

Trabalho Mininet

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1. `sudo mn --topo linear,6 --mac --link tc,bw=25`
 - `--topo linear,6` → topologia linear com 6 switches.
 - `--mac` → endereços MAC padronizados.
 - `--link bw=25` → largura de banda de 25 Mbps.
 - Controlador padrão do Mininet será usado automaticamente (não é necessário especificar).

```
mininet@mininet-vm:~$ sudo mn --topo linear,6 --mac --link tc,bw=25
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6
*** Adding switches:
s1 s2 s3 s4 s5 s6
*** Adding links:
(25.00Mbit) (25.00Mbit) (h1, s1) (25.00Mbit) (25.00Mbit) (h2, s2) (25.00Mbit) (2
5.00Mbit) (h3, s3) (25.00Mbit) (25.00Mbit) (h4, s4) (25.00Mbit) (25.00Mbit) (h5,
s5) (25.00Mbit) (25.00Mbit) (h6, s6) (25.00Mbit) (25.00Mbit) (s2, s1) (25.00Mbi
t) (25.00Mbit) (s3, s2) (25.00Mbit) (25.00Mbit) (s4, s3) (25.00Mbit) (25.00Mbit)
(s5, s4) (25.00Mbit) (25.00Mbit) (s6, s5)
*** Configuring hosts
h1 h2 h3 h4 h5 h6
*** Starting controller
c0
*** Starting 6 switches
s1 s2 s3 s4 s5 s6 ... (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit)
(25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00M
bit) (25.00Mbit) (25.00Mbit) (25.00Mbit) (25.00Mbit)
```

2. Listar hosts

```
mininet> nodes
available nodes are:
c0 h1 h2 h3 h4 h5 h6 s1 s2 s3 s4 s5 s6
```

3. Ver IP e MAC de cada host

- h1 ifconfig

```
mininet> h1 ifconfig
h1-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:01
         inet addr:10.0.0.1  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

- h2 ifconfig

```
mininet> h2 ifconfig
h2-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:02
         inet addr:10.0.0.2  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

- h3 ifconfig

```
mininet> h3 ifconfig
h3-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:03
         inet addr:10.0.0.3  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

- h4 ifconfig

```
mininet> h4 ifconfig
h4-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:04
         inet addr:10.0.0.4  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

- h5 ifconfig

```
mininet> h5 ifconfig
h5-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:05
         inet addr:10.0.0.5  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

- h6 ifconfig

```
mininet> h6 ifconfig
h6-eth0  Link encap:Ethernet  HWaddr 00:00:00:00:00:06
         inet addr:10.0.0.6  Bcast:10.255.255.255  Mask:255.0.0.0
         UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
         RX packets:30 errors:0 dropped:0 overruns:0 frame:0
         TX packets:20 errors:0 dropped:0 overruns:0 carrier:0
         collisions:0 txqueuelen:1000
         RX bytes:1820 (1.8 KB)  TX bytes:1400 (1.4 KB)

lo       Link encap:Local Loopback
         inet addr:127.0.0.1  Mask:255.0.0.0
         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)
```

4. Teste de ping entre os hosts

- pingall

```
mininet> pingall
*** Ping: testing ping reachability
h1 -> h2 h3 h4 h5 h6
h2 -> h1 h3 h4 h5 h6
h3 -> h1 h2 h4 h5 h6
h4 -> h1 h2 h3 h5 h6
h5 -> h1 h2 h3 h4 h6
h6 -> h1 h2 h3 h4 h5
*** Results: 0% dropped (30/30 received)
```

- h1 ping -c 4 h2

```
mininet> h1 ping -c 4 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=2.71 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=1.70 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.787 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.065 ms

--- 10.0.0.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3005ms
rtt min/avg/max/mdev = 0.065/1.318/2.715/0.994 ms
```

- h1 ping -c 4 h6

```
mininet> h1 ping -c 4 h6
PING 10.0.0.6 (10.0.0.6) 56(84) bytes of data.
64 bytes from 10.0.0.6: icmp_seq=1 ttl=64 time=5.28 ms
64 bytes from 10.0.0.6: icmp_seq=2 ttl=64 time=17.6 ms
64 bytes from 10.0.0.6: icmp_seq=3 ttl=64 time=3.82 ms
64 bytes from 10.0.0.6: icmp_seq=4 ttl=64 time=0.123 ms

--- 10.0.0.6 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3011ms
rtt min/avg/max/mdev = 0.123/6.717/17.647/6.584 ms
```

- h2 ping -c 4 h3

```
mininet> h2 ping -c 4 h3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
64 bytes from 10.0.0.3: icmp_seq=1 ttl=64 time=4.09 ms
64 bytes from 10.0.0.3: icmp_seq=2 ttl=64 time=2.58 ms
64 bytes from 10.0.0.3: icmp_seq=3 ttl=64 time=0.393 ms
64 bytes from 10.0.0.3: icmp_seq=4 ttl=64 time=0.083 ms

--- 10.0.0.3 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 0.083/1.786/4.090/1.642 ms
```

- h3 ping -c 4 h5

```
mininet> h3 ping -c 4 h5
PING 10.0.0.5 (10.0.0.5) 56(84) bytes of data.
64 bytes from 10.0.0.5: icmp_seq=1 ttl=64 time=3.70 ms
64 bytes from 10.0.0.5: icmp_seq=2 ttl=64 time=5.17 ms
64 bytes from 10.0.0.5: icmp_seq=3 ttl=64 time=1.54 ms
64 bytes from 10.0.0.5: icmp_seq=4 ttl=64 time=0.092 ms

--- 10.0.0.5 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3007ms
rtt min/avg/max/mdev = 0.092/2.629/5.177/1.954 ms
```

- h4 ping -c 4 h2

```
mininet> h4 ping -c 4 h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=4.28 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=1.98 ms
64 bytes from 10.0.0.2: icmp_seq=3 ttl=64 time=0.892 ms
64 bytes from 10.0.0.2: icmp_seq=4 ttl=64 time=0.063 ms

--- 10.0.0.2 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3003ms
rtt min/avg/max/mdev = 0.063/1.807/4.286/1.585 ms
```

- h5 ping -c 4 h1

```
mininet> h5 ping -c 4 h1
PING 10.0.0.1 (10.0.0.1) 56(84) bytes of data.
64 bytes from 10.0.0.1: icmp_seq=1 ttl=64 time=4.45 ms
64 bytes from 10.0.0.1: icmp_seq=2 ttl=64 time=13.4 ms
64 bytes from 10.0.0.1: icmp_seq=3 ttl=64 time=1.27 ms
64 bytes from 10.0.0.1: icmp_seq=4 ttl=64 time=0.118 ms

--- 10.0.0.1 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3006ms
rtt min/avg/max/mdev = 0.118/4.835/13.492/5.244 ms
```

- h6 ping -c 4 h4

```
mininet> h6 ping -c 4 h4
PING 10.0.0.4 (10.0.0.4) 56(84) bytes of data.
64 bytes from 10.0.0.4: icmp_seq=1 ttl=64 time=3.32 ms
64 bytes from 10.0.0.4: icmp_seq=2 ttl=64 time=7.21 ms
64 bytes from 10.0.0.4: icmp_seq=3 ttl=64 time=1.50 ms
64 bytes from 10.0.0.4: icmp_seq=4 ttl=64 time=0.106 ms

--- 10.0.0.4 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3008ms
rtt min/avg/max/mdev = 0.106/3.040/7.219/2.669 ms
```

5. Teste TCP com iperf (Cliente e Servidor)

- `iperf -s -p 5555`
- `iperf -c 10.0.0.1 -p 5555 -t 15 -i 1`

Node: h1

root@mininet-vm:~# iperf -s -p 5555

Server listening on TCP port 5555
TCP window size: 85,3 KByte (default)

[32] local 10.0.0.1 port 5555 connected with 10.0.0.2 port 50086
[ID] Interval Transfer Bandwidth
[32] 0.0-15.2 sec 42.5 MBytes 23.5 Mbits/sec

Node: h2

root@mininet-vm:~# iperf -c 10.0.0.1 -p 5555 -t 15 -i 1

Client connecting to 10.0.0.1, TCP port 5555
TCP window size: 85,3 KByte (default)

[31] local 10.0.0.2 port 50086 connected with 10.0.0.1 port 5555
[ID] Interval Transfer Bandwidth
[31] 0.0- 1.0 sec 3.12 MBytes 26.2 Mbits/sec
[31] 1.0- 2.0 sec 2.88 MBytes 24.1 Mbits/sec
[31] 2.0- 3.0 sec 2.88 MBytes 24.1 Mbits/sec
[31] 3.0- 4.0 sec 2.62 MBytes 22.0 Mbits/sec
[31] 4.0- 5.0 sec 2.88 MBytes 24.1 Mbits/sec
[31] 5.0- 6.0 sec 3.00 MBytes 25.2 Mbits/sec
[31] 6.0- 7.0 sec 2.75 MBytes 23.1 Mbits/sec
[31] 7.0- 8.0 sec 2.62 MBytes 22.0 Mbits/sec
[31] 8.0- 9.0 sec 2.75 MBytes 23.1 Mbits/sec
[31] 9.0-10.0 sec 2.88 MBytes 24.1 Mbits/sec
[31] 10.0-11.0 sec 2.75 MBytes 23.1 Mbits/sec
[31] 11.0-12.0 sec 2.75 MBytes 23.1 Mbits/sec
[31] 12.0-13.0 sec 3.12 MBytes 26.2 Mbits/sec
[31] 13.0-14.0 sec 2.75 MBytes 23.1 Mbits/sec
[31] 14.0-15.0 sec 2.62 MBytes 22.0 Mbits/sec
[31] 0.0-15.0 sec 42.5 MBytes 23.8 Mbits/sec

root@mininet-vm:~#