

MPLS Labels in Traceroute

Traceroute is a versatile tool that is frequently used to troubleshoot problems on the Internet. An excellent presentation is given in [NANOG 47 meeting](#) where a lot of real use cases are demystified.

When analysing MPLS deployments on the Internet, traceroute can also be helpful. Thanks to the support of [ICMP Extensions for Multiprotocol Label Switching](#), MPLS Label Switching Routers (LSR) append MPLS information to ICMP messages. Selected ICMP messages include the MPLS label stack, as it arrived at the router that is sending the ICMP message.

For example, a traceroute to www.univ-rennes1.fr reveals the different hops toward the destination:

```
$ traceroute -P icmp www.univ-rennes1.fr
traceroute to frontalhttp.univ-rennes1.fr (129.20.126.100), 64 hops max, 72
byte packets
 1  neufbox  1.804 ms  1.718 ms  1.510 ms
 2  129.112.16.109.rev.sfr.net  28.440 ms  34.535 ms  28.499 ms
 3  77.56.66.86.rev.sfr.net  28.384 ms  29.678 ms  27.561 ms
 4  185.73.66.86.rev.sfr.net  30.758 ms  30.744 ms  29.597 ms
 5  renater-ix1.sfinx.tm.fr  37.389 ms  38.937 ms  41.514 ms
 6  te4-2-rouen-rtr-021.noc.renater.fr  41.297 ms  42.737 ms *
 7  te4-2-caen-rtr-021.noc.renater.fr  42.710 ms  41.381 ms  40.157 ms
 8  tel-5-rennes-rtr-021.noc.renater.fr  42.530 ms  43.130 ms  43.615 ms
 9  * u-1-rennes-cri-gi8-1-rennes-rtr-021.noc.renater.fr  46.353 ms  41.514
ms
10  frontalhttp.univ-rennes1.fr  42.702 ms  41.322 ms  42.429 ms
```

Examining the detail of the received ICMP time exceeded messages with Wireshark reveals an ICMP Multi-part extension that carries the MPLS label as it arrived to the hop sending the message. In the following capture, the router `te4-2-rouen-rtr-021.noc.renater.fr` received label 53, most probably from the MPLS edge router `renater-ix1.sfinx.tm.fr`.

No.	Time	Source	Destination	Protocol
41	5.947446000	193.51.189.50	192.168.1.24	ICMP
182	Time-to-live exceeded (Time to live exceeded in transit)			

Internet Control Message Protocol

Type: 11 (Time-to-live exceeded)

Code: 0 (Time to live exceeded in transit)

Checksum: 0x3974 [correct]

Internet Protocol Version 4, Src: 192.168.1.24, Dst: 131.254.254.131

User Datagram Protocol, Src Port: 46416 (46416), Dst Port: 33452 (33452)

Data (24 bytes)

ICMP Multi-Part Extensions

Version: 2

Reserved: 0x000

Checksum: 0x8df2 [correct]

MPLS Stack Entry

Length: 8

Class: 1

C-Type: 1

Label: 53, Exp: 0, S: 1, TTL: 1

0000 0000 0000 0011 0101 = Label: 53

.... 000. = Experimental: 0

....1 = Stack bit: Set

Time to live: 1

In order to easily visualise the label switching, [MTR](#) produces a traceroute-like result with labels used at each hop:

```
$ mtr -e www.univ-rennes1.fr
 1. neufbox
 2. 129.112.16.109.rev.sfr.net
 3. 77.56.66.86.rev.sfr.net
 4. 185.73.66.86.rev.sfr.net
 5. renater-ix1.sfinx.tm.fr
 6. te4-2-rouen-rtr-021.noc.renater.fr
   [MPLS: Lbl 53 Exp 0 S 1 TTL 1]
 7. te4-2-caen-rtr-021.noc.renater.fr
   [MPLS: Lbl 546 Exp 0 S 1 TTL 1]
 8. tel-5-rennes-rtr-021.noc.renater.fr
 9. u-1-rennes-cri-gi8-1-rennes-rtr-021.noc.renater.fr
10. frontalhttp.univ-rennes1.fr
```

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