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Infrastructure as Code for ACI with Terraform

Thomas Renzy – Technical Leader Customer Experience
@ThomasRenzy
BRKDCN-1811

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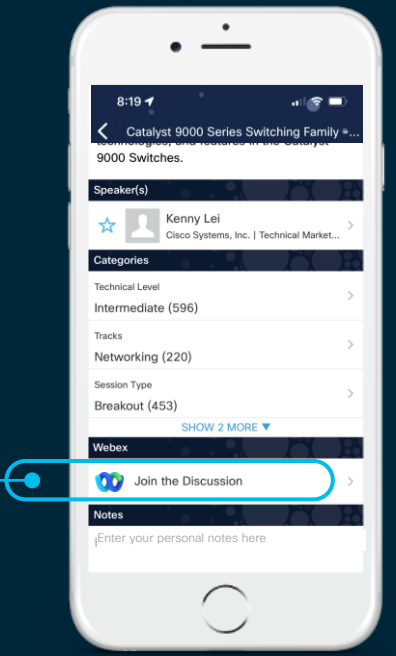

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Agenda

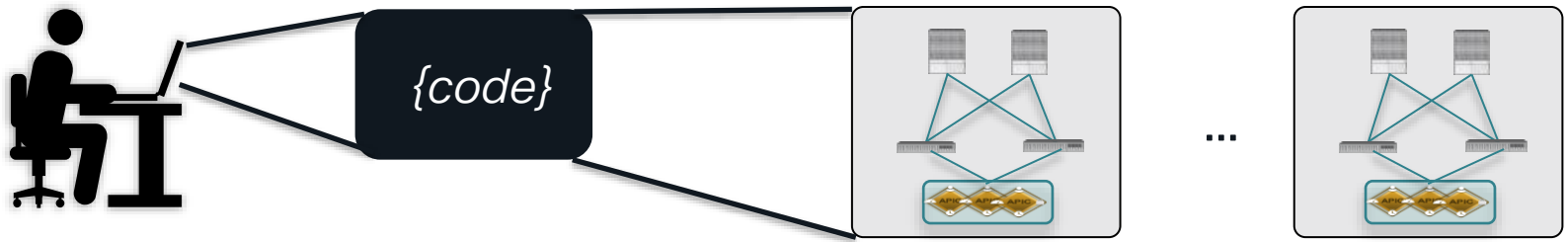
- Introduction to Terraform
- Terraform with ACI
- ACI Terraform Demos
- Next steps

Introduction to Terraform

Infrastructure as Code

- Using/Writing code to describe infrastructure
- Automate provisioning/repeatable tasks

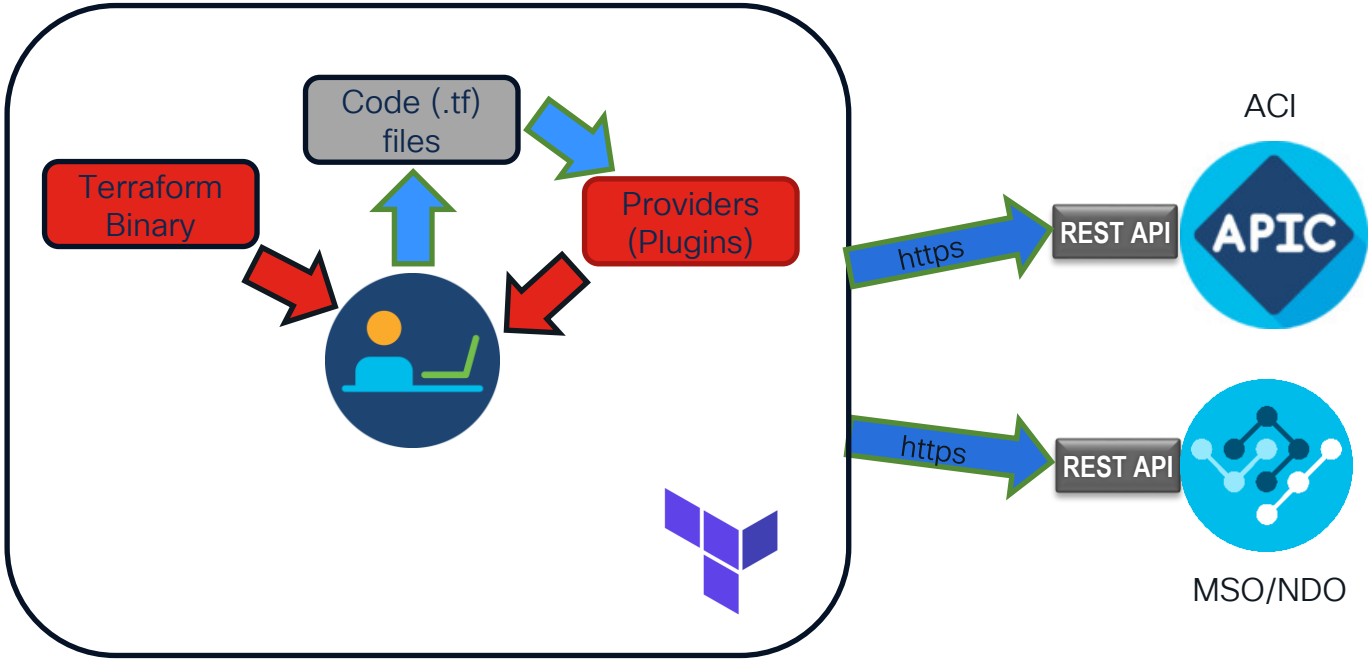
- Leverages Software Tools
  - Version control
  - Documentation
  - Testing
- Provides Speed & Scale



What is Terraform?

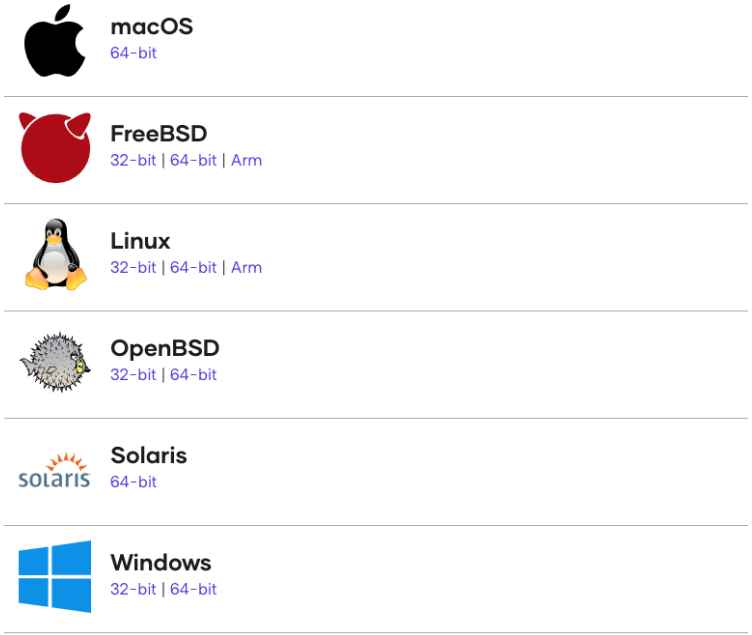
- Open Source
- Infrastructure provisioning tool
- Single binary – Linux, Windows, MacOS
- HashiCorp Configuration Language (HCL)
- Written in Go
  - No programming skills needed
- Declarative
- Leverages Plugins (providers)

Terraform overview



Terraform Installation

- https://www.terraform.io/downloads.html
- Pick your platform
- Unzip and install in your PATH
  - `/usr/local/bin`
  - `C:\Program Files (x86)`
- Run Terraform – That's it.



Terraform with ACI

Terraform Providers

- create/read/update/destroy infrastructure
- Relies on specific plugins
  - Downloaded Dynamically via initialization (via `terraform init`)
- Understands API interactions
  - APIC and MSO REST API calls

- Can use more than one vendor's providers
- Built by Vendor – certified by HashiCorp
- Can write your own providers
  - Terraform is open source
  - Written in Go

Types of Terraform Providers

Official

Owned & maintained by HashiCorp

Ex. AWS, Azure,GCP

Verified

Owned & maintained by partners.

Ex. ACI, MSO, ASA

Community

Published by individual groups or maintainers in the community

```
terraform {
  required_providers {
    aci = {
      source  = "CiscoDevNet/aci"
      version = "2.2.1"
    }
  }
}
```

```
terraform {
  required_providers {
    mso = {
      source = "CiscoDevNet/mso"
    }
  }
}
```

Terraform Resources & Data Sources

Resources

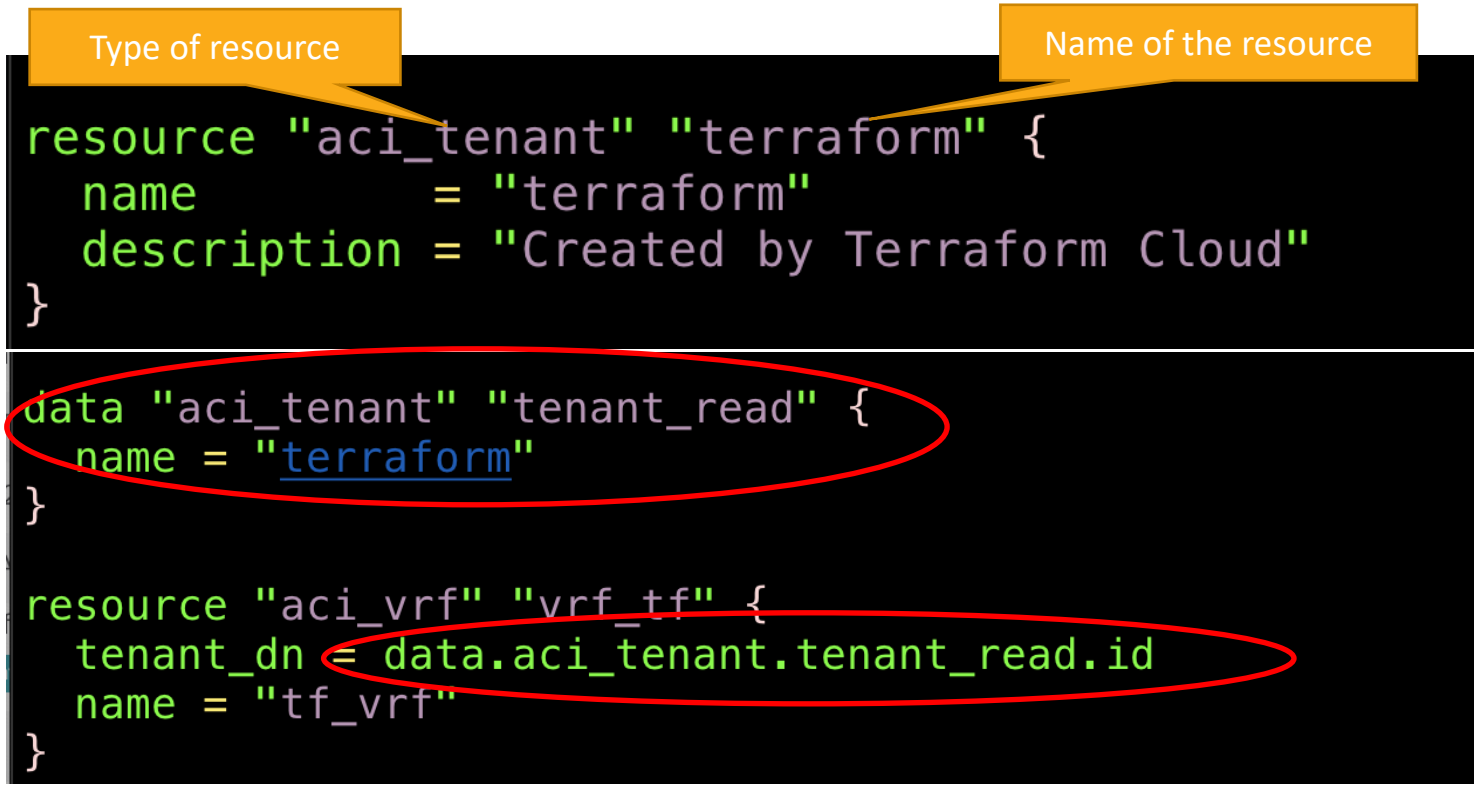
- Resources specific to a given provider
- Always Read/Write
- Terraform apply/destroy modifies resource
- Describes your intent for a particular infrastructure object

Data Sources

- Allow data to be fetched or computed for use elsewhere in Terraform configuration
- Always Read Only
- Terraform apply/destroy does not modify resource
- Query info outside of Terraform

Over 400 ACI Resources/Data Sources
Over 90 MSO Resources/Data Sources

Terraform Resources & Data Sources



Terraform Dependency Mapping

- Keeps track of dependencies and correct order of deployment
- Keeps a graph and state of infrastructure

```
resource "aci_tenant" "terraform" {
  name        = "terraform"
  description = "Created by Terraform Cloud"
}

resource "aci_vrf" "vrf1"{
  tenant_dn = aci_tenant.terraform.id
  name      = "tf-vrf"
}
```

Terraform State

- Records information about infrastructure it created
- Maps resources to configurations – terraform.tfstate
- Backends
  - State storage
  - Local
  - Terraform Cloud
  - AWS S3 bucket


```
{
  "version": 4,
  "terraform_version": "1.2.0",
  "serial": 1,
  "lineage": "9faa9d32-3d38-41b9-f0c5-b901370871ef",
  "outputs": {},
  "resources": [
    {
      "mode": "managed",
      "type": "aci_tenant",
      "name": "terraform",
      "provider": "provider[\"registry.terraform.io/ciscodevnet/aci\"]",
      "instances": [
        {
          "schema_version": 1,
          "attributes": {
            "annotation": "orchestrator:terraform",
            "description": "Created by Terraform Cloud",
            "id": "uni/tn-terraform",
            "name": "terraform",
            "name_alias": "",
            "relation_fv_rs_tenant_mon_pol": "",
            "relation_fv_rs_tn_deny_rule": null
          },
```

Variables

- Can use variables for value substitution
  - Specify type – string, number, boolean
  - Inside plans or external file – `variables.tf/variables.tfvar`

```
variable "tenant_name" {
        default = "terraform" # Name of our Tenant
}
```

```
resource "aci_tenant" "terraform" {
  name        = var.tenant_name
  description = "Created by Terraform Cloud"
}
```

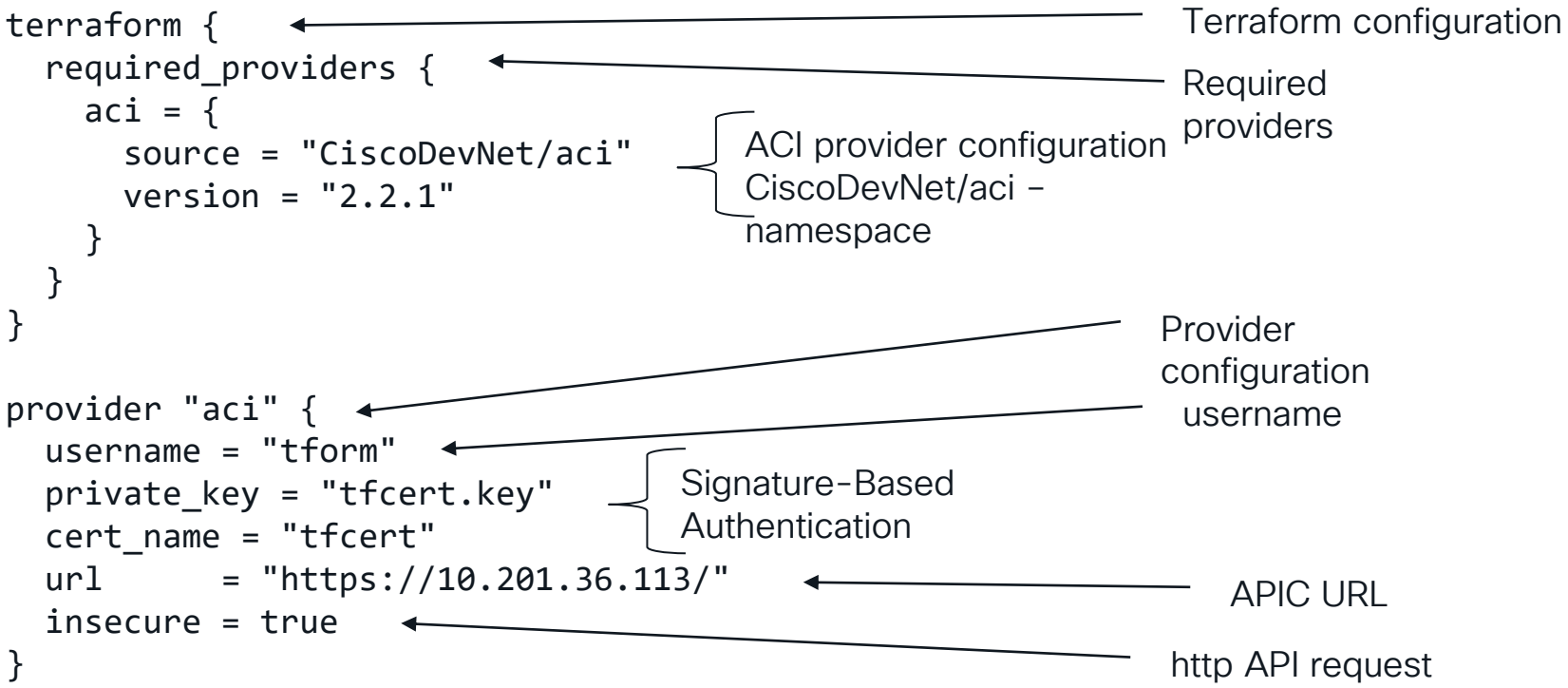
Terraform Plans/Configuration Files

- Collection of HCL instructions
  - What do you want to provision
- Can be in a singular file – main.tf
  - Can be broken up into smaller *.tf
- Can comment lines

  # This is a single line comment

  /* Can use this for a multiline comment */

Terraform Plan example

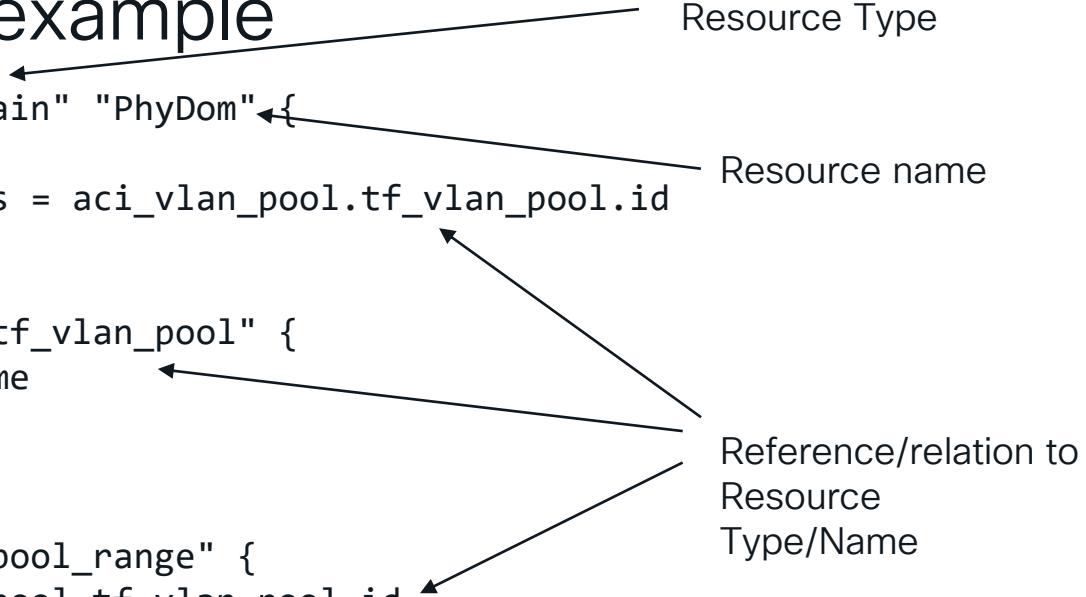


Terraform Plan example

```
resource "aci_physical_domain" "PhyDom" {
  name       = "PhyDom"
  relation_infra_rs_vlan_ns = aci_vlan_pool.tf_vlan_pool.id
}

resource "aci_vlan_pool" "tf_vlan_pool" {
  name       = var.pool_name
  alloc_mode = var.alloc
}

resource "aci_ranges" "tf_pool_range" {
  vlan_pool_dn = aci_vlan_pool.tf_vlan_pool.id
  from         = var.vlan_start
  to           = var.vlan_end
  alloc_mode   = "inherit"
  role         = "external"
}
```



When there isn't a Resource – aci_rest_managed

- Manages Objects via REST API calls with no provider
- Can reconcile state information
- Terraform does not track aci_rest content
- API calls can be captured via API Inspector/APIC GUI
- mso_rest for MSO

```
resource "aci_rest_managed" "aaaUserDomain_all" {
  dn         = "${aci_local_user.tform_user.id}/userdomain-all"
  class_name = "aaaUserDomain"
  content = {
    name = "all"
  }
}
```

Terraform commands

- `terraform init`
  - Installs plugins for configured providers
  - Must initialize before plan/apply
- `terraform plan`
  - determines what actions are necessary to achieve the desired state
- `terraform apply (-auto-approve)`
  - scans the current directory for the configuration
  - Applies the configuration to targets
- `terraform destroy`
  - Infrastructure managed by Terraform will be destroyed.
  - This will ask for confirmation before destroying

Terraform with ACI Demos

A Sample Three Tier Application with Terraform

- We want to do the following:
  - Create a new Tenant – Cisco
  - New VRF – cisco_vrf
  - New BDs – web-bd, app-bd, db-bd
  - Application Profile – cisco_ap
  - 3 EPGs:
    - web_epg , app_epg, db_epg
- 2 Contracts (and associated subjects/filters)
  - web_to_app – Communication between Web EPG and App EPG on http (tcp 80)
  - app_to_db – Communication between App EPG and DB EPG on sql (tcp 1433)

Demo – Three Tier Application

Creating Fabric Access Policies

- We want to do the following:
  - Create a new VLAN pool and VLAN Ranges
    - TF-VLAN-Pool, vlan range 121-130
  - New Physical Domain
  - Fabric policies
    - Link policy – 10G on
    - LLDP on
    - CDP Enable
  - Access port policy group
  - Leaf policies

Demo - Create Fabric Access Policies

Next Steps

Infrastructure as Code with Terraform

- Install Terraform
  - Available for most platforms
- Think big.....start small
  - Automate the simple, then build into more complex tasks
- Ease of writing Infrastructure as code with Terraform
- No special programming skills needed
- Resources/Data Sources for most common tasks
- Terraform and Robust APIC/MSO REST API makes automation easy and scalable

More information

- Walk in Lab – LABDCN-1776 (Intro to Terraform with ACI)
- https://www.terraform.io/
- https://registry.terraform.io/providers/CiscoDevNet/aci/latest/docs
- https://github.com/CiscoDevNet/terraform-provider-aci
- https://github.com/CiscoDevNet/terraform-provider-mso
- https://github.com/trenzy/
- https://developer.cisco.com/automation-terraform/

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