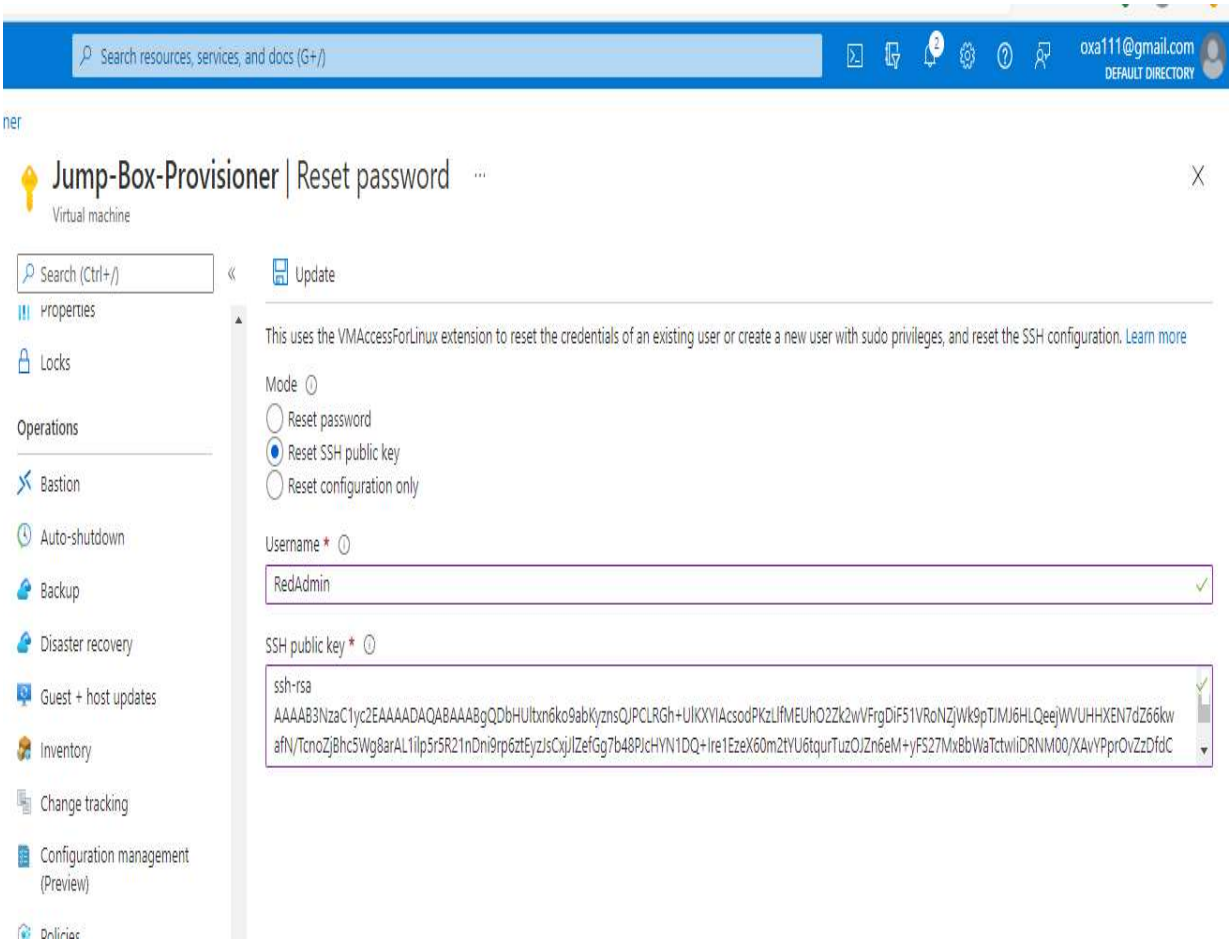
1.) We will need a mechanism that will allow us to use the jump box to access our virtual environment and configure all virtual machines inside our cloud infrastructure. Due to the security limitations of password authentication and their susceptibility to be brute forced, we will control access to our jump box server with SSH keys. To accomplish this, we will first run the command ssh-keygen within our gitbash terminal to create our SSH Key pair.



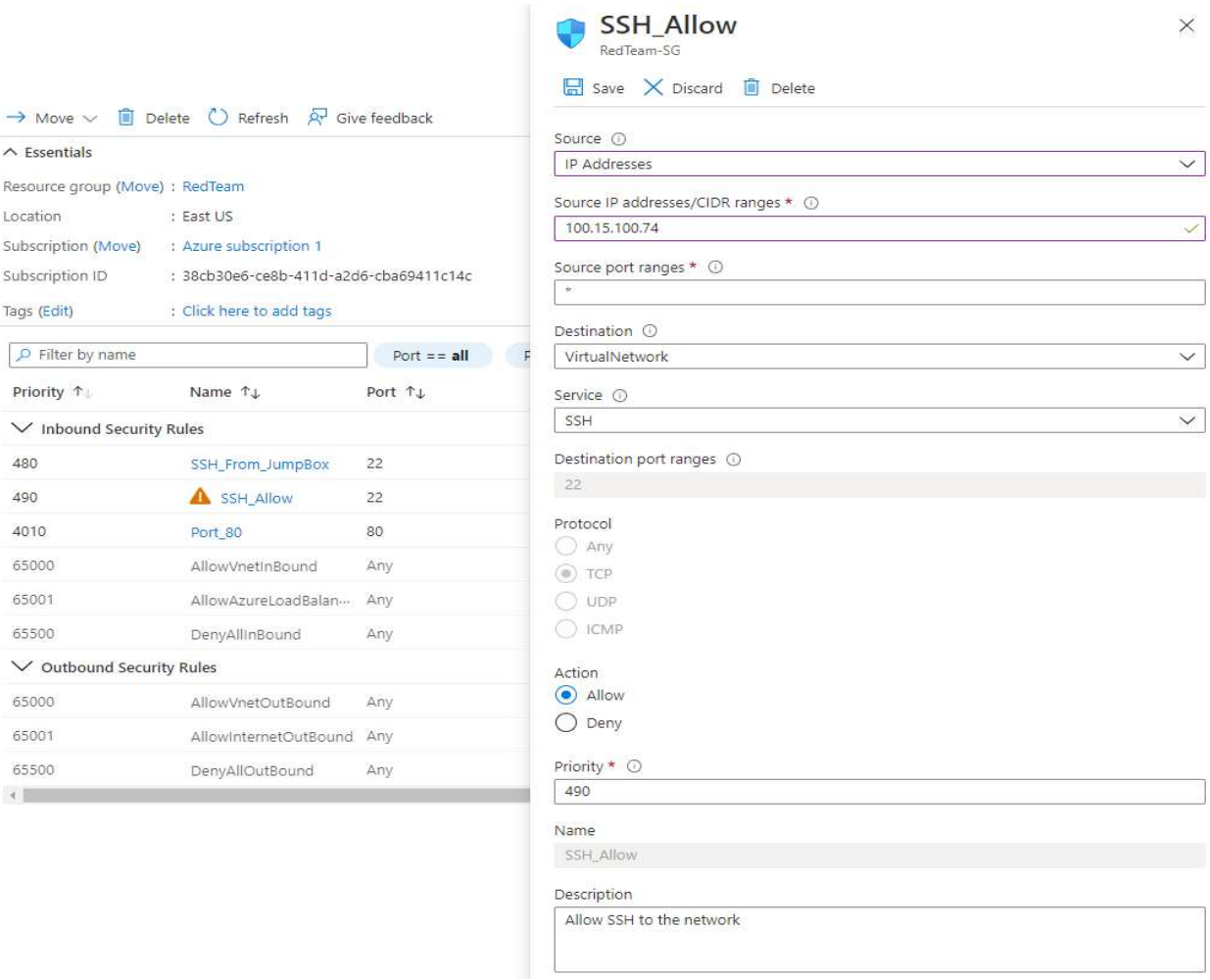
Now we will run the cat ~/.ssh/id_rsa.pub command within the terminal to display our public key.



To ensure this newly created public key can we used to access our jump box provisioner, we will copy and paste the key to the SSH public key field within the jump box VM



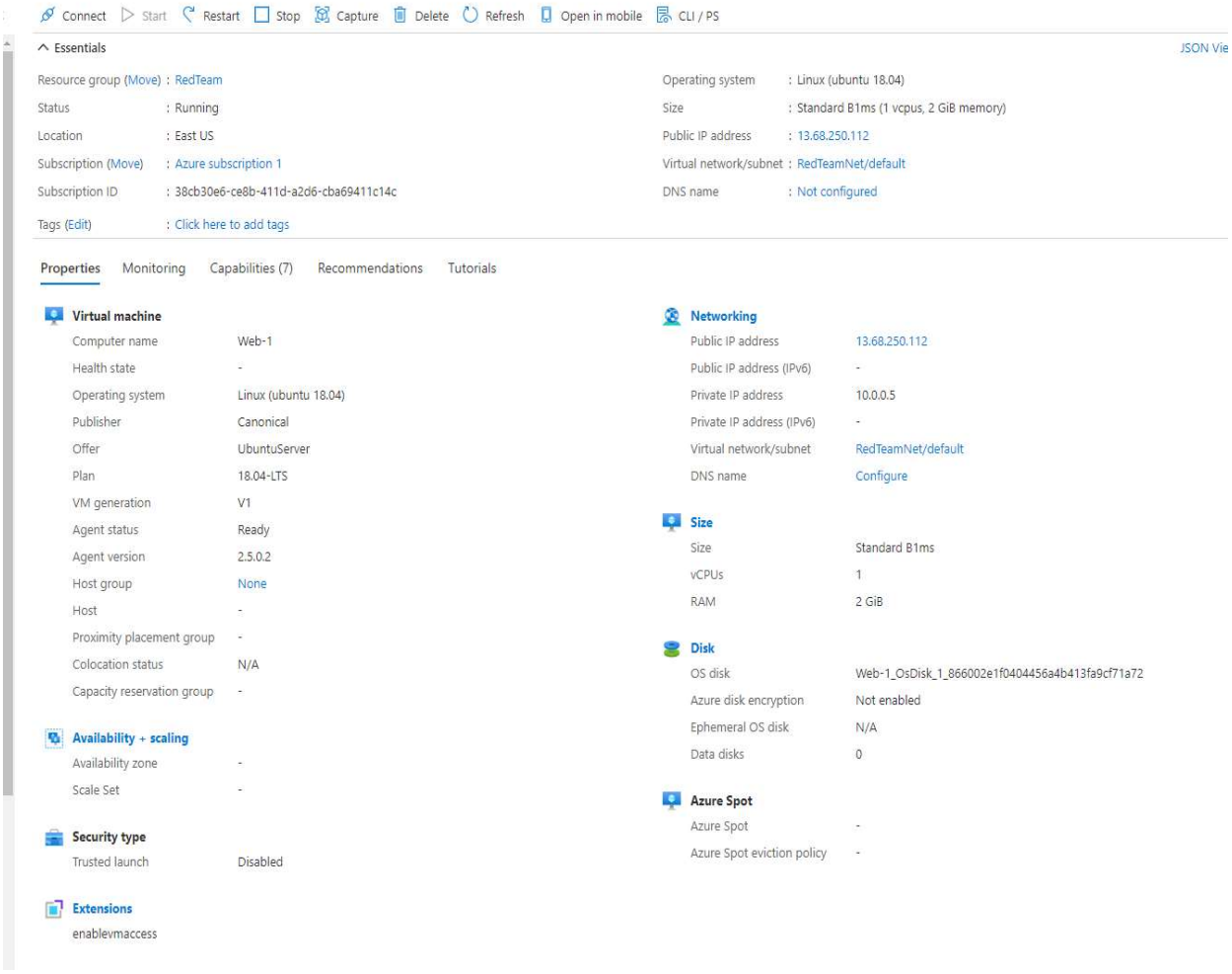
2.) We now have successfully added our SSH Key to our jump box provisioner VM. Even though our key has been added to the VM, we still cannot access the machine since we have not updated our NSG to allow inbound SSH connections. It is important to know that this was by design to prevent any malicious attackers to access the VM during our configuration process. Now that the SSH key has been added to our jump box VM, we will now update our NSG to allow inbound SSH traffic from only the IP address of our local workstation. To ensure this is configured properly, we will add an inbound network security rule to allow only our local workstation IP address from any source port to the virtual network destination using SSH port 22 with TCP traffic.



Now we are able to successfully access our jump box provisioner VM through a SSH connection from our local workstation. At the same time, we can ensure that even if our key has been compromised by a malicious attacker, our jump box VM cannot be accessed unless our local machine has also been compromised.

F.) Creating Two Additional Virtual Machines in the Virtual Network and Allowing SSH Connection From the Jump Box Provisioner

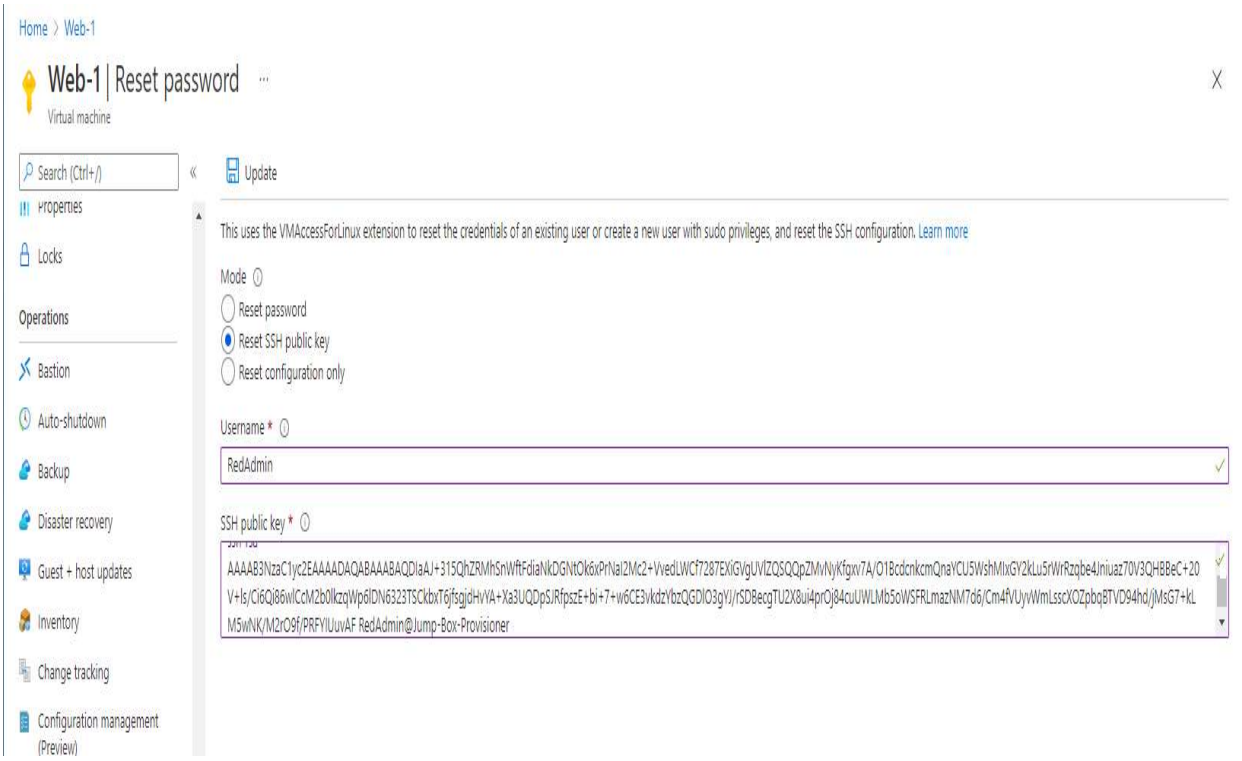
1.) We will now create 2 additional Ubuntu Server 18.04 LTS VMs inside our Red Team resource group and same US Region. Both of these machines will utilize the same Standard B1ms offering that allocates 1 CPU and 2 GiBs of RAM. We must also ensure that these VMs are in the same availability set so that they both can be added to the load balancer that we will later incorporate into our network. These VMS will also use SSH public key for authentication. In addition, they will be assigned to the same RedTeamNSG and will not have a public IP address. The configuration of the newly created Web-1 and Web-2 should have the below configuration:



2.) We will now configure both the Web-1 VM and the Web-2 VM so that they can be accessed and configured via the jump box provisioner by generating a new SSH key pair within the jump box provisioner and adding the key to each of the VMs.

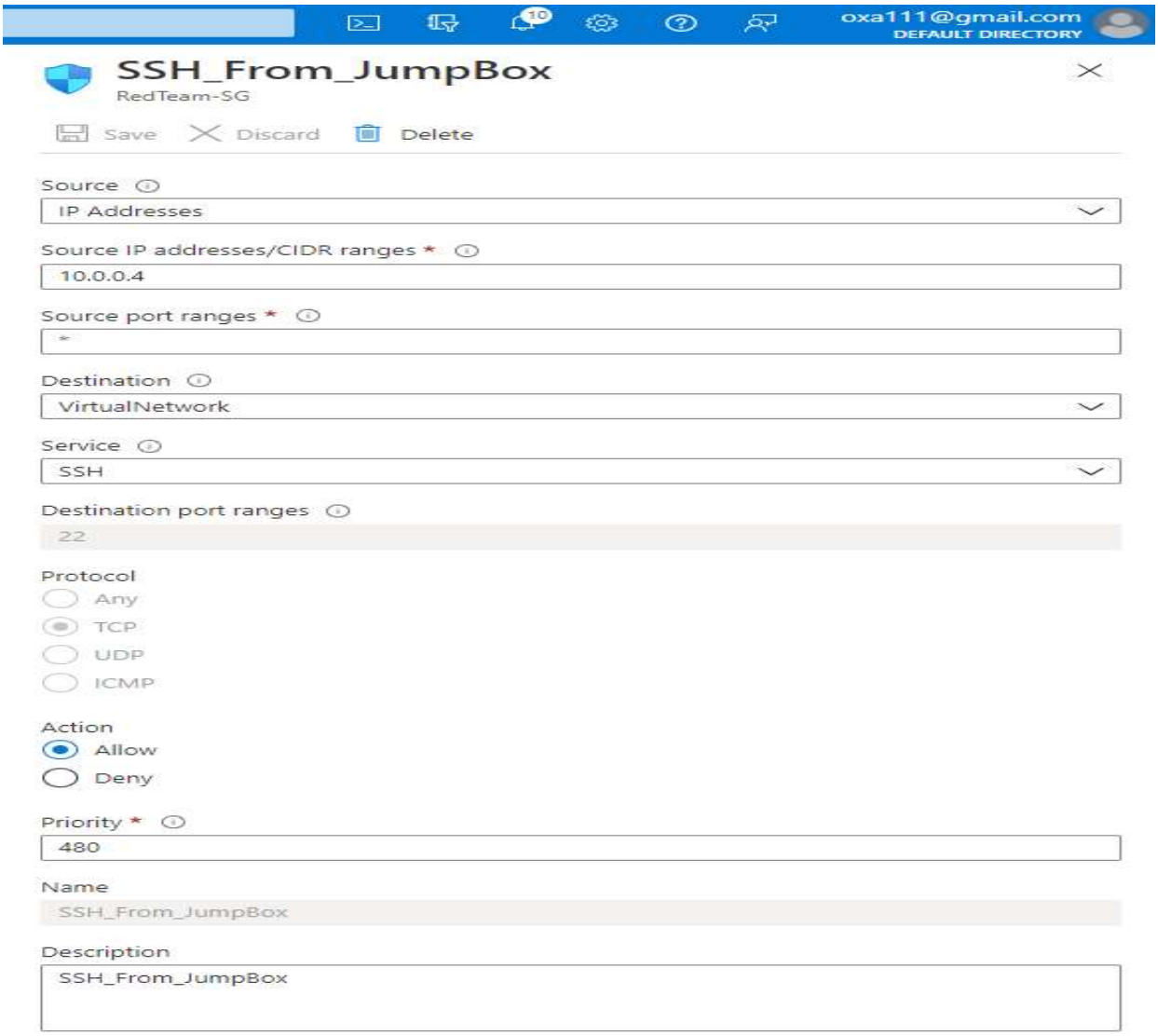
```
RedAdmin@Jump-Box-Provisioner:~$ ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/home/RedAdmin/.ssh/id_rsa):
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /home/RedAdmin/.ssh/id_rsa.
Your public key has been saved in /home/RedAdmin/.ssh/id_rsa.pub.
The key fingerprint is:
SHA256:j5/lMYVvK/D647IlUs5stNUgBkTlpgjetbxhDAtEvHs RedAdmin@Jump-Box-Provisioner
The key's randomart image is:
+---[RSA 2048]----+
|    oo  o+..     |
|    ..    o      |
|     o.. . = .   |
|    ..+ B = . +  |
|     ..+ S o o o |
|     . E. @.o o  |
|      .  + Oo= o |
|         +.*++ . |
|          =*+o.  |
+----[SHA256]-----+
RedAdmin@Jump-Box-Provisioner:~$ cat ~/.ssh/id_rsa.pub
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABAQDIaAJ+315QhZRMhSnWftFdiaNkDGNtOk6xPrNaI2Mc2+VvedLWCf728
kLu5rWrRzqbe4Jniuaz70V3QHBBeC+20V+ls/Ci6Qi86wlCcM2b0lkzqWp6lDN6323TSCkbxT6jfsgjdHvYA+Xa3UQDpS
4cuUWLMb5oWSFRLmazNM7d6/Cm4fVUyvWmLsscXOZpbqBTVD94hd/jMsG7+kLM5wNK/M2rO9f/PRFYIUuvAF RedAdmin
```

The key has been generated within the jump box provisioner.



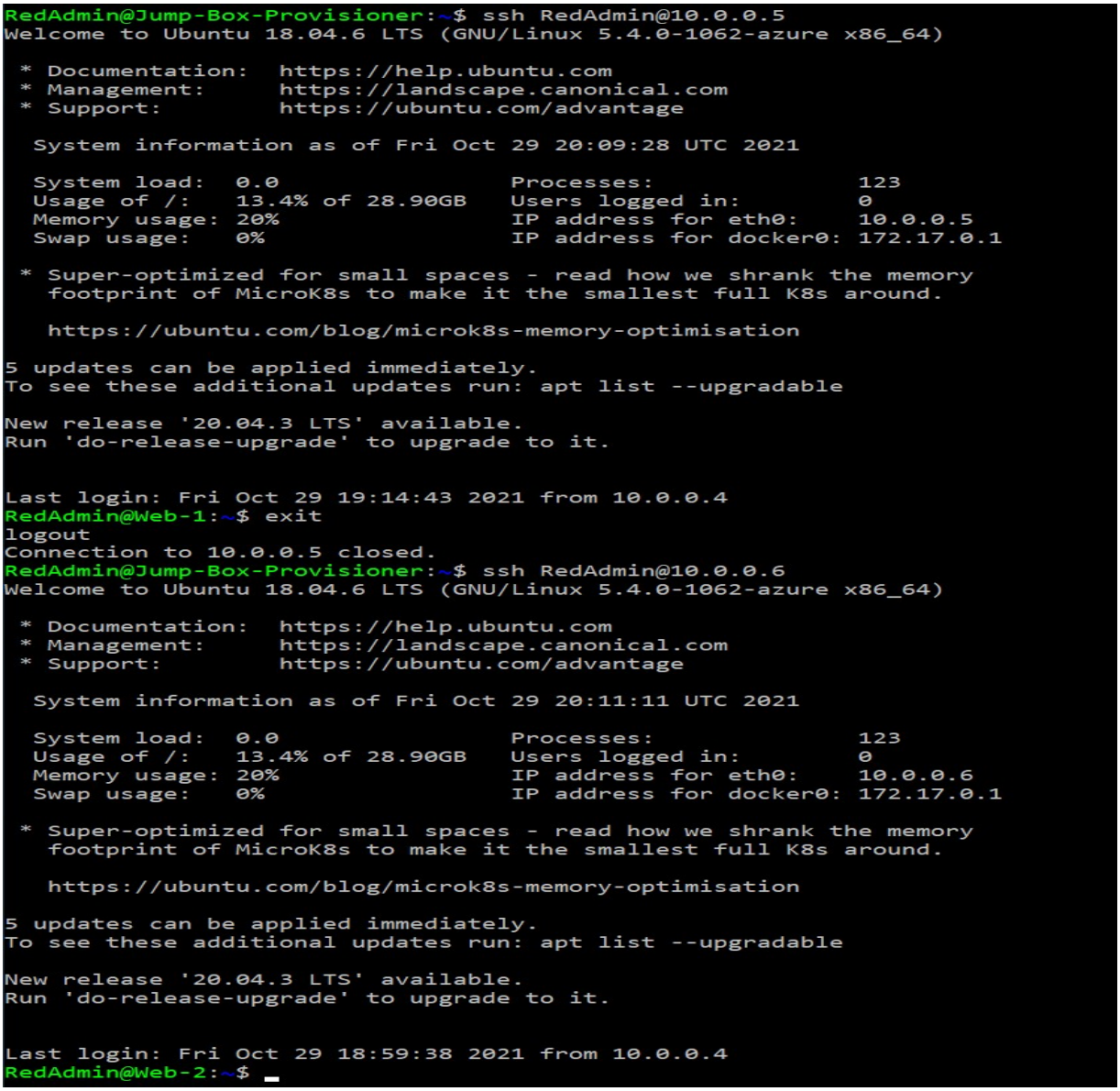
The key has been added to Web-1 and Web-2 to allow access from the jump box provisioner.

3.) Now that both newly created VMs have been configured with newly generated SSH key, we must now reconfigure our RedTeamSG to allow SSH connections from our jump box provisioner to our Web-1 and Web-2 VMs. To accomplish this, we will create a new inbound security rule that will specify the source IP private address of the jump box provisioner (10.0.0.4), allow traffic from any source port, designating the service as SSH on port 22, and selecting the virtual network as the destination. The newly configured rule allowing SSH from the jump box should resemble the following:



4.) Now that the SSH keys have been added to our web server VMs, we will now test out the connectivity from our jump box to each of the VMs to ensure they are properly configured.

From the jump box, we will attempt to SSH to each of the Web-1 and Web-2 using their private IP addresses of 10.0.05 and 10.0.0.6.



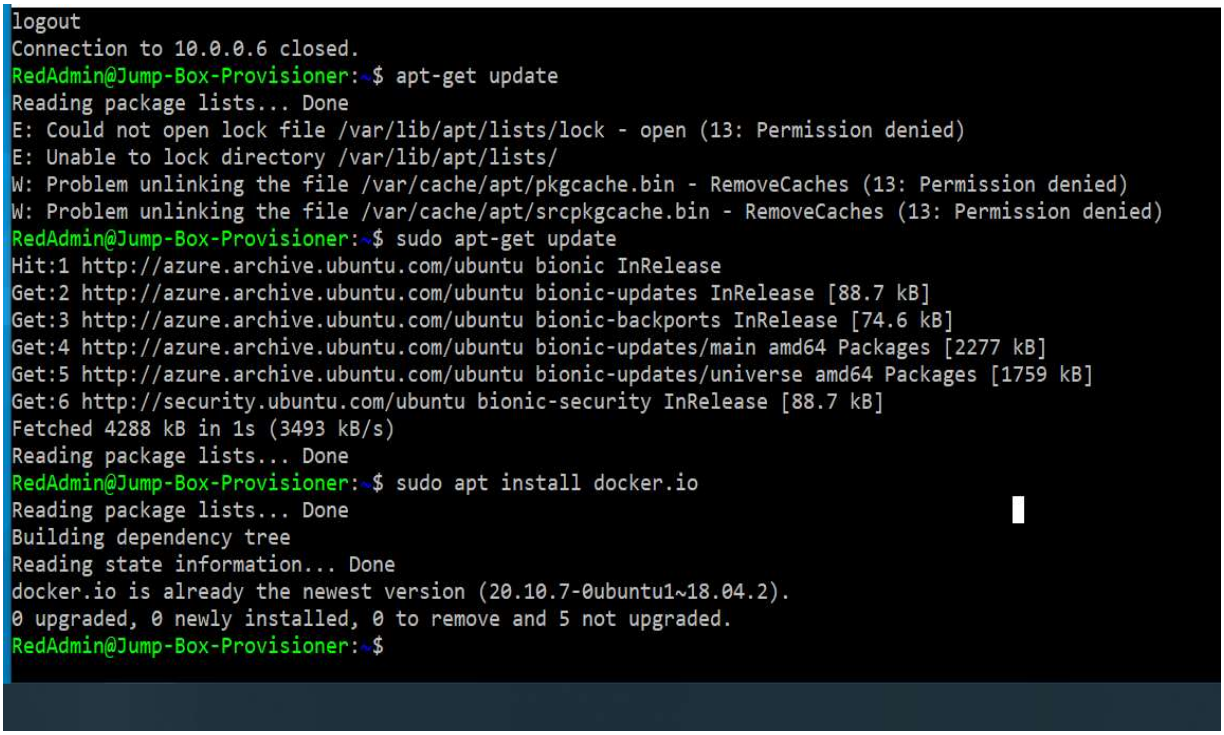
II.) Configuring the Jump Box VM to Provision Docker Containers

A.) Installing Docker Containers

1.) At this point we have created a resource group with a virtual network, 1 jump box provisioner, 2 addition VM web servers, and a network security group within our cloud infrastructure. The NSG has been properly configured to only allow access from the public IP address of our workstation while denying all other incoming traffic into the network. In addition, inbound rules

have been created to allow an SSH connection from our local workstation to our jump box provisioner and an SSH connection from the jump box provisioner to the Web-1 and Web-2 VMs. Our cloud environment has been properly setup and securely configured so that we can now install and run containers from our jump box to configure our Web-1 and Web-2 VMs. This will be accomplished by first installing Docker on our jump box provisioner and downloading an Ansible container that will act as a provisioner to our Web-1 and Web-2 VMs.

2.) After establishing an SSH connection to our jump box provisioner, we will run the apt-get update to ensure we are running the latest images and install docker with the sudo apt install docker.io command.



3.) We will verify the Docker server is running by running the sudo systemctl status docker command.

```
RedAdmin@Jump-Box-Provisioner:~$ sudo systemctl status docker
● docker.service - Docker Application Container Engine
   Loaded: loaded (/lib/systemd/system/docker.service; enabled; vendor preset: enabled)
   Active: active (running) since Fri 2021-10-29 18:14:36 UTC; 2h 4min ago
     Docs: https://docs.docker.com
 Main PID: 1461 (dockerd)
    Tasks: 13
   CGroup: /system.slice/docker.service
           └─1461 /usr/bin/dockerd -H fd:// --containerd=/run/containerd/containerd.sock

Oct 29 18:14:35 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:35.527219900Z" lev
Oct 29 18:14:35 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:35.527334800Z" lev
Oct 29 18:14:35 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:35.527785800Z" lev
Oct 29 18:14:35 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:35.869198500Z" lev
Oct 29 18:14:35 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:35.932188700Z" lev
Oct 29 18:14:36 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:36.326211757Z" lev
Oct 29 18:14:36 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:36.326846240Z" lev
Oct 29 18:14:36 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:36.329960177Z" lev
Oct 29 18:14:36 Jump-Box-Provisioner systemd[1]: Started Docker Application Container Engine.
Oct 29 18:14:36 Jump-Box-Provisioner dockerd[1461]: time="2021-10-29T18:14:36.416384074Z" lev
lines 1-19/19 (END)
```

4.) After verifying that the Docker service is up and running, we will now download a Docker image with the sudo docker pull cyberxsecurity/ansible command.

5.) Now that the Docker image has been downloaded, we will run the docker container list -a command to view the name of our container.

```
RedAdmin@Jump-Box-Provisioner:~$ sudo docker container list -a
CONTAINER ID   IMAGE                          COMMAND                  CREATED       STATUS                      PORTS     NAMES
115036c12357   cyberxsecurity/ansible         "/bin/sh -c /bin/bas…"   10 days ago   Exited (127) 10 days ago              objective_khorana
2bf428ca9a7d   cyberxsecurity/ansible:latest  "/bin/sh -c /bin/bas…"   12 days ago   Exited (127) 12 days ago              gracious_banzai
3eab3f49ae85   cyberxsecurity/ansible:latest  "/bin/sh -c /bin/bas…"   12 days ago   Exited (127) 12 days ago              focused_roentgen
83f2a245eaf2   cyberxsecurity/ansible:latest  "/bin/sh -c /bin/bas…"   12 days ago   Exited (127) 12 days ago              pensive_solomon
10483885e930   cyberxsecurity/ansible         "/bin/sh -c /bin/bas…"   13 days ago   Exited (127) 13 days ago              strange_shaw
11f0f2047a1c   cyberxsecurity/ansible:latest  "/bin/sh -c /bin/bas…"   13 days ago   Exited (137) 19 hours ago             goofy_easley
RedAdmin@Jump-Box-Provisioner:~$
```

The name of our container has been identified as goofy_easley.

6.) We will now start the container with the sudo docker start goofy_easley command and confirm it is running with the sudo docker ps command.

```
RedAdmin@Jump-Box-Provisioner:~$ sudo docker start goofy_easley
goofy_easley
RedAdmin@Jump-Box-Provisioner:~$ sudo docker ps
CONTAINER ID   IMAGE                              COMMAND
11f0f2047a1c   cyberxsecurity/ansible:latest      "/bin/sh -c /bin/
RedAdmin@Jump-Box-Provisioner:~$
```

B.) Provisioning the Ansible Container

1.) Now that we have started the container, our next task is to activate a shell and connect to the Ansible Docker Container with the sudo docker attach goofy_easley command.

```
RedAdmin@Jump-Box-Provisioner:~$ sudo docker attach goofy_easley
root@11f0f2047a1c:~#
```

The change in the prompt means we are now connected to the SSH container.

2.) To establish a connection from the Ansible Container to Web-1 and Web-2 we will first need to create an ssh key from inside the ansible container with the ssh-keygen command and run the cat .ssh/id_rsa.pub command to view the key.

```
RedAdmin@10.0.0.6: Permission denied (publickey).
root@11f0f2047a1c:~# ssh-keygen
Generating public/private rsa key pair.
Enter file in which to save the key (/root/.ssh/id_rsa):
/root/.ssh/id_rsa already exists.
Overwrite (y/n)? y
Enter passphrase (empty for no passphrase):
Enter same passphrase again:
Your identification has been saved in /root/.ssh/id_rsa
Your public key has been saved in /root/.ssh/id_rsa.pub
The key fingerprint is:
SHA256:yV6R9MYLQfWef4qGVLHjDvXb5IM16N+wJG5gAgqT5fA root@11f0f2047a1c
The key's randomart image is:
+---[RSA 3072]----+
|          .+..    |
|   . .    . =..   |
|    *      + +o.  |
|   + E  .. . +=o . |
|    o . .S .+.o+  |
|     .   ...= ...+.|
|         .+ =o ==+|
|           ..+*.==|
|            oo +.o|
+----[SHA256]-----+
root@11f0f2047a1c:~# cat .ssh/id_rsa.pub
ssh-rsa AAAAB3NzaC1yc2EAAAADAQABAAABgQCyJgYWkHK1nfHzA5rk6rzissewzbDL2xOF/QRW
6VIDeucOcdvpgrr86n7jyIhMK/Xx7Xmaj+sKDErSkk7SN1j6Gq4YLwdWm4ruafKIT7XL91OXuEJb
RhCehr/+XFYlzD5JtlToL8GPCDrPrzuNKTTXL5uMzl+Kc1z5a2iY+ERUs1r6x9f5XoDabVJIuH9u
3jzCZbCCeefQz+RVLFltSt7DGu8PWlbdEJ8s9V0FVZd/fKHOJ5ggmKzne664J9D2CRyKjuL9WzMG
h4l72ss= root@11f0f2047a1c
root@11f0f2047a1c:~#
```

3.) We will now use the newly generated key and install it on our Web-1 and Web-2 VMs.

4.) Verify the VMs have been property configured with the SSH key by establishing a SSH connection to each VM.

```
Connection to 10.0.0.6 closed.
root@11f0f2047a1c:~# ssh RedAdmin@10.0.0.5
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1062-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Fri Oct 29 20:53:41 UTC 2021

  System load:  0.0               Processes:              123
  Usage of /:   13.4% of 28.90GB  Users logged in:        0
  Memory usage: 20%               IP address for eth0:    10.0.0.5
  Swap usage:   0%                IP address for docker0: 172.17.0.1

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.

   https://ubuntu.com/blog/microk8s-memory-optimisation

5 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '20.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


Last login: Fri Oct 29 20:50:21 2021 from 10.0.0.4
RedAdmin@Web-1:~$ exit
logout
Connection to 10.0.0.5 closed.
root@11f0f2047a1c:~# ssh RedAdmin@10.0.0.6
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1062-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Fri Oct 29 20:53:45 UTC 2021

  System load:  0.0               Processes:              124
  Usage of /:   13.4% of 28.90GB  Users logged in:        0
  Memory usage: 20%               IP address for eth0:    10.0.0.6
  Swap usage:   0%                IP address for docker0: 172.17.0.1

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.
```

5.) Our VMs have now been properly configured with the SSH key generated from within the Ansible container. To ensure the Ansible Container can connect to the Web-1 and Web-2 VMs, we must configure the ansible.cfg file to add our RedAdmin username to allow Ansible to make the proper connections. First, we will navigate into the /etc/ansible directory and use the nano ansible.cfg command to edit the configuration file and add our RedAdmin username.

```
# default user to use for playbooks if user is not specified
# (/usr/bin/ansible will use current user as default)
remote_user = RedAdmin

# logging is off by default unless this path is defined
# if so defined, consider logrotate
#log_path = /var/log/ansible.log

# default module name for /usr/bin/ansible
#module_name = command

# use this shell for commands executed under sudo
# you may need to change this to bin/bash in rare instances
# if sudo is constrained
#executable = /bin/sh

# if inventory variables overlap, does the higher precedence one win
```

6.) Next, we will alter the hosts configuration file to add the private IP addresses of Web-1 and Web-2. After using the nano hosts command to enter the hosts file, we will locate the web servers group of IP address and add in 10.0.0.5 for Web-1 and 10.0.0.6 for Web-2. In addition, we will also add the python line ansible_python_interpreter=/usr/bin/python3 line to the right of each IP address.

```
[webservers]
#alpha.example.org
#beta.example.org
#192.168.1.100
#192.168.1.110
10.0.0.5 ansible_python_interpreter=/usr/bin/python3
10.0.0.6 ansible_python_interpreter=/usr/bin/python3
```

7.) We will now test our Ansible connection to our VMs with the following command ansible webservers -m ping.

```
root@11f0f2047a1c:/etc/ansible# ansible webservers -m ping
10.0.0.6 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
10.0.0.5 | SUCCESS => {
    "changed": false,
    "ping": "pong"
}
```

Based on the output we can see that the Ansible container was able to successfully connect to our VMs.

III.) Create an Ansible Playbook to Configure Each VM with the DVWA Web Application

A.) Creating an Ansible Playbook

1.) In the previous step, we deployed an Ansible container that can connect and access our Web-1 and Web-2 VMs. Using the concept of Infrastructure as a Code, we will now create an Ansible playbook that installed Docker in order to configure our Web-1 and Web-2 VMS with DVWA. The playbook will be written using YAML code that will be used to run our "plays" to run and configure each of our servers with the web application. The code that will be used is as follows:

```
---
  - name : Config Web VM with Docker
    hosts: webservers
    become: true
    tasks:

    - name: docker.io
      apt:
        update_cache: yes
        name: docker.io
        state: present

    - name: Install pip3
      apt:
        name: python3-pip
        state: present

    - name: Install Python Docker Module
      pip:
        name: docker
        state: present

    - name: download and launch a docker web container
      docker_container:
        name: dvwa
        image: cyberxsecurity/dvwa
        state: started
        restart_policy: always
        published_ports: 80:80
```

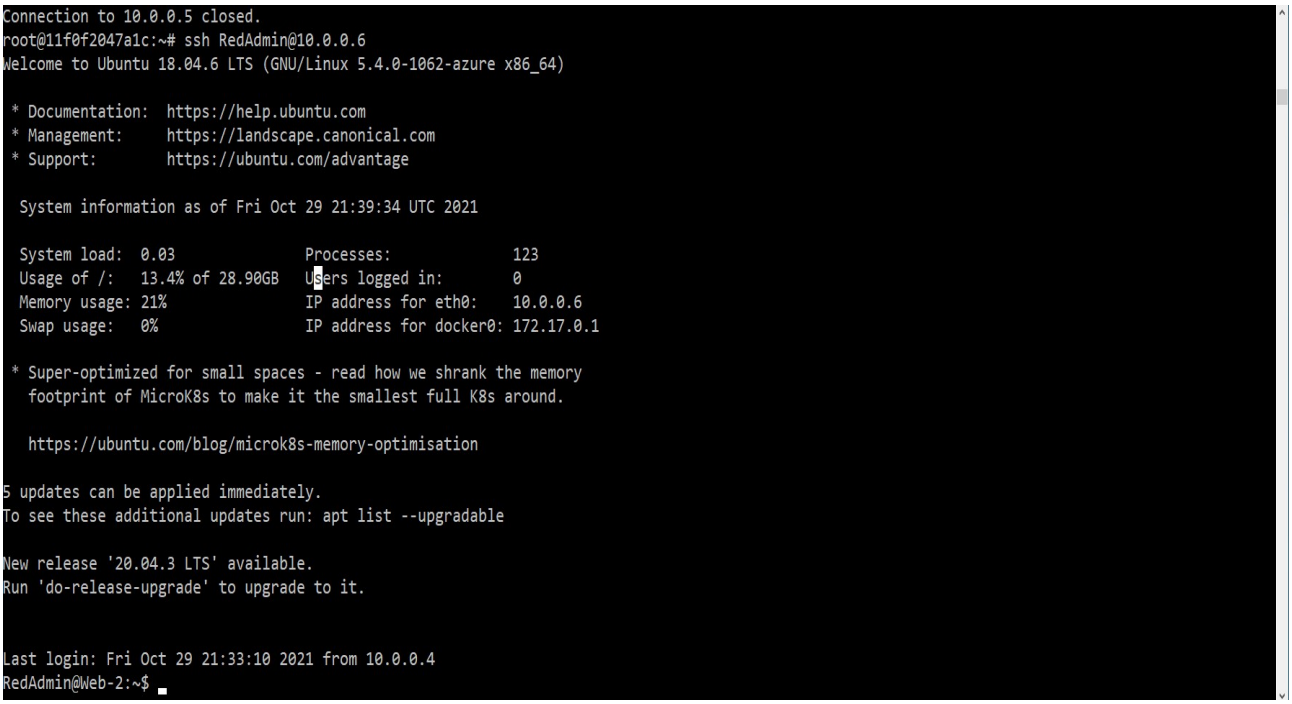
2.) We will now run our Ansible playbook using the ansible-playbook pentest.yml command. In this case pentest.yml is the name of our Ansible playbook that will configure each of the VMs with DVWA.

```
root@11f0f2047a1c:~# ansible-playbook pentest.yml
[WARNING]: ansible.utils.display.initialize_locale has not been called, this may result in incorrectly calculated text widths that can cause
Display to print incorrect line lengths

PLAY [Config Web VM with Docker] ***********************************************************************************************************

TASK [Gathering Facts] *********************************************************************************************************************
ok: [10.0.0.6]
ok: [10.0.0.5]
ok: [10.0.0.7]

TASK [docker.io] ***************************************************************************************************************************
ok: [10.0.0.6]
ok: [10.0.0.5]
ok: [10.0.0.7]

TASK [Install pip3] ************************************************************************************************************************
ok: [10.0.0.6]
ok: [10.0.0.7]
ok: [10.0.0.5]

TASK [Install Python Docker Module] ********************************************************************************************************
ok: [10.0.0.6]
ok: [10.0.0.7]
ok: [10.0.0.5]

TASK [download and launch a docker web container] ******************************************************************************************
[DEPRECATION WARNING]: The container_default_behavior option will change its default value from "compatibility" to "no_defaults" in
```

3.) We will now ensure that DVWA is running on Web-1 and Web-1 by establishing an SSH connection from the Ansible Container to each VM.

```
Select RedAdmin@Web-1: ~
10.0.0.5                   : ok=5    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=
10.0.0.6                   : ok=5    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=
10.0.0.7                   : ok=5    changed=0    unreachable=0    failed=0    skipped=0    rescued=0    ignored=

root@11f0f2047a1c:~# ssh RedAdmin@10.0.0.5
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1062-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Fri Oct 29 21:34:18 UTC 2021

  System load:  0.11              Processes:             123
  Usage of /:   13.4% of 28.90GB  Users logged in:       0
  Memory usage: 20%               IP address for eth0:   10.0.0.5
  Swap usage:   0%                IP address for docker0: 172.17.0.1

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.

   https://ubuntu.com/blog/microk8s-memory-optimisation

5 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '20.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
```

Web-1 with Private IP address of 10.0.0.5 is up and running.



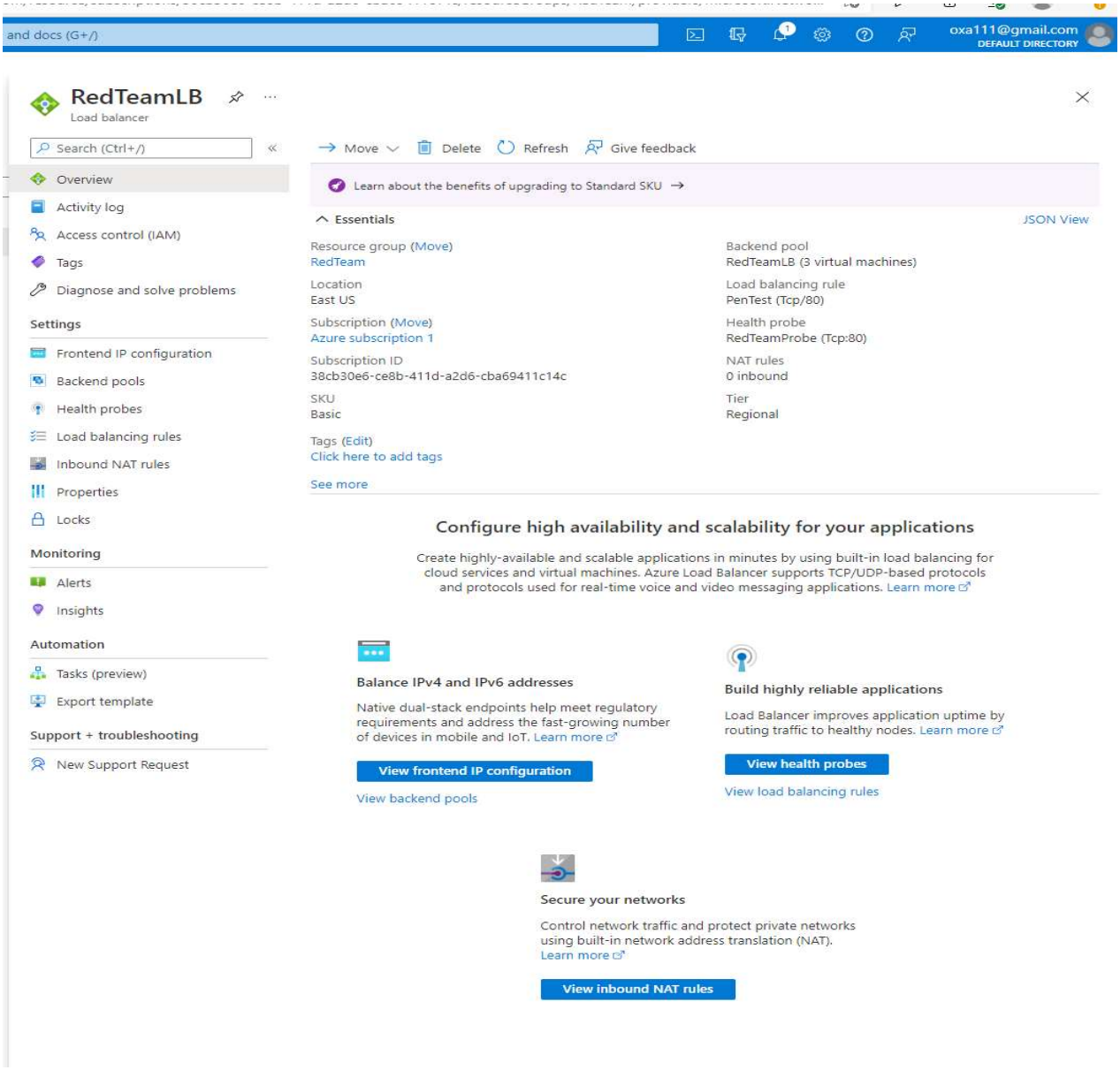
Web-2 with Private IP address of 10.0.0.6 is up and running.

V.) Deploying a Load Balancer in the Virtual Network

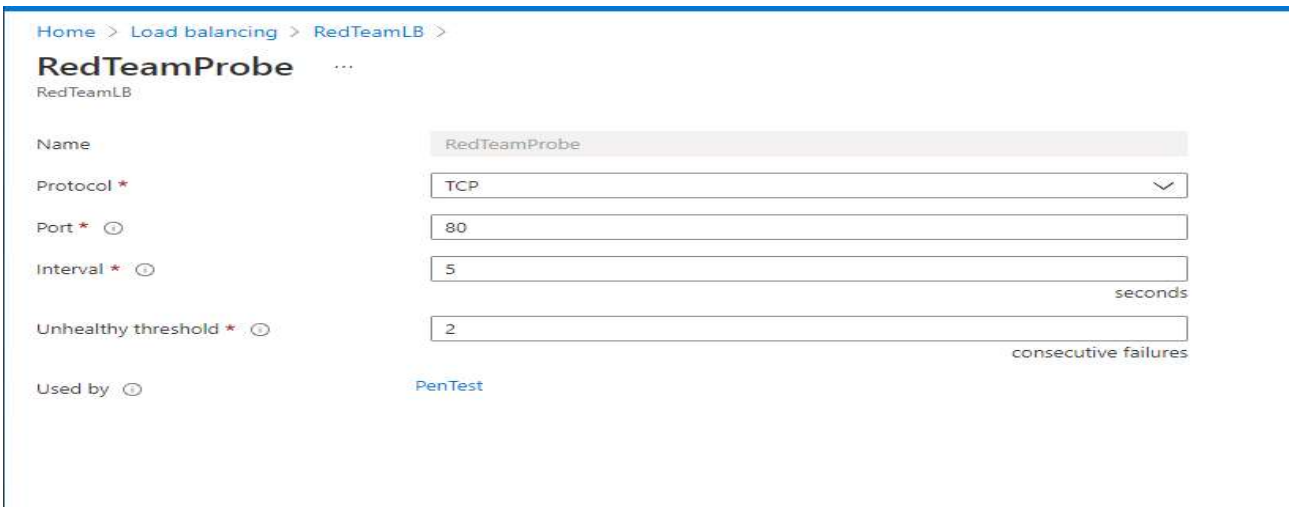
A.) Setting up the Load Balancer

1.) Now that Web-1 and Web-2 have been configured with DVWA, we will now add a load balancer in front of our VMs. A load balancer will help accomplish two goals. First it will create network redundancy by distributing network traffic and ensuring the services offered by the VMs has high availability. Second, the addition of a load balancer to the network will help mitigate against Denial of Service attacks by allocating traffic across the pool of servers to ensure the network isn't overwhelmed with incoming traffic.

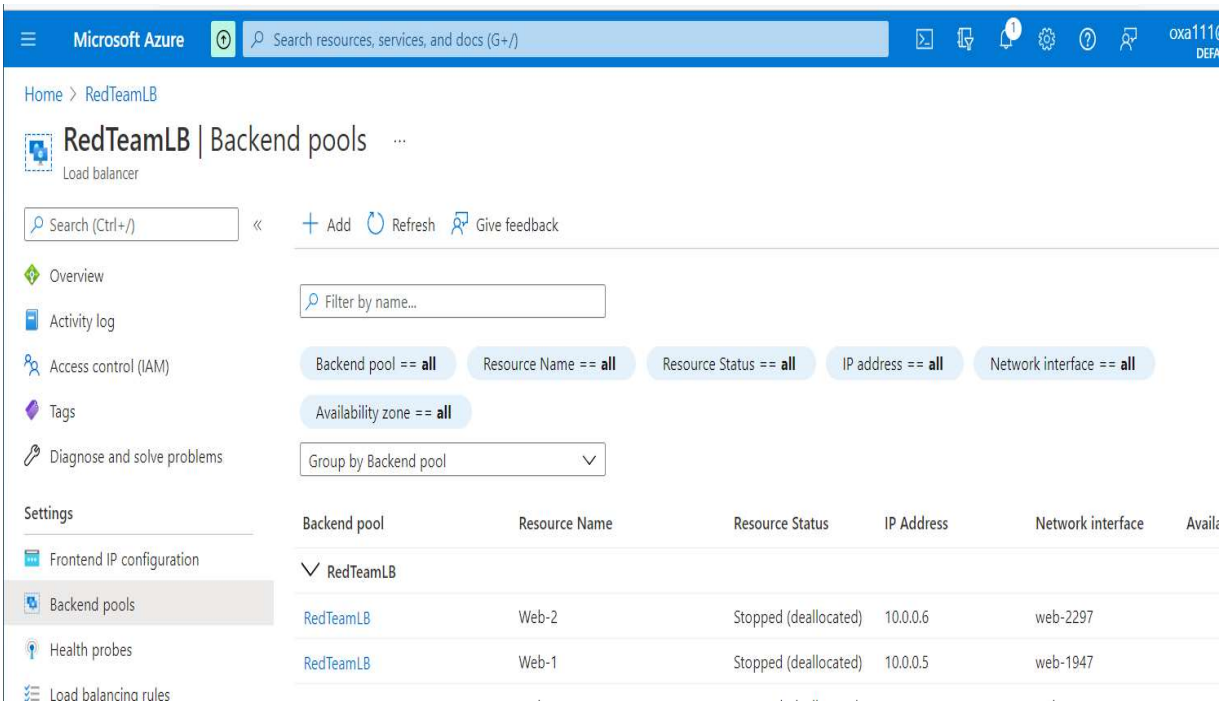
2.) From the Azure Portal we will search for load balancers and hit create. To configure the load balancer properly, we will assign it to the same RedTeam resource group and same East US region. We will also assign the Load Balancer with a static IP public address, select Basic for SKU, and click on the review + create button. The deployed load balancer will have the following settings:



3.) A health probe will next be added to the load balancer to ensure both Web-1 and Web-2 are able to safely receive traffic from the load balancer. The health probe will be configured to receive TCP traffic to port 80. In addition, the health probe will be run in 5 second intervals and will be designated as unhealthy if 2 consecutive failures are recorded.

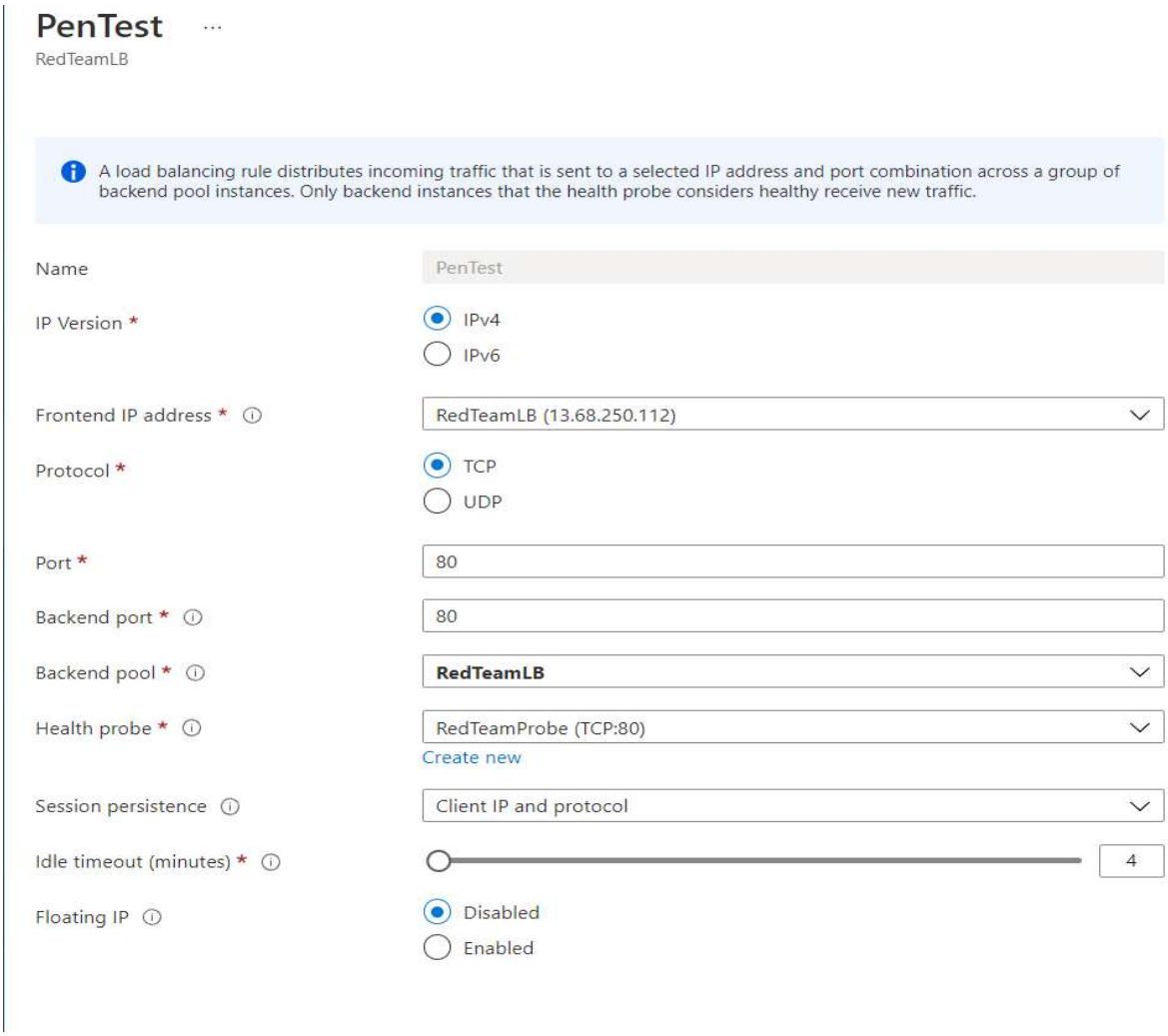


4.) We now need to ensure that our load balancer has a pool of servers it can distribute traffic to. This will be accomplished by adding both Web-1 and Web-2 to the backend server pool.

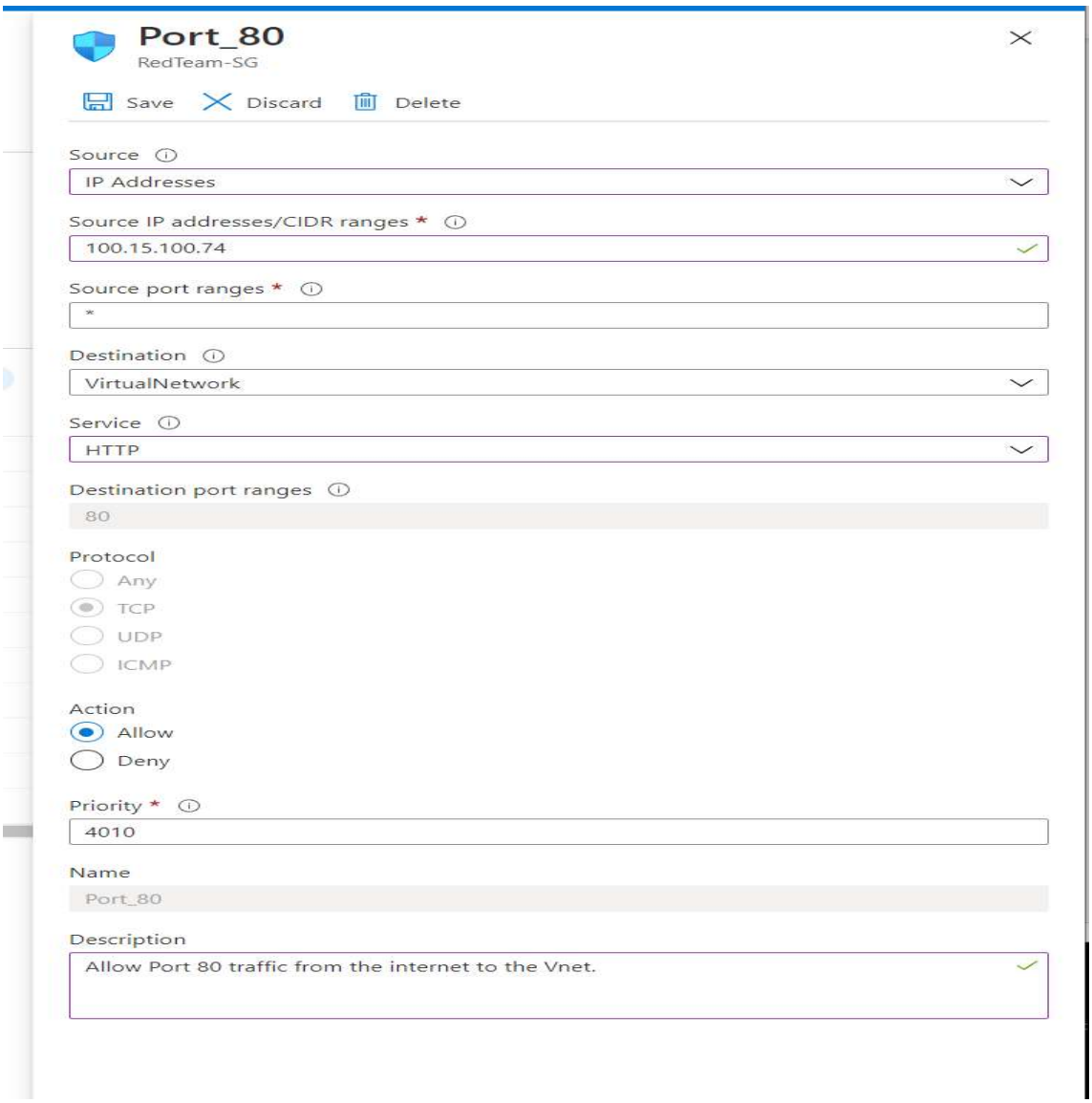


5.) With the load balancer deployed on the network we now have a mechanism that will allow us to distribute traffic and ensure the availability of our services. At this point the load balancer has been created, but not configured to allow traffic to the VM backend pool. In this step we will configure our load balancer by creating a load balancing rule to ensure traffic is correctly taken from the load balancer and distributed to the Web-1 and Web-2 VMs located in the backend pool. This rule will specify that we are using IPv4 traffic from our load balancer using standard TCP website traffic on port 80. In addition, we will specify the backend pool consisting of Web-

1 and Web-2 VMs, include the health probe created, and enable session persistence for Clint IP and protocol to ensure an open session does not change to a different server.

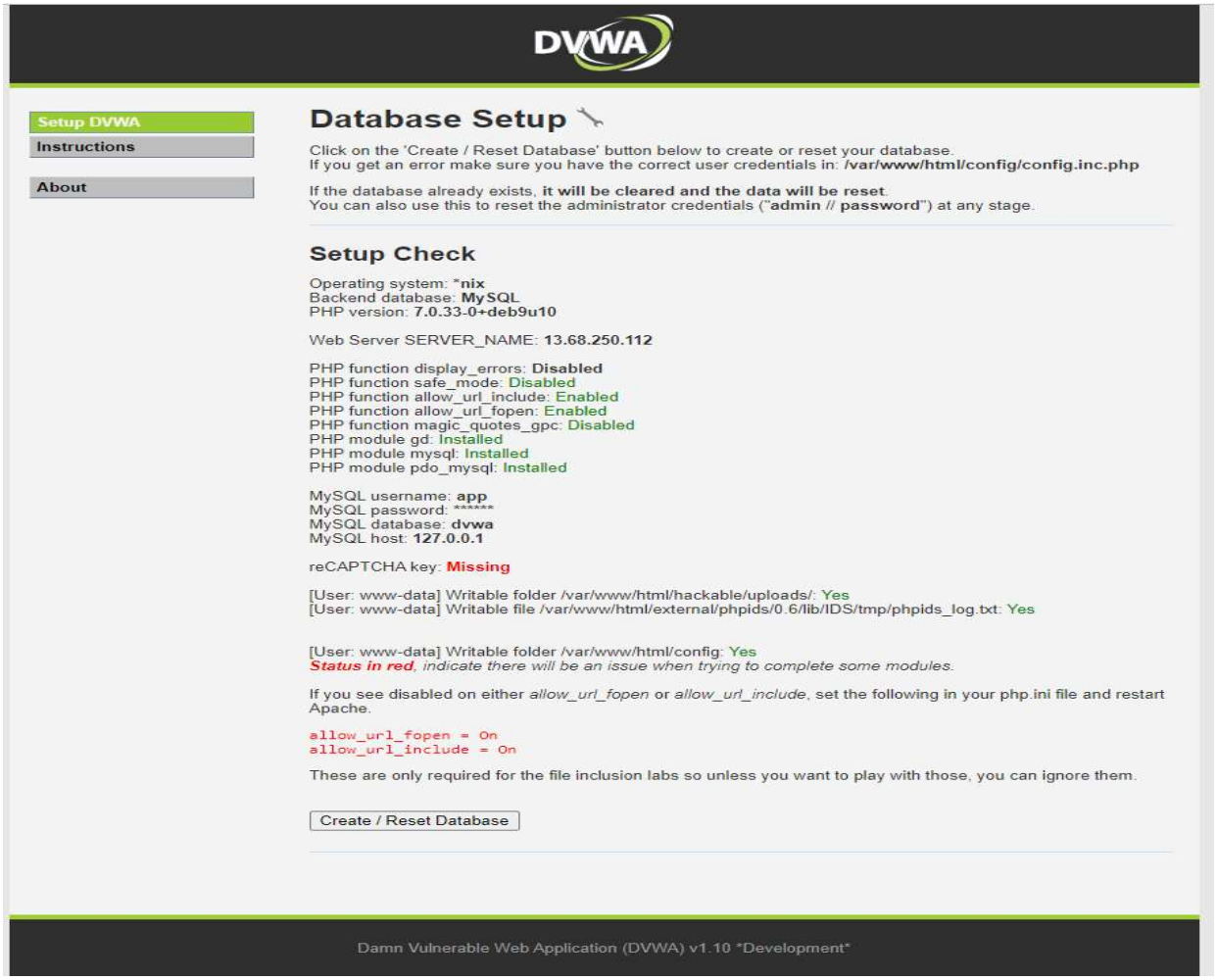


6.) In the previous step we created a load balancing rule that took TCP web traffic sent to the load balancer and distributed the traffic to Web-1 and Web-2. In this step we will add a new security group rule that will allow incoming web traffic sent to port 80 to flow into our virtual network. The newly created rule to allow traffic to come into our virtual network will be configured with the following settings.



7.) In the RedTeam NSG, we will now remove the incoming security rule that blocked all traffic coming into our Vnet to allow traffic to flow through our load balancer. In this step we will remove the previously defined default deny rule to now allow traffic to go through.

8.) Our load balancer has now been deployed and configured with the proper specifications. The next step we will take is verifying our DVWA application can be accessed from our browser via the internet. To accomplish this, we will type in the front-end IP address of our load balancer and add /setup.php to the URL to see if it accessible over the internet.

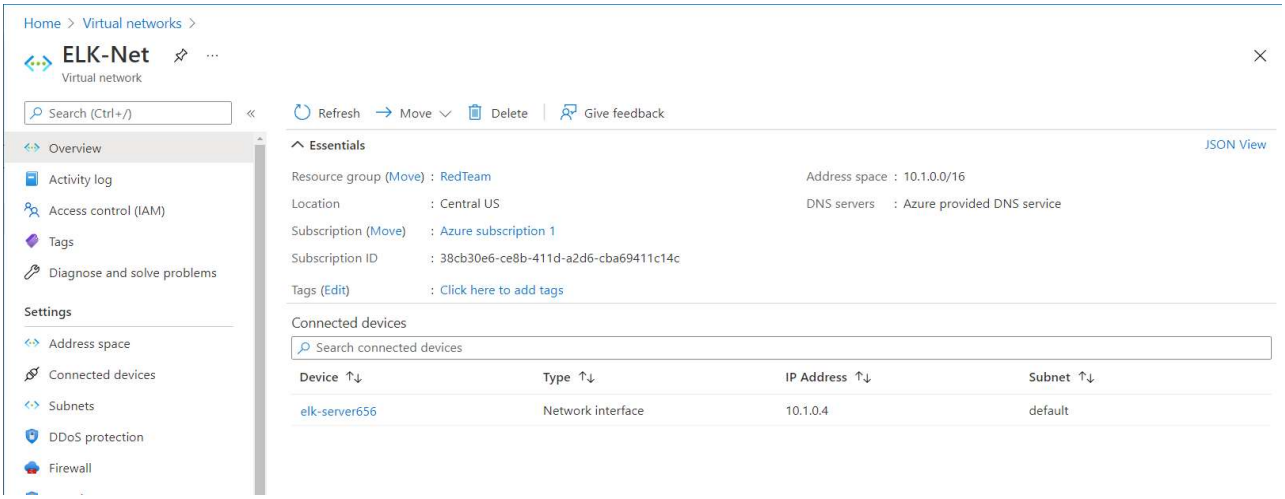


Connectivity to the DVWA application has been verified.

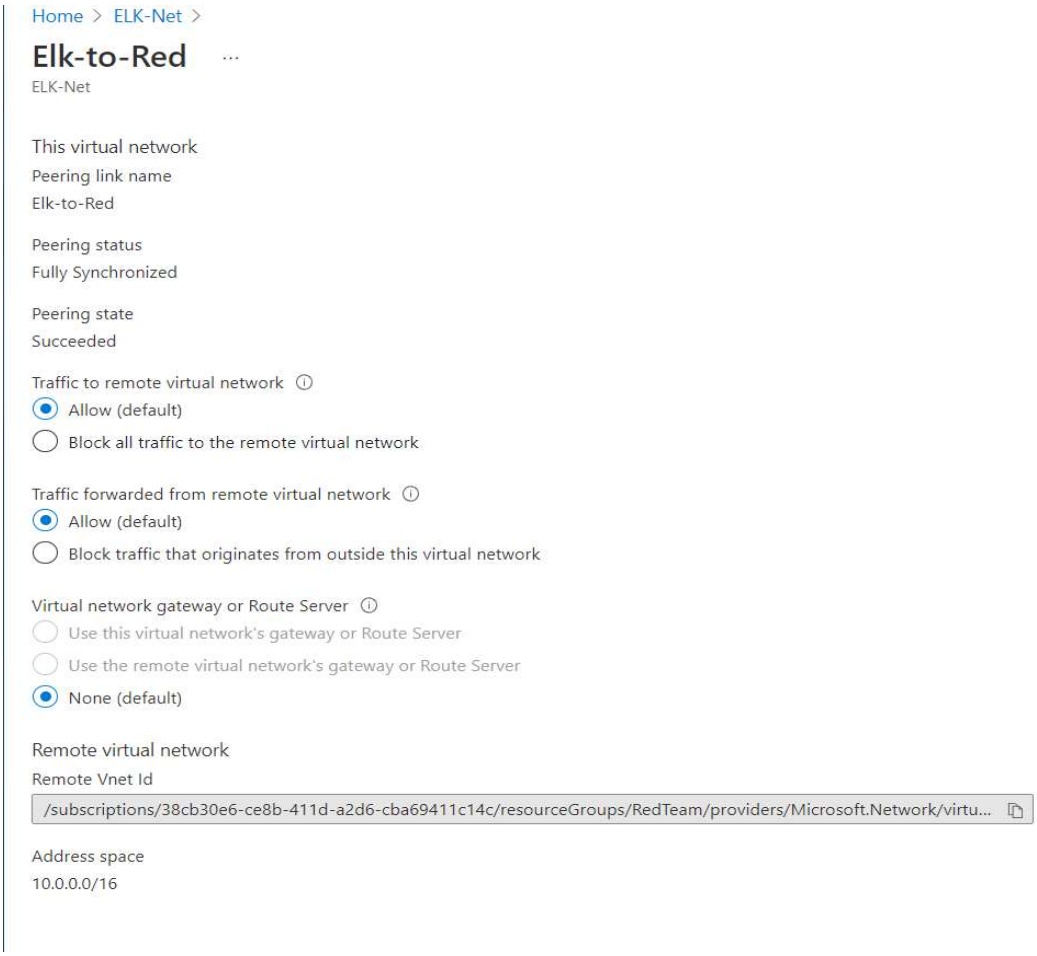
VI.) Deploying the ELK Stack Server and Creating an Ansible Playbook to install Filebeat and Metricbeat to the DVWA VMs

A.) Creating a New VNet and Connecting it to the Current VNet

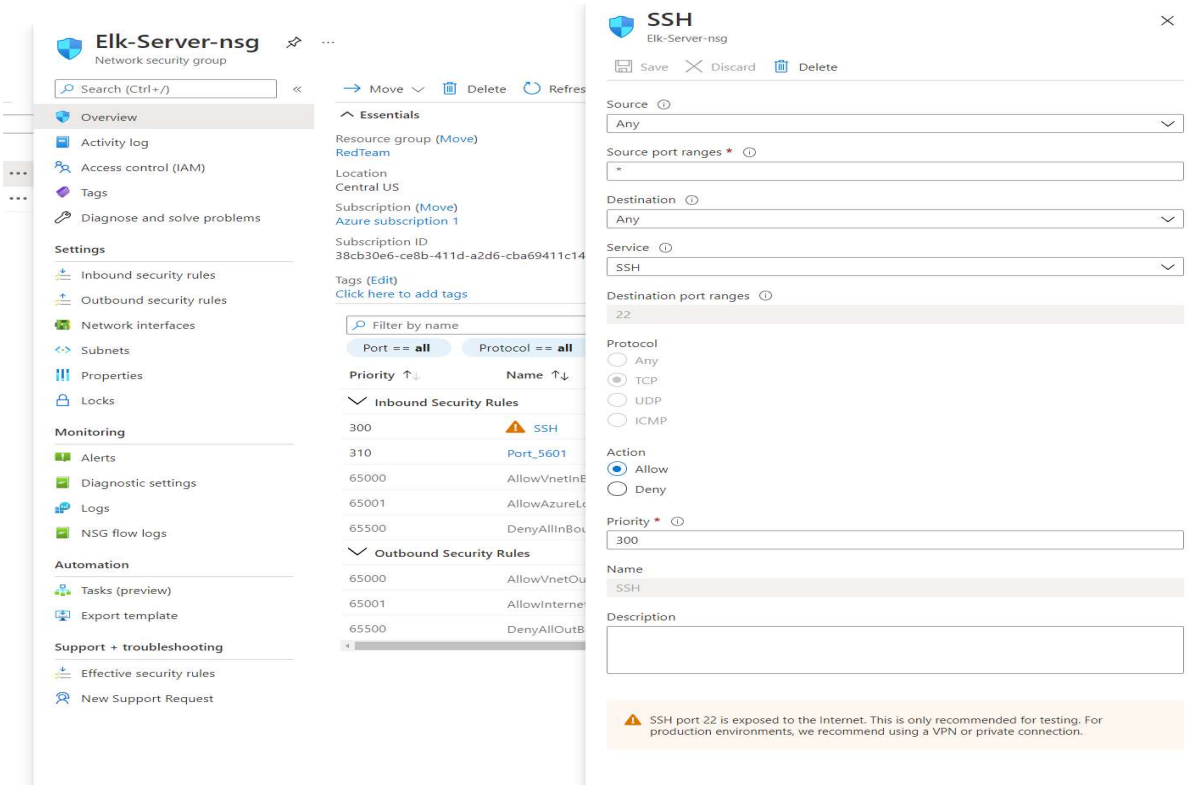
1.) The goal is to have the Elk stack server set up in a different virtual network to receive logs from the VMs in our RedTeam virtual network. To accomplish this we must first create a new virtual network that has the same configuration as our RedTeam resource group in a different region. The address space allocated to the newly created VM is 10.1.0.0/16.



2.) Now that the new virtual network has been created, we must ensure a connection can be established between the two virtual networks. In order to allow traffic to pass from our first vNet to our new vNet, we will create a peer connection between both vNets. Our peer connection will be established by selecting our new vNet and selecting the new peering option. Within the setup menu, we will choose our original RedTeam vNet from the Virtual Network dropdown box to specify this is the vNet we will be connecting with. The configuration of the peer network should resemble the following:

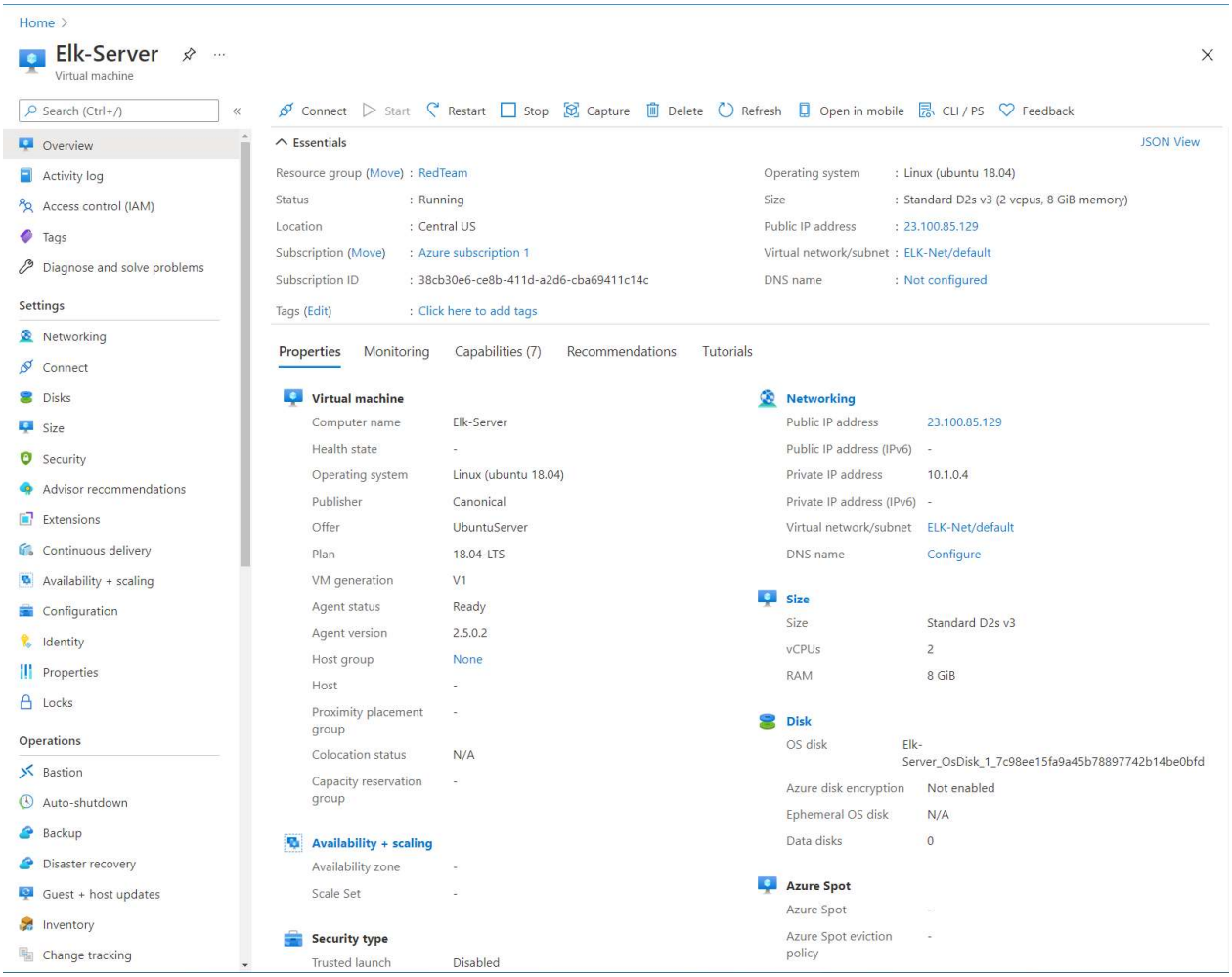


3.) We will now create a new network security group called Elk-Server-NSG and create an inbound security rule that will allow us to SSH into the network.

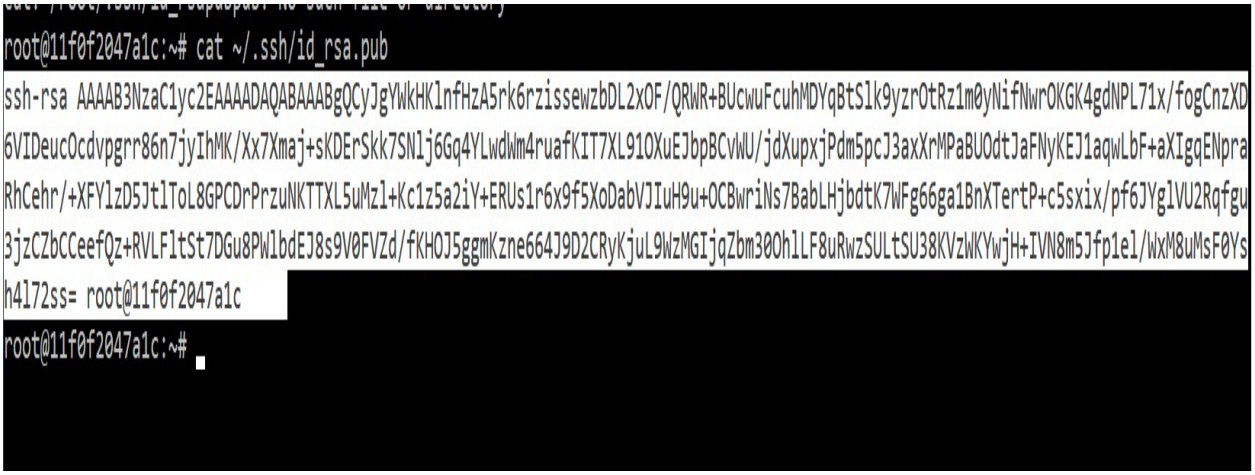


B.) Create a new VM and Designate it as the Elk Stack Server

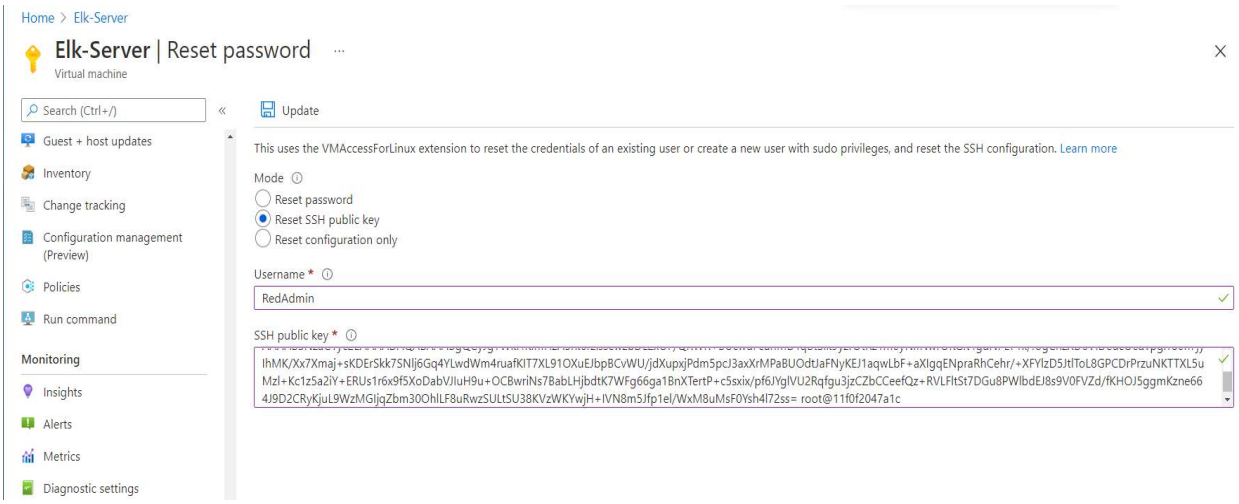
1.) The Elk Stack Server will be created by creating a new VM that is deployed in the same region as our newly created vNet, which is in the US Central region. We will then select an image that provides us with 4 GiBs of memory to allow the Elk server to properly run and deploy it with a public IP address and basic security group setting. The configuration of the new Elk Stack Server with private IP address of 10.1.0.4 is referenced below:



2.) The new Elk server just created must be accessible from within the Ansible container. To ensure we can connect to the Elk server we will add our SSH key generated from within our Ansible container and add it to the server.



SSH key generated in the Ansible container.



SSH key added to the Elk server

3.) After the Elk stack server has been created, we must ensure that we can establish connectivity to it from our Ansible container installed on our jump box virtual machine. To determine if the connection has been set up correctly, we will attempt to SSH into the Elk Server from our Ansible container.

```
root@11f0f2047a1c:~# ssh RedAdmin@10.1.0.4
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 5.4.0-1062-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

  System information as of Sat Oct 30 13:47:14 UTC 2021

  System load:  0.12              Processes:             132
  Usage of /:   18.5% of 28.90GB  Users logged in:       0
  Memory usage: 35%               IP address for eth0:   10.1.0.4
  Swap usage:   0%                IP address for docker0: 172.17.0.1

 * Super-optimized for small spaces - read how we shrank the memory
   footprint of MicroK8s to make it the smallest full K8s around.

   https://ubuntu.com/blog/microk8s-memory-optimisation

2 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

New release '20.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.


Last login: Sat Oct 30 13:43:02 2021 from 10.0.0.4
RedAdmin@Elk-Server:~$
```

The connection was successful.

C.) Downloading and Configuring the Container

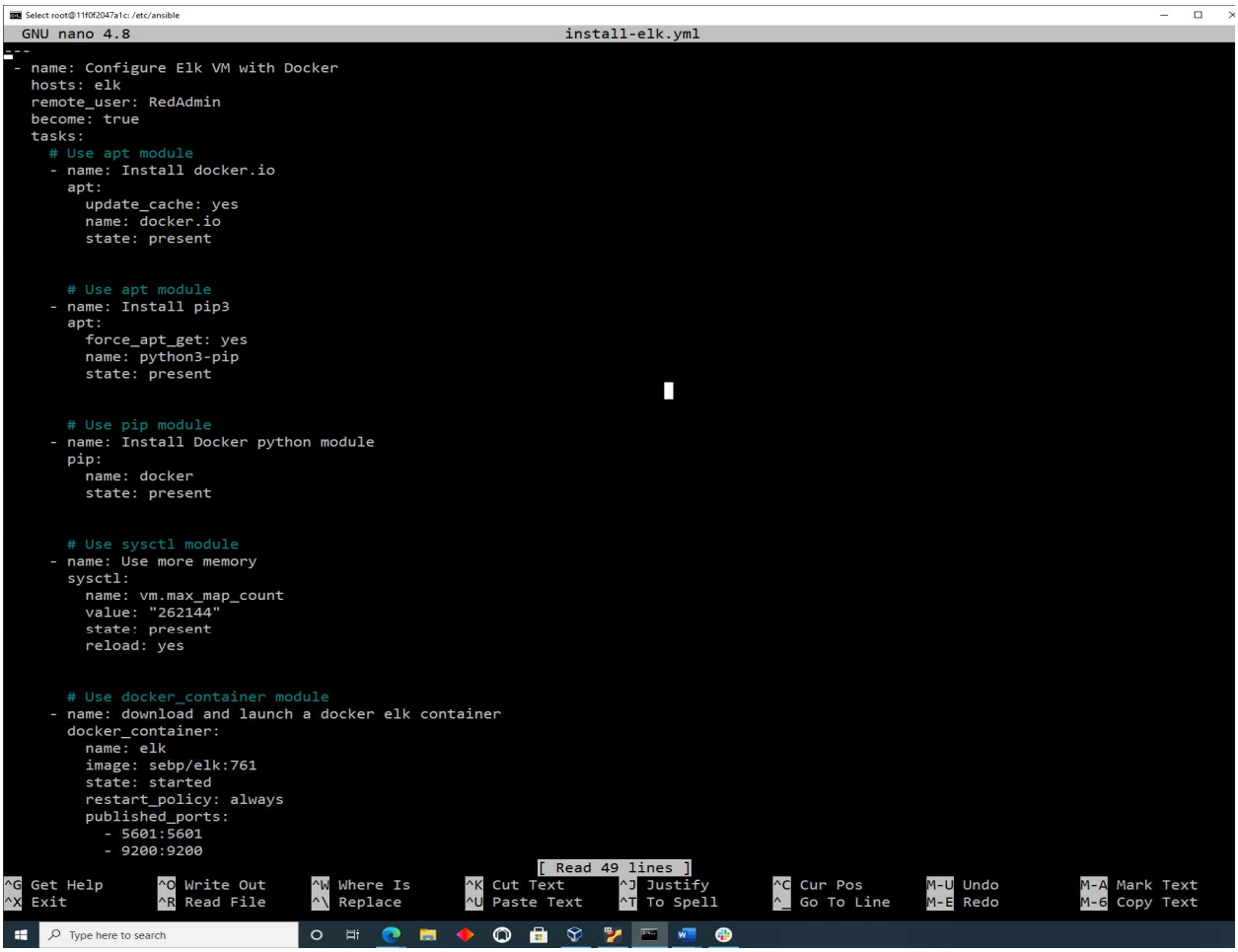
1.) At this point we have completed the following tasks:
- Created a vNet that will host our ELK server in a different region from our web servers and other resources
- Created a peer connection from the new vNet and the RedTeam vNet
- Configured the ELK Server with the same SSH key shared by our Web VMs, which were generated from within our Ansible container
- Verified that we can connect to the ELK server from within our Ansible Container

At this point we will use Ansible to configure our newly created ELK Server.

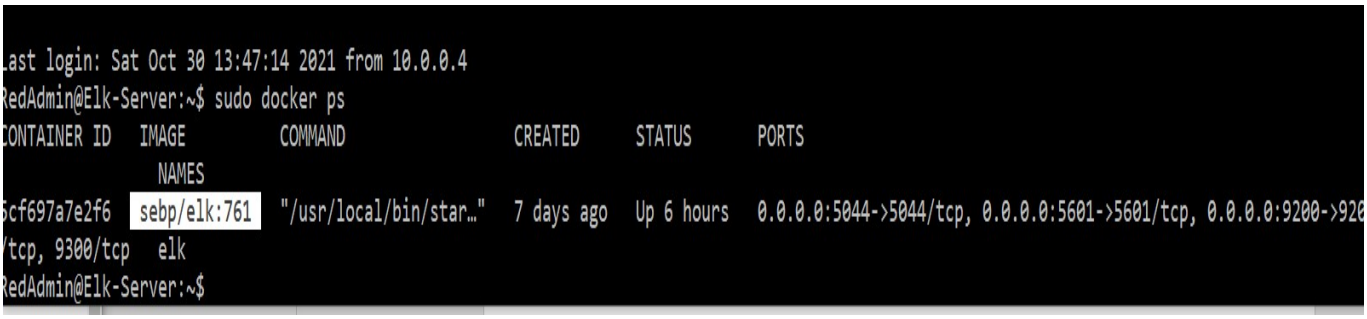
2.) In order for the ELK server to be recognized and configured by Ansible, we must first add it the ELK inventory list from within the ansible hosts file. A line in the file will be added below the ELK group list that references it's private IP address of 10.1.0.4 with the ansible_python_interpreter=/usr/bin/python3 line.

```
[webservers]
#alpha.example.org
#beta.example.org
#192.168.1.100
#192.168.1.110
10.0.0.5 ansible_python_interpreter=/usr/bin/python3
10.0.0.6 ansible_python_interpreter=/usr/bin/python3
10.0.0.7 ansible_python_interpreter=/usr/bin/python3

[elk]
10.1.0.4 ansible_python_interpreter=/usr/bin/python3
```

3.) We will now use YAML to create a playbook that will configure our ELK server. Within the playbook, we will install docker.io to install the required sebp/elk:761 Docker container and python3-pip to install Python software. In addition, the playbook will include a line to ensure the ELK server uses more memory to run properly by setting the vm.max_map_count line to 262144. In addition, the playbook will include the following port mappings for the container to start: 5601:5601, 9200:9200, 5044: 5044. A sample of the playbook is referenced below:



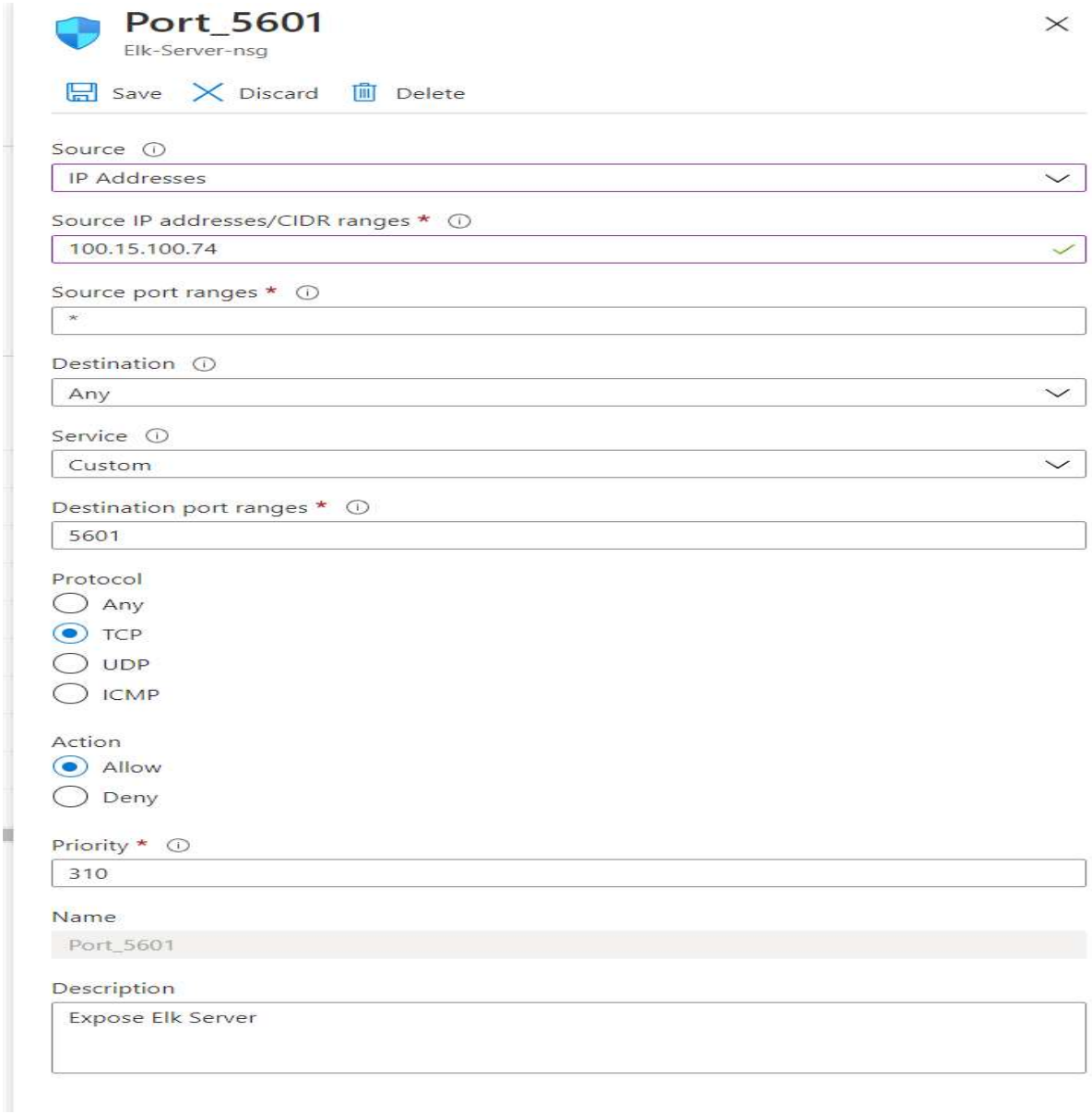
4.) The playbook created in the previous step will be run to install and configure the container. After the playbook has been run and executed, we will now SSH into the ELK server from our jump box to verify it is running the sebp/elk:761 container.



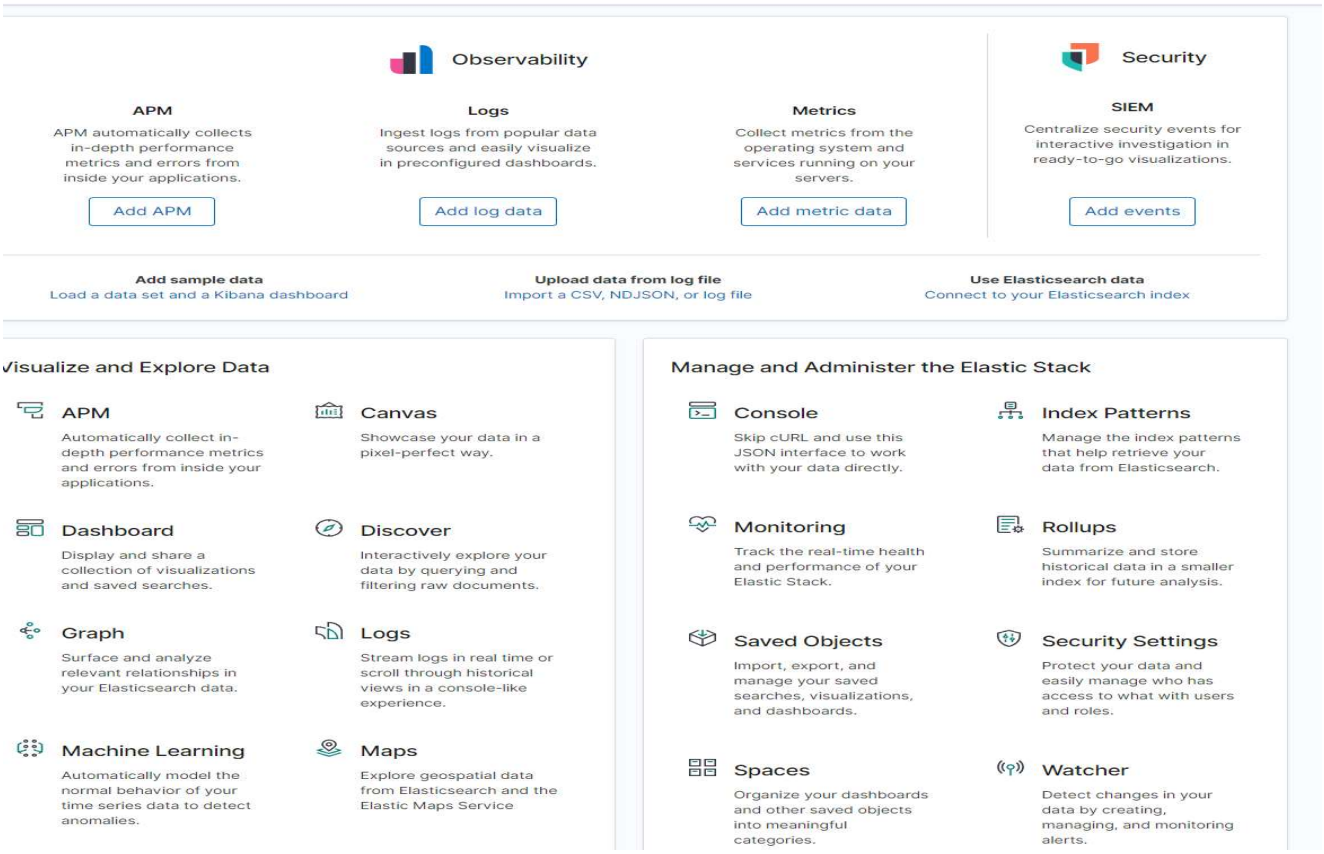
The sebp/elk:761 container is properly running on the ELK server.

5.) With the new vNet and ELK stack server created, we will now add an inbound security rule to our Elk-server network security group to restrict access to the ELK VM. This inbound rule will contain our public IP address to ensure it is added to the security group's whitelist and allow TCP

traffic from our local workstation IP address over port 5601, which is the port running the ELK web server.



6.) After the ELK server has been installed and configured and the NSG updated to allow access to the server from our local workstation, we will attempt to access the server by typing in http://[ELK server public IP]:[Designated Port Number]/app/kibana.



We are able to access the server from our local workstation.

VII.) Installing Filebeat and Metricbeat on the DVWA Containers

A.) Installing Filebeat on our DVWA VMs

1.) In the previous steps we have created an ELK monitoring server and used an Ansible playbook to install and configure an ELK container. In the steps to follow we will install Filebeat on our DVWA VMs to monitor database logs generated by Web-1 and Web-2. To accomplish this we will download the Filebeat configuration file and change the hosts line to include the private IP address and designated port number of our ELK server on lines #1106 and #1806 of the configuration file. A copy of the configuration file will be added to the /etc/filebeat directory.

```
  # In case you specify and additional path, the scheme is required: http://localhost:9200/path
  # IPv6 addresses should always be defined as: https://[2001:db8::1]:9200
  hosts: ["10.1.0.4:9200"]
  username: "elastic"
  password: "changeme" # TODO: Change this to the password you set

  # Set gzip compression level.
```

```
# can be installed.
#setup.ilm.check_exists: false

# Overwrite the lifecycle policy at startup. The default is false.
#setup.ilm.overwrite: false

#============================== Kibana =====================================

# Starting with Beats version 6.0.0, the dashboards are loaded via the Kibana API.
# This requires a Kibana endpoint configuration.
setup.kibana:
  host: "10.1.0.4:5601" # TODO: Change this to the IP address of your ELK server
  # Kibana Host
  # Scheme and port can be left out and will be set to the default (http and 5601)
```

2.) Next we will create a new playbook that will download and install filebeat on our VMs running DVWA.

```
---
- name: installing and launching filebeat
  hosts: 10.1.0.4
  become: yes
  tasks:
  - name: download filebeat deb
    command: curl -L -O https://artifacts.elastic.co/downloads/beats/filebeat/filebeat-7.4.0-amd64.deb

  - name: install filebeat deb
    command: dpkg -i filebeat-7.4.0-amd64.deb
  - name: drop in filebeat.yml
    copy:
      src: /etc/ansible/files/filebeat-config.yml
      dest: 10.0.0.5 10.0.0.6
  - name: enable and configure system module
    command: filebeat modules enable system
  - name: setup filebeat
    command: filebeat setup
  - name: start filebeat service
    command: service filebeat start
  - name: enable service filebeat on boot
    systemd:
      name: filebeat
      enabled: yes

^G Get Help    ^O Write Out   ^W Where Is    ^K Cut Text    ^J Justify     ^C Cur Pos     M-U Undo
^X Exit        ^R Read File   ^\ Replace     ^U Paste Text  ^T To Spell    ^_ Go To Line  M-E Redo
```

3.) After the configuration file has been correctly altered and the playbook created. We will now run the playbook and verify our ELK stack is able to receive logs from both Web-1 and Web-2 servers running DVWA. Within the ELK server Gui, we will navigate to add log data → System Logs → DEB tab → Module Status → Check Data → Verify Incoming Data.

2 Edit the configuration

Modify `filebeat.yml` to set the connection information: Copy snippet

```
output.elasticsearch:
  hosts: ["<es_url>"]
  username: "elastic"
  password: "<password>"
setup.kibana:
  host: "<kibana_url>"
```

Where `<password>` is the password of the `elastic` user, `<es_url>` is the URL of Elasticsearch, and `<kibana_url>` is the URL of Kibana.

3 Enable and configure the system module

From the installation directory, run: Copy snippet

```
./filebeat modules enable system
```

Modify the settings in the `modules.d/system.yml` file.

4 Start Filebeat

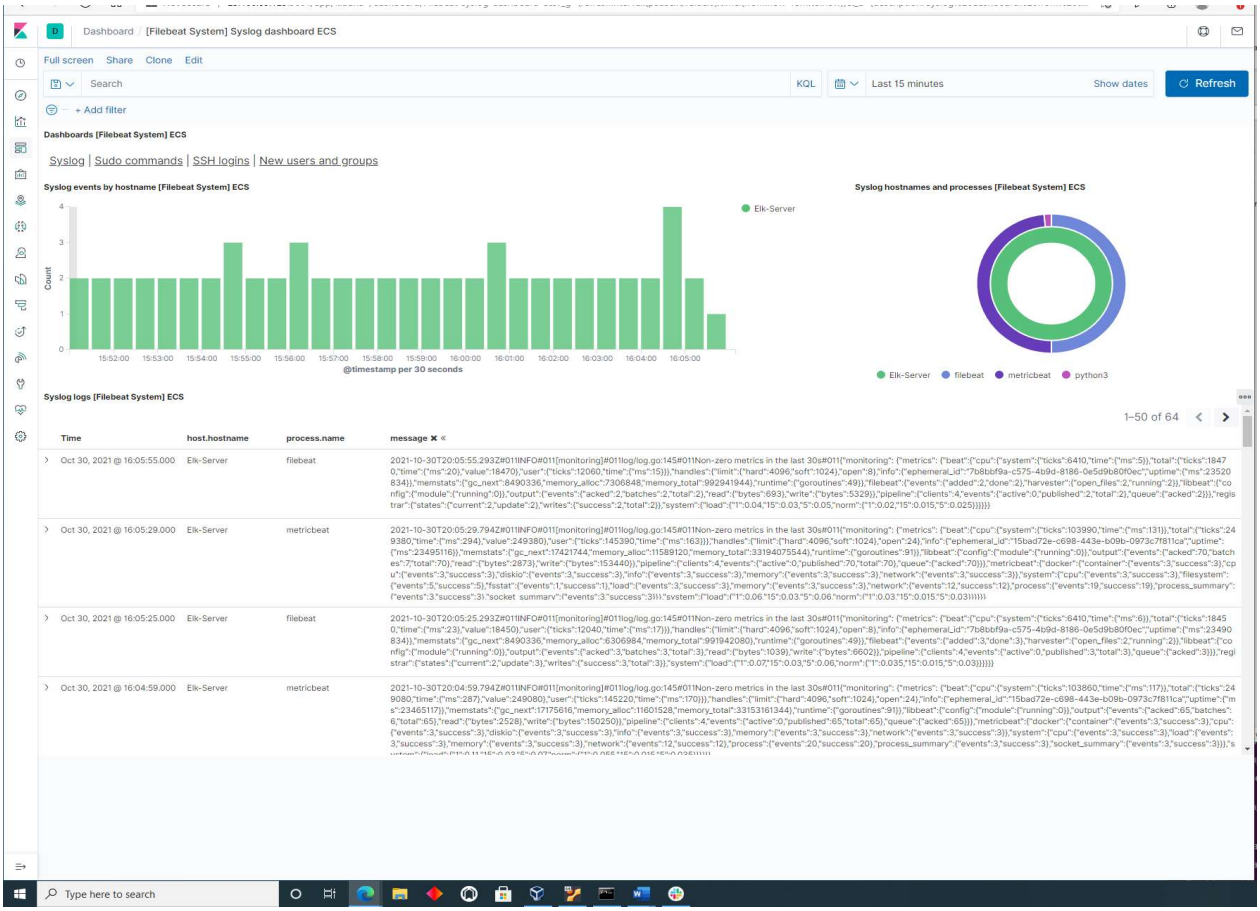
The `setup` command loads the Kibana dashboards. If the dashboards are already set up, omit this command. Copy snippet

```
./filebeat setup
./filebeat -e
```

Module status

Check that data is received from the Filebeat `system` module Check data

Data successfully received from this module



The data has been successfully received by the ELK stack from Web-1 and Web-2.

B.) Installing Metricbeat on our DVWA VMs

1.) We will now run similar steps from above to install metricbeat on Web-1 and Web-2 to collect machine metrics such as CPU usage and uptime from our VMs. We will first download the metricbeat configuration file and alter it to include the private IP address of our ELK server.

```
# `setup.kibana.host` options.
# You can find the `cloud.id` in the Elastic Cloud web UI.
#cloud.id:
# The cloud.auth setting overwrites the `output.elasticsearch.username` and
# `output.elasticsearch.password` settings. The format is `<user>:<pass>`.
#cloud.auth:
#================================ Outputs =====================================
# Configure what output to use when sending the data collected by the beat.
#-------------------------- Elasticsearch output ------------------------------
output.elasticsearch:
  # TODO: Change the hosts IP address to the IP address of your ELK server
  # TODO: Change password from `changem` to the password you created
  hosts: ["10.1.0.4:9200"]
  username: "elastic"
  password: "changeme"
#----------------------------- Logstash output --------------------------------
#output.logstash:
  # The Logstash hosts
  #hosts: ["localhost:5044"]
  # Optional SSL. By default is off.
  # List of root certificates for HTTPS server verifications
  #ssl.certificate_authorities: ["/etc/pki/root/ca.pem"]
  # Certificate for SSL client authentication
  #ssl.certificate: "/etc/pki/client/cert.pem"
  # Client Certificate Key

^G Get Help     ^O Write Out    ^W Where Is     ^K Cut Text     ^J Justify      ^C Cur
^X Exit         ^R Read File    ^\ Replace      ^U Paste Text   ^T To Spell     ^_ Go
```

2.) Next, we will create a playbook that will be used to install metricbeat-7.6.1 and run the playbook to start the installation process on both vms.

```
---
- name: Install metric beat
  hosts: 10.1.0.4
  become: true
  tasks:
    # Use command module
  - name: Download metricbeat
    command: curl -L -O https://artifacts.elastic.co/downloads/beats/metricbeat/metricbeat-7.6.1-amd64.deb
    # Use command module
  - name: install metricbeat
    command: dpkg -i metricbeat-7.6.1-amd64.deb
    # Use copy module
  - name: drop in metricbeat config
    copy:
      src: /etc/ansible/files/metricbeat-config.yml
      dest: 10.0.0.5 10.0.0.6
    # Use command module
  - name: enable and configure docker module for metric beat
    command: metricbeat modules enable docker
    # Use command module
  - name: setup metric beat
    command: metricbeat setup
    # Use command module
  - name: start metric beat
    command: service metricbeat start
    # Use systemd module
  - name: enable service metricbeat on boot
    systemd:
      name: metricbeat
      enabled: yes
```

3.) After the playbook has been run and metricbeat installed on our web VMS, we will now verify that the Elk server is receiving log data from Web-1 and Web-2 by navigation from within the ELK Stack GUI to Add Metric Data → Docker Metrics → Deb →Module Status → Check Data

2 Edit the configuration

Modify `metricbeat.yml` to set the connection information: Copy snippet

```
output.elasticsearch:
  hosts: ["<es_url>"]
  username: "elastic"
  password: "<password>"
setup.kibana:
  host: "<kibana_url>"
```

Where `<password>` is the password of the `elastic` user, `<es_url>` is the URL of Elasticsearch, and `<kibana_url>` is the URL of Kibana.

3 Enable and configure the docker module

From the installation directory, run: Copy snippet

```
./metricbeat modules enable docker
```

Modify the settings in the `modules.d/docker.yml` file.

4 Start Metricbeat

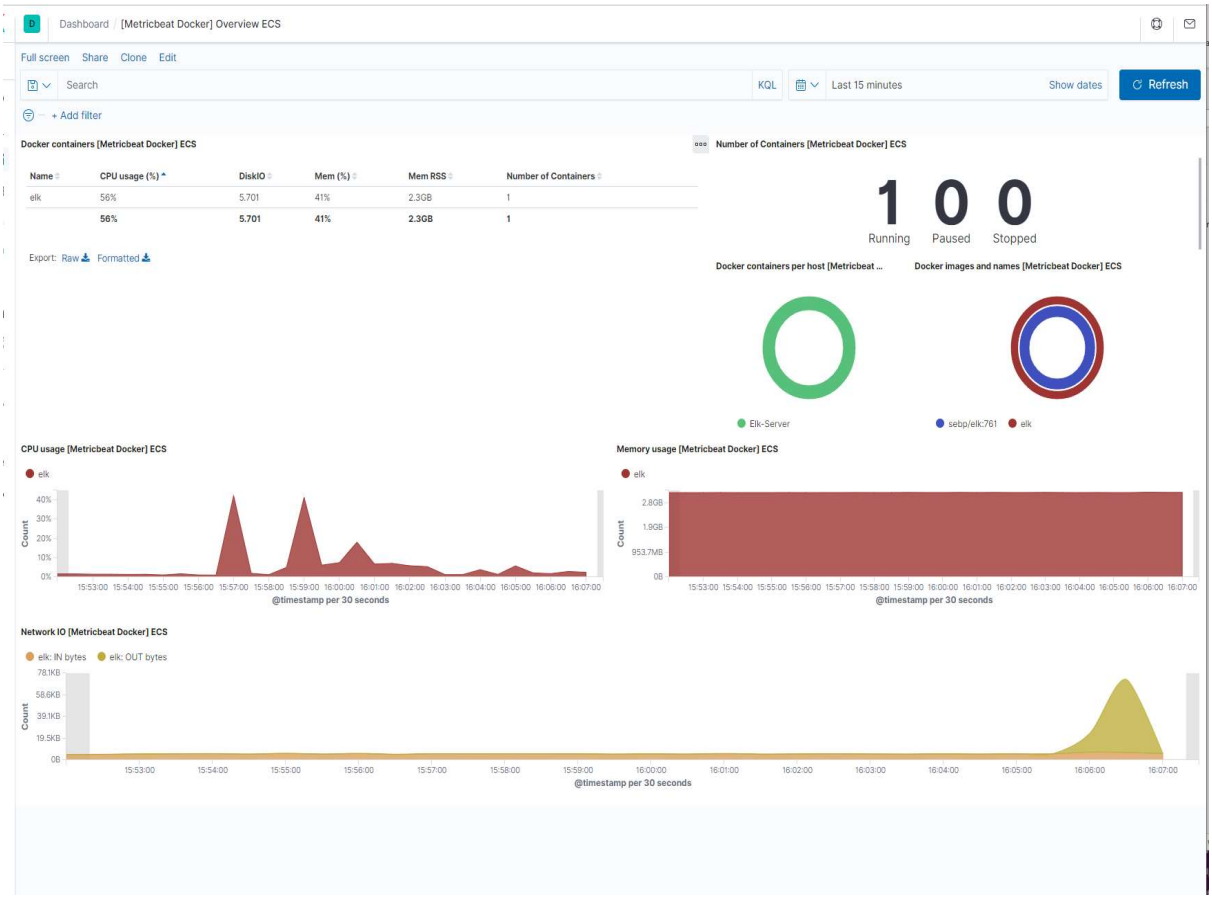
The `setup` command loads the Kibana dashboards. If the dashboards are already set up, omit this command. Copy snippet

```
./metricbeat setup
./metricbeat -e
```

Module status

Check that data is received from the Metricbeat `docker` module Check data

> Data successfully received from this module



The virtual network has been fully deployed with a cloud monitoring system.