TRONE Questions

(and maybe solutions)

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How should the advice be encoded?

- TRAIN has 6 bits and a 1:1 map to throughputs.
  - Difficult to choose “the right values”.
- SCONE has self-describing 32-bit value.
  - More granularity than we need.
  - Requires parsing to find the field.
- TRONE (current state) is fully TBD after header.

How should the advice be encoded?

Proposed:

Version-dependent bitrate field leveraging 6 low bits of first octet to express a range. The field is encoded as a logarithmically spaced distribution over the range b_min to b_max.

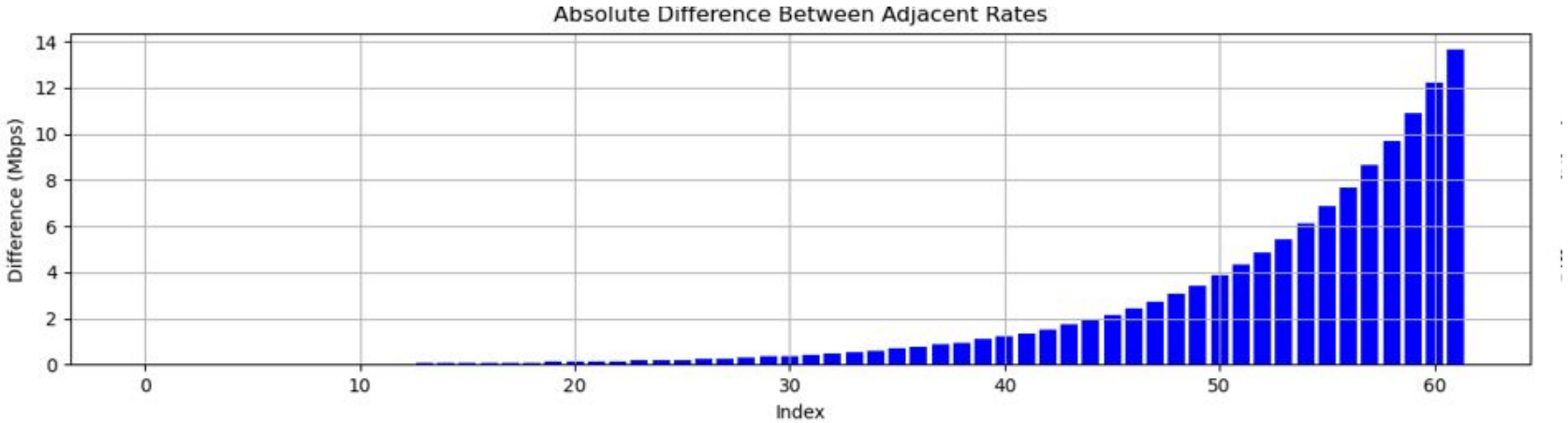
Example distribution:

- Bitrate at value n = b_min * 10^(n/20)
- With b_min = 100Kbps range looks like:
  - (0, 100), (1, 112), (2, 141) .. (20, 1000), (21, 1122) .. (40, 10000), (41, 11220) .. (62, 126000)
  - 63 used to indicate that there is no limit in this range.

Why Logarithmic?

- Efficiently encodes a large range of bitrates.
- Most granularity around the lower bitrates.
  - The higher the rate we want to express, the more coarse graining we can accept.

n = 100kbps * 10^(n/20)

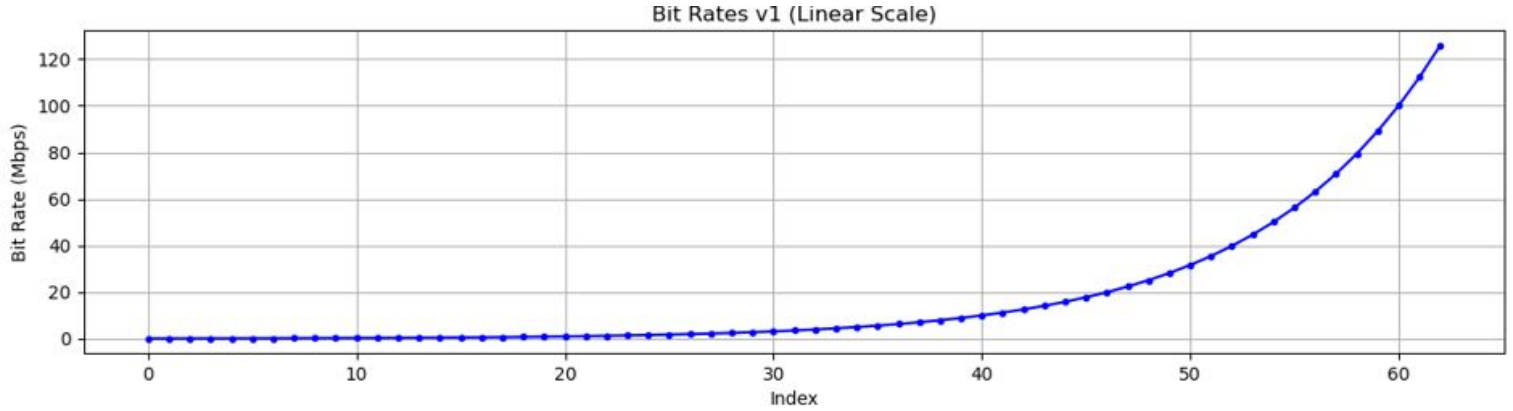


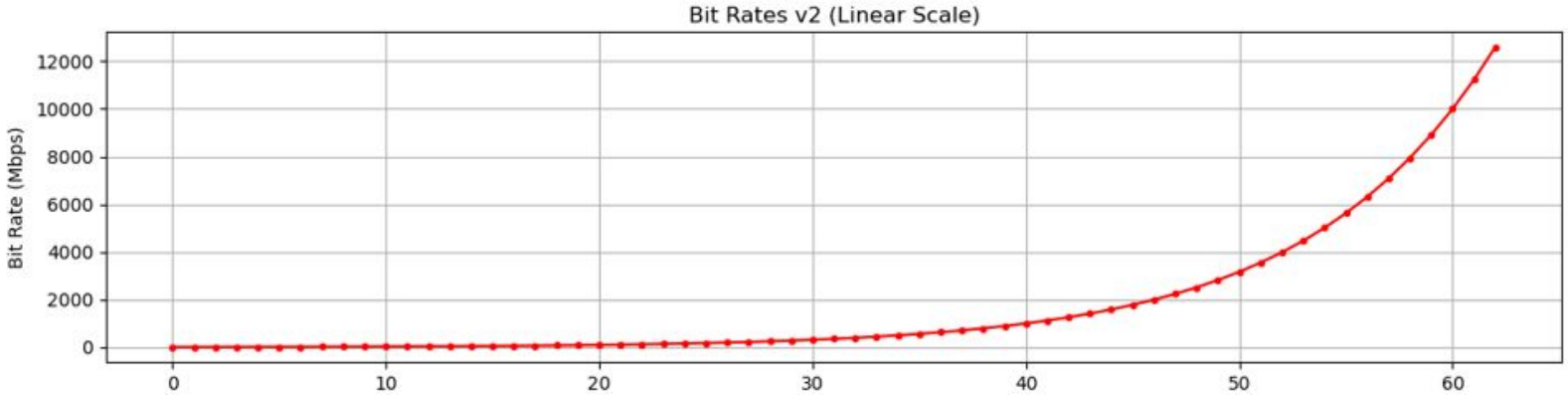
Version Dependent?

- Define two TRONE versions.
- A version corresponds to a rate with a starting point.
- E.g.,
  - Version A lowest bitrate = 100 Kbps (Max value 125 Mbps)
  - Version B lowest bitrate = 10000 Kbps (Max value 12.5 Gbps)
- Senders alternate TRONE packets with both versions.
- Network elements update both rates.
- Receivers use the minimum of both.
- If we decide to use different exponents for the different versions, we get finer granularity in the overlapping regions.

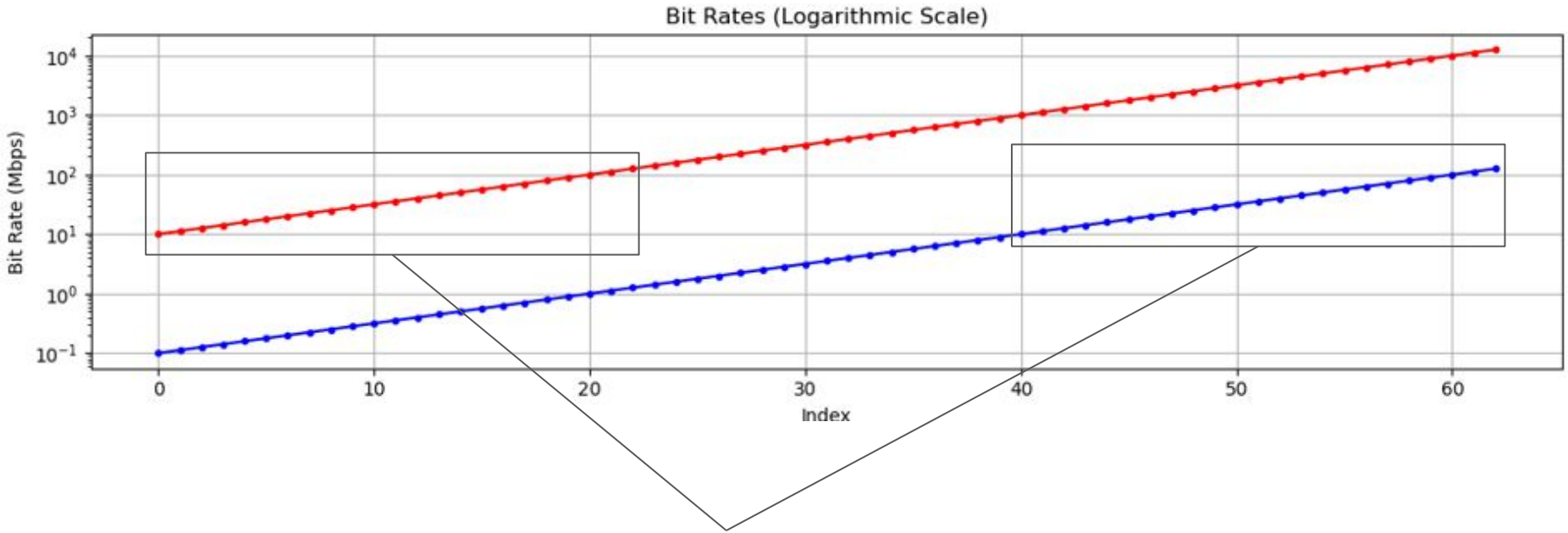
Example Distributions

n = b_min * 10^(n/20)





Example Distributions



Range Overlap

When can throughput advice be generated?

- TRAIN: advice can only be generated when an endpoint sends a TRAIN packet.
- SCONE: advice can be generated at any time by network element.
- TRONE: network element can expand datagram to fit TRONE packet.

Proposed: Guidance to endpoints on situations in which to send TRONE packets, no explicit defense against network expanding datagrams. E.g. once per video burst, on persistent congestion, on address tuple change, etc.

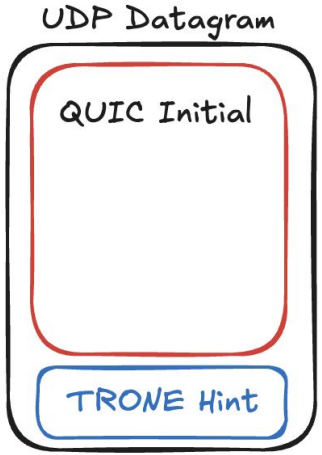
When can advice support be detected?

Problem: Removing the need of ClientHello DPI parsing for traffic management.

- TRAIN: attempt is detectable by parsing Client Hello or Server Hello, confirmed by tracking TLS handshake with DPI, or waiting for first TRAIN packet from an endpoint.
- SCONE: fully detectable post handshake, in principle could be pre-handshake.
- TRONE: Same as TRAIN.

When can advice support be detected?

Proposed: Attach a TRONE-indication packet after QUIC initial in first UDP datagram as an opportunistic signal of TRONE usage. Confirmation of usage tied to observing another TRONE packet.



What time window is advice applicable for?

Problem: 1Mbps measured over 1s is very different from 1Mbps over 60s.

- TRAIN: Unspecified.
- SCONE: Explicitly communicated window.
- TRONE: TBD.

Proposed: Decide on a fixed value (20s) large enough to allow for rough agreement on measurements between endpoints and network elements for compliance purposes

Rationale: Allow for large bursts of traffic; maintain long-term cap

What is the risk of damaging non-participant flows?

Problem: packets that have a signature which match these could be altered by a network element.

- TRAIN: No guidance.
- SCONE: Not applicable as there is no modification of e2e packets.
- TRONE: No guidance.

Proposed: Guidance to network elements to stop marking packets if frequency exceeds some threshold on a flow, e.g. 50%.