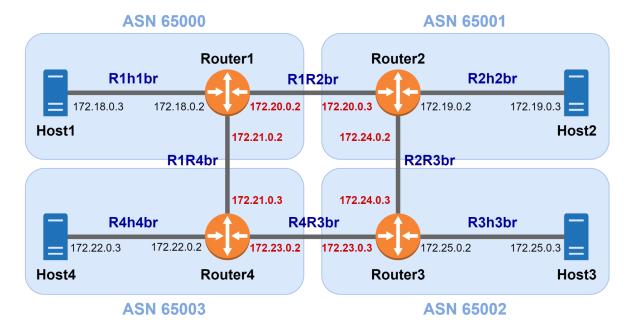
## Show topology with IP addresses, interfaces and ASNs



# Capture one BGP packet from wireshark and show screenshots

### R1R2br

#### Source: $R1 \rightarrow Destination: R2$

```
Source: R1 → Destination: R2

Frame 27: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0

Linux cooked capture

Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address length: 6
Source: 02: 42:ac:14:00:02 (02:42:ac:14:00:02)
Unused: 0000

Protocol: IPv4 (0x0800)

Internet Protocol Version 4, Src: 172.20.0.2, Dst: 172.20.0.3
0100 ... = Version: 4
... 0101 = Header Length: 20 bytes (5)

Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
1100 00. = Differentiated Services Codepoint: Class Selector 6 (48)
... ... 00 = Explicit Congestion Notification: Not ECN-Capable Transport (0)
Total Length: 71
Identification: 0x48fb (18683)

Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 0xd9c7 [validation disabled]
[Header checksum: 0xd9c7 [validation disabled]
[Header checksum: 0xd9c7 [validation disabled]
[Header checksum: 0xd9c7 [validation disabled]
Source: 172.20.0.2
Destination: 172.20.0.3

Transmission Control Protocol, Src Port: 179, Dst Port: 45672, Seq: 1, Ack: 20, Len: 19
Source Port: 179
Destination Port: 45672
[Stream index: 3]
[TCP Segment Len: 19]
Sequence number: 1 (relative sequence number)
[Next sequence number: 20 (relative sequence number)
[Next sequence number: 20 (relative ack number)
1000 ... = Header Length: 32 bytes (8)
Flags: 0x018 (PSH, ACK)
Window size value: 500
```

#### Source: R2 → Destination: R1

```
▶ Frame 25: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0 Linux cooked capture
Packet type: Unicast to another host (3)

v Linux cooked capture
    Packet type: Unicast to another host (3)
    Link-layer address type: 1
    Link-layer address length: 6
    Source: 02:42:ac:14:00:03 (02:42:ac:14:00:03)
    Unused: 0000
    Protocol: IPv4 (0x0800)

v Internet Protocol Version 4, Src: 172.20.0.3, Dst: 172.20.0.2
    0100 ... = Version: 4
    ... 0101 = Header Length: 20 bytes (5)
    Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
    Total Length: 71
    Identification: 0x2c81 (11393)
    Flags: 0x4000, Don't fragment
    Time to live: 255
    Protocol: TCP (6)
    Header checksum: 0xf641 [validation disabled]
    [Header checksum status: Unverified]
    Source: 172.20.0.3
    Destination: 172.20.0.2

▼ Transmission Control Protocol, Src Port: 45672, Dst Port: 179, Seq: 1, Ack: 1, Len: 19
    Source Port: 45672
    Destination Port: 179

Type: KEEPALIVE Message (4)
```

#### R2R3br

## Source: R2 → Destination: R3

```
Source: KZ → Destination: K3

Frame 21: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0

Linux cooked capture
Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address length: 6
Source: 02: 42:ac:18:00:02 (02:42:ac:18:00:02)
Unused: 0000
Protocol: IPv4 (0x0800)

Internet Protocol Version 4, Src: 172.24.0.2, Dst: 172.24.0.3
0100 ... = Version: 4
... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 71
Identification: 0x548f (21647)
Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 9xce2b [validation disabled]
[Header checksum status: Unverified]
Source: 172.24.0.2
Destination: 172.24.0.3

▼ Transmission Control Protocol, Src Port: 45766, Dst Port: 179, Seq: 1, Ack: 20, Len: 19
Source Port: 45766
Destination Port: 179
                         ransmission Control Protocol, Src Port: 45766, Dst Port: 1
Source Port: 45766
Destination Port: 179
[Stream index: 2]
[TCP Segment Len: 19]
Sequence number: 1 (relative sequence number)
[Next sequence number: 20 (relative sequence number)]
Acknowledgment number: 20 (relative ack number)
1000 ... = Header Length: 32 bytes (8)
Flags: 0x018 (PSH, ACK)
Window size value: 501
[Calculated window size: 501]
[Window size scaling factor: -1 (unknown)]
Checksum: 0x586f [unverified]
[Checksum Status: Unverified]
      Type: KEEPALIVE Message (4)
```

#### Source: R3 → Destination: R2

```
Frame 19: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0

V Linux cooked capture
Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address tength: 6
Source: 02:42:ac:18:00:03 (02:42:ac:18:00:03)
Unused: 0000
Protocol: IPv4 (0x0800)

Internet Protocol Version 4, Src: 172.24.0.3, Dst: 172.24.0.2
0100 ... = Version: 4
... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 71
Identification: 0x8cc7 (36039)
Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 0x95f3 [validation disabled]
IHeader checksum: 10x95f3 [validation disabled]
Source: 172.24.0.3
Destination: 172.24.0.2

Transmission Control Protocol, Src Port: 179, Dst Port: 45766, Seq: 1, Ack: 1, Len: 19
Source Port: 179
Destination: 172.24.0.2

[ITCP Segment Len: 19]
Sequence number: 1 (relative sequence number)
[Next sequence number: 20 (relative sequence number)
[Next sequence number: 1 (relative ack number)
1000 ... = Header Length: 32 bytes (8)
Flags: 0x408 (PSH, Ack)
Window size scaling factor: -1 (unknown)
Checksum: 0x506f [unverified]
Urgent pointer: 0
Poptions: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
Figure Supplemental Supplementa
```

#### R1R4br

#### Source: R1 → Destination: R4

```
Frame 4921: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0

▼ Linux cooked capture
Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address type: 1
Link-layer address length: 6
Source: 02:42:ac:15:00:02 (02:42:ac:15:00:02)
Unused: 0800
Protocol: IPV4 (0x0800)
▼ Internet Protocol Version 4, Src: 172.21.0.2, Dst: 172.21.0.3
0100 ... = Version: 4
... 0101 = Header Length: 20 bytes (5)
▶ Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 71
Identification: 0xa9aa (43434)
▶ Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 0x7916 [validation disabled]
[Header checksum: 0x7916 [validation disabled]
[Meader checksum: 0x7916 [validation disabled]
Source: 172.21.0.2
Destination: 172.21.0.3
▼ Transmission Control Protocol, Src Port: 179, Dst Port: 39856, Seq: 404, Ack: 423, Len: 19
Source Port: 179
Destination Port: 39856
[Stream index: 117]
[TCP Segment Len: 19]
Sequence number: 404 (relative sequence number)
[Next sequence number: 423 (relative sequence number)
Acknowledgment number: 423 (relative sequence number)
1000 ... = Header Length: 32 bytes (8)
▶ Flags: 0x018 (PSH, ACK)
Window size value: 508
[Calculated window size: 65024]
[Window size value: 508
[Calculated window size: 65024]
[Window size staling factor: 128]
Checksum: 0x5808 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
▶ Options: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps
▶ [SEQ/ACK analysis]
▶ [Timestamps]
TCP payload (19 bytes)

■ Border Gateway Protocol - KEEPALIVE Message
```

#### Source: R4 → Destination: R1

```
➤ Frame 4919: 87 bytes on wire (696 bits), 87 bytes captured (696

➤ Linux cooked capture
Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address length: 6
Source: 02:42:ac:15:00:03 (02:42:ac:15:00:03)
Unused: e7a5
Protocol: IPv4 (0x0800)

➤ Internet Protocol Version 4, Src: 172.21.0.3, Dst: 172.21.0.2
0100 ... = Version: 4
... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 71
Identification: 0x3061 (12385)
Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 0xf25f [validation disabled]
[Header checksum status: Unverified]
Source: 172.21.0.3
Destination: 172.21.0.2

➤ Transmission Control Protocol, Src Port: 39856, Dst Port: 179, S
                                                                                                                                                  es on wire (696 bits), 87 bytes captured (696 bits) on interface 0
Source: 172.21.0.3

Destination: 172.21.0.2

▼ Transmission Control Protocol, Src Port: 39856, Dst Port: 179, Seq: 404, Ack: 404, Len: 19

Source Port: 39856

Destination Port: 179

[Stream index: 117]

[TCP Segment Len: 19]

Sequence number: 404 (relative sequence number)

[Next sequence number: 423 (relative sequence number)]

Acknowledgment number: 404 (relative ack number)

1000 ... = Header Length: 32 bytes (8)

Flags: 0x018 (PSH, ACK)

Window size value: 501

[Calculated window size: 64128]

[Window size scaling factor: 128]

Checksum: 0x5869 [unverified]

Urgent pointer: 0

Poptions: (12 bytes), No-Operation (NOP), No-Operation (NOP), Timestamps

| [SEQ/ACK analysis]
| [Timestamps]
| TCP payload (19 bytes)

Border Gateway Protocol - KEEPALIVE Message
```

#### R4R3br

## Source: R4 → Destination: R3

```
me 15: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0
```

#### Source: R3 → Destination: R4

```
Source: R3 → Destination: R4

Frame 13: 87 bytes on wire (696 bits), 87 bytes captured (696 bits) on interface 0

Linux cooked capture
Packet type: Unicast to another host (3)
Link-layer address type: 1
Link-layer address length: 6
Source: 02:42:ac:17:00:03 (02:42:ac:17:00:03)
Unused: 0000
Protocol: IPv4 (0x0800)

Internet Protocol Version 4, Src: 172.23.0.3, Dst: 172.23.0.2
0100 .... = Version: 4
.... 0101 = Header Length: 20 bytes (5)
Differentiated Services Field: 0xc0 (DSCP: CS6, ECN: Not-ECT)
Total Length: 71
Identification: 0xeb84 (60292)
Flags: 0x4000, Don't fragment
Time to live: 255
Protocol: TCP (6)
Header checksum: 0x3738 [validation disabled]
[Header checksum: 0x3738 [validation disabled]
[Header checksum status: Unverified]
Source: 172.23.0.3
Destination: 172.23.0.2

Transmission Control Protocol, Src Port: 34988, Dst Port: 179, Seq: 1, Ack: 1, Len: 19
[Stream index: 1]
[TCP Segment Len: 19]
    Type: KEEPALIVE Message (4)
```

 Telnet zebra and bgpd daemons of each route and show route screenshots

#### Router1

```
/home/gina docker exec -it R1 bash
                                                                                               ✓ | root@SDN-NFV | 09:35:25 暮
root@96154ecf173b:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
Password:
R1zebra> 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>* 172.19.0.0/16 [20/0] via 172.20.0.3, eth2, 00:07:43
B>* 172.22.0.0/16 [20/0] via 172.21.0.3, eth3, 00:07:30
B>* 172.25.0.0/16 [20/0] via 172.20.0.3, eth2, 00:07:43
R1zebra> exit
Connection closed by foreign host.
root@96154ecf173b:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
R1bgp> show ip bgp summary
BGP router identifier 172.20.0.2, local AS number 65000
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory
                                               AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
169 171 0 0 0 00:08:15 3
Neighbor
172.20.0.3
172.21.0.3
                             4 65001
                             4 65003
                                                    167
                                                                   172
                                                                                               0
                                                                                                         0 00:08:02
Total number of neiahbors 2
```

#### Router2

```
/home/gina docker exec -it R2 bash
root@d96c8598b06c:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
Rassword.
R2zebra> 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>* 172.18.0.0/16 [20/0] via 172.20.0.2, eth2, 00:14:53
B>* 172.22.0.0/16 [20/0] via 172.24.0.3, eth3, 00:15:22
B>* 172.25.0.0/16 [20/0] via 172.24.0.3, eth3, 00:15:22
KZZEDTa> eXIT
Connection closed by foreign host
root@d96c8598b06c:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
Rassword:
R2Dgp> show ip bgp summary
BGP router identifier 172.20.0.3, local AS number 65001
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory
                           V
4 65000
                                              AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
334 338 0 0 0 00:15:56 2
332 337 0 0 0 00:16:25 2
Neighbor
172.20.0.2
172.24.0.3
                            4 65002
Total number of neighbors 2
```

#### Router3

```
/home/qina docker exec -it R3 bash
root@22e650c6fbe2:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
R3zebra> 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>* 172.18.0.0/16 [20/0] via 172.24.0.2, eth2, 00:19:29
B>* 172.19.0.0/16 [20/0] via 172.24.0.2, eth2, 00:19:59
B>* 172.22.0.0/16 [20/0] via 172.23.0.2, eth1, 00:20:21
кэгерга> exit
Connection closed by foreign host.
root@22e650c6fbe2:/# telnet localhost 2605
Trying 127.0.0.1..
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
Raspors show ip bgp summary
BGP router identifier 172.23.0.3, local AS number 65002
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory
                                             AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd 424 433 0 0 0 00:21:01 2
Neighbor
                            4 65003
172.23.0.2
172.24.0.2
                            4 65001
                                                                430
                                                                                                     0 00:20:40
Total number of neighbors 2
```

#### Router4

```
/home/gina docker exec -it R4 bash
root@0305ef27504f:/# telnet localhost 2601
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
R4zebra> 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>* 172.18.0.0/16 [20/0] via 172.21.0.2, eth1, 00:22:01
B>* 172.19.0.0/16 [20/0] via 172.23.0.3, eth3, 00:22:40
B>* 172.25.0.0/16 [20/0] via 172.23.0.3, eth3, 00:23:05
R4zebra> exit
Connection closed by foreign host.
root@0305ef27504f:/# telnet localhost 2605
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
Hello, this is Quagga (version 0.99.24.1).
Copyright 1996-2005 Kunihiro Ishiguro, et al.
User Access Verification
Password:
R4bgp> show ip bgp summary
BGP router identifier 172.23.0.2, local AS number 65003
RIB entries 7, using 784 bytes of memory
Peers 2, using 9136 bytes of memory
                                        AS MsgRcvd MsgSent
456 457
                                                                          TblVer InQ OutQ Up/Down State/PfxRcd
Neighbor
                         4 65000
172.21.0.2
                                                        457
                                                                          0 0
                                                                                          0 00:22:18
172.23.0.3
                         4 65002
                                            488
                                                         483
                                                                                          0 00:23:21
                                                                                                                       3
Total number of neighbors 2
```

# Write down what you have learned or solved

I learned how to look up and modify the host's default gateway. And how to turn on the host ip forwarding function to serve the bridge mode like a router role. I also learned how to install and configure quagga service config like zebra and bgpd to let the network communicate with each other.

At the beginning, I tried to add another router ASN setting on the same router. For example, router1 connects to router2 and router4, so I think router1 needs to be declared two router ASN, and each ASN defines how to connect one of the routers. After I tried to use the configuration that I mentioned, and restart the quagga service, it failed because quagga service couldn't restart successfully. Then, I tried to append another neighborhood setting as router ASN, it worked like a charm.

Thanks to the TA and professor for teaching us about networking knowledge, that is the most important ability I need to improve for my job.