Exercício 1

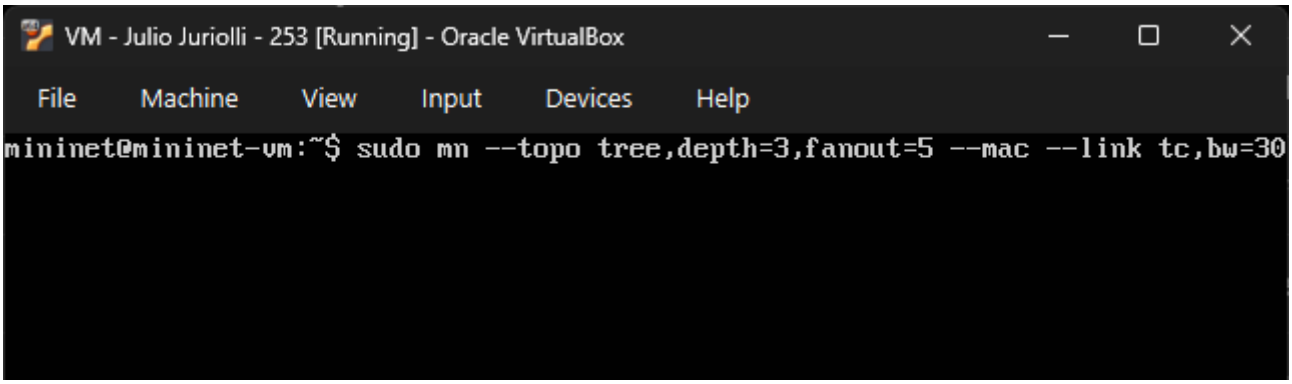
| Considerar uma topologia árvore com profundidade de três e ramificação de cinco.

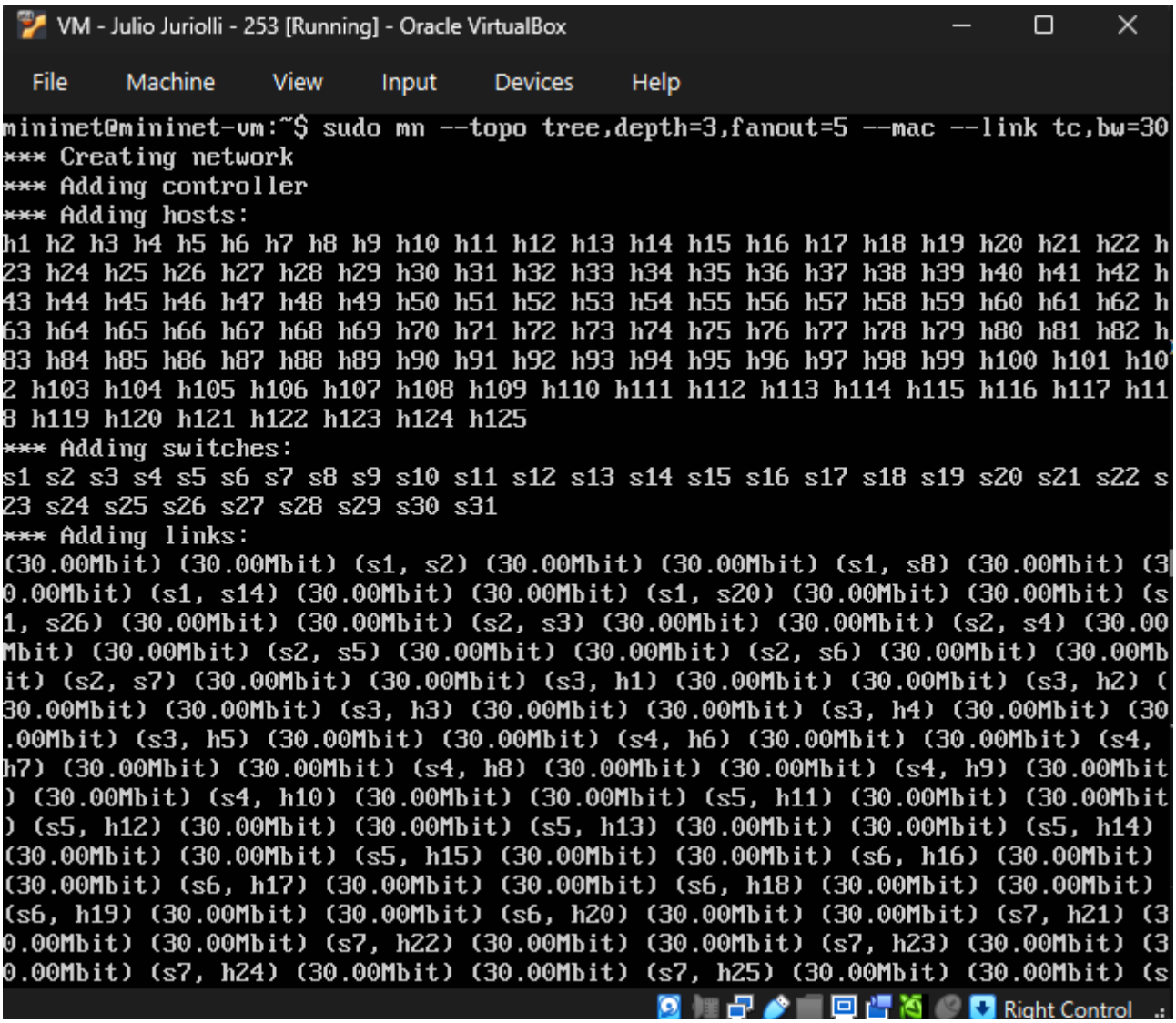
a) Criar uma topologia com largura de banda 30Mbps e controlador mininet

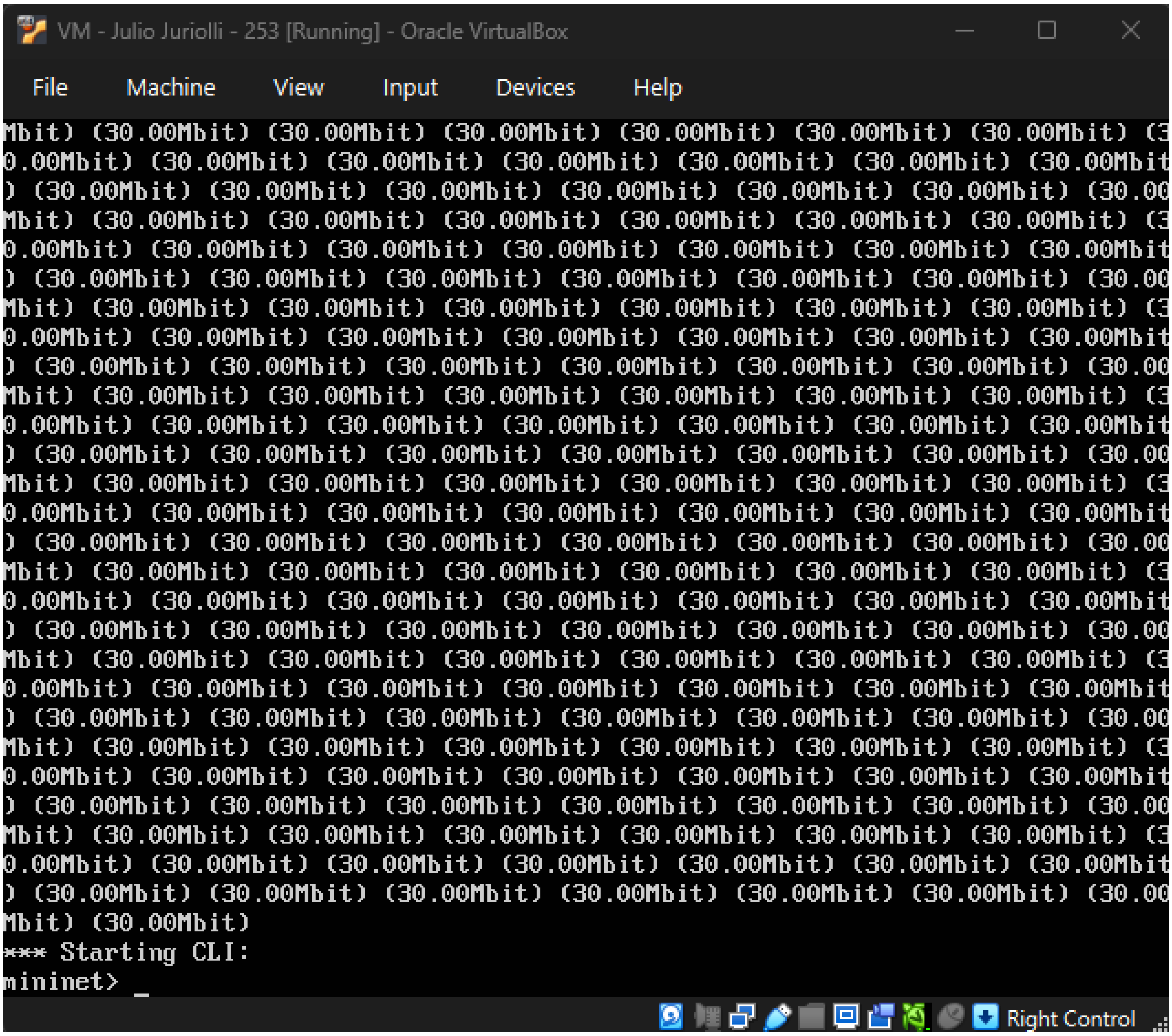
- Topologia tree com depth 3 e fanout 5
- MAC padronizado --mac
- Largura de banda 30Mbps usando `--link tc,bw=30`

```
sudo mn --topo tree,depth=3,fanout=5 --mac --link tc,bw=30
```

| Resultado:

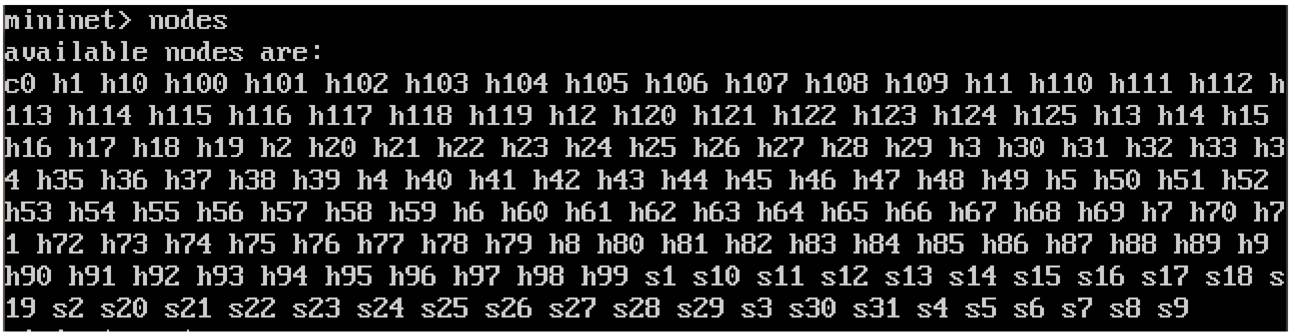



VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
mininet@mininet-vm:~$ sudo mn --topo tree,depth=3,fanout=5 --mac --link tc,bw=30
*** Creating network
*** Adding controller
*** Adding hosts:
h1 h2 h3 h4 h5 h6 h7 h8 h9 h10 h11 h12 h13 h14 h15 h16 h17 h18 h19 h20 h21 h22 h
23 h24 h25 h26 h27 h28 h29 h30 h31 h32 h33 h34 h35 h36 h37 h38 h39 h40 h41 h42 h
43 h44 h45 h46 h47 h48 h49 h50 h51 h52 h53 h54 h55 h56 h57 h58 h59 h60 h61 h62 h
63 h64 h65 h66 h67 h68 h69 h70 h71 h72 h73 h74 h75 h76 h77 h78 h79 h80 h81 h82 h
83 h84 h85 h86 h87 h88 h89 h90 h91 h92 h93 h94 h95 h96 h97 h98 h99 h100 h101 h10
2 h103 h104 h105 h106 h107 h108 h109 h110 h111 h112 h113 h114 h115 h116 h117 h11
8 h119 h120 h121 h122 h123 h124 h125
*** Adding switches:
s1 s2 s3 s4 s5 s6 s7 s8 s9 s10 s11 s12 s13 s14 s15 s16 s17 s18 s19 s20 s21 s22 s
23 s24 s25 s26 s27 s28 s29 s30 s31
*** Adding links:
(30.00Mbit) (30.00Mbit) (s1, s2) (30.00Mbit) (30.00Mbit) (s1, s8) (30.00Mbit) (3
0.00Mbit) (s1, s14) (30.00Mbit) (30.00Mbit) (s1, s20) (30.00Mbit) (30.00Mbit) (s
1, s26) (30.00Mbit) (30.00Mbit) (s2, s3) (30.00Mbit) (30.00Mbit) (s2, s4) (30.00
Mbit) (30.00Mbit) (s2, s5) (30.00Mbit) (30.00Mbit) (s2, s6) (30.00Mbit) (30.00Mb
it) (s2, s7) (30.00Mbit) (30.00Mbit) (s3, h1) (30.00Mbit) (30.00Mbit) (s3, h2) (
30.00Mbit) (30.00Mbit) (s3, h3) (30.00Mbit) (30.00Mbit) (s3, h4) (30.00Mbit) (30
.00Mbit) (s3, h5) (30.00Mbit) (30.00Mbit) (s4, h6) (30.00Mbit) (30.00Mbit) (s4,
h7) (30.00Mbit) (30.00Mbit) (s4, h8) (30.00Mbit) (30.00Mbit) (s4, h9) (30.00Mbit
) (30.00Mbit) (s4, h10) (30.00Mbit) (30.00Mbit) (s5, h11) (30.00Mbit) (30.00Mbit
) (s5, h12) (30.00Mbit) (30.00Mbit) (s5, h13) (30.00Mbit) (30.00Mbit) (s5, h14)
(30.00Mbit) (30.00Mbit) (s5, h15) (30.00Mbit) (30.00Mbit) (s6, h16) (30.00Mbit)
(30.00Mbit) (s6, h17) (30.00Mbit) (30.00Mbit) (s6, h18) (30.00Mbit) (30.00Mbit)
(s6, h19) (30.00Mbit) (30.00Mbit) (s6, h20) (30.00Mbit) (30.00Mbit) (s7, h21) (3
0.00Mbit) (30.00Mbit) (s7, h22) (30.00Mbit) (30.00Mbit) (s7, h23) (30.00Mbit) (3
0.00Mbit) (s7, h24) (30.00Mbit) (30.00Mbit) (s7, h25) (30.00Mbit) (30.00Mbit) (s
Right Control

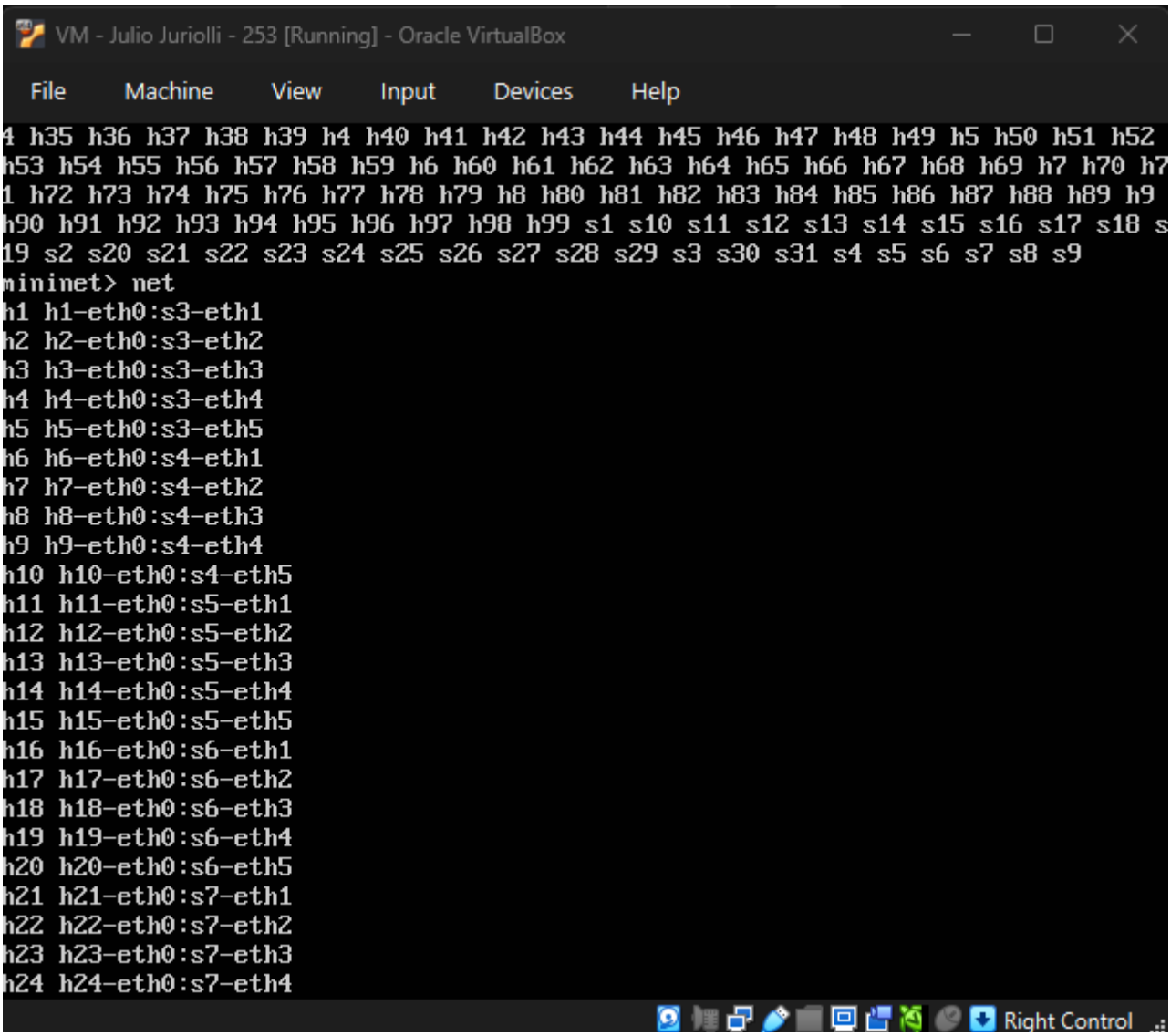


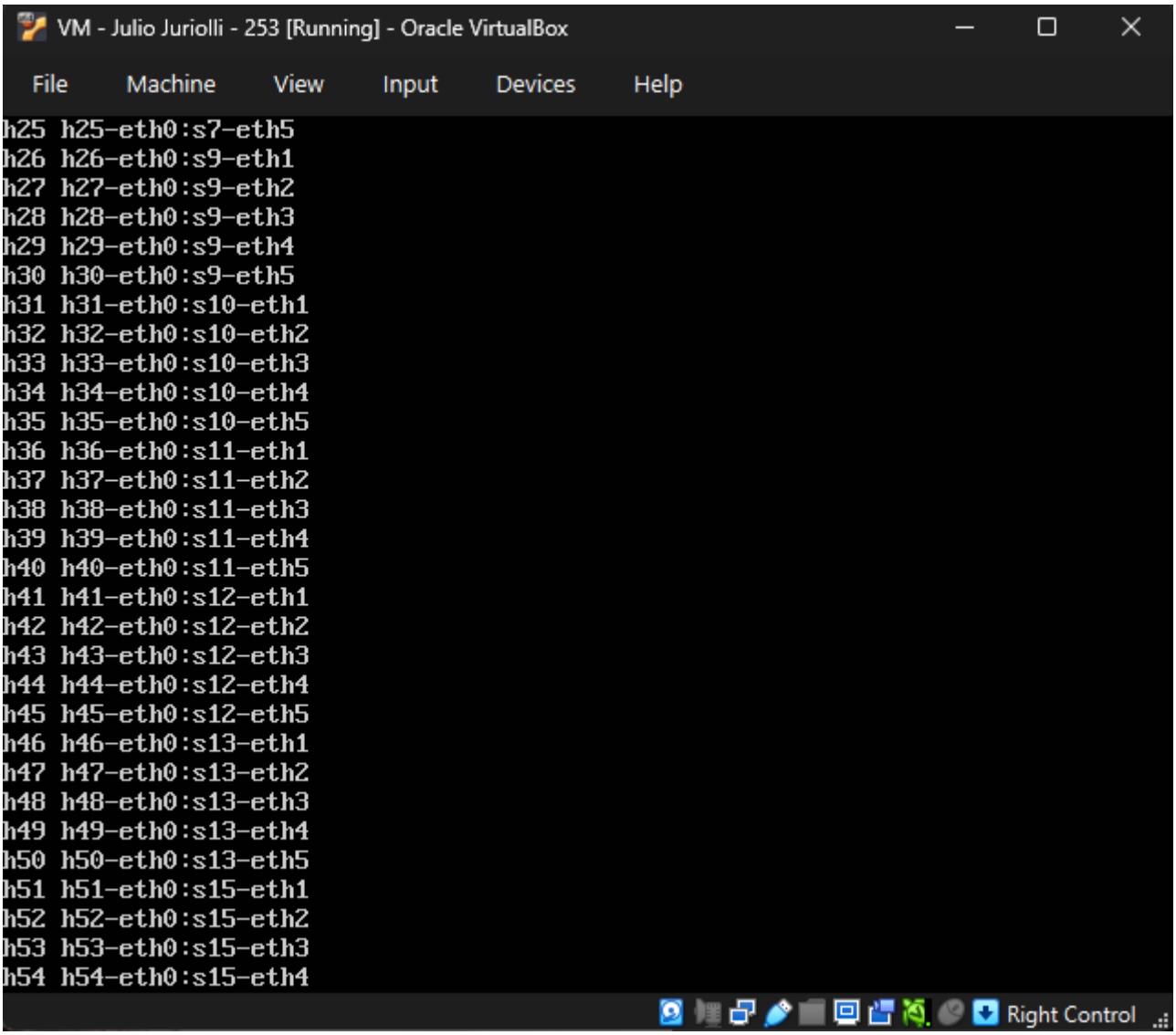
b) Inspecionando a rede

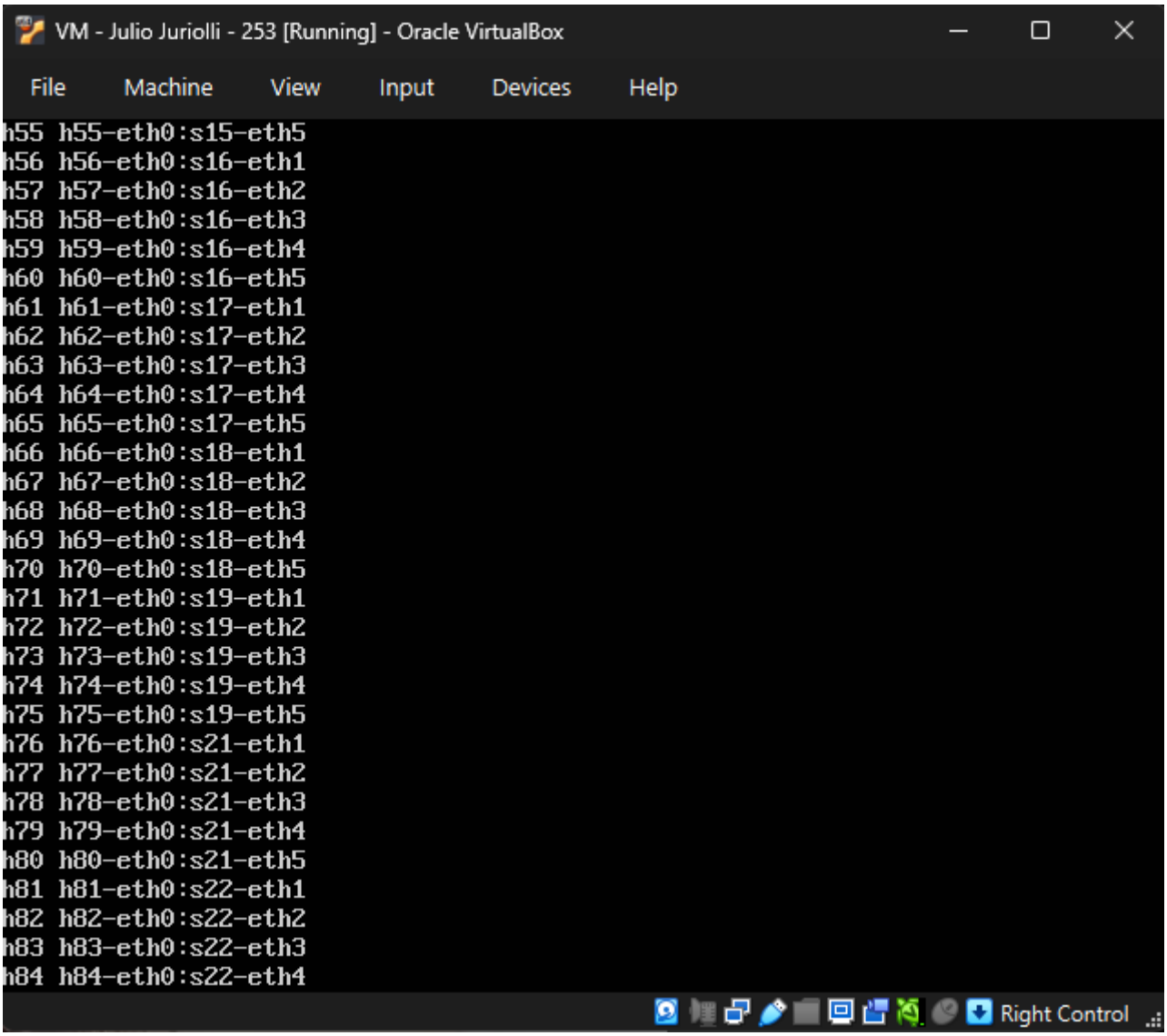
| Comando `nodes` para mostrar os nós da rede

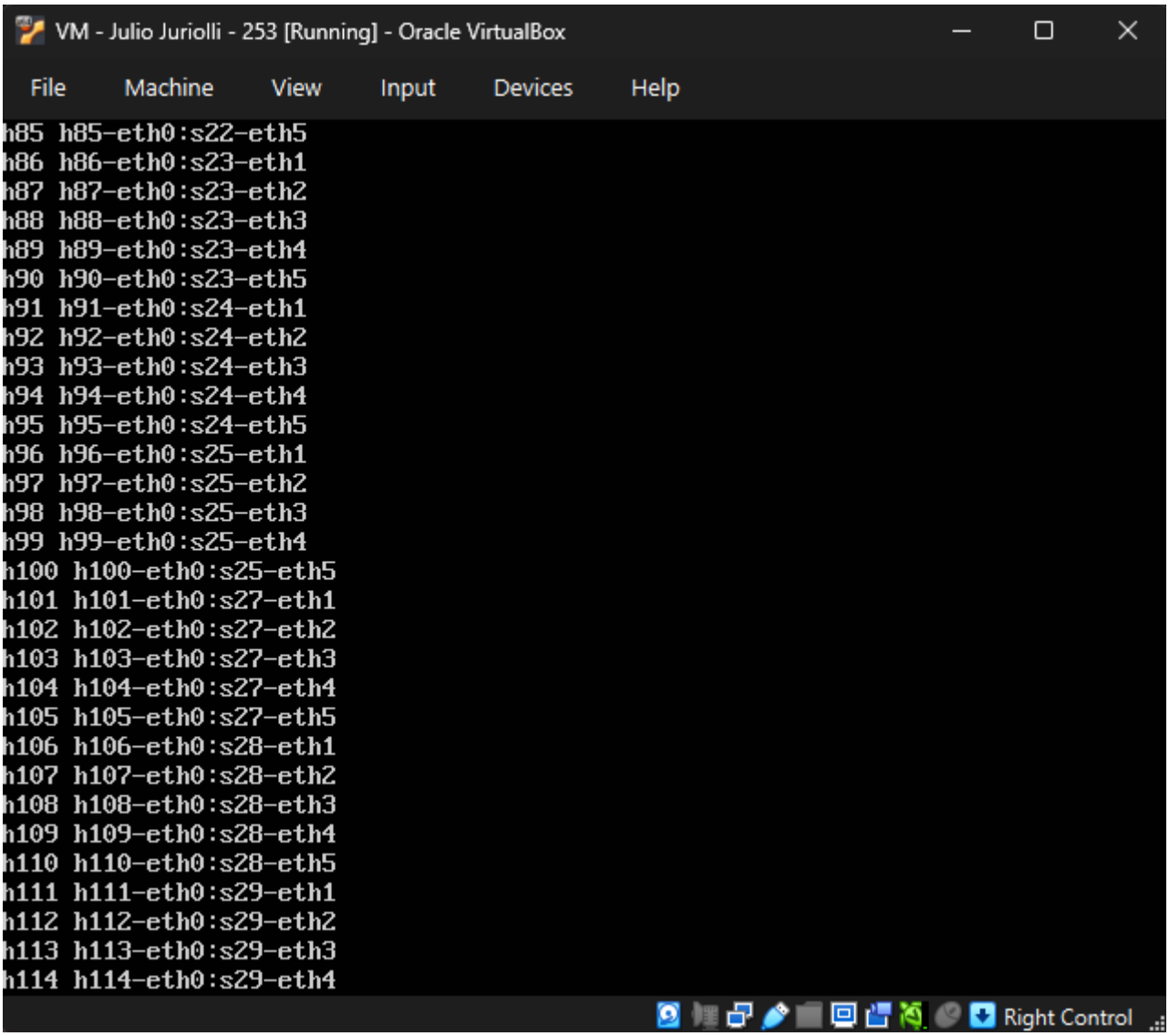


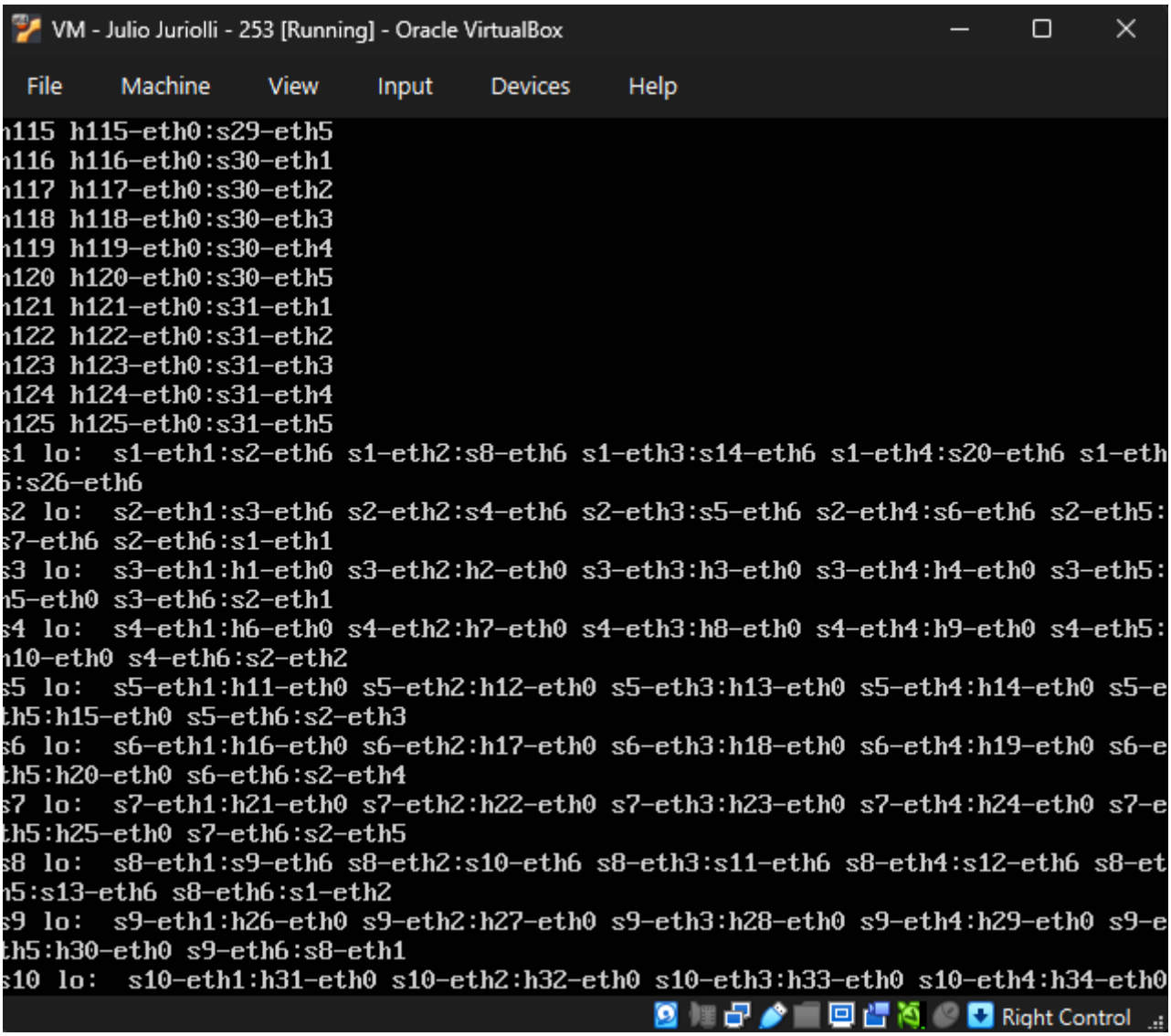
| Comando `net` para verificar as conexões entre os nós da rede (todo o resultado do comando)

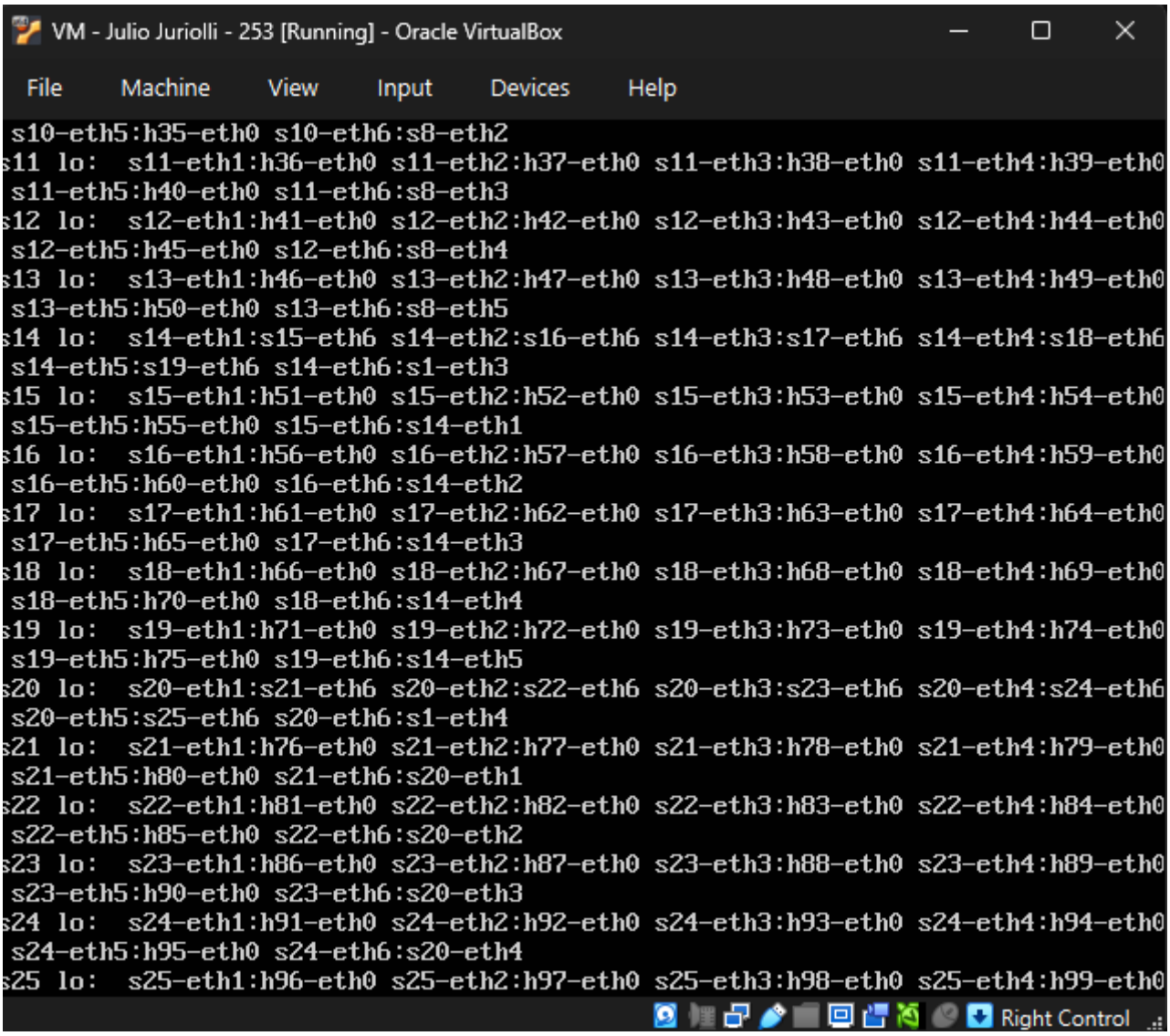

VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
4 h35 h36 h37 h38 h39 h4 h40 h41 h42 h43 h44 h45 h46 h47 h48 h49 h5 h50 h51 h52
h53 h54 h55 h56 h57 h58 h59 h6 h60 h61 h62 h63 h64 h65 h66 h67 h68 h69 h7 h70 h7
1 h72 h73 h74 h75 h76 h77 h78 h79 h8 h80 h81 h82 h83 h84 h85 h86 h87 h88 h89 h9
h90 h91 h92 h93 h94 h95 h96 h97 h98 h99 s1 s10 s11 s12 s13 s14 s15 s16 s17 s18 s
19 s2 s20 s21 s22 s23 s24 s25 s26 s27 s28 s29 s3 s30 s31 s4 s5 s6 s7 s8 s9
mininet> net
h1 h1-eth0:s3-eth1
h2 h2-eth0:s3-eth2
h3 h3-eth0:s3-eth3
h4 h4-eth0:s3-eth4
h5 h5-eth0:s3-eth5
h6 h6-eth0:s4-eth1
h7 h7-eth0:s4-eth2
h8 h8-eth0:s4-eth3
h9 h9-eth0:s4-eth4
h10 h10-eth0:s4-eth5
h11 h11-eth0:s5-eth1
h12 h12-eth0:s5-eth2
h13 h13-eth0:s5-eth3
h14 h14-eth0:s5-eth4
h15 h15-eth0:s5-eth5
h16 h16-eth0:s6-eth1
h17 h17-eth0:s6-eth2
h18 h18-eth0:s6-eth3
h19 h19-eth0:s6-eth4
h20 h20-eth0:s6-eth5
h21 h21-eth0:s7-eth1
h22 h22-eth0:s7-eth2
h23 h23-eth0:s7-eth3
h24 h24-eth0:s7-eth4
Right Control

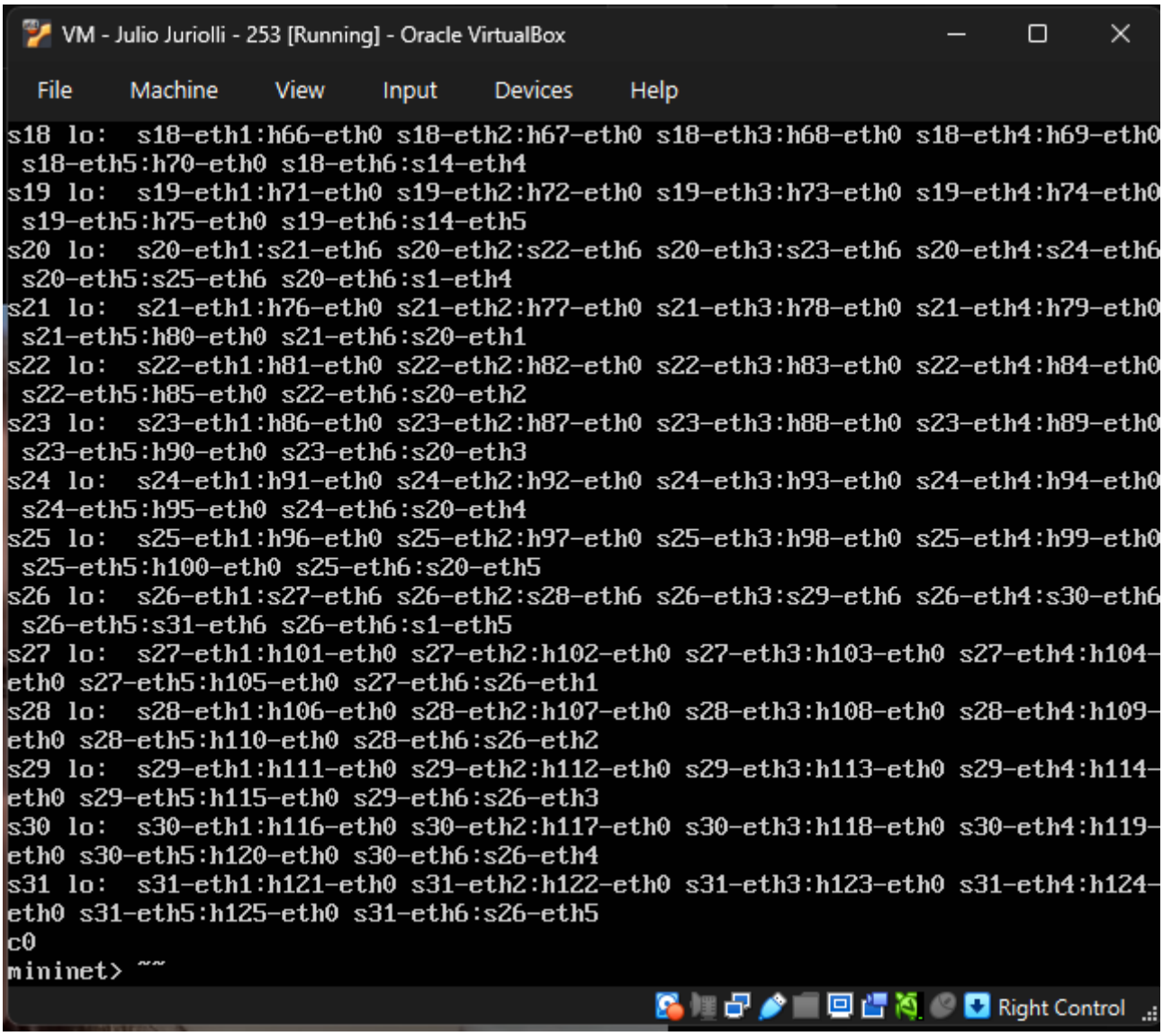

VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File
Machine
View
Input
Devices
Help
h25 h25-eth0:s7-eth5
h26 h26-eth0:s9-eth1
h27 h27-eth0:s9-eth2
h28 h28-eth0:s9-eth3
h29 h29-eth0:s9-eth4
h30 h30-eth0:s9-eth5
h31 h31-eth0:s10-eth1
h32 h32-eth0:s10-eth2
h33 h33-eth0:s10-eth3
h34 h34-eth0:s10-eth4
h35 h35-eth0:s10-eth5
h36 h36-eth0:s11-eth1
h37 h37-eth0:s11-eth2
h38 h38-eth0:s11-eth3
h39 h39-eth0:s11-eth4
h40 h40-eth0:s11-eth5
h41 h41-eth0:s12-eth1
h42 h42-eth0:s12-eth2
h43 h43-eth0:s12-eth3
h44 h44-eth0:s12-eth4
h45 h45-eth0:s12-eth5
h46 h46-eth0:s13-eth1
h47 h47-eth0:s13-eth2
h48 h48-eth0:s13-eth3
h49 h49-eth0:s13-eth4
h50 h50-eth0:s13-eth5
h51 h51-eth0:s15-eth1
h52 h52-eth0:s15-eth2
h53 h53-eth0:s15-eth3
h54 h54-eth0:s15-eth4
Right Control


VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
h55 h55-eth0:s15-eth5
h56 h56-eth0:s16-eth1
h57 h57-eth0:s16-eth2
h58 h58-eth0:s16-eth3
h59 h59-eth0:s16-eth4
h60 h60-eth0:s16-eth5
h61 h61-eth0:s17-eth1
h62 h62-eth0:s17-eth2
h63 h63-eth0:s17-eth3
h64 h64-eth0:s17-eth4
h65 h65-eth0:s17-eth5
h66 h66-eth0:s18-eth1
h67 h67-eth0:s18-eth2
h68 h68-eth0:s18-eth3
h69 h69-eth0:s18-eth4
h70 h70-eth0:s18-eth5
h71 h71-eth0:s19-eth1
h72 h72-eth0:s19-eth2
h73 h73-eth0:s19-eth3
h74 h74-eth0:s19-eth4
h75 h75-eth0:s19-eth5
h76 h76-eth0:s21-eth1
h77 h77-eth0:s21-eth2
h78 h78-eth0:s21-eth3
h79 h79-eth0:s21-eth4
h80 h80-eth0:s21-eth5
h81 h81-eth0:s22-eth1
h82 h82-eth0:s22-eth2
h83 h83-eth0:s22-eth3
h84 h84-eth0:s22-eth4
Right Control

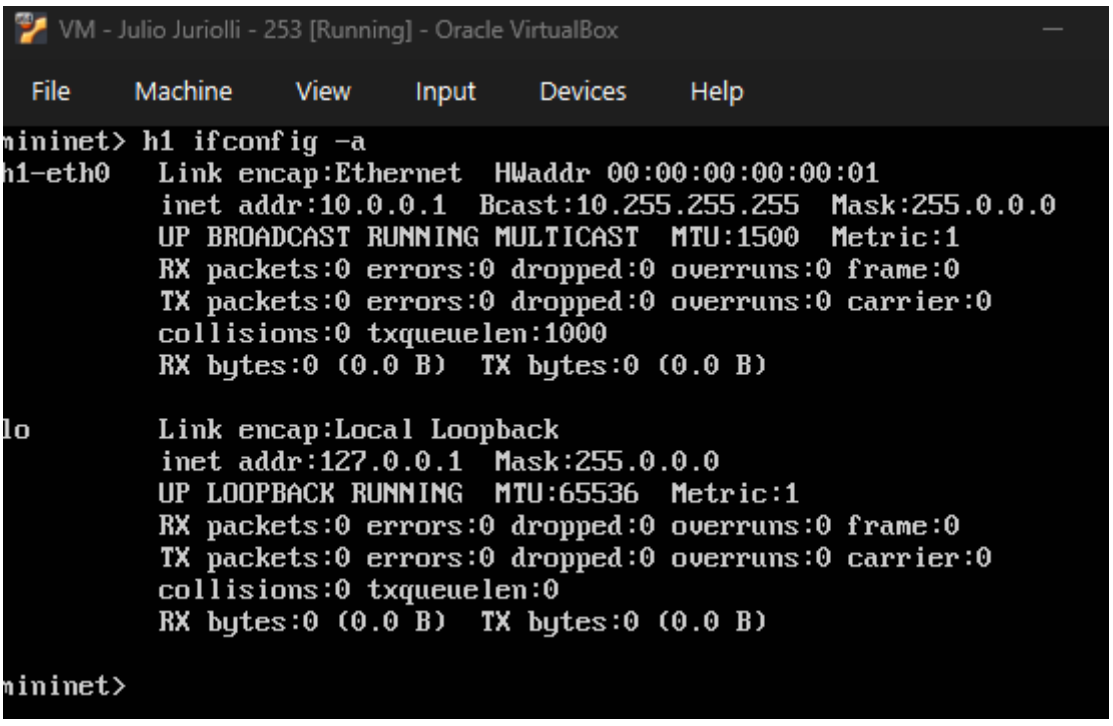

VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
h85 h85-eth0:s22-eth5
h86 h86-eth0:s23-eth1
h87 h87-eth0:s23-eth2
h88 h88-eth0:s23-eth3
h89 h89-eth0:s23-eth4
h90 h90-eth0:s23-eth5
h91 h91-eth0:s24-eth1
h92 h92-eth0:s24-eth2
h93 h93-eth0:s24-eth3
h94 h94-eth0:s24-eth4
h95 h95-eth0:s24-eth5
h96 h96-eth0:s25-eth1
h97 h97-eth0:s25-eth2
h98 h98-eth0:s25-eth3
h99 h99-eth0:s25-eth4
h100 h100-eth0:s25-eth5
h101 h101-eth0:s27-eth1
h102 h102-eth0:s27-eth2
h103 h103-eth0:s27-eth3
h104 h104-eth0:s27-eth4
h105 h105-eth0:s27-eth5
h106 h106-eth0:s28-eth1
h107 h107-eth0:s28-eth2
h108 h108-eth0:s28-eth3
h109 h109-eth0:s28-eth4
h110 h110-eth0:s28-eth5
h111 h111-eth0:s29-eth1
h112 h112-eth0:s29-eth2
h113 h113-eth0:s29-eth3
h114 h114-eth0:s29-eth4
Right Control


VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
h115 h115-eth0:s29-eth5
h116 h116-eth0:s30-eth1
h117 h117-eth0:s30-eth2
h118 h118-eth0:s30-eth3
h119 h119-eth0:s30-eth4
h120 h120-eth0:s30-eth5
h121 h121-eth0:s31-eth1
h122 h122-eth0:s31-eth2
h123 h123-eth0:s31-eth3
h124 h124-eth0:s31-eth4
h125 h125-eth0:s31-eth5
s1 lo: s1-eth1:s2-eth6 s1-eth2:s8-eth6 s1-eth3:s14-eth6 s1-eth4:s20-eth6 s1-eth
5:s26-eth6
s2 lo: s2-eth1:s3-eth6 s2-eth2:s4-eth6 s2-eth3:s5-eth6 s2-eth4:s6-eth6 s2-eth5:
s7-eth6 s2-eth6:s1-eth1
s3 lo: s3-eth1:h1-eth0 s3-eth2:h2-eth0 s3-eth3:h3-eth0 s3-eth4:h4-eth0 s3-eth5:
h5-eth0 s3-eth6:s2-eth1
s4 lo: s4-eth1:h6-eth0 s4-eth2:h7-eth0 s4-eth3:h8-eth0 s4-eth4:h9-eth0 s4-eth5:
h10-eth0 s4-eth6:s2-eth2
s5 lo: s5-eth1:h11-eth0 s5-eth2:h12-eth0 s5-eth3:h13-eth0 s5-eth4:h14-eth0 s5-e
th5:h15-eth0 s5-eth6:s2-eth3
s6 lo: s6-eth1:h16-eth0 s6-eth2:h17-eth0 s6-eth3:h18-eth0 s6-eth4:h19-eth0 s6-e
th5:h20-eth0 s6-eth6:s2-eth4
s7 lo: s7-eth1:h21-eth0 s7-eth2:h22-eth0 s7-eth3:h23-eth0 s7-eth4:h24-eth0 s7-e
th5:h25-eth0 s7-eth6:s2-eth5
s8 lo: s8-eth1:s9-eth6 s8-eth2:s10-eth6 s8-eth3:s11-eth6 s8-eth4:s12-eth6 s8-et
h5:s13-eth6 s8-eth6:s1-eth2
s9 lo: s9-eth1:h26-eth0 s9-eth2:h27-eth0 s9-eth3:h28-eth0 s9-eth4:h29-eth0 s9-e
th5:h30-eth0 s9-eth6:s8-eth1
s10 lo: s10-eth1:h31-eth0 s10-eth2:h32-eth0 s10-eth3:h33-eth0 s10-eth4:h34-eth0
Right Control


VM - Julio Juriolli - 253 [Running] - Oracle VirtualBox
File Machine View Input Devices Help
s10-eth5:h35-eth0 s10-eth6:s8-eth2
s11 lo: s11-eth1:h36-eth0 s11-eth2:h37-eth0 s11-eth3:h38-eth0 s11-eth4:h39-eth0
s11-eth5:h40-eth0 s11-eth6:s8-eth3
s12 lo: s12-eth1:h41-eth0 s12-eth2:h42-eth0 s12-eth3:h43-eth0 s12-eth4:h44-eth0
s12-eth5:h45-eth0 s12-eth6:s8-eth4
s13 lo: s13-eth1:h46-eth0 s13-eth2:h47-eth0 s13-eth3:h48-eth0 s13-eth4:h49-eth0
s13-eth5:h50-eth0 s13-eth6:s8-eth5
s14 lo: s14-eth1:s15-eth6 s14-eth2:s16-eth6 s14-eth3:s17-eth6 s14-eth4:s18-eth6
s14-eth5:s19-eth6 s14-eth6:s1-eth3
s15 lo: s15-eth1:h51-eth0 s15-eth2:h52-eth0 s15-eth3:h53-eth0 s15-eth4:h54-eth0
s15-eth5:h55-eth0 s15-eth6:s14-eth1
s16 lo: s16-eth1:h56-eth0 s16-eth2:h57-eth0 s16-eth3:h58-eth0 s16-eth4:h59-eth0
s16-eth5:h60-eth0 s16-eth6:s14-eth2
s17 lo: s17-eth1:h61-eth0 s17-eth2:h62-eth0 s17-eth3:h63-eth0 s17-eth4:h64-eth0
s17-eth5:h65-eth0 s17-eth6:s14-eth3
s18 lo: s18-eth1:h66-eth0 s18-eth2:h67-eth0 s18-eth3:h68-eth0 s18-eth4:h69-eth0
s18-eth5:h70-eth0 s18-eth6:s14-eth4
s19 lo: s19-eth1:h71-eth0 s19-eth2:h72-eth0 s19-eth3:h73-eth0 s19-eth4:h74-eth0
s19-eth5:h75-eth0 s19-eth6:s14-eth5
s20 lo: s20-eth1:s21-eth6 s20-eth2:s22-eth6 s20-eth3:s23-eth6 s20-eth4:s24-eth6
s20-eth5:s25-eth6 s20-eth6:s1-eth4
s21 lo: s21-eth1:h76-eth0 s21-eth2:h77-eth0 s21-eth3:h78-eth0 s21-eth4:h79-eth0
s21-eth5:h80-eth0 s21-eth6:s20-eth1
s22 lo: s22-eth1:h81-eth0 s22-eth2:h82-eth0 s22-eth3:h83-eth0 s22-eth4:h84-eth0
s22-eth5:h85-eth0 s22-eth6:s20-eth2
s23 lo: s23-eth1:h86-eth0 s23-eth2:h87-eth0 s23-eth3:h88-eth0 s23-eth4:h89-eth0
s23-eth5:h90-eth0 s23-eth6:s20-eth3
s24 lo: s24-eth1:h91-eth0 s24-eth2:h92-eth0 s24-eth3:h93-eth0 s24-eth4:h94-eth0
s24-eth5:h95-eth0 s24-eth6:s20-eth4
s25 lo: s25-eth1:h96-eth0 s25-eth2:h97-eth0 s25-eth3:h98-eth0 s25-eth4:h99-eth0
Right Control

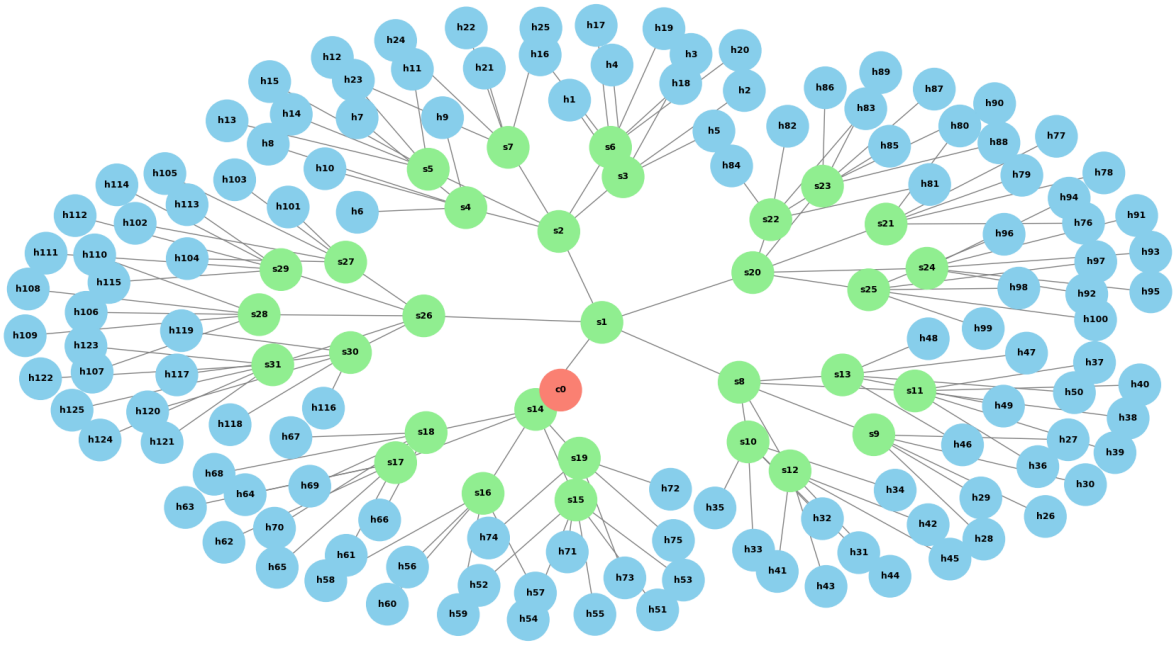


| Comando `ifconfig` para ver informações específicas de um nó



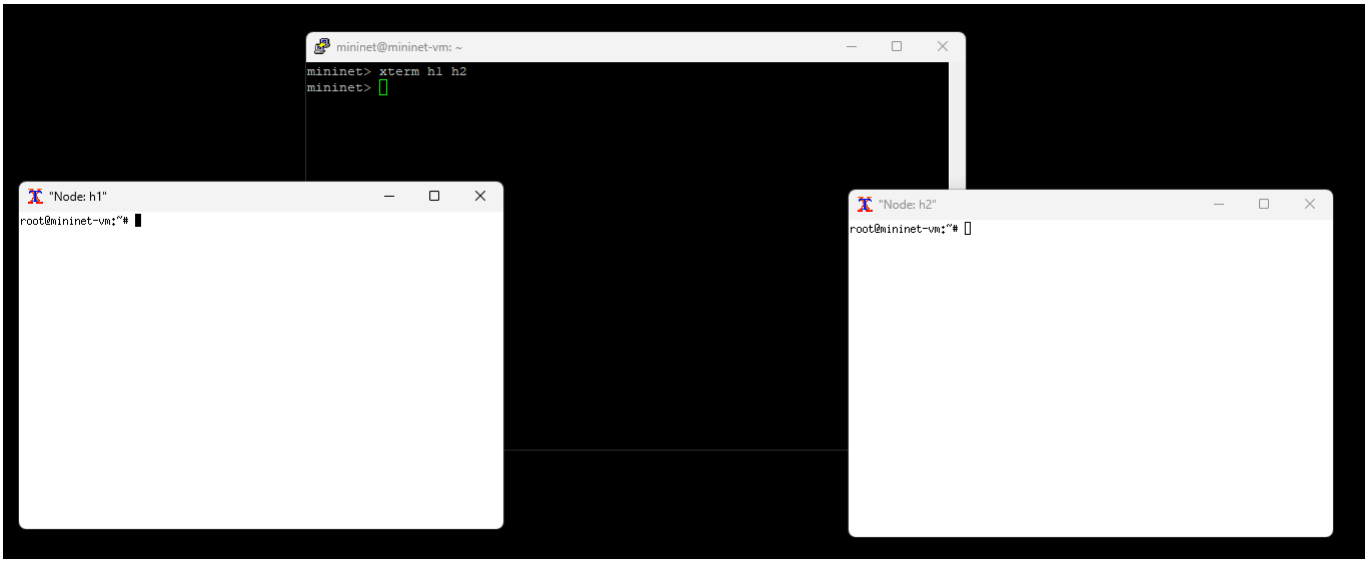
c) Ilustração da topologia da rede

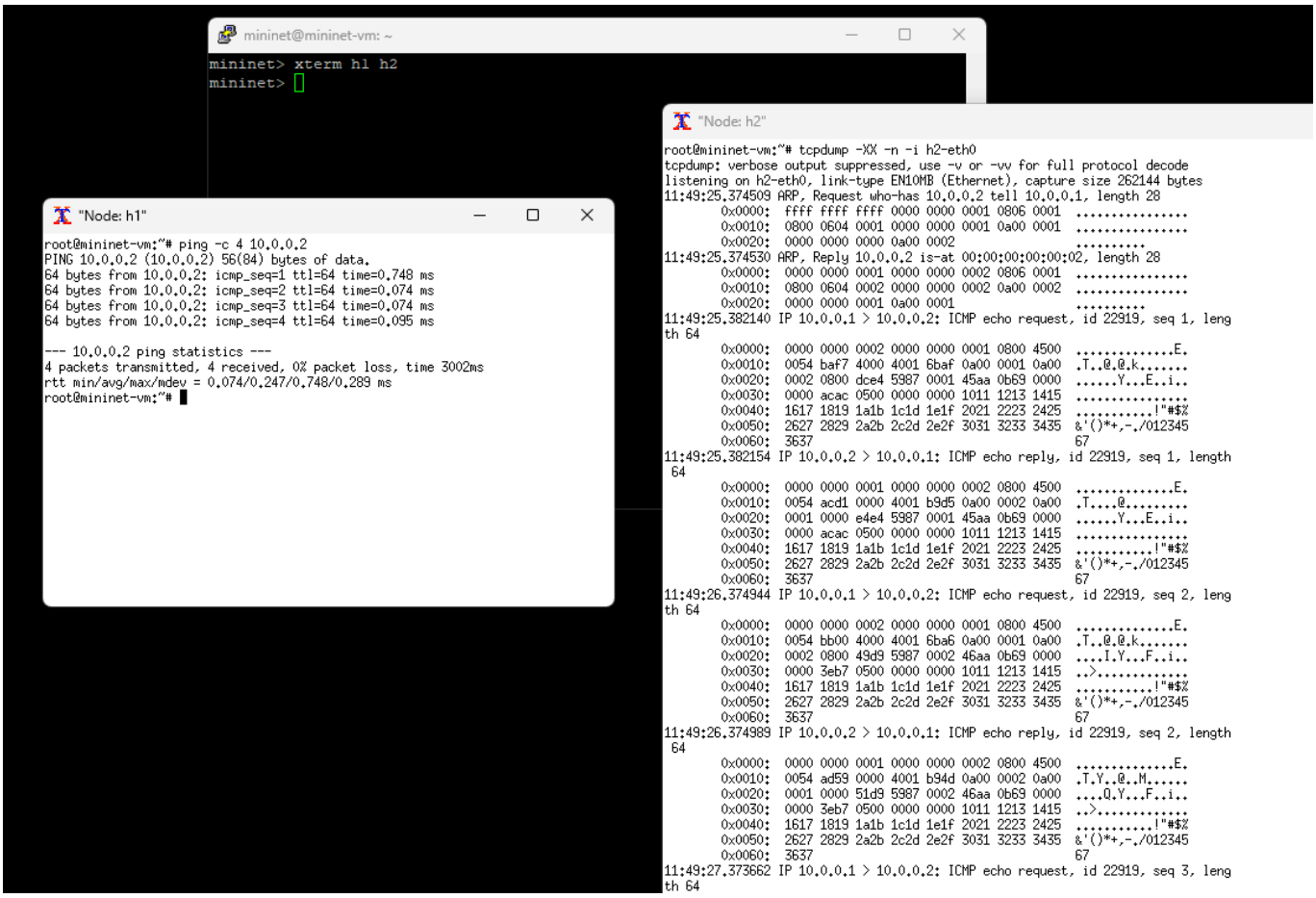
Esta ilustração foi criada utilizando o topology_builder.py, uma ferramenta que criei, semelhante à ferramenta disponibilida nos PDFs, para criar a ilustração da topologia baseada no comando dump, e links



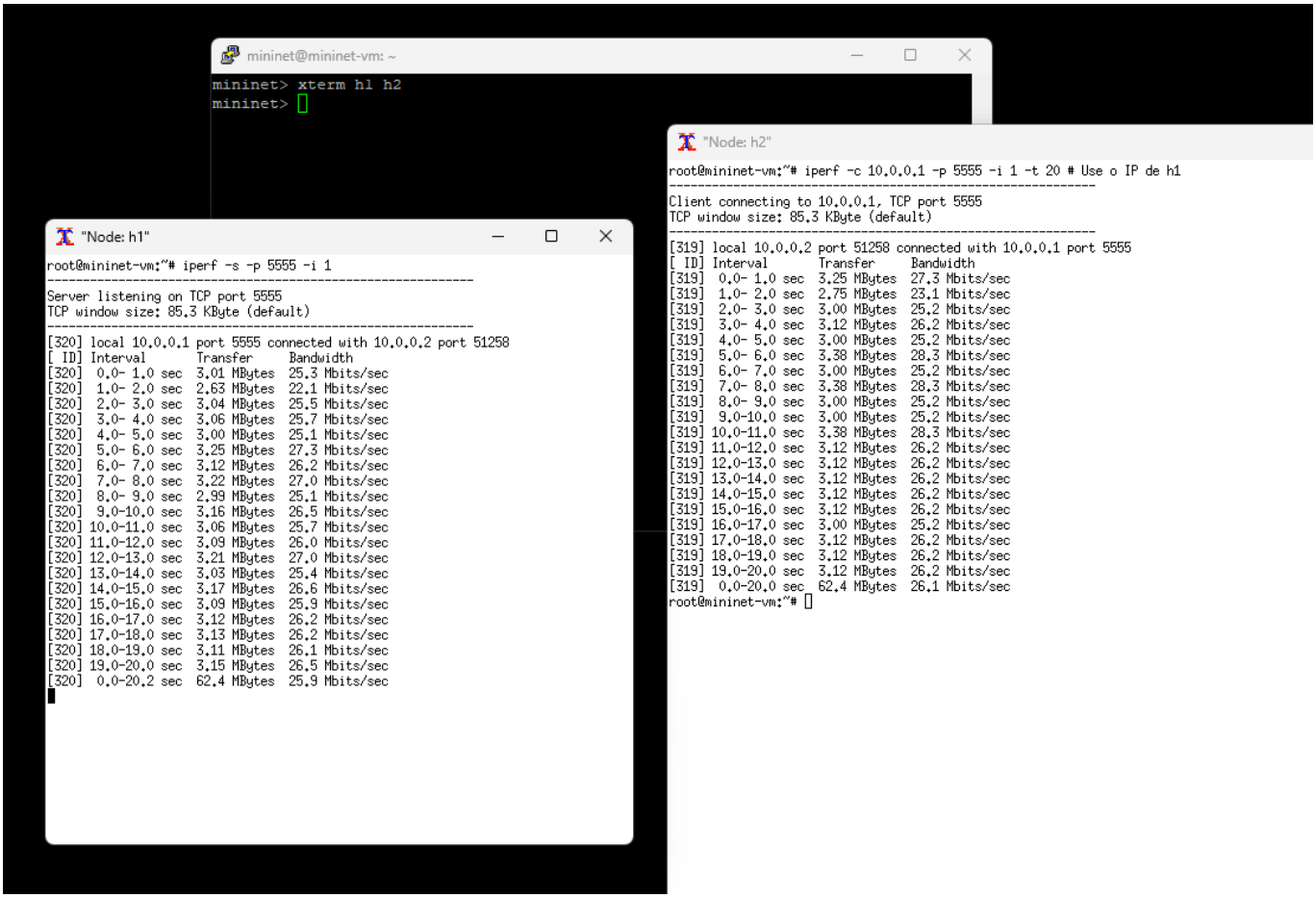
d) Testes de ping

Para os testes de ping, foi utilizado o xterm, para simulação de host 1 e host 2. Além disso, foi utilizado o comando tcpdump

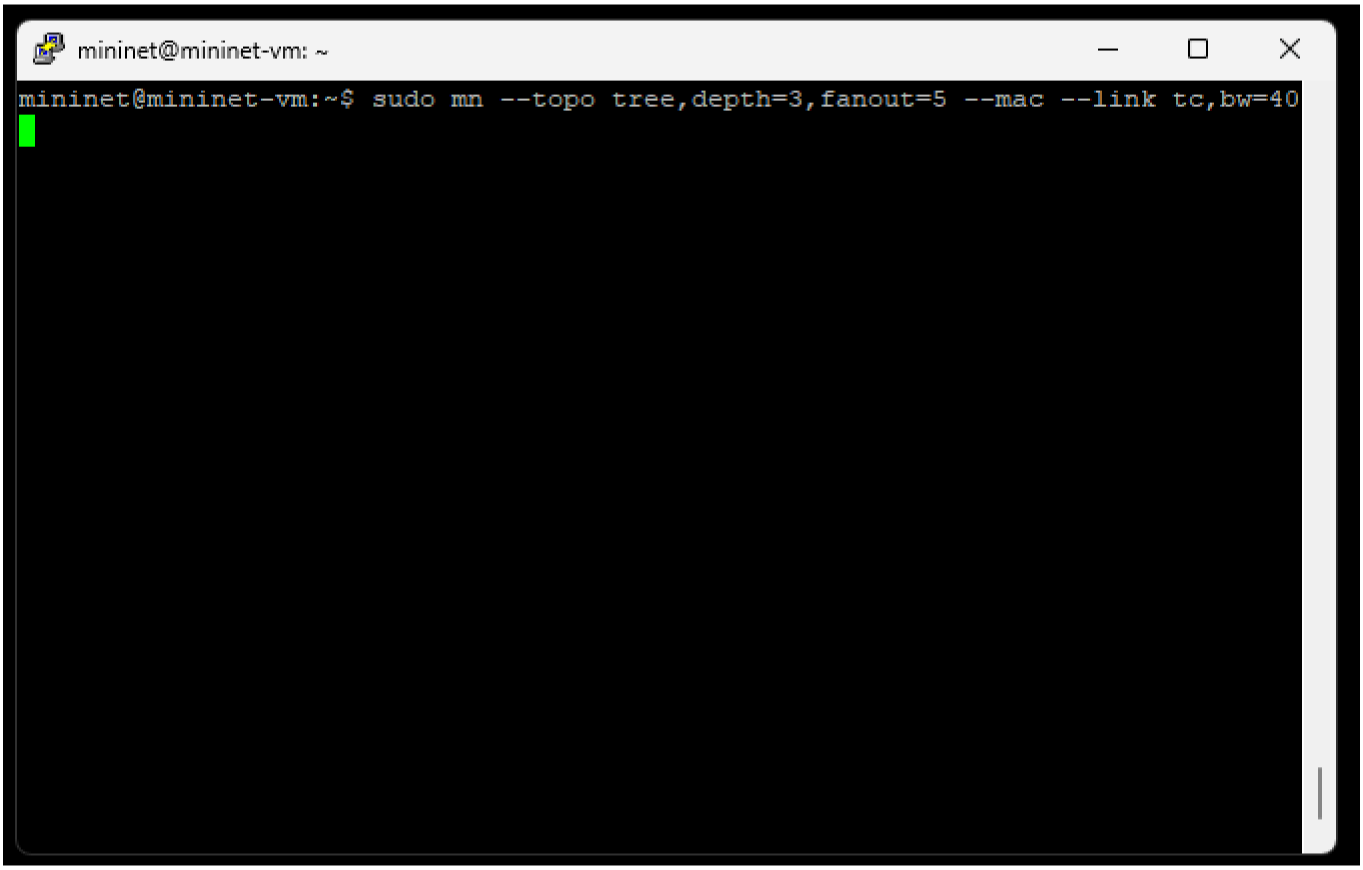


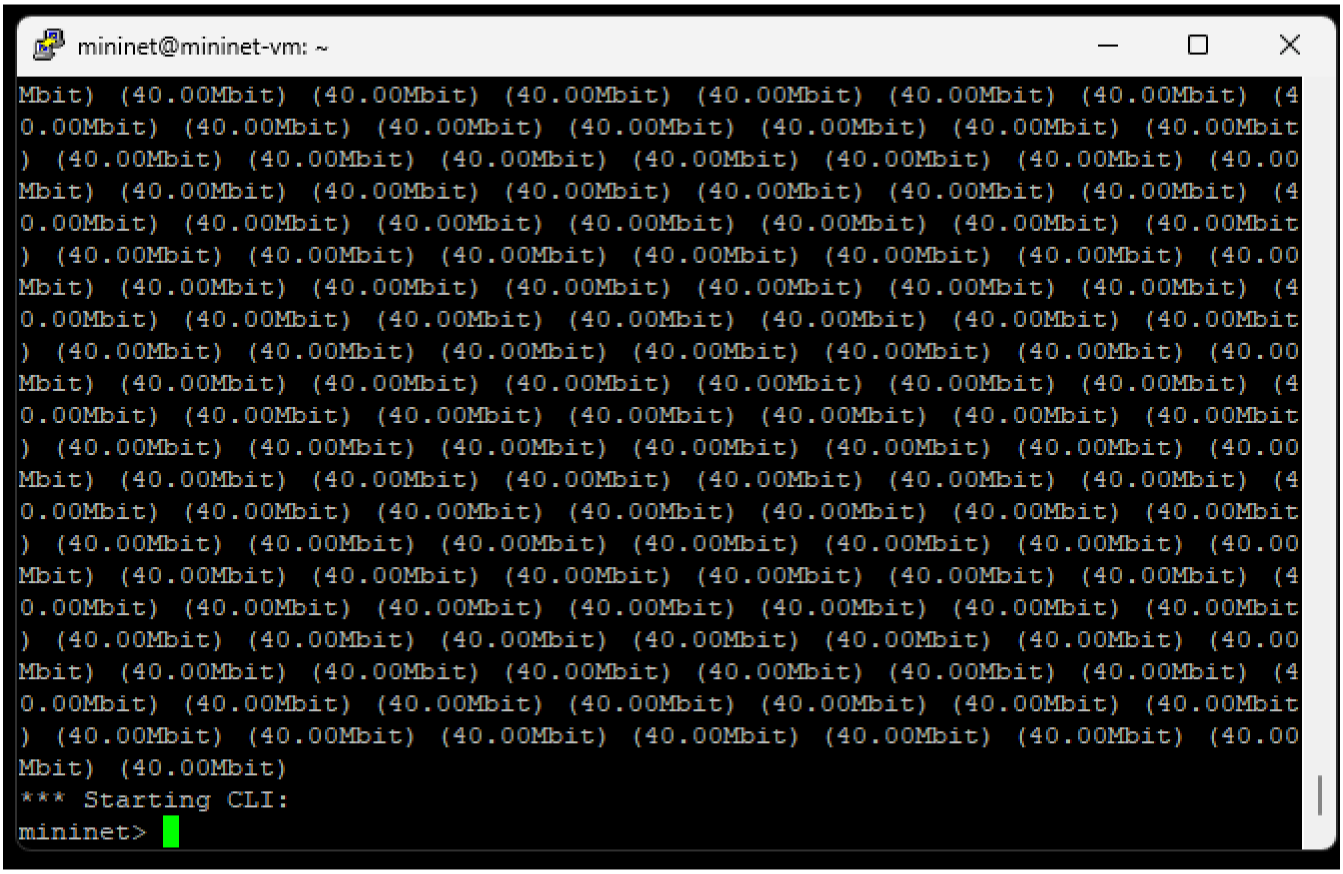


e) Testes com servidor TCP

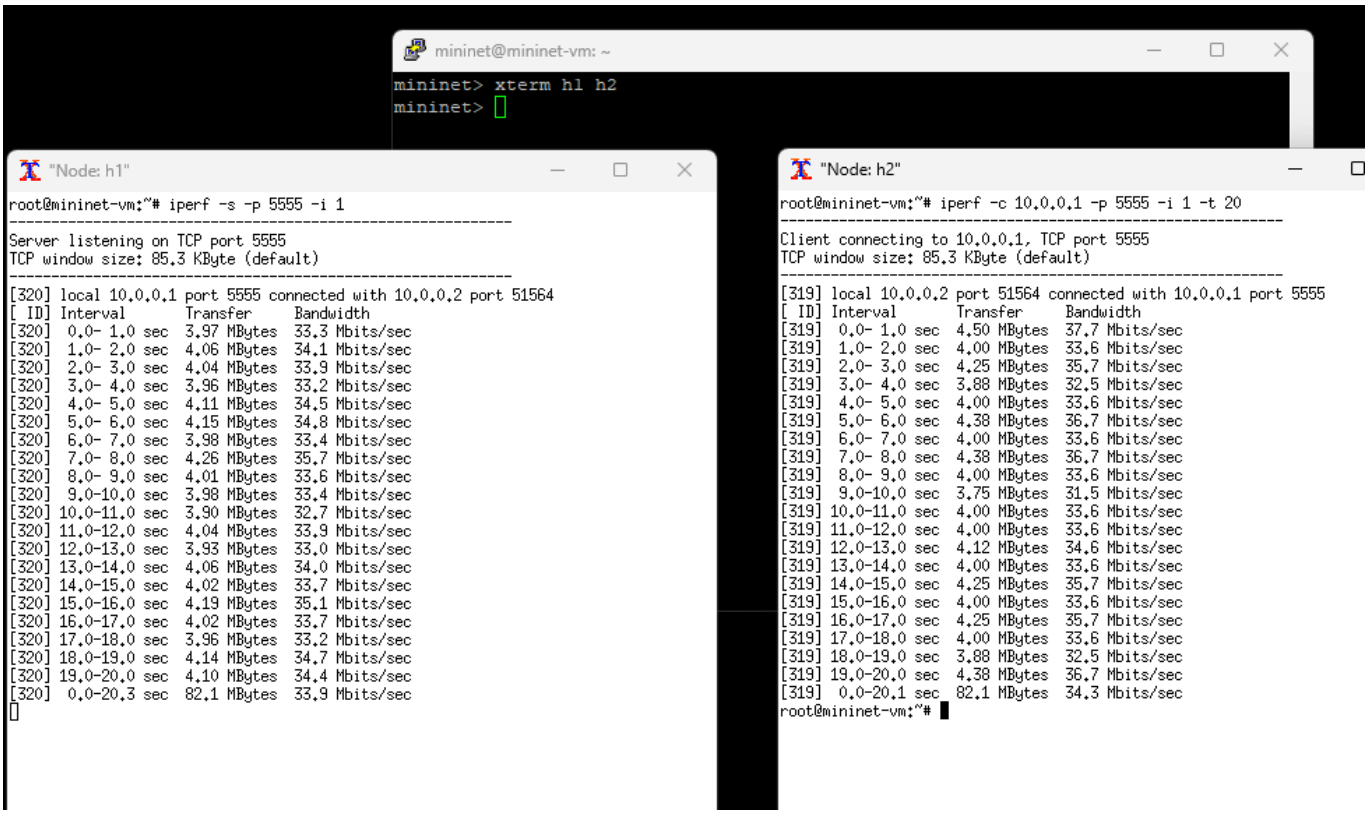


| Alterando a topologia da rede (criando uma rede nova, com as mesmas configurações, porém com 40MBps)





> Executando o iperf na rede de 40MBps


mininet@mininet-vm: ~
mininet> xterm h1 h2
mininet>
"Node: h1"
root@mininet-vm:~# iperf -s -p 5555 -i 1
Server listening on TCP port 5555
TCP window size: 85.3 KByte (default)
[320] local 10.0.0.1 port 5555 connected with 10.0.0.2 port 51564
[ID] Interval Transfer Bandwidth
[320] 0.0- 1.0 sec 3.97 MBytes 33.3 Mbits/sec
[320] 1.0- 2.0 sec 4.06 MBytes 34.1 Mbits/sec
[320] 2.0- 3.0 sec 4.04 MBytes 33.9 Mbits/sec
[320] 3.0- 4.0 sec 3.96 MBytes 33.2 Mbits/sec
[320] 4.0- 5.0 sec 4.11 MBytes 34.5 Mbits/sec
[320] 5.0- 6.0 sec 4.15 MBytes 34.8 Mbits/sec
[320] 6.0- 7.0 sec 3.98 MBytes 33.4 Mbits/sec
[320] 7.0- 8.0 sec 4.26 MBytes 35.7 Mbits/sec
[320] 8.0- 9.0 sec 4.01 MBytes 33.6 Mbits/sec
[320] 9.0-10.0 sec 3.98 MBytes 33.4 Mbits/sec
[320] 10.0-11.0 sec 3.90 MBytes 32.7 Mbits/sec
[320] 11.0-12.0 sec 4.04 MBytes 33.9 Mbits/sec
[320] 12.0-13.0 sec 3.93 MBytes 33.0 Mbits/sec
[320] 13.0-14.0 sec 4.06 MBytes 34.0 Mbits/sec
[320] 14.0-15.0 sec 4.02 MBytes 33.7 Mbits/sec
[320] 15.0-16.0 sec 4.19 MBytes 35.1 Mbits/sec
[320] 16.0-17.0 sec 4.02 MBytes 33.7 Mbits/sec
[320] 17.0-18.0 sec 3.96 MBytes 33.2 Mbits/sec
[320] 18.0-19.0 sec 4.14 MBytes 34.7 Mbits/sec
[320] 19.0-20.0 sec 4.10 MBytes 34.4 Mbits/sec
[320] 0.0-20.3 sec 82.1 MBytes 33.9 Mbits/sec
"Node: h2"
root@mininet-vm:~# iperf -c 10.0.0.1 -p 5555 -i 1 -t 20
Client connecting to 10.0.0.1, TCP port 5555
TCP window size: 85.3 KByte (default)
[319] local 10.0.0.2 port 51564 connected with 10.0.0.1 port 5555
[ID] Interval Transfer Bandwidth
[319] 0.0- 1.0 sec 4.50 MBytes 37.7 Mbits/sec
[319] 1.0- 2.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 2.0- 3.0 sec 4.25 MBytes 35.7 Mbits/sec
[319] 3.0- 4.0 sec 3.88 MBytes 32.5 Mbits/sec
[319] 4.0- 5.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 5.0- 6.0 sec 4.38 MBytes 36.7 Mbits/sec
[319] 6.0- 7.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 7.0- 8.0 sec 4.38 MBytes 36.7 Mbits/sec
[319] 8.0- 9.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 9.0-10.0 sec 3.75 MBytes 31.5 Mbits/sec
[319] 10.0-11.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 11.0-12.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 12.0-13.0 sec 4.12 MBytes 34.6 Mbits/sec
[319] 13.0-14.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 14.0-15.0 sec 4.25 MBytes 35.7 Mbits/sec
[319] 15.0-16.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 16.0-17.0 sec 4.25 MBytes 35.7 Mbits/sec
[319] 17.0-18.0 sec 4.00 MBytes 33.6 Mbits/sec
[319] 18.0-19.0 sec 3.88 MBytes 32.5 Mbits/sec
[319] 19.0-20.0 sec 4.38 MBytes 36.7 Mbits/sec
[319] 0.0-20.1 sec 82.1 MBytes 34.3 Mbits/sec
root@mininet-vm:~#