Experiments with Simulcast, Priorities and Congestion Control

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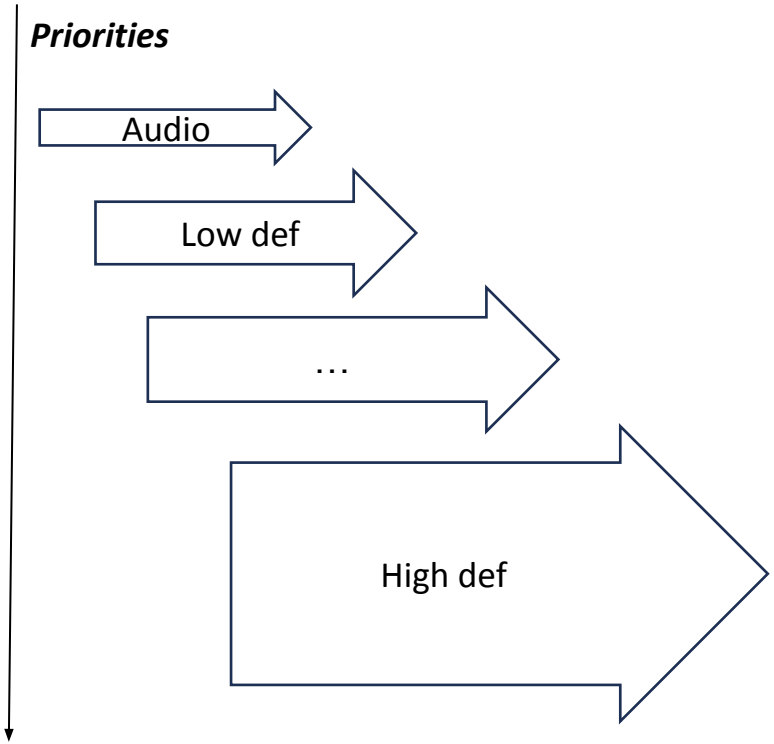
V2

Goals

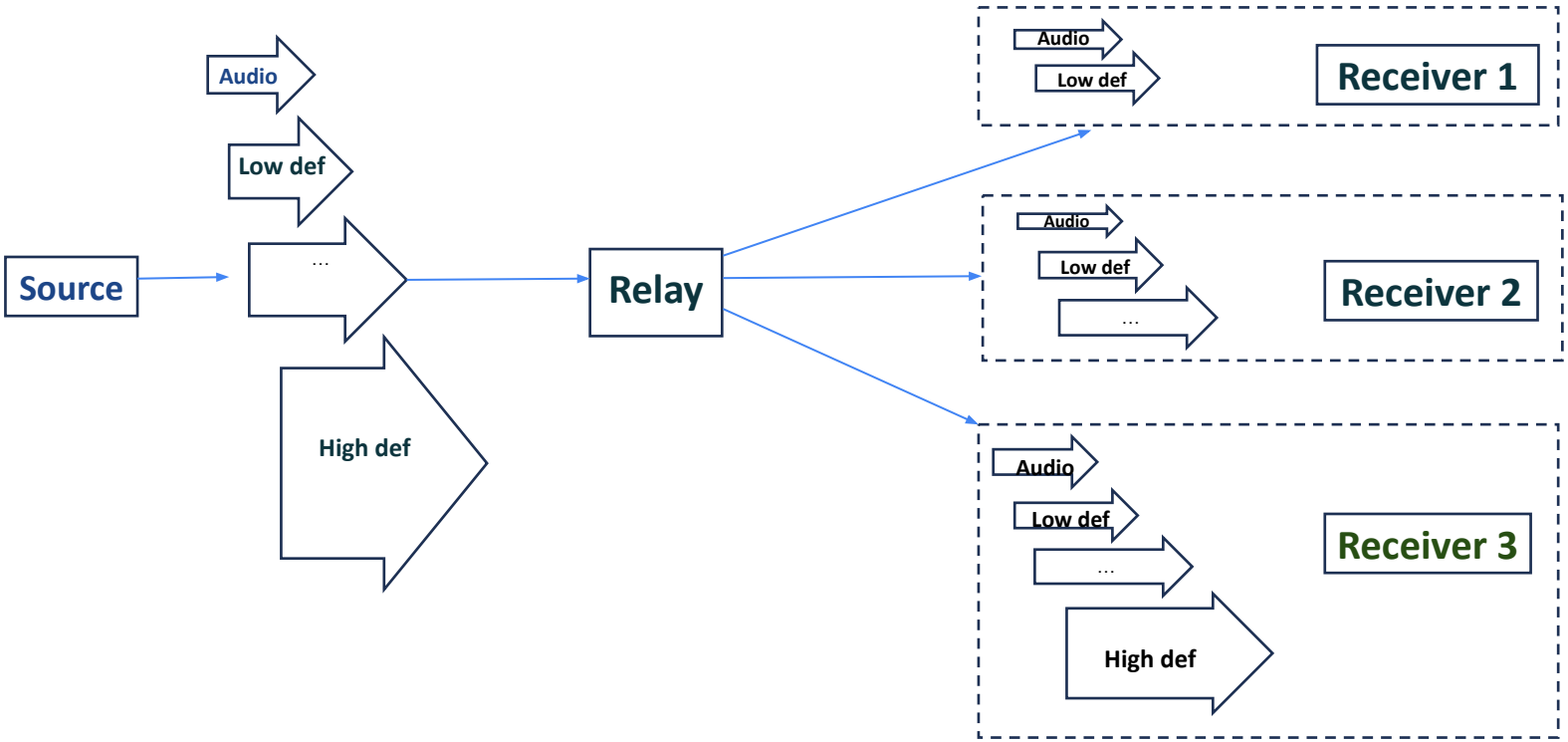
- Discuss
  - QUIC usage for Simulcast (Multi quality) real time media delivery over MoQ
  - Priorities as a tool for Relays/Senders to decide
    - What is more important and what gets sent ?
  - Under not-so-good network conditions
    - Issues observed
    - What changes were further needed to alleviate the problems ?

The layered media ambition

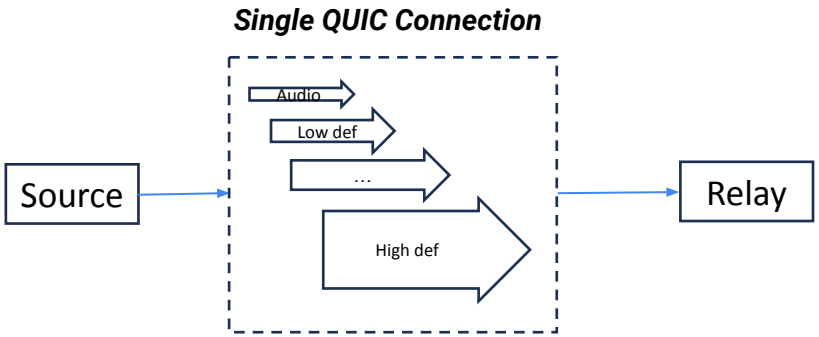


- Organize the media in multiple qualities
- If the network slows down, the user gets good lower quality
- If the data rate increases, the user gets high quality
- Possibly without requiring explicit selection of media
- **Quick decisions for timely reaction**

With multiple receivers



With QUIC



- Send all media on single QUIC connection
- Map media to QUIC streams
  - Or datagrams for audio’
- Assign Priorities to Streams
  - And Datagrams
- Use congestion control to get available data rate
- Ask QUIC to schedule most important streams first

Simulcast Realization in MoQ

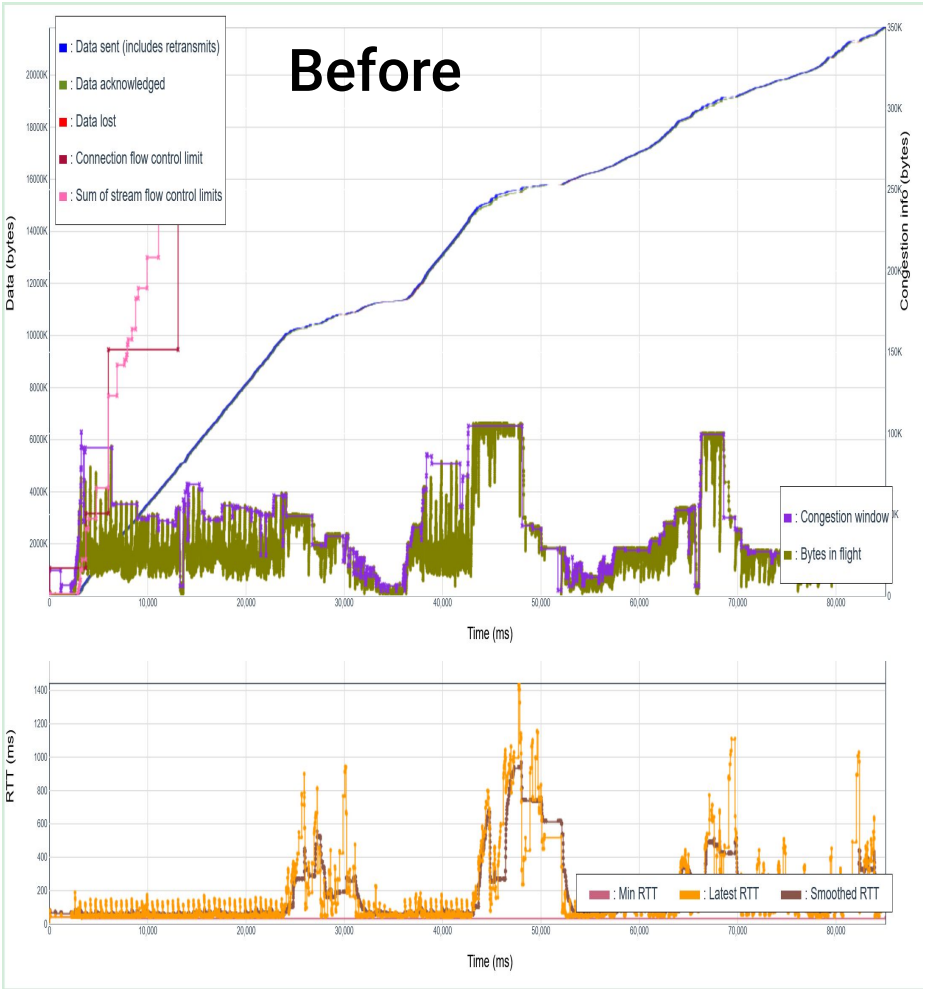
- One Stream per Group
  - If a stream is falling behind or having losses
    - Reset the stream
  - Receiver local decision to render the best quality frame and when (possibly unsubscribe to ease the conditions)
- Audio over Datagram - one per audio frame
- Priority set a track level and applied to streams and datagrams
  - Most Important - (audio > 360p > 720p > 1080p) - Least Important
- Under congestion drop/reset the least important stream

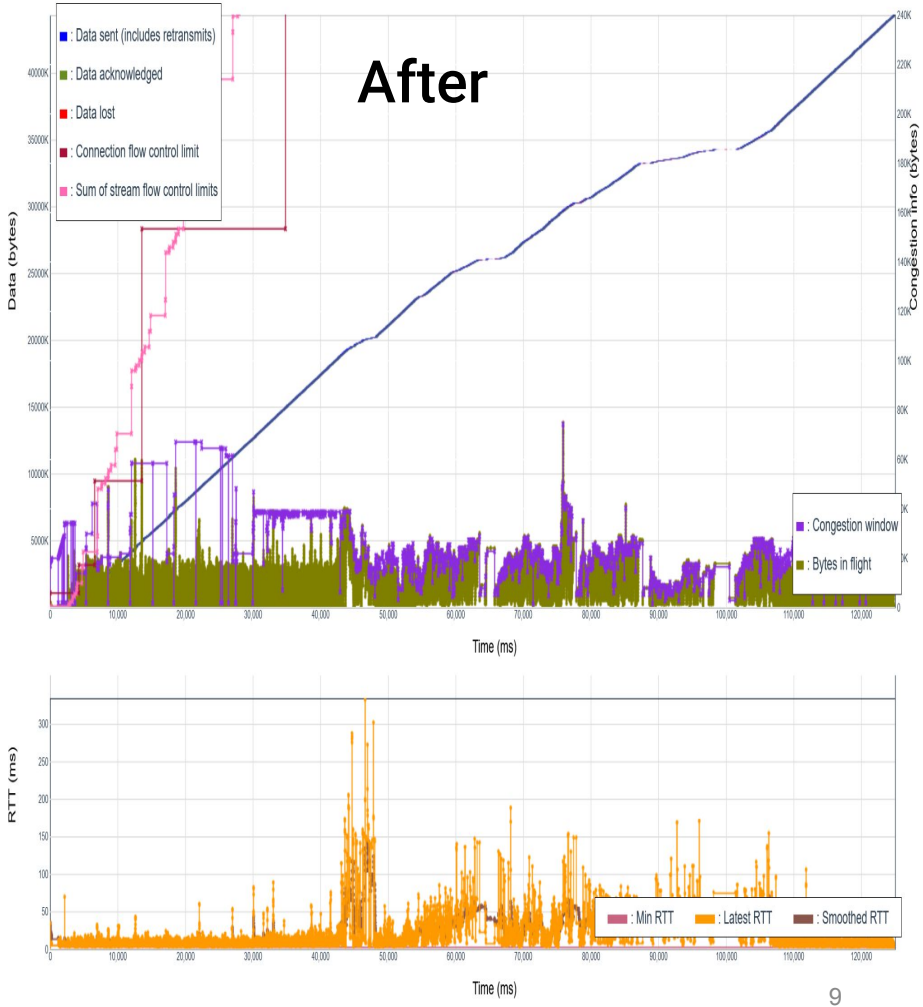
What did we find ?

- On Sudden drops in network capacity or jitter in WiFi delivery
  - Congestion Control will notice it after a delay (~ > 2 RTT)
  - Implies wrong scheduling decisions for that delay
  - Too many HD packets ends up getting scheduled
    - Causes random losses, including for Low Definition streams
    - Causes extra delay across all the streams

What did we explore & future ?

- Retransmissions to respect original stream priorities
  - Avoid less important media to impact important streams
    - RTX of HD streams slows down the SD streams
  - It proved useful and necessary
- Make Congestion Control react faster (work outside of moqwg)
  - Handle suspensions better
  - Detect and react to bandwidth changes sooner
  - We will propose incremental updates to BBRv3 to support interactive media use-cases.
- Investigate FEC (Research)


Before
: Data sent (includes retransmits)
: Data acknowledged
: Data lost
: Connection flow control limit
: Sum of stream flow control limits
Data (bytes)
Congestion info (bytes)
: Congestion window
: Bytes in flight
Time (ms)
RTT (ms)
: Min RTT
: Latest RTT
: Smoothed RTT
Time (ms)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What’s coming next

- IETF 120
  - Bring in learning from Congestion Control experiments.
  - Contribute to stream mapping and priority discussions.