Topologia Static & RIP

NAT (Network Address Translation) – é um serviço que faz uma tradução entre IP's externos e IP's internos!

- Ativar sempre NAT na saída das empresas!

RISP

Existe conectividade com o exterior!

```
RISP

%Error opening tftp://192.168.122.1/RISP-confg (Timed out)
RISP#
RISP#
RISP#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 11/11/12 ms
RISP#
```

E com a interface Loopback

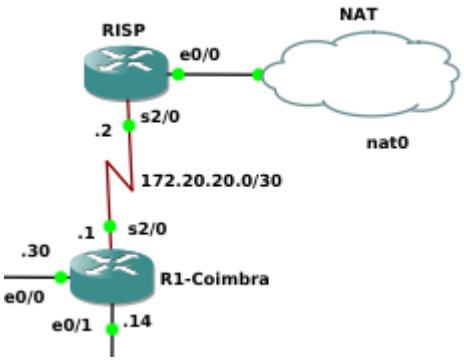
```
RISP
RISP#
RISP#ping 2.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 4/4/6 ms
RISP#
```

int s2/0

ip add 172.20.20.2 255.255.255.252

no shut

R1-Coimbra



Como é que consigo por o R1-Coimbra a pingar o exterior?

int s2/0

ip add 172.20.20.1 255.255.255.1

no shut

int e0/1

ip add 194.65.52.14 255.255.255.240

no shut

int e0/0

ip add 194.65.52.30 255.255.255.240

no shut

Verificamos as rotas que temos para fora! (tabela de encaminhamento)

sh ip route

RISP | R1-Coimbra

```
        + - replicated route, % - next hop override

Gateway of last resort is not set

      172.20.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.20.20.0/30 is directly connected, Serial2/0
L        172.20.20.1/32 is directly connected, Serial2/0
      194.65.52.0/24 is variably subnetted, 4 subnets, 2 masks
C        194.65.52.0/28 is directly connected, Ethernet0/1
L        194.65.52.14/32 is directly connected, Ethernet0/1
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.30/32 is directly connected, Ethernet0/0
R1-Coimbra#
```

Ao verificar a tabela de encaminhamento verificamos que temos 3 redes! **Connected (C)**

Cada rede que aqui está é cada uma das interfaces que o router tem!

Então, como dizemos ao router para que todo o tráfego por omissão vai para a internet (default route)?

conf t

ip route 0.0.0.0 0.0.0.0 s2/0

Se verificarmos a tabela de encaminhamento agora, já vai aparecer a default route!

```
RISP    R1-Coimbra

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S*     0.0.0.0/0 is directly connected, Serial2/0
       172.20.0.0/16 is variably subnetted, 2 subnets, 2 masks
C         172.20.20.0/30 is directly connected, Serial2/0
L         172.20.20.1/32 is directly connected, Serial2/0
       194.65.52.0/24 is variably subnetted, 4 subnets, 2 masks
C         194.65.52.0/28 is directly connected, Ethernet0/1
L         194.65.52.14/32 is directly connected, Ethernet0/1
C         194.65.52.16/28 is directly connected, Ethernet0/0
L         194.65.52.30/32 is directly connected, Ethernet0/0
R1-Coimbra#
```

É do tipo *static* (S*) porque foi introduzida estaticamente pelo gestor!

Conseguimos pingar o exterior agora? NÃO!

```
R1-Coimbra#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
R1-Coimbra#
```

E a Loopback? SIM!

```
R1-Coimbra#ping 2.2.2.2
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 2.2.2.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 9/10/14 m
s
R1-Coimbra#
```

Do R1-Coimbra conseguimos chegar ao RISP (2.2.2.2) mas não conseguimos sair para fora (internet, 1.1.1.1), mas no RISP conseguimos sair para fora (1.1.1.1), porque está a acontecer isto?

Porque temos uma cloud NAT que traduz os IP's a entrada (nat0) para os IP's da máquina host para seguir para o exterior.

Quando eu saio através do RISP saio com que IP? 192.168.122.255

```
RISP#sh ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                192.168.122.225 YES DHCP   up                    up
Ethernet0/1                unassigned      YES unset  administratively down down
Ethernet0/2                unassigned      YES unset  administratively down down
Ethernet0/3                unassigned      YES unset  administratively down down
Ethernet1/0                unassigned      YES unset  administratively down down
Ethernet1/1                unassigned      YES unset  administratively down down
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
Serial2/0                  172.20.20.2     YES manual up                    up
Serial2/1                  unassigned      YES unset  administratively down down
Serial2/2                  unassigned      YES unset  administratively down down
Serial2/3                  unassigned      YES unset  administratively down down
Serial3/0                  unassigned      YES unset  administratively down down
Serial3/1                  unassigned      YES unset  administratively down down
Serial3/2                  unassigned      YES unset  administratively down down
Serial3/3                  unassigned      YES unset  administratively down down
Loopback0                  2.2.2.2         YES manual up                    up
RISP#
```

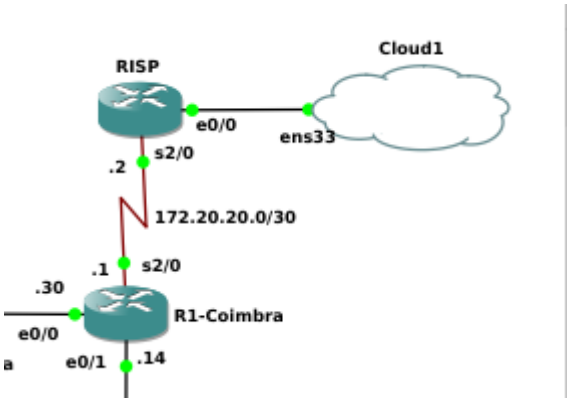
Quando eu saio do R1-Coimbra saio com que IP? 172.20.20.1

```
R1-Coimbra#sh ip interface br
R1-Coimbra#sh ip interface brief
Interface                  IP-Address      OK? Method Status                Protocol
Ethernet0/0                194.65.52.30    YES manual up                    up
Ethernet0/1                194.65.52.14    YES manual up                    up
Ethernet0/2                unassigned      YES unset  administratively down down
Ethernet0/3                unassigned      YES unset  administratively down down
Ethernet1/0                unassigned      YES unset  administratively down down
Ethernet1/1                unassigned      YES unset  administratively down down
Ethernet1/2                unassigned      YES unset  administratively down down
Ethernet1/3                unassigned      YES unset  administratively down down
Serial2/0                  172.20.20.1     YES manual up                    up
Serial2/1                  unassigned      YES unset  administratively down down
Serial2/2                  unassigned      YES unset  administratively down down
Serial2/3                  unassigned      YES unset  administratively down down
Serial3/0                  unassigned      YES unset  administratively down down
Serial3/1                  unassigned      YES unset  administratively down down
Serial3/2                  unassigned      YES unset  administratively down down
Serial3/3                  unassigned      YES unset  administratively down down
R1-Coimbra#
```

A cloud NAT está a responder bem porque não conhece pedidos com o IP 172.20.20.1!

Então a cloud NAT é só para os IP's da rede .122 e não de todos!

Para ajudar neste “problema”, podemos alterar a cloud NAT para cloud e assim esta cloud consegue traduzir tudo porque vamos ter a Máquina Virtual a fazer NAT para fora!



Desta forma o R1-Coimbra já consegue pingar o exterior!

```
RISP    R1-Coimbra

R1-Coimbra#
R1-Coimbra#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 20/21/23 ms
R1-Coimbra#
```

MAS se formos obrigados a usar a cloud NAT?

Ativar o NAT no RISP!!

RISP

conf t

access-list 10 permit any

*int e0/0 – **porta de saída***

ip nat outside

int s2/0

ip nat inside

exit

ip nat inside source list 10 interface e0/0 overload

Atenção: Outside só podemos ter 1, inside as que forem precisas (nas restantes interfaces para dentro)

Ping Exterior R1-Coimbra √

```
RISP    R1-Coimbra
R1-Coimbra#
R1-Coimbra#
R1-Coimbra#ping 1.1.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 1.1.1.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 21/21/21 ms
R1-Coimbra#
```

NAT R1-Coimbra

conf t

access-list 10 permit any

int s2/0

ip nat outside

int e0/0

ip nat inside

int e0/1

ip nat inside

exit

ip nat inside source list 10 int s2/0 overload

Neste momento já temos o PC1 a comunicar com o exterior √

```
RISP    R1-Coimbra    PC1

PC1> ping 1.1.1.1

84 bytes from 1.1.1.1 icmp_seq=1 ttl=125 time=21.630 ms
84 bytes from 1.1.1.1 icmp_seq=2 ttl=125 time=20.715 ms
84 bytes from 1.1.1.1 icmp_seq=3 ttl=125 time=22.037 ms
84 bytes from 1.1.1.1 icmp_seq=4 ttl=125 time=21.572 ms
84 bytes from 1.1.1.1 icmp_seq=5 ttl=125 time=21.745 ms

PC1>
```

PC2 a comunicar com o exterior √ (porque também está ligado ao R1-Coimbra)

```
RISP   R1-Coimbra   PC1   PC2

PC2 : 194.65.52.17 255.255.255.240 gateway 194.65.52.30

PC2> ping 1.1.1.1

84 bytes from 1.1.1.1 icmp_seq=1 ttl=125 time=22.198 ms
84 bytes from 1.1.1.1 icmp_seq=2 ttl=125 time=22.897 ms
84 bytes from 1.1.1.1 icmp_seq=3 ttl=125 time=23.242 ms
84 bytes from 1.1.1.1 icmp_seq=4 ttl=125 time=21.169 ms
84 bytes from 1.1.1.1 icmp_seq=5 ttl=125 time=18.367 ms

PC2>
```

R2-Coimbra

int e0/1

ip add 194.65.52.126 255.255.255.192

no shut

int e0/0

ip add 194.65.52.29 255.255.255.240

no shut

PC3 pinga o exterior? NÃO!

```
RISP | R1-Coimbra | PC1 | PC2 | R2-Coimbra | PC3

Executing the startup file


Checking for duplicate address...
PC3 : 194.65.52.65 255.255.255.192 gateway 194.65.52.126

PC3> ping 1.1.1.1

*194.65.52.126 icmp_seq=1 ttl=255 time=0.352 ms (ICMP type:3, code:
1, Destination host unreachable)
*194.65.52.126 icmp_seq=2 ttl=255 time=0.782 ms (ICMP type:3, code:
1, Destination host unreachable)
*194.65.52.126 icmp_seq=3 ttl=255 time=0.931 ms (ICMP type:3, code:
1, Destination host unreachable)
*194.65.52.126 icmp_seq=4 ttl=255 time=0.706 ms (ICMP type:3, code:
1, Destination host unreachable)
*194.65.52.126 icmp_seq=5 ttl=255 time=1.616 ms (ICMP type:3, code:
1, Destination host unreachable)

PC3>
```

Mensagem *"Destination host unreachable"* – é uma mensagem a dizer que o R2-Coimbra não encontra a rota!

Solução!

Ativar um protocolo de encaminhamento dinâmico! RIP

No RIP ativa-se as redes de dentro das empresas e não para fora! (Protocolo Interior)

R1-Coimbra

conf t

router rip

network 194.65.52.0

ATENÇÃO: O comando *network* é um comando **classful** (não tem mascara)!

R2-Coimbra

conf t

router rip

network 194.65.52.0

Com o protocolo ativado agora na tabela de encaminhamento aparece uma rota RIP (R)! (vai aparecer a rota que era interna ao R1-Coimbra 194.65.52.0/28)

```
RISP | R1-Coimbra | PC1 | PC2 | R2-Coimbra | PC3

       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

      194.65.52.0/24 is variably subnetted, 5 subnets, 3 masks
R        194.65.52.0/28 [120/1] via 194.65.52.30, 00:00:10, Ethernet0/0
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.29/32 is directly connected, Ethernet0/0
C        194.65.52.64/26 is directly connected, Ethernet0/1
L        194.65.52.126/32 is directly connected, Ethernet0/1
R2-Coimbra#
```

No R1-Coimbra aparece a rota (R)? NÃO!

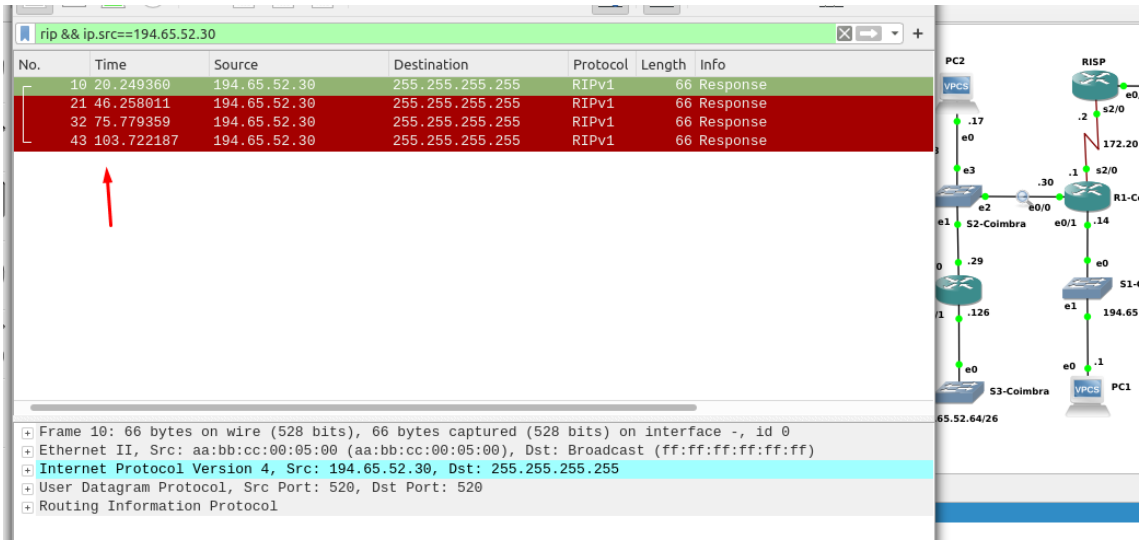
```
RISP | R1-Coimbra | PC1 | PC2 | R2-Coimbra | PC3

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S*    0.0.0.0/0 is directly connected, Serial2/0
      172.20.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.20.20.0/30 is directly connected, Serial2/0
L        172.20.20.1/32 is directly connected, Serial2/0
      194.65.52.0/24 is variably subnetted, 4 subnets, 2 masks
C        194.65.52.0/28 is directly connected, Ethernet0/1
L        194.65.52.14/32 is directly connected, Ethernet0/1
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.30/32 is directly connected, Ethernet0/0
R1-Coimbra#
```

PORQUÊ?

RIPv1 funciona em subnetting, **MAS NÃO FUNCIONA** em VLSM!!

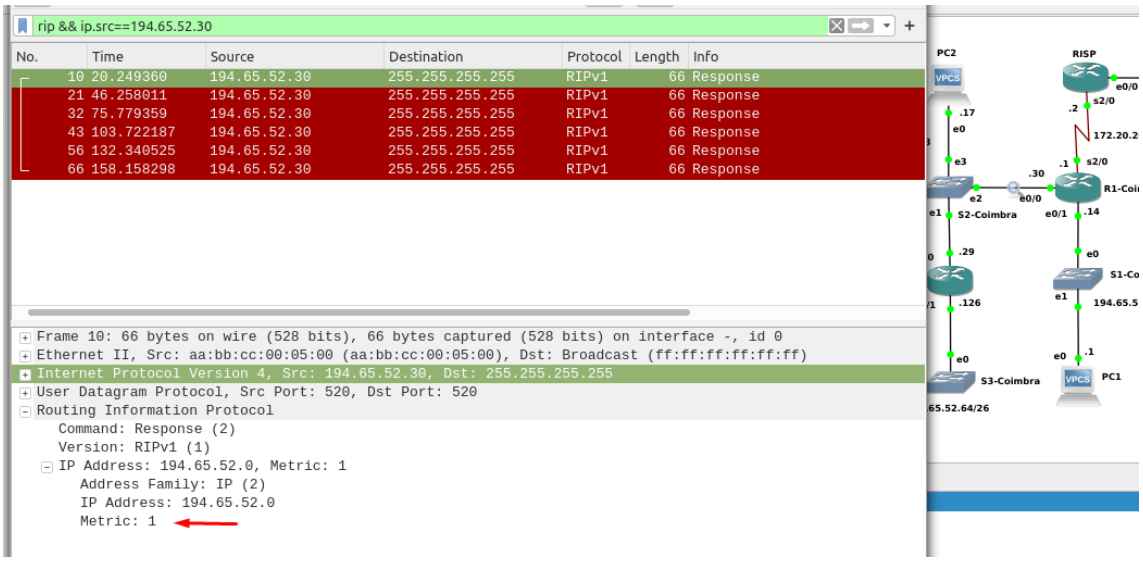
Como R2-Coimbra é uma rede /26 e em R1-Coimbra a rede é um /28 o RIPv1 não funciona!

Mensagens de RIP aparecem de 30 em 30 segundos (+/-). E as mensagens não têm máscara logo o protocolo **RIPv1** é um protocolo **classful.**

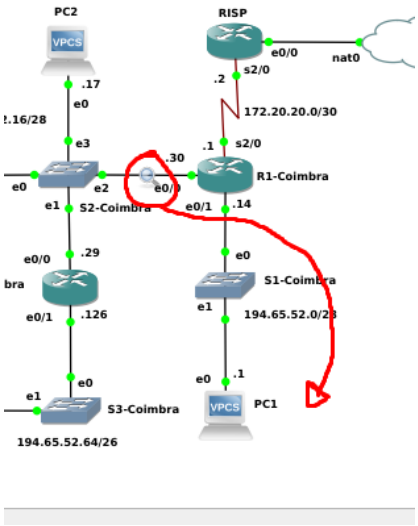


Métrica no RIPv1 é o número de saltos.

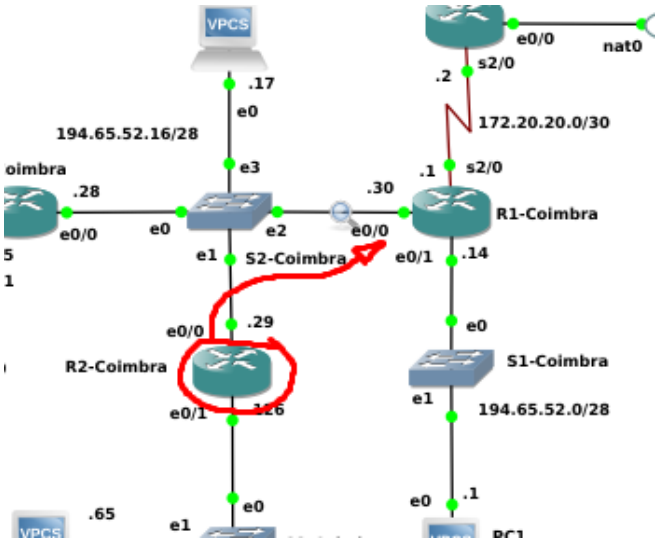
Neste caso, R1-Coimbra está a dizer que para chegar a rota de baixo, 194.65.52.0, tem de saltar 1 vez!



Ou seja, de onde está a capture, para chegar ao PC1 o R1-Coimbra dá um salto.



Quem estiver em R2-Coimbra quantos saltos precisa para chegar a 194.65.52.30?



RISP | R1-Coimbra | PC1 | PC2 | R2-Coimbra | PC3

```
        a - application route
        + - replicated route, % - next hop override

Gateway of last resort is not set

      194.65.52.0/24 is variably subnetted, 5 subnets, 3 masks
R        194.65.52.0/28 [120/1] via 194.65.52.30, 00:00:10, Ethernet0/0
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.29/32 is directly connected, Ethernet0/0
C        194.65.52.64/26 is directly connected, Ethernet0/1
L        194.65.52.126/32 is directly connected, Ethernet0/1
R2-Coimbra#
```

R3-Coimbra

```
conf t
int e0/0
ip add 194.65.52.28 255.255.255.240
no shut
int s2/1
ip add 10.0.0.5 255.255.255.252
no shut
int s2/0
ip add 10.0.0.1 255.255.255.252
no shut
exit
router rip
network 194.65.52.0
network 10.0.0.0
```

R-Porto

```
conf t
int s2/1
ip add 10.0.0.6 255.255.255.252
no shut
int s2/2
ip add 10.0.0.10 255.255.255.252
no shut
exit
router rip
network 194.65.52.0
network 10.0.0.0
```

R-Lisboa

```
conf t
int s2/2
ip add 10.0.0.9 255.255.255.252
no shut
int s2/0
ip add 10.0.0.2 255.255.255.252
no shut
exit
router rip
network 194.65.52.0
network 10.0.0.0
```

Rede contígua – os endereços são todos da mesma rede!

RIPv1 não suporta redes não contíguas!!

Esta topologia é uma rede NÃO CONTÍGUA!

Default-Information-Originate

O PC3 consegue sair para o exterior? NÃO!

```
PC1   PC2   R2-...   PC3   R3-...   R-Po...   R-Li...

PC3> save
Saving startup configuration to startup.vpc
.  done

PC3>
PC3>
PC3> ping 1.1.1.1

*194.65.52.126 icmp_seq=1 ttl=255 time=2.037 ms (ICMP type:3, code:1, De
stination host unreachable)
*194.65.52.126 icmp_seq=2 ttl=255 time=1.905 ms (ICMP type:3, code:1, De
stination host unreachable)
*194.65.52.126 icmp_seq=3 ttl=255 time=0.770 ms (ICMP type:3, code:1, De
stination host unreachable)
*194.65.52.126 icmp_seq=4 ttl=255 time=0.645 ms (ICMP type:3, code:1, De
stination host unreachable)
*194.65.52.126 icmp_seq=5 ttl=255 time=0.562 ms (ICMP type:3, code:1, De
stination host unreachable)

PC3>
```

Porque no R2-Coimbra, na tabela de encaminhamento não tem a rota 0.0.0.0 (default route)

```
PC1   PC2   R2-...   PC3   R3-...   R-Po...   R-Li...

       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS lev
el-2
       ia - IS-IS inter area, * - candidate default, U - per-user static
 route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is not set

R     10.0.0.0/8 [120/1] via 194.65.52.28, 00:00:24, Ethernet0/0
      194.65.52.0/24 is variably subnetted, 5 subnets, 3 masks
R        194.65.52.0/28 [120/1] via 194.65.52.30, 00:00:15, Ethernet0/0
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.29/32 is directly connected, Ethernet0/0
C        194.65.52.64/26 is directly connected, Ethernet0/1
L        194.65.52.126/32 is directly connected, Ethernet0/1
R2-Coimbra#
```

Então, no router de saída da empresa (R1-Coimbra):

R1-Coimbra

conf t

router rip

default-information originate

ATENÇÃO: O comando Default-information originate é colocado **APENAS** no router de saída!!

Agora na tabela de encaminhamento já aparece a rota 0.0.0.0

```
RISP | R1-... | PC1 | PC2 | R2-... | PC3 | R3-...

       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS lev
el-2
       ia - IS-IS inter area, * - candidate default, U - per-user static
 route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 194.65.52.30 to network 0.0.0.0

R*    0.0.0.0/0 [120/1] via 194.65.52.30, 00:00:15, Ethernet0/0
R     10.0.0.0/8 [120/1] via 194.65.52.28, 00:00:25, Ethernet0/0
      194.65.52.0/24 is variably subnetted, 5 subnets, 3 masks
R        194.65.52.0/28 [120/1] via 194.65.52.30, 00:00:15, Ethernet0/0
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.29/32 is directly connected, Ethernet0/0
C        194.65.52.64/26 is directly connected, Ethernet0/1
L        194.65.52.126/32 is directly connected, Ethernet0/1
R2-Coimbra#
```

Assim o PC3 já pinga o exterior? NÃO!

```
RISP | R1-... | PC1 | PC2 | R2-... | PC3 | R3-...
stination host unreachable)

PC3> ping 1.1.1.1

1.1.1.1 icmp_seq=1 timeout
1.1.1.1 icmp_seq=2 timeout
1.1.1.1 icmp_seq=3 timeout
1.1.1.1 icmp_seq=4 timeout
1.1.1.1 icmp_seq=5 timeout

PC3>
```

Porque o R2-Coimbra sabe "sair", mas o R1-Coimbra não sabe "entrar"! O R1-Coimbra não conhece a rede do PC3!

Já não aparece o "Destination host unreachable" porque o tráfego sai, vai até ao 1.1.1.1, devolve e para no R1-Coimbra! porque a rede do PC3 é /26 e em cima é /28.

Então para resolver este problema rápido, adiciona-se uma rota estática no R1-Coimbra.

R1-Coimbra

conf t

ip route 194.65.52.64 255.255.255.192 e0/0 194.65.52.29

RISP | R1-... | PC1 | PC2 | R2-... | PC3 | R3-...

```
       o - ODR, P - periodic downloaded static route, H - NHRP, l -
       a - application route
       + - replicated route, % - next hop override

Gateway of last resort is 0.0.0.0 to network 0.0.0.0

S*    0.0.0.0/0 is directly connected, Serial2/0
R     10.0.0.0/8 [120/1] via 194.65.52.28, 00:00:18, Ethernet0/0
      172.20.0.0/16 is variably subnetted, 2 subnets, 2 masks
C        172.20.20.0/30 is directly connected, Serial2/0
L        172.20.20.1/32 is directly connected, Serial2/0
      194.65.52.0/24 is variably subnetted, 5 subnets, 3 masks
C        194.65.52.0/28 is directly connected, Ethernet0/1
L        194.65.52.14/32 is directly connected, Ethernet0/1
C        194.65.52.16/28 is directly connected, Ethernet0/0
L        194.65.52.30/32 is directly connected, Ethernet0/0
S        194.65.52.64/26 [1/0] via 194.65.52.29, Ethernet0/0
R1-Coimbra#
```

PC3 já pinga o exterior √

RISP | R1-... | PC1 | PC2 | R2-... | PC3 | R3-...

```
PC3> ping 1.1.1.1

1.1.1.1 icmp_seq=1 timeout
1.1.1.1 icmp_seq=2 timeout
1.1.1.1 icmp_seq=3 timeout
1.1.1.1 icmp_seq=4 timeout
1.1.1.1 icmp_seq=5 timeout

PC3> ping 1.1.1.1

84 bytes from 1.1.1.1 icmp_seq=1 ttl=124 time=22.251 ms
84 bytes from 1.1.1.1 icmp_seq=2 ttl=124 time=22.288 ms
84 bytes from 1.1.1.1 icmp_seq=3 ttl=124 time=22.481 ms
84 bytes from 1.1.1.1 icmp_seq=4 ttl=124 time=22.825 ms
84 bytes from 1.1.1.1 icmp_seq=5 ttl=124 time=21.998 ms

PC3>
```