

Building Networks That Build Themselves: Full Lifecycle Automation from Planning to Monitoring

CISCO Live !

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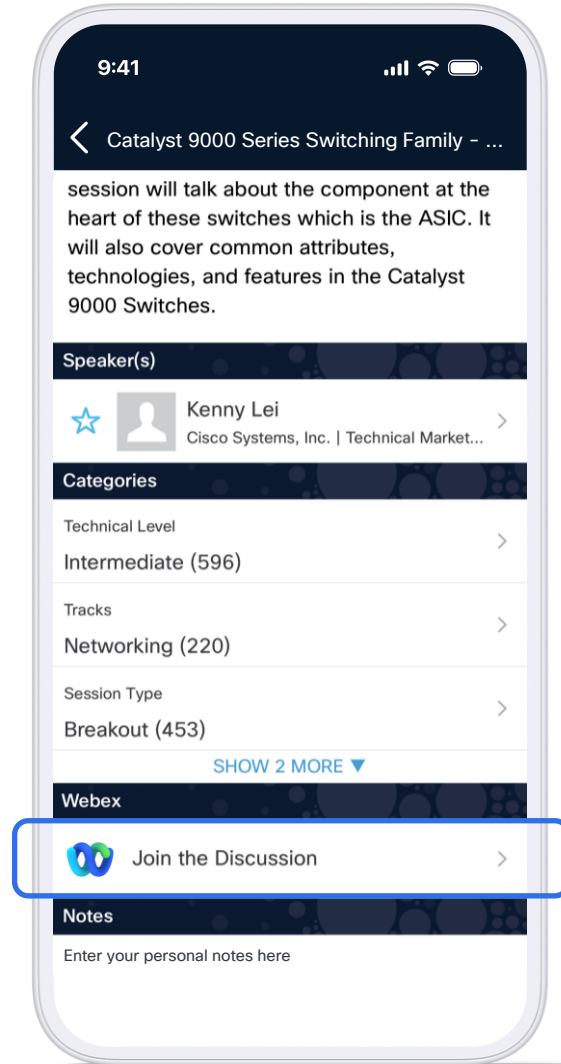
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Few words about us..



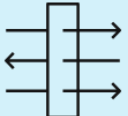
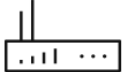
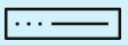
Agenda

Let me walk you
through how Cisco IT
builds a new site.

- 01 Cisco IT's Network
- 02 Network Infrastructure Refresh
- 03 Fleet as code
- 04 Device onboarding
- 05 Configuration management
- 06 ISE - Dynamic VLAN Assignment
- 07 Automated software upgrades
- 08 Assurance and Events

Cisco IT's Network

Network Gear, by the numbers

Network Device Classification		Corporate Network	Data Center	Home & Remote
Firewalls		440	144	95
Routers		1,382	430	16,267
Switches		3,114	2,382	51
Wireless LAN Controllers		97	-	-
Access Points		12,932	-	25,593

Deployments & Connections		
Buildings		443
Countries		89
Connected Devices		
Connected People		Employee 71,864 Vendor 32,509

Controller Footprint



 Production

 Non-Production

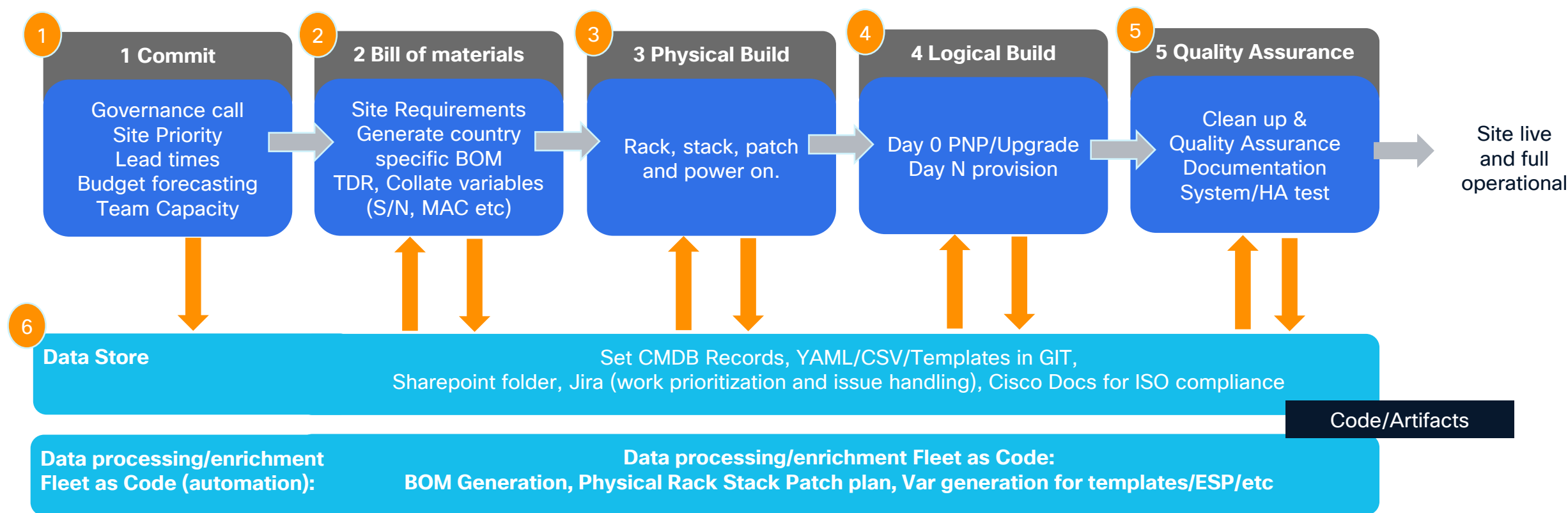
Network Infrastructure Refresh

Evolving network installations



- Solve for the machine (Data model/measure everything)
- Target Speed and Quality

Assembly line working groups

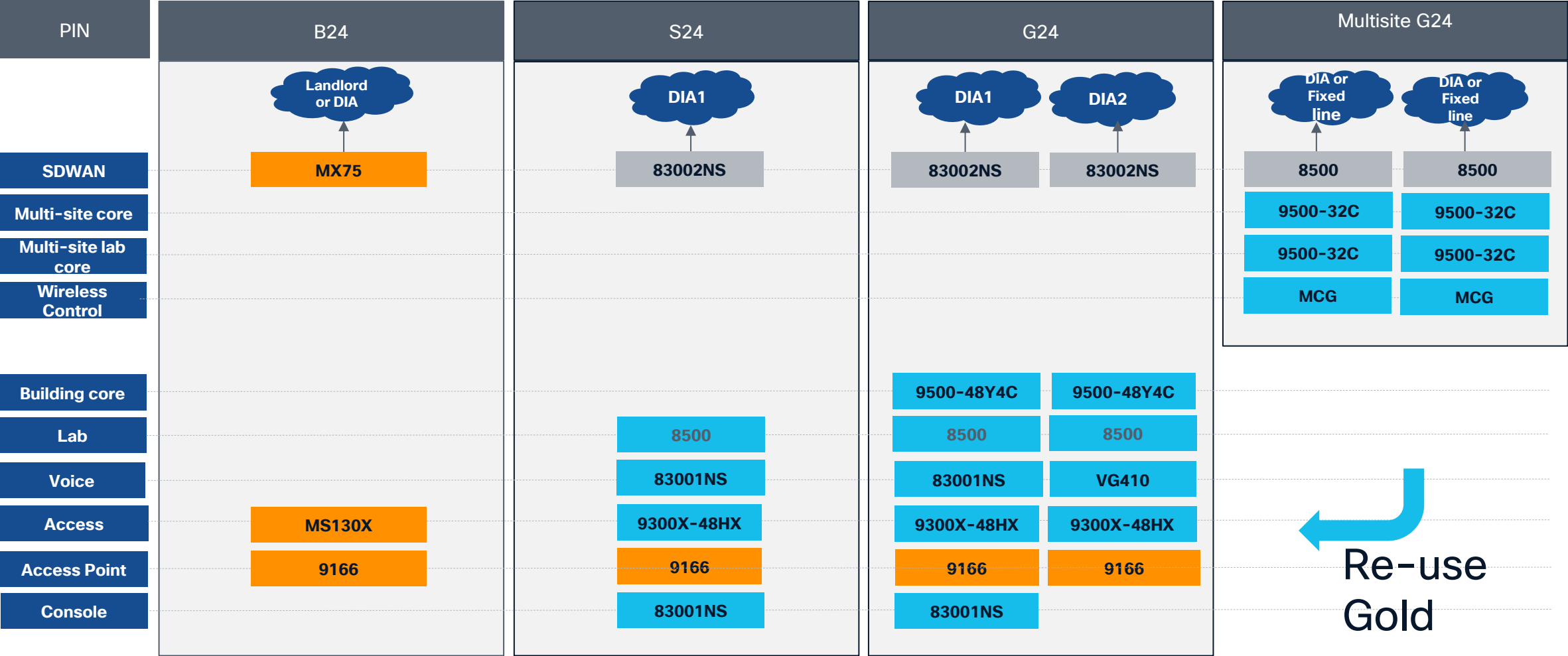


Branch Network Product Catalogue

Catalyst SDWAN (Viptela)

DNAC/Catalyst managed/monitored

Meraki managed/monitored



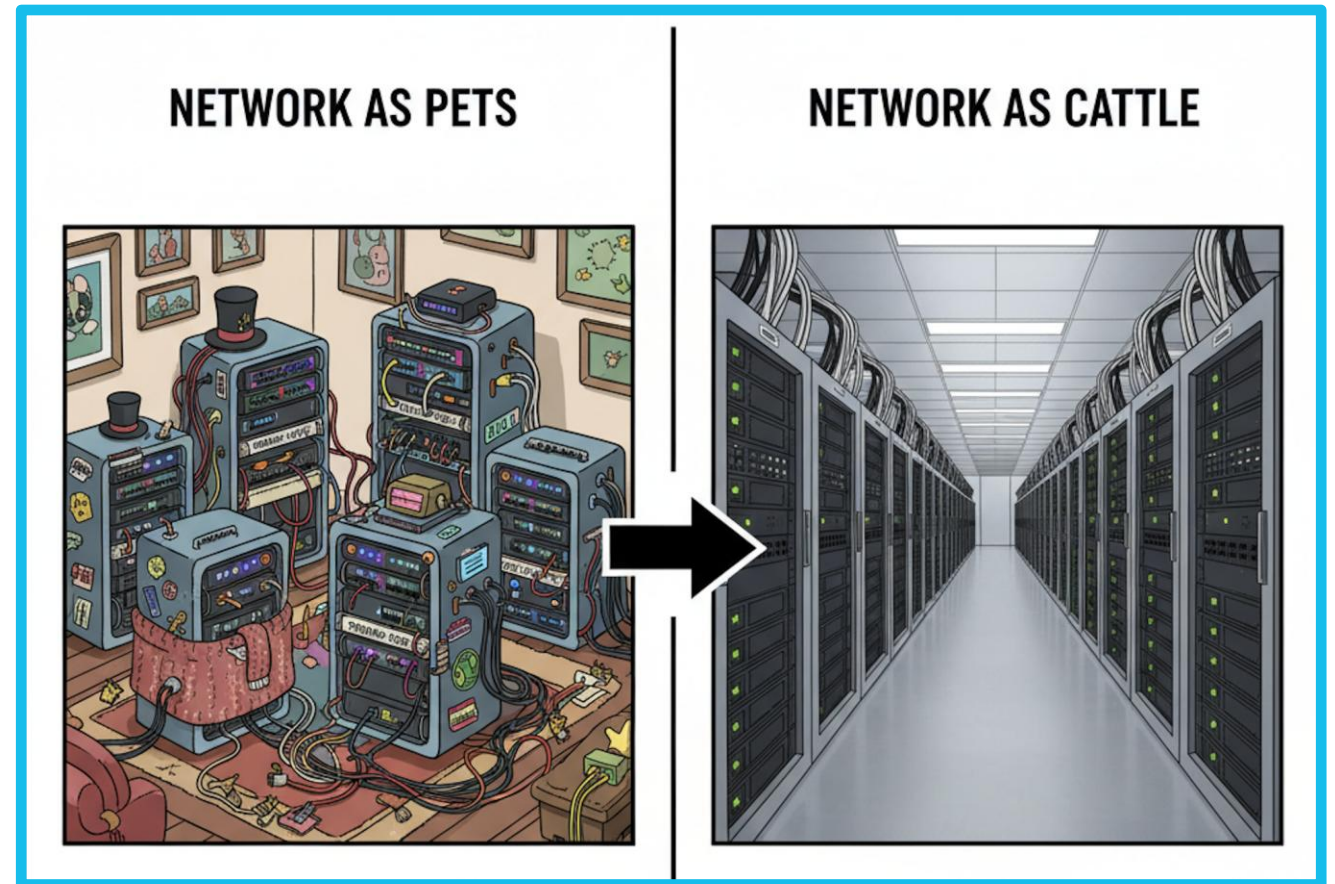
Fleet as Code

Time taken to upgrade and provision a device

		Access-switch (SW)	Building Backbone (BB)	Console Server (CS)
Step	Activity	9300X (stack of 6)	9500-484YC	8300-1N1S-4T2X
1	Add/Claim (Pre-Onboarding)	--	--	--
2	Discover/Secure (Epoch Start)	0:00	0:00	0:00
3	Authenticate	0:02	0:01	0:00
4	Init (Sys Task)	0:04	0:02	0:01
5	Directory/Day 0 Config	0:05	0:05	0:08
6	Golden Image	0:24	0:06	0:46
7	Backup & Site Config	0:44	0:33	0:47
8	Provisioned & Assigned	0:45	0:34	0:47
9	Final Day N Config	0:55	0:44	0:57

Standardize your network – avoid over customization

- Standardize VLANs – Consistent IDs and naming simplify provisioning.
- Align subnet sizes – Fixed sizes enable predictable planning and automation.
- Template configs – Uniform configs speed up deployment and reduce errors.
- Define schema standards – Clear schemas make automation scalable and repeatable.



"Treat sites like cattle, not pets – standardized, scalable, and built to run anywhere."

Pin topology and device schema

```
config > standards > topologies > ! gold24.yaml
1   Min_subscriptions:
2   - C8300-sdwan-gw1
3   - C8300-sdwan-gw2
4   - C8300-cs1
5   - 9500-bb-gw1
6   - 9500-bb-gw2
7   - 9300-sw1
8
9   Optional:
10  - 9300-sw2
11  - cg-wl-gw1
```

Lists the required and optional device subscriptions for each pin topology.

```
name: <sitecode>-<pin_function>-<pin_position>
model: C9500-32C
pin_topology: mbgold24
pin_function: abb # abb: access back bone
pin_position: gw1
bom: https://apps.cisco.com/ccw/cpc/estimate/items/ABCD1234567?localeChanged=en\_

console_port: yes
power:
  PSU1: AC
  PSU2: AC

port_assignments:
  - Hun1/0/1:
      description: <sitecode>-uplink-gw1
      sfp: SFP-100GBase-LR
  - Hun1/0/2:
      description: <sitecode>-uplink-gw2
      sfp: SFP-100GBase-LR
  - Hun1/0/3:
      description: <sitecode>-cross-link
      sfp: SFP-100GBase-LR
  - Hun1/0/4:
      description: <sitecode>-cross-link
      sfp: SFP-100GBase-LR
```

Schema defining the interfaces in a backbone gateway – this helps build the BOM using a pre-defined template and determine the required SFP count.

Address block schema

Enterprise Se...

Location

SJ-SANTANA ROW - 3098 OLSEN

Name

SJ-SANTANA ROW - 3098 OLSEN

Contact

ID

Building:SJC34

Phone

Code

SJC34

Fax phone

City

SAN JOSE

Latitude

37.31874

State / Province

Longitude

-121.949197

Zip / Postal Code

95128

Parent

SAN JOSE

Country

Hierarchy level

Building

Gmt offset

-7

World

WORLD

Time zone

-- None --

Theater

AMERICAS

Status

Online

Region

UNITED STATES

Country

UNITED STATES

State

CALIFORNIA

Metro

SAN JOSE CA

City

SAN JOSE

```
config > ! addr_blocks.yaml
1 route_point:
2   sjc: SAN_JOSE
3   alln: ALLN
4   rcdn: RICHARDSON
5   rtp: RTP
6   syn: SYDNEY
7   tky: TOKYO
8   shn: SHANGHAI
9   sng: SINGAPORE
10  bgl: BANGALORE
11  loncaf: LONDON
12  ntn: NETANYA
13  aer: AMSTERDAM
14
15 locations:
16   SAN_JOSE:
17     10.0.0.0/18:
18       function: NETWORK_INFRA
19     10.0.64.0/18:
20       function: INFRA_CAMPUS
21     2001:db8:c100::/45:
22       function: NETWORK_INFRA
23     2001:db8:c108::/46:
24       function: INFRA_CAMPUS
25     10.0.128.0/17:
26       function: BRANCH_ACCESS
27     10.1.0.0/17:
28       function: ACCESS_CAMPUS_WIRED
29     2001:db8:480::/41:
30       function: BRANCH_ACCESS
31     2001:db8:2e0::/43:
32       function: ACCESS_CAMPUS_WIRED
```

```
1 # describes block requirements for each topology by CIDR size
2 # function assignments come from block as seen in addr_blocks.yaml
3
4 site:
5   BRONZE24:
6     NETWORK_INFRA:
7       v4: 24
8       v6: 52
9     BRANCH_ACCESS:
10      v4: 25
11      v6: 48
12   SILVER24:
13     NETWORK_INFRA:
14       v4: 24
15       v6: 52
16     BRANCH_ACCESS:
17       v4: 23
18       v6: 48
19   GOLD24:
20     NETWORK_INFRA:
21       v4: 23
22       v6: 52
23     BRANCH_ACCESS:
24       v4: 21
25       v6: 48
26   SMART24:
27     NETWORK_INFRA:
28       v4: 23
29       v6: 52
30     BRANCH_ACCESS:
31       v4: 20
```

The automation would run for site SJC34, determine its route point based on region and metro data available on CMDB, check the pin topology, and carve out the required IPv4 and IPv6 subnets from the predefined address blocks.

Defining VLANs, Crosslinks and Security Groups

```
SUPPORT:
  NETWORK_INFRA:
    - <Support-Network-Group>
  BRANCH_ACCESS:
    - <Support-Network-Group>
  TENANT:
    - <Support-Tenant-Group>
  HOST_${ipclnl}:
    - <Support-Host-Group>
  HOST_${printer}:
    - <Support-Printer-Group>

SECURITY:
  NETWORK_INFRA:
    - <Security-Network-Infra-Group>
  BRANCH_ACCESS:
    - <Security-Branch-Group>
  TENANT:
    - <Security-Tenant-Group>
  DC:
    - <Security-DC-Group>
  CORP_SEC:
    - <Security-Corp-Group>
  VLAN300:
    - <Security-Voice-Group>
    - <Security-Corp-Group>
    - <Security-Printer-Group>
```

```
GOLD24:
  NETWORK_INFRA: &GOLD_INFRA
  desc: ${site_code} Infrastructure
  blocks:
    crosslinks:
      function: "INFRASTRUCTURE"
      size: 25
      v6_block: 56
      desc: ${site_code} Crosslinks
      v6_plan: nets_follow_v4
      subnets:
        - desc: ${site_code}-sdwan-gw1 <-> ${site_code}-bb-gw1
          size: 30
          dhcp: True
          security: +NETWORK_INFRA
          ref: sdwan1-bb1
          hosts:
            - ${site_code}-sdwan-gw1-ten0-0-4
            - ${site_code}-bb-gw1-hun1-0-49
```

```
BRANCH_ACCESS:
  VLANS: &ALL_GOLD
  Data:
    security: +VLAN300
    vlan: 300
    dhcp: True
    ipv4: 22
    ipv6: 64
    hosts:
      - *HSRP
      - ${site_code}-${floor}${room}-sw${index}
```

VLAN subnets are carved from access blocks, loopback subnets from network infra blocks, and support/security groups are defined and mapped to these subnets to control who can update them in the CMDB.

DHCP Schema

```
config > ! dhcp.yaml
1  DEFAULT:
2    240:
3      "policy": "default-dns-policy"
4      "offset": 30
5
6  SAN_JOSE:
7    "server1": "dhcp-site1.example.com"
8    "server2": "dhcp-site2.example.com"
9    "policy6": "SJC-IPv6-Policy"
10   0:
11     "policy": "PnP DHCP for controller-short"
12   10:
13     "policy": "Campus AP VLANs Cluster2 Buildings"
14     "offset": 6
15   300:
16     "policy": "Site IT LAN"
17     "offset": 40
18   400:
19     "policy": "Site Telephony"
20     "offset": 11
21   701:
22     "server1": "dhcp-iot-region1.example.com"
23     "server2": "dhcp-iot-region2.example.com"
24     "policy": "Regional LAN"
25   702:
26     "server1": "dhcp-iot-region1.example.com"
27     "server2": "dhcp-iot-region2.example.com"
28     "policy": "Regional LAN"
29   711:
30     "server1": "dhcp-iot-region1.example.com"
31     "server2": "dhcp-iot-region2.example.com"
32     "policy": "Regional LAN"
```

```
BRANCH_ACCESS:
  VLANS: &ALL_GOLD
  Data:
    security: +VLAN300
    vlan: 300
    dhcp: True
    ipv4: 22
    ipv6: 64
    hosts:
      - *HSRP
      - ${site_code}-${floor}${room}-sw${index}
```

DHCP configurations are mapped to the VLAN and crosslink schemas, ensuring each subnet automatically inherits the correct DHCP policy, server assignments, and offset parameters for consistent IP management across sites.

How does it all come together ?

Fleet as code output – install package per site

For each site, an install package is generated – a complete set of artifacts produced by the Fleet as Code automation:

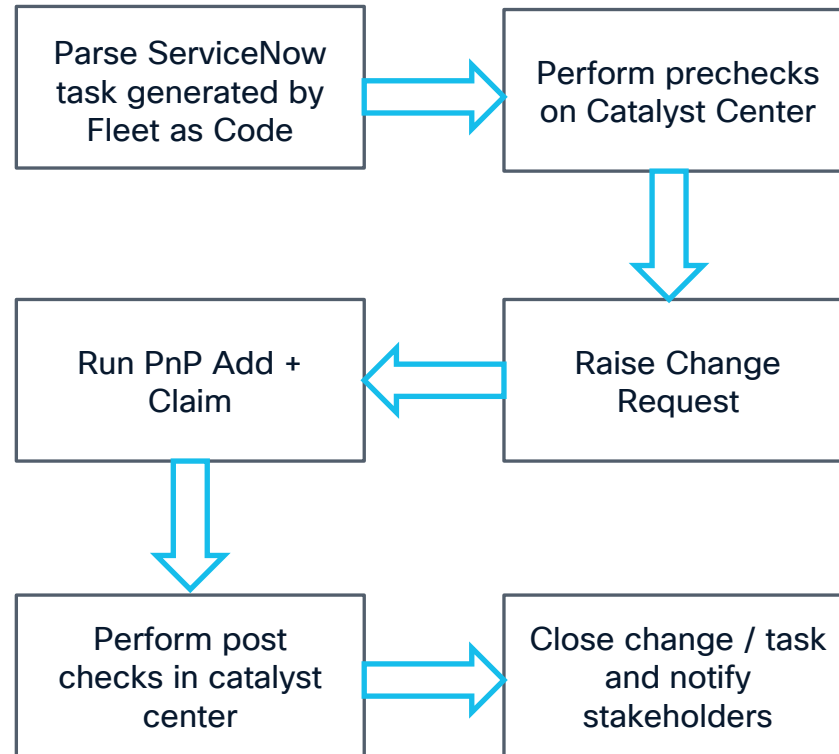
- **Address Plan** – Defines standardized subnet allocation across sites for consistent IP hierarchy and reuse.
- **IP Migration plan** – updates static reservations, removes inactive hosts, and alerts stakeholders.
- **Day0/N Configuration Variables** – Auto-generated parameters feeding DNAC templates for zero-touch provisioning.
- **Patch Plan** – Details physical rack, stack, and cable layouts to guide on-ground implementation.
- **Site Network UML Diagram (SVG)** – Visually represents site topology, device interconnects, and logical design.



Device Onboarding

Device Onboarding with Catalyst Center

PnP Preclaim Automation Workflow



```
kafka_listener.kafka_consumer: INFO > Listening....  
kafka_listener.kafka_consumer: INFO > Found a new Pre-Claim request: RITM6618203
```

PnP Preclaim automation pre-checks

- Verify site exists on catalyst center

```
145 2025-09-30 09:50:58 pnp_automation: [32mINFO[0m > Found site BGL18 with ID 65ca4012-11ef-4432-89cd-25edf999d302
```

- Find the right network profile and onboarding template for the device type

```
103 2025-09-30 09:50:58 checker_module.pre_checks: [32mINFO[0m > Checking for existing PnP device with serial number: FVH2902L1PB
110 2025-09-30 09:50:59 checker_module.pre_checks: [32mINFO[0m > No existing PnP device found with serial number FVH2902L1PB. Good to proceed.
178 2025-09-30 09:50:59 checker_module.pre_checks: [32mINFO[0m > Checking Network Profile: NE0-Switching (ID: b019c56c-f0d7-4b68-bcaf-4701dc7555b4)
41 2025-09-30 09:50:59 checker_module.pre_checks: [32mINFO[0m > Found day0 template: 9300_day0_gold24_template on Catlyst Center
```

- Extract variables from onboarding template and map it to values from Day0 onboarding file generated by fleet as code automation

```
191 2025-09-30 09:50:59 checker_module.pre_checks: [32mINFO[0m > All config day0 templates are present in DNAC for profile NE0-Switching
80 2025-09-30 09:51:00 checker_module.pre_checks: [32mINFO[0m > Variables extracted from template 9300_day0_gold24_template: ['MANAGEMENT_ADDRESS', 'MANAGEMENT_IPV6_ADDRESS', 'PRODUCT_ID', 'MANAGEMENT_ADDRESS_SUBNET_MASK', 'MANAGEMENT_ADDRESS_GW']
148 2025-09-30 09:51:00 pnp_automation: [32mINFO[0m > Template ID: 73f326a2-7c0f-49db-b8ee-62163a2a8f24
150 2025-09-30 09:51:00 pnp_automation: [32mINFO[0m > Verifying the CSV file against the template variables and checking for entered values
```

- Claim device successfully

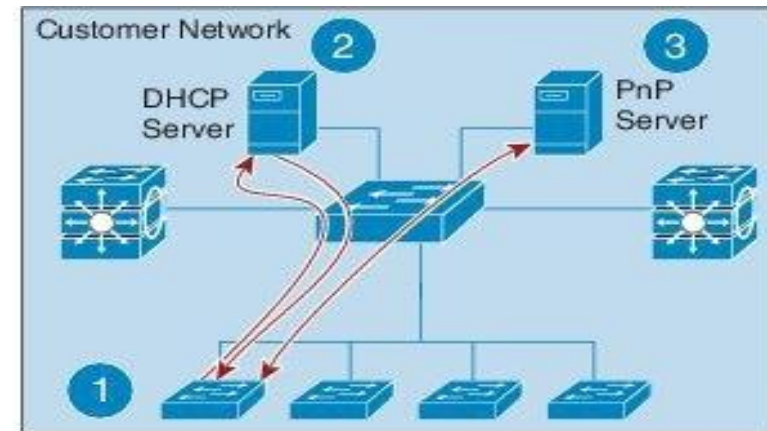
```
34 2025-09-30 09:54:13 pnp_module.pnp: [32mINFO[0m > Device claimed successfully: {'response': 'Device Claimed', 'version': '1.0'}
```

#	Device Name	Serial Number	Product ID	Last Contact	State	Onboarding Progress
1	 ciscolive-cs1	BZC4CV1JA7	C8300-1N1S-4T2X	Not Contacted	Planned	 Device Claimed.

Device Onboarding using Catalyst Center

Plug-n-Play Discovery through DHCP Server

- Cabling Vendor plugs the device to the uplink.
- Device attempts DHCP, gets an IP address and contacts catalyst center
- Since the device is already pre-claimed, it enters the Catalyst center inventory seamlessly.



- 1 New device is powered on. Device starts DHCP discovery
- 2 DHCP server responds with PnP server IP in Option 43 along with device IP
- 3 New devices establishes connects to PnP server

391 499

Config Management

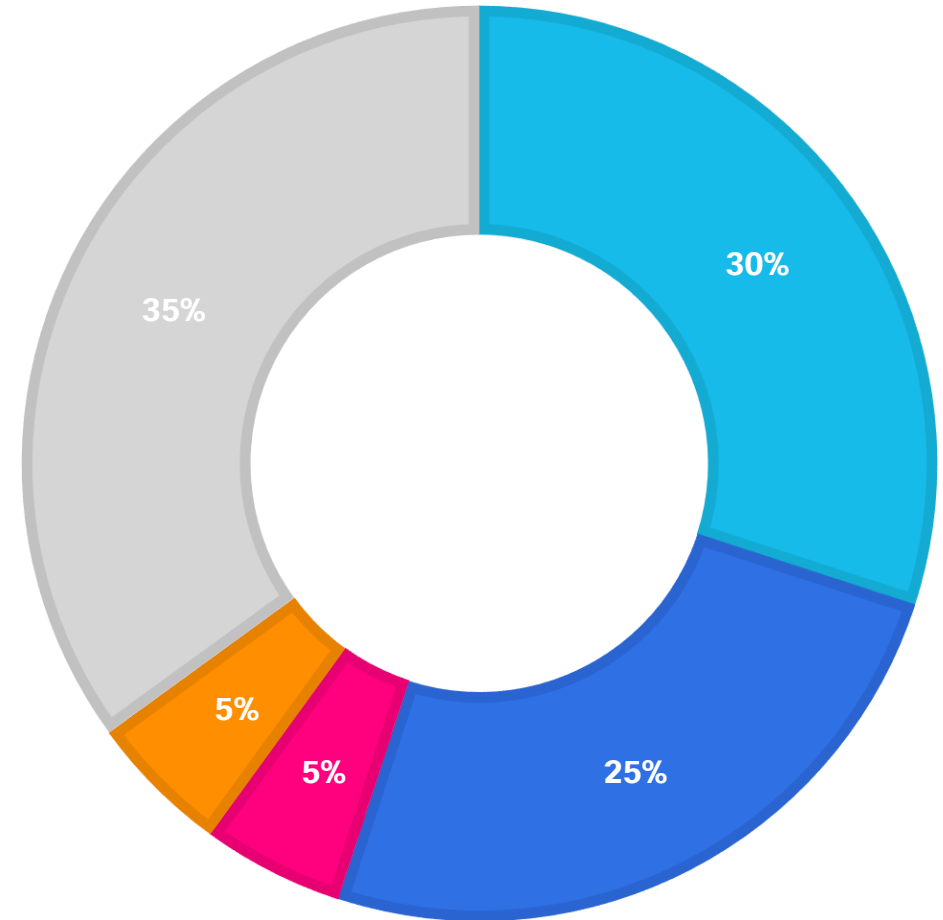
But why manage configuration using catalyst center ?

Root Cause of Major Incidents

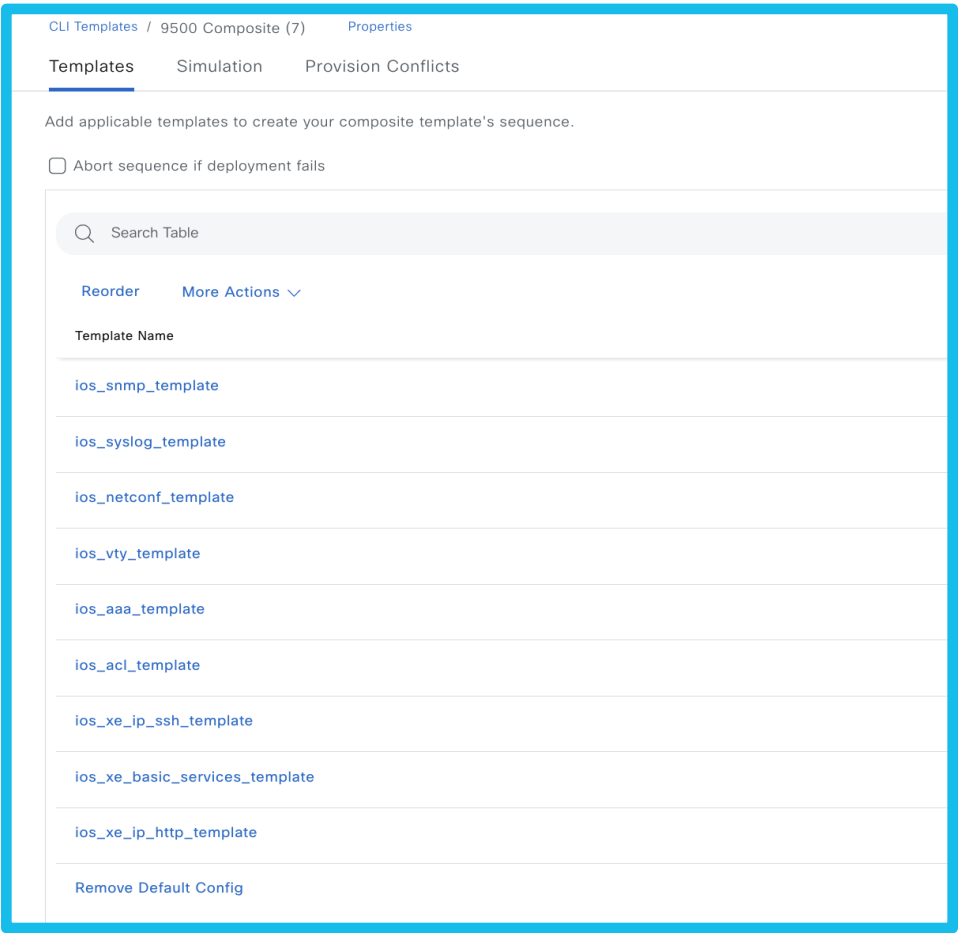
■ SP outage ■ Facilities / Power ■ Design Fault ■ Bug ■ Configuration / Software Change

Configuration / Software changes
should be entirely manageable

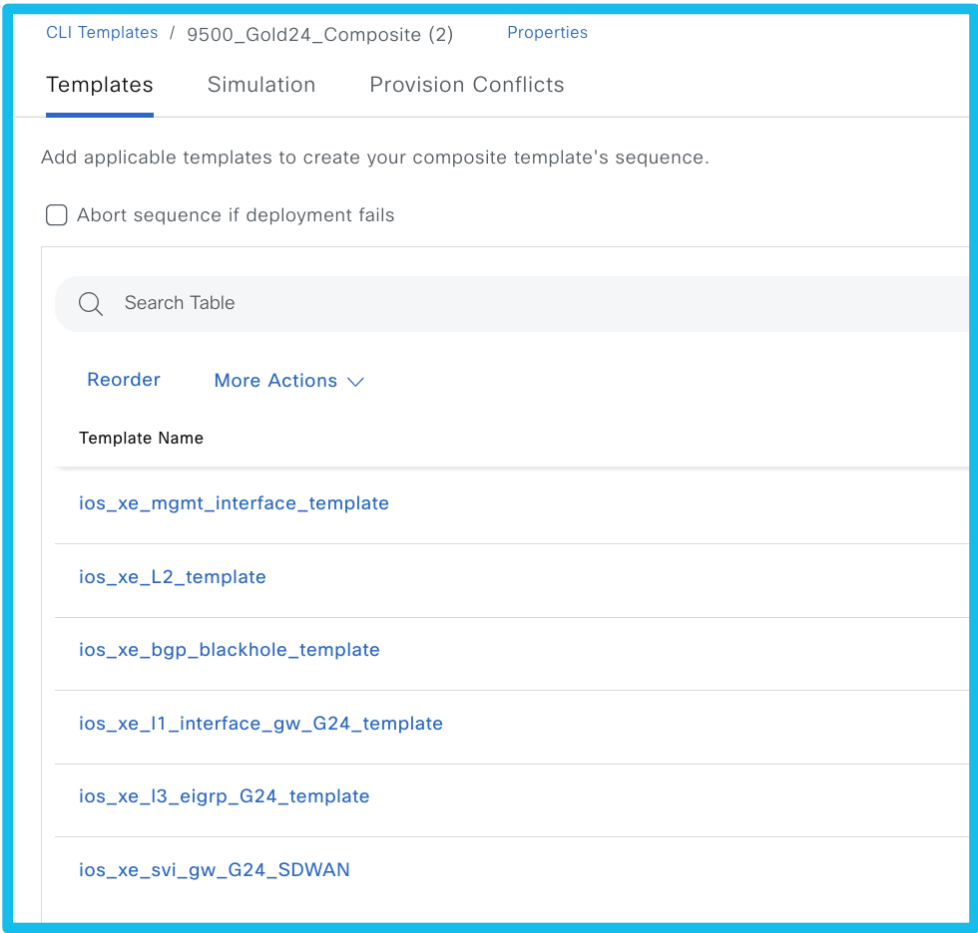
Configuration compliance,
automation are key to driving this to
zero



Templating with Catalyst Center – C9500 Example



Universal Template Composite : Foundational building blocks for every device.



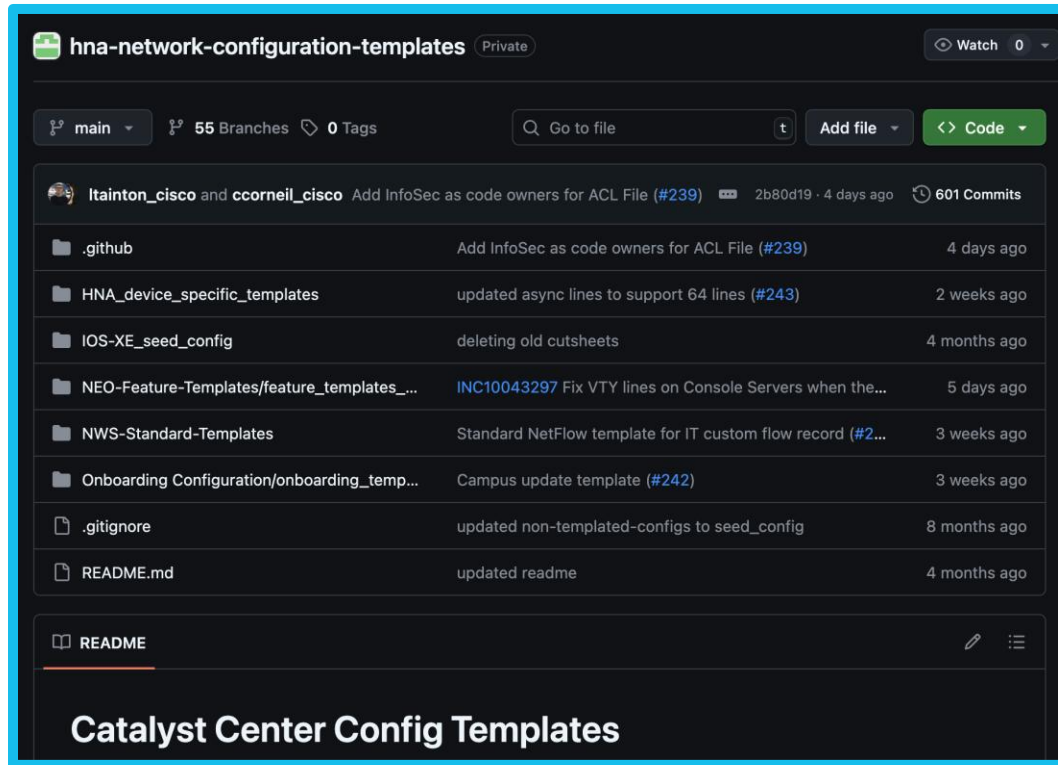
Device-Specific Composite: Custom templates for role-specific configuration

**But that was a lot of
templates, how do I
manage them?**

Git'init right -

How to manage so many templates across multiple catalyst center ?

Version control is the solution



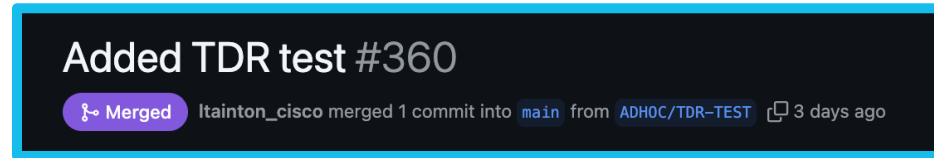
Any changes go through Pull Requests in GitHub and when merged to Main they are then updated in Catalyst Center clusters via automation.

GitHub acts as our SSOT (Single Source of Truth) for all templates.

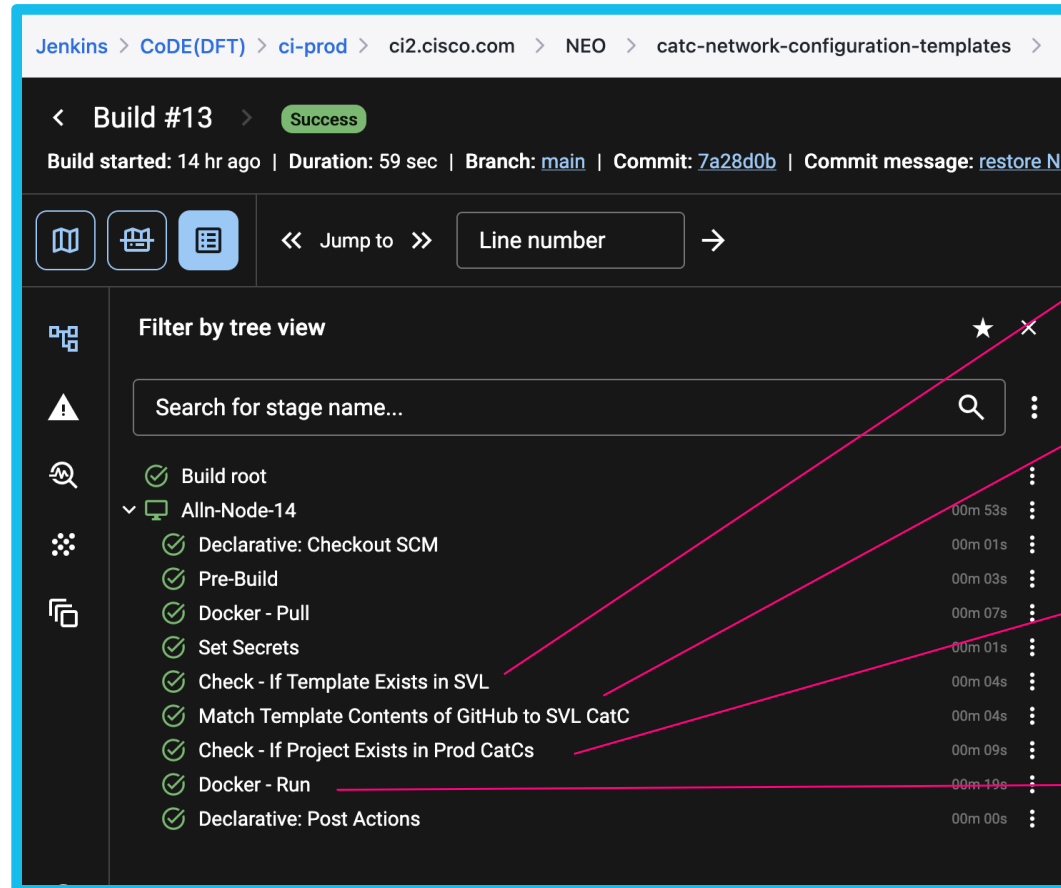
```
{#
  Creates one power stack if StackMemberCount ≤ 4, otherwise creates two.
  Assigns all switches to Powerstack-1 if StackMemberCount ≤ 4.
  Splits switches evenly between Powerstack-1 and Powerstack-2 if StackMemberCount > 4.
  If the count is odd, Powerstack-1 gets one extra switch.
#}
{% set StackMemberList = __device.serialNumber | split(",") %}
{% set StackMemberCount = StackMemberList | length %}
{% set StackMemberCountOffset = StackMemberCount + 1 %}
{% set powerstack_threshold = (StackMemberCount // 2) + (StackMemberCount % 2) %} {# If sta
stack-power stack Powerstack-1
{% if StackMemberCount > 4 %}
stack-power stack Powerstack-2
{% endif %}
{% for i in range(1, StackMemberCountOffset) %}
stack-power switch {{ i }}
  {% if StackMemberCount > 4 and i > powerstack_threshold %}
    stack Powerstack-2
  {% else %}
    stack Powerstack-1
  {% endif %}
{% endfor %}
{# set switch priority #}
!@start-ignore-compliance
#MODE_ENABLE
{% for i in range(1, StackMemberCountOffset) %}
switch {{ i }} priority {{ 16 - i }}
{% endfor %}
#MODE_END_ENABLE
!@end-ignore-compliance
```

Template Lifecycle Orchestrator

Github to Catalyst center template sync automation



Pull request created to update configuration template, triggers Jenkins build



Guardrails set in Jenkins pipeline -

- To prevent creation of template directly in github without testing
- To prevent direct updates on github without updating template on non production catalyst center
- To avoid creating template into a new project
- stage responsible for exporting template from non production catalyst center and importing to production, runs only when PR is approved and merged to main, **preserves template's metadata such as sensitive values, dropdowns etc.**

Extended capabilities with Catalyst Center

Config Backups

What is configured on the Device ?

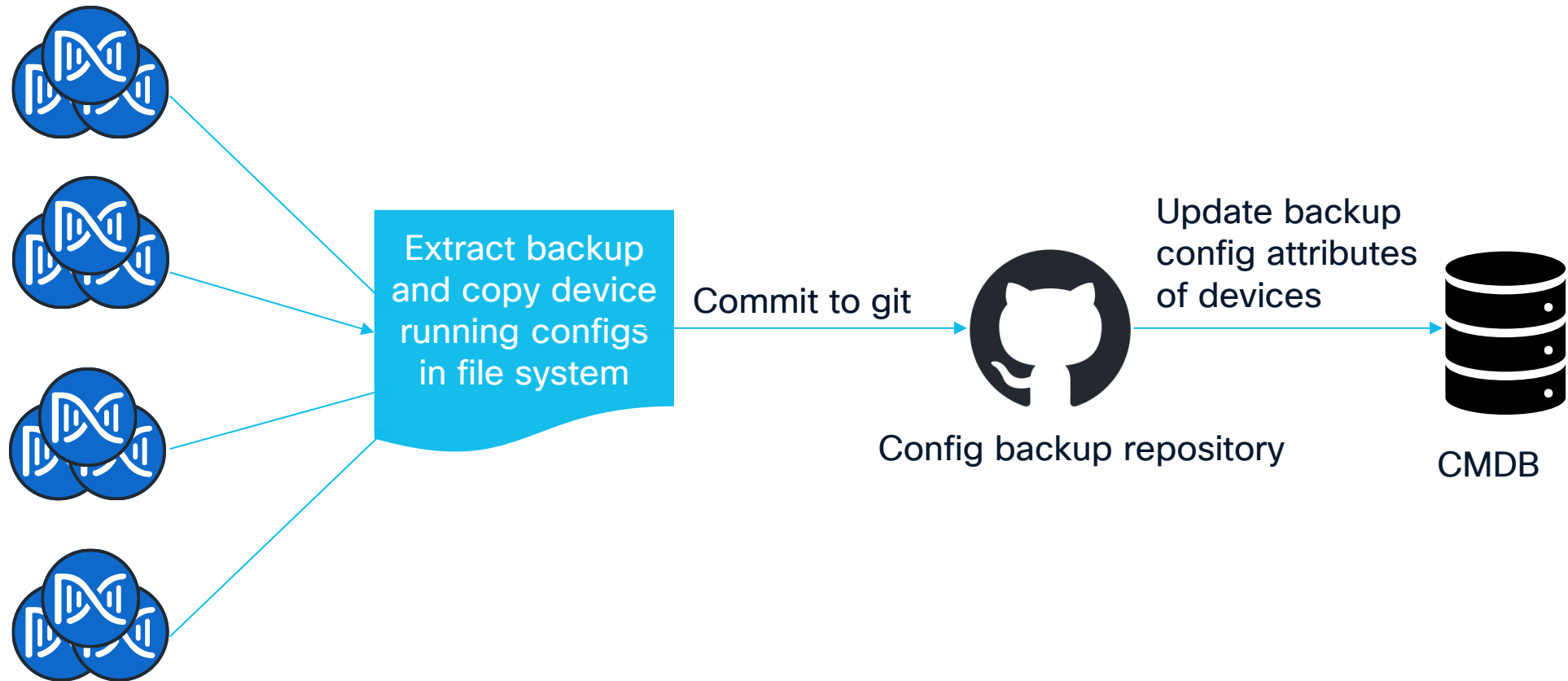
Config Drift

What configuration changed on the device ?

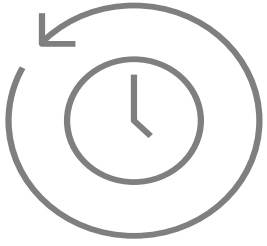
Config Compliance*

Does my device have desired configuration

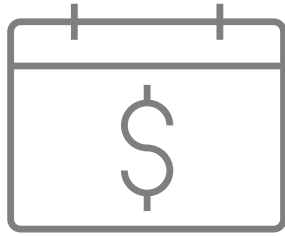
Extending Catalyst Center Config Backup Capability



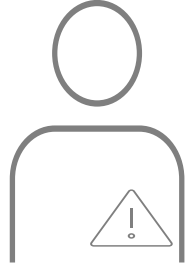
Benefits of deploying configuration using controllers



Time



Cost



Human
Error

100% standardized
config pushed and
managed by
Catalyst Center

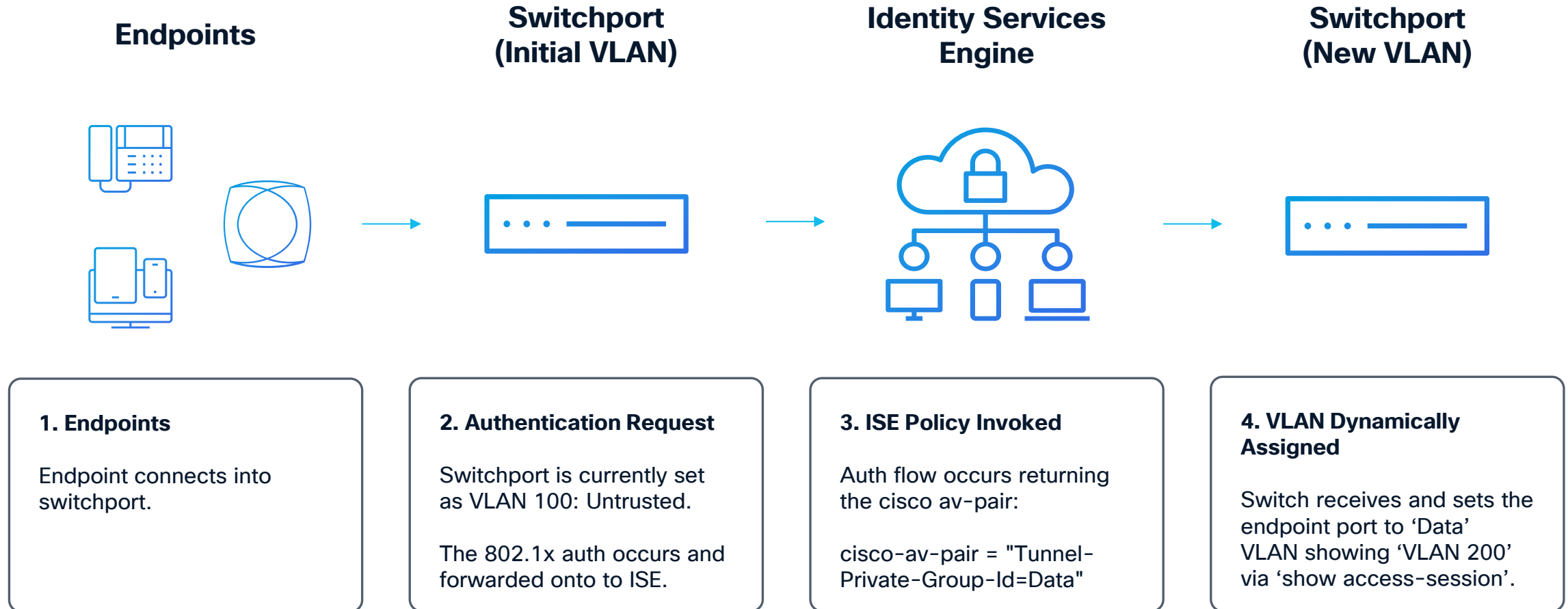
**Config
compliance**

Milestones achieved -

- PnP/DayN deployments live for Catalyst 9300, 9500 and 8000 series devices covering access switches, BB gateways and console servers
- 50+ sites fleeted or brought live using new process in 2HFY25
- Time to provision a switch now < 60 minutes with image upgrade. (stack of 6)

ISE - Dynamic VLAN Assignment

Dynamic VLAN Assignment – Cisco IT Use Case



Automated Software Upgrades

Image Repository and Software Image Management (SWIM)

Stores software images according to image type and version for the devices

Push software images to the devices in your network

Software upgrade can also be scheduled for later date and time

Pre/post checks and configuration differences

Catalyst Center SWIM

SWIM Upgrades in the Last Year:

- 17.9.3 x 4593 upgrades
- 17.12.2 x 4593 upgrades
- 17.15.1 x 4593 upgrades

Device Count:

- Routers – 1,382
- Switches – 3,114
- WLCs – 97
- Total = 4,593

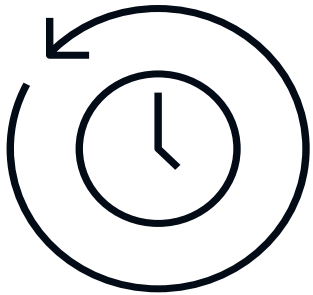
SWIM Metrics

- 4,593 upgrades
 - Devices are generally upgraded in batches of around 25
 - Each batch takes around 3 hours
- 
- 184 change requests
 - 552 hours of upgrading
 - 23 days of upgrading
 - If done back-to-back without stopping

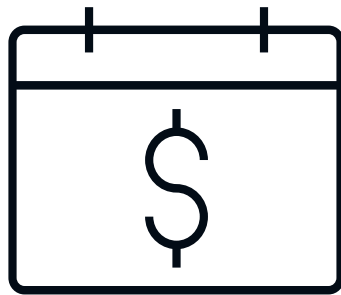
What is Atomic SWIM?

Automated workflow that enables unattended software upgrades for network devices and incident management

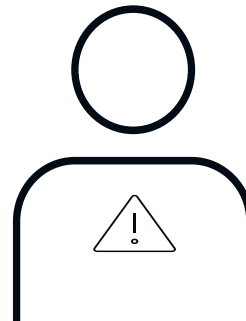
Why Atomic SWIM?



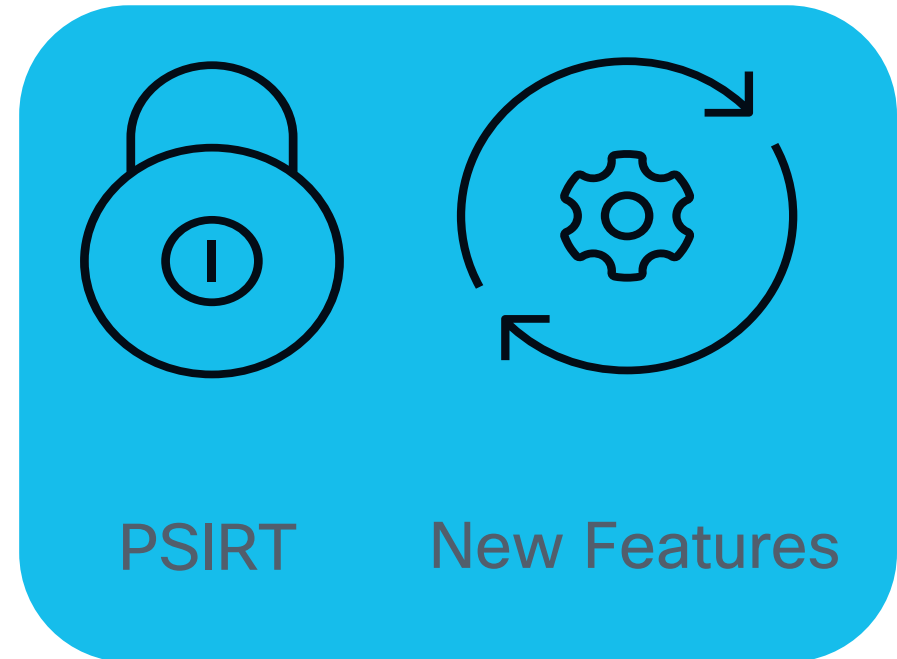
Time



\$
Cost

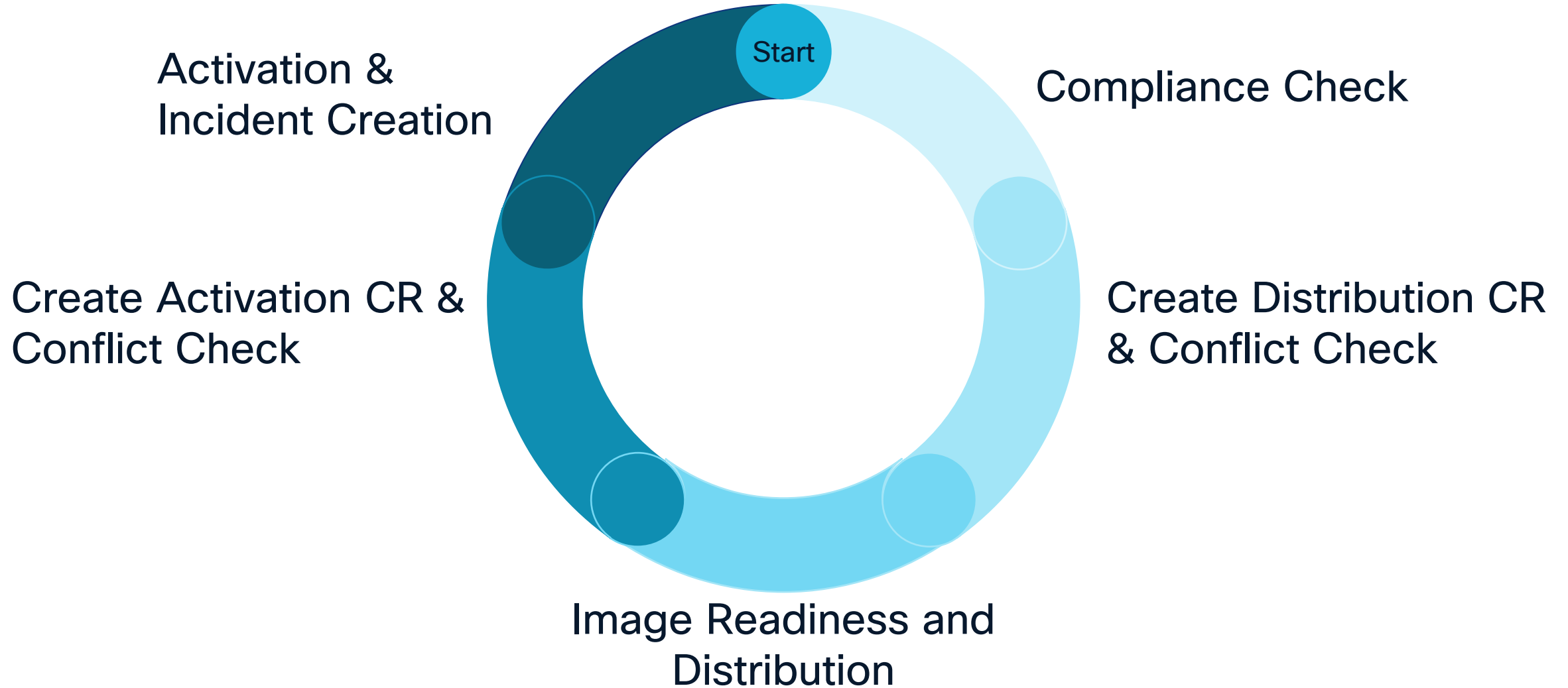


Human
Error



Fully Orchestrated Workflow

Golden Image Tagged for Site





Modular Design



servicenow

Compliance

Determines what devices require upgrade

Change

Creates/Implements/Cancels Change Requests in ServiceNow

Check

Conflict detection for CI's planned for Upgrade

Distribution

Copies software image to devices

Activation

Installation of new software and reload of devices. Runs pre and post checks

Incident

Opens Incidents in the event of a failed upgrade or if a device state check fails.

Example workflow

Compliance Module

Determines what devices require upgrade

```
2024-01-17 21:06:06 atomic_swim.dnac: INFO > getting the compliance status for the devices...
2024-01-17 21:06:06 atomic_swim.dnac: INFO > getting all the devices for given family:['Switches and Hubs'] and type: ['Cisco Catalyst 9300 Switch']

2024-01-17 21:06:07 atomic_swim.dnac: INFO > paginating for new devices page: 1 new devices found: 6
2024-01-17 21:06:07 atomic_swim.dnac: INFO > total devices found: 6
2024-01-17 21:06:08 atomic_swim.dnac: INFO > getting all the devices tagged as: NETWORK_DEVOPS_HNA
2024-01-17 21:06:09 atomic_swim.dnac: INFO > paginating for new tagged devices page: 1 new devices found: 12
2024-01-17 21:06:10 atomic_swim.dnac: INFO > getting all the devices tagged as: LD
2024-01-17 21:06:10 atomic_swim.dnac: INFO > paginating for new tagged devices page: 1 new devices found: 1
2024-01-17 21:06:11 atomic_swim.dnac: INFO > getting all the devices tagged as: DO_NOT_AUTO_SWIM
2024-01-17 21:06:11 atomic_swim.dnac: INFO > paginating for new tagged devices page: 1 new devices found: 0

2024-01-17 21:06:16 atomic_swim.dnac: INFO > compliance status fetched for 141 devices.
2024-01-17 21:06:16 __main__: INFO > compliance check took 11.819369316101074 sec.!
```

<Device Hostname> **<Controller Hostname>** **<Golden Image UUID>**

```
__main__: INFO > Controller: <Controller Hostname>, Hostname: svls
Compliance Status: NON COMPLIANT, Golden Image Version: cat9k_iosxe.17.03.08a.SPA.bin,
Golden Image UUID: <Golden Image UUID>, Running Image Version: cat9k_iosxe.17.06.04.SPA.bin.
```

- Checks Catalyst Center for images that need updating every 24 hrs
- Non-compliant when running image is a different version than set golden image
- Module returns the list of non-compliant devices

		<device hostname> NETCONF_MANAGED, ...	<device hostname>	Switches and Hubs (WLC Capable)	<hub>	Reachable	CAT9K[17.6.4] Needs Update	17.6.4
--	--	--	--------------------------------	------------------------------------	--------------------	-----------	--------------------------------------	--------

Change Module

Creates/Implements/Cancel Change Requests in Service Now

```
2024-01-17 21:51:23 atomic_swim.change.change: INFO > Retrieving site code from <CATC Hostname>
c.cisco.com for device <Device Hostname>
2024-01-17 21:51:26 atomic_swim.dnac: INFO > getting all tag id for tag WNA_SWIM_NON_PROD_TUES_A
2024-01-17 21:51:27 atomic_swim.dnac: INFO > getting all tag id for tag WNA_SWIM_NON_PROD_TUES_B
2024-01-17 21:51:28 atomic_swim.change.change: INFO > getting all changes for <Device>
2024-01-17 21:51:30 atomic_swim.change.change: INFO > CI= <Device> has CR's: ['CHG1646205', 'CHG164
6205', 'CHG1646205'] active
2024-01-17 21:51:30 atomic_swim.change.change: INFO > activation time window for C <Device>
, selected planned_time='CRPlannedTime(start_datetime=datetime.datetime(2024, 2, 13, 5, 0), hours_needed=3.
0, backout_delta=2.5, originating_planned_start_date_time='2024-02-13 05:00:00', originating_planned_end_da
te_time='2024-02-13 08:00:00', originating_backout_decision_date_time='2024-02-13 05:30:00')'
2024-01-17 21:51:30 atomic_swim.change.change: INFO > No sites for site_code= <Device>
2024-01-17 21:51:32 atomic_swim.change.change: INFO > CR=CHG1646206 for image activation created for CI
<Device>
2024-01-17 21:51:32 atomic_swim.change.change: INFO > CR=CHG1646206 has CI= <Device> set as outage
2024-01-17 21:51:34 atomic_swim.change.change: INFO > CR=CHG1646206 has been successfully submitted
2024-01-17 21:51:34 atomic_swim.change.change: INFO > getting CR=CHG1646206 conflict status
2024-01-17 21:51:34 atomic_swim.change.change: INFO > CR=CHG1646206 conflict status response: {'conflic
t_status': 'Not Run'}
2024-01-17 21:51:34 atomic_swim.change.change: INFO > CR=CHG1646206 conflict_status='Not Run'
2024-01-17 21:51:34 __main__: INFO > CR: CHG1646206 created for activation for device: <Device>
1.cisco.com
2024-01-17 21:51:34 __main__: INFO > change module took 13.461329221725464 seconds to run
```

- Creates a change request in ServiceNow for the distribution or activation of the image
- If the device being upgraded is the uplink device for other CIs, then these CIs are also added to the change
- Devices marked as outage

Check Module

Conflict detection for CI's planned for Upgrade

```
2024-01-25 22:45:27 atomic_swim.check.check: INFO > CI=: <Device Hostname>  
offering details found  
2024-01-25 22:45:29 atomic_swim.check.check: INFO > No INC found for CI:  
<Device Hostname>  
2024-01-25 22:45:29 atomic_swim.check.check: INFO > No CR found for CI=  
<Device Hostname>  
2024-01-25 22:45:29 atomic_swim.check.check: WARNING > CR=CHG1646207 outside st  
art/end time window or does not exist.  
2024-01-25 22:45:29 __main__: WARNING > not a good time for swim due to con  
flicts or pending incidents  
2024-01-25 22:45:29 __main__: INFO > check module took 8.062513828277588  
seconds to run
```

- Checks if there is an Incident or other Change Request open against the device and if so, cancels the upgrade
- If not, distribution can proceed

Distribution Module

Copies software image to devices after performing Image Upgrade Readiness Check

```
2024-01-17 21:21:37 atomic_swim.dnac: INFO > got device id: 343f653f-e2f. <Device UUID>
vice: svlsilv31-sw <Device Hostname>
2024-01-17 21:21:38 atomic_swim.dnac: INFO > starting the readiness check for CI=svlsilv31-sw1 <Device Hostname>
m
2024-01-17 21:21:39 atomic_swim.dnac: INFO > Waiting for Image Upgrade Readiness Check task_id='fb2cfcbf-7850-432e-9991-13bcfacee505' to complete
2024-01-17 21:21:39 atomic_swim.dnac: INFO > waiting on task_id='fb2cfcbf-7850-432e-9991-13bcfacee505'
for purpose: Image Upgrade Readiness Check
2024-01-17 21:21:40 atomic_swim.dnac: INFO > Image Upgrade Readiness Check task_id='fb2cfcbf-7850-432e-
9991-13bcfacee505' progress: Swim Network Validation
2024-01-17 21:21:43 atomic_swim.dnac: INFO > waiting on task_id='fb2cfcbf-7850-432e-9991-13bcfacee505'
for purpose: Image Upgrade Readiness Check
2024-01-17 21:21:43 atomic_swim.dnac: INFO > Image Upgrade Readiness Check task_id='fb2cfcbf-7850-432e-
9991-13bcfacee505' is complete with time taken: 3196ms
2024-01-17 21:21:44 atomic_swim.dnac: INFO > readiness check is good for CI=svlsilv31-sw1 <Device Hostname>
2024-01-17 21:21:44 atomic_swim.dnac: INFO > starting distribution for CI=svlsilv31-sw1 <Device Hostname>
2024-01-17 21:21:46 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
-b6e2-5f8f13bd2f77' to complete
2024-01-17 21:21:46 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
for purpose: Image Distribution
2024-01-17 21:21:46 atomic_swim.dnac: INFO > Image Distribution task_id='d974b97f-9c81-4900-b6e2-5f8f13
bd2f77' progress: Starting Distribution
2024-01-17 21:30:55 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
for purpose: Image Distribution
2024-01-17 21:30:55 atomic_swim.dnac: INFO > Image Distribution task_id='d974b97f-9c81-4900-b6e2-5f8f13
bd2f77' progress: Starting Distribution
2024-01-17 21:31:00 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
for purpose: Image Distribution
2024-01-17 21:31:00 atomic_swim.dnac: INFO > Image Distribution task_id='d974b97f-9c81-4900-b6e2-5f8f13
bd2f77' progress: Starting Distribution
2024-01-17 21:31:05 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
for purpose: Image Distribution
2024-01-17 21:31:06 atomic_swim.dnac: INFO > Image Distribution task_id='d974b97f-9c81-4900-b6e2-5f8f13
bd2f77' progress: Starting Distribution
2024-01-17 21:31:11 atomic_swim.dnac: INFO > waiting on task_id='d974b97f-9c81-4900-b6e2-5f8f13bd2f77'
for purpose: Image Distribution
2024-01-17 21:31:11 atomic_swim.dnac: INFO > Image Distribution task_id='d974b97f-9c81-4900-b6e2-5f8f13
bd2f77' is complete with time taken: 561793ms
2024-01-17 21:31:11 atomic_swim.dnac: INFO > image distribution had 1 success
2024-01-17 21:31:11 atomic_swim.dnac: INFO > image distribution on CI= <Device Hostname> completed
successfully
```

Provision / Inventory / Image Update Status

<device hostname>

Image Distribution

Date: Jan 17, 2024 3:51 PM Duration: 9 minutes 21 seconds Status: ✔ Successfully distributed cat9k_iosxe.17.03.08a.SPA.bin

Operations

Checks

✔ Distribution

9 minutes 21 seconds

Distribution of image: cat9k_iosxe.17.03.08a.SPA.bin on device: <hostname> with protocol: HTTPS completed successfully

✔ Image Integrity Verification(KGV)

1 second

✔ Pre Distribution Operation

1 second

✔ Distribution

3 minutes 59 seconds

✔ Post Distribution Operation

1 second

✔ Image Checksum Verification O

30 seconds

✔ Unpack Images

4 minutes 47 seconds

Image Update Readiness Check

DEVICE DETAILS

Device: <device hostname>

Running Image: cat9k_iosxe.17.06.04.SPA.bin

Golden Image: cat9k_iosxe.17.03.08a.SPA.bin

Reboot Required: Yes

Readiness Checks Results Re-Execute Checks Export As of: Jan 17, 2024 9:34 PM

Check Type	Description	Status	Last Checked
Startup config check	Startup configuration exist for this device	✔	Jan 17, 2024 9:21 PM
Config register check	Config-register verified successfully Expected: 0x102,0x2102 Action: No action required	✔	Jan 17, 2024 9:21 PM
Flash check	Flash check: SUCCESS Expected: 1909 MB Available Free space (s: 8324 MB [Install mode needs free space to 2.2 times of Image size])	✔	Jan 17, 2024 9:21 PM
File Transfer Check	HTTPS/SCP is reachable :svt290-aa29-dnac.cisco.com	✔	Jan 17, 2024 9:21 PM
Service Entitlement Check	Could not validate license service contract	⚠	Jan 17, 2024 9:21 PM

Activation Module

Installation of new software and reload of devices. Runs pre and post checks.

```
2024-01-17 21:52:36 __main__: INFO > collecting information to start the activation process...
2024-01-17 21:52:37 atomic_swim.dnac: INFO > got device id: <Device UUID> for de
vice: <Device Hostname>
2024-01-17 21:52:41 atomic_swim.dnac: INFO > Waiting for Image Activation task_id='e9f7ad58-fb73-44f0-8
0c3-560f98ce37bf' to complete
2024-01-17 21:52:41 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 21:52:42 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' progress: image activation
2024-01-17 21:52:52 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 21:52:52 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' progress: image activation
```

```
2024-01-17 22:13:05 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 22:13:05 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' progress: image activation
2024-01-17 22:13:15 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 22:13:15 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' progress: image activation
2024-01-17 22:13:25 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 22:13:26 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' progress: image activation
2024-01-17 22:13:36 atomic_swim.dnac: INFO > waiting on task_id='e9f7ad58-fb73-44f0-80c3-560f98ce37bf'
for purpose: Image Activation
2024-01-17 22:13:36 atomic_swim.dnac: INFO > Image Activation task_id='e9f7ad58-fb73-44f0-80c3-560f98ce
37bf' is complete with time taken: 1246767ms
2024-01-17 22:13:37 atomic_swim.dnac: INFO > check result for task: post with task_id=e9f7ad58-fb73-44f
0-80c3-560f98ce37bf with output: []
2024-01-17 22:13:37 atomic_swim.dnac: INFO > post check executed successfully
2024-01-17 22:13:37 atomic_swim.dnac: WARNING > differences for CI= <Device Hostname>
2024-01-17 22:13:37 atomic_swim.dnac: INFO > activation for CI= <Device Hostname> was completed su
ccessfully. Success = 1, Failure = 0, Running = 0, Pending = 0, Total = 1
2024-01-17 22:13:37 atomic_swim.dnac: INFO > image activation had 1 success
2024-01-17 22:13:37 atomic_swim.dnac: INFO > image activation on <Device Hostname> .com completed s
uccessfully
2024-01-17 22:13:37 __main__: INFO > Activation module took 1264.0125000476837 sec.!
```

Provision / Inventory / Image Update Status

<device hostname> .com) Image Update

Date: Jan 17, 2024 4:22 PM Duration: 20 minutes 46 seconds Status: Successfully updated with cat9k_iosxe.17.03.08a.SPA.bin

Operations Checks

✓ Activation 20 minutes 45 seconds

Activation of image : cat9k_iosxe.17.03.08a.SPA.bin on <hostname> .cisco.com completed successfully.

✓ Pre Activation Operation 2 seconds

✓ Image Activation 17 minutes 45 seconds

✓ Install Commit 18 seconds

✓ Remove Inactive Images 2 minutes 13 seconds

✓ Collect Running Image Details 4 seconds

✓ Verify Image Activation 1 second

✓ Post Activation Operation 20 seconds

PRE CHECK		POST CHECK	
No Differences Found		No Differences Found	

Legends

Colors

Links

Added (f)first change

Changed (n)ext change

Deleted (t)op

Milestones Reached

Catalyst 9300/9400 (Access Switches)

ISSU upgrades for 9400

Catalyst 8300/ ISR4K (Console Server)

Catalyst 9800 (Wireless Controller)

ISSU upgrades

Catalyst 9500 (Back-bone Gateway)

Workflow to ensure redundancy

Lessons Learned

- Used public APIs where possible, Cisco Internal APIs and the Catalyst Center SDK to create custom APIs *
- Used Catalyst Center SDK to perform custom APIs for Cisco internal APIs *
- Prioritize the automation of upgrades that deliver the most value in the shortest time
- Each device role/family must be handled slightly differently

Future Plans

- Tagging/maintenance module for approved maintenance window in ServiceNow
- Remove check module from distribution workflow
- Enhance automation capabilities to include support for Meraki-managed devices

Stop Upgrading Boxes !

**MANUALLY*

Unattended Atomic Software Image Management (Atomic Swim)

Assurance and Events

Results: Auto incident creation and triage



- Approximately 90% of the incidents we work on are not caused by the network itself, but we are engaged to assist with troubleshooting and issue identification
- Opportunity to reduce mean-time-to-resolution (MTTR)
- Triage & problem determination is part of our charter; we need innovative tools to do it well

Catalyst Center Issues and Events

AI Assurance



HNA CatC AI Assurance 04/02/2025, 15:56

Cisco DNA Center Notification

Source DNA

Center IP:

Severity:

Category:

Timestamp:

Issue Name:

Issue Description:

Issue Status:

dnac-rcdn9-prd.cisco.com

2

WARN

2025-02-04 12:00:00

Excessive time to connect - At least 78% increase in time on blizzard in Global/RTP-HUB/MND01.

The network is experiencing excessive onboarding time compared to usual. Clients are taking longer than the usual time to connect to SSID blizzard.

active

Cisco DNA Center Issue Details

Webhook from Catalyst Center to a room in Webex Teams.

Issues

Events

Global/AMER-NON-FA

9:30a

P1

P2

P3

P4

9:30a

Most Impacted Floors

AllP1: 0

Total Open: 1

Search Table

PriorityIssue Type

P2AI Exces

1 Record(s)

AI(P2)Excessive time to connect - High deviation from baseline

Feb 4, 2025 9:30 AM - 12:30 PM | AMER-NON-FAB/RTP-HUB/MND01

1

Open Issues

1

Area

1 Buildings, 0 Floors

Search Table

0 SelectedActions

Export

Issue

Site

Client Count

First Occurred Time

Excessive time to connect - At least 78% increase in time on blizzard in Global/RTP-HUB/MND01.

RTP-HUB/MND01

51

Feb 4, 2025 1:

1 Record(s)

Show Records: 10

1 - 1

<1>

Open link directly to source.

Results: Auto incident creation and triage



Overall table of event alerts

	_time ↕	alert_source ↕	CI_Name ↕	Subcategory ↕	Severity ↕	state ↕	Message ↕
1	2025-02-06 15:00:01.219	SNMP_TRAP		BGP4-MIB::bgpBackwardTransition	medium	True	BGP4-MIB::bgpBackwardTransition: SNMPv2-MIB::sysUpTime.0=194981643 BGP4-MIB::bgp
2	2025-02-06 15:00:01.220	Zabbix		Temperature State Change	high	True	Event ID: 824858410 Message: sensor-8 Homewood VM Instance 3: Temperature is abo
3	2025-02-06 15:00:01.220	SNMP_TRAP		BGP4-MIB::bgpBackwardTransition	medium	True	BGP4-MIB::bgpBackwardTransition: SNMPv2-MIB::sysUpTime.0=194982273 BGP4-MIB::bgp
4	2025-02-06 15:00:01.220	SNMP_TRAP		BGP4-MIB::bgpBackwardTransition	medium	True	BGP4-MIB::bgpBackwardTransition: SNMPv2-MIB::sysUpTime.0=194982983 BGP4-MIB::bgp
5	2025-02-06 15:00:01.220	Zabbix		Temperature State Change	low	False	Event ID: 511755429 Message: Slot 5 Temp: Coretemp: Temperature is above warning
6	2025-02-06 15:00:01.220	Zabbix		Temperature State Change	high	True	Event ID: 824858896 Message: Module-1, Carmel-2: Temperature is above critical th
7	2025-02-06 15:00:01.220	Zabbix		Temperature State Change	high	True	Event ID: 824858897 Message: Module-1, Carmel-4: Temperature is above critical th
8	2025-02-06 15:00:16.225	Meraki		vpn_connectivity_change	medium	True	Event ID: 3663678296881798617 Message: VPN connectivity changed: vpnType: telewor
9	2025-02-06 15:00:16.225	DNAC		NETWORK-NON-FABRIC_WIRED-1-			
10	2025-02-06 15:00:16.225	Splunk		asa-6-385812			
11	2025-02-06 15:00:16.225	Meraki		vpn_connectivity_change			
12	2025-02-06 15:00:16.226	SNMP_TRAP		BGP4-MIB::bgpBackwardTransi			
13	2025-02-06 15:00:16.226	SNMP_TRAP		BGP4-MIB::bgpBackwardTransi			
14	2025-02-06 15:00:16.226	Zabbix		Temperature State Change			
15	2025-02-06 15:00:16.226	Zabbix		Temperature State Change			
16	2025-02-06 15:00:16.226	DNAC		NETWORK-NON-FABRIC_WIRED-1-			
17	2025-02-06 15:00:16.226	Meraki		vpn_connectivity_change			
18	2025-02-06 15:00:16.226	Meraki		vpn_connectivity_change			
19	2025-02-06 15:00:16.226	Zabbix		Temperature State Change			
20	2025-02-06 15:00:16.226	Zabbix		Temperature State Change			
21	2025-02-06 15:00:31.410	Splunk		asa-6-106815			
22	2025-02-06 15:00:31.410	Splunk		asa-6-385812			
23	2025-02-06 15:00:31.410	DNAC		NETWORK-DEVICES-3-112			
24	2025-02-06 15:00:31.410	vManage		sla_violation			
25	2025-02-06 15:00:31.410	SNMP_TRAP		BGP4-MIB::bgpBackwardTransi			
26	2025-02-06 15:00:31.410	SNMP_TRAP		BGP4-MIB::bgpBackwardTransi			
27	2025-02-06 15:00:31.410	vManage		sla_violation			
28	2025-02-06 15:00:31.411	Splunk		asa-6-106815			
29	2025-02-06 15:00:31.411	vManage		sla_violation			

```
1 ---
2 - version: "1.0"
3 name: "HNA - Aggregation Device Interface Down"
4 description: "Check for interfaces down on backbone gateways"
5 category: "Interface Issue"
6 function: "last_alert_delta"
7 function_args: []
8 threshold: 2m
9 expression: "a AND b"
10 actions:
11   - Incident
12 filters:
13   a:
14     - field: "ci.service_offering"
15       operator: IN
16       value:
17         [
18           "VPN (AnyConnect, Employee VPN)",
19           "Workplace Network Access (Wired, Wireless LAN)",
20           "Lightweight & Hybrid Network Access (CVO, MVO)",
21           "Cisco Bridge Network (C-Bridge)",
22         ]
23     - field: "ci.install_status"
24       operator: EQUALS
25       value: "Installed"
26     - field: "ci.purpose"
27       operator: EQUALS
28       value: "Prod"
29   b:
30     - field: "ci.pin_function"
31       operator: EQUALS
32       value: "Backbone Gateway (bb/dt/dtbb)"
```

AI Assist powered by BridgeIT

Number

Impacted User

(neo-funnel)

Location

Impacted Service Offering

Workplace Network Access (Wired, Wireless LAN)

Impacted Area

Device Offline

Causing CI

Environment

Production

Category

Access

Subcategory

Network

Impact

2 - Medium

Urgency

1 - High

Priority

2 - High

Event

Summary

Availability - composite

Description

Event ID: 452269321
Message: C3 - Composite - Unavailable Composite
Zabbix Link: https://...
UM Global Link: https://...
Alert Triggered due to being active for 0:15:00

Opened

2025-01-11 10:01:34

Opened by

State

Closed

Source

Monitoring

Support Level

CI - Support

Assignment group

Network-DevOps-HNA

Assigned to

Group Assignment Count

0

Impacted Service Offering Count

0

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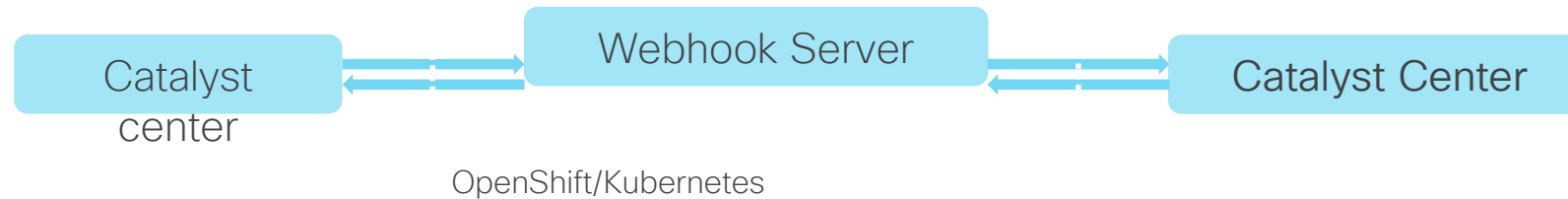
BRKOPS-2194

Automating Incidents – Access Point DOWN State

Step 1: Read new incidents from ServiceNow via ESP Messaging Service Application

Step 2: Kafka Consumer consumes Incidents created with Service Offering as “Workplace Network Access”

Step 3: Get the AP name from the Incident and using the CatC API get the status of AP, WLC and Switch



Step 5: Format the response from CatC and update the content in ServiceNow as work notes

Step 4: If AP is unreachable, trigger self-heal mechanisms and check for the status again

Conclusion

Network operations can be simplified !

Before automation

- ☒ Painful

Manual configuration via device CLI or text-based templates, manual network infrastructure planning

- ☒ Time-consuming

Configuration took time; troubleshooting took time, 2AM Nightmares while deploying sites !

- ☒ Repetitive

No time for more interesting work if we're upgrading switches all day

- ☒ (Boring)

After automation

- ☒ Simple and Programmable

Use standard network infrastructure schemas and configuration templates

- ☒ Speed and Scale

50+ switches and routers configured in less than an hour

- ☒ Event-driven automation*

Leverage controller's telemetry to auto resolve incidents

- ☒ Reduced toil



“Keep Calm and Automate Everything”

Complete your session evaluations



Complete a minimum of 4 session surveys and the Overall Event Survey to claim a Cisco Live T-Shirt.



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Contact me at: <https://www.linkedin.com/in/sandeep-rajakrishnan-87667111b/>

Thank you

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