CHARACTERIZING ICMP RATE LIMITATION ON ROUTERS
Riccardo Ravaiolli, Guillaume Urvoy-Keller, Chadi Barakat
ravaio1i@i3s.unice.fr, urvoy@i3s.unice.fr, chadi.barakat@inria.fr

Context
- Many tools infer network characteristics by relying on ICMP feedback from routers.
- ICMP time-exceeded messages, generated by TTL-limited probes, are used for instance in order to determine the network topology and measure path bandwidth.

Campaign
- Tested 850 routers along the path from 180 PlanetLab sites to a fixed destination.
- Targeted hops 1 to 5
- 3 runs of 30-second probing at a constant rate to a single router
- 17 exponentially-spaced rates in [1, 4000] pps

Router Responsiveness
Given a range of probing rates \([r_{min}, r_{max}]\), a router can have up to 3 responding phases:

<table>
<thead>
<tr>
<th></th>
<th>(r_{min})</th>
<th>(r_{max})</th>
</tr>
</thead>
<tbody>
<tr>
<td>fully responsive</td>
<td>(r_{min})</td>
<td>(r_{max})</td>
</tr>
<tr>
<td>rate-limited</td>
<td>(r_{min})</td>
<td>(r_{max})</td>
</tr>
<tr>
<td>irregular (on-off or rl)</td>
<td>(r_{min})</td>
<td>(r_{max})</td>
</tr>
</tbody>
</table>

Rate-limited routers
- fully responsive - on-off: 24.8%
- fully responsive - on-off - irregular: 21.2%
- fully responsive - generically rl: 13.9%

Non rate-limited routers
- fully responsive: 30.2%
- fully responsive - irregular: 6.0%

Unresponsive routers 3.9%

Challenge
- The generation of ICMP time-exceeded messages is often limited by a maximum rate (hard-wired or configurable)
  - How is rate limitation implemented?
    - What are the most common configurations?
- ICMP messages are usually assigned a low priority
  - Does it have an impact on the measured delay?

Rate Limitation and Configuration
On-Off

Configured with:
- burst size (in packets)
- inter-burst time

Detectable by analyzing the Coefficient of Variation (CoV) of these two parameters.

Generic rate-limitation

<table>
<thead>
<tr>
<th></th>
<th>(r_{min})</th>
<th>(r_{max})</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant answering rate</td>
<td>(r_{min})</td>
<td>(r_{max})</td>
</tr>
<tr>
<td>No evident pattern</td>
<td>(r_{min})</td>
<td>(r_{max})</td>
</tr>
</tbody>
</table>

Tool(s)
- End-user tool for router classification available at: riccardoravaio1i.wordpress.com/icmptool
- Based on these findings, we developed ChkDiff, a tool for the detection of traffic differentiation at the access ISP. riccardoravaio1i.wordpress.com/chkdiff/