Ansible Assignment

Cloud Infrastructure

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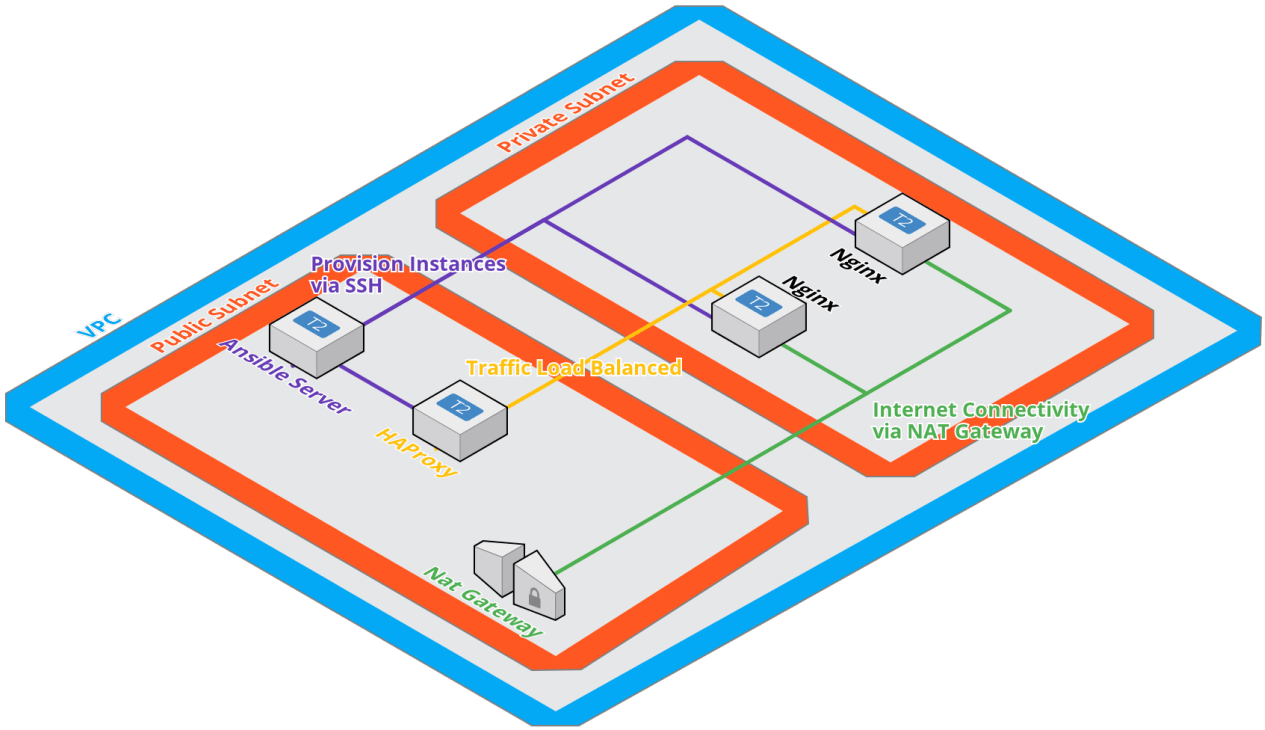
Contents

1 Introduction

The document will outline the concepts behind and the tasks required to configure and web server on AWS using Ansible. The web server will consist of two Nginx servers running in a private subnet, with a HAProxy load balancer running in a public subnet balancing traffic to the web servers. Also running in the public subnet is the Ansible server which will provision the Nginx and Haproxy servers. This is illustrated in Figure 1. For the purposes of this exercise, the NGinx server have been configured to redirect to *serversforhackers.com*.

Figure 1: System Architecture



2 Ansible

Ansible configures servers though the use of a number of key concepts, the first of which is *Playbooks*. Playbooks define the configuration to be deployed to a server. When executed against a server they run a number of tasks which will make the necessary installations, create the necessary file etc. to configure the server. The are also idempotent, meaning that can be run multiple times without changing or breaking the initial result.

Playbooks use *tasks* and *handlers* to configure servers. Tasks are the individual steps required for configuration, such as adding a package repository or installing a package. When a playbook is run, all of it's tasks are executed in order. Handlers, however are only executed when called. For example a handler to start a service might be called after installing the service.

Writing the entire configuration for a server in one playbook could be quite complex and would not be very reusable. This is where *roles* are used. Roles group task, handlers and other files such as variable files and templates

together in a standard directory structure. A role can then be called by a playbook. A role can even be called but instructed to use a different variable file. This allows for greater reuse in Ansible.

3 Roles

In order to deploy the system described above, Ansible must create EC2 instances within the VPC, then provision the necessary servers with Nginx or HAProxy. Therefore, three roles will be used to create this system:

- Provision EC2 Instance
- Nginx
- HAProxy

3.1 Provision EC2 Instance

This roles is used to provision an instances within EC2. The roles defines three main tasks:

- Provision the instance(s)
- Add the instances to the dynamic list of hosts held by ansible
- Wait for the instance(s) to be reachable via SSH

These tasks are shown below Code Sample 1. There are a number of aspect to note in these tasks.

- There are a large number of variables included in the tasks. This will allow the role to be reused. For example, the *instance_count* will allow the role to be used to create two Nginx servers initially but only one HAProxy server later.
- The task adds the instance(s) it created to a group in the hosts files, defined by the *host_group* variable. The means that instances create by the role can then be provisions with the correct configuration by running playbooks against the hosts in the *host_group*
- The task add the private IP addresses of the instance to the hosts file. This is necessary because some of the server are created in a private subnet and therefore have no public IP address. However, as the Ansible server is running in the public subnet, it can connect to any server in either the private or public subnets using their private IP addresses.

In order to use the role ro provision server differently, (i.e. for Nginx server or a HAProxy server) two different variable files are defined; *webserver.yml* and *loadbalancer.yml*. This are shown in appendix B.

Code Sample 1: provision-ec2-instance/tasks/main.yml

```
---
- name: Provision EC2 Box
local_action:
module: ec2
profile: "{{ aws_profile }}"
key_name: "{{ ec2_keypair }}"
group_id: "{{ ec2_security_group }}"
instance_type: "{{ ec2_instance_type }}"
image: "{{ ec2_image }}"
vpc_subnet_id: "{{ ec2_subnet_ids|random }}"
region: "{{ ec2_region }}"
instance_tags: '{"Name":"{{ec2_tag_Name}}","Type":"{{ec2_tag_Type}}","Environment":"{{
    ec2_tag_Environment}}"}'
assign_public_ip: "{{ assign_public_ip }}"
wait: true
count: "{{ instance_count }}"
volumes:
- device_name: /dev/sda1
device_type: gp2
volume_size: "{{ ec2_volume_size }}"
delete_on_termination: true
register: ec2

- debug: var=item
with_items: ec2.instances

- name: Add instances to host group
add_host:
hostname: "{{ item.private_ip }}"
ansible_user: "{{ ssh_user }}"
ansible_ssh_private_key_file: "{{ ssh_key_path }}"
ansible_python_interpreter: /usr/bin/python3
ansible_ssh_extra_args: '-o StrictHostKeyChecking=no'
groups: "{{ host_group }}"
with_items: "{{ ec2.instances }}"

- name: Wait for the instances to boot by checking the ssh port
wait_for: host={{item.private_ip}} port=22 delay=60 timeout=320 state=started
with_items: "{{ ec2.instances }}"
```

3.2 Nginx

The Nginx role consists of the following main elements:

- **Tasks:** These are the main tasks required to configure Nginx. They include adding the package repository

and installing Nginx, and moving the necessary configuration files into place.

- **Handlers:** The Nginx role defines two handlers: *Start Nginx* and *Reload Nginx*. The are called as required by the main tasks. For example, after creating the Nginx configuration, the *Reload Nginx* handler is called.
- **Templates:** Templates can be used to defined files that must be copied to the server. However they also allow for variable through the use of Jinja. The Nginx roles use a template to create the Nginx configuration file. This can be seen in Code Sample 2.
- **Variables:** The Nginx role also defines a variables files. In this case the web server domain is defined as a variable.

Code Sample 2: nginx/templates/serverforhacker.com.conf.j2

```
server {
  # Enforce the use of HTTPS
  listen 80 default_server;
  server_name {{ domain }};
  return 301 https://$server_name$request_uri;
}
server {
  listen 443 ssl default_server;
  root /var/www/{{ domain }}/public/;
  index index.html index.htm index.php;
  access_log /var/log/nginx/{{ domain }}.log;
  error_log /var/log/nginx/{{ domain }}-error.log error;
  server_name {{ domain }};
  charset utf-8;
  include h5bp/basic.conf;
  include h5bp/directive-only/ssl.conf;

  location / {
    try_files $uri $uri/ /index.php$is_args$args;
}
  location = /favicon.ico { log_not_found off; access_log off; }
  location = /robots.txt { log_not_found off; access_log off; }
}
```

3.3 HAProxy

The HAProxy roles is similar to the Nginx role. It defines two main tasks: *Install HAProxy* and *Update HAProxy Config*. Like, Nginx it also defines handlers to start and reload HAProxy. The HAProxy configuration is provided by a template file. This is shown below in Code Sample 3.

Of particular is the *server* block. This is adding the hosts in the *webservers* group and their IP addresses to the HAProxy server configuration. As stated above, when the Provision EC2 Instance role runs, it adds the instance to the Ansible hosts. When run with the *webservers* variables file, (which is used to provision the Nginx servers), the instances are added under the *webservers* group. Therefore, this section of the template is configuring any provisioned NGinx instances as the server for HAProxy.

Code Sample 3: haproxy/templates/haproxy.cfg

```
global
  log 127.0.0.1 local0 notice
  maxconn 2000
  user haproxy
  group haproxy

defaults
  log global
  mode http
  option httplog
  option dontlognull
  retries 3
  option redispatch
  timeout connect 5000
  timeout client 10000
  timeout server 10000

listen {{haproxy_app_name}}
  bind 0.0.0.0:80
  mode {{haproxy_mode}}
  stats {{haproxy_enable_stats}}
  {% if haproxy_enable_stats == 'enable' %}
  stats uri /haproxy_stats
  stats realm Strictly\ Private
  {% for user in haproxy_stats_users %}
  stats auth {{user.username}}:{{user.password}}
  {% endfor %}
  {% endif %}
  balance {{haproxy_algorithm}}
  option httpclose
  option forwardfor

  {% for host in groups['webservers'] %}
  server {{hostvars[host]['ansible_hostname']}} {{ hostvars[host]['ansible_eth0']['ipv4
       ']['address'] }}:80 check
  {% endfor %}
```

4 Playbooks

With all the roles defined, playbooks can be created to run these roles against the necessary servers. Although one playbook could be created to run each of the roles, it is preferable to create multiple playbooks for each of the server to be configured and include these in one *master* playbook. These playbooks are included in appendix C. The playbooks are then called from one master playbook, shown below in Code Sample 4

Code Sample 4: main-playbook.yml

```
---
- import_playbook: provision-ec2.yml type='webservers'
- import_playbook: nginx.yml hosts='webservers'
- import_playbook: provision-ec2.yml type='loadbalancer'
- import_playbook: haproxy.yml hosts='loadbalancer'
```

Here, the Provision EC2 playbook is called twice. However, in order to deploy the different instances (i.e. two in the private subnet for Nginx, one in the public subnet for HAProxyy), the *type* variable is used to specify which variables files should be used. Also, the *hosts* variables are used to instruct the Nginx and HAProxy playbooks which server they should run against.

5 Ansible Vault

Each of the roles have specified variable files. These have been used to allow for greater reuse of the roles. However, they can also contain sensitive information. Ansible Vault provides a method of encrypting these files while still allowing them to be used by playbooks, by providing a password. All of the variable files were encrypted using the following command:

Code Sample 5: vault.yml

```
ansible-vault encrypt roles/<rolename>/vars/<filename>
```

They can also be edited or decrypted using the *edit* and *decrypt* flags.

6 Running the Playbook

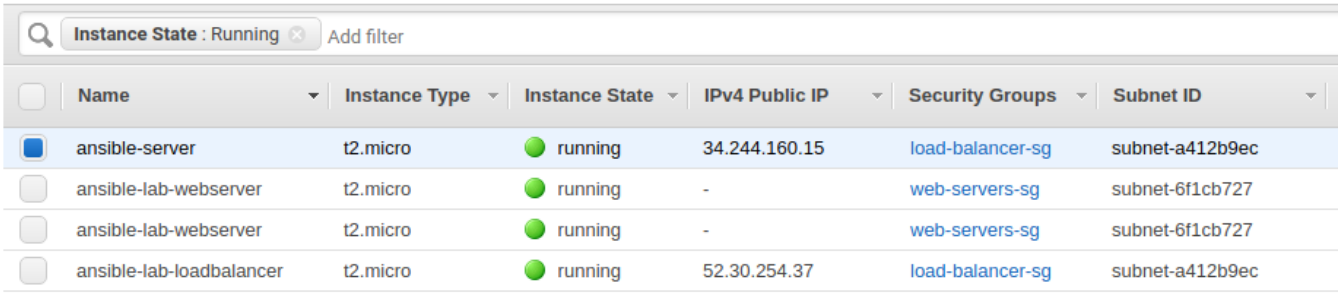
The *main-playbook* can now be run. However, Ansible must have SSH access to the server it created in the private subnet in order to install Nginx on them. Therefore, the playbook was run on the Ansible server within the VPC, specifically within the public subnet. The following command runs the playbook, asking the user to enter their password to use the variable files encrypted by Ansible vault.

Code Sample 6: run.yml

```
ansible-playbook --ask-vault-pass -i localhost, main-playbook.yml
```

Once the playbook visiting the AWS console verified that the correct instances have been created, shown in **??**. Note that the Nginx server have no public IP addresses as they are within the private subnet.

Figure 2: EC2 Instance



Instance State : Running | Add filter

Name	Instance Type	Instance State	IPv4 Public IP	Security Groups	Subnet ID
ansible-server	t2.micro	running	34.244.160.15	load-balancer-sg	subnet-a412b9ec
ansible-lab-webserver	t2.micro	running	-	web-servers-sg	subnet-6f1cb727
ansible-lab-webserver	t2.micro	running	-	web-servers-sg	subnet-6f1cb727
ansible-lab-loadbalancer	t2.micro	running	52.30.254.37	load-balancer-sg	subnet-a412b9ec

By visiting the *stats* page of the HAProxy server the status of the two web servers can be verified.

Figure 3: HAProxy

ansible-lab

	Queue			Session rate			Sessions					
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	Last
Frontend				1	4	-	1	4	2 000	10		
ip-10-0-1-158	0	0	-	0	1		0	1	-	1	1	1m38s
ip-10-0-1-173	0	0	-	0	1		0	1	-	1	1	35s
Backend	0	0		0	1		0	1	200	2	2	0s

Appendix A Project Repository

Relevant code samples have been provided in this document. However the project in it's entirety can be found at the following link:
https://github.com/robshelly/ansible-lab

Appendix B Provision EC2 Instance Variable files

Code Sample 7: provision-ec2-instance/vars/webserver.yml

```
---
ec2_keypair: "ansible"
ec2_security_group: "sg-73dbc209"
ec2_instance_type: "t2.micro"
ec2_image: "ami-f90a4880"
ec2_subnet_ids: ['subnet-6f1cb727']
ec2_region: "eu-west-1"
ec2_tag_Name: "ansible-lab-webserver"
ec2_tag_Type: "ansible-lab-webserver"
ec2_tag_Environment: "production"
ec2_volume_size: 8
assign_public_ip: no
host_group: webservers
instance_count: 2
ssh_user: ubuntu
ssh_key_path: ~/keypairs/ansible.pem
aws_profile: ansible
```

Code Sample 8: provision-ec2-instance/vars/loadbalance.yml

```
---
ec2_keypair: "ansible"
ec2_security_group: "sg-6cdcc516"
ec2_instance_type: "t2.micro"
ec2_image: "ami-f90a4880"
ec2_subnet_ids: ['subnet-a412b9ec']
ec2_region: "eu-west-1"
ec2_tag_Name: "ansible-lab-loadbalancer"
ec2_tag_Type: "ansible-lab-loadbalancer"
ec2_tag_Environment: "production"
ec2_volume_size: 8
assign_public_ip: yes
host_group: loadbalancer
instance_count: 1
ssh_user: ubuntu
ssh_key_path: ~/keypairs/ansible.pem
aws_profile: ansible
```

Appendix C Provision EC2 Instance Variable files

Code Sample 9: provision-ec2.yml

```
---
- hosts: localhost
connection: local
gather_facts: false
user: root
pre_tasks:
- include_vars: ~/ansible-lab/roles/provision-ec2-instance/vars/{{type}}.yml
roles:
- provision-ec2-instance
```

Code Sample 10: nginx.yml

```
---
- hosts: "{{hosts}}"
become: yes
become_user: root
roles:
- nginx
```

Code Sample 11: haproxy.yml

```
---
- hosts: "{{hosts}}"
become: yes
become_user: root
roles:
- haproxy
```