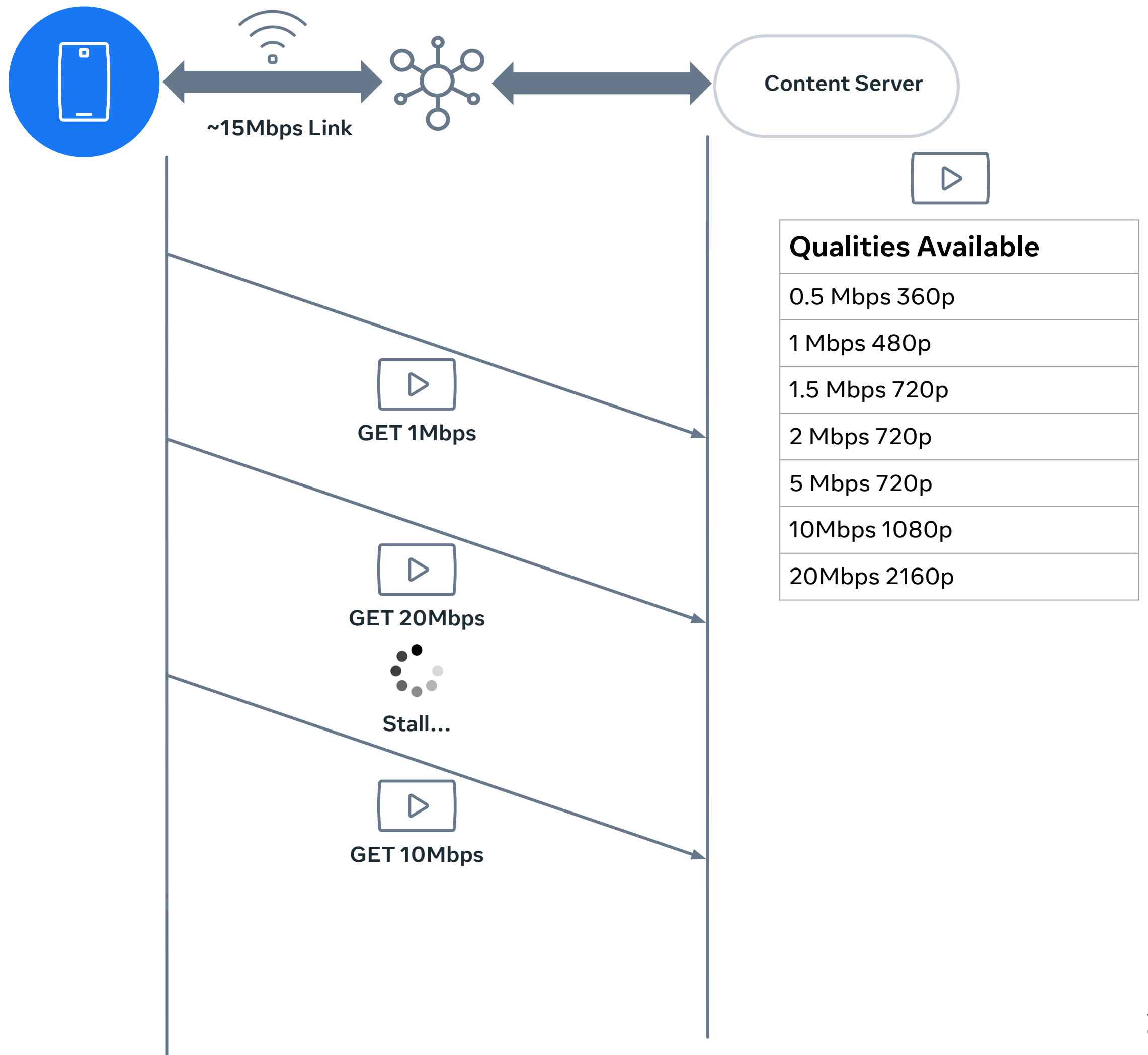# SCONEPRO MASQUE POC

Matt Joras
Software Engineer, Meta

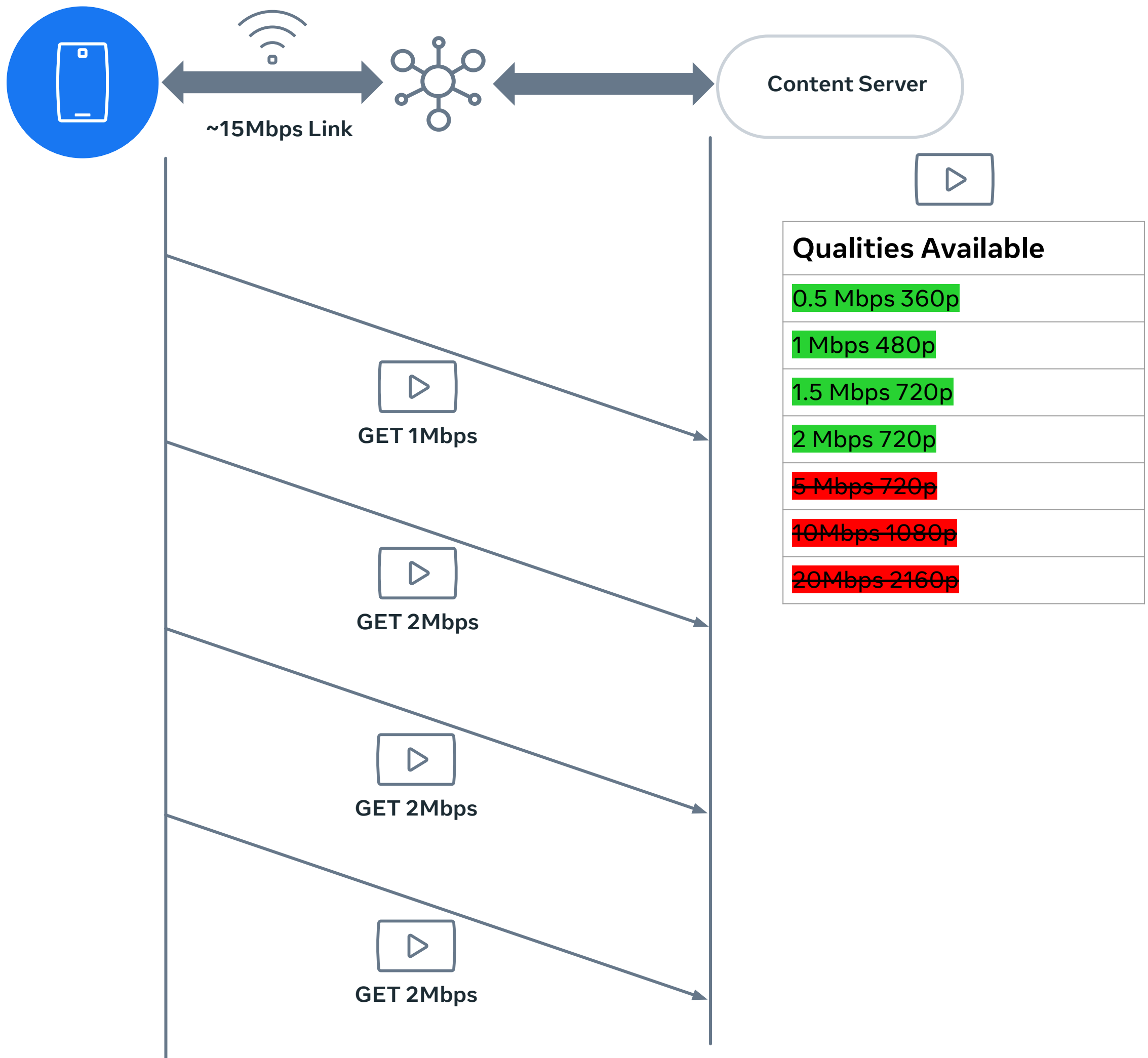# Adaptive Bitrate Video w/o Shaping

Modern ABR schemes (DASH, HLS) use multiple quality lanes, and allow the video player to vary the quality requested per request.

Client video player adapts quality fetched, trying to maximize bitrate without stalling based on measured bandwidth.

Content Server

~15Mbps Link

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

GET 1Mbps

GET 20Mbps

Stall...

GET 10Mbps

2

Adaptive Bitrate Video w/ Agreed Bitrate Cap

Video content provider and the operator agree on a certain video traffic profile that the video flow must conform to.

~15Mbps Link

Content Server

Qualities Available

0.5 Mbps 360p
1 Mbps 480p
1.5 Mbps 720p
2 Mbps 720p
~~5 Mbps 720p~~
~~10Mbps 1080p~~
~~20Mbps 2160p~~

GET 1Mbps

GET 2Mbps

GET 2Mbps

GET 2Mbps
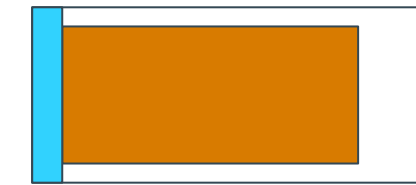
3

MASQUE + CONNECT UDP

- Easy experimentation platform.

- 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

- Facebook 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 requested video quality** based on this bitrate, and **instructs the CDN to use a maximum send rate**.

- Protocol details in draft-ihlar-masque-sconepro-mediabitrate.

- Re-encryption not required with QUIC-aware variant.

Outer MASQUE Packet

Blue: Media rate signal
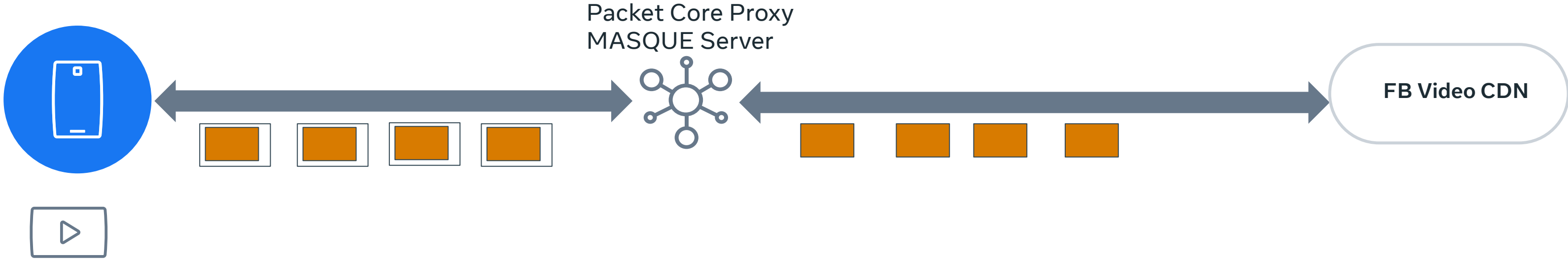Orange: E2E QUIC Packet

Packet Core Proxy
MASQUE Server

FB Video CDN
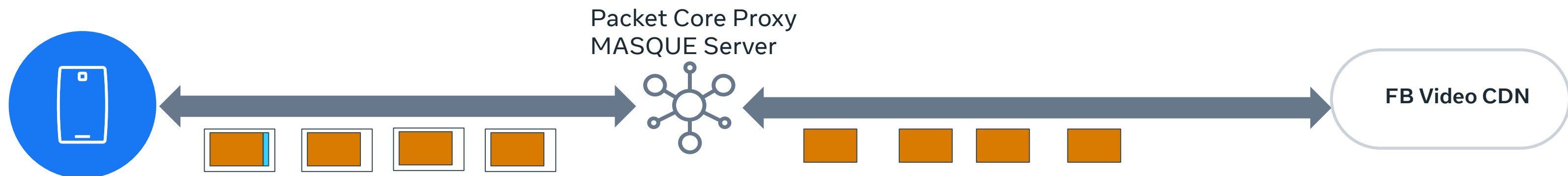
FB app establishes MASQUE Proxy Connection

Packet Core Proxy
MASQUE Server
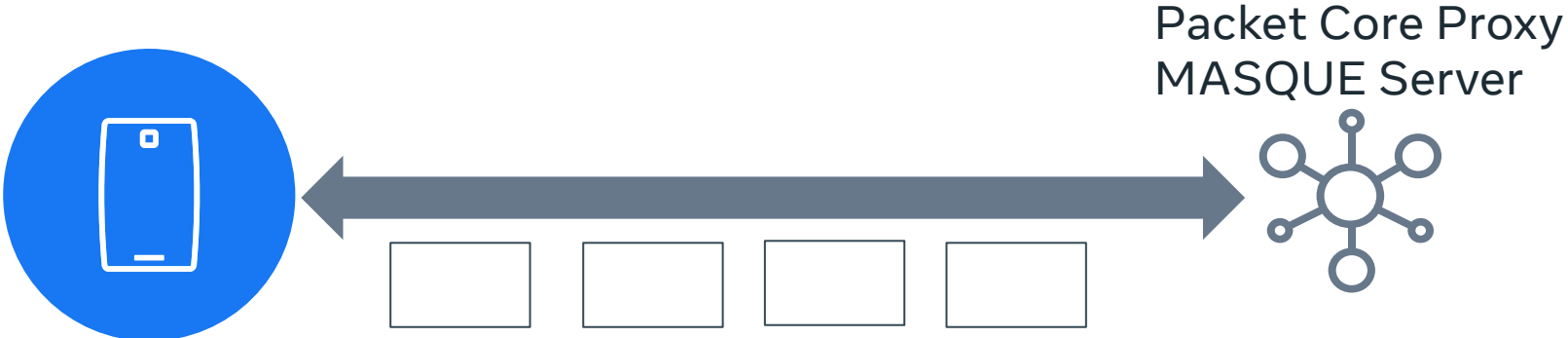
E2E QUIC connection to CDN established

Packet Core Proxy
MASQUE Server

FB Video CDN

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

FB app receives SCONEPRO capsule, player limits quality
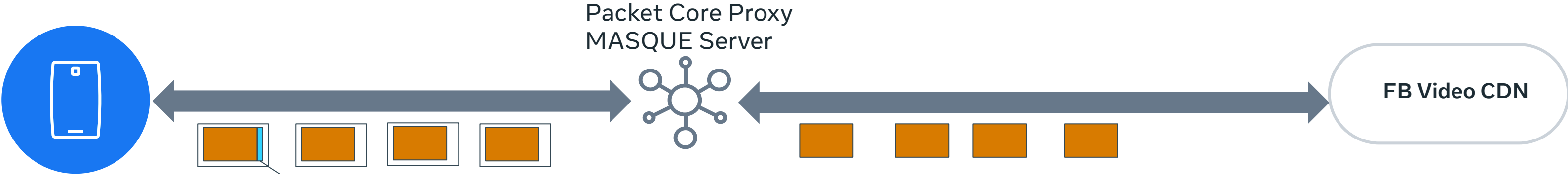
Packet Core Proxy
MASQUE Server

FB Video CDN

Media Rate: 2.5Mbps

Qualities Available
0.5 Mbps 360p
1 Mbps 480p
1.5 Mbps 720p
2 Mbps 720p
~~5 Mbps 720p~~
~~10Mbps 1080p~~
~~20Mbps 2160p~~

FB app (optionally) Instructs CDN to use a max send rate (pacing)
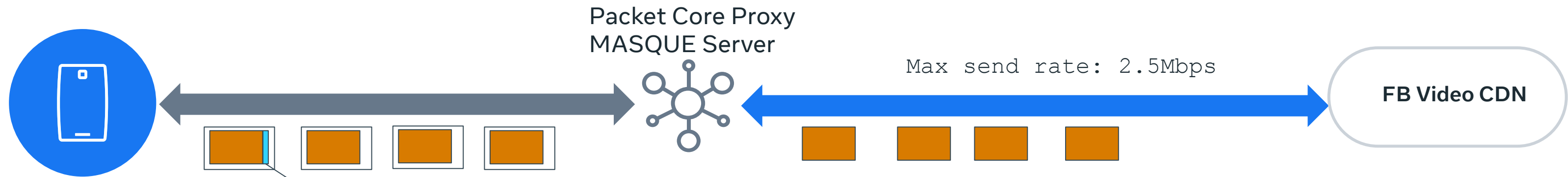
Packet Core Proxy
MASQUE Server

Max send rate: 2.5Mbps

FB Video CDN

Media Rate: 2.5Mbps

Qualities Available
0.5 Mbps 360p
1 Mbps 480p
1.5 Mbps 720p
2 Mbps 720p
~~5 Mbps 720p~~
~~10Mbps 1080p~~
~~20Mbps 2160p~~

Trial lab setup

SCONE - Proof of Concept Lab Setup

Lab Setup - cellular network

RF Shield box

HSS

S6a

MME — S11

PCRF

S1-C

Gx

Masque Proxy Server

Masque Client Inbuilt over FB app

LTE Uu

eNB

S1-U

S/PGW (PCEF)

Sgi

Meta enterprise network

Internet

ISP

Meta CDN

Reels data flow

Firewall

ADB

QoE KPI collector

N/W assisted (via Masque Proxy tunnel) Self - Adaptation Traffic flow

Network Throttled traffic flow

Results

- Repeated testing using a fixed video playlist in the FB app.

- Comparison between shaping at a fixed bitrate, and with self-adaptation based on the explicit signal received from the network element.

- Self-adaptation entails two things: **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 (data usage)**
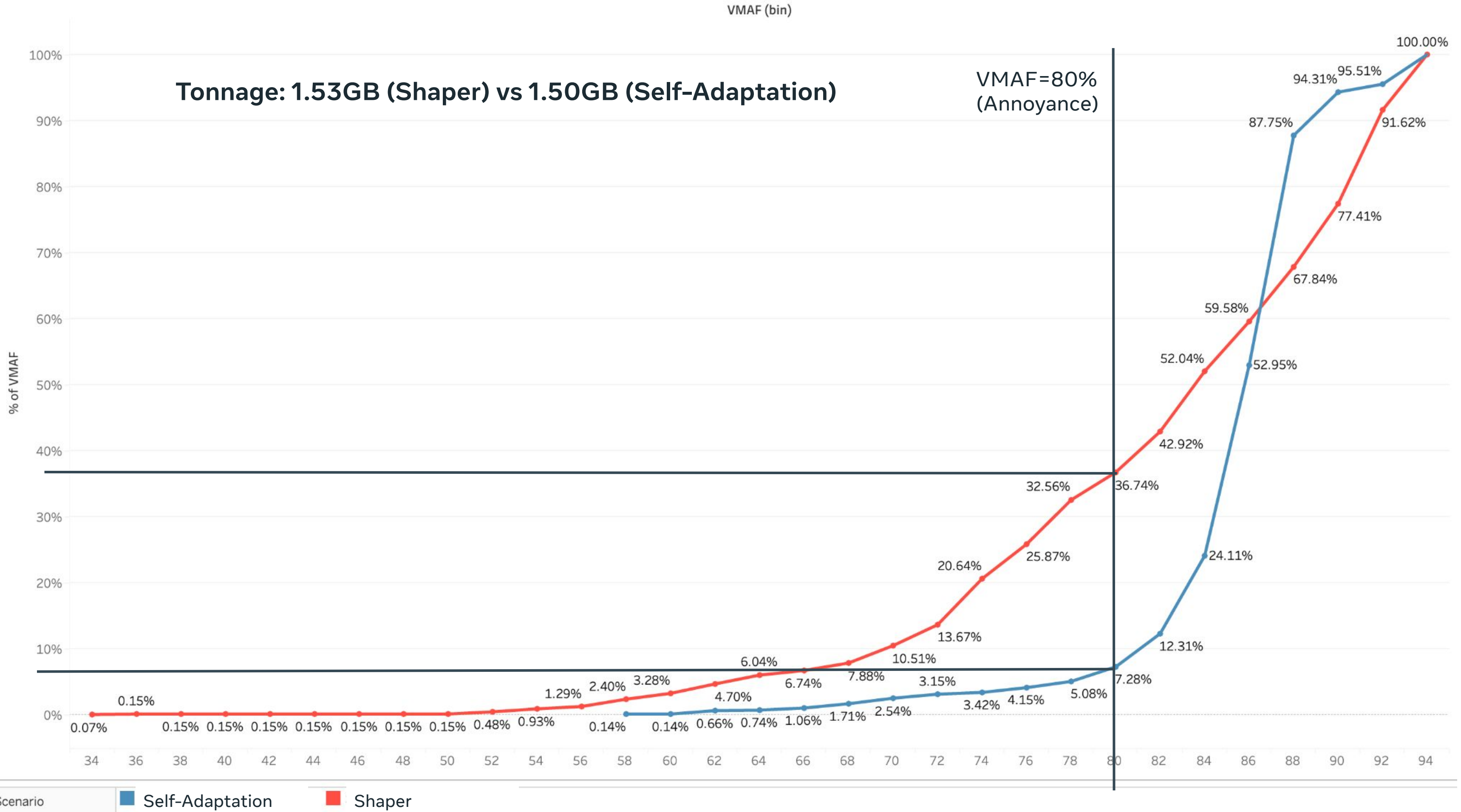
Video Quality

- Metrics used in PoC

  — [Video Multimethod Assessment Fusion (VMAF)](#) – A full reference visual quality metric widely used in the industry

  — Stall durations

- 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: **2% of 3 billion people is 60 million people**

CDF of VMAF | Self-Adaptation vs Network Shaper

VMAF (bin)

Tonnage: 1.53GB (Shaper) vs 1.50GB (Self-Adaptation)

VMAF=80%
(Annoyance)

% of VMAF

100.00%
95.51%
94.31%
91.62%
87.75%
77.41%
67.84%
59.58%
52.04%
52.95%
42.92%
36.74%
32.56%
25.87%
24.11%
20.64%
13.67%
12.31%
10.51%
7.88%
7.28%
6.74%
6.04%
5.08%
4.70%
4.15%
3.42%
3.28%
3.15%
2.54%
2.40%
1.71%
1.29%
1.06%
0.93%
0.74%
0.66%
0.48%
0.15%
0.15%
0.15%
0.15%
0.15%
0.15%
0.15%
0.15%
0.14%
0.14%
0.07%

34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90 92 94

Scenario   ■ Self-Adaptation   ■ Shaper

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Comparison of VMAF histograms for self-adaptation and network based shaping

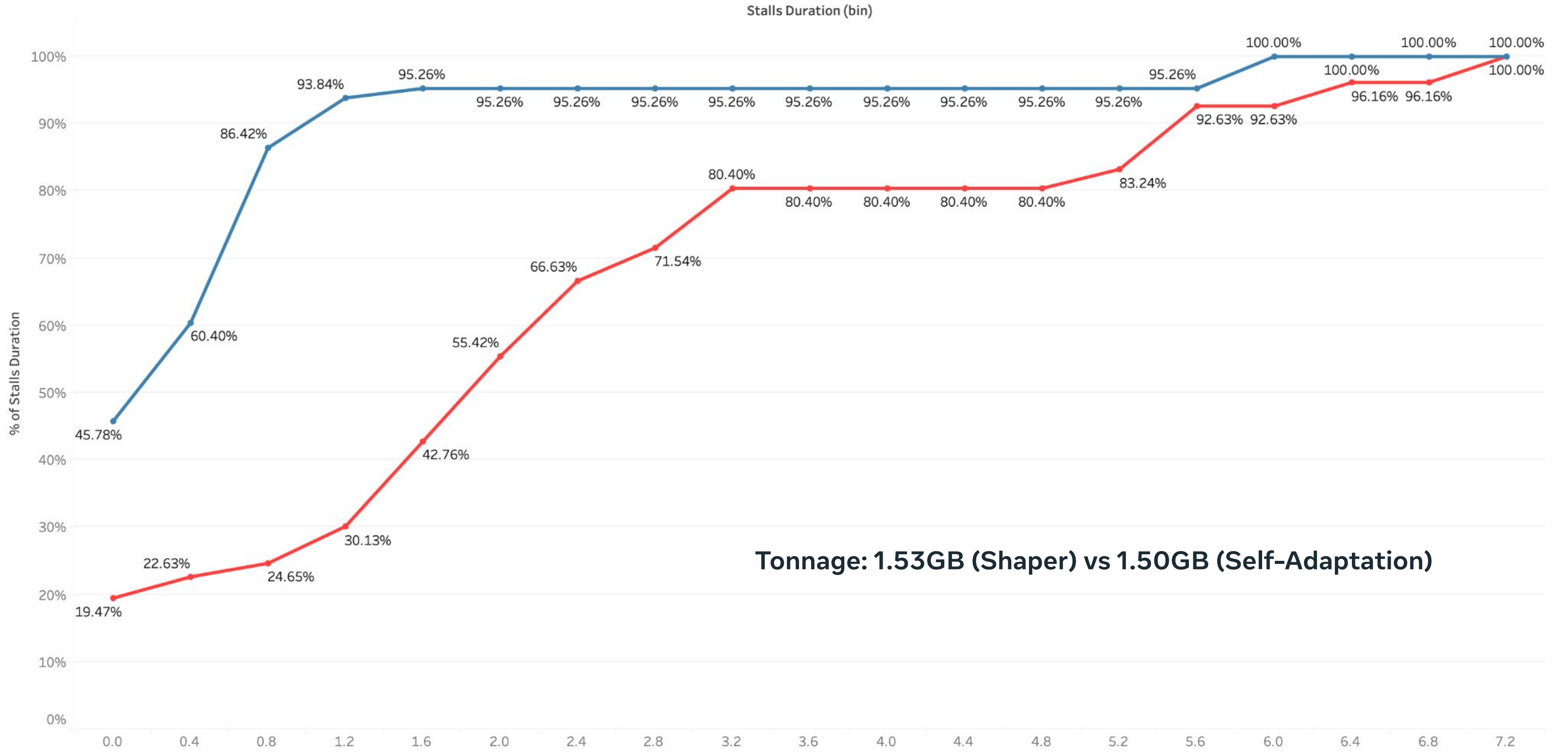**Tonnage: 1.53GB (Shaper) 1.50GB (Self-Adaptation)**

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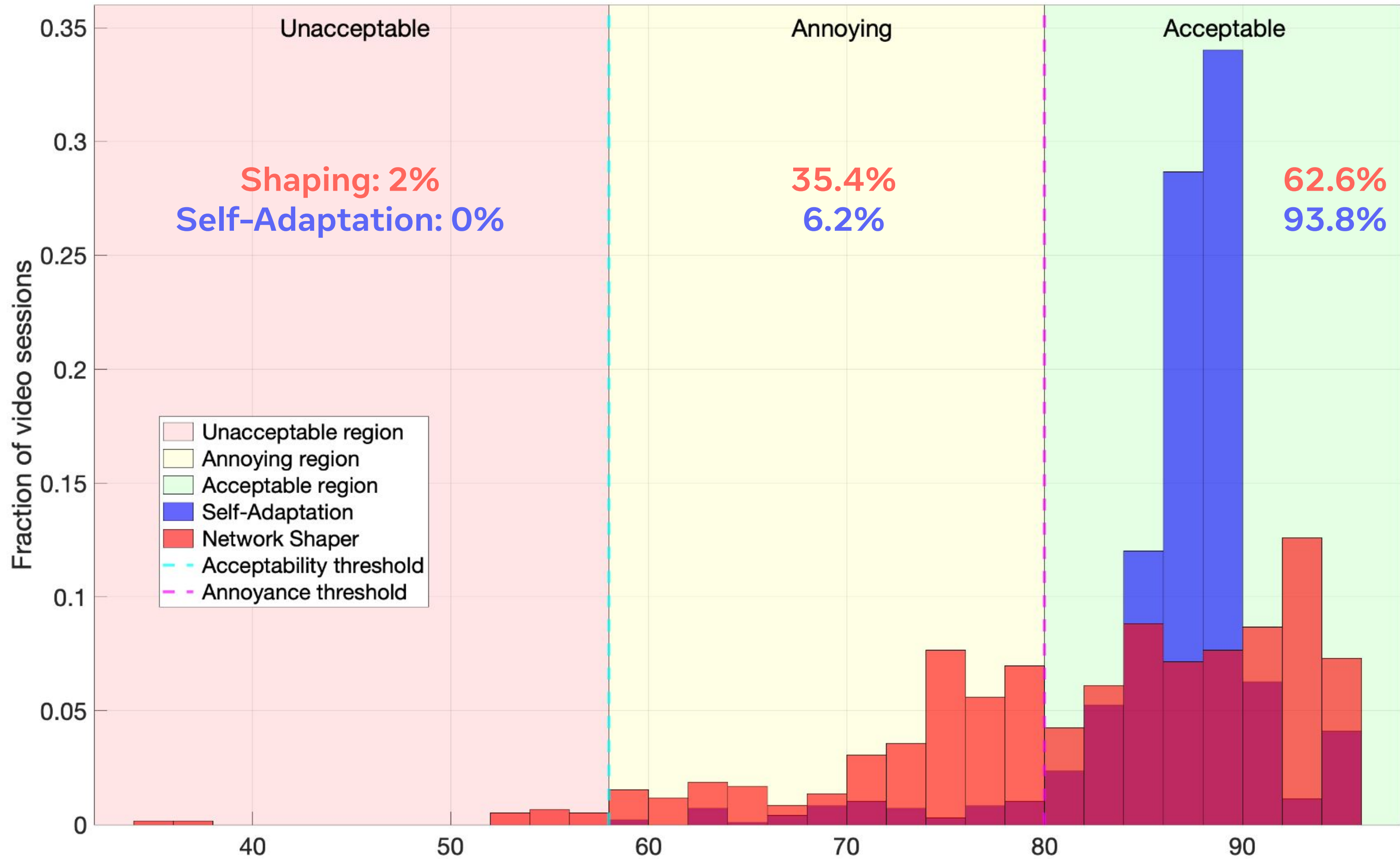
What does it mean?

- **2% is still a lot of sessions!**
  - — Outlier experience a key driver of user experience.
- The distribution with self-adaptation much "tighter".

- Leaving some "peak quality" on the table less important than **increased quality consistency**.

- **Tonnage (data usage) per session was essentially equal.**
- Self-adaptation has more judicious use of data, **using it where it matters most to user experience**.
- Shaper can be fine-tuned for better experience, but **it is not driven by content providers** with application context.
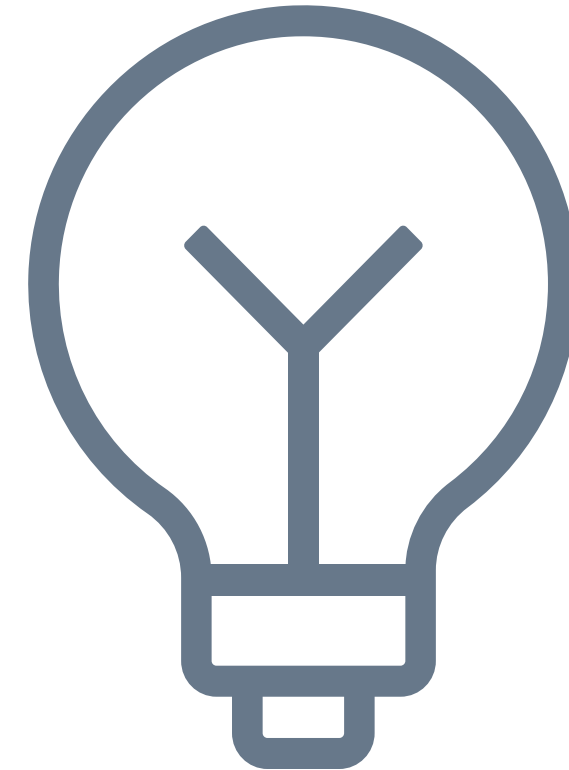
CDFs of Stall duration | Self-Adaptation vs Network Shaper

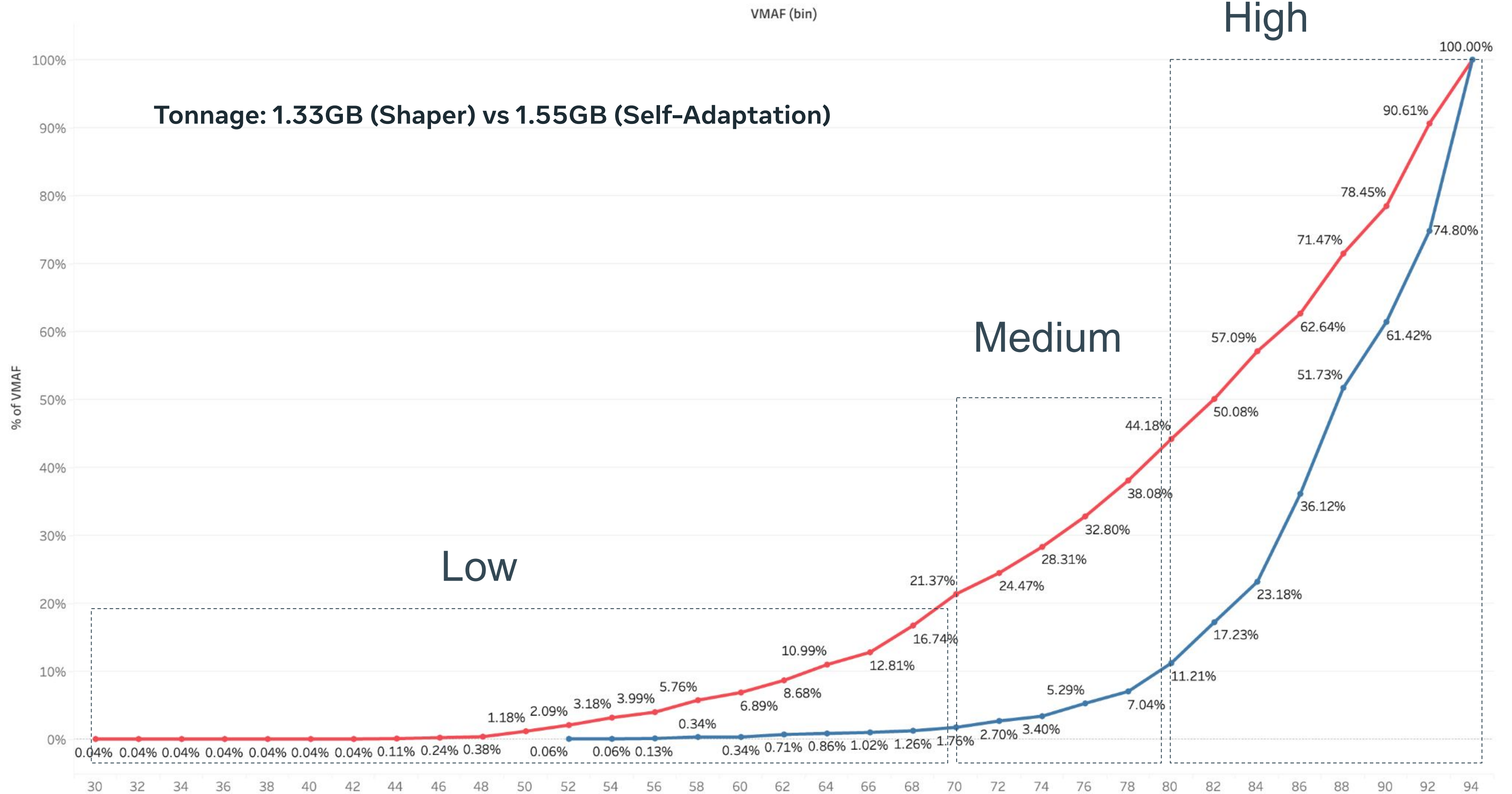**Tonnage: 1.53GB (Shaper) vs 1.50GB (Self-Adaptation)**

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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-adaptation.
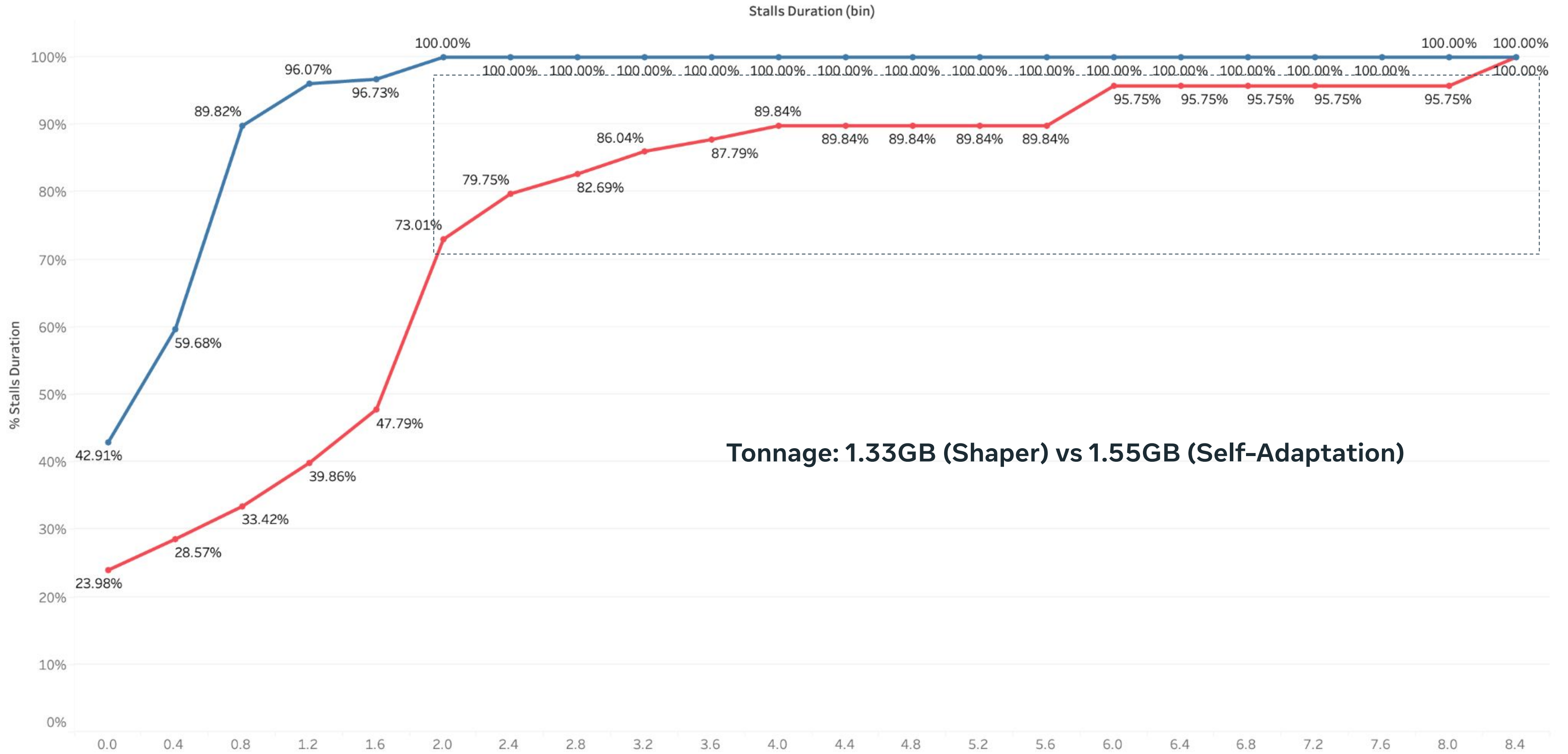
Backup slides

-

CDFs of VMAF : Self-Adaptation Vs Shaper

Tonnage: 1.33GB (Shaper) vs 1.55GB (Self-Adaptation)

CDFs of 'Stall Duration' : Self-Adaptation Vs Shaper

Tonnage: 1.33GB (Shaper) vs 1.55GB (Self-Adaptation)