Lessons learnt from the Beijing Olympic Games Website Measurement

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Motivations

- Test and compare our measurement system (OneProbe) with other methods.

- Compare and evaluate the web performance at different sites for this global event.

- Discover new and interesting results about Internet path and web performance.

Outline

- Measurement methodology

- Measurement results

  - Overall results

  - A measurement tool comparison

  - Correlation of loss and delay peak

  - Asymmetric loss patterns

  - Effects of network configuration changes

- Conclusions and future works

Measurement methodology

- Uncooperative methods
    - Ping (ICMP)
    - PPing (TCP SYN-ACK)
    - HTTPing (TCP SYN-ACK and HTTP data)
    - OneProbe (TCP data)
    - Traceroute on forward path
    - Changes in TTL on reverse path
- Measuring points
    - A data center in Hong Kong
    - Three Beijing origin servers, three Chinacache sites, and three Akamai/Quest sites

The three sets of network paths

- Three Chinacache sites
  - One of the went through the Korea Network Information Center.
  - They all went through the CNC Group Backbone.
  - The servers were located in three different provinces: Henan, Hebei, and Shandong.
- Three Beijing sites
  - The paths were very similar (going through the same subnets).
- Three Akamai/Quest sites
  - The first four of the five hops were the same.
  - The sites were located in Hong Kong.

Measurement parameters

- Measurement period
  - During the entire Olympic Games period and one week after the Games
- Sampling rate
  - OneProbe: sending a probe every 0.5 secs
  - Others: sending a probe every sec.
- Probe packet size
  - OneProbe: 1500 bytes
  - Ping: 100 and 1500 bytes
  - PPing: 40 bytes
  - HTTPing: variable

Path metrics

- Ping, PPing, and HTTPing
  - RTT and round-trip loss rate
- OneProbe
  - RTT
  - One-way loss rates
  - One-way reordering rates
 - One-way capacity

Overall path quality

- Chinacache:
  - RTT: 87ms-260ms
  - Loss rate: <= 10%
- Beijing
  - RTT: 78ms-132ms
  - Loss rate: <= 20%
- Akamai/Quest
  - RTT: 3.4ms-4.9ms
  - Loss rate: <= 10%
- No reordering events observed
- Mostly stable forward-path routes and reverse-path hop counts
  - Detected configuration changes
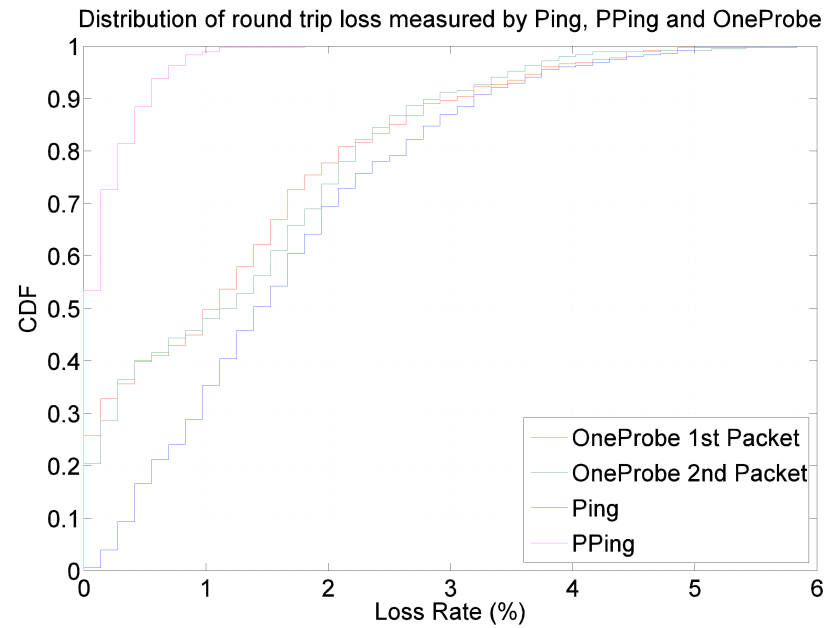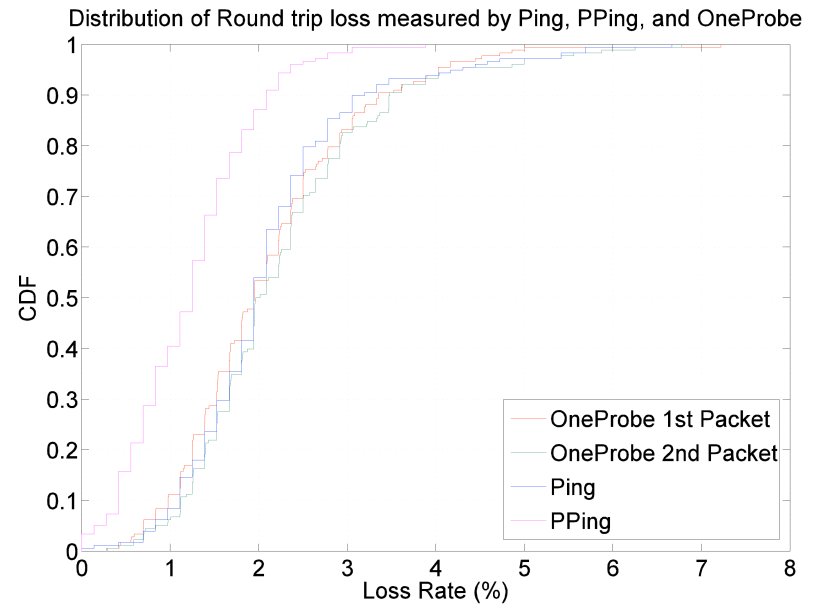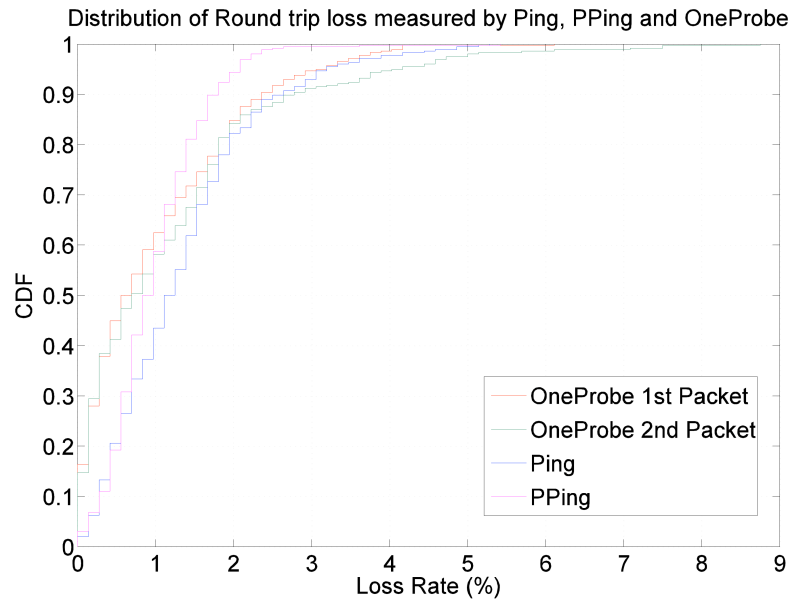 - Some persistent load-balancing

RTT measurement

- Diurnal patterns
  - Weekdays and weekends
- HTTPing's and PPing's results are compatible with OneProbe's.
  - HTTPing's RTTs are slightly higher.
- ICMP Ping RTTs do not always match with OneProbe's.

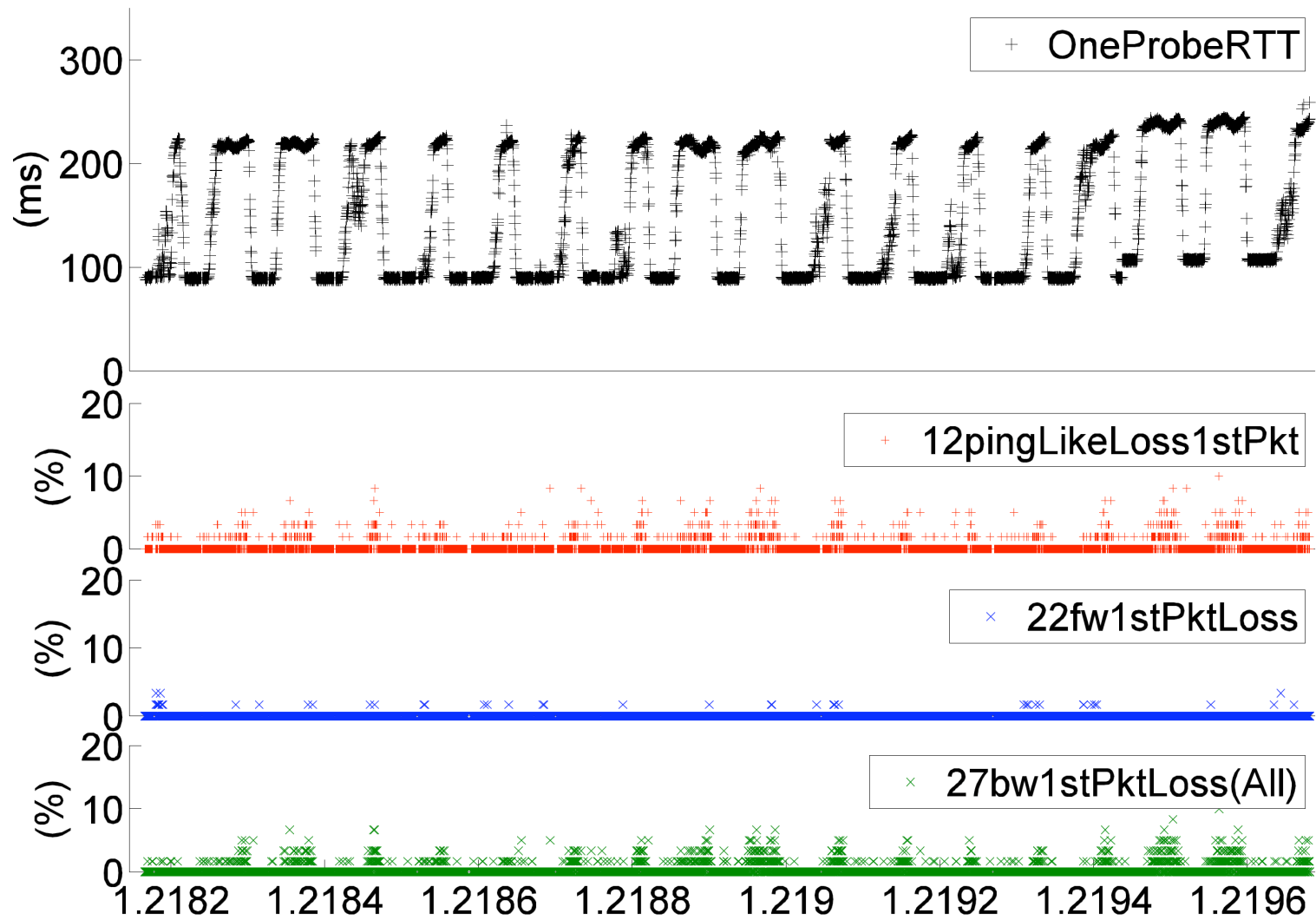Round-trip delay observed by different tools
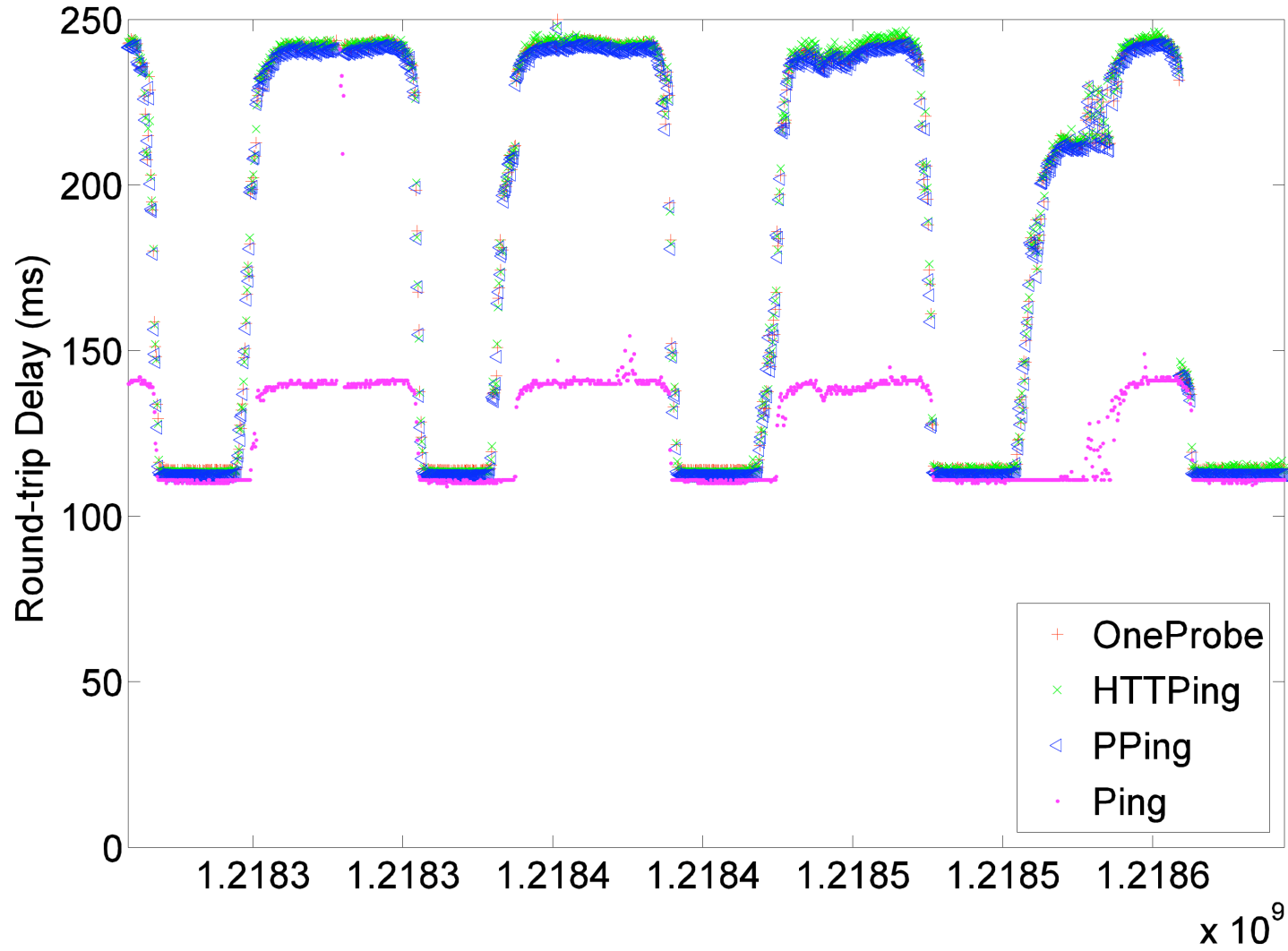
Packet loss patterns

- Diurnal patterns

- Correlation of the RTT peaks with the round-trip packet losses

- Ping's packet loss' accuracy

- Dominance of the reverse-path loss for the Chinacache and Beijing sites

Distribution of Round trip loss measured by Ping, PPing and OneProbe

Distribution of Round trip loss measured by Ping, PPing, and OneProbe

Distribution of round trip loss measured by Ping, PPing and OneProbe

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Timeseries of Round-trip delay and loss rates

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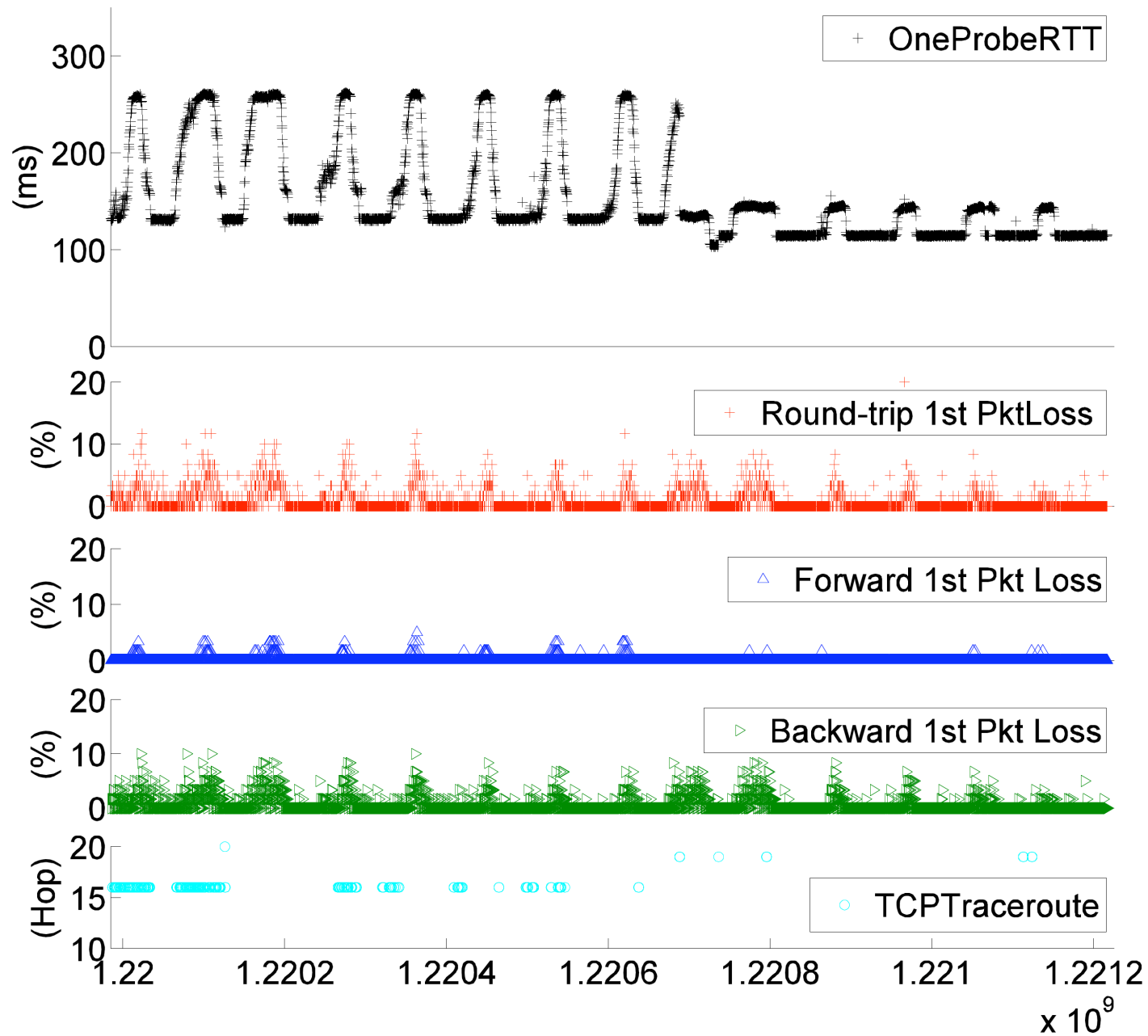Ranking of difference between measured forward and backward packet loss
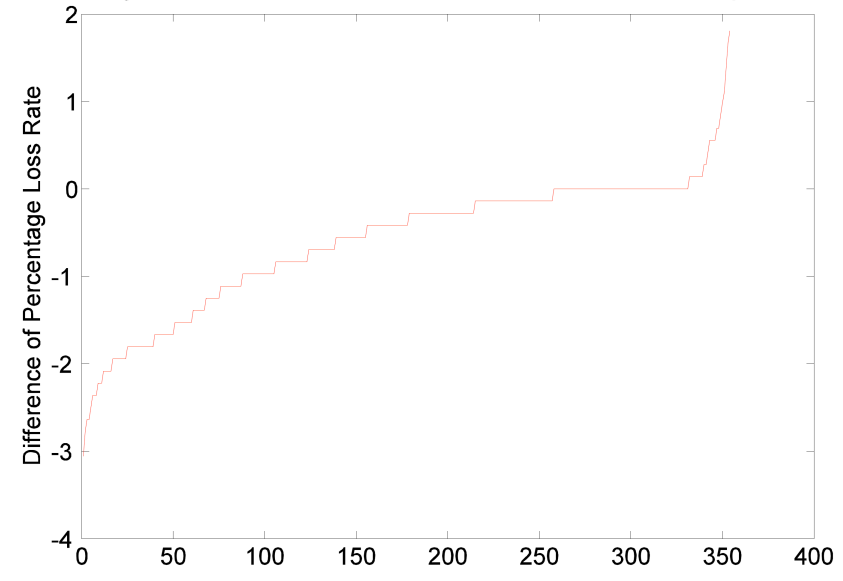
Ranking of difference between measured forward and backward packet loss
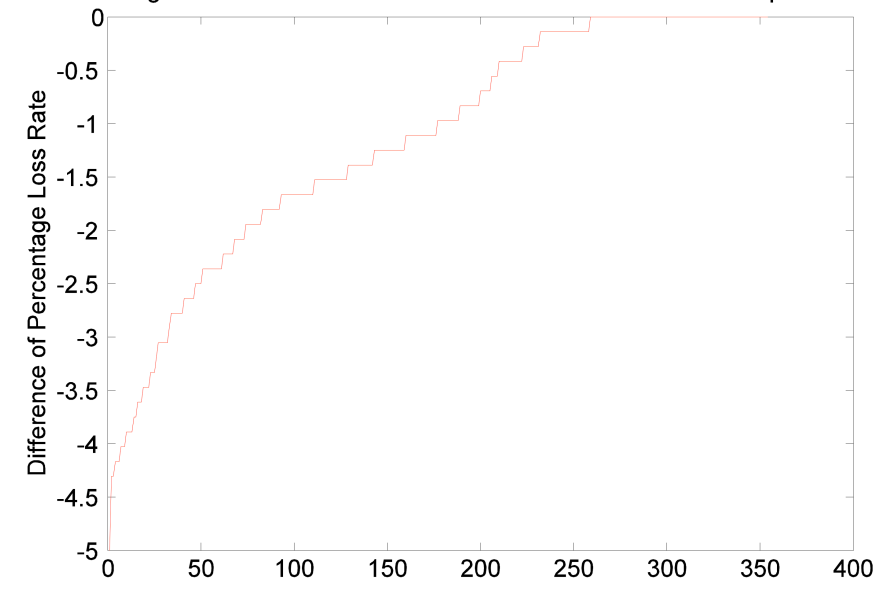
Special cases

- Effects of detectable route changes on the path performance

- Effects of undetectable route changes on the path performance

Timeseries of RTT, loss rate and route change

Conclusions

- Ping is not reliable for RTT measurement.

  - It could significantly underestimate the delay experienced by TCP data.

- Ping, PPing, and HTTPing cannot measure beyond round-trip loss rates.

  - E.g., cannot detect highly asymmetric path losses.

- The protocol used in the probes should match with the protocol under measurement.

- A careful measurement study can reveal configuration changes on the path.

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