# Scalable High Efficiency Video Coding based HTTP Adaptive Streaming over QUIC

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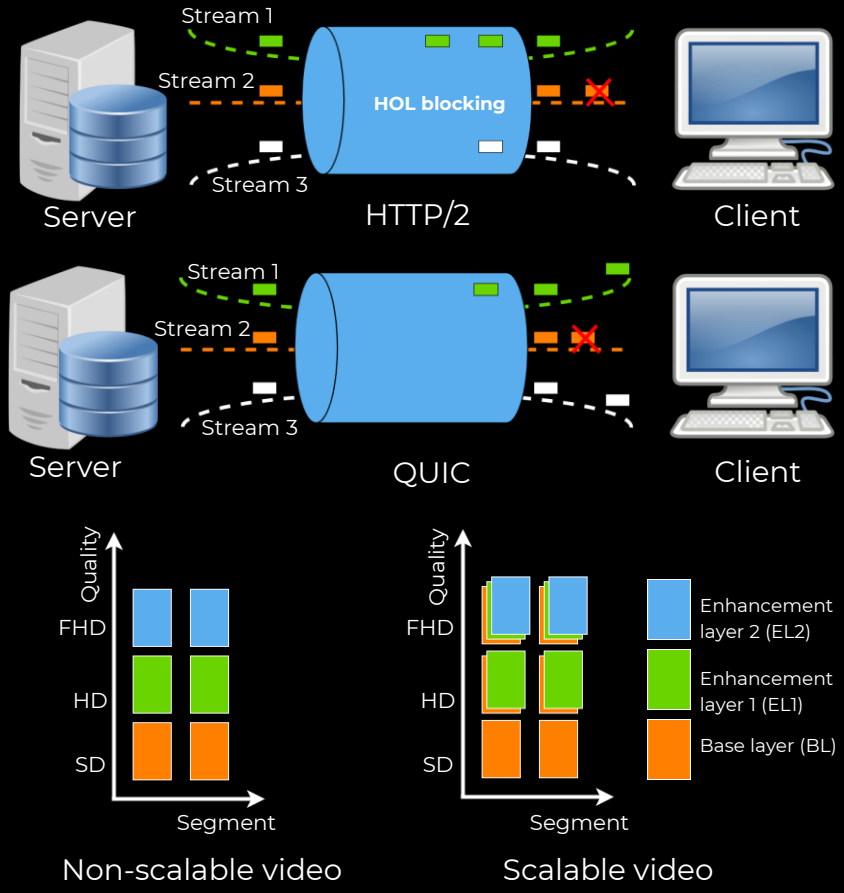
# Agenda

- Motivation
- Contributions
- Proposed method
- Evaluation and discussion
  - HTTP/3 over QUIC vs HTTP/2 over TCP
  - Proposed method vs state-of-the-art methods
- Conclusion and Future work

# Motivation

- Protocols
  - HTTP/2 suffers from Head-of-line (HOL) blocking.
  - QUIC running on top of UDP can tackle this issue.

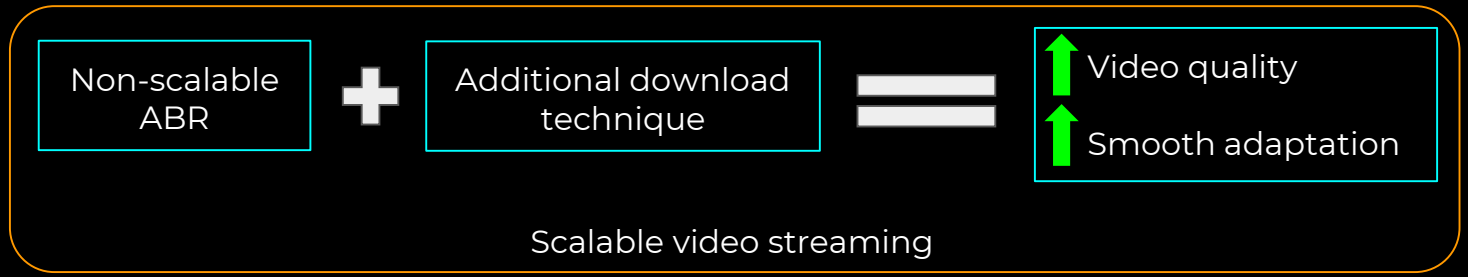
- Video streaming
  - Adaptive bitrate (ABR) algorithms are mainly designed for either non-scalable or scalable video coding formats.
  - Lack of an approach that works well for both non-scalable and scalable video coding formats.



# Contributions

- A systematic comparison of QUIC and HTTP/2 regarding the multiplexing feature.

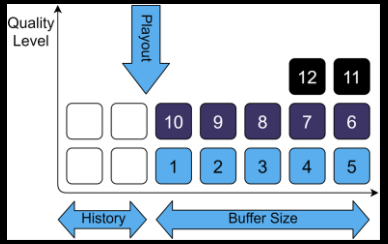

- A non-scalable video streaming ABR algorithm in combination with an additional download technique is proposed to not only improve the video quality but also to provide a smooth adaptation behavior.



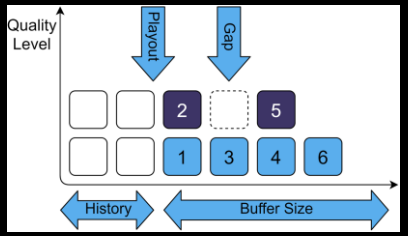
# Proposed method

- State-of-the-art ABR algorithms
  - Non-scalable based method: Aggressive ABR (AGG)
  - Scalable based method:  Backfilling

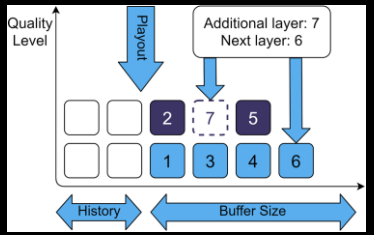
- Proposed method for Scalable Video Streaming
  - Modified AGG + **H**TTP/**2**-**B**ased **R**etransmission technique (H2BR)
  - Modified AGG
    - Choosing the number of layers for each segment based on the network condition,
    - Downloading sequentially from low to high layers of each segment.
  - H2BR [PV'20]
    - Filling quality gaps in the buffer,
    - Downloading concurrently next layers and the additional layer with priority and multiplexing features,
    - Terminating layers with termination feature.




Scalable based Backfilling




Modified non-scalable based AGG

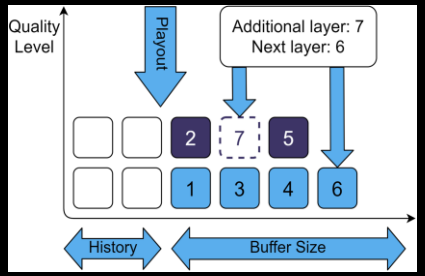



Modified non-scalable based AGG + H2BR

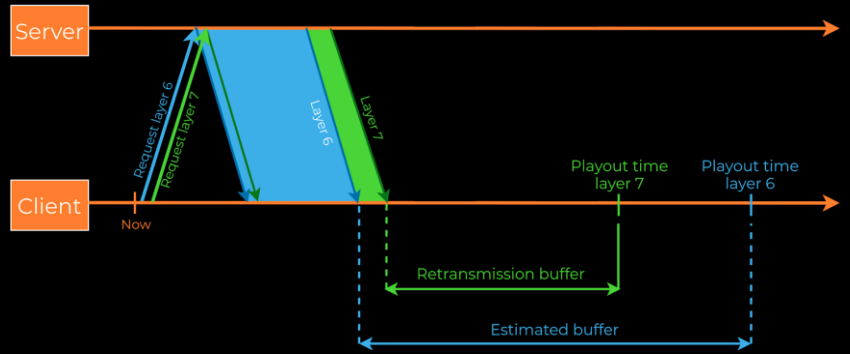
# Proposed method

How does H2BR work?

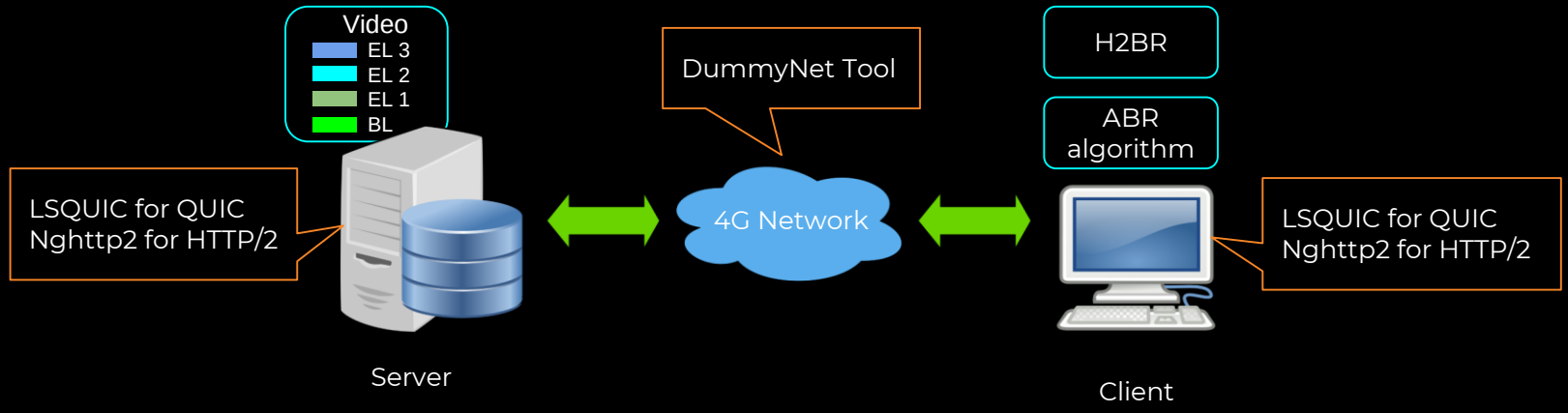
- Detecting gaps in the buffer.
- If there is a gap, additional layer will be 1-level higher (i.e., the segment has BL, the additional layer is EL 1).
- Additional layer will be downloaded if the throughput can sustain the next layer and additional layer so that:
  - Retransmission buffer > 0, and
  - Estimated buffer > BufferSize/4.
- Assigning priority weights for additional layer and next layer so that for these layers enough throughput is allocated.
- Sending 2 requests.
- Terminating the additional layer if:
  - Retransmission buffer < 100 ms, or
  - Current buffer < BufferSize/4.




Modified non-scalable based AGG + H2BR



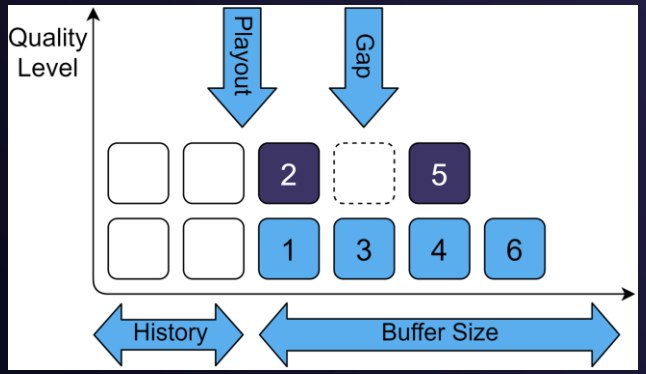
# Evaluation and discussion



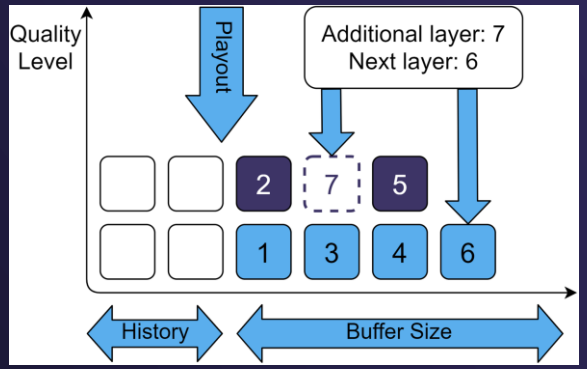

* BL: Base layer
* EL: Enhancement layer

Testbed

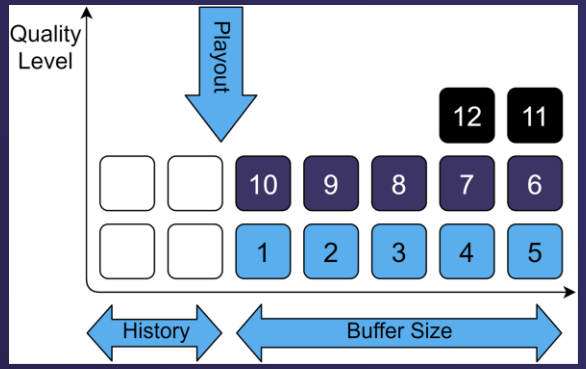
# Evaluation and discussion




Modified AGG
(M-AGG)




Modified AGG + H2BR
(H2BR)

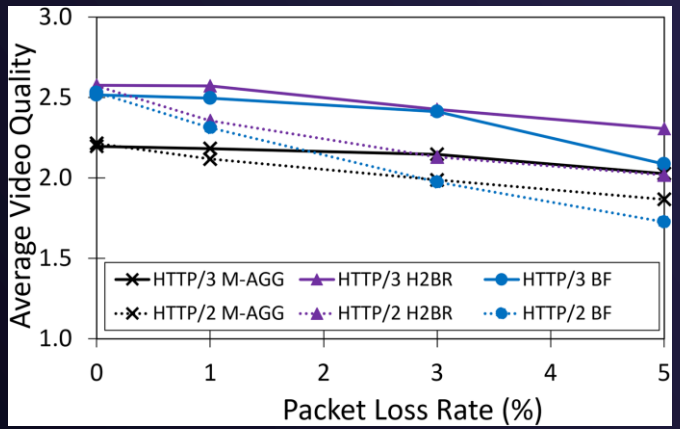



Backfilling
(BF)

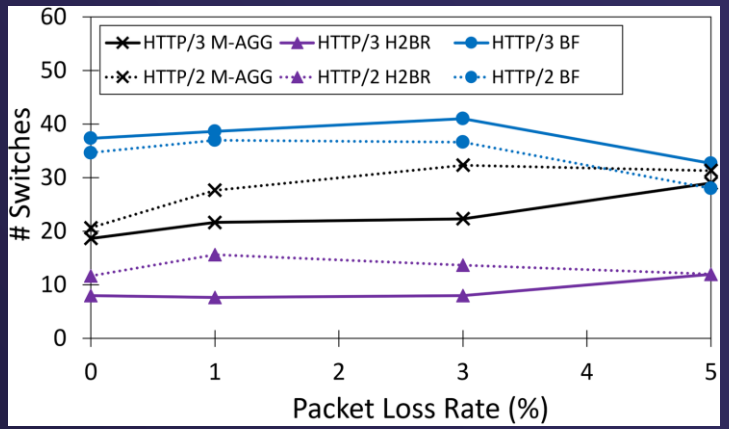
Compared methods

# Evaluation and discussion

**HTTP/3 over QUIC vs HTTP/2 over TCP**




Average quality level

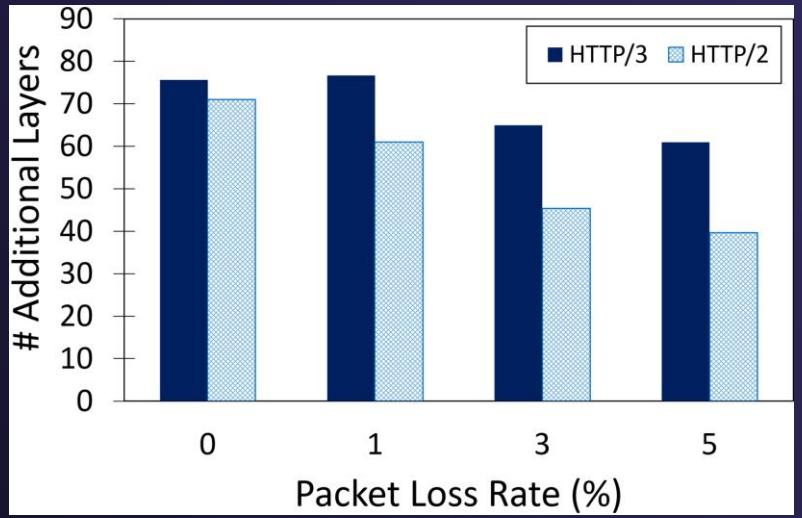



# downward switches

Impact of packet loss rate on the performance of adaptation approaches

# Evaluation and discussion

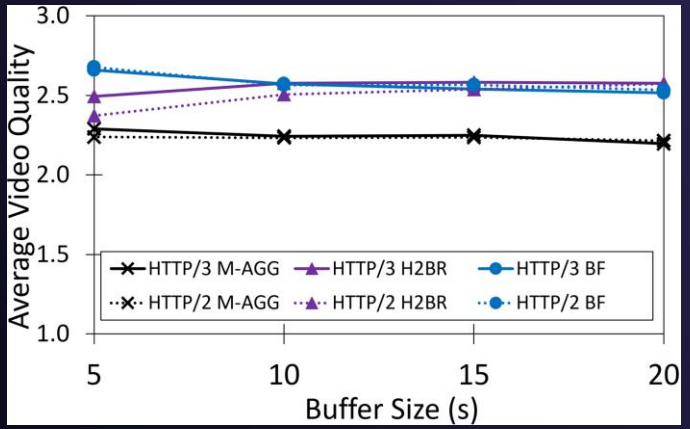
**HTTP/3 over QUIC vs HTTP/2 over TCP**



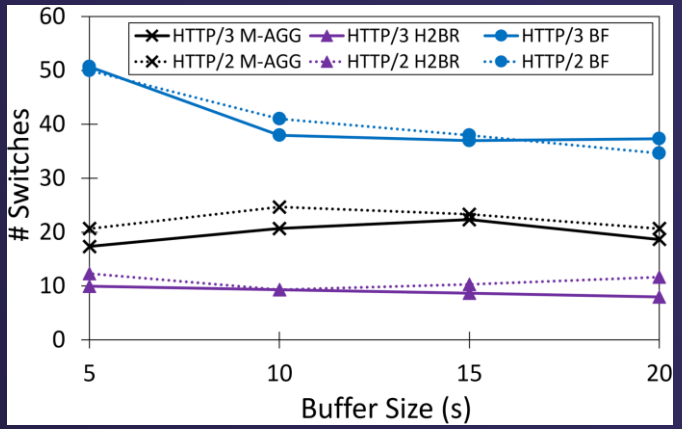

# additional layers successfully downloaded by H2BR

# Evaluation and discussion

**Proposed method vs state-of-the-art methods**




Average quality level

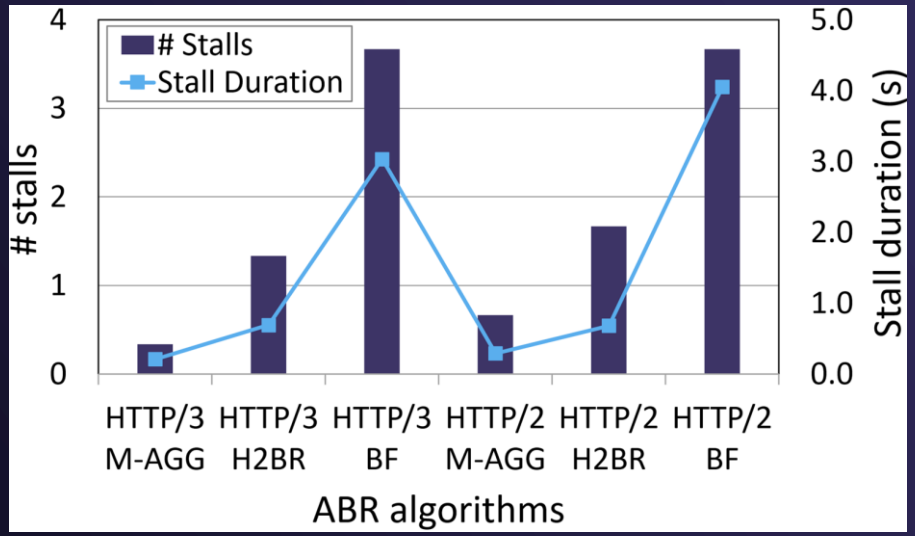



# downward switches

Impact of buffer size on the performance of adaptation approaches

# Evaluation and discussion

**Proposed method vs  state-of-the-art methods**




Buffer starvation when buffer size is 5s

# Conclusion and Future work

- Conclusion
  - QUIC can well support concurrent streams to provide a better performance in case of packet loss.
  - Proposed method makes non-trivial improvement in scalable video streaming.
  - H2BR might be a burden that can lead to buffer starvation when the buffer size is small.

- Future work
  - Investigating parameter selections for H2BR.
  - Considering different network traces and video contents.

# Thank you