Computer Network
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From Paris to Tokyo: On the Suitability of ping to Measure Latency

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Measuring network performance is important for companies to improve their service to users. *Ping* is a widely used tool which is able to measure network performance by reporting the Round-trip Time (RTT) when probing a server. But Pelsser et al. found an unexpected variance when they were running experiments with *ping*. They performed a series of rigorous experiments, trying to find out the reason.

A set of fields--Type, Code, Checksum--are combined to identify a flow (denoted as *flow-id*) because these fields are the factors which may influence transmission actions when load-balancing and redundancy mechanisms such as *Cost Multi-Path (ECAMP)* and *Link Aggregation Group (LGA)* come in. Probes with the same flow-id will decrease the contribution incurred by the forward and return path to the RTT variability.

By using the ***tokyo-ping*** (a modified version of paris-traceroute), researchers can craft the UDP payload of the probe to yield a constant return flow-id. Although it is not possible to yield a constant return flow-id for ICMP probes, there is a one-to-one mapping between the flow-id of the probe and the flow-id of the response. Experiments are conducted with both UDP and ICMP probes. For each run, 100 traditional pings are sent, followed by 100 probes for each different flow-id. This procedure is repeated 100 times, conducted on different days and different times to avoid the influence of cross-traffic.

First destination pair is Italy to the US. Results show that the RTT ranges from 105 ms to 109 ms, but the RTT variability in each individual flow is much smaller (five times) than the variability reported by ping. Doing experiments in 32 different flow-ids, the upper bound and lower bound is the same with the largest and smallest RTT in individual flows. The second experiment is conducted from Dallas to Ashburn using a single ISP. Results are quite the same with the last experiment, and make it more clear that the result from ping is actually a collection of each individual flow. Meaning that traditional ping can reliably measure the upper and lower bound for a network, but overestimate the jitter significantly. Next experiments exclude the ingress PoP LAG or the MPLS setting as a cause of the significant jitter, as they pointed out, two major cause are LAG and ECMP, but deeper experiments can not be done due to some restrictions.

In a word, the ping is unable to measure the RTT distributions because it will overestimate jitter significantly. What’s more, applications using multiple transports may not assume that all the channels experience the same delay. But it is good to see that the jitter in each individual flow is much smaller than the results by ping. Finally, the jitter overestimation in ping may have an impact on the accuracy of past researchers using the ping as a measurement tool. Future work may involve exploring the delay caused by LAG and ECMP in mo detail or conducting experiments to other commonly used network measurement tools and infrastructures such as *trace-route* and RIPE Atlas.