

# Lab 00: virtual networking

(Supplementary Materials)

# Intro to VBOX Networking Modes

# VBox Networking Modes

## ➤ Not attached

- ☐ In this mode, VirtualBox reports to the guest that a network card is present, but that there is no connection -- as if no Ethernet cable was plugged into the card.

## ➤ Network Address Translation (NAT)

- ☐ If all you want is to browse the Web, download files and view e-mail inside the guest, then this default mode should be sufficient for you.

## ➤ Bridged Networking

- ☐ This is for more advanced networking needs such as network simulations and running servers in a guest. When enabled, VirtualBox connects to one of your installed network cards and exchanges network packets directly, circumventing your host operating system's network stack.

## ➤ Host-Only Networking

- ☐ This can be used to create a network containing the host and a set of virtual machines, without the need for the host's physical network interface. Instead, a virtual network interface (similar to a loopback interface) is created on the host, providing connectivity among virtual machines and the host.

# Network Address Translation (NAT) Mode

- Network Address Translation (NAT) is the simplest way of accessing an external network from a virtual machine.
  - Usually, it does not require any configuration on the host network and guest system.
    - For this reason, it is the **default** networking mode in VirtualBox.
- A virtual machine with NAT enabled acts much like a real computer that connects to the Internet through a router.
  - The "router", in this case, is the **VirtualBox networking engine**, which maps traffic from and to the virtual machine transparently.
  - In VirtualBox this router is placed between each virtual machine and the host.
  - This separation maximizes security since by default virtual machines cannot talk to each other.

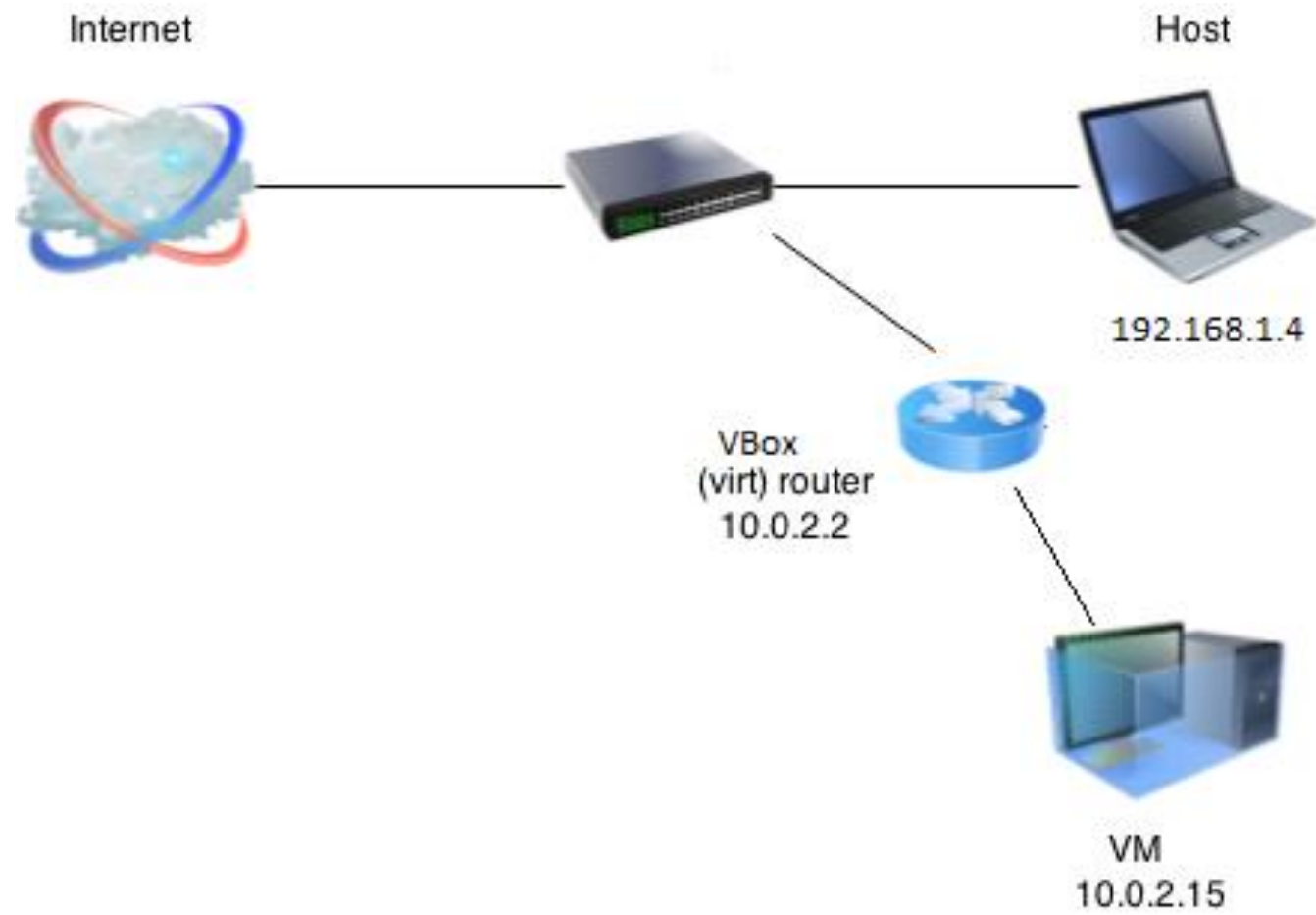
# NAT Mode (Cont'd)

- The disadvantage of NAT mode is that much like a private network behind a router, the virtual machine is invisible and unreachable from the outside internet; you cannot run a server this way unless you set up port forwarding
- The network frames sent out by the guest operating system are received by VirtualBox's NAT engine, which extracts the TCP/IP data and resends it using the host operating system.
- To an application on the host, or to another computer on the same network as the host, it looks like the data was sent by the VirtualBox application on the host, using an IP address belonging to the host. VirtualBox listens for replies to the packages sent, and repacks and resends them to the guest machine on its private network.

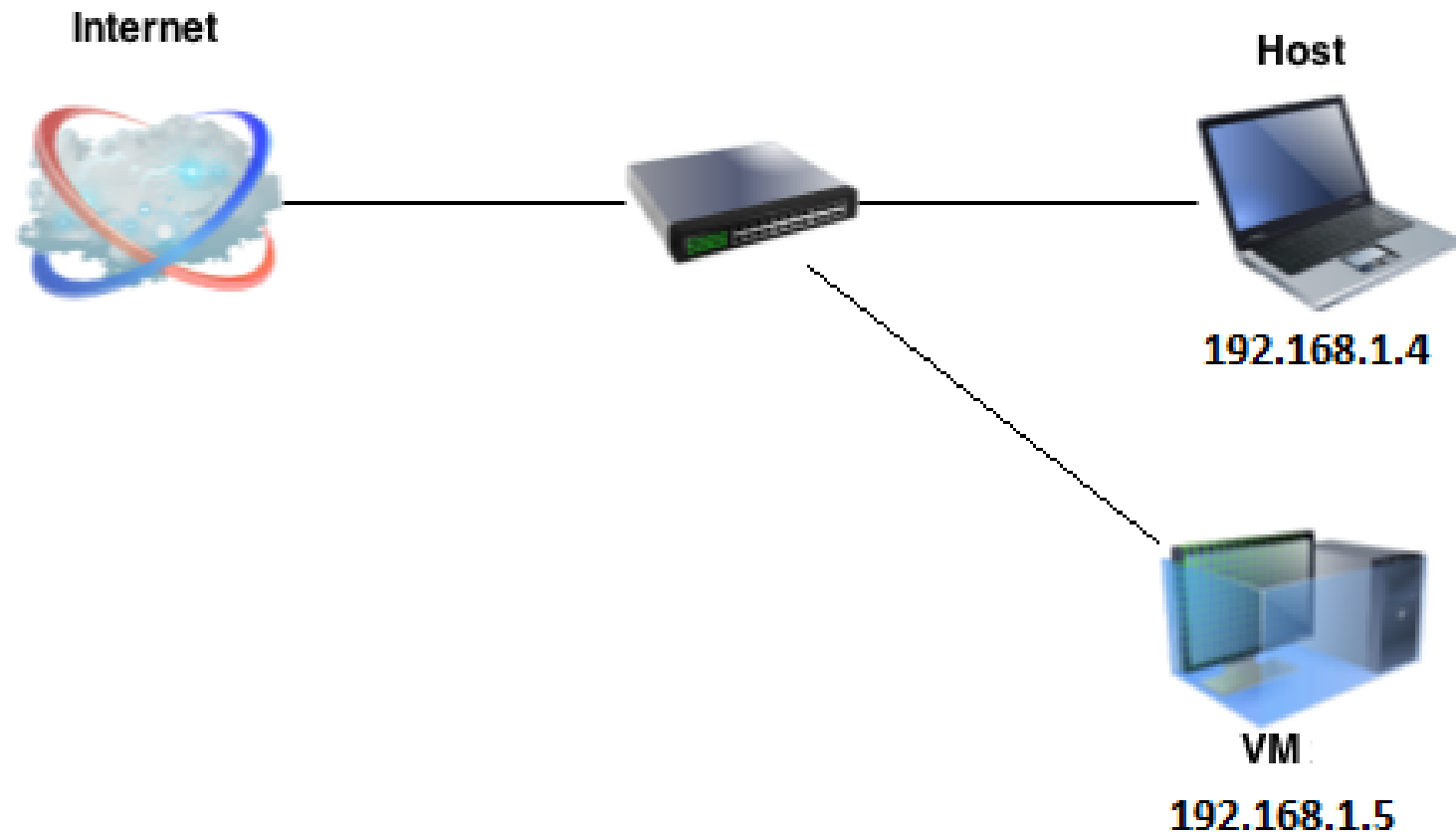
## NAT Mode (Cont'd)

- The virtual machine receives its network address and configuration on the private network from a DHCP server integrated into VirtualBox.
  - The IP address thus assigned to the virtual machine is usually on a completely different network than the host.
  - As more than one card of a virtual machine can be set up to use NAT, the first card is connected to the private network 10.0.2.0, the second card to the network 10.0.3.0 and so on.

# NAT

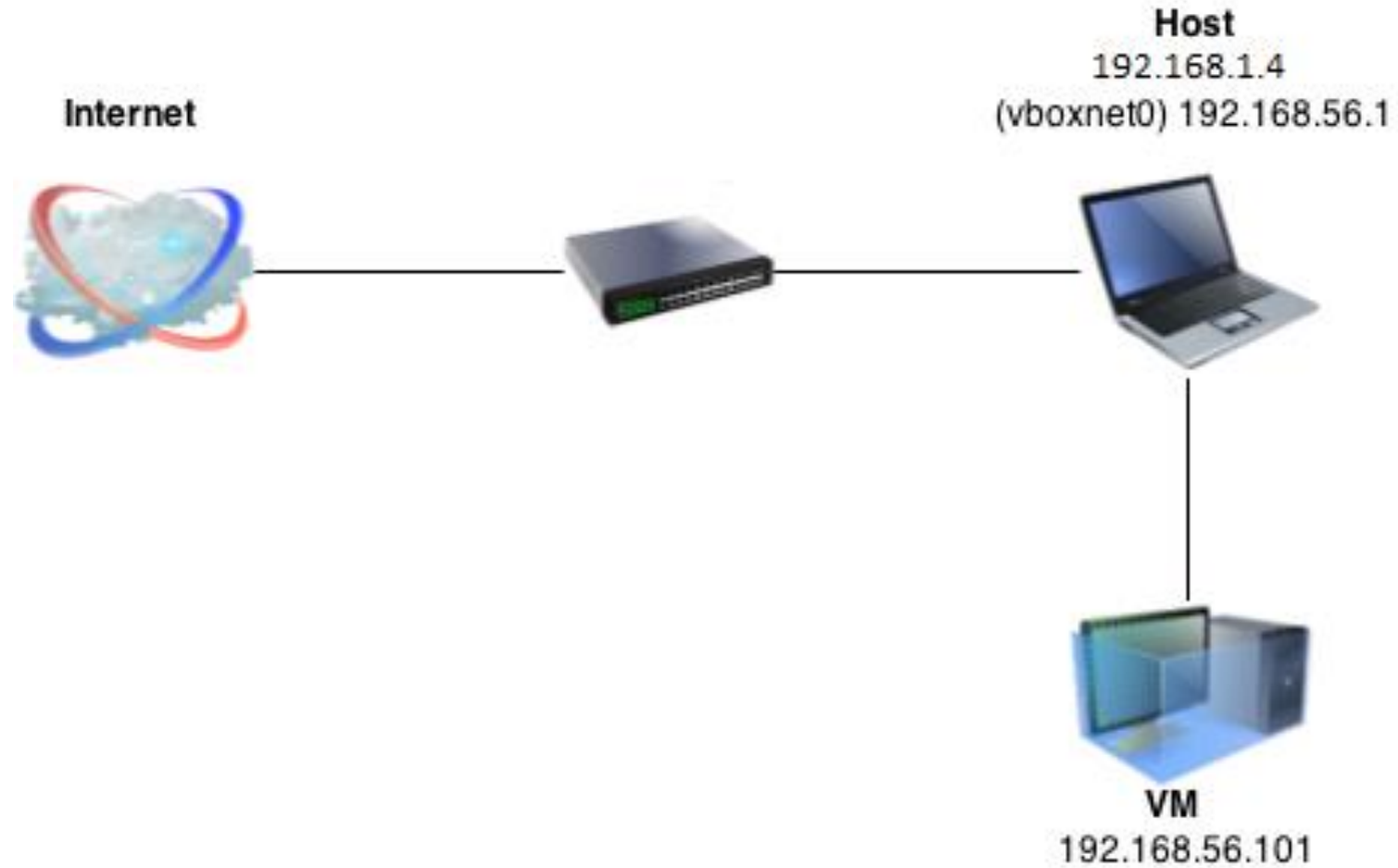


# Bridged



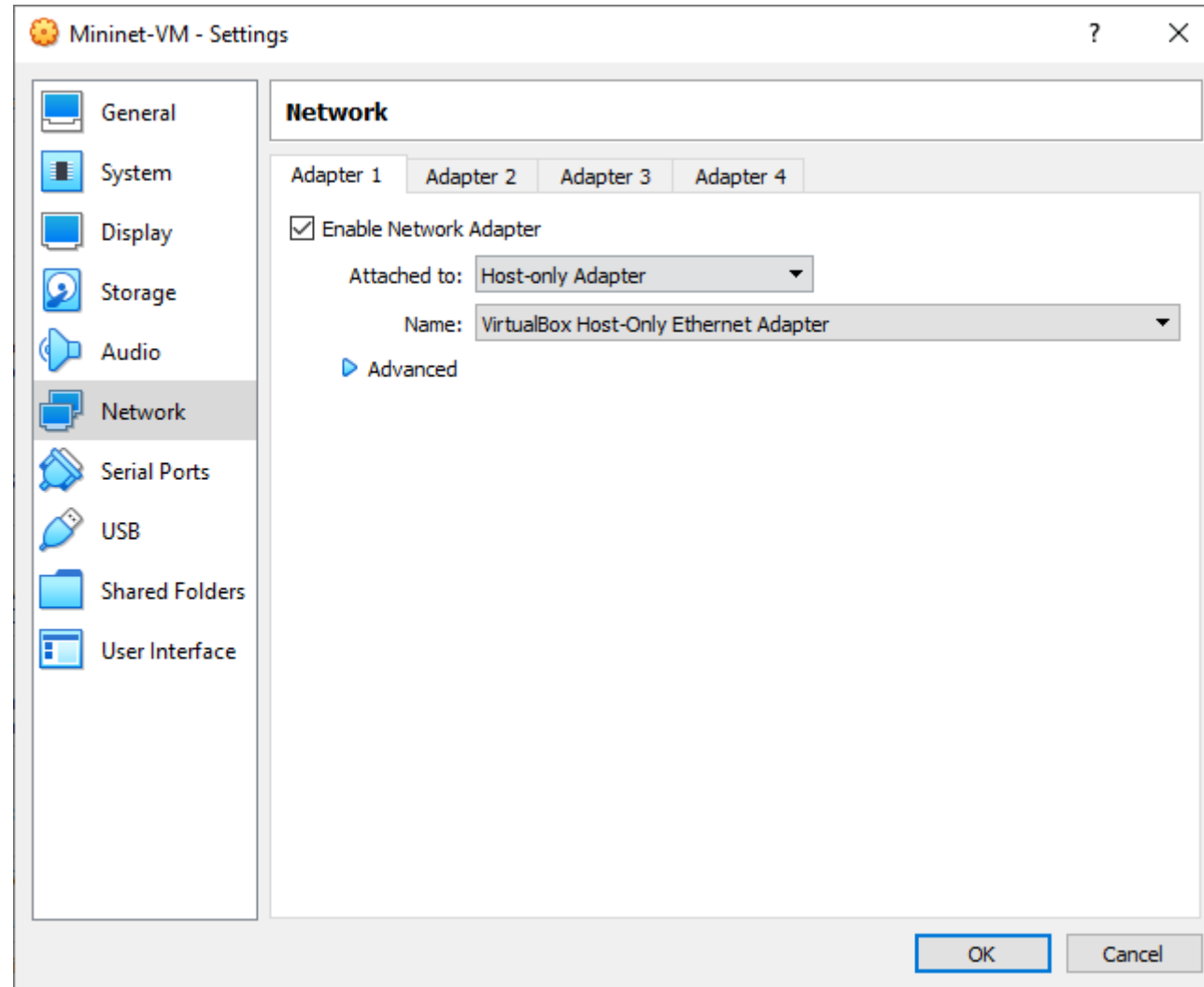


# Host-only



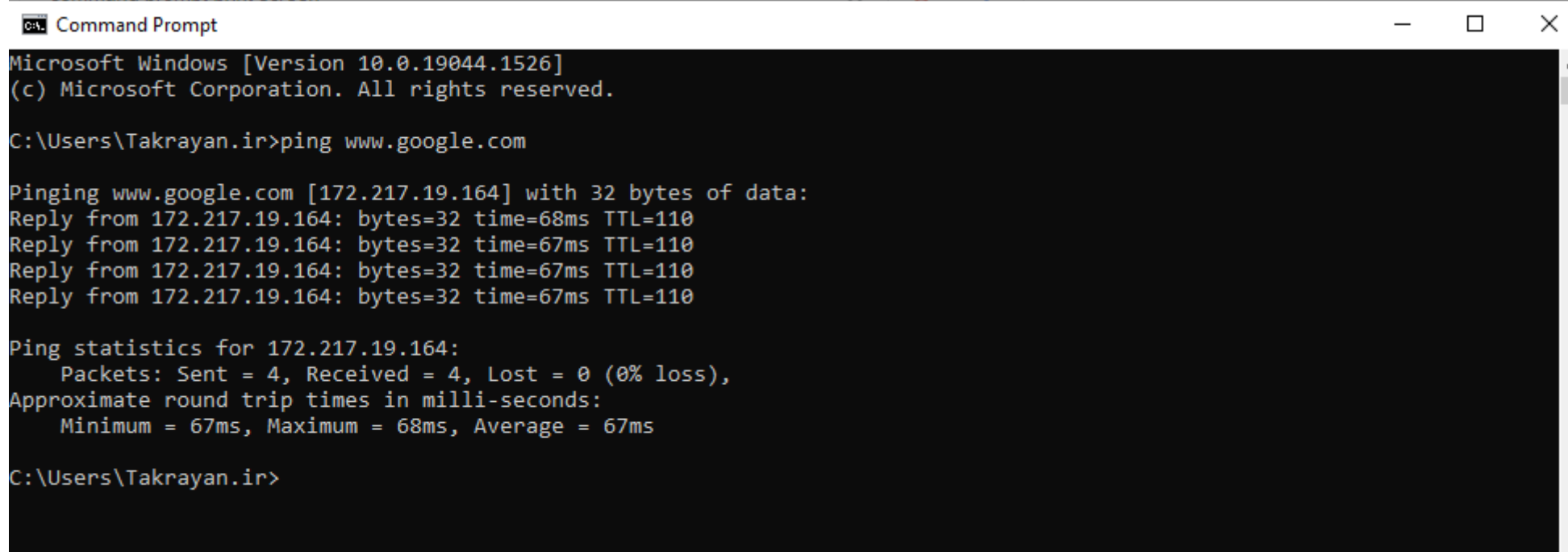
# Adapters

- Adapter:  
Host-only



# ping

- ICMP (Internet Control Message Protocol)
- Echo request
- Echo reply



```
Command Prompt
Microsoft Windows [Version 10.0.19044.1526]
(c) Microsoft Corporation. All rights reserved.

C:\Users\takrayan.ir>ping www.google.com

Pinging www.google.com [172.217.19.164] with 32 bytes of data:
Reply from 172.217.19.164: bytes=32 time=68ms TTL=110
Reply from 172.217.19.164: bytes=32 time=67ms TTL=110
Reply from 172.217.19.164: bytes=32 time=67ms TTL=110
Reply from 172.217.19.164: bytes=32 time=67ms TTL=110

Ping statistics for 172.217.19.164:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 67ms, Maximum = 68ms, Average = 67ms

C:\Users\takrayan.ir>
```

```
Mininet-VM [Running] - Oracle VM VirtualBox
Machine View Input Devices Help

Ubuntu 20.04.1 LTS mininet-vm tty1

mininet-vm login: mininet
Password:
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.4.0-42-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

Last login: Sun Feb 20 07:33:15 PST 2022 on tty1
mininet@mininet-vm:~$ ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST> mtu 1500
    inet 192.168.56.101 netmask 255.255.255.0 broadcast 192.168.56.255
    ether 08:00:27:ae:03:7b txqueuelen 1000 (Ethernet)
    RX packets 2 bytes 1180 (1.1 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 2 bytes 684 (684.0 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 80 bytes 5064 (5.0 KB)
    RX errors 0 dropped 0 overruns 0 frame 0
    TX packets 80 bytes 5064 (5.0 KB)
    TX errors 0 dropped 0 overruns 0 carrier 0 collisions 0

mininet@mininet-vm:~$
```

```
Command Prompt
Microsoft Windows [Version 10.0.19044.1526]
(c) Microsoft Corporation. All rights reserved.

C:\Users\takrayan.ir>ping 192.168.56.101

Pinging 192.168.56.101 with 32 bytes of data:
Reply from 192.168.56.101: bytes=32 time=1ms TTL=64
Reply from 192.168.56.101: bytes=32 time=3ms TTL=64
Reply from 192.168.56.101: bytes=32 time=3ms TTL=64
Reply from 192.168.56.101: bytes=32 time=2ms TTL=64

Ping statistics for 192.168.56.101:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 1ms, Maximum = 3ms, Average = 2ms

C:\Users\takrayan.ir>
```

Microsoft Windows [Version 10.0.19044.1526]  
(c) Microsoft Corporation. All rights reserved.

C:\Users\takrayan.ir>ping

Usage: ping [-t] [-a] [-n count] [-l size] [-f] [-i TTL] [-v TOS]  
[-r count] [-s count] [[-j host-list] | [-k host-list]]  
[-w timeout] [-R] [-S srcaddr] [-c compartment] [-p]  
[-4] [-6] target\_name

Options:

- t Ping the specified host until stopped.  
To see statistics and continue - type Control-Break;  
To stop - type Control-C.
- a Resolve addresses to hostnames.
- n count Number of echo requests to send.
- l size Send buffer size.
- f Set Don't Fragment flag in packet (IPv4-only).
- i TTL Time To Live.
- v TOS Type Of Service (IPv4-only. This setting has been deprecated and has no effect on the type of service field in the IP Header).
- r count Record route for count hops (IPv4-only).
- s count Timestamp for count hops (IPv4-only).
- j host-list Loose source route along host-list (IPv4-only).
- k host-list Strict source route along host-list (IPv4-only).
- w timeout Timeout in milliseconds to wait for each reply.
- R Use routing header to test reverse route also (IPv6-only).  
Per RFC 5095 the use of this routing header has been deprecated. Some systems may drop echo requests if this header is used.
- S srcaddr Source address to use.
- c compartment Routing compartment identifier.
- p Ping a Hyper-V Network Virtualization provider address.
- 4 Force using IPv4.
- 6 Force using IPv6.

C:\Users\takrayan.ir>\_

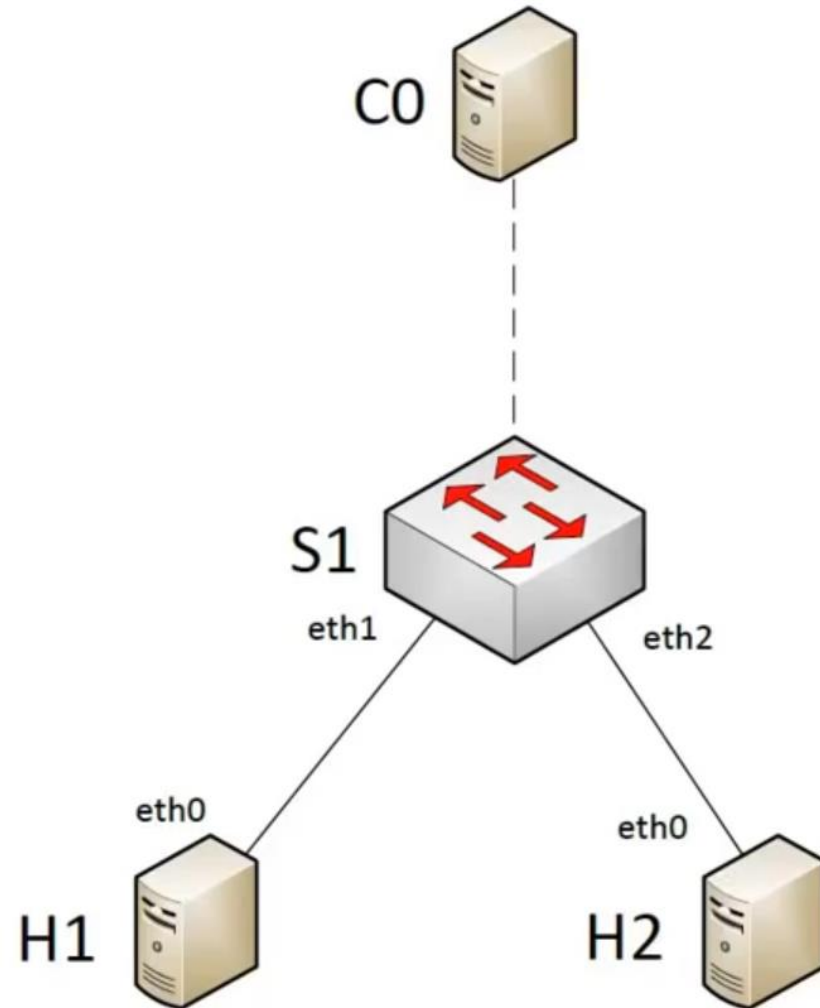
# Wireshark

- Capture packets
  - VirtualBox Host-Only Network
- Protocol: tcp (udp, http, ...)
- 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

# Topologies

- Minimal

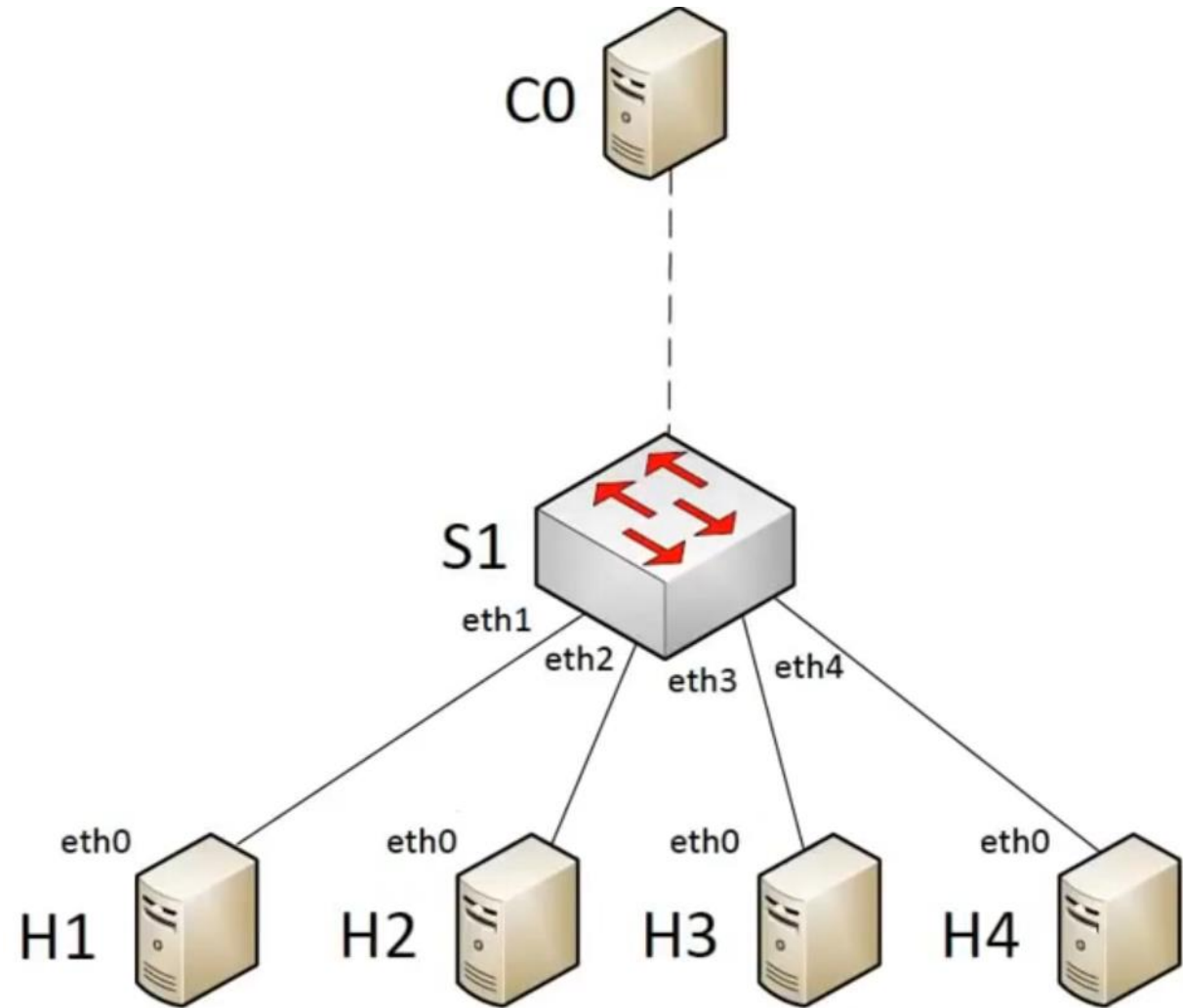
`sudo mn --topo minimal`



# Topologies

- Single

`sudo mn --topo single,4`

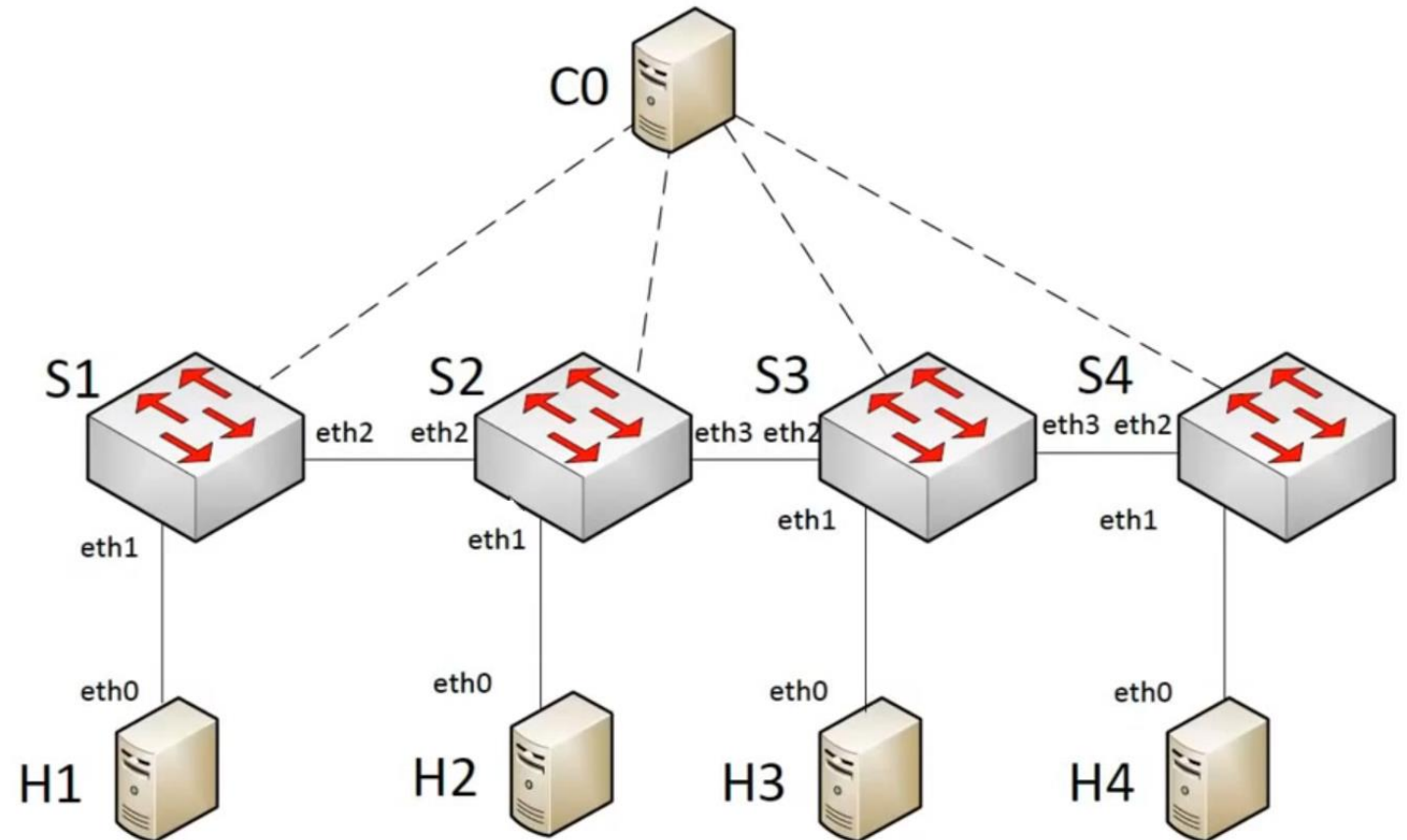




# Topologies

- Linear

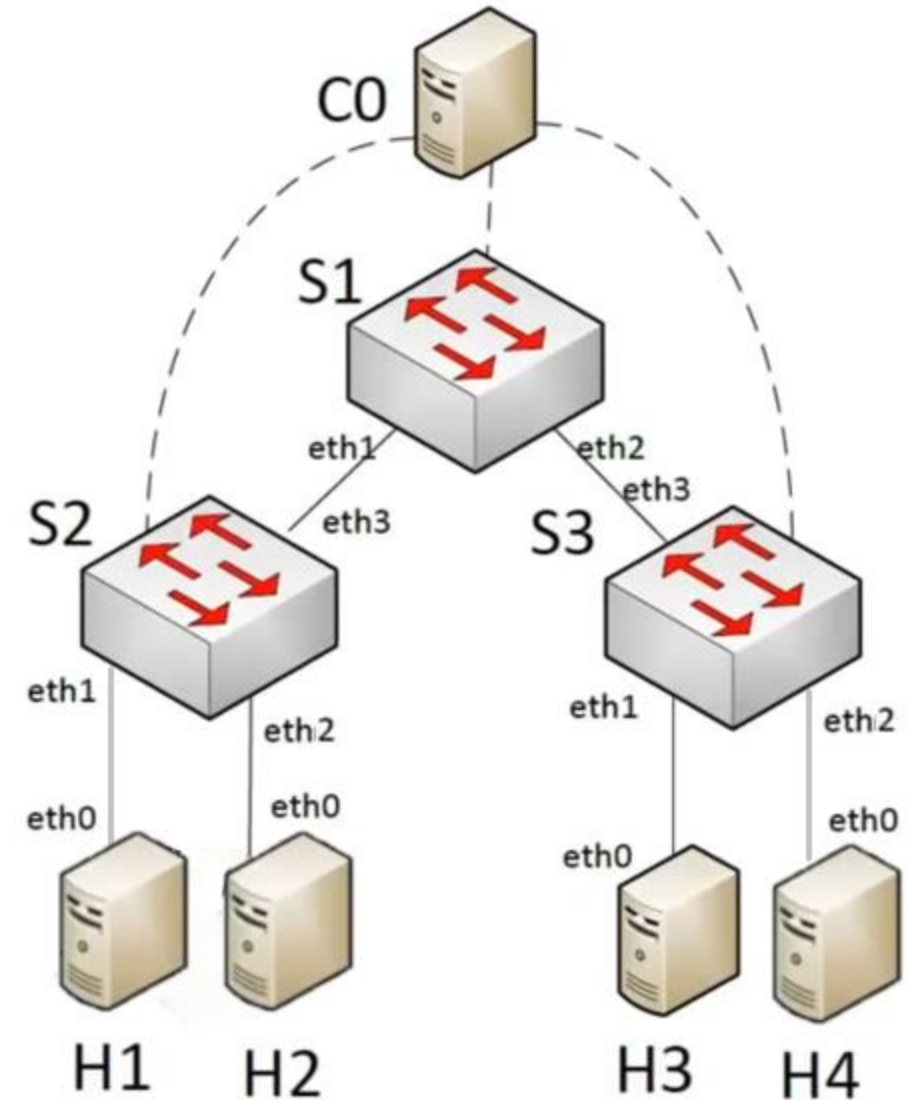
`sudo mn --topo linear,4,1`



# Topologies

- Tree

`sudo mn --topo tree,depth=2,fanout=2`



# MiniNet commands

- (...) --link tc,bw=100,delay=1ms,loss=0,max\_queue\_size=1000,...
- ping (10 echo requests)
  - h1 ping h2 -c 10
- iperf
  - To perform a TCP bandwidth test between hosts
  - iperf h1 h2
- exit
  - Release resources