CISCO Engage | Tech Day Miami

The Best Tool to Automate Your Data Center

Unlocking the Best-Kept Secret in the Networking Industry

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Agenda

1. Introduction and Objectives
2. Data Center Automation Fundamentals
3. The Automator's Toolbox
4. One Tool to Rule Them All!

Introduction

- Customer from 1997 – 2018. CCIE R&S 2016 (#54946)
- GES South Systems Architect (SA) 2018–2019
- DevNet Automation Bootcamp Delivery Engineer (Developer Advocate) 2021-2025
- Cisco Certified Systems Instructor (#35892) 2021 – Present. Cisco Instructor of Excellence Award, Datacenter, 2022
- Cisco Live! Distinguished Speaker Hall of Fame, 2025
- Technical Leader, Learn with Cisco, Office of Automation and Operational Excellence, 2025-present

Introduction and Objectives

Session Objectives

- This is **not** a deep-dive / tutorial into automation or coding.
- We **will** discuss fundamentals of data center automation.
- We **will** explore different tools that can be used to automate your datacenter.
- You **will** learn the most powerful tool for all automation use cases!

Data Center Automation Fundamentals

Why Do We Automate?

Time for "Big-Picture" Projects

Reduce Configuration Errors

Compliance Testing

What are some of the repetitive, manual tasks you need to do in your daily work?

Environmental Challenges

- Cloud
  - Reliant upon 3rd party (public or private); no devices
- "Traditional" (*n*-tier) networks
  - Inflexible; less performant
- Manually-managed fabrics
  - Modern but high management overhead
- Controller-based fabrics
  - Uses a different approach than we are familiar with

Use Cases and Automation Requirements

- **Day 0:** Topology Building
  - Cloud, manual or controller-based fabrics
- **Day 1:** Configuration Management
  - Generally, all **except** cloud
- **Day *n*:** Operate and Optimize
  - All environments

Data Center Environments: Cloud

For your reference

- Public or Private
- Topology building
- No devices to configure (usually!)
- Cloud provider's network can be a "black box"
  - We can't control the underlay!

Data Center Environments: *n*-Tier

For your reference

- Most familiar
  - Based on legacy core / distribution / access layers
- Static topology
- Focused on individual device configuration

Data Center Environments: Manually-Managed Fabrics

For your reference

- Spine-and-leaf (clos) topology
- Modern architectures and protocols
  - VXLAN, BGP EVPN
  - **More advanced engineering skills to operate and troubleshoot!**
- Individual device configuration
  - We control the underlay and overlay network(s)

Data Center Environments: Controller-Based

For your reference

- Spine-and-leaf
- Interact with a controller (e.g., APIC) to program devices
- Simplified management and troubleshooting
- Multitenancy
  - Virtual networks added or removed as needed

Modality: CLI vs REST API

```
leaf-1# config t
Enter configuration commands, one per line. End with CNTL/Z.
leaf-1(config)# interface Eth1/1
leaf-1(config-if)# description connected-to-spine-1-Ethernet1/1
leaf-1(config-if)# no switchport
leaf-1(config-if)# mtu 9216
leaf-1(config-if)# med
media-type   medium
leaf-1(config-if)# medium p2p
leaf-1(config-if)# no ip redirects
leaf-1(config-if)# ip unnumbered lo0
leaf-1(config-if)# no ipv6 redirects
leaf-1(config-if)# ip router isis UNDERLAY
leaf-1(config-if)# ip pim sparse-mode
leaf-1(config-if)# no shut
leaf-1(config-if)# end
leaf-1# copy run start
[########################################] 100%
Copy complete, now saving to disk (please wait)...
Copy complete.
leaf-1#
```

Modality: CLI vs REST API

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GET

POST

PUT

DELETE

{REST}

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leaf-1# copy run start
[########################################] 100%
Copy complete, now saving to disk (please wait)...
Copy complete.
leaf-1#
```

GET

POST

PUT

DELETE

{REST}

```
psample@PSAMPLE-M-HWJQ tmp % curl -s -k -X GET https://10.10.20.100/api/class/fvBD.json
{
  "totalCount": "4",
  "imdata": [
    {
      "fvBD": {
        "attributes": {
          "OptimizeWanBandwidth": "no",
          "annotation": "",
          "arpFlood": "no",
          "bcastP": "225.0.56.96",
          "childAction": "",
          "configIssues": "",
          "descr": "",
          "dn": "uni/tn-common/BD-default",
          "enableRogueExceptMac": "no",
          "epClear": "no",
          "epMoveDetectMode": "",
          "extMngdBy": "",
          "hostBasedRouting": "no",
          "intersiteBumTrafficAllow": "no",
          "intersiteL2Stretch": "no",
          "ipLearning": "yes",
```


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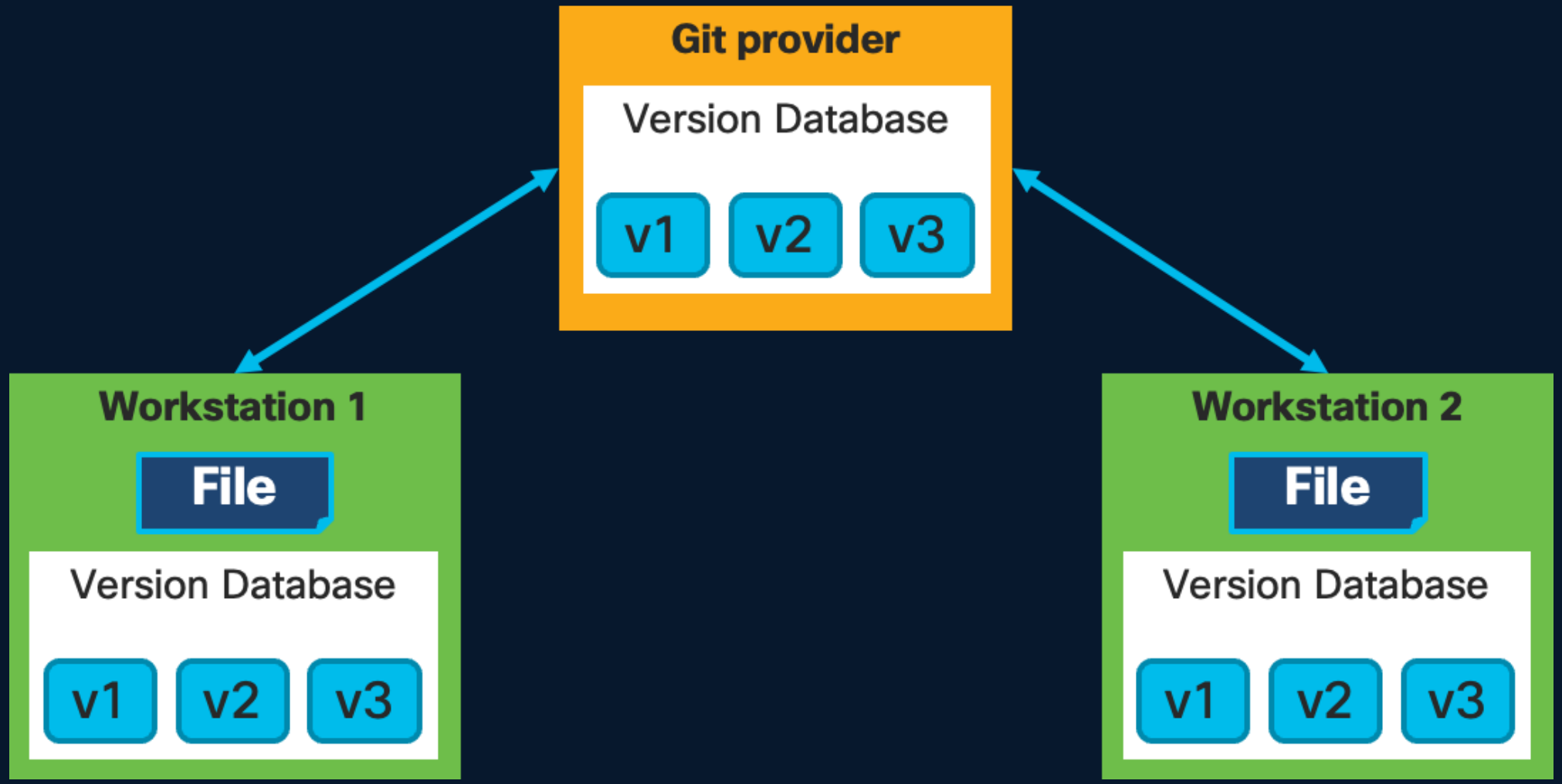
The Automator's Toolbox

Git

Git: Infrastructure-as-Code (IaC) Foundation

Your automation journey starts here!



Ansible

Ansible

- Python-based - `pip install ansible`
- **Agentless** configuration management
- Push model
  - Desired state based on **idempotence**
- **Playbooks** define configuration tasks
  - YAML-based
  - Tasks executed in order defined
  - **Modules** responsible for performing changes

Ansible: Components

Ansible Components: Inventory

```yaml
---
all:
  hosts:
    switch-1:
      ansible_host: 10.10.20.110
      ansible_user: developer
      ansible_password: C1sco12345!CL
      ansible_connection: ansible.netcommon.network_cli
      ansible_network_os: cisco.nxos.nxos
      ansible_network_cli_ssh_type: libssh
```

Ansible Components: Variables

```yaml
---
all:
  hosts:
    switch-1:
      ansible_host: 10.10.20.110
      ansible_user: developer
      ansible_password: C1sco12345!CL
      ansible_connection: ansible.netcommon.network_cli
      ansible_network_os: cisco.nxos.nxos
      ansible_network_cli_ssh_type: libssh
```

```yaml
---
switch_interfaces:
  - name: Ethernet1/1
    description: Uplink to core-1
    enabled: true
    mode: layer3
    mtu: 9216
    ipv4: 192.168.8.30/31
  - name: Ethernet1/2
    description: Uplink to core-2
    enabled: true
    mode: layer3
    mtu: 9216
    ipv4: 192.168.8.32/31
```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Ansible Components: Playbook

```yaml
---
all:
  hosts:
    switch-1:
      ansible_host: 10.10.20.110
      ansible_user: developer
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    enabled: true
    mode: layer3
    mtu: 9216
    ipv4: 192.168.8.30/31
  - name: Ethernet1/2
    description: Uplink to core-2
    enabled: true
    mode: layer3
    mtu: 9216
    ipv4: 192.168.8.32/31
```

```yaml
---
- name: Example NXOS playbook
  hosts: switch-1
  gather_facts: false
  tasks:
    - name: Set hostname
      cisco.nxos.nxos_hostname:
        config:
          hostname: "{{ inventory_hostname_short }}"

    - name: Configure interface to core
      cisco.nxos.nxos_interfaces:
        config:
          - name: "{{ item.name }}"
            description: "{{ item.description }}"
            enabled: "{{ item.enabled }}"
            mode: "{{ item.mode }}"
            mtu: "{{ item.mtu | default(9216) }}"
      loop: "{{ switch_interfaces }}"
```


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Ansible Demo: NXOS

```
(.venv) psample@PSAMPLE-M-HWJQ ansible %
```

Ansible: Before and After

```
inserthostname-here# show run int e1/1-2

!Command: show running-config interface Ethernet1/1-2
!Running configuration last done at: Mon Feb 16 20:01:22 2026
!Time: Mon Feb 16 20:01:49 2026

version 10.5(3) Bios:version

interface Ethernet1/1

interface Ethernet1/2

inserthostname-here#
```

Ansible: Before and After

```
inserthostname-here# show run int e1/1-2

!Command: show running-config interface Ethernet1/1-2
!Running configuration last done at: Mon Feb 16 20:01:22 2026
!Time: Mon Feb 16 20:01:49 2026

version 10.5(3) Bios:version

interface Ethernet1/1

interface Ethernet1/2

inserthostname-here#
```

```
switch-1# show run int e1/1-2

!Command: show running-config interface Ethernet1/1-2
!Running configuration last done at: Mon Feb 16 20:03:16 2026
!Time: Mon Feb 16 20:03:25 2026

version 10.5(3) Bios:version

interface Ethernet1/1
  description Uplink to core-1
  no switchport
  mtu 9216
  ip address 192.168.8.30/31
  no shutdown

interface Ethernet1/2
  description Uplink to core-2
  no switchport
```

Terraform

Terraform

- Binary installed via download from HashiCorp
- **Agentless** infrastructure management
- **Stateful** – can delete manually-created resources!
- Desired state reached via **resource graphs**
  - Domain-specific language - HCL
  - Order of resource definitions does not matter
- Designed for **mutable infrastructure**

Terraform: Example HCL for ACI

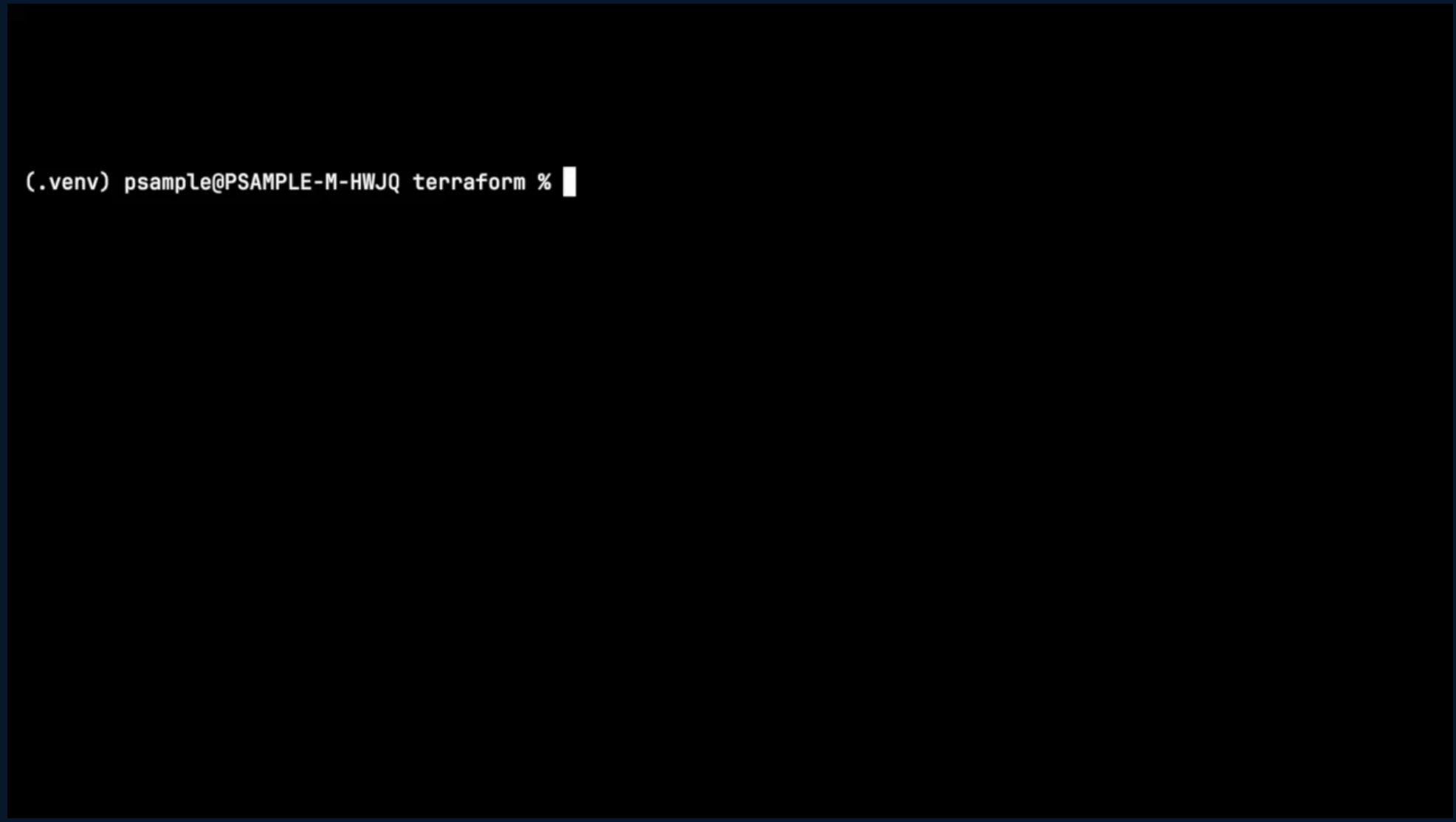
```
resource "aci_bridge_domain" "sales_bd" {  2 usages
  parent_dn = aci_tenant.sales.id
  name = "sales_bd"
  relation_to_vrf = {
    vrf_name = aci_vrf.sales_vrf.name
  }
}

resource "aci_tenant" "sales" {  3 usages
  name = "sales"
}

resource "aci_subnet" "sales_frontend" {  no usages
  parent_dn = aci_bridge_domain.sales_bd.id
  description = "Sales frontend subnet"
  ip = "172.16.0.1/16"
}

resource "aci_vrf" "sales_vrf" {  1 usage
```

Terraform Demo: ACI



Terraform Result

All Tenants

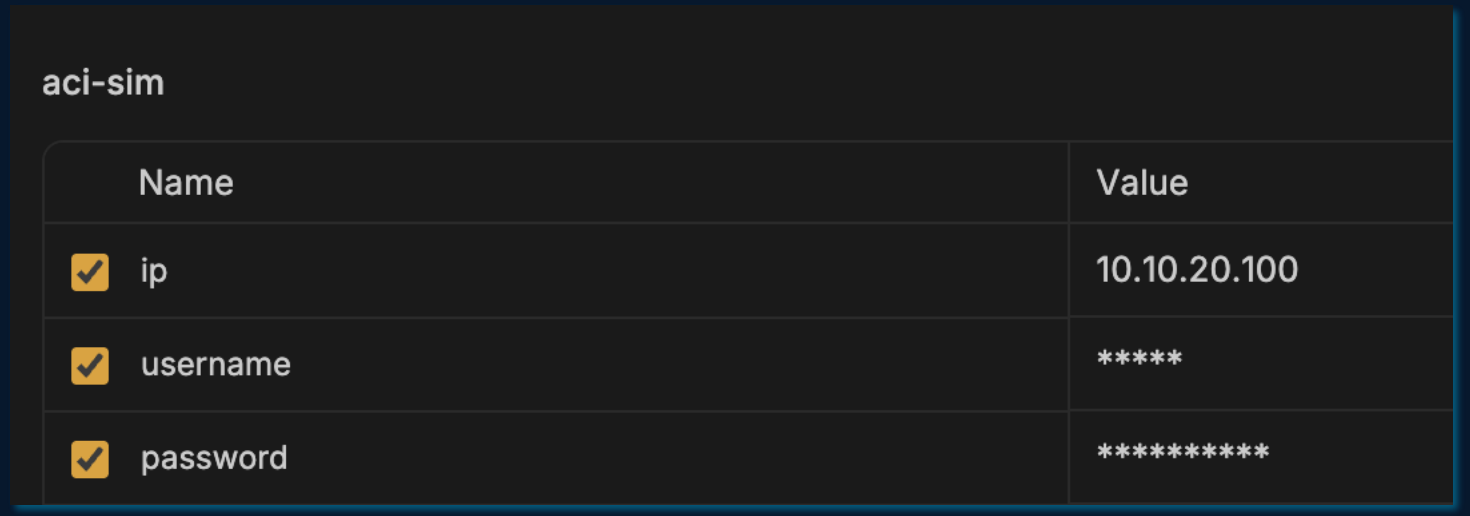
Name	Alias	Description	Bridge Domains	VRFs	EPGs
common			1	2	0
infra			2	2	2
mgmt			1	2	0
NetDevOps_dev Ansible		Development te...	2	1	0
sales Terraform			1	1	3

API Clients

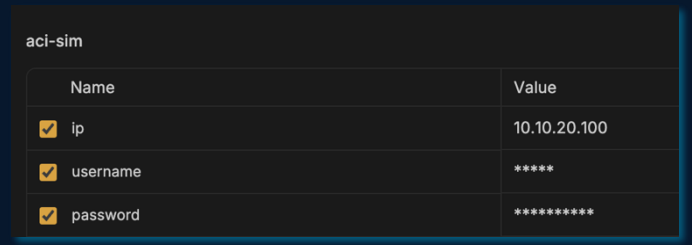
API Clients

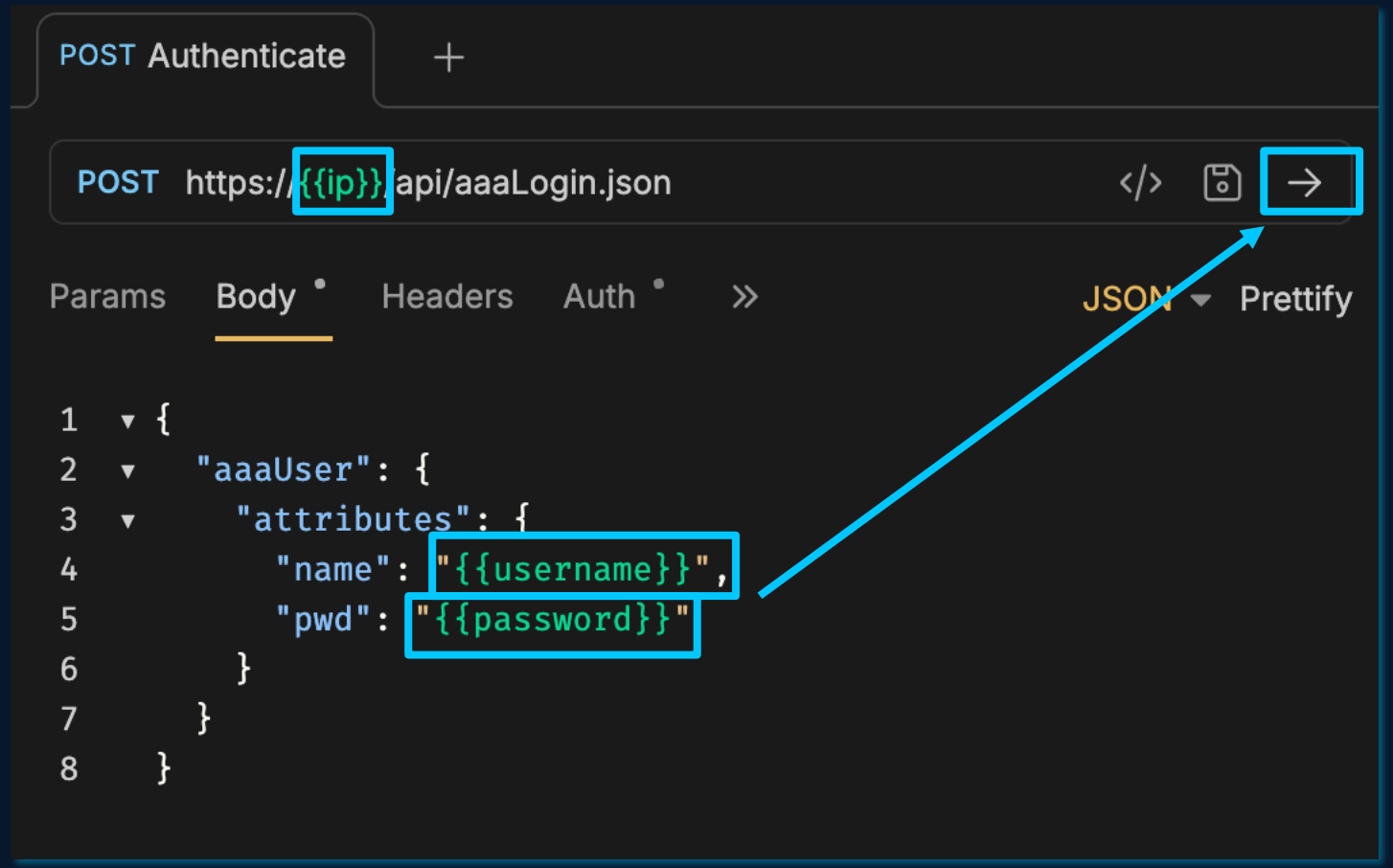
- Easy to use
- Designed for REST API interaction
- Supports all methods (GET, POST, PUT, DELETE, etc.)
- Supports environments and variables
- Most popular:
  - **Postman** – the original – now requires a cloud account for full functionality
  - **Bruno** – the challenger – no cloud account, some features require license

API Client (Bruno) - Fundamentals



API Client (Bruno) - Fundamentals





API Client (Bruno) - Fundamentals

aci-sim

Name	Value
ip	10.10.20.100
username	*****
password	**********

POST Authenticate

POST https://{{ip}}/api/aaaLogin.json

Params Body Headers Auth JSON Prettify

```
{
  "aaaUser": {
    "attributes": {
      "name": "{{username}}",
      "pwd": "{{password}}"
    }
  }
}
```

Response JSON 200 OK 51ms 1.78KB

```
{
  "totalCount": "1",
  "imdata": [
    {
      "aaaLogin": {
        "attributes": {
          "token": "eyJhbGciOiJSUzI1NiIsImtpZCI6IjQwZWdhc3
BmamNzNGo5cjJodmFpNnpqaTk5NjdjcDZlIiwidHlwIjoiand0In0.eyJv
```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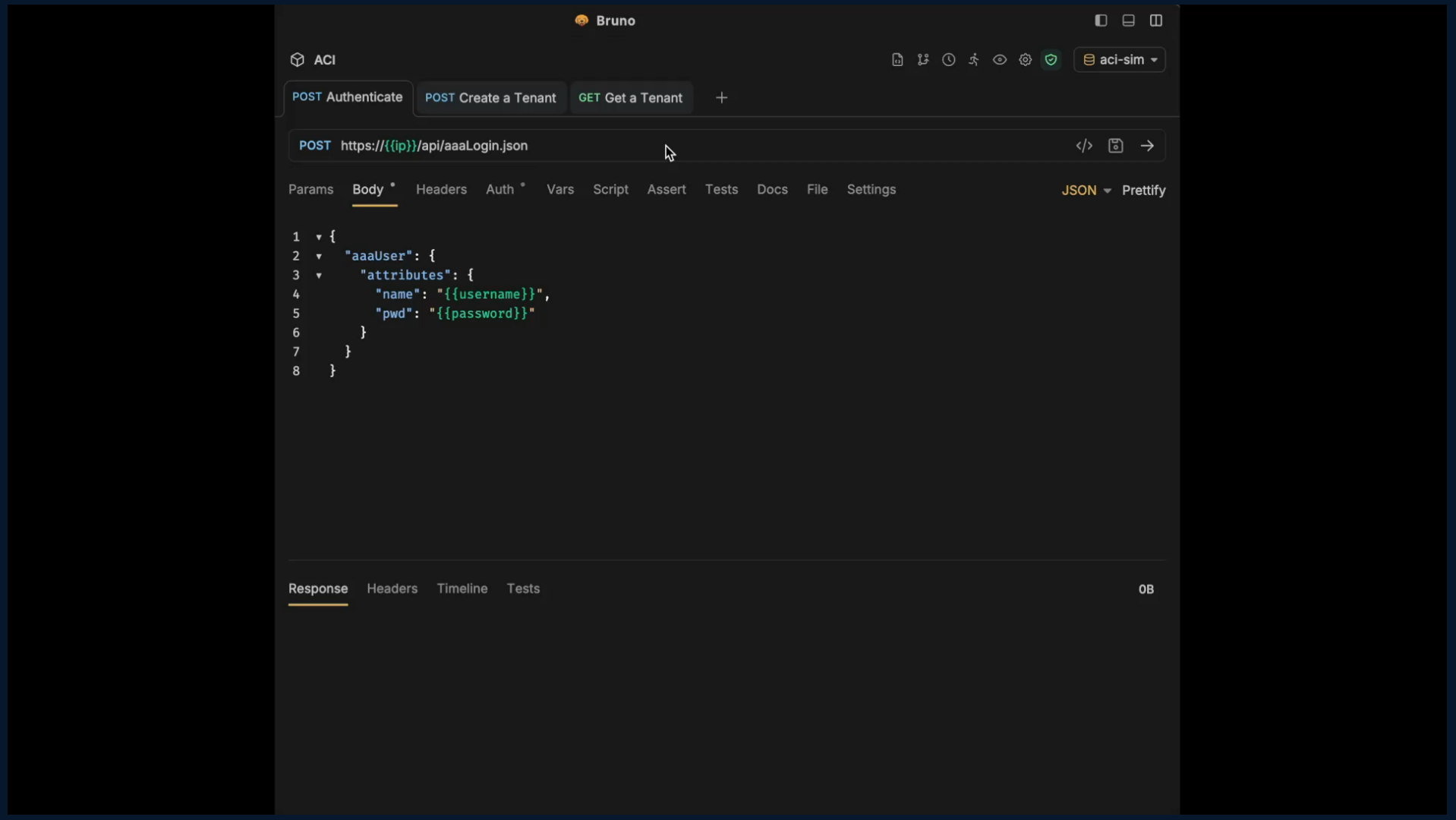
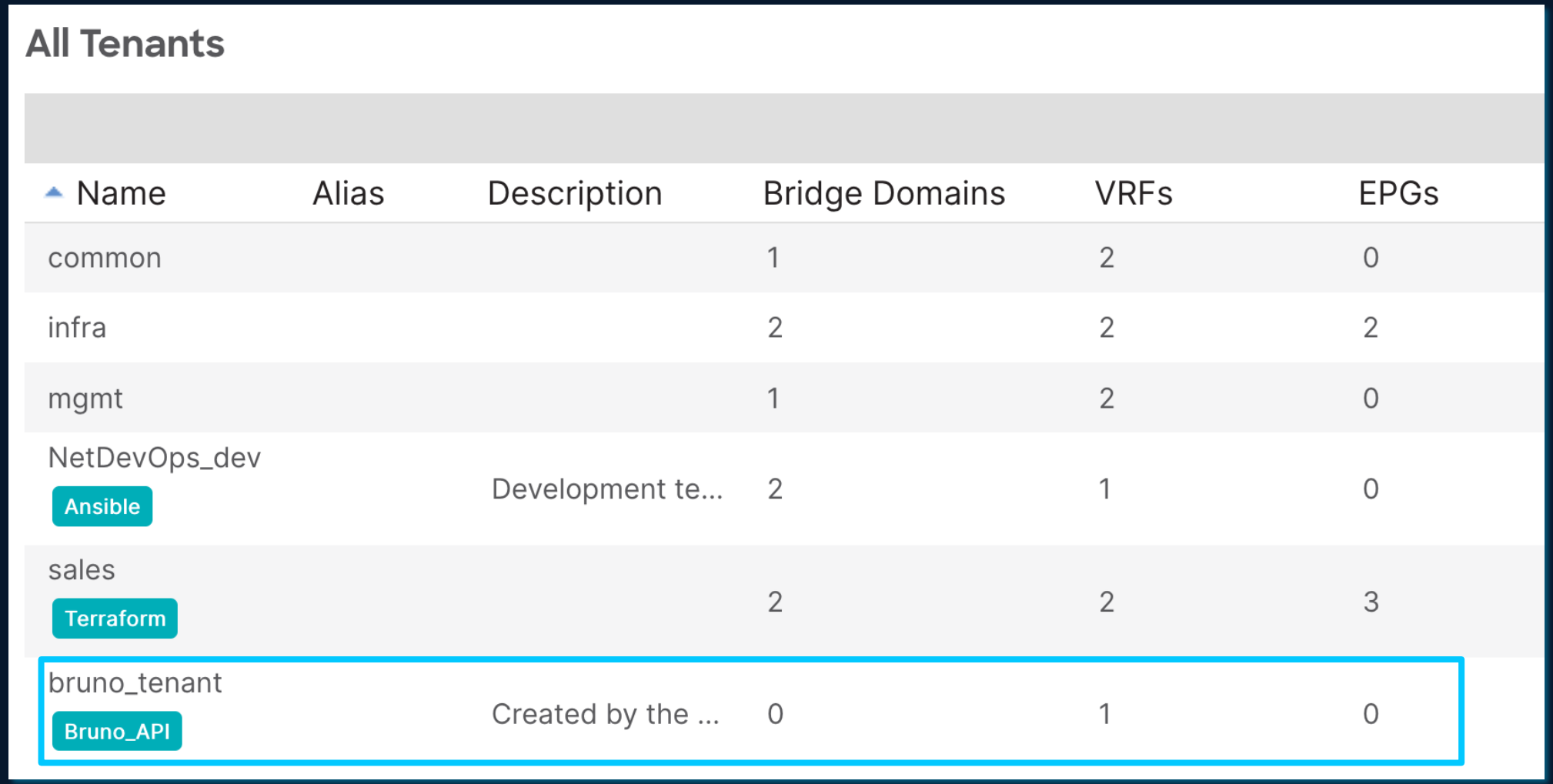
API Client Demo: Create and Get a Resource



Bruno API Client Result

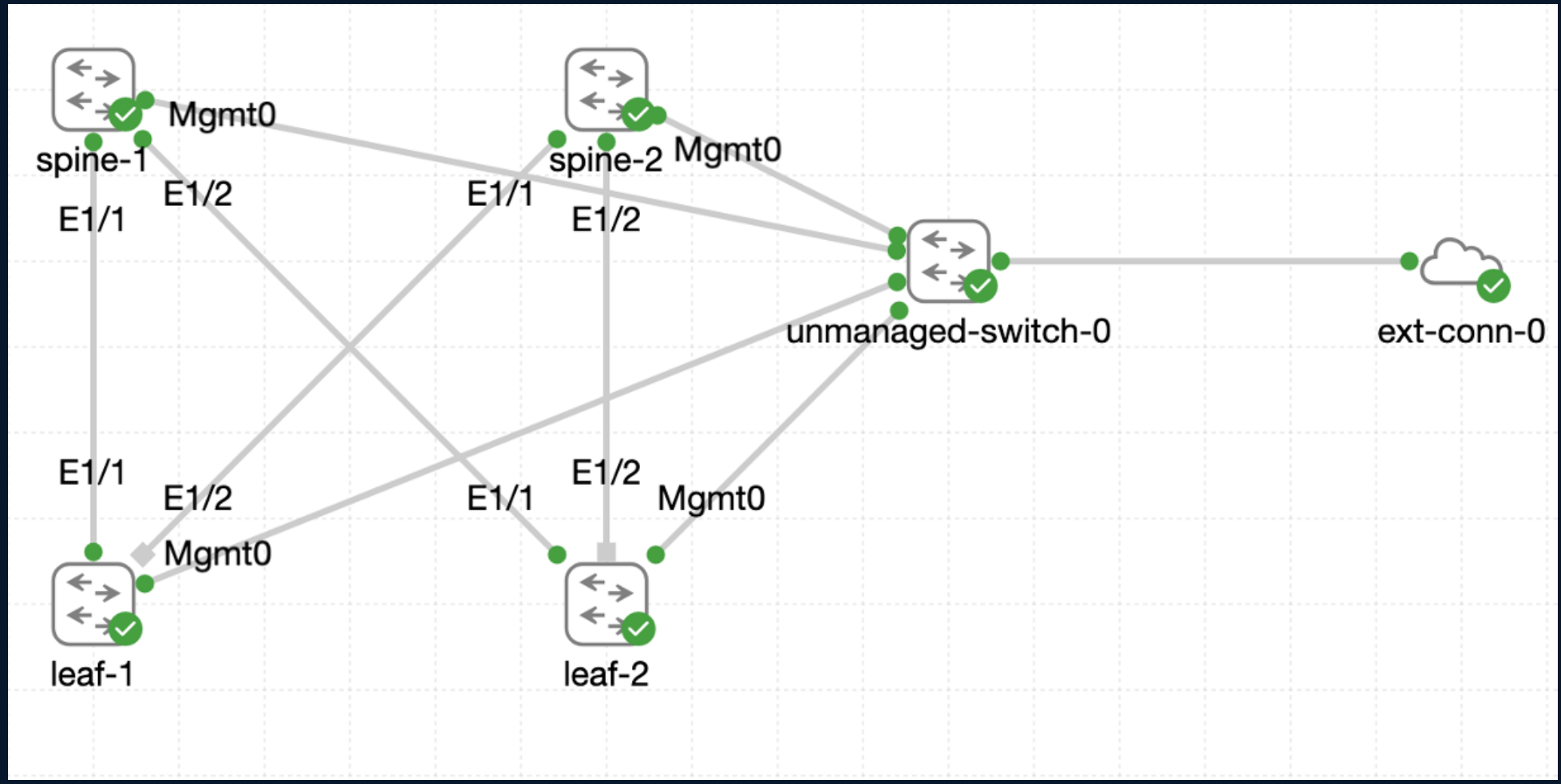


Cisco Nexus Dashboard Fabric Controller (NDFC)

Cisco Nexus Dashboard Fabric Controller (NDFC)

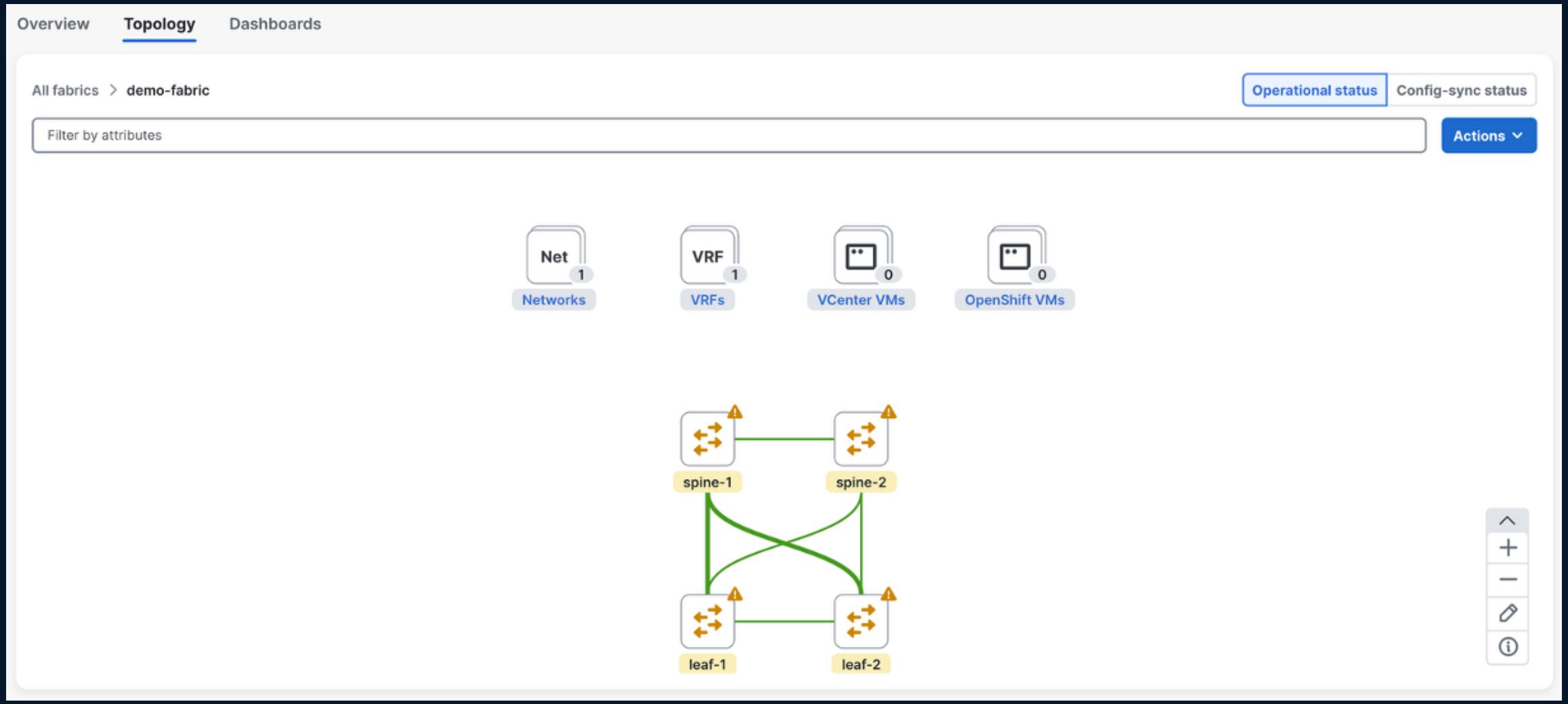
- As of ND 4.1, Fabric Controller is integrated
- Manage controller-based (ACI) fabrics
- Provision standalone (**non-ACI**) fabrics
- Gain health insights
- "Not a controller, but like a controller!"
  - Reduced troubleshooting and management tasks

NDFC Topology (CML)



NDFC Fabric Creation

NDFC Topology Visualization



NDFC Status Overview

Switches | VPC pairs | Other devices

Filter by attributes

Name	Anomaly level	IP address	Model	Configuration sync status	Role
leaf-1	Minor	10.10.20.102	N9K-C9300v	In-Sync	Leaf
leaf-2	Minor	10.10.20.103	N9K-C9300v	In-Sync	Leaf
spine-1	Minor	10.10.20.101	N9K-C9300v	In-Sync	Spine
spine-2	Minor	10.10.20.104	N9K-C9300v	In-Sync	Spine

One Tool to Rule Them All!

So Many Tools, So Many Choices...

	Ansible	Terraform	API Client	NDFC
Cloud	✅	✅	✅	❌
***n*-tier**	✅	❌	❓	❌
Manual Fabric	✅	❌	✅	✅
Controller Fabric	✅	✅	✅	✅

The Only Tool You Need

Thank you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