The bridge to possible

Automating Multi-Cloud Networking with Nexus Dashboard Orchestrator and Terraform

Starting with AWS and Azure

Marina Ferreira, Cloud and DC TSA
@_marinalf

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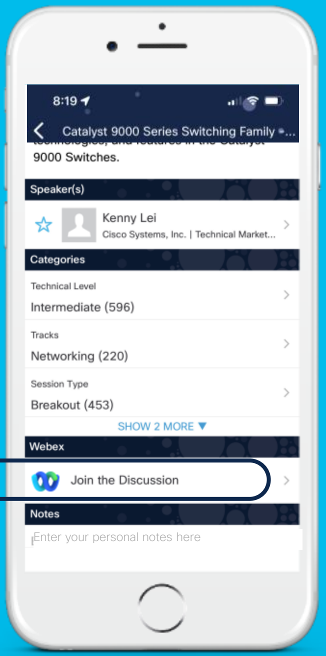

8:19

Catalyst 9000 Series Switching Family ...

9000 Switches.

Speaker(s)

☆ Kenny Lei
Cisco Systems, Inc. | Technical Market...

Categories

Technical Level
Intermediate (596)

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Agenda

- Multi-Cloud Networking Challenges
- Cisco Multi-Cloud Solution Overview
- Nexus Dashboard Orchestrator (NDO) REST API
- Using the NDO Terraform Provider + Demo
- Additional Resources
- Q&A

Multi-Cloud Networking Challenges

Different Clouds, Different Requirements

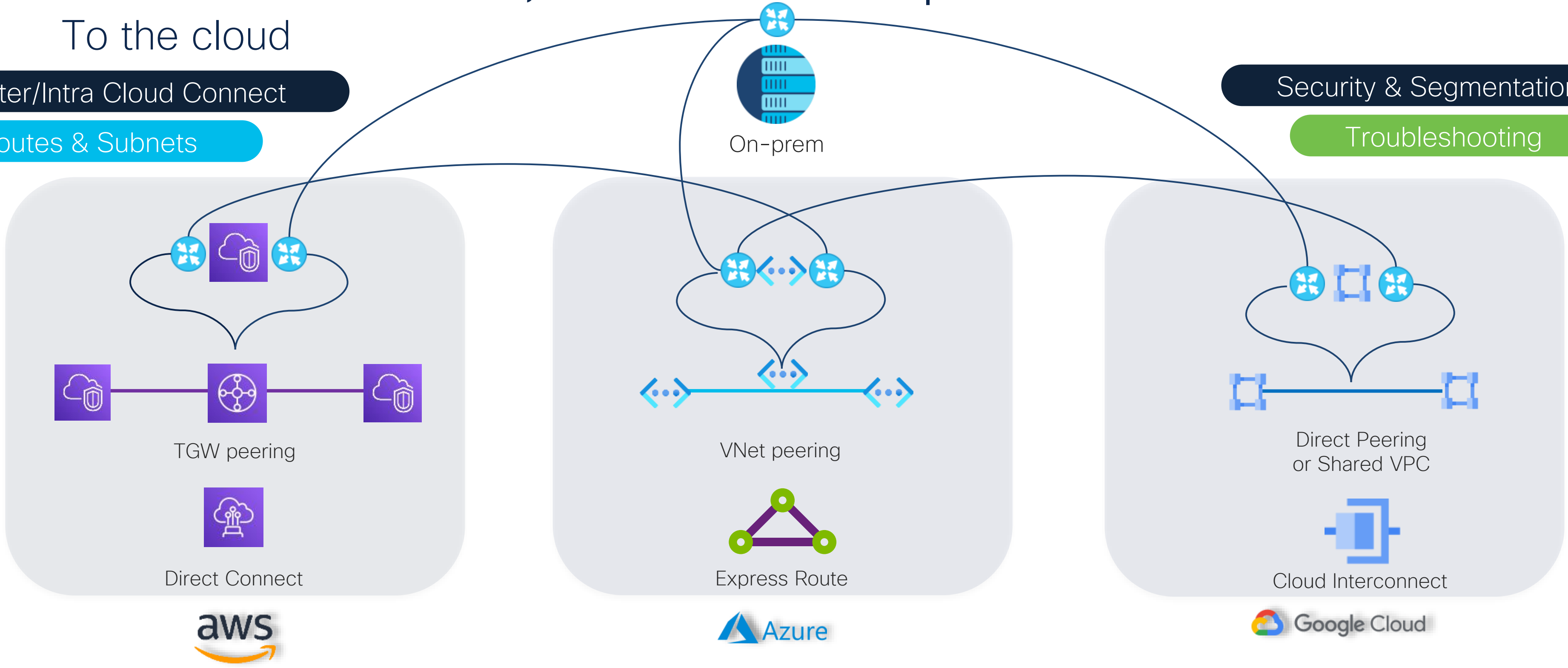
To the cloud

Inter/Intra Cloud Connect

Routes & Subnets

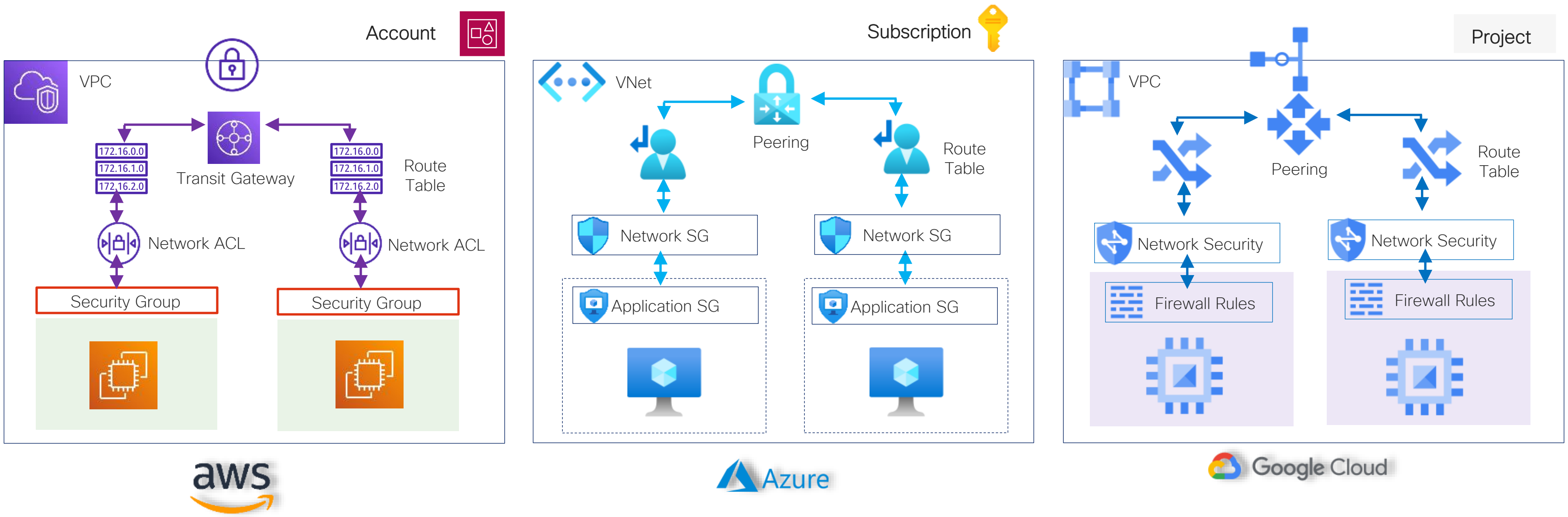
Security & Segmentation

Troubleshooting



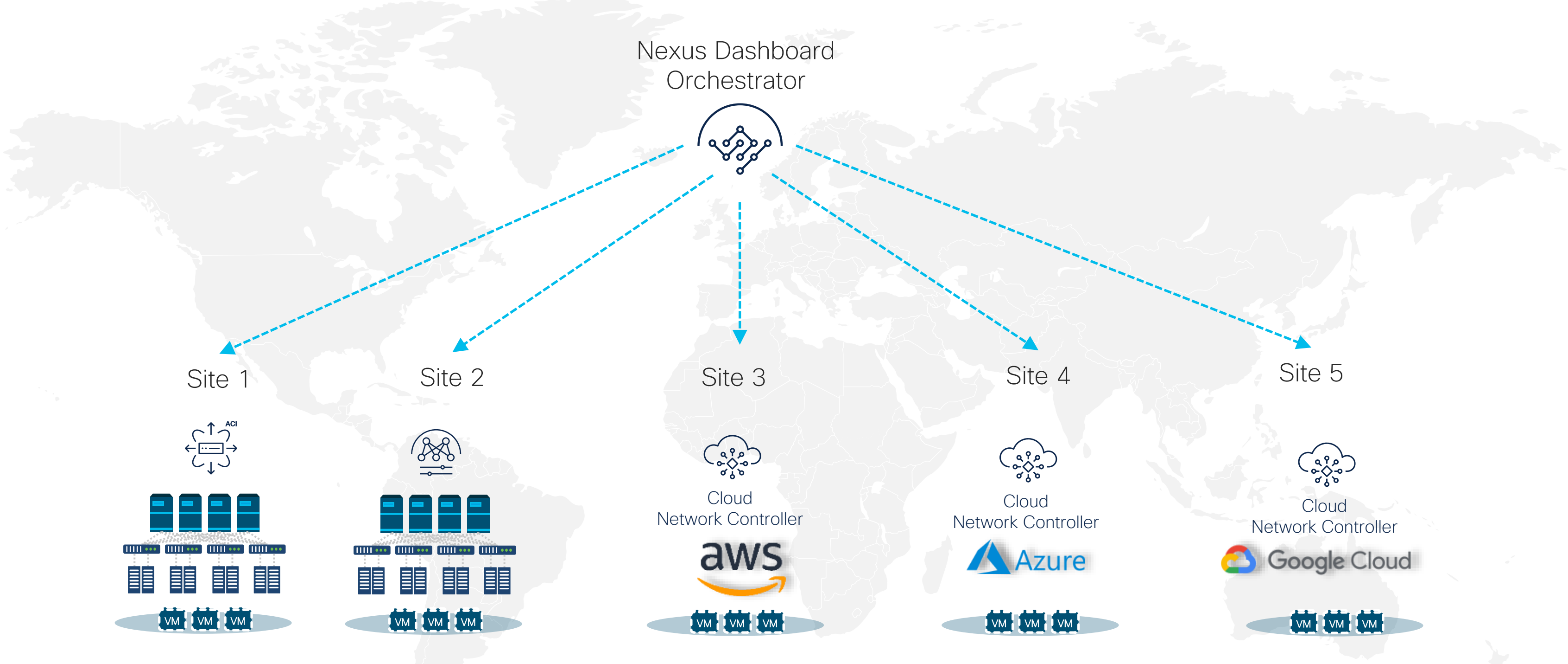
New Terminologies, Same Network Concepts

Inside the cloud



Cisco Multi-Cloud Solution

Cisco Multi-Cloud Solution Overview



✓ Consistent Network and Policy ✓ Secure Automated Connectivity ✓ Single Point of Orchestration

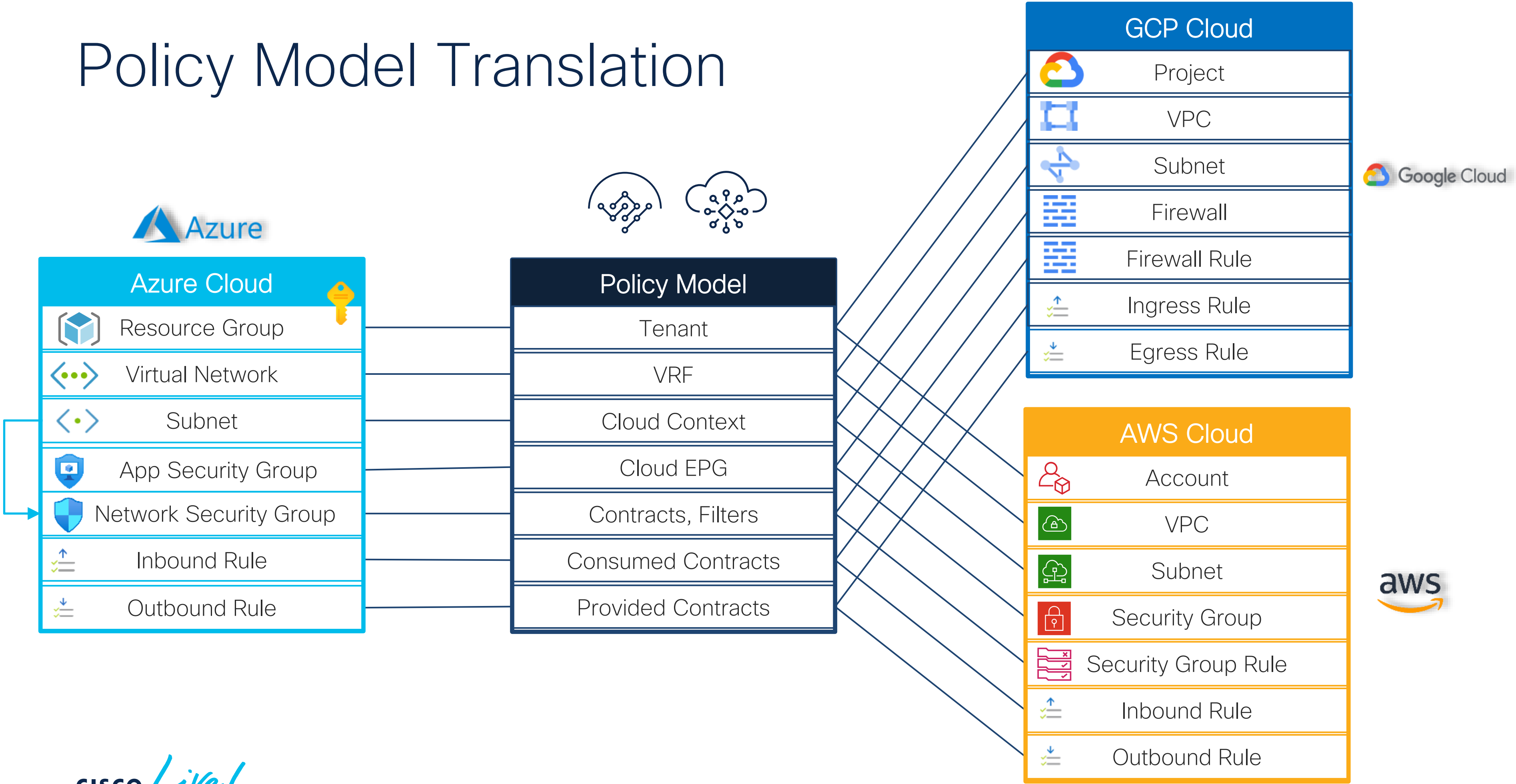
New Name from Release 25.0(5)

Cisco Cloud ACI

Cisco Cloud Network Controller

Modernize your Multi-Cloud Network with Cisco Cloud Network Controller

Policy Model Translation



Nexus Dashboard Orchestrator (NDO)

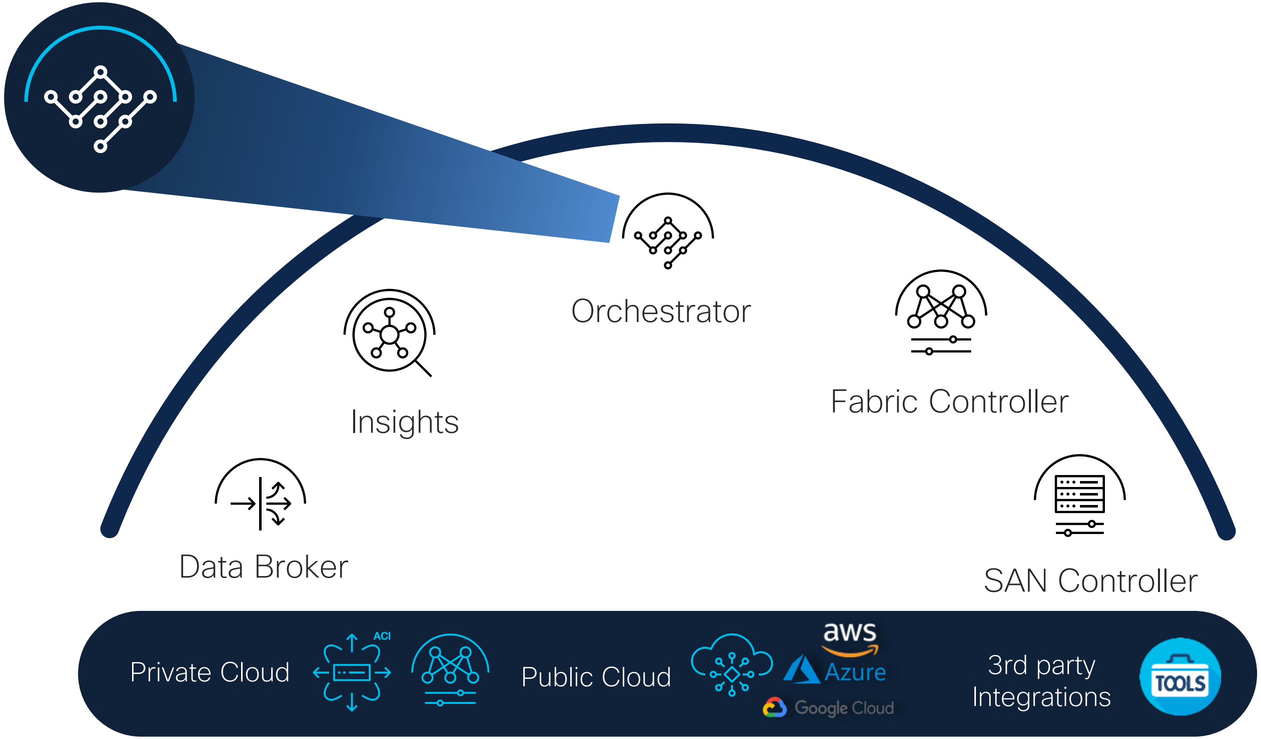
Nexus Dashboard Orchestrator

Simplified Multi-Cloud Networking

Connectivity

Segmentation

Visualization



Orchestrator

Insights

Fabric Controller

Data Broker

SAN Controller

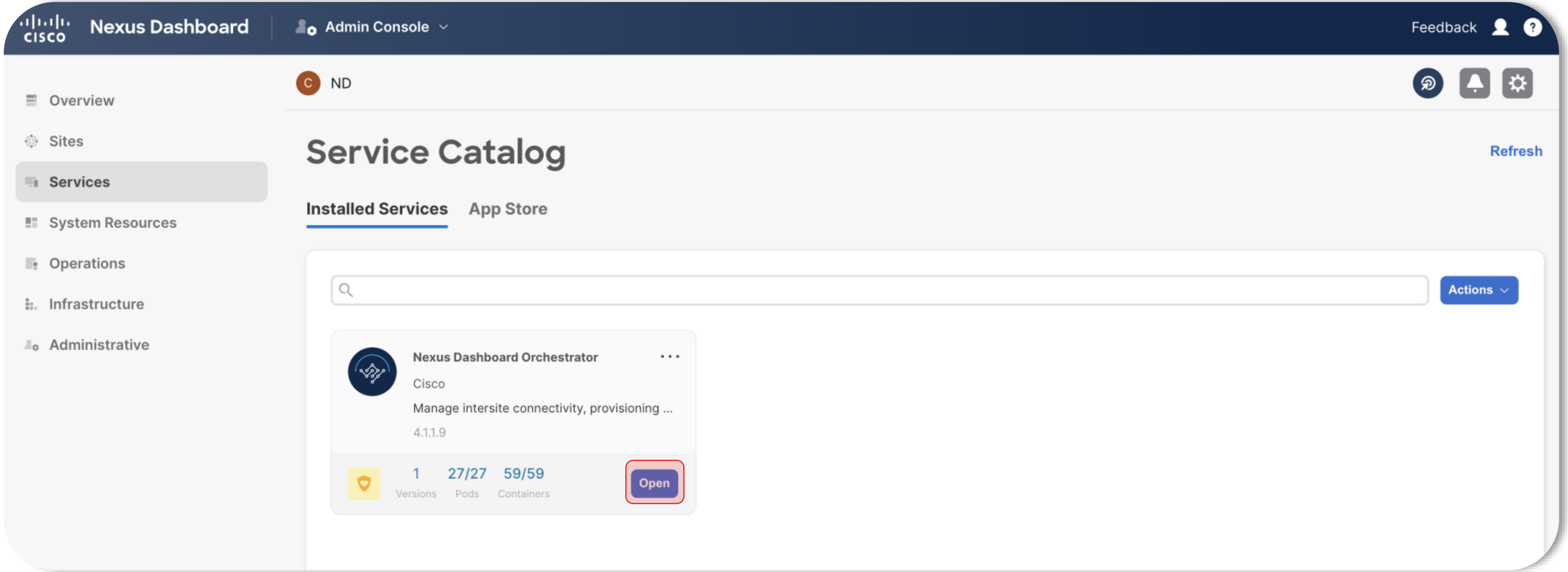
Private Cloud

Public Cloud

3rd party Integrations

Nexus Dashboard Orchestrator

Consumed as an App



Nexus Dashboard Orchestrator

Cisco

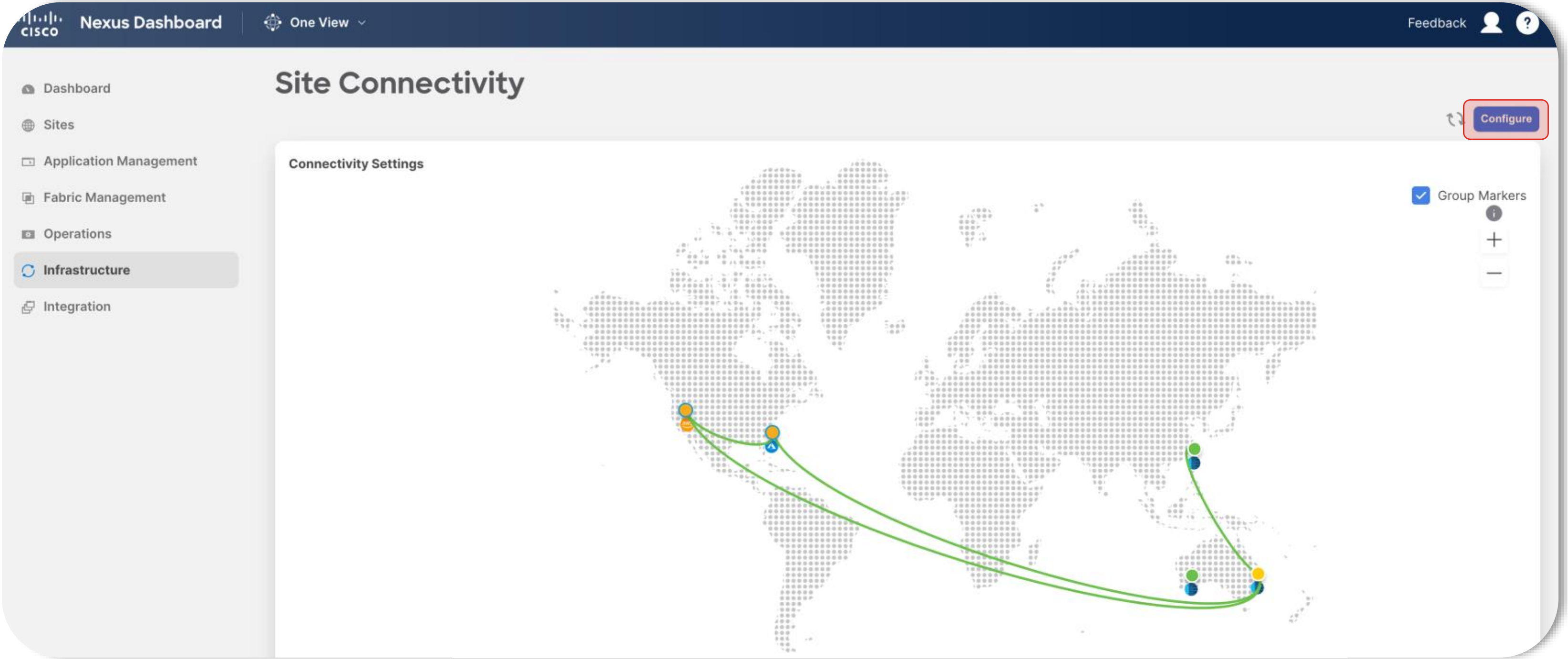
Manage intersite connectivity, provisioning ...

4.1.1.9

1	27/27	59/59
Versions	Pods	Containers

Nexus Dashboard Orchestrator

Connectivity View



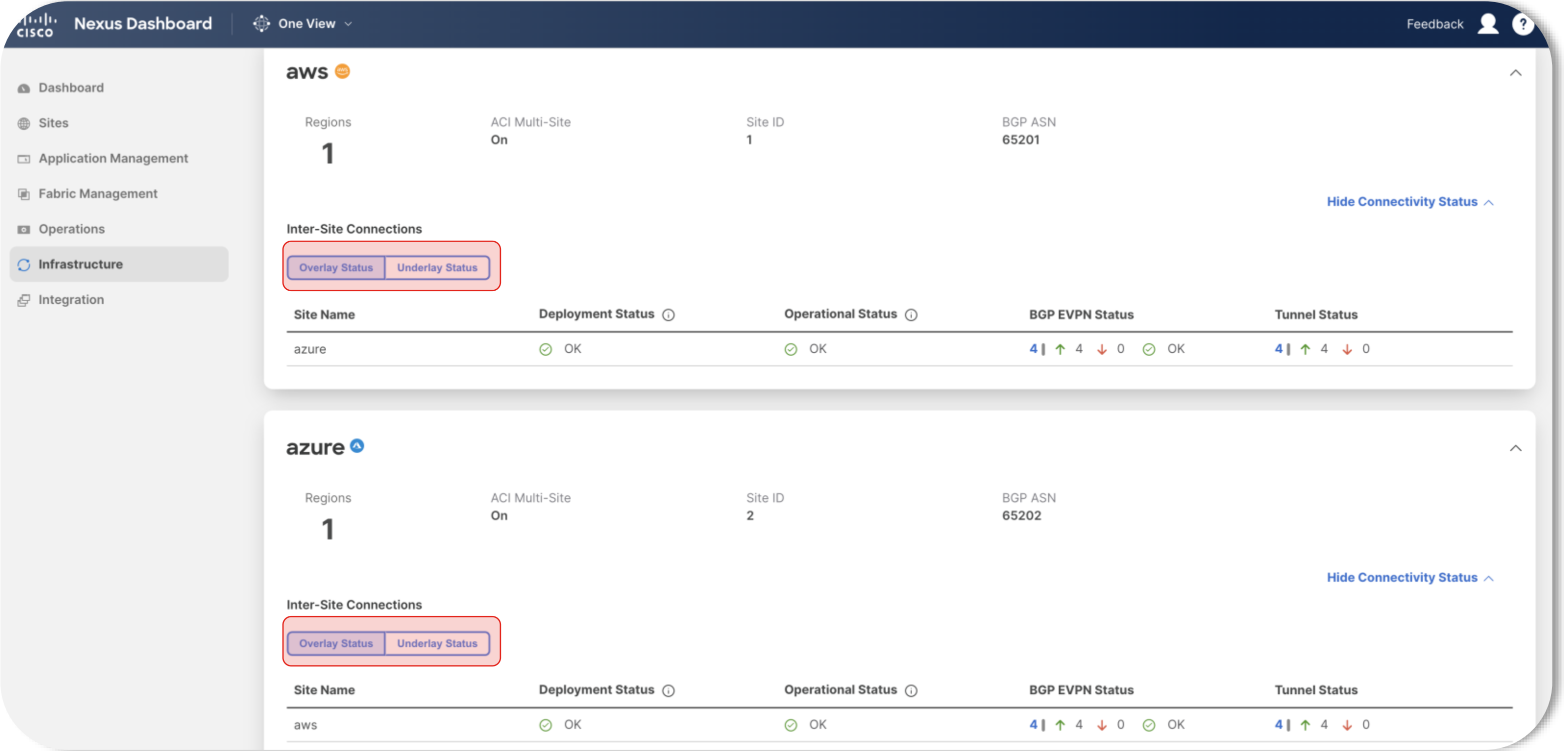
Site Connectivity

Connectivity Settings

☑ Group Markers

Nexus Dashboard Orchestrator

Overlay & Underlay Visibility: IPSec BGP IPv4 or BGP EVPN



aws

Regions	ACI Multi-Site	Site ID	BGP ASN
1	On	1	65201

Inter-Site Connections

Site Name	Deployment Status	Operational Status	BGP EVPN Status	Tunnel Status
azure	✓ OK	✓ OK	4 ❙ ↑ 4 ↓ 0 ✓ OK	4 ❙ ↑ 4 ↓ 0

azure

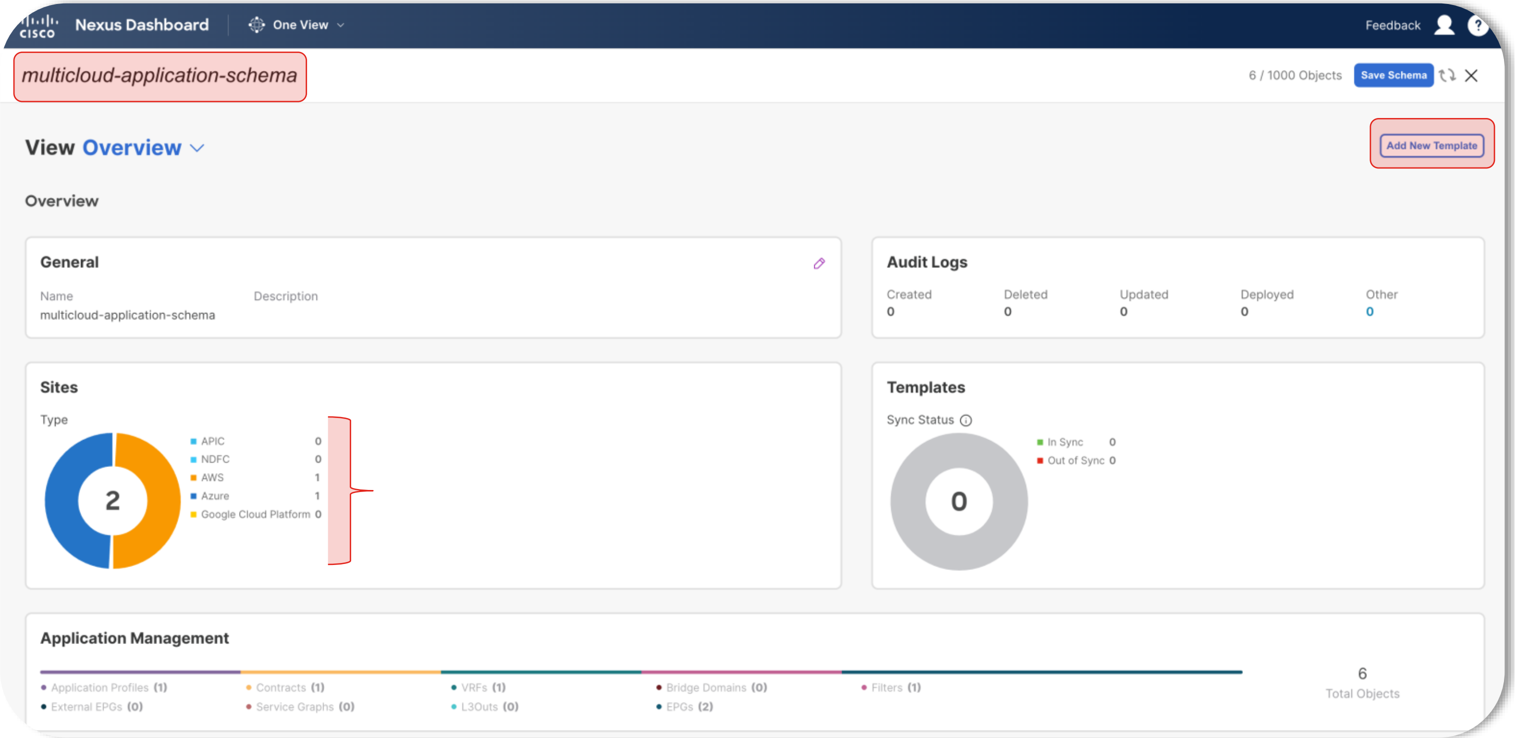
Regions	ACI Multi-Site	Site ID	BGP ASN
1	On	2	65202

Inter-Site Connections

Site Name	Deployment Status	Operational Status	BGP EVPN Status	Tunnel Status
aws	✓ OK	✓ OK	4 ❙ ↑ 4 ↓ 0 ✓ OK	4 ❙ ↑ 4 ↓ 0

Nexus Dashboard Orchestrator

Schemas & Templates: Network and App Segmentation



multicloud-application-schema

6 / 1000 Objects

View **Overview**

Overview

General

Name: multicloud-application-schema

Description:

Audit Logs

Created	Deleted	Updated	Deployed	Other
0	0	0	0	0

Sites

Type

APIC	0
NDFC	0
AWS	1
Azure	1
Google Cloud Platform	0

2

Templates

Sync Status

In Sync	0
Out of Sync	0

0

Application Management

- Application Profiles (1)
- External EPGs (0)
- Contracts (1)
- Service Graphs (0)
- VRFs (1)
- L3Outs (0)
- Bridge Domains (0)
- EPGs (2)
- Filters (1)

6 Total Objects

NDO REST API

NDO REST API

Introduction

- Nexus Dashboard Orchestrator provides a fully capable REST API

```
https://{ndo-ip}/mso/api/v2/sites/{id}
```

`host`	Nexus Dashboard IP address or hostname
`version`	API version. Depends on API endpoint
`resource`	Resource URI

NDO REST API

Supported Methods

- Nexus Dashboard Orchestrator supports the following methods

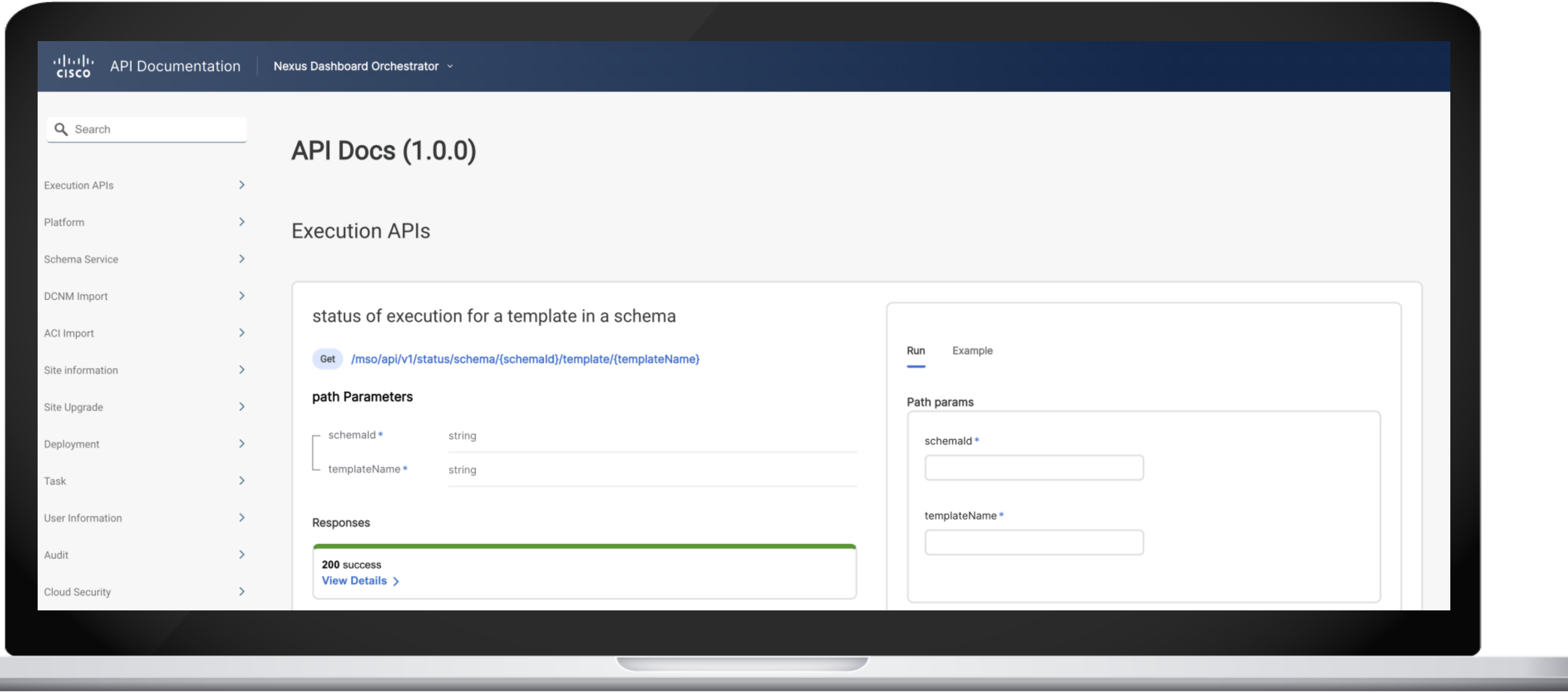
`GET`	Retrieves information about a resource
`POST`	Creates a resource
`PUT`	Updates a resource
`DELETE`	Deletes a resource
`PATCH`	Perform partial updates on a resource

API Reference: https://developer.cisco.com/docs/nexus-dashboard-orchestrator/latest/

NDO REST API

Swagger-like Interface

`https://{ndo-ip}/apidocs/`



API Docs (1.0.0)

Execution APIs

status of execution for a template in a schema

Get /mso/api/v1/status/schema/{schemaId}/template/{templateName}

path Parameters

schemaId *	string
templateName *	string

Responses

200 success

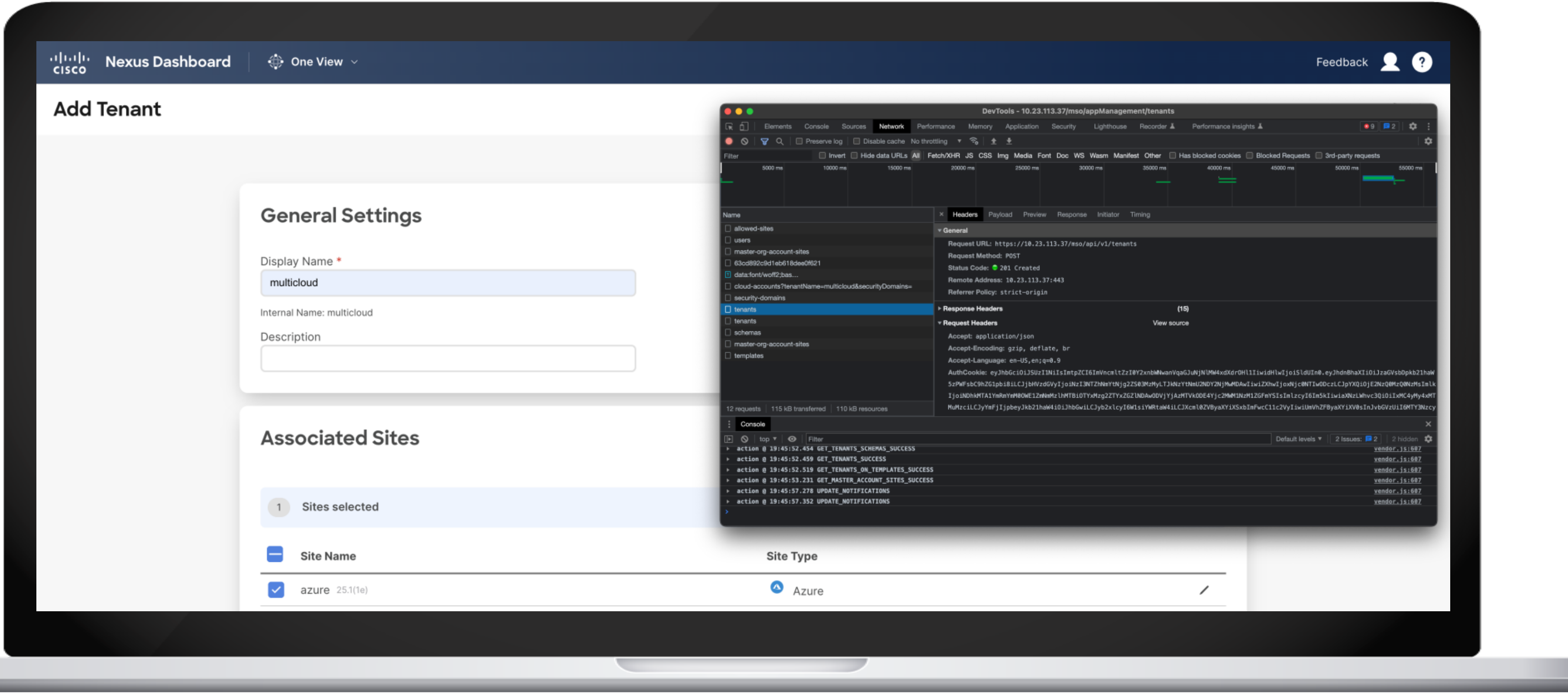
Path params

schemaId *

templateName *

NDO REST API

API Inspector



Add Tenant

General Settings

Display Name *

multicloud

Internal Name: multicloud

Description

Associated Sites

1 Sites selected

☐ Site Name	Site Type
☑ azure 25.1(1e)	Azure

Name
- allowed-sites
- users
- master-org-account-sites
- 63cd892c9d1eb618dee0f621
- data:font/woff2;bas...
- cloud-accounts?tenantName=multicloud&securityDomains=
- security-domains
- tenants
- tenants
- schemas
- master-org-account-sites
- templates

12 requests | 115 kB transferred | 110 kB resources

```
▾ General
  Request URL: https://10.23.113.37/mso/api/v1/tenants
  Request Method: POST
  Status Code: ● 201 Created
  Remote Address: 10.23.113.37:443
  Referrer Policy: strict-origin
▸ Response Headers (15)
▾ Request Headers
  Accept: application/json
  Accept-Encoding: gzip, deflate, br
  Accept-Language: en-US,en;q=0.9
  AuthCookie: eyJhbGciOiJSUzI1NiIsImtpZCI6ImVncmltZzI0Y2xnbWNwanVqaGJuNjNlMW4xdXdrOHl1IiwidHlwIjoiSldUIn0.eyJhdnBhaXIiOiJzaGVsbDpkb21haW
  5zPWFsbC9hZG1pbi8iLCJjbHVzdGVyIjoiNzI3NTZhNmYtNjg2ZS03MzMyLTJkNzYtNmU2NDY2NjMwMDAwIiwiZXhwIjoxNjc0NTIwODczLCJpYXQiOjE2NzQ0MzQ0NzMsImlk
  IjoiNDhkMTA1YmRmYmM0OWE1ZmNmMzlhMTBiOTYxMzg2ZTYxZGZlNDAwODVjYjAzMTVkODE4Yjc2MWM1NzM1ZGFmYSIsImlzcyI6Im5kIiwiaXNzLWhvc3QiOiIxMC4yMy4xMT
  MuMzciLCJyYmFjIjpbeyJkb21haW4iOiJhbGwiLCJyb2xlcyI6W1siYWRtaW4iLCJXcml0ZVByaXYiXSxbImFwcC11c2VyIiwiUmVhZFByaXYiXV0sInJvbGVzUiI6MTY3Nzcy
```

Console

```
▸ action @ 19:45:52.454 GET_TENANTS_SCHEMAS_SUCCESS          vendor.js:607
▸ action @ 19:45:52.459 GET_TENANTS_SUCCESS                  vendor.js:607
▸ action @ 19:45:52.519 GET_TENANTS_ON_TEMPLATES_SUCCESS     vendor.js:607
▸ action @ 19:45:53.231 GET_MASTER_ACCOUNT_SITES_SUCCESS     vendor.js:607
▸ action @ 19:45:57.278 UPDATE_NOTIFICATIONS                 vendor.js:607
▸ action @ 19:45:57.352 UPDATE_NOTIFICATIONS                 vendor.js:607
```

NDO REST API

Interacting with the REST API

- There are several ways to interact with the NDO REST API
  - Graphical User Interface
  - “Raw” API requests (e.g., via Postman)
  - Any programming language (JavaScript, Python, …)
  - Ansible
  - Terraform

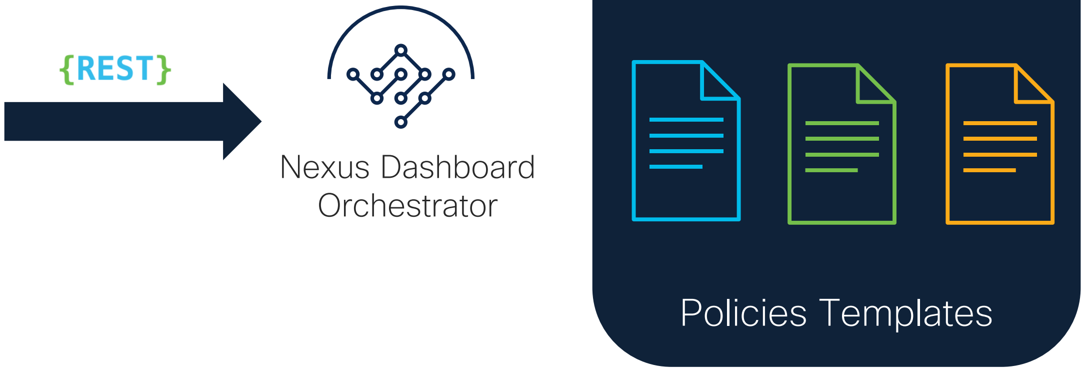
Using the NDO Terraform Provider

Using Terraform

Configuring the NDO Provider

provider.tf

```
terraform {
  required_providers {
    mso = {
      source = "ciscodevnet/mso”
      version = ">= 0.8.1"
    }
  }
}
provider ”mso" {
  username = var.username
  password = var.password
  url      = var.ndo_url
  insecure = true
  platform = “nd”
}
```

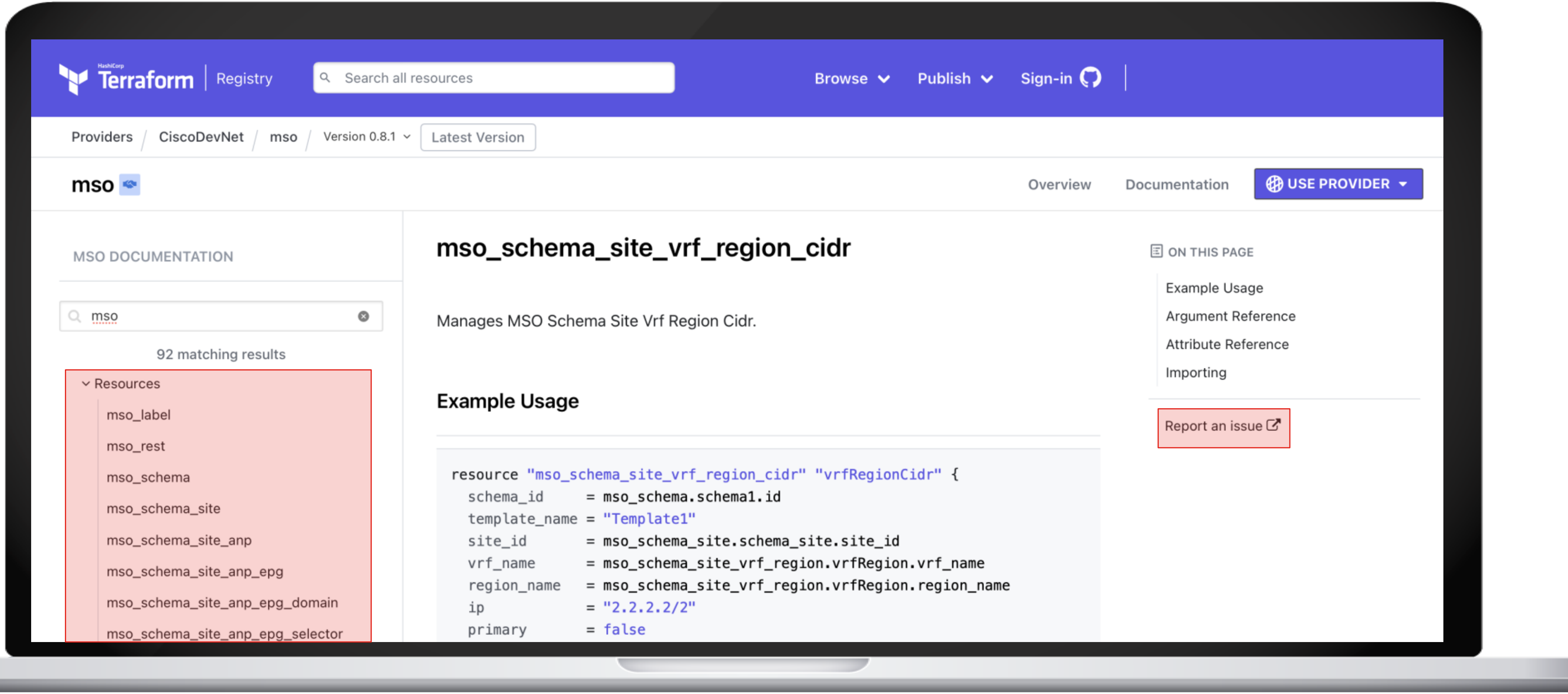


https://registry.terraform.io/providers/CiscoDevNet/mso/latest/docs

Using Terraform

Documentation

+ TAC Support!



mso_schema_site_vrf_region_cidr

Manages MSO Schema Site Vrf Region Cidr.

Example Usage

```
resource "mso_schema_site_vrf_region_cidr" "vrfRegionCidr" {
  schema_id     = mso_schema.schema1.id
  template_name = "Template1"
  site_id       = mso_schema_site.schema_site.site_id
  vrf_name      = mso_schema_site_vrf_region.vrfRegion.vrf_name
  region_name   = mso_schema_site_vrf_region.vrfRegion.region_name
  ip            = "2.2.2.2/2"
  primary       = false
```

Using Terraform

Resources and Data Sources

data_sources.tf

```
# Existing NDO Sites

data "mso_site" "aws_site" {
  name = var.aws_site_name
}
data "mso_site" "azure_site" {
  name = var.azure_site_name
}
```

always read-only

main.tf

```
# Define Tenant

resource "mso_tenant" "tenant" {
  name         = var.tenant.tenant_name
  display_name = var.tenant.display_name
site_associations {
    site_id                 = data.mso_site.aws_site.id
    vendor                  = "aws"
    aws_account_id          = var.aws.aws_account_id
    is_aws_account_trusted  = true
  }
  site_associations {
    site_id                 = data.mso_site.azure_site.id
    vendor                  = "azure"
    azure_subscription_id   = var.azure.azure_subscription_id
    azure_access_type       = "shared"
    azure_shared_account_id = var.azure.azure_subscription_id
  }
}

# Define Schema & Templates

resource "mso_schema" ”schema1" {
  name         = var.schema_name
  template {
    name       = var.template_name
    tenant_id  = mso_tenant.tenant.id
  }
}
[...]
```

Using Terraform

Deployment Notes

main.tf

```
# Deploy Template

resource ″mso_schema_template_deploy" ″template_deployer" {
  schema_id     = mso_schema.schema1.id
  template_name = var.template_name
  site_id       = data.mso_site.aws_site.id #if undeploying
  undeploy      = true
  depends_on    = [
    mso_tenant.tenant,
    mso_schema.schema1,
    mso_schema_site.aws_site,
    mso_schema_site.azure_site
  ]
}
```

deployer.tf

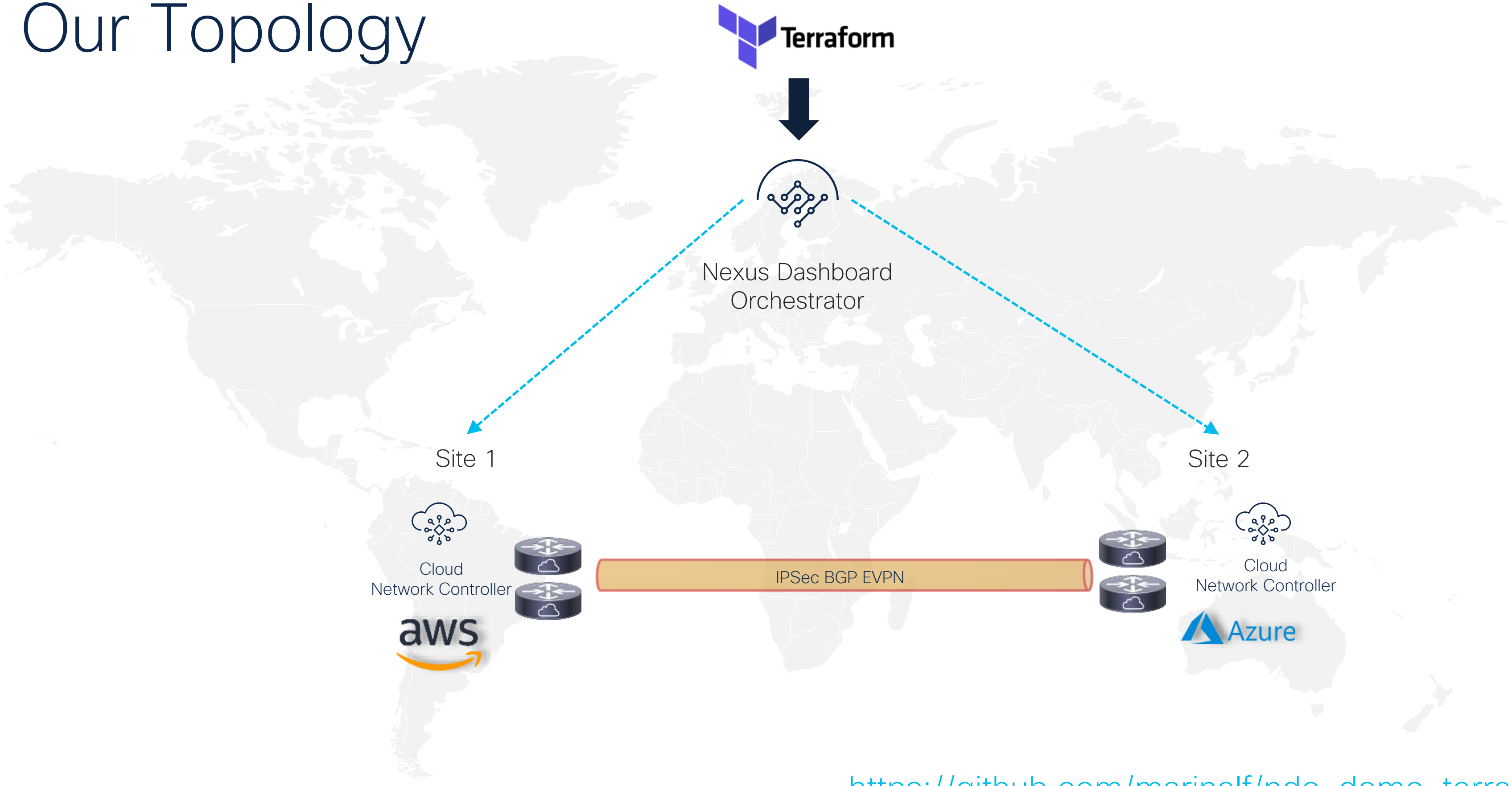
```
# Deploy Template

resource ″mso_schema_template_deploy_ndo" ″template_deployer″ {
  schema_id     = mso_schema.schema1.id
  template_name = var.template_name
    depends_on  = [
    mso_tenant.tenant,
    mso_schema.schema1,
    mso_schema_site.azure_site,
    mso_schema_template_anp.ap,
    mso_schema_template_vrf.vrf1,
    mso_schema_template_anp_epg.cloud_epg,

[...]
```

<0.7.1 → >0.8.1

Usage: It can be part of your .tf plan itself or of a more structured IaC pipeline

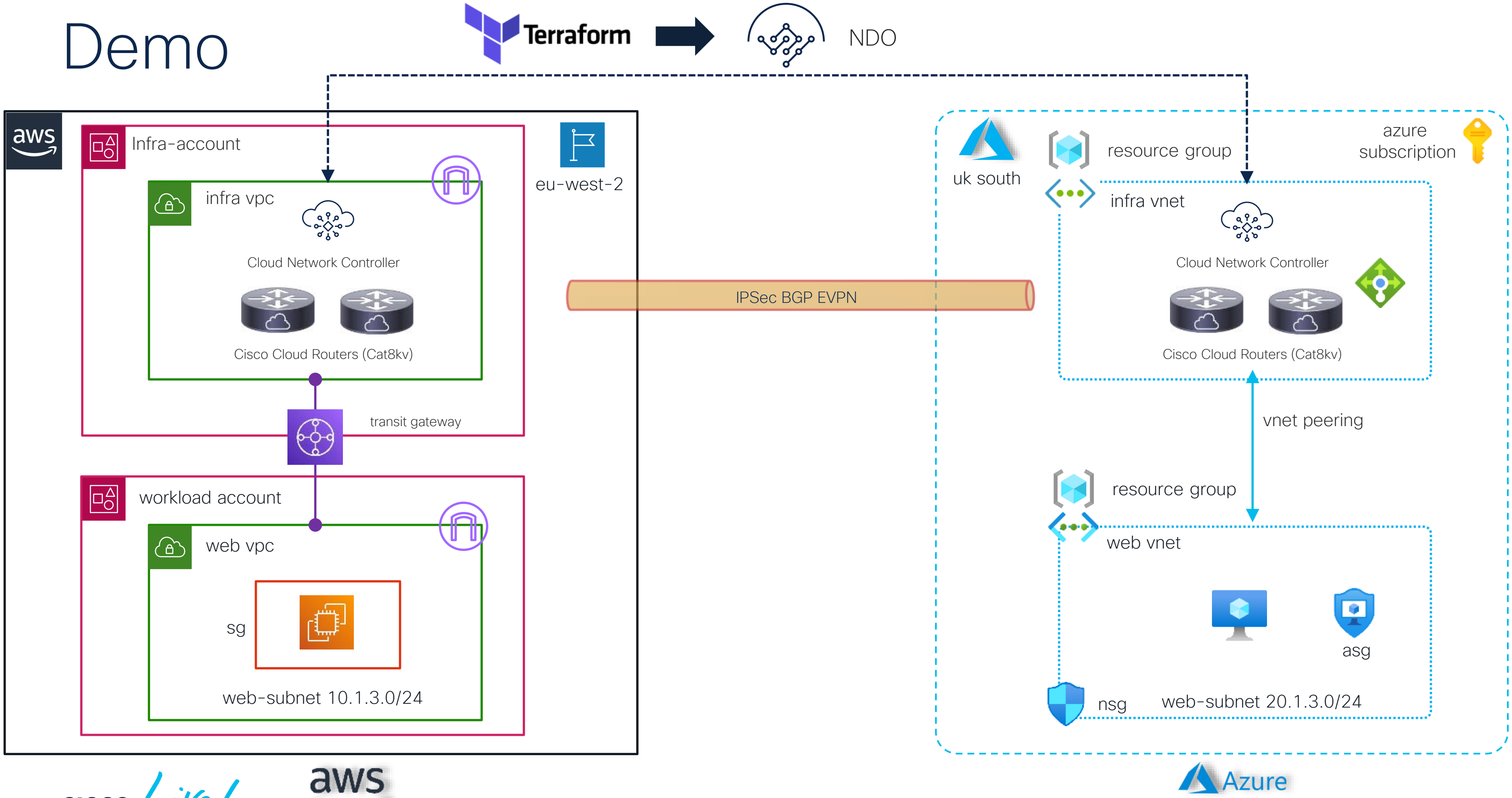
Demo

Our Topology

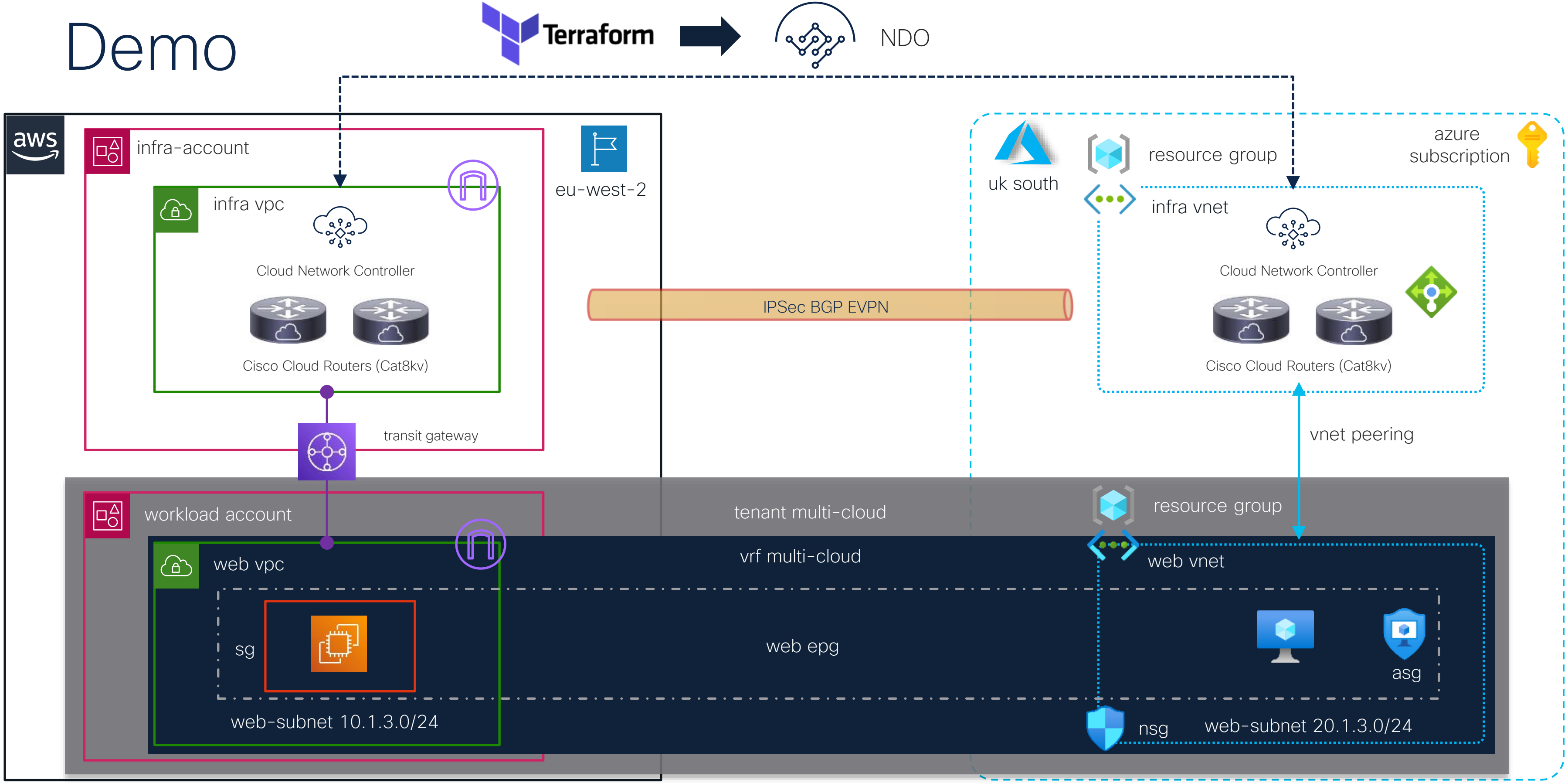


https://github.com/marinalf/ndo-demo-terraform

Demo


Terraform
NDO
aws
Infra-account
eu-west-2
infra vpc
Cloud Network Controller
Cisco Cloud Routers (Cat8kv)
transit gateway
workload account
web vpc
sg
web-subnet 10.1.3.0/24
IPSec BGP EVPN
uk south
resource group
azure
subscription
infra vnet
Cloud Network Controller
Cisco Cloud Routers (Cat8kv)
vnet peering
resource group
web vnet
asg
nsg
web-subnet 20.1.3.0/24
Azure

Demo


Terraform
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aws
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eu-west-2
transit gateway
IPSec BGP EVPN
uk south
resource group
azure subscription
infra vnet
Cloud Network Controller
Cisco Cloud Routers (Cat8kv)
vnet peering
workload account
tenant multi-cloud
resource group
web vpc
vrf multi-cloud
web vnet
sg
web epg
asg
web-subnet 10.1.3.0/24
nsg
web-subnet 20.1.3.0/24

Additional Resources

Building Terraform Code

Start with standard modules

provider.tf

```
terraform {
  required_providers {
    mso = {
      source  = "ciscodevnet/mso”
      version = ">= 0.8.1"
    }
  }
}
provider ”mso" {
  username = var.username
  password = var.password
  url      = var.ndo_url
  insecure = true
  platform = “nd”
}
```

main.tf

```
# Associate schema and template with cloud sites

resource "mso_schema_site" "azure_site" {
schema_id           = mso_schema.schema1.id
template_name       = var.template_name
site_id             = data.mso_site.azure_site.id
undeploy_on_destroy = true
}

resource "mso_schema_site" "aws_site" {
schema_id           = mso_schema.schema1.id
template_name       = var.template_name
site_id             = data.mso_site.aws_site.id
undeploy_on_destroy = true
}

[...]
```

variables.tf

```
variable "schema_name" {
type    = string
default = "multicloud"
}

variable "template_name" {
type    = string
default = "distributed-app"
}

variable "aws_region_name" {
type    = string
default = "eu-west-2"
}

[...]
```

Sample Module Config
https://github.com/marinalf/ndo-sample-terraform-mod

Additional Resources

Terraform

CNC

APIC

Orchestrator

450+ APIC & CNC resources/data sources available
https://github.com/CiscoDevNet/terraform-provider-aci

90+ Orchestrator resources/data sources available
https://github.com/CiscoDevNet/terraform-provider-mso

Infrastructure as Code

Embrace DevOps, APIs, and Automation to manage networks efficiently, control risk, and optimize for growth and innovation.

Cisco and Hashicorp announce collaboration

Cisco will sell Hashicorp Terraform alongside Cisco Infrastructure. Cisco's newest IaC solutions support a hybrid cloud operating model in which Terraform can provision and manage equipment inside private datacenters running Cisco Intersight.

Orchestration tools bring IaC to life

Explore Cisco's Terraform Providers, Ansible Collections, and NSO NED with Learning Labs, Sandboxes, and more.

https://developer.cisco.com/iac

Additional Sessions

Architecting Hybrid Multi-Cloud Infrastructures - **BRKDCN-2621**

Automating Cloud Network Controller Operations on Public Clouds - **DEVNET-2686**

How to Automate and Seamlessly Interconnect AWS & Azure with Cisco Cloud Network Controller - **LTRDCN-2241**

Explore Simplicity of Public Cloud Network Configuration with Cloud Network Controller and Nexus Dashboard Orchestrator - **LTRCLD-2557**

Q&A

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cs.co/DNZCLEUR2023

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- Attend any of the related sessions at the DevNet, Capture the Flag, and Walk-in Labs zones.
- Visit the On-Demand Library for more sessions at ciscolive.com/on-demand.

The bridge to possible

Thank you

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NDO REST API

PATCH example

PATCH https://{{nd_host}}/mso/api/v1/tenants/{{tenantId}}

```
[
  {
    "op": "replace",
    "path": "/displayName",
    "value": ”my_test_tenant"
  },
  {
    "op": "remove",
    "path": "/siteAssociations/609ee1bc8eea4d6068c63158",
    "disassociate": true
  },
  {
    "op": "add",
    "path": "/siteAssociations/-",
    "value": {
      "siteId": "600efe2016c6a89667a7865b",
      "securityDomains": [ ]
    }
  }
]
```

disassociate controls if tenant is removed from local sites or not. Only used when removing Site Association

path must indicate where to insert the object. “-” means at the end

Using Terraform

Disable Parallelism prior to 0.8.1

- By default, Terraform can provision multiple resources in parallel
  - Default parallelism is 10
  - A resource is considered for deployment as soon as all its dependencies have been deployed
- By default, NDO UI protects against concurrent configuration changes, but API does not.

```
$ terraform apply -parallelism 1
```

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ALL IN