Reverse Traceroute

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https://datatracker.ietf.org/doc/html/draft-heiwin-intarea-reverse-traceroute

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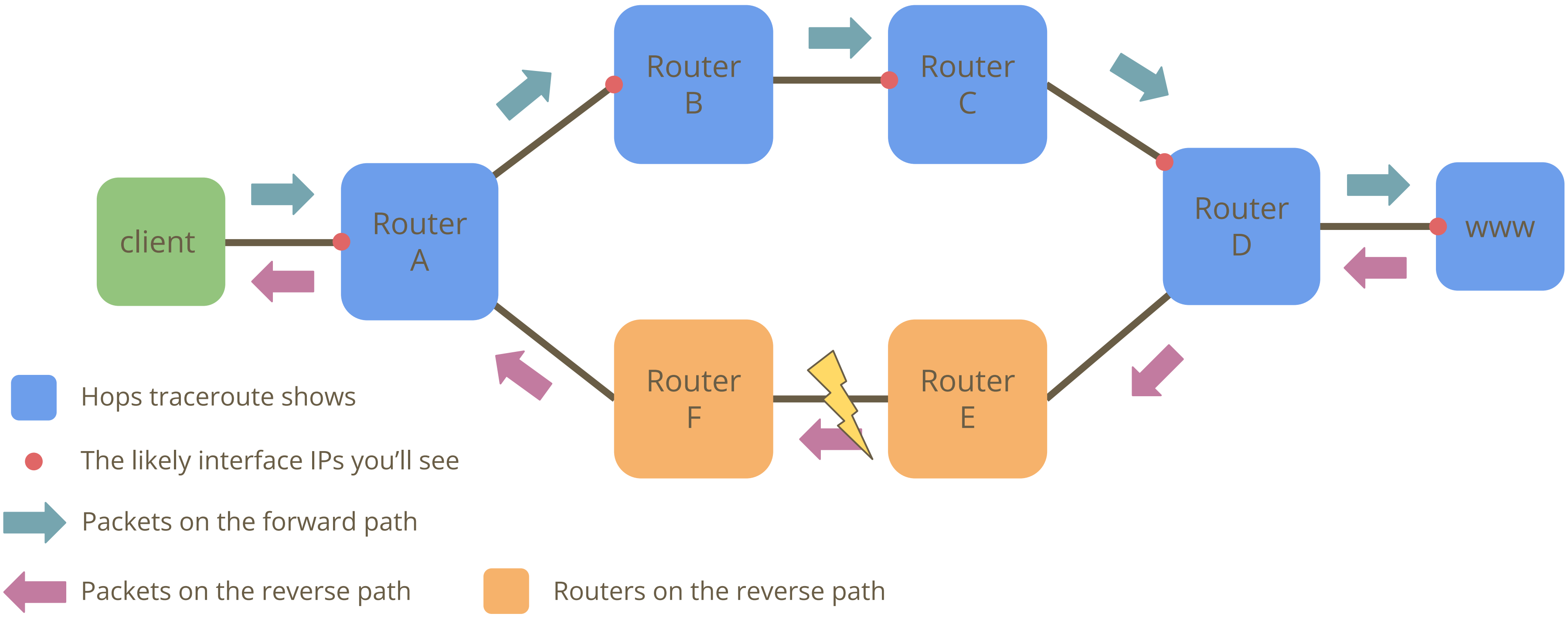
The problem

```
1    routerA.aug.net-a.com   (10.10.10.10)    1ms   2ms   1ms
2    routerB.muc.net-a.com   (20.20.20.20)    5ms   6ms   12ms
3    routerC.fra.net-a.com   (30.30.30.30)    11ms  21ms  14ms
4    routerD.fra.b-net.com   (40.40.40.40)    340ms 320ms 350ms
5    www.example.com         (50.50.50.50)    345ms 310ms 360ms
```

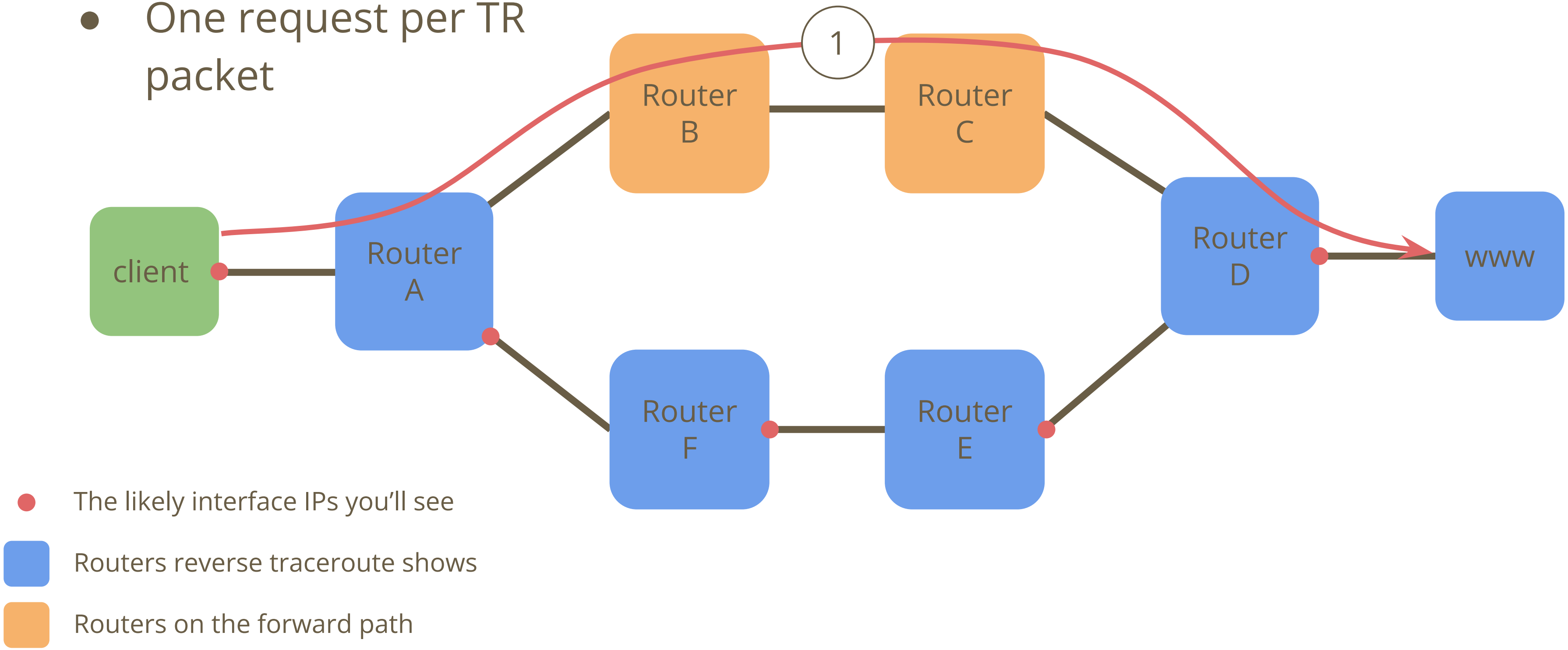


One past attempt

- "Traceroute Using an IP Option", RFC 1393, January 1993
  - A special IPv4 option is added to TR packets (incl. the IP address of the originator)
  - Causes a router to send a special TR message to the originator
  - Packet with the option is simply forwarded
  - The receiver also sends a packet incl. above option with the originators address
- Why don't we have this yet?
  - Well, likely the need for router support and the use of IP options
  - Could spoof originator's IP / Amplification attack vector
  - It teaches us to be careful with design choices
  - RFC 1393 was obsoleted in 2012
- Our design goals: https://youtu.be/Y7NtqLEtgjU

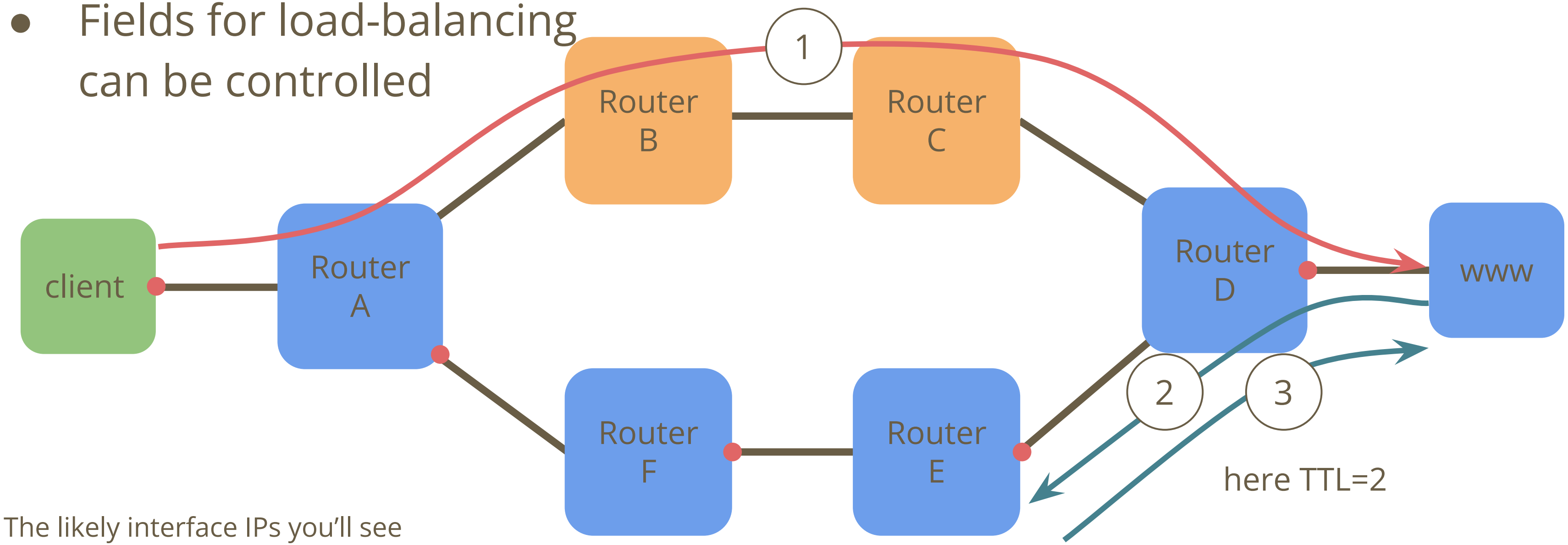
Meet reverse traceroute

- Uses a new ICMP request to trigger a reverse traceroute
- One request per TR packet



Meet reverse traceroute

- A regular TR packet is sent (UDP, ICMP or TCP)
- Fields for load-balancing can be controlled



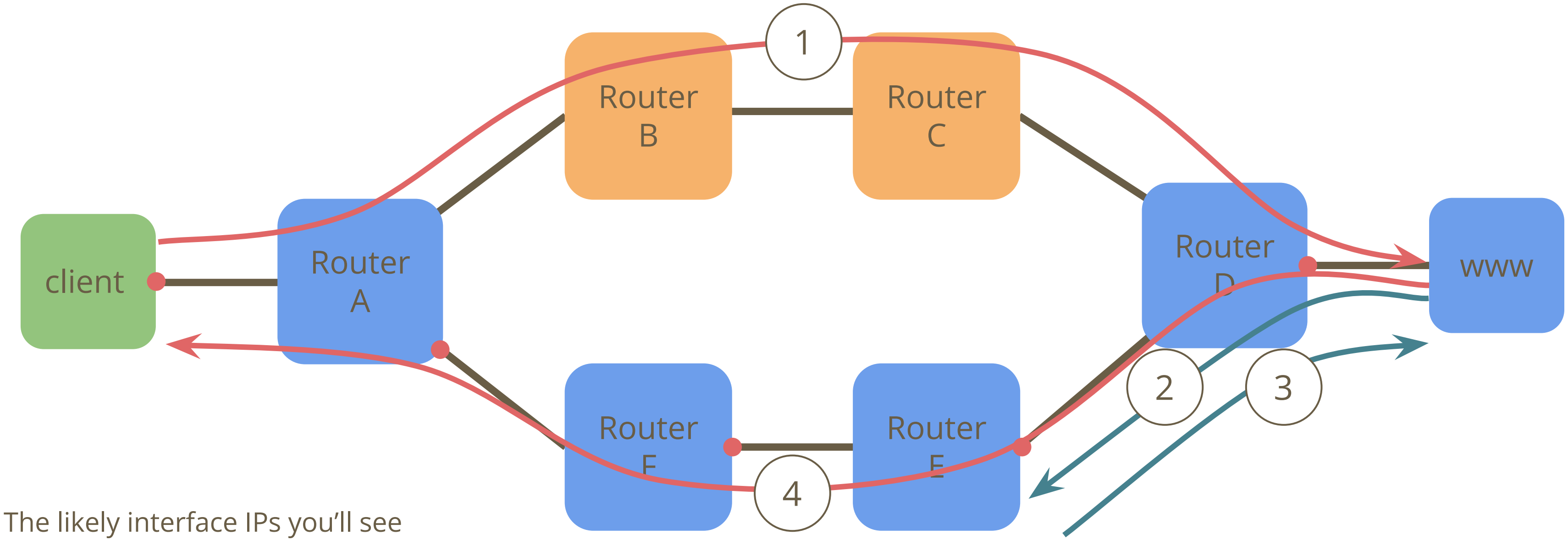
The likely interface IPs you'll see

Routers reverse traceroute shows

Routers on the forward path

Meet reverse traceroute

- For that single probe, an ICMP response is sent back



The likely interface IPs you'll see

Routers reverse traceroute shows

Routers on the forward path

Headers, code points ... oh my

- Reverse Traceroute is defined for both ICMP and ICMPv6
- ICMP messages typically start like this:

```
0                   1                   2                   3
0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|     Type      |     Code      |          Checksum             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

- Question, which `Type` and `Code` to use:
  - Option A: New types and codes
  - Option B: Existing type and new codes
- But, which ones work on today's internet?

What about middleboxes?

- The internet is ossified, mainly thanks to middleboxes
  - NATs e.g., are a pretty common middlebox
- Question: which packets go through NATs
- Tested 12 NAT implementation:
  - We sent two packets with type 8 (used by ping request) and codes 1 and 2 (standard ping uses 0), replies matched the code but used type 0
  - And two unassigned types (7 and 252) with code 0 each

ICMP request	forwarded	filtered	bypassed
Type 8, code 1	11	1 [a)]	0
Type 8, code2	11	1 [a)]	0
Type 7, code 0	1	7	4
Type 252, code 0	1	6	5

[a)] Response dropped

But what happens to those packets on the internet?

- We picked ten million IPv4 addresses at random and send an ICMP Echo request there (good old Ping)
- For each host that responded, we sent an ICMP Packet with the Echo type but a different code (code 1)

Filtered	Reflective	Unreflective	Erroneous
39.993	931.427	32.478	659[a)]

a) mostly dest. unreach.

Conclusion

- Presented at operator event (DENOG14)
  - Operational community quite positive about the proposal
- Running code
  - Github: https://github.com/HSAnet/reverse-traceroute
  - Debian package available for both server (eBPF) and client (Python)
  - Contact: valentin.heinrich@hs-augsburg.de
- Next steps
  - Finish the protocol design (mostly done, missing feedback)
  - Ask for WG adoption

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