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The bridge to possible

Inspect and Optimize the Performance of Ansible Playbooks

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DEVNET-2104

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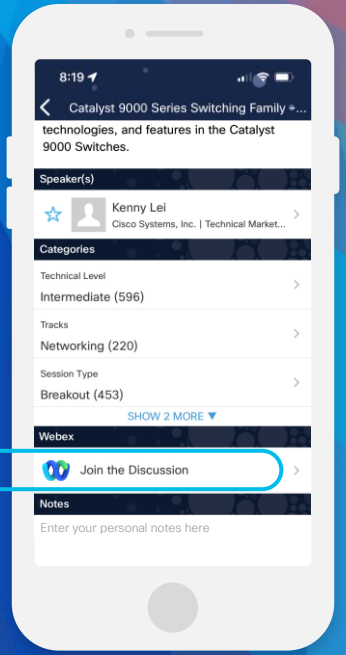

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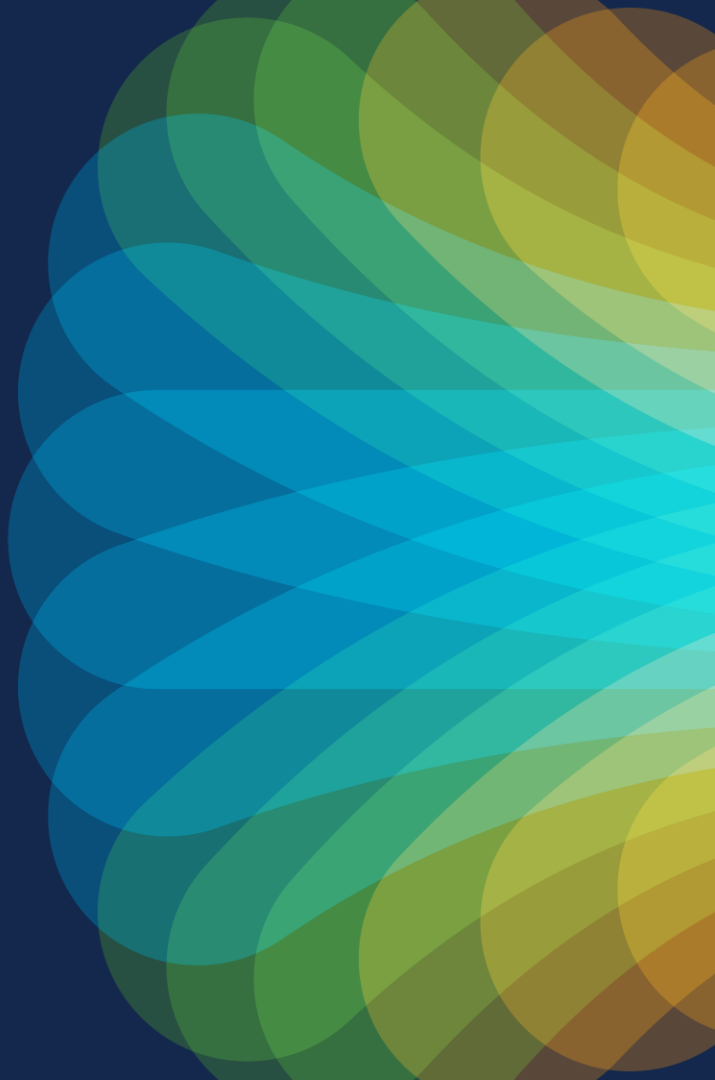
Agenda

- Introduction
- About CNC
- Best practices of tuning Ansible performance
- Playbook Inspection and Optimization
- Demo
- Summary

Introduction



Focus of the Session

- This session is **not** to:
  - Teach Ansible basics
  - Teach CNC basics

Focus of the Session

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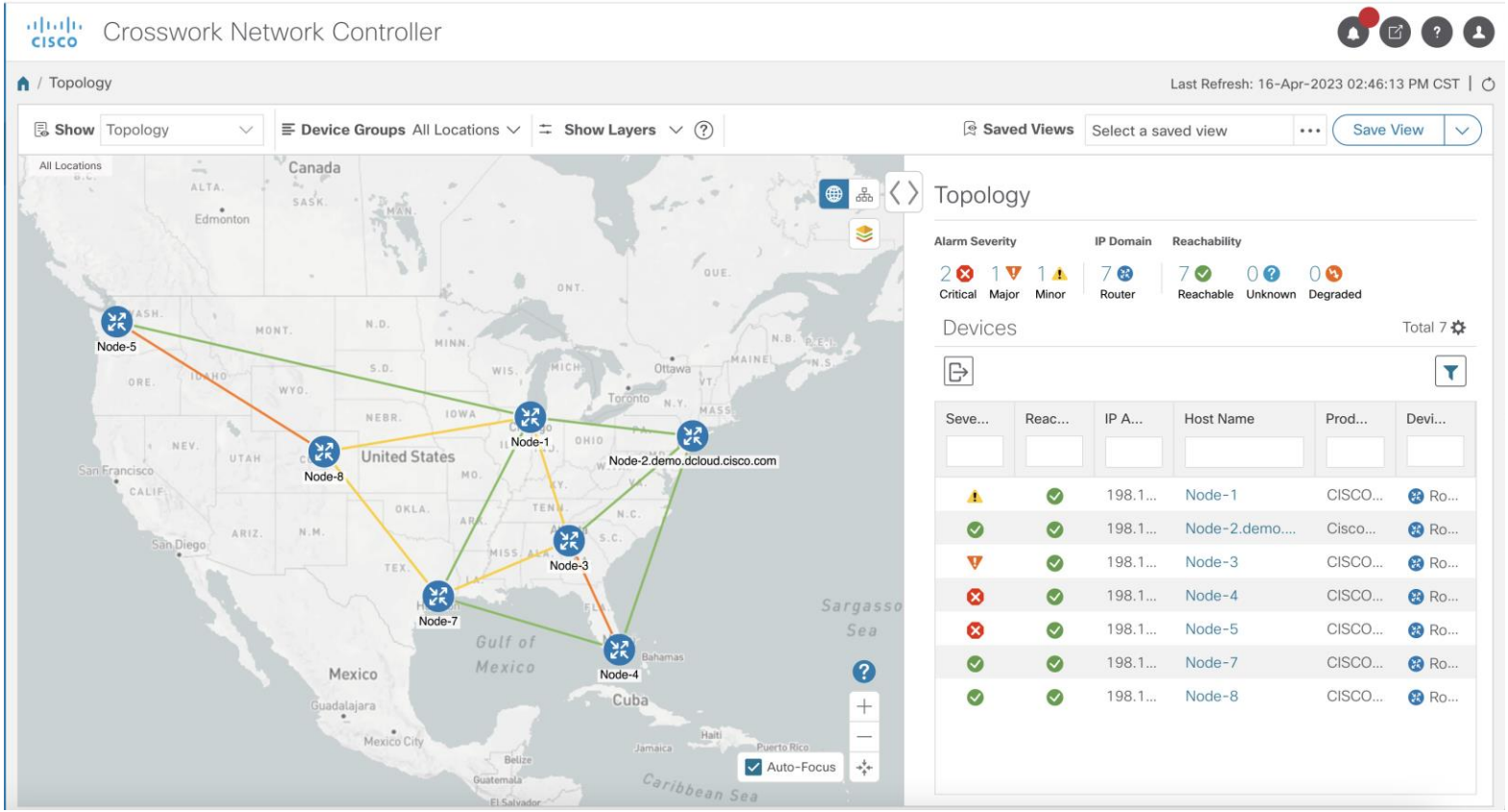
  - Teach Ansible basics
  - Teach CNC basics

So, what is this session about?

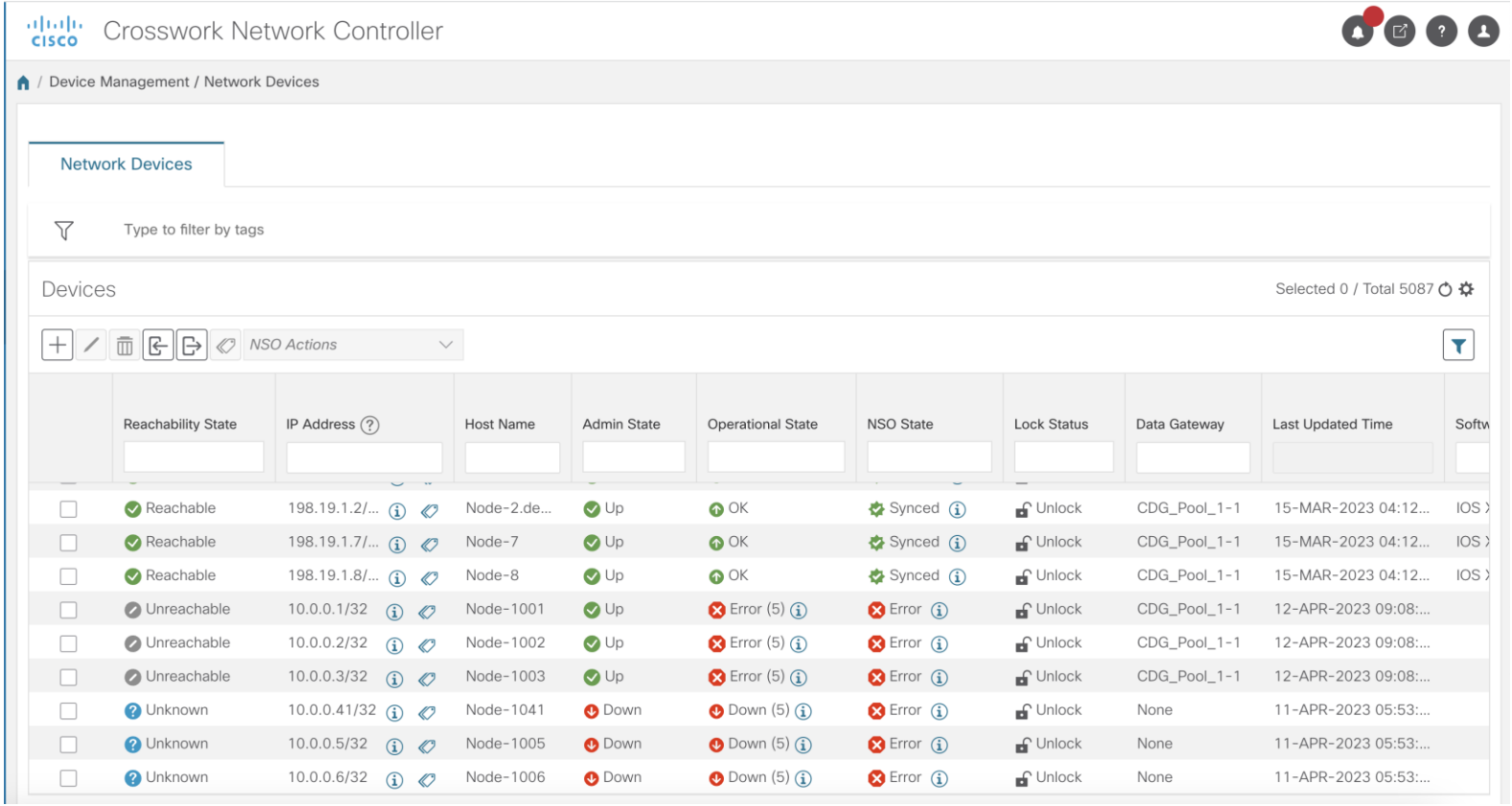
- Improve playbook performance by using:
  - Callbacks
  - Plugins
  - Ansible facts
  - Code Adjustments

About Crosswork Network Controller (CNC)

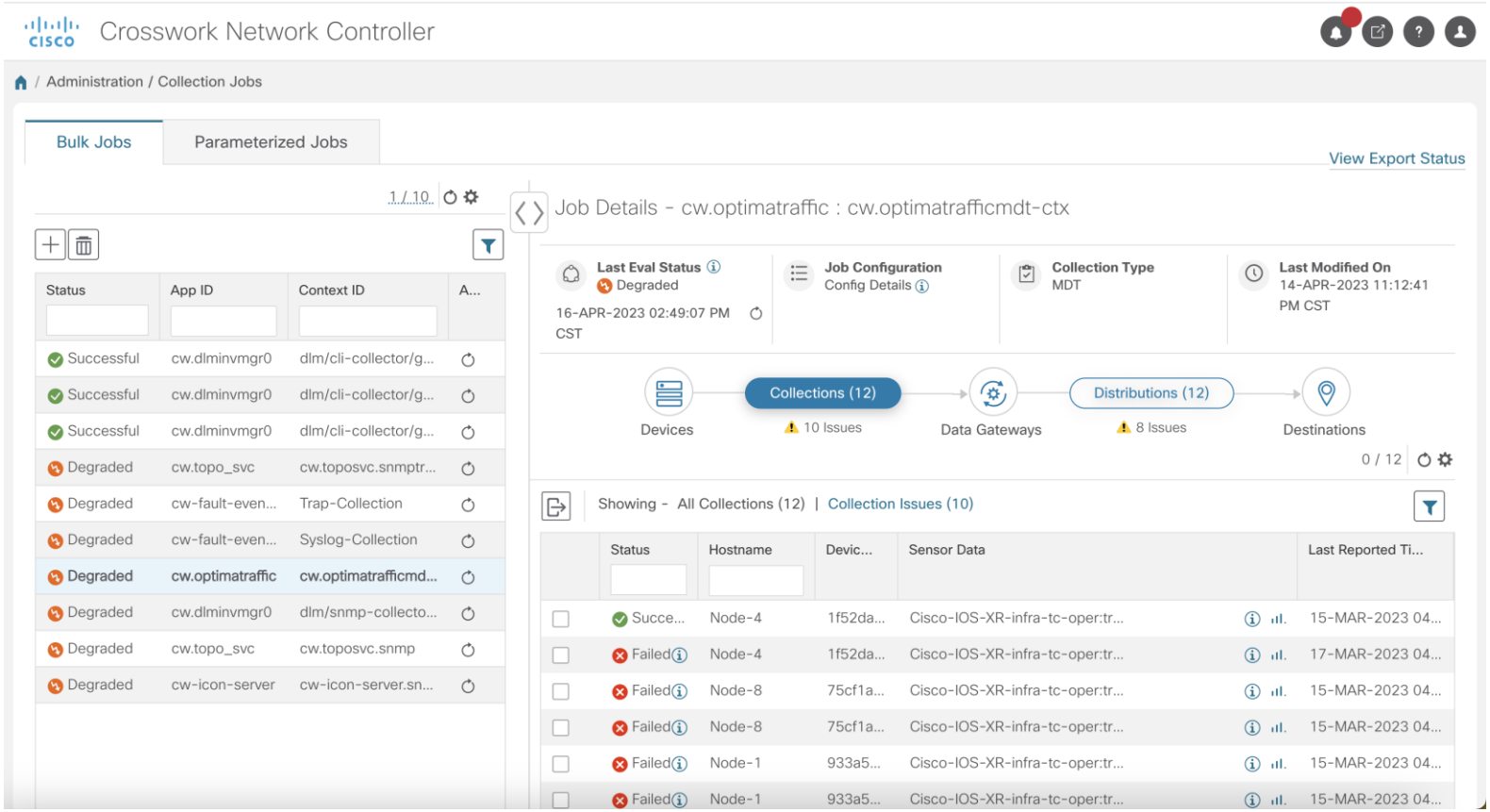
Crosswork Network Controller – Topology



Crosswork Network Controller – Devices



Crosswork Network Controller – Collection Jobs



The Requested Report...

hostname	ip	device_uuid	ssh	snmp_poll	syslog_col	gnmi_kafka	unique_snmpv3_engine_id	Gps_conf	passed_all	cdg_vip	software
Node-5	198.19.1.5	d6378d9b...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	7.7.1
Node-3	198.19.1.3	f288da6e...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	7.7.1
Node-4	198.19.1.4	1f52da5d...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	7.7.1
Node-1	198.19.1.1	933a5b8b...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	7.7.1
Node-2	198.19.1.2	064939ea...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	17.6.1a
Node-7	198.19.1.7	9cc8a130...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	198.18.1.220	7.7.1
Node-8	198.19.1.8	75cf1a0f...	Yes	Yes	No	Yes	Yes	Yes	No	198.18.1.220	7.7.1
Node-1001	10.0.0.1	38b77ebd...	No	No	No	Yes	Yes	Yes	No	198.18.1.220	na
Node-1002	10.0.0.2	539078d2...	No	No	No	Yes	Yes	Yes	No	198.18.1.220	na
Node-1003	10.0.0.3	46267a63...	No	No	No	Yes	Yes	Yes	No	198.18.1.220	na

SSH Connectivity

YES NO

GNMI Collection

YES NO

CNC Device Status

UP DOWN

Unique Engine ID

YES NO

Full Connectivity

YES NO

Best practices of tuning Ansible performance

Best practices of tuning Ansible performance

Time Consumption

- Use callback plugins for task time detection

Resource Utilization

- Use callback plugins for mem/CPU detection

Playbook Design

- Modular approach
- Use modules, variables, roles, inventory
- Use templates, tags

Ansible Settings

- Disable fact gathering
- Use execution strategies (Linear/Free)
- Use async tasks

Connectivity

- Configure parallelism(Forks)
- Configure SSH optimization (Timers/Sessions/Mitogen)
- Disable SSH host key check

Playbook Inspection and Optimization

Playbook Inspection

Time Analysis

Callback	Description	Enablement
ANSIBLE.POSIX. TIMER	Adds total play duration to the play stats.	**In:** ansible.cfg **Add:** callback_whitelist= timer, profile_roles, profile_tasks
ANSIBLE.POSIX. PROFILE_ROLES	Adds timing information to roles.	
ANSIBLE.POSIX. PROFILE_TASKS	Ansible callback plugin for timing individual tasks and overall execution time.	

Playbook Inspection

Time Analysis Example

TIMER

Playbook run took 0 days, 0 hours, 2 minutes, 39 seconds

PROFILE_ROLES

Monday 22 May 2023 14:32:13 -0400 (0:00:00.340)	0:02:39.106
CONNECTIVITY-CHECK	154.75s
GET_CROSSWORK_AUTHENTICATION	1.60s
...	
total	159.08s

PROFILE_TASKS

CONNECTIVITY-CHECK : Create a dictionary with device UUID and SNMPv3 engineID	116.02s
CONNECTIVITY-CHECK : Create device_connectivity_full_list in CSV format	1.52s
CONNECTIVITY-CHECK : Invoke collection job 1 status (one API call)	0.78s
...	

Playbook Inspection

Resource Analysis

Callback	Description	Enablement
COMMUNITY.GENERAL. CGROUP_MEMORY_RECAP	This is an Ansible callback plugin that profiles maximum memory usage of Ansible and individual tasks and displays a recap at the end using cgroups.	1. Install cgroup-tools 2. **In:** ansible.cfg **Add:** callback_whitelist = cgroup_memory_recap, cgroup_perf_recap 3. Add the user to cgroup 4. Run the playbook using the cgroup
ANSIBLE.POSIX. CGROUP_PERF_RECAP	This is an Ansible callback plugin that utilizes cgroups to profile system activity of Ansible and individual tasks and display a recap at the end of the playbook execution.	

Playbook Inspection

Resource Analysis Example

CGROUP_MEMORY_RECAP

Execution Maximum: 1149.34MB

Gathering Facts (00000000002e):	110.86MB
CONNECTIVITY-CHECK : Invoke API to obtain device UUID from CW (00000000000e):	411.53MB
CONNECTIVITY-CHECK : Create a dictionary with UUIDs and SNMPv3 engineID (00000000000f):	1149.34MB
ONNECTIVITY-CHECK : Invoke collection job 1 status (one API call) (000000000013):	326.39MB
CONNECTIVITY-CHECK : Create device_connectivity_full_list in CSV format (000000000022):	447.68MB

...

Playbook Inspection

Resource Analysis Example

CGROUP_PERF_RECAP

cpu Execution Maximum: 129.24%
pids Execution Maximum: 20.00

cpu:
Gathering Facts (00000000002e): 109.07%
CONNECTIVITY-CHECK : Invoke API to obtain device UUID from CW (00000000000e): 108.67%
CONNECTIVITY-CHECK : Create a dictionary with UUIDs and SNMPv3 engineID (00000000000f): 129.24%
CONNECTIVITY-CHECK : Invoke collection job 1 status (one API call) (000000000013): 106.48%
CONNECTIVITY-CHECK : Create device_connectivity_full_list in CSV format (000000000022): 113.79%
...
pids:
Gathering Facts (00000000002e): 12.00
CONNECTIVITY-CHECK : Invoke API to obtain device UUID from to CW (00000000000e): 11.00
CONNECTIVITY-CHECK : Create a dictionary UUIDs and SNMPv3 engineID (00000000000f): 9.00
CONNECTIVITY-CHECK : Invoke collection job 1 status (one API call) (000000000013): 11.00
CONNECTIVITY-CHECK : Create device_connectivity_full_list in CSV format (000000000022): 20.00
...

The Requested Report... Playbook Inspection

Resource Analysis Example

Time Consumption

- The full playbook was taking **30 min** to complete
- Tasks creating a custom list of dictionaries was consuming **68%** (≈ **20min**)

*Values were taken on an m5.2xlarge EC2 Instance

The Requested Report... Playbook Inspection

Resource Analysis Example

Time Consumption	Resource Utilization
• The full playbook was taking **30 min** to complete • Tasks creating a custom list of dictionaries was consuming **68%** (≈ **20min**)	• The playbook caused memory exhaustion. • Tasks creating custom dictionary list using 92% of total memory.

*Values were taken on an m5.2xlarge EC2 Instance

The Requested Report… Playbook Optimization

Design Analysis

Playbook Design

Problem

- Inefficient data filtering in creating dictionary list:
  - Using Traditional loop control

The Requested Report… Playbook Optimization

Design Analysis

Playbook Design

Problem	Solution

• Inefficient data filtering in creating dictionary list:
  • Using Traditional loop control
	• Refactor the tasks functions:
	  • Use of json_query (JMESPath Query)
	  • Pre-filter data before analyzing

The Requested Report… Playbook Optimization

Design Example

Playbook Design

Initial

```
- name: create a dictionary with device UUID and SNMPv3 engineID
  set_fact:
    device_snmp_engineID: "{{ device_snmp_engineID | default([]) | combine ({ item.0.uuid : item.1.snmpv3_engine_id }) }}"
  loop_control:
    label: "{{item.0.host_name}}"
  when: ( device_list_length | int == 0 or item.0.host_name.split('.')[0] in device_list | map('trim') )  and item.1.port == 161 and item.1.snmpv3_engine_id is defined
  with_subelements:
    - "{{getDeviceUUIDOutputFULL.json.data}}"
    - connectivity_info
```

Optimized

```
- name: create a dictionary with device UUID and SNMPv3 engineID
  set_fact:
    device_snmp_engineID: "{{ device_snmp_engineID | default({}) | combine({ item.uuid: item.connectivity_info[].snmpv3_engine_id }) }}"
  loop: "{{ getDeviceUUIDOutputFULL.json.data | json_query('[? port == `161` && connectivity_info[? snmpv3_engine_id ]].{uuid: uuid, connectivity_info: connectivity_info}') }}"
  loop_control:
    label: "{{ item.connectivity_info | map(attribute='host_name') | first }}"
  when: device_list_length | int == 0 or item.connectivity_info[0].host_name.split('.')[0] in device_list | map('trim')
```

The Requested Report... Playbook Inspection

Resource Analysis After Optimization

Time Consumption

- The playbook is taking **<10 min** to complete

*Values were taken on an m5.2xlarge EC2 Instance

The Requested Report... Playbook Inspection

Resource Analysis After Optimization

Time Consumption	Resource Utilization
• The playbook is taking **<10 min** to complete	• The playbook is using < 8GB of memory to complete

*Values were taken on an m5.2xlarge EC2 Instance

Demo

Summary

Fill out your session surveys!

Attendees who fill out a minimum of four session surveys and the overall event survey will get **Cisco Live-branded socks** (while supplies last)!

Attendees will also earn 100 points in the **Cisco Live Challenge** for every survey completed.

These points help you get on the leaderboard and increase your chances of winning daily and grand prizes

Continue your education

- Visit the Cisco Showcase for related demos
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- Attend the interactive education with DevNet, Capture the Flag, and Walk-in Labs
- Visit the On-Demand Library for more sessions at www.CiscoLive.com/on-demand

The bridge to possible

Thank you

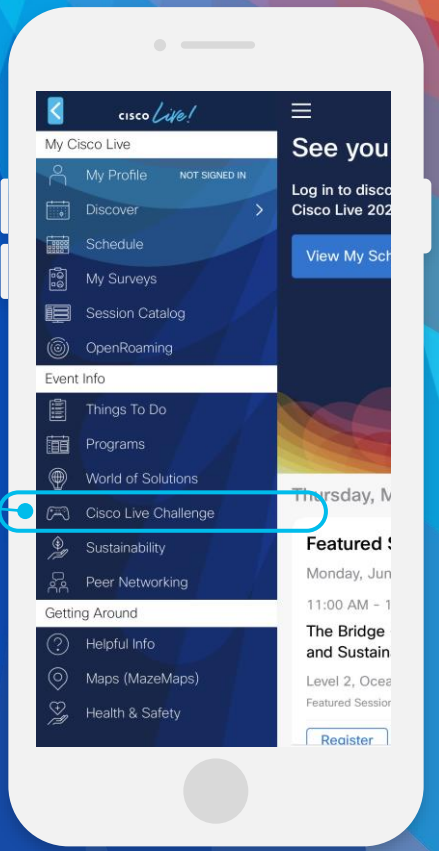
Cisco Live
Challenge

Gamify your Cisco Live experience!

Get points for attending this session!

How:

1. Open the Cisco Events App.
2. Click on 'Cisco Live Challenge' in the side menu.
3. Click on View Your Badges at the top.
4. Click the + at the bottom of the screen and scan the QR code:

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Demo Backup

Original Playbook

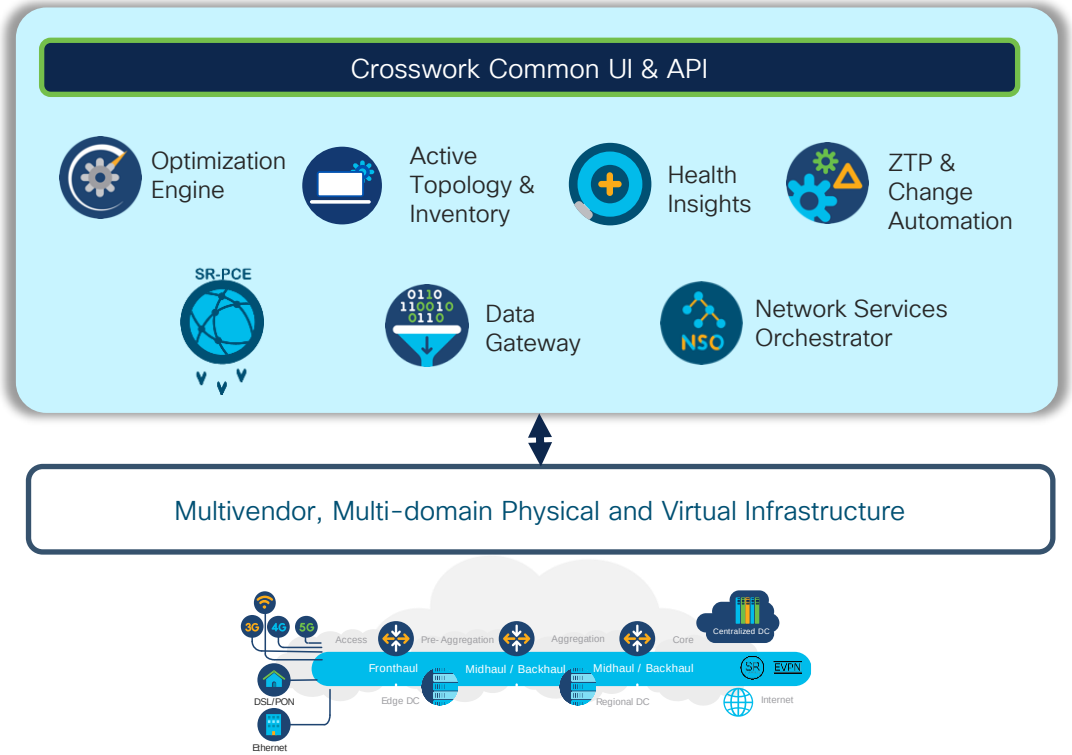
```
...
PLAY RECAP
localhost : ok=24 changed=8 unreachable=0 failed=0 skipped=3 rescued=0 ignored=0
Playbook run took 0 days, 0 hours, 2 minutes, 56 seconds
<OMITTED>
CONNECTIVITY-CHECK : Invoke nodes query API to obtain device UUID for devices that are onboarded to CW ------------------------------------------- 46.71s
<OMITTED>

Thursday 25 May 2023 18:04:25 -0400 (0:00:00.311) 0:02:56.540
CONNECTIVITY-CHECK ------------------------------------------------- 173.89s
GET_CROSSWORK_AUTHENTICATION ---------------------------------------- 1.92s
<OMITTED>
total ------------------------------------------------------------------ 176.52s

CGROUP PERF RECAP
Memory Execution Maximum: 1584.15MB
cpu Execution Maximum: 187.41%
pids Execution Maximum: 25.00

memory:
CONNECTIVITY-CHECK : Create a dictionary with device UUID and SNMPv3 engineID (a306de6e-b67a-951f-8724-00000000000f): 1584.15MB
<OMITTED>
cpu:
CONNECTIVITY-CHECK : Create a dictionary with device UUID and SNMPv3 engineID (a306de6e-b67a-951f-8724-00000000000f): 187.41%
<OMITTED>
pids:
GET_CROSSWORK_AUTHENTICATION : Get.ticket.step1 (a306de6e-b67a-951f-8724-0000000000ad): 25.00
<OMITTED>
CGROUP MEMORY RECAP
Execution Maximum: 1584.15MB
<OMITTED>
CONNECTIVITY-CHECK : Create a dictionary with device UUID and SNMPv3 engineID (a306de6e-b67a-951f-8724-00000000000f): 1584.15MB
...
```

Optimized Playbook

```
...
PLAY RECAP
localhost : ok=38 changed=3 unreachable=0 failed=0 skipped=3 rescued=0 ignored=0
Playbook run took 0 days, 0 hours, 0 minutes, 52 seconds
<OMITTED>
CONNECTIVITY-CHECK : Invoke nodes query API to obtain device UUID for devices that are onboarded to CW ---------------------------------------------- 40.82s
<OMITTED>

Thursday 25 May 2023 18:07:58 -0400 (0:00:00.641) 0:00:52.889 **********
CONNECTIVITY-CHECK ------------------------------------------------------ 50.06s
GET_CROSSWORK_AUTHENTICATION ------------------------------------------- 2.08s
<OMITTED>
total ------------------------------------------------------------------- 52.87s

CGROUP PERF RECAP
Memory Execution Maximum: 857.13MB
cpu Execution Maximum: 121.70%
pids Execution Maximum: 32.00

memory:
CONNECTIVITY-CHECK : Generate device connectivity in CSV format for ansible version >=2.10.0 (a306de6e-b67a-e9b3-8a93-00000000002e): 857.13MB
<OMITTED>
cpu:
CONNECTIVITY-CHECK : Invoke nodes query API to obtain device UUID for devices that are onboarded to CW (a306de6e-b67a-e9b3-8a93-00000000000f): 121.70%
<OMITTED>
pids:
CONNECTIVITY-CHECK : Invoke collection job 2 status (one API call) (a306de6e-b67a-e9b3-8a93-00000000001c): 32.00
<OMITTED>
CGROUP MEMORY RECAP
Execution Maximum: 857.13MB
<OMITTED>
CONNECTIVITY-CHECK : Generate device connectivity in CSV format for ansible version >=2.10.0 (a306de6e-b67a-e9b3-8a93-00000000002e): 857.13MB
...
```

Backup Slides

Crosswork Network Controller – Solution Overview



- Service Provisioning (L2VPN & L3VPN)
- Service-Oriented Transport Provisioning (Segment Routing & RSVP-TE)
- Bandwidth Optimization (Local Congestion Mitigation)
- Real-time Network Optimization
- Topology & Inventory
- Performance monitoring & closed loop
- Network Maintenance
- Initial Setup – Secure ZTP (Day-0)