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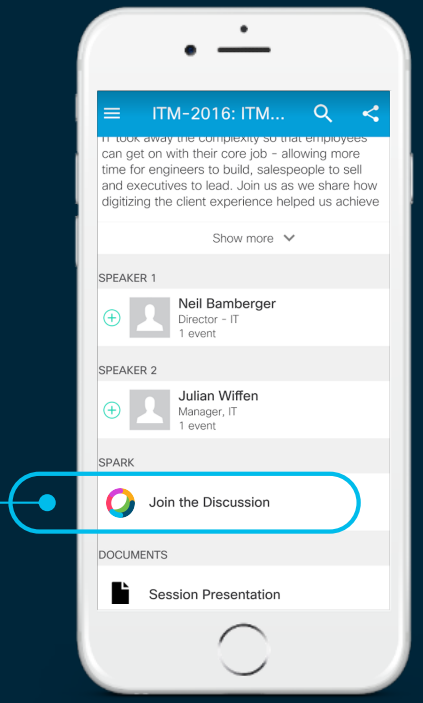

cs.co/ciscolivebot#DEVWKS-2594

Leveraging NX-API for Customized Operational Analytics

Dr Tim Miller, Virtual CSE DC/Cloud
@broadcaststorm

DEVWKS-2594

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June 9-13, 2019 • San Diego, CA
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Agenda

- Introduction
- NX-API Overview
- Metrics and Monitoring
- Hands On
- Conclusion

The Remainder of our 45 Minutes

- Who You Are
  - Command Line Fighter Pilot
  - Know your network
  - Have your favorite set of metrics
- What You'll Learn
  - Translate CLI to Python programming
  - Plethora of monitoring tools
  - Parsing and graphing the metrics

Parsing CLI Output

Vintage style versus Hip style

```
Software
  BIOS: version 07.59
  NXOS: version 7.0(3)I7(3)
  BIOS compile time:  08/26/2016
  NXOS image file is: bootflash:///nxos.7.0.3.I7.3.bin
  NXOS compile time:  2/12/2018 13:00:00 [02/12/2018 19:13:48]


Hardware
  cisco Nexus9000 C9372PX chassis
  Intel(R) Core(TM) i3- CPU @ 2.50GHz with 16400992 kB of memory.
  Processor Board ID SAL18516SA8

  Device name: spine-1
  bootflash:   51496280 kB
Kernel uptime is 0 day(s), 0 hour(s), 5 minute(s), 17 second(s)
```


```
{
   "bios_ver_str": "07.59",
   "kickstart_ver_str": "7.0(3)I7(3)",
   "bios_cmpl_time": "08/26/2016",
   "kick_file_name": "bootflash:///nxos.7.0.3.I7.3.bin",
   "kick_cmpl_time": "2/12/2018 13:00:00",
   "kick_tmstmp": "02/12/2018 19:13:48",
   "chassis_id": "Nexus9000 C9372PX chassis",
   "cpu_name": "Intel(R) Core(TM) i3- CPU @ 2.50GHz",
   "memory": "16400992",
   "mem_type": "kB",
   "proc_board_id": "SAL18516SA8",
   "host_name": "spine-1",
   "bootflash_size": "51496280",
   "kern_uptm_days": "0",
   "kern_uptm_hrs": "0",
   "kern_uptm_mins": "5",
   "kern_uptm_secs": "31",
}
```

Parsing CLI Output

Vintage style versus Hip style

```
(server) $ ssh admin@switch "show version" > output.txt
Password:
(server) $ awk '/BIOS:/ { print $3; }' output.txt
07.59
```

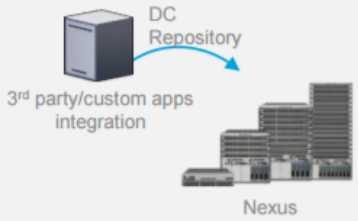
Vintage

Hip

```
print(output["bios_ver_str"])
```

Open NX-OS Provides

3rd Party Linux Applications

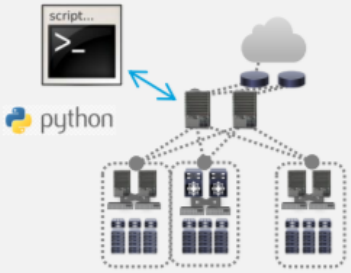


Use 3rd party applications using secure LXC containers

Linux Tools

Leverage Linux commands for config and troubleshooting

Programmable Open APIs



Object-based, model driven APIs (RESTful XML/JSON)

3rd Party DevOps Automation Tools

Leverage same software tools and expertise across different IT departments

NX-API Overview

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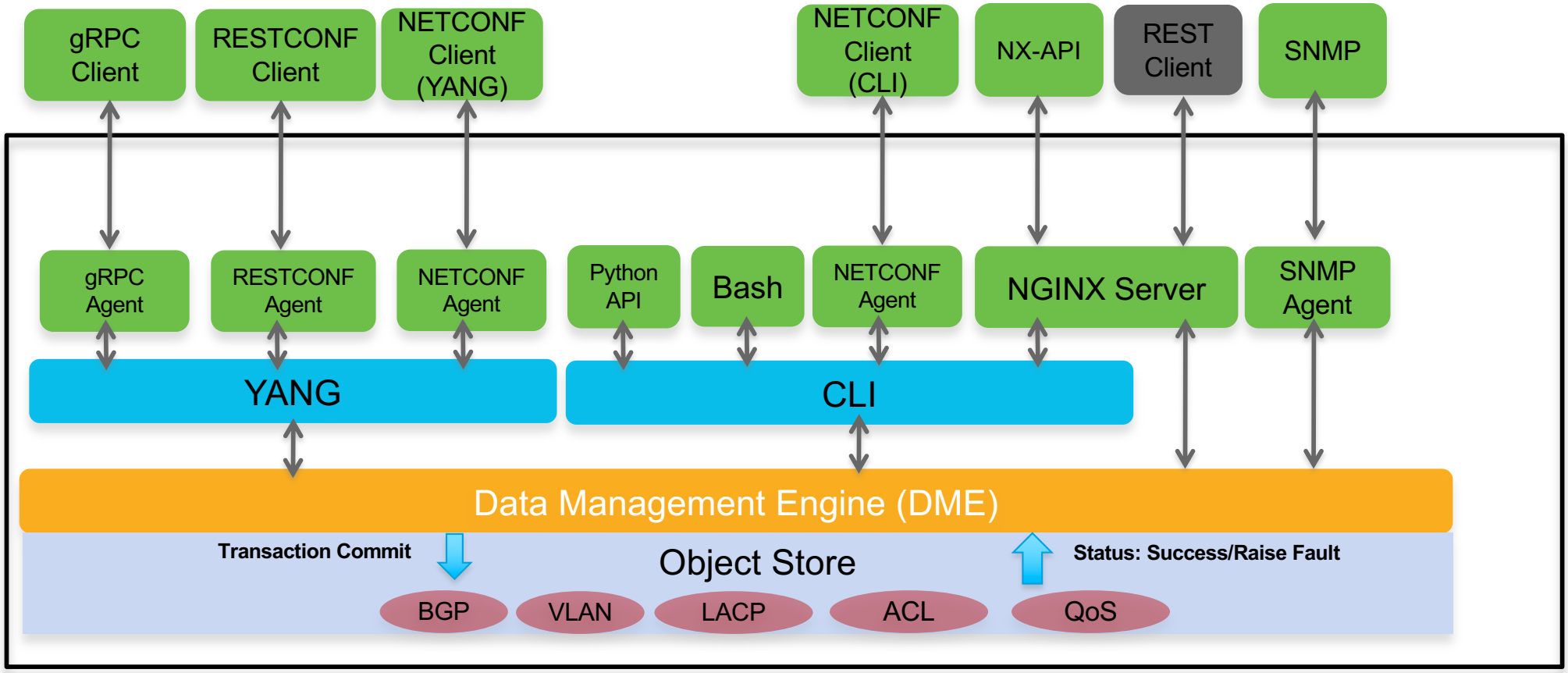
NX-OS Software Architecture

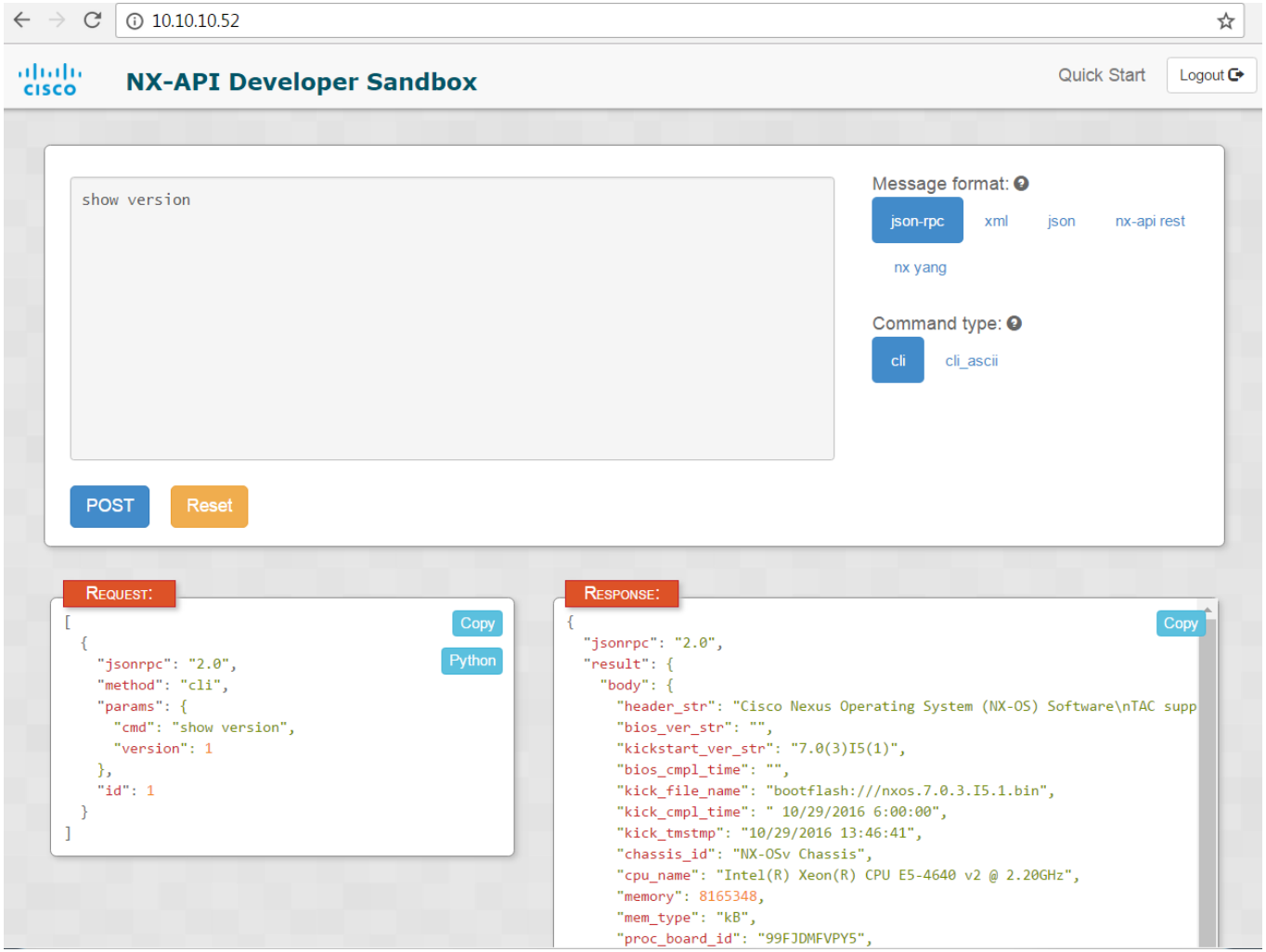


NX-API CLI Example

```
{
    "jsonrpc": "2.0",
    "method": "cli",
    "params": {
      "cmd": "show ver
      "version": 1
    },
    "id": 1
}
```

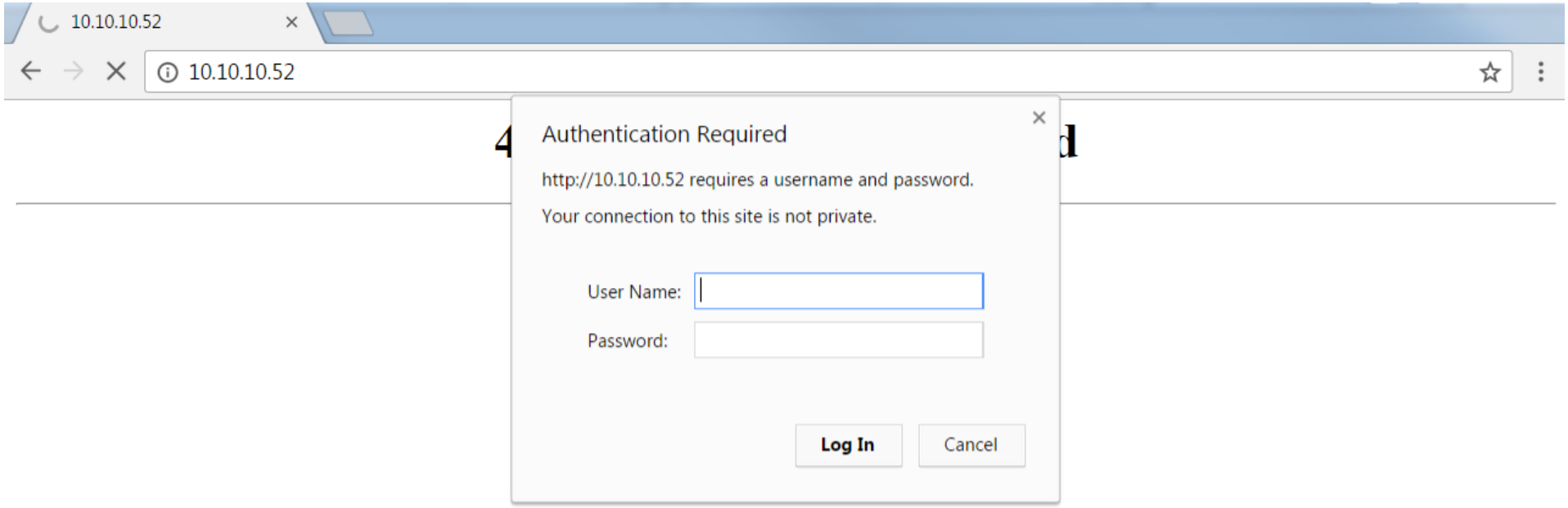
```
{
  "bios_ver_str": "07.59",
  "kickstart_ver_str": "7.0(3)I7(3)",
  "bios_cmpl_time": "08/26/2016",
  "kick_file_name": "bootflash:///nxos.7.0.3.I7.3.bin",
  "kick_cmpl_time": "2/12/2018 13:00:00",
  "kick_tmstmp": "02/12/2018 19:13:48",
  "chassis_id": "Nexus9000 C9372PX chassis",
  "cpu_name": "Intel(R) Core(TM) i3- CPU @ 2.50GHz",
  "memory": "16400992",
  "mem_type": "kB",
  "proc_board_id": "SAL18516SA8",
  "host_name": "spine-1",
  "bootflash_size": "51496280",
  "kern_uptm_days": "0",
  "kern_uptm_hrs": "0",
  "kern_uptm_mins": "5",
  "kern_uptm_secs": "31",
}
```

```
{ "jsonrpc": "2.0",
  "result": {
    "body": {
      ...
      "bios_ver_str": "07.59",
      "kickstart_ver_str": "7.0(3)I7(3)",
      "bios_cmpl_time": "08/26/2016",
```



NX-API CLI is Secure

- Users must have the correct device role to use NX-API CLI.
- For example, a read-only role will not be able to make changes using NX-API CLI.



NX-API CLI Has Many Use Cases

- Check versions of multiple switches in one command
- VLAN provisioning
- Poll routing table to watch for flapping routes
- Poll MAC address table for end point tracking
- Collect LLDP/CDP data to build wiring maps
- Couple collection of structured output with database backend for more advanced applications

NX-API CLI Demo!

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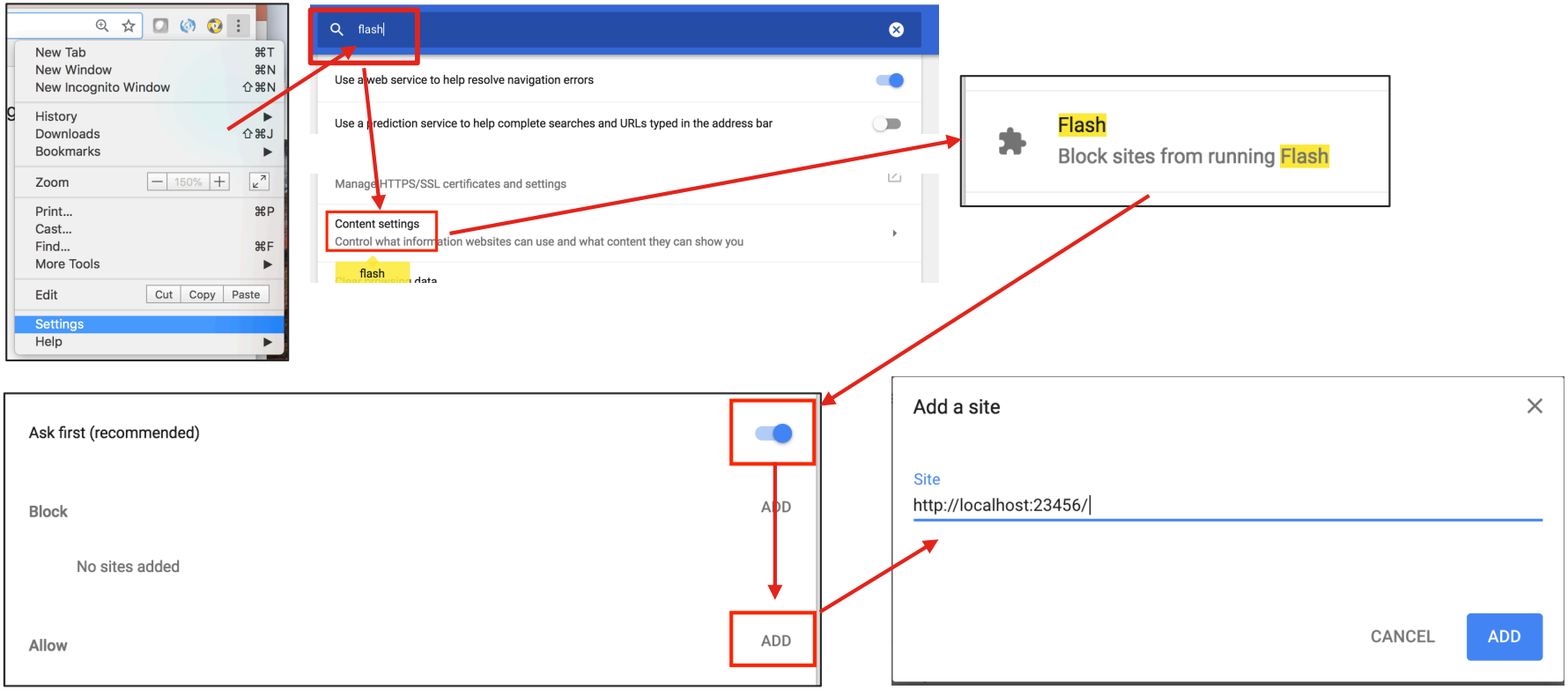
Connecting to Local N9KV Developer Sandbox

- Developer Sandbox is running on http://localhost:23456/
  - Username/Password is **admin/admin**
- May have to permit Flash in Chrome (next slide)
  - When connecting to the Developer Sandbox URL above, you'll get a warning that Flash is needed
  - OR… the "Python" button in the lower left request box does not produce Python text

Allowing Chrome to Use Flash for URL



Metrics

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Anatomy of Metrics Analytics

- Service to monitor
- Metric Generation
- Metric Collection
- Metric Storage
- Metric Visualization
- Browser to view it all

Metrics Generation

- Time Series Data
  - We are collecting measurements at regularly points in time
  - Name of Metric, Time Stamp, Metric Value, Metric Labels (units, source)
- Different Types of Metrics
  - Gauges
  - Counters
  - Timers (StatsD)
  - Histogram (Prometheus)
- Generators can be kernel level data, real time measurements, or calculated values

Prometheus

- Collection occurs via pull model over HTTP
  - Pushgateway exists for short-lived services or batch jobs
- Supported for service discovery (DNS, K8s, etc.)
- Data model for multi-dimension storage of time series data
  - Metric name, key/value pairs
  - Designed with microservices in mind

- https://prometheus.io/docs/introduction/overview/

One Python Script to Rule Them All

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Stop! Python Time...

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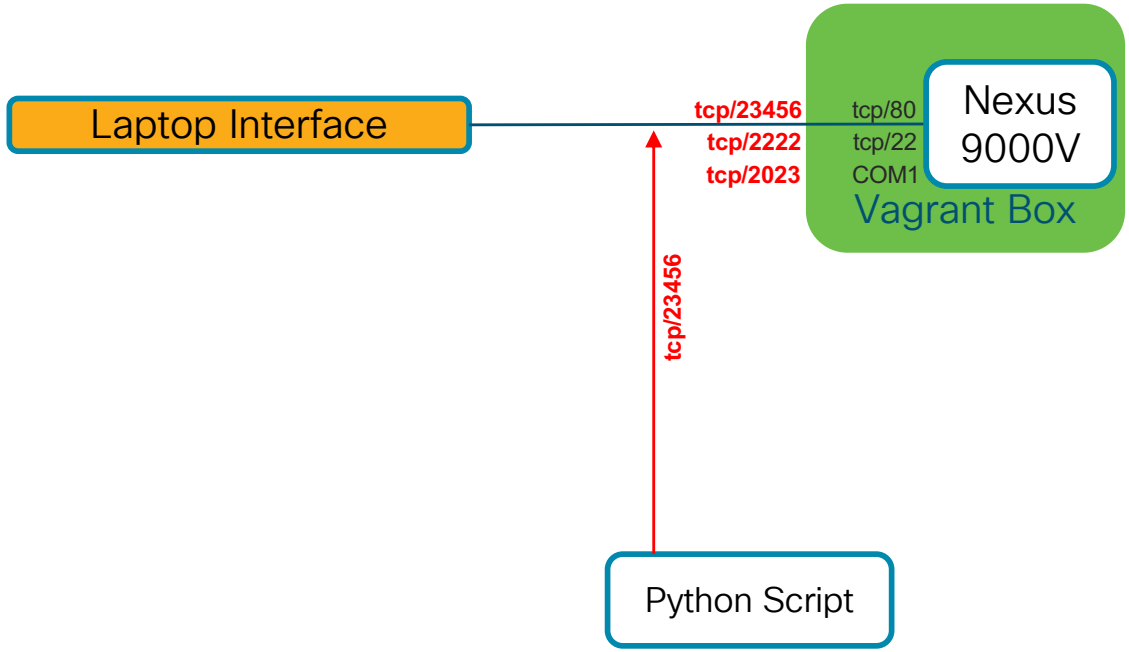
Metric Collection Service Connectivity Diagram

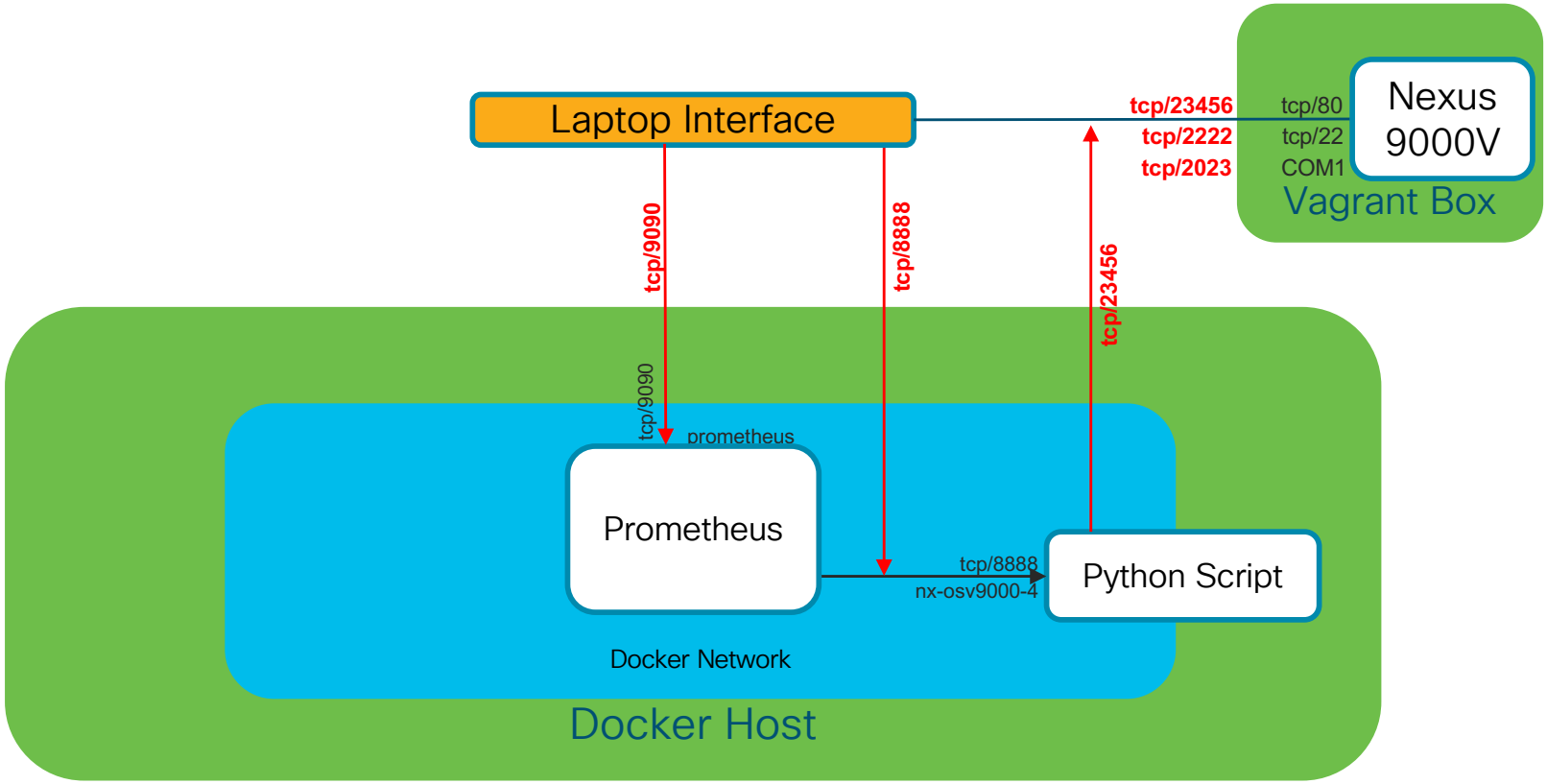


Commands found in README.md

Step-01 – Verify and Test Metric Generation

- Done for you:
  - Vagrant Box Nexus 9000v started
  - NXAPI and iCAM NX-OS features enabled
  - Workshop Git repo checked out to workspace folder
  - Python 3 modules populated
- Run script
  - `source ${HOME}/workspace/python/venv3/bin/activate`
  - `cd ${HOME}/workspace/DEVWKS-2594-CLUS19/nxapi_cli/step-01`
  - `python generate_l2table.py`

Metric Collection Service Connectivity Diagram



Commands found in README.md

Step-02 – Collect metric in Prometheus

- Build Docker image of Collector script

```
docker build -t devwks-2594/publish_l2table:latest -t devwks-2594/publish_l2table:1 .
```

- Create Docker network

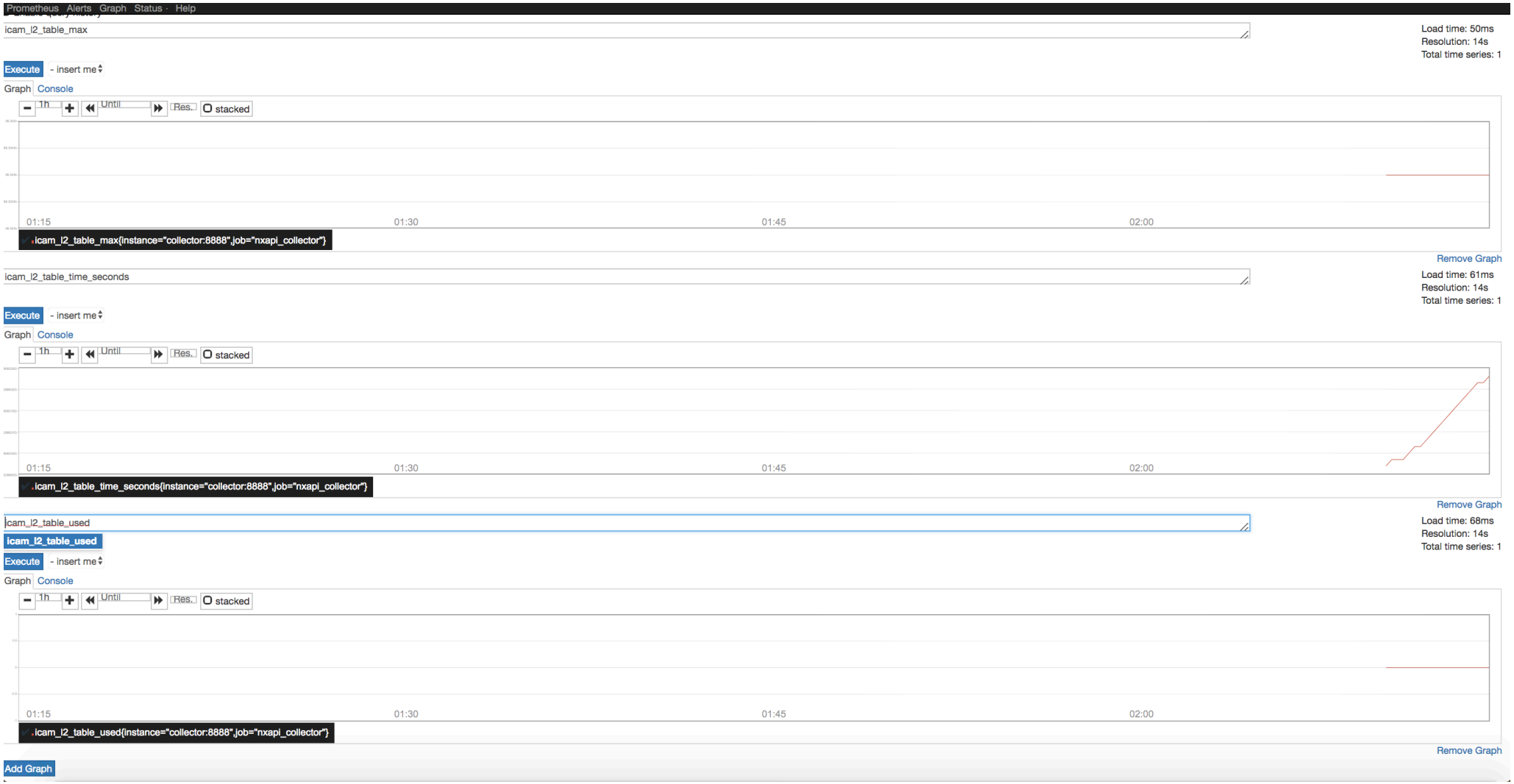
```
docker network create --driver=bridge --subnet=192.168.254.0/24 \
                      --gateway=192.168.254.254 --attachable demo0
```

- Deploy Prometheus container

```
docker run --name prometheus -d --network demo0 -p 127.0.0.1:9090:9090 \
           -v ${PWD}/prometheus.yml:/etc/prometheus/prometheus.yml \
           quay.io/prometheus/prometheus
```

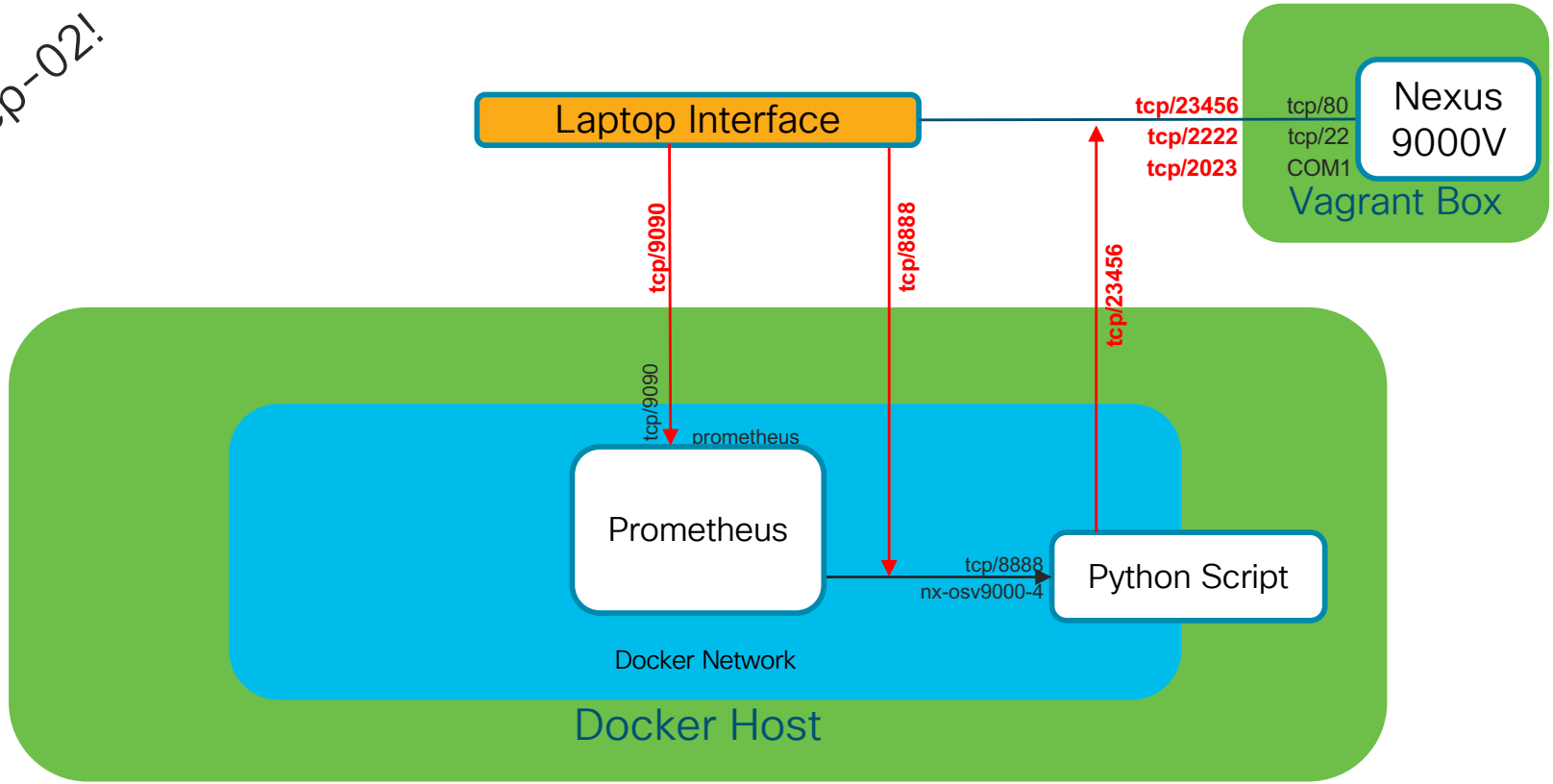
- Deploy Collector container

```
docker run --name collector -d --network demo0 -p 127.0.0.1:8888:8888 \
               devwks-2594/publish_l2table
```



Metric Collection Service Connectivity Diagram

Same as Step-02!



Step-03 – Expand metrics collected

Refactor Python Code

- Clean up from step-02 (cleanup_step02.sh)
- Build Docker image of Collector script

```
docker build -t devwks-2594/step-03:latest -t devwks-2594/step-03:1 .
```

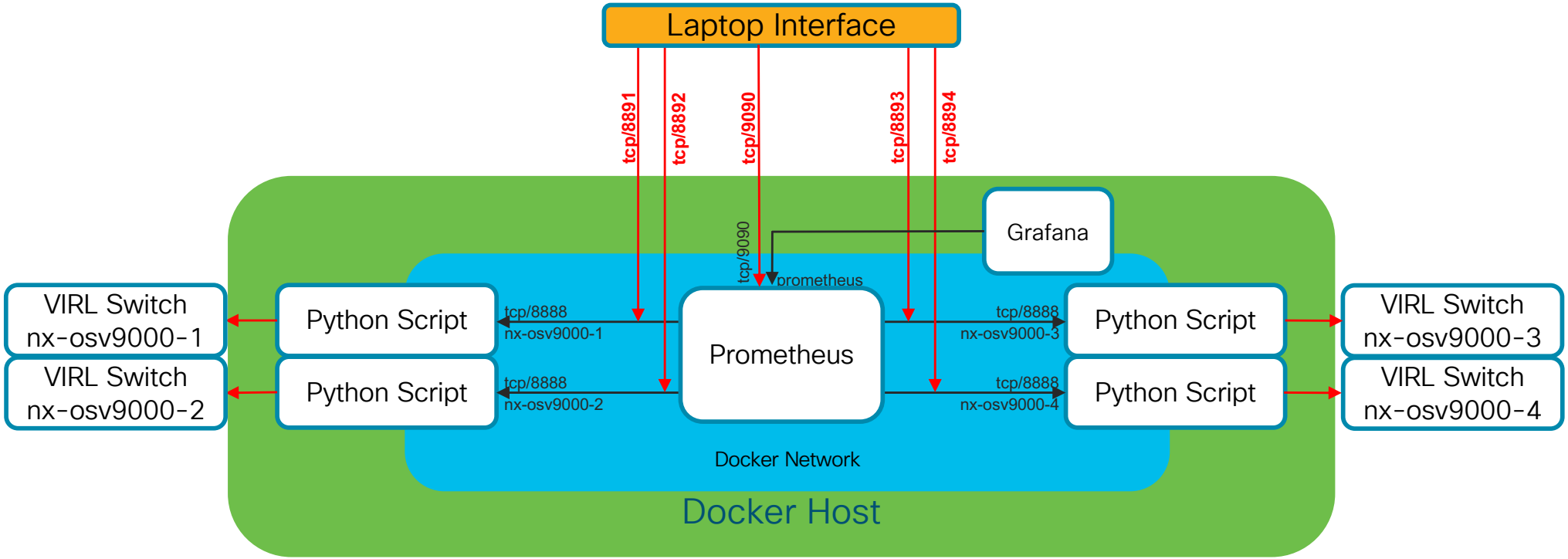
- Deploy Prometheus container

```
docker run --name prometheus -d --network demo0 -p 127.0.0.1:9090:9090 \
           -v ${PWD}/prometheus.yml:/etc/prometheus/prometheus.yml \
           quay.io/prometheus/prometheus
```

- Deploy Collector container

```
docker run --name icam -d --network demo0 -p 127.0.0.1:8888:8888 \
              devwks-2594/step-03
```

Metric Service Connectivity Diagram



Step-04 – Routing Metrics and Sandbox

- Clean up from step-03 (cleanup_step03.sh)
- VPN to the DEVNET Sandbox using instructions

- Build Docker image of Collector script

```
docker build -t devwks-2594/step-04:latest -t devwks-2594/step-04:1 .
```

- Deploy Prometheus container

```
docker run --name prometheus -d --network demo0 -p 127.0.0.1:9090:9090 \
           -v ${PWD}/prometheus.yml:/etc/prometheus/prometheus.yml \
           quay.io/prometheus/prometheus
```

Step-04 – Routing Metrics and Sandbox

- Deploy 4 collector container instances

```
docker run --name nx-osv9000-1 -d --network demo0 -p 127.0.0.1:8891:8888 \
        -e "NXAPI_HOST=172.16.30.101" -e "NXAPI_PORT=80" \
        -e "NXAPI_USER=cisco" -e "NXAPI_PASS=cisco" \
        devwks-2594/step-04
docker run --name nx-osv9000-2 -d --network demo0 -p 127.0.0.1:8892:8888 \
        -e "NXAPI_HOST=172.16.30.102" -e "NXAPI_PORT=80" \
        -e "NXAPI_USER=cisco" -e "NXAPI_PASS=cisco" \
        devwks-2594/step-04
```

Step-04 – Routing Metrics and Sandbox

- Deploy 4 collector container instances

```
docker run --name nx-osv9000-3 -d --network demo0 -p 127.0.0.1:8893:8888 \
        -e "NXAPI_HOST=172.16.30.103" -e "NXAPI_PORT=80" \
        -e "NXAPI_USER=cisco" -e "NXAPI_PASS=cisco" \
        devwks-2594/step-04
docker run --name nx-osv9000-4 -d --network demo0 -p 127.0.0.1:8894:8888 \
        -e "NXAPI_HOST=172.16.30.104" -e "NXAPI_PORT=80" \
        -e "NXAPI_USER=cisco" -e "NXAPI_PASS=cisco" \
        devwks-2594/step-04
```

Step-04 – Routing Metrics and Sandbox

- Deploy Grafana instance

```
docker run --name grafana -d --network demo0 \
           -p 127.0.0.1:3000:3000 \
           grafana/grafana
```

Summary

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Summary

What We Have Done

- Use your favorite CLI show commands to script metric generation
- Leverage containers to perpetually generate them
- Collect and visualize those metrics via next generation tools

What You Can Do

- Leverage DevNet resources to learn more about all of this
  - Python, Containers, Kubernetes, Git, Visualization, etc.
- Ease your operational pains

Complete your online session evaluation

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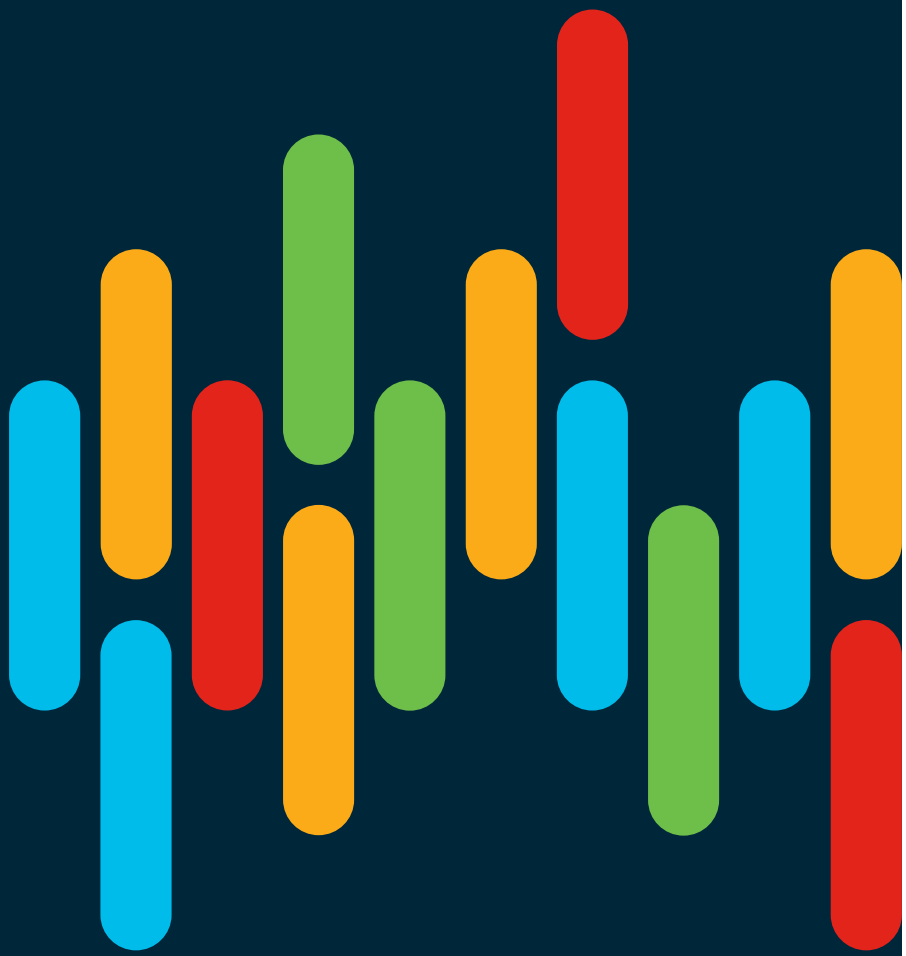

Thank you

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