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The bridge to possible

Prism of Possibilities with Cisco DevNet's Network Programmability & Automation

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BRKDEV-2883

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Agenda

- Introduction
- Cisco SD-WAN MSP
- Manage Cisco ACI using Smartsheet
- CI/CD pipelines in network automation
- Conclusion

Introduction



Objectives

- Why network programmability?
- Quick overview of Cisco SD-WAN, Cisco ACI, Smartsheet, GitLab
- Showcase the power of network programmability and automation:
 - Cisco SD-WAN Managed Service Provider Dashboard
 - Cisco ACI management with Smartsheet
 - CI/CD pipelines for infrastructure automation with GitLab

Why network programmability?



Automation



Integration



Innovation

Programmability Benefits

- Innovation and business agility
- Accelerated time to market
- Service delivery optimization
- Highly skilled architects and engineers focus on business
- Cost reduction and increased efficiencies
- Improved network availability due to reduced human error

Cisco SD-WAN MSP project



What is SD-WAN?

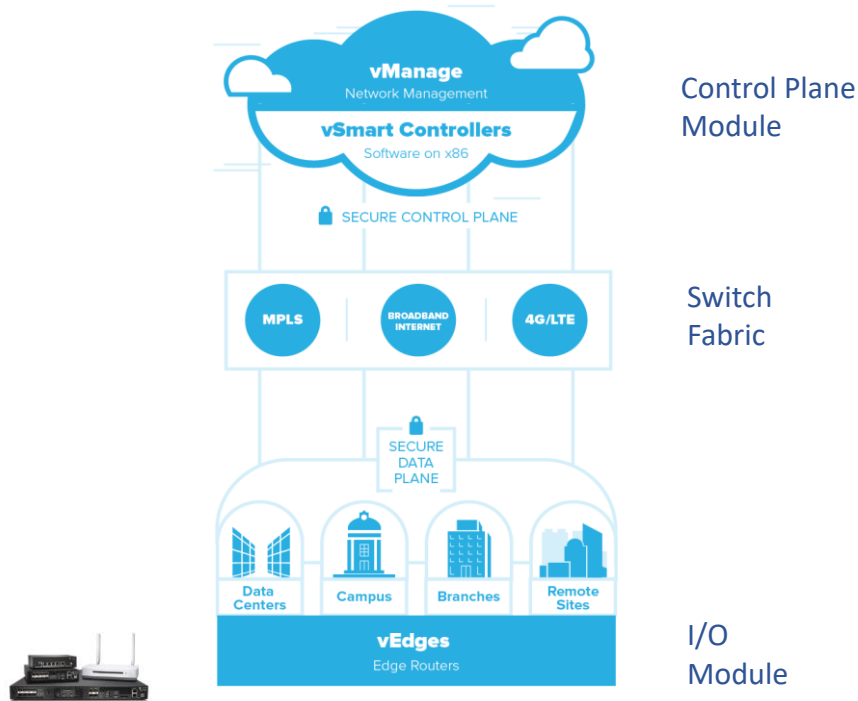
Switch Fabric

Control Plane
Module

I/O Module

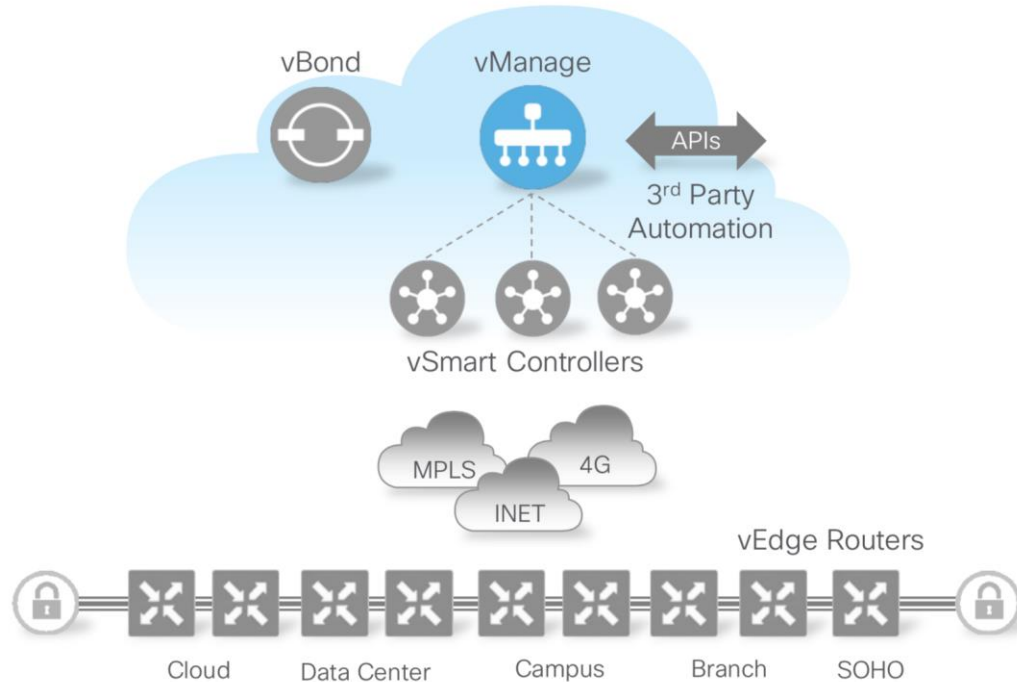


SD-WAN Architecture



Cisco SD-WAN Architecture Overview

Management Plane - vManage



vManage

- Single pane of glass for Day0, Day1 and Day2 operations
- Centralized provisioning, monitoring and troubleshooting
- Multitenant or single tenant
- Policies and Templates
- RBAC
- Programmatic REST API

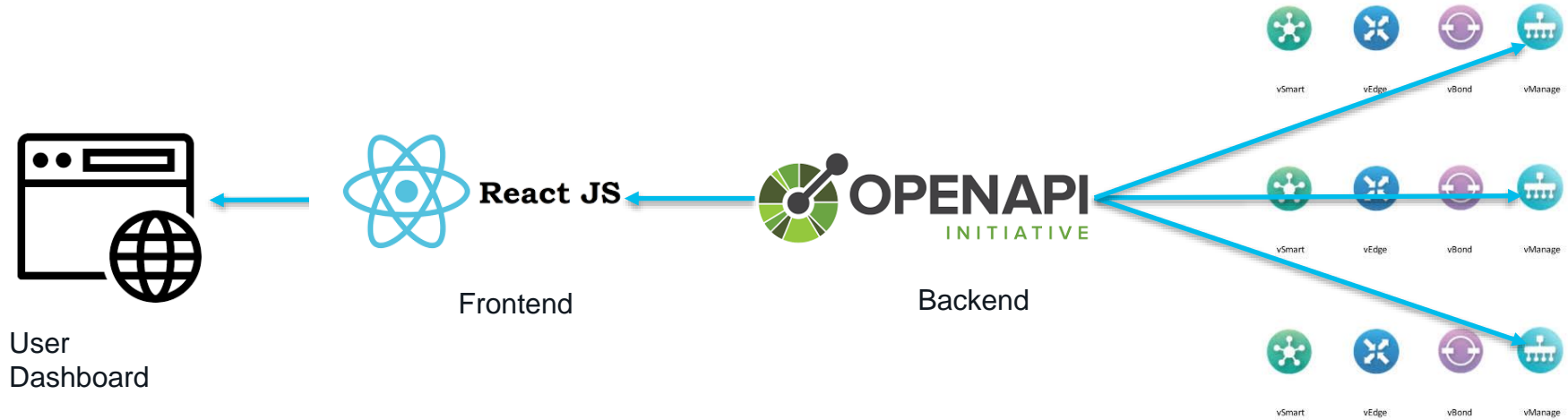
Challenge

- Managed Service Provider environments with multiple SD-WAN vManage instances
- Difficult and cumbersome to configure and monitor multiple vManage servers
- One single pane of glass web interface needed
- Cost constrains

Solution

- Take advantage of the vManage extensive REST API interface
- Develop a web application with Python backend and ReactJS frontend
- Consolidate operational status from multiple vManage servers into one interface

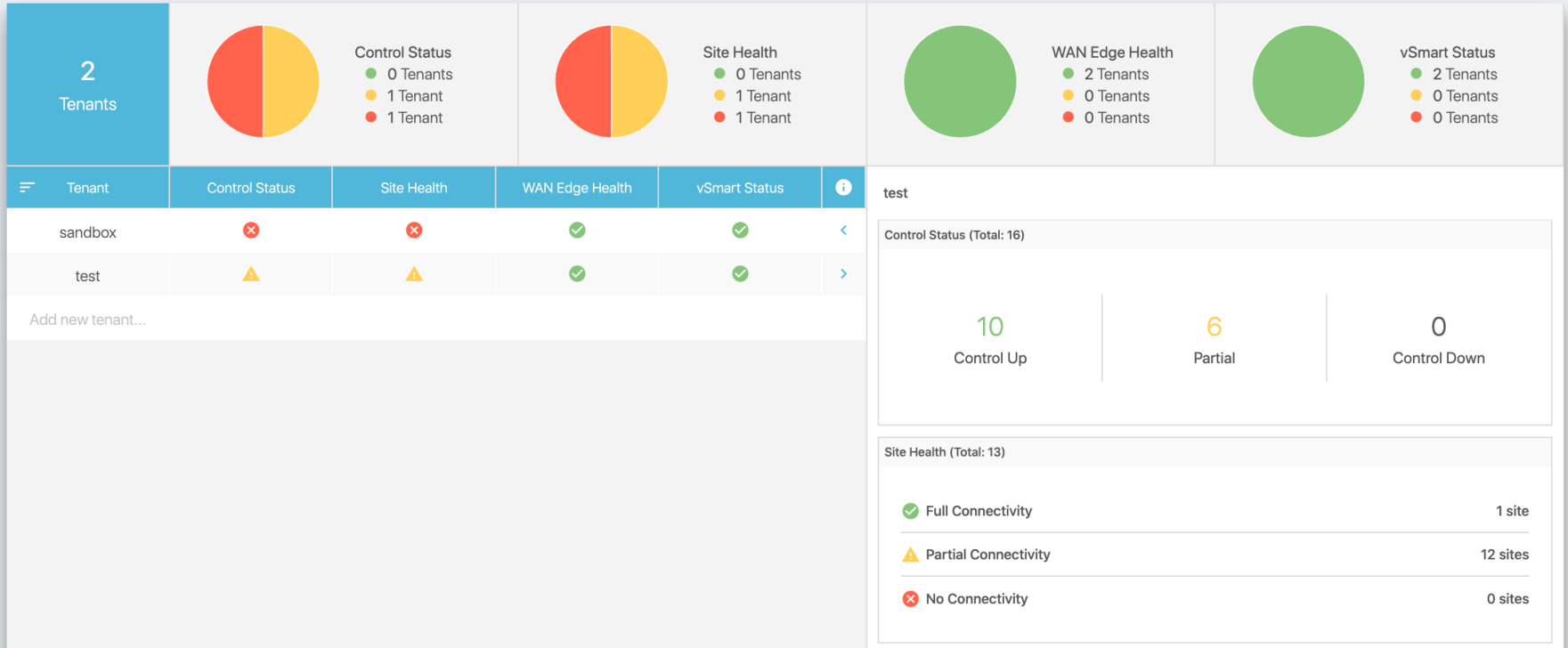
SD-WAN MSP dashboard




SD-WAN MSP frontend

SD-WAN MSP DASHBOARD

✓ Normal ⚠ Warning ✗ Error ⚙



SD-WAN MSP backend

 **swagger**

Authorize Explore

MSP Single Tenant SD-WAN REST API

This is an SD-WAN Single Tenant Service

Find out more about Swagger

<http://swagger.io>

[Contact the developer](#)

[Apache 2.0](#)

operation : Everything about operations

Show/Hide | List Operations | Expand Operations

POST /operation/create_tenant

Create a new tenant

info : Useful Info

Show/Hide | List Operations | Expand Operations

GET /info/control_status

Retrieve the control plane status

GET /info/site_health

Retrieve the site health status

GET /info/tenants

Retrieve a list of tenants

GET /info/vedges_status

Retrieve a list of vEdge devices status

GET /info/vsmarts_status

Retrieve a list of vSmart devices status

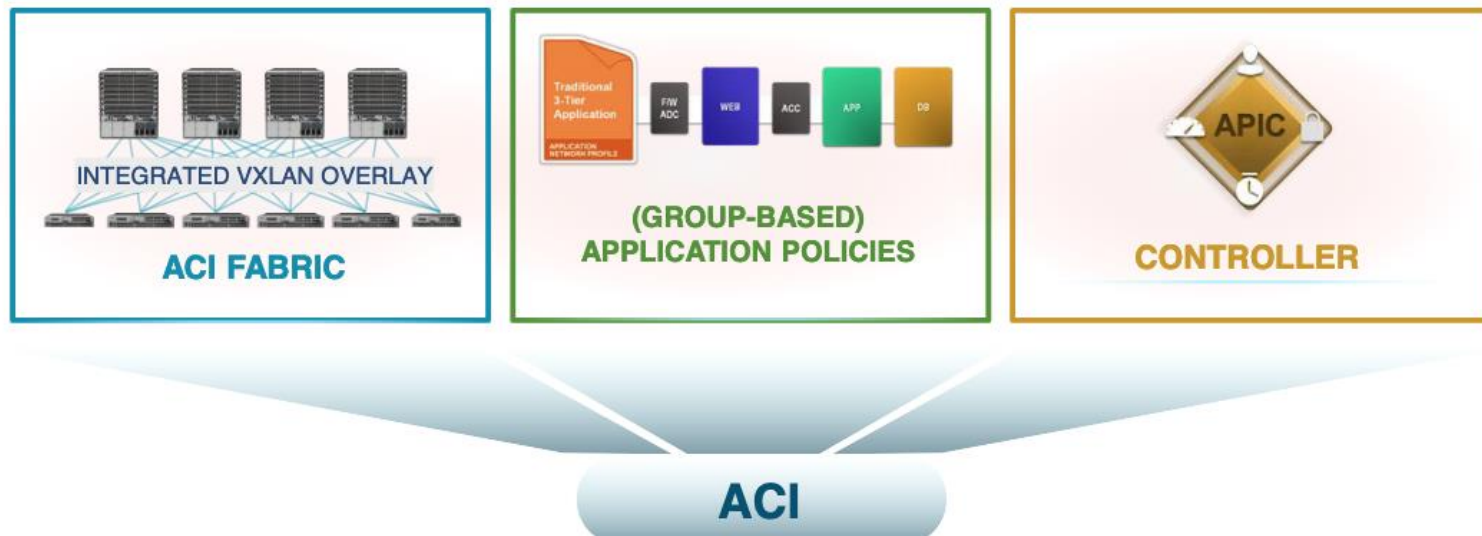
[BASE URL: /v1 , API VERSION: 1.0.0]

Managing Cisco ACI using Smartsheets

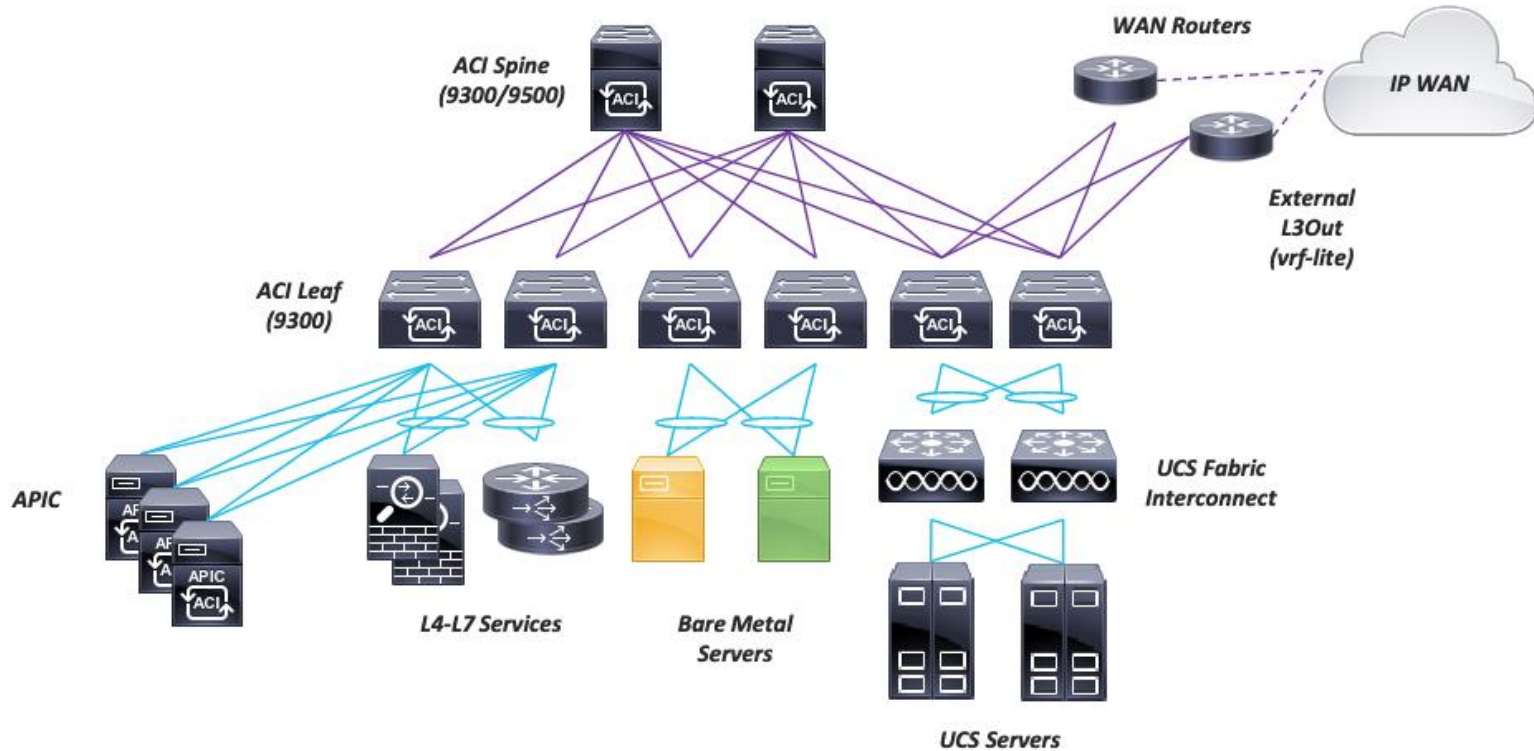


What is Application Centric Infrastructure (ACI)?

Declarative Intent-based Automation
Logical Network Provisioning of Stateless Hardware
Rapid Deployment of Applications onto Networks with Scale, Security and Full Visibility

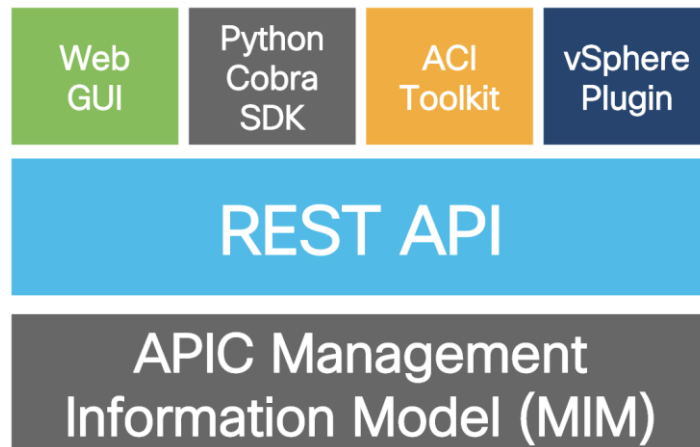


ACI Fabric Physical Overview



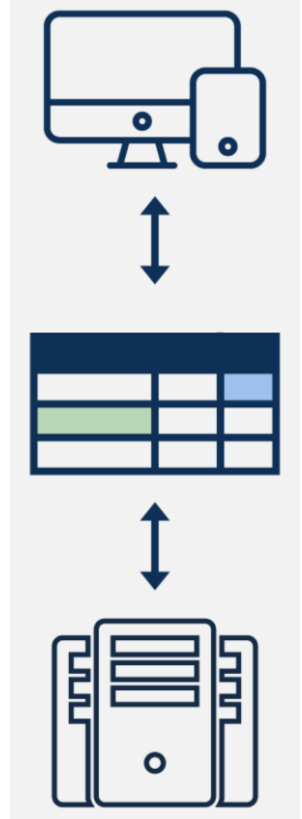
ACI Object Model + REST API

- ACI designed as “API First”
- Everything built on top of the REST API
 - APIC GUI
 - Cobra SDK
 - PyACI
 - acitoolkit
 - Plugins
 - ACI Kubernetes Integration



Smartsheet API

- Import/export data to other systems
- Automate processing
 - Without user interaction
 - On regular schedule/webhook
- Enforce standardization or compliance
- Read and update sheets
- Administer users and accounts
- Custom integrations



Getting started with Smartsheet API

- Smartsheet paid account
- Generate API token
- Get Postman
- Get Smartsheet collection
- Make your first API call

Personal Settings

Profile
Settings
Notifications
My Mobile Devices
Apps
API Access

Manage API Access Tokens

Generate new access token

Name	Value	Created	
aci	J89v...	07/20/21	revoke

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Close

Smartsheet SDKs

Languages

- Java
- C#
- *Python*
- Node.js
- Ruby

Benefits

- Native language object models
- Logging
- Error retry
- Sample code
- Full reference documentation

Challenge

- APIC GUI can be overwhelming for novice data center administrators
- Provide access to a limited subset of configuration options – rudimentary RBAC
- Simplify ACI fabric management
- Cost constrains

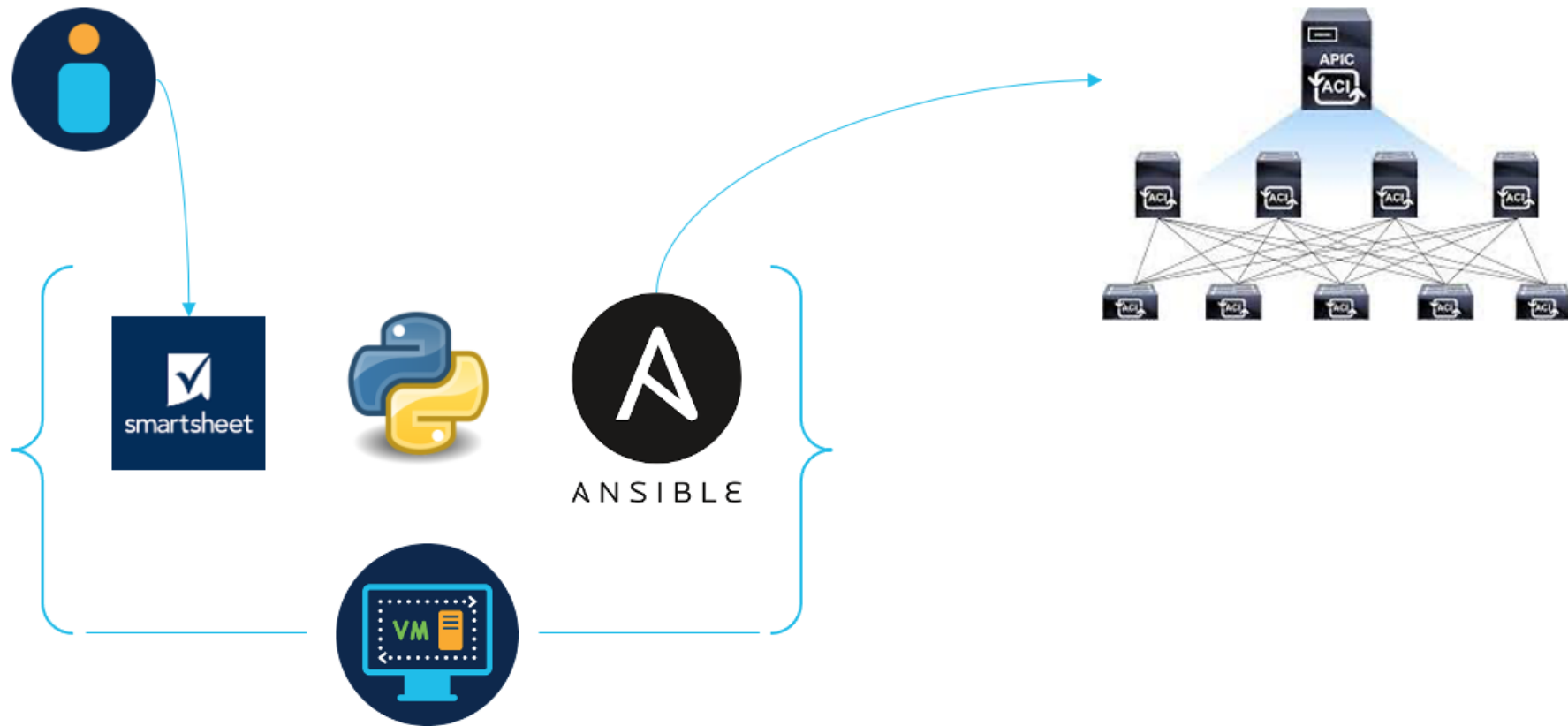
Solution

- Use Smartsheet to build a custom JavaScript frontend
- Develop a Python backend application that receives Smartsheet webhook notifications and triggers Ansible playbooks to perform ACI fabric configuration changes
- Simplified workflow for ACI configuration changes
- Parallelism of configuration changes
- Idempotency
- Alternative front-end for Cisco ACI REST API

Architecture / Framework

ACI Day 2 configuration with smartsheets

A Cisco DevNet Automation Exchange use case





ACI Provisioning Start Point

Site *

- ☐ APIC 1
- ☐ APIC 2

Use Case *

- ☐ Deploy an App
- ☐ Create Static Path Binding
- ☐ Configure Filters
- ☐ Configure Contracts
- ☐ Associate EPGs to Contracts
- ☐ Configure Policy Groups
- ☐ Configure Switch & Interface Profiles
- ☐ Associate Int to Policy Groups

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CI/CD pipelines in network automation



CI/CD pipelines

Continuous Integration - Software

- Practice of integrating code that developers are producing
- Code is developed in separate branches
 - Multiple developers
 - Multiple features
- When code is merged into a branch
 - Testing validates changes
 - Flush out potential bugs
 - Ensure quality and no integration issues

CI/CD pipelines

Continuous Delivery - Software

- Releases can be created and delivered at any time
- Changes have met integration requirements?
 - Push to a “stage” environment
 - Run additional tests and checks
- All tasks are automated

CI/CD pipelines

Continuous Deployment – Software

- Takes delivery a step further
- Deploys changes to a production environment
 - Many different deployment strategies available
 - Blue/Green, Canary, Rolling

GitLab

Overview

- Complete DevOps platform
- Project management
- Hosted Git repositories
- Built-in CI/CD

Stages of the DevOps lifecycle

Manage Plan Create Verify Package Secure Release Configure Monitor Defend

GitLab

Pipelines

- Fundamental building blocks for CI/CD

The screenshot shows the GitLab interface for the 'gitlab-runner' project. The left sidebar contains navigation links: Project overview, Repository, Issues (1,782), Merge Requests (236), Requirements, CI / CD (selected), Pipelines, Jobs, Schedules, Security & Compliance, Operations, Packages & Registries, Analytics, and Members. The main content area displays a list of pipelines. The top navigation bar includes the GitLab logo, 'Next' button, and search bar. The pipeline list has columns for Status, Pipeline ID, Triggerer, Commit, and Stages. The pipelines are sorted by 'All 1,000+'. The list shows various pipeline runs with their status (running, canceled, passed), pipeline ID, triggerer, commit hash, and stages. The 'Stages' column shows a sequence of icons representing the stages of the pipeline.

Status	Pipeline	Triggerer	Commit	Stages
running	#177869707	latest	!2346 -> 8effc580 Merge branch 'k8sexectorclust...	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
running	#177869404	latest	!2346 -> d3b5331f Merge branch 'k8sexectorclust...	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
running	#177860098	latest	!2325 -> cfa77e77 Merge branch 'patch-4' into 'm...	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
running	#177804493	latest	!master -> 3b94d486 Updated Windows steps	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
canceled	#177590399	latest	!2325 -> 2846f438 Merge branch 'patch-4' into 'm...	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
canceled	#177535883	latest	!2325 -> 2846f438 Merge branch 'patch-4' into 'm...	✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓
passed	#177412421	latest	!26632-gitla... -> 9a6505be Add helper binary	✓
passed	#177408271	latest	!26632-gitla... -> 825f9495 Add helper binary	✓

GitLab

Pipelines

- Composed of:
 - Jobs – What to do
 - Stages – When to run jobs
- A typical pipeline would contain four stages
 - Build (compile)
 - Test (unit-tests)
 - Staging (deploy-to-stage, integration-tests)
 - Production (deploy-to-prod)

GitLab

Runners

- Used to run the jobs and send results back to GitLab
- When a pipeline is triggered, a Runner will git clone the repo and then execute the instructions inside of `.gitlab-ci.yml`
- Implements a variety of executors
 - Jobs can run in different scenarios
 - SSH, Shell, Parallels, VirtualBox, Docker, Kubernetes, Custom

GitLab

.gitlab-ci.yml

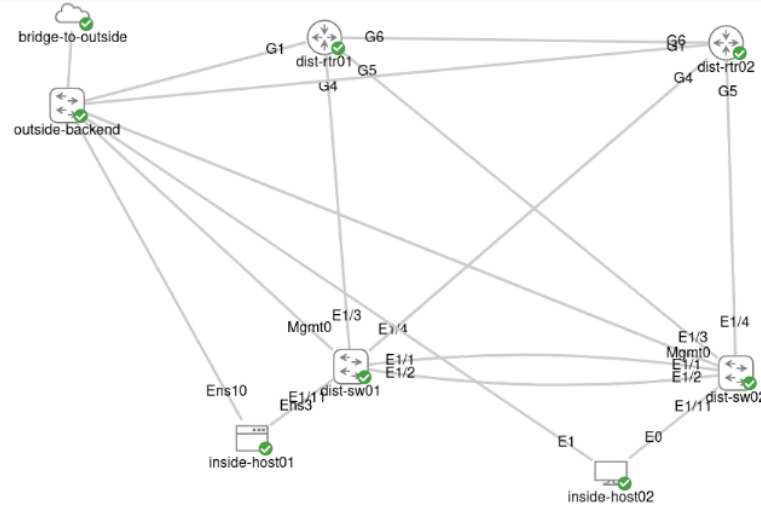
```
1 stages:
2   - build
3   - test
4   - deploy
5
6 image: alpine
7
8 compile_a:
9   stage: build
10  script:
11    - echo "This job builds something."
12
13 compile_b:
14   stage: build
15   script:
16     - echo "This job builds something else."
17
18 unit_test_a:
19   stage: test
20   script:
21     - echo "This job tests something. It will only run when all jobs in the"
22     - echo "build stage are complete."
23
24 unit_test_b:
25   stage: test
26   script:
27     - echo "This job tests something else. It will only run when all jobs in the"
28     - echo "build stage are complete too. It will start at about the same time as test_a."
29
30 deploy_a:
31   stage: deploy
32   script:
33     - echo "This job deploys something. It will only run when all jobs in the"
34     - echo "test stage complete."
35
36 deploy_b:
37   stage: deploy
38   script:
39     - echo "This job deploys something else. It will only run when all jobs in the"
40     - echo "test stage complete. It will start at about the same time as deploy_a."
```

Challenge

- Implement infrastructure as code
- Can we apply a continuous delivery approach to network changes?
- Continuous health and improvement approach to monitoring

Solution

- Use CI/CD pipelines for infrastructure automation
- Configuration changes are done through automation
- Validate changes prior to configuring the network
- If an issue is introduced in the network, those changes can be rolled back to a known good state
- Integration with change and ticketing system for true Continuous Deployment



+ ADD NODES

LAB INFO PERMISSIONS SIMULATE NODES DESIGN LOGS LAB NOTES

8 Nodes 16 Links 64 Interfaces

Lab Description

CPU 36.34%

MEMORY 18.95%

DISK 8.14%

Notifications 0

Status OK



C cisd

Project information

Repository

Issues 0

Merge requests 0

CI/CD

Pipelines

Jobs

Schedules

Deployments

Monitor

Packages & Registries

Analytics

Wiki

Snippets

Collapse sidebar

developer developer > cisd > Pipelines

All 20 Finished Branches Tags

Filter pipelines



Show Pipeline ID ▾

Status	Pipeline	Triggerer	Stages	
<div>passed</div> <div>00:02:43</div> <div>3 weeks ago</div>	Merge branch 'master' into 'main' #20 main 370d48c4 latest		<div>✓</div> <div>✓</div> <div>✓</div>	<div>⋮</div>
<div>passed</div> <div>00:02:41</div> <div>3 weeks ago</div>	demo-new-loopback-102 #19 master b1a3337f		<div>✓</div> <div>✓</div> <div>✓</div>	<div>⋮</div>
<div>passed</div> <div>00:01:54</div> <div>3 weeks ago</div>	Merge branch 'master' into 'main' #18 main 6b02af81		<div>✓</div> <div>✓</div> <div>✓</div>	<div>⋮</div>
<div>passed</div> <div>00:01:50</div> <div>3 weeks ago</div>	test #17 master bcee52e2		<div>✓</div> <div>✓</div> <div>✓</div>	<div>⋮</div>
<div>passed</div> <div>00:01:45</div> <div>3 weeks ago</div>	Merge branch 'master' into 'main' #16 main 13787446		<div>✓</div> <div>✓</div> <div>✓</div>	<div>⋮</div>

Conclusion



- REST APIs open a world of unlimited possibilities
 - Building a custom multi-tenant SD-WAN solution
 - Simplifying management of ACI fabrics with Smartsheets
- Increase resiliency, automate configuration, speed up changes with infrastructure as code
- Use CI/CD pipelines for infrastructure automation

Additional resources

- <https://developer.cisco.com/sdwan>
- <https://developer.cisco.com/codeexchange/github/repo/aidevnet/a-ci-day2-config-with-smartsheet/>
- <https://blogs.cisco.com/author/adrianiliesiu>

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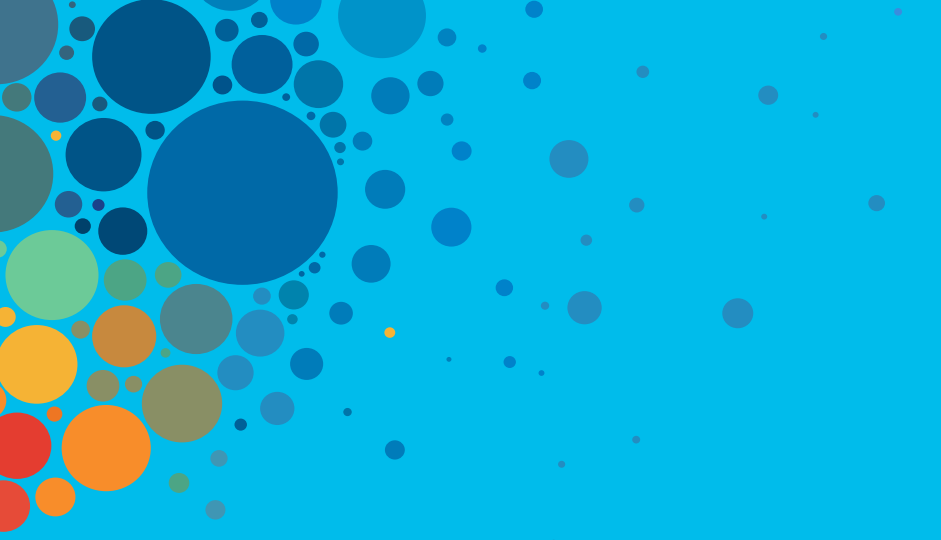
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