Multipath in Chromium

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Design

- PathID identifies the path
  - gQUIC didn’t have multiple connection IDs, so the PathID was in the packet header
- Unified ACK frame ACKs across all paths
  - Multiple Packet Number spaces
- Congestion controller per path
- Loss detection per packet number space

Implementation

Design wasn’t that difficult, but implementation…

- Retransmissions were **very** complex*
  - Sent packets owned the data within them
  - Once data sent on a path, moving it to the other was complex
  - Now streams own data, simplifying this immensely

If your code structure is not conducive, implementation will be hard

So we’re done, right?

Oh, you wanted to **use** both paths...

Scheduling

Needs to be driven by the application and deployment environment

- Latency sensitive?
- Bandwidth maximizing?
- Reliability?
- Costs?

Never got enough buy-in from a customer to help develop a scheduler

- *“Can you only send the GET on every path?”*

“Why don’t you improve connection migration first and see if it’s enough?”