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The bridge to possible

Enhanced Automation of a Meraki-based Environment

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DEVNET-2200

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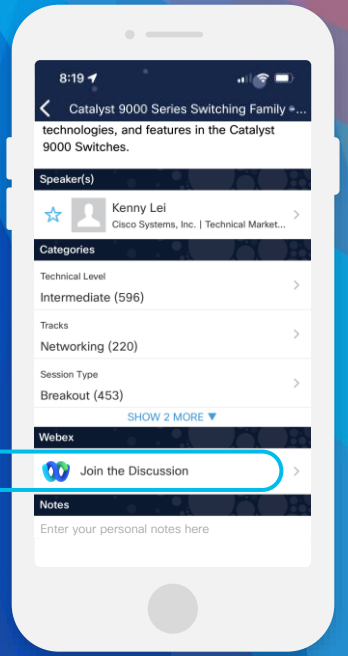


https://ciscolive.ciscoevents.com/ciscolivebot/#DEVENT-2200

Agenda

- Situation
- Proposed Solution
- Imagineering
- Refining
- Where the code is

Situation

A real-life scenario

- You are new to Meraki gear and happy with it
- Look -- Here come examiners to do audits
- Time to pull out proof of compliance!

Bruh, Meraki equipment is cloud-managed.

There are *NO* configs to download and review.
This isn't IOS-XE or NX-OS!

“Oh, that’s OK, we’ll just give the Auditor login access to our thousands of Meraki networks and devices

They can check themselves…”

$$\lim_{x \to \infty} f(x_{score}) = \frac{1}{x}$$

Math of Auditors

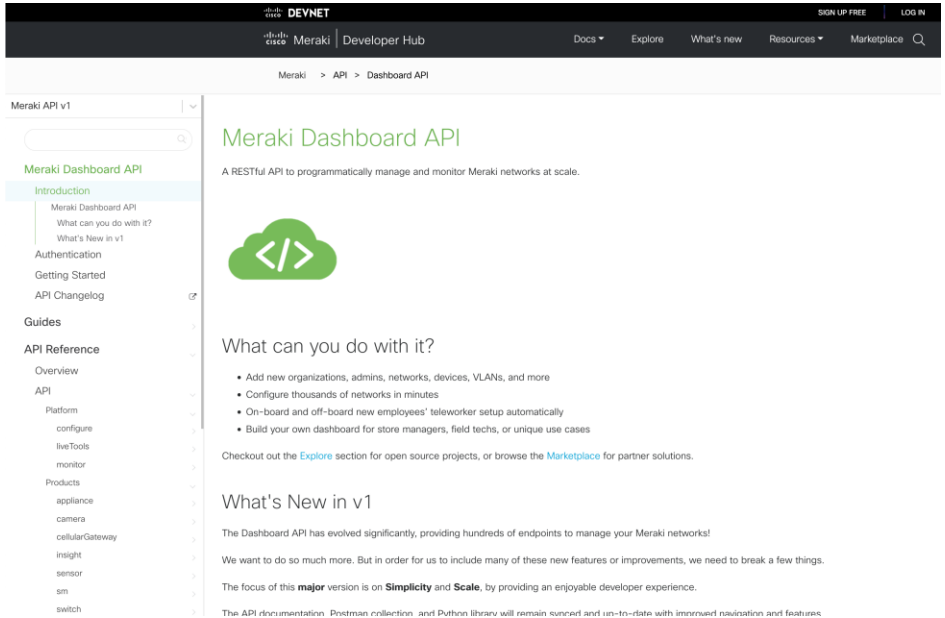
Imagineering

Getting the Requirements

- We must produce an approximation or analog of a device config
- Data format needs to be consumable and programmatically viable
- We need to store the data securely as it contains sensitive device configuration info
- Diffs must be able to be generated between runs
- We need to define how often to collect and analyze

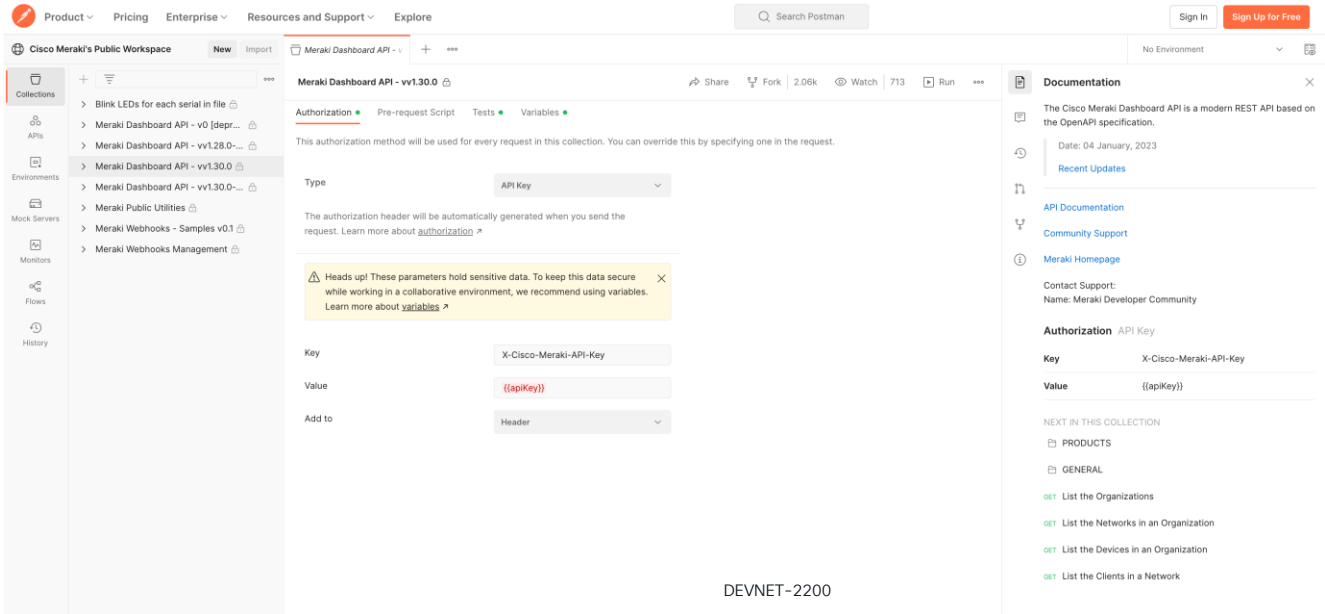
How Researched

- Meraki Dashboard API documentation
  https://developer.cisco.com/meraki/api-v1/



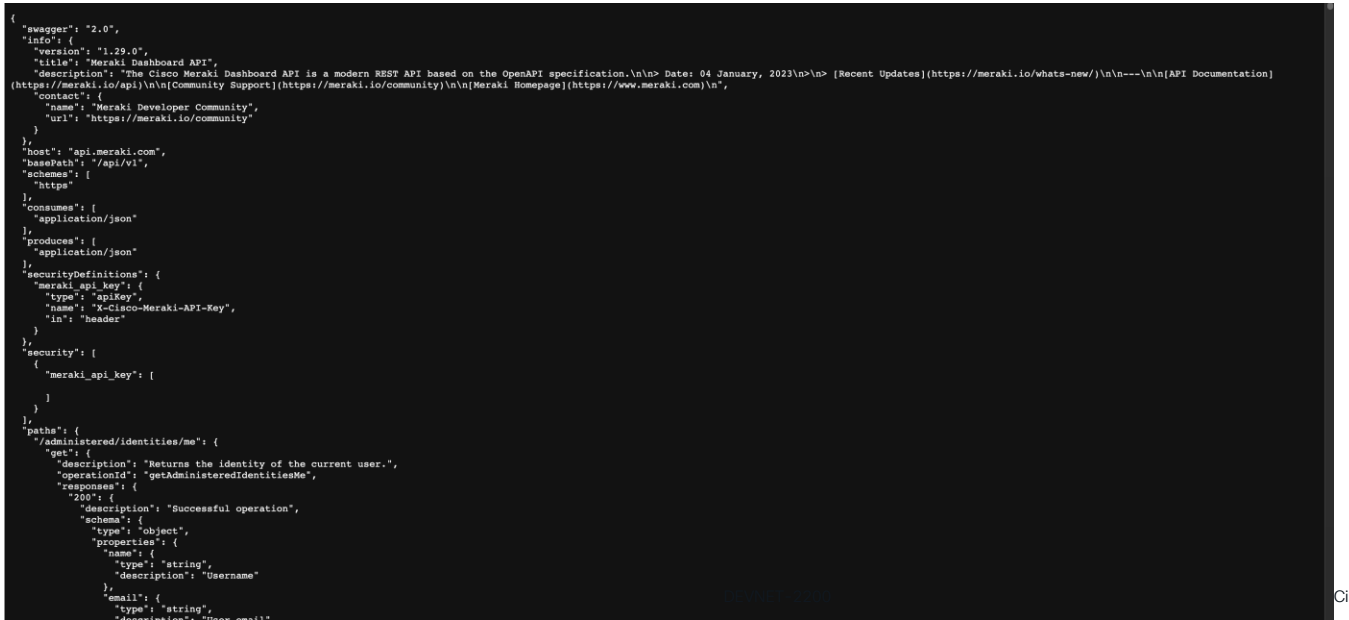
How Researched

- Postman collection
  http://cs.co/900438EmA



How Researched

- OpenAPI spec published to GitHub
  https://github.com/meraki/openapi



Parameterized API URLs

- Recognize data is indexed in several forms: organization, network, device

[, Interface, clientId, portId, vlanId, etc]

GET networks
https://api.meraki.com/api/v1/organizations/:organizationId/networks

GET devices
https://api.meraki.com/api/v1/organizations/:organizationId/devices

First Implementation

- Wrote a Python program to collect all network and device instances in an org; sequentially polled each API endpoint from OpenAPI spec

Logic	operationId	tags	description
	getOrganizationNetworks	['organizations', 'configure', 'networks']	List the networks that the user has priv
	getOrganizationConfigTemplates	['organizations', 'configure', 'configTemplates']	List the configuration templates for thi
	getOrganizationLicensesOverview	['organizations', 'monitor', 'licenses', 'overview']	Return an overview of the license state
	getOrganizationInventoryDevices	['organizations', 'configure', 'inventoryDevices']	Return the device inventory for an orga
	getOrganizationDevices	['organizations', 'configure', 'devices']	List the devices in an organization
	getOrganizationAdmins	['organizations', 'configure', 'admins']	List the dashboard administrators in th
	getOrganizationBrandingPolicies	['organizations', 'configure', 'brandingPolicies']	List the branding policies of an organiz
	getOrganizationBrandingPoliciesPriorities	['organizations', 'configure', 'brandingPolicies', 'priorities']	Return the branding policy IDs of an or
	getOrganizationSaml	['organizations', 'configure', 'saml']	Returns the SAML SSO enabled setting
	getOrganizationSamlIdps	['organizations', 'configure', 'saml', 'idps']	List the SAML IdPs in your organizatior
	getOrganizationSamlRoles	['organizations', 'configure', 'samlRoles']	List the SAML roles for this organizatio
	getOrganizationSnmp	['organizations', 'configure', 'snmp']	Return the SNMP settings for an organ
	getOrganizationApplianceSecurityIntrusion	['appliance', 'configure', 'security', 'intrusion']	Returns all supported intrusion setting
	getOrganizationApplianceVpnThirdPartyVPNPeers	['appliance', 'configure', 'vpn', 'thirdPartyVPNPeers']	Return the third party VPN peers for ar

Results – First Implementation

Archived

Diff-able

Scannable

- Extract Meraki device ***settings*** from the Meraki Dashboard API (REST) and store as JSON records in text files of a local, secure git repo
- Git provides change monitoring; JSON Path Queries enable compliance checking against the settings
- Reports are generated for review
- Light-weight Linux VM on-prem integrates to Meraki Dashboard API as SaaS-friendly deployment

Results – First Implementation

With the thousands of networks and devices, coupled with hundred+ API endpoints to parse...

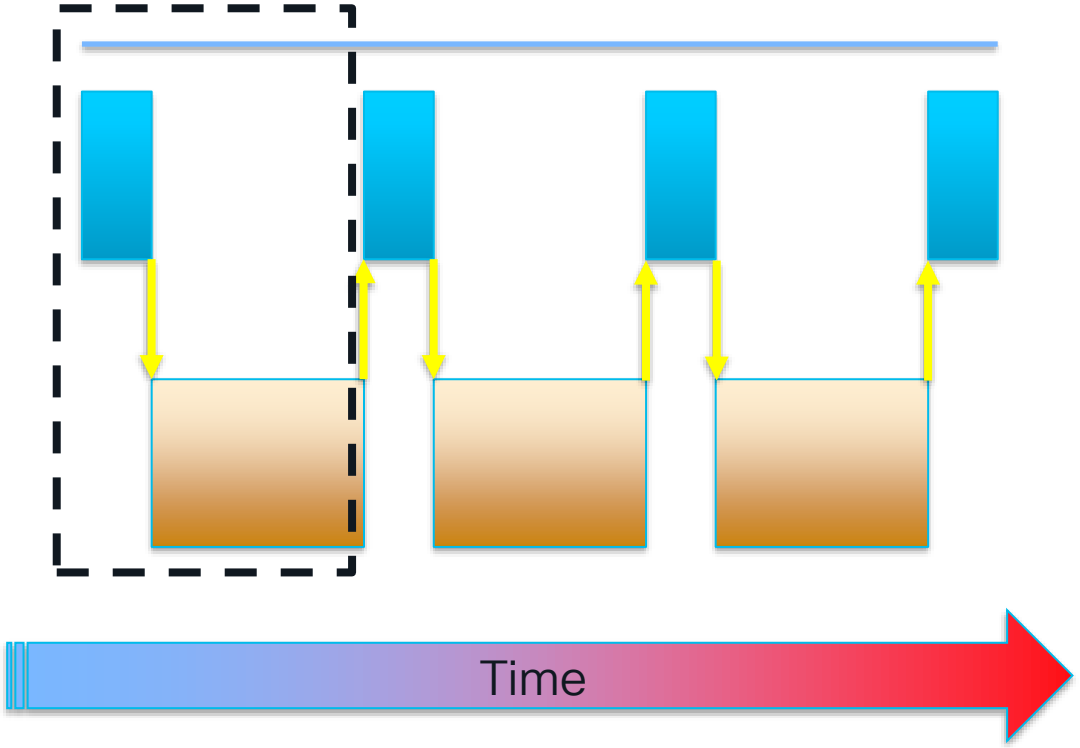
...the first experience due to Meraki API Rate Limiting (5/sec*)

57 hours

Why So? Original view of sequential work

Processing

I/O
Network, Disk



Example - Traditional Sequential Processing

getcard-requests.py > ...

```python
import requests
import time

start_time = time.time()

for number in range(1, 105):
    url = f'https://deckofcardsapi.com/api/deck/new/draw/'
    resp = requests.get(url)
    card = resp.json()
    print(f'{card["cards"][0]["value"]} of {card["cards"][0]["suit"]}')

print("--- %s seconds ---" % (time.time() - start_time))
```

OLE TERMINAL

```
2 of SPADES
7 of HEARTS
KING of SPADES
3 of CLUBS
8 of SPADES
4 of SPADES
3 of DIAMONDS
2 of DIAMONDS
6 of CLUBS
4 of HEARTS
3 of CLUBS
4 of CLUBS
3 of CLUBS
3 of CLUBS
8 of HEARTS
--- 12.645462989807129 seconds ---
```

12.64 seconds

Imagineering – Try 2

- How to speed up?
  Ideally get this down to around 12 hours so running once a day is feasible

- Multiprocessing?
  Multithreading?
  Multiple pollers?

Imagineering – Try 2

First, we need to recognize where the bottlenecks

- My program?

There are definite opportunities to optimize, but that's not the main culprit

- My environment?

No – throwing more compute, memory and faster network doesn't alleviate the cloud-based API server dependency

- The cloud API server dependency?

BINGO! I had 5 (now 10) API calls/sec allotted. Anything I optimize must work within that restriction

Imagineering – Try 2

So, increasing the complexity with Multiprocessing, Multithreading or multiple pollers won't be effective

We need a solution to queue all the work and operate within the constraints of the API server rate-limiting

Leading us to...

AsyncIO

- A type of concurrency that enables a single processor to handle mass amount of work -
  essentially cooperative multitasking
- Good for I/O-bound tasks
- As solution developers ***we*** define the queue of work and when it is OK to swap away to do other work
  - waiting for IO (network, disk)
  - API processing

https://docs.python.org/3/library/asyncio.html

AsyncIO

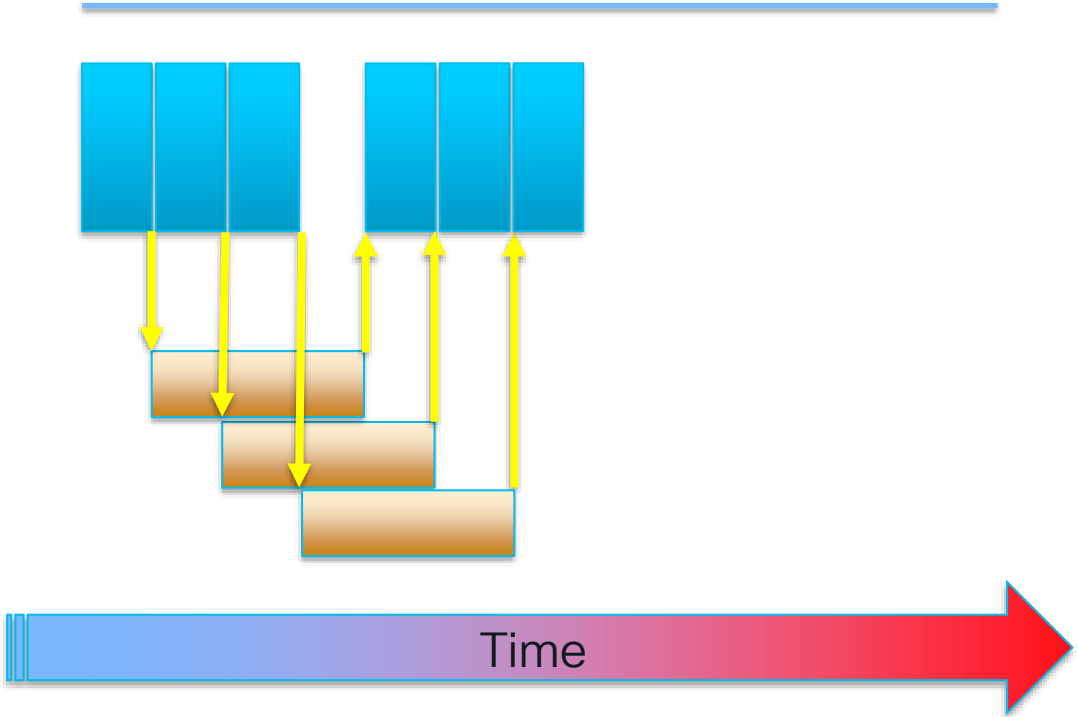
- You load up a ‘queue’ of work and the Python asyncio library uses an event loop to control processing and state of active/awaiting tasks
- You identify tasks that may take time to process, allowing asyncio opportunity to ‘switch away’ to the next task in the event loop queue

With Cooperative Multitasking / asyncio

Processing

I/O

Network, Disk



Example - Cooperative Multitasking with asyncio

getcard-asyncio.py > ...

```
1   import aiohttp
2   import asyncio
3   import time
4
5   start_time = time.time()
6
7   async def main():
8
9       async with aiohttp.ClientSession() as session:
10
11          for number in range(1, 105):
12              url = f'https://deckofcardsapi.com/api/deck/new/draw/'
13              async with session.get(url) as resp:
14                  card = await resp.json()
15                  print(f'{card["cards"][0]["value"]} of {card["cards"][0]["suit"]}')
16
17  asyncio.run(main())
18  print("--- %s seconds ---" % (time.time() - start_time))
```

1

2

3

4 & 5

6

OLE TERMINAL

```
QUEEN of HEARTS
ACE of HEARTS
10 of HEARTS
7 of CLUBS
8 of HEARTS
2 of HEARTS
4 of DIAMONDS
7 of DIAMONDS
4 of CLUBS
5 of HEARTS
--- 5.98675012588501 seconds ---
```

5.99 seconds

52% improvement

Results after Optimization

- Using the same thousands of networks and devices and Meraki API Rate Limiting (5/sec*), the second experience refactored with asyncio

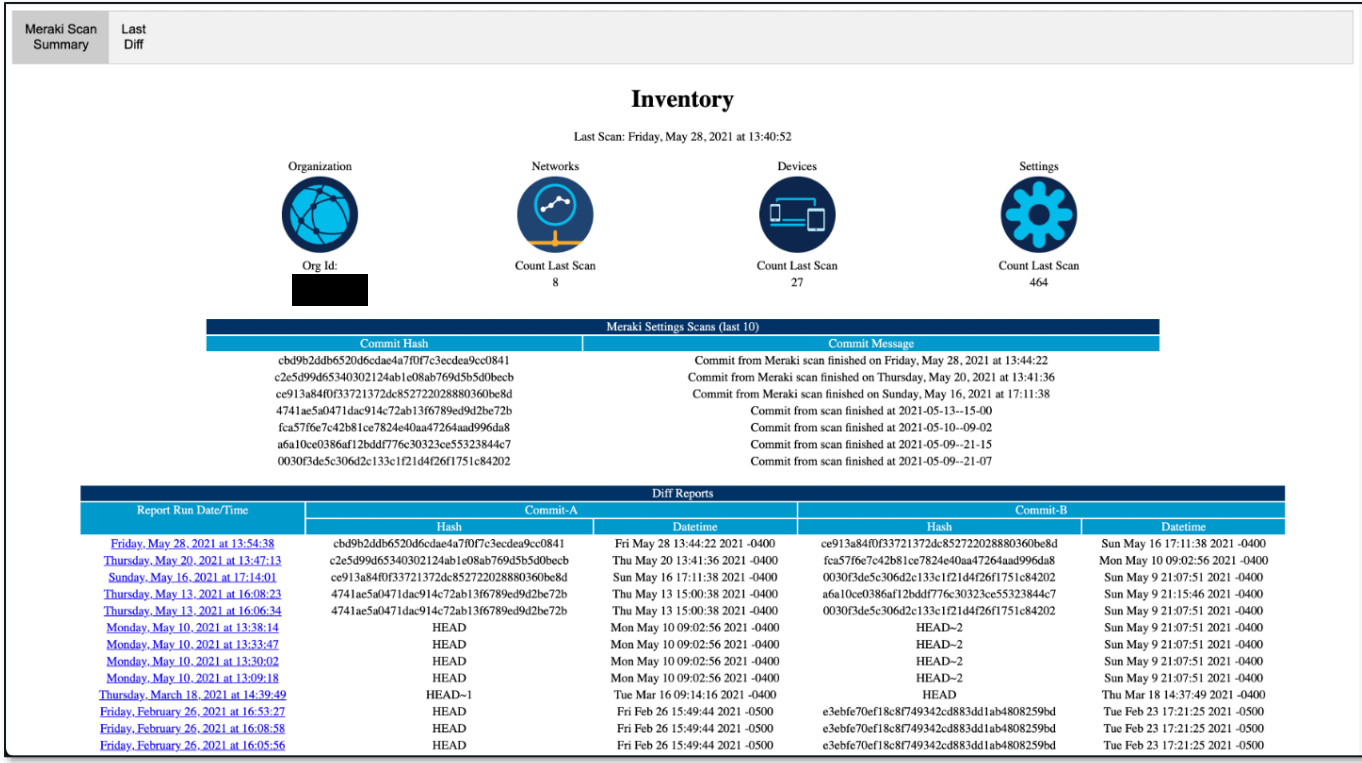
- 13 hours

77% improvement

Output of Meraki Settings Archive & Differ Project

Start Page

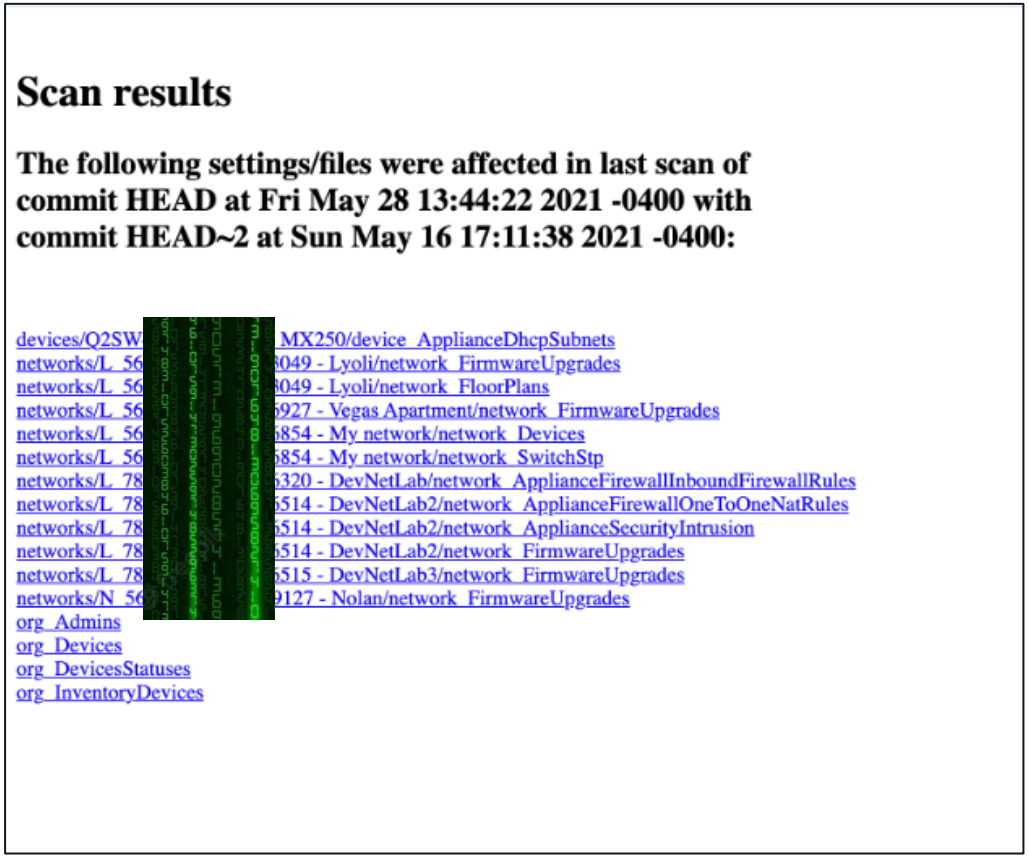
Scan Stats & List Diff Reports



Output of Meraki Settings Archive & Differ Project

Scan Results

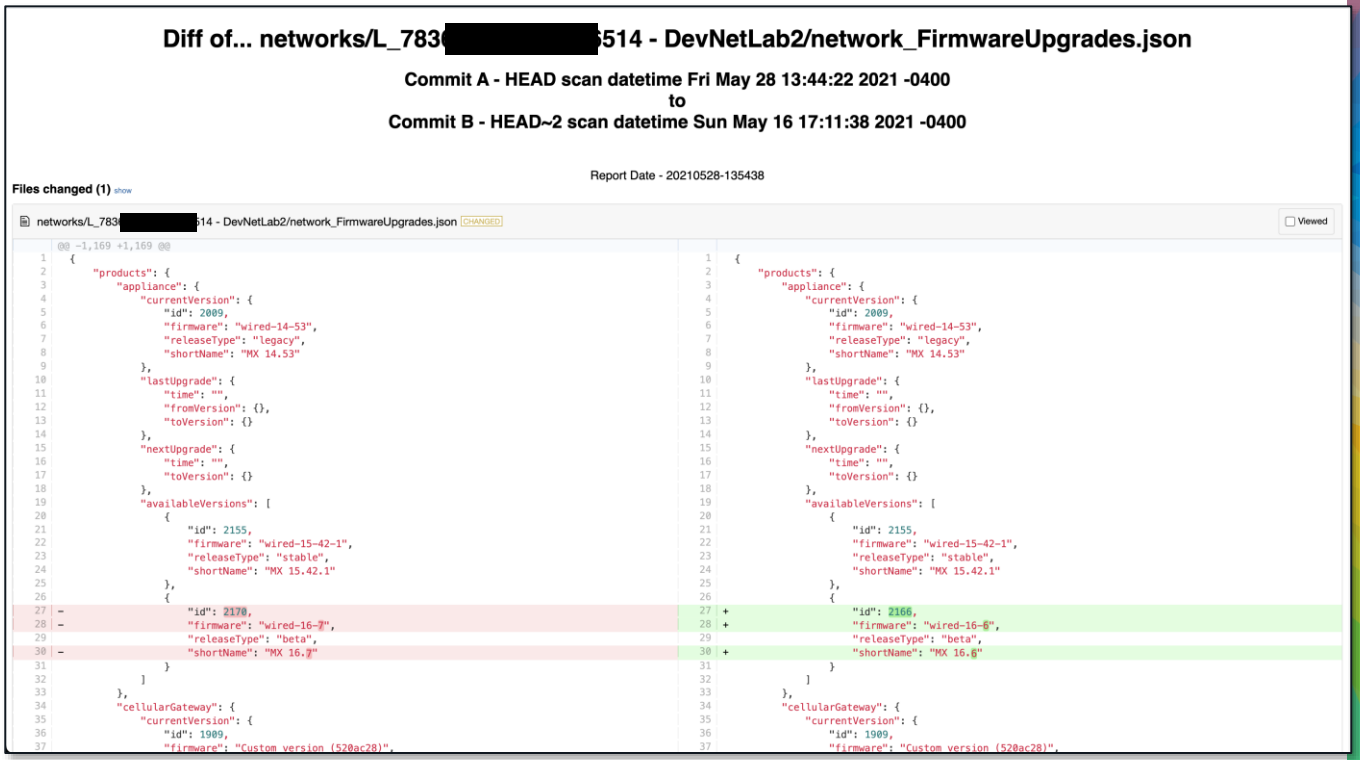
Individual category (Org, Network, Device) settings changes identified



Output of Meraki Settings Archive & Differ Project

Diff Results

Settings Diffs identified and colorized



Diff of... networks/L_783[redacted]514 - DevNetLab2/network_FirmwareUpgrades.json

Commit A - HEAD scan datetime Fri May 28 13:44:22 2021 -0400
to
Commit B - HEAD~2 scan datetime Sun May 16 17:11:38 2021 -0400

Report Date - 20210528-135438

Files changed (1) show

networks/L_783[redacted]514 - DevNetLab2/network_FirmwareUpgrades.json CHANGED — Viewed

```
@@ -1,169 +1,169 @@
 {
     "products": {
         "appliance": {
             "currentVersion": {
                 "id": 2009,
                 "firmware": "wired-14-53",
                 "releaseType": "legacy",
                 "shortName": "MX 14.53"
             },
             "lastUpgrade": {
                 "time": "",
                 "fromVersion": {},
                 "toVersion": {}
             },
             "nextUpgrade": {
                 "time": "",
                 "toVersion": {}
             },
             "availableVersions": [
                 {
                     "id": 2155,
                     "firmware": "wired-15-42-1",
                     "releaseType": "stable",
                     "shortName": "MX 15.42.1"
                 },
                 {
-                    "id": 2170,
-                    "firmware": "wired-16-7",
+                    "id": 2166,
+                    "firmware": "wired-16-6",
                     "releaseType": "beta",
-                    "shortName": "MX 16.7"
+                    "shortName": "MX 16.6"
                 }
             ]
         },
         "cellularGateway": {
             "currentVersion": {
                 "id": 1909,
                 "firmware": "Custom version (520ac28)",
```

Meraki Settings Archive & Differ on Cisco DevNet Code Repo

https://developer.cisco.com/network-automation/detail/bdbdb464-db3a-11eb-95a5-c6918c6fb71b/

Overall Org Compliance Assessment Scoring*

Compliance Assessment

Organization

ORGANIZATION:
48[redacted]

Scan Info

REPORT RUN
Tuesday, April 06, 2021 at 20:13:20
Meraki Data Gathered:
Sat Apr 3 22:15:31 2021 -0400

Detailed Compliance Info

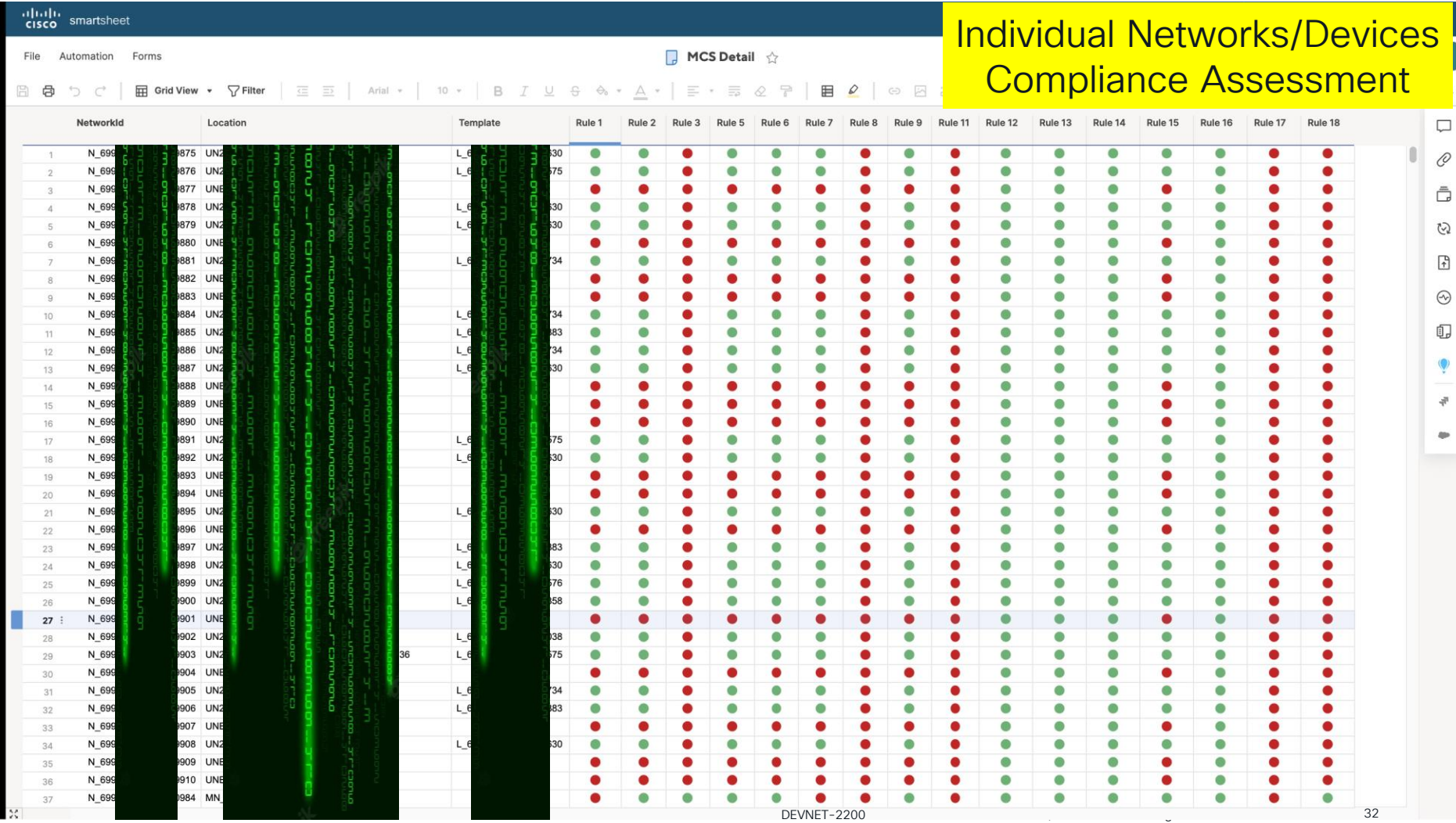
CLICK HERE

77.1%	77.8%	29.9%	78.0%	78.0%	50.7%	0.0%	79.7%	27.7%	100.0%
Rule netw_policy001 2670 / 3461 compliant	Rule netw_policy002 2694 / 3461 compliant	Rule netw_policy003 1035 / 3461 compliant	Rule netw_policy005 2699 / 3461 compliant	Rule netw_policy006 2699 / 3461 compliant	Rule netw_policy007 1754 / 3461 compliant	Rule netw_policy008 1 / 3461 compliant	Rule netw_policy009 2758 / 3461 compliant	Rule netw_policy011 958 / 3461 compliant	Rule netw_policy012 3461 / 3461 compliant
	100.0%	100.0%	77.5%	100.0%	0.0%	2.1%			
	Rule netw_policy013 3461 / 3461 compliant	Rule netw_policy014 3461 / 3461 compliant	Rule netw_policy015 2682 / 3461 compliant	Rule netw_policy016 3460 / 3461 compliant	Rule netw_policy017 0 / 3461 compliant	Rule netw_policy018 74 / 3461 compliant			

Rule Number	Rule Description
Rule 1	Disable local and remote device status pages
Rule 2	Explicit cleanup rule added to end of every L3 FW policy
Rule 3	Explicit cleanup rule added to end of every L3 FW Group Policy
Rule 5	Intrusion detection and prevention is set to: Mode=Prevention, Ruleset=Security

*not part of code repo

Individual Networks/Devices Compliance Assessment



You can do IT too!

Application/Challenge

- Watch for changes on the OpenAPI spec and API docs
  New features come out regularly - latest v1.30 January 4, 2023!
- Pay attention to the indexing of the API endpoints
- Remember you currently have a 10 calls/sec limit
- When dealing with large numbers of API endpoints and devices use asyncio to be more efficient
  Bonus - The Meraki Dashboard API Python library already uses asyncio internally - you only need wrappers for YOUR code

```
pip install meraki
```

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

Fill out your session surveys!

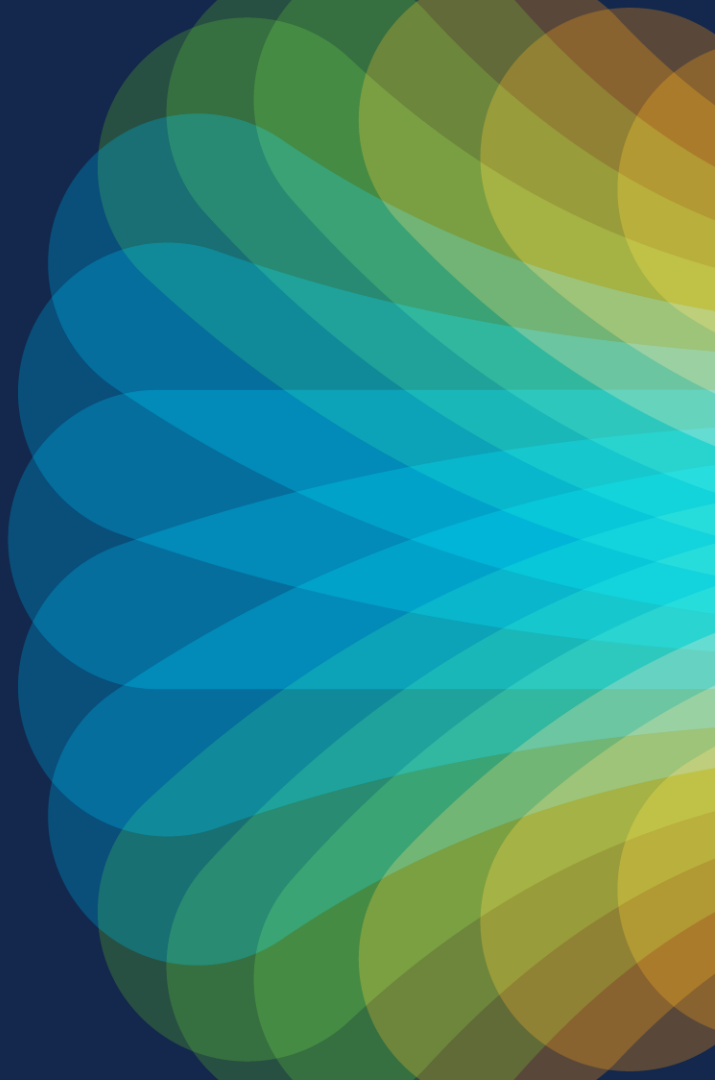
Attendees who fill out a minimum of four session surveys and the overall event survey will get **Cisco Live-branded socks** (while supplies last)!

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

The bridge to possible

Thank you

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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: