

# Hardwarepraktikum Internet-Technologien

## *Task 5: Router Configuration*

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**Julius-Maximilians-Universität Würzburg**

Chair of Computer Science III

A project report submitted by **Group 11**

Enrique Mesonero Ronco

Manuel Calvo Martín

Pablo E. Ortega Ureña

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## 5. Router Configuration

### 5.2. Configuration of the ports

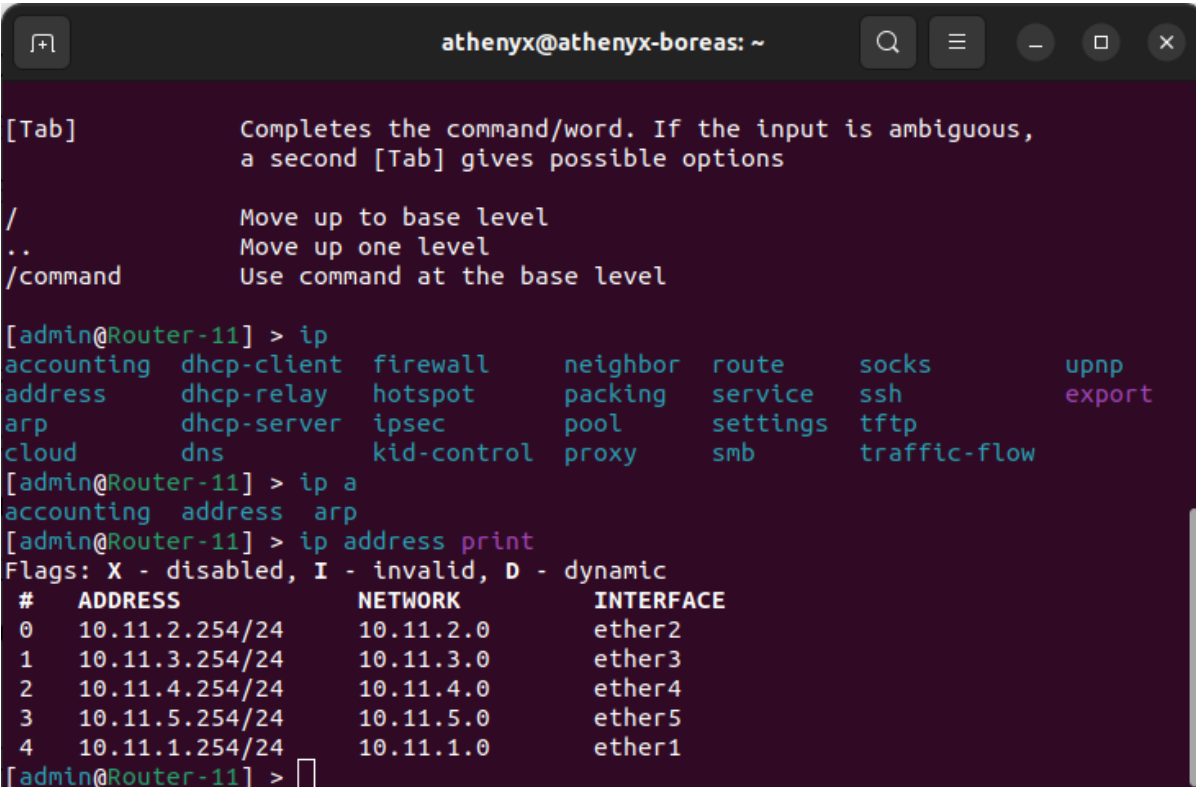
First, we have made the necessary configurations of the router, renaming it, setting the password and configuring the new IP addresses, as well as making the necessary configurations in our system.

```
[admin@MikroTik] > system identity set name=Router-11
[admin@Router-11] >
```

Figure 5.1: Setting router name

```
[admin@Router-11] > user set 0 password="hwp"
[admin@Router-11] >
```

Figure 5.2: Setting router password



```
athenyx@athenyx-boreas: ~
[Tab]          Completes the command/word. If the input is ambiguous,
                a second [Tab] gives possible options

/              Move up to base level
..            Move up one level
/command      Use command at the base level

[admin@Router-11] > ip
accounting    dhcp-client  firewall    neighbor    route       socks       upnp
address       dhcp-relay   hotspot    packing     service     ssh         export
arp           dhcp-server  ipsec      pool        settings    tftp
cloud         dns          kid-control proxy        smb         traffic-flow

[admin@Router-11] > ip a
accounting address arp
[admin@Router-11] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
#  ADDRESS          NETWORK    INTERFACE
0  10.11.2.254/24    10.11.2.0  ether2
1  10.11.3.254/24    10.11.3.0  ether3
2  10.11.4.254/24    10.11.4.0  ether4
3  10.11.5.254/24    10.11.5.0  ether5
4  10.11.1.254/24    10.11.1.0  ether1
[admin@Router-11] >
```

Figure 5.3: New IP addresses

```

[admin@Router-11] > quit
interrupted
      Connection to 192.168.88.1 closed.
athenyx@athenyx-boreas:~$ ping 192.168.88.1
PING 192.168.88.1 (192.168.88.1) 56(84) bytes of data.
64 bytes from 192.168.88.1: icmp_seq=1 ttl=64 time=0.168 ms
64 bytes from 192.168.88.1: icmp_seq=2 ttl=64 time=0.181 ms
^C
--- 192.168.88.1 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1012ms
rtt min/avg/max/mdev = 0.168/0.174/0.181/0.006 ms
athenyx@athenyx-boreas:~$ ssh admin@192.168.88.1
admin@192.168.88.1's password:

MMM      MMM      KKK      TTTTTTTTTT      KKK
MMMM     MMMM     KKK      TTTTTTTTTT      KKK
MMM MMMM MMM III KKK KKK RRRRRR      000000      TTT      III KKK KKK
MMM MM  MMM III KKKKK RRR RRR 000 000      TTT      III KKKKK
MMM      MMM III KKK KKK RRRRRR      000 000      TTT      III KKK KKK
MMM      MMM III KKK KKK RRR RRR 000000      TTT      III KKK KKK

MikroTik RouterOS 6.44.3 (c) 1999-2019      http://www.mikrotik.com/

[?]          Gives the list of available commands
command [?]  Gives help on the command and list of arguments

[Tab]        Completes the command/word. If the input is ambiguous,
              a second [Tab] gives possible options

/            Move up to base level
..           Move up one level
/command     Use command at the base level

[admin@Router-11] > 

```

*Figure 5.4: Connecting with new configuration*

DST-Addresses: IP Address  
 Pref-SRC: Gateway Address  
 Gateway: Pin number  
 (Figure 5.5)

```
athenyx@athenyx-boreas: ~  
bgp-communities      bgp-prepend  dst-address  routing-mark  vrf-interface  
bgp-local-pref       check-gateway gateway       scope         value-name  
[admin@Router-11] > ip route edit number=0 gateway  
[admin@Router-11] > interface b  
bonding bridge blink  
[admin@Router-11] > interface bridge  
calea host msti port vlan comment edit export monitor remove  
filter mdb nat settings add disable enable find print set  
[admin@Router-11] > interface bridge disable  
br1 numbers  
[admin@Router-11] > interface bridge disable b  
br1 numbers  
[admin@Router-11] > interface bridge disable br1  
[admin@Router-11] > ip route print  
Flags: X - disabled, A - active, D - dynamic,  
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,  
B - blackhole, U - unreachable, P - prohibit  
#      DST-ADDRESS      PREF-SRC      GATEWAY      DISTANCE  
0 ADC  10.11.1.0/24      10.11.1.254   ether1        0  
1 DC   10.11.2.0/24      10.11.2.254   ether2        255  
2 DC   10.11.3.0/24      10.11.3.254   ether3        255  
3 DC   10.11.4.0/24      10.11.4.254   ether4        255  
4 ADC  10.11.5.0/24      10.11.5.254   ether5        0  
[admin@Router-11] >
```

Figure 5.5: Gateways

Next, we ping the raspberry from the end device.

```
athenyx@athenyx-boreas:~$ ping 10.11.1.1  
PING 10.11.1.1 (10.11.1.1) 56(84) bytes of data.  
64 bytes from 10.11.1.1: icmp_seq=1 ttl=63 time=0.461 ms  
64 bytes from 10.11.1.1: icmp_seq=2 ttl=63 time=0.239 ms  
64 bytes from 10.11.1.1: icmp_seq=3 ttl=63 time=0.290 ms  
^C  
--- 10.11.1.1 ping statistics ---  
3 packets transmitted, 3 received, 0% packet loss, time 2033ms  
rtt min/avg/max/mdev = 0.239/0.330/0.461/0.094 ms  
athenyx@athenyx-boreas:~$
```

Figure 5.6: Pinging the Raspberry

(Note: To perform the ping, we had to deactivate the WLAN interface, otherwise it would not allow us to perform it, as it would default to it. We tried routing it manually but it would not work either.)

### 5.3. NAT Configuration

Next, we created the NAT and the filters, with the requirements of section 5.3., to subsequently carry out the necessary tests with the new configuration, trying to ping the Raspberry from the public end device. We saw that, from outside the network, unless it is done directly to the port it is not allowed. However, the other end device inside the same private network as the Raspberry is allowed, as that connection does not pass through the router.

```
[admin@Router-11] > ip firewall nat print
Flags: X - disabled, I - invalid, D - dynamic
 0 chain=srcnat action=masquerade out-interface=ether5

 1 chain=srcnat action=src-nat to-addresses=10.11.5.254
   src-address=10.11.5.0/24 out-interface=ether5
[admin@Router-11] >
```

*Figure 5.7: Creation of NAT*

```
[admin@Router-11] > ip firewall filter add chain=forward connection-state=new co
nnection-nat-state=!dstnat src-address=10.11.5.0/24
[admin@Router-11] > ip firewall filter
add      disable  enable  find  print  reset-counters  set
comment edit      export  move  remove  reset-counters-all  unset
[admin@Router-11] > ip firewall filter print
Flags: X - disabled, I - invalid, D - dynamic
 0 chain=forward connection-state=new connection-nat-state=!dstnat
   src-address=10.11.5.0/24
[admin@Router-11] >
```

*Figure 5.8: Creation of filter*

```
[admin@Router-11] > ip firewall filter print
Flags: X - disabled, I - invalid, D - dynamic
 0 chain=forward action=drop connection-state=new
   connection-nat-state=!dstnat src-address=10.11.5.0/24
[admin@Router-11] >

 2 chain=dstnat action=dst-nat to-addresses=10.11.1.1 to-ports=22
   protocol=tcp dst-address=10.11.5.254 dst-port=10022
[admin@Router-11] >
```

*Figure 5.9: Filter configuration*

No.	Time	Source	Destination	Protocol	Length	Info
2	0.000064581	fe80::7952:8d2b:716...	ff02::fb	MDNS	203	Standard query 0x0000 PTR _nfs._tcp.local, "Q"
3	4.087000945	10.11.5.254	255.255.255.255	MNDP	155	5678 → 5678 Len=113
4	4.087017717	Routerbo_ce:e6:e8	CDP/VTP/DTP/PagP/UD...	CDP	105	Device ID: Router-11 Port ID: ether5
5	4.087037914	Routerbo_ce:e6:e8	LLDP_Multicast	LLDP	112	MA/cc:2d:e0:ce:e6:e8 IN/ether5 120 SysN=Router
6	12.119237168	10.11.5.254	10.11.5.2	ICMP	98	Echo (ping) request id=0x02e4, seq=1/256, ttl
7	12.119257195	10.11.5.2	10.11.5.254	ICMP	98	Echo (ping) reply id=0x02e4, seq=1/256, ttl
8	13.131627419	10.11.5.254	10.11.5.2	ICMP	98	Echo (ping) request id=0x02e4, seq=2/512, ttl
9	13.131641646	10.11.5.2	10.11.5.254	ICMP	98	Echo (ping) reply id=0x02e4, seq=2/512, ttl
10	14.133134627	10.11.5.254	10.11.5.2	ICMP	98	Echo (ping) request id=0x02e4, seq=3/768, ttl
11	14.133147902	10.11.5.2	10.11.5.254	ICMP	98	Echo (ping) reply id=0x02e4, seq=3/768, ttl
12	15.211596422	10.11.5.254	10.11.5.2	ICMP	98	Echo (ping) request id=0x02e4, seq=4/1024, tt
13	15.211613875	10.11.5.2	10.11.5.254	ICMP	98	Echo (ping) reply id=0x02e4, seq=4/1024, tt
14	16.251583607	10.11.5.254	10.11.5.2	ICMP	98	Echo (ping) request id=0x02e4, seq=5/1280, tt
15	16.251596401	10.11.5.2	10.11.5.254	ICMP	98	Echo (ping) reply id=0x02e4, seq=5/1280, tt
16	17.110038670	Routerbo_ce:e6:e8	ASUSTekC_c7:4f:e5	ARP	60	Who has 10.11.5.2? Tell 10.11.5.254
17	17.110048618	ASUSTekC_c7:4f:e5	Routerbo_ce:e6:e8	ARP	42	10.11.5.2 is at 0c:9d:92:c7:4f:e5
18	17.369932959	ASUSTekC_c7:4f:e5	Routerbo_ce:e6:e8	ARP	42	Who has 10.11.5.254? Tell 10.11.5.2
19	17.370059676	Routerbo_ce:e6:e8	ASUSTekC_c7:4f:e5	ARP	60	10.11.5.254 is at cc:2d:e0:ce:e6:e8

Figure 5.10: Checking with Wireshark

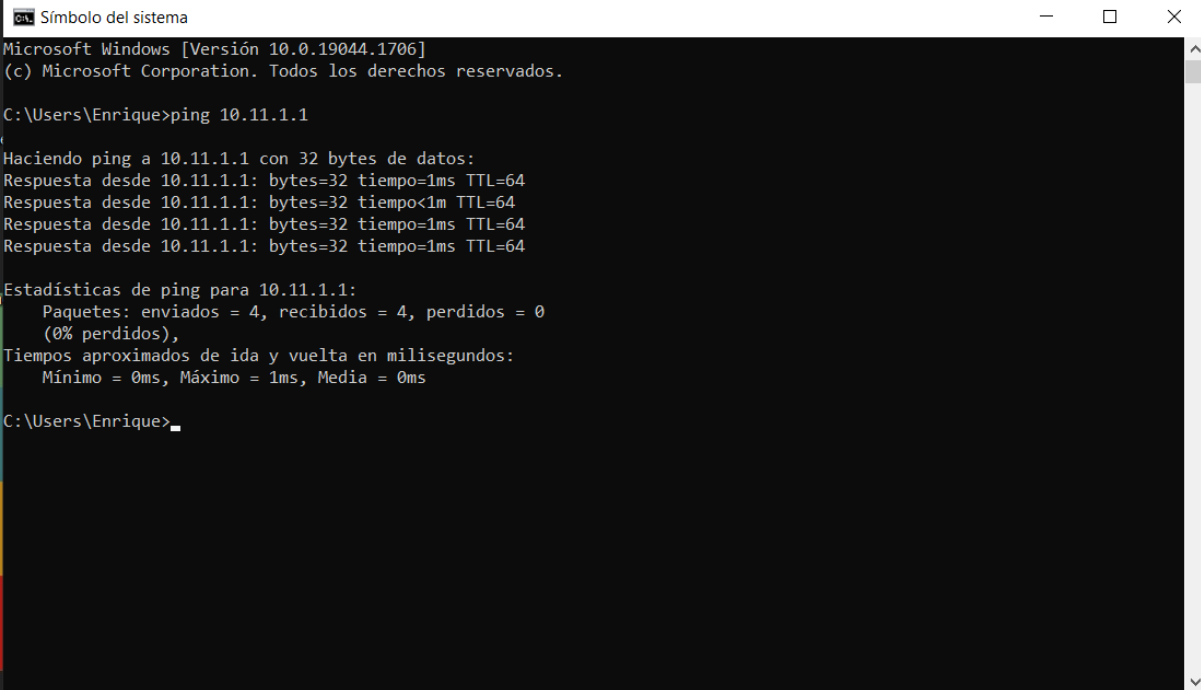
```

athenyx@athenyx-boreas:~$ ping 10.11.1.1
PING 10.11.1.1 (10.11.1.1) 56(84) bytes of data.
^C
--- 10.11.1.1 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 1019ms

athenyx@athenyx-boreas:~$ ping 10.11.5.254 -p 10022
PATTERN: 0x100202
PING 10.11.5.254 (10.11.5.254) 56(84) bytes of data.
64 bytes from 10.11.5.254: icmp_seq=1 ttl=64 time=0.250 ms
64 bytes from 10.11.5.254: icmp_seq=2 ttl=64 time=0.223 ms
64 bytes from 10.11.5.254: icmp_seq=3 ttl=64 time=0.232 ms
64 bytes from 10.11.5.254: icmp_seq=4 ttl=64 time=0.240 ms
64 bytes from 10.11.5.254: icmp_seq=5 ttl=64 time=0.211 ms
^C
--- 10.11.5.254 ping statistics ---
5 packets transmitted, 5 received, 0% packet loss, time 4091ms
rtt min/avg/max/mdev = 0.211/0.231/0.250/0.013 ms
athenyx@athenyx-boreas:~$

```

Figure 5.11: Pinging the Raspberry (Public device)



```
Símbolo del sistema
Microsoft Windows [Versión 10.0.19044.1706]
(c) Microsoft Corporation. Todos los derechos reservados.

C:\Users\Enrique>ping 10.11.1.1

Haciendo ping a 10.11.1.1 con 32 bytes de datos:
Respuesta desde 10.11.1.1: bytes=32 tiempo=1ms TTL=64
Respuesta desde 10.11.1.1: bytes=32 tiempo<1m TTL=64
Respuesta desde 10.11.1.1: bytes=32 tiempo=1ms TTL=64
Respuesta desde 10.11.1.1: bytes=32 tiempo=1ms TTL=64

Estadísticas de ping para 10.11.1.1:
    Paquetes: enviados = 4, recibidos = 4, perdidos = 0
        (0% perdidos),
    Tiempos aproximados de ida y vuelta en milisegundos:
        Mínimo = 0ms, Máximo = 1ms, Media = 0ms

C:\Users\Enrique>
```

*Figure 5.12: Pinging the Raspberry (Private device)*



## 5.4. Remote subnets and routing protocols

### 5.4.1. New test configuration

First, we configure the switch and the router, assigning the IP 10.0.0.2/30 to the port 1 of the switch and 10.0.0.1/30 to the router. Our bridge still retains the 10.11.1.3/24 IP address, which is also the gateway for the Raspberry. We make the connections between the switch and the router as shown in Figure 11 of the exercise, as well as the Raspberry and the two end devices. Both switch and router can communicate with each other using ping, but not our Raspberry and PC.

```
[admin@Switch-11] > ping 10.0.0.1
SEQ HOST                                SIZE TTL TIME  STATUS
 0 10.0.0.1                             56 64 0ms
 1 10.0.0.1                             56 64 0ms
sent=2 received=2 packet-loss=0% min-rtt=0ms avg-rtt=0ms max-rtt=0ms
[admin@Switch-11] > █
```

*Figure 5.13: Pinging the router via switch*

```
pi@raspberrypi:~ $ ping 10.11.4.2
PING 10.11.4.2 (10.11.4.2) 56(84) bytes of data.
^C
--- 10.11.4.2 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 4ms
pi@raspberrypi:~ $ █
```

*Figure 5.14: Trying to ping the public end device via Raspberry*

```
athenyx@athenyx-boreas:~$ ping 10.11.1.1
PING 10.11.1.1 (10.11.1.1) 56(84) bytes of data.
^C
--- 10.11.1.1 ping statistics ---
3 packets transmitted, 0 received, 100% packet loss, time 2050ms
```

*Figure 5.15: Trying to ping the Raspberry via public end device*

### 5.4.2. Static routes

Following that, in order to make the connection between end devices possible, we add new routes under /ip route, both in the router and the switch. Our added routes have two flags, A, meaning it is active and S, meaning it is a static route created by us. The ping between the end devices now works.

```

10.11.1.3 - PuTTY
3 A S 10.11.3.0/24 10.0.0.2 1
4 A S 10.11.4.0/24 10.0.0.2 1
5 A S 10.11.5.0/24 10.0.0.2 1
[admin@Switch-11] > ip route edit number=5 gateway
[admin@Switch-11] > ip route edit number=4 gateway
[admin@Switch-11] > ip route edit number=3 gateway
[admin@Switch-11] > ip route edit number=2 gateway
[admin@Switch-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.1 br1 0
1 ADC 10.11.1.0/24 10.11.1.3 br1 0
2 A S 10.11.2.0/24 10.0.0.2 1
3 A S 10.11.3.0/24 10.0.0.2 1
4 A S 10.11.4.0/24 10.0.0.2 1
5 A S 10.11.5.0/24 10.0.0.2 1
[admin@Switch-11] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
# ADDRESS NETWORK INTERFACE
0 10.11.1.3/24 10.11.1.0 br1
1 10.0.0.1/30 10.0.0.0 ether1
[admin@Switch-11] >

```

Figure 5.16: Static connections created (switch)

```

[admin@Router-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.1 ether1 0
1 A S 10.11.1.0/24 10.0.0.2 ether1 1
2 DC 10.11.2.0/24 10.11.2.254 ether2 255
3 DC 10.11.3.0/24 10.11.3.254 ether3 255
4 ADC 10.11.4.0/24 10.11.4.254 ether4 0
5 DC 10.11.5.0/24 10.11.5.254 ether5 255
[admin@Router-11] >

```

```

hwp@hwp-r: ~
File Edit View Search Terminal Help
hwp@hwp-r:~$ ping 10.11.1.1
PING 10.11.1.1 (10.11.1.1) 56(84) bytes of data.
64 bytes from 10.11.1.1: icmp_seq=1 ttl=62 time=0.784 ms
64 bytes from 10.11.1.1: icmp_seq=2 ttl=62 time=1.63 ms
64 bytes from 10.11.1.1: icmp_seq=3 ttl=62 time=0.667 ms
^C
--- 10.11.1.1 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2017ms
rtt min/avg/max/mdev = 0.667/1.029/1.636/0.431 ms

```

Figure 5.17: Static connections created (router) and proof of ping

### 5.3.3. Dynamic Routes and Routing Protocols

We remove the static routing routes from our switch and router devices. The ping no longer works. Then, we add the networks of both to the RIP protocol.

```

[admin@Router-11] > routing rip network remove numbers=0,1,2,3,4
[admin@Router-11] > routing rip network print
Flags: X - disabled
# NETWORK
[admin@Router-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.1 ether1 0
1 DC 10.11.2.0/24 10.11.2.254 ether2 255
2 DC 10.11.3.0/24 10.11.3.254 ether3 255
3 ADC 10.11.4.0/24 10.11.4.254 ether4 0
4 DC 10.11.5.0/24 10.11.5.254 ether5 255
[admin@Router-11] >

```

Figure 5.18: Static connections deleted (router)

```

[admin@Router-11] > routing rip network print
Flags: X - disabled
# NETWORK
0 10.0.0.0/30
1 10.11.2.0/24
2 10.11.3.0/24
3 10.11.4.0/24
4 10.11.5.0/24
[admin@Router-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.1 ether1 0
1 ADr 10.11.1.0/24 10.0.0.2 120
2 DC 10.11.2.0/24 10.11.2.254 ether2 255
3 DC 10.11.3.0/24 10.11.3.254 ether3 255
4 ADC 10.11.4.0/24 10.11.4.254 ether4 0
5 DC 10.11.5.0/24 10.11.5.254 ether5 255
[admin@Router-11] >

```

Figure 5.19: Networks added to RIP protocol (router)

```

[admin@Switch-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.2 ether1 0
1 ADC 10.11.1.0/24 10.11.1.3 br1 0
2 ADr 10.11.4.0/24 10.0.0.1 120
[admin@Switch-11] >

```

Figure 5.20: Networks added to RIP protocol (switch)

Again we tried to ping the end devices, now working successfully with the new RIP connection.

Finally, we removed the RIP connections and added the networks to the OSPF protocol. This time, it took more time for the route to appear on the route tables, but in the end it appeared, and the connection began working again.

```
[admin@Switch-11] > routing rip network remove numbers=0,1
[admin@Switch-11] > routing rip network print
Flags: X - disabled
# NETWORK
[admin@Switch-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.2 ether1 0
1 ADC 10.11.1.0/24 10.11.1.3 br1 0
[admin@Switch-11] >
```

Figure 5.21: Remove RIP connections (switch)

```
[admin@Router-11] > routing rip network remove numbers=0,1,2,3,4
[admin@Router-11] > routing rip network print
Flags: X - disabled
# NETWORK
[admin@Router-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
# DST-ADDRESS PREF-SRC GATEWAY DISTANCE
0 ADC 10.0.0.0/30 10.0.0.1 ether1 0
1 DC 10.11.2.0/24 10.11.2.254 ether2 255
2 DC 10.11.3.0/24 10.11.3.254 ether3 255
3 ADC 10.11.4.0/24 10.11.4.254 ether4 0
4 DC 10.11.5.0/24 10.11.5.254 ether5 255
[admin@Router-11] >
```

Figure 5.22: Remove RIP connections (router)

```
[admin@Switch-11] > routing ospf area print
Flags: X - disabled, I - invalid, * - default
# NAME AREA-ID TYPE DEFAULT-COST
0 * backbone 0.0.0.0 default
[admin@Switch-11] >
```

Figure 5.23: Seeing OSPF area (switch)

```
[admin@Router-11] > routing ospf area print
Flags: X - disabled, I - invalid, * - default
# NAME AREA-ID TYPE DEFAULT-COST
0 * backbone 0.0.0.0 default
[admin@Router-11] >
```

Figure 5.24: Seeing OSPF area (router)

```
[admin@Switch-11] > routing ospf network print
Flags: X - disabled, I - invalid
#   NETWORK          AREA
0   10.0.0.0/30       backbone
1   10.11.1.0/24      backbone
[admin@Switch-11] >
```

Figure 5.25: Adding networks to OSPF protocol (switch)

```
[admin@Router-11] > routing ospf network print
Flags: X - disabled, I - invalid
#   NETWORK          AREA
0   10.0.0.0/30       backbone
1   10.11.2.0/24      backbone
2   10.11.3.0/24      backbone
3   10.11.4.0/24      backbone
4   10.11.5.0/24      backbone
[admin@Router-11] >
```

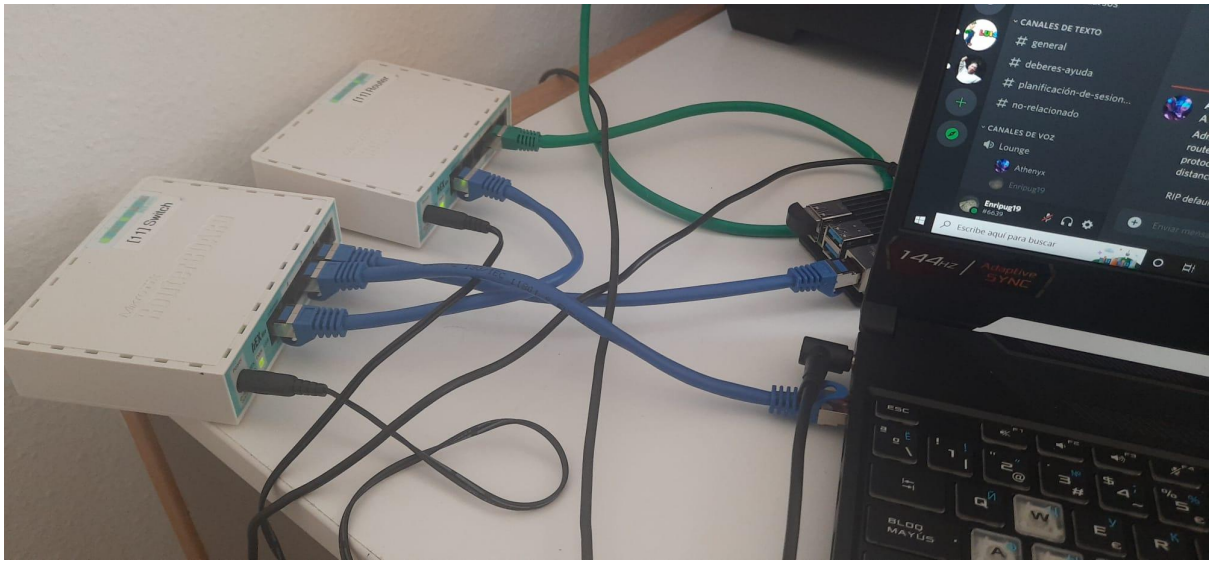
Figure 5.26: Adding networks to OSPF protocol (router)

```
[admin@Switch-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
#   DST-ADDRESS      PREF-SRC      GATEWAY      DISTANCE
0 ADC 10.0.0.0/30       10.0.0.2      ether1        0
1 ADC 10.11.1.0/24     10.11.1.3     br1           0
2 ADo 10.11.4.0/24      10.0.0.1      110
```

Figure 5.27: Seeing OSPF network (switch)

```
[admin@Router-11] > ip route print
Flags: X - disabled, A - active, D - dynamic,
C - connect, S - static, r - rip, b - bgp, o - ospf, m - mme,
B - blackhole, U - unreachable, P - prohibit
#   DST-ADDRESS      PREF-SRC      GATEWAY      DISTANCE
0 ADC 10.0.0.0/30       10.0.0.1      ether1        0
1 ADo 10.11.1.0/24     10.0.0.2      110
2 DC  10.11.2.0/24      10.11.2.254   ether2        255
3 DC  10.11.3.0/24      10.11.3.254   ether3        255
4 ADC 10.11.4.0/24     10.11.4.254   ether4        0
5 DC  10.11.5.0/24      10.11.5.254   ether5        255
[admin@Router-11] >
```

Figure 5.28: Seeing OSPF network (router)



*Figure 5.29: Physical connections*