Part B

Please find the attached topo.py and configs folder in the folder Part B.

To keep things simple i used **h1,h2,r1,r2,r3,r4** as router names for dynamic routing and **not H1,H2,R1,R2,R3,R4** (which were used as router names for static routing)

B1:

(a) the set of commands you used for the configuration in the correct order.

I first removed the static routes.

Before setting the configuration make sure that ip forwarding is enabled and interface ip's are set.

```
mininext>
mininext> h1 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> h2 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r1 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r2 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r3 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r4 echo 1 > /proc/sys/net/ipv4/ip_forward
[mininext>
```

```
[mininext>
[mininext> r1 ip addr add 172.0.2.1/24 dev r1-eth1
[mininext> r1 ip addr add 172.0.6.2/24 dev r1-eth2
[mininext> r2 ip addr add 172.0.3.1/24 dev r2-eth1
[mininext> r3 ip addr add 172.0.5.2/24 dev r3-eth1
[mininext> r4 ip addr add 172.0.3.2/24 dev r4-eth1
[mininext> r4 ip addr add 172.0.5.1/24 dev r4-eth2
[mininext>
```

Below are the set of commands which are needed for correct configuration.

I will take router r1 as an example.

For r1/daemon, turn on zebra and ripd and make sure the bgpd is off.

```
zebra=yes
bgpd=no
ospfd=no
ospf6d=no
ripd=yes
ripngd=no
isisd=no
```

For r1/zebra.conf, comment out any static code and set the hostname properly

```
hostname r1
password zebra
enable password zebra
```

For r1/ripd.conf, set hostname, router rip add the subnets as required.

```
hostname r1
password zebra
router rip
network 172.0.1.0/24
network 172.0.2.0/24
network 172.0.6.0/24
```

(b) Explanation of each command.

1) We need to set the hostname and password in zebra.conf to telnet quagga.

2) Running zebra is mandatory to run the ripd.conf, as rip portal requires the information of the interface which is maintained by zebra daemon. So, in daemons zebra and ripd needs to be turned on.

3) In ripd.conf

- router rip is required to enable rip

- network command sets the rip enable interface by network, interfaces whose addresses are matching with the network will be enabled.

to restart quagga use - **restart quagga - sudo /etc/init.d/quagga restart**

A pingall is ran on mininext to make sure that dynamic routes are up. below is the output.

```
mininext> pingall
*** Ping: testing ping reachability
h1 -> h2 r1 r2 r3 r4
h2 -> h1 r1 r2 r3 r4
r1 -> h1 h2 r2 r3 r4
r2 -> h1 h2 r1 r3 r4
r3 -> h1 h2 r1 r2 r4
r4 -> h1 h2 r1 r2 r3
*** Results: 0% dropped (30/30 received)
mininext>
```

B2:

(a) the routing tables at each node (both the kernel and the Quagga routing table)

h1 kernel routing table:

```
mininext>
mininext> h1 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       *               255.255.255.0   U     0      0        0 h1-eth0
172.0.2.0       172.0.1.2       255.255.255.0   UG    2      0        0 h1-eth0
172.0.3.0       172.0.1.2       255.255.255.0   UG    3      0        0 h1-eth0
172.0.4.0       172.0.1.2       255.255.255.0   UG    4      0        0 h1-eth0
172.0.5.0       172.0.1.2       255.255.255.0   UG    3      0        0 h1-eth0
172.0.6.0       172.0.1.2       255.255.255.0   UG    2      0        0 h1-eth0
mininext>
mininext>
```

h1 quagga routing table:

```
root@mininet-vm:~# cd miniNExT/
root@mininet-vm:~/miniNExT# ls
LICENSE  Makefile  README.md  __init__.py  a1  build  dist  examples  mininext  mininext.egg-info  mxexec  mxexec.1  mxexec.c  setup.py  util
root@mininet-vm:~/miniNExT# cd util
root@mininet-vm:~/miniNExT/util# ls
mx
root@mininet-vm:~/miniNExT/util# ./mx h1
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
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User Access Verification

Password:
h1> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network           Next Hop         Metric From            Tag Time
C(i) 172.0.1.0/24      0.0.0.0               1 self              0
R(n) 172.0.2.0/24      172.0.1.2             2 172.0.1.2         0 02:56
R(n) 172.0.3.0/24      172.0.1.2             3 172.0.1.2         0 02:56
R(n) 172.0.4.0/24      172.0.1.2             4 172.0.1.2         0 02:56
R(n) 172.0.5.0/24      172.0.1.2             3 172.0.1.2         0 02:56
R(n) 172.0.6.0/24      172.0.1.2             2 172.0.1.2         0 02:56
h1>
h1>
```

h2 kernel routing table:

```
mininext>
mininext>
mininext> h2 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       172.0.4.2       255.255.255.0   UG    4      0        0 h2-eth0
172.0.2.0       172.0.4.2       255.255.255.0   UG    3      0        0 h2-eth0
172.0.3.0       172.0.4.2       255.255.255.0   UG    2      0        0 h2-eth0
172.0.4.0       *               255.255.255.0   U     0      0        0 h2-eth0
172.0.5.0       172.0.4.2       255.255.255.0   UG    2      0        0 h2-eth0
172.0.6.0       172.0.4.2       255.255.255.0   UG    3      0        0 h2-eth0
mininext>
```

h2 quagga routing table:

```
mininet@mininet-vm:~$ cd miniNExT/
mininet@mininet-vm:~/miniNExT$ ls
LICENSE  Makefile  README.md  __init__.py  a1  build  dist  examples  mininext  mininext.egg-info  mxexec  mxexec.1  mxexec.c  setup.py  util
mininet@mininet-vm:~/miniNExT$ cd util
mininet@mininet-vm:~/miniNExT/util$ ls
mx
mininet@mininet-vm:~/miniNExT/util$ ./mx h2
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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


User Access Verification

Password:
h2> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
R(n) 172.0.1.0/24    172.0.4.2             4 172.0.4.2         0 02:57
R(n) 172.0.2.0/24    172.0.4.2             3 172.0.4.2         0 02:57
R(n) 172.0.3.0/24    172.0.4.2             2 172.0.4.2         0 02:57
C(i) 172.0.4.0/24    0.0.0.0               1 self              0
R(n) 172.0.5.0/24    172.0.4.2             2 172.0.4.2         0 02:57
R(n) 172.0.6.0/24    172.0.4.2             3 172.0.4.2         0 02:57
h2>
```

r1 kernel routing table:

```
mininext> r1 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       *               255.255.255.0   U     0      0        0 r1-eth0
172.0.2.0       *               255.255.255.0   U     0      0        0 r1-eth1
172.0.3.0       172.0.2.2       255.255.255.0   UG    2      0        0 r1-eth1
172.0.4.0       172.0.2.2       255.255.255.0   UG    3      0        0 r1-eth1
172.0.5.0       172.0.6.1       255.255.255.0   UG    2      0        0 r1-eth2
172.0.6.0       *               255.255.255.0   U     0      0        0 r1-eth2
mininext>
mininext>
mininext>
```

r1 quagga routing table:

```
mininet@mininet-vm:~$ cd miniNExT/
mininet@mininet-vm:~/miniNExT$ ls
LICENSE  Makefile  README.md  __init__.py  a1  build  dist  examples  mininext  mininext.egg-info  mxexec  mxexec.1  mxexec.c  setup.py  util
mininet@mininet-vm:~/miniNExT$ cd util
mininet@mininet-vm:~/miniNExT/util$ ls
mx
mininet@mininet-vm:~/miniNExT/util$ ./mx r1
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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


User Access Verification

Password:
r1> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
C(i) 172.0.1.0/24    0.0.0.0               1 self              0
C(i) 172.0.2.0/24    0.0.0.0               1 self              0
R(n) 172.0.3.0/24    172.0.2.2             2 172.0.2.2         0 02:56
R(n) 172.0.4.0/24    172.0.2.2             3 172.0.2.2         0 02:56
R(n) 172.0.5.0/24    172.0.6.1             2 172.0.6.1         0 02:56
C(i) 172.0.6.0/24    0.0.0.0               1 self              0
r1>
```

r2 kernel routing table:

```
mininext> r2 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       172.0.2.1       255.255.255.0   UG    2      0        0 r2-eth0
172.0.2.0       *               255.255.255.0   U     0      0        0 r2-eth0
172.0.3.0       *               255.255.255.0   U     0      0        0 r2-eth1
172.0.4.0       172.0.3.2       255.255.255.0   UG    2      0        0 r2-eth1
172.0.5.0       172.0.3.2       255.255.255.0   UG    2      0        0 r2-eth1
172.0.6.0       172.0.2.1       255.255.255.0   UG    2      0        0 r2-eth0
mininext>
mininext>
mininext>
```

r2 quagga routing table:

```
mininet@mininet-vm:~/miniNExT/util$ ./mx r2
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
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User Access Verification

Password:
r2> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop         Metric From            Tag Time
R(n) 172.0.1.0/24    172.0.2.1             2 172.0.2.1         0 02:46
C(i) 172.0.2.0/24    0.0.0.0               1 self              0
C(i) 172.0.3.0/24    0.0.0.0               1 self              0
R(n) 172.0.4.0/24    172.0.3.2             2 172.0.3.2         0 02:53
R(n) 172.0.5.0/24    172.0.3.2             2 172.0.3.2         0 02:53
R(n) 172.0.6.0/24    172.0.2.1             2 172.0.2.1         0 02:46
r2>
```

r3 kernel routing table:

```
mininext>
mininext> r3 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       172.0.6.2       255.255.255.0   UG    2      0        0 r3-eth0
172.0.2.0       172.0.6.2       255.255.255.0   UG    2      0        0 r3-eth0
172.0.3.0       172.0.5.1       255.255.255.0   UG    2      0        0 r3-eth1
172.0.4.0       172.0.5.1       255.255.255.0   UG    2      0        0 r3-eth1
172.0.5.0       *               255.255.255.0   U     0      0        0 r3-eth1
172.0.6.0       *               255.255.255.0   U     0      0        0 r3-eth0
mininext>
mininext>
```

r3 quagga routing table:

```
mininet@mininet-vm:~/miniNExT/util$ ./mx r3
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
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User Access Verification

Password:
r3> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network         Next Hop        Metric From            Tag Time
R(n) 172.0.1.0/24    172.0.6.2            2 172.0.6.2         0 02:42
R(n) 172.0.2.0/24    172.0.6.2            2 172.0.6.2         0 02:42
R(n) 172.0.3.0/24    172.0.5.1            2 172.0.5.1         0 02:46
R(n) 172.0.4.0/24    172.0.5.1            2 172.0.5.1         0 02:46
C(i) 172.0.5.0/24    0.0.0.0              1 self              0
C(i) 172.0.6.0/24    0.0.0.0              1 self              0
r3>
```

r4 kernel routing table:

```
mininext>
mininext> r4 route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use Iface
172.0.1.0       172.0.3.1       255.255.255.0   UG    3      0        0 r4-eth1
172.0.2.0       172.0.3.1       255.255.255.0   UG    2      0        0 r4-eth1
172.0.3.0       *               255.255.255.0   U     0      0        0 r4-eth1
172.0.4.0       *               255.255.255.0   U     0      0        0 r4-eth0
172.0.5.0       *               255.255.255.0   U     0      0        0 r4-eth2
172.0.6.0       172.0.5.2       255.255.255.0   UG    2      0        0 r4-eth2
mininext>
mininext>
```

r4 quagga routing table:

```
mininet@mininet-vm:~/miniNExT/util$ ./mx r4
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

Hello, this is Quagga (version 0.99.22.4).
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User Access Verification

Password:
r4> show ip rip
Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network            Next Hop         Metric From            Tag Time
R(n) 172.0.1.0/24       172.0.3.1             3 172.0.3.1         0 02:57
R(n) 172.0.2.0/24       172.0.3.1             2 172.0.3.1         0 02:57
C(i) 172.0.3.0/24       0.0.0.0               1 self              0
C(i) 172.0.4.0/24       0.0.0.0               1 self              0
C(i) 172.0.5.0/24       0.0.0.0               1 self              0
R(n) 172.0.6.0/24       172.0.5.2             2 172.0.5.2         0 02:57
r4>
```

(b) the traceroute output that gives the path between nodes H1 & H2

```
mininext>
mininext>
mininext> h1 traceroute h2
traceroute to 172.0.4.1 (172.0.4.1), 30 hops max, 60 byte packets
 1  172.0.1.2 (172.0.1.2)  0.021 ms  0.003 ms  0.003 ms
 2  172.0.2.2 (172.0.2.2)  0.012 ms  0.005 ms  0.004 ms
 3  172.0.3.2 (172.0.3.2)  0.014 ms  0.006 ms  0.005 ms
 4  172.0.4.1 (172.0.4.1)  0.013 ms  0.007 ms  0.007 ms
mininext>
```

(c) the time taken for the ping

```
mininext> h1 ping h2 -c 10
PING 172.0.4.1 (172.0.4.1) 56(84) bytes of data.
64 bytes from 172.0.4.1: icmp_seq=1 ttl=61 time=0.040 ms
64 bytes from 172.0.4.1: icmp_seq=2 ttl=61 time=0.059 ms
64 bytes from 172.0.4.1: icmp_seq=3 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=4 ttl=61 time=0.127 ms
64 bytes from 172.0.4.1: icmp_seq=5 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=6 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=7 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=8 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=9 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=10 ttl=61 time=0.067 ms

--- 172.0.4.1 ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9000ms
rtt min/avg/max/mdev = 0.040/0.068/0.127/0.023 ms
mininext>
mininext>
mininext>
mininext>
```

Average Time taken for ping is approximately - 0.0688 ms

(d) The convergence time

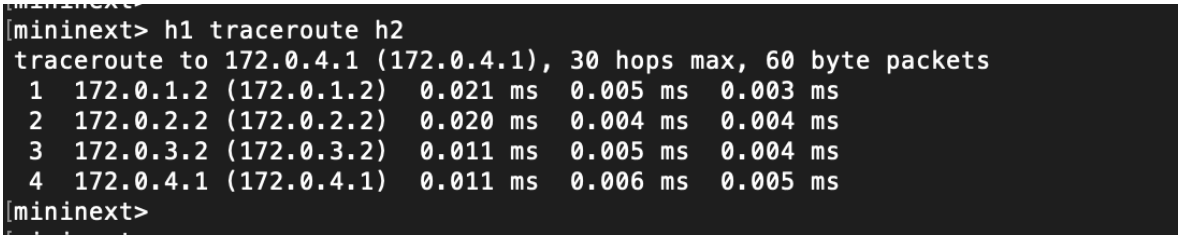
I used a stopwatch to calculate the convergence time and which varied between **1 second to 1.5 seconds**

```
mininext> h1 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> h2 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r1 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r2 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r3 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r4 echo 1 > /proc/sys/net/ipv4/ip_forward
mininext> r1 ip addr add 172.0.2.1/24 dev r1-eth1
mininext> r1 ip addr add 172.0.6.2/24 dev r1-eth2
mininext> r2 ip addr add 172.0.3.1/24 dev r2-eth1
mininext> r3 ip addr add 172.0.5.2/24 dev r3-eth1
mininext> r4 ip addr add 172.0.3.2/24 dev r4-eth1
mininext> r4 ip addr add 172.0.5.1/24 dev r4-eth2
mininext> h1 ping h2
PING 172.0.4.1 (172.0.4.1) 56(84) bytes of data.
64 bytes from 172.0.4.1: icmp_seq=1 ttl=61 time=0.077 ms
64 bytes from 172.0.4.1: icmp_seq=2 ttl=61 time=0.086 ms
64 bytes from 172.0.4.1: icmp_seq=3 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=4 ttl=61 time=0.086 ms
64 bytes from 172.0.4.1: icmp_seq=5 ttl=61 time=0.081 ms
64 bytes from 172.0.4.1: icmp_seq=6 ttl=61 time=0.087 ms
64 bytes from 172.0.4.1: icmp_seq=7 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=8 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=9 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=10 ttl=61 time=0.083 ms
64 bytes from 172.0.4.1: icmp_seq=11 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=12 ttl=61 time=0.082 ms
64 bytes from 172.0.4.1: icmp_seq=13 ttl=61 time=0.083 ms
64 bytes from 172.0.4.1: icmp_seq=14 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=15 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=16 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=17 ttl=61 time=0.118 ms
64 bytes from 172.0.4.1: icmp_seq=18 ttl=61 time=0.084 ms
64 bytes from 172.0.4.1: icmp_seq=19 ttl=61 time=0.070 ms
64 bytes from 172.0.4.1: icmp_seq=20 ttl=61 time=0.118 ms
64 bytes from 172.0.4.1: icmp_seq=21 ttl=61 time=0.077 ms
64 bytes from 172.0.4.1: icmp_seq=22 ttl=61 time=0.117 ms
64 bytes from 172.0.4.1: icmp_seq=23 ttl=61 time=0.070 ms
^C
--- 172.0.4.1 ping statistics ---
23 packets transmitted, 23 received, 0% packet loss, time 21999ms
rtt min/avg/max/mdev = 0.070/0.086/0.118/0.016 ms
```

B3:

a) how you got the link to go down

Traceroute between h1 and h2 was along r1-r2 which i understood by running “h1 traceroute h2”



In another terminal(Terminal 2), i logged in to router r1 and started to bring down r1-r2 link by following the below commands (while running “ping h1 h2” on terminal 1)

1) give -> ./mx r1
2) telnet localhost 2602
3) password - zebra
4) r1> enable
5) r1# configure terminal
6) r1(config)# router rip
7) r1(config-router)# no network 172.0.2.1/24

```
mininet@mininet-vm:~$ cd miniNExT/
mininet@mininet-vm:~/miniNExT$ ls
LICENSE    __init__.py  dist      mininext.egg-info  mxexec.c
Makefile   a1           examples  mxexec             setup.py
README.md  build        mininext  mxexec.1           util
mininet@mininet-vm:~/miniNExT$ cd util/
mininet@mininet-vm:~/miniNExT/util$ ls
mx
mininet@mininet-vm:~/miniNExT/util$ ./mx r1
root@mininet-vm:/# telnet localhost 2602
Trying ::1...
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.

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


User Access Verification

Password:
r1> enable
r1# configure terminal
r1(config)# router rip
r1(config-router)# no network 172.0.2.1/24
r1(config-router)#
```

(b) the time it takes for connectivity to be established

I used a stopwatch to see how long it took to setup again - which varied between **2 mins 30 seconds to 3 mins 15 seconds**

```
64 bytes from 172.0.4.1: icmp_seq=102 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=103 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=104 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=105 ttl=61 time=0.056 ms
64 bytes from 172.0.4.1: icmp_seq=106 ttl=61 time=0.069 ms
64 bytes from 172.0.4.1: icmp_seq=107 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=108 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=109 ttl=61 time=0.052 ms
64 bytes from 172.0.4.1: icmp_seq=110 ttl=61 time=0.068 ms
64 bytes from 172.0.4.1: icmp_seq=111 ttl=61 time=0.056 ms
64 bytes from 172.0.4.1: icmp_seq=112 ttl=61 time=0.068 ms
64 bytes from 172.0.4.1: icmp_seq=113 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=114 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=115 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=116 ttl=61 time=0.053 ms
64 bytes from 172.0.4.1: icmp_seq=117 ttl=61 time=0.056 ms
64 bytes from 172.0.4.1: icmp_seq=118 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=119 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=120 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=121 ttl=61 time=0.068 ms
64 bytes from 172.0.4.1: icmp_seq=122 ttl=61 time=0.067 ms
```

```
64 bytes from 172.0.4.1: icmp_seq=123 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=124 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=125 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=126 ttl=61 time=0.069 ms
64 bytes from 172.0.4.1: icmp_seq=127 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=128 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=129 ttl=61 time=0.069 ms
64 bytes from 172.0.4.1: icmp_seq=130 ttl=61 time=0.066 ms
ping: sendmsg: Network is unreachable
ping: sendmsg: Network is unreachable
ping: sendmsg: Network is unreachable
ping: sendmsg: Network is unreachable


64 bytes from 172.0.4.1: icmp_seq=284 ttl=61 time=0.080 ms
64 bytes from 172.0.4.1: icmp_seq=285 ttl=61 time=0.068 ms
64 bytes from 172.0.4.1: icmp_seq=286 ttl=61 time=0.063 ms
64 bytes from 172.0.4.1: icmp_seq=287 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=288 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=289 ttl=61 time=0.130 ms
64 bytes from 172.0.4.1: icmp_seq=290 ttl=61 time=0.064 ms
64 bytes from 172.0.4.1: icmp_seq=291 ttl=61 time=0.068 ms
64 bytes from 172.0.4.1: icmp_seq=292 ttl=61 time=0.056 ms
64 bytes from 172.0.4.1: icmp_seq=293 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=294 ttl=61 time=0.064 ms
64 bytes from 172.0.4.1: icmp_seq=295 ttl=61 time=0.064 ms
64 bytes from 172.0.4.1: icmp_seq=296 ttl=61 time=0.054 ms
64 bytes from 172.0.4.1: icmp_seq=297 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=298 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=299 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=300 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=301 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=302 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=303 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=304 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=305 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=306 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=307 ttl=61 time=0.066 ms
64 bytes from 172.0.4.1: icmp_seq=308 ttl=61 time=0.067 ms
64 bytes from 172.0.4.1: icmp_seq=309 ttl=61 time=0.065 ms
64 bytes from 172.0.4.1: icmp_seq=310 ttl=61 time=0.066 ms
```

(c) provide the traceroute output that gives the new path between nodes H1 & H2.

The new route was along r1-r3.