電腦網路實驗實驗報告 <Openflow >

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1. 實驗名稱

Introduction of OpenFlow

2. 實驗目的

瞭解如何使用 Openflow

3. 實驗設備

電腦、記事本、Terminal、Mininet、MininetTopology、Openflow

4. 實驗步驟

Exercise:

1. IPv4 Routing

```
mininet> sh ovs-ofctl add-flow s1 in_port=1,dl_type=0x0800,nw_dst=10.0.0.2,nw_src=10.0.0.1,actions=output:2
mininet> sh ovs-ofctl add-flow s1 in_port=1,dl_type=0x0806,arp_tpa=10.0.0.2,arp_spa=10.0.0.1,actions=output:2
mininet> sh ovs-ofctl add-flow s1 in_port=2,dl_type=0x0800,nw_dst=10.0.0.1,nw_src=10.0.0.2,actions=output:1
mininet> sh ovs-ofctl add-flow s1 in_port=2,dl_type=0x0806,arp_tpa=10.0.0.1,arp_spa=10.0.0.2,actions=output:1
```

圖一、規則撰寫

```
mininet> h1 ping h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=0.205 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.154 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.162 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.155 ms
64 bytes from 10.0.0.2: icmp_seq=5 ttl=64 time=0.160 ms
64 bytes from 10.0.0.2: icmp_seq=6 ttl=64 time=0.159 ms
64 bytes from 10.0.0.2: icmp_seq=7 ttl=64 time=0.161 ms
64 bytes from 10.0.0.2: icmp_seq=8 ttl=64 time=0.149 ms
64 bytes from 10.0.0.2: icmp_seq=9 ttl=64 time=0.159 ms
64 bytes from 10.0.0.2: icmp_seq=10 ttl=64 time=0.157 ms
```

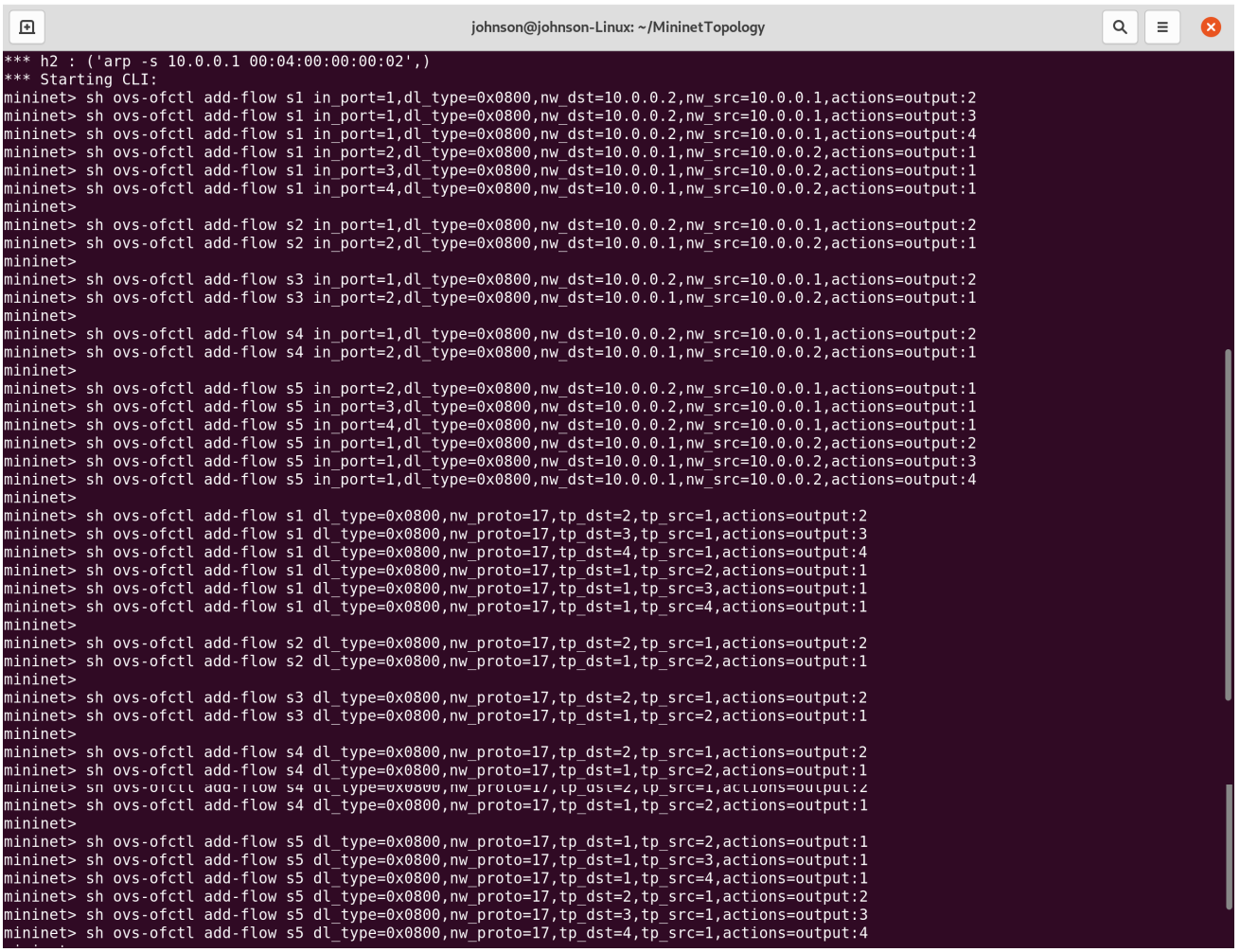
圖二、H1 ping H2

```
mininet> sh ovs-ofctl dump-flows s1
 cookie=0x0, duration=83.831s, table=0, n_packets=10, n_bytes=980, ip,in_port="s1-eth1",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=outpu
t:"s1-eth2"
 cookie=0x0, duration=74.905s, table=0, n_packets=2, n_bytes=84, arp,in_port="s1-eth1",arp_spa=10.0.0.1,arp_tpa=10.0.0.2 actions=outp
ut:"s1-eth2"
 cookie=0x0, duration=64.687s, table=0, n_packets=10, n_bytes=980, ip,in_port="s1-eth2",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=outpu
t:"s1-eth1"
 cookie=0x0, duration=58.256s, table=0, n_packets=2, n_bytes=84, arp,in_port="s1-eth2",arp_spa=10.0.0.2,arp_tpa=10.0.0.1 actions=outp
ut:"s1-eth1"
```

圖三、觀察交換機規則內容

Homework:

1. IPv4 Routing



圖四、編寫路由規則

```
mininet> sh ovs-ofctl dump-flows s1
 cookie=0x0, duration=330.808s, table=0, n_packets=0, n_bytes=0, ip,in_port="s1-eth1",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s1-eth4"
 cookie=0x0, duration=330.804s, table=0, n_packets=0, n_bytes=0, ip,in_port="s1-eth2",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s1-eth1"
 cookie=0x0, duration=330.800s, table=0, n_packets=0, n_bytes=0, ip,in_port="s1-eth3",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s1-eth1"
 cookie=0x0, duration=327.680s, table=0, n_packets=0, n_bytes=0, ip,in_port="s1-eth4",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s1-eth1"
 cookie=0x0, duration=260.943s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=2 actions=output:"s1-eth2"
 cookie=0x0, duration=260.939s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=3 actions=output:"s1-eth3"
 cookie=0x0, duration=260.935s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=4 actions=output:"s1-eth4"
 cookie=0x0, duration=260.930s, table=0, n_packets=0, n_bytes=0, udp,tp_src=2,tp_dst=1 actions=output:"s1-eth1"
 cookie=0x0, duration=260.926s, table=0, n_packets=0, n_bytes=0, udp,tp_src=3,tp_dst=1 actions=output:"s1-eth1"
 cookie=0x0, duration=259.992s, table=0, n_packets=0, n_bytes=0, udp,tp_src=4,tp_dst=1 actions=output:"s1-eth1"
```

```
mininet> sh ovs-ofctl dump-flows s2
 cookie=0x0, duration=302.572s, table=0, n_packets=0, n_bytes=0, ip,in_port="s2-eth1",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s2-eth2"
 cookie=0x0, duration=301.614s, table=0, n_packets=0, n_bytes=0, ip,in_port="s2-eth2",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s2-eth1"
 cookie=0x0, duration=256.811s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=2 actions=output:"s2-eth2"
 cookie=0x0, duration=255.944s, table=0, n_packets=0, n_bytes=0, udp,tp_src=2,tp_dst=1 actions=output:"s2-eth1"
```

```
mininet> sh ovs-ofctl dump-flows s3
 cookie=0x0, duration=301.962s, table=0, n_packets=0, n_bytes=0, ip,in_port="s3-eth1",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s3-eth2"
 cookie=0x0, duration=301.443s, table=0, n_packets=0, n_bytes=0, ip,in_port="s3-eth2",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s3-eth1"
 cookie=0x0, duration=257.009s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=2 actions=output:"s3-eth2"
 cookie=0x0, duration=256.177s, table=0, n_packets=0, n_bytes=0, udp,tp_src=2,tp_dst=1 actions=output:"s3-eth1"
```

```
mininet> sh ovs-ofctl dump-flows s4
 cookie=0x0, duration=297.081s, table=0, n_packets=0, n_bytes=0, ip,in_port="s4-eth1",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s4-eth2"
 cookie=0x0, duration=296.520s, table=0, n_packets=0, n_bytes=0, ip,in_port="s4-eth2",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s4-eth1"
 cookie=0x0, duration=254.068s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=2 actions=output:"s4-eth2"
 cookie=0x0, duration=253.288s, table=0, n_packets=0, n_bytes=0, udp,tp_src=2,tp_dst=1 actions=output:"s4-eth1"
```

```
mininet> sh ovs-ofctl dump-flows s5
 cookie=0x0, duration=290.333s, table=0, n_packets=0, n_bytes=0, ip,in_port="s5-eth2",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s5-eth1"
 cookie=0x0, duration=290.329s, table=0, n_packets=0, n_bytes=0, ip,in_port="s5-eth3",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s5-eth1"
 cookie=0x0, duration=290.325s, table=0, n_packets=0, n_bytes=0, ip,in_port="s5-eth4",nw_src=10.0.0.1,nw_dst=10.0.0.2 actions=output:
"s5-eth1"
 cookie=0x0, duration=289.286s, table=0, n_packets=0, n_bytes=0, ip,in_port="s5-eth1",nw_src=10.0.0.2,nw_dst=10.0.0.1 actions=output:
"s5-eth4"
 cookie=0x0, duration=248.662s, table=0, n_packets=0, n_bytes=0, udp,tp_src=2,tp_dst=1 actions=output:"s5-eth1"
 cookie=0x0, duration=248.658s, table=0, n_packets=0, n_bytes=0, udp,tp_src=3,tp_dst=1 actions=output:"s5-eth1"
 cookie=0x0, duration=248.654s, table=0, n_packets=0, n_bytes=0, udp,tp_src=4,tp_dst=1 actions=output:"s5-eth1"
 cookie=0x0, duration=248.650s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=2 actions=output:"s5-eth2"
 cookie=0x0, duration=248.646s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=3 actions=output:"s5-eth3"
 cookie=0x0, duration=247.699s, table=0, n_packets=0, n_bytes=0, udp,tp_src=1,tp_dst=4 actions=output:"s5-eth4"
```

圖五、檢視每一台交換機上的規則

```
root@johnson-Linux:/home/johnson/MininetTopology# bash  ./TestScript_Homework.sh
Testing, 1
Testing, 2
Testing, 3
Testing, 4
Testing, 5
Testing, 6
Testing, 7
Testing, 8
Testing, 9
Testing, 10
root@johnson-Linux:/home/johnson/MininetTopology#
```

圖六、打開 Host H1 終端機進行測試

```
50001-s.log [唯讀]
~/MininetTopology
1 ------------------------------------------------------------
2 Server listening on UDP port 50001
3 Receiving 1470 byte datagrams
4 UDP buffer size:  208 KByte (default)
5 ------------------------------------------------------------
6 [  3] local 10.0.0.2 port 50001 connected with 10.0.0.1 port 50001
7 [ ID] Interval       Transfer     Bandwidth        Jitter   Lost/Total Datagrams
8 [  3]  0.0-10.0 sec  38.7 MBytes  32.4 Mbits/sec   1.662 ms    0/27593 (0%)
9 [  3] 0.0000-10.0009 sec  2 datagrams received out-of-order
```

```
50002-s.log [唯讀]
~/MininetTopology
1 ------------------------------------------------------------
2 Server listening on UDP port 50002
3 Receiving 1470 byte datagrams
4 UDP buffer size:  208 KByte (default)
5 ------------------------------------------------------------
6 [  3] local 10.0.0.2 port 50002 connected with 10.0.0.1 port 50002
7 [ ID] Interval       Transfer     Bandwidth        Jitter   Lost/Total Datagrams
8 [  3]  0.0-10.0 sec  38.7 MBytes  32.4 Mbits/sec   1.313 ms    0/27589 (0%)
9 [  3] 0.0000-10.0197 sec  12 datagrams received out-of-order
```

```
50003-s.log [唯讀]
~/MininetTopology
1 ------------------------------------------------------------
2 Server listening on UDP port 50003
3 Receiving 1470 byte datagrams
4 UDP buffer size:  208 KByte (default)
5 ------------------------------------------------------------
6 [  3] local 10.0.0.2 port 50003 connected with 10.0.0.1 port 50003
7 [ ID] Interval       Transfer     Bandwidth        Jitter   Lost/Total Datagrams
8 [  3]  0.0-10.0 sec  38.6 MBytes  32.4 Mbits/sec   1.998 ms    0/27553 (0%)
9 [  3] 0.0000-10.0076 sec  8 datagrams received out-of-order
```

圖七、測試結果

5. 問題與討論

這次實驗蠻複雜的，在打程式時，花了很久的時間，常常會不小心連錯，還有時候會打到錯亂忘記自己在連什麼，希望我以後能更小心。

6. 心得與感想

這次的實驗蠻難的，在課堂上做 Exercise 時，就覺得蠻難的了，而 Homework 又更難了，在網路上找了好久資料，然後一直翻講義，才終於打出來，這次實驗第一次用 Openflow，希望經過這次經驗，下次實驗能更熟悉 Openflow。

7. 參考文獻