The bridge to possible

Secure Data Center in Record Time:

Using Cisco to Automate, Deliver and Validate your Pipeline

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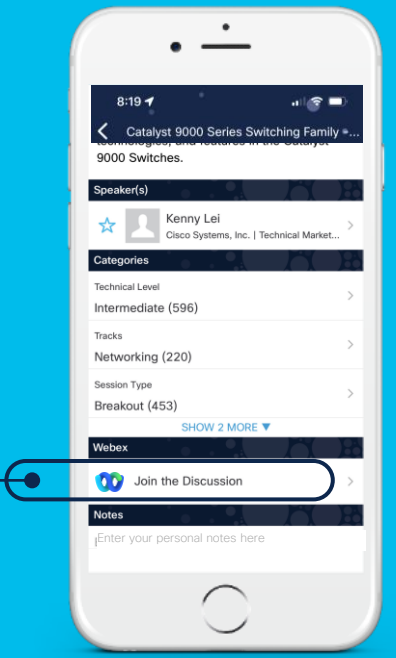


Agenda

- Introduction
- What is an Infrastructure as Code Pipeline
- Pushbutton Data Center (ACI, Nexus Dashboard)
- Auto-Provision Compute and Storage (Intersight)
- Continued Compliance (NSO, AppDynamics, Secure Network Analytics)
- Conclusion

Learning Objective

What this session covers:

- Understand basics of Infrastructure as Code (IaC)
- Explore Components of IaC
- Explore how Cisco Data Center, Cloud, Security and Orchestration tools fit into an existing IaC pipeline

What it does not:

- Code or product deep dive

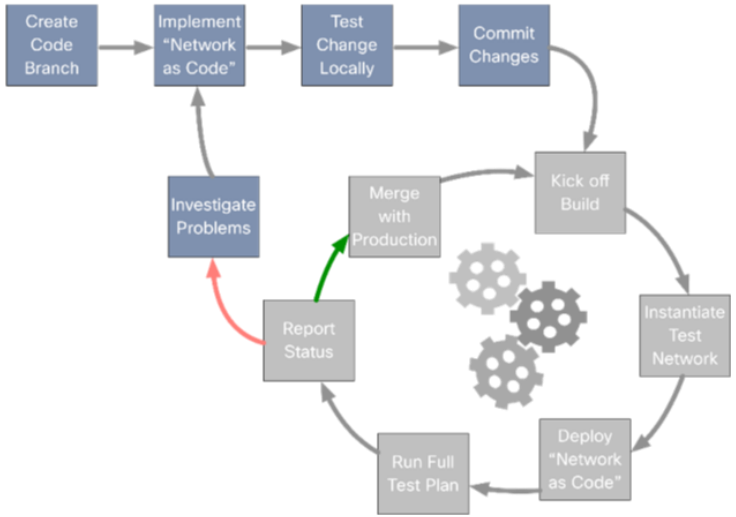
Why Infrastructure as Code?

In a world where cars drive themselves, why are we still configuring Data Centers by CLI?

What is an IaC Pipeline?

Why Infrastructure as Code?

Infrastructure Testing Pipeline



- A Source of Truth database exists that stores standard/gold and site-specific infrastructure designs.
- Model-based infrastructure designs can be programmatically deployed to the test lab.
- Changes (configuration, hardware, vulnerability) are injected into the design.
- Testing pipelines for all targeted infrastructure models and applications are executed and OQE is collected for each test.

One-Click Data Center with ACI and Nexus Dashboard

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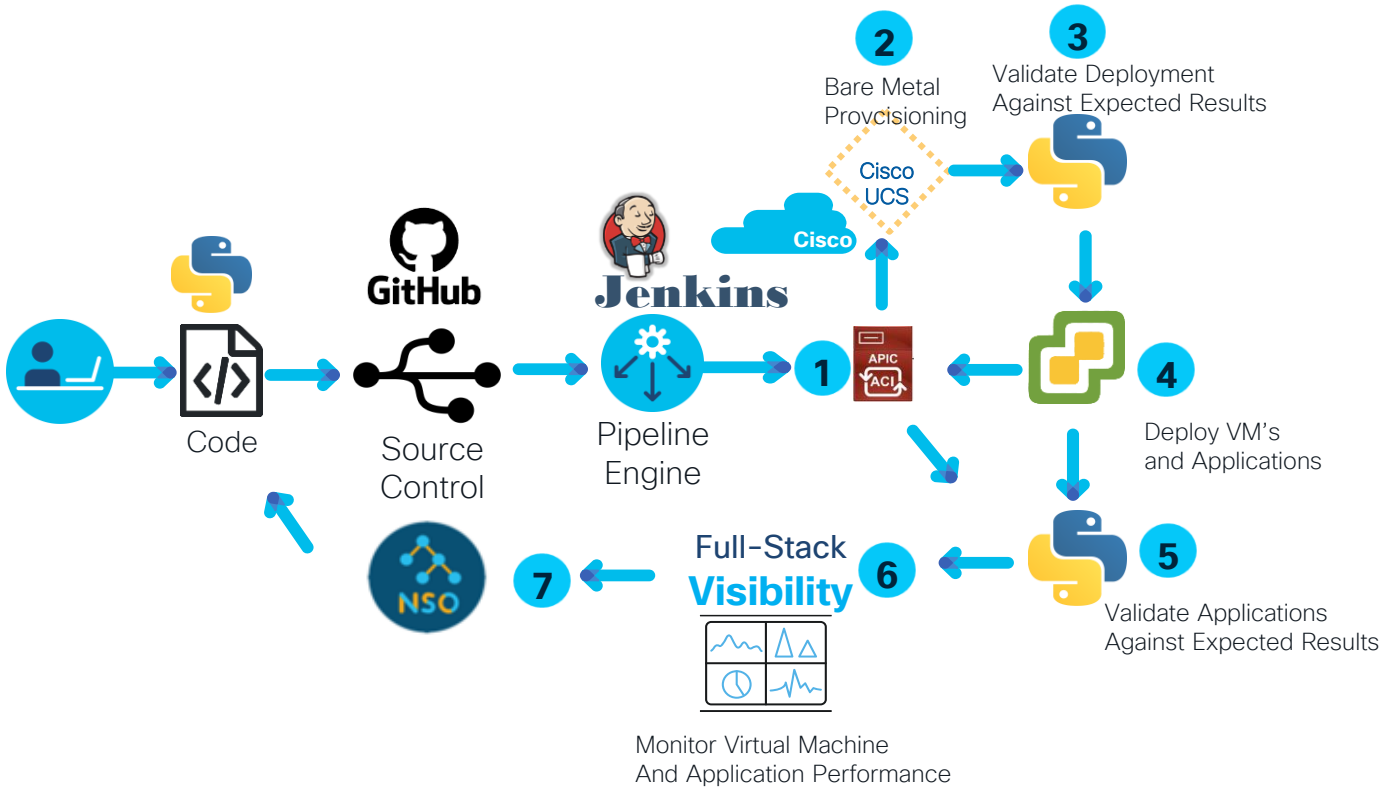
Automated Deployment and Compliance Pipeline



Jenkins Pipeline:

1. Deploy ACI Fabric
2. Deploy Bare Metal Hosts
3. Validate against Expected Results
4. Deploy VMs and Applications
5. Validate Against Expected Results
6. Full Stack Visibility
   - Intersight, AppD, SNA
7. Compliance Check
   - NSO,
   - AppDynamics
   - Secure Network Analytics

Source of Truth to Code

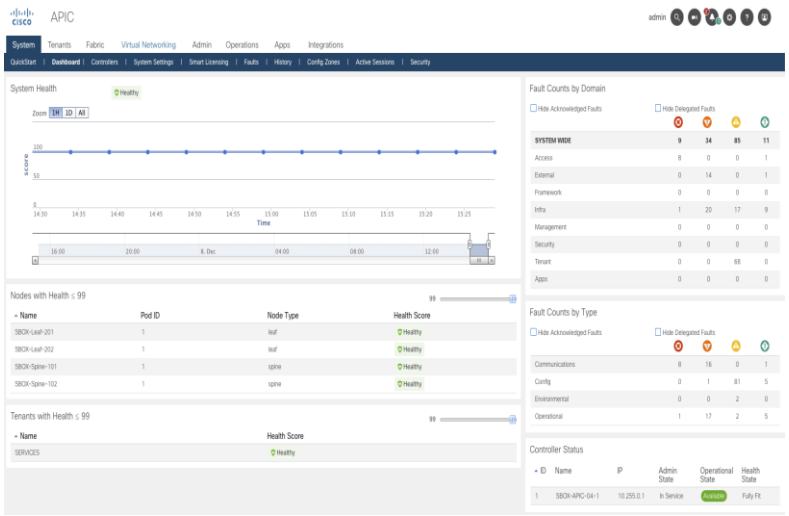
ACI Variables in .csv format

```
bridgeDomain,gateway,prefixLength,tenant,vrf,appProfile,descriptioin,epg,domain,domainType,contract,vlanEncaps,encapsType,filter,l3Out,multivrf,rp,dhcpRelay,c
BD_1200,172.16.115.254,22,SERVICES,services-vrf,Management,ESXi Management EPG,EPG_1200,Infrastructure,phys,SERVICES-Contract,1200,vlan,services-allow_all,out
BD_1201,172.16.116.254,24,SERVICES,services-vrf,Management,HX Storage Data EPG HX-1,EPG_1201,Infrastructure,phys,SERVICES-Contract,1201,vlan,services-allow_a
BD_1202,172.16.117.254,24,SERVICES,services-vrf,Management,ESXi vMtion EPG,EPG_1202,Infrastructure,phys,SERVICES-Contract,1202,vlan,services-allow_all,NA,NA,N
BD_1200,172.16.115.254,22,SERVICES,services-vrf,Management,ESXi Management EPG,EPG_1200,HX-VMM,vmm,SERVICES-Contract,1200,vlan,services-allow_all,out-L3Out_SB
BD_1202,172.16.117.254,24,SERVICES,services-vrf,Management,ESXi vMtion EPG,EPG_1202,HX-VMM,vmm,SERVICES-Contract,1202,auto,services-allow_all,NA,NA,NA,NA,N
BD_5,172.16.125.14,28,SERVICES,services-vrf,Management,Security EPG,EPG_5,HX-VMM,vmm,SERVICES-Contract,1205,vlan,services-allow_all,out-L3Out_SBOX,NA,NA,YES,
BD_1225,172.16.118.254,24,SERVICES,services-vrf,Management,Security EPG,EPG_1225,HX-VMM,vmm,SERVICES-Contract,1225,vlan,services-allow_all,out-L3Out_SBOX,NA,N
```

Deployment YAML

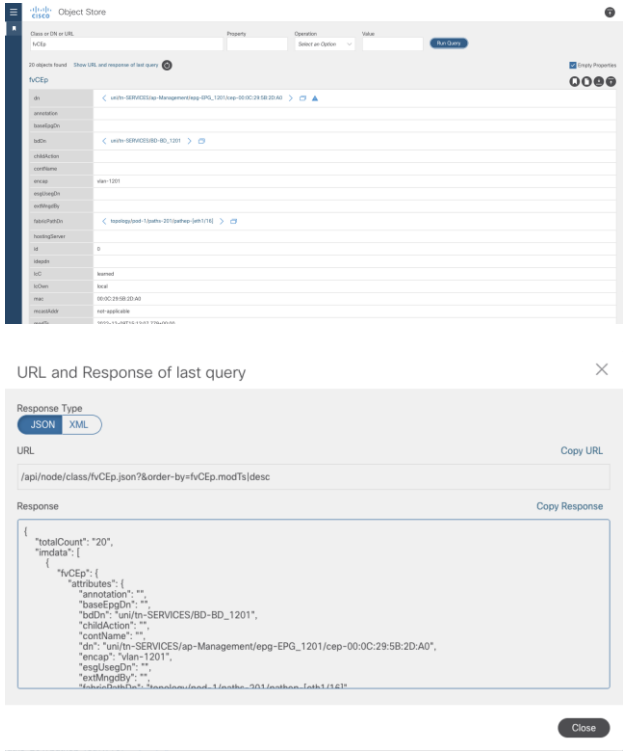
```yaml
tenants:
  - tenant: SERVICES
vrfs:
  - vrf: services-vrf
    tenant: SERVICES
    rp: 172.16.115.254
aps:
  - ap: Management
    tenant: SERVICES
bridge_domains:
  - bd: BD_1200
    gateway: 172.16.115.254
    mask: 22
    tenant: SERVICES
    vrf: services-vrf
    scope: public,shared
    L3Out: out-L3Out_SBOX
  - bd: BD_1201
    gateway: 172.16.116.254
    mask: 24
    tenant: SERVICES
    vrf: services-vrf
    scope: public,shared
    L3Out: NA
  - bd: BD_1202
    gateway: 172.16.117.254
    mask: 24
    tenant: SERVICES
    vrf: services-vrf
    scope: public,shared
    L3Out: NA
  - bd: BD_1200
    gateway: 172.16.115.254
    mask: 22
```

ACI Role in the Pipeline



- ACI – Application Centric Infrastructure, a software-defined data center infrastructure solution built on a zero-trust model.
- ACI consists of Cisco Nexus 9000 Series switches running ACI software and an APIC (Application Programmable Interface Controller) cluster.
- The APIC acts as the central control point for all configuration and policy.
- ACI is model-based with open API's that provide the ability to automate every aspect of the fabric configuration.

ACI DevOps Tools– REST API's



- Visore, the APIC object store browser, provides the ability to query Managed Objects (MO) and display the results.
- Visore also provides the ability to display the URL and Response of the query which will be used for API calls in automation scripts.
- Visore uses Class, DN, or URL for queries. By enabling 'Show Debug Info' in the APIC GUI and navigating, you can determine applicable the Class Name or DN.

ACI DevOps Tools – Ansible and Terraform

- Ansible

```yaml
- name: TASK 01 - ENSURE TENANT EXISTS
  aci_tenant:
    host: "{{ inventory_hostname }}"
    username: "{{ username }}"
    private_key: ../creds/ansible.key
    state: "present"
    validate_certs: False
    tenant: "{{ item.tenant }}"
  with_items: "{{ tenants }}"
  tags: tenant
```

- Terraform

```
terraform {
  required_providers {
    aci = {
      source = "ciscodevnet/aci"
    }
  }
}

#configure provider with your cisco aci credentials.
provider "aci" {
  # cisco-aci user name
  username = "admin"
  # cisco-aci password
  password = "password"
  # cisco-aci url
  url      = "https://my-cisco-aci.com"
  insecure = true
}

resource "aci_tenant" "test-tenant" {
  name        = "test-tenant"
  description = "This tenant is created by terraform"
}

resource "aci_application_profile" "test-app" {
  tenant_dn   = aci_tenant.test-tenant.id
  name        = "test-app"
  description = "This app profile is created by terraform"
}
```

ACI DevOps Tools – Ansible and Terraform

Ansible

Open-source tool for cross-platform deployment.

- Extensive library of modules that leverages existing ACI API's.
- The aci_rest module provides the ability to deploy configurations that do not have modules.

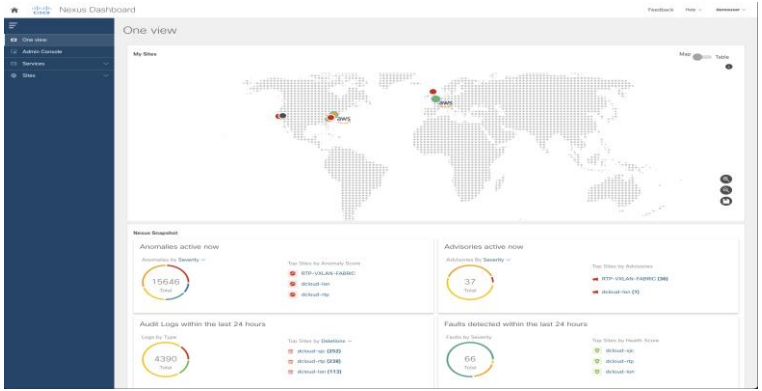
https://docs.ansible.com/ansible/devel/scenario_guides/guide_aci.html

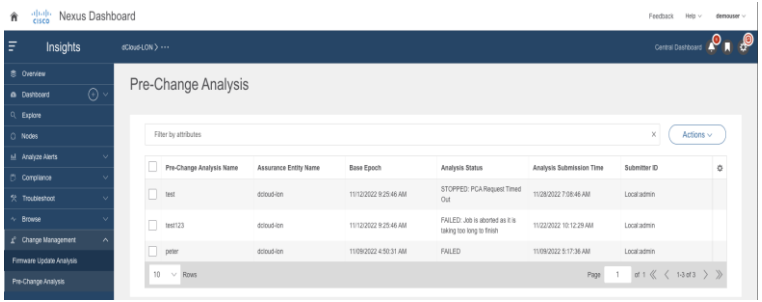
Terraform

- Open-source infrastructure as code software tool designed for safe and predictable infrastructure creation and change
- Extensive library of modules that leverages existing ACI API's
- Maintains state data for the infrastructure and configuration and refreshes this state prior to an operation

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

Nexus Dashboard - Insights





- Nexus Dashboard Insights provides the ability to monitor, maintain, troubleshoot, and manage multiple data center fabrics.
- Nexus Dashboard Insights includes pre-change analysis to validate changes to a fabric prior to deployment.
- The Nexus Dashboard API's provide the ability to utilize the pre-change analysis function to validate changes via a pipeline prior to automated changes.

Auto-Provision Compute and Storage with Intersight

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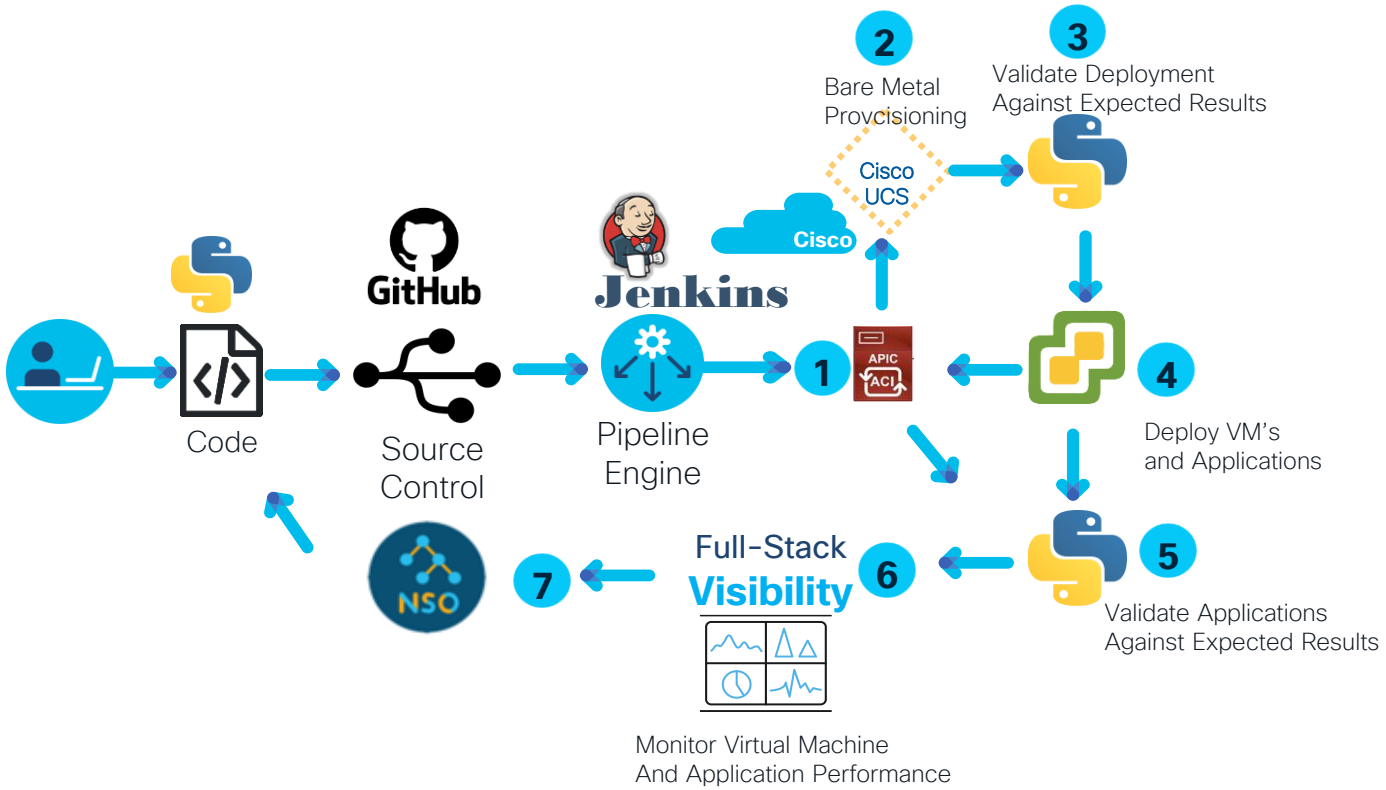
Automated Deployment and Compliance Pipeline



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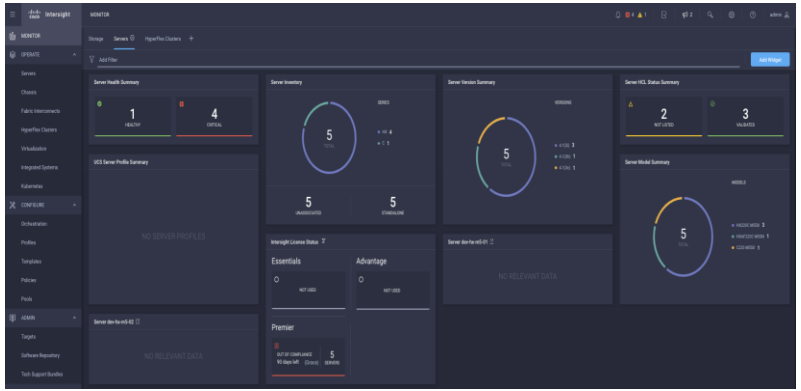
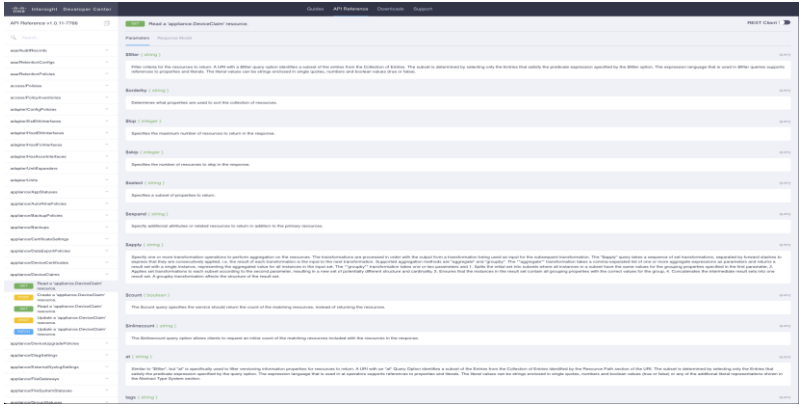
   - Secure Network Analytics

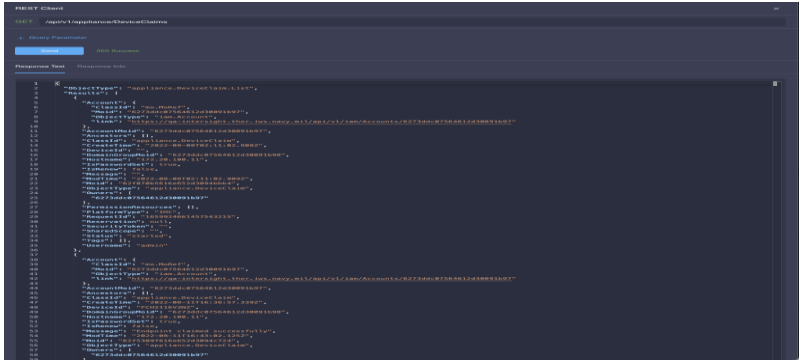
Intersight Role in the Pipeline



- Intersight is a management and automation tool
  - Provides visibility into physical and virtual workloads
  - Facilitates workload automation
  - Consolidates firmware management and inventory in a single location.
  - Bulk OS deployment for bare-metal provisioning.
  - Robust workflow engine to orchestrate tasks across platforms via http API endpoints, ansible executor, etc.

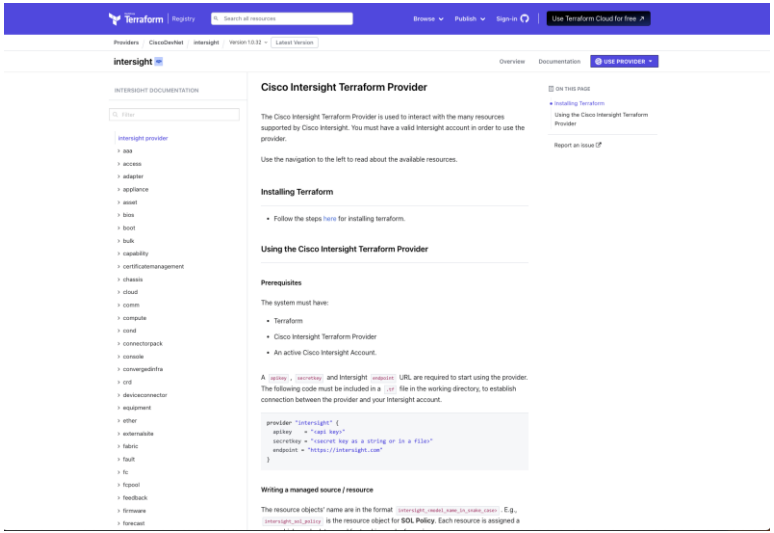
Intersight API’s





- Intersight exposes all functions available in the GUI via API’s.
- Intersight API’s can be executed directly from the api explorer.
- The Intersight API’s can be leveraged for CI/CD pipelines for deployment, verification, and continuous compliance.

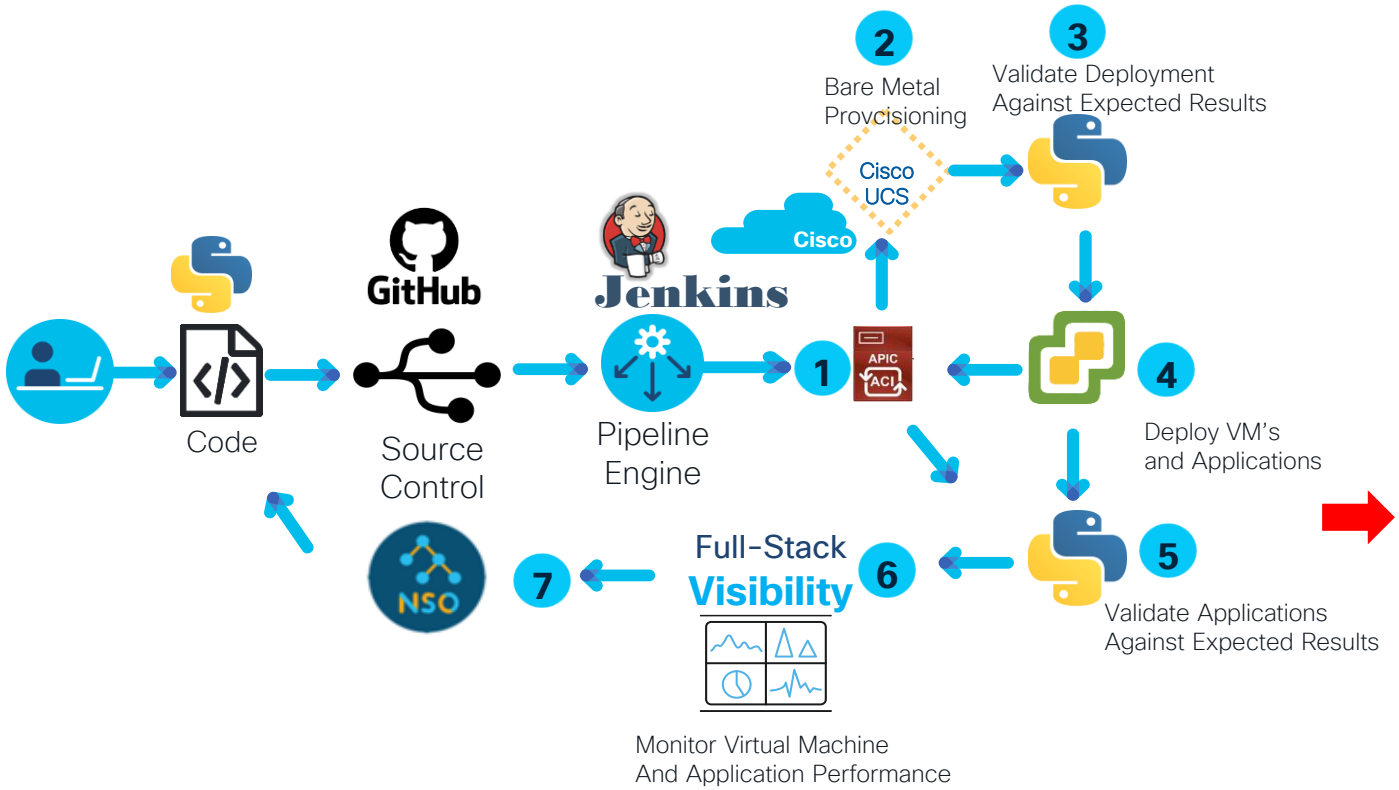
Intersight and Terraform



- Terraform is an infrastructure as code tool that simplifies provisioning of resources with minimal code expertise.
- Terraform utilizes the API's available from various resources through the use of providers.
- The Intersight Terraform provider leverages the API's provided by Intersight to automate infrastructure tasks with low code overhead.

Continued Visibility and Compliance

Automated Deployment and Compliance Pipeline



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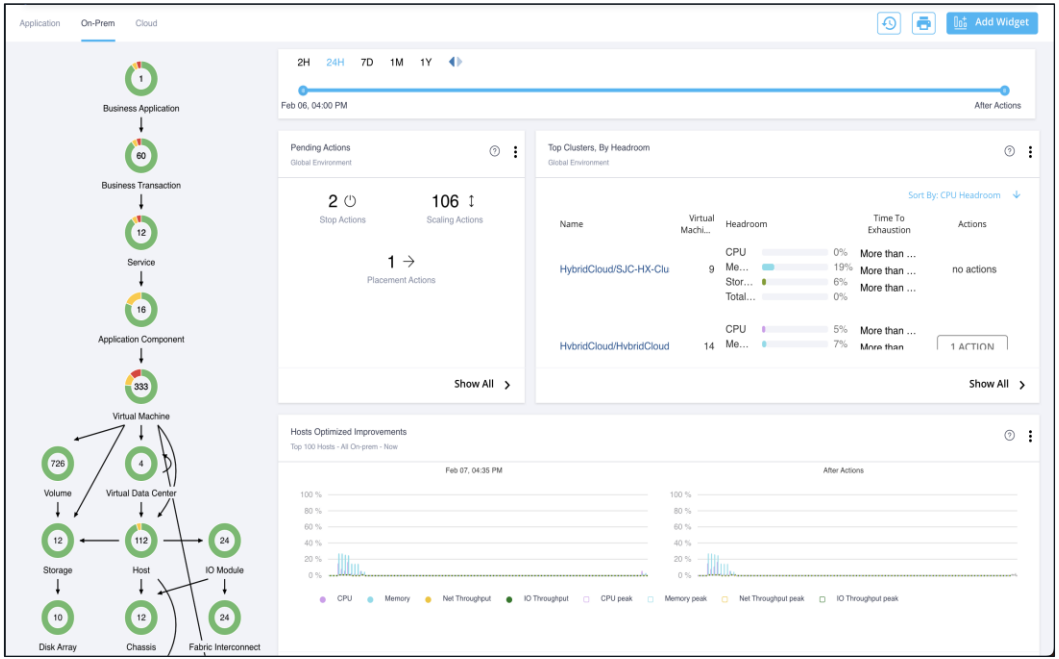
Continued Visibility and Compliance

NSO, AppDynamics, Secure Network Analytics

IWO+AppD	Dynamic application performance baselines based on machine learning and artificial intelligence
Secure Network Analytics	Continuous monitoring of devices, applications, and users throughout infrastructure
NSO	Model-based programmatic interface that allows for control from simple device turn-up and configuration management to sophisticated full lifecycle service management across 170+ vendor devices..

Intersight Workload Optimizer (IWO)

Give Workload Resources When and Where Needed



- Continuously analyze workload consumption, costs and compliance constraints in real time
- Automatically re-allocate compute and storage resources in real-time based on demand or consumption
- Integrates with AppDynamics to provide a common view of Applications in both business and infrastructure perspective

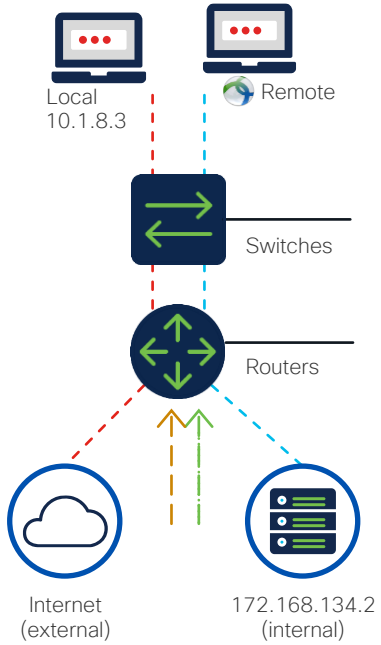
<u>Sample Use Cases:</u>

- Tie components of an application to a specific Data Center Rack
- Auto-scale resources
- Roll-back poor performing application upgrade

Secure Network Analytics (SNA):

The network as the source of truth

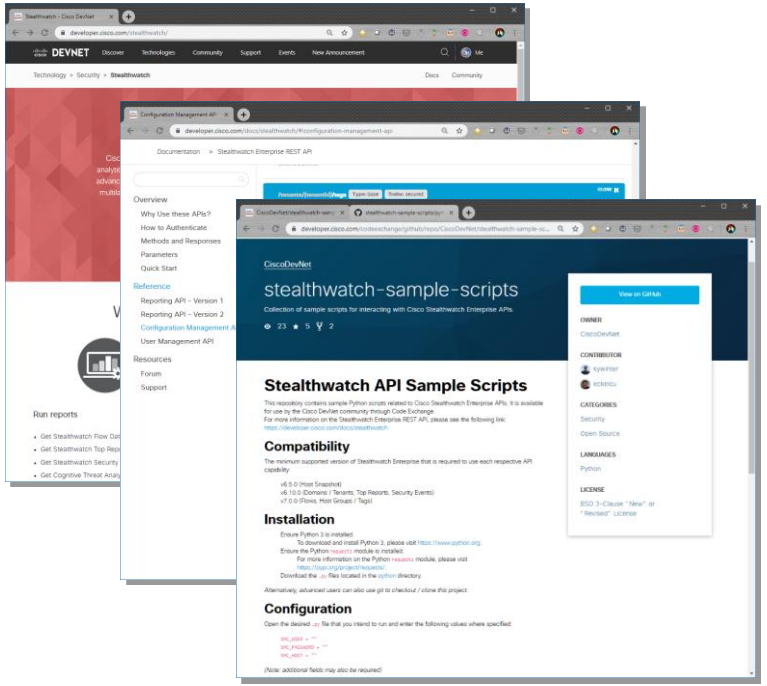
- A Trace of every conversation
- Agentless information collection
- Remote worker endpoint data collection
- Cloud Telemetry ingest
- East-west and north-south visibility
- Light meta data collection using the existing infrastructure
- Capture enhanced NetFlow for encrypted traffic analysis from Cisco ASR, ISR and Catalyst 9000 platforms



Flow information	Packets
Source address	10.1.8.3
Destination address	172.168.134.2
Source port	47321
Destination port	443
Interface	Gi0/0/1
IP TOS	0x00
IP protocol	6
Next hop	172.168.25.1
TCP flags	0x1A
Source SGT	100
:	:
ETA meta data	IDP | SPLT
Application name	NBAR SECURE-HTTP
Process Name	chrome.exe
Process Account User	Acme/john

Automate with Secure Network Analytics APIs

- Secure Network Analytics has REST API capabilities available to get, add, modify, and delete host groups.
- These APIs provide an easy programmatic mechanism to maintain host group configurations.
- Sample scripts are provided via DevNet to enable customers to use these API capabilities with success.



Run reports

- Get Secure Network Analytics Flow Data
- Get Secure Network Analytics Top Reports
- Get Secure Network Analytics Security Events

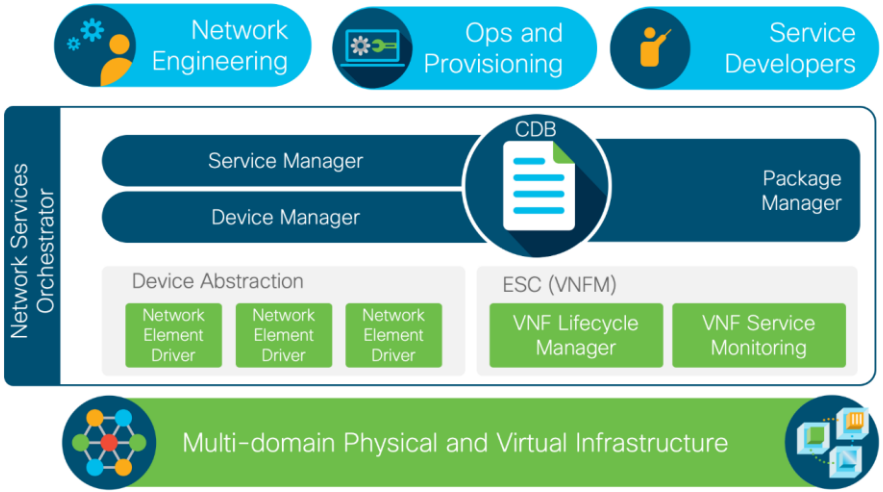
Manage configurations

- Get & Modify Host Groups / Tags
- Get & Modify Core / Relationship Policy
- Get & Modify Custom Security Events

Manage users

- Get & Modify User Information
- Get & Modify User Roles
- Modify Users Passwords

Cisco Network Services Orchestrator (NSO)

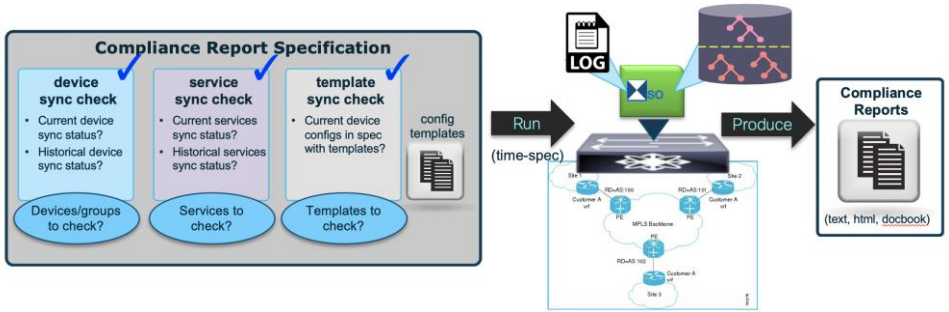


- Seamless integration with northbound tooling
- Single datastore for all network elements under management
- Applies YANG as service-layer abstraction to model intent
- NED: Abstracts underlying protocol and data-models
  - Normalize Device Configurations
  - 170+ vendors supported

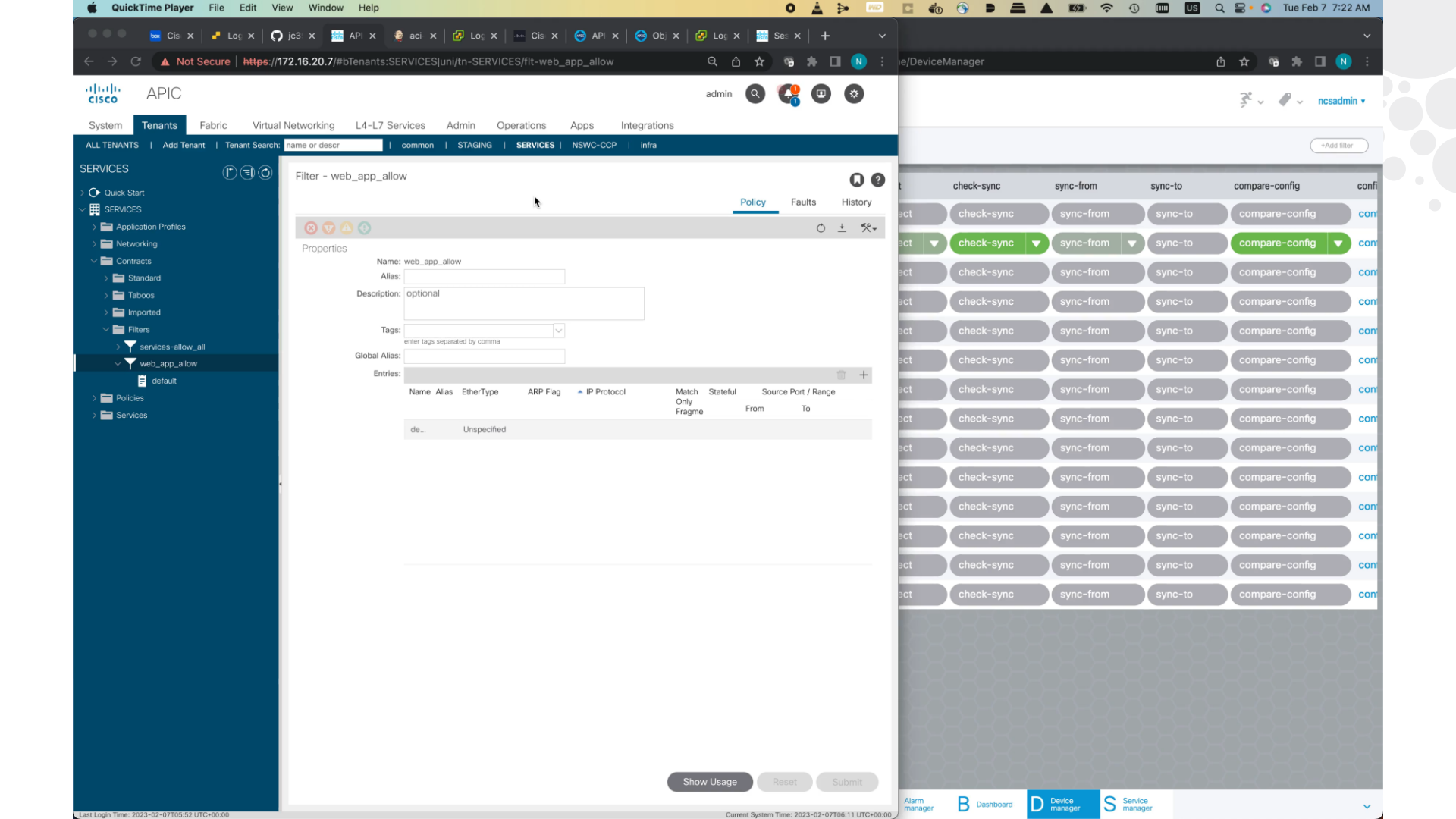
Cisco Network Services Orchestrator (NSO):

Model-driven, Stateful compliance

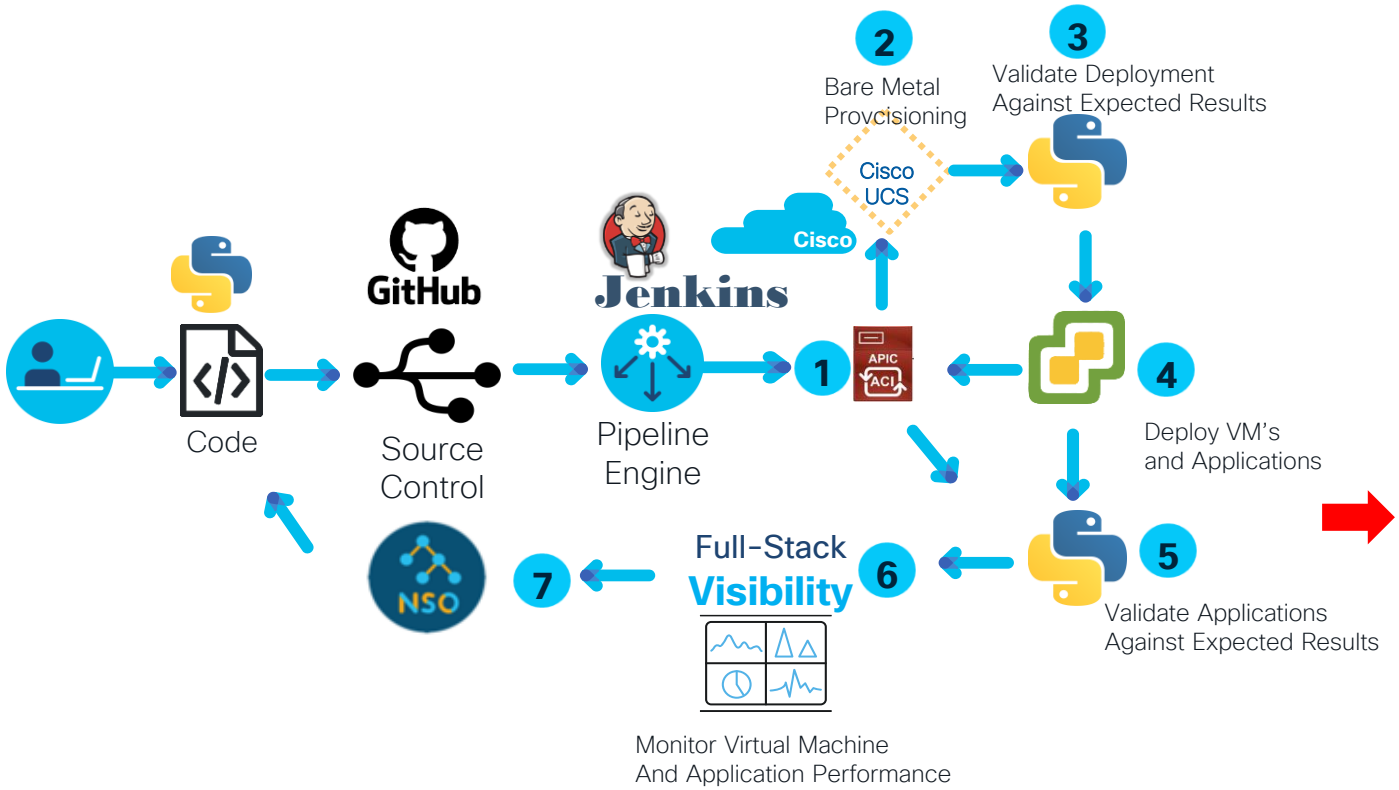
- Create device configuration "golden template"
  - Template can be the same as “applied” to device, “re-applied” to device, or can be “updated” from device
- NSO generates identifies delta between golden template and current device config and saves in plain text, XML or HTML
  - this represents “what would need to be applied to match the template”
- Process can be fed into automated validation pipeline



Demo
Management and Visibility


QuickTime Player File Edit View Window Help
Tue Feb 7 7:22 AM
Not Secure https://172.16.20.7/#bTenants:SERVICES|uni/tn-SERVICES/flt-web_app_allow
APIC
admin
System Tenants Fabric Virtual Networking L4-L7 Services Admin Operations Apps Integrations
ALL TENANTS | Add Tenant | Tenant Search: name or descr | common | STAGING | SERVICES | NSWC-CCP | infra
SERVICES
Quick Start
SERVICES
Application Profiles
Networking
Contracts
Standard
Taboos
Imported
Filters
services-allow_all
web_app_allow
default
Policies
Services
Filter - web_app_allow
Policy Faults History
Properties
Name: web_app_allow
Alias:
Description: optional
Tags:
enter tags separated by comma
Global Alias:
Entries:
Name Alias EtherType ARP Flag IP Protocol Match Only Fragme Stateful Source Port / Range From To
de... Unspecified
Show Usage Reset Submit
Last Login Time: 2023-02-07T05:52 UTC+00:00
Current System Time: 2023-02-07T06:11 UTC+00:00
ncsadmin
check-sync sync-from sync-to compare-config
Alarm manager Dashboard Device manager Service manager

Automated Deployment and Compliance Pipeline



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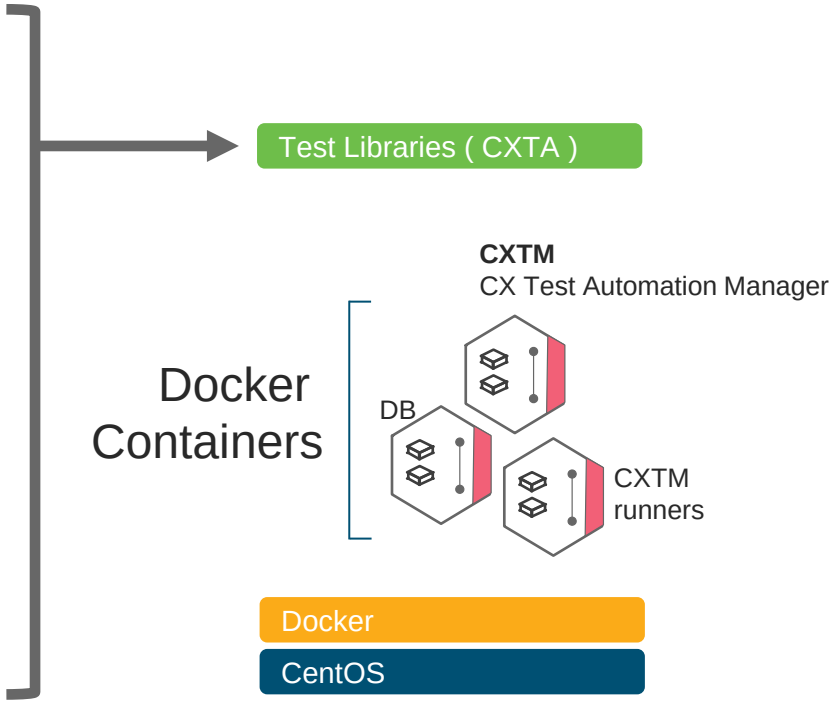
Cisco Continuous Automation & Integration Testing (CAIT) Solution Validation Services

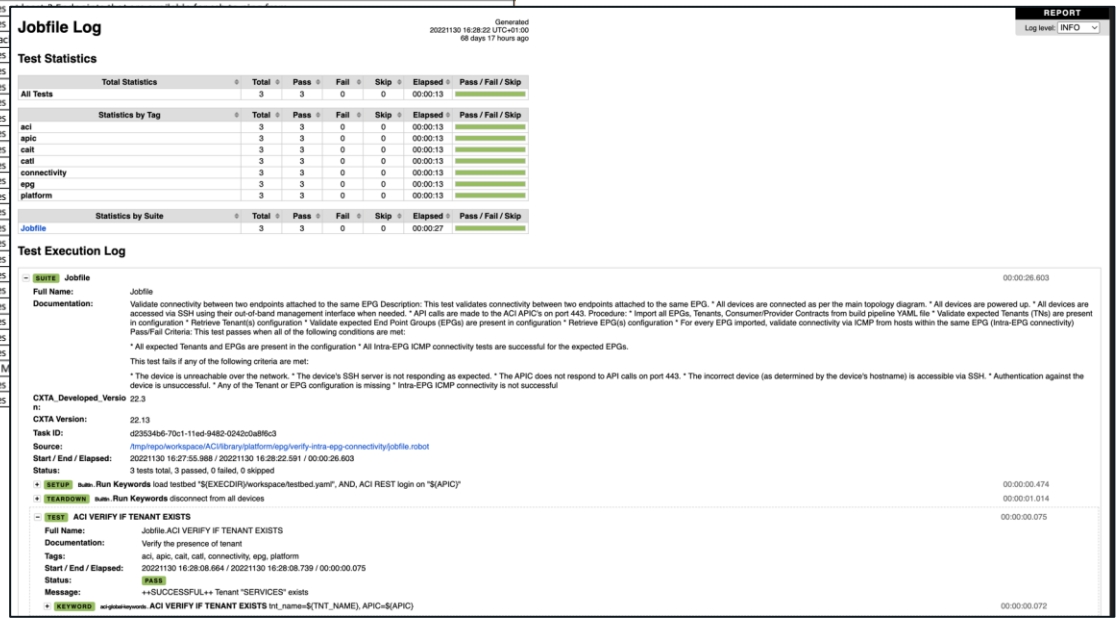
- Over 1,000 keywords developed by our test consulting engineers that accelerate creation of test case logic
- Utilizes the open-source Robot Framework to build test case logic using easy to understand English sentences
- Capable of controlling packet generation from many vendors including Spirent and IXIA
- Support for all of Cisco devices and third-party network devices via CLI and ReST interfaces



CAIT Solution Validation Service

Over 100 ACI Standard Tests

Test Case Number	Description	Requirement
3.0.0.0	ACI - Validate ACI Default Gateway Functionality	Requires at least 2 Endpoints that are available for ssh to ping from
3.0.1.0	ACI - Validate ACI Fabric as L2 GW MP	Requires at least 1 Endpoint that are available for ssh to ping from
3.0.2.0	ACI - Validate ACI L2 Gateway	Requires at least 1 Endpoint that are available for ssh to ping from
3.0.3.0	ACI - Validate ACI L3 Gateway	Requires at least 2 Endpoints that are available for ssh to ping from with l3 out
3.1.4.1	ACI - Validate Import/Export Remote Location	Requires External Backup Location to be configured
3.1.5.0	ACI - Validate Intra EPG Connectivity	Requires
3.1.7.1	ACI - Validate NXOS IPN Link Failure Behavior	Requires
3.1.11.0	ACI - Validate Uplink Port Tracking	Port Trac
3.1.12.0	ACI - Validate Switch Profile Interface Profile Association Spine	Requires
3.1.13.1	ACI - Validate IPN Multicast	Requires
3.1.16.0	ACI - Validate Switch and APIC Software Version	Requires
3.2.1.0	ACI - Validate BFD Sessions on Border Leaf Switches	Requires
3.2.3.0	ACI - Validate External Routes Learned on Border Leafs	Requires
3.2.4.0	ACI - Validate L3Out EIGRP Configuration and Adjacency	Requires
3.2.5.0	ACI - ACI Fabric as L3 GW MP	Requires
3.2.6.0	ACI - Validate L3 Domain Configuration	Requires
3.2.7.0	ACI - Validate OSPF Functionality Between IPN and ACI Switch	Requires
3.2.8.0	ACI - Validate VRF Configuration	Requires
3.3.0.0	ACI - Validate AAA Authentication Policies Configuration	Requires
3.3.2.0	ACI - Validate Authentication Fallback	Requires
3.3.2.1	ACI - Validate TACACS Authentication	Requires
3.3.2.2	ACI - Validate TACACS Local Authentication	Requires
3.4.0.0	ACI - Validate CDP Configuration and Functionality	Requires
3.4.1.0	ACI - Validate IPN Device's DHCP Relay Configuration	Requires
3.4.3.0	ACI - Validate Global Miscabling Protocol Configuration	Requires
3.4.5.0	ACI - Validate Port-Channel Interface Policy Configuration	Requires
3.4.6.0	ACI - Validate ACI SNMP Configuration	Requires
3.4.7.0	ACI - Validate APIC Console Reachability	Requires
3.4.7.2	ACI - Validate APIC Inband SSH Reachability	Inband M
3.4.8.0	ACI - Validate APIC Syslog Configuration	Requires
3.4.9.0	ACI - Validate Global DNS Configuration	Requires



Jobfile Log

Generated
20221130 16:28:22 UTC+01:00
68 days 17 hours ago

REPORT
Log level: INFO

Test Statistics

Total Statistics	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
All Tests	3	3	0	0	00:00:13	

Statistics by Tag	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
aci	3	3	0	0	00:00:13	
apic	3	3	0	0	00:00:13	
call	3	3	0	0	00:00:13	
catl	3	3	0	0	00:00:13	
connectivity	3	3	0	0	00:00:13	
epg	3	3	0	0	00:00:13	
platform	3	3	0	0	00:00:13	

Statistics by Suite	Total	Pass	Fail	Skip	Elapsed	Pass / Fail / Skip
Jobfile	3	3	0	0	00:00:27	

Test Execution Log

SUITE Jobfile 00:00:26.603

Full Name: Jobfile

Documentation: Validate connectivity between two endpoints attached to the same EPG Description: This test validates connectivity between two endpoints attached to the same EPG. * All devices are connected as per the main topology diagram. * All devices are powered up. * All devices are accessed via SSH using their out-of-band management interface when needed. * API calls are made to the ACI APIC's on port 443. Procedure: * Import all EPGs, Tenants, Consumer/Provider Contracts from build pipeline YAML file * Validate expected Tenants (TNs) are present in configuration * Retrieve Tenant(s) configuration * Validate expected End Point Groups (EPGs) are present in configuration * Retrieve EPG(s) configuration * For every EPG imported, validate connectivity via ICMP from hosts within the same EPG (Intra-EPG connectivity) Pass/Fail Criteria: This test passes when all of the following conditions are met:

* All expected Tenants and EPGs are present in the configuration * All Intra-EPG ICMP connectivity tests are successful for the expected EPGs.

This test fails if any of the following criteria are met:

* The device is unreachable over the network. * The device's SSH server is not responding as expected. * The APIC does not respond to API calls on port 443. * The incorrect device (as determined by the device's hostname) is accessible via SSH. * Authentication against the device is unsuccessful. * Any of the Tenant or EPG configuration is missing * Intra-EPG ICMP connectivity is not successful

CXTA_Developed_Version: 22.3

CXTA Version: 22.13

Task ID: d23534b6-70c1-11ed-9482-0242c0a8f6c3

Source: /tmp/repo/workspace/ACI/library/platform/epg/verify-intra-epg-connectivity/jobfile.robot

Start / End / Elapsed: 20221130 16:27:55.988 / 20221130 16:28:22.591 / 00:00:26.603

Status: 3 tests total, 3 passed, 0 failed, 0 skipped

SETUP Suite. Run Keywords load testbed "${EXECDIR}/workspace/testbed.yaml", AND, ACI REST login on "${APIC}" 00:00:00.474

TEARDOWN Suite. Run Keywords disconnect from all devices 00:00:01.014

TEST ACI VERIFY IF TENANT EXISTS 00:00:00.075

Full Name: Jobfile.ACI VERIFY IF TENANT EXISTS

Documentation: Verify the presence of tenant

Tags: aci, apic, call, catl, connectivity, epg, platform

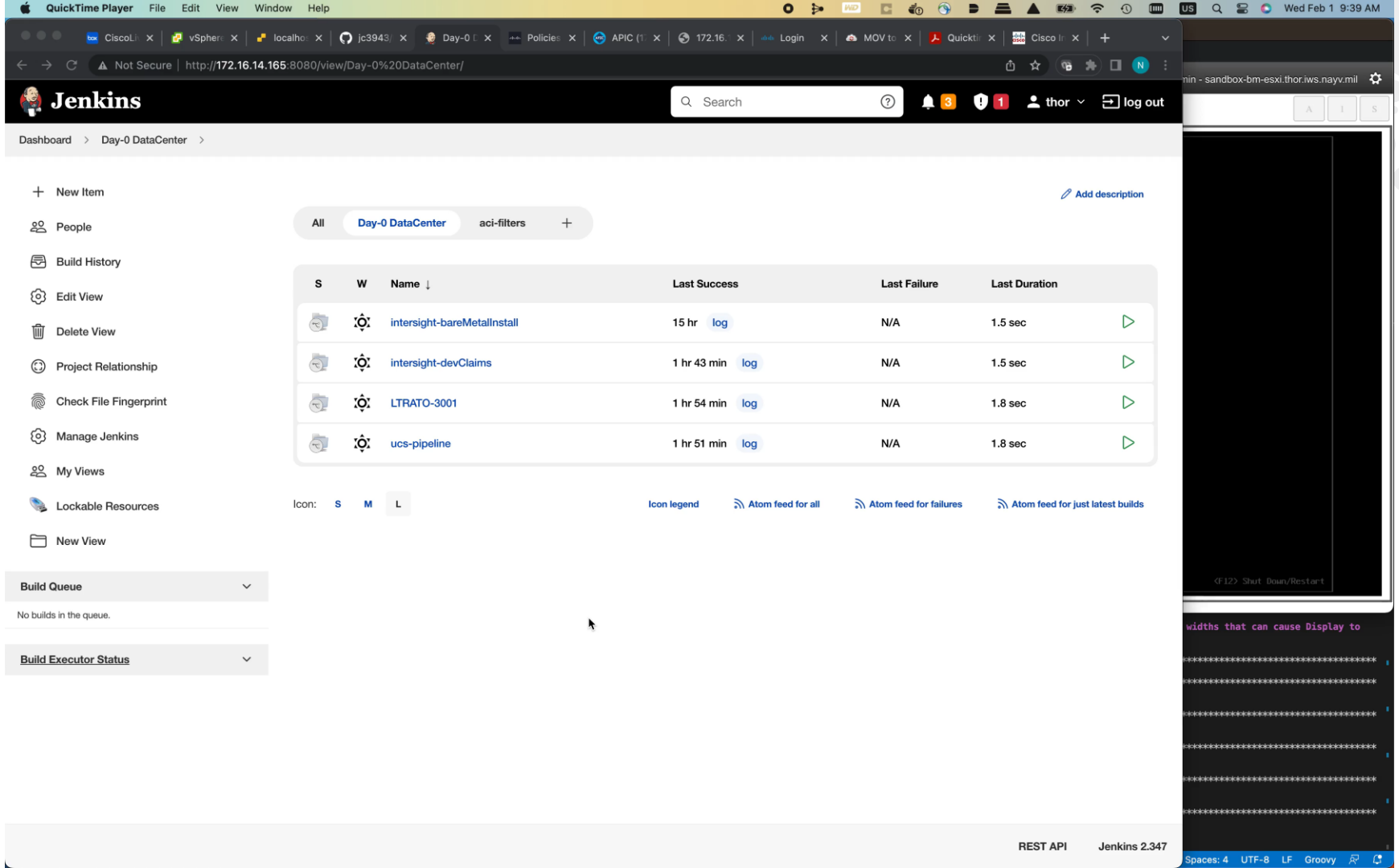
Start / End / Elapsed: 20221130 16:28:08.664 / 20221130 16:28:08.739 / 00:00:00.075

Status: PASS

Message: ++SUCCESSFUL++ Tenant "SERVICES" exists

KEYWORD acl-global-keywords. ACI VERIFY IF TENANT EXISTS tnt_name=${TNT_NAME}, APIC=${APIC} 00:00:00.072

Demo – Putting it all together


QuickTime Player File Edit View Window Help
Wed Feb 1 9:39 AM
Not Secure http://172.16.14.165:8080/view/Day-0%20DataCenter/
Jenkins
Search
thor
log out
Dashboard
Day-0 DataCenter
New Item
People
Build History
Edit View
Delete View
Project Relationship
Check File Fingerprint
Manage Jenkins
My Views
Lockable Resources
New View
Add description
All
Day-0 DataCenter
aci-filters
S
W
Name
Last Success
Last Failure
Last Duration
intersight-bareMetalInstall
15 hr log
N/A
1.5 sec
intersight-devClaims
1 hr 43 min log
N/A
1.5 sec
LTRATO-3001
1 hr 54 min log
N/A
1.8 sec
ucs-pipeline
1 hr 51 min log
N/A
1.8 sec
Icon: S M L
Icon legend
Atom feed for all
Atom feed for failures
Atom feed for just latest builds
Build Queue
No builds in the queue.
Build Executor Status
REST API
Jenkins 2.347


Questions?

Learn More:

- Videos
  - DevNet Create 2021 – Secure Data Center at the push of a button
    https://youtu.be/InCftyYTmZg
  - DevNet Create 2021 – AppDynamics, it's not just for software anymore
    Demo of AppDynamics as a Fiber Checking Tool
    https://www.youtube.com/watch?v=193Ox7vy57k&t=334s
- Meet the Speaker
  - Meet the Speaker BRKCLD-2731 –MTS-1055
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