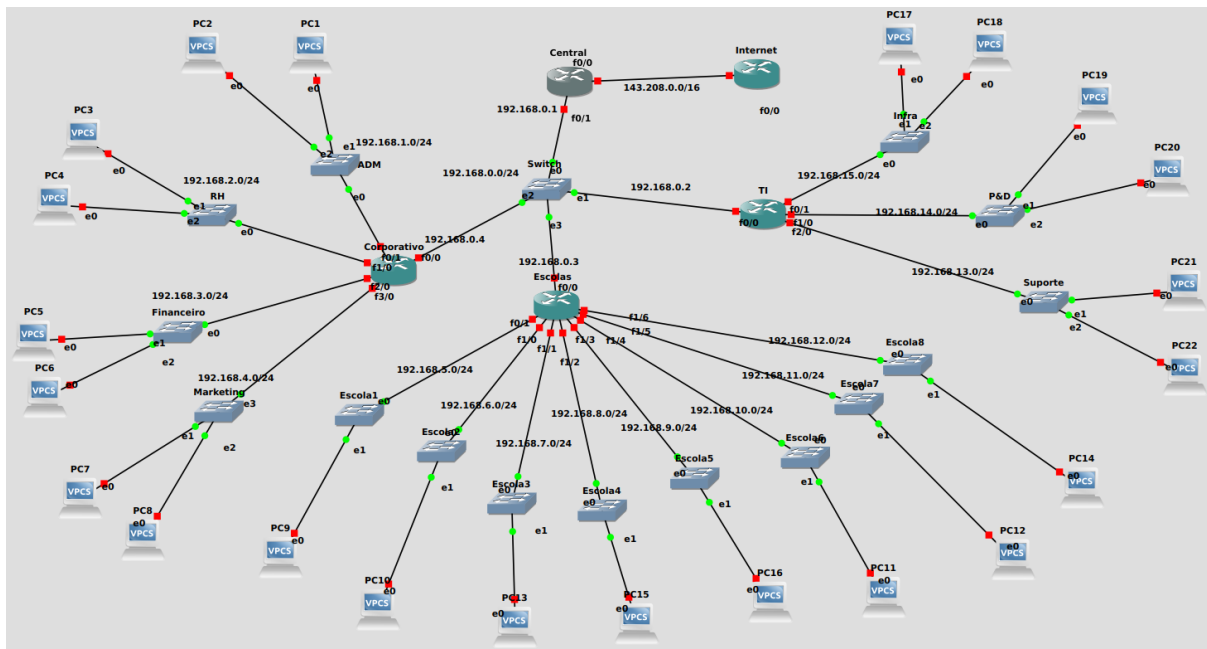


Relatório Trabalho 1 - Redes de Computadores Avançadas

Deivid Santos

1. Topologia

Na topologia foram escolhidos endereços de IP's da classe C, com subredes de 192.168.0.0/24 até 192.168.15.0/24 conforme visto na figura 1 abaixo. Para ser possível aplicar os filtros de redes solicitados a topologia foi dividida conforme os ambientes propostos, com um roteador separado para as sub redes do corporativo, um para o TI, outro para as Escolas e um roteador central que é o ponto de comunicação externa com a internet. Nesse roteador também está configurada a Nat dessa rede. A sub rede que conecta os roteadores é a 192.168.0.0/24. Para simular uma conexão com a internet foi utilizado um endereço de IP de classe B, 143.208.0.0/16. Para simplificar e tornar a configuração mais possível, cada um dos ambientes está conectada há um switch, a quantidade de VPC's utilizada é só um exemplo, mas poderia ter muito mais VPC's conectadas em cada switch.



```

ip dhcp excluded-address 192.168.1.1
ip dhcp excluded-address 192.168.1.255
ip dhcp excluded-address 192.168.2.1
ip dhcp excluded-address 192.168.2.255
ip dhcp excluded-address 192.168.3.1
ip dhcp excluded-address 192.168.3.255
ip dhcp excluded-address 192.168.4.1
ip dhcp excluded-address 192.168.4.255
!
ip dhcp pool ADM
 network 192.168.1.0 255.255.255.0
 dns-server 192.168.1.1
 default-router 192.168.1.1
!
ip dhcp pool RH
 network 192.168.2.0 255.255.255.0
 dns-server 192.168.2.1
 default-router 192.168.2.1
!
ip dhcp pool Financeiro
 network 192.168.3.0 255.255.255.0
 dns-server 192.168.3.1
 default-router 192.168.3.1
!
ip dhcp pool Marketing
 network 192.168.4.0 255.255.255.0
 dns-server 192.168.4.1
 default-router 192.168.4.1
!

```

Figura 2 - DHCP Corporativo

2.1. Portas

Na figura 3 cada uma das portas está recebendo um IP referente a sub rede em que está conectado. Esse IP, além de ser utilizado para enviar pacotes para as sub redes conectadas, também é utilizado para o DHCP saber para onde distribuir os endereços.

```

interface FastEthernet0/0
ip address 192.168.0.4 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet0/1
ip address 192.168.1.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet1/0
ip address 192.168.2.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet2/0
ip address 192.168.3.1 255.255.255.0
duplex auto
speed auto
!
interface FastEthernet3/0
ip address 192.168.4.1 255.255.255.0
duplex auto
speed auto
!

```

Figura 3 - Portas e IP's

Todos os roteadores estão configurados da mesma maneira, somente com IP's, portas e nomes diferentes.

Ao esperar alguns segundos até que o roteador esteja pronto e configurado, conseguimos acessar as VPC's e por meio do comando "dhcp" conseguimos obter o endereço de IP da máquina desejada.

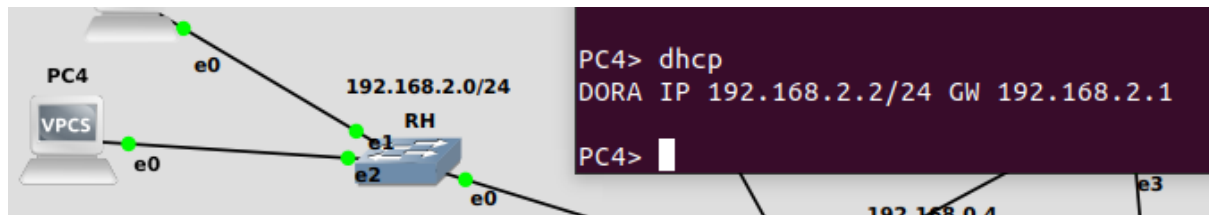


Figura 4 - Obtendo DHCP em uma VPC

Na figura 5 conseguimos ver os pacotes trafegados pelo DHCP destacados em azul, inclusive é possível ver os pacotes de acordo com a sigla da imagem 4, DORA sendo, discover, offer, request e ack. Onde a VPC tenta encontrar o servidor DHCP, ao encontrar, o servidor oferece o IP e então é feito um Ack e o IP é atribuído.

1	0.000000	::	ff02::2	ICMPv6	62 Router Solicitation
2	0.162665	::	ff02::2	ICMPv6	62 Router Solicitation
3	24.338676	c4:03:f1:96:00:01	Broadcast	ARP	60 Gratuitous ARP for 192.168.1.1 (Reply)
4	24.509758	c4:03:f1:96:00:01	Broadcast	ARP	60 Gratuitous ARP for 192.168.1.1 (Reply)
5	24.539968	c4:03:f1:96:00:01	Broadcast	ARP	60 Gratuitous ARP for 192.168.1.1 (Reply)
6	24.600419	c4:03:f1:96:00:01	CDP/VTP/DTP/PagP/UD...	CDP	363 Device ID: Corporativo Port ID: FastEthernet0/1
7	24.610545	c4:03:f1:96:00:01	DEC-MOP-Remote-Cons...	0x6002	77 DEC DNA Remote Console
8	25.586881	c4:03:f1:96:00:01	CDP/VTP/DTP/PagP/UD...	CDP	363 Device ID: Corporativo Port ID: FastEthernet0/1
9	26.592937	c4:03:f1:96:00:01	CDP/VTP/DTP/PagP/UD...	CDP	363 Device ID: Corporativo Port ID: FastEthernet0/1
10	32.212828	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0xe548d056
11	32.279363	c4:03:f1:96:00:01	Broadcast	ARP	60 Who has 192.168.1.2? Tell 192.168.1.1
12	33.050154	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0xbc8de744
13	33.212886	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0xe548d056
14	34.050202	0.0.0.0	255.255.255.255	DHCP	406 DHCP Discover - Transaction ID 0xbc8de744
15	34.270367	192.168.1.1	192.168.1.2	DHCP	342 DHCP Offer - Transaction ID 0xe548d056
16	34.280462	c4:03:f1:96:00:01	Broadcast	ARP	60 Who has 192.168.1.3? Tell 192.168.1.1
17	36.213034	0.0.0.0	255.255.255.255	DHCP	406 DHCP Request - Transaction ID 0xe548d056
18	36.283287	192.168.1.1	192.168.1.2	DHCP	342 DHCP Offer - Transaction ID 0xe548d056
19	36.303402	192.168.1.1	192.168.1.2	DHCP	342 DHCP ACK - Transaction ID 0xe548d056
20	37.213022	Private_66:68:01	Broadcast	ARP	64 Gratuitous ARP for 192.168.1.2 (Request)
21	38.050382	Private_66:68:00	Broadcast	ARP	64 Gratuitous ARP for 192.168.1.3 (Request)
22	38.214052	Private_66:68:01	Broadcast	ARP	64 Gratuitous ARP for 192.168.1.2 (Request)
23	39.050395	Private_66:68:00	Broadcast	ARP	64 Gratuitous ARP for 192.168.1.3 (Request)

Figura 5 - Captura do DHCP no wireshark

Existe um problema ao obter o DHCP automaticamente nas VPC's por meio do arquivo startup que não foi possível resolver de maneira completa. O comando dhcp está rodando antes do roteador inicializar, por esse motivo ocorre um erro e somente é possível configurar o DHCP entrando na VPC conforme a figura 4. Para tentar resolver esse problema de forma parcial é possível colocar um sleep na inicialização da VPC conforme visto na figura 6, porém ao fazer isso em muitas máquinas o mesmo erro acontece.

```
PC2 startup.vpc

# This the configuration for PC2
#
# Uncomment the following line to enable DHCP
sleep 32
dhcp
# or the line below to manually setup an IP address and subnet mask
# ip 192.168.1.1 255.0.0.0
#

set pcname PC2
```

Figura 6 - VPC startup

3. OSPF

Para configurar o OSPF nessa topologia somente a divulgação das rotas para a mesma rede 192.168.0.0 foi suficiente pois todos os roteadores estão conectados nela.

```
!
router ospf 1
log-adjacency-changes
redistribute connected
network 192.168.0.0 0.0.0.255 area 0
!
```

Figura 7 - OSPF setup

Na figura 7 conseguimos ver o resultado das divulgações feita pelo protocolo OSPF a partir da tabela ARP de cada um dos roteadores.

```
Codes: 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

Gateway of last resort is not set

C    192.168.12.0/24 is directly connected, FastEthernet1/6
O E2 192.168.13.0/24 [110/20] via 192.168.0.2, 00:27:49, FastEthernet0/0
O E2 192.168.14.0/24 [110/20] via 192.168.0.2, 00:27:49, FastEthernet0/0
O E2 192.168.15.0/24 [110/20] via 192.168.0.2, 00:27:49, FastEthernet0/0
C    192.168.8.0/24 is directly connected, FastEthernet1/2
C    192.168.9.0/24 is directly connected, FastEthernet1/3
C    192.168.10.0/24 is directly connected, FastEthernet1/4
C    192.168.11.0/24 is directly connected, FastEthernet1/5
O    143.208.0.0/16 [110/20] via 192.168.0.1, 00:27:50, FastEthernet0/0
O E2 192.168.4.0/24 [110/20] via 192.168.0.4, 00:27:50, FastEthernet0/0
C    192.168.5.0/24 is directly connected, FastEthernet0/1
C    192.168.6.0/24 is directly connected, FastEthernet1/0
C    192.168.7.0/24 is directly connected, FastEthernet1/1
C    192.168.0.0/24 is directly connected, FastEthernet0/0
O E2 192.168.1.0/24 [110/20] via 192.168.0.4, 00:27:52, FastEthernet0/0
O E2 192.168.2.0/24 [110/20] via 192.168.0.4, 00:27:52, FastEthernet0/0
O E2 192.168.3.0/24 [110/20] via 192.168.0.4, 00:27:52, FastEthernet0/0
Escalas#
```

Figura 8 - Router table

Na figura 9 conseguimos ver o comportamento do protocolo OSPF, que primeiramente envia as mensagens de hello em multicast para que todos saibam que as redes diretamente conectadas estão funcionando. As mensagens que estão na cor escura, de description, request, update e acknowledge representam a troca link-state do OSPF, compartilhando todos caminhos conhecidos entre todos os roteadores.

No.	Time	Source	Destination	Protocol	Length	Info
41	2.574017	c4:03:f1:96:00:00	CDP/VTP/DTP/PAgP/UDLD	CDP	363	Device ID: Corpora
42	7.244445	c4:04:f1:b4:00:00	c4:04:f1:b4:00:00	LOOP	60	Reply
43	10.211194	192.168.0.3	224.0.0.5	OSPF	102	Hello Packet
44	10.215518	192.168.0.2	192.168.0.3	OSPF	102	Hello Packet
45	10.255853	192.168.0.2	224.0.0.5	OSPF	102	Hello Packet
46	10.259548	192.168.0.1	192.168.0.2	OSPF	102	Hello Packet
47	10.261865	192.168.0.4	192.168.0.2	OSPF	98	Hello Packet
48	10.360146	192.168.0.1	224.0.0.5	OSPF	102	Hello Packet
49	10.584019	192.168.0.4	224.0.0.5	OSPF	102	Hello Packet
50	17.239969	c4:04:f1:b4:00:00	c4:04:f1:b4:00:00	LOOP	60	Reply
51	20.222585	192.168.0.3	224.0.0.5	OSPF	102	Hello Packet
52	20.258111	192.168.0.2	224.0.0.5	OSPF	102	Hello Packet
53	20.361069	192.168.0.1	224.0.0.5	OSPF	102	Hello Packet
54	20.588449	192.168.0.4	224.0.0.5	OSPF	102	Hello Packet
55	27.244422	c4:04:f1:b4:00:00	c4:04:f1:b4:00:00	LOOP	60	Reply
56	30.211311	192.168.0.3	224.0.0.5	OSPF	102	Hello Packet
57	30.255774	192.168.0.2	224.0.0.5	OSPF	102	Hello Packet
58	30.361978	192.168.0.1	224.0.0.5	OSPF	102	Hello Packet
59	30.583560	192.168.0.4	224.0.0.5	OSPF	102	Hello Packet
60	37.237989	c4:04:f1:b4:00:00	c4:04:f1:b4:00:00	LOOP	60	Reply
61	40.218848	192.168.0.3	192.168.0.2	OSPF	78	DB Description
62	40.228997	192.168.0.3	224.0.0.5	OSPF	102	Hello Packet
63	40.258063	192.168.0.2	192.168.0.1	OSPF	78	DB Description
64	40.268172	192.168.0.2	192.168.0.4	OSPF	78	DB Description
65	40.278398	192.168.0.2	192.168.0.3	OSPF	78	DB Description
66	40.288410	192.168.0.2	224.0.0.5	OSPF	102	Hello Packet
67	40.289274	192.168.0.3	192.168.0.2	OSPF	258	DB Description
68	40.298499	192.168.0.2	192.168.0.3	OSPF	158	DB Description
69	40.319515	192.168.0.3	192.168.0.2	OSPF	78	DB Description
70	40.328673	192.168.0.2	192.168.0.3	OSPF	78	DB Description
71	40.329586	192.168.0.3	192.168.0.2	OSPF	106	LS Request
72	40.338753	192.168.0.2	192.168.0.3	OSPF	166	LS Request
73	40.339651	192.168.0.3	192.168.0.2	OSPF	78	DB Description
74	40.348875	192.168.0.2	192.168.0.3	OSPF	206	LS Update
75	40.349729	192.168.0.3	192.168.0.2	OSPF	386	LS Update
76	40.358943	192.168.0.2	224.0.0.5	OSPF	98	LS Update
77	40.369846	192.168.0.3	192.168.0.2	OSPF	78	LS Acknowledge
78	40.373067	192.168.0.1	192.168.0.2	OSPF	78	DB Description
▶ Frame 198: 102 bytes on wire (816 bits), 102 bytes captured (816 bits) on interface -, id 0 ▶ Ethernet II, Src: c4:05:f2:40:00:00 (c4:05:f2:40:00:00), Dst: IPv4mcast_05 (01:00:5e:00:00:05) ▶ Internet Protocol Version 4, Src: 192.168.0.3, Dst: 224.0.0.5 ▶ Open Shortest Path First						
0000	01 00 5e 00 00 05 c4 05 f2 40 00 00 08 00 45 c0	..^.....@...E.				
0010	00 58 00 38 00 00 01 59 17 a5 c0 a8 00 03 e0 00	.X.8...Y.....				
0020	00 05 02 01 00 38 c0 a8 0c 01 00 00 00 00 49 958...I.				
0030	00 00 00 00 00 00 00 00 00 00 ff ff 00 00 0a				
0040	12 01 00 00 00 28 c0 a8 00 02 c0 a8 00 03 c0 a8(.....				
0050	00 01 c0 a8 04 01 c0 a8 0f 01 ff f6 00 03 00 01				

Figura 9 - Wireshark OSPF

4. NAT

O NAT foi configurado no roteador central, que é o ponto de entrada e saída para a internet, que é representada pelo roteador mais externo e com um IP diferente.

A porta f0/0 é a porta com o NAT outside e o IP 143.208.0.2, que seria o IP externo.

A porta f0/1 é a porta com o NAT inside e o IP 192.168.0.1, que seria um dos IP's internos.

A configuração do NAT ficou conforme a figura 10 abaixo, com um pool chamado facultadepool que vai do IP 143.208.0.10 até o 143.208.0.80 no modo overload para mapear para múltiplos IP's.

```
ip nat pool facultadepool 143.208.0.10 143.208.0.80 netmask 255.255.0.0
ip nat inside source list 1 pool facultadepool overload
!
access-list 1 permit 192.168.0.0 0.0.255.255
```

Figura 10 - Configuração do NAT

Na simulação vista na figura 11, a tabela de mapeamento do nat inicia vazia, ao realizar um ping a partir de uma VPC para o roteador que representa a internet conseguimos visualizar a tabela de mapeamento de IP's feito pelo NAT

```
PC9>
PC9>
PC9>
PC9> ping 143.208.0.1

84 bytes from 143.208.0.1 icmp_seq=1 ttl=253 time=29.120 ms
84 bytes from 143.208.0.1 icmp_seq=2 ttl=253 time=24.797 ms
84 bytes from 143.208.0.1 icmp_seq=3 ttl=253 time=24.984 ms
84 bytes from 143.208.0.1 icmp_seq=4 ttl=253 time=25.618 ms
84 bytes from 143.208.0.1 icmp_seq=5 ttl=253 time=25.613 ms

PC9>
Central#
Central#
Central#
Central#show ip nat translations

Central#show ip nat translations
Pro Inside global      Inside local      Outside local      Outside global
icmp 143.208.0.10:47635 192.168.5.2:47635 143.208.0.1:47635 143.208.0.1:47635
icmp 143.208.0.10:47891 192.168.5.2:47891 143.208.0.1:47891 143.208.0.1:47891
icmp 143.208.0.10:48147 192.168.5.2:48147 143.208.0.1:48147 143.208.0.1:48147
icmp 143.208.0.10:48403 192.168.5.2:48403 143.208.0.1:48403 143.208.0.1:48403
icmp 143.208.0.10:48659 192.168.5.2:48659 143.208.0.1:48659 143.208.0.1:48659

Central#
```

Figura 11 - Funcionamento do NAT

5. Simulação de queda

Ao iniciar a topologia, temos as tabelas e conexões todas funcionando corretamente conforme a imagem 12 abaixo.

```
Gateway of last resort is not set

0 E2 192.168.12.0/24 [110/20] via 192.168.0.3, 00:00:04, FastEthernet0/0
0 E2 192.168.13.0/24 [110/20] via 192.168.0.2, 00:00:04, FastEthernet0/0
0 E2 192.168.14.0/24 [110/20] via 192.168.0.2, 00:00:04, FastEthernet0/0
0 E2 192.168.15.0/24 [110/20] via 192.168.0.2, 00:00:04, FastEthernet0/0
0 E2 192.168.8.0/24 [110/20] via 192.168.0.3, 00:00:04, FastEthernet0/0
0 E2 192.168.9.0/24 [110/20] via 192.168.0.3, 00:00:04, FastEthernet0/0
0 E2 192.168.10.0/24 [110/20] via 192.168.0.3, 00:00:05, FastEthernet0/0
0 E2 192.168.11.0/24 [110/20] via 192.168.0.3, 00:00:05, FastEthernet0/0
0 E2 143.208.0.0/16 [110/20] via 192.168.0.1, 00:00:05, FastEthernet0/0
C 192.168.4.0/24 is directly connected, FastEthernet3/0
0 E2 192.168.5.0/24 [110/20] via 192.168.0.3, 00:00:05, FastEthernet0/0
0 E2 192.168.6.0/24 [110/20] via 192.168.0.3, 00:00:05, FastEthernet0/0
0 E2 192.168.7.0/24 [110/20] via 192.168.0.3, 00:00:05, FastEthernet0/0
C 192.168.0.0/24 is directly connected, FastEthernet0/0
C 192.168.1.0/24 is directly connected, FastEthernet0/1
C 192.168.2.0/24 is directly connected, FastEthernet1/0
C 192.168.3.0/24 is directly connected, FastEthernet2/0

Corporativo#
Corporativo#
Corporativo#
Corporativo#
Corporativo#

Gateway of last resort is not set

C 192.168.12.0/24 is directly connected, FastEthernet1/6
0 E2 192.168.13.0/24 [110/20] via 192.168.0.2, 00:00:05, FastEthernet0/0
0 E2 192.168.14.0/24 [110/20] via 192.168.0.2, 00:00:05, FastEthernet0/0
0 E2 192.168.15.0/24 [110/20] via 192.168.0.2, 00:00:05, FastEthernet0/0
C 192.168.8.0/24 is directly connected, FastEthernet1/2
C 192.168.9.0/24 is directly connected, FastEthernet1/3
C 192.168.10.0/24 is directly connected, FastEthernet1/4
C 192.168.11.0/24 is directly connected, FastEthernet1/5
0 E2 143.208.0.0/16 [110/20] via 192.168.0.1, 00:00:07, FastEthernet0/0
0 E2 192.168.4.0/24 [110/20] via 192.168.0.4, 00:00:07, FastEthernet0/0
C 192.168.5.0/24 is directly connected, FastEthernet0/1
C 192.168.6.0/24 is directly connected, FastEthernet1/0
C 192.168.7.0/24 is directly connected, FastEthernet1/1
C 192.168.0.0/24 is directly connected, FastEthernet0/0
0 E2 192.168.1.0/24 [110/20] via 192.168.0.4, 00:00:09, FastEthernet0/0
0 E2 192.168.2.0/24 [110/20] via 192.168.0.4, 00:00:09, FastEthernet0/0
0 E2 192.168.3.0/24 [110/20] via 192.168.0.4, 00:00:09, FastEthernet0/0

Escolas#
Escolas#
Escolas#
Escolas#
Escolas#
```

Figura 12 - Tabelas de roteamento

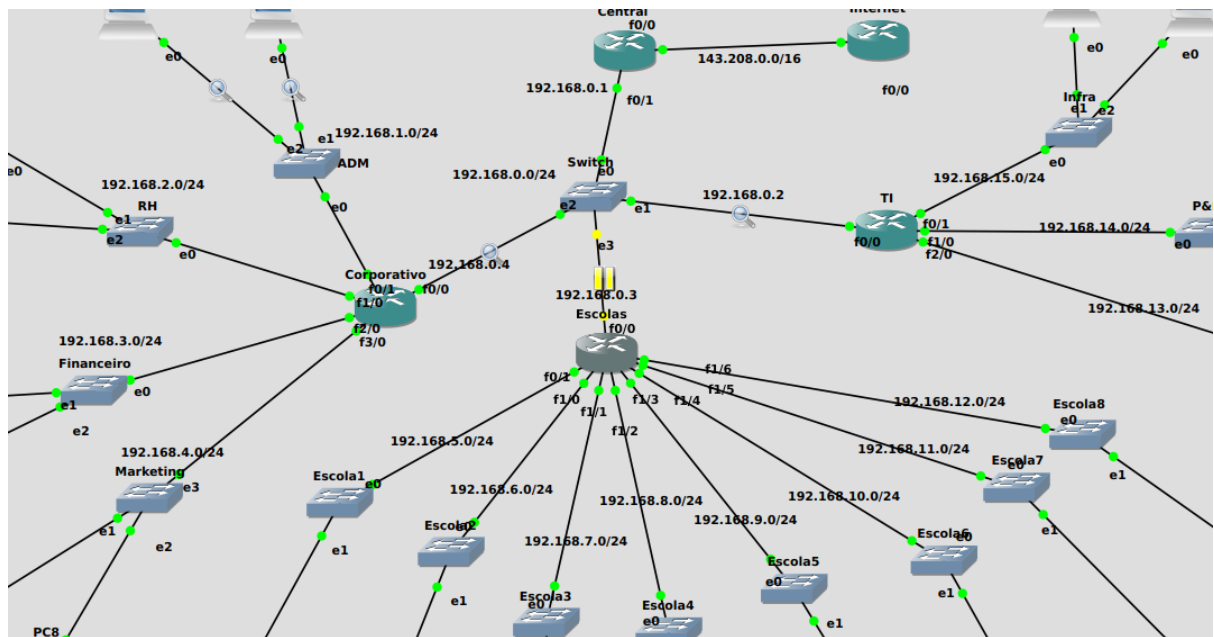


Figura 13 - Queda do enlace das escolas

Ao derrubar o enlace entre o roteador das escolas e o switch principal conseguimos notar o seguinte comportamento, o pacote hello do ip 192.168.0.3 demorou muito tempo para chegar, atingindo o tempo limite, por esse motivo foi detectada uma falha na comunicação, por isso os roteadores que identificaram a falha trocaram os pacotes pelo protocolo OSPF novamente conforme visto nas duas imagens a seguir.

151	110.318125	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
152	111.062221	192.168.0.3	224.0.0.5	OSPF	102 Hello Packet
153	111.326575	192.168.0.2	224.0.0.5	OSPF	102 Hello Packet
154	111.938168	192.168.0.4	224.0.0.5	OSPF	102 Hello Packet
155	117.953457	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
156	120.322346	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
157	121.063555	192.168.0.3	224.0.0.5	OSPF	102 Hello Packet
158	121.324295	192.168.0.2	224.0.0.5	OSPF	102 Hello Packet
159	121.936149	192.168.0.4	224.0.0.5	OSPF	102 Hello Packet
160	122.314980	c4:02:f1:77:00:01	CDP/VTP/DTP/PAGP/UDLD	CDP	359 Device ID: Central Port ID: FastEthernet0/1
161	123.035928	c4:05:f2:40:00:00	CDP/VTP/DTP/PAGP/UDLD	CDP	359 Device ID: Escolas Port ID: FastEthernet0/0
162	123.298911	c4:04:f1:b4:00:00	CDP/VTP/DTP/PAGP/UDLD	CDP	354 Device ID: TI Port ID: FastEthernet0/0
163	123.908846	c4:03:f1:96:00:00	CDP/VTP/DTP/PAGP/UDLD	CDP	363 Device ID: Corporativo Port ID: FastEthernet0/0
164	127.956022	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
165	130.321083	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
166	131.325160	192.168.0.2	224.0.0.5	OSPF	102 Hello Packet
167	131.934576	192.168.0.4	224.0.0.5	OSPF	102 Hello Packet
168	137.959264	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
169	140.316021	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
170	141.322111	192.168.0.2	224.0.0.5	OSPF	102 Hello Packet
171	141.928991	192.168.0.4	224.0.0.5	OSPF	102 Hello Packet
172	147.961059	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
173	150.322933	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
174	151.318211	192.168.0.2	224.0.0.5	OSPF	102 Hello Packet
175	151.936500	192.168.0.4	224.0.0.5	OSPF	102 Hello Packet
176	157.962144	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
177	160.315434	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
178	161.065103	192.168.0.4	192.168.0.1	OSPF	78 DB Description
179	161.073399	192.168.0.1	192.168.0.4	OSPF	78 DB Description
180	161.083467	192.168.0.1	192.168.0.4	OSPF	498 DB Description
181	161.085207	192.168.0.4	192.168.0.1	OSPF	498 DB Description

Figura 14 - Hello timeout

177	160.315434	192.168.0.1	224.0.0.5	OSPF	102 Hello Packet
178	161.065103	192.168.0.4	192.168.0.1	OSPF	78 DB Description
179	161.073399	192.168.0.1	192.168.0.4	OSPF	78 DB Description
180	161.083467	192.168.0.1	192.168.0.4	OSPF	498 DB Description
181	161.085207	192.168.0.4	192.168.0.1	OSPF	498 DB Description
182	161.093568	192.168.0.1	192.168.0.4	OSPF	78 DB Description
183	161.095313	192.168.0.4	192.168.0.1	OSPF	78 DB Description
184	161.103651	192.168.0.1	192.168.0.4	OSPF	78 DB Description
185	161.325488	192.168.0.2	224.0.0.5	OSPF	98 Hello Packet
186	161.567052	192.168.0.2	224.0.0.5	OSPF	98 LS Update
187	161.932224	192.168.0.4	224.0.0.5	OSPF	98 Hello Packet
188	164.067097	192.168.0.4	224.0.0.5	OSPF	78 LS Acknowledge
189	164.077103	192.168.0.1	224.0.0.6	OSPF	78 LS Acknowledge
190	167.961172	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
191	170.322632	192.168.0.1	224.0.0.5	OSPF	98 Hello Packet
192	171.321977	192.168.0.2	224.0.0.5	OSPF	98 Hello Packet
193	171.936999	192.168.0.4	224.0.0.5	OSPF	98 Hello Packet
194	177.961822	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60 Reply
195	180.318058	192.168.0.1	224.0.0.5	OSPF	98 Hello Packet
196	181.326607	192.168.0.2	224.0.0.5	OSPF	98 Hello Packet
197	181.928458	192.168.0.4	224.0.0.5	OSPF	98 Hello Packet
198	182.309319	c4:02:f1:77:00:01	CDP/VTP/DTP/PAGP/UDLD	CDP	359 Device ID: Central Port ID: FastEthernet0/1

Figura 15 - Remoção do enlace

Ao verificar novamente as tabelas de roteamento conseguimos notar que todas foram atualizadas removendo as informações do enlace que caiu.

Corporativo	Escolas
<pre>*Mar 1 00:02:49.943: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.0.1 on FastEthernet0/0 from LOADING to FULL, Loading Done Corporativo#show ip route Codes: 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 Gateway of last resort is not set O E2 192.168.13.0/24 [110/20] via 192.168.0.2, 00:00:13, FastEthernet0/0 O E2 192.168.14.0/24 [110/20] via 192.168.0.2, 00:00:13, FastEthernet0/0 O E2 192.168.15.0/24 [110/20] via 192.168.0.2, 00:00:13, FastEthernet0/0 O E2 143.208.0.0/16 [110/20] via 192.168.0.1, 00:00:13, FastEthernet0/0 C 192.168.4.0/24 is directly connected, FastEthernet3/0 C 192.168.0.0/24 is directly connected, FastEthernet0/0 C 192.168.1.0/24 is directly connected, FastEthernet0/1 C 192.168.2.0/24 is directly connected, FastEthernet1/0 C 192.168.3.0/24 is directly connected, FastEthernet2/0 Corporativo# Corporativo#</pre>	<pre>*Mar 1 00:03:00.487: %OSPF-5-ADJCHG: Process 1, Nbr 192.168.0.1 on FastEthernet0/0 from FULL to DOWN, Neighbor Down: Dead timer expired Escolas#show ip route Codes: 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 Gateway of last resort is not set C 192.168.12.0/24 is directly connected, FastEthernet1/6 C 192.168.8.0/24 is directly connected, FastEthernet1/2 C 192.168.9.0/24 is directly connected, FastEthernet1/3 C 192.168.10.0/24 is directly connected, FastEthernet1/4 C 192.168.11.0/24 is directly connected, FastEthernet1/5 C 192.168.5.0/24 is directly connected, FastEthernet0/1 C 192.168.6.0/24 is directly connected, FastEthernet1/0 C 192.168.7.0/24 is directly connected, FastEthernet1/1 C 192.168.0.0/24 is directly connected, FastEthernet0/0 Escolas# Escolas#</pre>

Figura 16 - Tabela de roteamento com o enlace removido

Ao ativar novamente o enlace conseguimos notar que o roteador das Escolas mandou uma mensagem em multicast novamente e os roteadores que receberam adicionaram novamente na sua tabela e elas voltaram ao estado original.

No.	Time	Source	Destination	Protocol	Length	Info
477	791.928708	192.168.0.4	224.0.0.5	OSPF	98	Hello Packet
478	797.959671	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60	Reply
479	800.322205	192.168.0.1	224.0.0.5	OSPF	98	Hello Packet
480	801.322713	192.168.0.2	224.0.0.5	OSPF	98	Hello Packet
481	801.928367	192.168.0.4	224.0.0.5	OSPF	98	Hello Packet
482	807.957470	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60	Reply
483	810.324248	192.168.0.1	224.0.0.5	OSPF	98	Hello Packet
484	811.316659	192.168.0.2	224.0.0.5	OSPF	98	Hello Packet
485	811.936203	192.168.0.4	224.0.0.5	OSPF	98	Hello Packet
486	817.957712	c4:03:f1:96:00:00	c4:03:f1:96:00:00	LOOP	60	Reply
487	820.315902	192.168.0.1	224.0.0.5	OSPF	98	Hello Packet
488	821.062199	192.168.0.3	224.0.0.5	OSPF	94	Hello Packet
489	821.071165	192.168.0.4	192.168.0.3	OSPF	102	Hello Packet
490	821.092371	192.168.0.3	192.168.0.4	OSPF	78	DB Description
491	821.101410	192.168.0.4	192.168.0.3	OSPF	78	DB Description
492	821.102449	192.168.0.3	192.168.0.4	OSPF	102	Hello Packet
493	821.111447	192.168.0.4	192.168.0.3	OSPF	498	DB Description
494	821.122618	192.168.0.3	192.168.0.4	OSPF	498	DB Description
495	821.131603	192.168.0.4	192.168.0.3	OSPF	78	DB Description
496	821.142774	192.168.0.3	192.168.0.4	OSPF	78	DB Description
497	821.151741	192.168.0.4	192.168.0.3	OSPF	70	LS Request
498	821.152865	192.168.0.3	192.168.0.4	OSPF	70	LS Request
499	821.163510	192.168.0.4	192.168.0.3	OSPF	78	DB Description
500	821.172126	192.168.0.4	192.168.0.3	OSPF	98	LS Update
501	821.193194	192.168.0.3	192.168.0.4	OSPF	98	LS Update
502	821.203331	192.168.0.3	192.168.0.4	OSPF	78	LS Acknowledge
503	821.322680	192.168.0.2	224.0.0.5	OSPF	102	Hello Packet
504	821.575835	192.168.0.3	224.0.0.5	OSPF	98	LS Update
505	821.685402	192.168.0.2	224.0.0.5	OSPF	102	LS Update
506	821.938122	192.168.0.4	224.0.0.5	OSPF	102	Hello Packet
507	828.070000	192.168.0.4	224.0.0.5	OSPF	98	Hello Packet

Figura 17 - Roteador do corporativo recuperando dados das Escolas.