

# SCONEPRO MASQUE POC

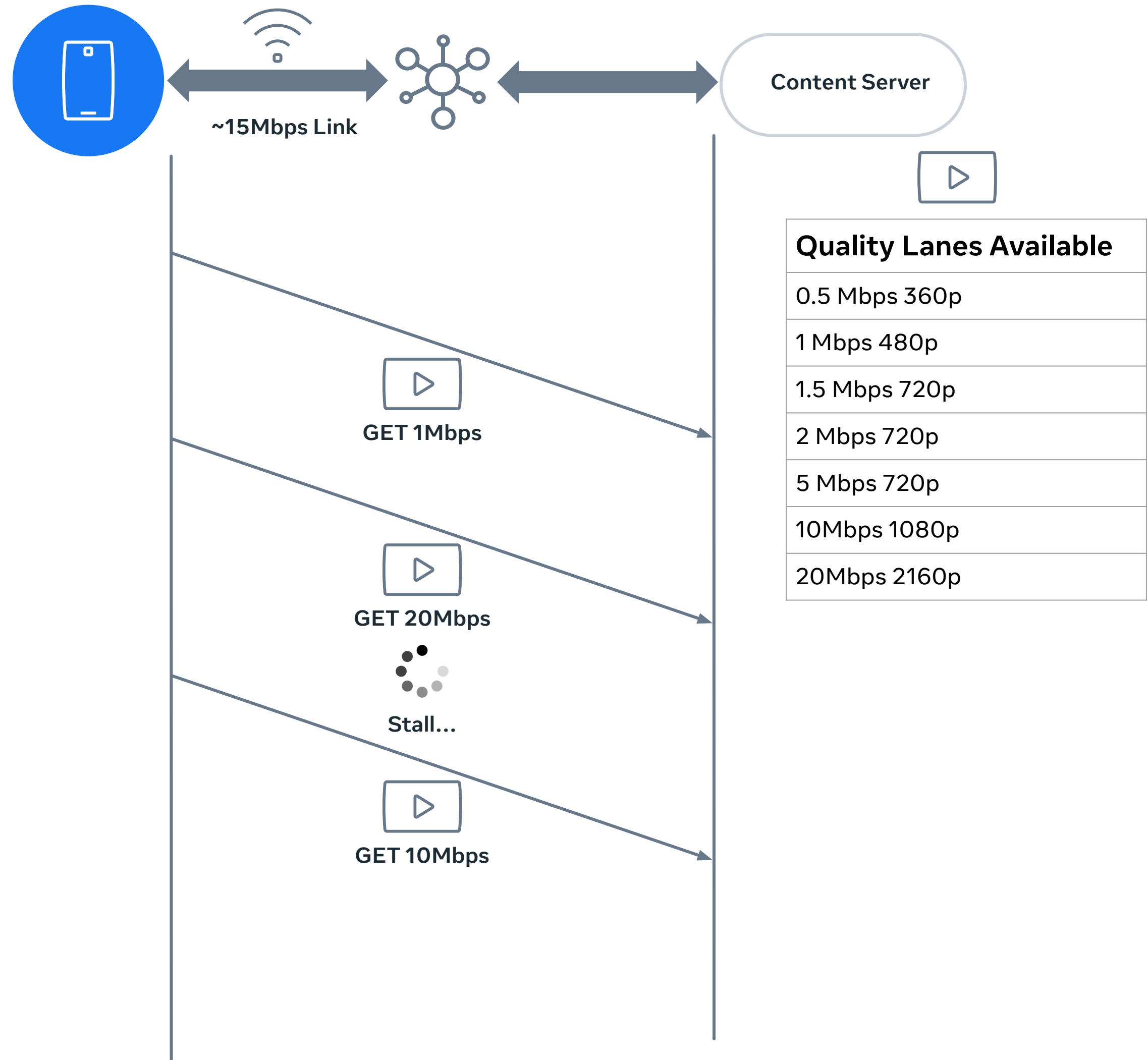
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Software Engineer, Meta



# Adaptive Bitrate Video w/o Shaping

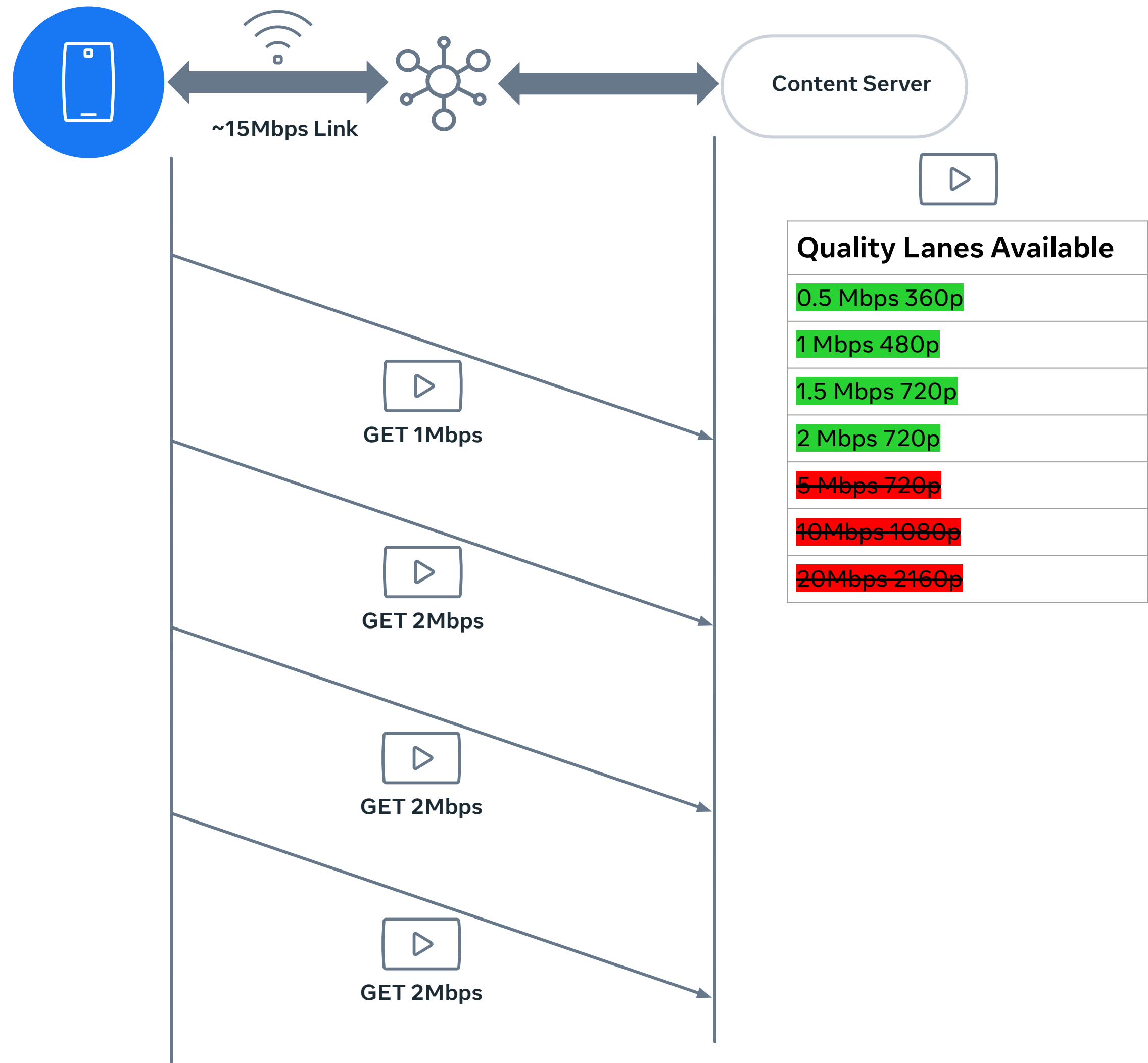
Modern ABR schemes can vary video quality requested per segment (e.g. HLS or DASH).

Adapts quality fetched to try to maximize bitrate without stalling based on measured bandwidth.



# Adaptive Bitrate Video w/ Agreed Bitrate Cap

Video content provider and the operator agree to an instantaneous maximum quality.



# MASQUE + CONNECT UDP

- Easy to experiment with.
- Has many similar properties to what we'd like from a standardized SCONEPRO.
- **Not necessarily ideal solution**, but has many of the same implementation and deployment considerations.



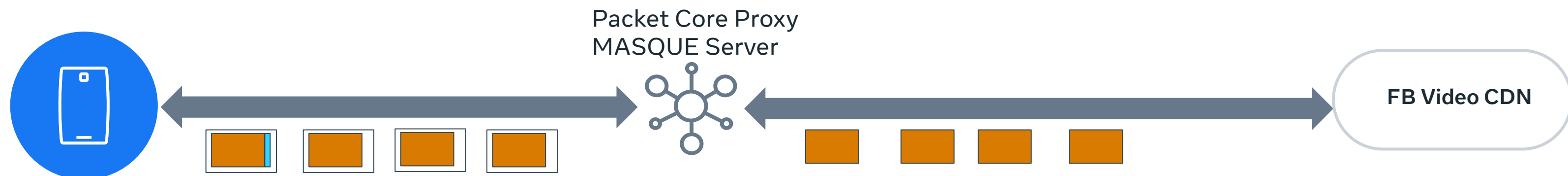
## Use MASQUE + Proxying, and a HTTP Capsule for Media Bitrate

- FB App connects to MASQUE Proxy Server in Packet Core
- Proxy server proxies **end-to-end encrypted QUIC Packets**.
- Proxy server sends a “media capsule” with the desired bitrate.
- FB App **limits the available video quality** based on this bitrate, and **instructs the CDN to have a maximum send rate**.
- Details in [draft-ihlar-masque-scone-pro-mediabitrate](#).
- Re-encryption not required with QUIC-aware variant.

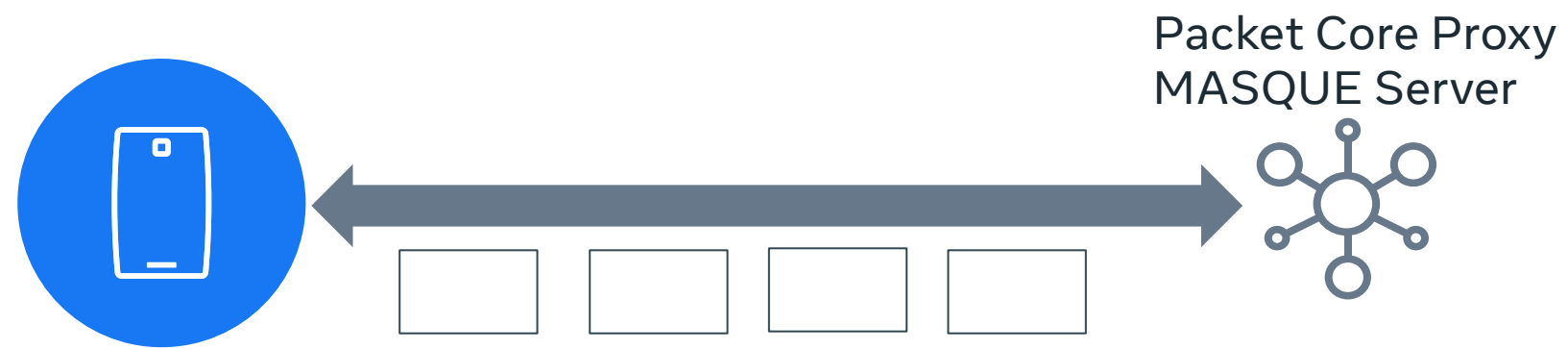
Outer MASQUE Packet



Blue: SCONEPRO signal  
Orange: E2E QUIC Packet

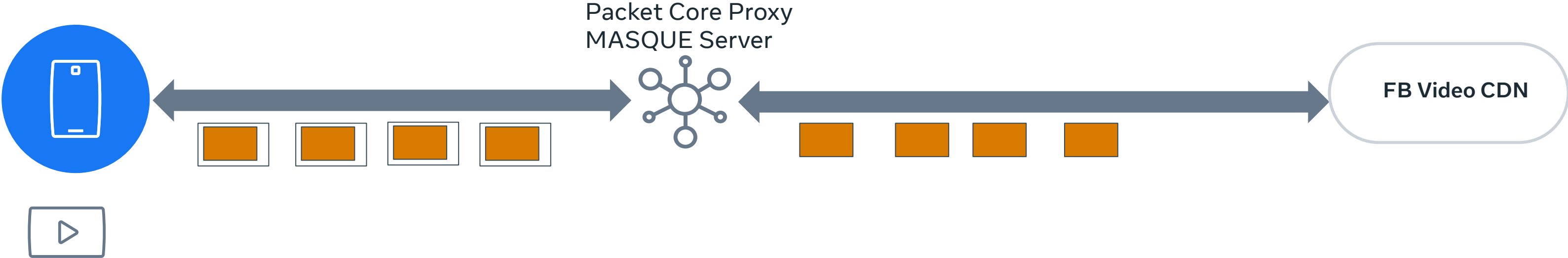


## Client establishes MASQUE Proxy Connection



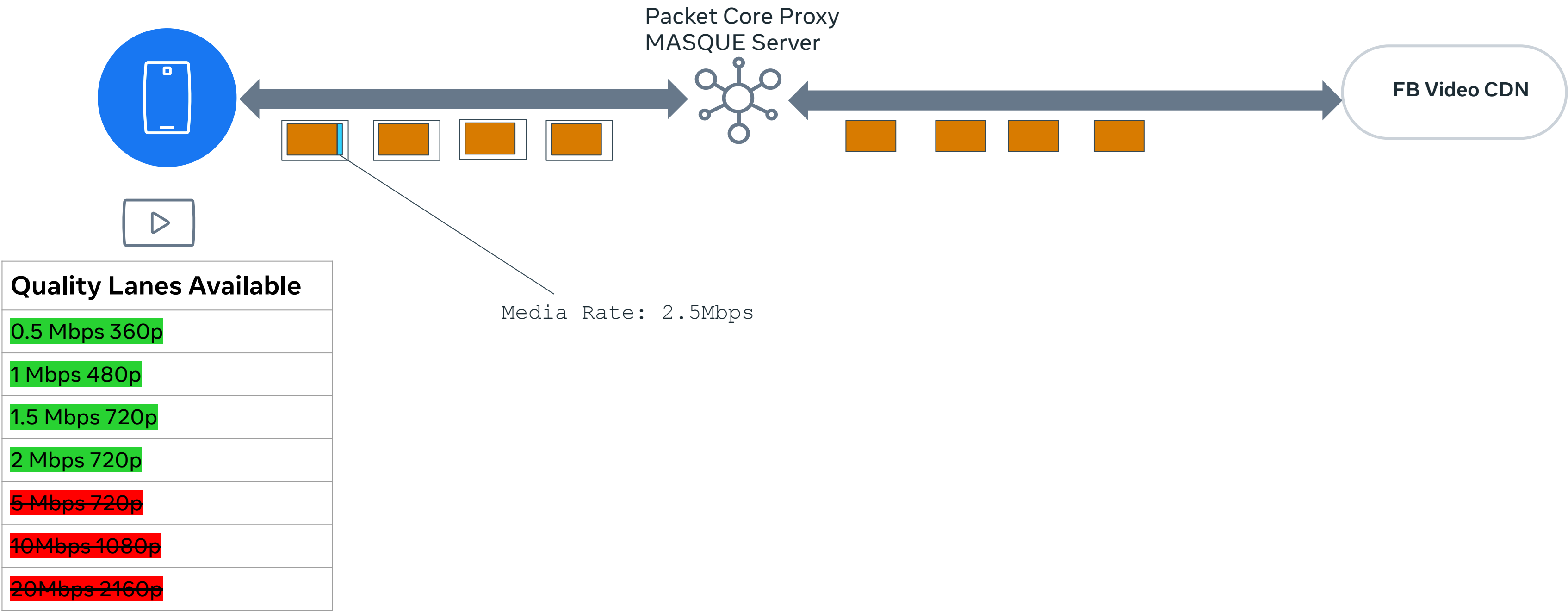


# E2E QUIC connection to CDN established



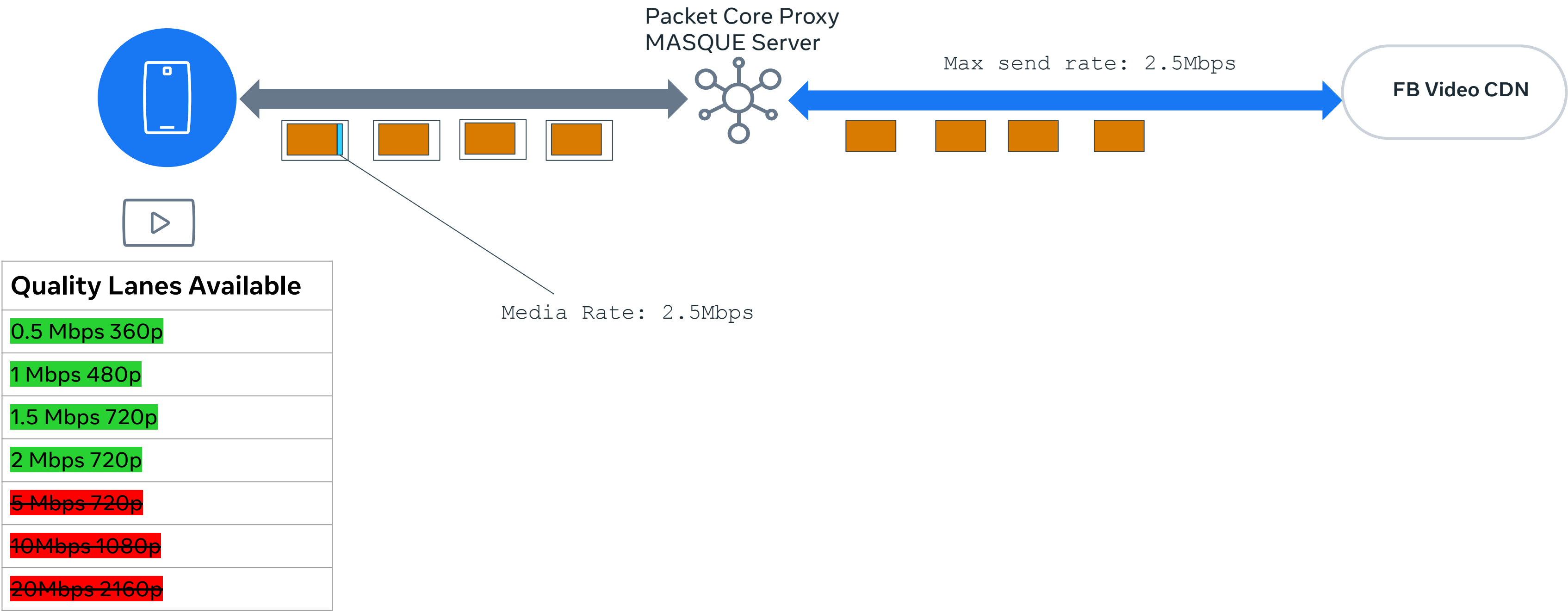
Quality Lanes Available
0.5 Mbps 360p
1 Mbps 480p
1.5 Mbps 720p
2 Mbps 720p
5 Mbps 720p
10Mbps 1080p
20Mbps 2160p

# Client receives SCONEPRO capsule, player limits quality

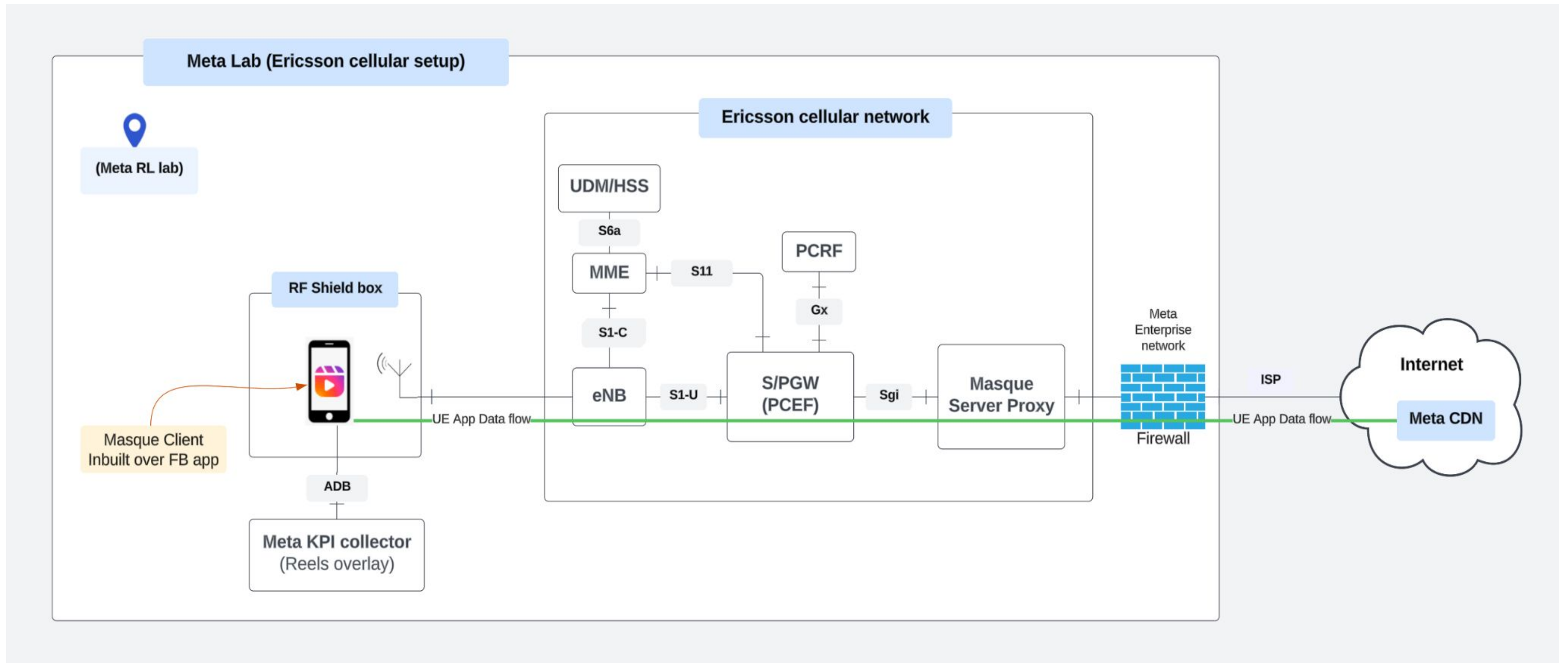




# Client (optionally) Instructs CDN with a max send rate (pacing)



# Trial lab setup



# Results

- Repeated testing using a fixed video playlist in the FB app.
- Comparison between shaping at a fixed bitrate, and with self-limitation and pacing from the explicit signal.
- Application responds in two ways: **capping quality** and instructing **CDN server transport to have a max send rate**.
- TL;DR – we are able to **achieve better video experience with similar network tonnage**



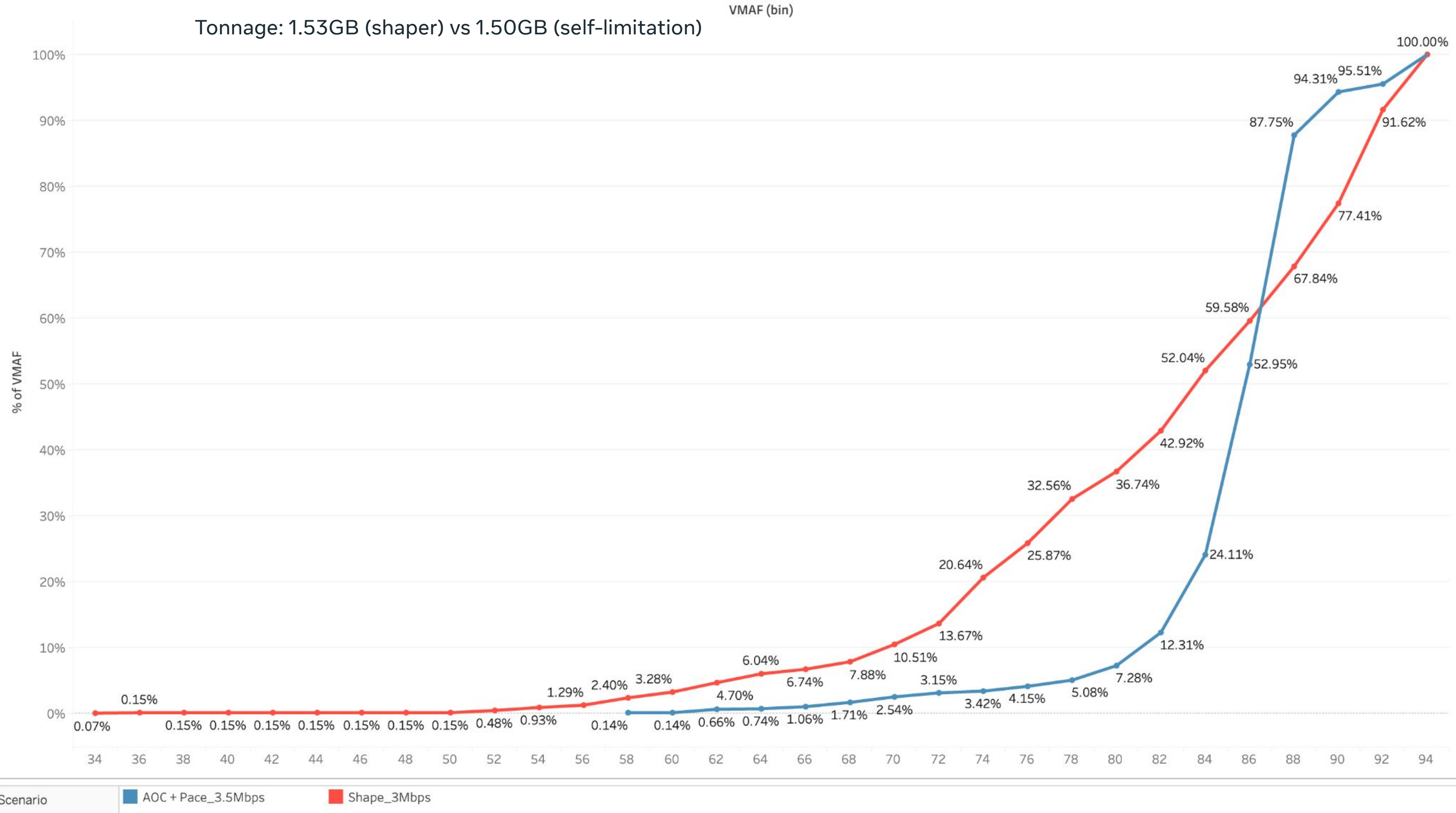
# Video Quality

- [Video Multimethod Assessment Fusion \(VMAF\)](#) – metric of video quality against reference
- Higher peak quality less important than **consistency**
- **Lower qualities much more damaging to user experience** than peak qualities are to improving user experience
- “Outlier” experience extremely important: **5% of 3 billion is 150 million people**

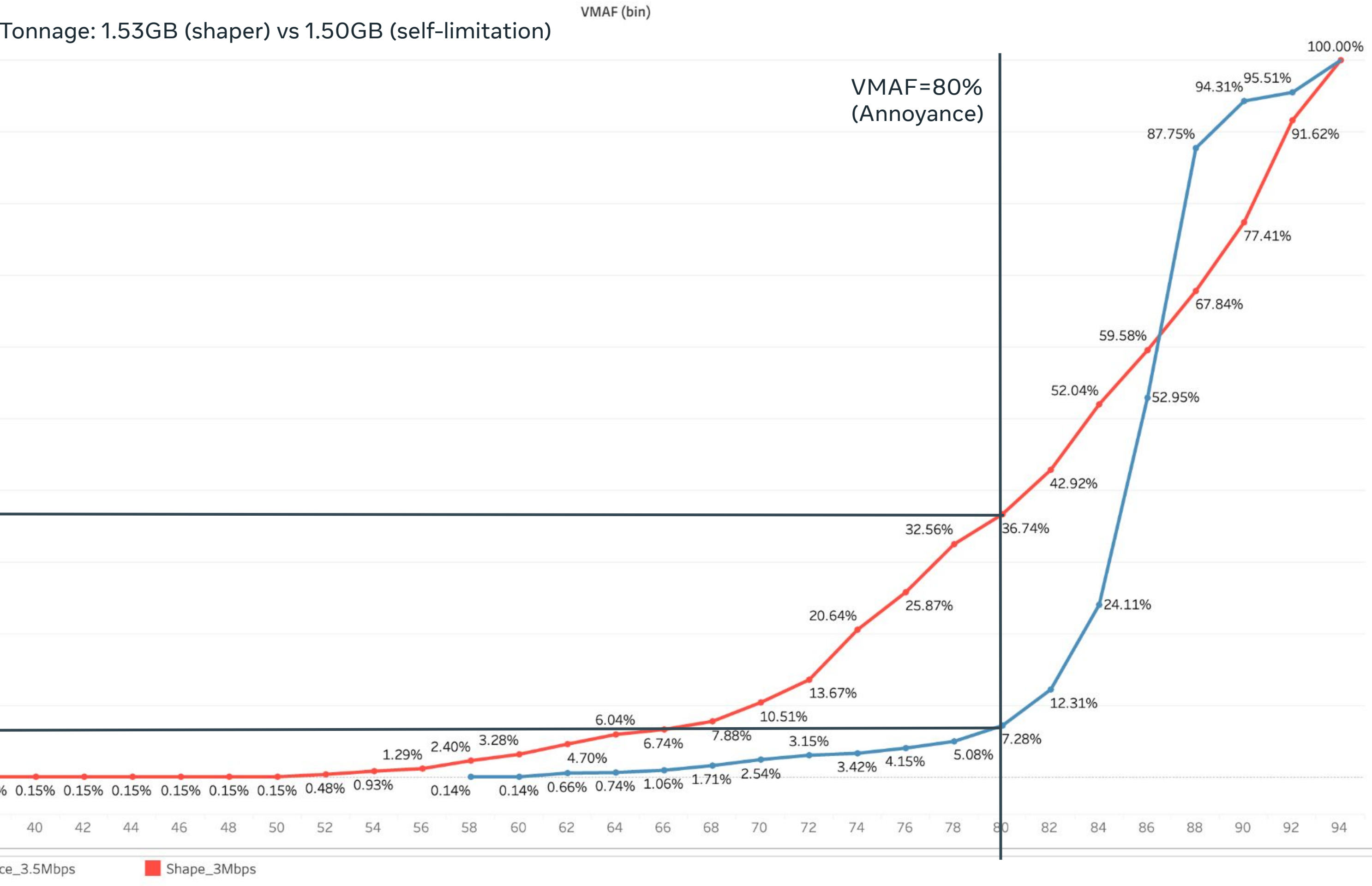


# CDF of VMAF | Self-Limitation + Pacing vs Network Shaper

Tonnage: 1.53GB (shaper) vs 1.50GB (self-limitation)



# CDF of VMAF | Self-Limitation + Pacing vs Network Shaper



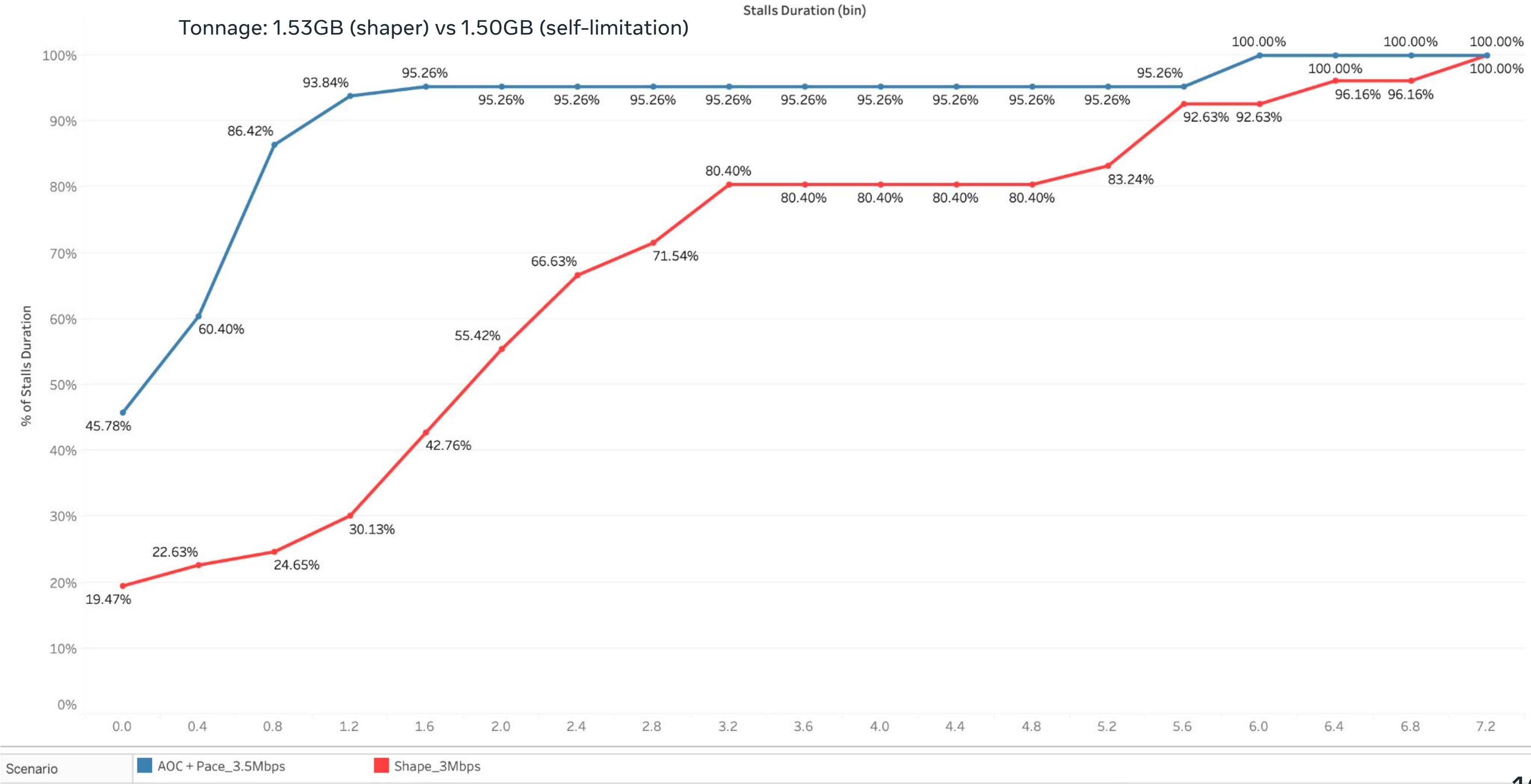
# What does it mean?

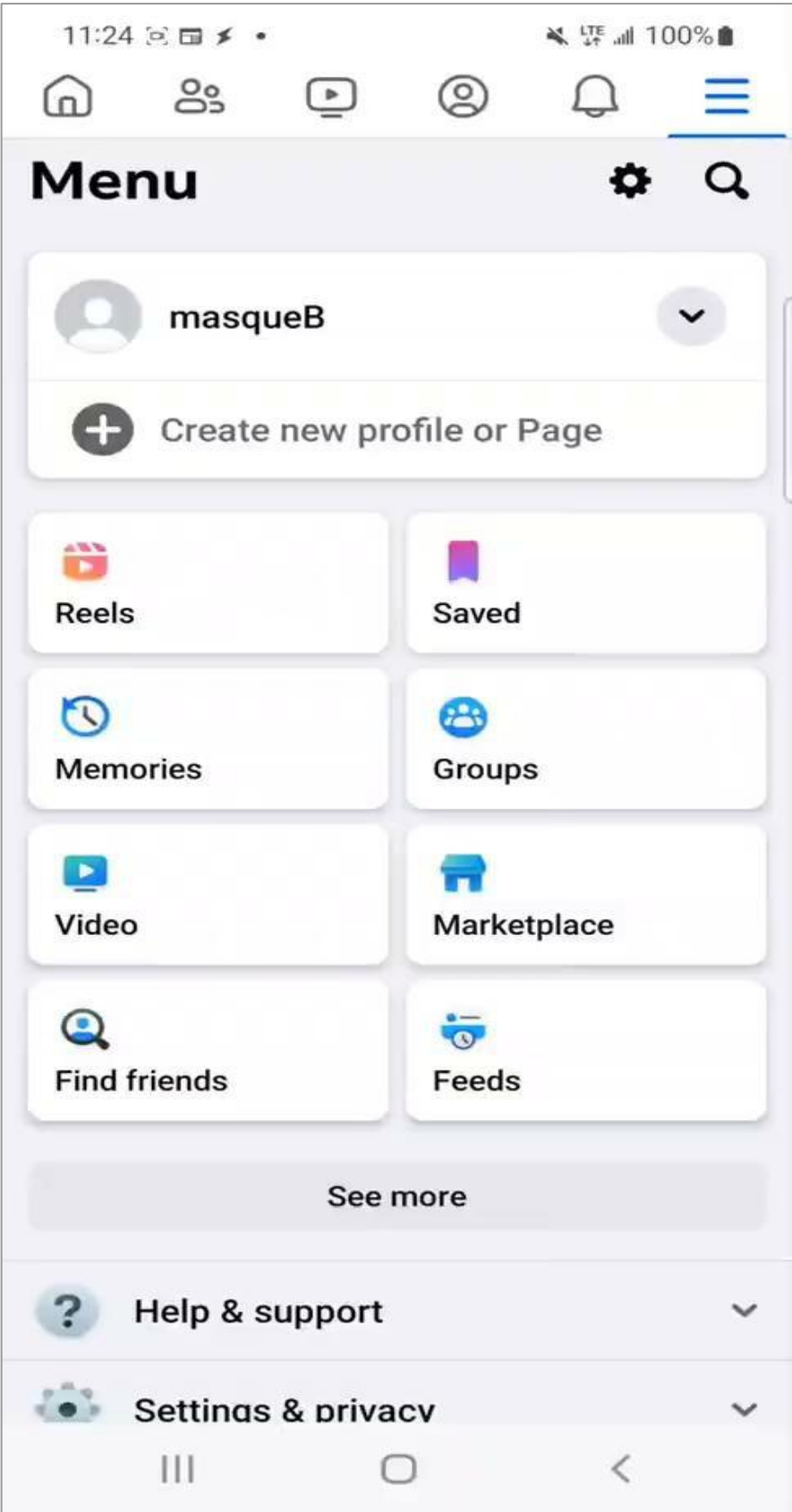
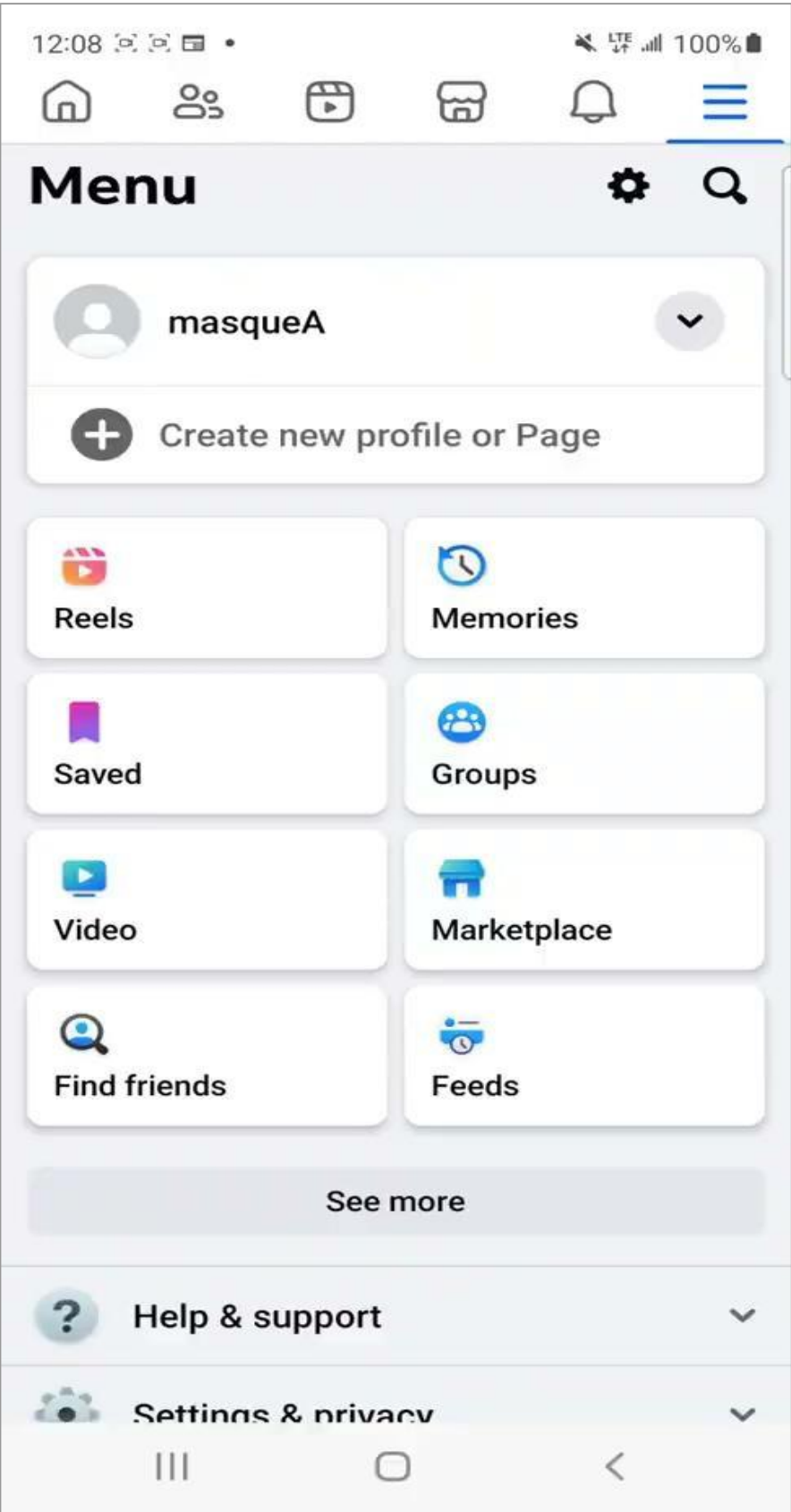
- [“Annoyance” threshold for VMAF ~80.](#)
- With self-limitation: **93% above annoyance threshold**
- With shaping: only **63% above annoyance threshold**.
- “Acceptability” threshold ~58.
- With self-adaptation: **0% below acceptability threshold**.
- With shaping: **2.4% below acceptability threshold**.
- **2.4% is still a lot!**
- The distribution with self-limitation much “tighter”.
- Leaving some “peak quality” on the table not important.





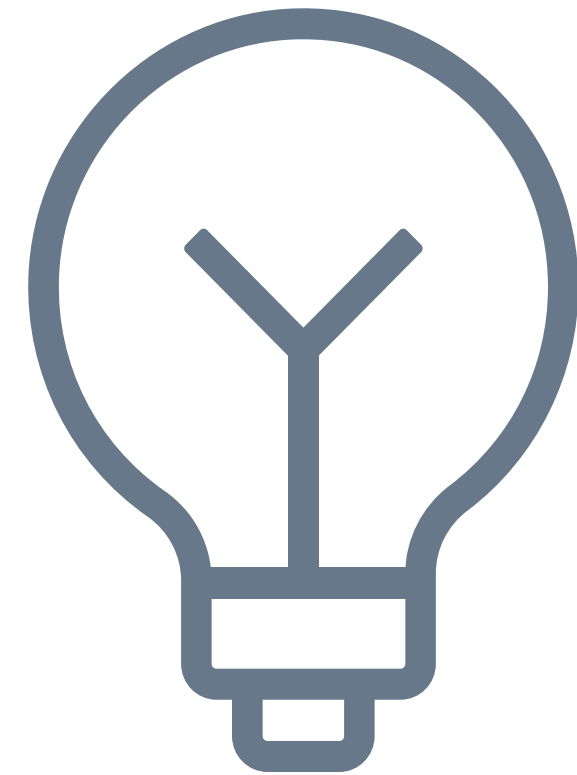
# CDFs of Stall duration | Self-Limitation + Pacing vs Network Shaper





# Takeaways

- This style of integration with a **real application and real HTTP/3 video playback is possible today with relatively little complexity.**
- It is feasible to implement this in a real cellular packet core and similar network deployments.
- There are **tangible benefits to end-user experience** from using this approach of protocol-assisted self-optimization.
- **Application-level** adaptation or **transport-level** adaptation or utilizing both (as our test did) are feasible.
- Lab results reflect real world experience with self-limitation.

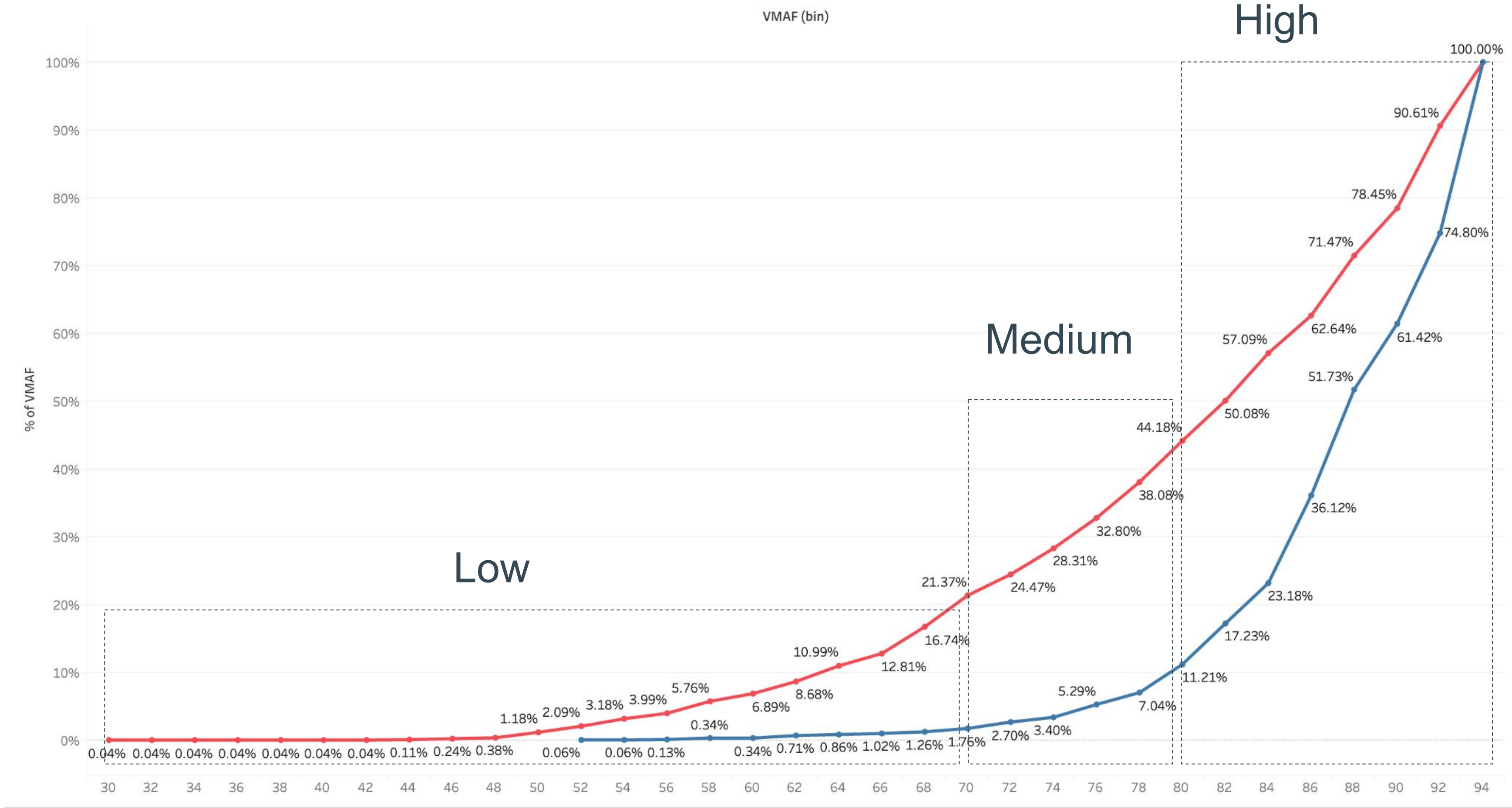


# Backup slides / raw data

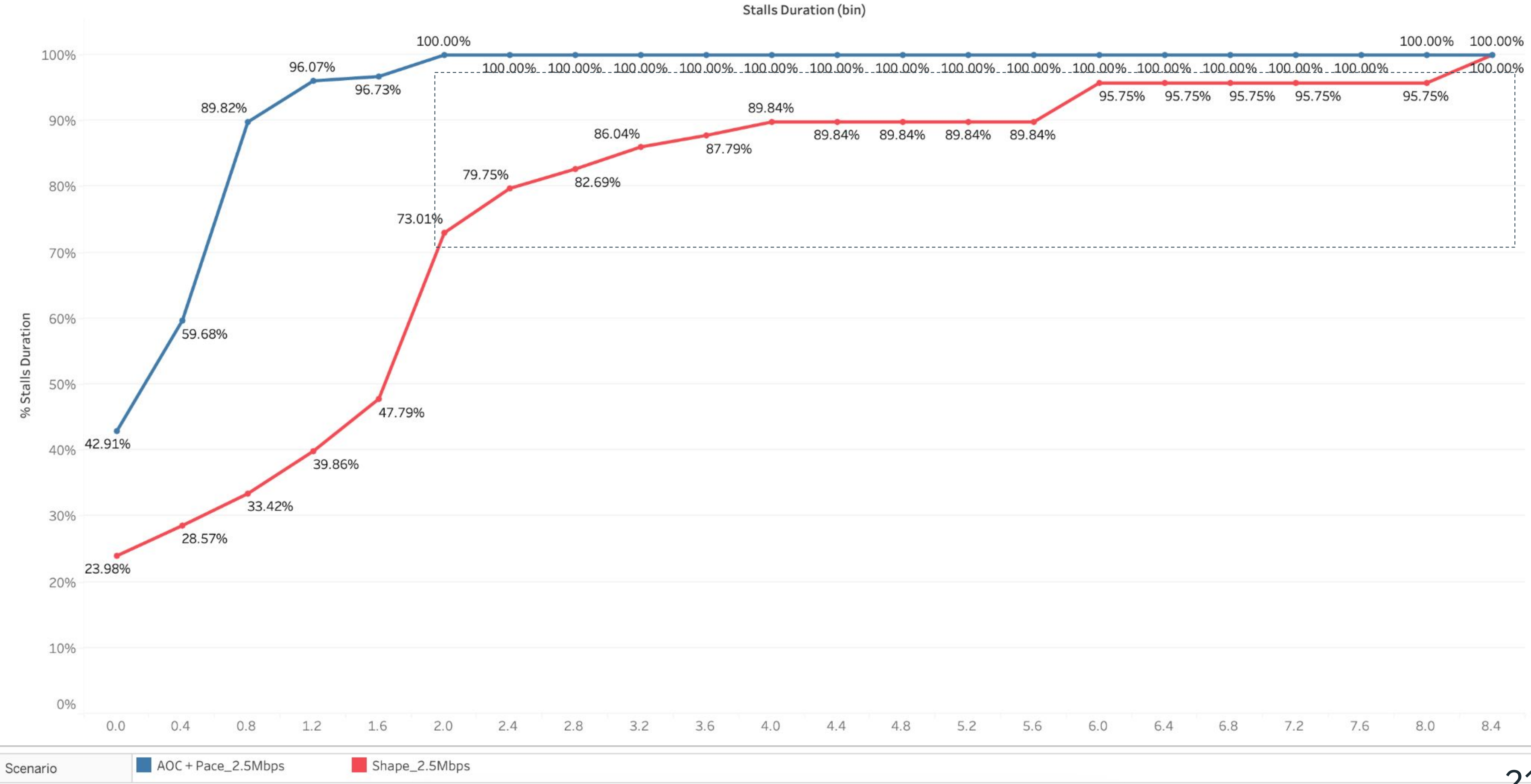
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CDFs of 'CSVQM' | Test set-1 | AOC+Pace @2.5Mbps vs Network throttle\_Shaper @2.5Mbps

VMAF = CSVQM



CDFs of 'Stall Duration' | Test set-1 | AOC+Pace @2.5Mbps vs Network throttle\_Shaper @2.5Mbps





# Test cases and execution

Test ID	Test Scenario	Configured Traffic Management Policy	Notes
TC0	No Throttling (In E2E data path)	<ul style="list-style-type: none"> <li>• <b>No Shaper/Policer</b></li> <li>• No AOC</li> <li>• No Pacing</li> </ul>	Ref only
TC1	AOC only (Meta CDN)	<ul style="list-style-type: none"> <li>• No Shaper/Policer</li> <li>• <b>AOC @1.6Mbps</b></li> </ul>	Ref only
TC2	AOC + Pacing (Meta CDN)	<ul style="list-style-type: none"> <li>• No Shaper/Policer</li> <li>• <b>AOC @1.6Mbps + Pacing @ 5Mbps (Initial starting value)</b></li> </ul>	This test is iterative (TC2.x) Each test varies pacing rate to match tonnage of Shaper (TC3)
TC3	Shaper ON (Ericsson Core)	<ul style="list-style-type: none"> <li>• <b>Rate: 2.560Mbps (Start value)</b></li> <li>• <b>Burst size: 50KB</b></li> <li>• <b>Burst Interval: 50ms</b></li> </ul>	This test is iterative (TC3.x) Each test varies shaper rate & <del>burst</del> to match tonnage of AOC + Pacing (TC2)
TC4	MASQUE ON (Ericsson Core)	<ul style="list-style-type: none"> <li>• Shaper OFF (MASQUE proxy server + PCEF will control this on the fly based on Reels flow detection)</li> <li>• Config Steering through Masque Client in FB App.</li> <li>• <b>AOC @1.6Mbps + Pacing @ X (X = result of TC2/TC3)</b></li> </ul>	Customized FB app with MASQUE client used



Tonnage & QOE summary

Qualified sets	TC id	Scenario (Param Values)	Tonnage EC Table (Video chunks only)	Tonnage CDN AL Table (Unfiltered)	CSVQM (Avg)	Stall duration_sec (Max / Avg)
	TC0	No Throttle	1362 MB	1373 MB	95.4	0.488 / 0.0461
	TC1	AOC (1.6Mbps) only	1008 MB	1024 MB	91.9	0.0454 / 0.0454
	TC2.0	AOC (1.6Mbps) + Pace (5Mbps)	616 MB	658 MB	87.7	0.860 / 0.0609
Set-2	TC2.2	AOC (1.6Mbps) + Pace (3.5Mbps)	486 MB	525 MB	84.4	1.36 / 0.0704
	TC2.4	AOC (1.6Mbps) + Pace (3Mbps)	335 Mb	380 MB	83.7	0.920 / 0.0856
Set-1	TC2.1	AOC (1.6Mbps) + Pace (2.5Mbps)	411 MB	457 MB	82.5	1.07 / 0.0757
	TC2.3	AOC (1.6Mbps) + Pace (2Mbps)	261 MB	390 MB	80.8	1.28 / 0.0771
Set-1	TC3	Shaper_1 - Base (~@2.5Mbps + 50KB burst size + 50MS burst Interval)	307 MB	421 MB	82.6	3.10 / 0.119
	TC3.1	Shaper_2 - Tuning (~@3Mbps + 100KB burst size + 50MS burst Interval)	339 MB	518 MB	81.7	6.52 / 0.141
Set-2	TC3.2	Shaper_3 - Tuning (~@3Mbps + 50KB burst size + 50MS burst Interval)	445 MB	494 MB	81.8	7.36 / 0.108
	TC3.3	Shaper_3 - Tuning (~@3.5Mbps + 50KB burst size + 50MS burst Interval)	528 MB	598 MB	83.7	6.25 / 0.120

# Tonnage match check (Pace vs Shaper)

	Retrival param = lpx	2001:438:fffd:300:	Reels fixed playlist	
Scenario	Source: <b>EC</b> Bytes_Volume (Video chunks only)	Source: <b>CDN AL</b> (Un filtered)	Test runs	Date
No Throttle	1362 MB	1373 MB	10	2/22/2024
AOC (1.6Mbps) only	1008 MB	1024 MB	10	2/22/2024
AOC (1.6Mbps) + Pace (2Mbps)	261 MB	390 MB	10	2/28/2024
AOC (1.6Mbps) + Pace (2.5Mbps)	411 MB	457 MB	10	2/27/2024
	320 MB	354MB	10	3/2/2024
	303 MB	346 MB	10	3/2/2024
AOC (1.6Mbps) + Pace (3Mbps)	335 MB	380 MB	10	3/1/2024
	317 MB	368 MB	10	3/1/2024
AOC (1.6Mbps) + Pace (3.5Mbps)	486 MB	525 MB	10	2/27/2024
	374 MB	404 MB	10	3/2/2024
	330 MB	370 MB	10	3/2/2024
AOC (1.6Mbps) + Pace (5Mbps)	616 MB	658 MB	10	2/22/2024
Shaper_base (~@2.5Mbps + 50KB burst size)	307 MB	421 MB	10	2/21/2024
	255 MB	306 MB	10	3/1/2024
	253 MB	324 MB	10	3/1/2024
Shaper_base (~@3Mbps + 100KB burst size)	339 MB	518 MB	10	2/28/2024
Shaper_base (~@3Mbps + 50KB burst size)	445 MB	494 MB	10	2/29/2024
Shaper_base (~@3.5Mbps + 50KB burst size)	492 MB	553 MB	10	2/29/2024
	528 MB	598 MB	10	2/29/2024

### Time to Execute

- Each data point take time, e.g,
- Ericsson configuration change take abt 1-2 hours
- EC & CDN data availability is 24 hours after running the test

### Observations from Execution and Results:

- There is a difference in tonnage
- Each test run executed produced a unique tonnage value
- Tonnage has changed over time (for the same test run), meaning that we have seen a decrease of tonnage between Feb 27 and March ½ for the same test runs

### Best Match Recommendation:

- AOC1.6+Pace2.5 and Shaper 2.5 + Burst size 50KB
- F



# Tonnage match check (Pace vs Shaper)

	Retrival param = lpfx	2001:438:fffd:300:		Reels fixed playlist		
Scenario	Source: <b>EC</b> Bytes_Volume (Video chunks only)	Source: <b>CDN AL</b> (Un filtered)	Test runs	Date	Start time	End time
No Throttle	1362 MB	1373 MB	10	2/22/2024	10:52	11:55
AOC (1.6Mbps) only	1008 MB	1024 MB	10	2/22/2024	13:04	14:07
AOC (1.6Mbps) + Pace (2Mbps)	261 MB	390 MB	10	2/28/2024	11:09	12:12
AOC (1.6Mbps) + Pace (2.5Mbps)	411 MB	457 MB	10	2/27/2024	12:54	13:58
	320 MB	354MB	10	3/2/2024	10:26	11:29
	303 MB	346 MB	10	3/2/2024	11:33	12:36
AOC (1.6Mbps) + Pace (3Mbps)	335 MB	380 MB	10	3/1/2024	15:42	16:46
	317 MB	368 MB	10	3/1/2024	18:46	19:51
AOC (1.6Mbps) + Pace (3.5Mbps)	486 MB	525 MB	10	2/27/2024	14:36	15:39
	374 MB	404 MB	10	3/2/2024	17:15	18:19
	330 MB	370 MB	10	3/2/2024	18:23	19:27
AOC (1.6Mbps) + Pace (5Mbps)	616 MB	658 MB	10	2/22/2024	15:23	16:27
Shaper_base (~@2.5Mbps + 50KB burst size)	307 MB	421 MB	10	2/21/2024	15:32	16:36
	255 MB	306 MB	10	3/1/2024	10:51	11:54
	253 MB	324 MB	10	3/1/2024	12:20	13:25
Shaper_base (~@3Mbps + 100KB burst size)	339 MB	518 MB	10	2/28/2024	16:59	17:03
Shaper_base (~@3Mbps + 50KB burst size)	445 MB	494 MB	10	2/29/2024	10:55	11:59
Shaper_base (~@3.5Mbps + 50KB burst size)	492 MB	553 MB	10	2/29/2024	16:15	17:19
	528 MB	598 MB	10	2/29/2024	18:07	19:10

## Time to Execute

- Each data point take time, e.g,
- Ericsson configuration change take 2 hours



# Video QOE

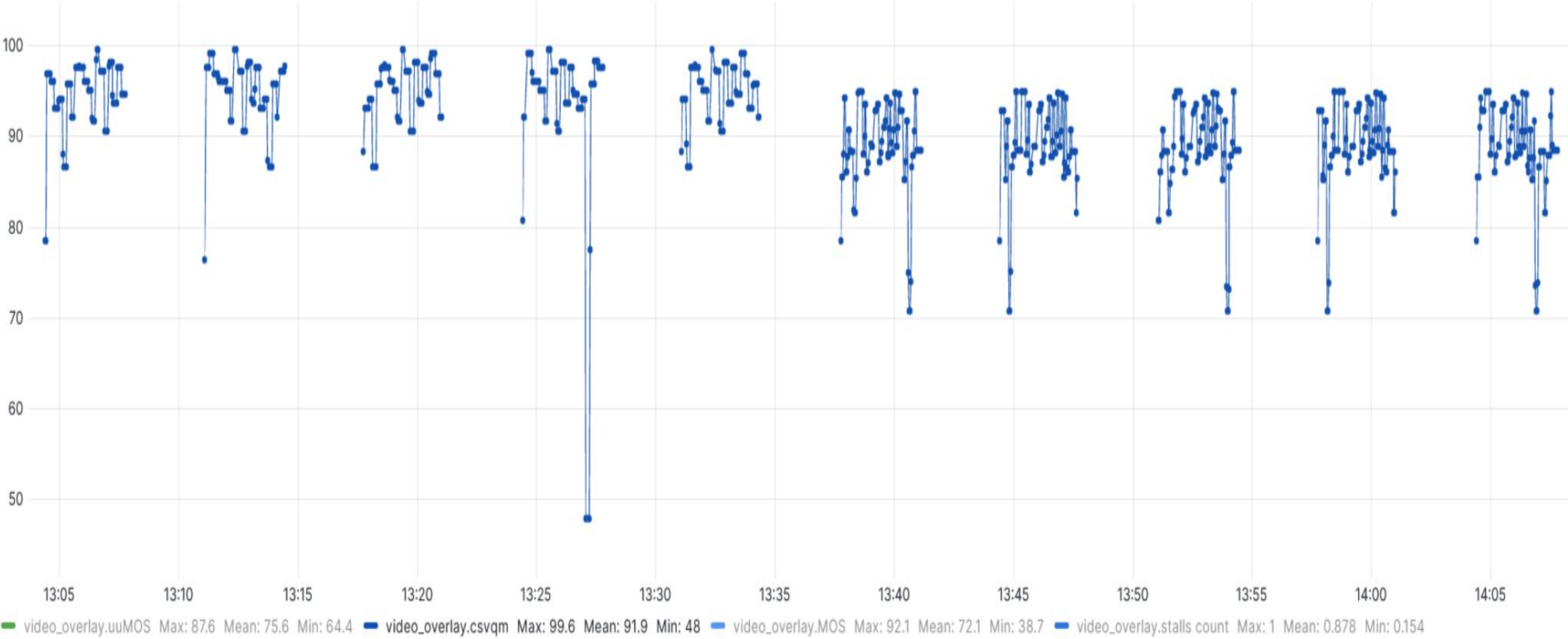
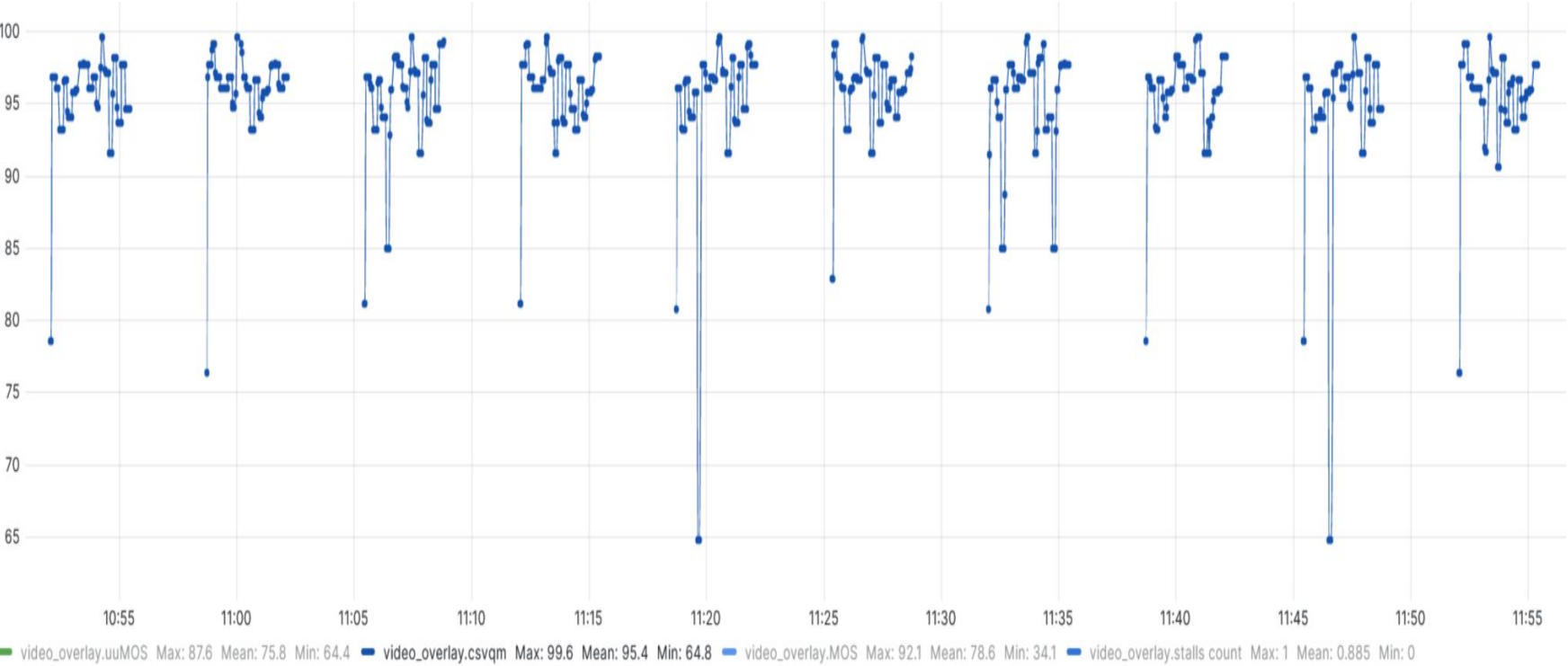
Test duration: ~1 hrs

TC:0 No Throttle | No AOC | No Pacing.

TC:1 No Throttle | AOC (1.6Mbps) | No Pacing.

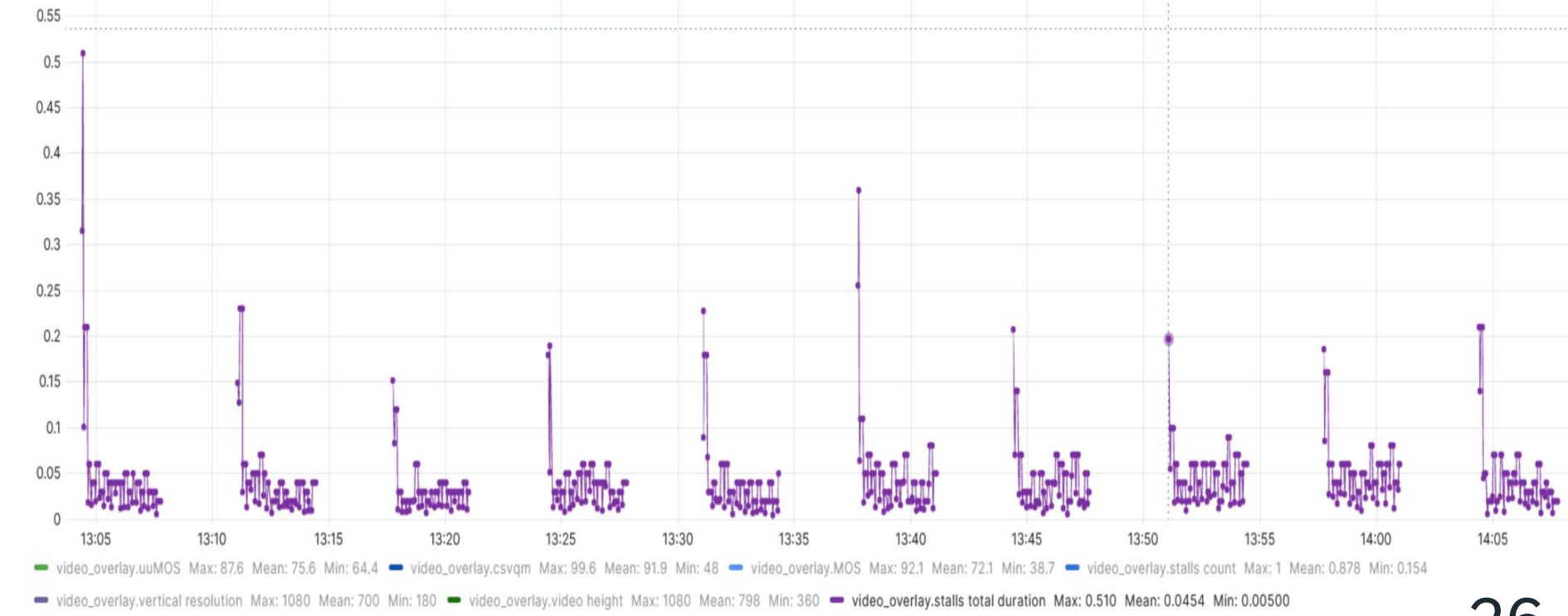
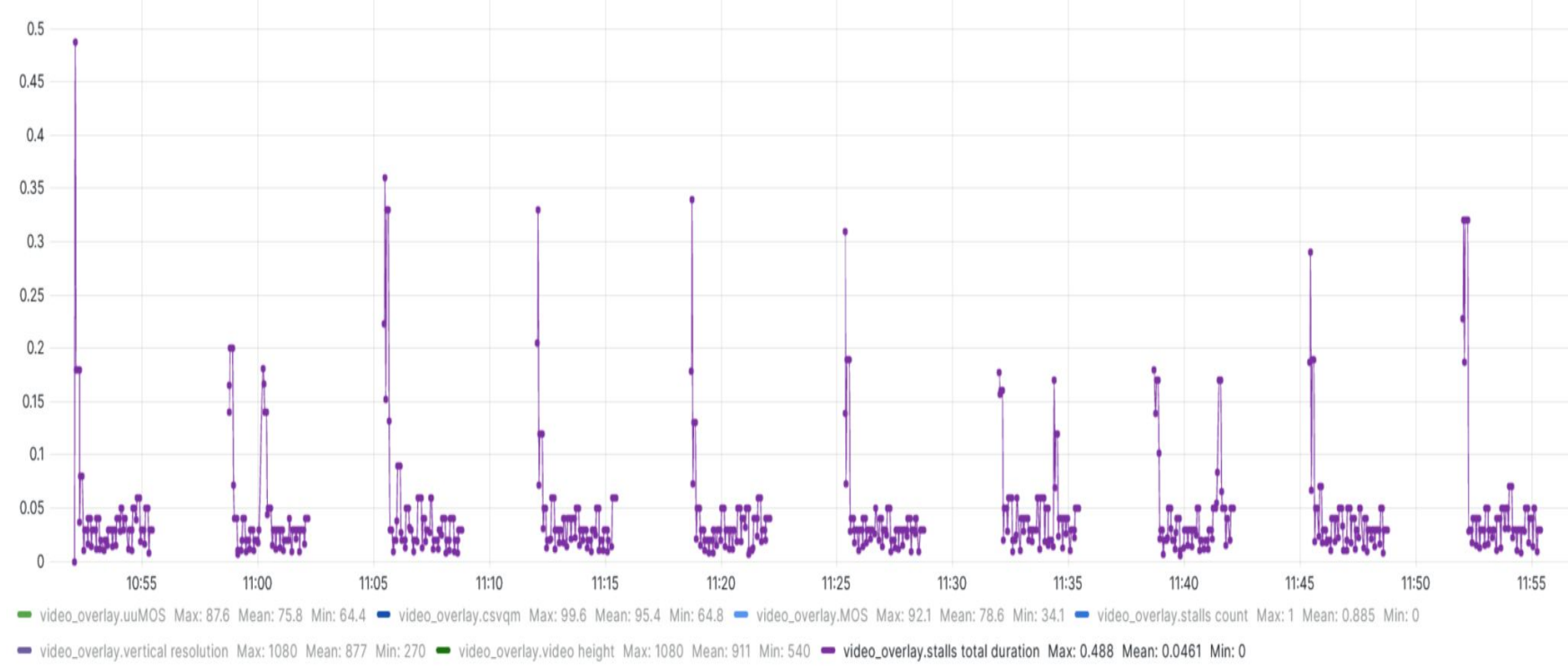
Csvqm

Csvqm



Stalls duration

Stalls duration

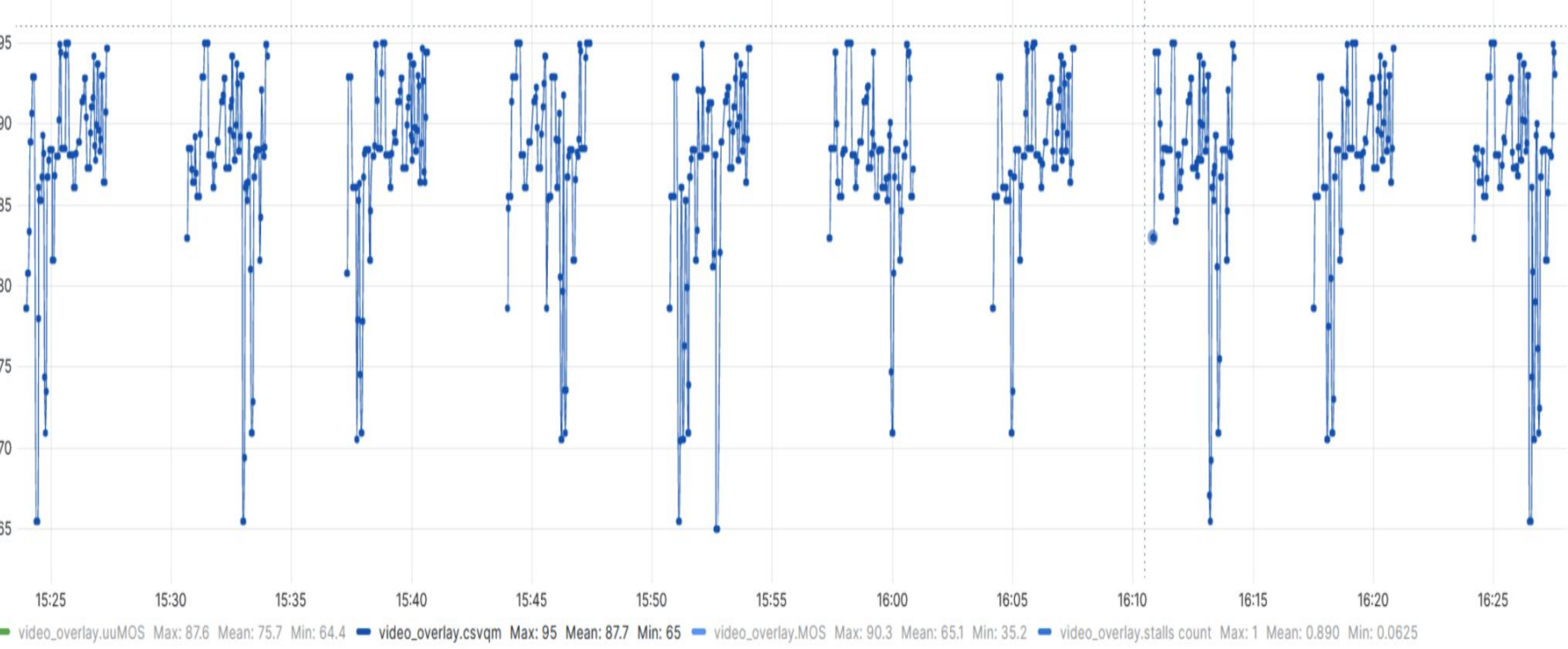


Video QOE

Test duration: ~1 hrs

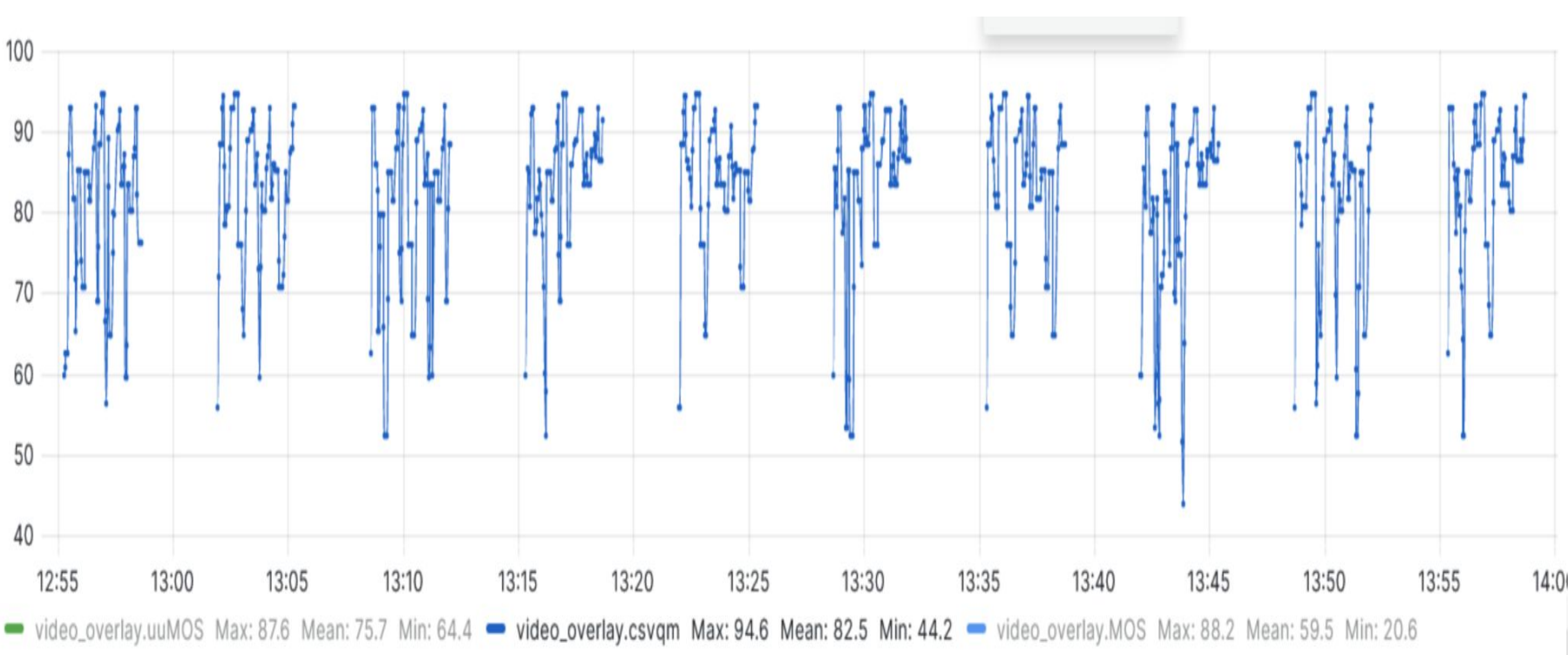
TC:2.0 No Throttle | AOC (1.6Mbps) | Pace (5Mbps).

Csvqm

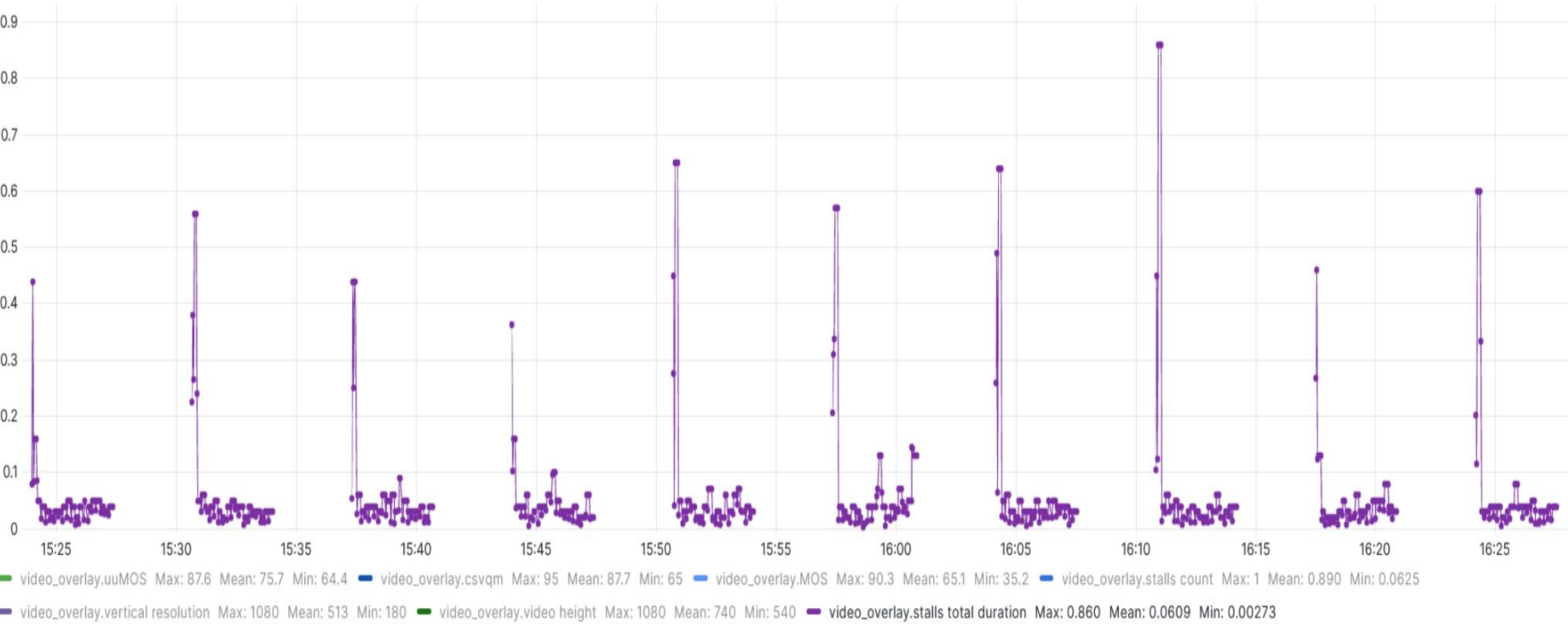


TC:2.1 No Throttle | AOC (1.6Mbps) | Pace (2.5Mbps).

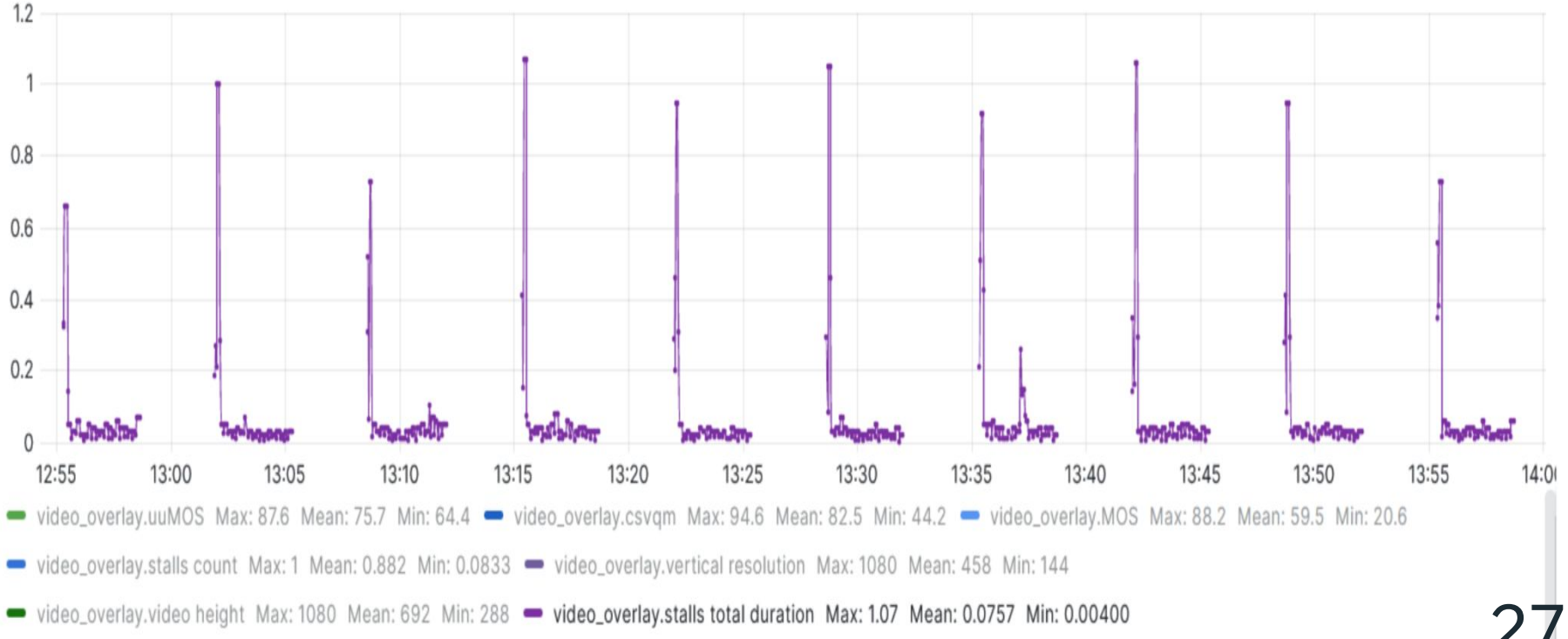
Csvqm



Stalls duration



Stalls duration



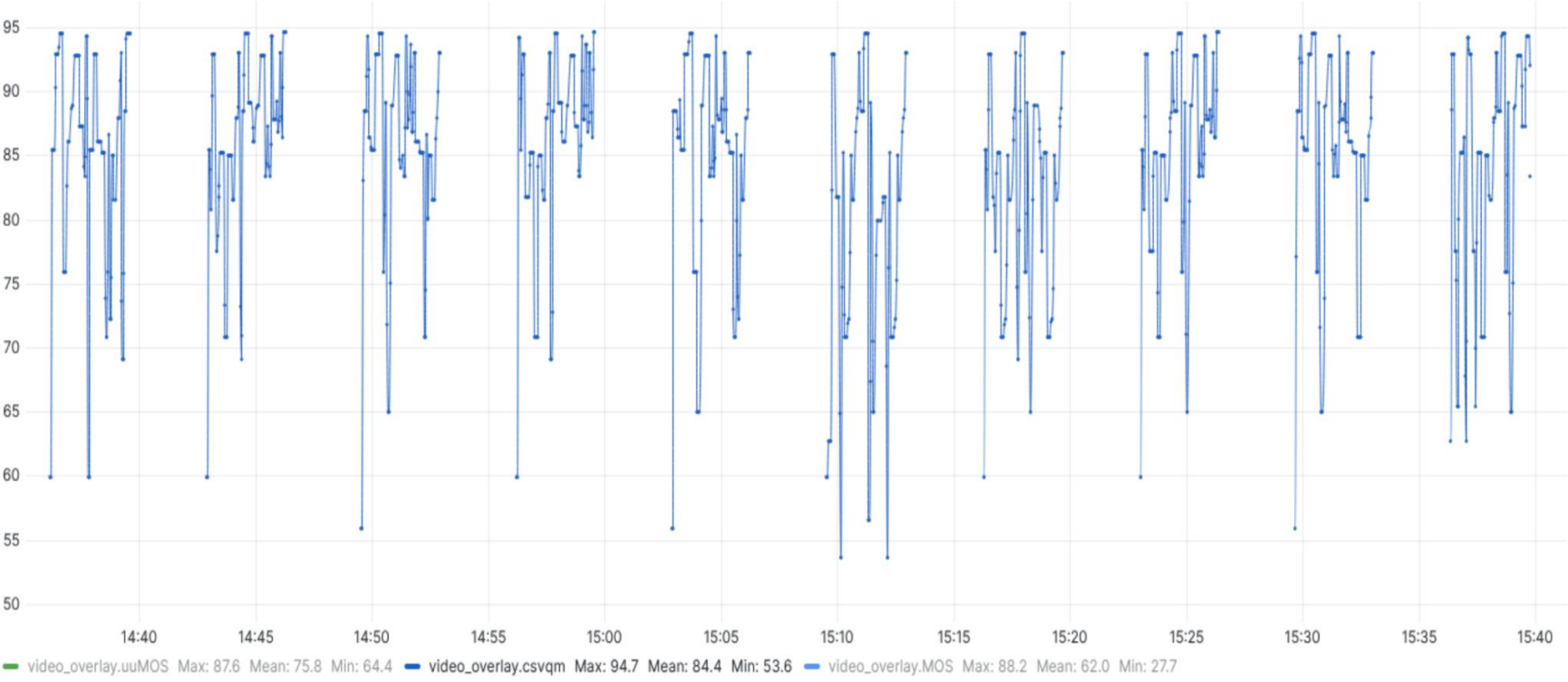


Video QOE

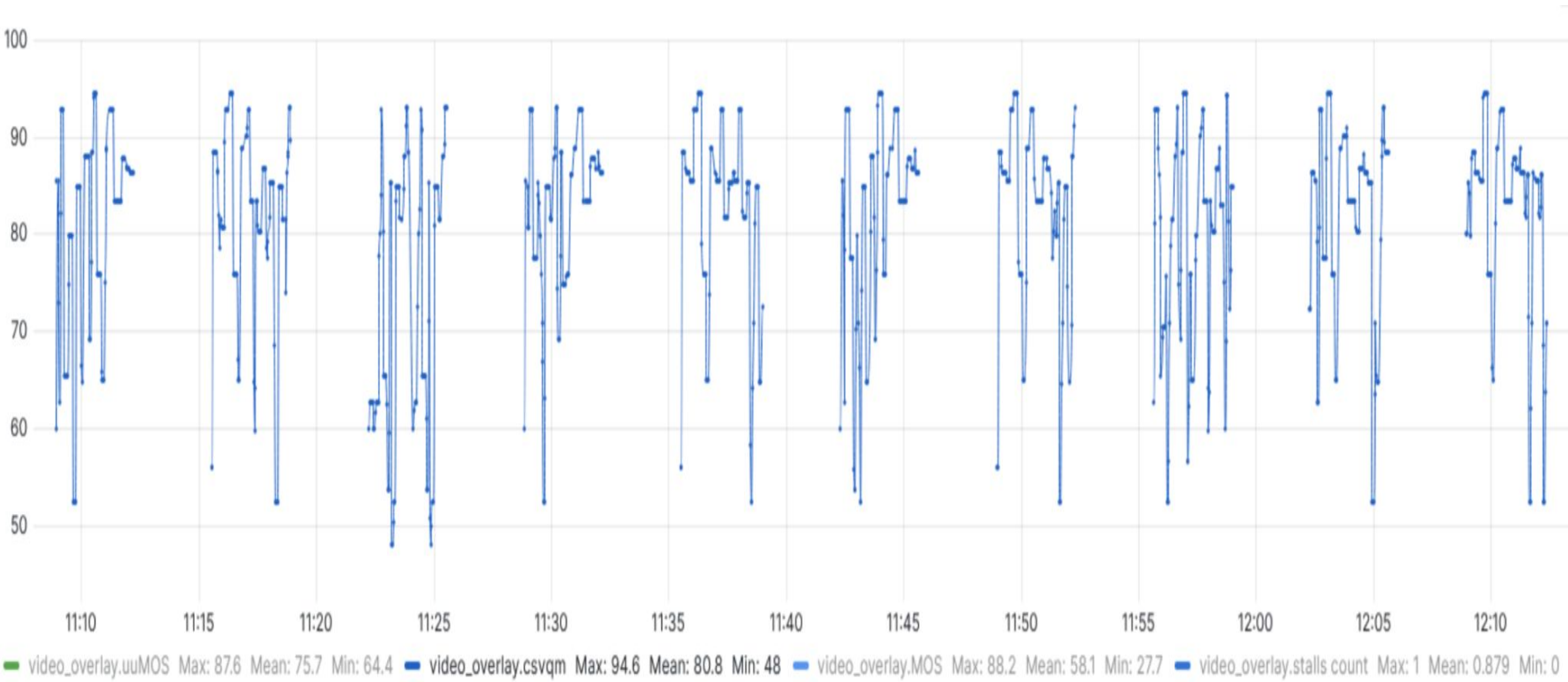
Test duration: ~1 hrs

TC:2.2 No Throttle | AOC (1.6Mbps) | Pace (3.5Mbps).

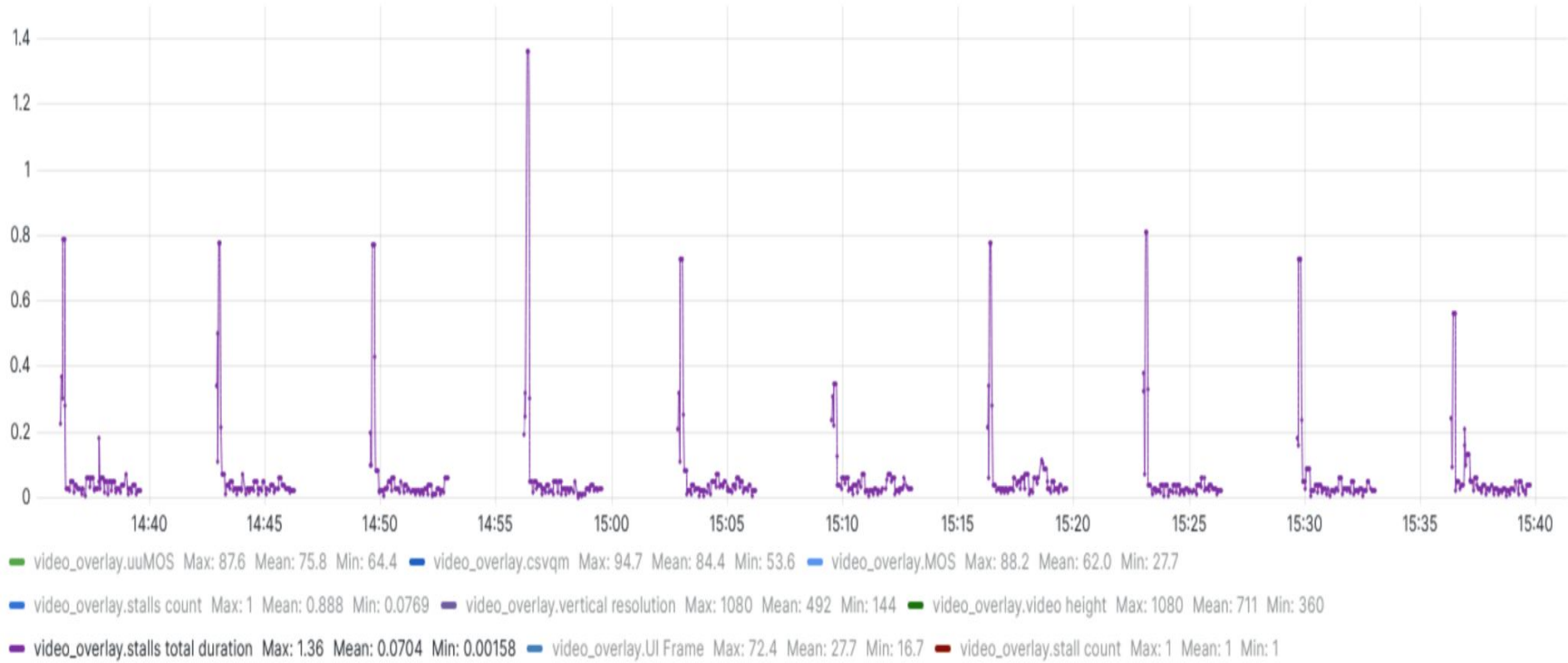
Csvqm



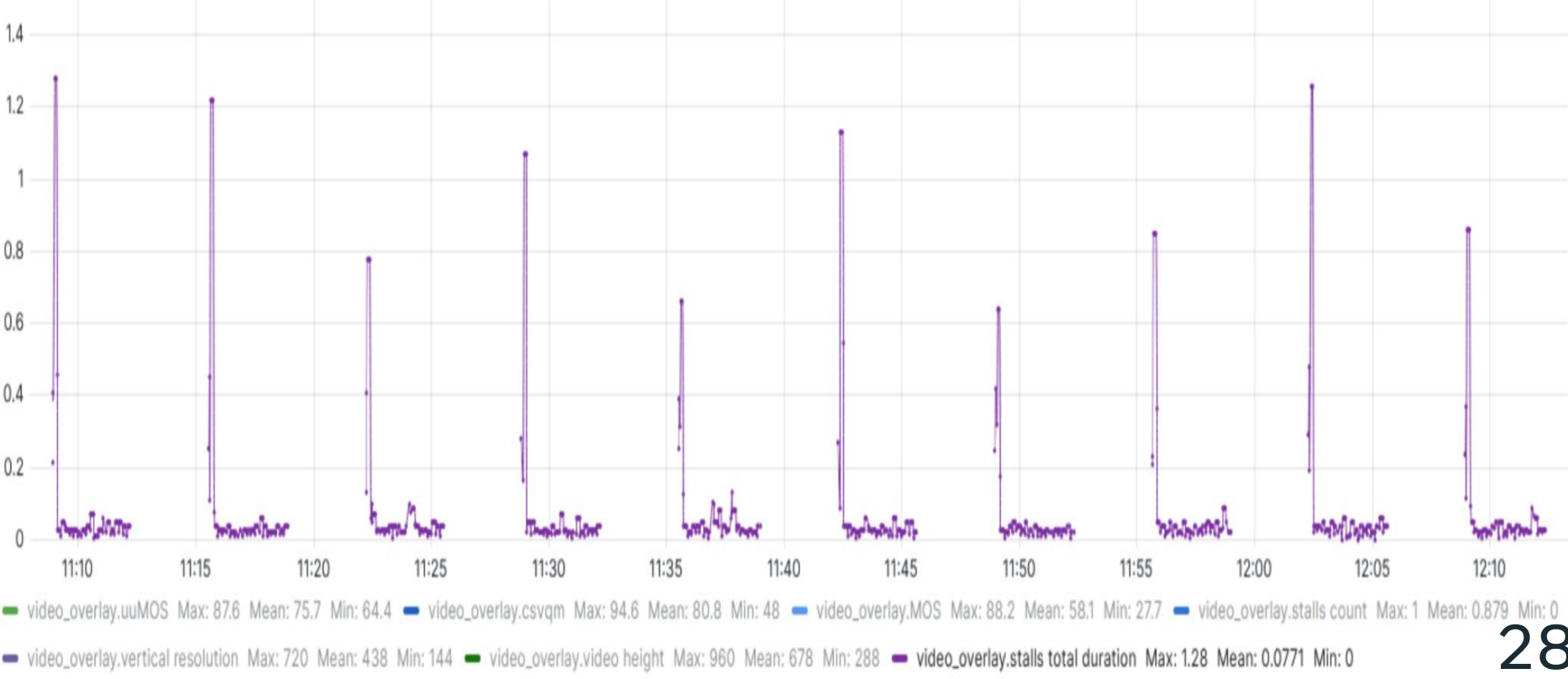
TC:2.3 No Throttle | AOC (1.6Mbps) | Pace (2Mbps).



Stalls duration

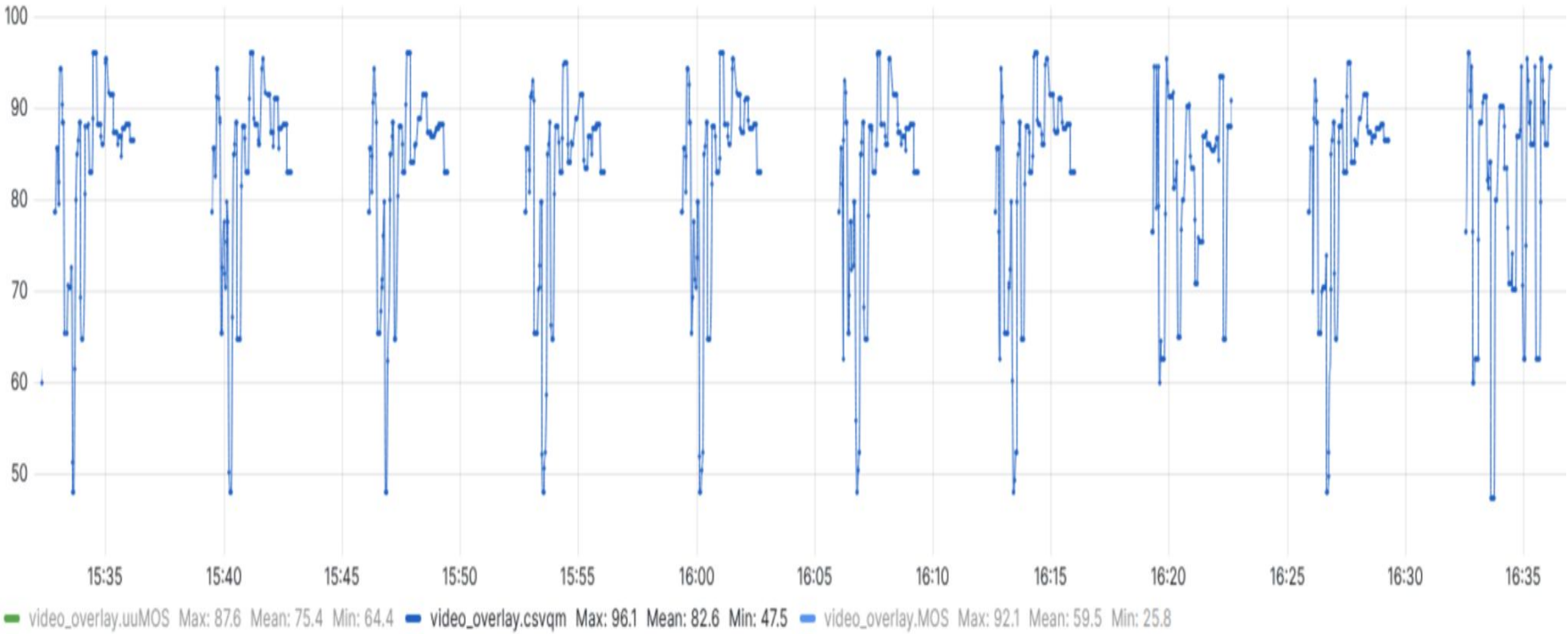


Stalls duration



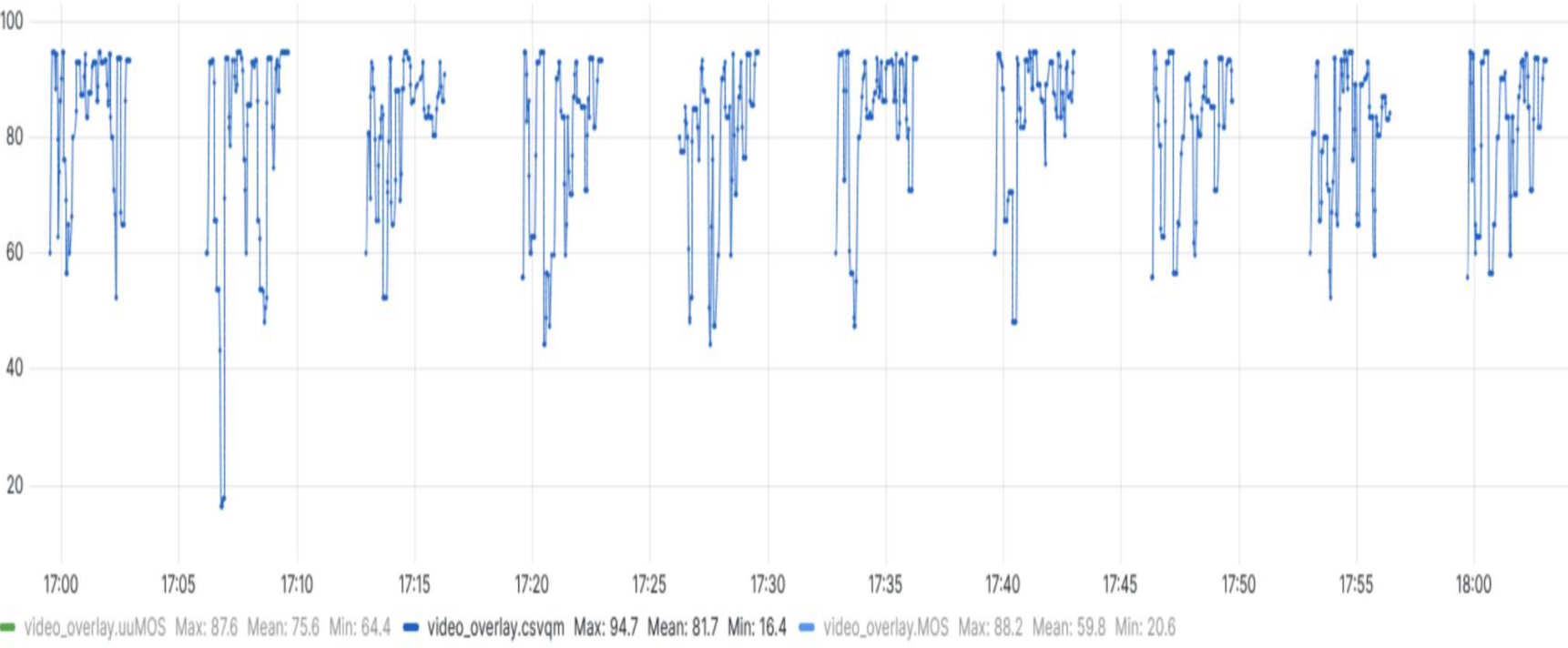
Video QOE

TC:3.0 Shape @2.5Mbps & 50KB Burst | No AOC | No Pacing  
Csvqm

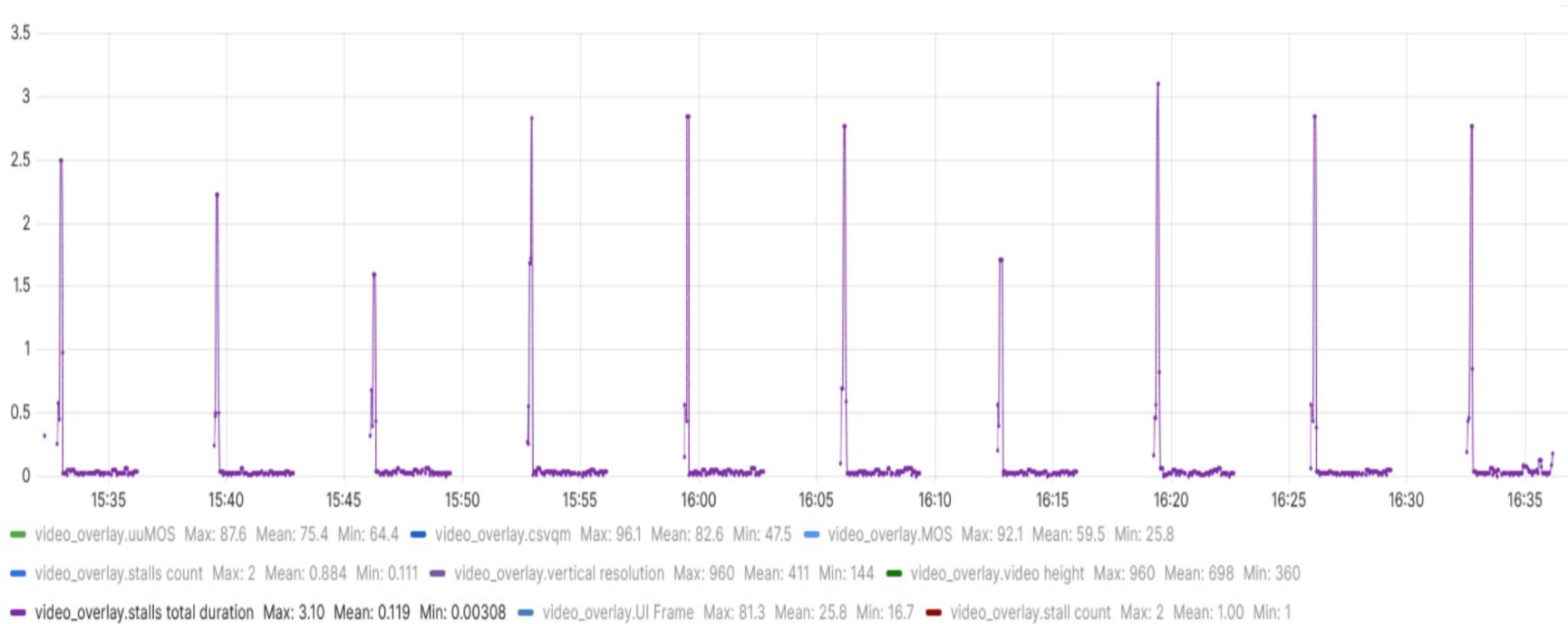


Test duration: ~1 hrs

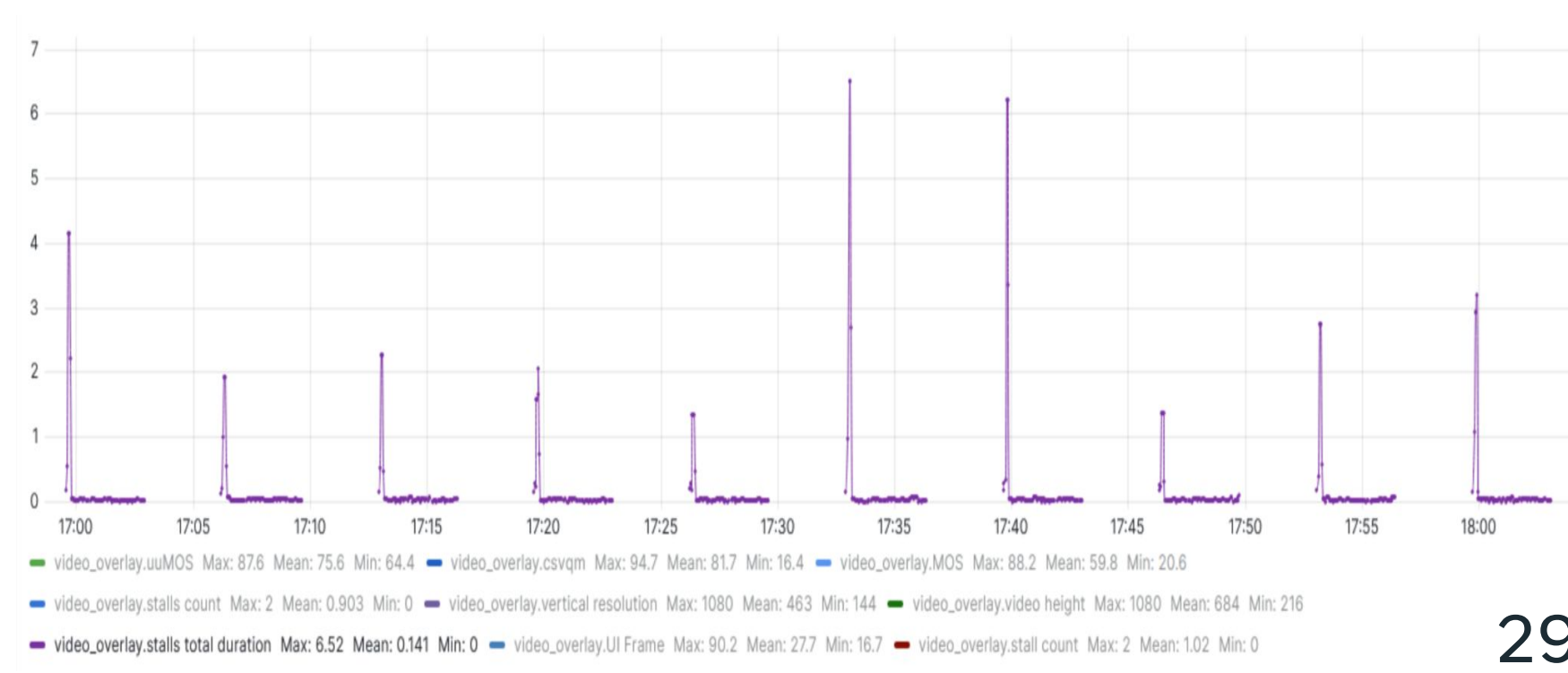
TC:3.1 Shape @2.5Mbps & 50KB Burst | No AOC | No Pacing  
Csvqm



Stalls duration



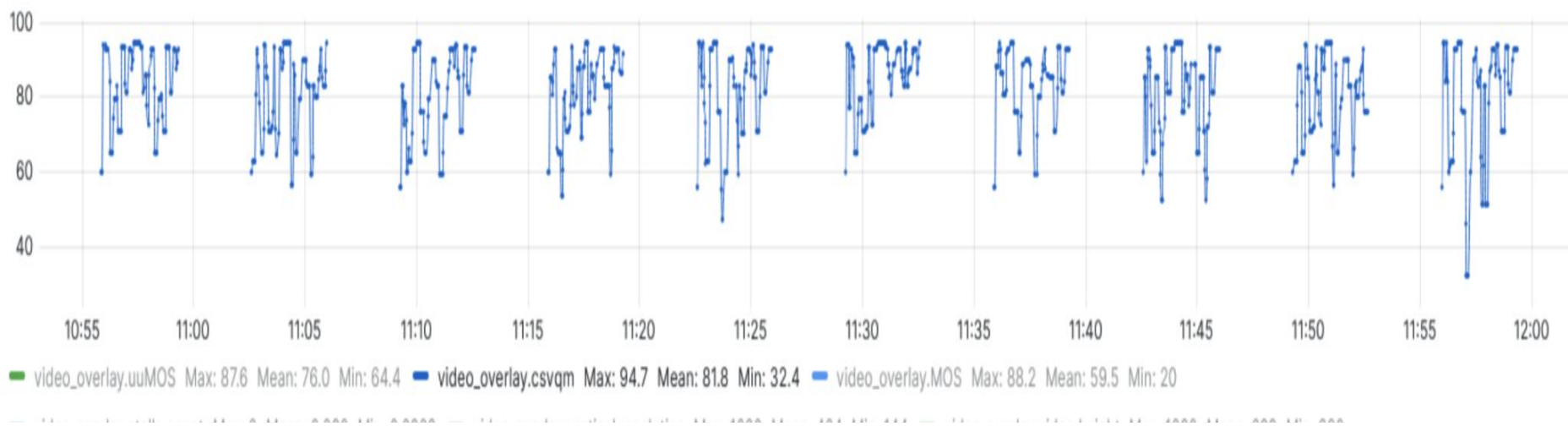
Stalls duration



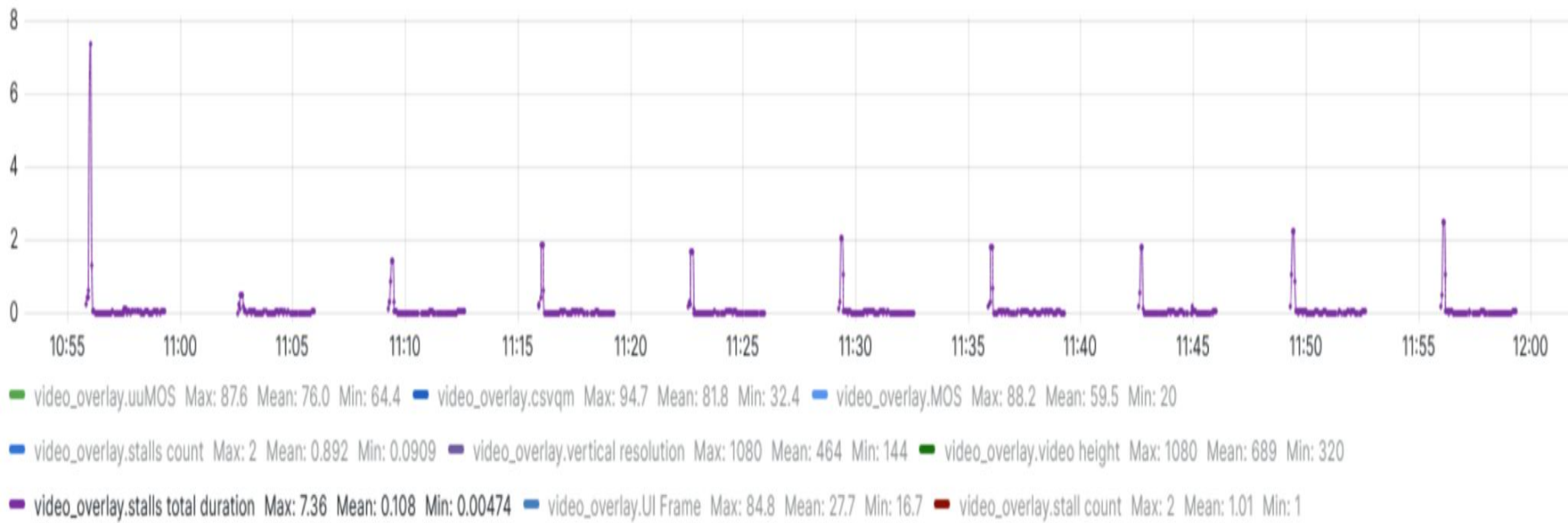


Video QOE

TC:3.2 Shape @3Mbps & 50KB Burst | No AOC | No Pacing  
Csvqm



Stalls duration

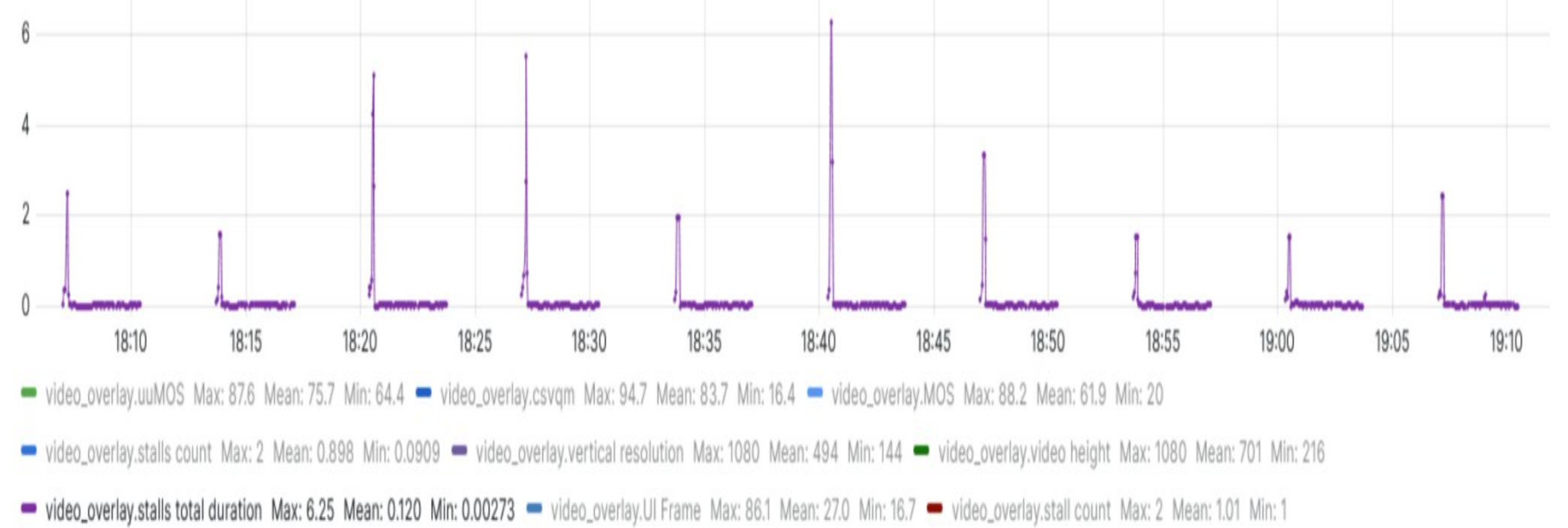


Test duration: ~1 hrs

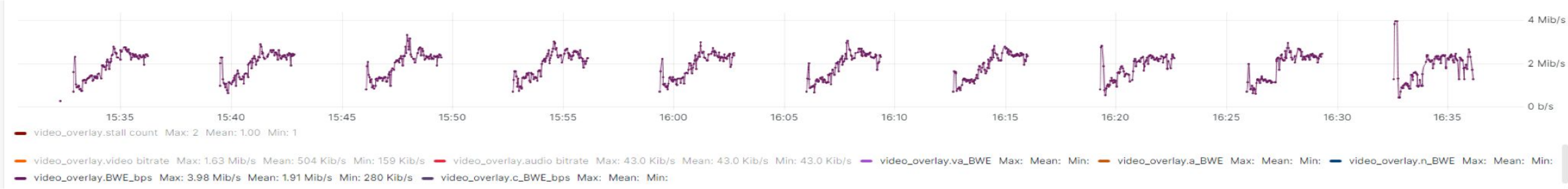
TC:3.3 Shape @3.5Mbps & 50KB Burst | No AOC | No Pacing - Run 2  
Csvqm



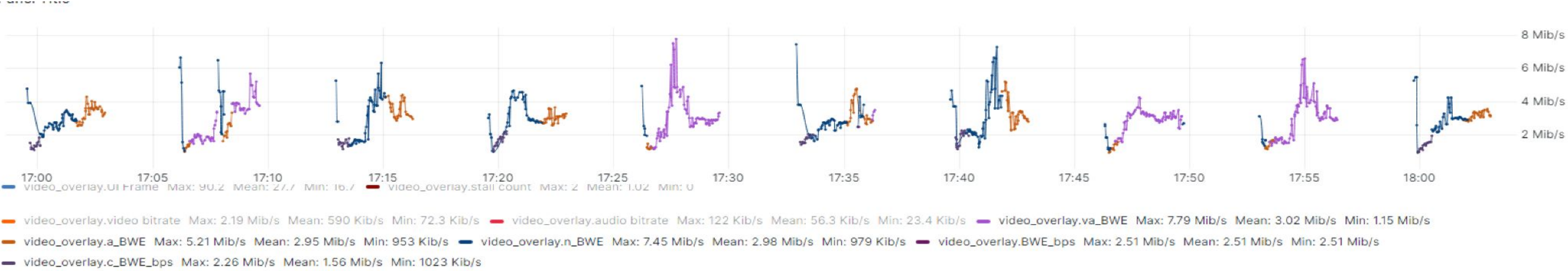
Stalls duration



TC:3.0 Shape @2.5Mbps & 50KB Burst | No AOC | No Pacing



TC:3.1 Shape @3Mbps & 100KB Burst | No AOC | No Pacing



TC:3.2 Shape @3Mbps & 50KB Burst | No AOC | No Pacing

