**Don’t Trust Traceroute (Completely)**

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**Traceroute and its Applications**

- **How Traceroute works**
- **Uses of Traceroute**
  - Network Troubleshooting
  - Anomaly Detection
  - Performance Analysis
  - Geolocation
  - Censorship Detection
  - Internet Topology Discovery
- **Our Contributions**
  - Analysis and preliminary quantification of the following observed phenomena:
    - Traceroute
    - may suggest false path changes
    - may overestimate the presence of load-balancers

**Don’t trust Traceroute that much!**

**Scenarios**

- **False path changes**
  - Different IPs appearing at the same hop of consecutive Traceroute measurements do not necessarily imply the path has changed
  - Hops: 1 2 3 4 5
  - At time $t_1$: [A, D, A, B, C]
  - At time $t_2$: [B, D, A, B, C]
  - Differing IP, Different Routers?
  - Did the path from S to D really change?

- **Overestimation of load-balanced paths**
  - Multiple IPs appearing at the same hop of a multipath Traceroute measurement are not always related to multiple paths at router level
  - Hops: 1 2 3 4 5 6 7
  - Flow1: [S, A, B, C, D]
  - Flow2: [S, B, C, D]
  - Flow3: [S, A, C, D]
  - Differing IP, Different Routers?
  - How many different paths exist from S to D?

**Preliminary Experimental Analysis**

- **How is it possible?**
  - Traceroute is commonly believed to report the incoming interface of the routers. However, Traceroute may actually report also outgoing interfaces.
  - RFC1812: The source address of an ICMP error packet must correspond to the outgoing interface of the ICMP reply, rather than the interface on which the packet triggering the error was received.
  - RFC-compliant routers exist

**Conclusion and Future Work**

- Traceroute reports **interfaces**, not **routers**
- Traceroute can suggest that two measurements represent distinct paths even though they traverse the same routers
- Alias Resolution is essential to improve state-of-the-art implementations of Traceroute
- In the light of our findings, previous results on route stability and path diversity could be reassessed

**Acknowledgements.** This work is partially funded by the MIUR projects: PLATINO (PON01_01007), SMART HEALTH (PON04a2_C1), S2-MOVE (PON04a3_00058).