Spin Bit

Summary of work and issues

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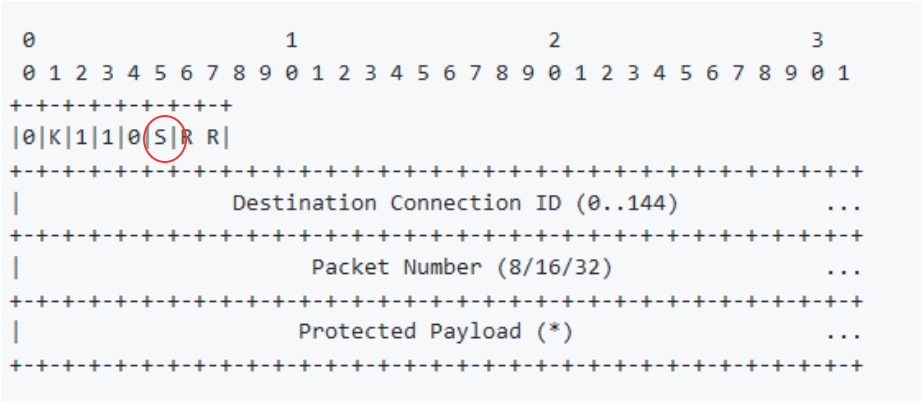
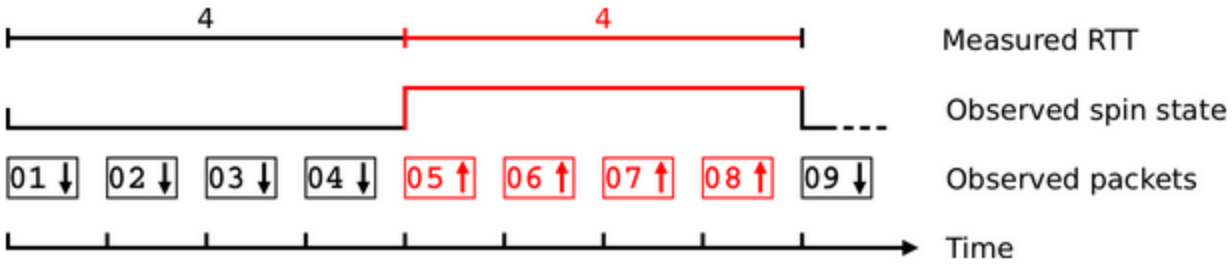
On-path Passive RTT Measurement





Simple algorithm utilizing a single bit to convey RTT information.

- When a server sends a packet, it sets the spin bit to the spin bit on the last packet it received from the client.
- When a client sends a packet, it sets the spin bit to the *inverse* of the spin bit on the last packet it received from the server.

Examples of why RTT is measured

- Inter-Domain Troubleshooting
  - Process of honing in on the network segment(s) responsible for faulty behavior.
- Quality Monitoring
  - Collection of QoE and QoS metrics, for use in dashboards etc.
- Bufferbloat Detection
  - Detection and mitigation of downstream bufferbloat.
- Internet Measurement Research

Privacy and Ossification Concerns

- Geolocation Threat
  - Analyzed by Design Team
  - RTT data is very coarse and generally lacks required precision.
  - Tracking Handshake RTT for a set of connections gives similar min RTT data.

- Selectively opting out of spinning
  - Requires an anonymity set in order to not "stick out".

- Semantics of the bit can potentially change between QUIC versions
  - Requires a sizeable amount of non-spinning endpoints from the start.

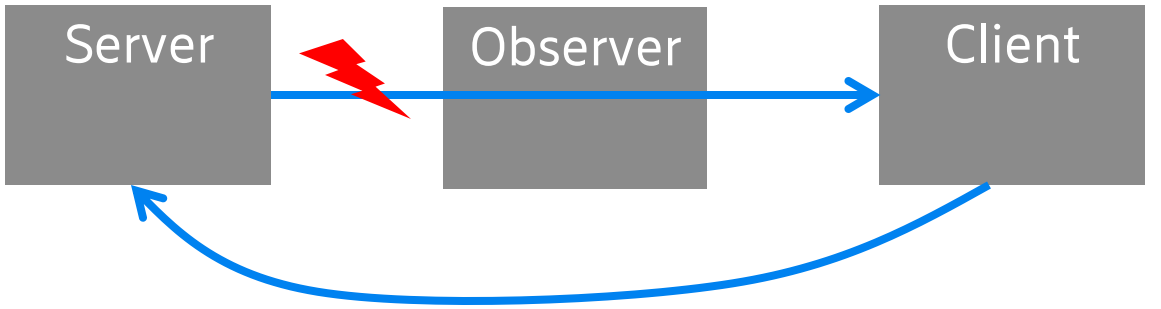
Robustness Concerns

- Shown to work under good conditions *
- Susceptible to loss and reordering *
  - Reordering causes spurious edge transitions and introduces noise to the signal
  - Severe packet loss causes the RTT samples to be somewhat overestimated.

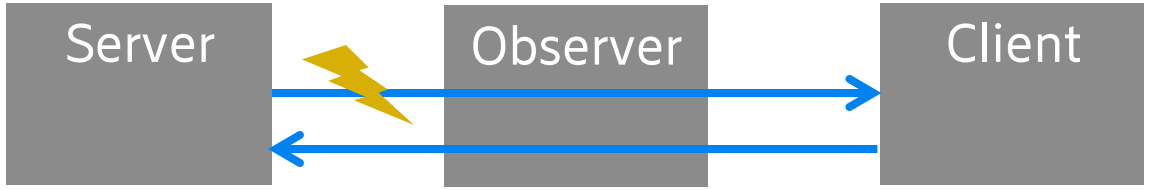
- Non Participating Endpoints

- Solutions:
  - Valid Edge Counter
    - Allows for precise but potentially low frequency sampling
  - Non-explicit edge validation
    - Heuristics
    - Reverse path validation

Unidirectional measurments require heuristics or additional bits for edge validation

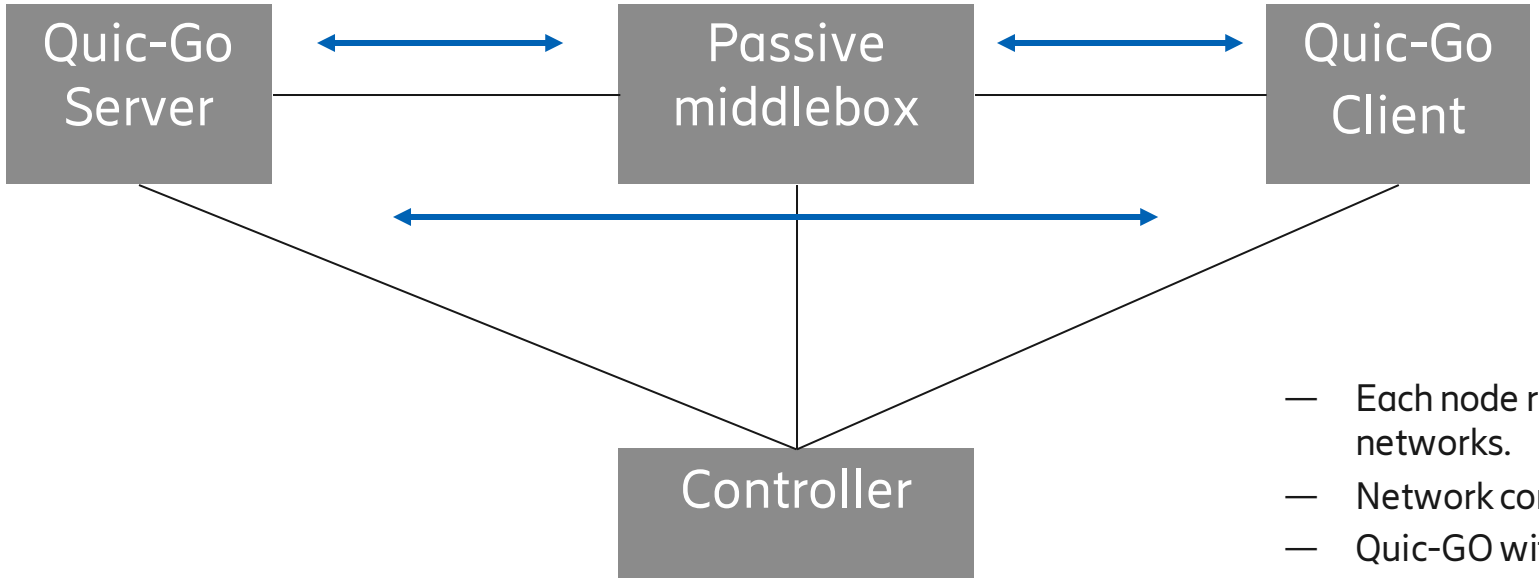


Bi-directional measurements can use reverse path for edge validation



* Piet De Vaere, Tobias Bühler, Mirja Kühlewind, and Brian Trammell. 2018. Three Bits Suffice: Explicit Support for Passive, Measurement of Internet Latency in QUIC and TCP. In Proceedings of IMC '18. ACM, New York, NY, USA

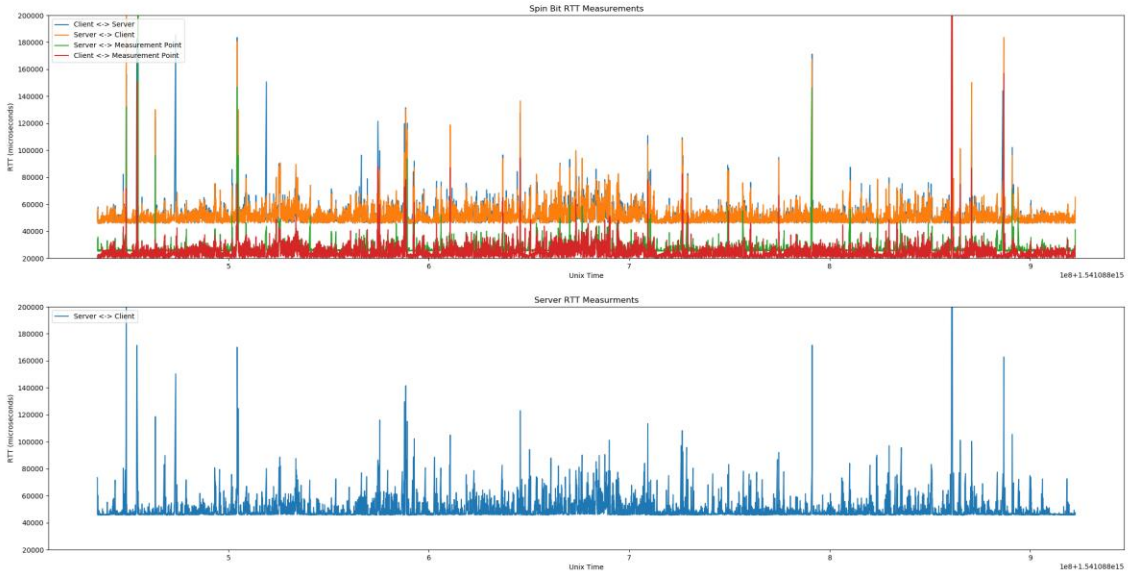
Single Bit Measurement Examples

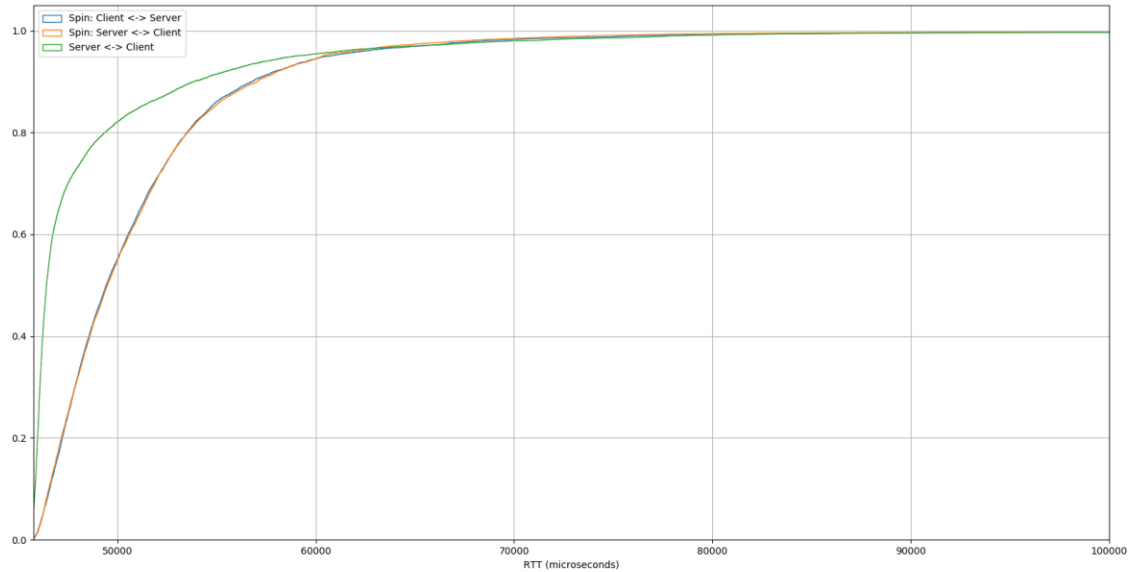


- Each node runs on a Linux VM connected via emulated networks.
- Network conditions applied per egress.
- Quic-GO with added spinbit functionality and RTT logging.
- Realtime RTT sampling in middlebox w. reverse path validation.
- Measurement of end-to-end RTT and RTT between endpoints and measurement point
- Comparisson of Spin Bit RTT estimates and QUIC Server RTT estimates.

Single Bit Measurements w. Reverse Path Validation

5% Random Packet Loss
Loss correlation of 30%
Bi-directional measurement and edge validations.





Single Bit Measurements w. Reverse Path Validation

10% Random Packet Reordering

Bi-directional measurement and edge validations.