Ack Frequency

draft-ietf-quic-ack-frequency

https://github.com/quicwg/ack-frequency

QUIC WG, Philadelphia, July 2022

Current Frame Formats

```
ACK_FREQUENCY Frame {
     Type (i) = 0xaf,
     Sequence Number (i),
     Ack-Eliciting Threshold (i),
     Request Max Ack Delay (i),
     Reserved (6),
     Ignore CE (1),
     Ignore Order (1)
}
```

```
IMMEDIATE_ACK Frame {
     Type (i) = 0xaf
}
```

Sequence Number: Allows receivers to ignore obsolete frames after reordering.

Ack-Eliciting Threshold: The maximum number of ack-eliciting packets the recipient of this frame can receive before sending an acknowledgment.

Request Max Ack Delay: The value to which the endpoint requests the peer update its max_ack_delay

Ignore CE: This field is set to true by an endpoint that does not wish to receive an immediate acknowledgement when the peer receives CE-marked packets.

Ignore Order: This field is set to true by an endpoint that does not wish to receive an immediate acknowledgement when the peer receives a packet out of order.

IMMEDIATE_ACK 1 byte frame type? (#119)

Issue: Currently its `0xac`. It's likely to be sent quite often, should we switch to a 1 byte codepoint? Particularly given we may want to bundle IMMEDIATE_ACK with PTO packets.

Question: Should we switch to 1 byte?

Is Ignore CE Useful? (#118)

Issue: Unclear if Ignore CE is really useful, and a number of concerns were expressed on #87 and #107.

PR #116 added: *"Ignore-CE bit SHOULD NOT be set if the sender sets ECT(1) in its outgoing packets, such as with L4S"*

Question: Is Ignore CE worth keeping?

Examples or Suggestions of use? (#53)

Status Quo: PR #115 Attempts to update the Congestion Control section, but isn't proscriptive and doesn't have examples.

Questions:

- Should examples of use be included?
  - If so, what?
- Should there be suggestions of use?
  - Particularly for Reno/Cubic?

Latency to detect packet loss? (#96)

Issue: One ACK is sent immediately upon a missing packet. But after that, the next ACK will not be sent until there are more missing packets or the `Ack-Eliciting Threshold` or `max_ack_delay` are hit.

Result: Loss detection delayed when `Ack-Eliciting Threshold` is larger than the Packet Threshold.

Can't detect loss immediately with the immediate ACK

Loss detection latency is worse than QUIC v1 when `Ack-Eliciting Threshold` > 2

Latency to detect packet loss? (#96)

Proposal (#100):

- Communicate `Reordering Threshold` to receiver instead of `Ignore Order`
- Receiver immediately ACKs when missing packets in:

  `[largest_acknowledged_sent - Reordering Threshold, largest_acknowledged - Reordering Threshold]`

Result: Receiver reduces ACKs when packets received out of order while improving loss detection latency over QUIC v1