

# lab3 report

## part1

### 1. Take routing tables screenshot before/after on [r1-r4]

Ans:

before

```
mininet> r1 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.1.0        0.0.0.0           255.255.255.0   U     0      0      0 r1-eth0
192.168.1.0     0.0.0.0           255.255.255.192 U     0      0      0 r1-eth1
192.168.1.64    0.0.0.0           255.255.255.192 U     0      0      0 r1-eth2
mininet> r2 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.0.0         0.0.0.0           255.255.255.0   U     0      0      0 r2-eth0
10.0.1.0         0.0.0.0           255.255.255.0   U     0      0      0 r2-eth1
mininet> r3 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.0.0         0.0.0.0           255.255.255.0   U     0      0      0 r3-eth0
10.0.2.0         0.0.0.0           255.255.255.0   U     0      0      0 r3-eth1
mininet> r4 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.2.0         0.0.0.0           255.255.255.0   U     0      0      0 r4-eth0
140.114.0.0     0.0.0.0           255.255.255.0   U     0      0      0 r4-eth1
```

after

```
mininet> r1 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.1.0        0.0.0.0           255.255.255.0   U     0      0      0 r1-eth0
140.114.0.0     10.0.1.1          255.255.255.0   UG    20     0      0 r1-eth0
192.168.1.0     0.0.0.0           255.255.255.192 U     0      0      0 r1-eth1
192.168.1.64    0.0.0.0           255.255.255.192 U     0      0      0 r1-eth2
mininet> r2 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.0.0         0.0.0.0           255.255.255.0   U     0      0      0 r2-eth0
10.0.1.0         0.0.0.0           255.255.255.0   U     0      0      0 r2-eth1
140.113.0.0     10.0.1.2          255.255.0.0     UG    20     0      0 r2-eth1
140.114.0.0     10.0.0.2          255.255.255.0   UG    20     0      0 r2-eth0
mininet> r3 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.0.0         0.0.0.0           255.255.255.0   U     0      0      0 r3-eth0
10.0.2.0         0.0.0.0           255.255.255.0   U     0      0      0 r3-eth1
140.113.0.0     10.0.0.1          255.255.0.0     UG    20     0      0 r3-eth0
140.114.0.0     10.0.2.3          255.255.255.0   UG    20     0      0 r3-eth1
mininet> r4 route
Kernel IP routing table
Destination      Gateway            Genmask          Flags Metric Ref  Use Iface
10.0.2.0         0.0.0.0           255.255.255.0   U     0      0      0 r4-eth0
140.113.0.0     10.0.2.1          255.255.0.0     UG    20     0      0 r4-eth0
140.114.0.0     0.0.0.0           255.255.255.0   U     0      0      0 r4-eth1
```

## 2. Telnet zebra and bgpd daemons of [r1-r4] and take screenshots of routes in zebra and bgpd daemons.

Ans:

r1

```
zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
      0 - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
      > - selected route, * - FIB route
B>* 140.114.0.0/24 [20/0] via 10.0.1.1, r1-eth0, 00:09:42
zebra> █
```

```
r1> show ip bgp summary
BGP router identifier 10.0.1.2, local AS number 65001
RIB entries 3, using 336 bytes of memory
Peers 1, using 9088 bytes of memory

Neighbor          V        AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/P
fxRcd
10.0.1.1         4 65002     306     309       0     0    0 00:15:13      1

Total number of neighbors 1

Total num. Established sessions 1
Total num. of routes received 1
```

r2

```
zebra> show ip route bgp
Codes: K - kernel route, C - connected, S - static, R - RIP,
      0 - OSPF, I - IS-IS, B - BGP, P - PIM, A - Babel, N - NHRP,
      > - selected route, * - FIB route
B>* 140.113.0.0/16 [20/0] via 10.0.1.2, r2-eth1, 00:18:39
B>* 140.114.0.0/24 [20/0] via 10.0.0.2, r2-eth0, 00:18:34
```

```
r2> show ip bgp summary
BGP router identifier 10.0.0.1, local AS number 65002
RIB entries 3, using 336 bytes of memory
Peers 2, using 18 KiB of memory

Neighbor          V        AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/P
fxRcd
10.0.0.2         4 65003     401     404       0     0    0 00:19:57      1
10.0.1.2         4 65001     402     403       0     0    0 00:19:57      1

Total number of neighbors 2

Total num. Established sessions 2
Total num. of routes received 2
```

r3

```
zebra> 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, N - NHRP,
      > - selected route, * - FIB route

B>* 140.113.0.0/16 [20/0] via 10.0.0.1, r3-eth0, 00:33:17
B>* 140.114.0.0/24 [20/0] via 10.0.2.3, r3-eth1, 00:33:22
```

```
r3> show ip bgp summary
BGP router identifier 10.0.2.1, local AS number 65003
RIB entries 3, using 336 bytes of memory
Peers 2, using 18 KiB of memory

Neighbor      V        AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/P
fxRcd
10.0.0.1      4 65002    686     687       0     0     0 00:34:11      1
10.0.2.3      4 65004    685     688       0     0     0 00:34:11      1

Total number of neighbors 2

Total num. Established sessions 2
Total num. of routes received    2
```

r4

```
zebra> 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, N - NHRP,
      > - selected route, * - FIB route

B>* 140.113.0.0/16 [20/0] via 10.0.2.1, r4-eth0, 00:35:48
```

```
r4> show ip bgp summary
BGP router identifier 10.0.2.3, local AS number 65004
RIB entries 3, using 336 bytes of memory
Peers 1, using 9088 bytes of memory

Neighbor      V        AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/P
fxRcd
10.0.2.1      4 65003    744     745       0     0     0 00:37:07      1

Total number of neighbors 1

Total num. Established sessions 1
Total num. of routes received    1
```

### 3. Capture BGP packets from wireshark and take screenshot to verify your answer for the following questions

#### 3-1. Show BGP packets (OPEN, UPDATE, KEEP ALIVE) exchanged by r2 and r3

**Ans:**

wireshark on r2-eth0 and r3-eth0(open, update, keep alive)

\*r2-eth0

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

bpg Expression...

No.	Time	Source	Destination	Protocol	Length	Info
20	167.070960780	10.0.0.2	10.0.0.1	BGP	125	OPEN Message
22	167.071438200	10.0.0.1	10.0.0.2	BGP	144	OPEN Message, KEEPALIVE Message
24	167.071706495	10.0.0.2	10.0.0.1	BGP	104	KEEPALIVE Message, KEEPALIVE Message
26	167.071966050	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message
28	168.072290763	10.0.0.2	10.0.0.1	BGP	89	UPDATE Message
30	168.072659641	10.0.0.1	10.0.0.2	BGP	140	UPDATE Message, UPDATE Message
32	170.071872353	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message
34	170.072067091	10.0.0.2	10.0.0.1	BGP	85	KEEPALIVE Message
36	173.072645844	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message

Frame 20: 125 bytes on wire (1000 bits), 125 bytes captured (1000 bits) on interface 0  
 Ethernet II, Src: be:a8:f0:52:19:0e (be:a8:f0:52:19:0e), Dst: 32:8b:04:6d:38:ee (32:8b:04:6d:38:ee)  
 Internet Protocol Version 4, Src: 10.0.0.2, Dst: 10.0.0.1  
 Transmission Control Protocol, Src Port: 53598, Dst Port: 179, Seq: 1, Ack: 1, Len: 59

Border Gateway Protocol - OPEN Message

Marker: ffffffffffffffffffffff  
 Length: 59  
 Type: OPEN Message (1)  
 Version: 4  
 My AS: 65003  
 Hold Time: 9

```

0000 32 8b 04 6d 38 ee be a8 f0 52 19 0e 08 00 45 c0 2..m8... .R...E.
0010 00 6f 82 45 40 00 ff 06 e4 80 0a 00 00 02 0a 00 .o E@... .
0020 00 01 d1 5e 00 b3 f9 a3 f4 6c 00 d7 59 0a 80 18 ..A.... 1.Y...
0030 00 53 14 64 00 00 01 01 08 0a 1f 27 77 f9 ec f8 .S d.... 'w...
0040 bd 1c ff .....;.....
0050 ff ff 00 3b 01 04 fd eb 00 09 0a 00 02 01 1e 02 .....;.....
0060 06 01 04 00 01 00 01 02 02 80 00 02 02 02 00 02 .....;.....
0070 06 41 04 00 00 fd eb 02 04 40 02 80 78 .A.....@..x

```

\*r3-eth0

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

bpg Expression...

No.	Time	Source	Destination	Protocol	Length	Info
20	167.071015604	10.0.0.2	10.0.0.1	BGP	125	OPEN Message
22	167.071501188	10.0.0.1	10.0.0.2	BGP	144	OPEN Message, KEEPALIVE Message
24	167.071760698	10.0.0.2	10.0.0.1	BGP	104	KEEPALIVE Message, KEEPALIVE Message
26	167.072025058	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message
28	168.072344799	10.0.0.2	10.0.0.1	BGP	89	UPDATE Message
30	168.072723522	10.0.0.1	10.0.0.2	BGP	140	UPDATE Message, UPDATE Message
32	170.071935767	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message
34	170.072122646	10.0.0.2	10.0.0.1	BGP	85	KEEPALIVE Message
36	173.072710260	10.0.0.1	10.0.0.2	BGP	85	KEEPALIVE Message

Frame 20: 125 bytes on wire (1000 bits), 125 bytes captured (1000 bits) on interface 0  
 Ethernet II, Src: be:a8:f0:52:19:0e (be:a8:f0:52:19:0e), Dst: 32:8b:04:6d:38:ee (32:8b:04:6d:38:ee)  
 Internet Protocol Version 4, Src: 10.0.0.2, Dst: 10.0.0.1  
 Transmission Control Protocol, Src Port: 53598, Dst Port: 179, Seq: 1, Ack: 1, Len: 59

Border Gateway Protocol - OPEN Message

```

0000 32 8b 04 6d 38 ee be a8 f0 52 19 0e 08 00 45 c0 2..m8... .R...E.
0010 00 6f 82 45 40 00 ff 06 e4 80 0a 00 00 02 0a 00 .o E@... .
0020 00 01 d1 5e 00 b3 f9 a3 f4 6c 00 d7 59 0a 80 18 ..A.... 1.Y...
0030 00 53 14 64 00 00 01 01 08 0a 1f 27 77 f9 ec f8 .S d.... 'w...
0040 bd 1c ff .....;.....
0050 ff ff 00 3b 01 04 fd eb 00 09 0a 00 02 01 1e 02 .....;.....
0060 06 01 04 00 01 00 01 02 02 80 00 02 02 02 00 02 .....;.....
0070 06 41 04 00 00 fd eb 02 04 40 02 80 78 .A.....@..x

```

### 3-2. What will happen to the routing table if you set r4-eth0 down?

Ans:

r1, r2, r3的routing table會失去有關r4的資料，r4的routing table會失去r1, r2, r3的資料 (r1, r2, r3 can't reach r4, r4 can't reach r1, r2, r3 as well)

before

```
mininet> r1 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.1.0        0.0.0.0        255.255.255.0  U     0      0      0  r1-eth0
140.114.0.0     10.0.1.1       255.255.255.0  UG    20     0      0  r1-eth0
192.168.1.0     0.0.0.0        255.255.255.192 U     0      0      0  r1-eth1
192.168.1.64    0.0.0.0        255.255.255.192 U     0      0      0  r1-eth2
mininet> r2 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.0.0        0.0.0.0        255.255.255.0  U     0      0      0  r2-eth0
10.0.1.0        0.0.0.0        255.255.255.0  U     0      0      0  r2-eth1
140.113.0.0     10.0.1.2       255.255.0.0   UG    20     0      0  r2-eth1
140.114.0.0     10.0.0.2       255.255.255.0  UG    20     0      0  r2-eth0
mininet> r3 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.0.0        0.0.0.0        255.255.255.0  U     0      0      0  r3-eth0
10.0.2.0        0.0.0.0        255.255.255.0  U     0      0      0  r3-eth1
140.113.0.0     10.0.0.1       255.255.0.0   UG    20     0      0  r3-eth0
140.114.0.0     10.0.2.3       255.255.255.0  UG    20     0      0  r3-eth1
mininet> r4 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.2.0        0.0.0.0        255.255.255.0  U     0      0      0  r4-eth0
140.113.0.0     10.0.2.1       255.255.0.0   UG    20     0      0  r4-eth0
140.114.0.0     0.0.0.0        255.255.255.0  U     0      0      0  r4-eth1
```

after

```
mininet> r1 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.1.0        0.0.0.0        255.255.255.0  U     0      0      0  r1-eth0
192.168.1.0     0.0.0.0        255.255.255.192 U     0      0      0  r1-eth1
192.168.1.64    0.0.0.0        255.255.255.192 U     0      0      0  r1-eth2
mininet> r2 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.0.0        0.0.0.0        255.255.255.0  U     0      0      0  r2-eth0
10.0.1.0        0.0.0.0        255.255.255.0  U     0      0      0  r2-eth1
140.113.0.0     10.0.1.2       255.255.0.0   UG    20     0      0  r2-eth1
mininet> r3 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
10.0.0.0        0.0.0.0        255.255.255.0  U     0      0      0  r3-eth0
10.0.2.0        0.0.0.0        255.255.255.0  U     0      0      0  r3-eth1
140.113.0.0     10.0.0.1       255.255.0.0   UG    20     0      0  r3-eth0
mininet> r4 route
Kernel IP routing table
Destination     Gateway         Genmask        Flags Metric Ref  Use Iface
140.114.0.0     0.0.0.0        255.255.255.0  U     0      0      0  r4-eth1
```

### **3-3. How does r3 know r4 is unreachable? Explain how**

**Ans:**

conf檔中有一條指令：timers bgp 3 9，代表r3會每三秒傳遞一個packet給r4，如果r4 9秒之後沒有回覆就會認定r4 unreachable

### **3-4. How does r2 know r4 is unreachable? Explain how**

**Ans:**

r3發現r4 unreachable之後，會告訴r2 r4 unreachable

## part2

### 1.Take screenshot of curl result

Ans:

```
mininet> h3 python -m SimpleHTTPServer &
Serving HTTP on 0.0.0.0 port 8000 ...
[2] 18352
mininet> h4 curl 140.113.0.40:80
<!DOCTYPE html PUBLIC "-//W3C//DTD HTML 3.2 Final//EN"><html>
<title>Directory listing for /</title>
<body>
<h2>Directory listing for /</h2>
<hr>
<ul>
<li><a href="c-ares-1.17.1/">c-ares-1.17.1/</a>
<li><a href="c-ares-1.17.1.tar.gz">c-ares-1.17.1.tar.gz</a>
<li><a href="configs/">configs/</a>
<li><a href="quagga-1.2.4/">quagga-1.2.4/</a>
<li><a href="quagga-1.2.4.tar.gz">quagga-1.2.4.tar.gz</a>
<li><a href="topology.py">topology.py</a>
</ul>
<hr>
</body>
</html>
mininet> █
```

### 2.Check reachability and take screenshot

Ans:

```
mininet> h1 ping h4 -c 1
PING 140.114.0.1 (140.114.0.1) 56(84) bytes of data.
64 bytes from 140.114.0.1: icmp_seq=1 ttl=60 time=0.529 ms
--- 140.114.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.529/0.529/0.529/0.000 ms
mininet> h2 ping h4 -c 1
PING 140.114.0.1 (140.114.0.1) 56(84) bytes of data.
64 bytes from 140.114.0.1: icmp_seq=1 ttl=60 time=0.289 ms
--- 140.114.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.289/0.289/0.289/0.000 ms
mininet> h3 ping h4 -c 1
PING 140.114.0.1 (140.114.0.1) 56(84) bytes of data.
64 bytes from 140.114.0.1: icmp_seq=1 ttl=60 time=0.277 ms
--- 140.114.0.1 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.277/0.277/0.277/0.000 ms
```

### 3.Run wireshark on r1 to take screenshot of input/output packet. Explain the difference of packet headers

Ans:

r1-eth0

*r1-eth0						
No.	Time	Source	Destination	Protocol	Length	Info
38	30.645959301	140.113.0.30	140.114.0.1	ICMP	98	Echo (ping) request id=0x4b2d, seq=1/256, ttl=128
39	30.646023127	140.114.0.1	140.113.0.30	ICMP	98	Echo (ping) reply id=0x4b2d, seq=1/256, ttl=128
47	36.449975412	140.113.0.40	140.114.0.1	ICMP	98	Echo (ping) request id=0x4b2f, seq=1/256, ttl=128
48	36.450006638	140.114.0.1	140.113.0.40	ICMP	98	Echo (ping) reply id=0x4b2f, seq=1/256, ttl=128

r1-eth1

Capturing from r1-eth1						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	192.168.1.2	140.114.0.1	ICMP	98	Echo (ping) request id=0x4b2d, seq=1/256, ttl=128
2	0.000099552	140.114.0.1	192.168.1.2	ICMP	98	Echo (ping) reply id=0x4b2d, seq=1/256, ttl=128
3	5.045146514	1e:83:18:85:81:76	a6:30:36:9c:ca:9c	ARP	42	Who has 192.168.1.2? Tell 192.168.1.62
4	5.045384526	a6:30:36:9c:ca:9c	1e:83:18:85:81:76	ARP	42	Who has 192.168.1.62? Tell 192.168.1.2
5	5.045390969	1e:83:18:85:81:76	a6:30:36:9c:ca:9c	ARP	42	192.168.1.62 is at 1e:83:18:85:81:76
6	5.045487233	a6:30:36:9c:ca:9c	1e:83:18:85:81:76	ARP	42	192.168.1.2 is at a6:30:36:9c:ca:9c

r1-eth2

Capturing from r1-eth2						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	fe80::b82e:53ff:fe9... ff02::2		ICMPv6	70	Router Solicitation from ba:2e:53:93:fe:b5
2	17.144079420	192.168.1.65	140.114.0.1	ICMP	98	Echo (ping) request id=0x4b2f, seq=1/256, ttl=128
3	17.144125228	140.114.0.1	192.168.1.65	ICMP	98	Echo (ping) reply id=0x4b2f, seq=1/256, ttl=128
4	22.271990075	3a:62:e1:4b:7a:c2	a2:0e:03:c4:63:f7	ARP	42	Who has 192.168.1.65? Tell 192.168.1.126
5	22.272125796	a2:0e:03:c4:63:f7	3a:62:e1:4b:7a:c2	ARP	42	Who has 192.168.1.126? Tell 192.168.1.65
6	22.272193375	3a:62:e1:4b:7a:c2	a2:0e:03:c4:63:f7	ARP	42	192.168.1.126 is at 3a:62:e1:4b:7a:c2
7	22.272232288	a2:0e:03:c4:63:f7	3a:62:e1:4b:7a:c2	ARP	42	192.168.1.65 is at a2:0e:03:c4:63:f7

第一個指令是h1 ping h4，所以eth1先將h1的ip address (192.168.1.2) 和目的地傳達給r1，r1接收後將h1的ip

address換成140.113.0.30 (根據eth0) ，再傳到h4，第二個指令是h2 ping h4，所以eth2將h2的ip address

(192.168.1.65) 和目的地傳達給r1，r1接收後將h2的ip address換成140.113.0.40 (根據eth0) ，再傳到h4