

# Part1

h1's interface:

```
eric070021@ubuntu:~/Desktop$ docker exec -it h1 bash
root@18ce7cdcb2ed:/# ifconfig
eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:02
          inet addr:172.17.0.2  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8554 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6273 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:20582577 (20.5 MB)  TX bytes:343826 (343.8 KB)

h1R1veth  Link encap:Ethernet  HWaddr ce:46:85:88:c0:7b
          inet addr:192.168.1.2  Bcast:0.0.0.0  Mask:255.255.255.255
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:5 errors:0 dropped:0 overruns:0 frame:0
          TX packets:53 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:210 (210.0 B)  TX bytes:4236 (4.2 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

root@18ce7cdcb2ed:/# ip r
default via 192.168.1.1 dev h1R1veth
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.2
192.168.1.0/24 dev h1R1veth proto kernel scope link src 192.168.1.2
```

h2's interface:

```
eric070021@ubuntu:~/Desktop$ docker exec -it h2 bash
root@a21c72bfcf76:/# ifconfig
eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:03
          inet addr:172.17.0.3  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8708 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6679 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:20589727 (20.5 MB)  TX bytes:365834 (365.8 KB)

h2R1veth  Link encap:Ethernet  HWaddr ee:ce:c3:4c:5b:fd
          inet addr:192.168.2.2  Bcast:0.0.0.0  Mask:255.255.255.255
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

root@a21c72bfcf76:/# ip r
default via 192.168.2.1 dev h2R1veth
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.3
192.168.2.0/24 dev h2R1veth proto kernel scope link src 192.168.2.2
```

R1's interface:

```
root@d141e430a3a0:/# ifconfig
R1R2veth  Link encap:Ethernet  HWaddr 22:93:7a:73:2e:7a
           inet addr:140.113.2.1  Bcast:0.0.0.0  Mask:255.255.255.255
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:1184 errors:0 dropped:0 overruns:0 frame:0
           TX packets:1167 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:95957 (95.9 KB)  TX bytes:85620 (85.6 KB)

R1h1veth  Link encap:Ethernet  HWaddr 9e:9a:ee:c5:3e:11
           inet addr:192.168.1.1  Bcast:0.0.0.0  Mask:255.255.255.255
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:53 errors:0 dropped:0 overruns:0 frame:0
           TX packets:5 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:4236 (4.2 KB)  TX bytes:210 (210.0 B)

R1h2veth  Link encap:Ethernet  HWaddr 16:94:f9:48:28:f7
           inet addr:192.168.2.1  Bcast:0.0.0.0  Mask:255.255.255.255
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:0 errors:0 dropped:0 overruns:0 frame:0
           TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:04
           inet addr:172.17.0.4  Bcast:172.17.255.255  Mask:255.255.0.0
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
           RX packets:9758 errors:0 dropped:0 overruns:0 frame:0
           TX packets:8013 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:0
           RX bytes:23564810 (23.5 MB)  TX bytes:441090 (441.0 KB)

lo        Link encap:Local Loopback
           inet addr:127.0.0.1  Mask:255.0.0.0
           UP LOOPBACK RUNNING  MTU:65536  Metric:1
           RX packets:303 errors:0 dropped:0 overruns:0 frame:0
           TX packets:303 errors:0 dropped:0 overruns:0 carrier:0
           collisions:0 txqueuelen:1000
           RX bytes:17098 (17.0 KB)  TX bytes:17098 (17.0 KB)

root@d141e430a3a0:/# ip r
default via 172.17.0.1 dev eth0
140.113.1.0/24 via 140.113.2.2 dev R1R2veth proto zebra
140.113.2.0/24 dev R1R2veth proto kernel scope link src 140.113.2.1
172.17.0.0/16 dev eth0 proto kernel scope link src 172.17.0.4
192.168.1.0/24 dev R1h1veth proto kernel scope link src 192.168.1.1
192.168.2.0/24 dev R1h2veth proto kernel scope link src 192.168.2.1
```

R2's interface:

```

eric070021@ubuntu:~/Desktop$ docker exec -it R2 bash
root@5fe41b4c7ff0:/# ifconfig
R2R1veth  Link encap:Ethernet  HWaddr 4a:d3:21:25:97:f5
          inet addr:140.113.2.2  Bcast:0.0.0.0  Mask:255.255.255.255
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:48530 errors:0 dropped:0 overruns:0 frame:0
          TX packets:49435 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:3716617 (3.7 MB)  TX bytes:3785562 (3.7 MB)

R2hRveth  Link encap:Ethernet  HWaddr ee:04:58:d6:7f:27
          inet addr:140.113.1.1  Bcast:0.0.0.0  Mask:255.255.255.255
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:05
          inet addr:172.17.0.5  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:9984 errors:0 dropped:0 overruns:0 frame:0
          TX packets:7683 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:23580525 (23.5 MB)  TX bytes:421884 (421.8 KB)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:231 errors:0 dropped:0 overruns:0 frame:0
          TX packets:231 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:13189 (13.1 KB)  TX bytes:13189 (13.1 KB)

root@5fe41b4c7ff0:/# ip r
default via 172.17.0.1 dev eth0
140.113.1.0/24 dev R2hRveth  proto kernel  scope link  src 140.113.1.1
140.113.2.0/24 dev R2R1veth  proto kernel  scope link  src 140.113.2.2
172.17.0.0/16 dev eth0      proto kernel  scope link  src 172.17.0.5
192.168.1.0/24 via 140.113.2.1 dev R2R1veth  proto zebra
192.168.2.0/24 via 140.113.2.1 dev R2R1veth  proto zebra

```

hR's interface:

```

eric070021@ubuntu:~/Desktop$ docker exec -it hR bash
root@a24810be5242:/# ifconfig
eth0      Link encap:Ethernet  HWaddr 02:42:ac:11:00:06
          inet addr:172.17.0.6  Bcast:172.17.255.255  Mask:255.255.0.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:8897 errors:0 dropped:0 overruns:0 frame:0
          TX packets:6655 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:0
          RX bytes:20601932 (20.6 MB)  TX bytes:364474 (364.4 KB)

hRR2veth  Link encap:Ethernet  HWaddr d6:9b:a8:c8:30:53
          inet addr:140.113.1.2  Bcast:0.0.0.0  Mask:255.255.255.255
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          UP LOOPBACK RUNNING  MTU:65536  Metric:1
          RX packets:0 errors:0 dropped:0 overruns:0 frame:0
          TX packets:0 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

root@a24810be5242:/# ip r
default via 140.113.1.1 dev hRR2veth
140.113.1.0/24 dev hRR2veth  proto kernel  scope link  src 140.113.1.2
172.17.0.0/16 dev eth0      proto kernel  scope link  src 172.17.0.6

```

R1's bgp summary:

```
R1bgp> show ip bgp summary
BGP router identifier 140.113.2.1, local AS number 65000
RIB entries 5, using 560 bytes of memory
Peers 1, using 4568 bytes of memory

Neighbor      V      AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
140.113.2.2    4 65001   26971   26972       0    0    0 22:29:03        1

Total number of neighbors 1
```

R2's bgp summary:

```
R2bgp> show ip bgp summary
BGP router identifier 140.113.2.2, local AS number 65001
RIB entries 5, using 560 bytes of memory
Peers 1, using 4568 bytes of memory

Neighbor      V      AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
140.113.2.1    4 65000   26990   26993       0    0    0 22:30:06        2

Total number of neighbors 1
```

R1's bgpd.conf:

```
! BGP configuration for R1
!
hostname R1bgp
password vRouter
!
router bgp 65000
    bgp router-id 140.113.2.1
    timers bgp 3 9
    neighbor 140.113.2.2 remote-as 65001
    neighbor 140.113.2.2 ebgp-multihop
    neighbor 140.113.2.2 timers connect 5
    neighbor 140.113.2.2 advertisement-interval 5
    network 192.168.1.0/24
    network 192.168.2.0/24
!
log stdout
```

R2's bgpd.conf:

```
! BGP configuration for R2
!
hostname R2bgp
password vRouter
!
router bgp 65001
    bgp router-id 140.113.2.2
    timers bgp 3 9
    neighbor 140.113.2.1 remote-as 65000
    neighbor 140.113.2.1 ebgp-multihop
    neighbor 140.113.2.1 timers connect 5
    neighbor 140.113.2.1 advertisement-interval 5
    network 140.113.1.0/24
!
log stdout
```

## Part 2

h1 and h2 both can't ping hR.

Since the packet send from h1 or h2 will be converted to another ip rather than router's ip by snat, hR will send the icmp ack packet back to the modified ip but there is this ip is not in this network, thus h1 and h2 can't ping hR.

```
eric070021@ubuntu:~/Desktop$ docker exec -it h1 bash
root@18ce7cdcb2ed:/# ping 140.113.1.2 -c 3
PING 140.113.1.2 (140.113.1.2) 56(84) bytes of data.

--- 140.113.1.2 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2056ms
```

```
eric070021@ubuntu:~/Desktop$ docker exec -it h2 bash
root@a21c72bfcf76:/# ping 140.113.1.2 -c 3
PING 140.113.1.2 (140.113.1.2) 56(84) bytes of data.

--- 140.113.1.2 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2053ms
```

This is the rule of snat.

```
root@d141e430a3a0:/# iptables -t nat -nv -L POSTROUTING
Chain POSTROUTING (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target      prot opt in      out     source           destination
 8   672 SNAT        all  --  *      R1R2veth 192.168.1.0/24   0.0.0.0/0      to:140.113.2.30
 1    84 SNAT        all  --  *      R1R2veth 192.168.2.0/24   0.0.0.0/0      to:140.113.2.40
```

In the tcpdump, we can see the ip change from 192.168.1.2 to 140.113.2.30 (take h1 ping hR for example)

```
File Edit View Search Terminal Help
root@d141e430a3a0:/
root@18ce7cdcb2ed:/# tcpdump -i R1R2veth -xx
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on R1R2veth, link-type EN10MB (Ethernet), capture size 262144 bytes
07:44:33.044061 ce:46:85:88:c0:7b (out Unknown) > 9e:9a:ee:c5:3e:11 (out Unknown
), ethertype IPv4 (0x0800), length 98: 192.168.1.2 > not-a-legal-address: ICMP e
...cho request, id 1149, seq 1, length 64
1 P
0x0000: 9e9a eec5 3e11 ce46 8588 c07b 0800 4500 .....F...{..E.
0x0010: 0054 74ab 4000 4001 76e0 c0a8 0102 8c71 ..t.0.0.v....q
0x0020: 0102 0800 8959 047d 0001 61c4 3e62 0000 ....V...a..b...
0x0030: 0000 fe2e 0d00 0000 0000 1011 1213 1415 .....
0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425 .....1P$%
0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 8'()*+,-./012345
0x0060: 3637 .....67
07:44:39.040120 ce:46:85:88:c0:7b (out Unknown) > 9e:9a:ee:c5:3e:11 (out Unknown
root), ethertype ARP (0x0806), length 42: Request who-has 192.168.1.1 tell 192.168.1
PIN^, length 28
0x0000: 9e9a eec5 3e11 ce46 8588 c07b 0806 0001 .....F...{..E.
0x0010: 0800 0604 0001 ce46 8588 c07b c0a8 0102 .....F...{..E.
0x0020: 0000 0000 0000 c0a8 0101 .....
07:44:39.040354 9e:9a:ee:c5:3e:11 (out Unknown) > ce:46:85:88:c0:7b (out Unknown
root), ethertype ARP (0x0806), length 42: Reply 192.168.1.1 is-at 9e:9a:ee:c5:3e:11
pin(out Unknown), length 28
0x0000: ce46 8588 c07b 9e9a eec5 3e11 0806 0001 .....F...{..E.
0x0010: 0800 0604 0002 9e9a eec5 3e11 c0a8 0101 .....
0x0020: ce46 8588 c07b c0a8 0102 .....F...{..E.
1 P,c
root@18ce7cdcb2ed:/# ping 140.113.1.2 -c 1
PING 140.113.1.2 (140.113.1.2) 56(84) bytes of data.

--- 140.113.1.2 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms

root@18ce7cdcb2ed:/# ping 140.113.1.2 -c 1
PING 140.113.1.2 (140.113.1.2) 56(84) bytes of data.

--- 140.113.1.2 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms

root@18ce7cdcb2ed:/#
```

```
File Edit View Search Terminal Help
root@d141e430a3a0:/
root@18ce7cdcb2ed:/# tcpdump -i R1R2veth -xx
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on R1R2veth, link-type EN10MB (Ethernet), capture size 262144 bytes
07:44:33.029403 4a:d3:21:25:97:f5 (out Unknown) > 22:93:7a:73:2e:7a (out Unknown
), ethertype IPv4 (0x0800), length 85: d2-spool-lb.nctu.edu.tw.bgp > not-a-legal
-address:48066: Flags [P.], seq 670536863:670536882, ack 3945821364, win 509, op
tions [nop,nop,TS val 3571331473 ecr 3925124953], length 19: BGP
0x0000: 2293 7a73 2e7a 4ad3 2125 97f5 0800 45c0 "...z.z.1W....E.
0x0010: 0047 b10f 4000 ff06 ac7b 8c71 0202 8c71 ..G.0.....q
0x0020: 0201 00b3 bbc2 27f7 949f eb30 74b4 8018 .....0t....
0x0030: 01fd 1d1f 0000 0101 080a d4de 3191 e9f4 .....1...
0x0040: a759 ffff ffff ffff ffff ffff ffff .....V.....
0x0050: ffff 0013 04 .....
07:44:33.029674 22:93:7a:73:2e:7a (out Unknown) > 4a:d3:21:25:97:f5 (out Unknown
), ethertype IPv4 (0x0800), length 85: not-a-legal-address:48066 > d2-spool-lb.n
ctu.edu.tw.bgp: Flags [P.], seq 1:20, ack 19, win 502, options [nop,nop,TS val 3
925127955 ecr 3571331473], length 19: BGP
0x0000: 4ad3 2125 97f5 2293 7a73 2e7a 0800 45c0 J.W...".z.z..E.
0x0010: 0047 b98a 4000 ff06 a480 8c71 0201 8c71 ..G.0.....q
0x0020: 0202 bbc2 00b3 eb30 74b4 27f7 94b2 8018 .....0t....
0x0030: 01fd 1d1f 0000 0101 080a e9f4 b313 d4de .....1...
0x0040: 3191 ffff ffff ffff ffff ffff ffff .....1.....
0x0050: ffff 0013 04 .....
07:44:33.029734 4a:d3:21:25:97:f5 (out Unknown) > 22:93:7a:73:2e:7a (out Unknown
), ethertype IPv4 (0x0800), length 66: d2-spool-lb.nctu.edu.tw.bgp > not-a-legal
-address:48066: Flags [P.], ack 20, win 509, options [nop,nop,TS val 3571331473 e
cr 3925127955], length 0
0x0000: 2293 7a73 2e7a 4ad3 2125 97f5 0800 45c0 "...z.z.1W....E.
0x0010: 0054 74ab 4000 ff06 ac7b 8c71 0202 8c71 ..t.0.0.v....q
0x0020: 0201 00b3 bbc2 27f7 94b2 eb30 74c7 8010 .....0t....
0x0030: 01fd 1d0c 0000 0101 080a d4de 3191 e9f4 .....1...
0x0040: b313 .....
07:44:33.064995 22:93:7a:73:2e:7a (out Unknown) > 4a:d3:21:25:97:f5 (out Unknown
), ethertype IPv4 (0x0800), length 98: not-a-legal-address > not-a-legal-address
: ICMP echo request, id 1149, seq 1, length 64
0x0000: 4ad3 2125 97f5 2293 7a73 2e7a 0800 4500 J.W...".z.z..E.
0x0010: 0054 74ab 4000 ff01 aaf0 8c71 021e 8c71 ..t.0.7....q
0x0020: 0102 0800 8959 047d 0001 61c4 3e62 0000 ....V...a..b...
0x0030: 0000 fe2e 0d00 0000 0000 1011 1213 1415 .....
0x0040: 1617 1819 1a1b 1c1d 1e1f 2021 2223 2425 .....1P$%
0x0050: 2627 2829 2a2b 2c2d 2e2f 3031 3233 3435 8'()*+,-./012345
0x0060: 3637 .....67
07:44:33.064176 4a:d3:21:25:97:f5 (out Unknown) > Broadcast, ethertype ARP (0x08
06), length 42: Request who-has not-a-legal-address tell d2-spool-lb.nctu.edu.tw
```



## Part 3

hR curl h1:

```
eric070021@ubuntu:~/Desktop$ docker exec -it hR bash
root@a24810be5242:/# curl 140.113.2.1:8080
<!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=".dockerenv"> .dockerenv</a>
<li><a href="bin/">bin/</a>
<li><a href="boot/">boot/</a>
<li><a href="dev/">dev/</a>
<li><a href="etc/">etc/</a>
<li><a href="home/">home/</a>
<li><a href="lib/">lib/</a>
<li><a href="lib64/">lib64/</a>
<li><a href="media/">media/</a>
<li><a href="mnt/">mnt/</a>
<li><a href="opt/">opt/</a>
<li><a href="proc/">proc/</a>
<li><a href="root/">root/</a>
<li><a href="run/">run/</a>
<li><a href="sbin/">sbin/</a>
<li><a href="srv/">srv/</a>
<li><a href="sys/">sys/</a>
<li><a href="tmp/">tmp/</a>
<li><a href="usr/">usr/</a>
<li><a href="var/">var/</a>
</ul>
</body>
</html>
root@a24810be5242:/#
```

```
root@18ce7cdcb2ed:/
File Edit View Search Terminal Help
eric070021@ubuntu:~$ docker exec -it h1 bash
root@18ce7cdcb2ed:/# python -m SimpleHTTPServer 8080
Serving HTTP on 0.0.0.0 port 8080 ...
140.113.1.2 - - [26/Mar/2022 08:17:28] "GET / HTTP/1.1" 200 -
```

hR curl h2:

```
root@a24810be5242:/# curl 140.113.2.1:9090
<!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=".dockerenv"> .dockerenv</a>
<li><a href="bin/">bin/</a>
<li><a href="boot/">boot/</a>
<li><a href="dev/">dev/</a>
<li><a href="etc/">etc/</a>
<li><a href="home/">home/</a>
<li><a href="lib/">lib/</a>
<li><a href="lib64/">lib64/</a>
<li><a href="media/">media/</a>
<li><a href="mnt/">mnt/</a>
<li><a href="opt/">opt/</a>
<li><a href="proc/">proc/</a>
<li><a href="root/">root/</a>
<li><a href="run/">run/</a>
<li><a href="sbin/">sbin/</a>
<li><a href="srv/">srv/</a>
<li><a href="sys/">sys/</a>
<li><a href="tmp/">tmp/</a>
<li><a href="usr/">usr/</a>
<li><a href="var/">var/</a>
</ul>
</body>
</html>
root@a24810be5242:/#
```

```
root@a21c72bfcf76:/
File Edit View Search Terminal Help
eric070021@ubuntu:~$ docker exec -it h2 bash
root@a21c72bfcf76:/# python -m SimpleHTTPServer 9090
Serving HTTP on 0.0.0.0 port 9090 ...
140.113.1.2 - - [26/Mar/2022 08:18:42] "GET / HTTP/1.1" 200 -
```

This is the rule of dnat.

```
root@d141e430a3a0:/# iptables -t nat -nv -L PREROUTING
Chain PREROUTING (policy ACCEPT 0 packets, 0 bytes)
pkts bytes target      prot opt in      out     source            destination
  0      0 DNAT        tcp  --  *      *        0.0.0.0/0         0.0.0.0/0         tcp dpt:8080 to:192.168.1.2:8080
  0      0 DNAT        tcp  --  *      *        0.0.0.0/0         0.0.0.0/0         tcp dpt:9090 to:192.168.2.2:9090
```

In the picture, we can see the http request to 140.113.2.1:8080 be converted to 192.168.1.2:8080 (h1's ip).

```
File Edit View Search Terminal Help
root@d141e430a3a0:/
<ll File Edit View Search Terminal Help
<ll 0 packets dropped by kernel
<ll root@d141e430a3a0:/# clear
<ll
<ll root@d141e430a3a0:/# tcpdump -i Rihiveth
<ll tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
<ll listening on Rihiveth, link-type EN10MB (Ethernet), capture size 262144 bytes
<ll 08:31:57.114112 IP not-a-legal-address.60524 > 192.168.1.2.http-alt: Flags [S],
<ll seq 2309213152, win 64240, options [mss 1460,sackOK,TS val 1575212746 ecr 0,nop,
<ll wscale 7], length 0
<ll 08:31:57.114187 IP 192.168.1.2.http-alt > not-a-legal-address.60524: Flags [S.],
<ll seq 4021369705, ack 2309213153, win 65160, options [mss 1460,sackOK,TS val 1387
<ll 450023 ecr 1575212746,nop,wscale 7], length 0
<ll 08:31:57.114220 IP not-a-legal-address.60524 > 192.168.1.2.http-alt: Flags [.],
<ll ack 1, win 502, options [nop,nop,TS val 1575212746 ecr 1387450023], length 0
<ll 08:31:57.115374 IP not-a-legal-address.60524 > 192.168.1.2.http-alt: Flags [P.],
<ll id seq 1:81, ack 1, win 502, options [nop,nop,TS val 1575212747 ecr 1387450023], l
<ll length 80: HTTP: GET / HTTP/1.1
<ll 08:31:57.115409 IP 192.168.1.2.http-alt > not-a-legal-address.60524: Flags [.],
<ll ack 81, win 509, options [nop,nop,TS val 1387450024 ecr 1575212747], length 0
<ll 08:31:57.117244 IP 192.168.1.2.http-alt > not-a-legal-address.60524: Flags [P.],
<ll seq 1:18, ack 81, win 509, options [nop,nop,TS val 1387450026 ecr 1575212747], l
<ll length 17: HTTP: HTTP/1.0 200 OK
<ll 08:31:57.117309 IP not-a-legal-address.60524 > 192.168.1.2.http-alt: Flags [.],
<ll ack 18, win 502, options [nop,nop,TS val 1575212749 ecr 1387450026], length 0
<ll 08:32:02.179926 ARP, Request who-has 192.168.1.2 tell 192.168.1.1, length 28
<ll 08:32:02.180942 ARP, Request who-has 192.168.1.1 tell 192.168.1.2, length 28
<ll 08:32:02.180965 ARP, Reply 192.168.1.1 ts-at 9e:9a:ee:c5:3e:11 (oui Unknown), le
<ll length 28
<ll 08:32:02.181034 ARP, Reply 192.168.1.2 ts-at ce:46:85:88:c0:7b (oui Unknown), le
<ll length 28
<ll ^C
<ll <a href="#opt/">opt/</a>
<ll <a href="#proc/">proc/</a>
<ll <a href="#root/">root/</a>
<ll <a href="#run/">run/</a>
<ll <a href="#sbin/">sbin/</a>
<ll <a href="#srv/">srv/</a>
<ll <a href="#sys/">sys/</a>
<ll <a href="#tmp/">tmp/</a>
<ll <a href="#usr/">usr/</a>
<ll <a href="#var/">var/</a>
<ll />
<ll <hr>
<ll </body>
<ll </html>
root@b24818be5242:/#
```