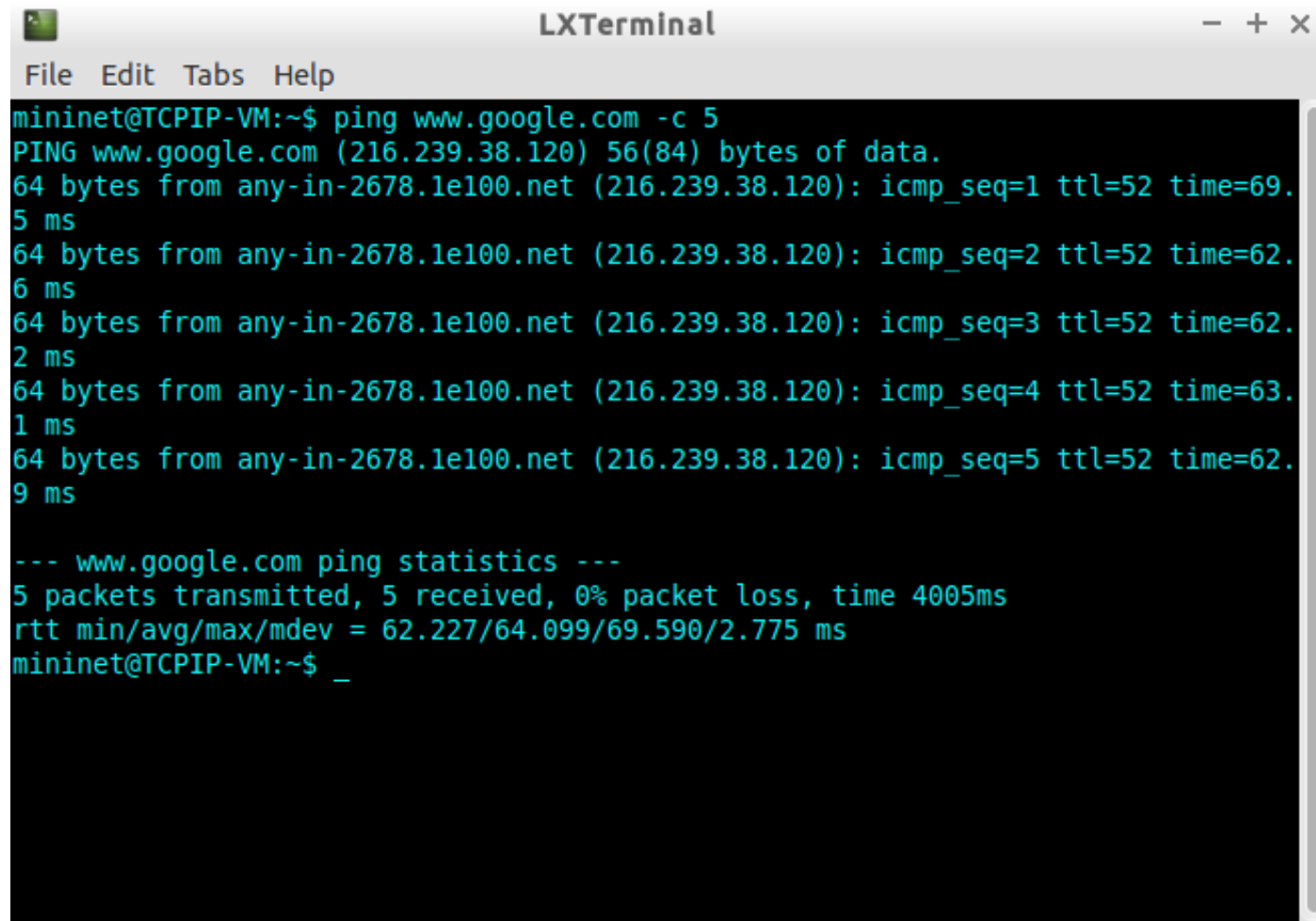


MiniNet

Check internet connectivity

- Open LXTerminal on desktop
- `$ ping (web address)`
- `-c`: the number of packets

A screenshot of an LXTerminal window titled "LXTerminal". The terminal shows the execution of a ping command: `mininet@TCPIP-VM:~$ ping www.google.com -c 5`. The output displays five successful ping responses from the IP address 216.239.38.120, each with a TTL of 52 and varying response times between 62.1 ms and 69.5 ms. At the end, it shows the ping statistics: 5 packets transmitted, 5 received, 0% packet loss, and a total time of 4005ms. The round-trip times (rtt) are summarized as min/avg/max/mdev = 62.227/64.099/69.590/2.775 ms. The prompt returns to `mininet@TCPIP-VM:~$`.

```
mininet@TCPIP-VM:~$ ping www.google.com -c 5
PING www.google.com (216.239.38.120) 56(84) bytes of data.
64 bytes from any-in-2678.1e100.net (216.239.38.120): icmp_seq=1 ttl=52 time=69.5 ms
64 bytes from any-in-2678.1e100.net (216.239.38.120): icmp_seq=2 ttl=52 time=62.6 ms
64 bytes from any-in-2678.1e100.net (216.239.38.120): icmp_seq=3 ttl=52 time=62.2 ms
64 bytes from any-in-2678.1e100.net (216.239.38.120): icmp_seq=4 ttl=52 time=63.1 ms
64 bytes from any-in-2678.1e100.net (216.239.38.120): icmp_seq=5 ttl=52 time=62.9 ms

--- www.google.com ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4005ms
rtt min/avg/max/mdev = 62.227/64.099/69.590/2.775 ms
mininet@TCPIP-VM:~$ _
```

- Type *cmd* on search box
- Open Command Prompt
- > ipconfig

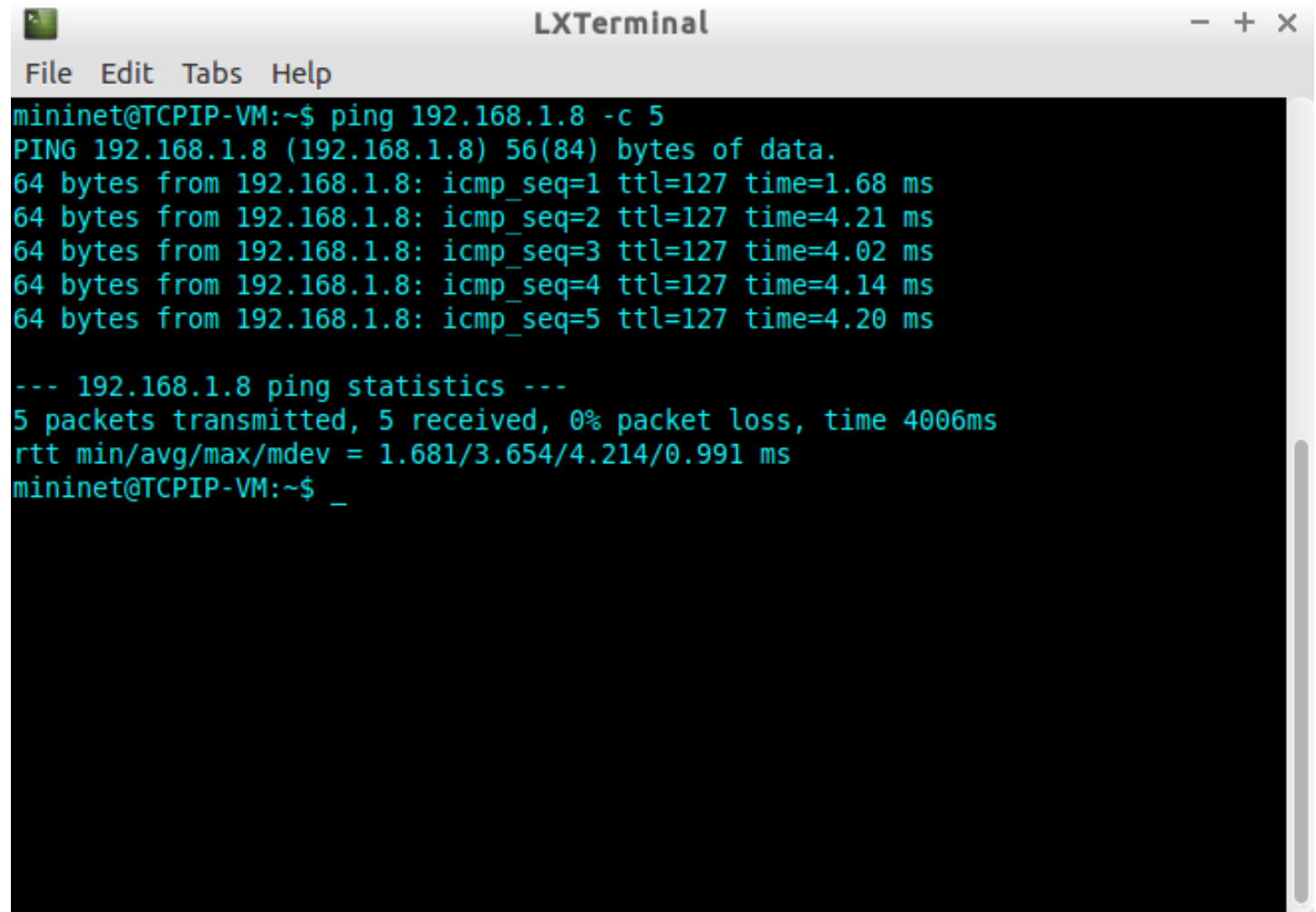
- Type *cmd* on search box
- Open Command Prompt
- > ipconfig

```
Cat Command Prompt
```

```
Microsoft Windows [Version 10.0.19045.2546]  
(c) Microsoft Corporation. All rights reserved.  
  
C:\Users\Takrayan.ir>ipconfig  
  
Windows IP Configuration  
  
Ethernet adapter Ethernet 2:  
  
    Connection-specific DNS Suffix  . :  
    Link-local IPv6 Address . . . . . : fe80::b72c:28b1:47d8:8b83%59  
    IPv4 Address. . . . . : 192.168.56.1  
    Subnet Mask . . . . . : 255.255.255.0  
    Default Gateway . . . . . :  
  
Unknown adapter Local Area Connection 2:  
  
    Media State . . . . . : Media disconnected  
    Connection-specific DNS Suffix  . :  
  
Wireless LAN adapter Wi-Fi:  
  
    Media State . . . . . : Media disconnected  
    Connection-specific DNS Suffix  . :  
  
Wireless LAN adapter Local Area Connection* 10:  
  
    Media State . . . . . : Media disconnected  
    Connection-specific DNS Suffix  . :  
  
Wireless LAN adapter Local Area Connection* 11:  
  
    Media State . . . . . : Media disconnected  
    Connection-specific DNS Suffix  . :  
  
Ethernet adapter Ethernet:  
  
    Connection-specific DNS Suffix  . : domain.name  
    Link-local IPv6 Address . . . . . : fe80::c8ae:75fa:f55:118f%3  
    IPv4 Address. . . . . : 192.168.1.8  
    Subnet Mask . . . . . : 255.255.255.0  
    Default Gateway . . . . . : fe80::76da:daff:fe77:9b91%3  
                               192.168.1.1  
  
C:\Users\Takrayan.ir>
```

Ping Windows adapter

- \$ ping (IP address)

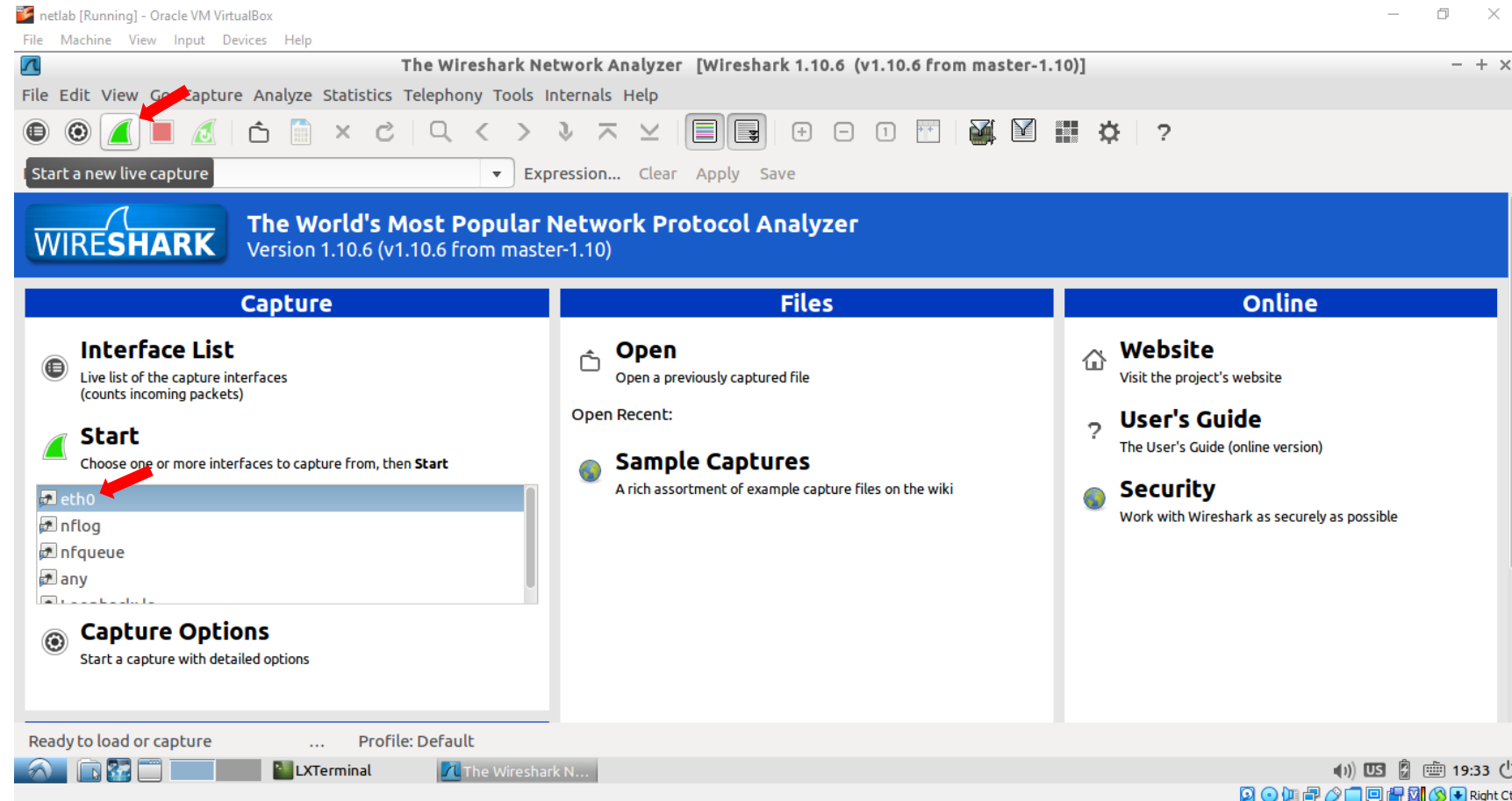


```
LXTerminal
File Edit Tabs Help
mininet@TCPIP-VM:~$ ping 192.168.1.8 -c 5
PING 192.168.1.8 (192.168.1.8) 56(84) bytes of data.
64 bytes from 192.168.1.8: icmp_seq=1 ttl=127 time=1.68 ms
64 bytes from 192.168.1.8: icmp_seq=2 ttl=127 time=4.21 ms
64 bytes from 192.168.1.8: icmp_seq=3 ttl=127 time=4.02 ms
64 bytes from 192.168.1.8: icmp_seq=4 ttl=127 time=4.14 ms
64 bytes from 192.168.1.8: icmp_seq=5 ttl=127 time=4.20 ms

--- 192.168.1.8 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4006ms
rtt min/avg/max/mdev = 1.681/3.654/4.214/0.991 ms
mininet@TCPIP-VM:~$ _
```

Wireshark

- On Linux, open a separate terminal.
- `$ sudo wireshark`
- (Click OK)
- Choose eth0
- Press on start



Capturing packets on Wireshark

netlab [Running] - Oracle VM VirtualBox

File Machine View Input Devices Help

*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
5	8.478284000	0a:00:27:00:00:0d	Broadcast	ARP	60	Who has 192.168.56.106? Tell 192.168.56.1
6	8.478321000	CadmusCo_43:1a:0f	0a:00:27:00:00:0d	ARP	42	192.168.56.106 is at 08:00:27:43:1a:0f
7	8.478727000	192.168.56.1	192.168.56.106	ICMP	74	Echo (ping) request id=0x0001, seq=467/54017, ttl=128 (reply in 8)
8	8.478767000	192.168.56.106	192.168.56.1	ICMP	74	Echo (ping) reply id=0x0001, seq=467/54017, ttl=64 (request in 7)
9	9.483589000	192.168.56.1	192.168.56.106	ICMP	74	Echo (ping) request id=0x0001, seq=468/54273, ttl=128
10	9.483636000	192.168.56.106	192.168.56.1	ICMP	74	Echo (ping) reply id=0x0001, seq=468/54273, ttl=64 (request in 9)
11	10.490098000	192.168.56.1	192.168.56.106	ICMP	74	Echo (ping) request id=0x0001, seq=469/54529, ttl=128
12	10.490140000	192.168.56.106	192.168.56.1	ICMP	74	Echo (ping) reply id=0x0001, seq=469/54529, ttl=64 (request in 11)
13	11.495213000	192.168.56.1	192.168.56.106	ICMP	74	Echo (ping) request id=0x0001, seq=470/54785, ttl=128
14	11.495278000	192.168.56.106	192.168.56.1	ICMP	74	Echo (ping) reply id=0x0001, seq=470/54785, ttl=64 (request in 13)

► Frame 1: 217 bytes on wire (1736 bits), 217 bytes captured (1736 bits) on interface 0

► Ethernet II, Src: 0a:00:27:00:00:0d (0a:00:27:00:00:0d), Dst: IPv4mcast_7f:ff:fa (01:00:5e:7f:ff:fa)

► Internet Protocol Version 4, Src: 192.168.56.1 (192.168.56.1), Dst: 239.255.255.250 (239.255.255.250)

► User Datagram Protocol, Src Port: 64306 (64306), Dst Port: ssdp (1900)

► Hypertext Transfer Protocol

0000 01 00 5e 7f ff fa 0a 00 27 00 00 0d 08 00 45 00 ..^.... '.....E.
0010 00 cb 67 27 00 00 01 11 69 57 c0 a8 38 01 ef ff ..g'.... iW..8...
0020 ff fa fb 32 07 6c 00 b7 95 a1 4d 2d 53 45 41 52 ...2.l... ..M-SEAR
0030 43 48 20 2a 20 48 54 54 50 2f 31 2e 31 0d 0a 48 CH * HTTP/1.1..H

File: "/tmp/wireshark_pcapng_... Profile: Default

LXTerminal *eth0 [Wireshar...

20:32 Right Ctrl

Wireshark filters

- Protocol: tcp (udp, icmp, ...)
- IP address: ip.addr == x.x.x.x
 - Source address: ip.src == x.x.x.x
 - Destination address: ip.dst == x.x.x.x
- Sequence number: tcp.seq >= x
- Port number: tcp.port == xxx
- Content: tcp contains xxx
- Conditions: ip.src == x.x.x.x and(or) ip.dst != x.x.x.x

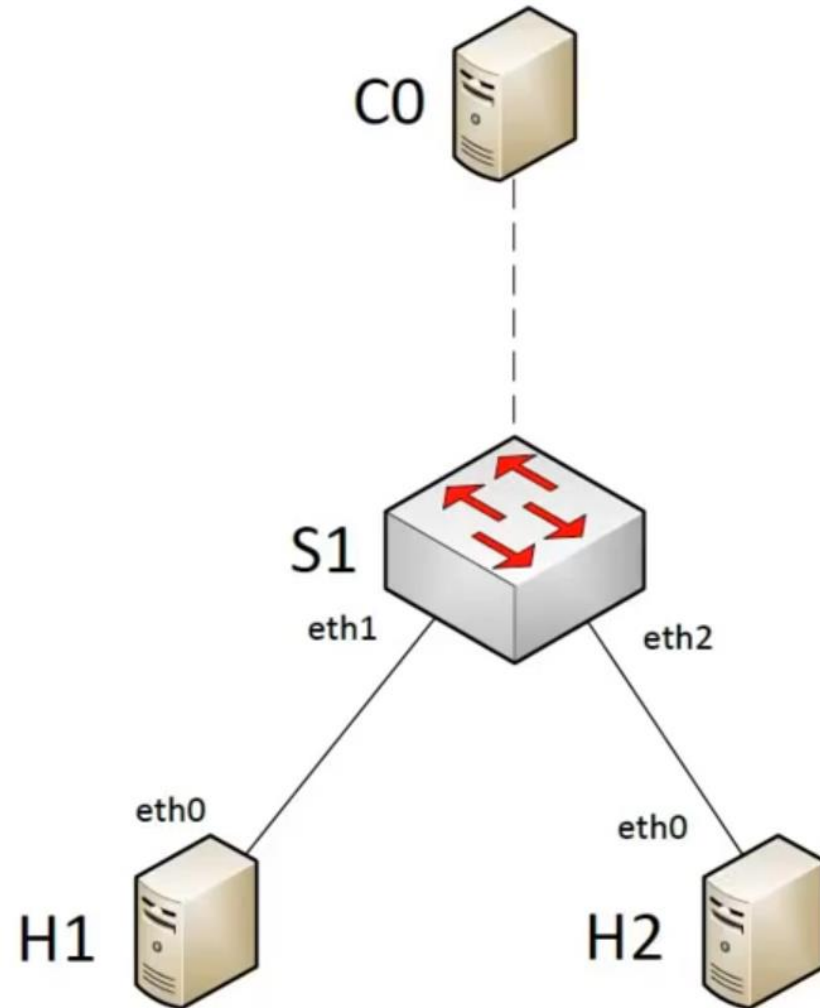
Mininet commands

1. `$ sudo mn`
 - Start Mininet with a minimal topology (1 switch and 2 connected hosts).
2. `mininet> pingall`
 - Verify the connectivity between all pairs of hosts.
3. `mininet> nodes`
 - Display nodes.
4. `mininet> net`
 - Display links.
5. `mininet> dump`
 - Display information about all nodes.
6. `mininet> exit`
 - Exit Mininet.
7. `$ sudo mn -c`
 - Clean up.

Topologies

- Minimal

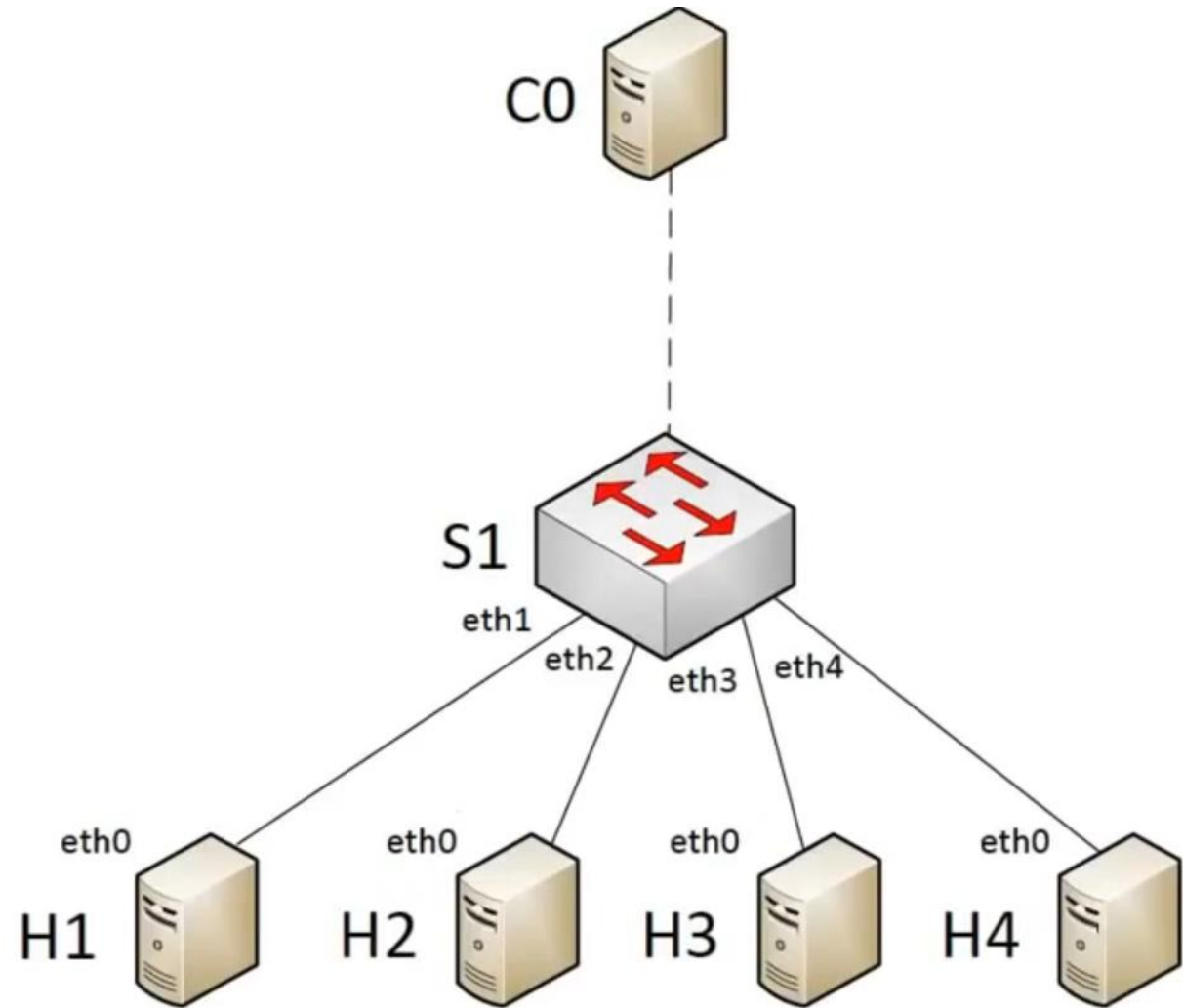
\$ sudo mn --topo minimal



Topologies

- Single

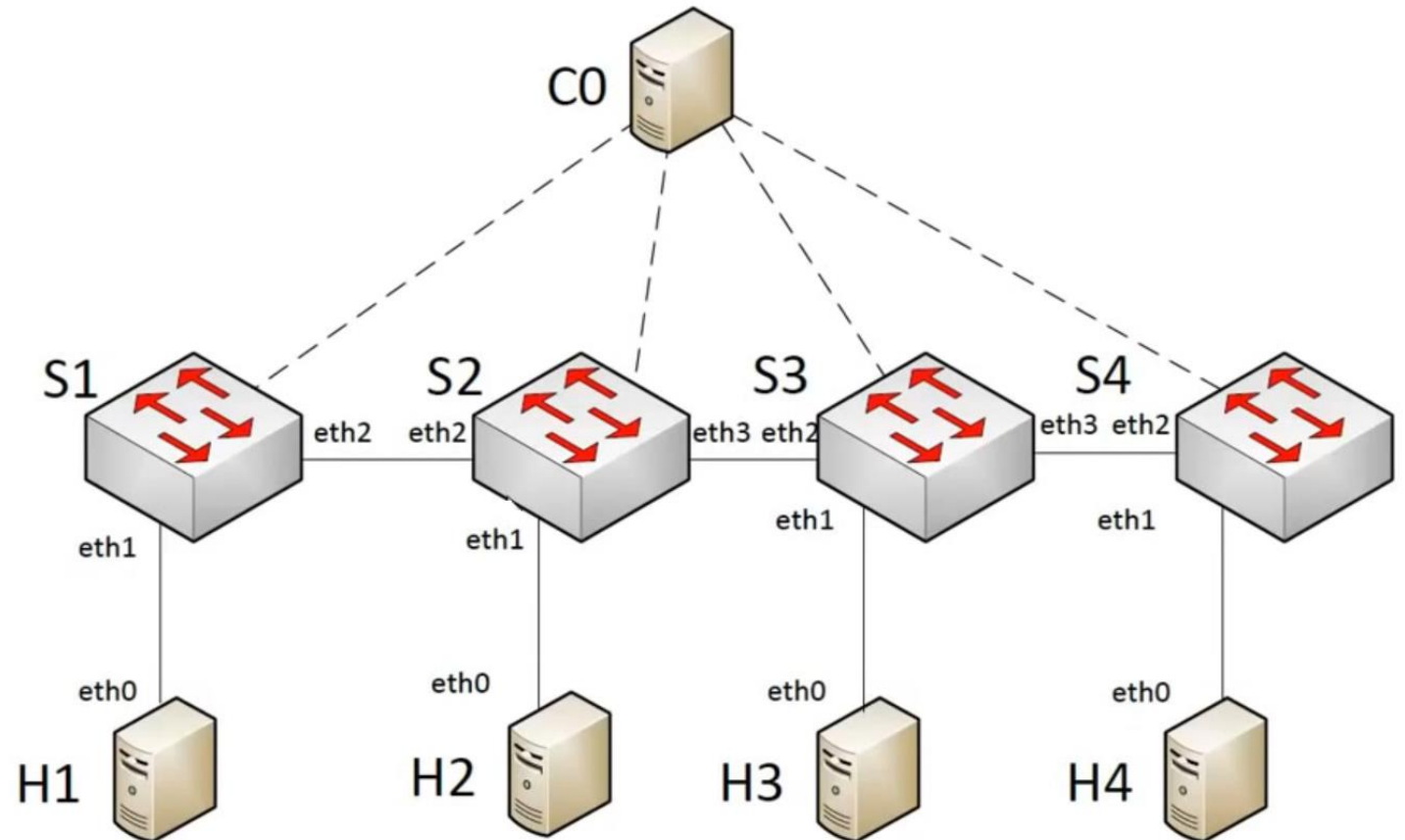
\$ sudo mn --topo single,4



Topologies

- Linear

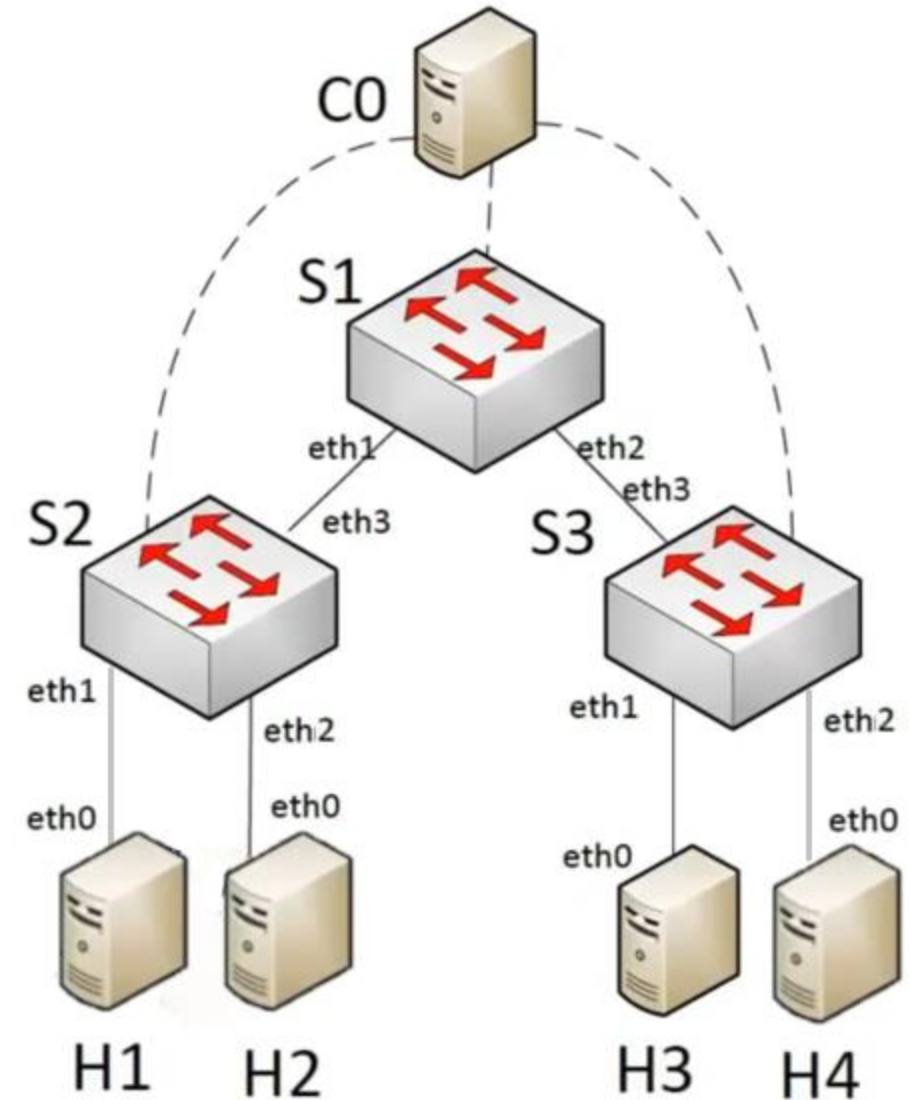
\$ sudo mn --topo linear,4,1



Topologies

- Tree

\$ sudo mn --topo tree,depth=2,fanout=2



Mininet commands

- `$ sudo mn (--topo ...) --link tc,bw=100,delay=1ms`
 - Start Mininet by assigning bandwidth of 100 Mbps and delay of 1 ms to all links.
- `mininet> h1 ping h2 -c 10`
 - Verify the connectivity by pinging from host h1 to host h2.
- `mininet> iperf h1 h2`
 - Perform a TCP bandwidth test between hosts h1 and h2.