



# N9K/ACI Programmability Use Case

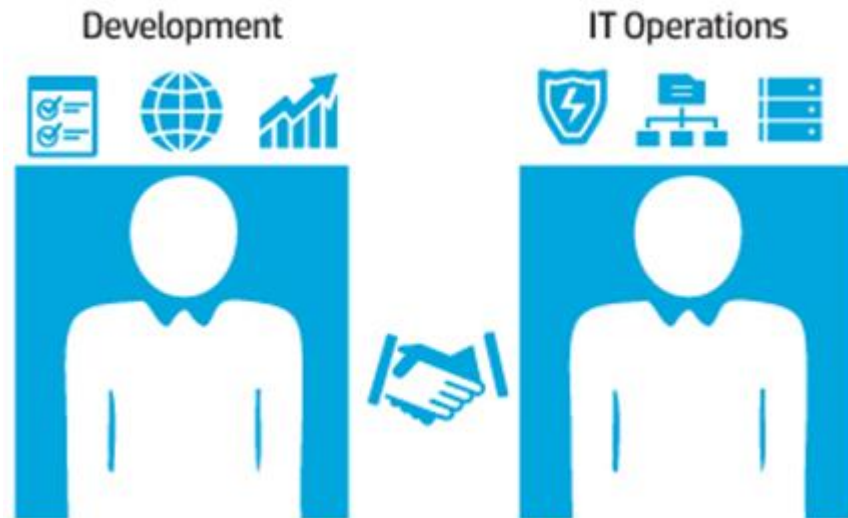
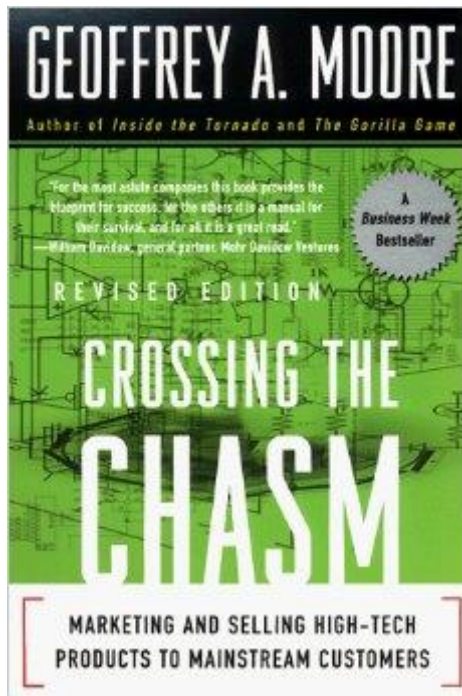
Version 1.0

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DC CSE (DataCenter Consulting Systems Engineer)

# 01. 시작에 앞서

# 당신은 누구십니까?



# 오늘 시간의 준비 내용과 과제

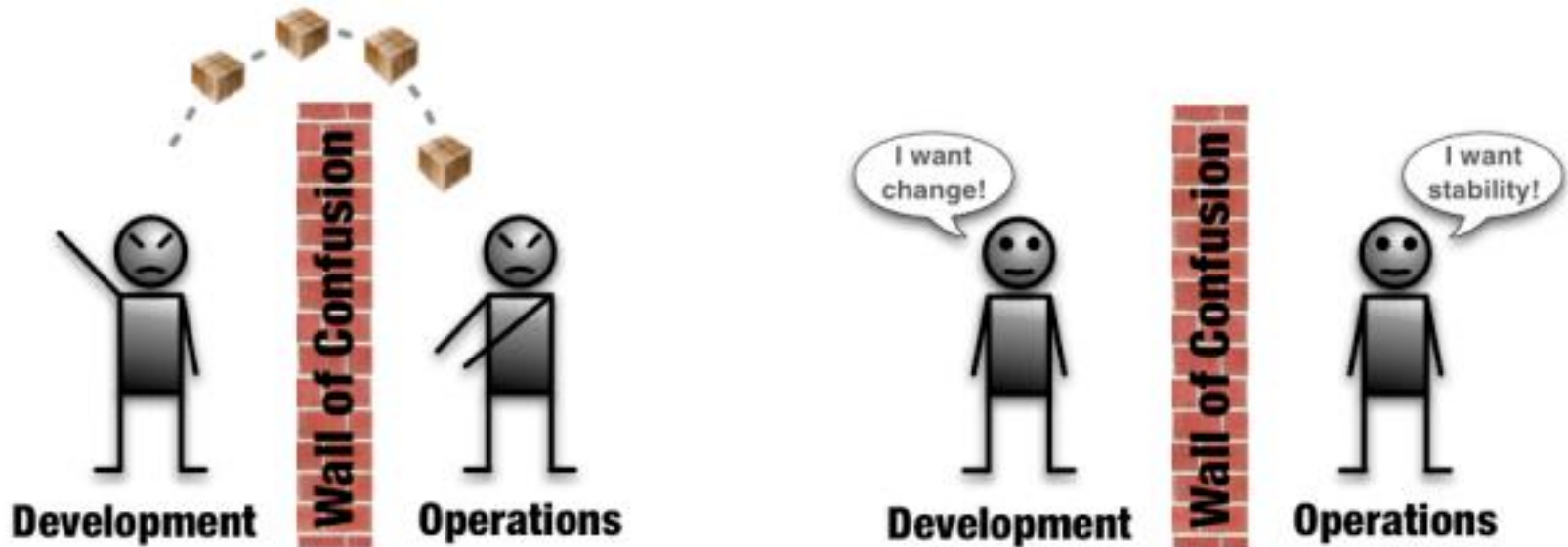
- 프로그래밍 관련 어떠한 선수지식도 필요없음.
- GitHub 기반의 공개 Python 활용
- 편리한 운영을 위한 첫걸음과 활용법
- DevOps로 거듭나기 위한 IT 운영자를 위한 시간

## Nexus Programmability



# Crossing The Chasm (DevOps) – 소통의 벽

“ 목표와 방향이 다른 두 조직...”



# Crossing The Chasm (DevOps)

“ 서로가 상생한다면, 훨씬 더 강력한 효과를 누릴 수 있습니다. “

## Ops (운영팀)

- CLI config
- Scalability
- Resiliency
- Stability
- Availability
- Stuck in the DC



## Dev (개발팀)

- Code
- Agility
- Automation
- Testing
- Advanced Tools
- Coding where you like



# 현재 데이터센터 네트워크 운영 방법

“ 네트워크 엔지니어가 너무도 사랑하는 CLI (Command Line Interface) “

```
Wed Jan 28 12:16:19.938 UTC
Building configuration...
!! IOS XR Configuration 5.1.1.53U
!! Last configuration change at Wed Jan 28 07:29:19 2015 by CVAC
!
! IOS-XR Config generated on 2014-10-29 16:02
! by VIRL Configuration Engine 0.9.9
hostname iosxrv-1
service timestamps log datetime msec
service timestamps debug datetime msec
telnet vrf default ipv4 server max-servers 10
domain lookup disable
line template vty
  timestamp
  exec-timeout 720 0
!
line console

!
interface GigabitEthernet0/0/0/1
  circuit-type level-2-only
  point-to-point
  address-family ipv4 unicast
    metric 1
  !
!
!
router bgp 64496
  bgp router-id 192.168.0.1
  address-family ipv4 unicast
    network 192.168.0.1/32
  !
```

# 현재 데이터센터 네트워크 운영 발전사

“그래도 운영 및 구성방법은 발전해 왔습니다.”

```
change.txt - Notepad
File Edit Format View Help

NYC-RTR01A:

int gi0/2
 shutdown
int gi1/3
 switchport
 no shut
router bgp 65000
 redistribute ospf 1 route-map REDIST
 neighbor 1.2.3.4 remote-as 65000
 network 192.168.2.0 mask 255.255.0
end
```

```
R1_out - Notepad
File Edit Format View Help

Last configuration change at 17:41:34 EST Sat May 4 2013 by admin
NVRAM config last updated at 17:42:05 EST Sat May 4 2013 by admin

version 12.4
service timestamps debug datetime msec
service timestamps log datetime msec localtime show-timezone
no service password-encryption
!
hostname R1
!
boot-start-marker
boot-end-marker
!
logging buffered 4096 notification
!
no aaa new-model
clock timezone EST -5
dot11 syslog
ip cef
!
no ip dhcp use vrf connected
ip dhcp excluded-address 192.168.
!
ip dhcp pool mypool
 network 192.168.1.0 255.255.25
 default-router 192.168.1.254
 dns-server 8.8.8.8
```

```
17
18 For Each objFile In objFolder.Files
19 Set objReadFile = objFSO.OpenTextFile(objFile.Path, ForReading)
20 Do Until objReadFile.AtEndOfStream
21 strLine = objReadFile.ReadLine
22 If left(strLine,8) = "hostname" Then
23 strHostName = Mid(strLine, 10)
24 ElseIf left(strLine,9) = "interface" Then
25 strIntName = Mid(strLine, 11)
26 If left(strIntName,2) = "Fa" or left(strIntName,2) = "Te" Then
27 intRow1 = intRow1+1
28 strIntCfg = " shutdown"
29 strTrunk = ""
30 strLine = objReadFile.ReadLine
31 Do Until objReadFile.AtEndOfStream or (left(strLine,1)<>" ")
32 If strLine = " switchport mode trunk" Then
33 strTrunk = " trunk"
34 ElseIf strLine = " spanning-tree portfast" Then
35 strLine = " spanning-tree port type edge"&strTrunk
36 End If
37 If strLine <> " no ip address" Then
38 strIntCfg = strIntCfg&Chr(10)&strLine
39 End If
40 strLine = objReadFile.ReadLine
41 Loop
42 strIntName=Replace(strIntName,"FastEthernet","")
43 strIntName=Replace(strIntName,"GigabitEthernet","")
44 strIntName=Replace(strIntName,"TenGigabitEthernet","")
45 objSheet.Cells(intRow1,1).Value = strHostName
46 objSheet.Cells(intRow1,2).NumberFormat = "0"
47 objSheet.Cells(intRow1,2).Value = strIntName
48 objSheet.Cells(intRow1,3).Value = strIntCfg&Chr(10)&"!"
49 ElseIf left(strIntName,4) = "Port" Then
50 intRow2 = intRow2+1
51 strIntCfg = ""
52 strLine = objReadFile.ReadLine
53 Do Until objReadFile.AtEndOfStream or (left(strLine,1)<>" ")
54 strIntCfg = strIntCfg&strLine&Chr(10)
55 strLine = objReadFile.ReadLine
56 Loop
57 objSheet2.Cells(intRow2,1).Value = strHostName
58 objSheet2.Cells(intRow2,2).Value = strIntName
59 objSheet2.Cells(intRow2,3).Value = strIntCfg
60 End If
61 End If
```

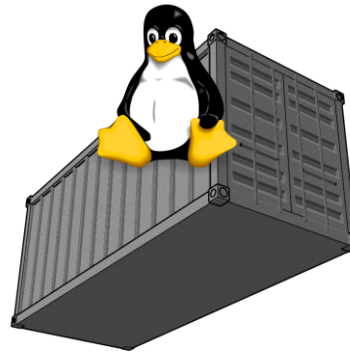
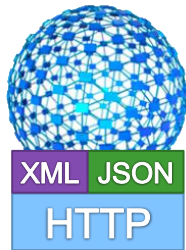
```
IP Range.bat - Notepad
File Edit Format View Help

@echo off
SET t=0
:start
SET /a t=t+1
ping -n 1 -l 1 192.168.1.%t% > nul
if %errorlevel%==0 echo Host %t% is UP! >> 192.168.1.%t%-up.txt
if %errorlevel%==1 echo Host %t% is DOWN! >> 192.168.1.%t%-down.txt
IF %t%==999 Exit
Goto start
```



# 02. 넥서스 프로그래밍

# Nexus 9000 Programmability Capabilities



# NX-OS NX-API

- Open RPC API, XML, JSON 지원
- Programmability Oriented 기반
- NX-API Developer Sandbox 지원
- CLI 기반 Input / Output에 대한 JSON/XML 결과값 도출 가능
- 개발자들을 위한 강력한 도구

The screenshot displays the NX-API Developer Sandbox interface. At the top, it features the Cisco logo and the title "NX-API Developer Sandbox", along with "Quick Start" and "Logout" links. The main area contains a text input field with the command "show interface brief". To the right of the input field, there are two dropdown menus: "Message format:" with options "json-rpc", "xml", and "json"; and "Command type:" with options "cli" and "cli\_ascii". Below the input field are "POST" and "Reset" buttons. The interface is divided into two panels: "REQUEST:" and "RESPONSE:". The "REQUEST:" panel shows a JSON object: 

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

 with "Copy" and "Python" buttons. The "RESPONSE:" panel shows a JSON object: 

```
{
  "jsonrpc": "2.0",
  "result": {
    "body": {
      "TABLE_interface": {
        "ROW_interface": [
          {
            "interface": "mgmt0",
            "state": "up",
            "ip_addr": "10.201.30.194",
            "speed": "100",
            "mtu": 1500
          },
          {
            "interface": "Ethernet2/1",
            "vlan": "1",
            "type": "eth",
            "portmode": "trunk",

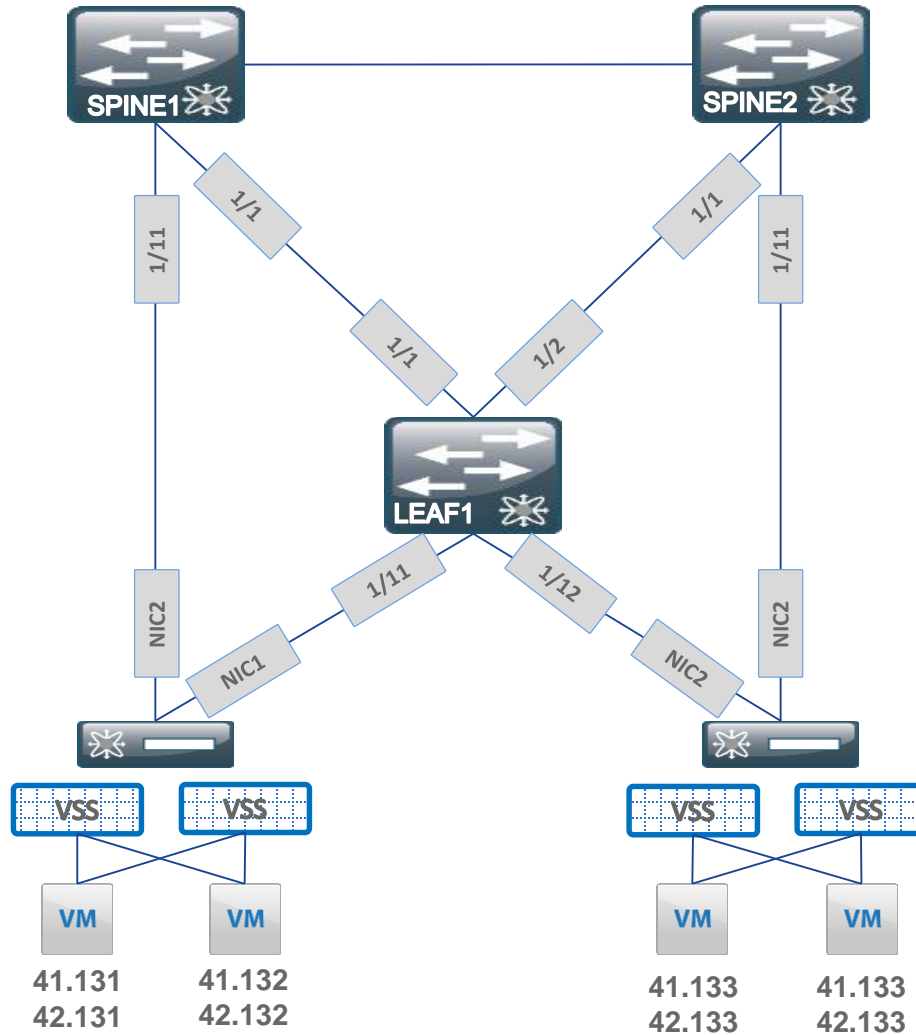
```

 with a "Copy" button.

# 03. GitHub 기반의 활용



# 시험 환경



# Who-moved-my-cli python 받기

<https://github.com/datacenter>

[who-moved-my-cli](#)

Python ★ 26 🍴 29

A collection of simple Python scripts to help convert network engineers into programmer network engineers

Updated 26 days ago

1

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datacenter / who-moved-my-cli Watch 93 Star 26 Fork 30

A collection of simple Python scripts to help convert network engineers into programmer network engineers

40 commits 2 branches 0 releases 2 contributors

branch: master who-moved-my-cli +

Commit	Message	Time
minor tweaks		
paullesiak authored on 2 Feb	latest commit eF5b805ea9	
NexusConfigToEPGasVLAN.py	minor tweaks	2 months ago
README.md	Update README.md	8 months ago
bcmnxosintcompare.py	Fixed duplicated code	a year ago
cdp2desc.py	New changes for BRKDCT-1302	a year ago
cdp2descv2.py	New changes for BRKDCT-1302	a year ago
easy-ofa.py	Updated platform search logic; Added controller IP input validation	11 months ago
httpserver.py	New changes for BRKDCT-1302	a year ago
interface_rate.py	Replace cli() decorator; minor PEP8 fix	8 months ago
nxapicdp2desc.py	Update to support running both onbox and offbox	7 months ago
nxapicompare.py	New changes for BRKDCT-1302	a year ago
pingrange.py	Updated 'cli' usage to work on all Nexus platforms	a year ago
servermon.py	New changes for BRKDCT-1302	a year ago
supercommand.py	Injected with GHG.	8 months ago

Code Issues 0 Pull requests 1 Pulse Graphs

HTTPS clone URL  
<https://github.com/c>  
 You can clone with HTTPS or Subversion

Clone in Desktop Download ZIP

Python Download

# Who-moved-my-cli python Loading

## 1. nxapi Feature enable

```
LEAF-1-N9396(config)# feature nxapi
LEAF-1-N9396(config)# show feature | inc nxapi
nxapi                1                enabled
```

## 2. who-moved-my-cli python script uploading

```
LEAF-1-N9396# copy ftp://root:root@64.104.105.89/supercommand.py bootflas
h:whchoi/who-moved-my-cli
Enter vrf (If no input, current vrf 'default' is considered): management
Password:
***** Transfer of file Completed Successfully *****
Copy complete, now saving to disk (please wait)...
```

## 3. 새로운 명령어 만들기

```
LEAF-1-N9396(config)# cli alias name supercommand python bootflash:whchoi/who-moved-my-cli/supercommand.py
LEAF-1-N9396(config)# sh cli alias
CLI alias commands
=====
alias          :show cli alias
supercommand   :python bootflash:whchoi/who-moved-my-cli/supercommand.py
```

# Supercommand

“ 데이터센터, 캠퍼스에서 접속자 추적 하기 “

## Show ip arp

```
LEAF-1-N9396# sh ip arp 192.168.41.131

Flags: * - Adjacencies learnt on non-active FHRP router
+ - Adjacencies synced via CFSOE
# - Adjacencies Throttled for Glean
D - Static Adjacencies attached to down interface
```

```
IP ARP Table
Total number of entries: 1
Address      Age      MAC Address      Interface
192.168.41.131  00:12:30  0050.5602.0131  Vlan41
```



## Show mac address-table

```
LEAF-1-N9396# sh mac address-table address 0050.5602.0131
Legend:
 * - primary entry, G - Gateway MAC, (R) - Routed MAC, O - Overlay MAC
 age - seconds since last seen,+ - primary entry using vPC Peer-Link,
 (T) - True, (F) - False
```

VLAN	MAC Address	Type	age	Secure	NTFY	Ports
* 41	0050.5602.0131	dynamic	0	F	F	Po11

```
LEAF-1-N9396# supercommand 192.168.41.131
Here is some information on 192.168.41.131:
MAC address: 0050.5602.0131
L3 gateway: Vlan41
Local interface: Ethernet1/1
VLAN: 41
CDP Platform: N9K-C9396TX
CDP Device ID: LEAF-3-N9396TX(SAL18370NX3)
CDP Remote Port ID: Ethernet1/1
```

## Show cdp neighbor

```
LEAF-1-N9396# sh cdp neighbors interface port-channel 11
Capability Codes: R - Router, T - Trans-Bridge, B - Source-Route-Bridge
S - Switch, H - Host, I - IGMP, r - Repeater,
V - VoIP-Phone, D - Remotely-Managed-Device,
s - Supports-STP-Dispute
```

Device-ID	Local Infrfce	Hldtme	Capability	Platform	Port ID
LEAF-3-N9396TX(SAL18370NX3)	Eth1/1	170	R S I s	N9K-C9396TX	Eth1/1



# autodescription

“ 한달에 한번 포트에 Description 달기 “

## Show cdp neighbor

## Interface description

```
N9504-A# sh cdp neighbors
Capability Codes: R - Router, T - Trans-Bridge, B - Source-Route-Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater,
                  V - VoIP-Phone, D - Remotely-Managed-Device,
                  s - Supports-STP-Dispute

Device-ID         Local Intrfce  Hldtme  Capability  Platform  Port ID
Mobile-00B-2     mgmt0         121     R S I       WS-C3750G-24P Gig1/0/8
ESXihost01       Eth1/41       171     S           VMware ESX  vmnic2
LEAF-3-N9396TX(SAL18370NX3)
Eth1/49          152          R S I s    N9K-C9396TX  Eth2/1
N9504-B(FOX1829G3FV)
Eth1/51          128          R S I s    N9K-C9504    Eth1/51
N9504-B(FOX1829G3FV)
Eth1/52          139          R S I s    N9K-C9504    Eth1/52

Total entries displayed: 5
N9504-A# conf t
Enter configuration commands, one per line. End with CNTL/Z.
N9504-A(config)# inter
interface interver
N9504-A(config)# inter ethernet 1/49
N9504-A(config-if)# description "ESX-SERVER-01"
```



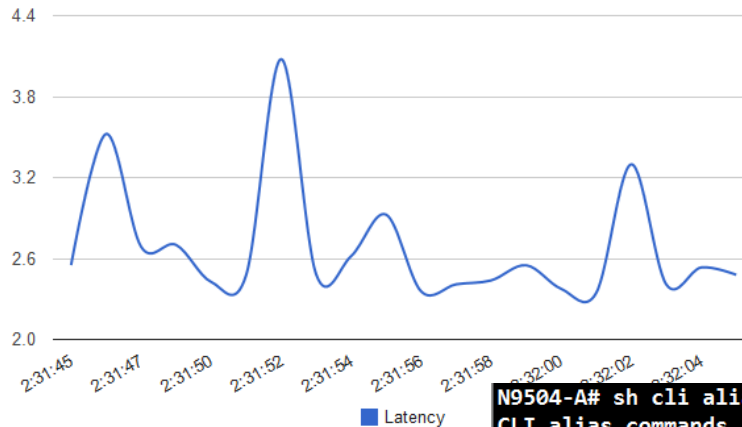
## autodescription

```
N9504-A# autocdpdec
conf t ; interface Ethernet1/41 ; description ESXihost01 vmnic2
conf t ; interface Ethernet1/49 ; description LEAF-3-N9396TX(SAL18370NX3) Ethernet2/1
conf t ; interface Ethernet1/52 ; description N9504-B(FOX1829G3FV) Ethernet1/52
conf t ; interface mgmt0 ; description Mobile-00B-2 GigabitEthernet1/0/8
conf t ; interface Ethernet1/51 ; description N9504-B(FOX1829G3FV) Ethernet1/51
```

# 응답시간 httpserver

“ httpserver 올려서 응답시간 점검하기 ”

## httpsever



```
---- addrf: ipv4
----- uptime: PT13H5M47S
----- pref: 1
----- metric: 0
----- ubest: true
----- clientname: static
----- attached: false
----- mcast-nhops: 0
----- ucast-nhops: 1
----- ipprefix: 0.0.0.0/0
-- vrf-name-out: management
```

```
N9504-A# sh cli alias
CLI alias commands
=====
alias          :show cli alias
autocdpcdec   :python bootflash:whchoi/who-moved-my-cli/nxapicdp2desc.py
interver      :python bootflash:whchoi/who-moved-my-cli/get_all_internal_versions.py
intrate       :python bootflash:whchoi/who-moved-my-cli/interface_rate.py
pingrange     :python bootflash:whchoi/who-moved-my-cli/pingrange.py
servermon     :python bootflash:whchoi/who-moved-my-cli/servermon.py
showtrans     :python bootflash:whchoi/who-moved-my-cli/showtrans.py
supercommand  :python bootflash:whchoi/who-moved-my-cli/supercommand.py
webserver     :python bootflash:whchoi/who-moved-my-cli/httpserver.py
N9504-A# webserver
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
10.139.4.65 - - [14/May/2015 01:30:01] "GET /latency HTTP/1.1" 200 -
```

# Interface\_rate 기반 트래픽 전체 점검

“intrate 으로 한방에 인터페이스 모니터링”



Interface\_rate

```
N9504-A# sh interface ethernet 1/1
Ethernet1/1 is down (XCVR not inserted)
admin state is up, Dedicated Interface
Hardware: 1000/10000 Ethernet, address: 1c6a.7a1f.13ff (bia 1c6a.7ac1.caa8)
MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, medium is broadcast
auto-duplex, auto-speed
Beacon is turned off
Auto-Negotiation is turned on
Input flow-control is off, output flow-control is off
Auto-mdix is turned off
Switchport monitor is off
EtherType is 0x8100
EEE (efficient-ethernet) : n/a
Last link flapped never
Last clearing of "show interface" counters never
0 interface resets
5 seconds input rate 0 bits/sec, 0 packets/sec
5 seconds output rate 0 bits/sec, 0 packets/sec
Load-Interval #2: 5 minute (300 seconds)
input rate 0 bps, 0 pps; output rate 0 bps, 0 pps
RX
0 unicast packets 0 multicast packets 0 broadcast packets
0 input packets 0 bytes
0 jumbo packets 0 storm suppression packets
```

개별 인터페이스 모니터링

```
N9504-A# sh cli alias
CLI alias commands
=====
alias          :show cli alias
autocdpdec     :python bootflash:whchoi/who-moved-my-cli/nxapicdp2desc.py
interver       :python bootflash:whchoi/who-moved-my-cli/get_all_internal_versions.py
intrate        :python bootflash:whchoi/who-moved-my-cli/interface_rate.py
pingrange      :python bootflash:whchoi/who-moved-my-cli/pingrange.py
servermon      :python bootflash:whchoi/who-moved-my-cli/servermon.py
showtrans      :python bootflash:whchoi/who-moved-my-cli/showtrans.py
supercommand   :python bootflash:whchoi/who-moved-my-cli/supercommand.py
webserver      :python bootflash:whchoi/who-moved-my-cli/httpserver.py
```

```
N9504-A# intrate
Collecting and processing interface statistics ...

-----
Port          Intvl   Rx Mbps  Rx %    Rx pps  Tx Mbps  Tx %    Tx pps
-----
Ethernet1/1   5/5    0.0     0.0%    0       0.0     0.0%    0
Ethernet1/2   5/5    0.0     0.0%    0       0.0     0.0%    0
Ethernet1/3   5/5    0.0     0.0%    0       0.0     0.0%    0
Ethernet1/4   5/5    0.0     0.0%    0       0.0     0.0%    0
-----
```

# Showtrans - Transceiver 정보를 한번에...

“showtrans로 한방에 transceiver 정보를...”

```
N9504-A# sh interface ethernet 1/41 transceiver
Ethernet1/41
transceiver is present
type is SFP-H10GB-CU3M
name is CISCO-TYCO
part number is 1-2053783-2
revision is T
serial number is TED1849B4HC
nominal bitrate is 10300 MBit/sec
Link length supported for copper is 3 m
cisco id is --
cisco extended id number is 4

N9504-A# sh interface ethernet 1/41 status
-----
Port          Name                Status      Vlan    Duplex  Speed  Type
-----
Eth1/41      ESXihost01 vmnic2  connected  trunk   full    10G    SFP-H10GB-CU3M

N9504-A# sh interface ethernet 1/41
Ethernet1/41 is up
admin state is up, Dedicated Interface
Hardware: 1000/10000 Ethernet, address: 1c6a.7ac1.cad0 (bia 1c6a.7ac1.cad0)
Description: ESXihost01 vmnic2
MTU 1500 bytes, BW 10000000 Kbit, DLY 10 usec
reliability 255/255, txload 1/255, rxload 1/255
Encapsulation ARPA, medium is broadcast
Port mode is trunk
```

Show interface 관련 명령어



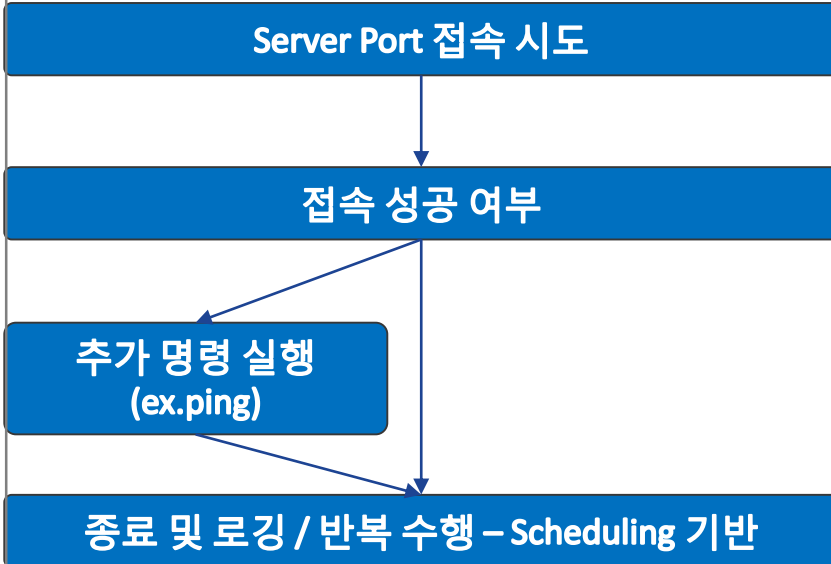
showtrans

```
N9504-A# showtrans
```

Interface	Model	Type	Name	Part	Speed	Len	CDP Neighbor
Eth1/41	N9K-X9564PX	SFP-H10GB-CU3M	CISCO-TYCO	1-2053783-2	1000,10000	3	ESXihost01@vmnic2
Eth1/49	N9K-X9564PX	QSFP-H40G-AOC3M	CISCO	AFBR-7QER03Z-CS1	40000	3	LEAF-3-N9396TX(SAL18370NX3)@Ethernet2/1
Eth1/51	N9K-X9564PX	QSFP-H40G-AOC5M	CISCO	AFBR-7QER05Z-CS1	40000	5	N9504-B(FOX1829G3FV)@Ethernet1/51
Eth1/52	N9K-X9564PX	QSFP-H40G-AOC5M	CISCO	AFBR-7QER05Z-CS1	40000	5	N9504-B(FOX1829G3FV)@Ethernet1/52

# Servermon으로 서비스 포트별 상세 모니터링

“servermon으로 서비스 포트별 모니터링”



```

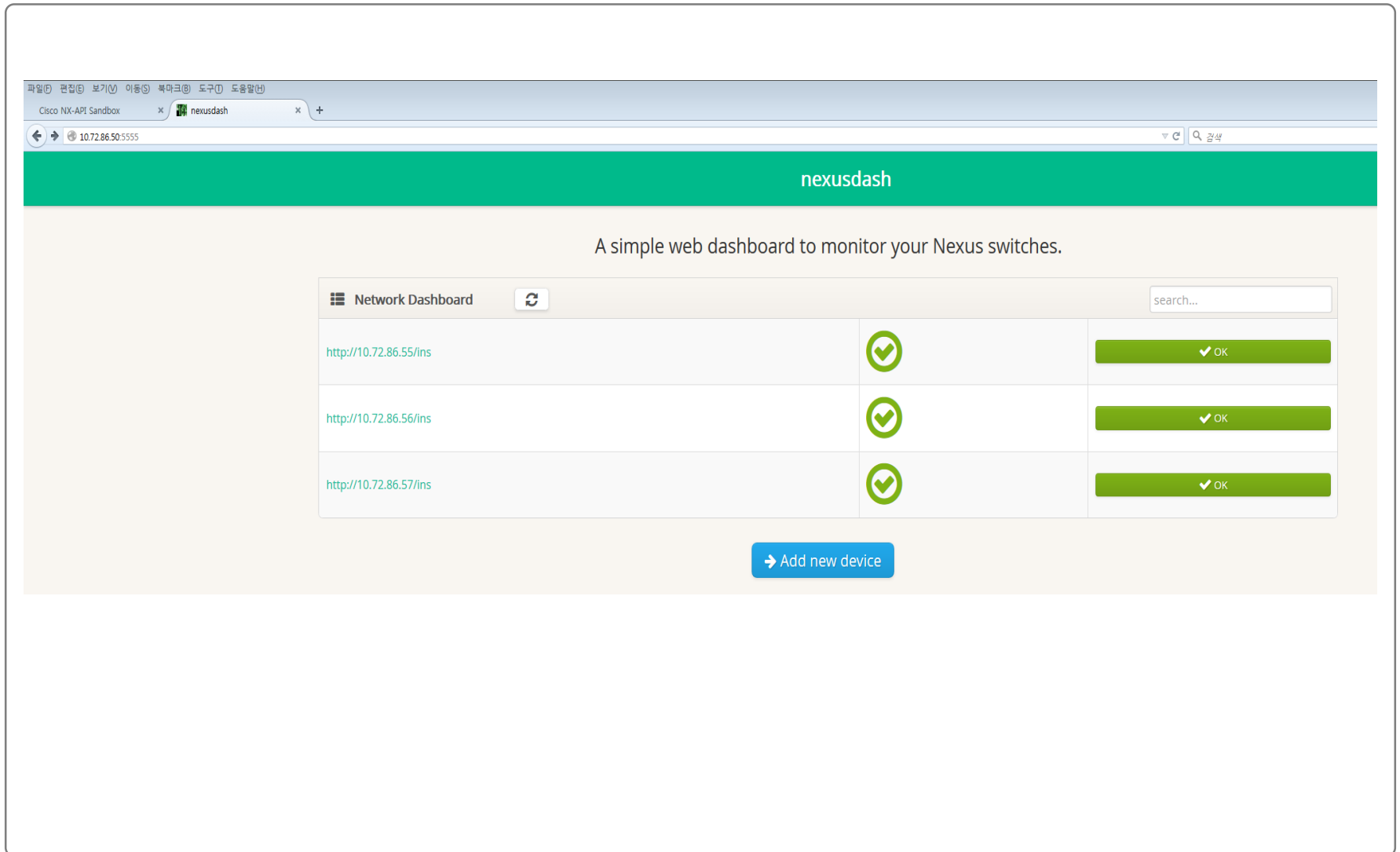
scheduler job name servermon
python bootflash:/whchoi/who-moved-my-cli/servermon.py -s 192.168.41.11 -p 80 ping 192.168.41.11 count 1

end-job

scheduler schedule name servermon
job name servermon
  
```

# 03. Nexusdash 보드 활용

# Nexusdash 기반 활용



# 오늘 시간의 준비 내용과 과제

- 프로그래밍 관련 어떠한 선수지식도 필요없음.
- GitHub 기반의 공개 Python 활용
- 편리한 운영을 위한 첫걸음과 활용법
- DevOps로 거듭나기 위한 IT 운영자를 위한 시간

## Nexus Programmability

