Automate Network Operation Tasks

with NetDevOps and Source of Truth

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BRKOPS-2357

Agenda

1 Setting the Stage

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1.2. Partner Use Case
1.3. Scenario Overview

2 Technology Deep Dive

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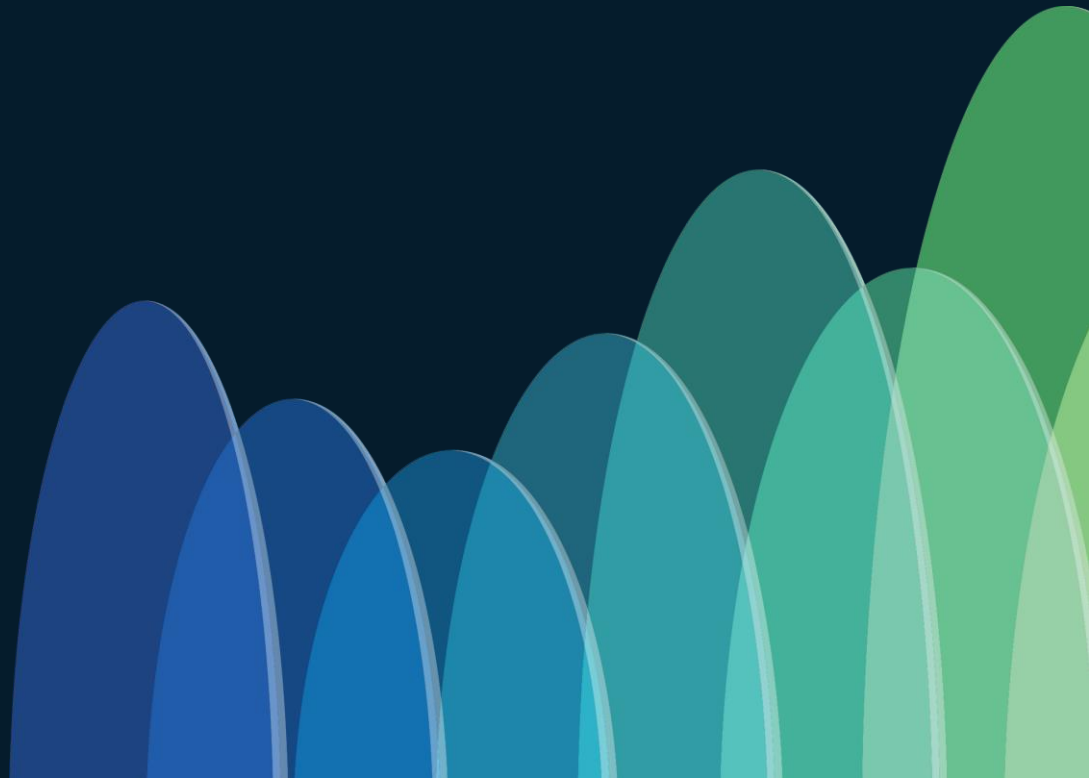
2.2. Automation Tools
2.3. Testing Framework

3 Tying It All Together

3.1. Orchestration
3.2. Key Takeaways
3.3. Call Out

Setting the Stage



About Patrick...

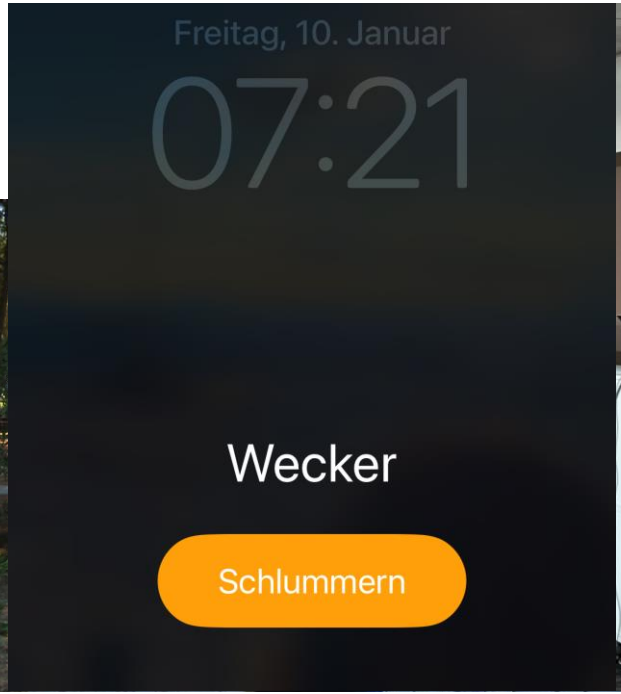
18+ years in Networking
3 years as customer
3 years as a partner
3 years as a competitor
9+ years at Cisco

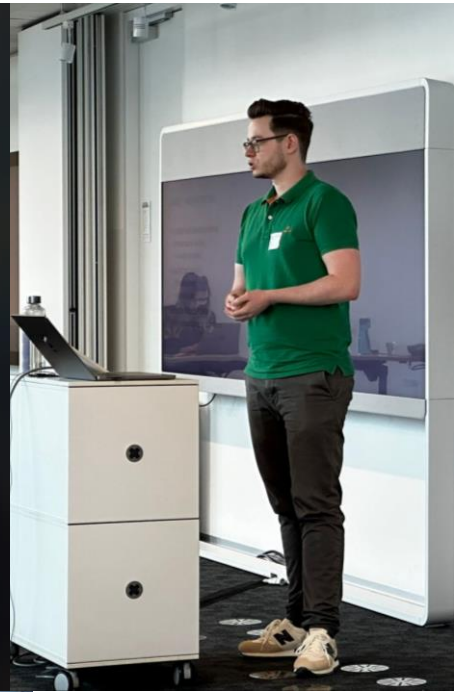
Session Introduction

About Luca...

2023::4

6+ years in Networking
6 years as a partner





- Mobile networks for public transportation
- Network Access Control (NAC)
- Bring-Your-Own-Device (BYOD)
- Guest Access solutions

DevNet Academy

Theory

Access a wide range of theory materials, including videos and insightful text content, specifically tailored to help you succeed in the Cisco Certified DevNet Expert exam.

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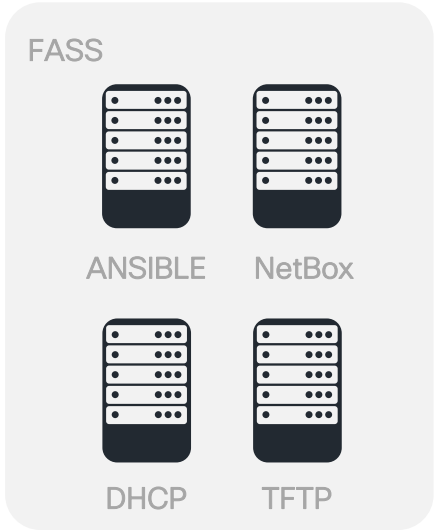
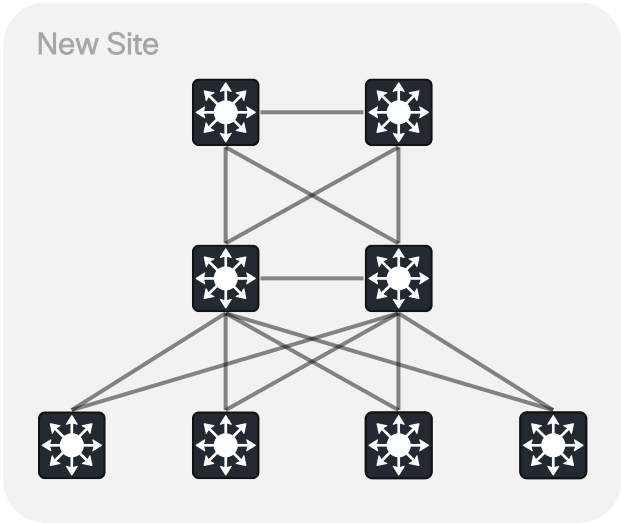
- DevNet Expert e-learning
- Theory, videos, exercises, quizzes, and workbook
- Coaching and mentoring
- Sample course with Python Click and Flask-RESTX
- https://devnet-academy.com

Overview

Fully Automated Staging Setup (FASS)





Scope

Fully Automated Staging Setup (FASS)

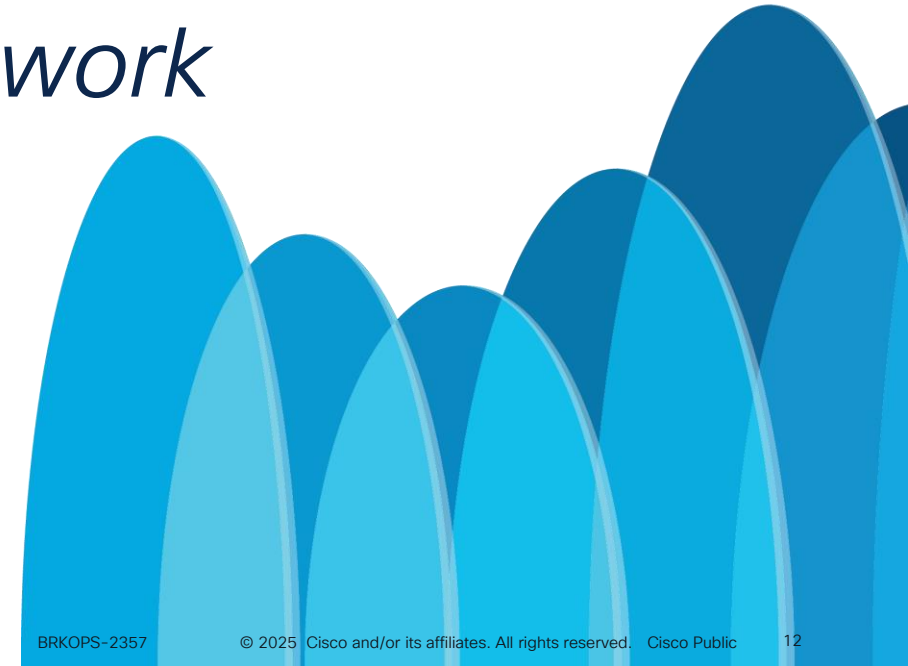
Scale	80 routers and switches
Speed	Staged in less than a day
Efficiency	Only two engineers on site
Approach	Data-driven automation with a source of truth

Components

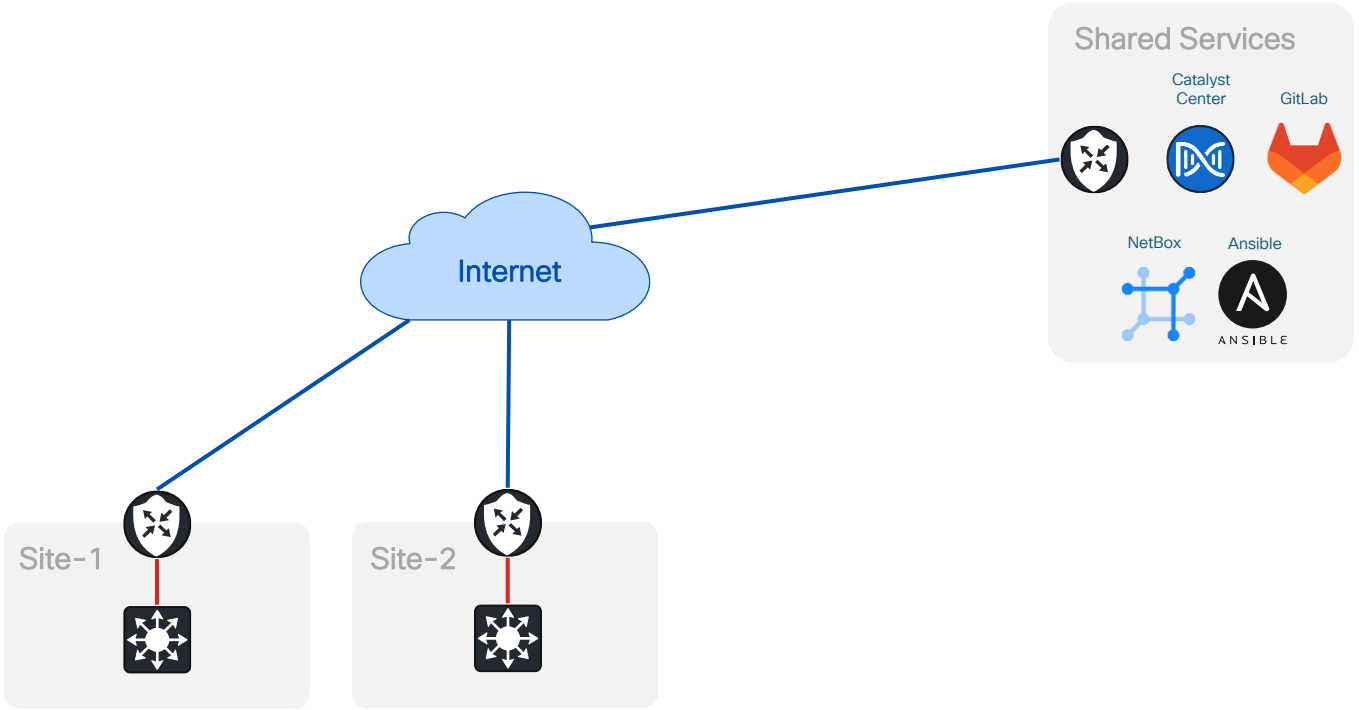
Fully Automated Staging Setup (FASS)

 NetBox	Single Source of Truth (SSoT) Centralized inventory
 DHCP Server	IP addressing based on MAC address Pass TFTP server and boot file to device
 TFTP Server	Provides Day0 config to each device Configures mgmt interface and staging user
 Ansible	Use NetBox inventory plugin Push config to each device
 Observium	Continuous monitoring Long-term metrics & Proactive insights

Automate boring, repetitive tasks with data-driven network automation!



As Is - High Level Layout
of the Scenario



To Be – High Level Layout
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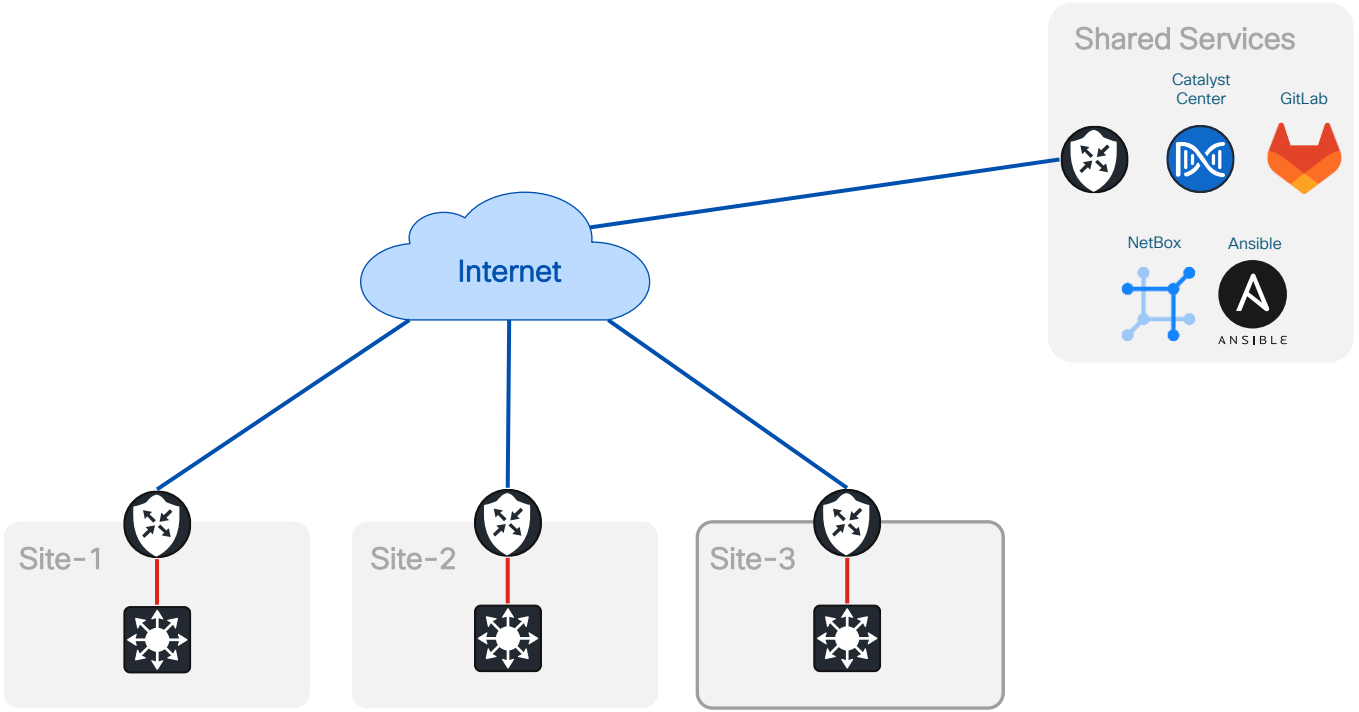
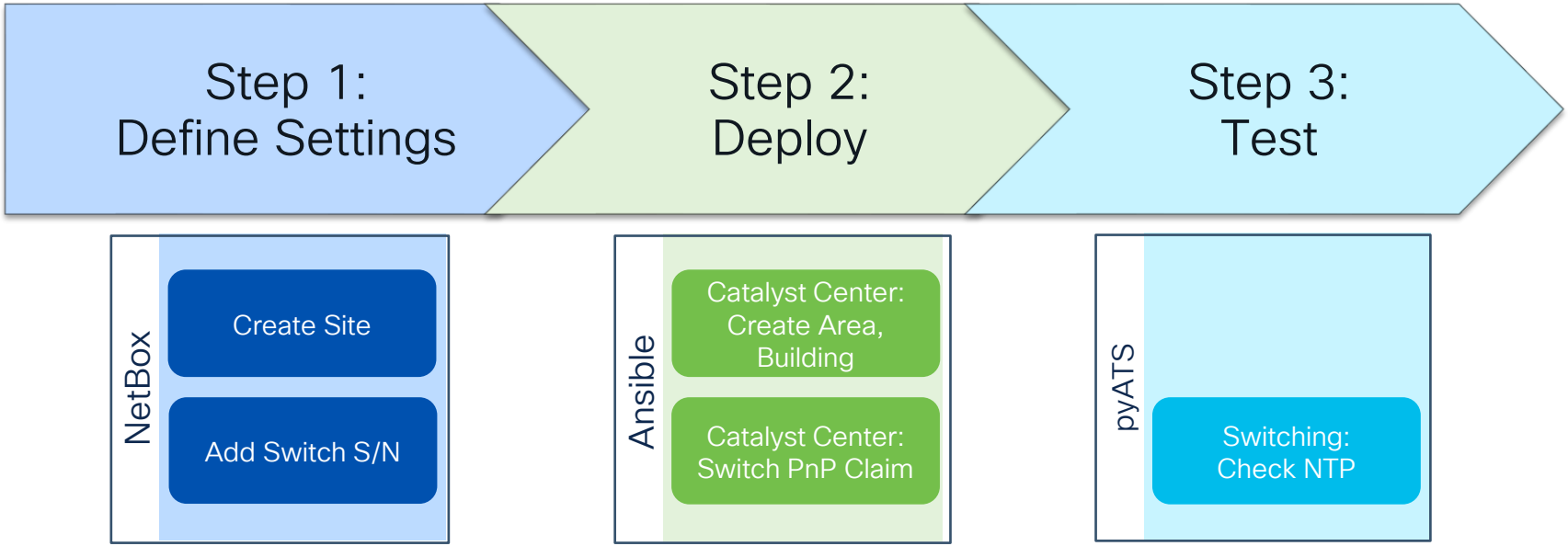


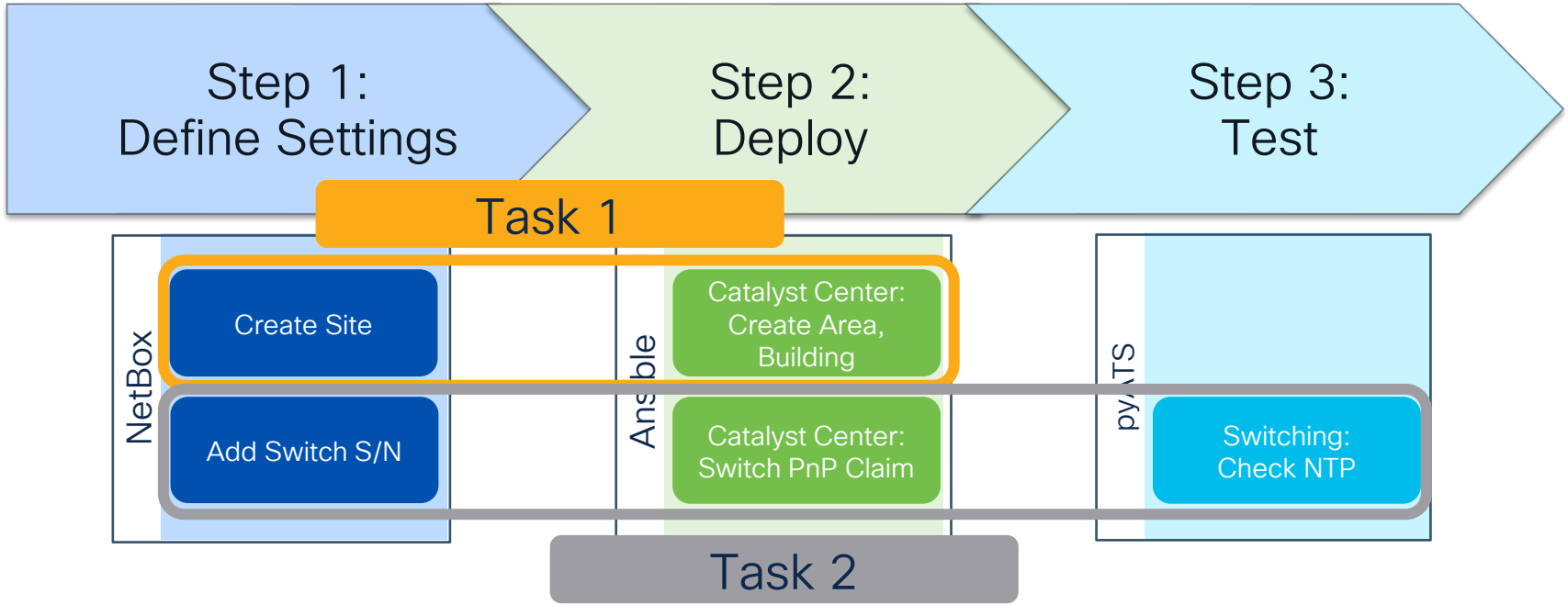
Business Intent

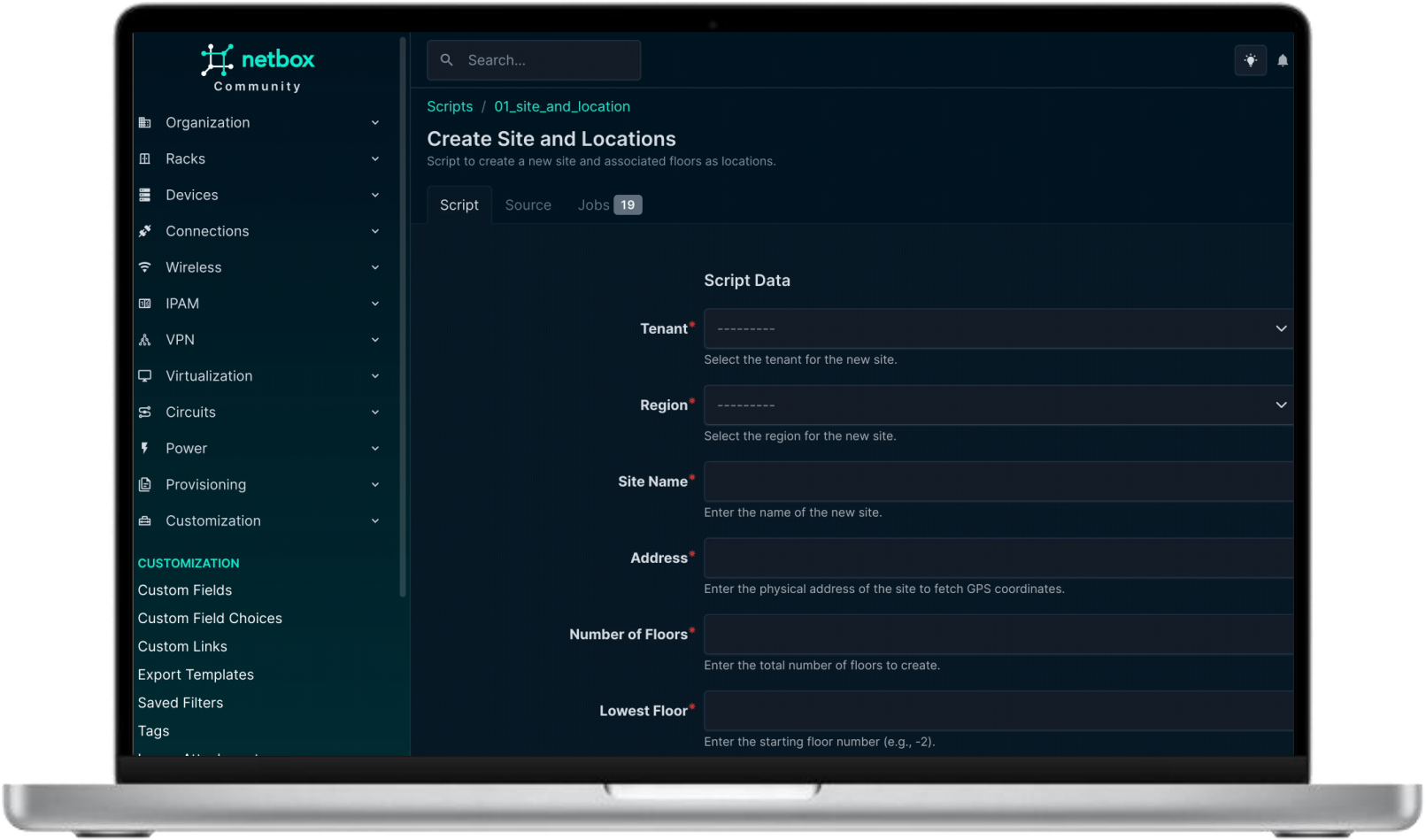
of the Scenario

Workflow
of the Scenario

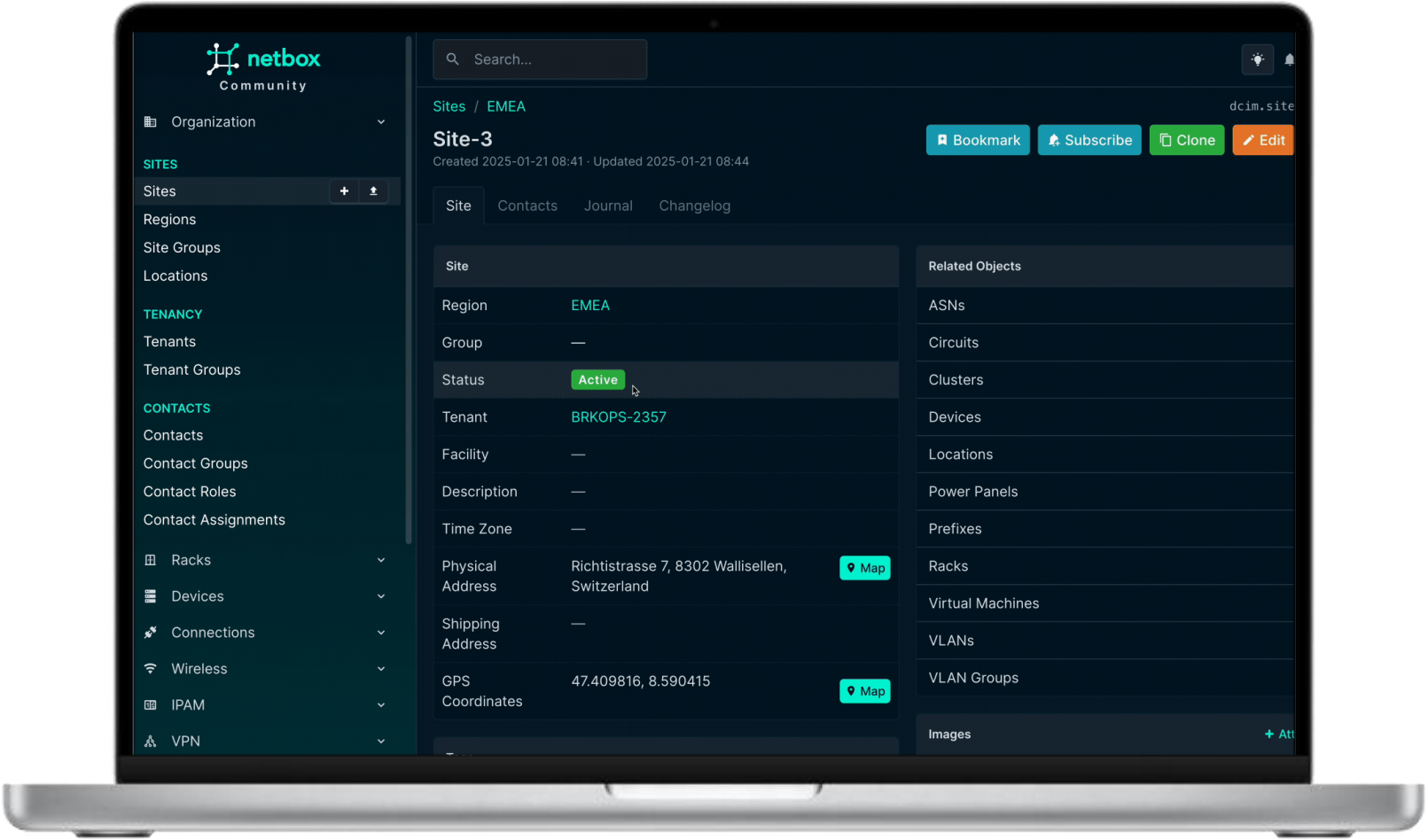


Workflow Tasks
of the Scenario





Get the code: https://github.com/pamosima/BRKOPS-2357



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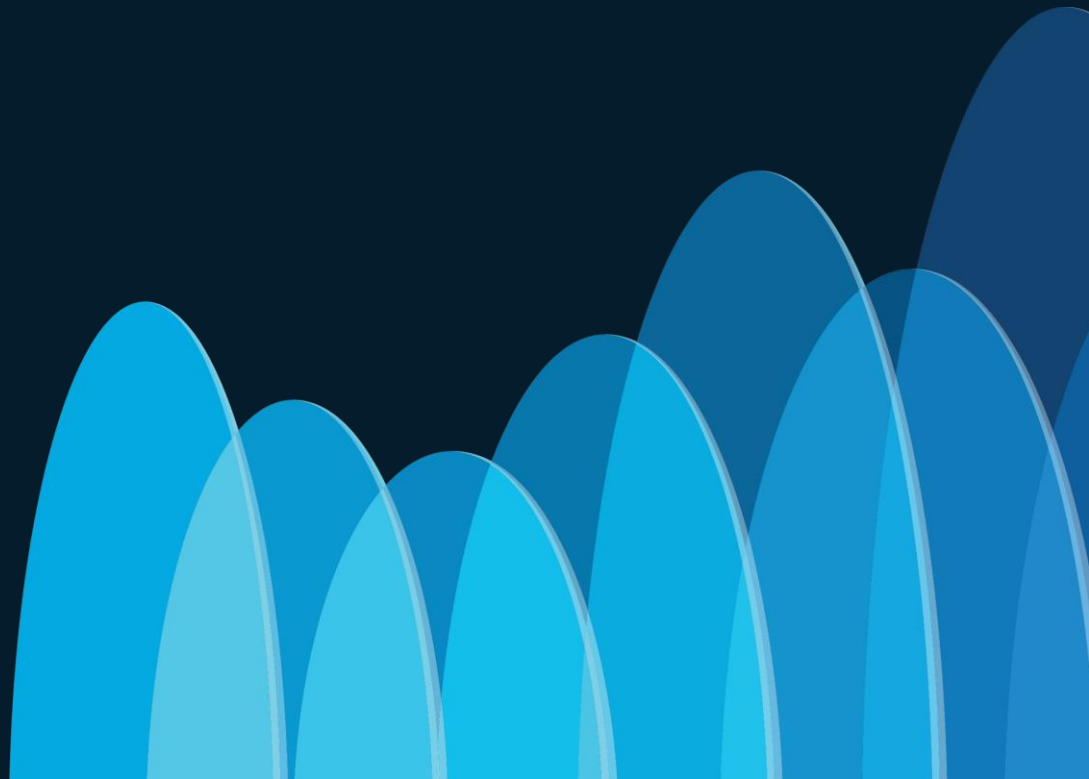
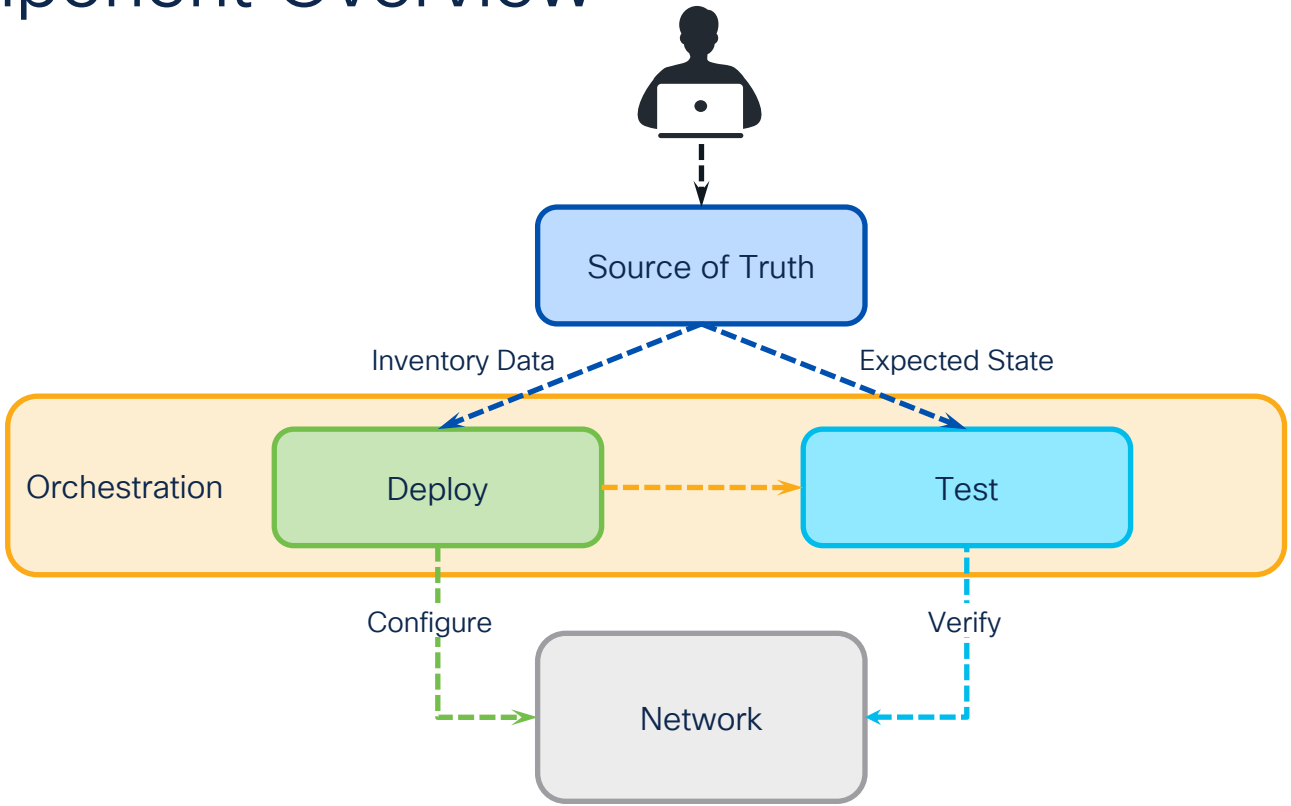
Technology Deep Dive



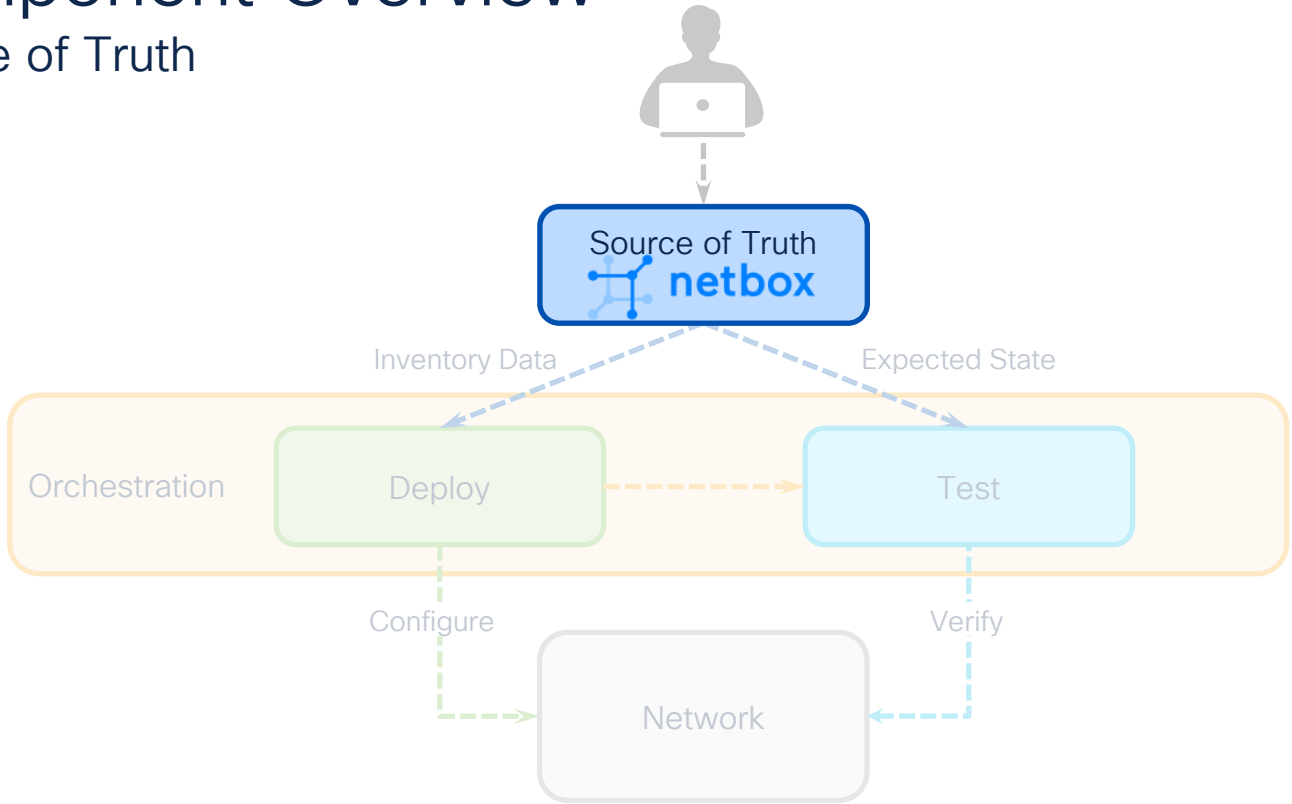
cisco Live!

Component Overview



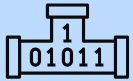
Component Overview

Source of Truth



What Is an IPAM / DCIM?

Source of Truth



IP Address Management (IPAM)

IPs, Subnets, VLANs, VRFs, etc.

Data Center Infrastructure Management (DCIM)

Devices, racks, locations, etc.

Source of Truth (SoT)

IPAM + DCIM

Benefits of a Single Source of Truth

Source of Truth

Reduces human error

Easy administration

Auditing

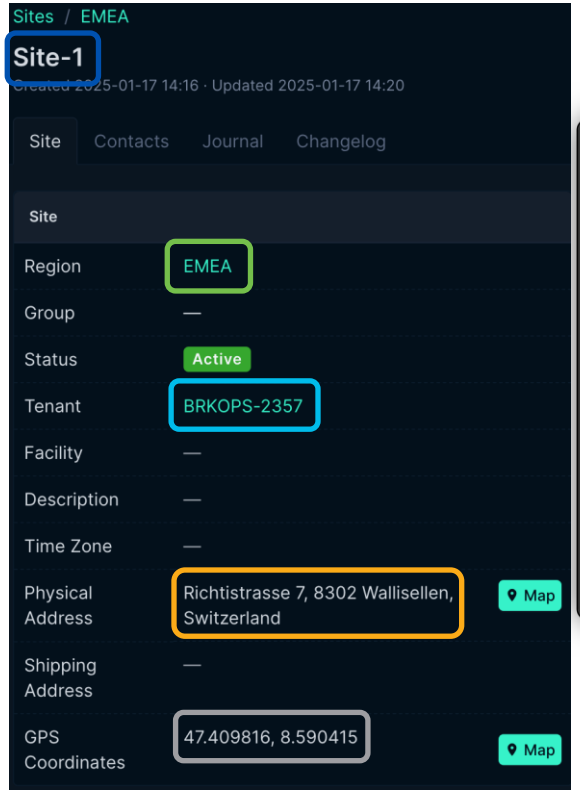
Eliminates inconsistencies

Ensures data is accurate

No more spreadsheets!

Config Example

Source of Truth

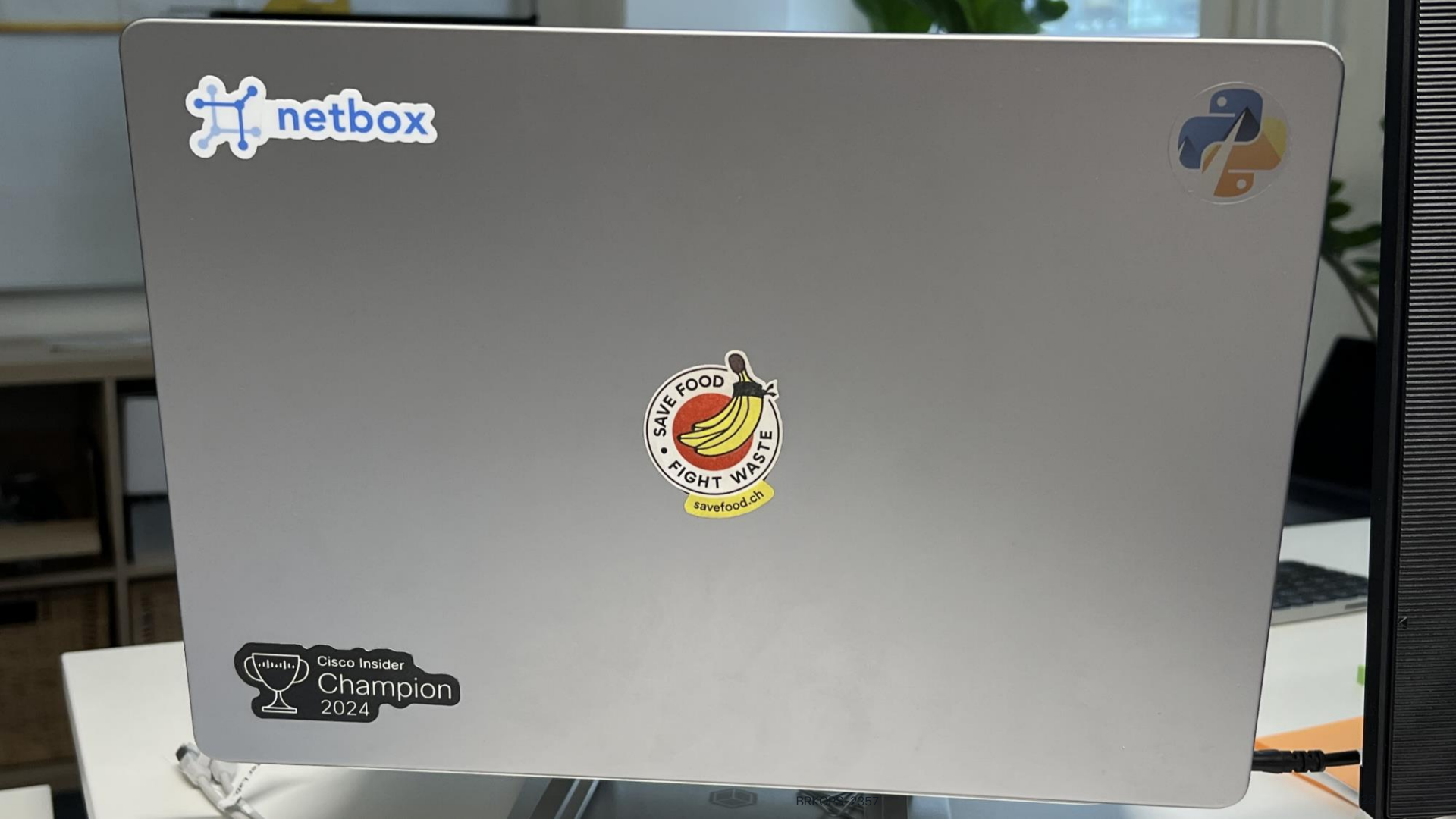


playbook.yml

```yaml
config:
  - site:
      - building:
          name: "{{ name }}"
          parent_name: "Global/{{ tenant_name }}/{{ region_name }}"
          address: "{{ physical_address }}"
          latitude: "{{ latitude }}"
          longitude: "{{ longitude }}"
          country: "{{ physical_address.split(',')[-1].strip() }}"
        type: building
```

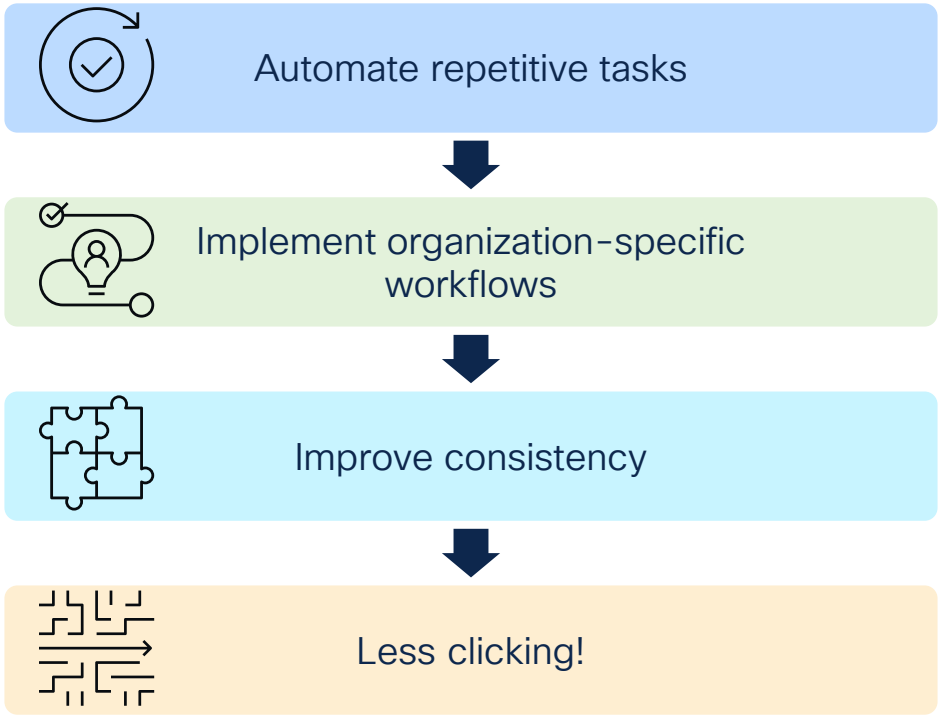
Why NetBox?

- **Open Source & Popular:** Free to use with options for cloud and enterprise plans.
- **API-Driven Automation:** Ideal for automating processes with extensive API support.
- **Seamless Ansible Integration:** Supports plugins like inventory, or lookup for efficient workflows.


netbox
SAVE FOOD
FIGHT WASTE
savefood.ch
Cisco Insider
Champion
2024

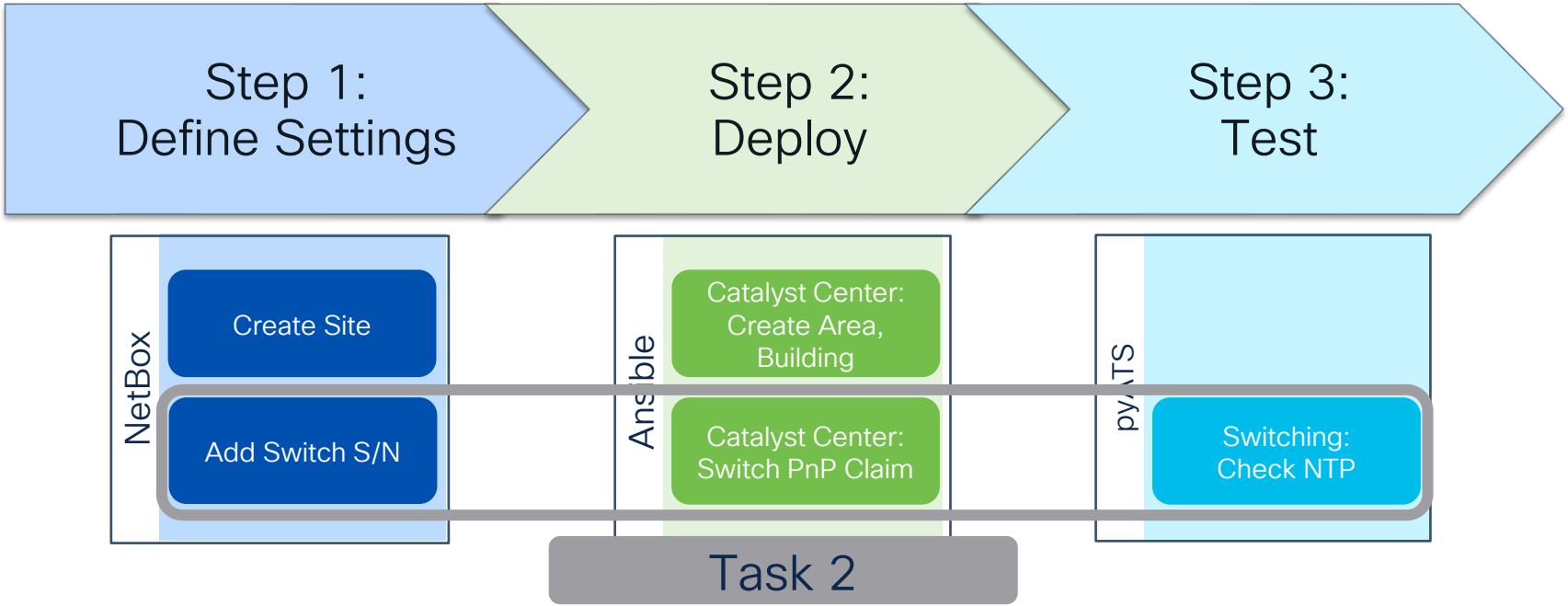
NetBox Custom Scripts

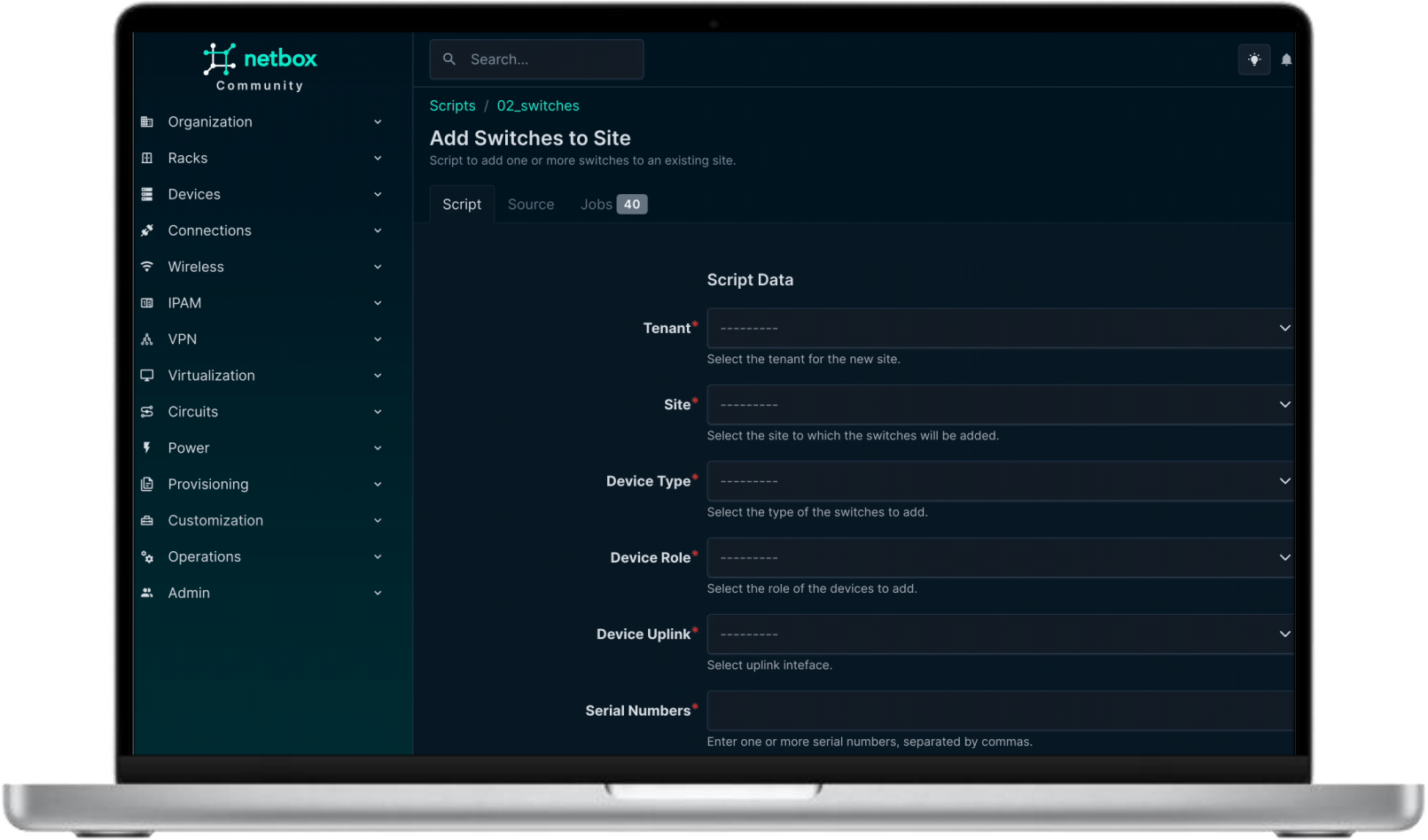
Source of Truth



Remember the Workflow Tasks?

Source of Truth





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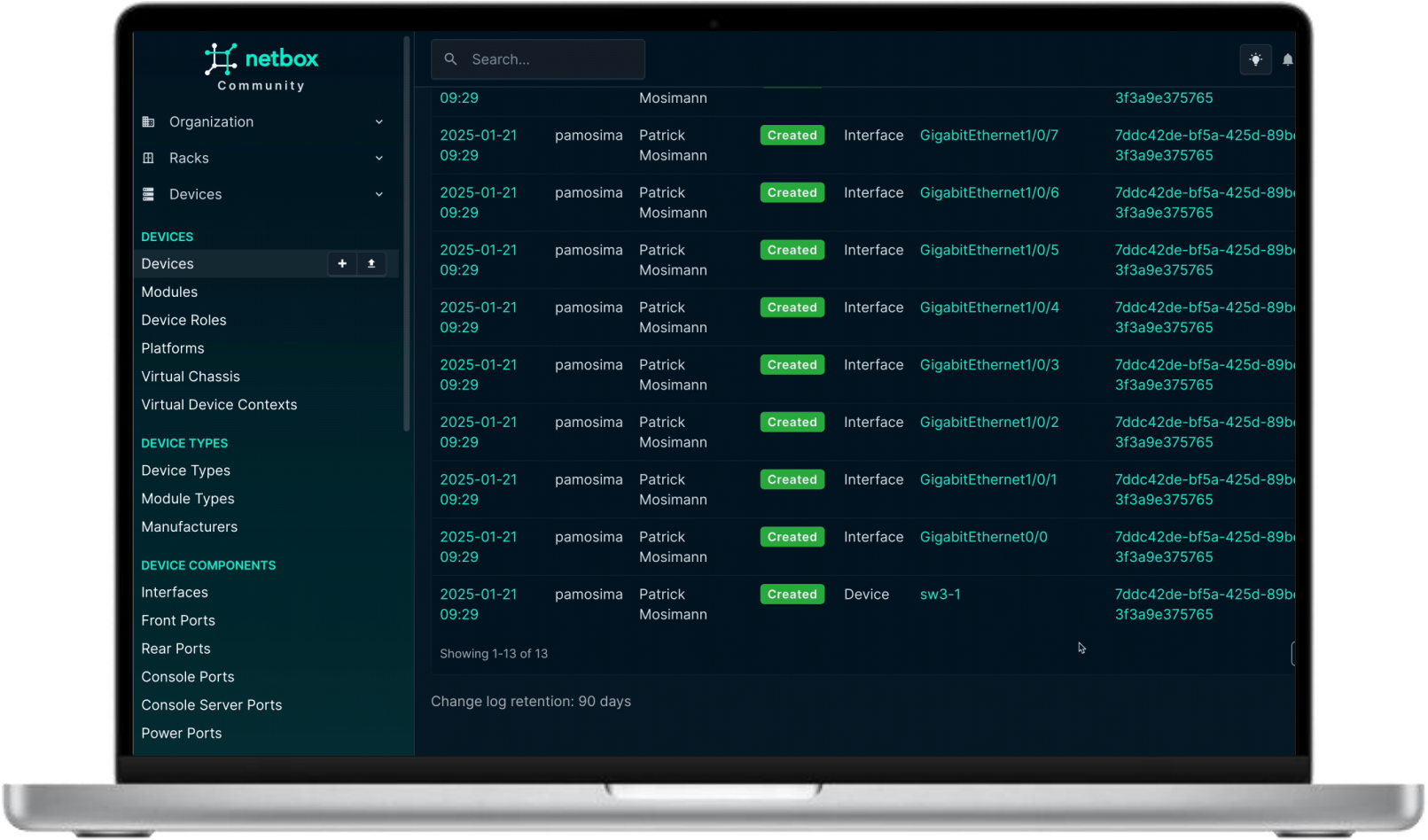

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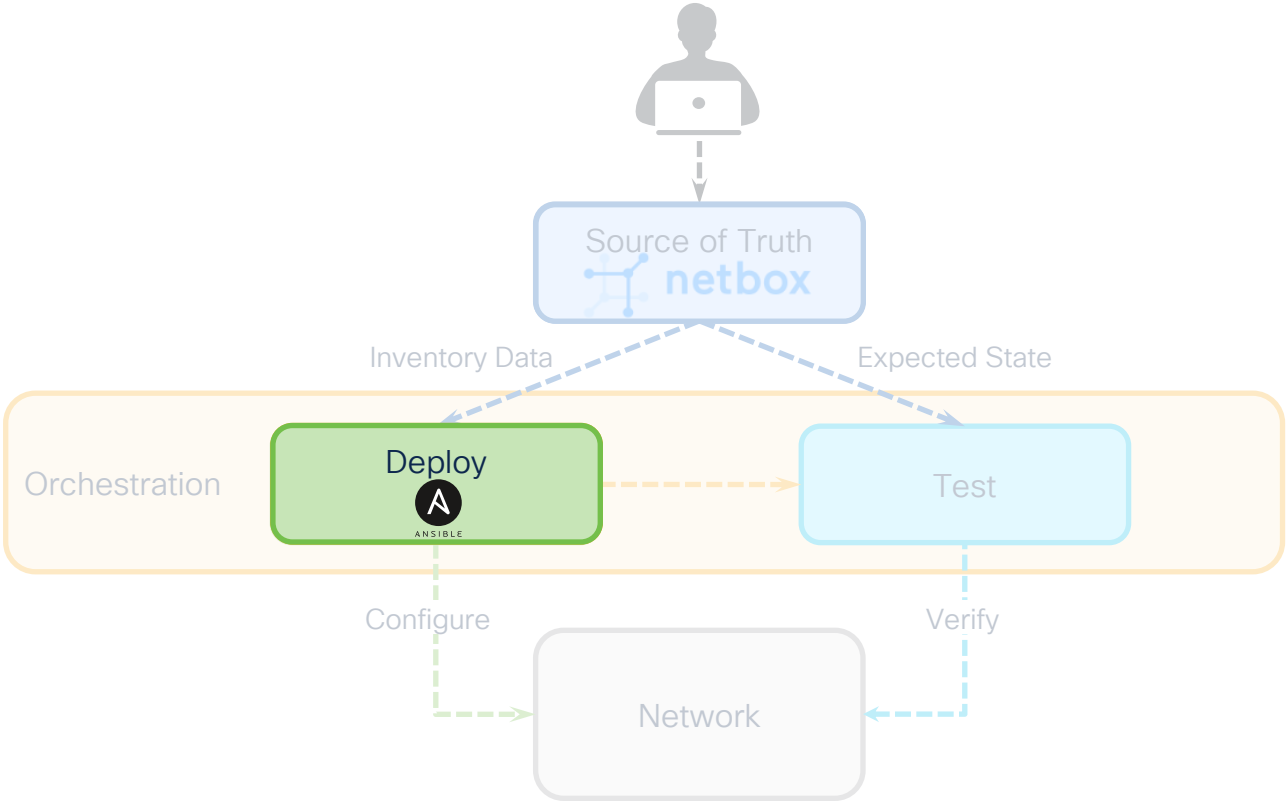
Component Overview

Deploy



Ansible Building Blocks (1/2)

Deploy

Reference

Playbook

- Repeatable and reusable task
- Simple config management

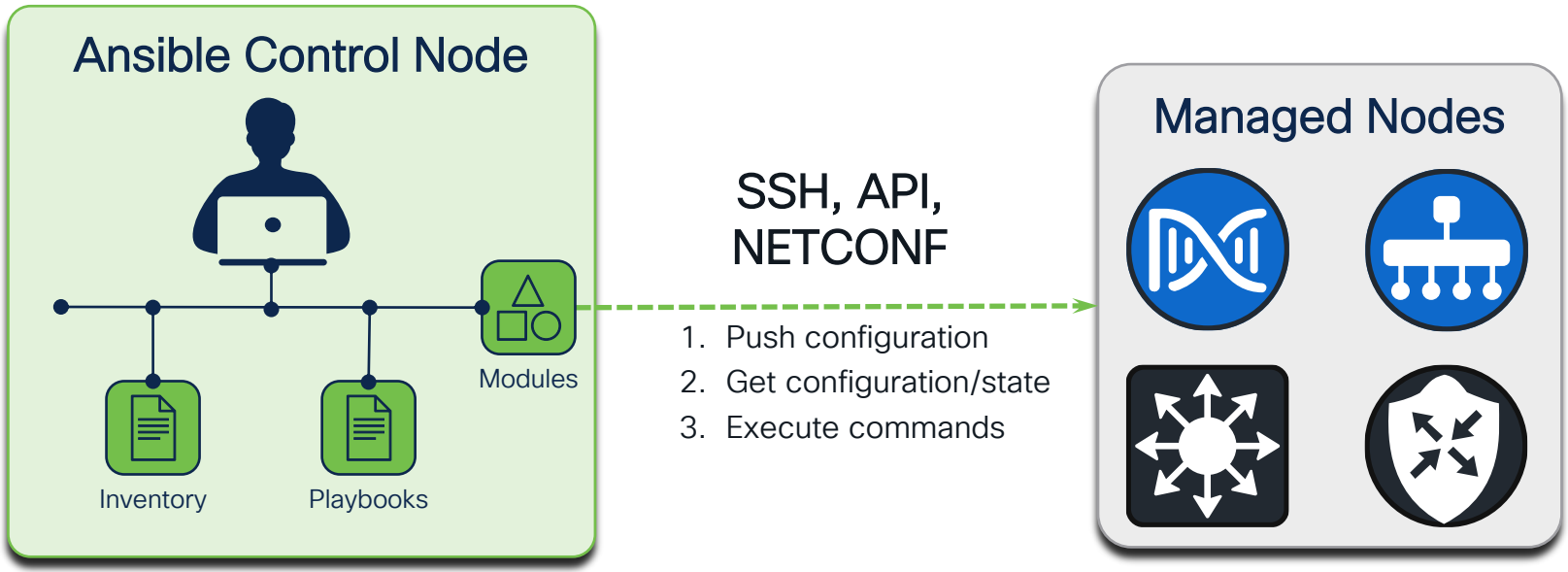
Inventory

- Defines hosts and groups
- Stores variables

Reference

Ansible Building Blocks (2/2)

Deploy

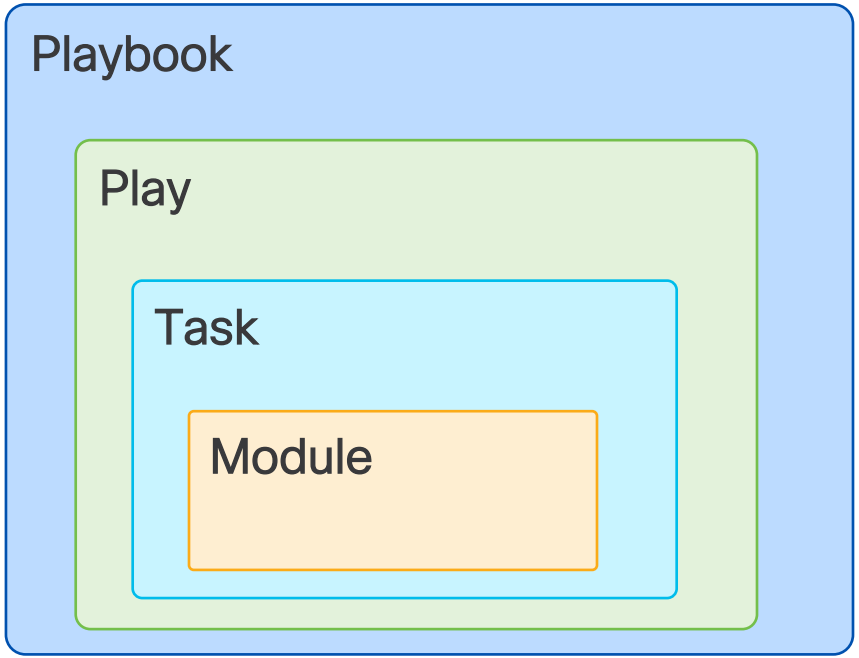


Reference

Ansible Playbooks

Deploy

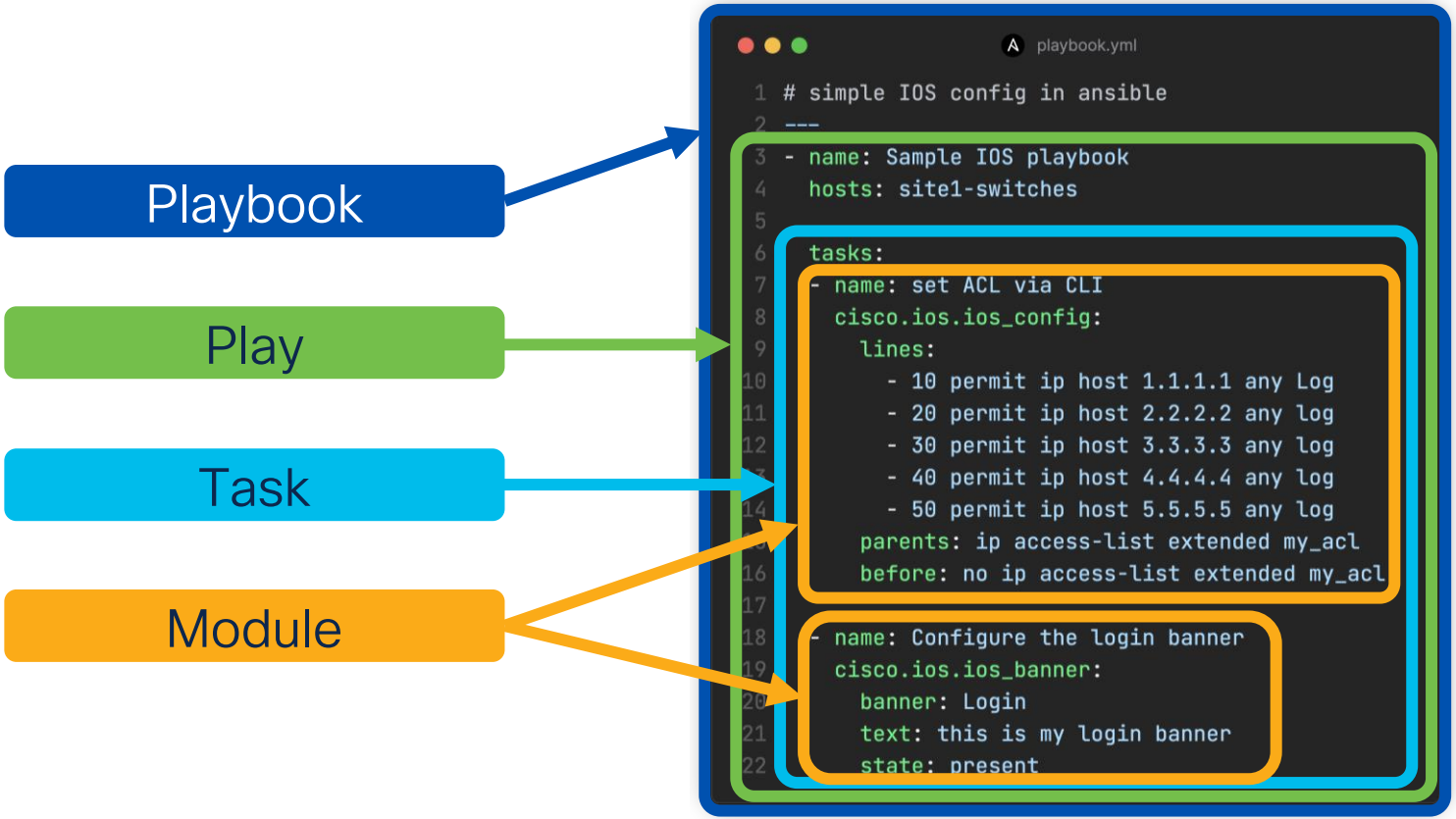
- Playbook
  - Repeatable standard config
- Play
  - A set of tasks
- Task
  - A single action that uses a module
- Module
  - Reusable, standalone scripts



Ansible Playbook Example

Deploy

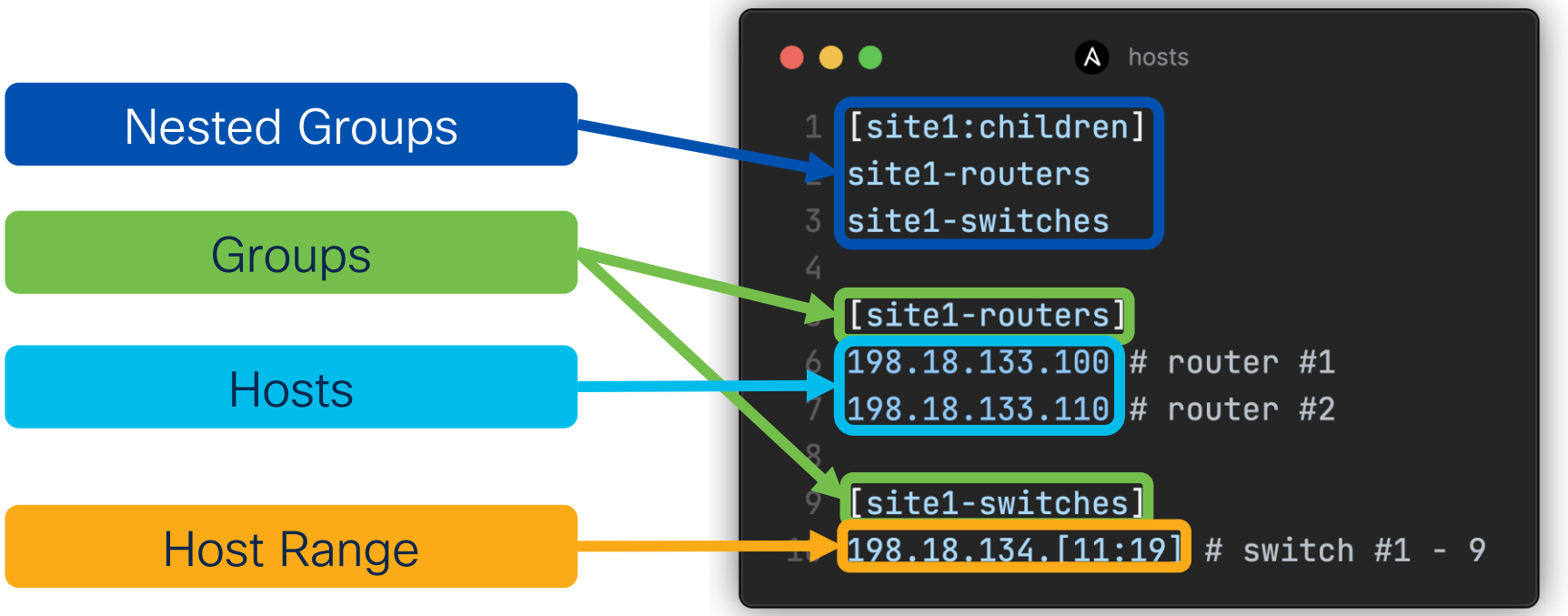
Reference



Ansible Inventory

Deploy

Reference



Ansible Inventory Plugin

Deploy

nb_inventory.yml

```yaml
plugin: netbox.netbox.nb_inventory
validate_certs: true
config_context: false
group_by:
  - device_roles
query_filters:
  - role: switches
device_query_filters:
  - has_primary_ip: true
```

Terminal

```
ansible-inventory --graph -i nb_inventory.yml

@all:
  |--@ungrouped:
  |--@device_roles_switches:
  |  |--sw1-1
  |  |--sw2-1
  |  |--sw3-1
  |  |--sw4-1
```

Inventory plugins allow users to point at data sources to compile the inventory of hosts that Ansible uses to target tasks

Ansible Idempotency

Reference

Deploy

Definition:

Applying the same playbook multiple times results in the same state without unintended changes.

Benefits:

- **Efficiency:** Avoids unnecessary actions, saving time.
- **Reliability:** Reduces errors by ensuring systems remain in the desired state.

Example:
Installs a package only if not already present, maintaining system consistency.

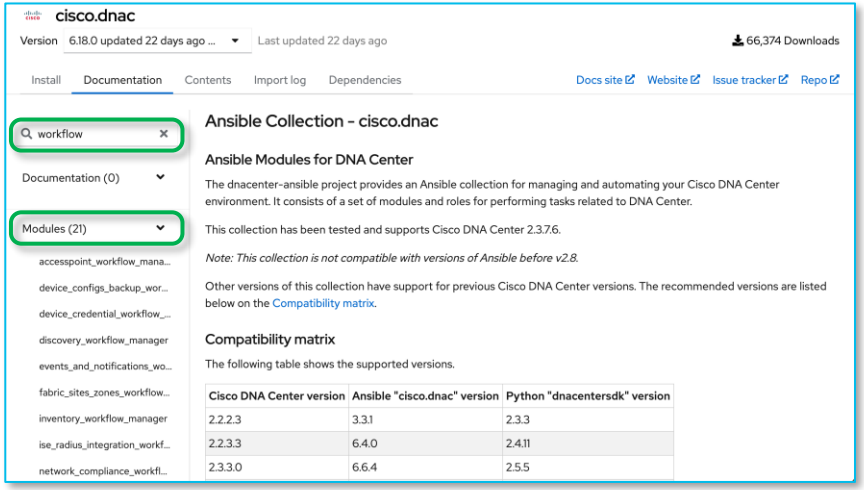
Why Ansible?

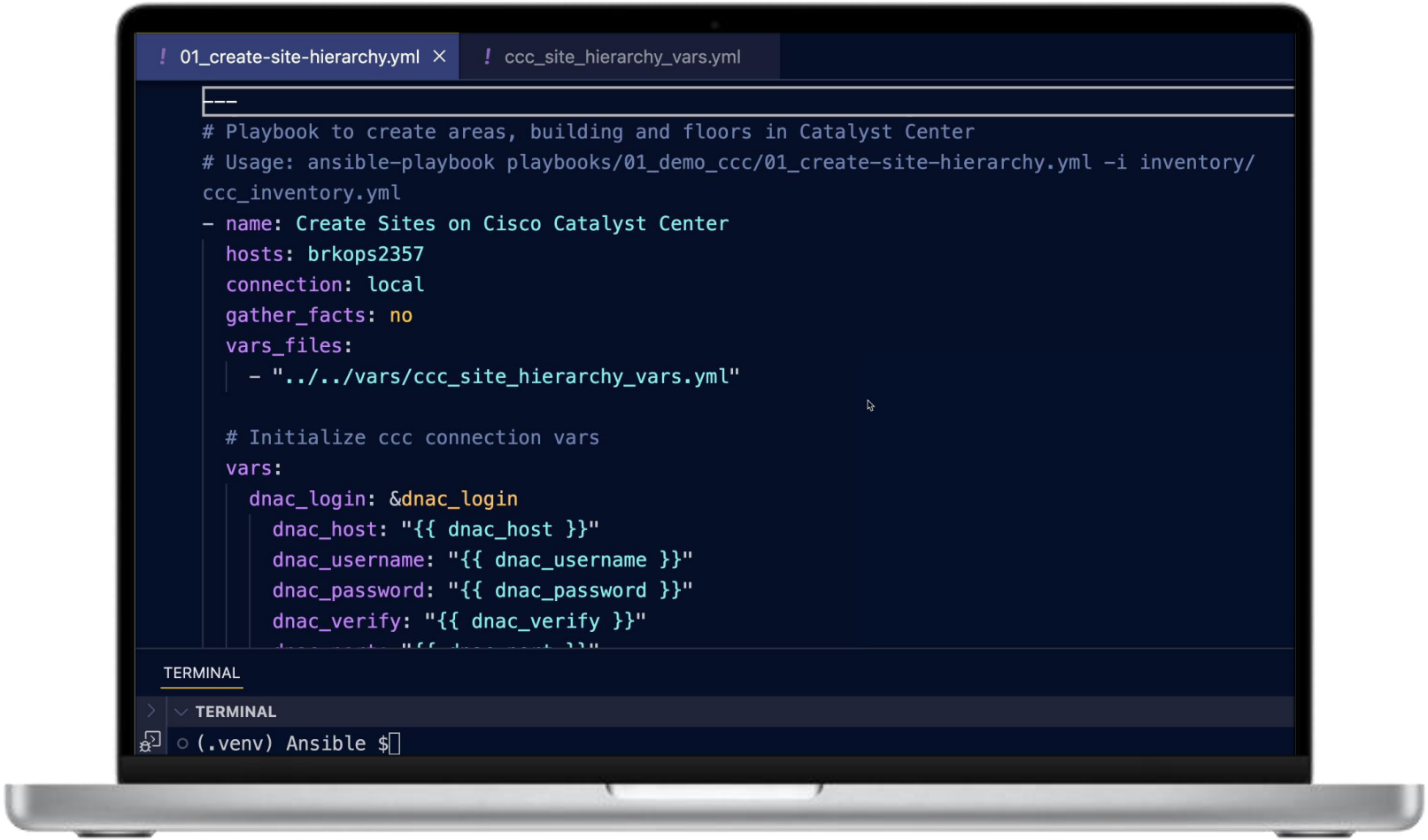
- **Automation & Efficiency:** Automate repetitive tasks to save time and resources.
- **Simplicity & Ease of Use:** YAML syntax makes it accessible and easy to learn.
- **Extensive Modules:** Includes Cisco Catalyst Center and NetBox for flexibility.

Catalyst Center Ansible Collection

Deploy

- TAC/Engineering Supported starting with Cisco Catalyst Center version 2.3.7.6
- Identified with the module name including “workflow_manager”
- Ansible playbooks for common operations for sites, PnP, SWIM, compliance, templates, network settings, …





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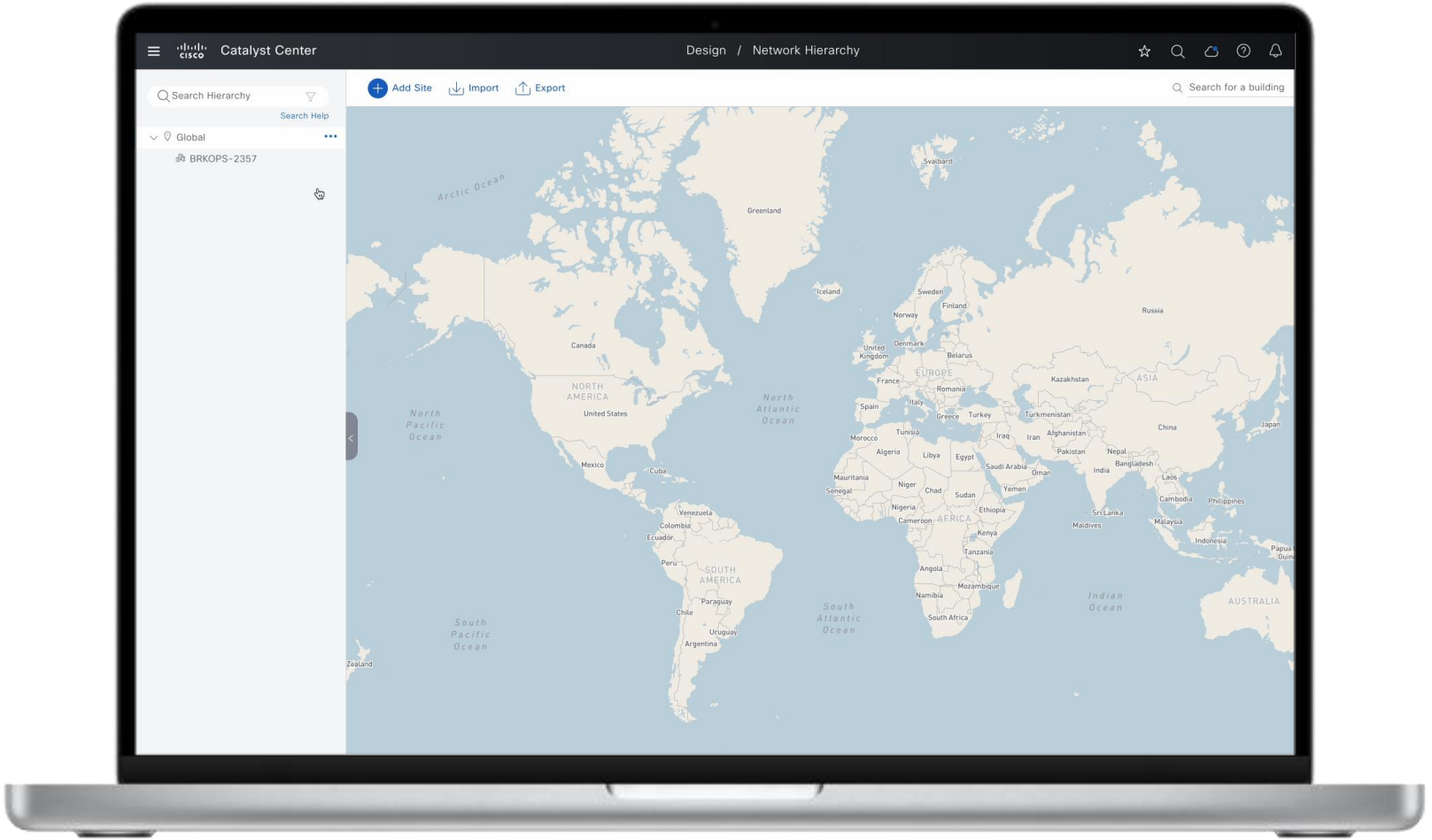

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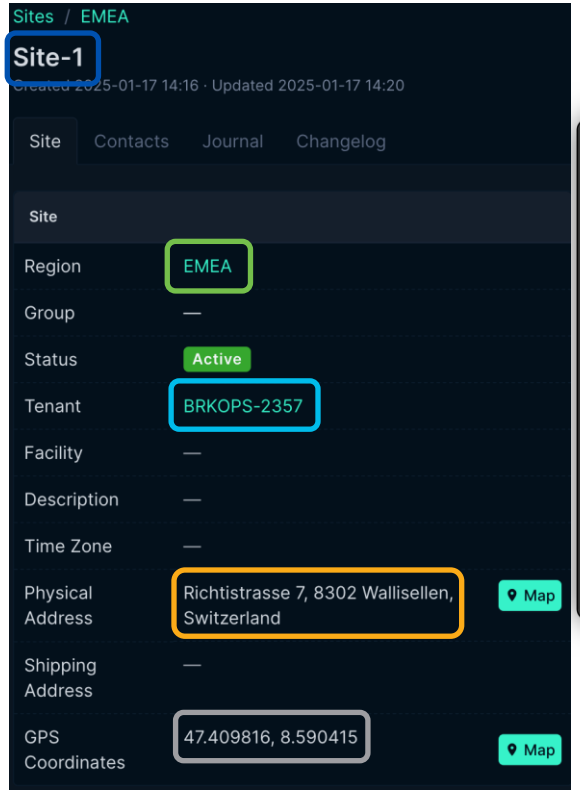
Remember the Config Example?

Deploy



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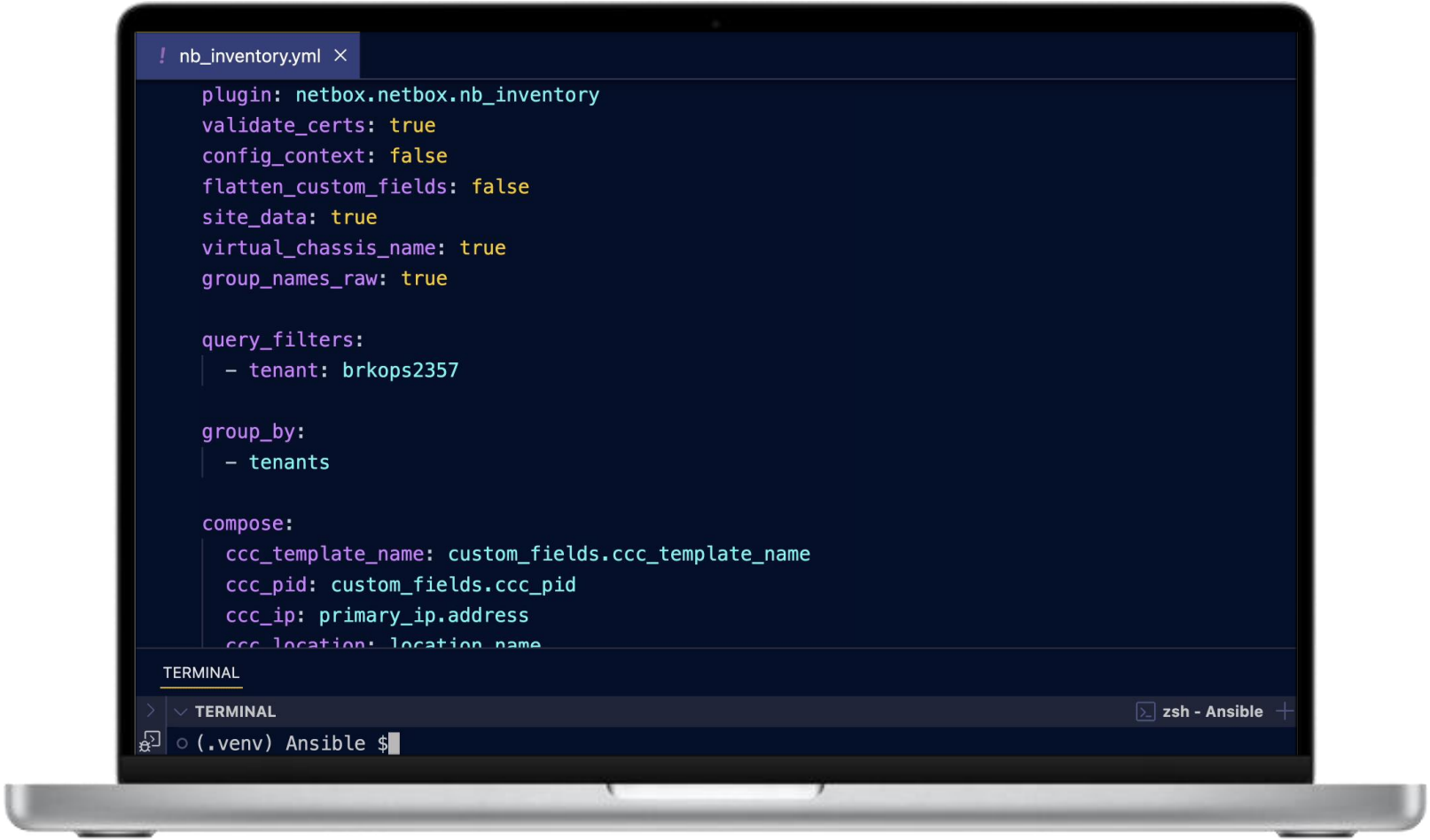
          country: "{{ physical_address.split(',')[-1].strip() }}"
        type: building
```



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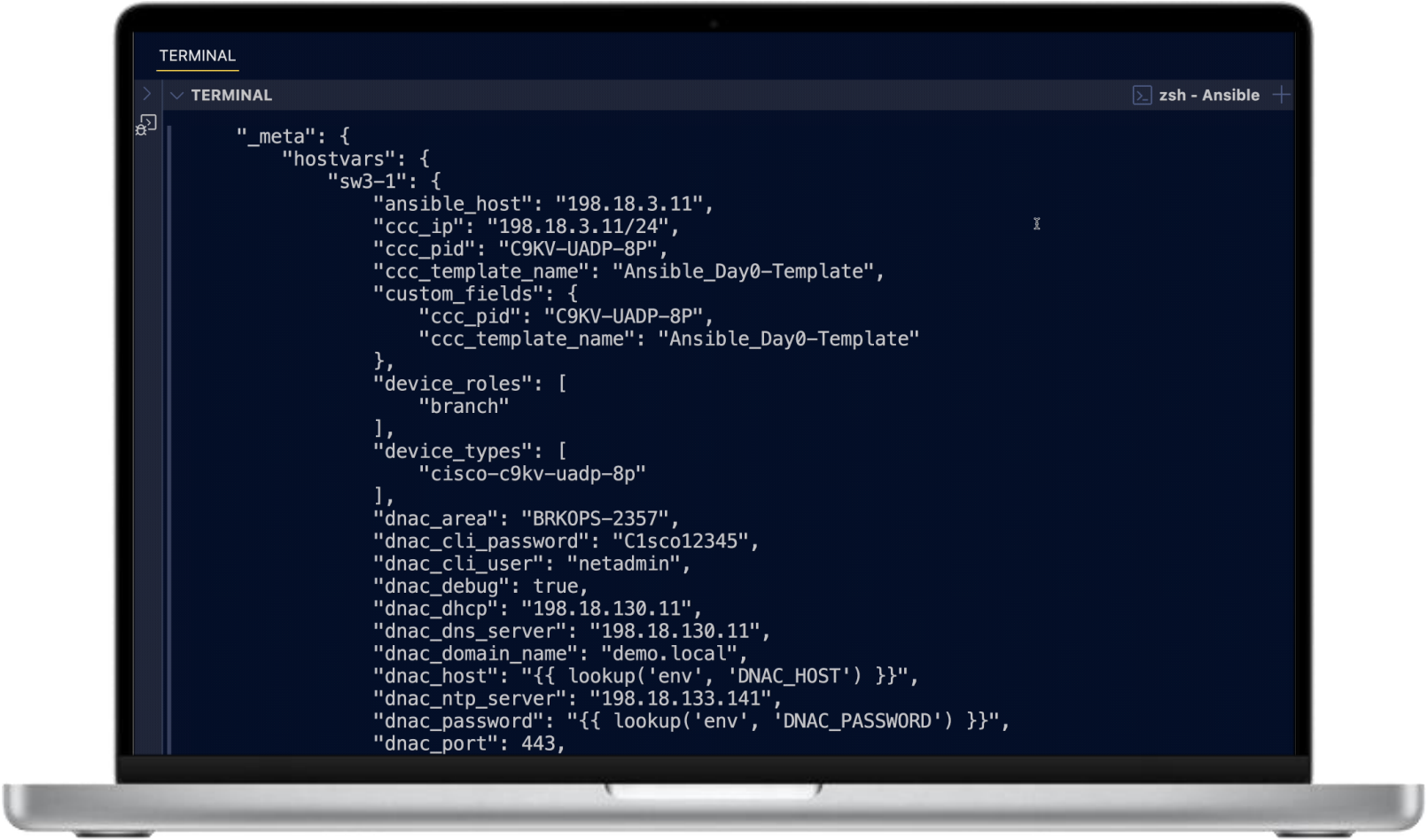

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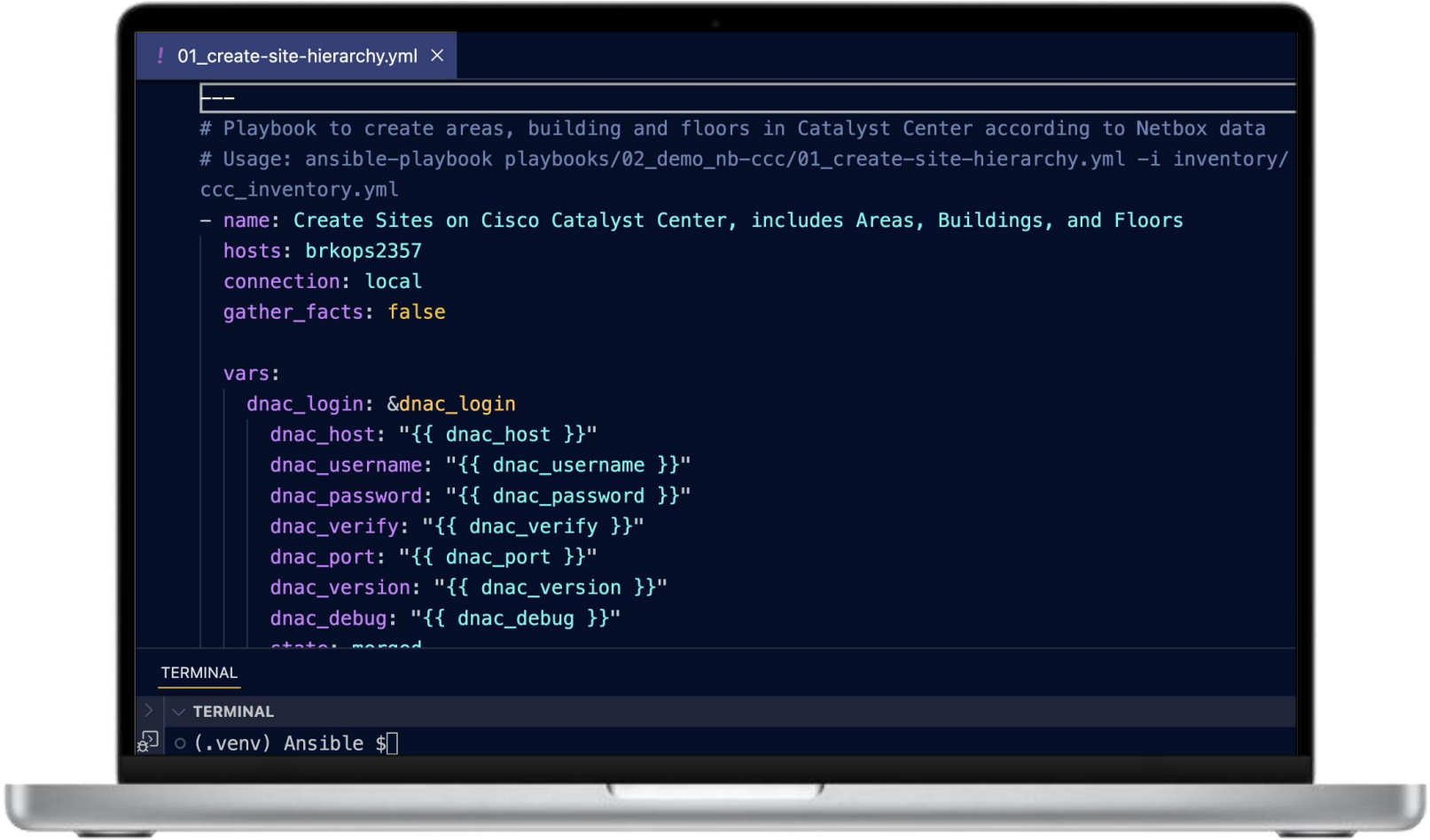
Ansible Lookup Plugin

Deploy

nb_lookup.yml

```
1 tasks:
2   # query a list of devices
3   - name: Obtain list of devices from NetBox
4     debug:
5       msg: >
6         "Device ({ item.value.display_name }} (ID: ({ item.key }})"
7       loop: "{{ query( netbox.netbox.nb_lookup', 'devices'
8         api_endpoint='http://localhost/',
9         token='<redacted>') }}"
```

Queries NetBox via its API to return virtually any information capable of being held in NetBox.



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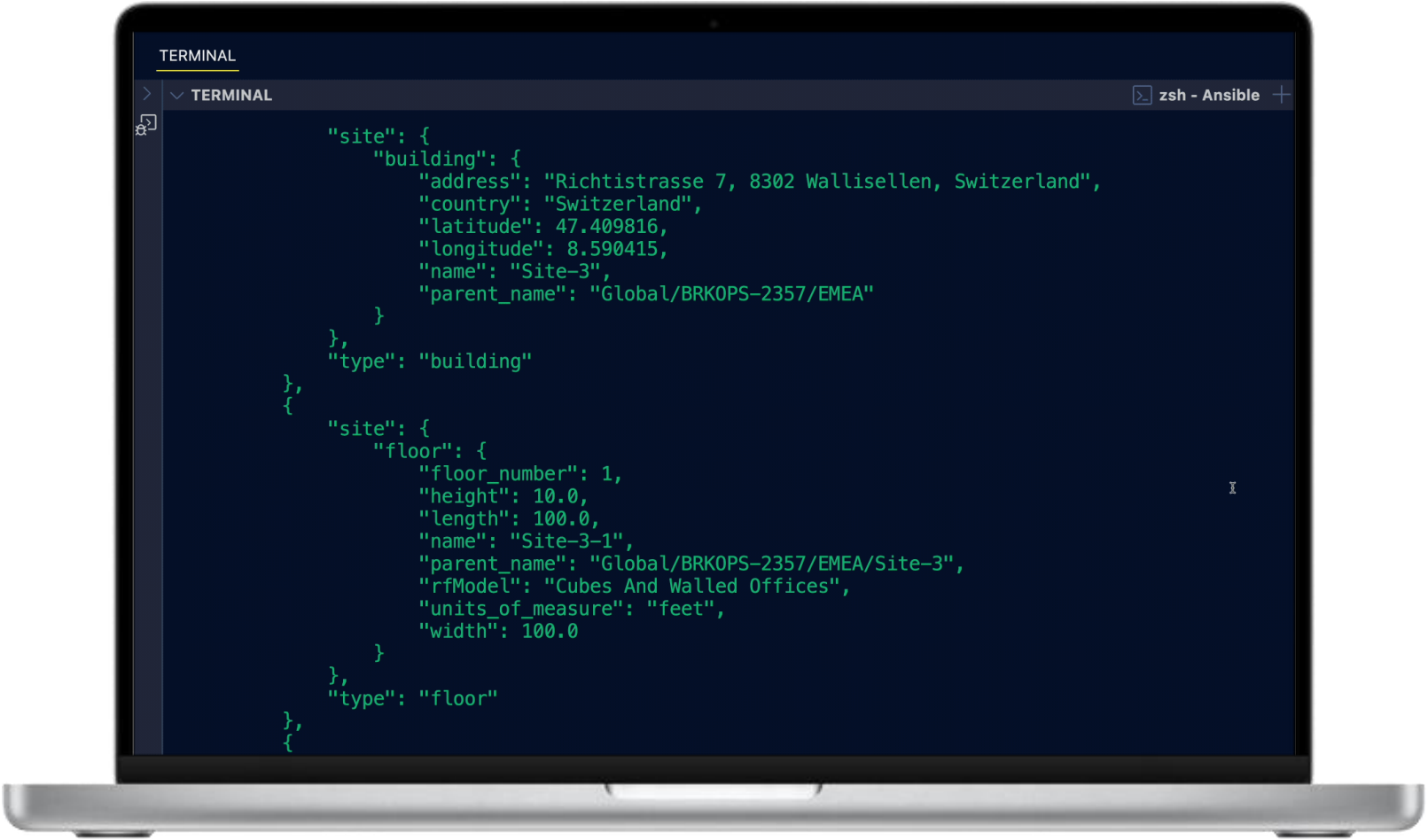

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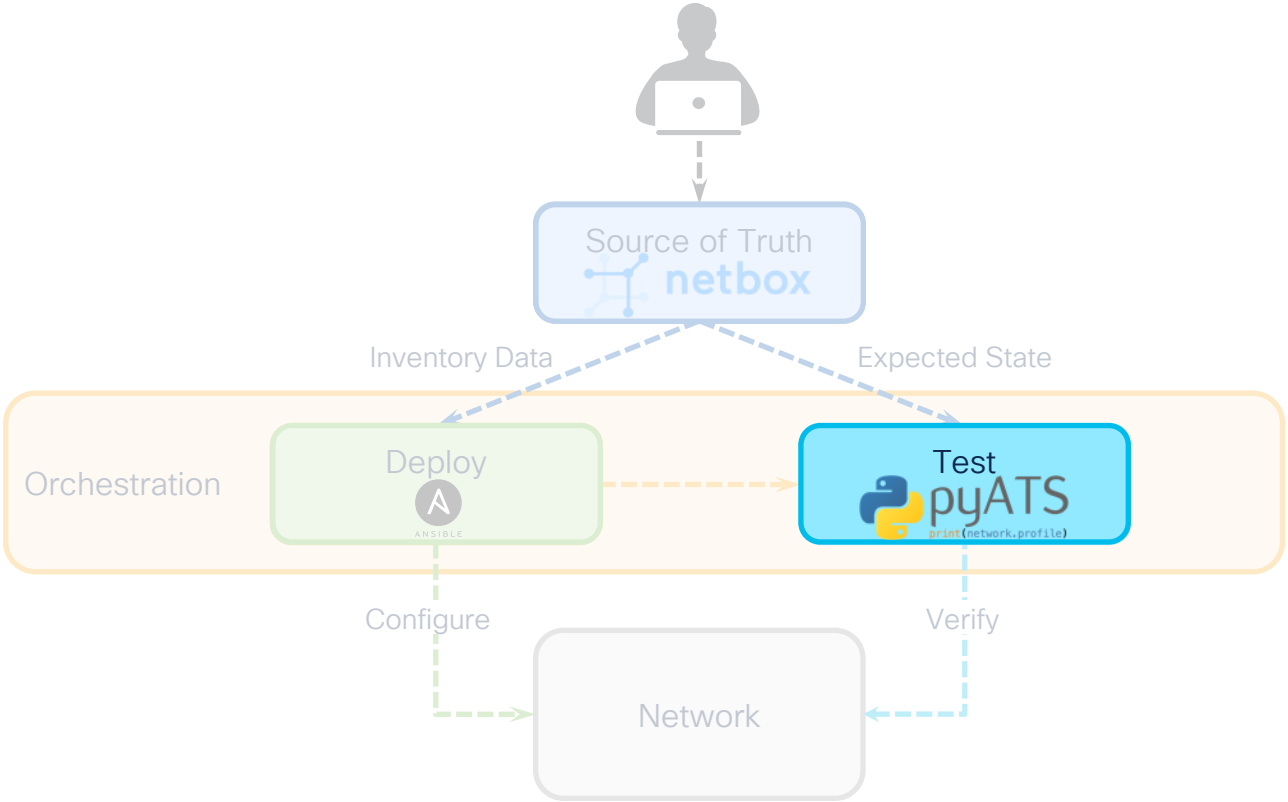
Component Overview

Test



Types of Tests

Testing

Unit Testing	Local tests Check interface, ACL, VLAN
Integration Testing	Test multiple systems Routing Table, Port Status
End-to-End Testing	Complete network test Ping, Traceroute
Regression Testing	Check if new feature breaks network Run validation before and after a change

Why pyATS?

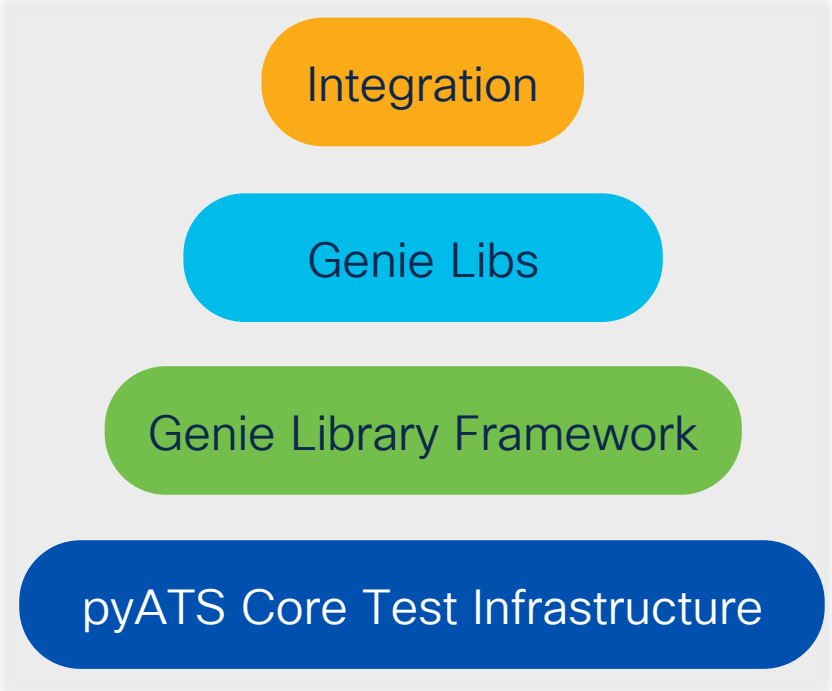
- Automate repetitive network validation tasks
- Ensure operational consistency across devices
- Reduces manual effort and human error
- Fast testing cycles

Reference

Cisco pyATS

Test

- Testbed
  - Network topology
- AEtest Infrastructure
  - Testing framework
- Unicon
  - Device connectivity
- pyATS Library (Genie)
  - Data parsing
- Easypy
  - Runtime environment



pyATS Testbed

Test

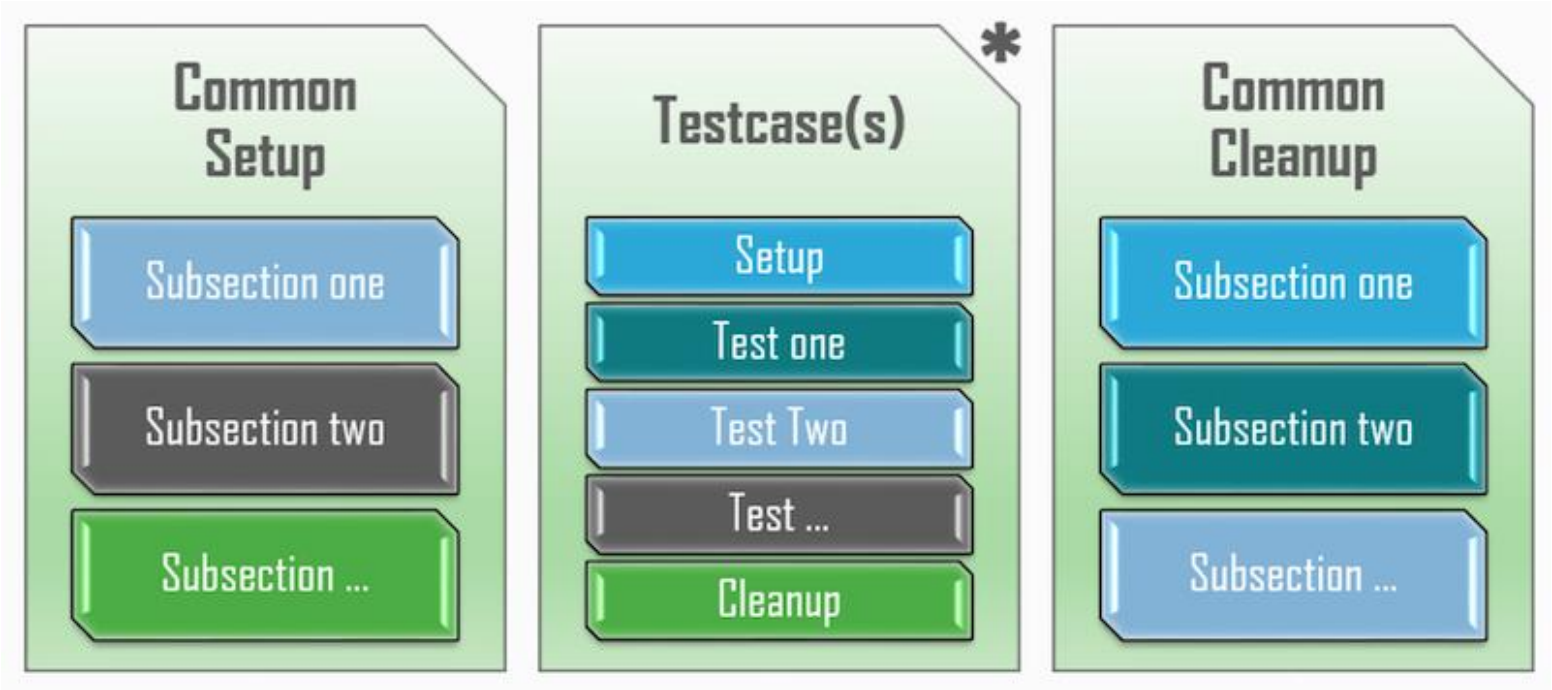
Reference

testbed.yml

```yaml
---
devices:
  sw3-1:
    type: switch
    os: iosxe
    credentials:
      default:
        username: netadmin
        password: C1sco12345
    connections:
      mgmt:
        protocol: ssh
        ip: 198.18.3.11
```

pyATS AEtest Structure

Test



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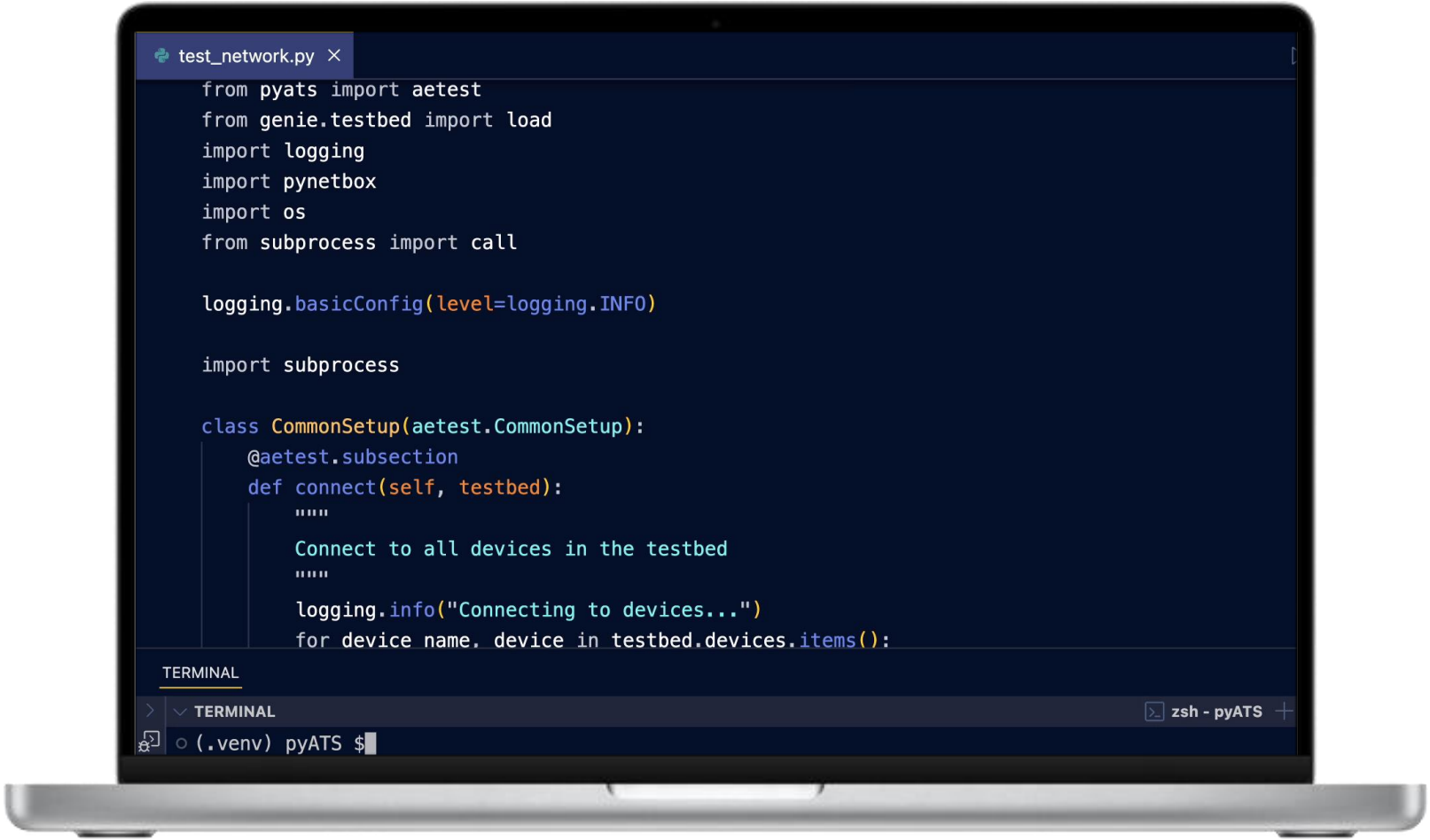

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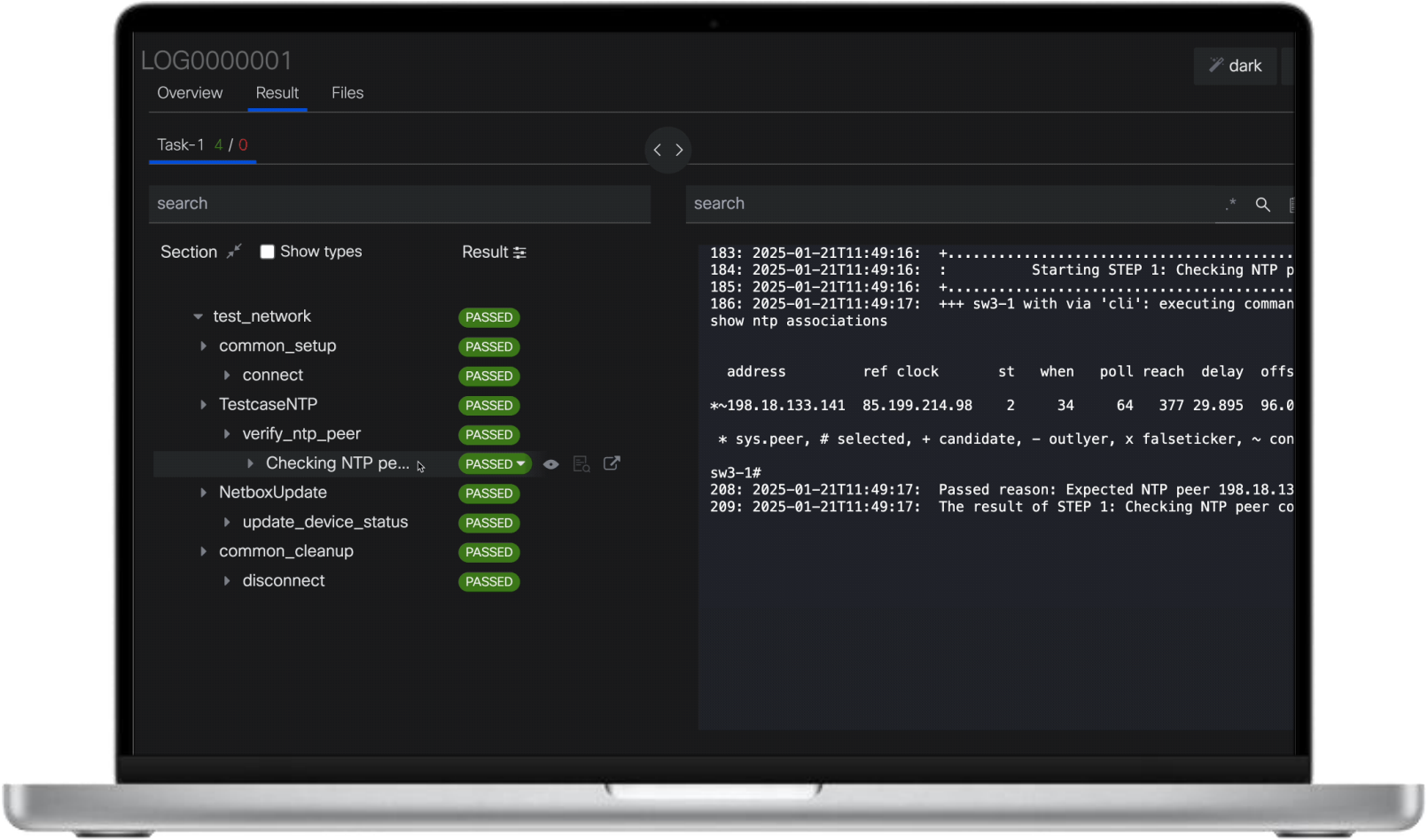

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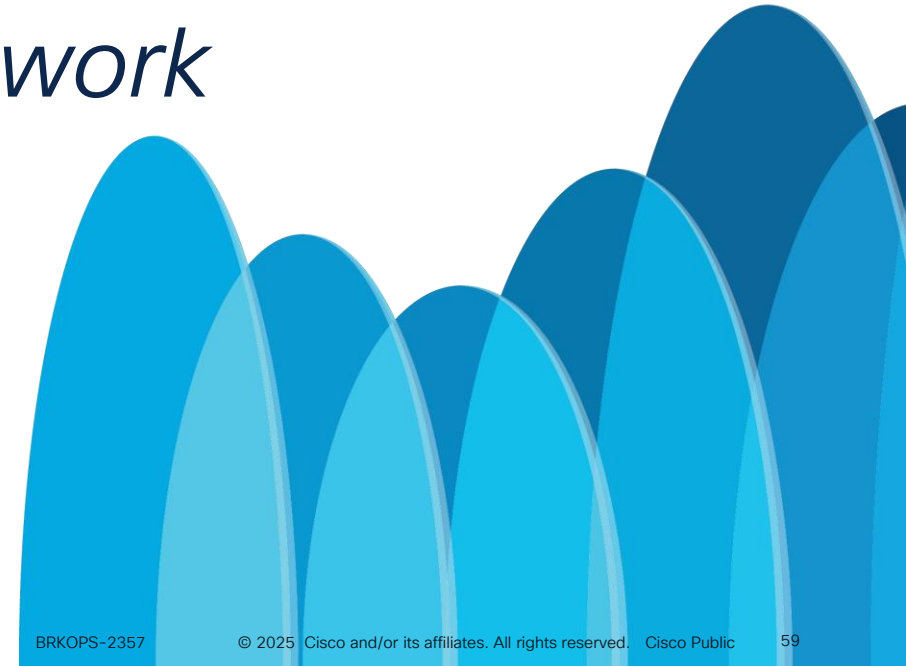
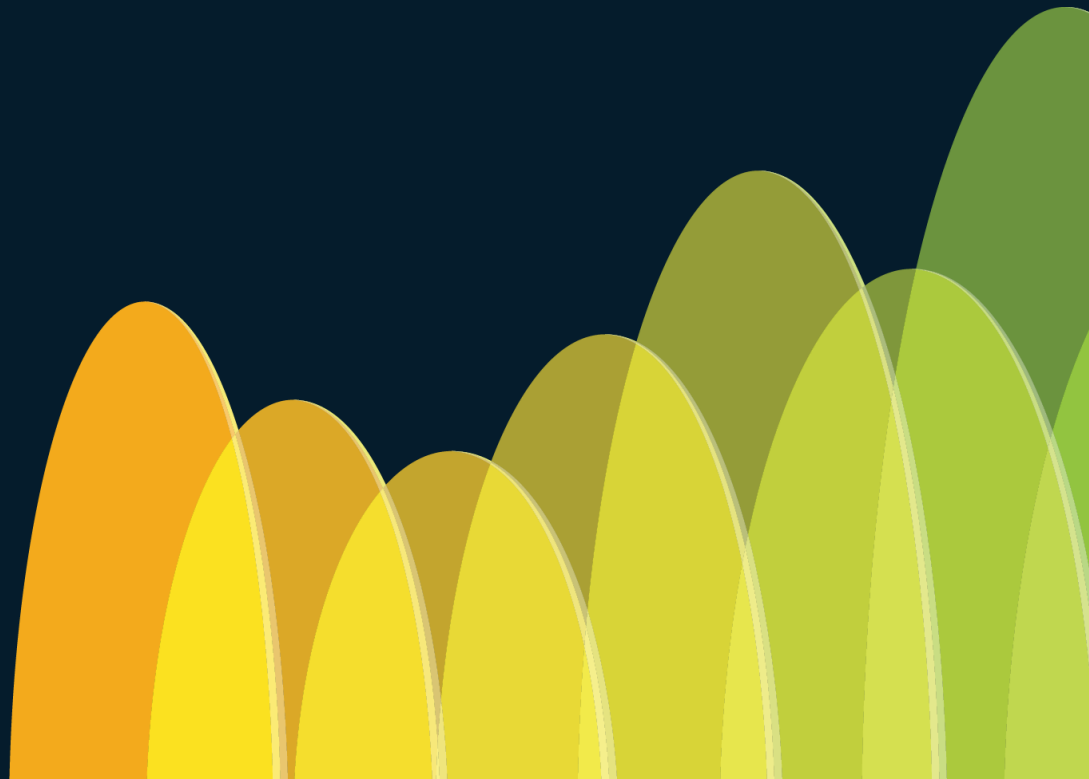


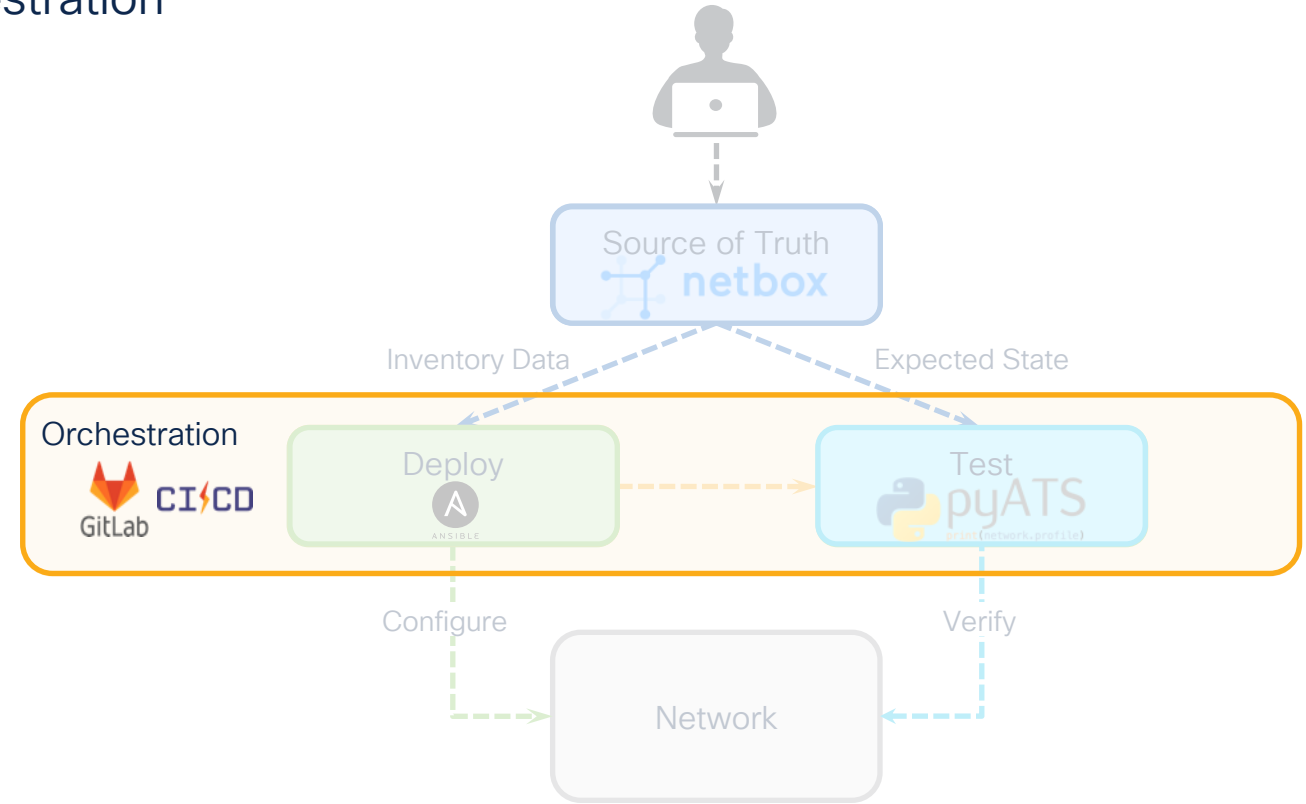
Tying It All Together



cisco Live!

Component Overview

Orchestration



GitLab CI/CD

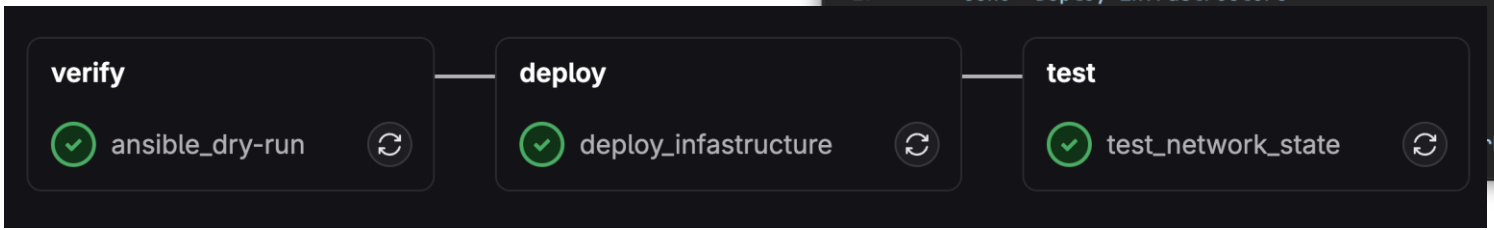
Orchestration

- .gitlab-ci.yml File:
  - Configuration file defining CI/CD pipeline steps.

- Pipeline:
  - A series of automated steps (jobs) from code commit to deployment.

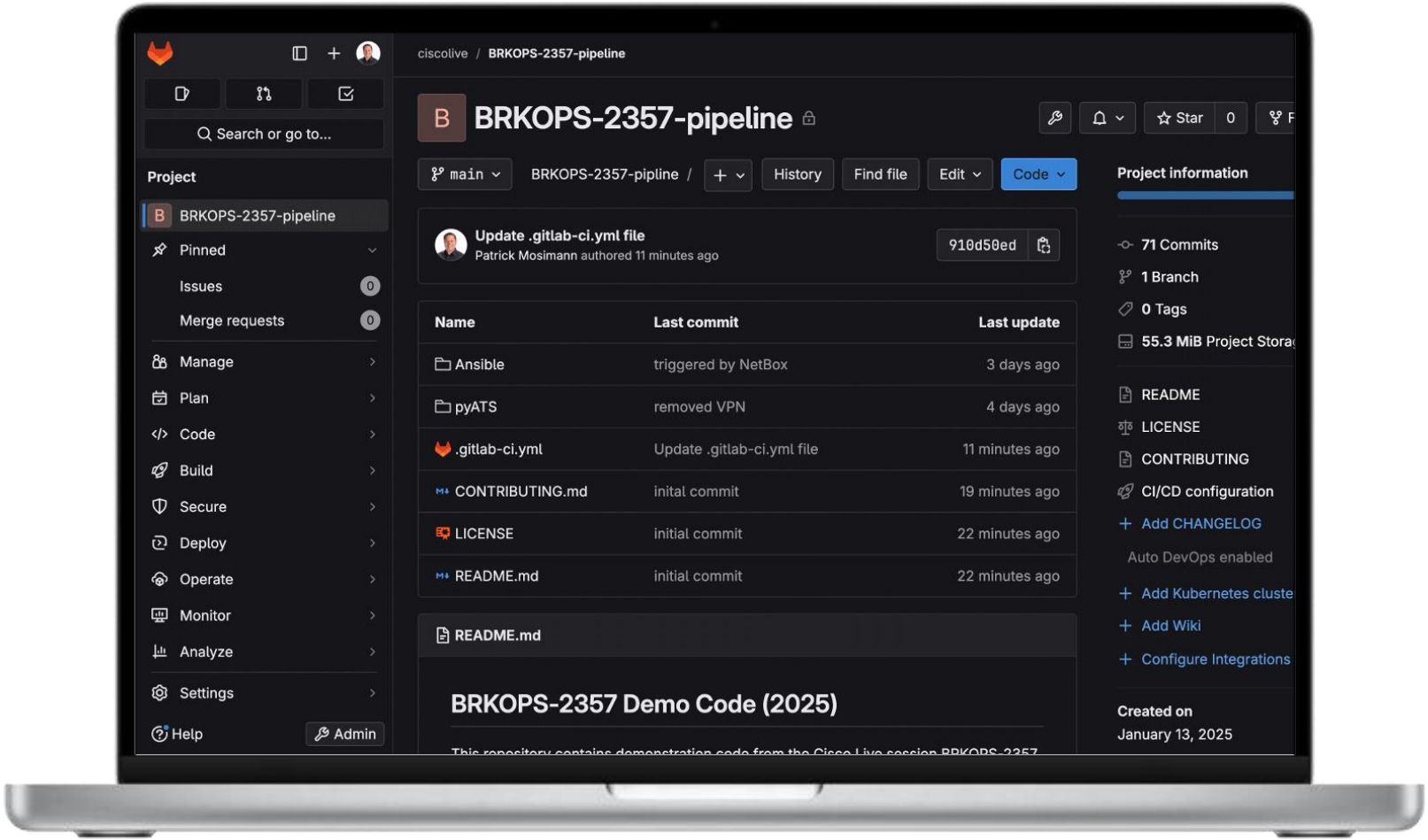
.gitlab-ci.yml

```yaml
default:
  image: git.its-best.ch:5050/ciscolive/brkops-2357:1.2

stages:
  - verify
  - deploy
  - test

ansible_dry-run:
  stage: verify
  script:
    - echo "Check Mode & preview changes"

deploy_infastructure:
  stage: deploy
  script:
    - echo "Deploy infrastructure"
```

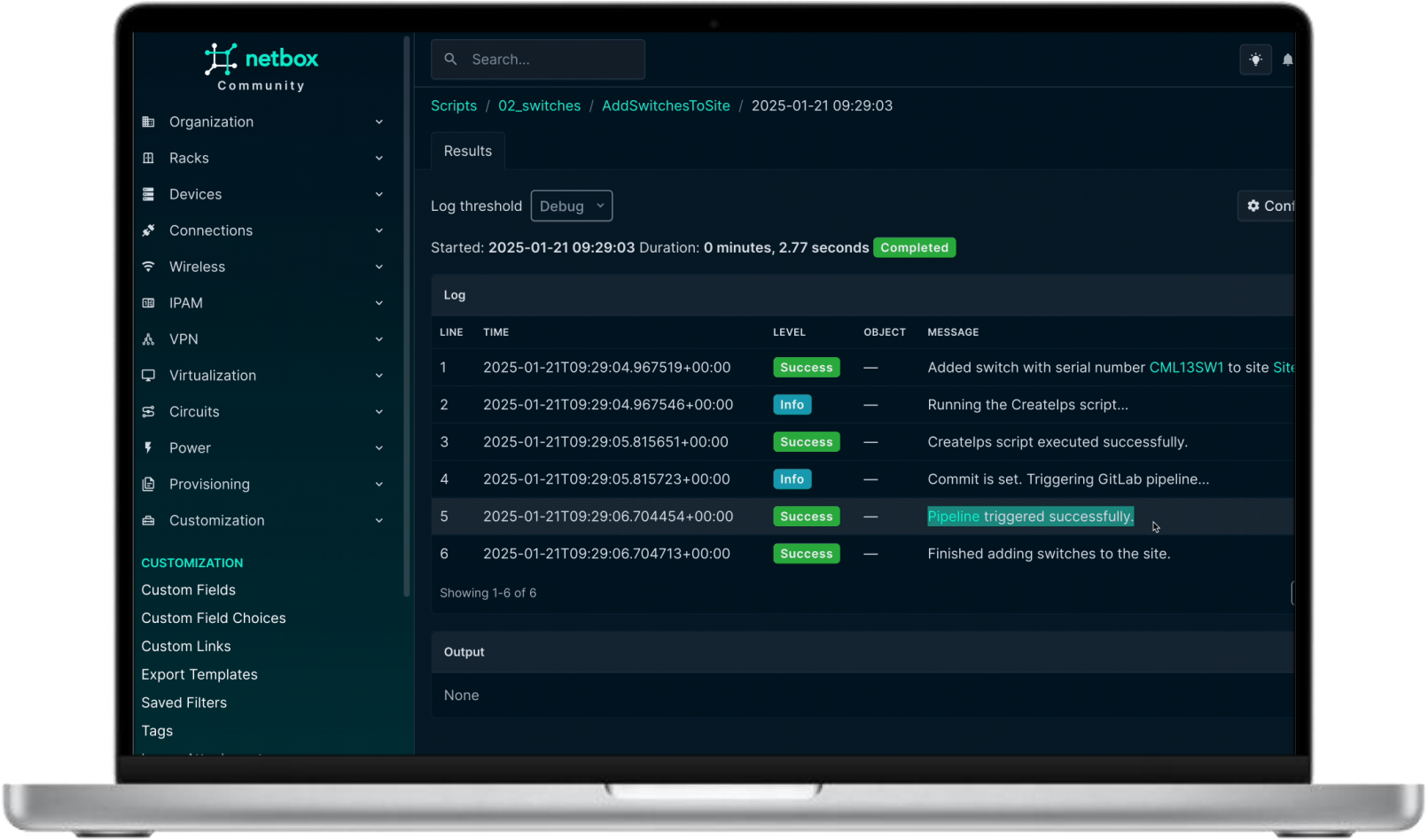


Why GitLab CI/CD?

- **Workflow Automation:** Run tasks in order with historical tracking for review and auditing.
- **Variable Management:** Store ENV vars centralized and securely.
- **Flexible Runners**: Execute Ansible, and pyATS jobs efficiently.

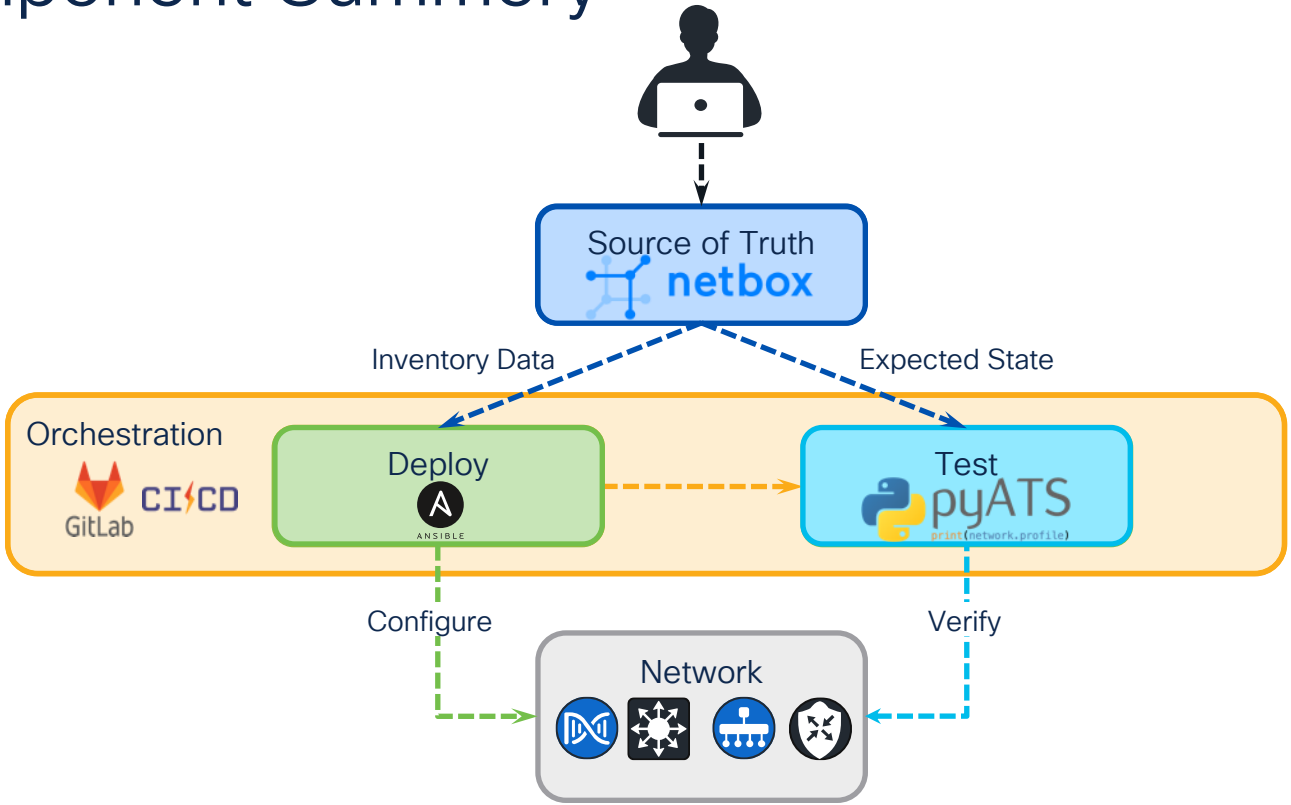


Get the code: https://github.com/pamosima/BRKOPS-2357



Get the code: https://github.com/pamosima/BRKOPS-2357

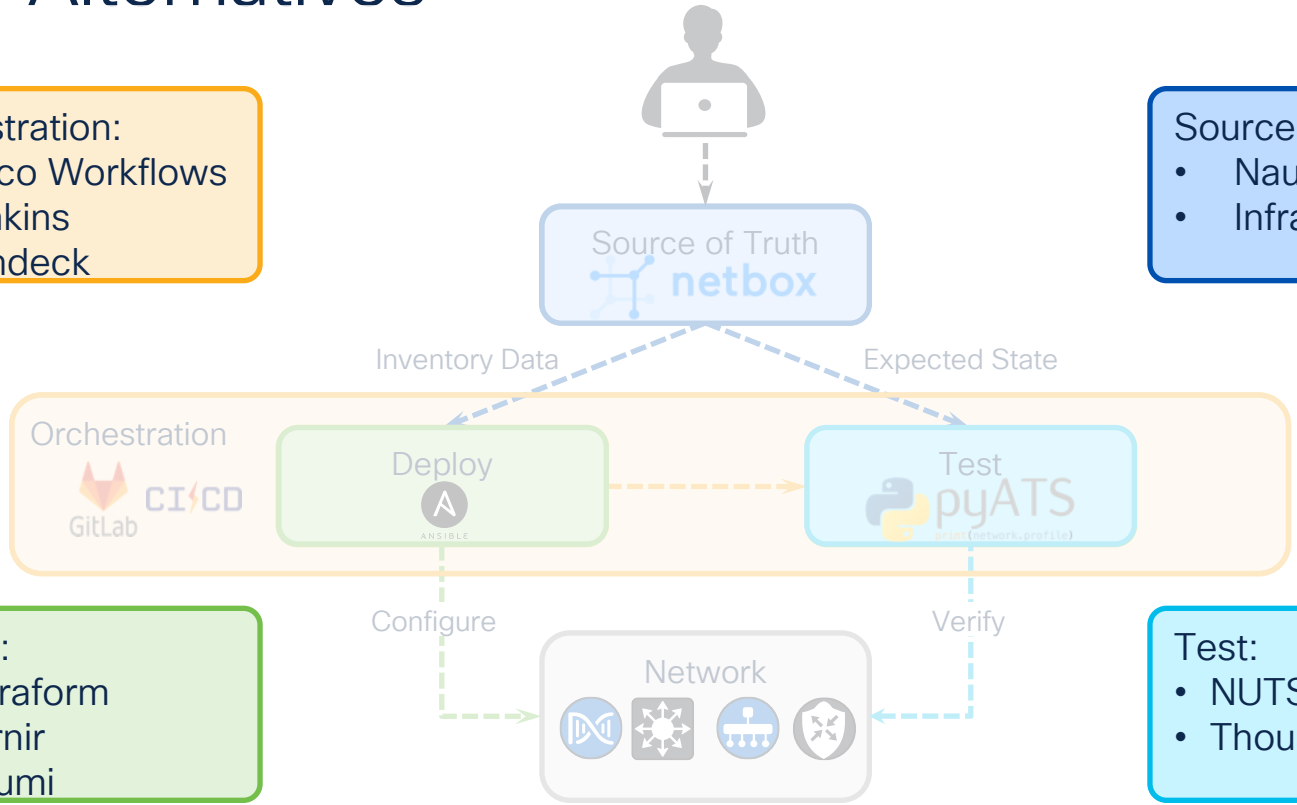
Component Summery



Tool Alternatives

Orchestration:
- Cisco Workflows
- Jenkins
- Rundeck

Source of Truth:
- Nautobot
- Infrahub



Deploy:
- Terraform
- Nornir
- Pulumi

Test:
- NUTS
- ThousandEyes

Procedural vs Declarative

Tool Alternatives: Deploy

Reference

1. Prepare ingredients
2. Add meat sauce layer to dish
3. Add pasta layer to dish
4. Repeat step 2+3 several times
5. Top with cheese
6. Cook in oven at 190C for 25 minutes
7. Remove from oven and split up into portions

Procedural

Create a Lasagna

Declarative

Ansible vs Terraform?

Tool Alternatives: Deploy

Reference

VS

Ansible

Many generic options but can result in configuration drift

Terraform

Requires a provider and creates immutable infrastructure

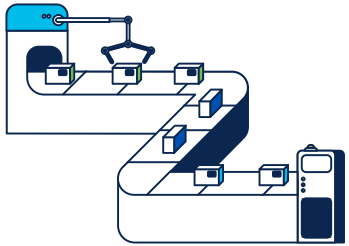
It is not either or, use a combination of both!

Ansible → send commands to provisioned systems
Terraform → provision immutable infrastructure

Further Developments (MVP+)

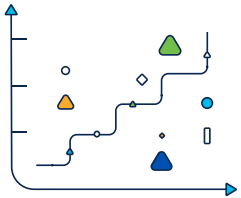
Future Features:

- Day N Tasks Automation:
  - VLAN Management
  - Switch Port Configuration



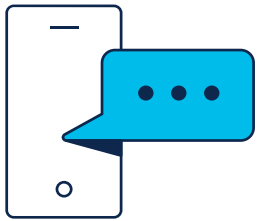
Integration Plans:

- Cisco Catalyst SD-WAN Manager
- DHCP Server

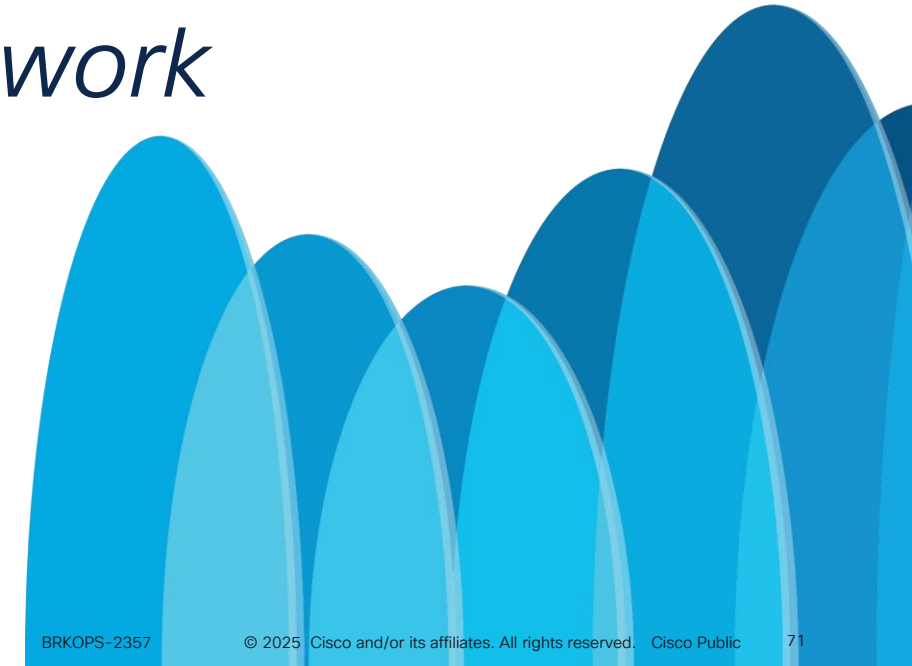


User Feedback:

- Write Your Idea in the Webex Space
- Contribute to the GitHub Project



Automate boring, repetitive tasks with data-driven network automation!



Key Takeaways

1

Reduce Errors:
Ensure data accuracy with a centralized Source of Truth.

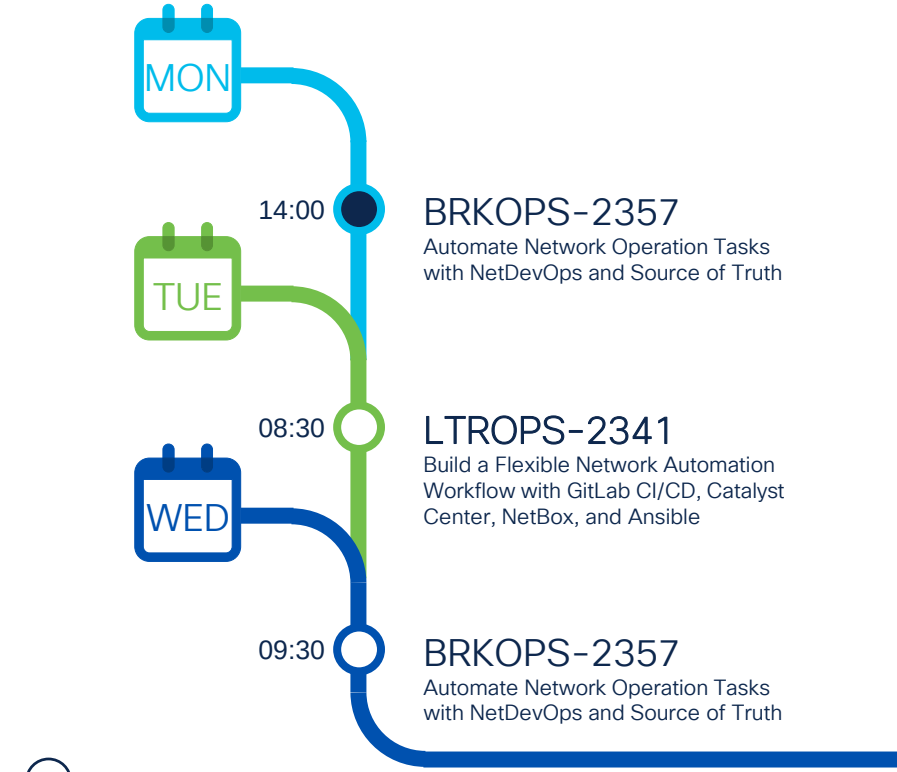
2

Streamline Deployments:
Use Ansible and GitLab CI/CD for fast, reliable setups.

3

Validate with Confidence:
Automate testing and validation with pyATS.

Continue your education



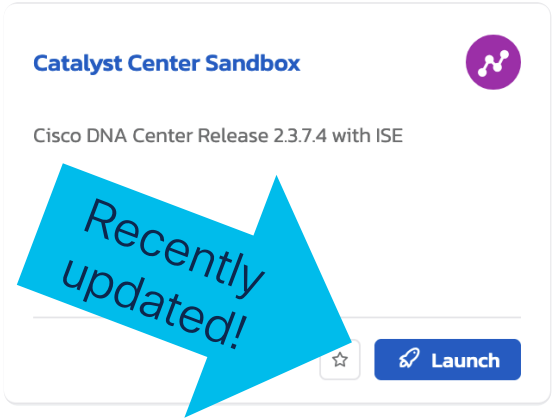
Check out GitHub, Cisco DevNet, and DevNet Academy!

Call Out

Get the code from GitHub:

https://github.com/pamosima/BRKOPS-2357

Catalyst Center Sandbox:



- Running version 2.3.7.4
- Include CML, 4 Cat 9kv, ISE
- 10x increased capacity

NetBox Cloud:

sign up for the Free Plan which includes

- up to 100 devices
- 500 IP addresses
- 10k API requests/month
- 2 operational branches

perfect for a small network/lab/PoC.

Webex App

Questions?

Use the Webex app to chat with the speaker after the session

How

1. Find this session in the Cisco Events mobile app
2. Click “Join the Discussion”
3. Install the Webex app or go directly to the Webex space
4. Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until February 28, 2025.

Fill Out Your Session Surveys

Participants who fill out a minimum of 4 session surveys and the overall event survey will get a unique Cisco Live t-shirt.

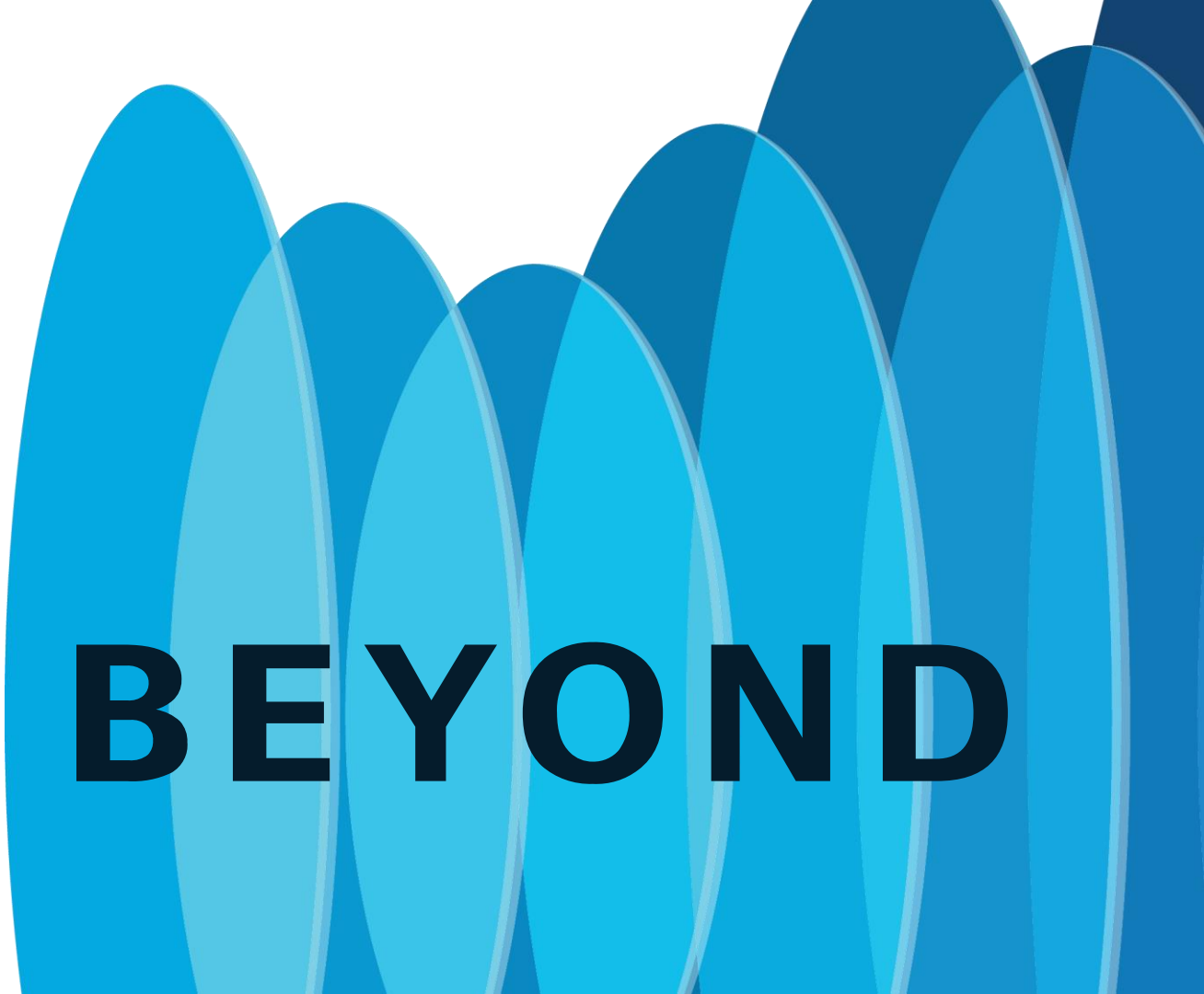
(from 11:30 on Thursday, while supplies last)

All surveys can be taken in the Cisco Events mobile app or by logging in to the Session Catalog and clicking the ‘Participant Dashboard’

Content Catalog


cisco
Thank you
cisco Live!

cisco Live!



GO BEYOND