Active Inference of Network Neutrality

Riccardo Ravaioli, Guillaume Urvoy-Keller, Chadi Barakat
ravaioli@i3s.unice.fr, urvoy@i3s.unice.fr, chadi.barakat@inria.fr

Labex User Centric Network @ Sophia

Context

In recent years, some ISPs have been degrading the performance of selected user traffic, especially when:

- it uses a large fraction of the available bandwidth (e.g. BitTorrent, YouTube, etc.)
- it competes with services offered by the ISP (e.g. VoIP)

⇒ violation of Internet neutrality

Detecting Traffic Differentiation

In contrast to existing methods, ChkDiff:

- is independent of the user applications it tests
- makes no assumptions on how differentiation is implemented, as long as it degrades flow performance.

We achieve this by:

⇒ replaying real user traffic, not a set of pre-defined traces

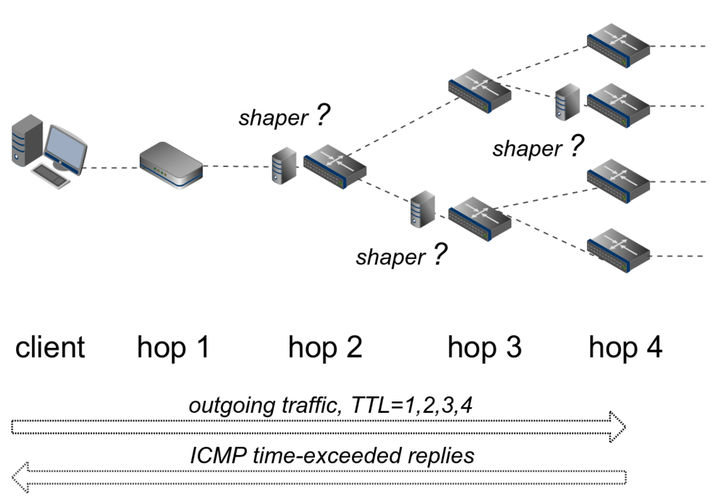
⇒ comparing the performance (delay distribution and losses) of one application against the rest of the traffic

⇒ shuffling the trace so that, when replayed, each flow will see the same network conditions (PASTA property)

ChkDiff: the upstream experiment

Upstream execution

Capture outgoing user traffic
for each hop $h \in \{1, 2...k\}$ **do**
  for each run $r \in \{1, 2, 3\}$ **do**
    shuffle trace
    replay trace with $TTL \leftarrow h$
    collect ICMP time-exceeded replies
  end for
  detect shaped flows at hop h
end for
aggregate results and locate shaper(s)



Delay analysis: Kolmogorov-Smirnov.

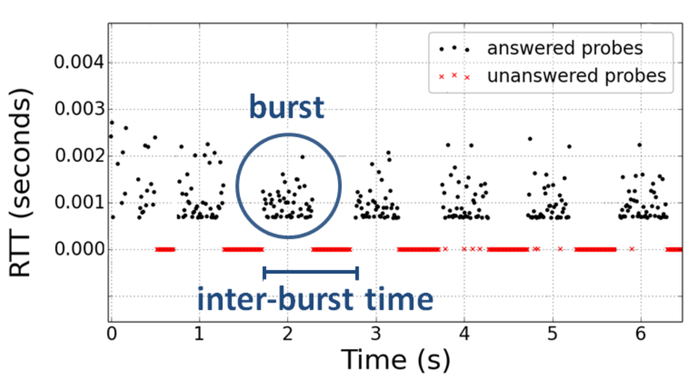
Loss analysis: binomial-inspired.

Validated in a controlled setup with:

- two differentiation scenarios with bandwidth throttling and uniform losses
- wired and WiFi connections

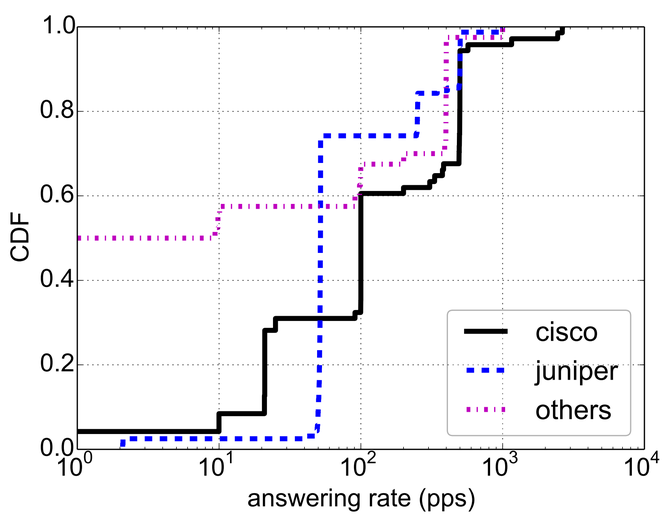
Riccardo Ravaioli, Guillaume Urvoy-Keller, and Chadi Barakat. Towards a general solution for detecting traffic differentiation at the Internet access. In *Teletraffic Congress (ITC 27), 2015 27th International*, pages 1–9. IEEE, 2015.

Characterizing ICMP rate limitation

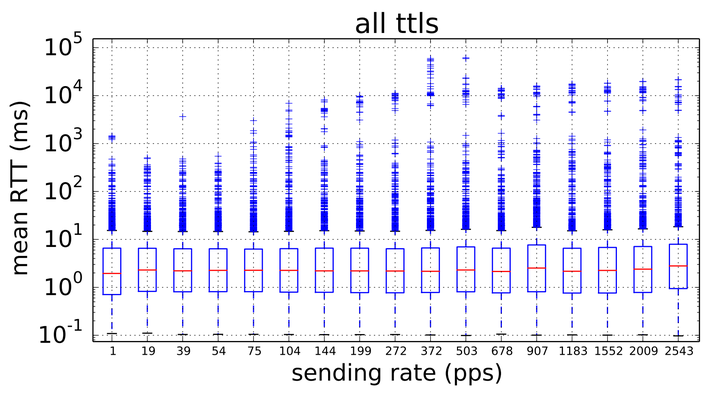


How is ICMP rate limitation implemented?

Riccardo Ravaioli, Guillaume Urvoy-Keller, and Chadi Barakat. Characterizing ICMP Rate Limitation on Routers. In *IEEE International Conference on Communications (ICC)*, 2015.



What are the most common configurations?



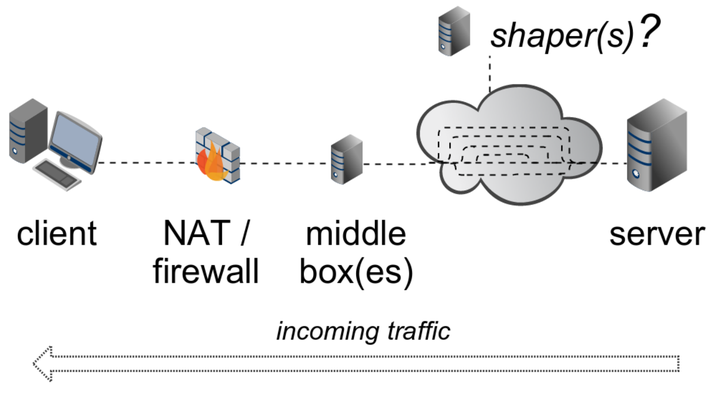
Does the probing rate have an impact on the measured delay?

⇒ Not hitting any capacity limits of routers when probing rate is high.

ChkDiff: the downstream experiment

Downstream execution

Capture outgoing user traffic
for each run $r \in \{1, 2, 3\}$ **do**
  shuffle trace
  for each flow f in trace **do**
    find NAT mapping for f
    initiate connection from client
  end for
  replay trace from server to client
  compute one-way delays and losses
end for
detect shaped flows



Riccardo Ravaioli, Guillaume Urvoy-Keller, and Chadi Barakat. Testing for traffic differentiation with chkdiff: the downstream case. In *Teletraffic Congress (ITC 28), 2016 28th International*. IEEE, 2016.

Delay analysis: dbscan (clustering), in order to separate different paths and isolate shaped flows.

Loss analysis: binomial-inspired.

Validated with:

- two differentiation scenarios with bandwidth throttling and uniform losses
- wired, WiFi and 3G connections
- server located in three Amazon data centers

ChkDiff: what next?

- distribute the tool to a larger audience (e.g. undergraduate students)
- implement lightweight version for mobile phones
- offer multiple server locations for downstream experiment (e.g. from M-Lab) to cover more paths
- integrate with ongoing QoE-prediction project (ACQUA)

The Tool(s)

- ChkDiff: `http://chkdiff.gforge.inria.fr/`
- ICMP tool: `https://pypi.python.org/pypi/IcmpTool`