QUIC passive RTT measurement

IETF 99

By Ian Swett

Background

Almost all of QUIC is encrypted, including acks

Network monitoring and AQM use RTT

Only Handshake RTT is visible

Issue #631

Motivation

RTT (and change of RTT from baseline) widely used for trouble detection and diagnosis in network/application management:

- min(RTT) over interval t on a group of flows on a path → network latency.
- deviations from min(RTT) on a given flow → application latency.
- TCP methodologies vary: match SEQ/ACK, TSval/TSecr.

RTTs on-path also used by some AQM algorithms.

QUIC currently doesn’t expose equivalents.

Concerns

Potential Privacy Issues

- RTT measurement enables correlation of a packet in one direction with a corresponding packet
  - The corresponding packet MAY be in response to the first packet. Or not.
- min-RTT necessarily exposes an upper bound on physical distance
  - Tightens the bounds further from handshake RTT

Misimplementation

- Implementers may incorrectly interpret data and poorly manage AQM

Option 1: Do nothing

Provide no passive RTT measurement

Pros:

- Adds no complexity
- No privacy concerns

Cons:

- Provides no RTT or congestion window information to the path.
- ‘Innovative’ middleboxes may attempt to infer RTT
    - Ie: From the number of small packets going by in the reverse direction, etc.

Option 2: Packet Number Echo

The sent packet exposes a packet number and the peer echos that packet number back on ack-only packets.

Pros

- Provides downstream RTT

Cons

- Consumes bytes on the wire, changes available payload length.
- Measurement requires saving all recent packet numbers, because it doesn’t know which will be echoed.
- Total RTT estimation requires bidirectional observation

Option 3: One ‘spin’ bit set per RTT

One packet per round trip sets a spin bit in the header to up(1) others are sent with the bit down(0), which is echoed by the peer.

Pros

- Provides downstream RTT
- Provides total RTT and approximate congestion window

Cons

- Must be re-started once lost
- RTT estimate must be filtered to account for lost spin bits.

Option 3a: Identical bit value for an RTT of packets

The connection initiator sends packets with a spin value of up, the peer reflects the spin in response packets, and the initiator flips the spin.

Pros

- Provides downstream RTT
- Provides total RTT and approximate congestion window

Cons

- Requires the endpoints to fix the signal upon reordering
- RTT estimate must be filtered to account for reordered spin bits.

PR #609