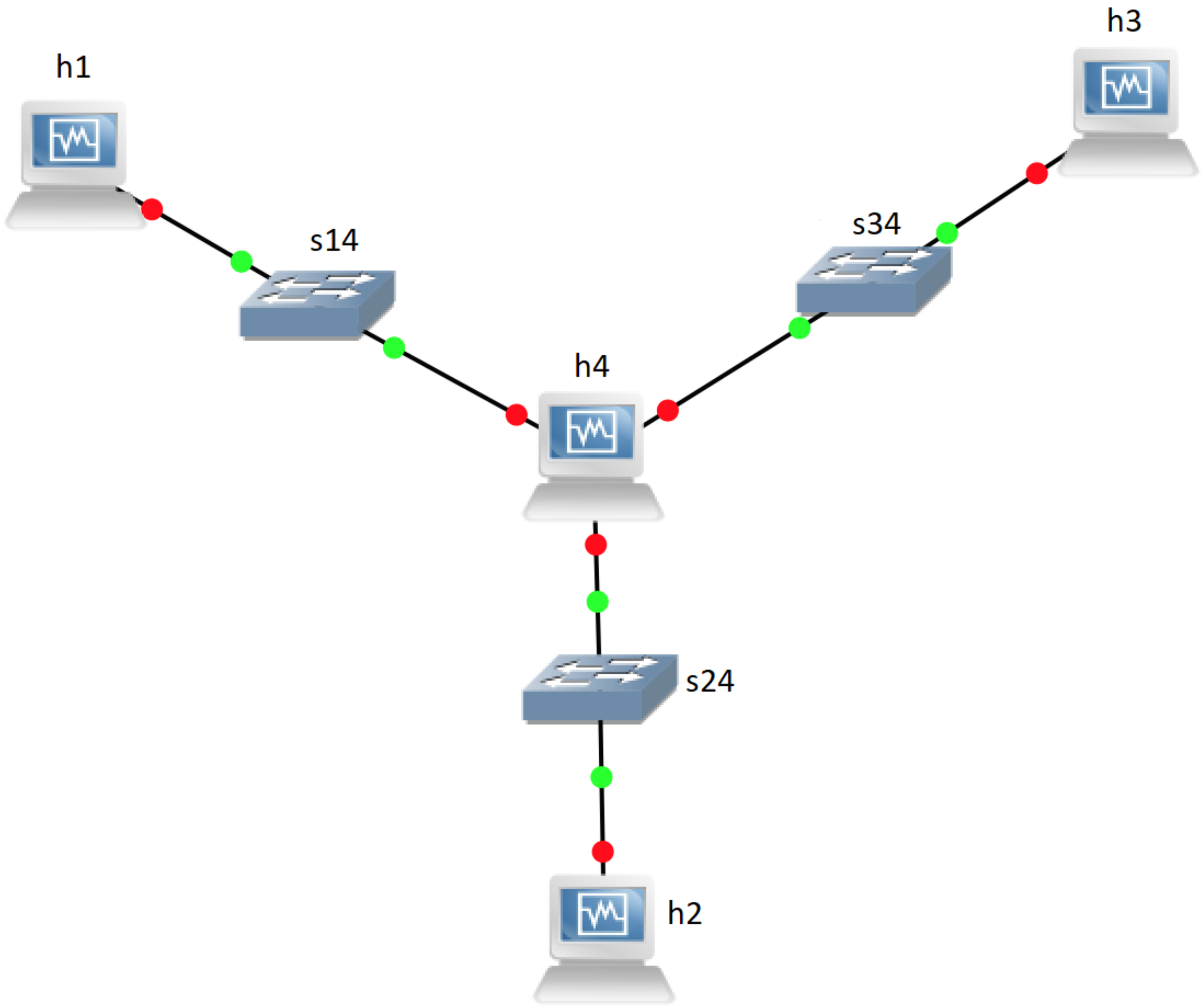
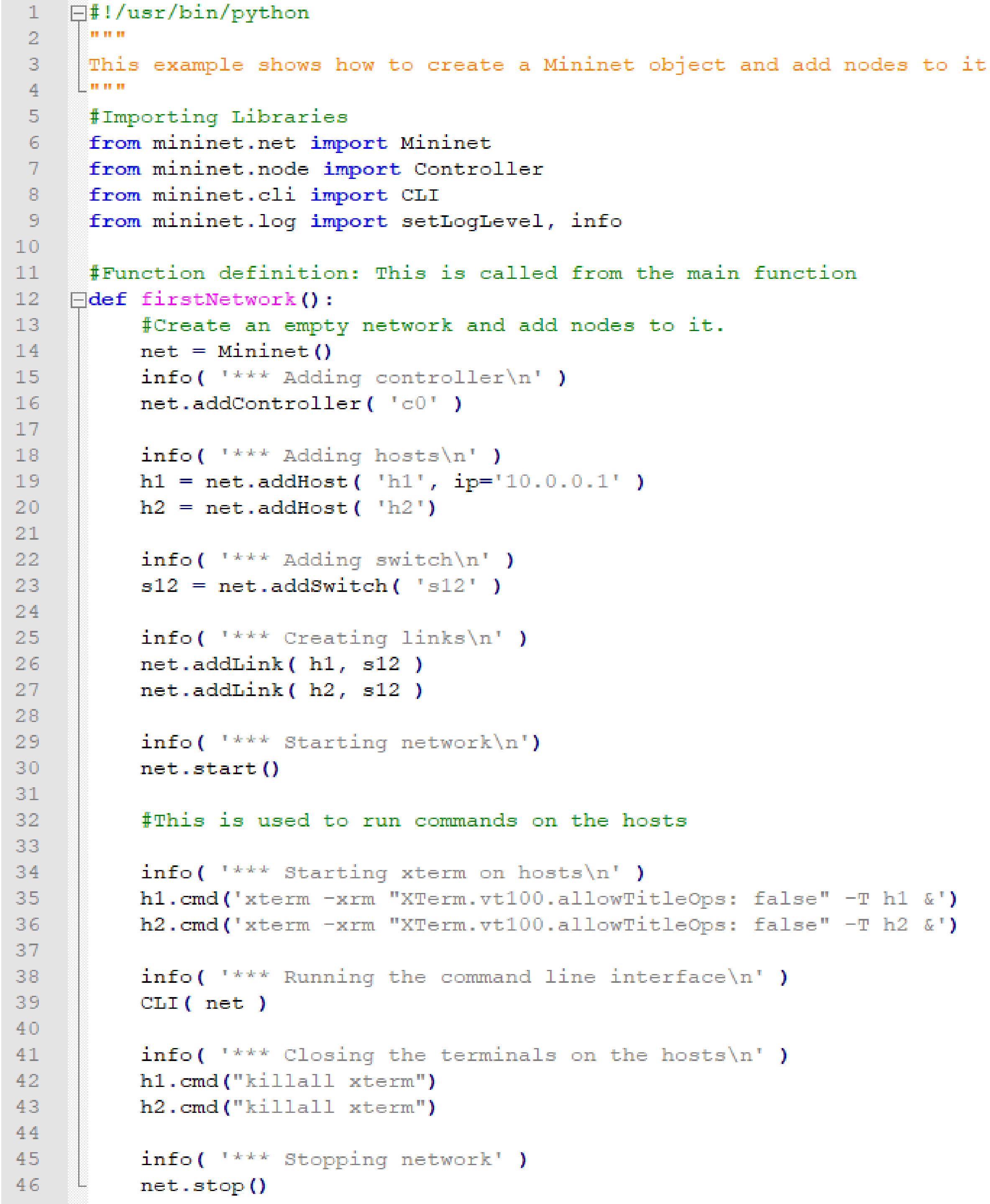
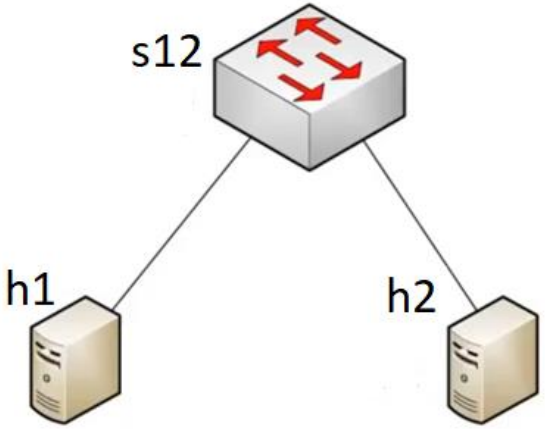
LAN Configuration

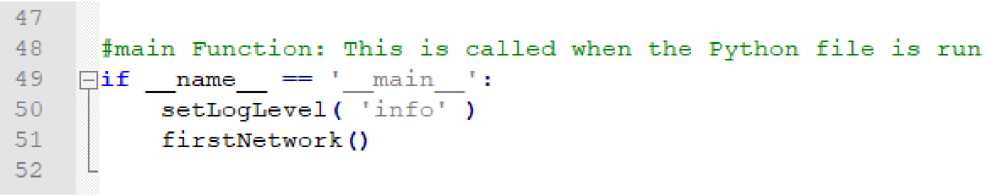
Custom topology





```python
#!/usr/bin/python
"""
This example shows how to create a Mininet object and add nodes to it
"""
#Importing Libraries
from mininet.net import Mininet
from mininet.node import Controller
from mininet.cli import CLI
from mininet.log import setLogLevel, info

#Function definition: This is called from the main function
def firstNetwork():
    #Create an empty network and add nodes to it.
    net = Mininet()
    info( '*** Adding controller\n' )
    net.addController( 'c0' )

    info( '*** Adding hosts\n' )
    h1 = net.addHost( 'h1', ip='10.0.0.1' )
    h2 = net.addHost( 'h2')

    info( '*** Adding switch\n' )
    s12 = net.addSwitch( 's12' )

    info( '*** Creating links\n' )
    net.addLink( h1, s12 )
    net.addLink( h2, s12 )

    info( '*** Starting network\n')
    net.start()

    #This is used to run commands on the hosts

    info( '*** Starting xterm on hosts\n' )
    h1.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h1 &')
    h2.cmd('xterm -xrm "XTerm.vt100.allowTitleOps: false" -T h2 &')

    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")

    info( '*** Stopping network' )
    net.stop()
```

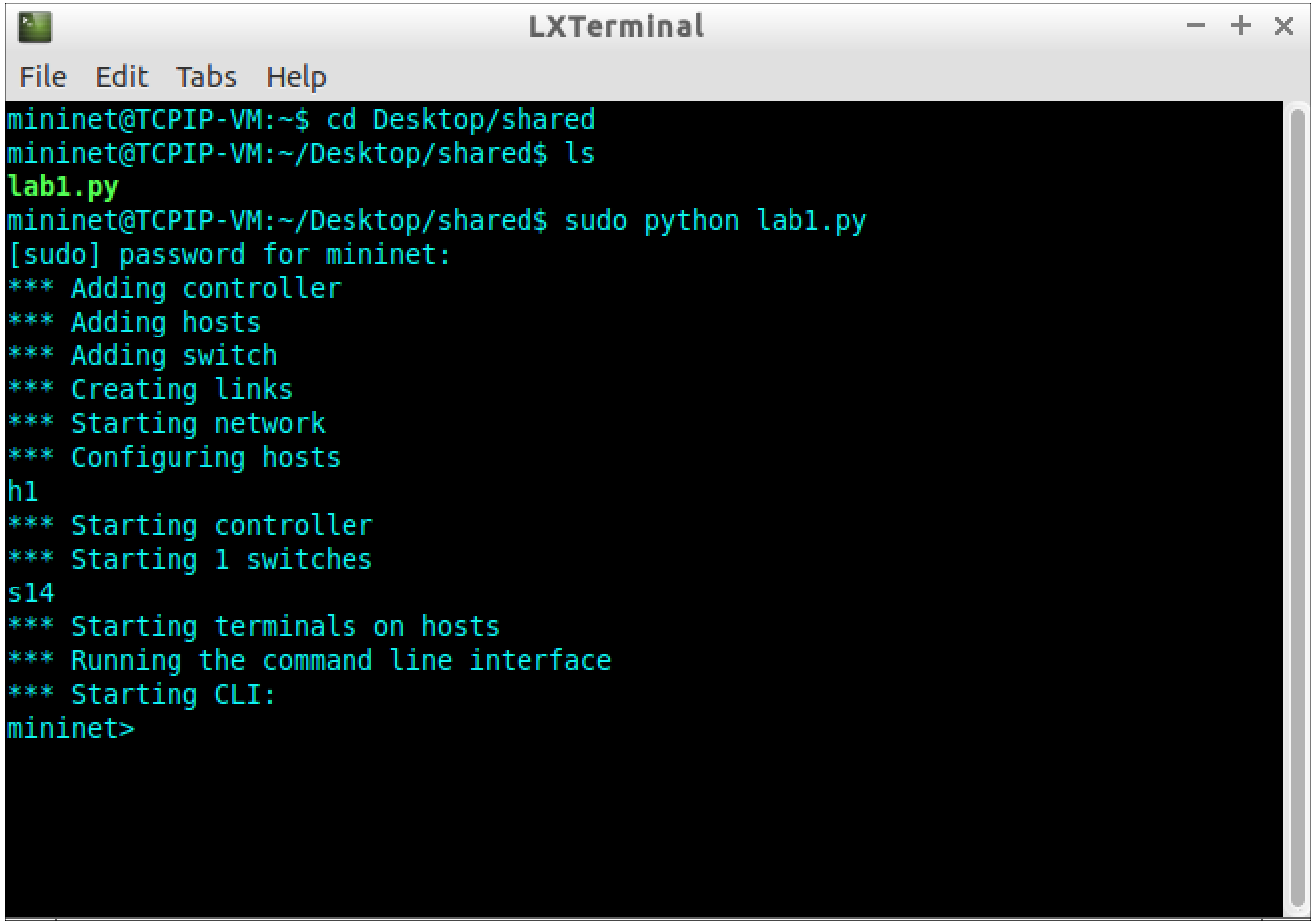




```python

#main Function: This is called when the Python file is run
if __name__ == '__main__':
    setLogLevel( 'info' )
    firstNetwork()

```

Custom topology

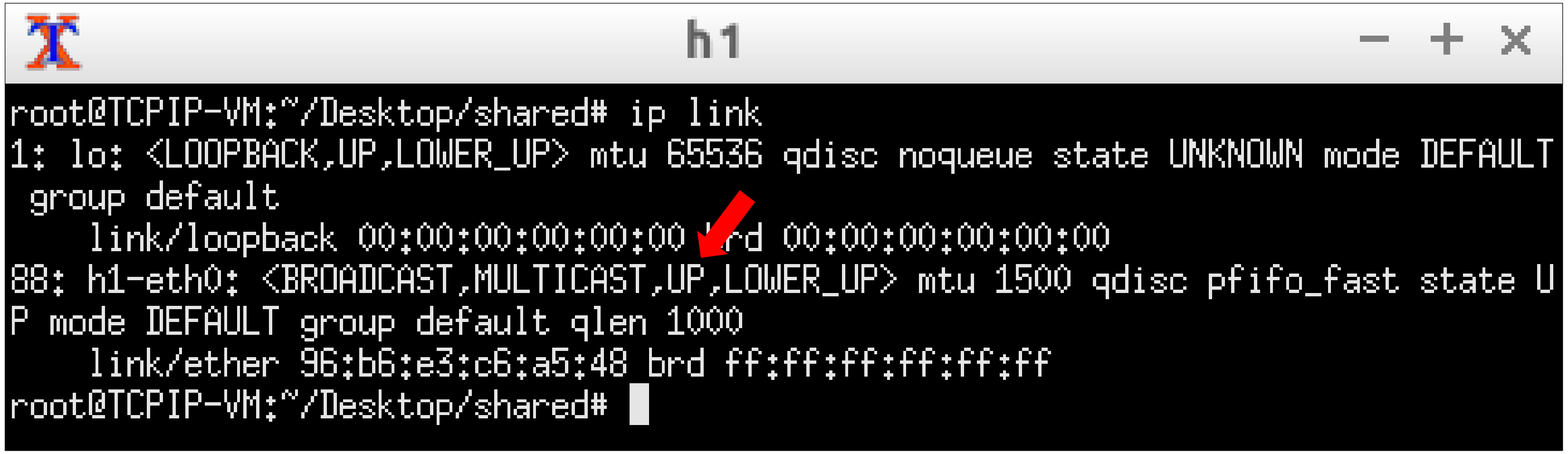
- Change directory to shared folder:
  - $ cd Desktop/shared
- Edit a python file, e.g. lab1.py:
  - $ sudo leafpad lab1.py
- Run topology:
  - $ sudo python lab1.py
- Exit topology:
  - mininet> exit
- Clean up:
  - $ sudo mn -c



```
mininet@TCPIP-VM:~$ cd Desktop/shared
mininet@TCPIP-VM:~/Desktop/shared$ ls
lab1.py
mininet@TCPIP-VM:~/Desktop/shared$ sudo python lab1.py
[sudo] password for mininet:
*** Adding controller
*** Adding hosts
*** Adding switch
*** Creating links
*** Starting network
*** Configuring hosts
h1
*** Starting controller
*** Starting 1 switches
s14
*** Starting terminals on hosts
*** Running the command line interface
*** Starting CLI:
mininet>
```

Interfaces

- Show the mode of a host interfaces:
  - # ip link

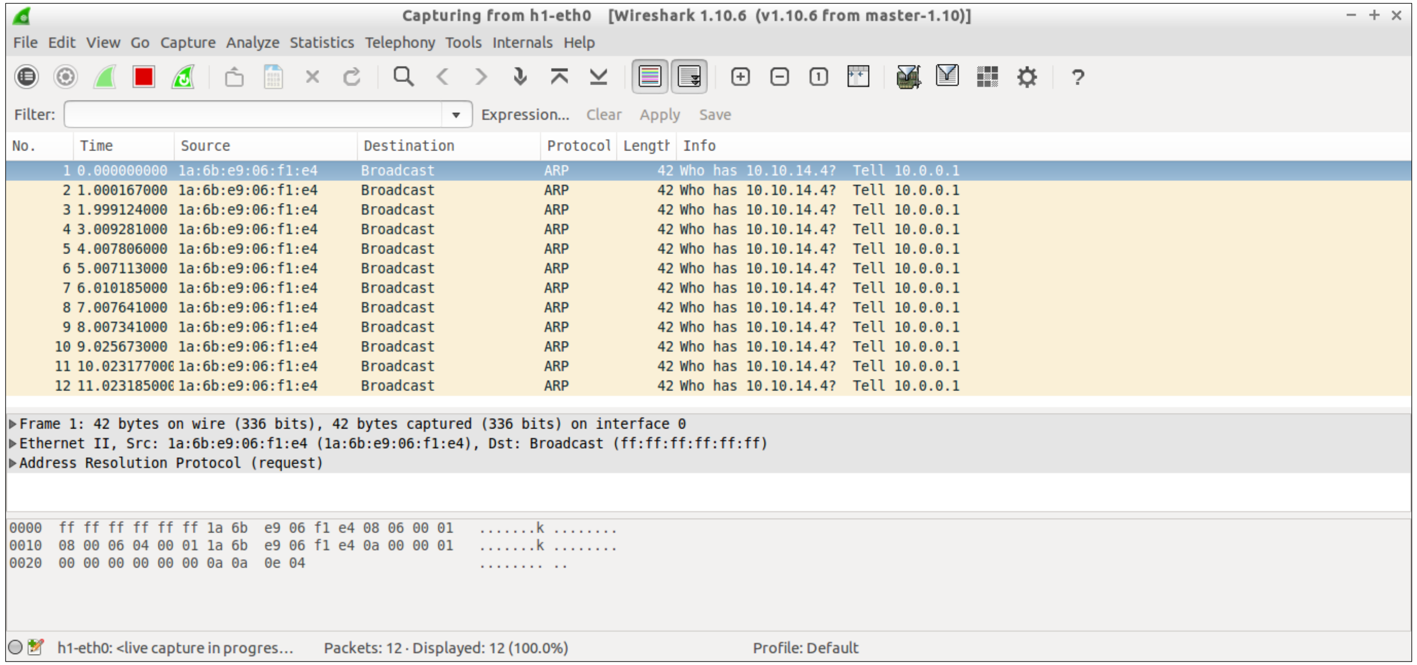


```
root@TCPIP-VM:~/Desktop/shared# ip link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536 qdisc noqueue state UNKNOWN mode DEFAULT
 group default
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
88: h1-eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast state U
P mode DEFAULT group default qlen 1000
    link/ether 96:b6:e3:c6:a5:48 brd ff:ff:ff:ff:ff:ff
root@TCPIP-VM:~/Desktop/shared# 
```

- If an interface mode is DOWN, change it to UP, e.g. h1-eth0:
  - # ip link set h1-eth0 up
- ping ✘

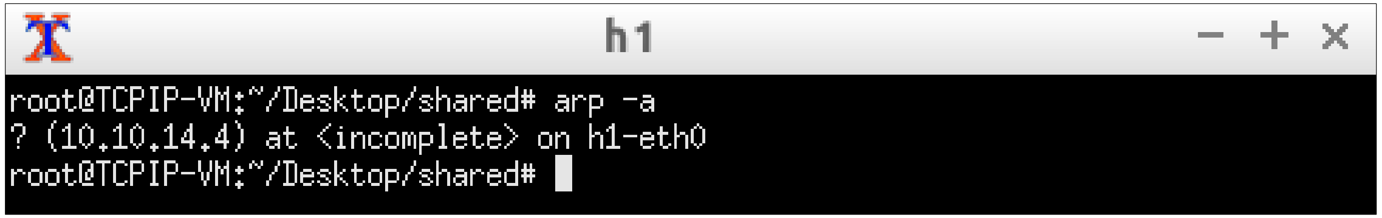
ARP (Address Resolution Protocol)

- A procedure for mapping a dynamic IP address to a physical address, known as a media access control (MAC) address.
    - ARP request
    - ARP reply
- Open Wireshark on a host:
    - # wireshark &
- Show ARP table of a host:
    - # arp -a

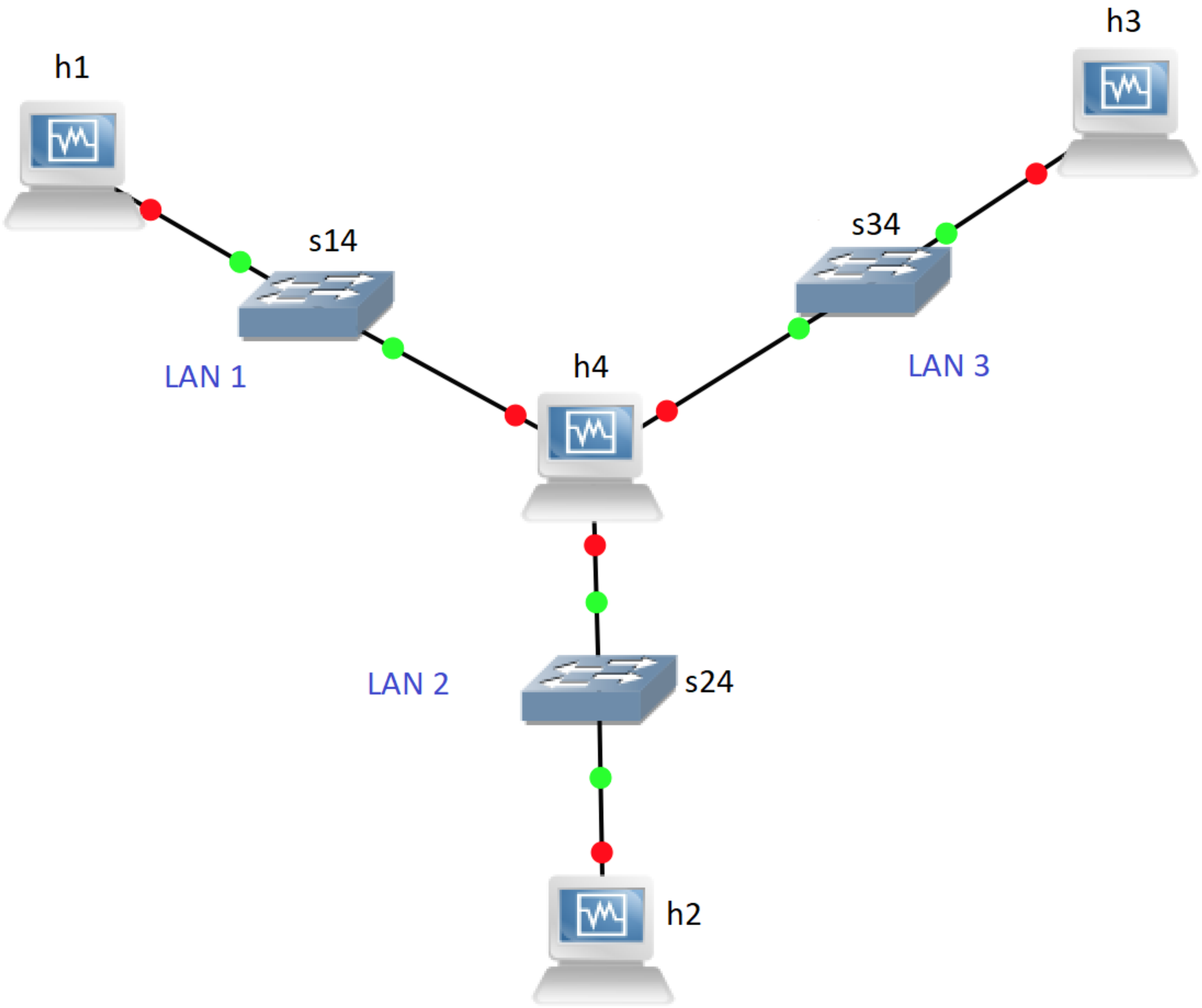

Capturing from h1-eth0   [Wireshark 1.10.6 (v1.10.6 from master-1.10)]
File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help
Filter:
Expression...
Clear
Apply
Save

```
No.   Time         Source              Destination   Protocol Length Info
    1 0.000000000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    2 1.000167000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    3 1.999124000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    4 3.009281000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    5 4.007806000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    6 5.007113000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    7 6.010185000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    8 7.007641000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
    9 8.007341000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
   10 9.025673000  1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
   11 10.02317700( 1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1
   12 11.02318500( 1a:6b:e9:06:f1:e4   Broadcast     ARP        42 Who has 10.10.14.4?  Tell 10.0.0.1

▶Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits) on interface 0
▶Ethernet II, Src: 1a:6b:e9:06:f1:e4 (1a:6b:e9:06:f1:e4), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
▶Address Resolution Protocol (request)

0000  ff ff ff ff ff ff 1a 6b  e9 06 f1 e4 08 06 00 01   .......k ........
0010  08 00 06 04 00 01 1a 6b  e9 06 f1 e4 0a 00 00 01   .......k ........
0020  00 00 00 00 00 00 0a 0a  0e 04                     ........ ..
```

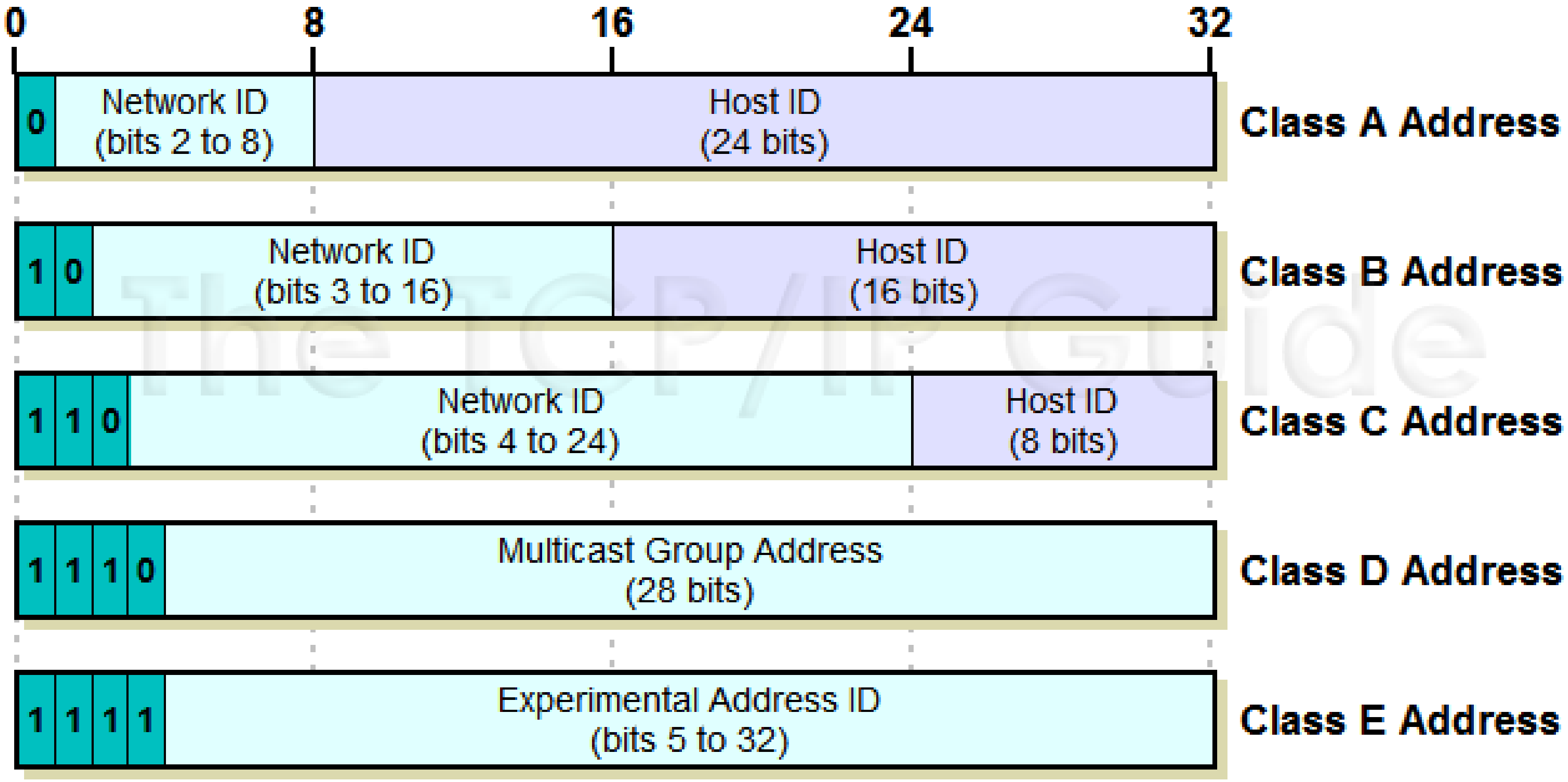
h1-eth0: <live capture in progres...   Packets: 12 · Displayed: 12 (100.0%)   Profile: Default



```
root@TCPIP-VM:~/Desktop/shared# arp -a
? (10.10.14.4) at <incomplete> on h1-eth0
root@TCPIP-VM:~/Desktop/shared# 
```


h1
h3
s14
s34
h4
LAN 1
LAN 3
LAN 2
s24
h2

IP Address Class Bit Assignments and Network/Host ID Sizes



0 | Network ID (bits 2 to 8) | Host ID (24 bits) — Class A Address

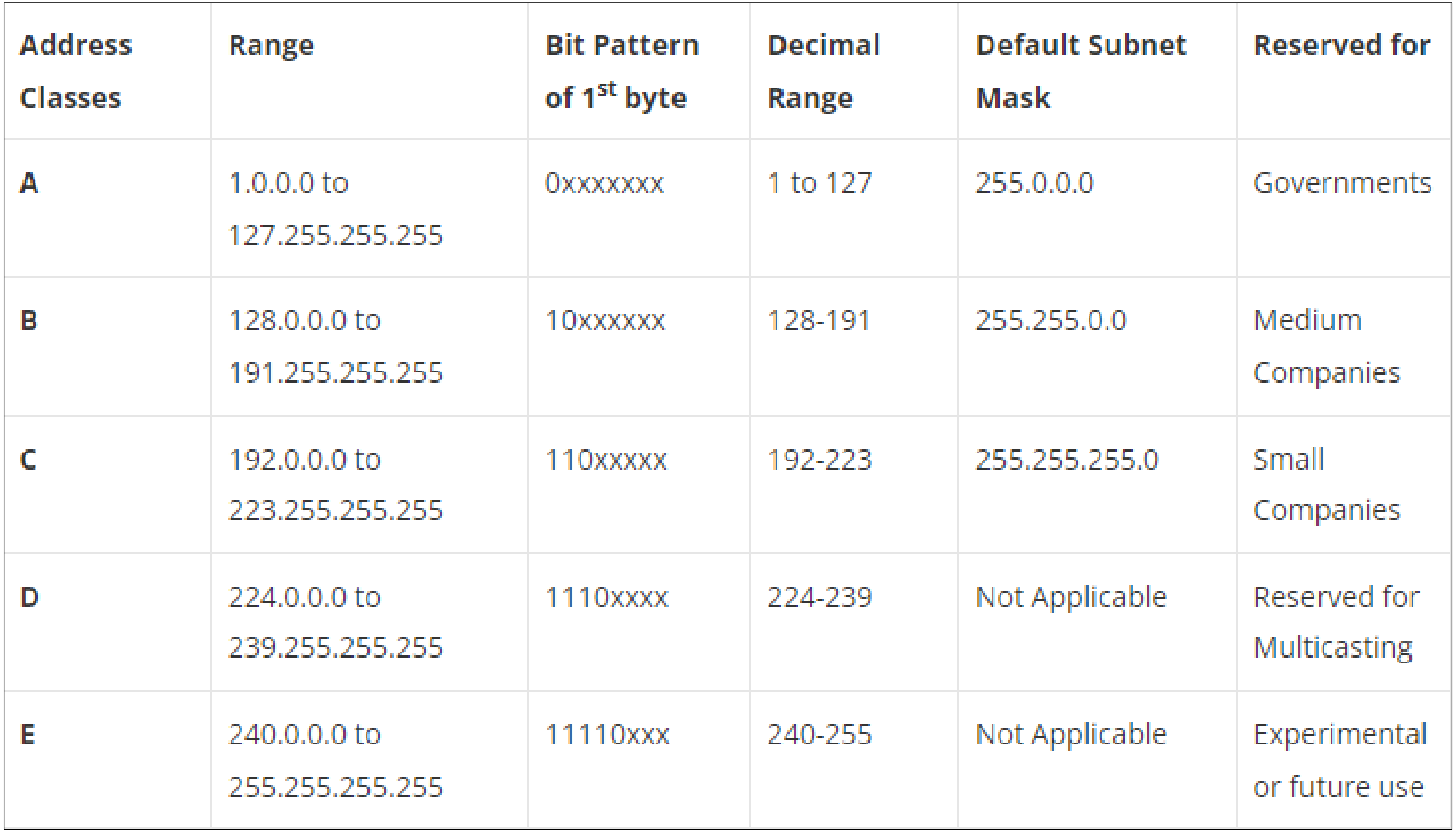
1 | 0 | Network ID (bits 3 to 16) | Host ID (16 bits) — Class B Address

1 | 1 | 0 | Network ID (bits 4 to 24) | Host ID (8 bits) — Class C Address

1 | 1 | 1 | 0 | Multicast Group Address (28 bits) — Class D Address

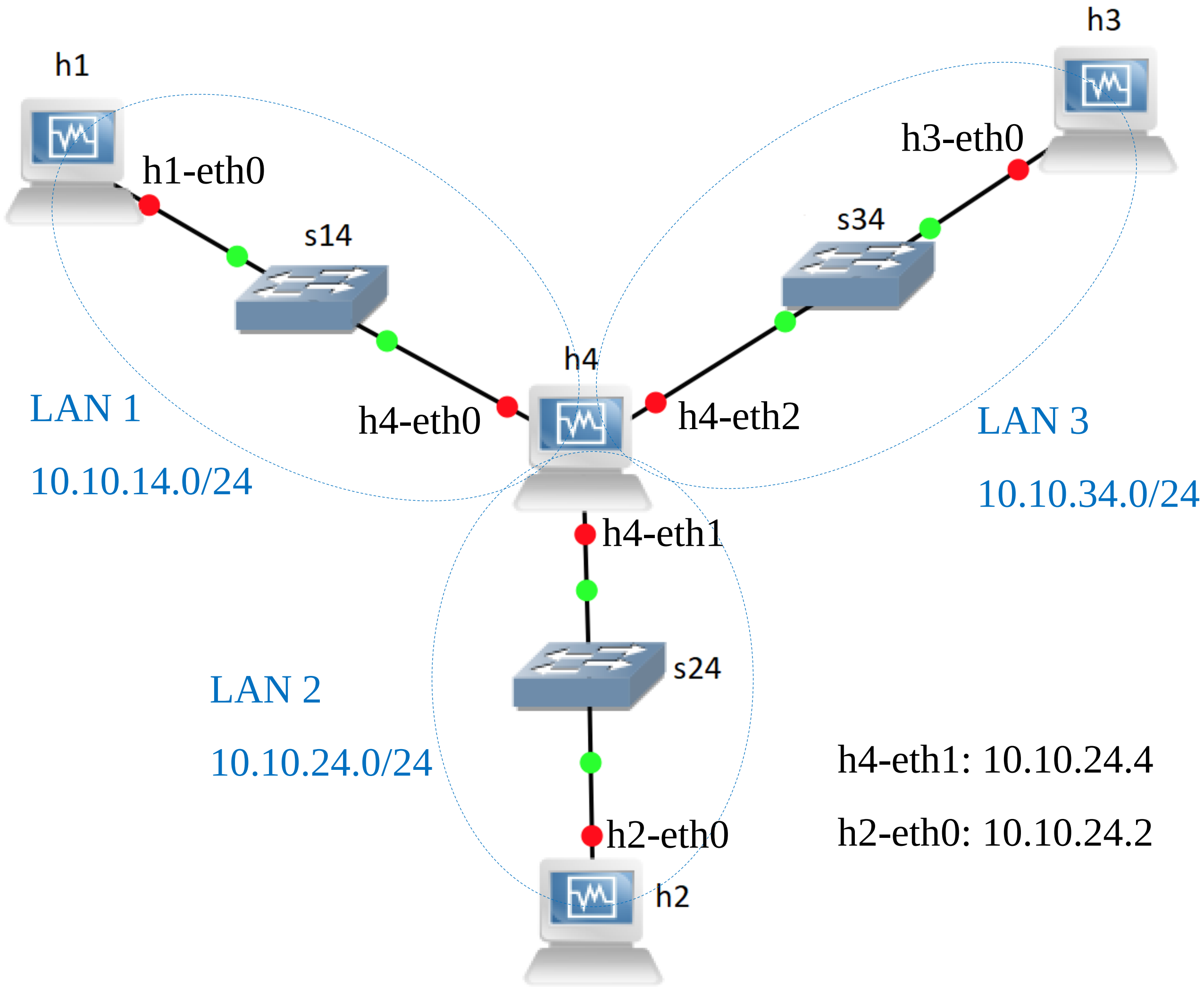
1 | 1 | 1 | 1 | Experimental Address ID (bits 5 to 32) — Class E Address

IP Address classes: Chart Representation



Address Classes	**Range**	**Bit Pattern of 1^{st} byte**	**Decimal Range**	**Default Subnet Mask**	**Reserved for**
A	1.0.0.0 to 127.255.255.255	0xxxxxxx	1 to 127	255.0.0.0	Governments
B	128.0.0.0 to 191.255.255.255	10xxxxxx	128-191	255.255.0.0	Medium Companies
C	192.0.0.0 to 223.255.255.255	110xxxxx	192-223	255.255.255.0	Small Companies
D	224.0.0.0 to 239.255.255.255	1110xxxx	224-239	Not Applicable	Reserved for Multicasting
E	240.0.0.0 to 255.255.255.255	11110xxx	240-255	Not Applicable	Experimental or future use

10.10.0.0/16



h1-eth0: 10.10.14.1

h4-eth0: 10.10.14.4

LAN 1

10.10.14.0/24

h3-eth0: 10.10.34.3

h4-eth2: 10.10.34.4

LAN 3

10.10.34.0/24

LAN 2

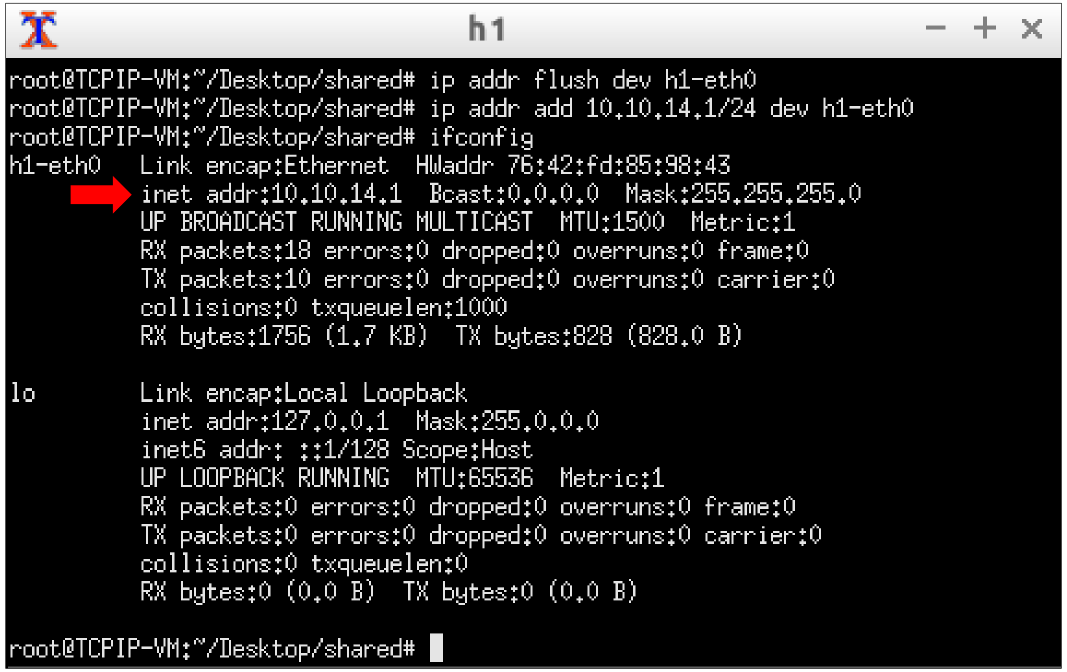
10.10.24.0/24

h4-eth1: 10.10.24.4

h2-eth0: 10.10.24.2

Assign an IP address to an interface

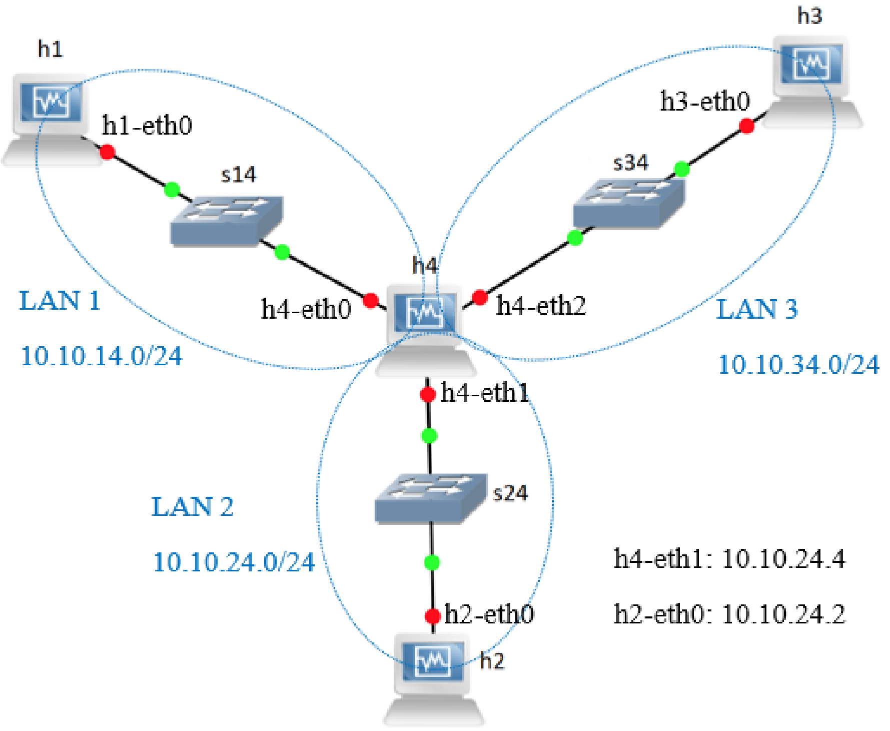
- # ip addr flush dev h1-eth0
- # ip addr add 10.10.14.1/24 dev h1-eth0
- # ifconfig -a



```
root@TCPIP-VM:~/Desktop/shared# ip addr flush dev h1-eth0
root@TCPIP-VM:~/Desktop/shared# ip addr add 10.10.14.1/24 dev h1-eth0
root@TCPIP-VM:~/Desktop/shared# ifconfig
h1-eth0   Link encap:Ethernet  HWaddr 76:42:fd:85:98:43
          inet addr:10.10.14.1  Bcast:0.0.0.0  Mask:255.255.255.0
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:18 errors:0 dropped:0 overruns:0 frame:0
          TX packets:10 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:1756 (1.7 KB)  TX bytes:828 (828.0 B)

lo        Link encap:Local Loopback
          inet addr:127.0.0.1  Mask:255.0.0.0
          inet6 addr: ::1/128 Scope:Host
          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:0
          RX bytes:0 (0.0 B)  TX bytes:0 (0.0 B)

root@TCPIP-VM:~/Desktop/shared# 
```

h1-eth0: 10.10.14.1

h4-eth0: 10.10.14.4



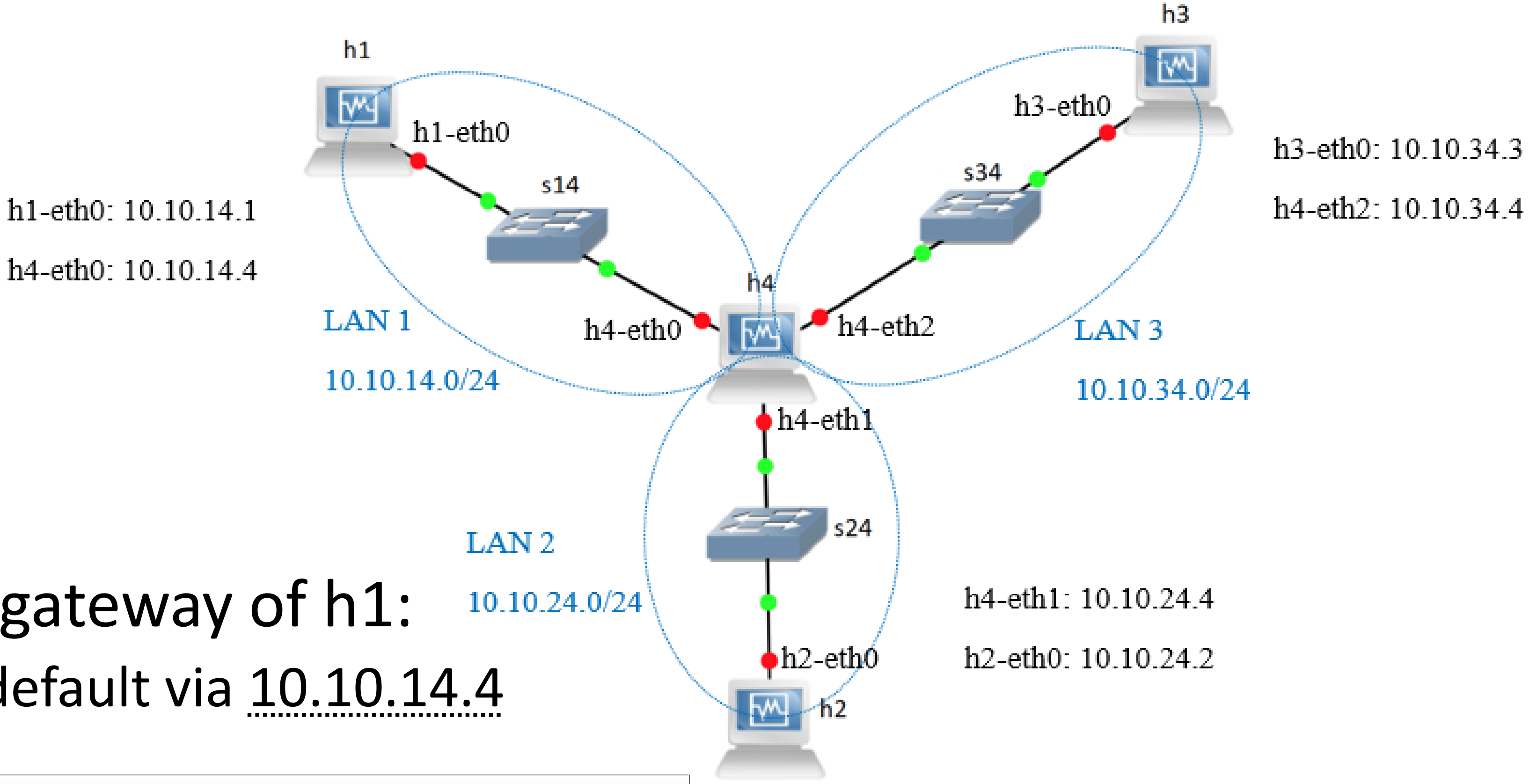
h3-eth0: 10.10.34.3

h4-eth2: 10.10.34.4

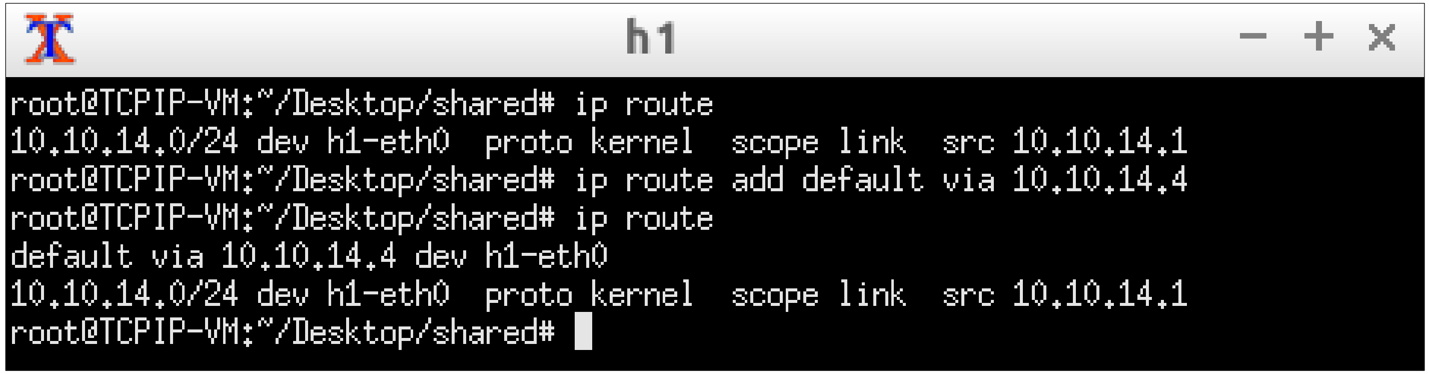
h4-eth1: 10.10.24.4

h2-eth0: 10.10.24.2

Set gateway



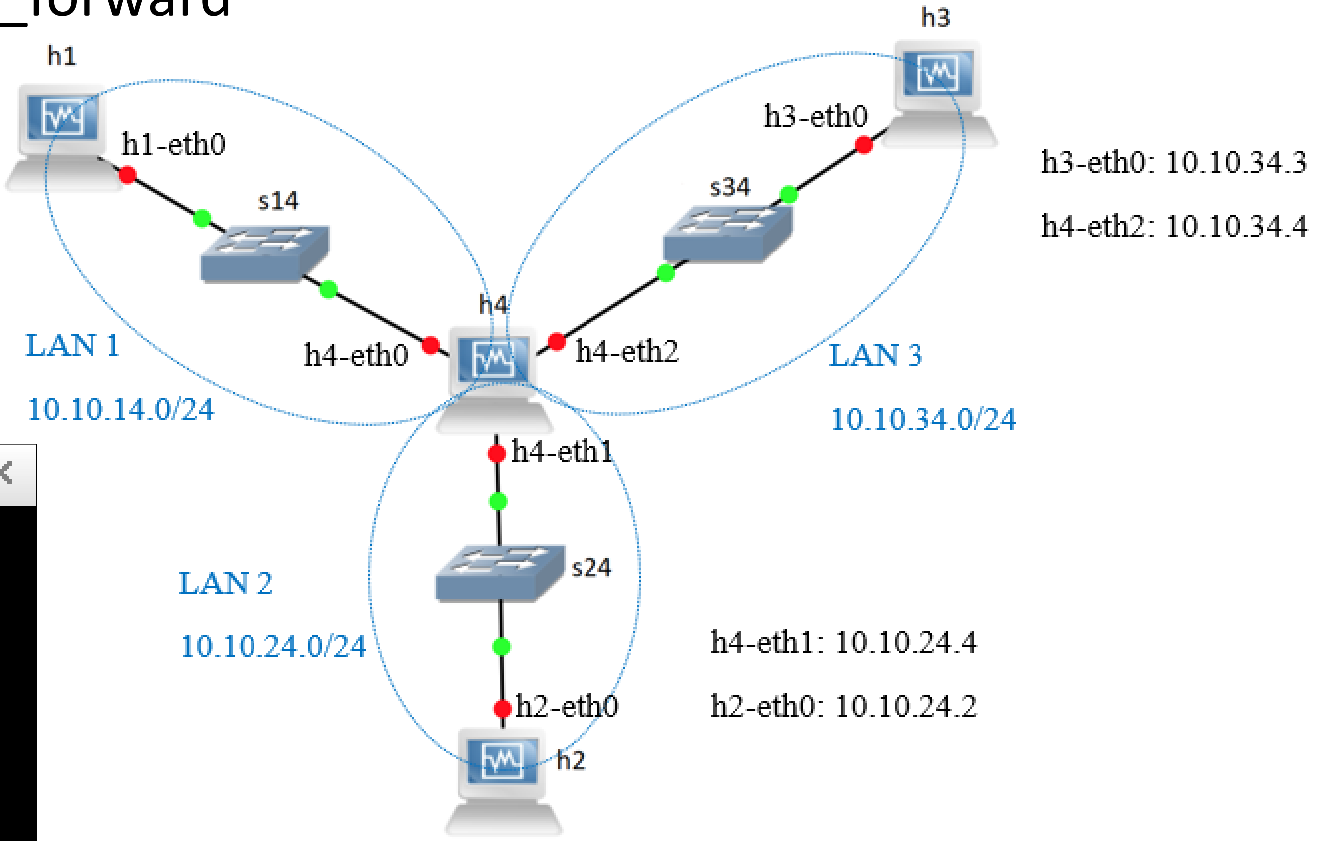
- Show routing table:
  - # ip route
- Add(Delete) default gateway of h1:
  - # ip route add(del) default via 10.10.14.4



```
root@TCPIP-VM:~/Desktop/shared# ip route
10.10.14.0/24 dev h1-eth0  proto kernel  scope link  src 10.10.14.1
root@TCPIP-VM:~/Desktop/shared# ip route add default via 10.10.14.4
root@TCPIP-VM:~/Desktop/shared# ip route
default via 10.10.14.4 dev h1-eth0
10.10.14.0/24 dev h1-eth0  proto kernel  scope link  src 10.10.14.1
root@TCPIP-VM:~/Desktop/shared# 
```

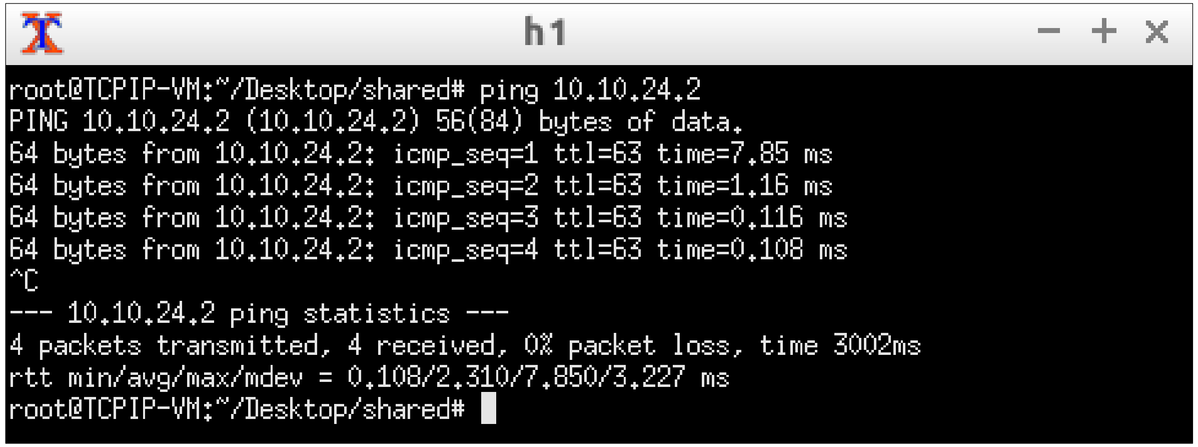
Convert into router

- Convert h4 into a router:
  - # echo 1 > /proc/sys/net/ipv4/ip_forward



h1-eth0: 10.10.14.1

h4-eth0: 10.10.14.4



```
root@TCPIP-VM:~/Desktop/shared# ping 10.10.24.2
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=7.85 ms
64 bytes from 10.10.24.2: icmp_seq=2 ttl=63 time=1.16 ms
64 bytes from 10.10.24.2: icmp_seq=3 ttl=63 time=0.116 ms
64 bytes from 10.10.24.2: icmp_seq=4 ttl=63 time=0.108 ms
^C
--- 10.10.24.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3002ms
rtt min/avg/max/mdev = 0.108/2.310/7.850/3.227 ms
root@TCPIP-VM:~/Desktop/shared# 
```