

523454

# Computer Network Programming

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LAB5 - Python for networking (Netmiko)

Chatdanai Phakaket,  
zchatdanai@gmail.com

# What's netmiko

Multi-vendor library to simplify Paramiko SSH connections to network devices

The purposes of netmiko library

- Successfully establish an SSH connection to the device
- Simplify the execution of show commands and the retrieval of output data
- Simplify execution of configuration commands including possibly commit actions
- Do the above across a broad set of networking vendors and platforms

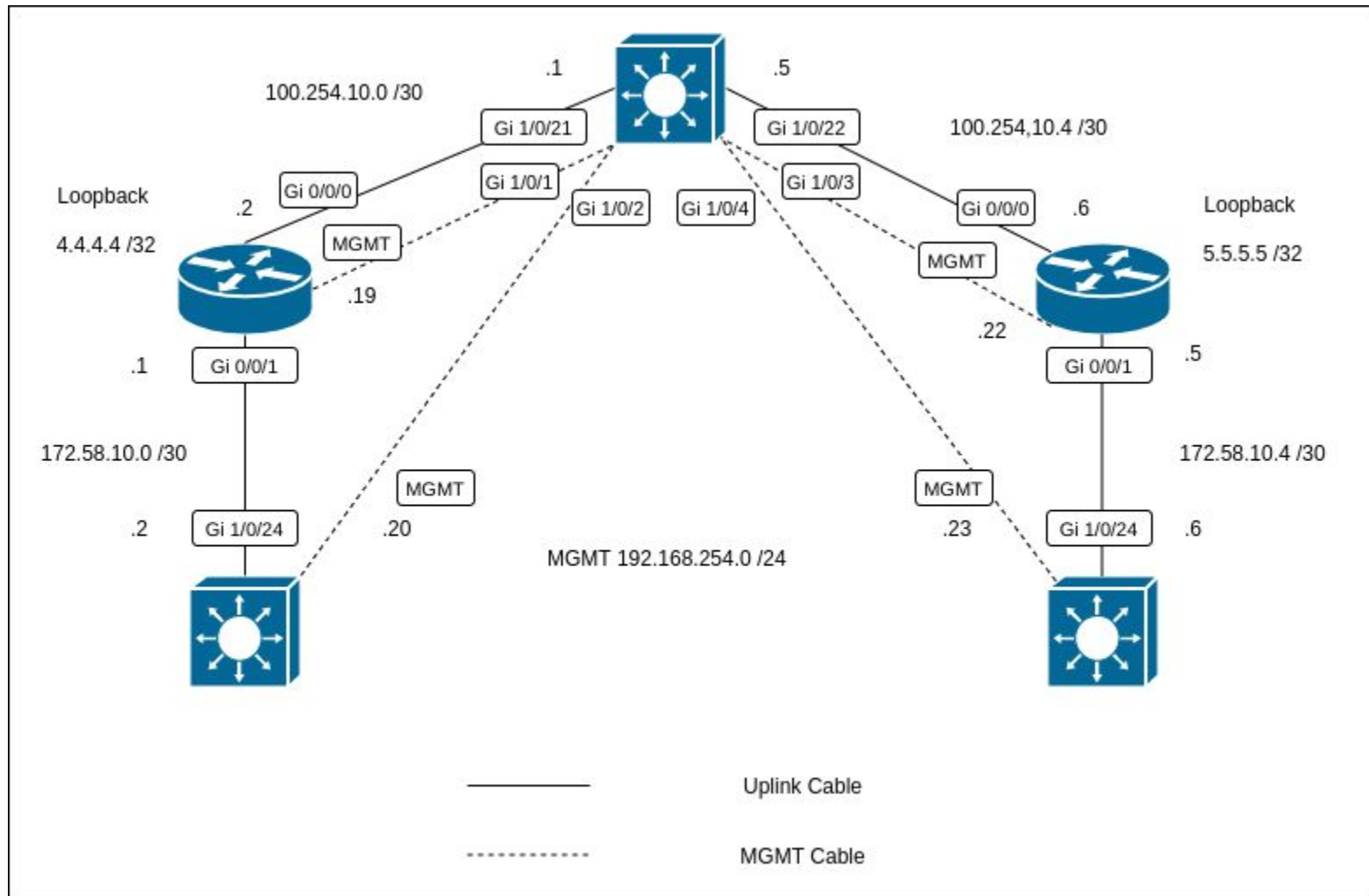
# Methods

- **enable()**
  - Enter enable mode.
- **check\_enable\_mode()**
  - Check if in enable mode.
  - Return boolean.
- **config\_mode()**
  - Enter into config\_mode and exit config mode automatically
- **check\_config\_mode()**
  - Checks if the device is in configuration mode or not.
  - Return boolean.
- **send\_config\_set(config\_commands=""")**
  - Send configuration commands down the SSH channel. config\_commands is an iterable containing all of the configuration commands. The commands will be executed one after the other. **In config mode.** Multiple configuration commands to be sent to the device :type **config\_commands**: **list** or **string**

# Methods (Continue)

- **send\_command()**
  - Execute `command_string` on the SSH channel using a pattern-based mechanism. Generally used for show commands. By default this method will keep waiting to receive data until the network device prompt is detected. The current network device prompt will be determined automatically. **In enable mode.**
  - Return string
- **disconnect()**
  - Try to gracefully close the session

# Topology overview



Create a dictionary representing and establish an SSH connection to the device.

```
from netmiko import ConnectHandler

cisco_device = {
    "device_type": "cisco_ios",          #OS
    "host": "192.168.254.19",            #Host ip address
    "username": "cpe",                   #Username
    "password": "cpe",                   #Password
    "secret": "cpe",                     #Secret
}

connection = ConnectHandler(**cisco_device)
```

## Example get output

```
# Call 'enable()' method to elevate privileges
connection.enable()
# Check is enable mode
if connection.check_enable_mode():

    # Get running config
    running_config = connection.send_command("show run")
    print(running_config)

connection.disconnect()
```

# Example send config to device

```
# Call 'enable()' method to elevate privileges
connection.enable()
# Check is enable mode
if connection.check_enable_mode():

    # Enter is config mode
    connection.config_mode()

    # Check is config mode
    if connection.check_config_mode():

        # Send config list to device
        connection.send_config_set("hostname Example")

    # Verify hostname
    output_prompt = connection.find_prompt()
    print(output_prompt)

connection.disconnect()
```



# Verify script

```
from netmiko import ConnectHandler
import sys

if len(sys.argv) < 3:
    print("python3 verify.py <MGMT address> <destination  
address>")
    exit(0)

cisco_device = {
    "device_type": "cisco_ios",          #OS
    "host": sys.argv[1],                 #Host ip address
    "username": "cpe",                   #Username
    "password": "cpe",                   #Password
    "secret": "cpe",                     #Secret
}
```

## Verify script (Continue)

```
connection = ConnectHandler(**cisco_device)
# Call 'enable()' method to elevate privileges
connection.enable()

# Check is enable mode
if connection.check_enable_mode():
    dest = sys.argv[2]
    output = connection.send_command("ping " + dest)
    print(output)

connection.disconnect()
```

# Cisco IOS command suggestion

- **Routing enable**
  - ip routing
- **Assign static route**
  - ip route <network address> <netmask> <next hop address>
- **Create loopback**
  - int loopback <interface number>

# Checkpoint 1

# Router 4

```
#Verify hostname
```

```
ROUTER-LAN-4#
```

```
#Verify interfaces
```

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0/0	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0/0/1	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0	192.168.254.19	YES	NVRAM	up	up

```
#Verify routes
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from PfR

```
Gateway of last resort is not set
```

# Checkpoint 1

# CORE-SW-4

```
#Verify hostname
```

```
CORE-SW-4#
```

```
#Verify interfaces
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	unassigned	YES	NVRAM	up	up
GigabitEthernet0/0	192.168.254.20	YES	NVRAM	up	up
GigabitEthernet1/0/1	unassigned	YES	unset	down	down
GigabitEthernet1/0/2	unassigned	YES	unset	down	down
GigabitEthernet1/0/3	unassigned	YES	unset	down	down
GigabitEthernet1/0/4	unassigned	YES	unset	down	down
GigabitEthernet1/0/5	unassigned	YES	unset	down	down
GigabitEthernet1/0/6	unassigned	YES	unset	down	down
GigabitEthernet1/0/7	unassigned	YES	unset	down	down
GigabitEthernet1/0/8	unassigned	YES	unset	down	down
GigabitEthernet1/0/9	unassigned	YES	unset	down	down
GigabitEthernet1/0/10	unassigned	YES	unset	down	down
GigabitEthernet1/0/11	unassigned	YES	unset	down	down
GigabitEthernet1/0/12	unassigned	YES	unset	down	down
GigabitEthernet1/0/13	unassigned	YES	unset	down	down
GigabitEthernet1/0/14	unassigned	YES	unset	down	down
GigabitEthernet1/0/15	unassigned	YES	unset	down	down
GigabitEthernet1/0/16	unassigned	YES	unset	down	down
GigabitEthernet1/0/17	unassigned	YES	unset	down	down
GigabitEthernet1/0/18	unassigned	YES	unset	down	down
GigabitEthernet1/0/19	unassigned	YES	unset	down	down
GigabitEthernet1/0/20	unassigned	YES	unset	down	down
GigabitEthernet1/0/21	unassigned	YES	unset	down	down
GigabitEthernet1/0/22	unassigned	YES	unset	down	down
GigabitEthernet1/0/23	unassigned	YES	unset	down	down
GigabitEthernet1/0/24	unassigned	YES	unset	down	down
GigabitEthernet1/1/1	unassigned	YES	unset	down	down
GigabitEthernet1/1/2	unassigned	YES	unset	down	down
GigabitEthernet1/1/3	unassigned	YES	unset	down	down
GigabitEthernet1/1/4	unassigned	YES	unset	down	down

Te1/1/1	unassigned	YES	unset	down	down
Te1/1/2	unassigned	YES	unset	down	down
Te1/1/3	unassigned	YES	unset	down	down
Te1/1/4	unassigned	YES	unset	down	down
Te1/1/5	unassigned	YES	unset	down	down
Te1/1/6	unassigned	YES	unset	down	down
Te1/1/7	unassigned	YES	unset	down	down
Te1/1/8	unassigned	YES	unset	down	down
Fo1/1/1	unassigned	YES	unset	down	down
Fo1/1/2	unassigned	YES	unset	down	down
TwentyFiveGigE1/1/1	unassigned	YES	unset	down	down
TwentyFiveGigE1/1/2	unassigned	YES	unset	down	down
Ap1/0/1	unassigned	YES	unset	up	up

```
#Verify routes
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from PFR

```
Gateway of last resort is not set
```

# Checkpoint 1

# Router 5

```
#Verify hostname
```

```
ROUTER-LAN-5#
```

```
#Verify interfaces
```

Interface	IP-Address	OK?	Method	Status	Protocol
GigabitEthernet0/0/0	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0/0/1	unassigned	YES	NVRAM	administratively down	down
GigabitEthernet0	192.168.254.22	YES	NVRAM	up	up

```
#Verify routes
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from PfR

```
Gateway of last resort is not set
```

# Checkpoint 1

# CORE-SW-5

```
#Verify hostname
```

```
CORE-SW-5#
```

```
#Verify interfaces
```

Interface	IP-Address	OK?	Method	Status	Protocol
Vlan1	unassigned	YES	NVRAM	up	up
GigabitEthernet0/0	192.168.254.23	YES	NVRAM	up	up
GigabitEthernet1/0/1	unassigned	YES	unset	down	down
GigabitEthernet1/0/2	unassigned	YES	unset	down	down
GigabitEthernet1/0/3	unassigned	YES	unset	down	down
GigabitEthernet1/0/4	unassigned	YES	unset	down	down
GigabitEthernet1/0/5	unassigned	YES	unset	down	down
GigabitEthernet1/0/6	unassigned	YES	unset	down	down
GigabitEthernet1/0/7	unassigned	YES	unset	down	down
GigabitEthernet1/0/8	unassigned	YES	unset	down	down
GigabitEthernet1/0/9	unassigned	YES	unset	down	down
GigabitEthernet1/0/10	unassigned	YES	unset	down	down
GigabitEthernet1/0/11	unassigned	YES	unset	down	down
GigabitEthernet1/0/12	unassigned	YES	unset	down	down
GigabitEthernet1/0/13	unassigned	YES	unset	down	down
GigabitEthernet1/0/14	unassigned	YES	unset	down	down
GigabitEthernet1/0/15	unassigned	YES	unset	down	down
GigabitEthernet1/0/16	unassigned	YES	unset	down	down
GigabitEthernet1/0/17	unassigned	YES	unset	down	down
GigabitEthernet1/0/18	unassigned	YES	unset	down	down
GigabitEthernet1/0/19	unassigned	YES	unset	down	down
GigabitEthernet1/0/20	unassigned	YES	unset	down	down
GigabitEthernet1/0/21	unassigned	YES	unset	down	down
GigabitEthernet1/0/22	unassigned	YES	unset	down	down
GigabitEthernet1/0/23	unassigned	YES	unset	down	down
GigabitEthernet1/0/24	unassigned	YES	unset	down	down
GigabitEthernet1/1/1	unassigned	YES	unset	down	down
GigabitEthernet1/1/2	unassigned	YES	unset	down	down
GigabitEthernet1/1/3	unassigned	YES	unset	down	down
GigabitEthernet1/1/4	unassigned	YES	unset	down	down

Te1/1/1	unassigned	YES	unset	down	down
Te1/1/2	unassigned	YES	unset	down	down
Te1/1/3	unassigned	YES	unset	down	down
Te1/1/4	unassigned	YES	unset	down	down
Te1/1/5	unassigned	YES	unset	down	down
Te1/1/6	unassigned	YES	unset	down	down
Te1/1/7	unassigned	YES	unset	down	down
Te1/1/8	unassigned	YES	unset	down	down
Fo1/1/1	unassigned	YES	unset	down	down
Fo1/1/2	unassigned	YES	unset	down	down
TwentyFiveGigE1/1/1	unassigned	YES	unset	down	down
TwentyFiveGigE1/1/2	unassigned	YES	unset	down	down
Ap1/0/1	unassigned	YES	unset	up	up

```
#Verify routes
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, \* - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from Pfr

```
Gateway of last resort is not set
```



# Checkpoint 2 (Verify config)

# Router 4

```
#Verify hostname

ROUTER-4#

#Verify interfaces

Interface                IP-Address      OK? Method Status          Protocol
GigabitEthernet0/0/0     100.254.10.2    YES manual up              up
GigabitEthernet0/0/1     172.58.10.1     YES manual up              up
GigabitEthernet0         192.168.254.19  YES NVRAM  up              up
Loopback0                4.4.4.4         YES manual up              up

#Verify routes

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

  4.0.0.0/32 is subnetted, 1 subnets
C      4.4.4.4 is directly connected, Loopback0
 100.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
C      100.254.10.0/30 is directly connected, GigabitEthernet0/0/0
L      100.254.10.2/32 is directly connected, GigabitEthernet0/0/0
S      100.254.10.4/30 [1/0] via 100.254.10.1
 172.58.0.0/16 is variably subnetted, 3 subnets, 2 masks
C      172.58.10.0/30 is directly connected, GigabitEthernet0/0/1
L      172.58.10.1/32 is directly connected, GigabitEthernet0/0/1
S      172.58.10.4/30 [1/0] via 100.254.10.1
```



# Checkpoint 2 (Verify config)

## CORE-SW-4

```
#Verify hostname
```

```
CORE-SW-4#
```

```
#Verify routes
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, * - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from PfR
```

```
Gateway of last resort is not set
```

```
100.0.0.0/30 is subnetted, 2 subnets  
S    100.254.10.0 [1/0] via 172.58.10.1  
S    100.254.10.4 [1/0] via 172.58.10.1  
172.58.0.0/16 is variably subnetted, 3 subnets, 2 masks  
C    172.58.10.0/30 is directly connected, GigabitEthernet1/0/24  
L    172.58.10.2/32 is directly connected, GigabitEthernet1/0/24  
S    172.58.10.4/30 [1/0] via 172.58.10.1
```

# Checkpoint 2 (Verify config)

# Router 5

```
#Verify hostname

ROUTER-5#

#Verify interfaces

Interface                IP-Address      OK? Method Status        Protocol
GigabitEthernet0/0/0     100.254.10.6    YES manual up            up
GigabitEthernet0/0/1     172.58.10.5     YES manual up            up
GigabitEthernet0         192.168.254.22  YES NVRAM  up            up
Loopback0                5.5.5.5         YES manual up            up

#Verify routes

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
       n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       H - NHRP, G - NHRP registered, g - NHRP registration summary
       o - ODR, P - periodic downloaded static route, l - LISP
       a - application route
       + - replicated route, % - next hop override, p - overrides from PfR

Gateway of last resort is not set

      5.0.0.0/32 is subnetted, 1 subnets
C        5.5.5.5 is directly connected, Loopback0
      100.0.0.0/8 is variably subnetted, 3 subnets, 2 masks
S        100.254.10.0/30 [1/0] via 100.254.10.5
C        100.254.10.4/30 is directly connected, GigabitEthernet0/0/0
L        100.254.10.6/32 is directly connected, GigabitEthernet0/0/0
      172.58.0.0/16 is variably subnetted, 3 subnets, 2 masks
S        172.58.10.0/30 [1/0] via 100.254.10.5
C        172.58.10.4/30 is directly connected, GigabitEthernet0/0/1
L        172.58.10.5/32 is directly connected, GigabitEthernet0/0/1
```

# Checkpoint 2 (Verify config)

## CORE-SW-5

```
#Verify hostname
```

```
C-SW-5#
```

```
#Verify routes
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
ia - IS-IS inter area, * - candidate default, U - per-user static route  
H - NHRP, G - NHRP registered, g - NHRP registration summary  
o - ODR, P - periodic downloaded static route, l - LISP  
a - application route  
+ - replicated route, % - next hop override, p - overrides from PfR
```

```
Gateway of last resort is not set
```

```
100.0.0.0/30 is subnetted, 2 subnets  
S    100.254.10.0 [1/0] via 172.58.10.5  
S    100.254.10.4 [1/0] via 172.58.10.5  
172.58.0.0/16 is variably subnetted, 3 subnets, 2 masks  
S    172.58.10.0/30 [1/0] via 172.58.10.5  
C    172.58.10.4/30 is directly connected, GigabitEthernet1/0/24  
L    172.58.10.6/32 is directly connected, GigabitEthernet1/0/24
```

## Checkpoint 2

\*\*\*\*\*

**Verify from your network to another network with Verify script**

**Command:** python3 verify.py <MGMT address> <destination address>

```
python3 verify.py 192.168.254.19 172.58.10.6
```

### Output

```
Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 172.58.10.6, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 1/1/1 ms
```

# References

- <https://ktbyers.github.io/netmiko/docs/netmiko/>