



دانشکده مهندسی کامپیوتر
آزمایشگاه شبکه‌های کامپیوتری

گزارش کار آزمایش ۱

گروه ۴

علی صدیقی ۹۷۵۲۱۳۷۸

دانیال بازمانده ۹۷۵۲۱۱۳۵

۱ بخش الف

پیاده‌سازی این بخش با تغییرات درون فایل lanTopology.py ایجاد شده است.

```
info( '*** Adding hosts\n' )
h1 = net.addHost( 'h1' )
h2 = net.addHost( 'h2' )
h3 = net.addHost( 'h3' )
h4 = net.addHost( 'h4' )

info( '*** Adding switch\n' )
s14 = net.addSwitch( 's14' )
s24 = net.addSwitch( 's24' )
s34 = net.addSwitch( 's34' )

info( '*** Creating links\n' )
net.addLink( h1, s14 )
net.addLink( h2, s24 )
net.addLink( h3, s34 )
net.addLink( h4, s14 )
net.addLink( h4, s24 )
net.addLink( h4, s34 )
```

```
#This is used to run commands on the hosts
info( '*** Starting terminals on hosts\n' )
h1.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h1 &')
h2.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h2 &')
h3.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h3 &')
h4.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h4 &')

info( '*** Running the command line interface\n' )
CLI( net )

info( '*** Closing the terminals on the hosts\n' )
h1.cmd("killall xterm")
h2.cmd("killall xterm")
h3.cmd("killall xterm")
h4.cmd("killall xterm")
```

از دستور scp برای انتقال این فایل از ماشین لوکال به ماشین مجازی استفاده می‌کنیم.

```
scp lanTopology.py mininet@192.168.83.3:/home/mininet/py-scripts
```

برنامه xterm و محیط گرافیکی را نیز از طریق دستور زیر نصب می‌کنیم:

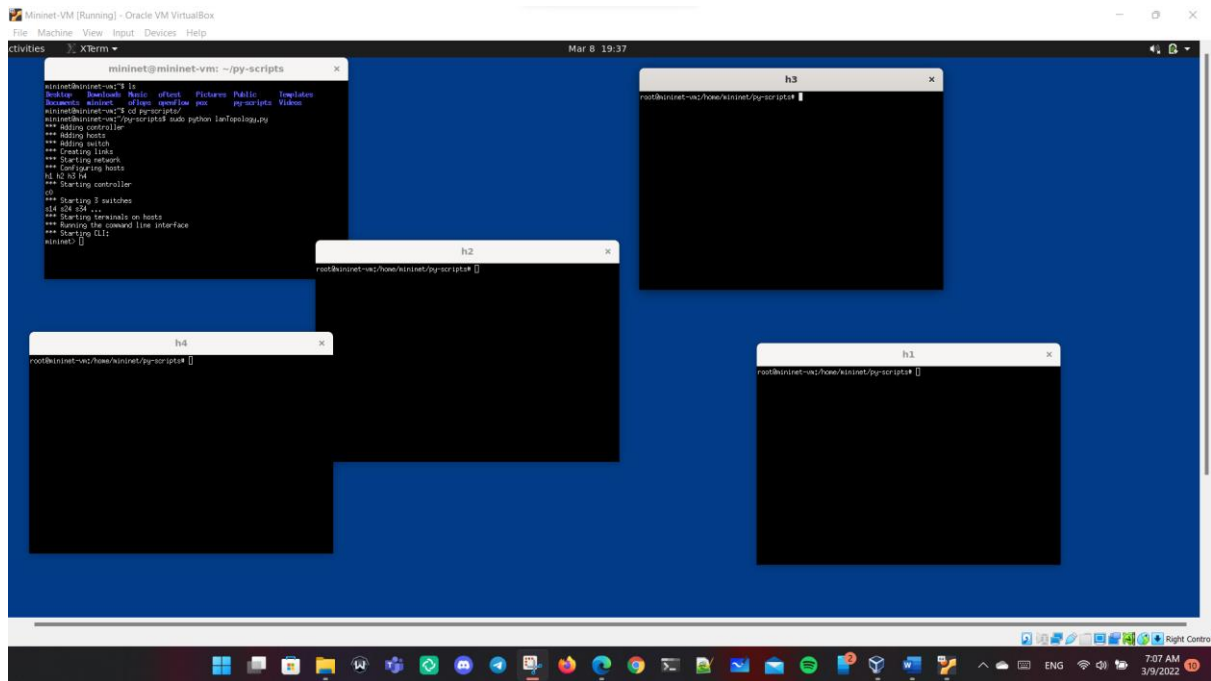
```
sudo apt-get update
```

```
sudo apt-get install xinit x11-xserver-utils lxde
```

```
sudo apt-get install xterm
```

شبکه درون فایل را از طریق دستور زیر اجرا می‌کنیم:

```
sudo mn --custom lanTopology.py --topo=lanTopology
```



۲ سوال ب

دستورات ip link و ifconfig را روی همه هاست‌ها اجرا می‌کنیم.

مشاهده می‌کنیم تمامی اینترفیس‌ها در مد UP هستند و نیازی به زدن دستور توسط ما نیست.

```
h1
root@mininet-vm:/home/mininet/py-scripts# ifconfig
h1-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.1 netmask 255.0.0.0 broadcast 10.255.255.255
    ether ea:5a:0c:98:c5:af txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet/py-scripts# ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
    group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: h1-eth0@if4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
P mode DEFAULT group default qlen 1000
    link/ether ea:5a:0c:98:c5:af brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@mininet-vm:/home/mininet/py-scripts#
```

```
h2
h2-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.2 netmask 255.0.0.0 broadcast 10.255.255.255
    ether 82:0d:68:69:5e:a8 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet/py-scripts# ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
    group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: h2-eth0@if5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
P mode DEFAULT group default qlen 1000
    link/ether 82:0d:68:69:5e:a8 brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@mininet-vm:/home/mininet/py-scripts#
```

```
h3 x
root@mininet-vm:/home/mininet/py-scripts# ifconfig
h3-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.3 netmask 255.0.0.0 broadcast 10.255.255.255
    ether 9e:7c:15:bb:c2:9a txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet/py-scripts# ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
    group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: h3-eth0@if6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
    mode DEFAULT group default qlen 1000
    link/ether 9e:7c:15:bb:c2:9a brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@mininet-vm:/home/mininet/py-scripts#
```

```
h4 x
root@mininet-vm:/home/mininet/py-scripts# ifconfig
h4-eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 10.0.0.4 netmask 255.0.0.0 broadcast 10.255.255.255
    ether 1e:ed:04:dc:af:0a txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

h4-eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    ether 5a:f9:43:71:2a:d3 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

h4-eth2: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    ether ee:5c:d6:2b:b4:46 txqueuelen 1000 (Ethernet)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING> mtu 65536
    inet 127.0.0.1 netmask 255.0.0.0
    loop txqueuelen 1000 (Local Loopback)
    RX packets 0 bytes 0 (0.0 B)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 0 bytes 0 (0.0 B)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

root@mininet-vm:/home/mininet/py-scripts# ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
    group default qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: h4-eth0@if7: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
    mode DEFAULT group default qlen 1000
    link/ether 1e:ed:04:dc:af:0a brd ff:ff:ff:ff:ff:ff link-netnsid 0
3: h4-eth1@if8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
    mode DEFAULT group default qlen 1000
    link/ether 5a:f9:43:71:2a:d3 brd ff:ff:ff:ff:ff:ff link-netnsid 0
4: h4-eth2@if9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
    mode DEFAULT group default qlen 1000
    link/ether ee:5c:d6:2b:b4:46 brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@mininet-vm:/home/mininet/py-scripts#
```

روی هاست h1 برنامه Wireshark را اجرا می‌کنیم و به اینترفیس h1-eth0 آن گوش می‌دهیم. یک بسته پینگ نیز از h1 به آدرس 10.10.14.4 ارسال می‌کنیم.

```
root@mininet-vm:/home/mininet/py-scripts# sudo wireshark
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-root'
^Z
[1]+  Stopped                  sudo wireshark
root@mininet-vm:/home/mininet/py-scripts# bg
[1]+  sudo wireshark &
root@mininet-vm:/home/mininet/py-scripts# ping 10.10.14.4 -c 1
PING 10.10.14.4 (10.10.14.4) 56(84) bytes of data.
From 10.0.0.1 icmp_seq=1 Destination Host Unreachable

--- 10.10.14.4 ping statistics ---
1 packets transmitted, 0 received, +1 errors, 100% packet loss, time 0ms

root@mininet-vm:/home/mininet/py-scripts#
```

Capturing from h1-eth0						
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help						
Apply a display filter ... <Ctrl-/>						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	ea:5a:0c:98:c5:af	Broadcast	ARP	42	Who has 10.10.14.4? Tell 10.0.0.1
2	1.029248159	ea:5a:0c:98:c5:af	Broadcast	ARP	42	Who has 10.10.14.4? Tell 10.0.0.1
3	2.053205373	ea:5a:0c:98:c5:af	Broadcast	ARP	42	Who has 10.10.14.4? Tell 10.0.0.1

سوال (۱)

درخواست (Request) ICMP ارسال نمی‌شود.

جدول ARP در h1 آدرس فیزیکی معادل IP داده شده را ندارد.

در ابتدا درخواست (Request) ARP فرستاده می‌شود و از آنجایی که چنین IP ای در شبکه موجود نیست، پاسخی دریافت نمی‌شود.

یعنی هیچ reply ARP ارسال نمی‌شود و دریافت نیز نمی‌شود.

```
root@mininet-vm:/home/mininet/py-scripts# arp -a
? (10.0.0.4) at 1e:ed:04:dc:af:0a [ether] on h1-eth0
? (10.10.14.4) at <incomplete> on h1-eth0
root@mininet-vm:/home/mininet/py-scripts#
```

۳ سوال ج

دستورات ip addr del و ip addr add را روی هر ۴ هاست به صورت زیر اجرا می کنیم.

```

h1
root@mininet-vm:/home/mininet/py-scripts# ip addr del 10.0.0.1 dev h1-eth0
Warning: Executing wildcard deletion to stay compatible with old scripts.
        Explicitly specify the prefix length (10.0.0.1/32) to avoid this warning
.
        This special behaviour is likely to disappear in further releases,
        fix your scripts!
RTNETLINK answers: Cannot assign requested address
root@mininet-vm:/home/mininet/py-scripts# ip addr add 10.10.14.1/24 dev h1-eth0
root@mininet-vm:/home/mininet/py-scripts# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: h1-eth0@if4: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP
    group default qlen 1000
    link/ether ea:5a:0c:98:c5:af brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.14.1/24 scope global h1-eth0
        valid_lft forever preferred_lft forever
root@mininet-vm:/home/mininet/py-scripts#

```

```

h2
root@mininet-vm:/home/mininet/py-scripts# ip addr del 10.0.0.2 dev h2-eth0
Warning: Executing wildcard deletion to stay compatible with old scripts.
        Explicitly specify the prefix length (10.0.0.2/32) to avoid this warnin
9.
        This special behaviour is likely to disappear in further releases,
        fix your scripts!
RTNETLINK answers: Cannot assign requested address
root@mininet-vm:/home/mininet/py-scripts# ip addr add 10.10.24.2/24 dev h2-eth0
root@mininet-vm:/home/mininet/py-scripts# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: h2-eth0@if5: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    group default qlen 1000
    link/ether 82:0d:68:69:5e:a8 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.24.2/24 scope global h2-eth0
        valid_lft forever preferred_lft forever
root@mininet-vm:/home/mininet/py-scripts#

```

```

h3
root@mininet-vm:/home/mininet/py-scripts# ip addr del 10.0.0.3 dev h3-eth0
Warning: Executing wildcard deletion to stay compatible with old scripts.
        Explicitly specify the prefix length (10.0.0.3/32) to avoid this warnin
9.
        This special behaviour is likely to disappear in further releases,
        fix your scripts!
RTNETLINK answers: Cannot assign requested address
root@mininet-vm:/home/mininet/py-scripts# ip addr add 10.10.34.3/24 dev h3-eth0
root@mininet-vm:/home/mininet/py-scripts# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    qlen 1000
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: h3-eth0@if6: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    group default qlen 1000
    link/ether 9e:7c:15:bb:c2:9a brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.34.3/24 scope global h3-eth0
        valid_lft forever preferred_lft forever
root@mininet-vm:/home/mininet/py-scripts#

```

```

h4
root@mininet-vmt:/home/mininet/py-scripts# ip addr del 10.0.0.4 dev h4-eth0
Warning: Executing wildcard deletion to stay compatible with old scripts.
Explicitly specify the prefix length (10.0.0.4/32) to avoid this warning.
9.
This special behaviour is likely to disappear in further releases,
fix your scripts!
root@mininet-vmt:/home/mininet/py-scripts# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: h4-eth0@if7: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether 1e:ed:04:dc:af:0a brd ff:ff:ff:ff:ff:ff link-netnsid 0
3: h4-eth1@if8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether 5a:f9:43:71:2a:d3 brd ff:ff:ff:ff:ff:ff link-netnsid 0
4: h4-eth2@if9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether ee:5c:d6:2b:b4:46 brd ff:ff:ff:ff:ff:ff link-netnsid 0
root@mininet-vmt:/home/mininet/py-scripts# ip addr add 10.10.14.4/24 dev h4-eth0
root@mininet-vmt:/home/mininet/py-scripts# ip addr add 10.10.24.4/24 dev h4-eth1
root@mininet-vmt:/home/mininet/py-scripts# ip addr add 10.10.34.4/24 dev h4-eth2
root@mininet-vmt:/home/mininet/py-scripts# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN group default
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
        valid_lft forever preferred_lft forever
2: h4-eth0@if7: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether 1e:ed:04:dc:af:0a brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.14.4/24 scope global h4-eth0
        valid_lft forever preferred_lft forever
3: h4-eth1@if8: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether 5a:f9:43:71:2a:d3 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.24.4/24 scope global h4-eth1
        valid_lft forever preferred_lft forever
4: h4-eth2@if9: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state U
    P group default qlen 1000
    link/ether ee:5c:d6:2b:b4:46 brd ff:ff:ff:ff:ff:ff link-netnsid 0
    inet 10.10.34.4/24 scope global h4-eth2
        valid_lft forever preferred_lft forever
root@mininet-vmt:/home/mininet/py-scripts#

```

یک بسته پینگ از مبدا h1 به 10.10.14.4 ارسال می‌کنیم.

```

h1
root@mininet-vmt:/home/mininet/py-scripts# sudo wireshark
QStandardPaths: XDG_RUNTIME_DIR not set, defaulting to '/tmp/runtime-root'
^Z
[1]+  Stopped                  sudo wireshark
root@mininet-vmt:/home/mininet/py-scripts# bg
[1]+  sudo wireshark &
root@mininet-vmt:/home/mininet/py-scripts# ping 10.10.14.4 -c 1
PING 10.10.14.4 (10.10.14.4) 56(84) bytes of data:
64 bytes from 10.10.14.4: icmp_seq=1 ttl=64 time=2.81 ms

--- 10.10.14.4 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 2.814/2.814/2.814/0.000 ms
root@mininet-vmt:/home/mininet/py-scripts# arp -a
? (10.10.14.4) at 1e:ed:04:dc:af:0a [ether] on h1-eth0
root@mininet-vmt:/home/mininet/py-scripts#

```

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	ea:5a:0c:98:c5:af	Broadcast	ARP	42	Who has 10.10.14.4? Tell 10.10.14.1
2	0.002007356	1e:ed:04:dc:af:0a	ea:5a:0c:98:c5:af	ARP	42	10.10.14.4 is at 1e:ed:04:dc:af:0a
3	0.002015588	10.10.14.1	10.10.14.4	ICMP	98	Echo (ping) request id=0x0949, seq=1/256, ttl=64 (reply in 4)
4	0.002779832	10.10.14.4	10.10.14.1	ICMP	98	Echo (ping) reply id=0x0949, seq=1/256, ttl=64 (request in 3)
5	5.228446080	1e:ed:04:dc:af:0a	ea:5a:0c:98:c5:af	ARP	42	Who has 10.10.14.1? Tell 10.10.14.4
6	5.228465427	ea:5a:0c:98:c5:af	1e:ed:04:dc:af:0a	ARP	42	10.10.14.1 is at ea:5a:0c:98:c5:af

سوال (۲)

بله Wireshark توانسته هر دو بسته ARP Reply و ICMP Request را روی اینترفیس h1-eth0 انجام دهد. در واقع هاست h1 موفق شده آدرس واقعی h4 را پیدا کند.

۴ بخش د

سوال (۳)

```
h1
root@mininet-virtual-machine:~# ping 10.10.24.4 -c 1
ping: connect: Network is unreachable
root@mininet-virtual-machine:~# ping 10.10.34.4 -c 1
ping: connect: Network is unreachable
root@mininet-virtual-machine:~#
```

خیر کار نمی‌کند. زیرا میان این دو آدرس هیچ اینترفیسی وجود ندارد. h4 نیز نمی‌تواند پیام‌های ICMP را Forward کند.

سوال (۴)

```
h1
root@mininet-virtual-machine:~# ip route
10.10.14.0/24 dev h1-eth0 proto kernel scope link src 10.10.14.1
root@mininet-virtual-machine:~#
```

در اینجا دو مورد وجود دارد. یکی 10.10.14.0/24 که به عنوان مبدا هر بسته ایست که اینترفیسی برای ارسال آن تعیین نشده. دومی نیز 10.10.14.1 است که بیانگر h1-eth0 است.

سوال (۵)

```
h1
root@mininet-virtual-machine:~# ip route add default via 10.10.14.4
root@mininet-virtual-machine:~# ping 10.10.34.4 -c 1
PING 10.10.34.4 (10.10.34.4) 56(84) bytes of data:
64 bytes from 10.10.34.4: icmp_seq=1 ttl=64 time=6.36 ms

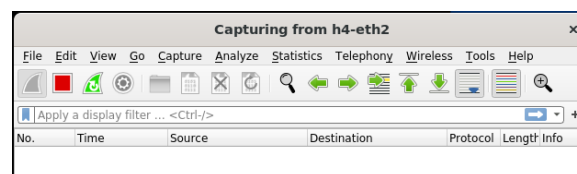
--- 10.10.34.4 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 6.361/6.361/6.361/0.000 ms
root@mininet-virtual-machine:~#
```

این بار اینترفیس eth2 در هاست h4 از طریق h1 قابل دسترسی است. زیرا Default Gateway را در h1 برابر اینترفیسی قرار دادیم که با اینترفیس مقصد در ارتباط است.

سوال (۶)

```
h1
root@mininet-virtual-machine:~# ping 10.10.34.3 -c 1
PING 10.10.34.3 (10.10.34.3) 56(84) bytes of data:

--- 10.10.34.3 ping statistics ---
1 packets transmitted, 0 received, 100% packet loss, time 0ms
root@mininet-virtual-machine:~#
```



```
h4
root@mininet-virtual-machine:~# echo 1 > /proc/sys/net/ipv4/ip_forward
root@mininet-virtual-machine:~#
```

```

h1
root@mininet-vml:/home/mininet/py-scripts# ping 10.10.34.3 -c 1
PING 10.10.34.3 (10.10.34.3) 56(84) bytes of data.

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

root@mininet-vml:/home/mininet/py-scripts#

```

Capturing from h4-eth2						
No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000000	ee:5c:d6:2b:b4:46	Broadcast	ARP	42	Who has 10.10.34.3? Tell 10.10.34.4
2	0.000836195	9e:7c:15:bb:c2:9a	ee:5c:d6:2b:b4:46	ARP	42	10.10.34.3 is at 9e:7c:15:bb:c2:9a
3	0.000841139	10.10.14.1	10.10.34.3	ICMP	98	Echo (ping) request id=0x09b2, seq=1/256, ttl=63 (no response found!)

حل مشکل:

بایستی Default Gateway بر روی h2 و h3 را نیز تغییر دهیم.

روی h2:

ip route add default via 10.10.24.4

روی h3:

ip route add default via 10.10.34.4

```

h1
root@mininet-vml:/home/mininet/py-scripts# ping 10.10.34.3 -c 1
PING 10.10.34.3 (10.10.34.3) 56(84) bytes of data.
64 bytes from 10.10.34.3: icmp_seq=1 ttl=63 time=2.42 ms

--- 10.10.34.3 ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 2.424/2.424/2.424/0.000 ms

root@mininet-vml:/home/mininet/py-scripts#

```

4	300.150816759	10.10.14.1	10.10.34.3	ICMP	98	Echo (ping) request id=0x09bc, seq=1/256, ttl=63 (reply in 5)
5	300.151518970	10.10.34.3	10.10.14.1	ICMP	98	Echo (ping) reply id=0x09bc, seq=1/256, ttl=64 (request in 4)
6	305.376207209	ee:5c:d6:2b:b4:46	9e:7c:15:bb:c2:9a	ARP	42	Who has 10.10.34.3? Tell 10.10.34.4
7	305.377144327	9e:7c:15:bb:c2:9a	ee:5c:d6:2b:b4:46	ARP	42	Who has 10.10.34.4? Tell 10.10.34.3
8	305.377160005	ee:5c:d6:2b:b4:46	9e:7c:15:bb:c2:9a	ARP	42	10.10.34.4 is at ee:5c:d6:2b:b4:46
9	305.384214273	9e:7c:15:bb:c2:9a	ee:5c:d6:2b:b4:46	ARP	42	10.10.34.3 is at 9e:7c:15:bb:c2:9a

همانطور که مشاهده می شود آدرس پیدا شد و پینگ گرفته شد.

سوال ۷) بایستی در هر هاست Default Gateway ها را تعریف کنیم تا به h4 (مرکزی) متصل شوند.

h2 از طریق h1: مقدار RTT: 0.363

```

h1
root@mininet-vml:/home/mininet/py-scripts# ping 10.10.24.2 -c 5
PING 10.10.24.2 (10.10.24.2) 56(84) bytes of data.
64 bytes from 10.10.24.2: icmp_seq=1 ttl=63 time=1.38 ms
64 bytes from 10.10.24.2: icmp_seq=2 ttl=63 time=0.227 ms
64 bytes from 10.10.24.2: icmp_seq=3 ttl=63 time=0.071 ms
64 bytes from 10.10.24.2: icmp_seq=4 ttl=63 time=0.073 ms
64 bytes from 10.10.24.2: icmp_seq=5 ttl=63 time=0.071 ms

--- 10.10.24.2 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4083ms
rtt min/avg/max/mdev = 0.071/0.363/1.376/0.509 ms

root@mininet-vml:/home/mininet/py-scripts#

```

h3 از طریق h2: مقدار RTT: 1.011

```
h2
root@mininet-vm:/home/mininet/py-scripts# ping 10.10.34.3 -c 5
PING 10.10.34.3 (10.10.34.3) 56(84) bytes of data.
64 bytes from 10.10.34.3: icmp_seq=1 ttl=63 time=3.81 ms
64 bytes from 10.10.34.3: icmp_seq=2 ttl=63 time=0.791 ms
64 bytes from 10.10.34.3: icmp_seq=3 ttl=63 time=0.263 ms
64 bytes from 10.10.34.3: icmp_seq=4 ttl=63 time=0.117 ms
64 bytes from 10.10.34.3: icmp_seq=5 ttl=63 time=0.076 ms

--- 10.10.34.3 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4041ms
rtt min/avg/max/mdev = 0.076/1.011/3.810/1.422 ms
root@mininet-vm:/home/mininet/py-scripts#
```

h1 از طریق h3: مقدار RTT: 2.810

```
h3
root@mininet-vm:/home/mininet/py-scripts# ping 10.10.14.1 -c 5
PING 10.10.14.1 (10.10.14.1) 56(84) bytes of data.
64 bytes from 10.10.14.1: icmp_seq=1 ttl=63 time=3.82 ms
64 bytes from 10.10.14.1: icmp_seq=2 ttl=63 time=9.77 ms
64 bytes from 10.10.14.1: icmp_seq=3 ttl=63 time=0.308 ms
64 bytes from 10.10.14.1: icmp_seq=4 ttl=63 time=0.082 ms
64 bytes from 10.10.14.1: icmp_seq=5 ttl=63 time=0.072 ms

--- 10.10.14.1 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4038ms
rtt min/avg/max/mdev = 0.072/2.810/9.768/3.758 ms
root@mininet-vm:/home/mininet/py-scripts#
```

با توجه به وجود تقارن در شبکه مقادیر RTT نباید اختلاف زیادی با هم داشته باشند. که این مورد در تصاویر نیز مشاهده می‌شود (با شک)