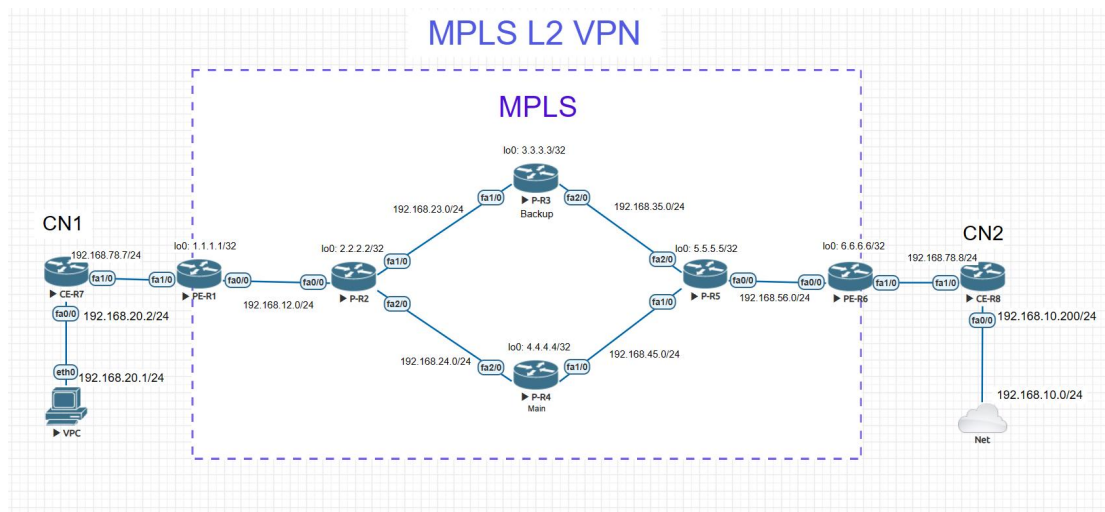


Mô hình:



Nội dung mô phỏng:

Ở nội dung mô phỏng này, ta sẽ thực hiện mô phỏng kết nối 2 chi nhánh với nhau bằng đường truyền MPLS-VPN. Cụ thể chính là đường MPLS-VPN Layer 2 để kết nối 2 chi nhánh này.

Giữa 2 chi nhánh sẽ được kết nối với nhau thông qua lớp mạng 192.168.78.0/24 qua router biên (CE - Customer Edge) ở mỗi phía chi nhánh.

Vùng MPLS sẽ được sử dụng giao thức định tuyến OSPF, đường truyền chính sẽ là được qua router lõi R4 (P-R4) còn đường truyền dự phòng là đường qua router lõi R3 (P-R3). Cũng chính vì sử dụng giao thức định tuyến OSPF nên nếu đường truyền chính gặp sự cố hay không hoạt động thì dữ liệu sẽ được tự động chuyển qua đường dự phòng.

Ngoài ra, để dễ phân biệt thì các router trong vùng MPLS sẽ có dãy label khác nhau. Cụ thể như sau:

- + R1: 100 - 149
- + R2: 150 - 199
- + R3: 200 - 249
- + R4: 350 - 399
- + R5: 250 - 299

+ R6: 300 - 349

Kết quả :

Bảng forwarding-table

```
PE-R1
*Mar 26 07:40:06.319: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on FastEthernet0/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:12.695: %LDP-5-NBRCHG: LDP Neighbor 2.2.2.2:0 (1) is UP
*Mar 26 07:40:22.503: %LDP-5-NBRCHG: LDP Neighbor 6.6.6.6:0 (2) is UP
PE-R1>
PE-R1>
PE-R1>
PE-R1>en
PE-R1#sh mpls for
PE-R1#sh mpls forwarding-table
Local      Outgoing    Prefix      Bytes Label  Outgoing    Next Hop
Label      Label       or Tunnel Id Switched      interface
100        No Label    12ckt(1)    5174         Fa1/0       point2point
101        Pop Label   2.2.2.2/32  0            Fa0/0       192.168.12.2
102        Pop Label   192.168.23.0/24 0          Fa0/0       192.168.12.2
103        Pop Label   192.168.24.0/24 0          Fa0/0       192.168.12.2
104        151        6.6.6.6/32  0            Fa0/0       192.168.12.2
105        152        5.5.5.5/32  0            Fa0/0       192.168.12.2
106        153        4.4.4.4/32  0            Fa0/0       192.168.12.2
107        154        3.3.3.3/32  0            Fa0/0       192.168.12.2
108        155        192.168.35.0/24 0          Fa0/0       192.168.12.2
109        156        192.168.56.0/24 0          Fa0/0       192.168.12.2
110        157        192.168.45.0/24 0          Fa0/0       192.168.12.2
PE-R1#
```

```
P-R2
et3/0, changed state to down
*Mar 26 07:40:05.703: %OSPF-5-ADJCHG: Process 1, Nbr 1.1.1.1 on FastEthernet0/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:06.863: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on FastEthernet1/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:06.967: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on FastEthernet2/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:12.827: %LDP-5-NBRCHG: LDP Neighbor 1.1.1.1:0 (1) is UP
*Mar 26 07:40:25.067: %LDP-5-NBRCHG: LDP Neighbor 4.4.4.4:0 (2) is UP
*Mar 26 07:40:32.151: %LDP-5-NBRCHG: LDP Neighbor 3.3.3.3:0 (3) is UP
P-R2>en
P-R2#sh mpls for
P-R2#sh mpls forwarding-table
Local      Outgoing    Prefix      Bytes Label  Outgoing    Next Hop
Label      Label       or Tunnel Id Switched      interface
150        Pop Label   1.1.1.1/32  11089        Fa0/0       192.168.12.1
151        350        6.6.6.6/32  10294        Fa2/0       192.168.24.4
152        351        5.5.5.5/32  0            Fa2/0       192.168.24.4
153        Pop Label   4.4.4.4/32  0            Fa2/0       192.168.24.4
154        Pop Label   3.3.3.3/32  0            Fa1/0       192.168.23.3
155        Pop Label   192.168.35.0/24 0          Fa1/0       192.168.23.3
156        357        192.168.56.0/24 0          Fa2/0       192.168.24.4
157        Pop Label   192.168.45.0/24 0          Fa2/0       192.168.24.4
P-R2#
```

```

P-R3
*Mar 26 07:40:04.679: %OSPF-5-ADJCHG: Process 1, Nbr 2.2.2.2 on FastEthernet1/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:05.499: %OSPF-5-ADJCHG: Process 1, Nbr 5.5.5.5 on FastEthernet2/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:19.927: %LDP-5-NBRCHG: LDP Neighbor 5.5.5.5:0 (1) is UP
*Mar 26 07:40:28.719: %LDP-5-NBRCHG: LDP Neighbor 2.2.2.2:0 (2) is UP
P-R3>
P-R3>
P-R3>en
P-R3#sh mpls for
P-R3#sh mpls forwarding-table

```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Label Switched	Outgoing interface	Next Hop
200	Pop Label	2.2.2.2/32	0	Fa1/0	192.168.23.2
201	150	1.1.1.1/32	0	Fa1/0	192.168.23.2
202	Pop Label	192.168.12.0/24	0	Fa1/0	192.168.23.2
203	Pop Label	192.168.24.0/24	0	Fa1/0	192.168.23.2
204	250	6.6.6.6/32	0	Fa2/0	192.168.35.5
205	Pop Label	5.5.5.5/32	0	Fa2/0	192.168.35.5
206	153	4.4.4.4/32	0	Fa1/0	192.168.23.2
	251	4.4.4.4/32	0	Fa2/0	192.168.35.5
207	Pop Label	192.168.56.0/24	0	Fa2/0	192.168.35.5
208	Pop Label	192.168.45.0/24	0	Fa2/0	192.168.35.5

```

P-R3#

```

```

P-R4
*Mar 26 07:40:05.715: %OSPF-5-ADJCHG: Process 1, Nbr 5.5.5.5 on FastEthernet1/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:18.803: %LDP-5-NBRCHG: LDP Neighbor 5.5.5.5:0 (1) is UP
*Mar 26 07:40:22.807: %LDP-5-NBRCHG: LDP Neighbor 2.2.2.2:0 (2) is UP
P-R4>
P-R4>
P-R4>
P-R4>en
P-R4#sh mp
P-R4#sh mpls for
P-R4#sh mpls forwarding-table

```

Local Label	Outgoing Label	Prefix or Tunnel Id	Bytes Label Switched	Outgoing interface	Next Hop
350	250	6.6.6.6/32	11100	Fa1/0	192.168.45.5
351	Pop Label	5.5.5.5/32	0	Fa1/0	192.168.45.5
352	154	3.3.3.3/32	0	Fa2/0	192.168.24.2
	252	3.3.3.3/32	0	Fa1/0	192.168.45.5
353	Pop Label	2.2.2.2/32	0	Fa2/0	192.168.24.2
354	150	1.1.1.1/32	12596	Fa2/0	192.168.24.2
355	Pop Label	192.168.35.0/24	0	Fa1/0	192.168.45.5
356	Pop Label	192.168.23.0/24	0	Fa2/0	192.168.24.2
357	Pop Label	192.168.56.0/24	0	Fa1/0	192.168.45.5
358	Pop Label	192.168.12.0/24	0	Fa2/0	192.168.24.2

```

P-R4#

```



```
P-R5
*Mar 26 07:40:08.299: %OSPF-5-ADJCHG: Process 1, Nbr 4.4.4.4 on FastEthernet1/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:08.871: %OSPF-5-ADJCHG: Process 1, Nbr 3.3.3.3 on FastEthernet2/0
from LOADING to FULL, Loading Done
*Mar 26 07:40:12.727: %LDP-5-NBRCHG: LDP Neighbor 6.6.6.6:0 (1) is UP
*Mar 26 07:40:22.179: %LDP-5-NBRCHG: LDP Neighbor 4.4.4.4:0 (2) is UP
*Mar 26 07:40:24.175: %LDP-5-NBRCHG: LDP Neighbor 3.3.3.3:0 (3) is UP
P-R5>
P-R5>
P-R5>en
P-R5#sh mp
P-R5#sh mpls fo
P-R5#sh mpls forwarding-table
Local      Outgoing  Prefix      Bytes Label  Outgoing  Next Hop
Label      Label     or Tunnel Id Switched      interface
250        Pop Label  6.6.6.6/32   12373        Fa0/0      192.168.56.6
251        Pop Label  4.4.4.4/32   0            Fa1/0      192.168.45.4
252        Pop Label  3.3.3.3/32   0            Fa2/0      192.168.35.3
253        353       2.2.2.2/32   0            Fa1/0      192.168.45.4
254        354       1.1.1.1/32   14058        Fa1/0      192.168.45.4
255        Pop Label  192.168.23.0/24 0            Fa2/0      192.168.35.3
256        358       192.168.12.0/24 0            Fa1/0      192.168.45.4
257        Pop Label  192.168.24.0/24 0            Fa1/0      192.168.45.4
P-R5#
```

```
PE-R6
*Mar 26 07:40:08.751: %LDP-5-NBRCHG: LDP Neighbor 5.5.5.5:0 (1) is UP
*Mar 26 07:40:19.859: %LDP-5-NBRCHG: LDP Neighbor 1.1.1.1:0 (2) is UP
PE-R6>
PE-R6>
PE-R6>
PE-R6>en
PE-R6#sh mpl
PE-R6#sh mpls f
PE-R6#sh mpls fo
PE-R6#sh mpls forwarding-table
Local      Outgoing  Prefix      Bytes Label  Outgoing  Next Hop
Label      Label     or Tunnel Id Switched      interface
300        No Label  12ckt(1)     6053         Fa1/0      point2point
301        Pop Label  5.5.5.5/32   0            Fa0/0      192.168.56.5
302        Pop Label  192.168.35.0/24 0            Fa0/0      192.168.56.5
303        Pop Label  192.168.45.0/24 0            Fa0/0      192.168.56.5
304        251       4.4.4.4/32   0            Fa0/0      192.168.56.5
305        252       3.3.3.3/32   0            Fa0/0      192.168.56.5
306        253       2.2.2.2/32   0            Fa0/0      192.168.56.5
307        254       1.1.1.1/32   0            Fa0/0      192.168.56.5
308        255       192.168.23.0/24 0            Fa0/0      192.168.56.5
309        256       192.168.12.0/24 0            Fa0/0      192.168.56.5
310        257       192.168.24.0/24 0            Fa0/0      192.168.56.5
PE-R6#
```

Thông tin công VPN:

```

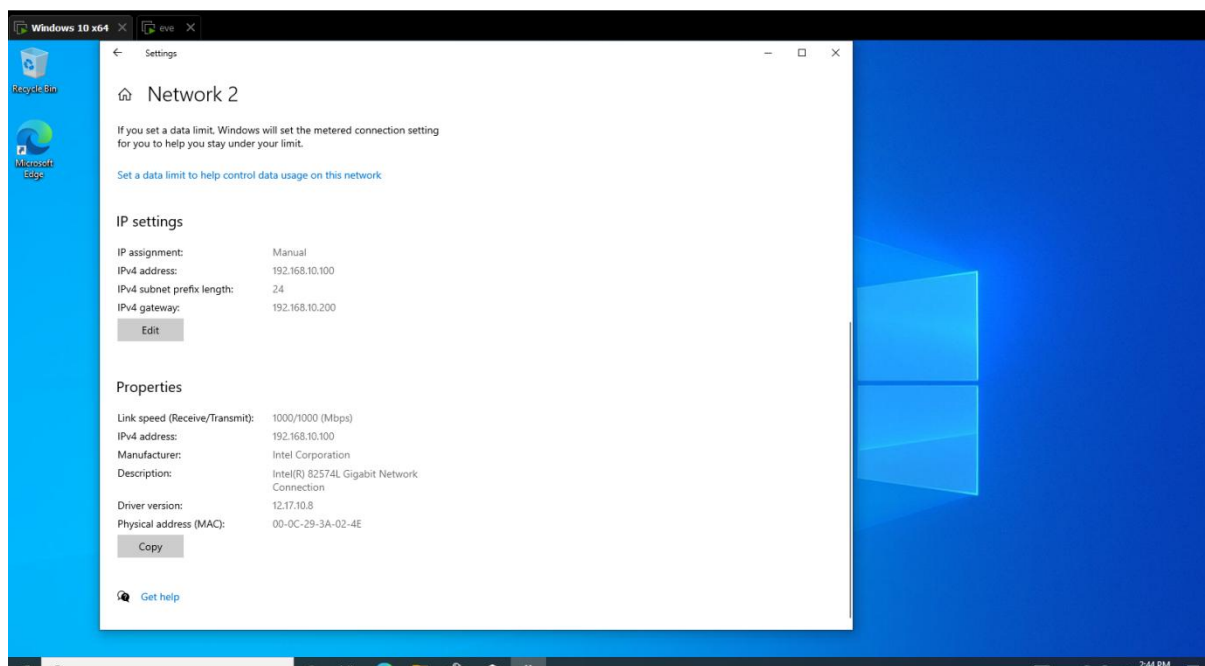
PE-R6#sh xconnect peer 1.1.1.1 all detail
Legend:      XC ST=Xconnect State   S1=Segment1 State   S2=Segment2 State
             UP=Up                 DN=Down             AD=Admin Down       IA=Inactive
             SB=Standby            HS=Hot Standby      RV=Recovering       NH=No Hardware

XC ST  Segment 1                               S1 Segment 2                               S2
-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+-----+
UP pri  ac Fa1/0:3(Ethernet)                    UP mpls 1.1.1.1:130                               UP
                                     Interworking: none                               Local VC label 300
                                     Local VC label 100                               Remote VC label 100
PE-R6#

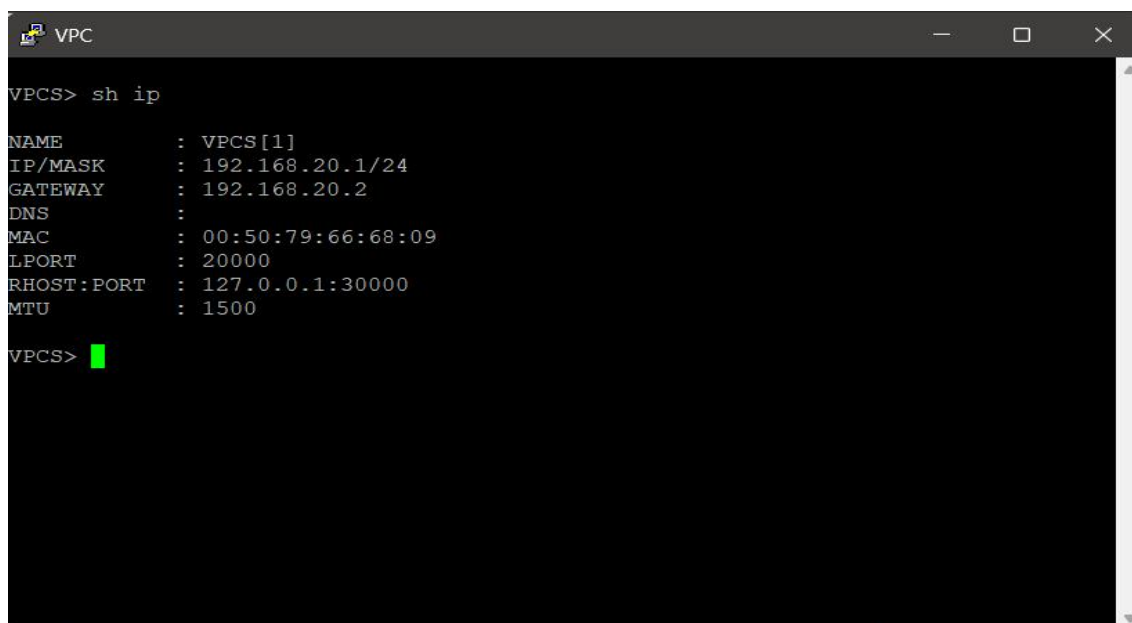
```

Ping giữa 2 chi nhánh:

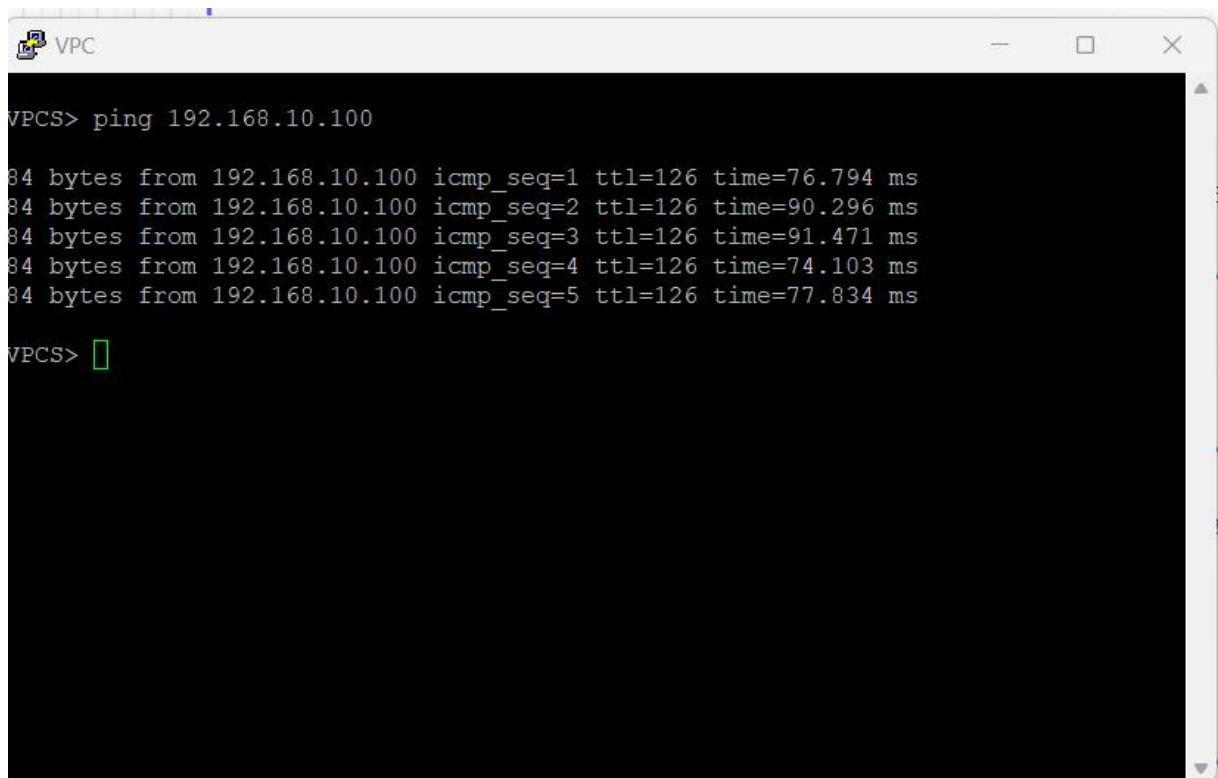
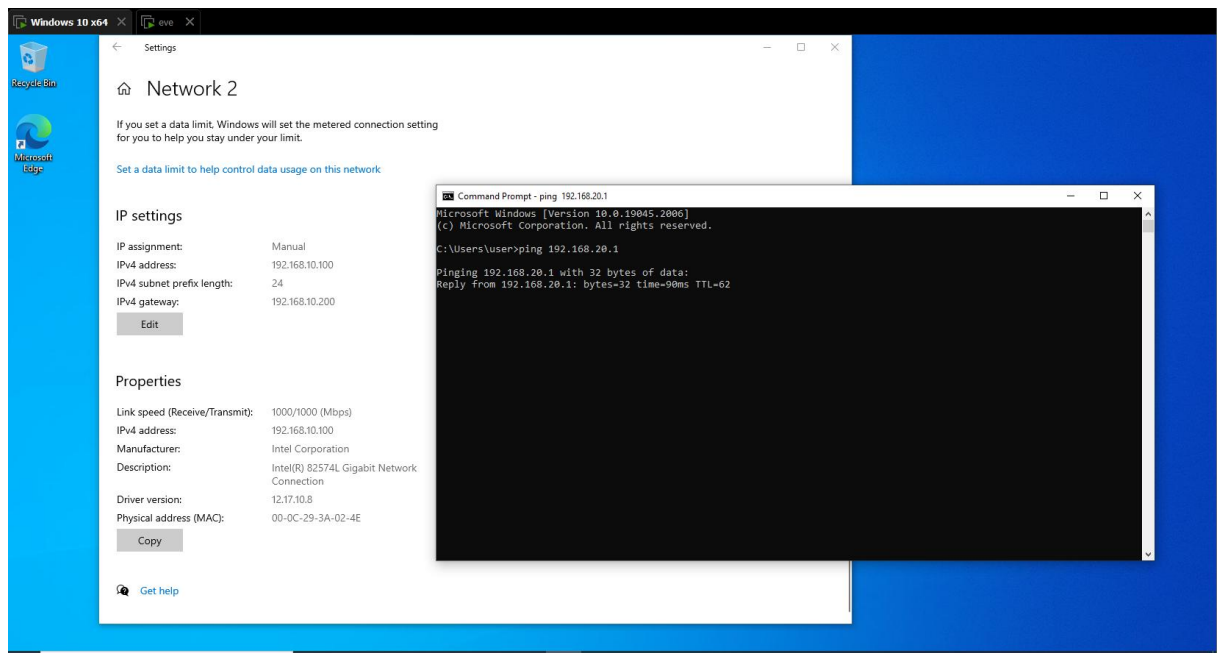
Thông tin máy ở chi nhánh 2:



Thông tin máy ở chi nhánh 1:



Kết quả ping:



Kiểm tra bằng wireshark:

Ping từ CN2 sang CN1

165	180.172771	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=1/256, ttl=12
166	180.248907	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=1/256, ttl=63
167	181.190119	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=2/512, ttl=12
168	181.242094	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=2/512, ttl=63
169	182.212009	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=3/768, ttl=12
170	182.273121	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=3/768, ttl=63
171	182.593393	one.one.one.one	6.6.6.6	LDP	80 Hello Message	
172	182.613577	ca:05:0c:c0:00:1c	CDP/VTP/DTP/PagP/UD...	CDP	368 Device ID: P-R5 Port ID: FastEthernet1/0	
173	183.038556	192.168.45.5	all-routers.mcast.n...	LDP	76 Hello Message	
174	183.235858	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=4/1024, ttl=1
175	183.281352	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=4/1024, ttl=6

> Frame 169: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0
 > Ethernet II, Src: ca:05:0c:c0:00:1c (ca:05:0c:c0:00:1c), Dst: ca:04:0d:5d:00:1c (ca:04:0d:5d:00:1c)
 > MultiProtocol Label Switching Header, Label: 357, Exp: 0, S: 0, TTL: 254
 > MultiProtocol Label Switching Header, Label: 100, Exp: 0, S: 1, TTL: 255
 > PW Ethernet Control Word
 > Ethernet II, Src: ca:08:0a:cd:00:1c (ca:08:0a:cd:00:1c), Dst: ca:07:0b:55:00:1c (ca:07:0b:55:00:1c)
 > Internet Protocol Version 4, Src: 192.168.10.100 (192.168.10.100), Dst: 192.168.20.1 (192.168.20.1)
 > Internet Control Message Protocol

165	180.172771	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=1/256, ttl=12
166	180.248907	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=1/256, ttl=63
167	181.190119	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=2/512, ttl=12
168	181.242094	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=2/512, ttl=63
169	182.212009	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=3/768, ttl=12
170	182.273121	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=3/768, ttl=63
171	182.593393	one.one.one.one	6.6.6.6	LDP	80 Hello Message	
172	182.613577	ca:05:0c:c0:00:1c	CDP/VTP/DTP/PagP/UD...	CDP	368 Device ID: P-R5 Port ID: FastEthernet1/0	
173	183.038556	192.168.45.5	all-routers.mcast.n...	LDP	76 Hello Message	
174	183.235858	192.168.10.100	192.168.20.1	ICMP	100 Echo (ping) request	id=0x0001, seq=4/1024, ttl=1
175	183.281352	192.168.20.1	192.168.10.100	ICMP	100 Echo (ping) reply	id=0x0001, seq=4/1024, ttl=6

> Frame 170: 100 bytes on wire (800 bits), 100 bytes captured (800 bits) on interface 0
 > Ethernet II, Src: ca:04:0d:5d:00:1c (ca:04:0d:5d:00:1c), Dst: ca:05:0c:c0:00:1c (ca:05:0c:c0:00:1c)
 > MultiProtocol Label Switching Header, Label: 250, Exp: 0, S: 0, TTL: 253
 > MultiProtocol Label Switching Header, Label: 300, Exp: 0, S: 1, TTL: 255
 > PW Ethernet Control Word
 > Ethernet II, Src: ca:07:0b:55:00:1c (ca:07:0b:55:00:1c), Dst: ca:08:0a:cd:00:1c (ca:08:0a:cd:00:1c)
 > Internet Protocol Version 4, Src: 192.168.20.1 (192.168.20.1), Dst: 192.168.10.100 (192.168.10.100)
 > Internet Control Message Protocol

Từ CN1 sang CN2:

11	5.468208	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa656, seq=2/512, ttl=63 (req
12	5.502550	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa656, seq=2/512, ttl=127 (re
13	6.553469	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa756, seq=3/768, ttl=63 (req
14	6.589052	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa756, seq=3/768, ttl=127 (re
15	6.943921	192.168.45.5	all-routers.mcast.n...	LDP	76 Hello Message	
16	7.631007	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa856, seq=4/1024, ttl=63 (re
17	7.679546	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa856, seq=4/1024, ttl=127 (r
18	8.731662	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa956, seq=5/1280, ttl=63 (re
19	8.773187	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa956, seq=5/1280, ttl=127 (r
20	8.969376	one.one.one.one	6.6.6.6	LDP	80 Hello Message	

> Frame 11: 124 bytes on wire (992 bits), 124 bytes captured (992 bits) on interface 0
 > Ethernet II, Src: ca:04:0d:5d:00:1c (ca:04:0d:5d:00:1c), Dst: ca:05:0c:c0:00:1c (ca:05:0c:c0:00:1c)
 > MultiProtocol Label Switching Header, Label: 250, Exp: 0, S: 0, TTL: 253
 > MultiProtocol Label Switching Header, Label: 300, Exp: 0, S: 1, TTL: 255
 > PW Ethernet Control Word
 > Ethernet II, Src: ca:07:0b:55:00:1c (ca:07:0b:55:00:1c), Dst: ca:08:0a:cd:00:1c (ca:08:0a:cd:00:1c)
 > Internet Protocol Version 4, Src: 192.168.20.1 (192.168.20.1), Dst: 192.168.10.100 (192.168.10.100)
 > Internet Control Message Protocol

11	5.468208	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa656, seq=2/512, ttl=63 (repl
12	5.502550	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa656, seq=2/512, ttl=127 (req
13	6.553469	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa756, seq=3/768, ttl=63 (repl
14	6.589052	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa756, seq=3/768, ttl=127 (req
15	6.943921	192.168.45.5	all-routers.mcast.n...	LDP	76 Hello Message	
16	7.631007	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa856, seq=4/1024, ttl=63 (rep
17	7.679546	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa856, seq=4/1024, ttl=127 (re
18	8.731662	192.168.20.1	192.168.10.100	ICMP	124 Echo (ping) request	id=0xa956, seq=5/1280, ttl=63 (rep
19	8.773187	192.168.10.100	192.168.20.1	ICMP	124 Echo (ping) reply	id=0xa956, seq=5/1280, ttl=127 (re
20	8.969376	one.one.one.one	6.6.6.6	LDP	80 Hello Message	

```

> Frame 12: 124 bytes on wire (992 bits), 124 bytes captured (992 bits) on interface 0
> Ethernet II, Src: ca:05:0c:c0:00:1c (ca:05:0c:c0:00:1c), Dst: ca:04:0d:5d:00:1c (ca:04:0d:5d:00:1c)
> MultiProtocol Label Switching Header, Label: 357, Exp: 0, S: 0, TTL: 254
> MultiProtocol Label Switching Header, Label: 100, Exp: 0, S: 1, TTL: 255
> PW Ethernet Control Word
> Ethernet II, Src: ca:08:0a:cd:00:1c (ca:08:0a:cd:00:1c), Dst: ca:07:0b:55:00:1c (ca:07:0b:55:00:1c)
> Internet Protocol Version 4, Src: 192.168.10.100 (192.168.10.100), Dst: 192.168.20.1 (192.168.20.1)
> Internet Control Message Protocol

```