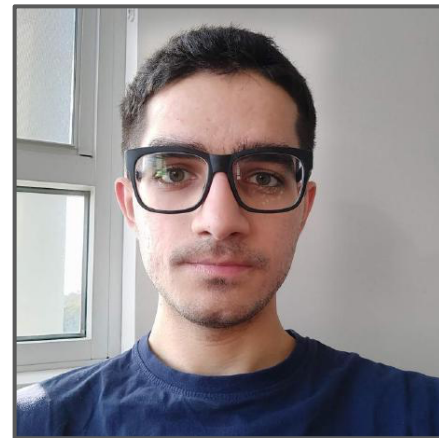# Virtual Lab Provisioning

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About me

Network Engineer

Devops Engineer

Python Developer

Areas of interest

- Operations tooling and Automation
- Continuous delivery and continuous integration
- Service Orchestration in programmable Networks

Introduction

A modern way to provision a networking development lab that can quickly get you started.

- Low startup cost
- Public cloud resources for prototyping
- Repeatable infrastructure
- Automated integration tests
- Integrates with CI platforms

Take Home Code Included:

github.com/qasimraz/terraform-sdn-lab/
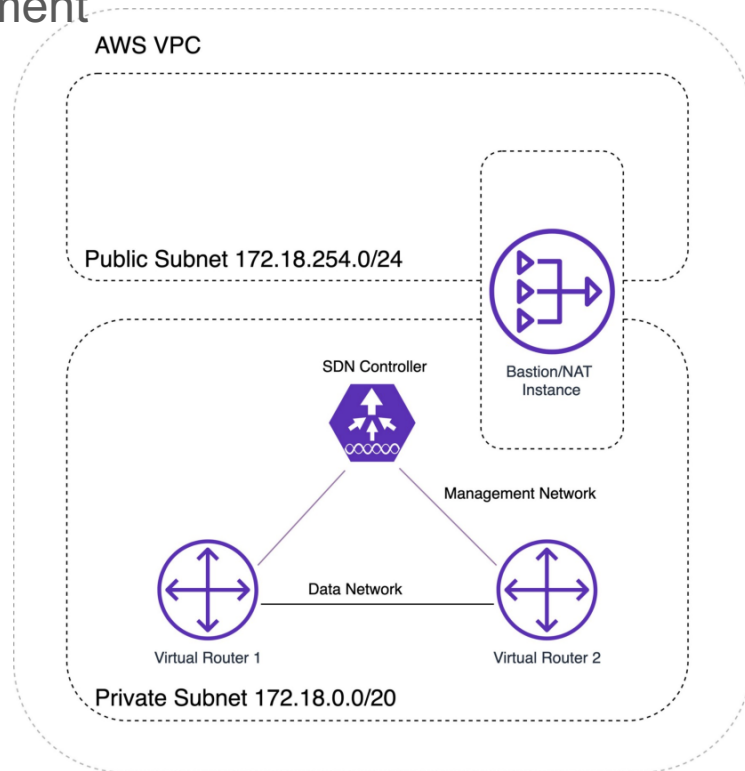
Agenda

➔ **Cloud Network Labs**

➔ Infrastructure as code

➔ Terraform

➔ Use Cases

➔ Live Demo

Why Public Clouds? e.g AWS, GCP, Azure

Many **open source** tools

Track record **uptime**

Flexible pricing

Reliable **security**

Easy to **scale out**

Virtual device images on the marketplace

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Cloud Network Lab Use Cases

- Staging infrastructure for **internal education/experimentation**

  - New engineers can be onboarded easily and grasp the end-user experience

- Staging infrastructure for **testing and integration**

  - Easy to change, augment, improve, modularize

- Staging infrastructure for **customer demos**

  - Can be terminated when not needed

- Staging infrastructure for **customer evaluation labs**

  - Customers can use the same code to build their own labs in AWS

  - Easy product evaluation

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Agenda

➔ Cloud Network Labs

➔ **Infrastructure as code**

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Infrastructure as code

Infrastructure as code (**IaC**) is the process of managing and provisioning computer data centers through machine-readable definition files, rather than physical hardware configuration or interactive configuration tools.

- IaC is very community driven
- Several open-source matured tools
- Providers can be used to provision hybrid clouds
- Take advantage of increasingly elastic infrastructure

Sample of Infrastructure as Code in Terraform

```
resource "aws_instance" "app" {
  count = 5

  ami           = "ami-408c7f28"
  instance_type = "t1.micro"
}
```

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Benefits of IaC

Template labs **quickly** and **reliably**

Conserve costs when lab is not in use

Share templates or replicate the lab for other users

Continuous integration and testing

Centralized security policies

Git managed versioning

Enables local development/deployment of infrastructure

Licensed vendor hardware includes **support** on the AWS marketplace

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Infrastructure practices to avoid

Reusing static VMs

- Risk of cross contamination between tests
- Lost state/stale lab VMs

Running tests locally

- "Worked on my machine" problem
- Resource limitations and inelasticity
- Reduced visibility into code reliability and quality

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Network Devices on the AWS Marketplace

Over 500 device AMIs available at a moment's notice, some also offer hourly licences, most are BYOL.

- F5 Networks
- Citrix
- Cisco
- Barracuda Networks
- Array Networks
- Fortinet Inc.
- Juniper
- Arista

Network Infrastructure   ✕

| Q Search | | | ‹ 1 2 3 4 › |

☐ F5 Networks (32)	☐ 9STAR (7)	☐ TrueStack (4)	☐ FireMon (3)
☐ Citrix (30)	☐ Cognosys Inc. (7)	☐ aiScaler (4)	☐ Aurora (3)
☐ Cisco (24)	☐ A10 Networks (6)	☐ MapR Technologies (4)	☐ Riverbed Technology (3)
☐ Nginx Inc.. (22)	☐ Varnish Software Inc (6)	☐ DataSunrise Database and Data Security (4)	☐ Loadbalancer.org (3)
☐ Barracuda Networks (12)	☐ Symantec (6)	☐ SANGFOR (4)	☐ Device42 (3)
☐ Kemp Technologies (10)	☐ TurnKey GNU/Linux (6)	☐ AppEx Networks (4)	☐ Cyxtera Federal Group (3)
☐ Pulse Secure LLC (10)	☐ Unisys Corporation (6)	☐ Cisco Stealthwatch Cloud (4)	☐ Netspectrum Inc. (3)
☐ ZOHO Corporation Private Limited (10)	☐ Hyperglance (6)	☐ Aviatrix Systems, Inc. (4)	☐ Treestle (3)
☐ BT Diamond IP (8)	☐ Fortinet Inc. (5)	☐ BlueCat Networks (3)	☐ Cyxtera (3)
☐ Array Networks (8)	☐ Sophos (5)	☐ 128 Technology (3)	☐ edgeNEXUS (3)
☐ Radware (7)	☐ Juniper Networks (5)	☐ Palo Alto Networks (3)	☐ netCUBED (3)
☐ OpenVPN Inc. (7)	☐ IBM Security (5)	☐ Pantheon technologies (3)	☐ Cohesive Networks (3)

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➔ **Terraform**

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Terraform

HashiCorp Terraform enables you to safely and predictably create, change, and improve infrastructure. It is an open source tool that codifies APIs into declarative configuration files that can be shared, treated as code, edited, reviewed, and versioned.

```
resource "aws_instance" "app" {
  count = 5

  ami           = "ami-408c7f28"
  instance_type = "t1.micro"
}
```

WRITE
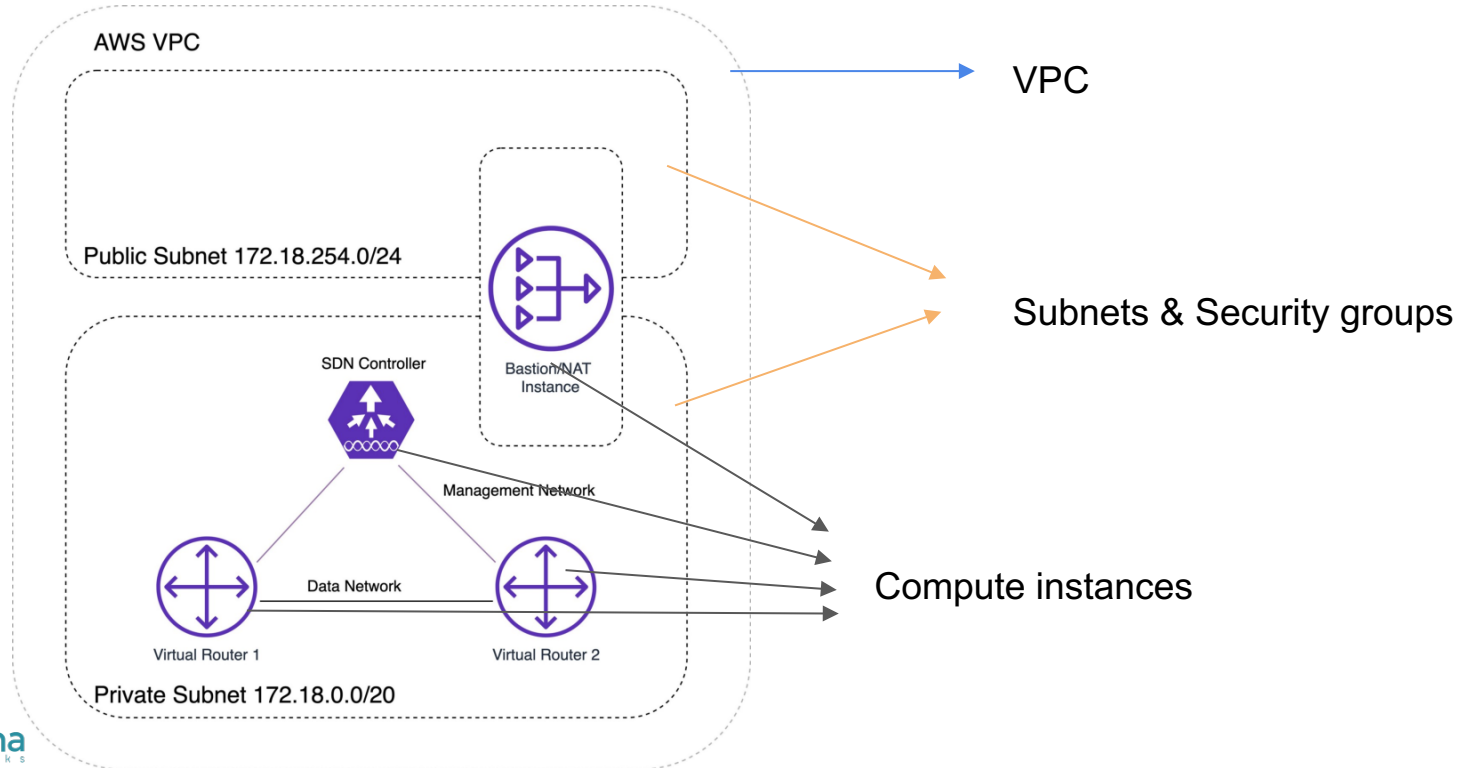INFRASTRUCTURE AS CODE

PLAN
PREVIEW CHANGES BEFORE APPLYING

CREATE
REPRODUCIBLE INFRASTRUCTURE

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Building a Network Lab in AWS

Code Snippets

VPC →

```
resource "aws_vpc" "vpc" {
  cidr_block          = "${var.my_cidr_block}"
  enable_dns_support  = true
  enable_dns_hostnames = true
  You, 9 days ago | 1 author (You)
  tags {
    Name = "${var.my_vpc_name}"
  }
}
```

```
resource "aws_subnet" "private" {
  vpc_id = "${aws_vpc.vpc.id}"
  cidr_block = "${var.pri_sub}"
  availability_zone = "${aws_subnet.public.availability_zone}"
  You, 9 days ago | 1 author (You)
  tags {
    Name = "${var.my_vpc_name}-private"
  }
}
```

Subnet →

EC2 Instance →

```
resource "aws_instance" "odl" {
  ami = "${var.my_ubuntu_ami}"
  instance_type = "${var.my_ubuntu_instance_type}"
  key_name = "${var.my_key_name}"
  subnet_id = "${module.lab.aws_subnet_private}"
  security_groups = ["${module.lab.aws_security_group_private}"]
  availability_zone = "${module.lab.aws_availability_zone_private}"
  You, a day ago | 1 author (You)
  tags {
    Name = "${var.my_vpc_name}-odl"
    User = "ubuntu"
    Type = "odl"
  }
}
```

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Integrates with Ansible

Terraform inventory produces a list of IP address based on tags

```
[user_jnpr]
172.18.5.211
172.18.7.87

[user_ubuntu]
172.18.11.24

[vMX1]
172.18.5.211

[vMX1.0]
172.18.5.211

[vMX1_ge0-0-0]
172.18.253.160
```

```
> TF_HOSTNAME_KEY_NAME=name ansible-playbook --inventory-file=/path/to/terraform-inventory deploy/playbook.yml
```

https://github.com/adammck/terraform-inventory

Terraform inventory provides information about the Terraform infrastructure state

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Not limited to AWS

100+ other terraform providers, many proprietary solutions have open-source providers

-   KVM Libvrt

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Agenda

➔ Cloud Network Labs

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➔ Terraform

➔ **Use Cases**

➔ Live Demo

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Use Cases

Deployment

- Controlling/validating the deployment/upgrade processes

Training Demos

- Infrastructure code is easy to read and follow

Product Demos

- Equip sales/customers with the tools to deploy products for evaluation

Continuous Integration & Testing

Utilize the Cloud Lab Infrastructure as an on-demand testbed

Recreate environments reliably

Limitations/Disadvantages

- Layer 2 functionality isn't usually available (AWS Baremetal lab-in-a-lab)

- Corporate security policies may not allow public clouds (hybrid clouds?)

- Software/Devops skill-barrier

- Physical hardware is already present in your lab
- Can <u>not</u> modify the kernel for marketplace images

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Live Demo

- Build a lab

- Provision the components

- Different ways to interact with the setup

    - sshuttle/openvpn/hybrid cloud

    - postman/jupyter notebook/front-end GUI

- Internal use-cases
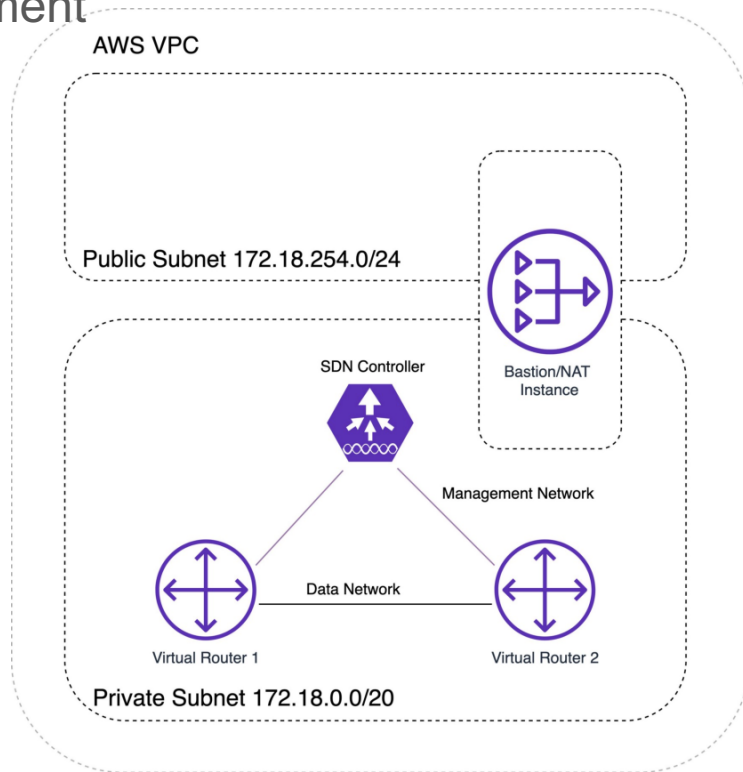
    - Demo/tutorial

    - CI/CD
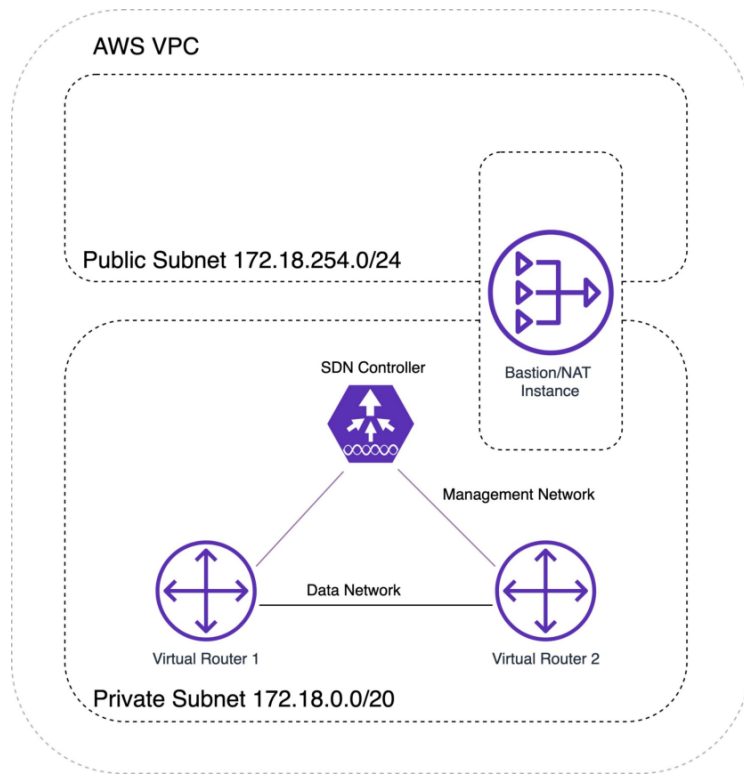
Recap

A modern way to provision a networking development lab

- Low startup cost
- Public cloud resources for prototyping
- Repeatable infrastructure
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- Integrates with CI platforms

Code: github.com/qasimraz/terraform-sdn-lab/

Why lumina networks

#1 Commercially Deployed ODL Vendor

100+ Customers

3 In production in Tier-1 Telco Networks

8 Startup-to-Watch & Best-of Awards

8 Open Source Leadership Roles

8 World Wide Offices

Funded by 2 Tier-1 Customers
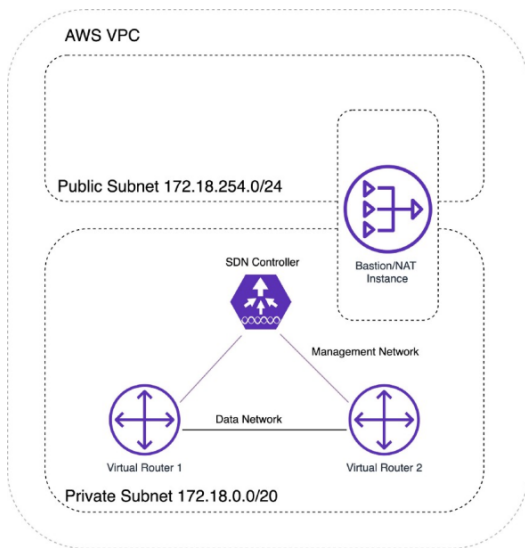
Engaged in **22** Open Source Projects

- Pure-play open source
- Flexibility to the core
- Expertise - Software & Agile Dev
- Culture & Training

Questions?

qasim@luminanetworks.com

Code available at github.com/qasimraz/terraform-sdn-lab/

AWS VPC

Public Subnet 172.18.254.0/24

Bastion/NAT Instance

SDN Controller

Management Network

Virtual Router 1 — Data Network — Virtual Router 2

Private Subnet 172.18.0.0/20

Terraform SDN Lab

This repository contains the Terraform blueprint to provision an SDN lab in AWS

Requirements

- Terraform v0.11.14 (TFswitch to downgrade)

Terraform Setup

```
export TF_VAR_access_key=''
export TF_VAR_secret_key=''
export TF_VAR_personal_ssh_key_path='/home/.ssh/lab.pem'
```

Provision

```
cd odl-csr/
terraform init
terraform plan
terraform apply
```

Questions?

Code available at github.com/qasimraz/terraform-sdn-lab/