Redes de Computador

Fase 3

ISEL

ADEETC

Área Departamental de Engenharia Electrónica e Telecomunicações e de Computadores

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Objetivo

Semelhanteaoquesefezanteriormente,estafasedoprojetovisaaconfiguraçãodeumaredeede todososseus componentes. Destavezumaredevirtualjáestabelecidaemaiscomplexa. Pondodelado osobstáculoscriados pelohardwareutilizado, foca-semaisnadivisãoda rede–criaçãodesub-redese atribuição de IPs e gateways estáticos.

Desenvolvimento

A topologia de rede fornecida consiste de três LANs interligadas. Primeiro passo foi a divisão da rede e atribuição de IPs.

Os clientes das LANs foram calculados da seguinte forma:

Hosts_LAN_A = sum(números dos alunos)%100

Sendo,

n = 2

AlunoA=42355

AlunoB=42357

Hosts_LAN_A = (42355 + 42357) % 100 = 12

Gama de IPs mais próxima abrange 14 hosts

Máscara =/28

Hosts_LAN_B=Hosts_LAN_A/2=6

Máscara =/29

LAN T usa uma máscara de endereço de /30

Hosts_LAN_T =2

Máscara = /30

LAN C de usar próximo maior bloco de IPs. Assim, ficou que Hosts_LAN_C =

30

Máscara = /27

	LAN A	LAN B	LAN C	LAN T
CLIENTES [GAMA IPs]	14 (12)[16]	6[8]	30[32]	2[4]
	\28	\29	\27	\30
Máscara	255.255.255.240	255.255.255.248	255.255.255.224	255.255.255.252

NETWORK - 192.168.1.0	192.168.1.224	192.168.1.240	192.168.1.192	192.168.1.248
e0	192.168.1.225	192.168.1.241	192.168.1.193	192.168.1.249
e1	192.168.1.226	192.168.1.242	192.168.1.194	192.168.1.250
e2			192.168.1.195	
e3			192.168.1.196	
BROADCAST - 192.168.1.X, X = CLTS + 1	192.168.1.239	192.168.1.247	192.168.1.223	192.168.1.251

Nocontextodatopologiautilizada:

LAN A e0 = eth0

LAN A e1 = e0

LAN B e0 = eth0

LAN B e1 = e1

LAN T e0 = e3

LAN Te1 = fa0/0

LAN Ce0 = e1/0

LAN C e1 = e0

LAN C e2 = e0

LAN C e3 = e0

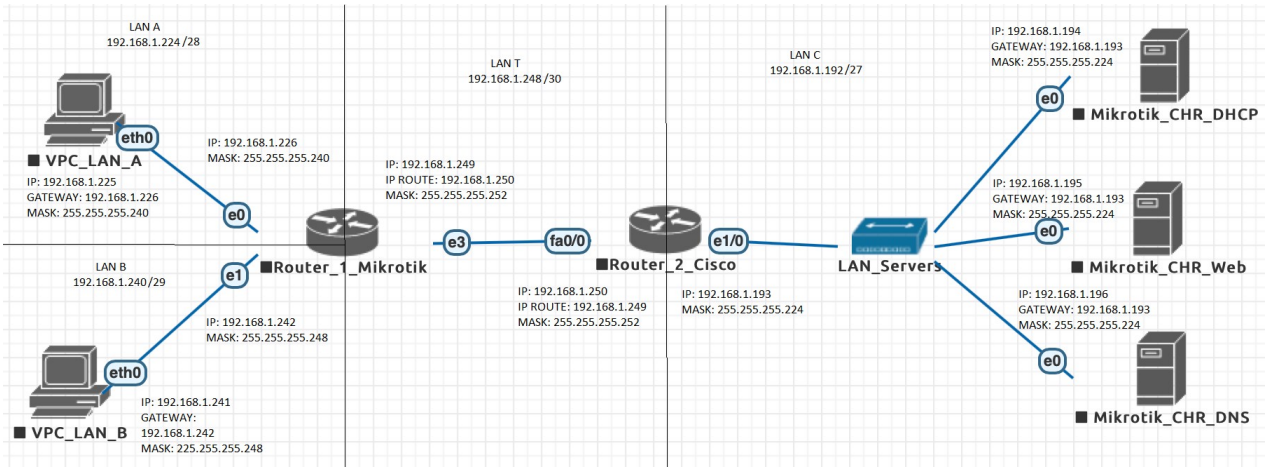

Figure 1 - Topologia da rede

Foi necessário um emulador de redes – EVE-NG, acessível a partir da rede do ISEL (Continha uma rede pré-estabelecida que só pedia configuração de cada componente), e um cliente telnet – PuTTy, já usado na fase anterior, que permite aceder ao terminal de cada componente.

Foram usados três terminais diferentes: VPC, Mikrotik e Cisco.

Foi feita a ativação e configuração de cada componente separadamente e, de seguida testou-se a ligação entre os mesmos.

Para PCA e PCB, os terminais não pedem especificação da interface, apenas IP e gateway.

VPC_LAN_A

VPCS>ip 192.168.1.225 255.255.255.240 192.168.1.226
VPCS>save

```
VPCS> show ip

NAME        : VPCS[1]
IP/MASK     : 192.168.1.225/28
GATEWAY     : 192.168.1.226
DNS         :
MAC         : 00:50:79:66:68:04
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500

VPCS>
```

Figure 2 - IPs PC LAN A

VPC_LAN_B

VPCS>ip 192.168.1.241 255.255.255.248 192.168.1.242

VPCS>save

```
VPCS> show ip

NAME        : VPCS[1]
IP/MASK     : 192.168.1.241/29
GATEWAY     : 192.168.1.242
DNS         :
MAC         : 00:50:79:66:68:05
LPORT       : 20000
RHOST:PORT  : 127.0.0.1:30000
MTU         : 1500

VPCS>
```

Figure 3 - IPs PC LAN B

Os terminais Mikrotik já necessitam da interface. Devido à maneira como estas são atribuídas na consola, deciciu-se:

LAN A e1 = e0 = ether1

LAN B e1 = e1 = ether2

LAN Te0=e3=ether4

Mikrotik Router 1

MikroTik 6.41.2 (stable)

MikroTik Login: admin

Password:

[admin@MikroTik] >ip address add address=192.168.1.226/28 interface=ether1

[admin@MikroTik] >ip address add address=192.168.1.242/29 interface=ether2

[admin@MikroTik] >ip address add address=192.168.1.249/30 interface=ether4

[admin@MikroTik] >ip route add gateway=192.168.1.250

Ctrl X

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         INTERFACE
 0   192.168.1.226/28   192.168.1.224   ether1
 1   192.168.1.242/29   192.168.1.240   ether2
 2   192.168.1.249/30   192.168.1.248   ether4
[admin@MikroTik] > 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 A S  0.0.0.0/0                          192.168.1.250             1
 1 ADC  192.168.1.224/28   192.168.1.226   ether1                    0
 2 ADC  192.168.1.240/29   192.168.1.242   ether2                    0
 3 ADC  192.168.1.248/30   192.168.1.249   ether4                    0
[admin@MikroTik] >
```

Figure 4 - IPs Router 1

Cisco Router 2

Router>Enable

Router#Config terminal

Router(config)#Interface fa0/0

Router(config)#Ip address 192.168.1.250 255.255.255.252 Router(config)#no

shutdown

Ctrl Z

Router#Config terminal

Router(config)#Interface e1/0

Router(config)#Ip address 192.168.1.193 255.255.255.224 Router(config)#no

shutdown

Ctrl Z

Router#Config terminal

Router(config)#Interface fa0/0

Router(config)#Ip route 0.0.0.0 0.0.0.0 192.168.1.249 Ctrl Z

copy running-config startup-config

```
*May 25 13:10:15.791: %LINK-5-CHANGED: Interface Ethernet1/1, changed state to a
dministratively down
*May 25 13:10:15.927: %LINK-5-CHANGED: Interface Ethernet1/2, changed state to a
dministratively down
*May 25 13:10:15.987: %LINK-5-CHANGED: Interface Ethernet1/3, changed state to a
dministratively down
Router>show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        192.168.1.250   YES NVRAM  up                    up
Ethernet1/0            192.168.1.193   YES NVRAM  up                    up
Ethernet1/1            unassigned      YES NVRAM  administratively down down
Ethernet1/2            unassigned      YES NVRAM  administratively down down
Ethernet1/3            unassigned      YES NVRAM  administratively down down
Router>show ip route
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       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 level-2
       ia - IS-IS inter area, * - candidate default, U - per-user static route
       o - ODR, P - periodic downloaded static route, H - NHRP, l - LISP
       + - replicated route, % - next hop override

Gateway of last resort is 192.168.1.249 to network 0.0.0.0

S*    0.0.0.0/0 [1/0] via 192.168.1.249
      192.168.1.0/24 is variably subnetted, 4 subnets, 3 masks
C        192.168.1.192/27 is directly connected, Ethernet1/0
L        192.168.1.193/32 is directly connected, Ethernet1/0
C        192.168.1.248/30 is directly connected, FastEthernet0/0
L        192.168.1.250/32 is directly connected, FastEthernet0/0
Router>
```

Figure 5 - IPs Router 2

Para os Servidores procedeu-se da mesma maneira

Mikrotik Server_DHCP

MikroTik 6.41.2 (stable)

MikroTik Login: admin

Password:

[admin@MikroTik] >ip address add address=192.168.1.194/27 interface=ether1 [admin@MikroTik] >ip

route add gateway=192.168.1.193

Ctrl X

```
may/23/2019 04:06:00 system,error,critical router was rebooted without pro
u
tdown

[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #    ADDRESS            NETWORK         INTERFACE
 0    192.168.1.194/27   192.168.1.192   ether1
[admin@MikroTik] > 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 A S  0.0.0.0/0                          192.168.1.193             1
 1 ADC  192.168.1.192/27   192.168.1.194   ether1                    0
```

Figure 6 - IPs Servidor DHCP

Mikrotik Server_Web

MikroTik 6.41.2 (stable)

MikroTik Login: admin

Password:

[admin@MikroTik] >ip address add address=192.168.1.195/27 interface=ether1 [admin@MikroTik] >ip route add gateway=192.168.1.193

Ctrl X

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #    ADDRESS            NETWORK         INTERFACE
 0    192.168.1.195/27   192.168.1.192   ether1
[admin@MikroTik] > 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 A S  0.0.0.0/0                          192.168.1.193             1
 1 ADC  192.168.1.192/27   192.168.1.195   ether1                    0
```

Figure 7 - IPs Servidor WEB

Mikrotik Server_DNS

MikroTik 6.41.2 (stable)

MikroTik Login: admin

Password:

[admin@MikroTik] >ip address add address=192.168.1.196/27 interface=ether1 [admin@MikroTik] >ip route add gateway=192.168.1.193

Ctrl X

```
[admin@MikroTik] > ip address print
Flags: X - disabled, I - invalid, D - dynamic
 #   ADDRESS            NETWORK         INTERFACE
 0   192.168.1.196/27   192.168.1.192   ether1
[admin@MikroTik] > 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 A S  0.0.0.0/0                          192.168.1.193             1
 1 ADC  192.168.1.192/27   192.168.1.196   ether1                    0
[admin@MikroTik] >
```

Figure 8 - IPs Servidor DNS

Testes

Procedeu-se aos testes. Começou-se por fazer ping a todos os nós a partir do PCA e PCB.

```
VPCS> ping 192.168.1.226

84 bytes from 192.168.1.226 icmp_seq=1 ttl=64 time=0.675 ms
84 bytes from 192.168.1.226 icmp_seq=2 ttl=64 time=0.493 ms
84 bytes from 192.168.1.226 icmp_seq=3 ttl=64 time=0.495 ms
84 bytes from 192.168.1.226 icmp_seq=4 ttl=64 time=0.555 ms
84 bytes from 192.168.1.226 icmp_seq=5 ttl=64 time=0.479 ms

VPCS>
```

```
*192.168.1.250 icmp_seq=5 ttl=254 time=319.640 ms (ICMP type:11, co
ired in transit)

VPCS> ping 192.168.1.241

84 bytes from 192.168.1.241 icmp_seq=1 ttl=63 time=0.944 ms
84 bytes from 192.168.1.241 icmp_seq=2 ttl=63 time=1.038 ms
84 bytes from 192.168.1.241 icmp_seq=3 ttl=63 time=0.880 ms
84 bytes from 192.168.1.241 icmp_seq=4 ttl=63 time=1.096 ms
84 bytes from 192.168.1.241 icmp_seq=5 ttl=63 time=0.956 ms

VPCS> ping 192.168.1.249

84 bytes from 192.168.1.249 icmp_seq=1 ttl=64 time=0.549 ms
84 bytes from 192.168.1.249 icmp_seq=2 ttl=64 time=0.525 ms
84 bytes from 192.168.1.249 icmp_seq=3 ttl=64 time=0.445 ms
84 bytes from 192.168.1.249 icmp_seq=4 ttl=64 time=0.550 ms
84 bytes from 192.168.1.249 icmp_seq=5 ttl=64 time=0.473 ms
```

```
84 bytes from 192.168.1.249 icmp_seq=3 ttl=64 time=0.445 ms
84 bytes from 192.168.1.249 icmp_seq=4 ttl=64 time=0.550 ms
84 bytes from 192.168.1.249 icmp_seq=5 ttl=64 time=0.473 ms

VPCS> ping 192.168.1.250

84 bytes from 192.168.1.250 icmp_seq=1 ttl=254 time=3.988 ms
84 bytes from 192.168.1.250 icmp_seq=2 ttl=254 time=6.504 ms
84 bytes from 192.168.1.250 icmp_seq=3 ttl=254 time=5.643 ms
84 bytes from 192.168.1.250 icmp_seq=4 ttl=254 time=6.657 ms
84 bytes from 192.168.1.250 icmp_seq=5 ttl=254 time=5.926 ms
```

```
84 bytes from 192.168.1.250 icmp_seq=3 ttl=254 time=5.643 ms
84 bytes from 192.168.1.250 icmp_seq=4 ttl=254 time=6.657 ms
84 bytes from 192.168.1.250 icmp_seq=5 ttl=254 time=5.926 ms

VPCS> ping 192.168.1.193

84 bytes from 192.168.1.193 icmp_seq=1 ttl=254 time=3.786 ms
84 bytes from 192.168.1.193 icmp_seq=2 ttl=254 time=8.751 ms
84 bytes from 192.168.1.193 icmp_seq=3 ttl=254 time=6.595 ms
84 bytes from 192.168.1.193 icmp_seq=4 ttl=254 time=5.501 ms
84 bytes from 192.168.1.193 icmp_seq=5 ttl=254 time=8.180 ms
```

Figure 9 - Ping PC LAN A

```
84 bytes from 192.168.1.193 icmp_seq=3 ttl=254 time=6.595 ms
84 bytes from 192.168.1.193 icmp_seq=4 ttl=254 time=5.501 ms
84 bytes from 192.168.1.193 icmp_seq=5 ttl=254 time=8.180 ms

VPCS> ping 192.168.1.194

84 bytes from 192.168.1.194 icmp_seq=1 ttl=62 time=11.381 ms
84 bytes from 192.168.1.194 icmp_seq=2 ttl=62 time=17.867 ms
84 bytes from 192.168.1.194 icmp_seq=3 ttl=62 time=16.897 ms
84 bytes from 192.168.1.194 icmp_seq=4 ttl=62 time=16.509 ms
84 bytes from 192.168.1.194 icmp_seq=5 ttl=62 time=17.693 ms

VPCS> ping 192.168.1.195

84 bytes from 192.168.1.195 icmp_seq=1 ttl=62 time=19.161 ms
84 bytes from 192.168.1.195 icmp_seq=2 ttl=62 time=16.868 ms
84 bytes from 192.168.1.195 icmp_seq=3 ttl=62 time=16.540 ms
84 bytes from 192.168.1.195 icmp_seq=4 ttl=62 time=17.463 ms
84 bytes from 192.168.1.195 icmp_seq=5 ttl=62 time=14.328 ms

VPCS> ping 192.168.1.196

84 bytes from 192.168.1.196 icmp_seq=1 ttl=62 time=18.506 ms
84 bytes from 192.168.1.196 icmp_seq=2 ttl=62 time=12.214 ms
84 bytes from 192.168.1.196 icmp_seq=3 ttl=62 time=16.898 ms
84 bytes from 192.168.1.196 icmp_seq=4 ttl=62 time=17.109 ms
84 bytes from 192.168.1.196 icmp_seq=5 ttl=62 time=17.096 ms
```

Figure 10 - continuação - Ping PC LAN A

```
VPCS> ping 192.168.1.242

84 bytes from 192.168.1.242 icmp_seq=1 ttl=64 time=0.456 ms
84 bytes from 192.168.1.242 icmp_seq=2 ttl=64 time=0.469 ms
84 bytes from 192.168.1.242 icmp_seq=3 ttl=64 time=0.564 ms
84 bytes from 192.168.1.242 icmp_seq=4 ttl=64 time=0.469 ms
84 bytes from 192.168.1.242 icmp_seq=5 ttl=64 time=0.477 ms

VPCS> ping 192.168.1.225

84 bytes from 192.168.1.225 icmp_seq=1 ttl=63 time=1.229 ms
84 bytes from 192.168.1.225 icmp_seq=2 ttl=63 time=1.020 ms
84 bytes from 192.168.1.225 icmp_seq=3 ttl=63 time=0.965 ms
84 bytes from 192.168.1.225 icmp_seq=4 ttl=63 time=0.883 ms
84 bytes from 192.168.1.225 icmp_seq=5 ttl=63 time=1.073 ms

VPCS>
```

```
84 bytes from 192.168.1.225 icmp_seq=2 ttl=63 time=1.020 ms
84 bytes from 192.168.1.225 icmp_seq=3 ttl=63 time=0.965 ms
84 bytes from 192.168.1.225 icmp_seq=4 ttl=63 time=0.883 ms
84 bytes from 192.168.1.225 icmp_seq=5 ttl=63 time=1.073 ms

VPCS> ping 192.168.1.249

84 bytes from 192.168.1.249 icmp_seq=1 ttl=64 time=0.684 ms
84 bytes from 192.168.1.249 icmp_seq=2 ttl=64 time=0.501 ms
84 bytes from 192.168.1.249 icmp_seq=3 ttl=64 time=0.590 ms
84 bytes from 192.168.1.249 icmp_seq=4 ttl=64 time=0.547 ms
84 bytes from 192.168.1.249 icmp_seq=5 ttl=64 time=0.534 ms
```

Figure 11 - Ping PC LAN B

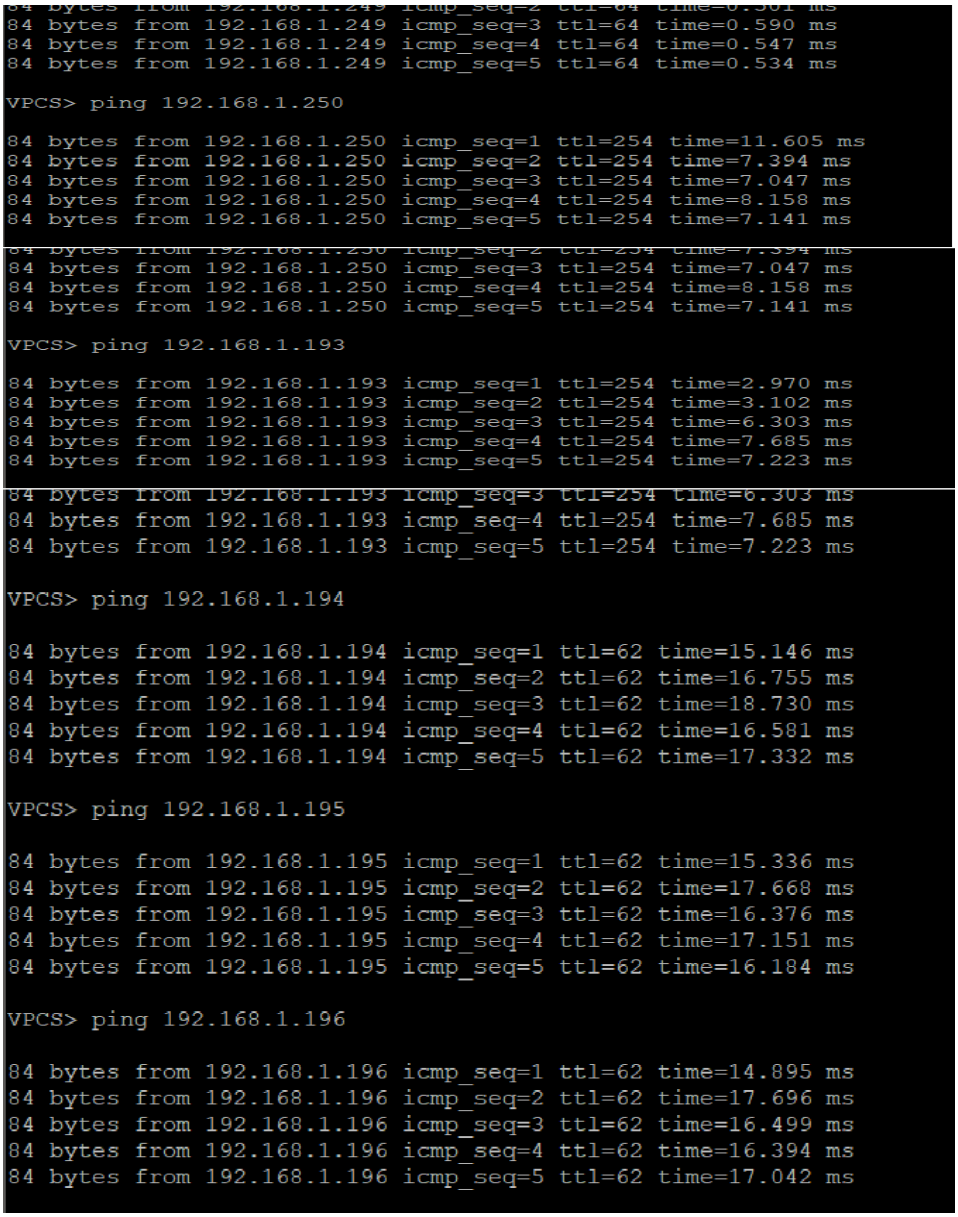

Figure 12 - continuação - Ping PC LAN B

De seguida testou-se ligação entre os servidores DHCP, Web e DNS e os PCA e PCB

```
[admin@MikroTik] > ping 192.168.1.225
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.225                              56  62 19ms
    1 192.168.1.225                              56  62 18ms
    2 192.168.1.225                              56  62 12ms
    3 192.168.1.225                              56  62 13ms
    4 192.168.1.225                              56  62 12ms
    5 192.168.1.225                              56  62 17ms
    6 192.168.1.225                              56  62 11ms
    7 192.168.1.225                              56  62 11ms
    8 192.168.1.225                              56  62 18ms
    9 192.168.1.225                              56  62 13ms
   10 192.168.1.225                              56  62 13ms
   11 192.168.1.225                              56  62 12ms
   12 192.168.1.225                              56  62 13ms
   13 192.168.1.225                              56  62 12ms
   14 192.168.1.225                              56  62 14ms
   15 192.168.1.225                              56  62 20ms
   16 192.168.1.225                              56  62 12ms
   17 192.168.1.225                              56  62 19ms
   18 192.168.1.225                              56  62 18ms
   19 192.168.1.225                              56  62 14ms
    sent=20 received=20 packet-loss=0% min-rtt=11ms avg-rtt=14ms max-rtt=20ms
  SEQ HOST                                     SIZE TTL TIME  STATUS
   20 192.168.1.225                              56  62 14ms
   21 192.168.1.225                              56  62 14ms
   22 192.168.1.225                              56  62 13ms
   23 192.168.1.225                              56  62 14ms
    sent=24 received=24 packet-loss=0% min-rtt=11ms avg-rtt=14ms max-rtt=20ms

[admin@MikroTik] > ping 192.168.1.241
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.241                              56  62 18ms
    1 192.168.1.241                              56  62 17ms
    2 192.168.1.241                              56  62 12ms
    3 192.168.1.241                              56  62 11ms
    4 192.168.1.241                              56  62 11ms
    5 192.168.1.241                              56  62 13ms
    6 192.168.1.241                              56  62 12ms
    7 192.168.1.241                              56  62 13ms
    sent=8 received=8 packet-loss=0% min-rtt=11ms avg-rtt=13ms max-rtt=18ms
```

Figure 13 - Ping servidor DHCP para LAN A e B

```
[admin@MikroTik] > ping 192.168.1.225
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.225                              56  62 13ms
    1 192.168.1.225                              56  62 17ms
    2 192.168.1.225                              56  62 11ms
    3 192.168.1.225                              56  62 11ms
    4 192.168.1.225                              56  62 14ms
    5 192.168.1.225                              56  62 14ms
    sent=6 received=6 packet-loss=0% min-rtt=11ms avg-rtt=13ms max-rtt=17ms

[admin@MikroTik] > ping 192.168.1.241
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.241                              56  62 13ms
    1 192.168.1.241                              56  62 12ms
    2 192.168.1.241                              56  62 12ms
    3 192.168.1.241                              56  62 11ms
    4 192.168.1.241                              56  62 12ms
    5 192.168.1.241                              56  62 12ms
    6 192.168.1.241                              56  62 20ms
    sent=7 received=7 packet-loss=0% min-rtt=11ms avg-rtt=13ms max-rtt=20ms
```

Figure14-PingservidorWEBparaLANAeB

```
[admin@MikroTik] > ping 192.168.1.225
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.225                              56  62 18ms
    1 192.168.1.225                              56  62 18ms
    2 192.168.1.225                              56  62 11ms
    3 192.168.1.225                              56  62 14ms
    4 192.168.1.225                              56  62 14ms
    5 192.168.1.225                              56  62 11ms
    6 192.168.1.225                              56  62 12ms
    7 192.168.1.225                              56  62 13ms
    sent=8 received=8 packet-loss=0% min-rtt=11ms avg-rtt=13ms max-rtt=18ms

[admin@MikroTik] > ping 192.168.1.241
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.241                              56  62 17ms
    1 192.168.1.241                              56  62 17ms
    2 192.168.1.241                              56  62 14ms
    3 192.168.1.241                              56  62 13ms
    4 192.168.1.241                              56  62 14ms
    5 192.168.1.241                              56  62 13ms
    6 192.168.1.241                              56  62 14ms
    sent=7 received=7 packet-loss=0% min-rtt=13ms avg-rtt=14ms max-rtt=17ms
```

Figure15-PingservidorDNSparaLANAeB

Testou-se ainda ligação entre os Routers:

```
Router>ping 192.168.1.249
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 192.168.1.249, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/37/48 ms
Router>
```

Figure 16 - Ping Router 2 para Router 1

```
[admin@MikroTik] > ping 192.168.1.250
  SEQ HOST                                     SIZE TTL TIME  STATUS
    0 192.168.1.250                              56 255 10ms
    1 192.168.1.250                              56 255 9ms
    2 192.168.1.250                              56 255 2ms
    3 192.168.1.250                              56 255 7ms
    4 192.168.1.250                              56 255 2ms
    5 192.168.1.250                              56 255 3ms
    sent=6 received=6 packet-loss=0% min-rtt=2ms avg-rtt=5ms max-rtt=10ms
```

Figure 17 - Ping Router 1 para Router 2

Finalmente, correu-se o comando traceroute entre o servidor_DHCP e o PCA

```
VPCS> trace 192.168.1.194
trace to 192.168.1.194, 8 hops max, press Ctrl+C to stop
 1    192.168.1.226    0.472 ms  0.389 ms  0.412 ms
 2    192.168.1.250    5.042 ms  9.775 ms  9.194 ms
 3    *192.168.1.194    19.734 ms (ICMP type:3, code:3, Destination port unreachab
le)

VPCS> trace 192.168.1.193
trace to 192.168.1.193, 8 hops max, press Ctrl+C to stop
 1    192.168.1.226    0.594 ms  0.374 ms  0.398 ms
 2    *192.168.1.250    10.808 ms (ICMP type:3, code:3, Destination port unreachab
```

Figure 18 – Trace PC LAN A para servidor DHCP

```
[admin@MikroTik] > tool
[admin@MikroTik] /tool> traceroute 192.168.1.225
 # ADDRESS                          LOSS SENT    LAST     AVG    BEST   WORST
 1 192.168.1.193                     0%   10    5.3ms     6.5     2.5    10.4
 2 192.168.1.249                     0%   10   21.5ms    20.5    19.6    23.3
 3 192.168.1.225                     0%   10    20ms     20.4      20    21.3
```

Figure 19 – Trace servidor DHCP para PC LAN A

Conclusões

Este projeto permitiu compreender melhor as minucias da configuração de redes e dos seus componentes, bem a criação de sub-redes. Visto que é retirada a preocupação de estabelecer ligações físicas corretas, pode-se focar mais a atenção nos detalhes programáticos da rede, routers, PCs e servidores.