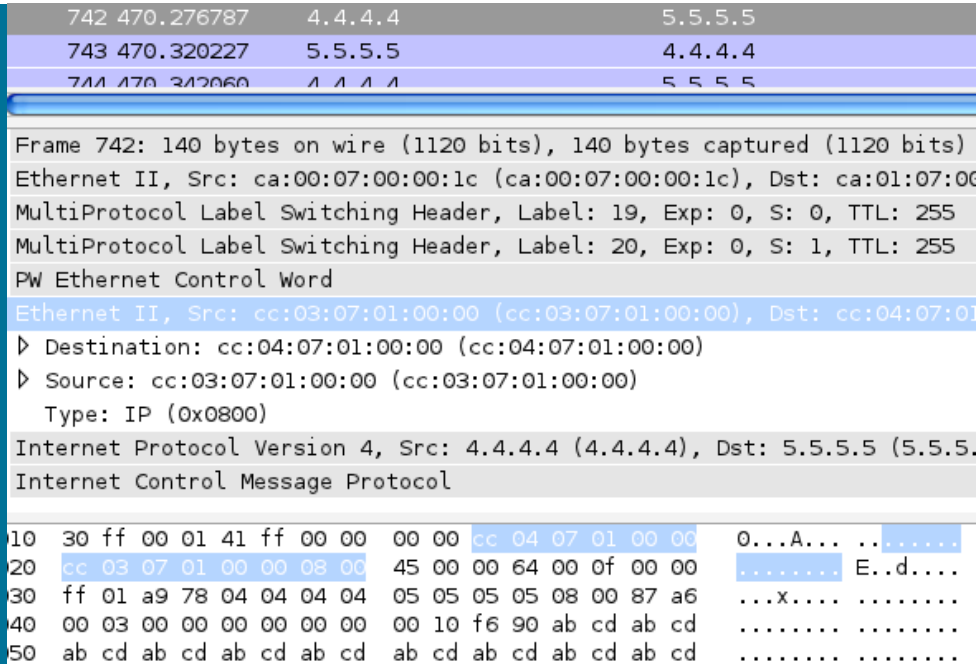
Jak wygląda mój pakiet?



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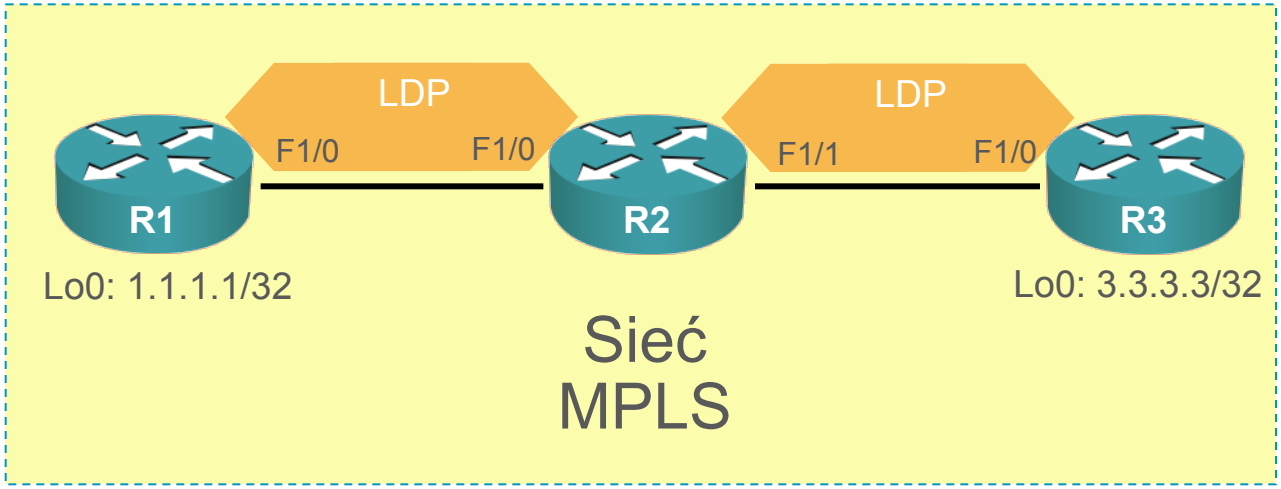
Dzisiejsze menu

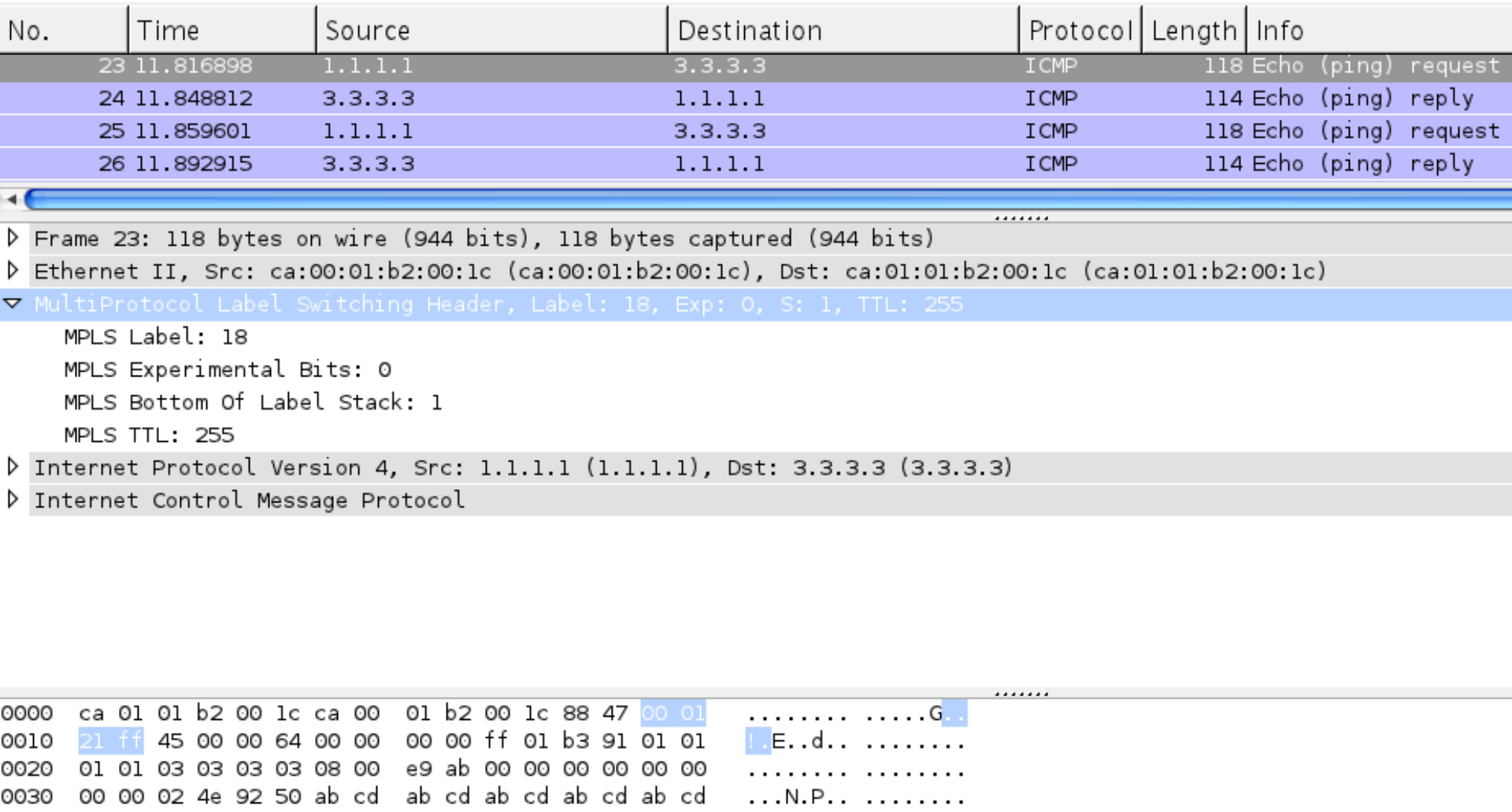
1. Pojedyncza etykieta MPLS
2. Port-based EoMPLS VC Type-5 + CW
3. Vlan-based EoMPLS VC Type-5 + CW + TE
4. Vlan-based EoMPLS VC Type-5 + TE (bez CW)
5. Vlan-based EoMPLS VC Type-4 + CW
6. L3VPN
7. L3VPN + TE
8. Carrier Supporting Carrier
9. 6PE

Pojedyncza etykieta MPLS

- Jeden proces IGP/LDP w całej sieci.
- Capture zawsze na R1 F1/0.



Pakiet MPLS z pojedynczą etykietą



No.	Time	Source	Destination	Protocol	Length	Info
23	11.816898	1.1.1.1	3.3.3.3	ICMP	118	Echo (ping) request
24	11.848812	3.3.3.3	1.1.1.1	ICMP	114	Echo (ping) reply
25	11.859601	1.1.1.1	3.3.3.3	ICMP	118	Echo (ping) request
26	11.892915	3.3.3.3	1.1.1.1	ICMP	114	Echo (ping) reply

```
▷ Frame 23: 118 bytes on wire (944 bits), 118 bytes captured (944 bits)
▷ Ethernet II, Src: ca:00:01:b2:00:1c (ca:00:01:b2:00:1c), Dst: ca:01:01:b2:00:1c (ca:01:01:b2:00:1c)
▽ MultiProtocol Label Switching Header, Label: 18, Exp: 0, S: 1, TTL: 255
    MPLS Label: 18
    MPLS Experimental Bits: 0
    MPLS Bottom Of Label Stack: 1
    MPLS TTL: 255
▷ Internet Protocol Version 4, Src: 1.1.1.1 (1.1.1.1), Dst: 3.3.3.3 (3.3.3.3)
▷ Internet Control Message Protocol
```

```
0000  ca 01 01 b2 00 1c ca 00  01 b2 00 1c 88 47 00 01   ........ .....G..
0010  21 ff 45 00 00 64 00 00  00 00 ff 01 b3 91 01 01   !.E..d.. ........
0020  01 01 03 03 03 03 08 00  e9 ab 00 00 00 00 00 00   ........ ........
0030  00 00 02 4e 92 50 ab cd  ab cd ab cd ab cd ab cd   ...N.P.. ........
```

Rozgłoszenie etykiety LDP

No.	Time	Source	Destination	Protoc	Length	Info
128	48.134332	2.2.2.2	1.1.1.1	LDP	113	Initialization Message
129	48.177301	1.1.1.1	2.2.2.2	LDP	121	Initialization Message Keep Alive
130	48.231463	2.2.2.2	1.1.1.1	LDP	273	Address Message Label Mapping Mess
131	48.316943	1.1.1.1	2.2.2.2	LDP	342	Address Message Label Mapping Mess

```
▷ Frame 130: 273 bytes on wire (2184 bits), 273 bytes captured (2184 bits)
▷ Ethernet II, Src: ca:01:01:b2:00:1c (ca:01:01:b2:00:1c), Dst: ca:00:01:b2:00:1c (ca:00:01:b2:00:1c)
▷ Internet Protocol Version 4, Src: 2.2.2.2 (2.2.2.2), Dst: 1.1.1.1 (1.1.1.1)
▷ Transmission Control Protocol, Src Port: 59311 (59311), Dst Port: ldp (646), Seq: 60, Ack: 68, Len: 219
▷ Label Distribution Protocol
▽ Label Distribution Protocol
    Version: 1
    PDU Length: 197
    LSR ID: 2.2.2.2 (2.2.2.2)
    Label Space ID: 0
```

Pakiet skrócony

```
  ▽ FEC Elements
    ▽ FEC Element 1
        FEC Element Type: Prefix FEC (2)
        FEC Element Address Type: IPv4 (1)
        FEC Element Length: 32
        Prefix: 3.3.3.3
▽ Generic Label TLV
    00.. .... = TLV Unknown bits: Known TLV, do not Forward (0x00)
    TLV Type: Generic Label TLV (0x200)
    TLV Length: 4
    Generic Label: 18
```

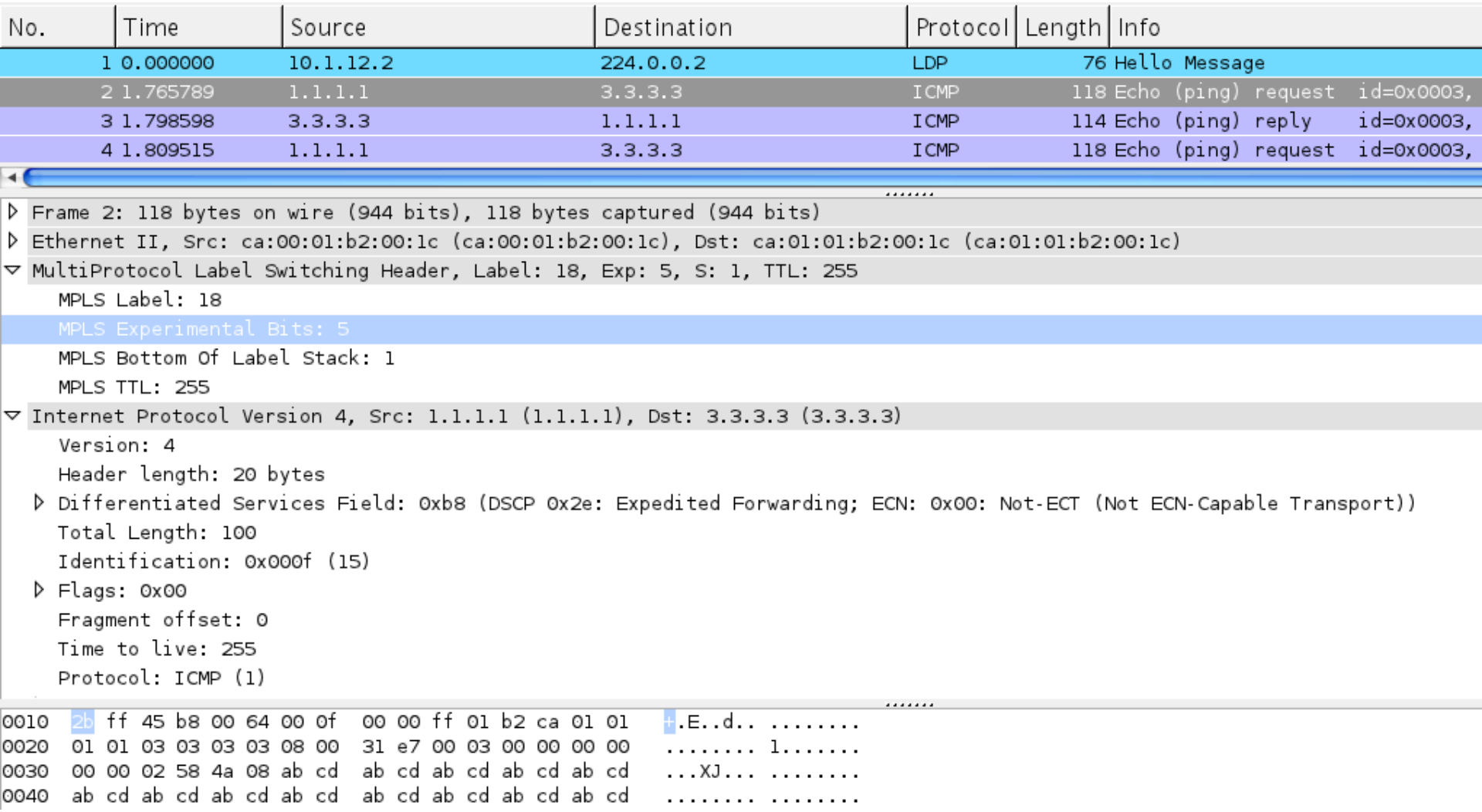
Weryfikacja: Jedna etykieta MPLS

- Ping z R1 do R3

```
Rack1R1#sh ip cef 3.3.3.3
3.3.3.3/32
  nexthop 10.1.12.2 FastEthernet1/0 label 18
```

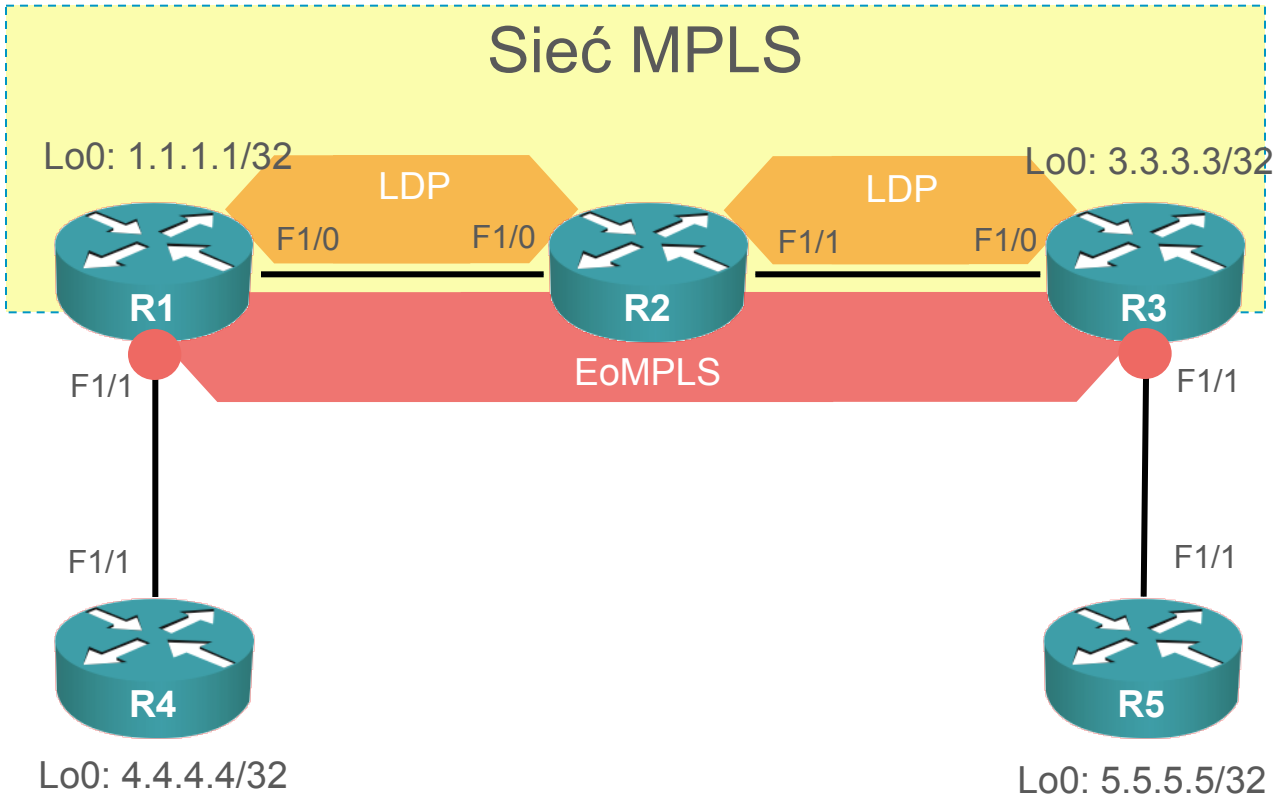
```
Rack1R1#show mpls forwarding-table
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
16         17         5.5.5.5/32[V]    0             Fa1/1.30   10.3.14.4
17         No Label   12.1.1.0/30[V]   0             aggregate/aa
18         No Label   l2ckt(102)       408060        Fa1/1.10   point2point
19         explicit-n 2.2.2.2/32       0             Fa1/0      10.1.12.2
20         explicit-n 10.1.23.0/24     0             Fa1/0      10.1.12.2
21         18         3.3.3.3/32       0             Fa1/0      10.1.12.2
22         19         10.2.35.0/24     0             Fa1/0      10.1.12.2
26         23         31.1.1.0/30[V]   0             Fa1/0      10.1.12.2
27         24         32.1.1.0/30[V]   0             Fa1/0      10.1.12.2
29         Pop Label  4.4.4.4/32[V]    0             Fa1/1.30   10.3.14.4
30         Pop Label  10.1.45.0/24[V]  0             Fa1/1.30   10.3.14.4
```

QoS: Mapowanie DSCP do EXP



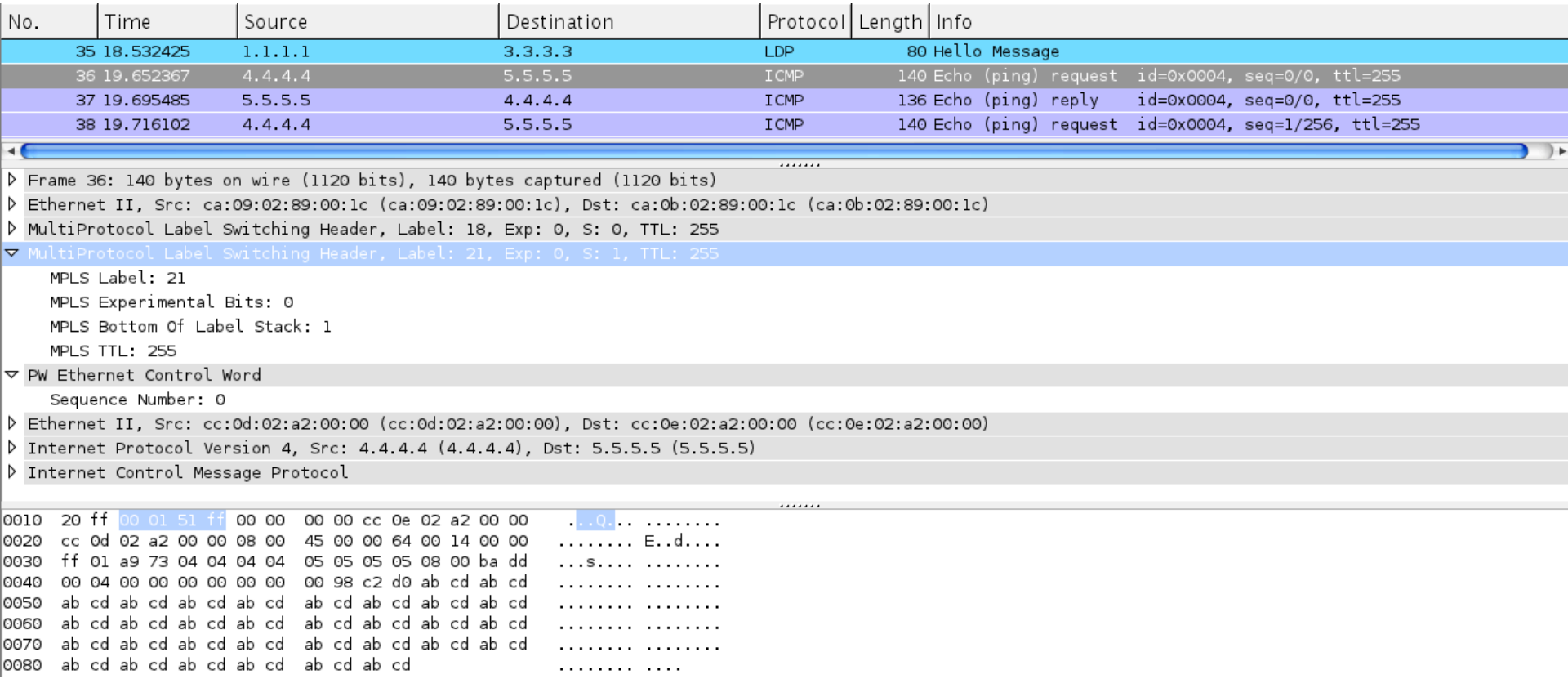
EoMPLS VC Type-5 + CW

- Port-based xconnect z control word (CW)



EoMPLS Port-based VC-Type 5 + CW

- Dwie etykiety + Control Word

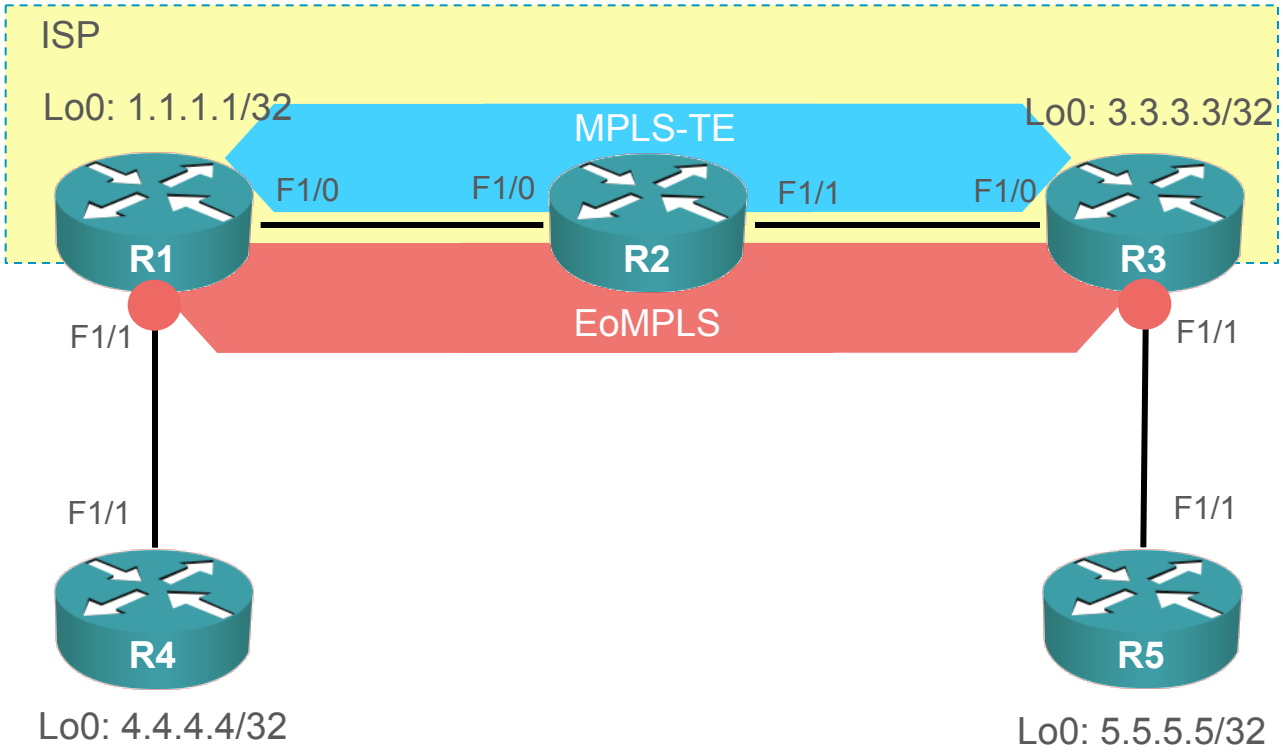


EoMPLS Port-based VC-Type 5 + CW

```
Rack1R1#sh mpls for
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
16         Pop Label  2.2.2.2/32       0             Fa1/0      10.1.12.2
17         Pop Label  10.1.23.0/24     0             Fa1/0      10.1.12.2
18         18         3.3.3.3/32       0             Fa1/0      10.1.12.2
21         No Label   l2ckt(101)       158687        Fa1/1      point2point


Rack1R1#sh mpls l2transport vc det | i label
    Output interface: Fa1/0, imposed label stack {18 21}
    MPLS VC labels: local 21, remote 21


Rack1R1#sh mpls l2transport binding
  Destination Address: 3.3.3.3,  VC ID: 101
    Local Label:  21
        Cbit: 1,    VC Type: Ethernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]
    Remote Label: 21
        Cbit: 1,    VC Type: Ethernet,    GroupID: 0
        MTU: 1500,   Interface Desc: n/a
        VCCV: CC Type: CW [1], RA [2]
              CV Type: LSPV [2]

R1:
!
interface FastEthernet1/1
 xconnect 3.3.3.3 101 encapsulation mpls
!
```

EoMPLS VC Type-5 + CW + TE

- VLAN-based xconnect w trybie Ethernet z control word (CW)



EoMPLS VC Type-5 + CW + TE

- PW na podinterfejsie w trybie Ethernet + CW poprzez tunel TE

No.	Time	Source	Destination	Protocol	Length	Info
	741 469.598880	1.1.1.1	3.3.3.3	TCP	60	ldp > 12768 [ACK] Seq=314 Ack=314 Win=3815 Len=0
	742 470.276787	4.4.4.4	5.5.5.5	ICMP	140	Echo (ping) request id=0x0003, seq=0/0, ttl=255
	743 470.320227	5.5.5.5	4.4.4.4	ICMP	136	Echo (ping) reply id=0x0003, seq=0/0, ttl=255

```
Frame 742: 140 bytes on wire (1120 bits), 140 bytes captured (1120 bits)
Ethernet II, Src: ca:00:07:00:00:1c (ca:00:07:00:00:1c), Dst: ca:01:07:00:00:1c (ca:01:07:00:00:1c)
MultiProtocol Label Switching Header, Label: 19, Exp: 0, S: 0, TTL: 255
MultiProtocol Label Switching Header, Label: 20, Exp: 0, S: 1, TTL: 255
PW Ethernet Control Word
Ethernet II, Src: cc:03:07:01:00:00 (cc:03:07:01:00:00), Dst: cc:04:07:01:00:00 (cc:04:07:01:00:00)
  Destination: cc:04:07:01:00:00 (cc:04:07:01:00:00)
  Source: cc:03:07:01:00:00 (cc:03:07:01:00:00)
  Type: IP (0x0800)
Internet Protocol Version 4, Src: 4.4.4.4 (4.4.4.4), Dst: 5.5.5.5 (5.5.5.5)
Internet Control Message Protocol
```

```
0010  30 ff 00 01 41 ff 00 00  00 00 cc 04 07 01 00 00   0...A... ........
0020  cc 03 07 01 00 00 08 00  45 00 00 64 00 0f 00 00   ........ E..d....
0030  ff 01 a9 78 04 04 04 04  05 05 05 05 08 00 87 a6   ...x.... ........
0040  00 03 00 00 00 00 00 00  00 10 f6 90 ab cd ab cd   ........ ........
0050  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0060  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0070  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0080  ab cd ab cd ab cd ab cd  ab cd ab cd               ........ ....
```

EoMPLS VC Type-5 + CW + TE

```
Rack1R1#sh mpls l2transport vc det
Local interface: Fa1/1.10 up, line protocol up, Eth VLAN 10 up
  Interworking type is Ethernet
  Destination address: 3.3.3.3, VC ID: 102, VC status: up
    Output interface: Tu0, imposed label stack {19 20}
    Preferred path: Tunnel0,  active
    Default path: ready
    Next hop: point2point
  Create time: 00:11:47, last status change time: 00:06:45
  Signaling protocol: LDP, peer 3.3.3.3:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 3.3.3.3, LDP is UP
…
    MPLS VC labels: local 17, remote 20
```

```
!
pseudowire-class p1
 encapsulation mpls
 interworking ethernet
 preferred-path interface Tunnel0
!
interface FastEthernet1/1.10
 encapsulation dot1Q 10
 xconnect 3.3.3.3 102 pw-class p1
!
```

EoMPLS VC Type-5 + bez CW + TE

No.	Time	Source	Destination	Protocol	Length	Info
23	11.119836	10.1.45.4	224.0.0.5	OSPF	116	Hello Packet
24	11.311686	4.4.4.4	5.5.5.5	ICMP	136	Echo (ping) request
25	11.365584	5.5.5.5	4.4.4.4	ICMP	132	Echo (ping) reply
26	11.387124	4.4.4.4	5.5.5.5	ICMP	136	Echo (ping) request

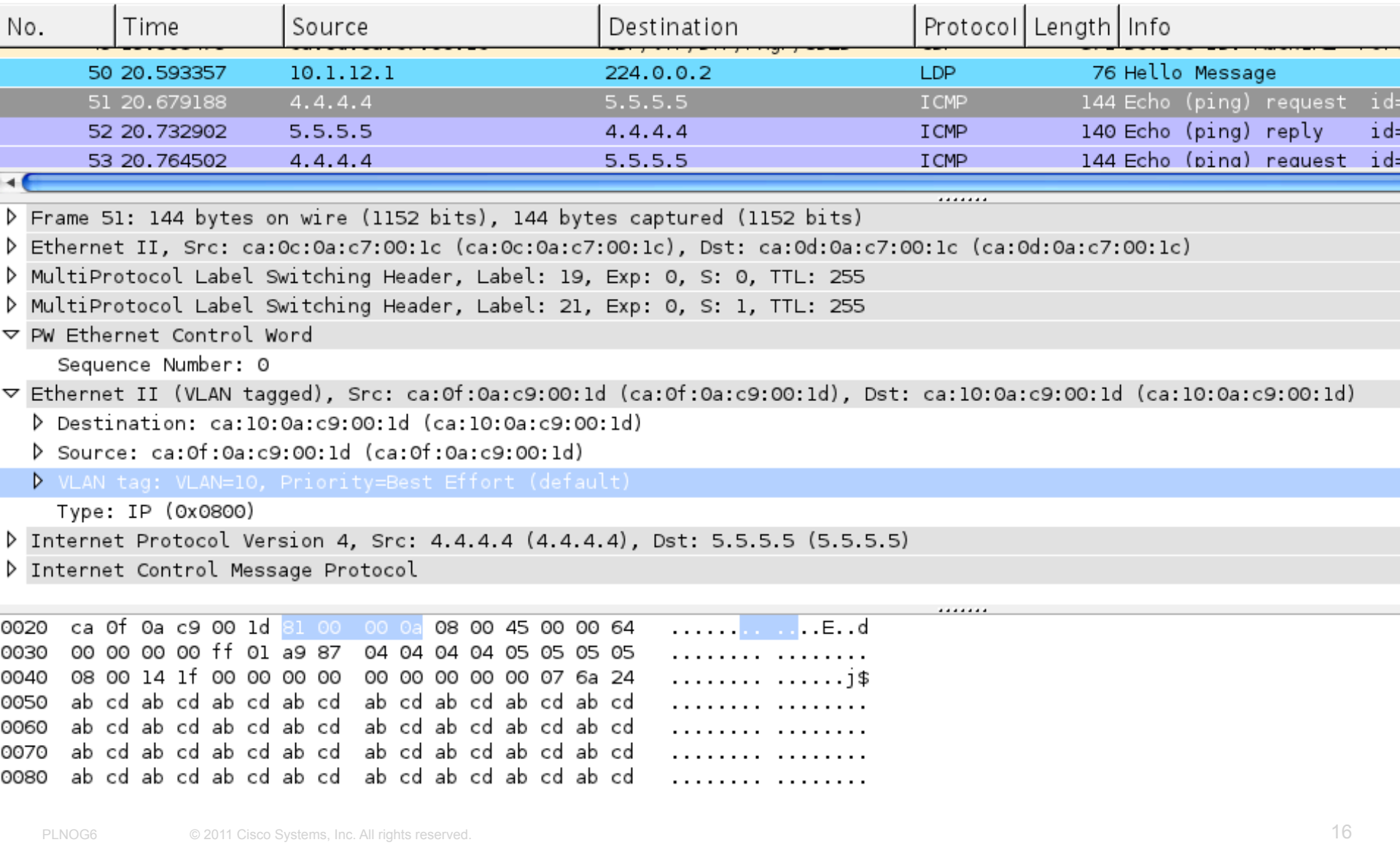
```
▷ Frame 24: 136 bytes on wire (1088 bits), 136 bytes captured (1088 bits)
▷ Ethernet II, Src: ca:00:07:00:00:1c (ca:00:07:00:00:1c), Dst: ca:01:07:00:00:1c (ca:01:07:00:00:1c)
▷ MultiProtocol Label Switching Header, Label: 19, Exp: 0, S: 0, TTL: 255
▽ MultiProtocol Label Switching Header, Label: 21, Exp: 0, S: 1, TTL: 255
    MPLS Label: 21
    MPLS Experimental Bits: 0
    MPLS Bottom Of Label Stack: 1
    MPLS TTL: 255
▽ Ethernet II, Src: cc:03:07:01:00:00 (cc:03:07:01:00:00), Dst: cc:04:07:01:00:00 (cc:04:07:01:00:00)
  ▷ Destination: cc:04:07:01:00:00 (cc:04:07:01:00:00)
  ▷ Source: cc:03:07:01:00:00 (cc:03:07:01:00:00)
    Type: IP (0x0800)
▷ Internet Protocol Version 4, Src: 4.4.4.4 (4.4.4.4), Dst: 5.5.5.5 (5.5.5.5)
▷ Internet Control Message Protocol
```

```
0000  ca 01 07 00 00 1c ca 00  07 00 00 1c 88 47 00 01   ........ .....G..
0010  30 ff 00 01 51 ff cc 04  07 01 00 00 cc 03 07 01   0...Q... ........
0020  00 00 08 00 45 00 00 64  00 19 00 00 ff 01 a9 6e   ....E..d .......n
0030  04 04 04 04 05 05 05 05  08 00 f0 6d 00 05 00 00   ........ ...m....
0040  00 00 00 00 00 2f 8d a8  ab cd ab cd ab cd ab cd   ...../.. ........
0050  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0060  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0070  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
```

EoMPLS VC Type-5 + bez CW + TE

```
Rack1R1#sh mpls l2transport vc det
Local interface: Fa1/1.10 up, line protocol up, Eth VLAN 10 up
  Interworking type is Ethernet
  Destination address: 3.3.3.3, VC ID: 102, VC status: up
    Output interface: Tu0, imposed label stack {19 21}
    Preferred path: Tunnel0,  active
    Default path: ready
    Next hop: point2point
  Create time: 00:26:28, last status change time: 00:26:15
  Signaling protocol: LDP, peer 3.3.3.3:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 3.3.3.3, LDP is UP
    Status TLV support (local/remote)   : enabled/supported
..
MPLS VC labels: local 16, remote 21
MTU: local 1500, remote 1500
Control Word: Off


!
pseudowire-class p1
 encapsulation mpls
 interworking ethernet
 no control-word
 preferred-path interface Tunnel0
!
interface FastEthernet1/1.10
 encapsulation dot1Q 10
 xconnect 3.3.3.3 102 pw-class p1
!
```

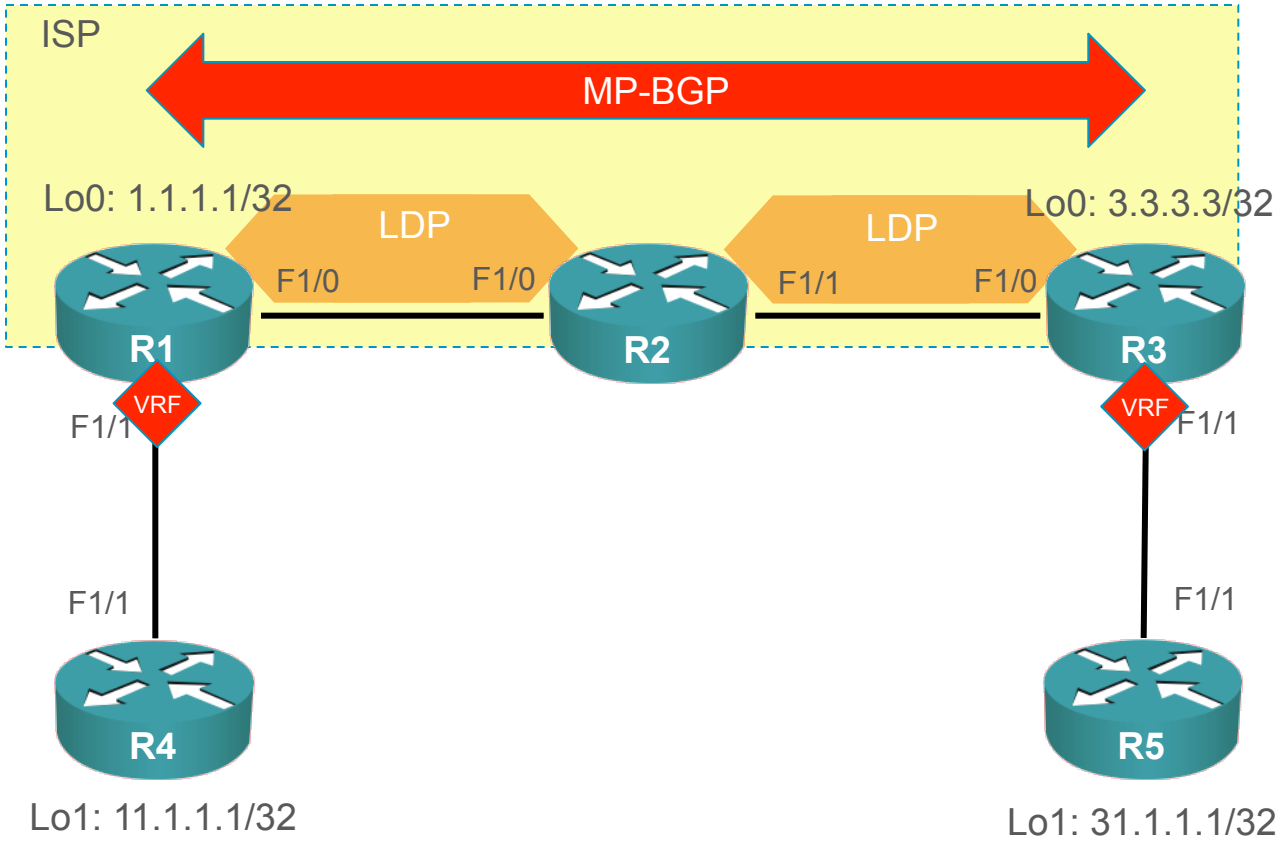
EoMPLS VC Type-4 + CW



EoMPLS VC Type-4 + CW

```
Rack1R1#sh mpls l2transport vc det
Local interface: Fa1/1.10 up, line protocol up, Eth VLAN 10 up
  Destination address: 3.3.3.3, VC ID: 102, VC status: up
    Output interface: Fa1/0, imposed label stack {19 21}
    Preferred path: not configured
    Default path: active
    Next hop: 10.1.12.2
  Create time: 00:00:50, last status change time: 00:00:50
  Signaling protocol: LDP, peer 3.3.3.3:0 up
    Targeted Hello: 1.1.1.1(LDP Id) -> 3.3.3.3, LDP is UP
    Status TLV support (local/remote)   : enabled/supported
…
    MPLS VC labels: local 22, remote 21
    Group ID: local 0, remote 0
    MTU: local 1500, remote 1500

Rack1R2#sh mpls for
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
18     [T] Pop Label  1.1.1.1/32       13628         Tu0        point2point
19         explicit-n 3.3.3.3/32       13581         Fa1/1      10.1.23.3

!
pseudowire-class p2
 encapsulation mpls
 interworking vlan
!
interface FastEthernet1/1.10
 encapsulation dot1Q 10
 xconnect 3.3.3.3 102 pw-class p2
!
```

Usługa L3VPN



Usługa L3VPN

No.	Time	Source	Destination	Protocol	Length	Info
12	3.007889	11.1.1.1	31.1.1.1	ICMP	122	Echo (ping) request
13	3.039939	31.1.1.1	11.1.1.1	ICMP	118	Echo (ping) reply
14	3.050626	11.1.1.1	31.1.1.1	ICMP	122	Echo (ping) request
15	3.082476	31.1.1.1	11.1.1.1	ICMP	118	Echo (ping) reply

```
▷ Frame 12: 122 bytes on wire (976 bits), 122 bytes captured (976 bits)
▷ Ethernet II, Src: ca:0c:0a:c7:00:1c (ca:0c:0a:c7:00:1c), Dst: ca:0d:0a:c7:00:1c (ca:0d:0a:c7:00:1c)
▷ MultiProtocol Label Switching Header, Label: 19, Exp: 0, S: 0, TTL: 255
▽ MultiProtocol Label Switching Header, Label: 23, Exp: 0, S: 1, TTL: 255
    MPLS Label: 23
    MPLS Experimental Bits: 0
    MPLS Bottom Of Label Stack: 1
    MPLS TTL: 255
▷ Internet Protocol Version 4, Src: 11.1.1.1 (11.1.1.1), Dst: 31.1.1.1 (31.1.1.1)
▷ Internet Control Message Protocol
```

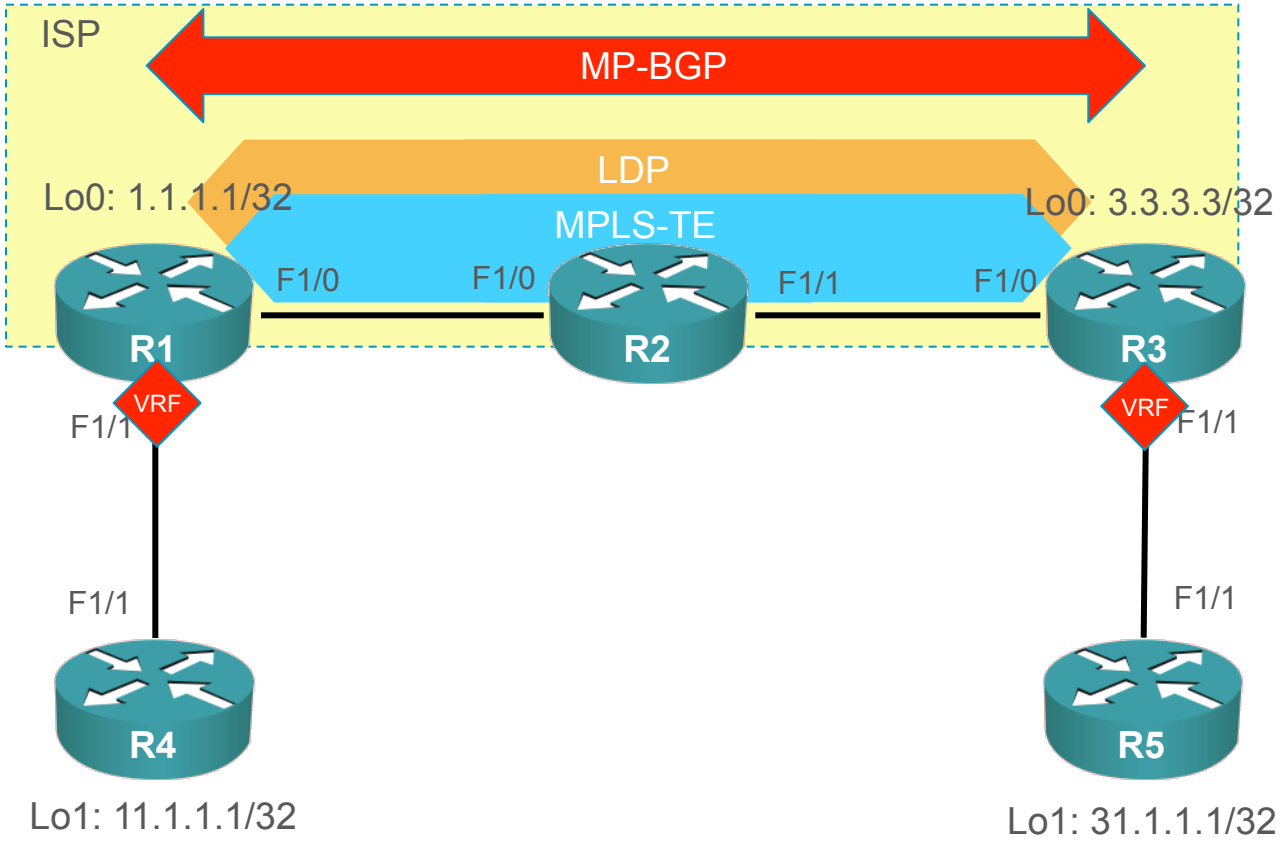
```
0010  30 ff 00 01 71 ff 45 00  00 64 00 0b 00 00 ff 01   0...q.E. .d......
0020  8f 8a 0b 01 01 01 1f 01  01 01 08 00 fc 68 00 02   ........ .....h..
0030  00 01 00 00 00 00 00 1e  81 c0 ab cd ab cd ab cd   ........ ........
0040  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0050  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0060  ab cd ab cd ab cd ab cd  ab cd ab cd ab cd ab cd   ........ ........
0070  ab cd ab cd ab cd ab cd  ab cd                     ........ ..
```

L3VPN

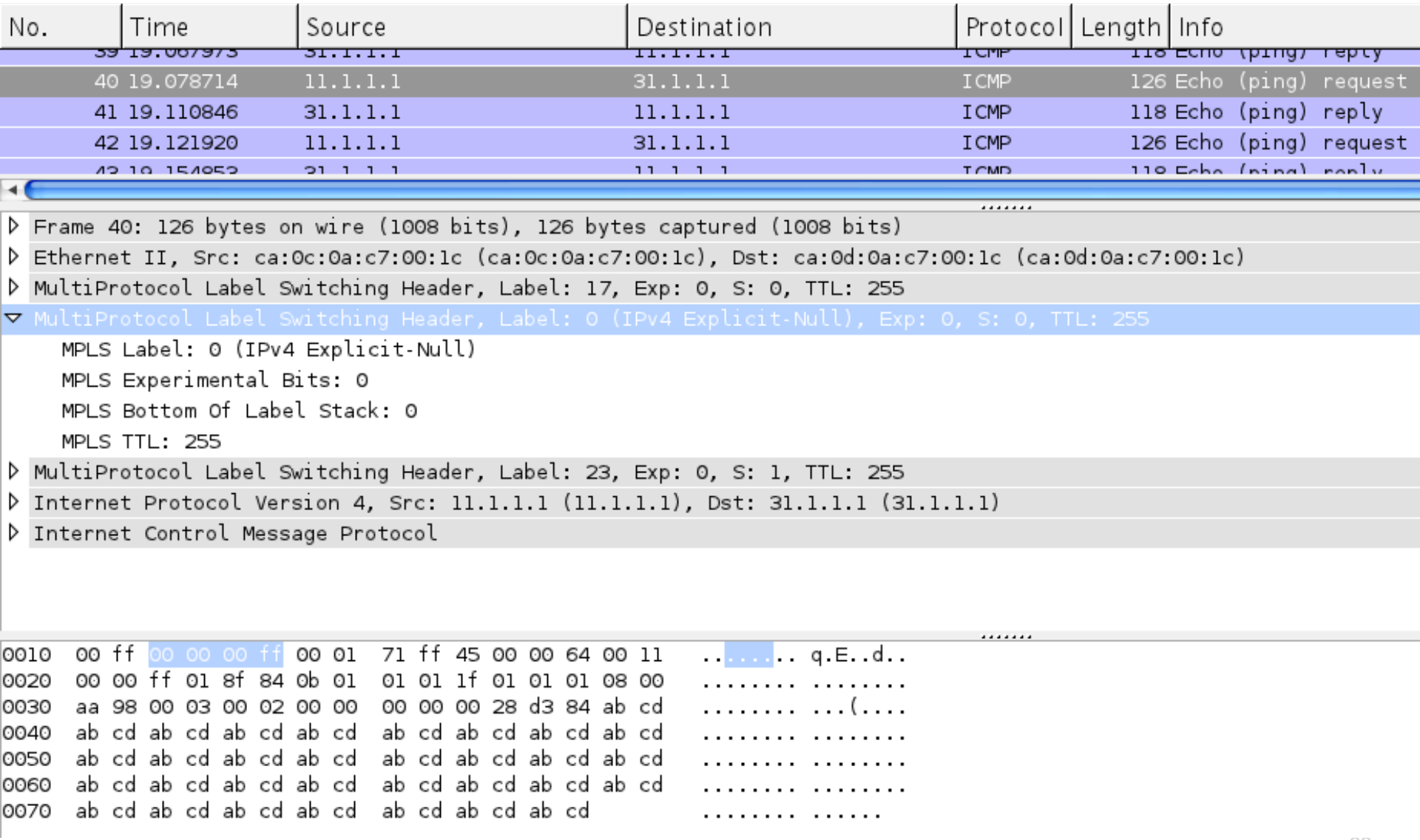
```
Rack1R1#sh ip cef vrf aa 31.1.1.1
31.1.1.0/30
  nexthop 10.1.12.2 FastEthernet1/0 label 19 23

Rack1R1#sh ip bgp vpnv4 all labels
   Network          Next Hop      In label/Out label
Route Distinguisher: 1:1 (aa)
   11.1.1.0/30      0.0.0.0         21/nolabel(aa)
   31.1.1.0/30      3.3.3.3         nolabel/23


Rack1R1#sh mpls for
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
19          19         3.3.3.3/32       0             Fa1/0      10.1.12.2

!
router bgp 13
 bgp log-neighbor-changes
 neighbor 3.3.3.3 remote-as 13
 neighbor 3.3.3.3 update-source Loopback0
 !
 address-family vpnv4
  neighbor 3.3.3.3 activate
  neighbor 3.3.3.3 send-community extended
 exit-address-family
 !
 address-family ipv4 vrf aa
  no synchronization
  redistribute connected
 exit-address-family
!
```

L3VPN + TE

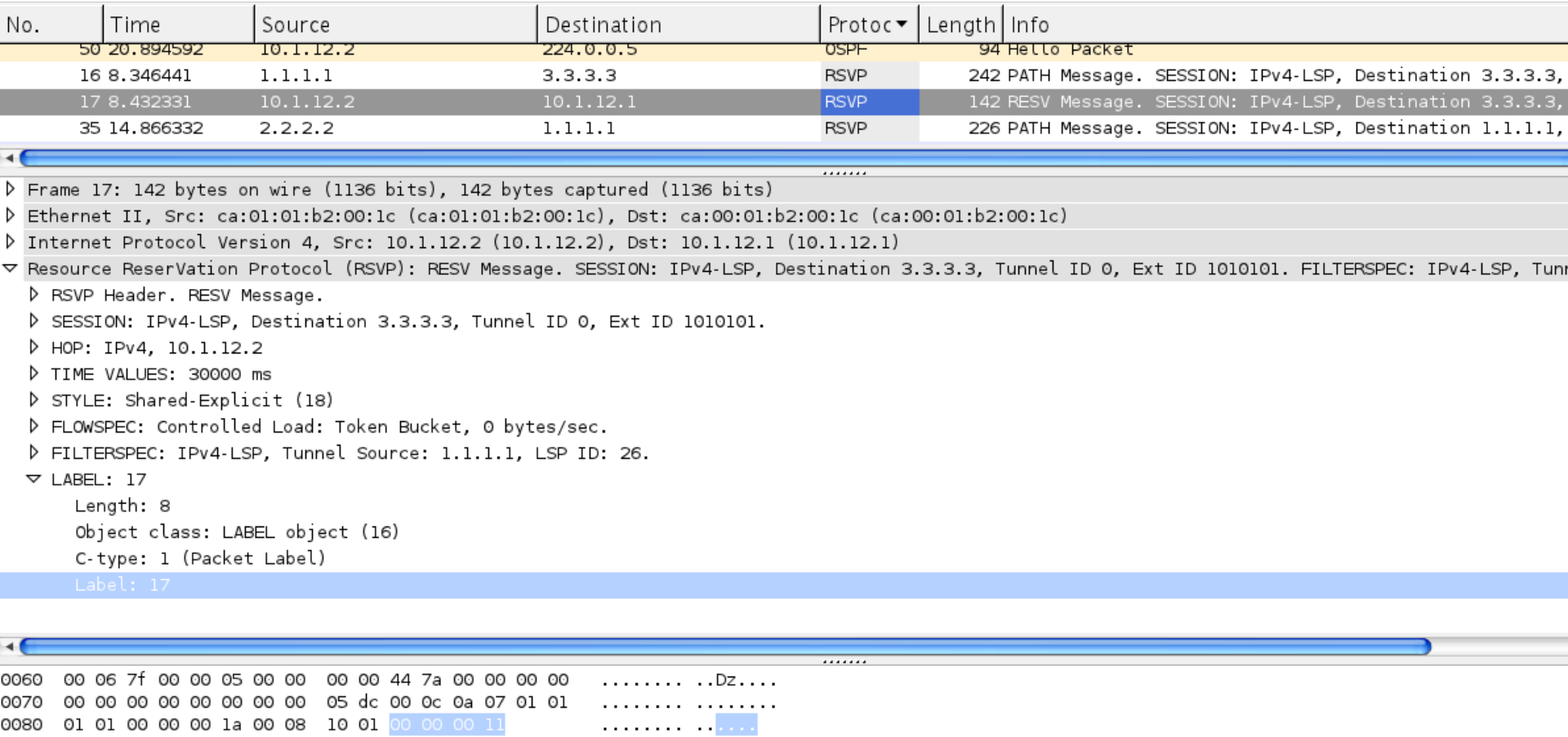
- Tunel TE między R1, a R3.
- LDP explicit-null uruchomiony w tunelu TE.



L3VPN + TE



Rozgłoszenie etykiety TE



Rozgłoszenie etykiety VPN

No.	Time	Source	Destination	Protocol	Length	Info
33	8.790404	3.3.3.3	1.1.1.1	BGP	73	KEEPALIVE Message
34	8.877352	3.3.3.3	1.1.1.1	BGP	73	KEEPALIVE Message
35	8.888443	3.3.3.3	1.1.1.1	BGP	277	UPDATE Message, UPDATE Message, UPDATE Message
36	8.899269	3.3.3.3	1.1.1.1	BGP	171	UPDATE Message, UPDATE Message

```
▷ Ethernet II, Src: ca:01:01:b2:00:1c (ca:01:01:b2:00:1c), Dst: ca:00:01:b2:00:1c (ca:00:01:b2:00:1c)
▷ Internet Protocol Version 4, Src: 3.3.3.3 (3.3.3.3), Dst: 1.1.1.1 (1.1.1.1)
▷ Transmission Control Protocol, Src Port: bgp (179), Dst Port: 44060 (44060), Seq: 121, Ack: 102, Len: 223
▽ Border Gateway Protocol
  ▽ UPDATE Message
```

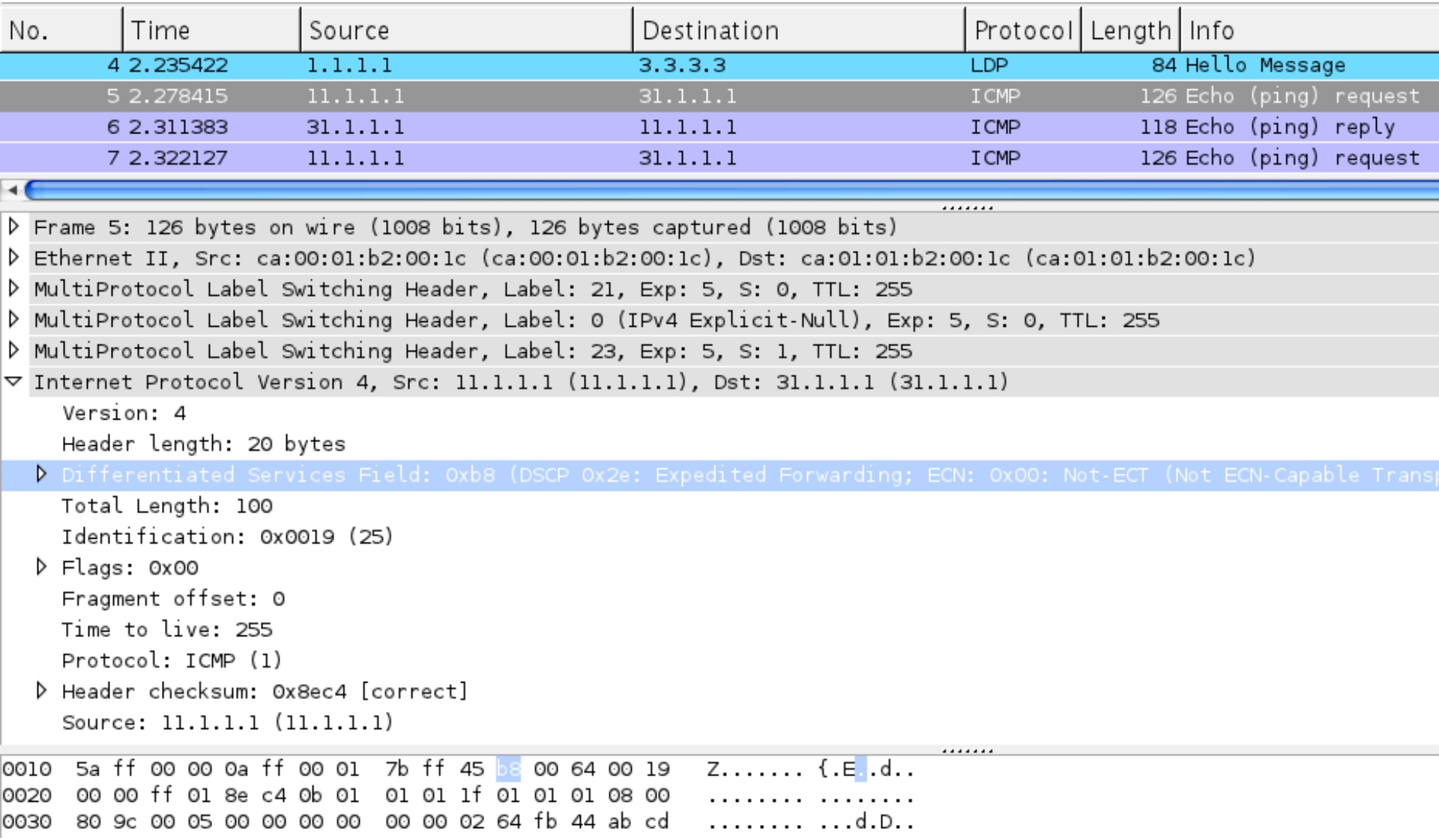
Pakiet skrócony

```
    ▽ MP_REACH_NLRI (48 bytes)
      ▷ Flags: 0x80 (Optional, Non-transitive, Complete)
        Type code: MP_REACH_NLRI (14)
        Length: 45 bytes
        Address family: IPv4 (1)
        Subsequent address family identifier: Labeled VPN Unicast (128)
      ▷ Next hop network address (12 bytes)
        Subnetwork points of attachment: 0
      ▽ Network layer reachability information (28 bytes)
        ▷ Label Stack=22 (bottom) RD=1:1, IPv4=0.0.0.0/0
        ▽ Label Stack=23 (bottom) RD=1:1, IPv4=31.1.1.0/30
            MP Reach NLRI Prefix length: 118
            MP Reach NLRI Label Stack: 23 (bottom)
            MP Reach NLRI Route Distinguisher: 1:1
            MP Reach NLRI IPv4 prefix: 31.1.1.0 (31.1.1.0)
```

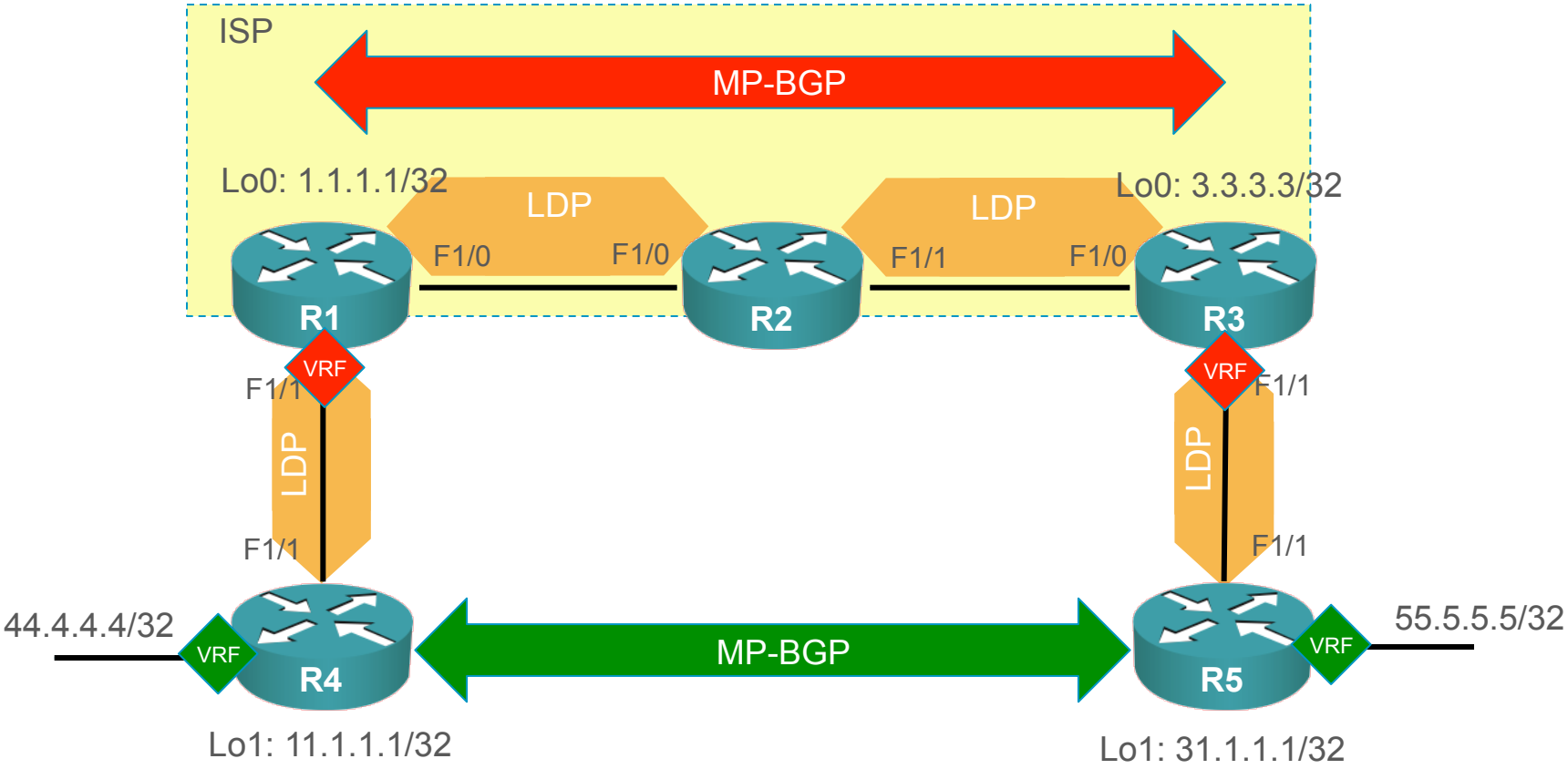
L3VPN + TE

```
Rack1R1#sh ip cef vrf aa 31.1.1.1 int
31.1.1.0/30, epoch 0, flags need ps clean, rib defined all labels, RIB[B],
refcount 5, per-destination sharing
  sources: RIB, LTE
 ..
output chain: label 23 label explicit-null TAG midchain out of Tunnel0
669428C0 label 17 TAG adj out of FastEthernet1/0, addr 10.1.12.2 65464100



Rack1R1#sh mpls for
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
21     [T]  explicit-n 3.3.3.3/32       0             Tu0        point2point



Rack1R1#sh mpls traffic-eng tunnels
Name: Rack1R1_t0                          (Tunnel0) Destination: 3.3.3.3
  Status:
    Admin: up         Oper: up     Path: valid       Signalling: connected
    path option 7, type dynamic (Basis for Setup, path weight 2)
..
  InLabel  :  -
  OutLabel : FastEthernet1/0, 17
  Next Hop : 10.1.12.2
  RSVP Signalling Info:
       Src 1.1.1.1, Dst 3.3.3.3, Tun_Id 0, Tun_Instance 26
```

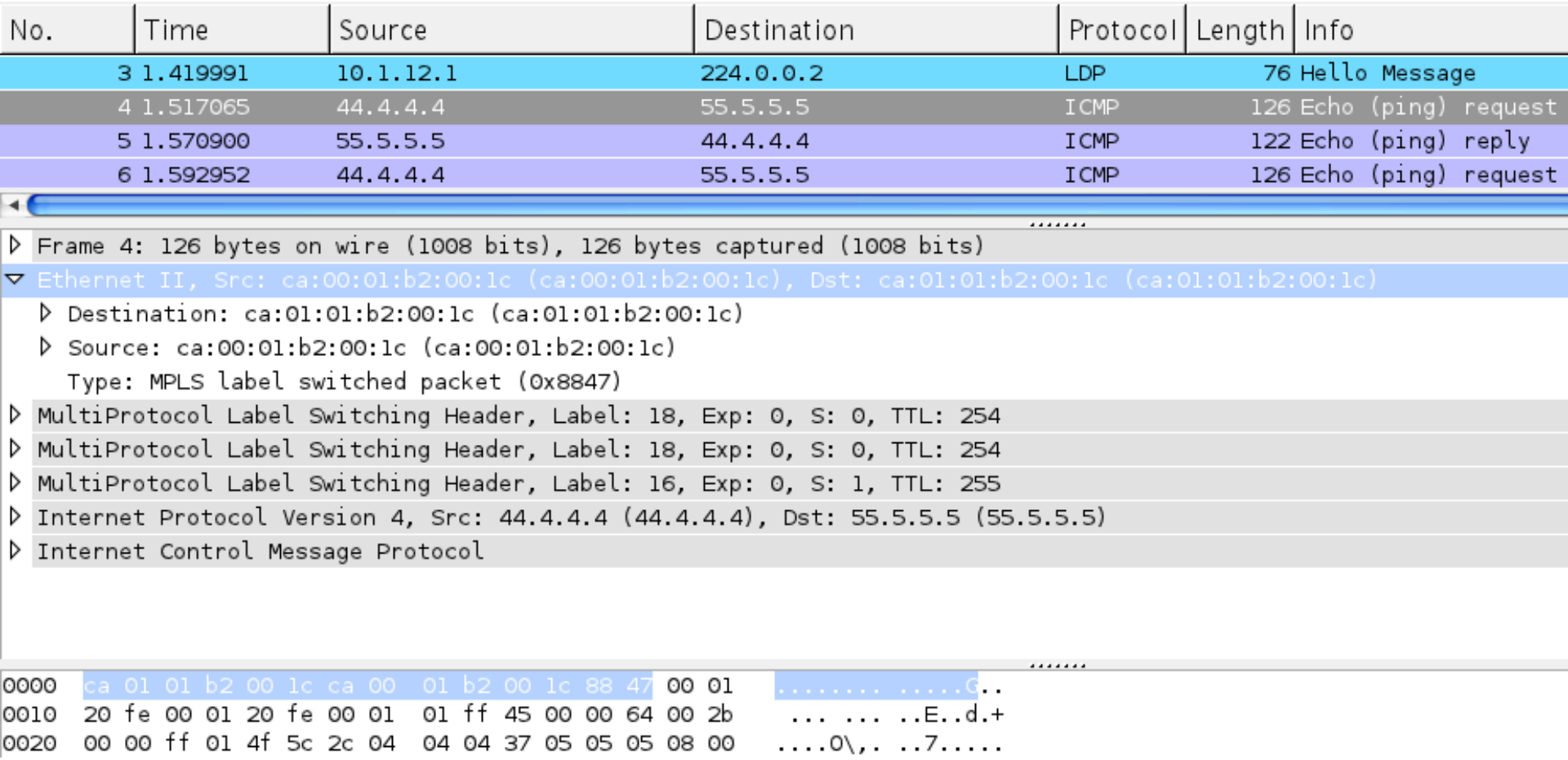
L3VPN + TE + QoS



Carrier Supporting Carrier



Carrier Supporting Carrier

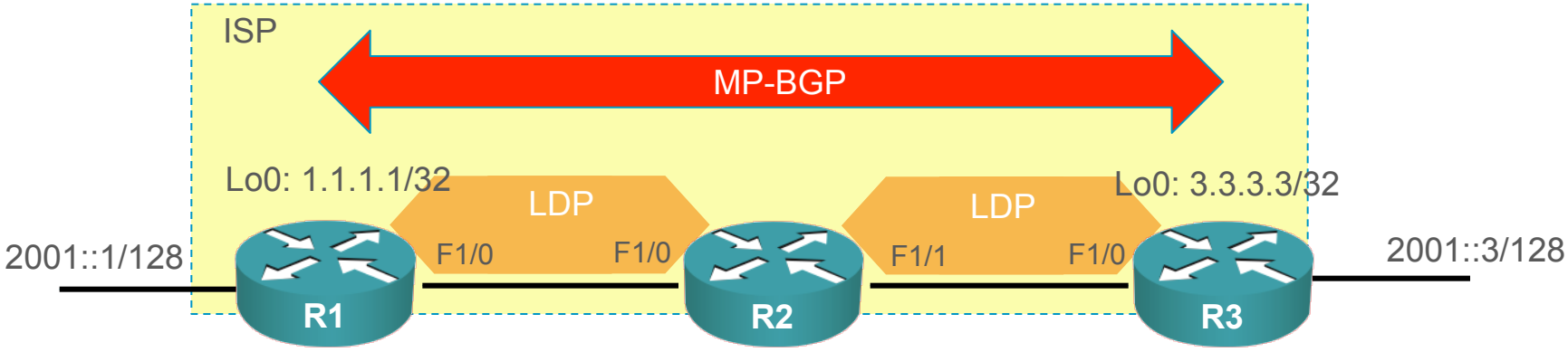


Carrier Supporting Carrier

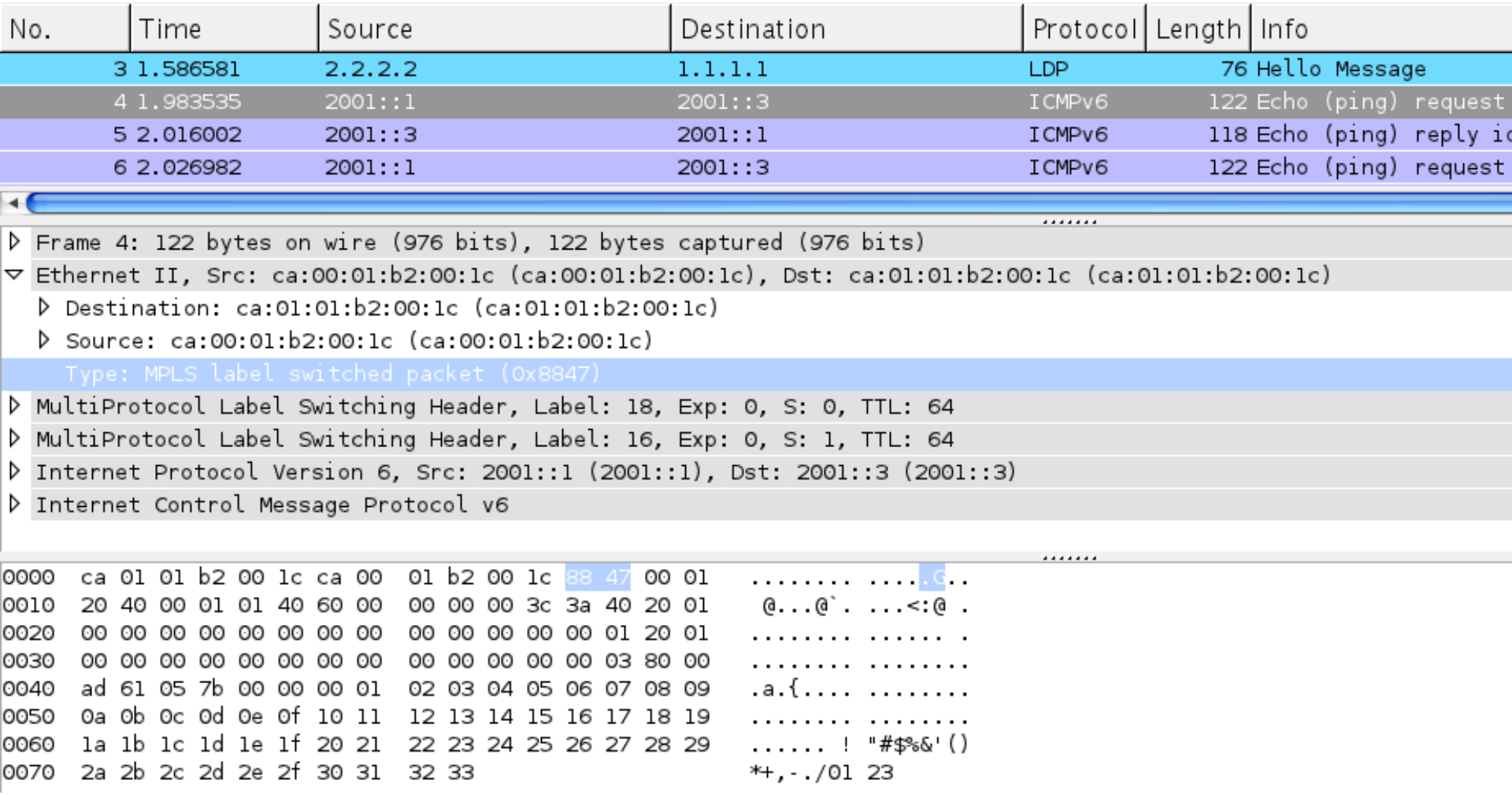
```
Rack1R4#traceroute vrf aa 55.5.5.5 s 44.4.4.4

Type escape sequence to abort.
Tracing the route to 55.5.5.5

  1 10.3.14.1 [MPLS: Labels 24/16 Exp 0] 452 msec 148 msec 72 msec
  2 10.1.12.2 [MPLS: Labels 18/18/16 Exp 0] 92 msec 84 msec 84 msec
  3 10.1.23.3 [MPLS: Labels 0/18/16 Exp 0] 84 msec 88 msec 84 msec
  4 55.5.5.5 72 msec *  44 msec


Rack1R4#sh ip cef vrf aa 55.5.5.5
55.5.5.5/32
  nexthop 10.3.14.1 FastEthernet1/1.30 label 24 16


Rack1R1#sh ip cef vrf sp 5.5.5.5
5.5.5.5/32
  nexthop 10.1.12.2 FastEthernet1/0 label 18 18


Rack1R1#sh mpls for 3.3.3.3
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
21         18         3.3.3.3/32       0             Fa1/0      10.1.12.2
```

6PE

- Sieć MPLS IPv4 między R1, a R3.
- Klienci IPv6 dołączeni do R1 oraz R3.



6PE



6PE

No.	Time	Source	Destination	Protoc	Length	Info
35	8.888443	3.3.3.3	1.1.1.1	BGP	277	UPDATE Message, UPDATE Message, UPDATE Message
36	8.899269	3.3.3.3	1.1.1.1	BGP	171	UPDATE Message, UPDATE Message
37	8.909460	3.3.3.3	1.1.1.1	BGP	77	UPDATE Message
42	9.707178	1.1.1.1	3.3.3.3	BGP	77	KEEPALIVE Message

```
▷ Frame 36: 171 bytes on wire (1368 bits), 171 bytes captured (1368 bits)
▷ Ethernet II, Src: ca:01:01:b2:00:1c (ca:01:01:b2:00:1c), Dst: ca:00:01:b2:00:1c (ca:00:01:b2:00:1c)
▷ Internet Protocol Version 4, Src: 3.3.3.3 (3.3.3.3), Dst: 1.1.1.1 (1.1.1.1)
▷ Transmission Control Protocol, Src Port: bgp (179), Dst Port: 44060 (44060), Seq: 344, Ack: 102, Len: 117
▽ Border Gateway Protocol
  ▽ UPDATE Message
      Marker: 16 bytes
      Length: 88 bytes
      Type: UPDATE Message (2)
      Unfeasible routes length: 0 bytes
      Total path attribute length: 65 bytes
    ▽ Path attributes
      ▷ ORIGIN: INCOMPLETE (4 bytes)
      ▷ AS_PATH: empty (3 bytes)
      ▷ MULTI_EXIT_DISC: 0 (7 bytes)
      ▷ LOCAL_PREF: 100 (7 bytes)
      ▽ MP_REACH_NLRI (44 bytes)
        ▷ Flags: 0x80 (Optional, Non-transitive, Complete)
          Type code: MP_REACH_NLRI (14)
          Length: 41 bytes
          Address family: IPv6 (2)
          Subsequent address family identifier: Labeled Unicast (4)
        ▽ Next hop network address (16 bytes)
            Next hop: ::ffff:3.3.3.3 (16)
          Subnetwork points of attachment: 0
        ▽ Network layer reachability information (20 bytes)
            Label Stack=16 (bottom), IPv6=2001::3/128
```

6PE

```
Rack1R1#sh ipv6 cef 2001::3/128
2001::3/128
  nexthop 10.1.12.2 FastEthernet1/0 label 18 16


Rack1R1#sh mpls for
Local      Outgoing   Prefix           Bytes Label   Outgoing   Next Hop
Label      Label      or Tunnel Id     Switched      interface
21         18         3.3.3.3/32       0             Fa1/0      10.1.12.2


Rack1R1#sh bgp ipv6 uni la
   Network          Next Hop      In label/Out label
   2001::1/128      ::              23/nolabel
   2001::3/128      ::FFFF:3.3.3.3  nolabel/16

R1:
!
router bgp 13
 neighbor 3.3.3.3 remote-as 13
 neighbor 3.3.3.3 update-source Loopback0
!
 address-family ipv6
  redistribute connected
  no synchronization
  neighbor 3.3.3.3 activate
  neighbor 3.3.3.3 send-label
!
```

Quiz

- Której enkapsulacji nie można uzyskać?

1. ETH | TE | TE | VPNv4 | IP
2. ETH | LDP | VC | LDP | VC | ETH | IP
3. ETH | TE | VPNv4 | VPNv4 | IP
4. ETH | IP | GRE | VPNv4 | IP
5. ETH | TE | LDP | IP
6. ETH | LDP | TE | IP
7. ETH | TE | IP

Podsumowanie karty dań

- Najczęściej spotykane stosy etykiet

ETH | LDP | VC | ETH | IP – usługa L2VPN

ETH | LDP | VPNv4 | IP – usługa L3VPN

ETH | TE | VPNv4 | IP – L3VPN poprzez tunel TE

ETH | TE | VC | CW | ETH | IP – L2VPN poprzez tunel

Pytania i odpowiedzi