

Relatório de E.T.

Laboratório nº2

Curso: METI

Turno: 3ª feira 08:00 > 09:30

Grupo: Bancada 8

Trabalho realizado por:

Luís Pereira, nº77984
Ruben Condesso, nº 81969

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1. Introdução

A finalidade do segundo e terceiro trabalhos laboratoriais da disciplina de Engenharia de Tráfego, têm por base simular e analisar através da plataforma GNS3 uma rede simples e uma rede mais complexa recorrendo ao uso de MPLS.

O relatório está dividido em dois tópicos, referentes aos dois exercícios realizados nas aulas laboratoriais.

No relatório, para cada exercício, é feita uma explicação do desenvolvimento do programa, é feita uma demonstração de várias figuras que nos permitem analisar os resultados e auxiliar as conclusões a retirar.

2. Laboratório 2

Para esta parte começamos por atribuir os endereços IP a todas as interfaces da rede que podemos verificar na figura seguinte:

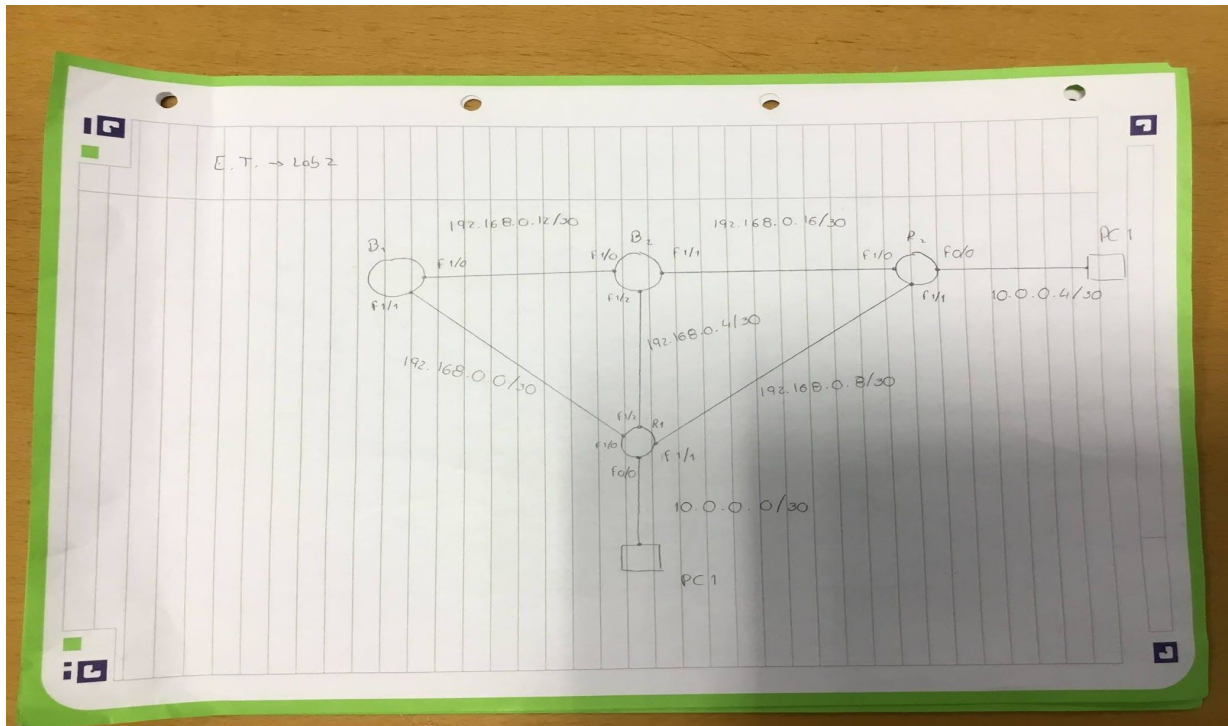


Figura 1: Atribuição de endereços IP a todas as interfaces da rede

Optámos por utilizar endereços públicos nas ligações entre os routers e endereços privados nos PC's.

Para que existisse conectividade entre todos os pontos da rede introduzimos o protocolo de encaminhamento OSPF.

3. Laboratório 3

Neste exercício, foi proposta a utilização de uma nova rede que passamos a demonstrar de seguida:

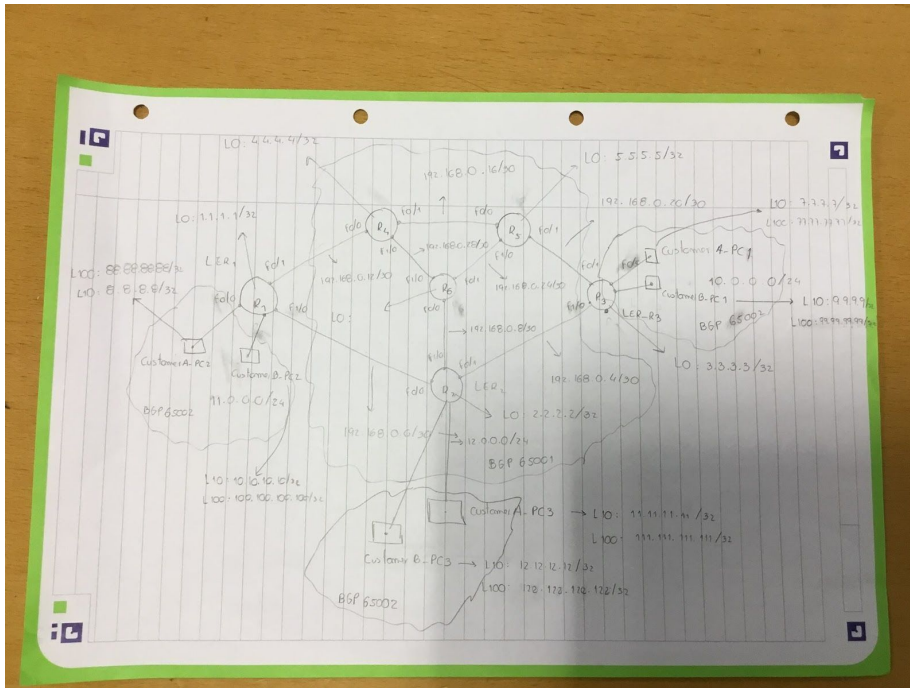
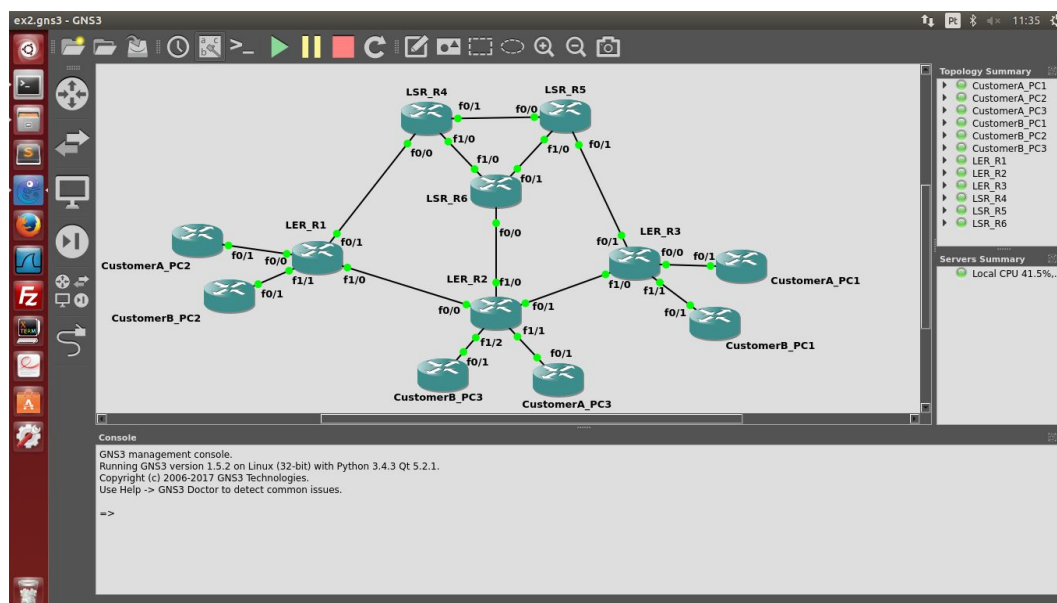


Figura 2: Atribuição de endereços IP a todas as interfaces da rede bem como endereços para loopback

Na figura seguinte podemos perceber melhor quais são os routers LSR, LER e os PC para cada um dos costumers(A e B).



Para demonstrar a funcionalidade da rede, guardamos alguma informação para discutir os resultados.

```

CustomerA_PC1
*Mar 1 00:00:33.159: %SYS-5-RESTART: System restarted --
Cisco IOS Software, 3700 Software (C3725-ADVIPSERVICESK9-M), Version 12.4(21), RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 10-Jul-08 06:32 by prod_rel_team
*Mar 1 00:00:33.191: %SNMP-5-COLDSTART: SNMP agent on host Customer_PC1 is undergoing a cold start
*Mar 1 00:01:09.963: %BGP-5-ADJCHANGE: neighbor 10.0.0.1 Up
Customer_PC1#sh ip bgp
BGP table version is 7, local router ID is 77.77.77.77
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network        Next Hop        Metric LocPrf Weight Path
*> 7.7.7.7/32      0.0.0.0              0         32768 i
*> 8.8.8.8/32      10.0.0.1             0        65001 65001 i
*> 11.11.11.11/32  10.0.0.1             0        65001 65001 i
*> 77.77.77.77/32  0.0.0.0              0         32768 i
*> 88.88.88.88/32  10.0.0.1             0        65001 65001 i
*> 111.111.111.111/32  10.0.0.1             0        65001 65001 i
Customer_PC1#

```

```

CustomerB_PC2
Cisco IOS Software, 3700 Software (C3725-ADVIPSERVICESK9-M), Version 12.4(21), RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 10-Jul-08 06:32 by prod_rel_team
*Mar 1 00:00:33.491: %SNMP-5-COLDSTART: SNMP agent on host CustomerB_PC2 is undergoing a cold start
*Mar 1 00:01:07.111: %BGP-5-ADJCHANGE: neighbor 11.0.0.3 Up
CustomerB_PC2#sh ip bgp
BGP table version is 7, local router ID is 100.100.100.100
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network        Next Hop        Metric LocPrf Weight Path
*> 9.9.9.9/32      11.0.0.3              0         65001 65001 i
*> 10.10.10.10/32  0.0.0.0              0         32768 i
*> 12.12.12.12/32  11.0.0.3              0        65001 65001 i
*> 99.99.99.99/32  11.0.0.3              0        65001 65001 i
*> 100.100.100.100/32  0.0.0.0              0         32768 i
*> 122.122.122.122/32  11.0.0.3              0        65001 65001 i
CustomerB_PC2#

```

Com estas duas figuras pretendemos demonstrar as tabelas de bgp no PC1 do Customer_A e no PC2 do Customer_B. Desta forma podemos perceber quais os routers a eles ligados e quais os loopbacks existentes.

```

LER_R1
1011 Untagged 8.8.8.8/32[V] 0 Fa0/0 11.0.0.2
1012 Untagged 88.88.88.88/32[V] 0 Fa0/0 11.0.0.2
1013 Untagged 10.10.10.10/32[V] 0 Fa1/1 11.0.0.4
1014 Untagged 100.100.100.100/32[V] \ Fa1/1 11.0.0.4
R1#sh ip bgp vpnv4 all sum
BGP router identifier 1.1.1.1, local AS number 65001
BGP table version is 21, main routing table version 21
12 network entries using 1644 bytes of memory
12 path entries using 816 bytes of memory
6/4 BGP path/bestpath attribute entries using 744 bytes of memory
1 BGP AS-PATH entries using 24 bytes of memory
2 BGP extended community entries using 48 bytes of memory
0 BGP route-map cache entries using 0 bytes of memory
0 BGP filter-list cache entries using 0 bytes of memory
BGP using 3276 total bytes of memory
BGP activity 12/0 prefixes, 12/0 paths, scan interval 15 secs

Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
2.2.2.2 4 65001 24 24 21 0 0 00:18:33 4
3.3.3.3 4 65001 24 24 21 0 0 00:18:28 4
11.0.0.2 4 65002 23 23 21 0 0 00:19:04 2
11.0.0.4 4 65002 23 23 21 0 0 00:19:05 2
R1#

```

```

LER_R1
*Mar 1 00:01:22.611: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on FastEthernet0/1 from LOADING to FULL, Loading Done
*Mar 1 00:01:26.031: %LDP-5-NBRCHG: LDP Neighbor 2.2.2.2:0 (1) is UP
*Mar 1 00:01:36.283: %LDP-5-NBRCHG: LDP Neighbor 4.4.4.4:0 (2) is UP
*Mar 1 00:01:38.507: %BGP-5-ADJCHANGE: neighbor 2.2.2.2 Up
*Mar 1 00:01:43.795: %BGP-5-ADJCHANGE: neighbor 3.3.3.3 Up
R1#sh mpls ldp neigh
Peer LDP Ident: 2.2.2.2:0; Local LDP Ident 1.1.1.1:0
TCP connection: 2.2.2.2.62678 - 1.1.1.1.646
State: Oper; Msgs sent/rcvd: 34/34; Downstream
Up time: 00:14:21
LDP discovery sources:
FastEthernet1/0, Src IP addr: 192.168.0.2
Addresses bound to peer LDP Ident:
192.168.0.2 2.2.2.2 192.168.0.5 192.168.0.9
Peer LDP Ident: 4.4.4.4:0; Local LDP Ident 1.1.1.1:0
TCP connection: 4.4.4.4.45415 - 1.1.1.1.646
State: Oper; Msgs sent/rcvd: 33/32; Downstream
Up time: 00:14:11
LDP discovery sources:
FastEthernet0/1, Src IP addr: 192.168.0.14
Addresses bound to peer LDP Ident:
192.168.0.14 4.4.4.4 192.168.0.17 192.168.0.29
R1#

```

Com a figura da esquerda pretendemos demonstrar o estado da MPLS IP VPN , que nos permite verificar a ligação entre o R1 e o LER_R2 e LER_R3 através do protocolo BGP. Com a figura do lado direito pretendemos demonstrar os neighbours dados pelo LDP protocol. Neste caso para o LER_R1 temos o 2.2.2.2 e o 4.4.4.4 (routers LER_R2 e LSR_R4)

```
LER_R1
LDP discovery sources:
FastEthernet0/1, Src IP addr: 192.168.0.14
Addresses bound to peer LDP Ident:
192.168.0.14 4.4.4.4 192.168.0.17 192.168.0.29
R1#show mpls forwarding-table
Local Outgoing Prefix Bytes tag Outgoing Next Hop
tag tag or VC or Tunnel Id switched interface
1000 Pop tag 2.2.2.2/32 0 Fa1/0 192.168.0.2
1001 Pop tag 192.168.0.4/30 0 Fa1/0 192.168.0.2
1002 Pop tag 192.168.0.8/30 0 Fa1/0 192.168.0.2
1003 2002 192.168.0.28/30 0 Fa1/0 192.168.0.2
1004 2003 192.168.0.24/30 0 Fa1/0 192.168.0.2
1005 2004 192.168.0.16/30 0 Fa1/0 192.168.0.2
1006 2005 192.168.0.20/30 0 Fa1/0 192.168.0.2
1007 2006 3.3.3.3/32 0 Fa1/0 192.168.0.2
1008 2007 4.4.4.4/32 0 Fa1/0 192.168.0.2
1009 2008 5.5.5.5/32 0 Fa1/0 192.168.0.2
1010 2009 6.6.6.6/32 0 Fa1/0 192.168.0.2
1011 Untagged 8.8.8.8/32[V] 0 Fa0/0 11.0.0.2
1012 Untagged 88.88.88.88/32[V] 0 Fa0/0 11.0.0.2
1013 Untagged 10.10.10.10/32[V] 0 Fa1/1 11.0.0.4
1014 Untagged 100.100.100.100/32[V] 0 Fa1/1 11.0.0.4
R1#
```

Com a figura acima pretendemos demonstrar a forwarding table de MPLS no router LER_R1.

```
LER_R1
BGP using 3276 total bytes of memory
BGP activity 12/0 prefixes, 12/0 paths, scan interval 15 secs
Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
2.2.2.2 4 65001 24 24 21 0 0 00:18:33 4
3.3.3.3 4 65001 24 24 21 0 0 00:18:28 4
11.0.0.2 4 65002 23 23 21 0 0 00:19:04 2
11.0.0.4 4 65002 23 23 21 0 0 00:19:05 2
R1#show ip bgp vpnv4 vrf Customer_A
BGP table version is 21, local router ID is 1.1.1.1
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
Network Next Hop Metric LocPrf Weight Path
Route Distinguisher: 65002:1 (default for vrf Customer_A)
*>17.7.7.7/32 3.3.3.3 0 100 0 65002 i
*> 8.8.8.8/32 11.0.0.2 0 100 0 65002 i
*>11.11.11.11/32 2.2.2.2 0 100 0 65002 i
*>177.77.77.77/32 3.3.3.3 0 100 0 65002 i
*> 88.88.88.88/32 11.0.0.2 0 100 0 65002 i
*>111.111.111.111/32 2.2.2.2 0 100 0 65002 i
R1#
```

```
LER_R2
BGP using 3276 total bytes of memory
BGP activity 12/0 prefixes, 12/0 paths, scan interval 15 secs
Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
1.1.1.1 4 65001 27 27 21 0 0 00:21:45 4
3.3.3.3 4 65001 27 27 21 0 0 00:21:47 4
12.0.0.2 4 65002 26 26 21 0 0 00:22:14 2
12.0.0.4 4 65002 26 26 21 0 0 00:22:17 2
R2#show ip bgp vpnv4 vrf Customer_A
BGP table version is 21, local router ID is 2.2.2.2
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
r RIB-failure, S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete
Network Next Hop Metric LocPrf Weight Path
Route Distinguisher: 65002:1 (default for vrf Customer_A)
*>17.7.7.7/32 3.3.3.3 0 100 0 65002 i
*>18.8.8.8/32 1.1.1.1 0 100 0 65002 i
*> 11.11.11.11/32 12.0.0.2 0 100 0 65002 i
*>177.77.77.77/32 3.3.3.3 0 100 0 65002 i
*>188.88.88.88/32 1.1.1.1 0 100 0 65002 i
*> 111.111.111.111/32 12.0.0.2 0 100 0 65002 i
R2#
```

Continuando pela nossa configuração, mostramos também o VRF para o mesmo Customer para dois routers diferentes (LER_R1 e LER_R2) que permite perceber a que router temos ligação ou que conhecemos.

Para todos estes casos realizámos as configurações no GNS3 e as quais apresentamos em ficheiros anexos ao relatório.

Para termos uma comparação, desligámos algumas interfaces para verificar o que acontecia aos vários caminhos percorridos pelos pacotes na rede.

Para o primeiro caso não temos nada desligado e fazemos traceroute do CustomerA_PC1 para o CustomerA_PC3:

```
CustomerA_PC3
*Mar 1 00:00:28.775: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet2/0, changed state to down
*Mar 1 00:00:28.775: %LINK-3-UPDOWN: Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:29.939: %LINEPROTO-5-UPDOWN: Line protocol on Interface FastEthernet0/1, changed state to up
*Mar 1 00:00:33.135: %SYS-5-RESTART: System restarted --
Cisco IOS Software, 3700 Software (C3725-ADVIPSERVICESK9-M), Version 12.4(21), RELEASE SOFTWARE (fc1)
Technical Support: http://www.cisco.com/techsupport
Copyright (c) 1986-2008 by Cisco Systems, Inc.
Compiled Thu 10-Jul-08 06:32 by prod_rel_team
*Mar 1 00:00:33.167: %SNMP-5-COLDSTART: SNMP agent on host CustomerA_PC3 is undergoing a cold start
*Mar 1 00:01:09.207: %BGP-5-ADJCHANGE: neighbor 12.0.0.1 Up
CustomerA_PC3#trace 77.77.77.77 source 1100

Type escape sequence to abort.
Tracing the route to 77.77.77.77

  1 12.0.0.1 0 msec 56 msec 132 msec
  2 10.0.0.1 [MPLS: Label 3012 Exp 0] 76 msec 124 msec 148 msec
  3 10.0.0.2 12 msec 260 msec 196 msec
CustomerA_PC3#
```

Para comparação ainda desligámos a interface f1/0 do router LER_R2:

```
CustomerB_PC3
*> 99.99.99.99/32 12.0.0.3 0 65001 65001 i
*> 100.100.100.100/32 12.0.0.3 0 65001 65001 i
*> 122.122.122.122/32 0.0.0.0 0 32768 i
CustomerB_PC3#trace 10.10.10.10 source 110

Type escape sequence to abort.
Tracing the route to 10.10.10.10

  1 12.0.0.3 44 msec 68 msec 68 msec
  2 11.0.0.3 [MPLS: Label 1013 Exp 0] 80 msec 68 msec 40 msec
  3 11.0.0.4 72 msec 148 msec 52 msec
CustomerB_PC3#trace 9.9.9.9 source 110

Type escape sequence to abort.
Tracing the route to 9.9.9.9

  1 12.0.0.3 20 msec 20 msec 44 msec
  2 192.168.0.10 [MPLS: Labels 6007/3013 Exp 0] 176 msec 68 msec 84 msec
  3 192.168.0.25 [MPLS: Labels 5007/3013 Exp 0] 112 msec 88 msec 96 msec
  4 10.0.0.3 [MPLS: Label 3013 Exp 0] 96 msec 72 msec 84 msec
  5 10.0.0.4 124 msec 84 msec 92 msec
CustomerB_PC3#
```

Para comparação ainda desligámos a interface f1/0 do router LSR_R5:

```
CustomerB_PC3
1 12.0.0.3 20 msec 20 msec 44 msec
2 192.168.0.10 [MPLS: Labels 6007/3013 Exp 0] 176 msec 68 msec 84 msec
3 192.168.0.25 [MPLS: Labels 5007/3013 Exp 0] 112 msec 88 msec 96 msec
4 10.0.0.3 [MPLS: Label 3013 Exp 0] 96 msec 72 msec 84 msec
5 10.0.0.4 124 msec 84 msec 92 msec
CustomerB_PC3#trace 9.9.9.9 source 110

Type escape sequence to abort.
Tracing the route to 9.9.9.9

  1 12.0.0.3 12 msec 28 msec 32 msec
  2 192.168.0.10 [MPLS: Labels 6007/3013 Exp 0] 184 msec 132 msec 120 msec
  3 192.168.0.29 [MPLS: Labels 4007/3013 Exp 0] 108 msec 100 msec 104 msec
  4 192.168.0.18 [MPLS: Labels 5007/3013 Exp 0] 148 msec 96 msec 120 msec
  5 10.0.0.3 [MPLS: Label 3013 Exp 0] 116 msec 84 msec 68 msec
  6 10.0.0.4 104 msec 100 msec 128 msec
CustomerB_PC3#
```

Com isto podemos afirmar que ao desligar estas portas o caminho efectuado pelos pacotes dentro da rede se altera de forma a chegar ao seu destino.

Para concluir, iremos agora demonstrar alguns traceroutes entre os diversos componentes do nosso sistema que nos permitem afirmar que temos conectividade entre diferentes PC's do mesmo Costumer.

```
*Mar  1 00:01:07.235: %BGP-5-ADJCHANGE: neighbor 11.0.0.1 Up
Customer_PC2#trace 7.7.7.7 source l10

Type escape sequence to abort.
Tracing the route to 7.7.7.7

  1 11.0.0.1 244 msec 36 msec 132 msec
  2 192.168.0.14 [MPLS: Labels 4007/3011 Exp 0] 424 msec 392 msec 324 msec
  3 192.168.0.18 [MPLS: Labels 5007/3011 Exp 0] 184 msec 88 msec 144 msec
  4 10.0.0.1 [MPLS: Label 3011 Exp 0] 96 msec 88 msec 96 msec
  5 10.0.0.2 88 msec 124 msec 88 msec
Customer_PC2#
```

Costumer_A PC1 to PC2

```
Customer_PC1#traceroute 8.8.8.8 source l10

Type escape sequence to abort.
Tracing the route to 8.8.8.8

  1 10.0.0.1 4 msec 28 msec 8 msec
  2 192.168.0.5 [MPLS: Labels 2000/1011 Exp 0] 228 msec 104 msec 968 msec
  3 11.0.0.1 [MPLS: Label 1011 Exp 0] 112 msec 108 msec 52 msec
  4 11.0.0.2 240 msec 100 msec 60 msec
Customer_PC1#
```

Costumer_A PC2 to PC1

```
CustomerB_PC3
* > 99.99.99.99/32 12.0.0.3 0 65001 65001 i
* > 100.100.100.100/32 12.0.0.3 0 65001 65001 i
* > 122.122.122.122/32 0.0.0.0 0 32768 i
CustomerB_PC3#trace 10.10.10.10 source l10

Type escape sequence to abort.
Tracing the route to 10.10.10.10

  1 12.0.0.3 44 msec 68 msec 68 msec
  2 11.0.0.3 [MPLS: Label 1013 Exp 0] 80 msec 68 msec 40 msec
  3 11.0.0.4 72 msec 148 msec 52 msec
CustomerB_PC3#trace 9.9.9.9 source l10

Type escape sequence to abort.
Tracing the route to 9.9.9.9

  1 12.0.0.3 20 msec 20 msec 44 msec
  2 192.168.0.10 [MPLS: Labels 6007/3013 Exp 0] 176 msec 68 msec 84 msec
  3 192.168.0.25 [MPLS: Labels 5007/3013 Exp 0] 112 msec 88 msec 96 msec
  4 10.0.0.3 [MPLS: Label 3013 Exp 0] 96 msec 72 msec 84 msec
  5 10.0.0.4 124 msec 84 msec 92 msec
CustomerB_PC3#
```

Costumer_B PC3 to 10.10.10.10 and 9.9.9.9