

Content Steering: a Standard for Multi-CDN Streaming

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L3 tutorials
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San Diego, CA

MULTI-CDN DELIVERY

ESSENTIAL FOR

- ▶ Multi-region delivery
- ▶ Better scale
- ▶ Improved reliability / failover
- ▶ Improved QOE

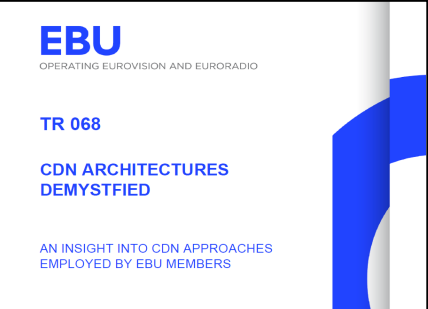
NOT TRIVIAL TO IMPLEMENT

- ▶ Many approaches proposed over last decade

Architecture	Pros	Cons
DNS-based	This is the simplest of all solutions since the source video URL always remains constant.	Switch delay is more time-consuming, ranging from 300 seconds to even five minutes in case of CDN failures. This can immensely hamper the user QoE.
On-the-fly manifest rewrite	Better user experience due to midstream switching eliminating the need for hard refresh during video playback. No matter the volume of simultaneous session resets, this method reduces the chances of a cascade effect that may hamper the video workflow.	Rewriting the manifest can sometimes bring about errors. Midstream switching is not completely seamless, and takes time for the server to understand that a particular CDN is unavailable.
Server-side	It is a relatively simple CDN switching method to implement since changes happen in the server itself that is easier for the operator to control.	Page loading may take some time, adding to delays. Since CDN switching is based on the collective data from many clients, it does necessarily consider the unique conditions of the actual clients.
Client-side	QoS data is almost accurate as it is fetched based on individual clients' local and real-time performance metrics. Seamless midstream CDN switching is possible.	It is a complex procedure to implement when built in-house due to the code complexity of the algorithms that requires detailed planning.

<https://www.svta.org/2023/01/03/investigating-approaches-to-multi-cdn-delivery/>

BIG TOPIC



SVTA

Investigating Approaches to Multi-CDN Delivery

Home > 2023 > January > 3 > Investigating Approaches to Multi-CDN Delivery

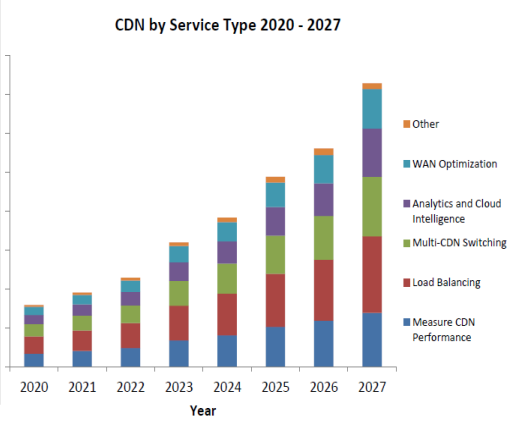
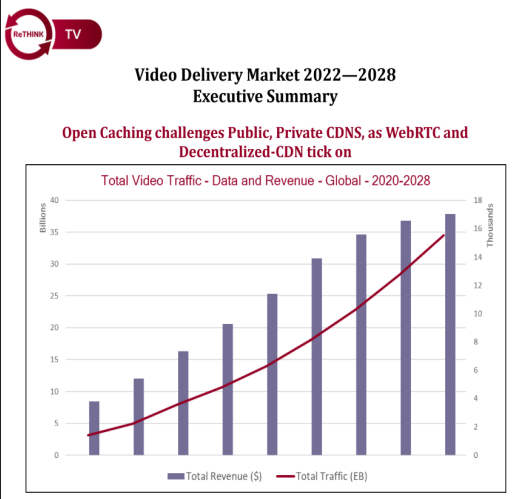
Players and Playback Study Group January 3, 2023 12:32 pm

When streaming on-demand or live video, issues with a particular CDN can impact the user quality of experience (QoE). If the CDN struggles to fulfill the request, if the player has access to multiple CDNs, switching to another CDN or using multiple CDNs simultaneously might help maintain a good user experience. Generally speaking, most streaming services use a multi-CDN delivery approach for redundancy and business purposes.

Why Do Streaming Platforms Want to Switch CDNs?

There are various reasons a streaming operator may want to utilize CDN switching:

- Performance: A CDN performing poorly in a specific geographic region may compromise QoE. When this happens, it could adversely affect video engagement (how long viewers watch) or even result in churn.
- Capacity: A CDN may sometimes develop capacity issues because of competing traffic on its network.
- Traffic commit: A streaming platform may sometimes want to switch because of contractual obligations. For example, CDN A may need to get 35% of traffic, while CDN B may need to get 65%.
- Cost: Streaming platforms may want to switch to CDNs because of lower costs in specific regions or at specific times of the day.



streaming media

October 16, 2019 By David Pearson CEO, Realtime Network Solutions

How to Jump-Start Your Multi-CDN Strategy and Deliver Every Time

The advantages of pursuing a multi-CDN distribution strategy are obvious—not risking your content delivery on a single point of failure being shared among them. But what's the best approach to maintaining the highest-quality delivery, building redundancy and resiliency into your streams, and addressing origin load capacity? In this article, we'll explore multi-CDN options, highlight key providers, and identify the right questions to ask and issues to consider as you continue your multi-CDN journey.

Problems That Multi-CDN Delivery Addresses

The big driver behind the migration to multi-CDN is that the single-CDN approach limits you to a single point of failure. Naturally, some CDNs might not perform as well as others, especially when active delivery workloads.

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Everything you Need to Know about Multi CDN Switching

DTT Video Streaming Live Streaming Con Buffering

Srejanita Basu Published on: 13 October 2019

SEAMLESS CDN SWITCHING

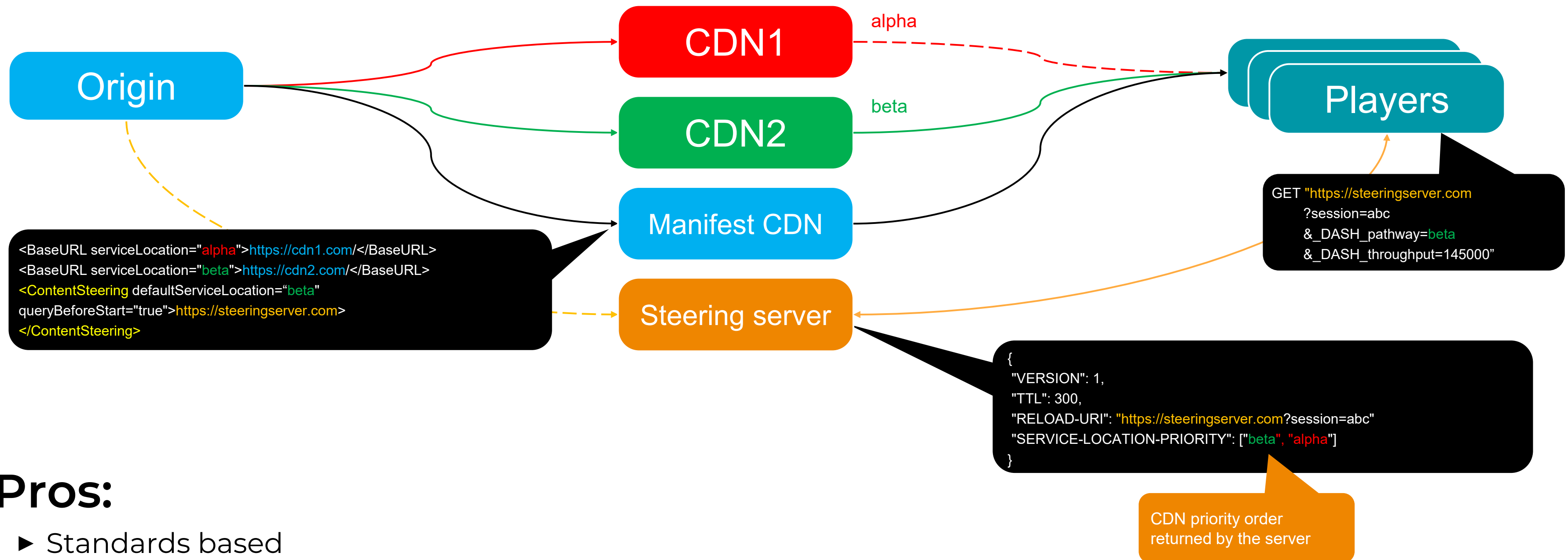
The diagram illustrates a multi-CDN architecture. A Content Origin is connected to multiple Edge Servers. These Edge Servers are distributed across different geographic regions. User Requests are sent to the Edge Servers, which then deliver the content to the User. The diagram highlights the seamless switching between different CDNs to ensure high availability and performance.

CDN Market by Technology, Platform, Application, Service Type, Customer Type, and Industry Verticals 2021 – 2026

MIND COMMERCE

HLS/DASH CONTENT STEERING

General concept

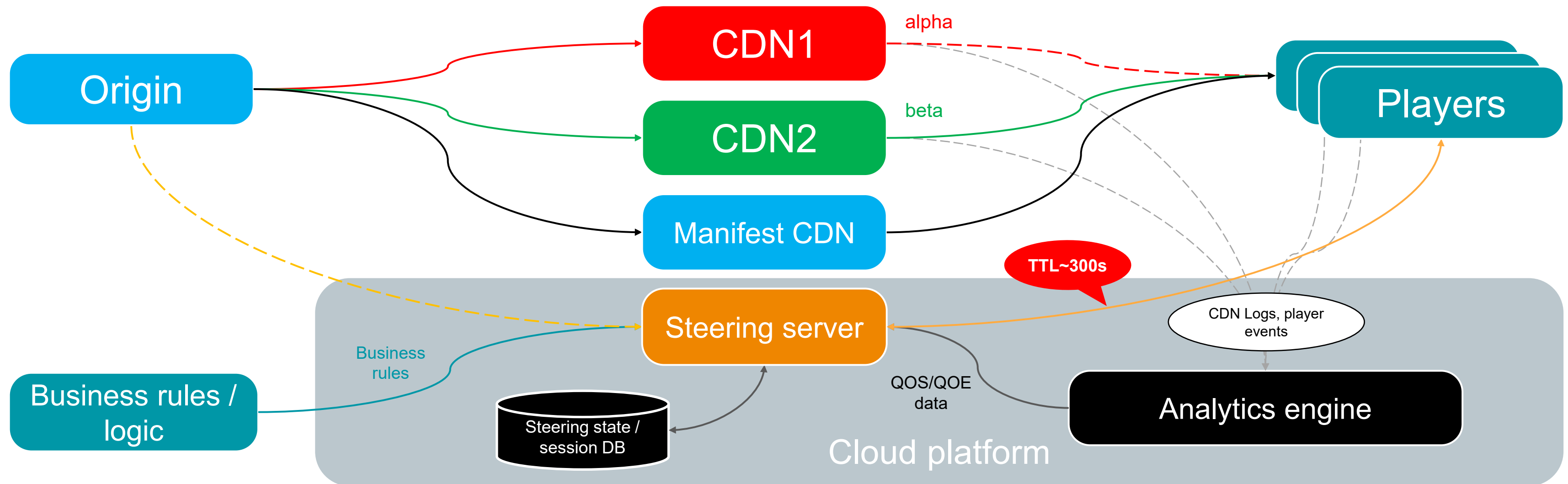


Pros:

- ▶ Standards based
- ▶ The same steering protocol & server is used for both HLS and DASH
- ▶ Simple integration – no need to patch players!
- ▶ Backwards compatible
- ▶ Complements the existing BaseURL redundancy / failover behavior mechanisms

CONTENT STEERING SERVER

Direct implementation

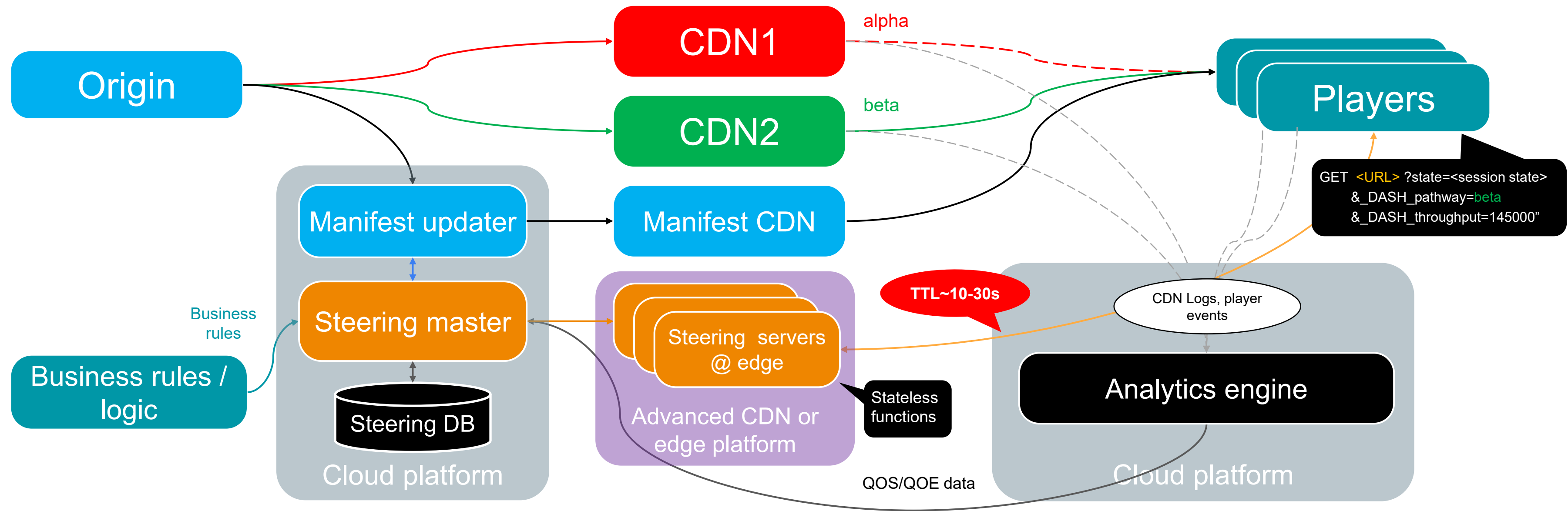


Challenges / tradeoffs:

- ▶ **TTL time**: 300s default is too long! Suitable for basic CDN load balancing. Not suitable for QOE optimizations.
- ▶ **Scalability**: the steering server should be at least as scalable as manifest CDN!
- ▶ **Costs**: reducing TTL will increase number of requests and traffic to the steering server!

CONTENT STEERING @ EDGE

Edge-based implementation



Advantages:

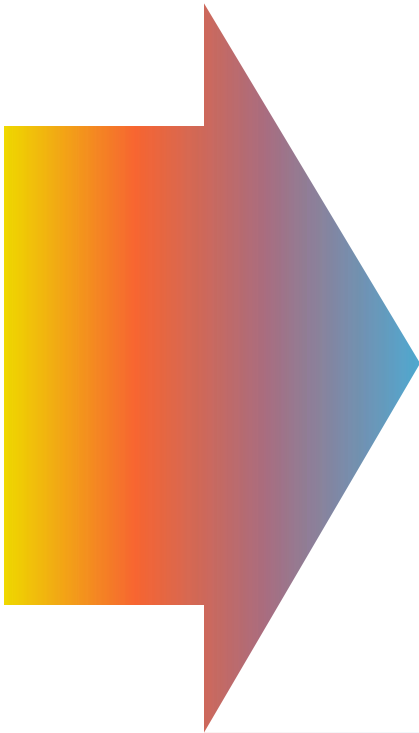
- ▶ TTL can be much smaller – comparable to player buffer delay
- ▶ Enables QOE optimizations, faster switching / failover, more precise load-balancing.
- ▶ Scales well. Multiple CDNs or platforms can be used for redundancy.

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PERFORMANCE STUDY

Methodology

- Systems compared:
 - > CDN A/B/C – single-CDN systems
 - > CDN A+B+C – multi-CDN system with content steering
- Testing orchestration
 - > Over 150 proxies utilized
 - > Broad spread of geo locations
 - > Using K6, and several VPN networks
- Volumes
 - > Over 8000 sessions
 - > Over 1300 of playback hours
 - > Over 1.3TB of media data delivered
- Protocols & clients:
 - > DASH, DASH.js client
 - > HLS, HLS.js client
- Steering servers, analytics
 - > Brightcove



www.testbed.content-steering.com

Playback statistics

Volume

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Video views	4838	2766	2923	3031
Seconds played	2908810	1656690	1748420	1828050
Traffic [GB]	545.73 CDN-A: 174.67 [32.01%] CDN-B: 157.20 [28.80%] CDN-C: 213.87 [39.19%]	452.98	413.86	476.68

QoS

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Throughput [Mbps]	246.47	127.48	60.63	128.55
Throughput SD [Mbps]	361.61	227.22	179.56	245.00
Latency [ms]	45.30	98.61	257.50	90.35
Latency SD [ms]	151.54	172.27	434.51	295.02
CDN switches	127	0	0	0

QoE

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Start time [ms]	798.53	973.07	1667.90	1018.01
Re-buffering ratio [%]	0.03	0.54	5.57	0.54
Re-buffering events [#/session]	0.06	0.19	7.04	0.11
Video bitrate [Mbps]	5.66	5.74	4.28	5.86
Resolution [lines]	1059	1038	840	1060
Rendition switches [#/session]	0.12	0.58	0.40	0.31

Start playback session

System

CDN A + B + C + Content Steering

Media / Format

Big Buck Bunny - DASH

Streaming client

DASH.js

Load

CDN A + B + C + Content Steering

Pathway	Target load allocation
cdn-a	34 %
cdn-b	33 %
cdn-c	33 %

PERFORMANCE STUDY

Performance in different regions

Playback statistics

All Continents

France

All Streaming protocols

Volume

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Video views	272	148	177	138
Seconds played	164962	89936	107333	82577
Traffic [GB]	27.23 CDN-A: 0.48 [1.77%] CDN-B: 26.29 [96.52%] CDN-C: 0.47 [1.71%]	16.33	23.18	13.02

QoS

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Throughput [Mbps]	312.89	186.37	165.64	142.39
Throughput SD [Mbps]	454.87	264.07	293.98	203.92
Latency [ms]	16.70	22.97	19.31	26.29
Latency SD [ms]	62.32	52.98	67.23	65.49
CDN switches	2	0	0	0

QoE

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Start time [ms]	399.94	376.24	642.87	391.55
Re-buffering ratio [%]	0.00	0.00	0.00	0.00
Re-buffering events [#/session]	0.00	0.00	0.00	0.00
Video bitrate [Mbps]	5.63	4.90	5.67	5.68
Resolution [lines]	1056	967	1061	1053
Rendition switches [#/session]	0.01	0.01	0.01	0.04

Playback statistics

All Continents

India

All Streaming protocols

Volume

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Video views	131	114	109	104
Seconds played	71299	63462	56869	56957
Traffic [GB]	13.09 CDN-A: 2.28 [17.40%] CDN-B: 0.87 [6.66%] CDN-C: 9.94 [75.94%]	17.22	14.14	15.13

QoS

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Throughput [Mbps]	45.99	36.65	8.27	47.27
Throughput SD [Mbps]	41.11	37.36	12.24	41.25
Latency [ms]	73.20	139.79	583.60	57.69
Latency SD [ms]	191.72	221.82	1838.23	141.54
CDN switches	7	0	0	0

QoE

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Start time [ms]	1223.16	1724.05	3875.79	1676.91
Re-buffering ratio [%]	0.14	0.22	4.68	1.81
Re-buffering events [#/session]	0.24	0.31	4.90	0.36
Video bitrate [Mbps]	5.42	5.29	3.81	5.65
Resolution [lines]	1036	996	783	1053
Rendition switches [#/session]	0.59	1.18	0.83	0.27

- Improvements depend on:
- > Diversity of performance of CDNs used in the mix

> The more diverse it is the more QOE/QOS gains are achievable

> This translates to geographic reach: the wider it is the more important is multi-CDN and QOE-based steering

PERFORMANCE STUDY

QOS/QOE gains

Playback statistics



All Continents ▾

Hong Kong ▾

All Streaming protocols ▾

Volume

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Video views	134	139	133	131
Seconds played	75908	76232	69627	75343
Traffic [GB]	14.51 CDN-A: 0.76 [5.27%] CDN-B: 0.33 [2.26%] CDN-C: 13.42 [92.48%]	22.81	17.31	20.33

QoS

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Throughput [Mbps]	53.21	36.88	10.23	47.57
Throughput SD [Mbps]	41.09	42.13	17.14	42.69
Latency [ms]	39.71	205.77	645.35	91.53
Latency SD [ms]	127.28	258.43	430.34	204.69
CDN switches	6	0	0	0

QoE

System	CDN A + B + C + Content Steering	CDN A	CDN B	CDN C
Start time [ms]	1275.35	1918.46	3581.55	1768.08
Re-buffering ratio [%]	0.04	0.04	4.30	0.07
Re-buffering events [#/session]	0.04	0.20	8.17	0.21
Video bitrate [Mbps]	5.61	4.79	3.49	5.50
Resolution [lines]	1058	919	745	1025
Rendition switches [#/session]	0.24	2.29	0.61	1.24

- Substantial improvements:
- > Up to 30% higher resolution
 - > Up to 5x reduction in buffering
 - > Up 5x fewer switches

Playback statistics



All Continents ▾

India ▾

All Streaming protocols ▾

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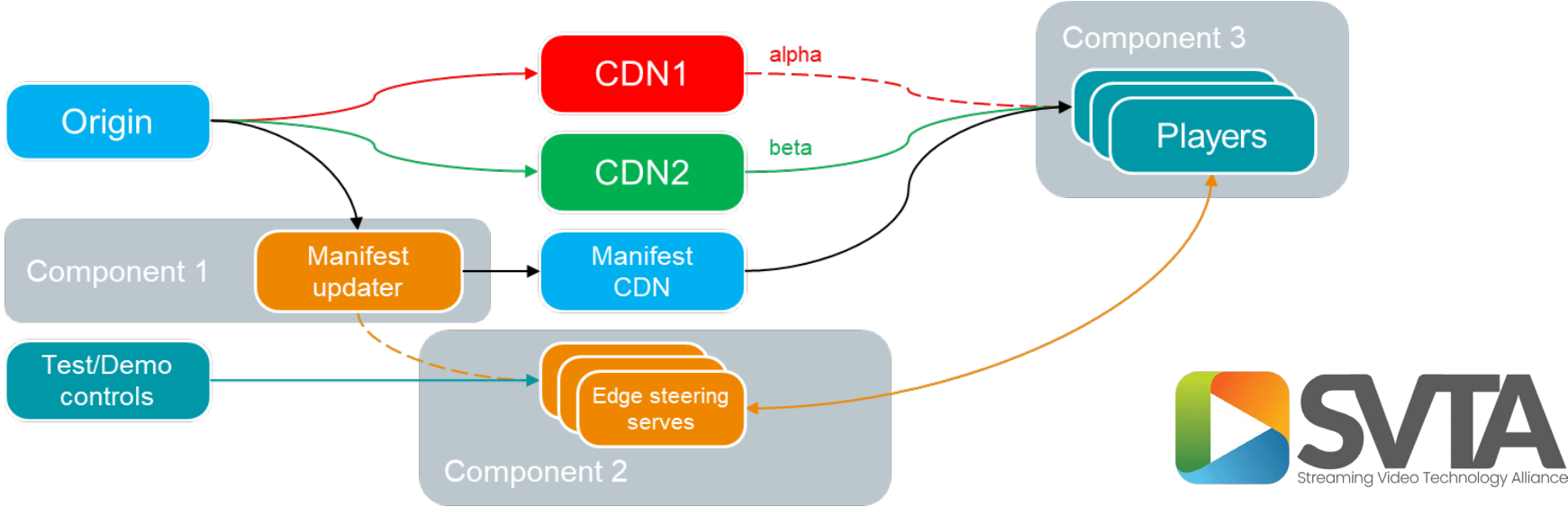
INDUSTRY ADOPTION

Significant momentum

► Players:

Media Player	DASH Content Steering	HLS Content Steering
 dash.js	since version 4.5.0	
 VIDEO.JS	since version 8.8.0	since version 8.8.0
 Shaka Player	since version 4.6.0	since version 4.6.0
 ExoPlayer	planned for 2024	planned for 2024
 hls.js		since version 1.4.0
 AVPlayer		since iOS version 15.0

► Open source tools

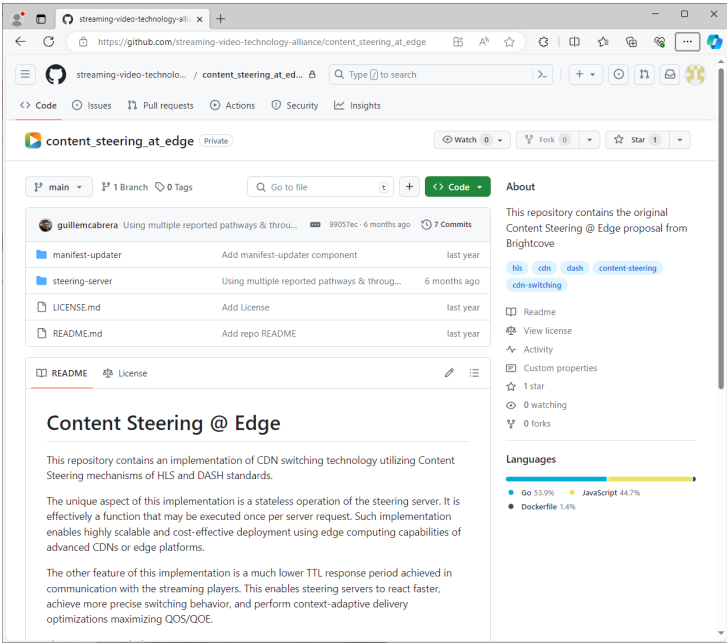


► Packagers & servers:

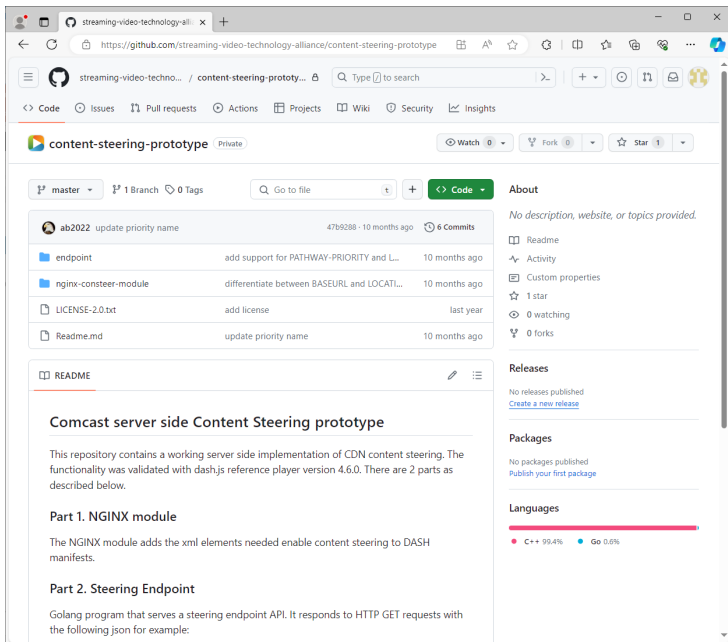
> Brightcove, Synamedia, Google (Shaka)

► Standards & guidelines

- IETF RFC 8216bis (HLS)
- ISO/IEC 23009-1 (DASH)
- ETSI TS 103 998 (DASH-IF Content Steering)



https://github.com/streaming-video-technology-alliance/content_steering_at_edge



<https://github.com/streaming-video-technology-alliance/content-steering-prototype>



**THANK
YOU**