

# Report for Lab 2

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## 1. Part 1

```
root@mininet-vm:/home/cs551/evansprite-cs551/lab2/vms# ./go_to.sh NEWY-host
root@mininet-vm:/# ping 11.109.0.1 -c 10
PING 11.109.0.1 (11.109.0.1) 56(84) bytes of data.
64 bytes from 11.109.0.1: icmp_seq=1 ttl=59 time=0.071 ms
64 bytes from 11.109.0.1: icmp_seq=2 ttl=59 time=0.146 ms
64 bytes from 11.109.0.1: icmp_seq=3 ttl=59 time=0.147 ms
64 bytes from 11.109.0.1: icmp_seq=4 ttl=59 time=0.193 ms
64 bytes from 11.109.0.1: icmp_seq=5 ttl=59 time=0.241 ms
64 bytes from 11.109.0.1: icmp_seq=6 ttl=59 time=0.079 ms
64 bytes from 11.109.0.1: icmp_seq=7 ttl=59 time=0.053 ms
64 bytes from 11.109.0.1: icmp_seq=8 ttl=59 time=0.056 ms
64 bytes from 11.109.0.1: icmp_seq=9 ttl=59 time=0.078 ms
64 bytes from 11.109.0.1: icmp_seq=10 ttl=59 time=0.064 ms

--- 11.109.0.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9007ms
rtt min/avg/max/mdev = 0.053/0.112/0.241/0.063 ms
root@mininet-vm:/#
```

## 2. Part 2

```
root@mininet-vm:/home/cs551/evansprite-cs551/lab2/vms# ./go_to.sh NEWY-host
root@mininet-vm:/# traceroute 11.109.0.1
traceroute to 11.109.0.1 (11.109.0.1), 30 hops max, 60 byte packets
 1  11.101.0.2 (11.101.0.2)  0.020 ms  0.005 ms  0.004 ms
 2  11.0.1.2 (11.0.1.2)  0.012 ms  0.008 ms  0.007 ms
 3  11.0.6.2 (11.0.6.2)  0.016 ms  0.012 ms  0.012 ms
 4  11.0.9.2 (11.0.9.2)  0.134 ms  0.031 ms  0.028 ms
 5  11.0.12.2 (11.0.12.2)  0.022 ms  0.017 ms  0.017 ms
 6  11.109.0.1 (11.109.0.1)  0.024 ms  0.040 ms  0.021 ms
root@mininet-vm:/#
```

According to the traceroute results, the path from NEWY-host to SEAT-host is NEWY-host→NEWY→CHIC→KANS→SALT→SEAT→SEAT-host, the total cost is  $1000 + 690 + 1330 + 913 = 3933$ , which is smallest among all paths from NEWY-host to SEAT-host. So, the OSPF weights are configured properly.

## 3. Part 3

### Changes:

- 1) For links in the path NEWY→CHIC→KANS→SALT→SEAT, each of the four links is assigned weight 5.
- 2) For links in the path NEWY→WASH→ATLA→HOUS→LOSA→SEAT, each of the five links is assigned weight 4.
- 3) For links of CHIC→WASH, CHIC→ATLA, KANS→HOUS, SALT→LOSA, each of the four

links is assigned weight 1000.

**Reason:**

if make above changes, there will be two equal-cost paths from SEAT-host to NEWY-host, which are:

- a) SEAT-host→SEAT→SALT→KANS→CHIC→NEWY→NEWY-host
- b) SEAT-host→SEAT→LOSA→HOUS→ATLA→WASH→NEWY→NEWY-host

The paths cost 20 equally, which is the smallest cost among all paths from SEAT-host to NEWY-host. Besides, for the two paths between SEAT and NEWY, there is no common router, so it will be helpful to analyze splitting traffic on these two paths.

From the results of routes received by ospf, there are two different routes with same smallest cost, from SALT and LOSA separately.

```
G5_SEAT# sh ip route ospf
Codes: K - kernel route, C - connected, S - static, R - RIP,
       O - OSPF, I - IS-IS, B - BGP, A - Babel,
       > - selected route, * - FIB route

O>* 11.0.1.0/24 [110/20] via 11.0.12.1, salt, 00:03:53
O>* 11.0.2.0/24 [110/1015] via 11.0.12.1, salt, 00:03:53
O>* 11.0.3.0/24 [110/1012] via 11.0.13.1, losa, 00:03:54
O>* 11.0.4.0/24 [110/20] via 11.0.13.1, losa, 00:03:54
O>* 11.0.5.0/24 [110/16] via 11.0.13.1, losa, 00:03:54
O>* 11.0.6.0/24 [110/15] via 11.0.12.1, salt, 00:03:53
O>* 11.0.7.0/24 [110/12] via 11.0.13.1, losa, 00:03:54
O>* 11.0.8.0/24 [110/1008] via 11.0.13.1, losa, 00:03:54
O>* 11.0.9.0/24 [110/10] via 11.0.12.1, salt, 00:03:53
O>* 11.0.10.0/24 [110/8] via 11.0.13.1, losa, 00:03:54
O>* 11.0.11.0/24 [110/1004] via 11.0.13.1, losa, 00:03:54
O 11.0.12.0/24 [110/5] is directly connected, salt, 00:03:53
O 11.0.13.0/24 [110/4] is directly connected, losa, 00:03:54
O>* 11.101.0.0/24 [110/30] via 11.0.12.1, salt, 00:03:53
*      *      via 11.0.13.1, losa, 00:03:53
O>* 11.102.0.0/24 [110/25] via 11.0.12.1, salt, 00:03:53
O>* 11.103.0.0/24 [110/26] via 11.0.13.1, losa, 00:03:54
O>* 11.104.0.0/24 [110/22] via 11.0.13.1, losa, 00:03:54
O>* 11.105.0.0/24 [110/20] via 11.0.12.1, salt, 00:03:53
O>* 11.106.0.0/24 [110/18] via 11.0.13.1, losa, 00:03:54
O>* 11.107.0.0/24 [110/15] via 11.0.12.1, salt, 00:03:53
O>* 11.108.0.0/24 [110/14] via 11.0.13.1, losa, 00:03:54
O 11.109.0.0/24 [110/10] is directly connected, host, 1d21h20m
G5_SEAT#
```

Traceroute results (From SEAT-host to NEWY-host):

```

root@mininet-vm:/home/cs551/evansprite-cs551/lab2/vms# ./go_to.sh SEAT-host
root@mininet-vm:/# traceroute 11.101.0.1
traceroute to 11.101.0.1 (11.101.0.1), 30 hops max, 60 byte packets
 1  11.109.0.2 (11.109.0.2)  0.054 ms  0.011 ms  0.009 ms
 2  11.0.12.1 (11.0.12.1)  0.030 ms  11.0.13.1 (11.0.13.1)  0.032 ms  11.0.12.1 (11.0.12.1)  0.017 ms
 3  11.0.10.1 (11.0.10.1)  0.041 ms  11.0.9.1 (11.0.9.1)  0.045 ms  11.0.10.1 (11.0.10.1)  0.035 ms
 4  11.0.6.1 (11.0.6.1)  0.041 ms  11.0.7.1 (11.0.7.1)  0.039 ms  11.0.6.1 (11.0.6.1)  0.041 ms
 5  11.0.5.1 (11.0.5.1)  0.064 ms  11.0.4.1 (11.0.4.1)  0.060 ms  11.0.5.1 (11.0.5.1)  0.060 ms
 6  11.101.0.1 (11.101.0.1)  0.073 ms  11.0.1.1 (11.0.1.1)  0.064 ms  11.101.0.1 (11.101.0.1)  0.043 ms
root@mininet-vm:/#

```

From the traceroute results we learn that for each hop, different packets go to different router randomly, but the hops all belong to the two shortest paths. For example, from hop 3 there are 2 packets reaching router interface 11.0.10.1 (HOUS) and 1 packet reaching router interface 11.0.9.1 (KANS). We can infer that the 2 packets go through the path SEAT-host→SEAT→SALT→KANS and the 1 packet goes through the path SEAT-host→SEAT→LOSA→HOUS, because this choice is the only way for packets to reach such interfaces on hop 3. Thus, the results show that the modification effectively split the traffic on different paths.

#### 4. Part 4

```

root@mininet-vm:/home/cs551/evansprite-cs551/lab2/vms# ./go_to.sh NEWY
root@mininet-vm:/# vtysh

Hello, this is Quagga (version 0.99.22.4).
Copyright 1996-2005 Kunihiro Ishiguro, et al.

G5_NEWY# sh ip bgp summary
BGP router identifier 11.101.0.2, local AS number 11
RIB entries 0, using 0 bytes of memory
Peers 8, using 36 KiB of memory

Neighbor      V    AS MsgRcvd MsgSent  TblVer  InQ OutQ Up/Down  State/PfxRcd
11.102.0.2    4    11     15     80       0    0    0 00:10:41      0
11.103.0.2    4    11     22     83       0    0    0 00:11:52      0
11.104.0.2    4    11     15     78       0    0    0 00:09:06      0
11.105.0.2    4    11     15     78       0    0    0 00:08:16      0
11.106.0.2    4    11     16     76       0    0    0 00:07:33      0
11.107.0.2    4    11     14     76       0    0    0 00:06:54      0
11.108.0.2    4    11     15     72       0    0    0 00:06:13      0
11.109.0.2    4    11     36     83       0    0    0 00:05:37      0

Total number of neighbors 8
G5_NEWY#

```

The command used to specify a particular router interface is :

**router\_name(config-router)# neighbor <ip\_address> update-source host**

this command specify the interface to host (required in Lab2) as the interface to send announcements to other BGP router.