

CSEE 4119 Computer Networks

Project 2 Build your own Internet Stage A

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Task 3.2.1: Setup interfaces and set up OSPF

The screenshot of ping results from NEWY-host to SEAT-host by using command **ping 6.109.0.1 -c 10**:

```
qiaoyu — root@byoi-as6: ~ — ssh -p 3006 byoi-user@104.197.46.2 — 80x24
64 bytes from 6.109.0.1: icmp_seq=1 ttl=59 time=0.257 ms
64 bytes from 6.109.0.1: icmp_seq=2 ttl=59 time=0.152 ms
64 bytes from 6.109.0.1: icmp_seq=3 ttl=59 time=0.149 ms
^C
--- 6.109.0.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2029ms
rtt min/avg/max/mdev = 0.149/0.186/0.257/0.050 ms
NEWY-host:~$ ping 6.109.0.1 -c 10
PING 6.109.0.1 (6.109.0.1) 56(84) bytes of data.
64 bytes from 6.109.0.1: icmp_seq=1 ttl=59 time=0.431 ms
64 bytes from 6.109.0.1: icmp_seq=2 ttl=59 time=0.211 ms
64 bytes from 6.109.0.1: icmp_seq=3 ttl=59 time=0.296 ms
64 bytes from 6.109.0.1: icmp_seq=4 ttl=59 time=0.200 ms
64 bytes from 6.109.0.1: icmp_seq=5 ttl=59 time=0.153 ms
64 bytes from 6.109.0.1: icmp_seq=6 ttl=59 time=0.165 ms
64 bytes from 6.109.0.1: icmp_seq=7 ttl=59 time=0.269 ms
64 bytes from 6.109.0.1: icmp_seq=8 ttl=59 time=0.172 ms
64 bytes from 6.109.0.1: icmp_seq=9 ttl=59 time=0.191 ms
64 bytes from 6.109.0.1: icmp_seq=10 ttl=59 time=0.209 ms
--- 6.109.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9209ms
rtt min/avg/max/mdev = 0.153/0.229/0.431/0.081 ms
NEWY-host:~$
```

Task 3.2.2: Assign OSPF weights

The screenshot of traceroute results from NEWY-host to SEAT-host:

```
qiaoyu — root@byoi-as6: ~ — ssh -p 3006 byoi-user@104.197.46.2 — 80x24
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Tue Nov 19 20:36:30 2019 from 127.0.0.1
✓ Mininet is running

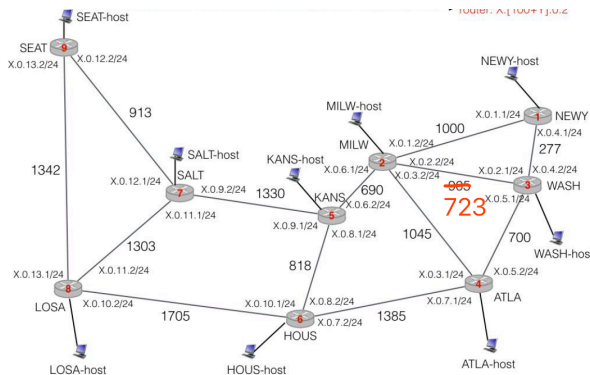
Use ./bash-in.sh <ROUTER> to get a shell in <ROUTER>
byoi-user@byoi-as6:~$ sudo su -
✓ Mininet is running

Use ./bash-in.sh <ROUTER> to get a shell in <ROUTER>
root@byoi-as6:~# ./bash-in.sh NEWY-host
NEWY-host:~$ traceroute 6.109.0.1
traceroute to 6.109.0.1 (6.109.0.1), 30 hops max, 60 byte packets
 1  6.101.0.2 (6.101.0.2)  0.150 ms  0.010 ms  0.011 ms
 2  6.0.1.2 (6.0.1.2)  0.055 ms  0.013 ms  0.016 ms
 3  6.0.6.2 (6.0.6.2)  0.065 ms  0.015 ms  0.014 ms
 4  6.0.9.2 (6.0.9.2)  0.047 ms  0.017 ms  0.018 ms
 5  6.0.12.2 (6.0.12.2)  0.054 ms  0.023 ms  0.023 ms
 6  6.109.0.1 (6.109.0.1)  0.060 ms  0.163 ms  0.043 ms
NEWY-host:~$ exit
exit
```

As is shown from the figure above, when connecting to SEAT-host, NEWY-host passes through NEWY, MILW, KANS, SALT, SEAT, SEAT-host sequentially. Such route is the shortest path between two hosts, which corresponds to the mechanism of OSPF. Hence, I have configured OSPF weights properly.

Task 3.2.3: Load balance with ECMP

In this part, I changed OSPF weight between MILW and WASH from 905 to 723. As is shown below:



After making such change, when connecting from NEWY to SEAT, there exists two paths with the same cost of 1000: NEWY- MILW- KANS- SALT- SEAT, NEWY- WASH- MILW- KANS- SALT- SEAT. Due to multiple shortest paths, these routers can split traffic across all of them.

In order to prove ECMP, we can use **show ip route ospf** command. From the result, we can see that when connecting from NEWY to SEAT and SEAT-host, there are equally two paths, via wash or milw separately.

The screenshot of the output of running **show ip route ospf**

```
G6_NEWY# show ip route ospf
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

O 6.0.1.0/24 [110/1000] is directly connected, milw, 1d00h07m
O*> 6.0.2.0/24 [110/1000] via 6.0.4.2, wash, 21:02:55
O*> 6.0.3.0/24 [110/2022] via 6.0.4.2, wash, 1d00h07m
O 6.0.4.0/24 [110/277] is directly connected, wash, 1d00h07m
O*> 6.0.5.0/24 [110/977] via 6.0.4.2, wash, 1d00h07m
O*> 6.0.6.0/24 [110/1690] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.0.7.0/24 [110/2362] via 6.0.4.2, wash, 1d00h07m
O*> 6.0.8.0/24 [110/2508] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.0.9.0/24 [110/3020] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.0.10.0/24 [110/4067] via 6.0.4.2, wash, 1d00h07m
O*> 6.0.11.0/24 [110/4323] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.0.12.0/24 [110/3933] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.0.13.0/24 [110/5275] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O 6.101.0.0/24 [110/10] is directly connected, host, 1d00h08m
O*> 6.102.0.0/24 [110/1010] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.103.0.0/24 [110/287] via 6.0.4.2, wash, 1d00h07m
O*> 6.104.0.0/24 [110/987] via 6.0.4.2, wash, 1d00h07m
O*> 6.105.0.0/24 [110/1700] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.106.0.0/24 [110/2372] via 6.0.4.2, wash, 1d00h07m
O*> 6.107.0.0/24 [110/3030] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
O*> 6.108.0.0/24 [110/4077] via 6.0.4.2, wash, 1d00h07m
O*> 6.109.0.0/24 [110/3943] via 6.0.4.2, wash, 21:02:55
* via 6.0.1.2, milw, 21:02:55
G6_NEWY#
```

Task 3.3: Setup iBGP

The screenshot of **show ip bgp summary** results from NEWY router:

```
qiaoyu — root@byoi-as6: ~ — ssh -p 3006 byoi-user@104.197.46.2 — 80x24
B> 6.0.0.0/8 [200/0] via 6.102.0.2 (recursive), 00:02:39
*   via 6.0.4.2, wash, 00:02:39
*   via 6.0.1.2, milw, 00:02:39
B> 22.0.0.0/8 [200/0] via 6.102.0.2 (recursive), 00:02:39
*   via 6.0.4.2, wash, 00:02:39
*   via 6.0.1.2, milw, 00:02:39
[G6_NEWY# show ip bgp summary
BGP router identifier 6.101.0.2, local AS number 6
RIB entries 3, using 336 bytes of memory
Peers 8, using 71 KiB of memory

Neighbor      V      AS MsgRcvd MsgSent  TblVer  InQ  OutQ Up/Down  State/P
fxRcd
6.102.0.2     4      6      13      13      0      0    0 00:04:18  2
6.103.0.2     4      6       6      11      0      0    0 00:01:54  0
6.104.0.2     4      6       9      14      0      0    0 00:04:37  0
6.105.0.2     4      6      10      14      0      0    0 00:05:09  0
6.106.0.2     4      6       9      16      0      0    0 00:05:27  0
6.107.0.2     4      6       9      15      0      0    0 00:05:47  0
6.108.0.2     4      6      10      17      0      0    0 00:06:07  0
6.109.0.2     4      6      11      15      0      0    0 00:06:25  0

Total number of neighbors 8
G6_NEWY#
```

The screenshot of **show route bgp** results from NEWY router:

```
qiaoyu — root@byoi-as6: ~ — ssh -p 3006 byoi-user@104.197.46.2 — 80x24
Use ./bash-in.sh <ROUTER> to get a shell in <ROUTER>
byoi-user@byoi-as6:~$ sudo su -
✓ Mininet is running

Use ./bash-in.sh <ROUTER> to get a shell in <ROUTER>
root@byoi-as6:~# ./bash-in.sh NEWY
NEWY:~$ vtysh

Hello, this is Quagga (version 1.1.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

G6_NEWY# show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel,
       > - selected route, * - FIB route

B> 6.0.0.0/8 [200/0] via 6.102.0.2 (recursive), 00:11:46
*   via 6.0.4.2, wash, 00:11:46
*   via 6.0.1.2, milw, 00:11:46
B> 22.0.0.0/8 [200/0] via 6.102.0.2 (recursive), 00:11:46
*   via 6.0.4.2, wash, 00:11:46
*   via 6.0.1.2, milw, 00:11:46
G6_NEWY#
```

When specifying a particular router interface, there needs three steps:

router_name(config-router): neighbor 6.X.0.2 remote-as 6

router_name(config-router): neighbor 6.X.0.2 next-hop-self

router_name(config-router): neighbor 6.X.0.2 update-source 6.Y.0.2

6 is my AS number;

6.X.0.2 is the ip address of host interface of the router we want to connect to under iBGP;

6.Y.0.2 is the ip address of host interface of current router.