TRACK SWITCHING MADE EASY IN MEDIA-OVER-QUIC TRANSPORT

atomic operation for track switching
between alternative tracks in media streaming
MOQ Interim / May 2025 / Stockholm

draft-gurel-moq-track-switching
and IEEE ICME LIVES 2025

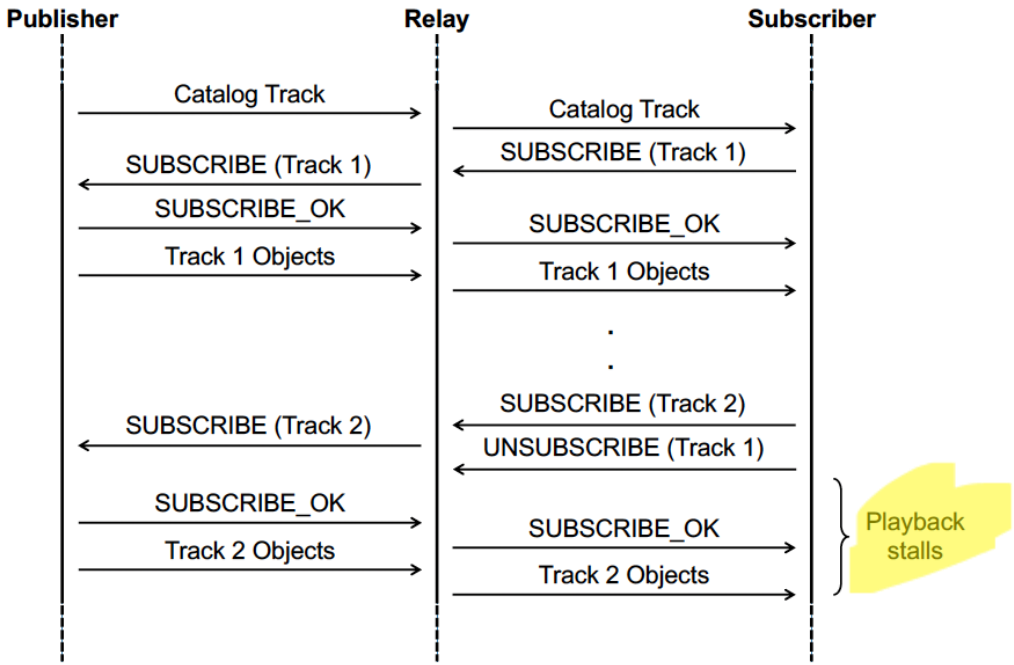

Fig. 2. MOQT: Message flow diagram with immediate UNSUBSCRIBE after SUBSCRIBE when switching from Track 1 to Track 2. The UNSUBSCRIBE and SUBSCRIBE messages are sent in the bi-directional control stream. Hence, the delivery order of the messages is guaranteed.

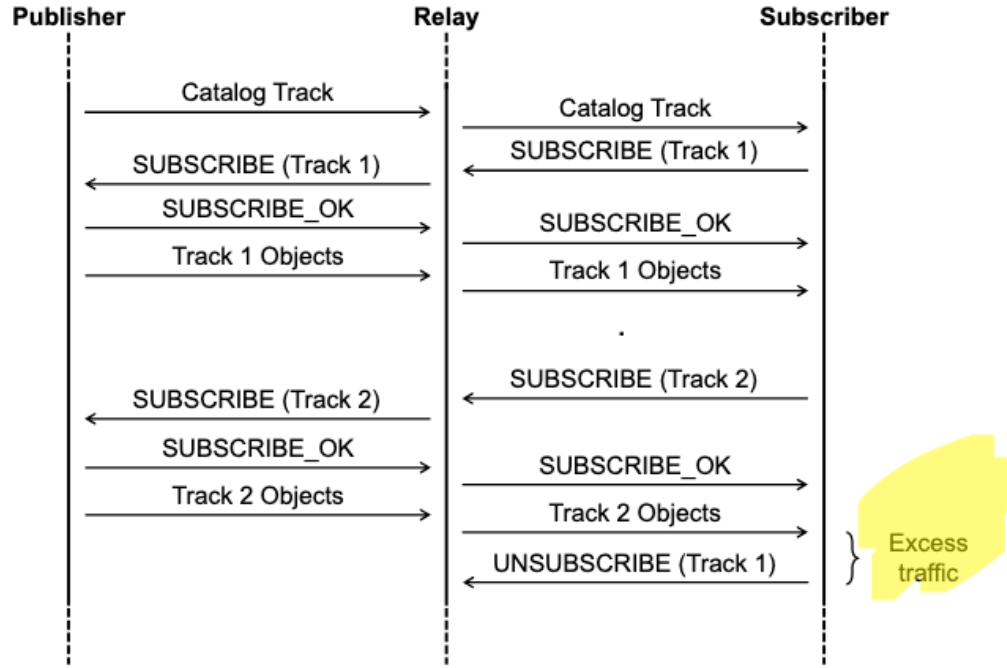

Fig. 3. MOQT: Message flow diagram with a deferred UNSUBSCRIBE message when switching from Track 1 to Track 2.

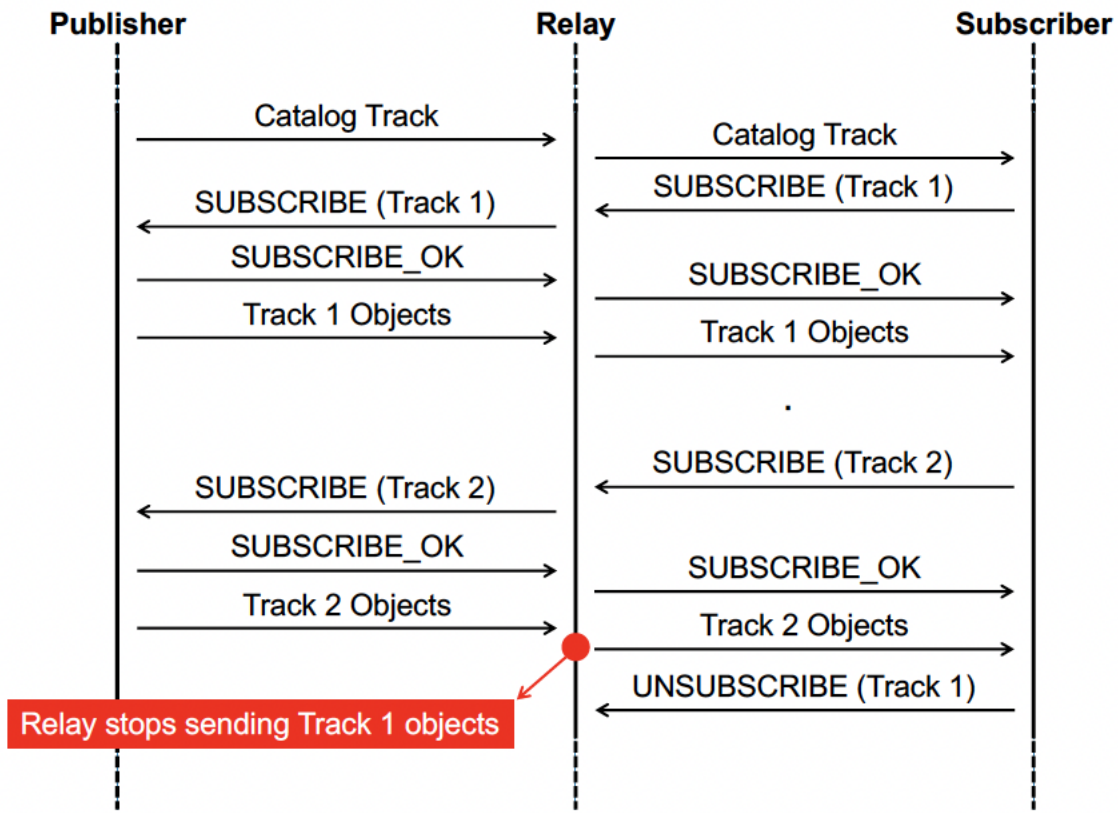

Fig. 4. MOQT: Message flow diagram with guaranteed atomicity.

SwitchTrackId in Subscribe Message

SUBSCRIBE Message {
  Type (i) = 0x3,
  Length (i),
  Request ID (i),
  Track Alias (i),
  Track Namespace (tuple),
  Track Name Length (i),
  Track Name (..),
  SwitchTrackId (i),
  Subscriber Priority (8),
  Group Order (8),
  Forward (8),
  Filter Type (i),
  [Start Location (Location)],
  [End Group (i)],
  Number of Parameters (i),
  Subscribe Parameters (..) ...
}

What We Tested

Hypothesis 1:

As the amount of time increases between the consecutive SUBSCRIBE and UNSUBSCRIBE messages for a track, the amount of overlapping egress traffic of the relay also increases. The STID method helps avoid bitrate spikes by reducing the excess traffic

Hypothesis 2:

The excess traffic transmitted over a congested network results in stalling on the subscriber side. The STID method decreases stall times by reducing the excess traffic generated by the relay

Hypothesis 3:

Network congestion results in an increase in the switching delta times. The STID method decreases the switching delta times in a congested network

Test Conditions

- The forwarding preference is Subgroup
- A group of pictures (GoP) structure, which consists of video frames, is mapped to a MOQT subgroup. Individual video frames are mapped to MOQT objects
- Each MOQT group has only one subgroup
- Boundaries of subgroups with the same group ID and subgroup ID are temporally aligned across the switching tracks

The Effect of Induced Delay

AETR: Average Excess Traffic Ratio

The mean value of the ratios of the total excess traffic to the total egress traffic
(total number of bytes sent by the relay)

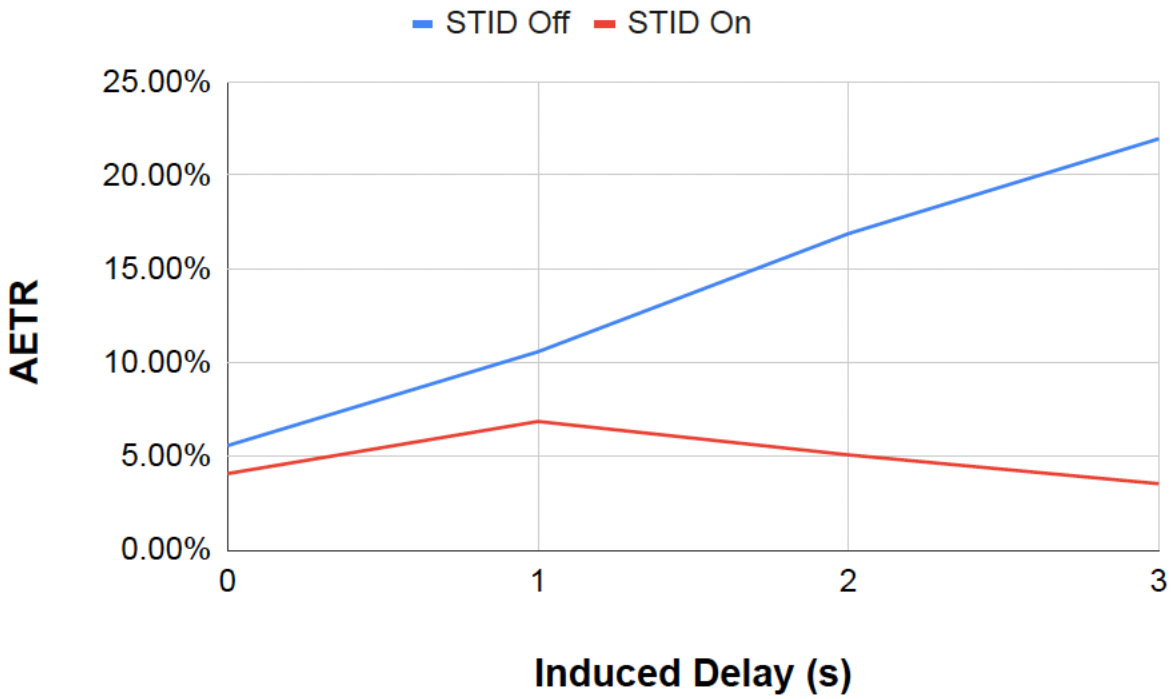

Fig. 5. Subscriber induced delay.

Test Flow

Time (s)	Event	Light Congestion	Heavy Congestion
0	Subscribe to Track 1		
15	**Set bandwidth** →	1.5 Mbps	1.1 Mbps
25	**Switch** → Track 2		
30	**Set bandwidth** →	3.1 Mbps	2 Mbps
35	**Switch** → Track 3		
40	**Set bandwidth** →	5 Mbps	3 Mbps
45	**Switch** → Track 4		
55	End		

Table 4. The test flow.

Stall Times – Light Congestion

	Mean (ms)	Std Dev (ms)	Median (ms)	90^{th} (ms)	95^{th} (ms)	99^{th} (ms)
STID Off	4776	586	4895	5351	5451	5721
STID On	4706	588	4835	5357	5461	5638
Reduction	1.5%	-0.4%	1.2%	-0.1%	-0.2%	1.5%

Table 5. Stall time statistics (light congestion).

	Mean (ms)	Std Dev (ms)	Median (ms)	90^{th} (ms)	95^{th} (ms)	99^{th} (ms)
STID Off	945	340	968	1295	1491	1861
STID On	915	333	969	1271	1389	1776
Reduction	3.1%	1.9%	-0.1%	1.9%	6.8%	4.6%

Table 6. Switching delta time statistics (light congestion).

Stall Times – Heavy Congestion

	Mean (ms)	Std Dev (ms)	Median (ms)	90^{th} (ms)	95^{th} (ms)	99^{th} (ms)
STID Off	17241	3493	16541	17641	30986	31705
STID On	16412	856	16432	17413	17753	18711
Reduction	4.8%	75.5%	0.7%	1.3%	42.7%	41%

Table 7. Stall time statistics (heavy congestion).

	Mean (ms)	Std Dev (ms)	Median (ms)	90^{th} (ms)	95^{th} (ms)	99^{th} (ms)
STID Off	1856	3640	1044	1107	16743	17079
STID On	1192	1110	1034	1095	4915	5783
Reduction	35.8%	69.5%	1.0%	1.1%	70.6%	66.1%

Table 8. Switching delta time statistics (heavy congestion).

Stall-Time Percentiles

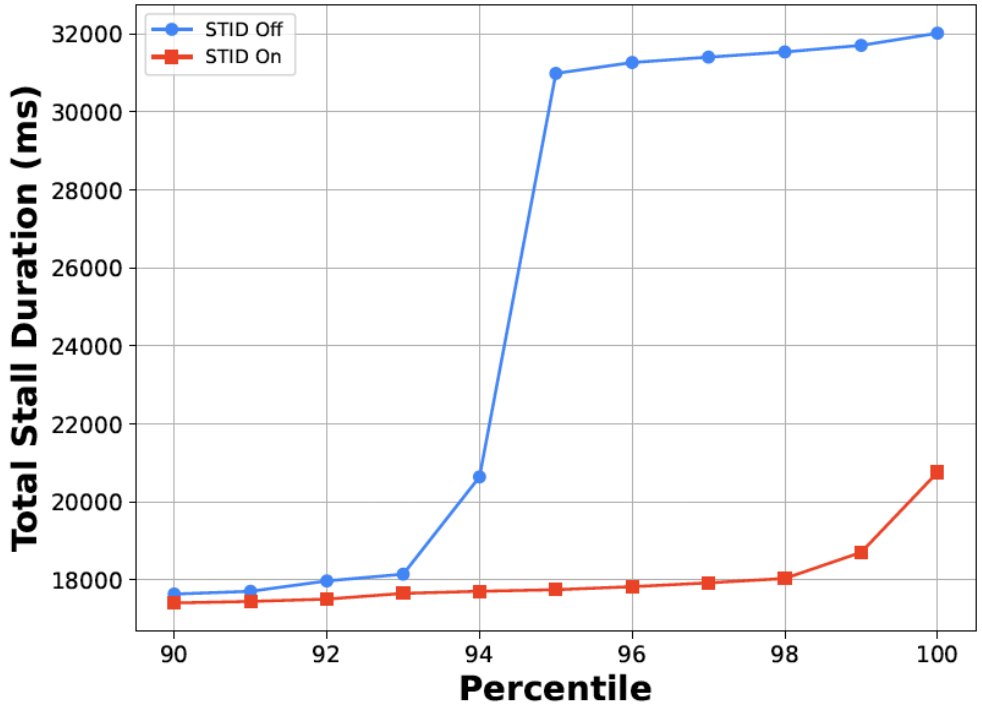

Fig. 6. Stall time percentiles (heavy congestion).