

# Passive RTT measurement in QUIC

IETF 99

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# 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:

- $\min(\text{RTT})$  over interval  $t$  on a group of flows on a path  $\rightarrow$  network latency.
- deviations from  $\min(\text{RTT})$  on a given flow  $\rightarrow$  application latency.
- TCP methodologies vary: match SEQ/ACK, TSval/TSseq.

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:

- Networks may be managed poorly
- AQM may be impaired or useless
- ‘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

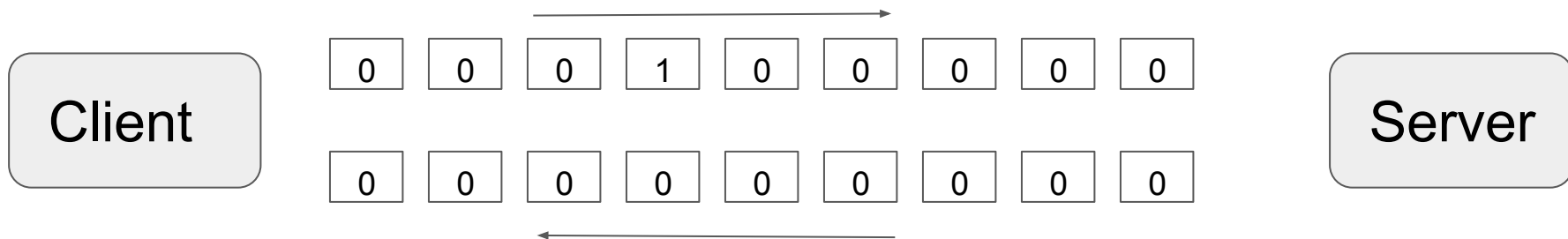
- Provides downstream RTT

### 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.

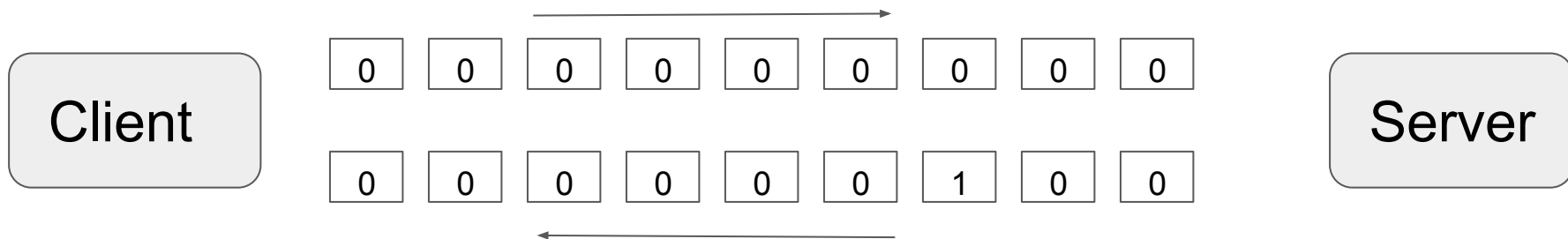






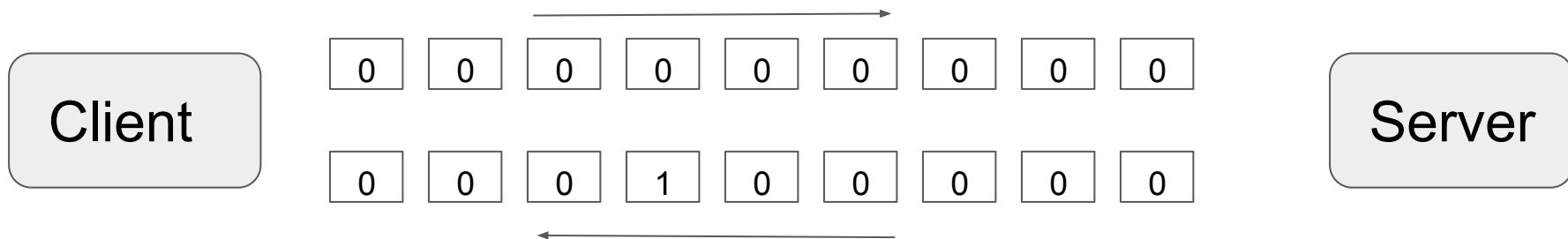
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## Option 3: One 'spin' bit set per RTT (continued)

### Pros

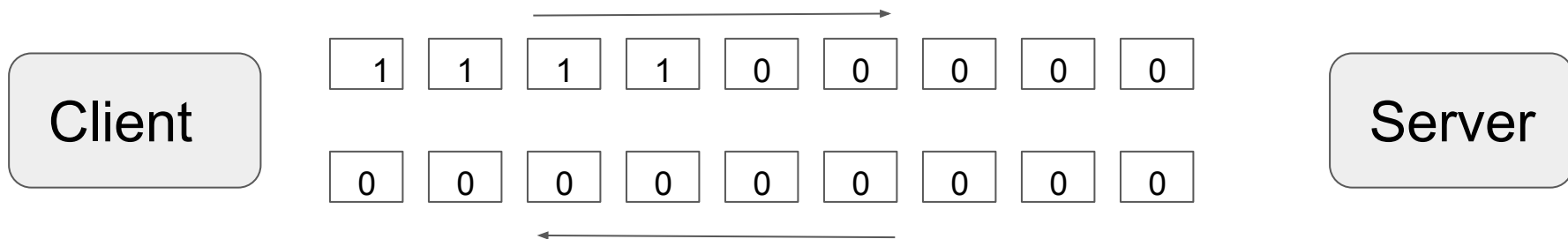
- Provides downstream RTT
- Provides total RTT and approximate congestion window

### Cons

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

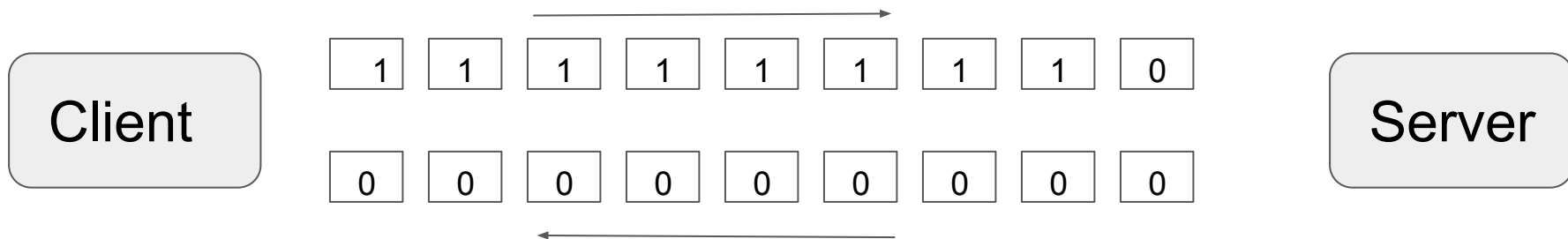
## Option 3a: Identical bit value for an RTT of packets

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.



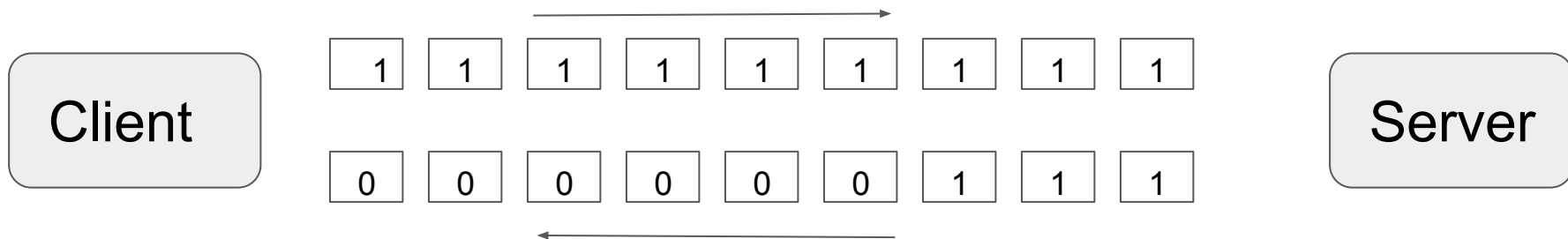
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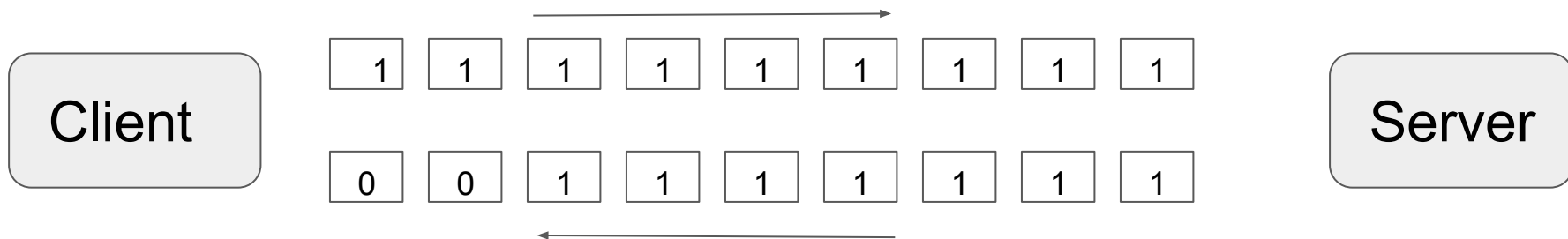
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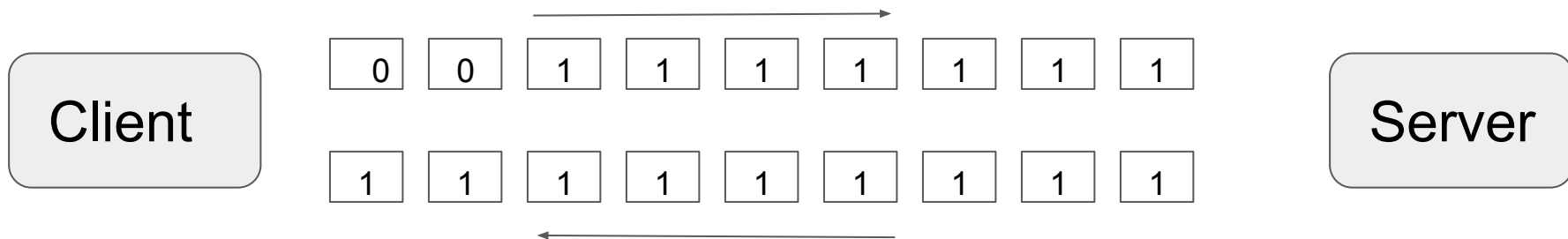
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# Option 3a: Identical bit value for an RTT of packets

## 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.