

The background is a vibrant, abstract graphic. It features a central bright white light source from which numerous colorful rays emanate, creating a sunburst or starburst effect. The rays transition through a spectrum of colors: yellow, orange, red, pink, purple, blue, and green. Overlaid on this are large, soft, wavy shapes in shades of orange, red, and yellow, giving the impression of clouds or flowing liquid. The overall composition is dynamic and energetic.

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Let's go

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The bridge to possible

Inspect and Optimize the Performance of Ansible Playbooks

Weigang Huang, Pablo Bonilla
Senior Software Architect
DEVNET-2104

CISCO *Live!*

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Cisco Webex App

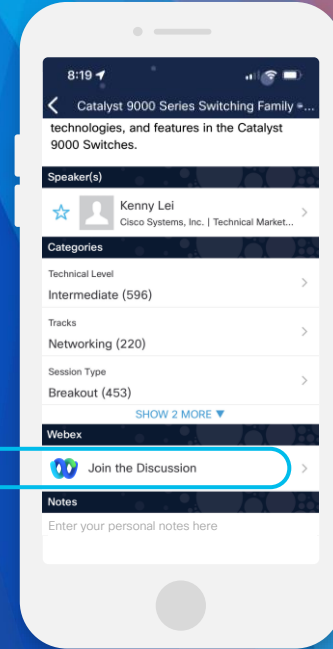
Questions?

Use Cisco Webex App to chat with the speaker after the session

How

- 1 Find this session in the Cisco Live Mobile App
- 2 Click “Join the Discussion”
- 3 Install the Webex App or go directly to the Webex space
- 4 Enter messages/questions in the Webex space

Webex spaces will be moderated by the speaker until June 9, 2023.



<https://ciscolive.ciscoevents.com/ciscolivebot/#DEVNET-2104>

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

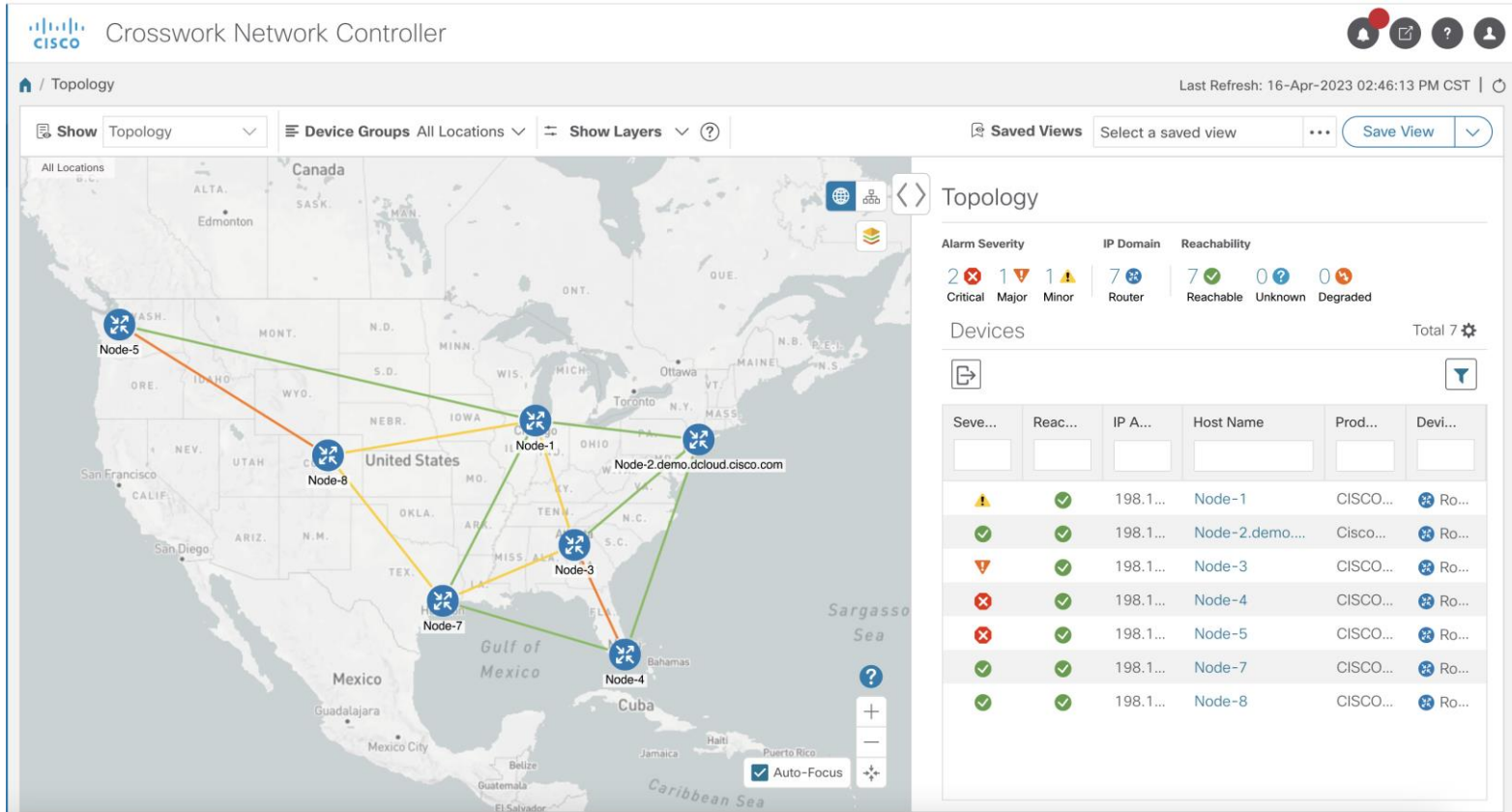
- This session is **not** to:
 - Teach Ansible basics
 - Teach CNC basics

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










/ Device Management / Network Devices


Network Devices


































 Type to filter by tags

Devices Selected 0 / Total 5087  





NSO Actions 



	Reachability State	IP Address ?	Host Name	Admin State	Operational State	NSO State	Lock Status	Data Gateway	Last Updated Time	Softw
<input type="checkbox"/>	✓ Reachable	198.19.1.2/...  	Node-2.de...	✓ Up	↑ OK	✓ Synced 	🔒 Unlock	CDG_Pool_1-1	15-MAR-2023 04:12...	IOS >
<input type="checkbox"/>	✓ Reachable	198.19.1.7/...  	Node-7	✓ Up	↑ OK	✓ Synced 	🔒 Unlock	CDG_Pool_1-1	15-MAR-2023 04:12...	IOS >
<input type="checkbox"/>	✓ Reachable	198.19.1.8/...  	Node-8	✓ Up	↑ OK	✓ Synced 	🔒 Unlock	CDG_Pool_1-1	15-MAR-2023 04:12...	IOS >
<input type="checkbox"/>	⚡ Unreachable	10.0.0.1/32  	Node-1001	✓ Up	✗ Error (5) 	✗ Error 	🔒 Unlock	CDG_Pool_1-1	12-APR-2023 09:08:...	
<input type="checkbox"/>	⚡ Unreachable	10.0.0.2/32  	Node-1002	✓ Up	✗ Error (5) 	✗ Error 	🔒 Unlock	CDG_Pool_1-1	12-APR-2023 09:08:...	
<input type="checkbox"/>	⚡ Unreachable	10.0.0.3/32  	Node-1003	✓ Up	✗ Error (5) 	✗ Error 	🔒 Unlock	CDG_Pool_1-1	12-APR-2023 09:08:...	
<input type="checkbox"/>	❓ Unknown	10.0.0.41/32  	Node-1041	⬇ Down	⬇ Down (5) 	✗ Error 	🔒 Unlock	None	11-APR-2023 05:53:...	
<input type="checkbox"/>	❓ Unknown	10.0.0.5/32  	Node-1005	⬇ Down	⬇ Down (5) 	✗ Error 	🔒 Unlock	None	11-APR-2023 05:53:...	
<input type="checkbox"/>	❓ Unknown	10.0.0.6/32  	Node-1006	⬇ Down	⬇ Down (5) 	✗ Error 	🔒 Unlock	None	11-APR-2023 05:53:...	

Crosswork Network Controller – Collection Jobs

 Crosswork Network Controller





[Administration / Collection Jobs](#)



Bulk Jobs


Parameterized Jobs











[View Export Status](#)




1.1.10.10 



 Job Details - cw.optimattraffic : cw.optimattrafficmdt-ctx









Status	App ID	Context ID	A...
	Successful	cw.dlminvmgr0	dlm/cli-collector/g...
	Successful	cw.dlminvmgr0	dlm/cli-collector/g...
	Successful	cw.dlminvmgr0	dlm/cli-collector/g...
	Degraded	cw.topo_svc	cw.toposvc.snmptr...
	Degraded	cw-fault-even...	Trap-Collection
	Degraded	cw-fault-even...	Syslog-Collection
	Degraded	cw.optimattraffic	cw.optimattrafficmd...
	Degraded	cw.dlminvmgr0	dlm/snmp-collecto...
	Degraded	cw.topo_svc	cw.toposvc.snmp
	Degraded	cw-icon-server	cw-icon-server.sn...



 Last Eval Status 
 Degraded
16-APR-2023 02:49:07 PM CST


 Job Configuration
Config Details 


 Collection Type
MDT



 Last Modified On
14-APR-2023 11:12:41 PM CST
























 Collections (12)
 10 Issues

 Distributions (12)
 8 Issues



0 / 12 

 Showing - All Collections (12) | Collection Issues (10) 

	Status	Hostname	Devic...	Sensor Data	Last Reported Ti...
<input type="checkbox"/>	 Suce...	Node-4	1f52da...	Cisco-IOS-XR-infra-tc-oper.tr...	  15-MAR-2023 04...
<input type="checkbox"/>	 Failed 	Node-4	1f52da...	Cisco-IOS-XR-infra-tc-oper.tr...	  17-MAR-2023 04...
<input type="checkbox"/>	 Failed 	Node-8	75cf1a...	Cisco-IOS-XR-infra-tc-oper.tr...	  15-MAR-2023 04...
<input type="checkbox"/>	 Failed 	Node-8	75cf1a...	Cisco-IOS-XR-infra-tc-oper.tr...	  15-MAR-2023 04...
<input type="checkbox"/>	 Failed 	Node-1	933a5...	Cisco-IOS-XR-infra-tc-oper.tr...	  15-MAR-2023 04...
<input type="checkbox"/>	 Failed 	Node-1	933a5...	Cisco-IOS-XR-infra-tc-oper.tr...	  15-MAR-2023 04...

The Requested Report...

hostname	ip	device_uuid	ssh	snmp_poll	syslog_col	gnmi_kafka	unique_snm pv3_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



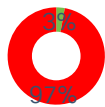
■ YES ■ NO

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
ANSIBLE.POSIX. PROFILE_ROLES	Adds timing information to roles.	Add: callback_whitelist= timer, profile_roles,
ANSIBLE.POSIX. PROFILE_TASKS	Ansible callback plugin for timing individual tasks and overall execution time.	profile_tasks

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.	<ol style="list-style-type: none">1. Install cgroup-tools2. In: ansible.cfg Add: callback_whitelist = cgroup_memory_recap, cgroup_perf_recap
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.	<ol style="list-style-type: none">3. Add the user to cgroup4. Run the playbook using the cgroup

Playbook Inspection

Resource Analysis Example

CGROUP_MEMORY_RECAP

Execution Maximum: 1149.34MB ←

Gathering Facts (000000000002e):	110.86MB
CONNECTIVITY-CHECK : Invoke API to obtain device UUID from CW (000000000000e):	411.53MB
CONNECTIVITY-CHECK : Create a dictionary with UUIDs and SNMPv3 engineID (000000000000f):	1149.34MB →
CONNECTIVITY-CHECK : Invoke collection job 1 status (one API call) (0000000000013):	326.39MB
CONNECTIVITY-CHECK : Create device_connectivity_full_list in CSV format (0000000000022):	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
<ul style="list-style-type: none">• The full playbook was taking 30 min to complete• Tasks creating a custom list of dictionaries was consuming 68% (≈ 20min)	<ul style="list-style-type: none">• 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

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

Solution

- 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
<ul style="list-style-type: none">• The playbook is taking <10 min to complete	<ul style="list-style-type: none">• 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
- Book your one-on-one Meet the Engineer meeting
- 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!*

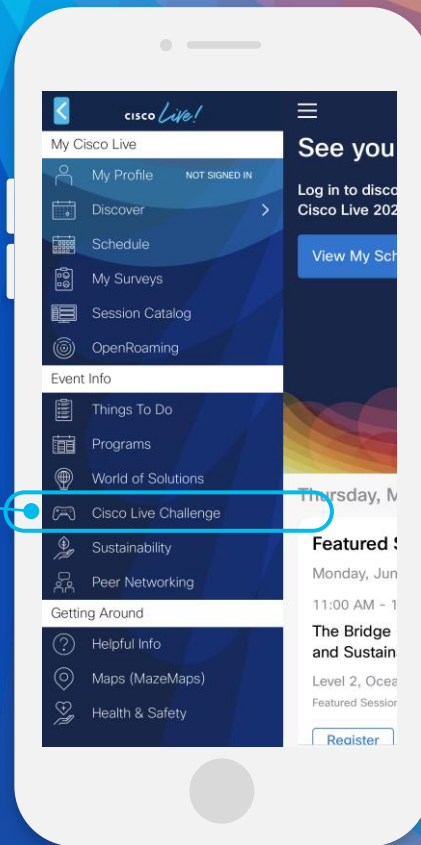
#CiscoLive

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:



The background features a vibrant, multi-colored abstract design. On the left, there are overlapping, wavy bands of color in shades of red, orange, yellow, and green. On the right, a bright white light source emits a series of colorful rays in shades of blue, cyan, and yellow, creating a sunburst effect. The overall composition is dynamic and energetic.

cisco *Live!*

Let's go

#CiscoLive

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-8724-00000000000ad): 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
...
```



Microsoft Word
Document

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

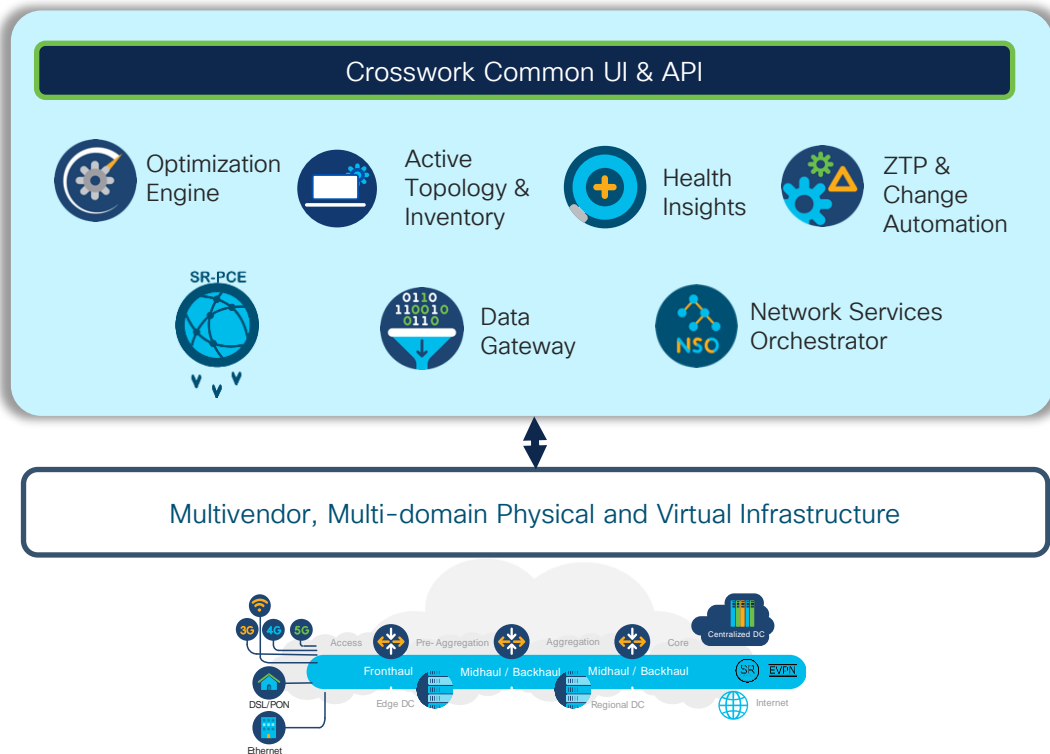
memory:
CONNECTIVITY-CHECK : Generate device connectivity in CSV format for ansible version >=2.10.0 (a306de6e-b67a-e9b3-8a93-00000000002e): 857.13MB
<OMITTED>
cpu:
CONNECTIVITY-CHECK : Invoke nodes query API to obtain device UUID for devices that are onboarded to CW (a306de6e-b67a-e9b3-8a93-00000000000f): 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
...
```



Microsoft Word
Document

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)