

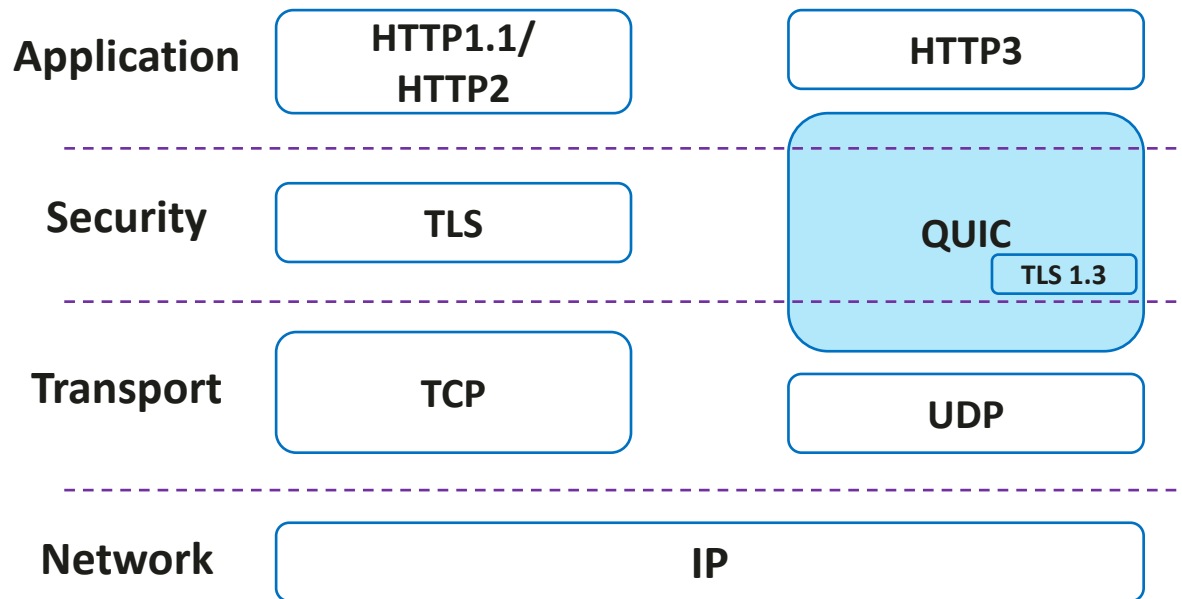
JVET-AM0188

An introduction to the next generation media transport protocol—Media over QUIC(MoQ)

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What is QUIC

- QUIC is a secure general-purpose transport protocol based on UDP.
- QUIC is a connection-oriented protocol that creates a stateful interaction between a client and server [1].



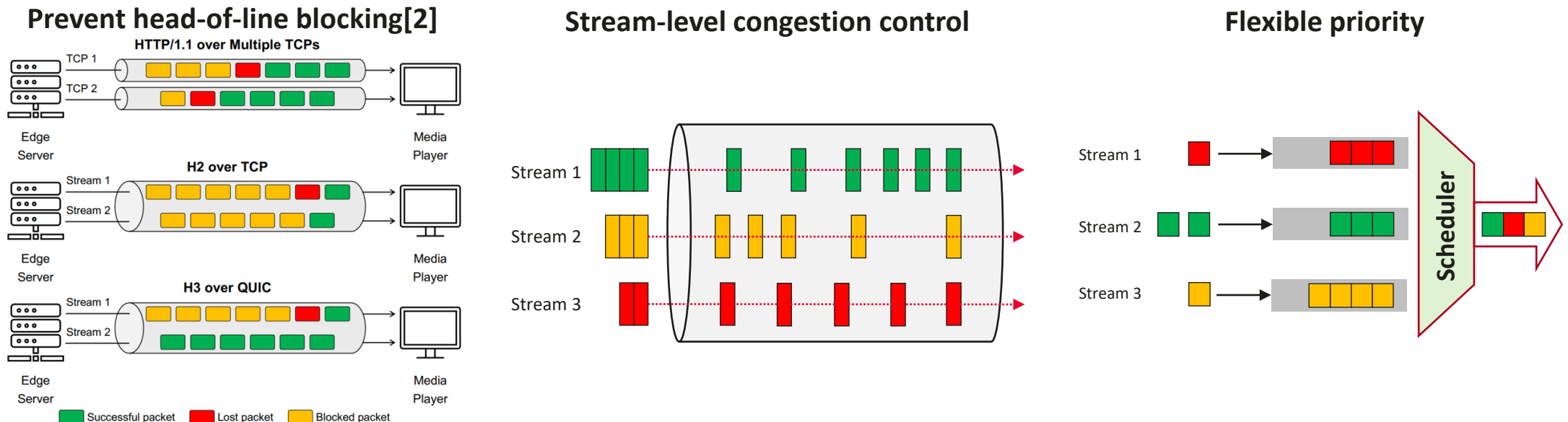
Benefits of QUIC:

- Faster connection establishment
- Multi-stream
- Enhanced security
- Congestion control
- Connection migration

[1] IETF RFC 9000: "QUIC: A UDP-Based Multiplexed and Secure Transport", < <https://www.rfc-editor.org/rfc/rfc9000> >.

QUIC has multiple streams

- Streams in QUIC provide a lightweight, ordered byte-stream abstraction to an application. Streams can be unidirectional or bidirectional.
- QUIC allows for an arbitrary number of streams to operate concurrently and for an arbitrary amount of data to be sent on any stream, subject to flow control constraints and stream limits.
- Streams are flow controlled both individually and across a connection as a whole.
- QUIC relies on receiving priority information from the application [1].



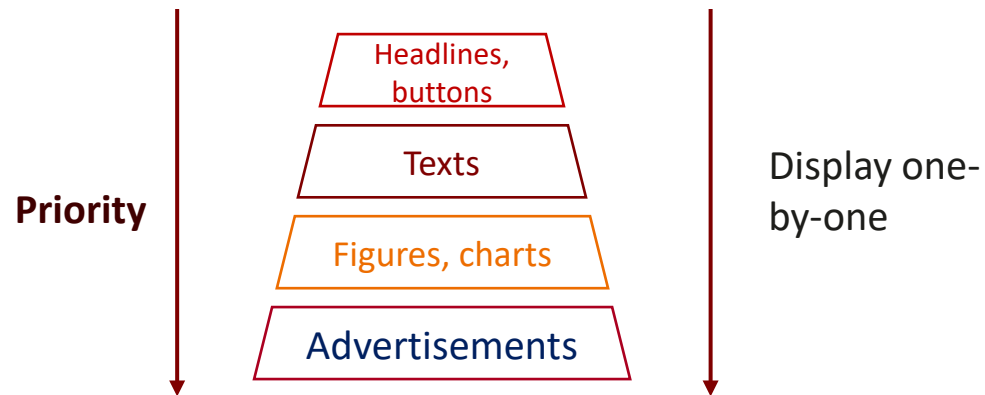
[1] IETF RFC 9000: "QUIC: A UDP-Based Multiplexed and Secure Transport", < <https://www.rfc-editor.org/rfc/rfc9000> >.

[2] A. B. Demir, M. Parlak, Z. Gurel, D. Ugur and A. C. Begen, "Impact of Prioritized HTTP/3 Transport on Low-Latency Live Streaming," 2024 IEEE International Conference on Multimedia and Expo Workshops (ICMEW), Niagara Falls, ON, Canada, 2024, pp. 1-6.

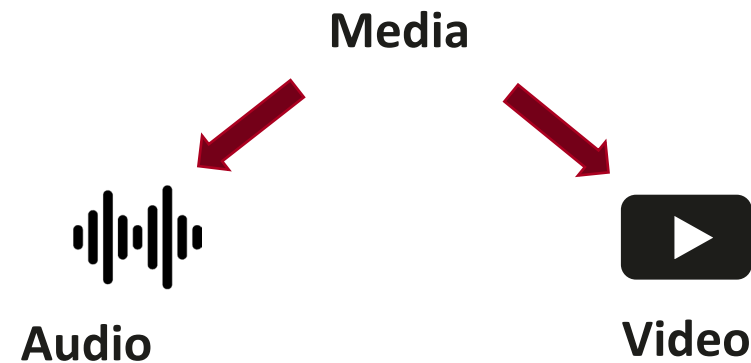
What kind of data is suitable for QUIC?

- The data that can be partitioned into multiple streams with different priorities.

Example: open a websites:



In media transport:



Audio has a higher priority than video, but that is all. In most cases, there are only two streams: audio and video.

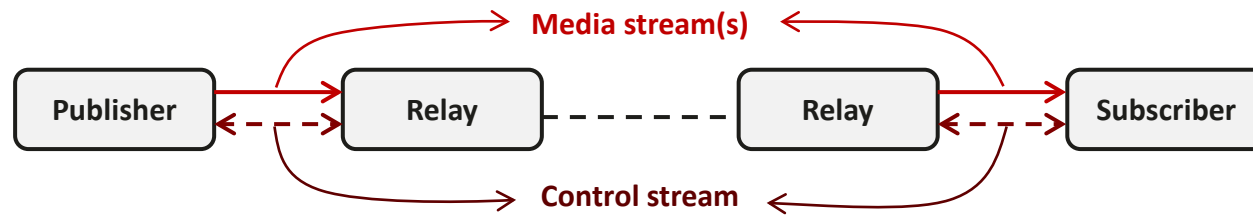
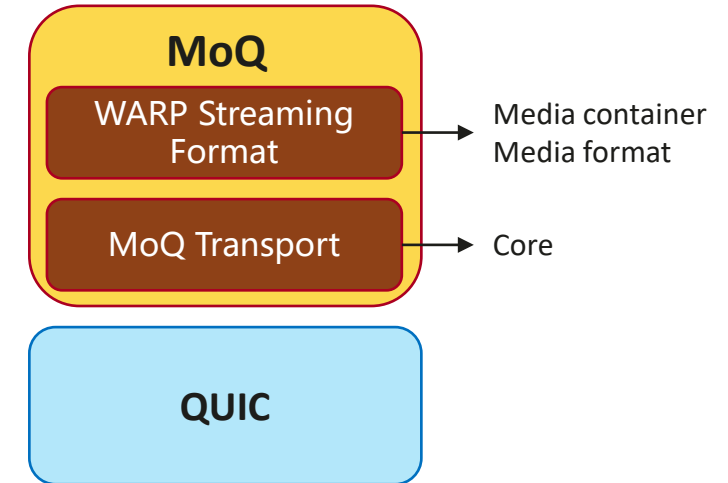
The proportion of bits allocated to audio depends on the resolution and scenario, but it is generally less than 20%.

This means that more than 80% of the data flow belongs to a single stream.

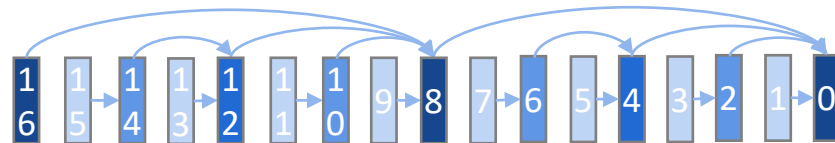
The benefit of QUIC is limited in media transport.

To leverage the benefit of QUIC -- MoQ

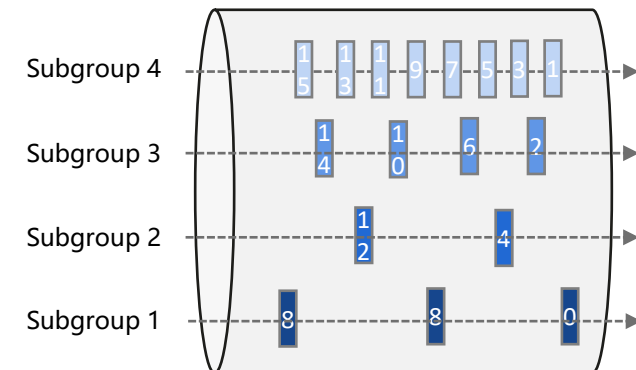
- MoQ, a next-generation media transport protocol backed by many companies in OS, CDN, and OTT.
- MoQ also:
 - > Low latency
 - > is a unified media transport protocol, support VoD, live streaming, RTC, etc.
 - > Use relays to achieve high scalability [3].
- IETF MoQ Group released the first MoQ Transport (MoQT) draft [3] in July 2023, The primary MoQ draft is nearing completion, and an RFC is expected to be published by 2027.



- **MoQ Hierarchical Object Model: Track > Group > Subgroup > Object**
 - > Example with temporal SVC:

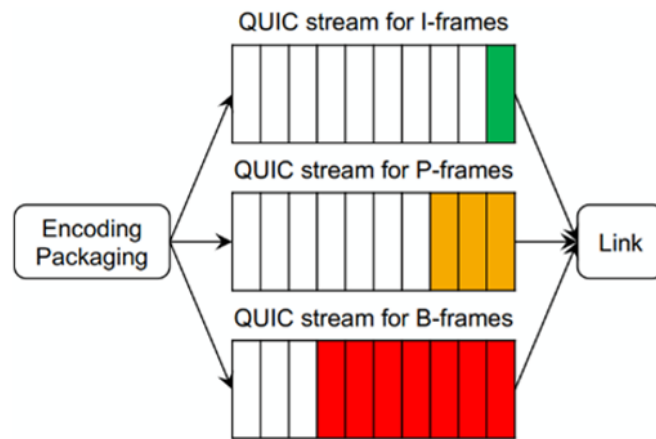


Transport
→

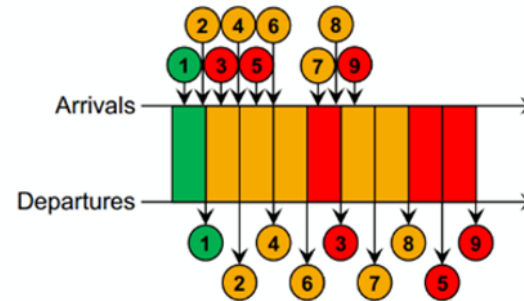


[3] IETF draft-ietf-moq-transport-11: "Media over QUIC Transport (MoQT)", < <https://www.ietf.org/archive/id/draft-ietf-moq-transport-11.html> >.

Feature 1: Flexible priority mechanism



An example illustrating the priority mechanism in MoQ [4].



- Critical media elements and control messages are assigned high priority.
- Objects with higher priority are prioritized while scheduling.
- Low-priority objects might be dropped during congestion.

- What hides behind the priority mechanism is that **high-priority streams should be recoverable without low-priority layers**.
- This is particularly helpful in ULL, as it is infeasible to expect each packet to arrive on time.
- Temporal SVC serves as a good example to illustrate this stream-level priority mechanism.
- However, temporal SVC experiences significant degradation when the lowest-priority layer is lost—for instance, a 50% frame rate drop occurs when 25% of data is dropped [5].

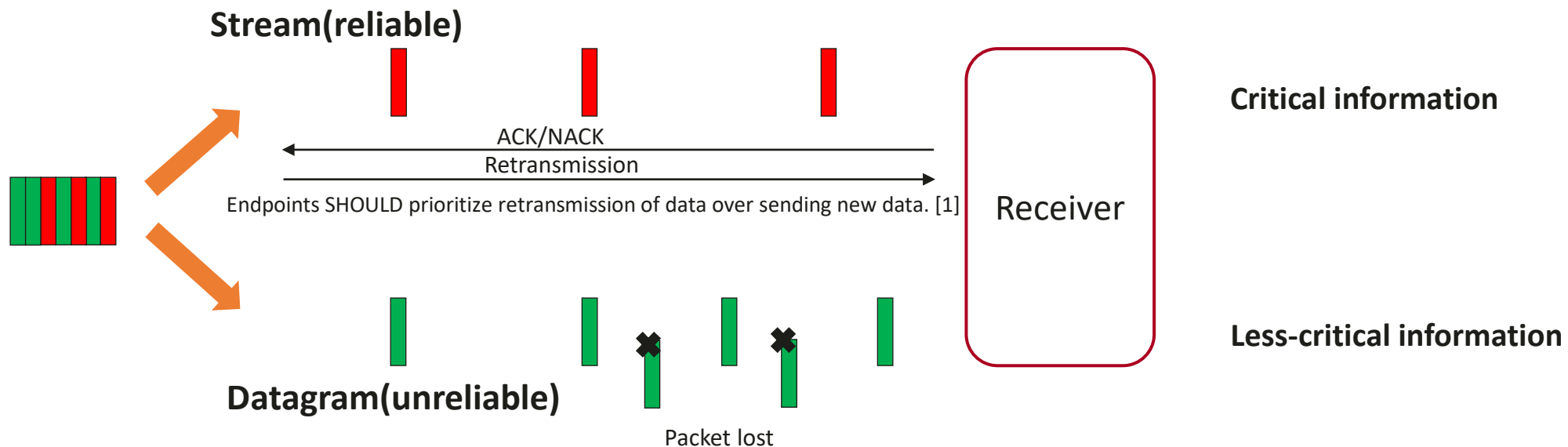
[4] Zafer Gurel, Tugce Erkilic Civelek, and Ali C. Begen. 2024. "This is The Way: Prioritization in Media-over-QUIC Transport," In Proceedings of the 3rd Mile-High Video Conference (MHV '24). Association for Computing Machinery, New York, NY, USA, 113–114.

[5] Texas Instruments, "Overview of Temporal Scalability With Scalable Video Coding(SVC), " SPRABG3-November 2010 <<https://www.tij.co.jp/jp/lit/pdf/sprabg3>>

Feature 2: support both reliable and unreliable transmission

- Inherited this capability from QUIC.
- QUIC has two modes:
 - > Stream—reliable
 - > Datagram—unreliable, an extension designed for support RTC [6].

} Over a single connection



[1] IETF RFC 9000: "QUIC: A UDP-Based Multiplexed and Secure Transport", < <https://www.rfc-editor.org/rfc/rfc9000> >.

[6] IETF RFC 9221: "An Unreliable Datagram Extension to QUIC", < <https://www.rfc-editor.org/rfc/rfc9221> >.

MoQ prefer the video codec to be:

- **Support multiple streams**

- > Video codec should support the hierarchical data model that adapts to the stream-level priority mechanism.

- **Error resilience**

- > The video should remain recoverable when low-priority streams or unreliable datagrams are dropped.

- **The video quality should not degrade significantly when low-priority streams are dropped.**

Conclusion

- MoQ is a next-generation media transport protocol, which is being designed by IETF.
- MoQ has two features that are particularly suitable for ULL:
 - > Flexible priority mechanism
 - > Reliable and unreliable transmissions over one connection.
- Better performance can be achieved for ULL if the next-generation video codec can leverage the features of MoQ.

Thank you.

