10 Innovations At the Edge

April 2021
12th SMPTE Workshop on Emerging Technologies

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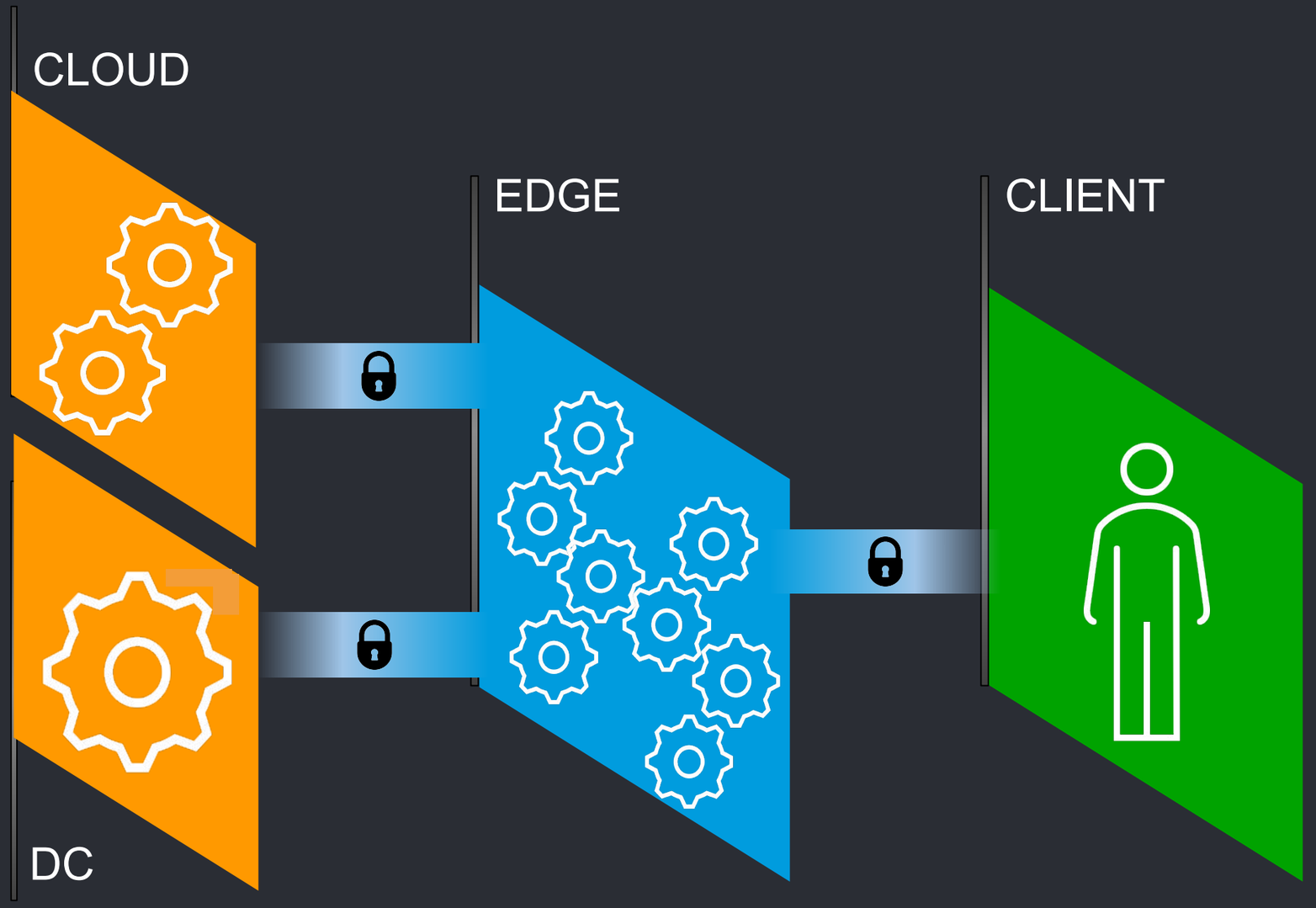
Senior Solutions Engineer

Akamai
Experience the Edge

CHECK OUT THE LINKS AT THE BOTTOM OF THE SLIDES

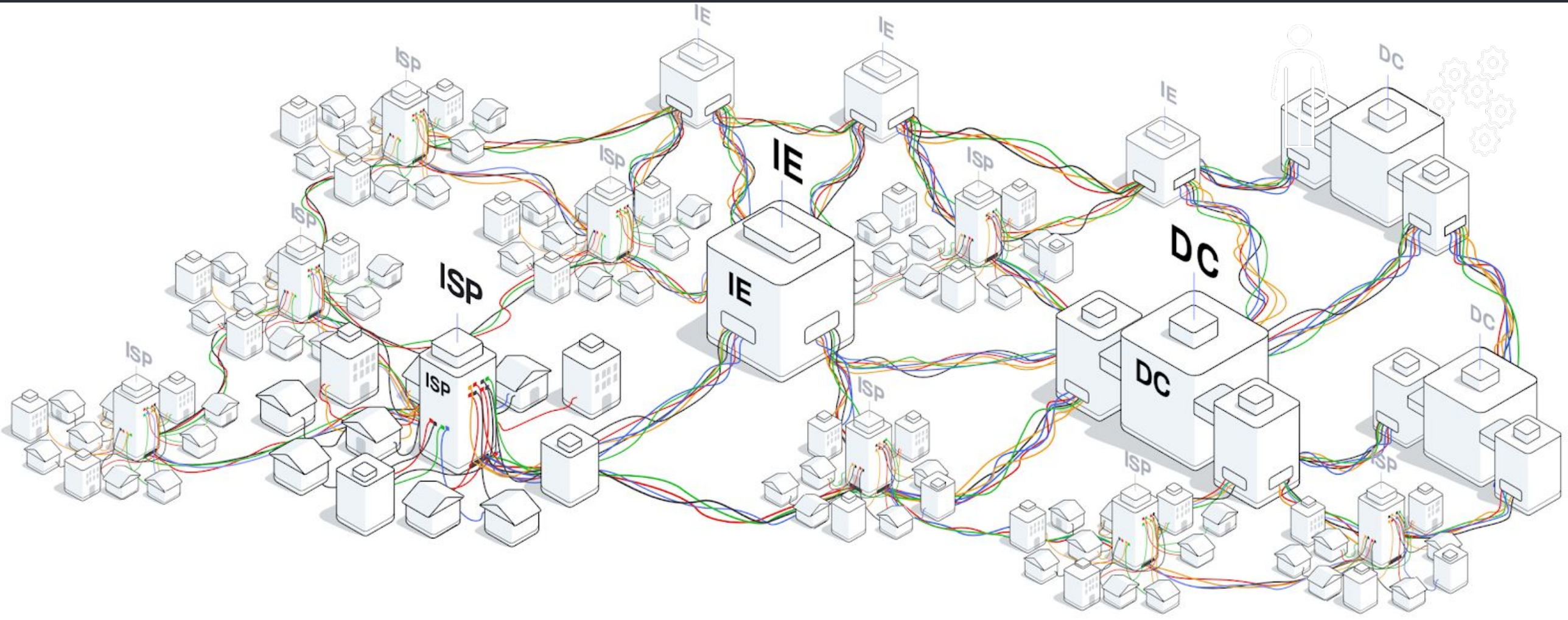
https://blogs.akamai.com/2021/03/akamai-focused-on-whats-next-following-new-traffic-milestone.html

Secure all the connections



https://blogs.akamai.com/2020/10/three-cloud-first-akamai-initiatives-to-support-your-cloud-journey.html
https://blogs.akamai.com/2020/10/whats-new-in-delivery.html
https://www.akamai.com/it/it/products/media-delivery/direct-connect.jsp

Secure all the connections



https://www.akamai.com/uk/en/about/facts-figures.jsp

Security Posture

Akamai Has Been Seeing Huge Increases in Attacks

1,800+
DDoS attacks mitigated in Q4 (+40% Y/Y)

2 Billion
WAF alerts fired in Q4, (+20% Q/Q)

200 Billion
credential abuse attacks in 2020 (+300% Y/Y)

New Record

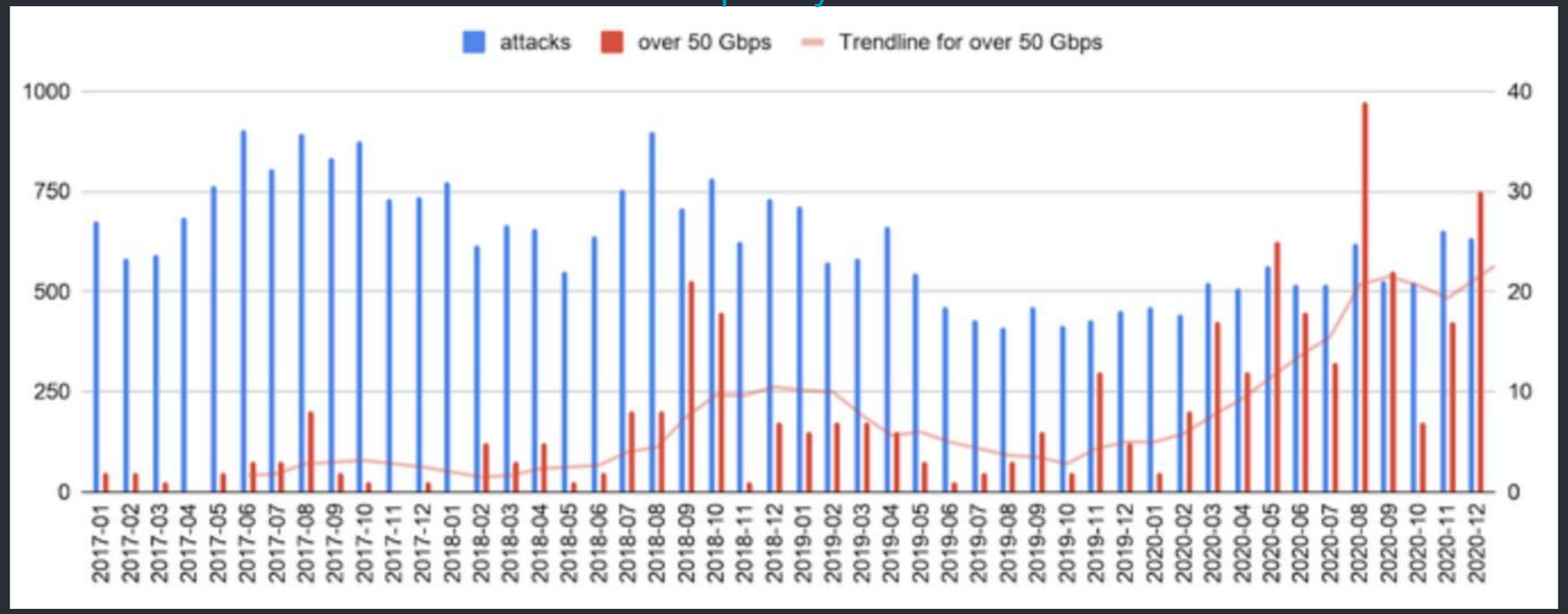
We experienced our first “1 billion malicious login attempts” day

1 Dec 2020:
1,003,963,614

We analyze 290 TB of new attack data every day

Security Posture

DDOS Attack Frequency from 2017 to 2020



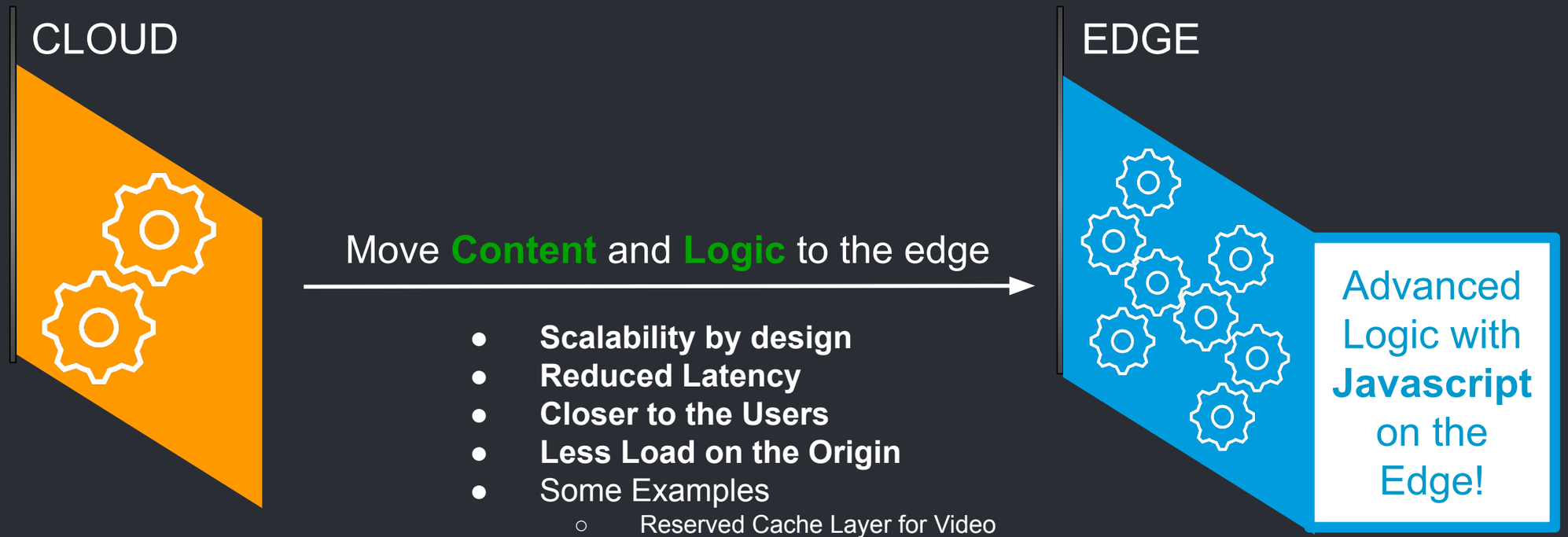
In the first week of June 2020, Akamai mitigated an attack that is so far the largest seen on the Akamai platform. This time, it was against one of our internet hosting provider customers, with globally distributed attack traffic resulting in a **1.44 terabit per second** (Tbps) lasting nearly two hours.

On June 21, 2020, Akamai mitigated the largest packet per second (PPS) distributed denial-of-service (DDoS) attack ever recorded on the Akamai platform. The attack generated **809 million packets per second** (Mpps).

https://blogs.akamai.com/2020/06/largest-ever-recorded-packet-per-secondbased-ddos-attack-mitigated-by-akamai.html
https://blogs.akamai.com/2020/06/akamai-mitigates-sophisticated-144-tbps-and-385-mpps-ddos-attack.html
https://blogs.akamai.com/2021/01/part-i-retrospective-2020-ddos-was-back-bigger-and-badder-than-ever-before.html

Offload the Origin*

*also the web functions



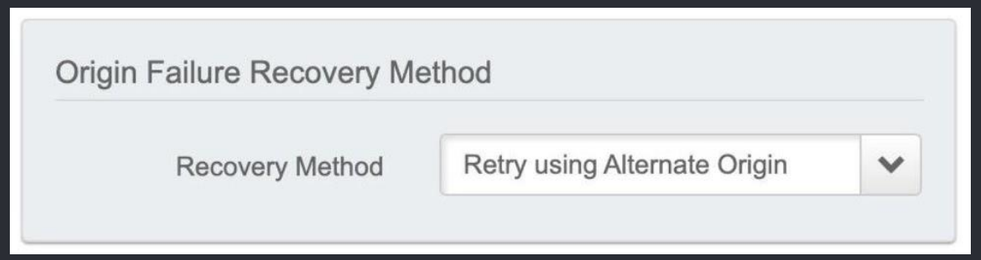
- **Scalability by design**
- **Reduced Latency**
- **Closer to the Users**
- **Less Load on the Origin**
- Some Examples
  - Reserved Cache Layer for Video
  - Manifest Personalization
  - Geo Services
  - Images Optimization
  - Text Compression
  - Security on Video
  - ….

https://www.akamai.com/it/it/products/media-delivery/cloud-wrapper.jsp
https://developer.akamai.com/akamai-edgeworkers-overview

Have Alternatives..

..with logic on the edge

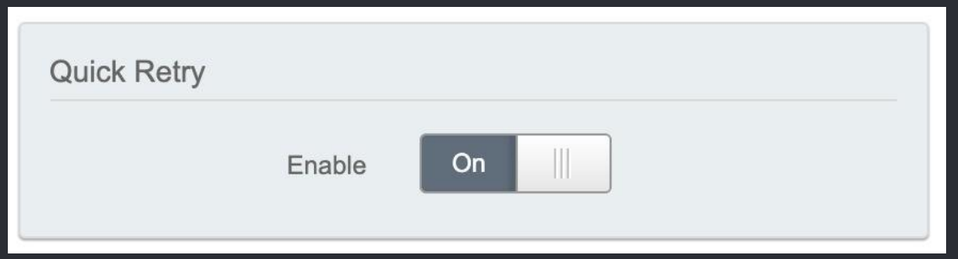
Step 1: Failure detection



Step 2: Failover actions

https://blogs.akamai.com/2020/01/maintain-your-streaming-posture-during-failures-with-origin-failover.html

..inside a network

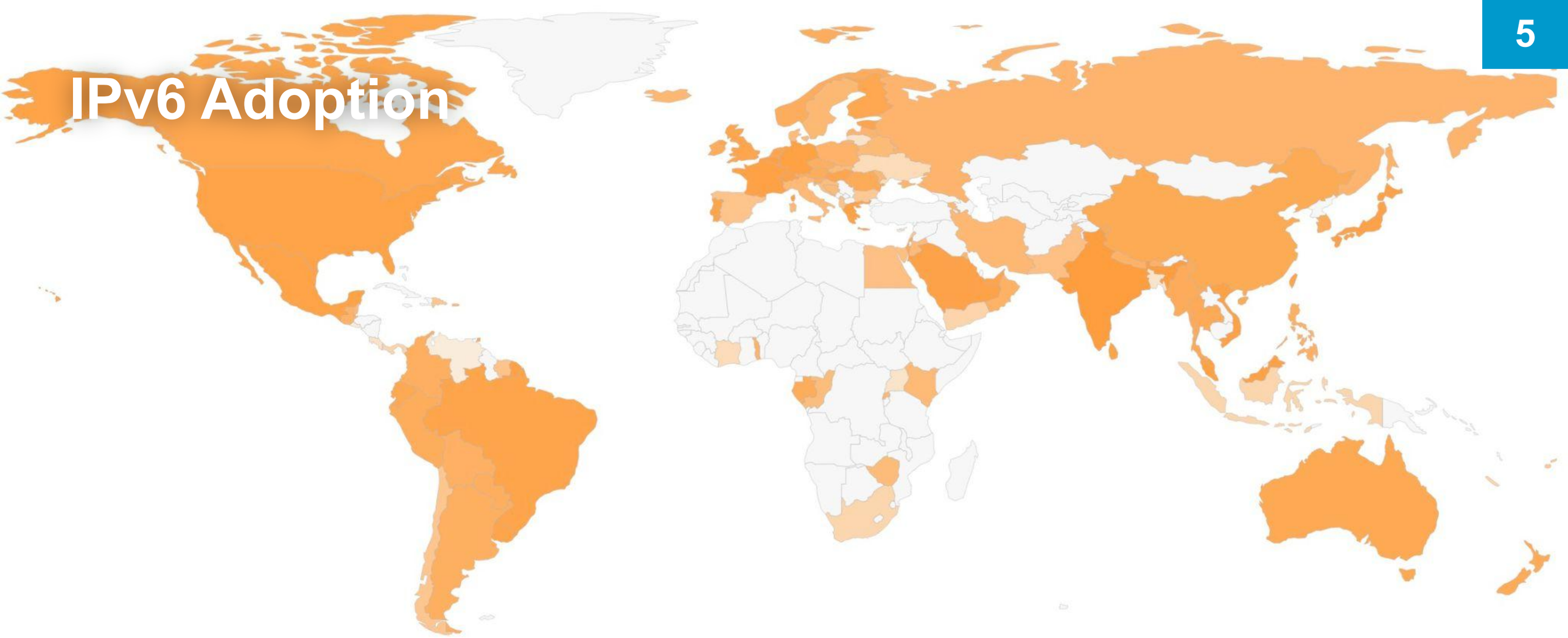


It detects that an expected response for a user request is taking too long and quickly retries the same request over a different route.

Customers who implement Quick Retry can see a reduction in rebuffer rates by 15%

https://blogs.akamai.com/2019/10/quick-retry-per-request-route-optimization-to-reduce-video-rebuffer-rates.html

IPv6 Adoption



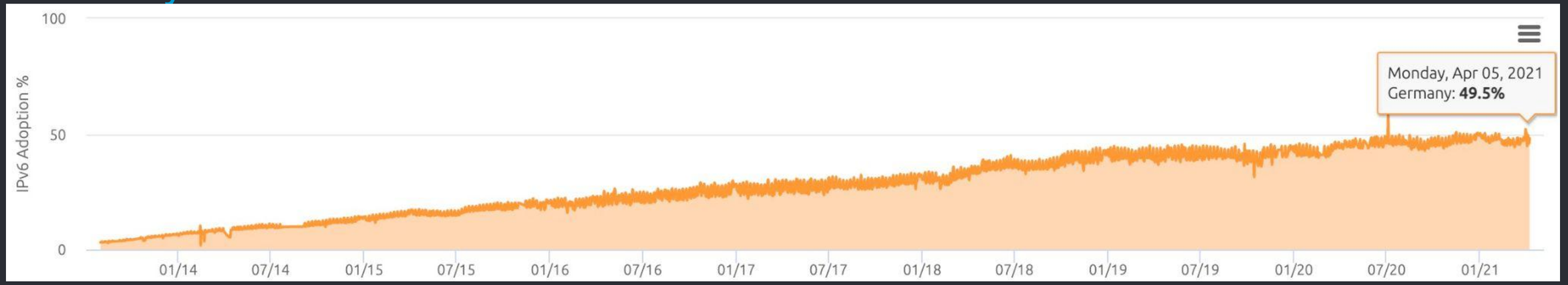
With Internet growth exceeding the limited number of IPv4 addresses, many ISPs and service providers have broadly deployed IPv6. Hosts available over both IPv6 and IPv4 are known as dual stacked. Akamai recommends that sites be enabled with IPv6 wherever possible, both for performance and scale.

We see that IPv6 typically gets delivered with higher throughput than IPv4. One reason for this is that some large network providers, especially mobile networks, are shifting to IPv6-only for end-user connectivity and provide legacy IPv4 connectivity via IPv4-as-a-service over IPv6. This means that IPv6 traffic can reach the Internet directly, while IPv4 traffic needs to go through network address translation (NAT) exit points.

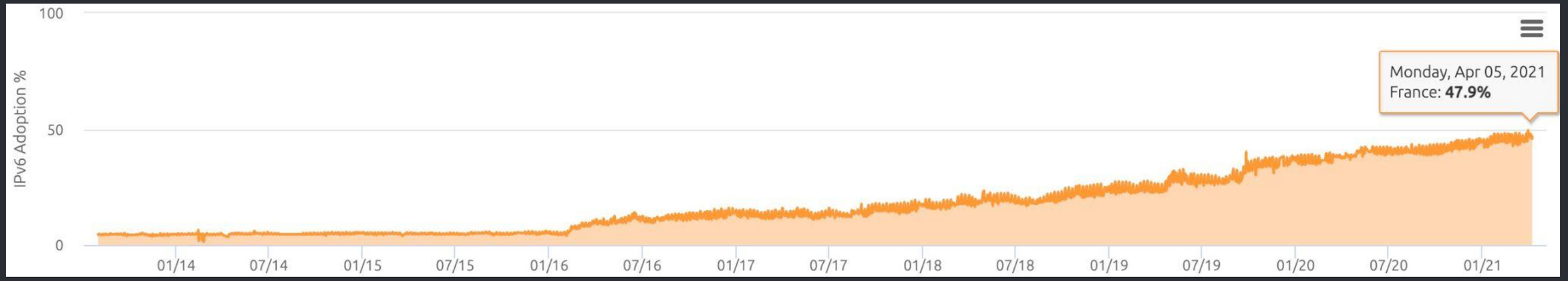
https://developer.akamai.com/blog/2020/05/04/introduction-ipv6

IPv6 Adoption

Germany



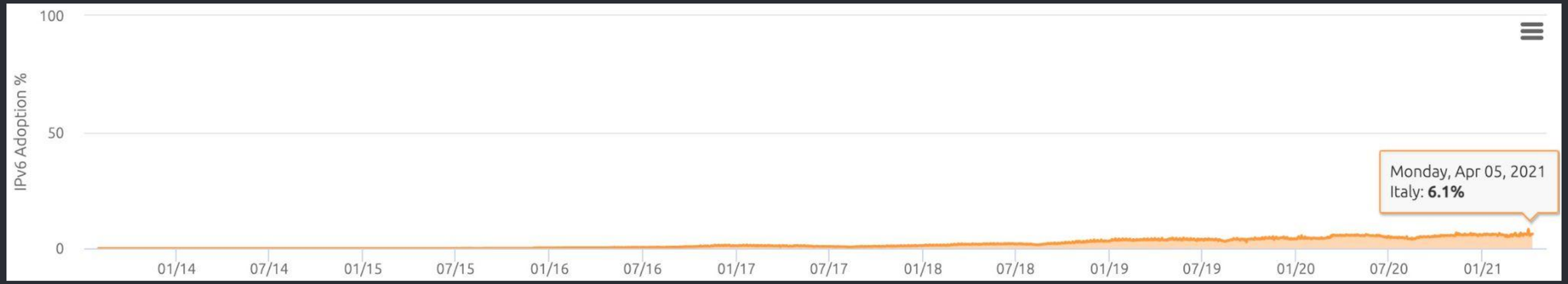
France



https://www.akamai.com/it/it/resources/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp
Growth of IPv6 usage (% of requests which are IPv6) from June 2013 to February 2020 for dual-stacked hosts on Akamai.

IPv6 Adoption

And Italy?



https://www.akamai.com/it/it/resources/our-thinking/state-of-the-internet-report/state-of-the-internet-ipv6-adoption-visualization.jsp
Growth of IPv6 usage (% of requests which are IPv6) from June 2013 to February 2020 for dual-stacked hosts on Akamai.

HTTP2 and HTTP3

HTTP protocol (also known as web protocol), powers most websites, mobile apps, and videos. It was created by Tim Berners-Lee at CERN in 1989, and has been enhanced over the years to keep up with the ever-changing World Wide Web. Each new version of the protocol provides features that improve the performance, usability, and security of the web.

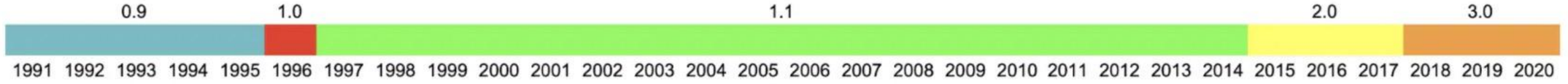


Figure 1. HTTP protocol timeline. Although the IETF HTTP/3 draft started in 2016, HTTP/3 was officially coined in December 2018 with draft version 17 and has not been finalized as of this publication. See the IETF email archive for more details.

Quick UDP Internet Connection (QUIC), is a new multiplexed and secure transport protocol optimized for HTTP/2 on top of UDP, being standardized within IETF's QUIC Working Group.

Chrome and Chromium-based browsers are already using QUIC at large-scale when using Google’s and Akamai's services.

https://developer.akamai.com/blog/2020/04/14/quick-introduction-http3
https://blogs.akamai.com/2020/11/http3-ready-to-land.html
https://developer.akamai.com/blog/2018/10/10/introducing-quic-web-content

Anti-Congestion Algorithms

AKAMAI IMPROVES GLOBAL DELIVERY PERFORMANCE

By Alex Balford **December 19, 2019 8:55 AM**

As part of Akamai's ongoing investments in improving delivery performance, last month we completed the worldwide deployment of the Bottleneck Bandwidth and RTT (BBR) TCP congestion control algorithm across our Edge Platform. The BBR algorithm is designed to help improve the reliability and resiliency of data by optimizing the rate at which it's transmitted over last-mile networks to end users. After more than a year of extensive testing, we've rolled out a version of BBR that is optimized specifically for the Akamai network to impressive results.

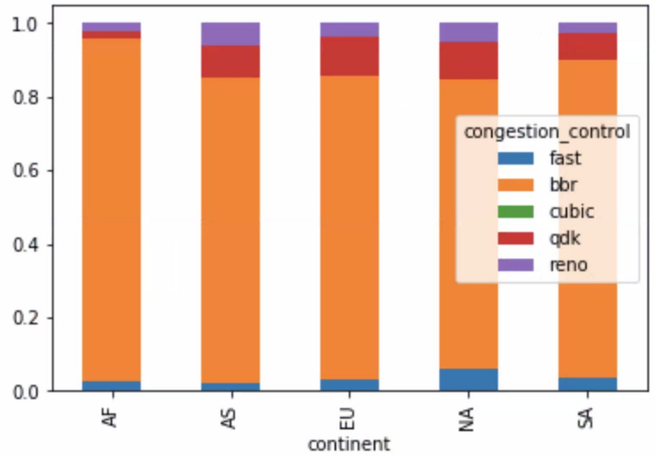
Since its introduction on the Akamai network, BBR has been used as the congestion control algorithm of choice, now serving more than 80 percent of end user connections. Product performance tests and customers have also shown an increase in throughput and improvements in video rebuffering rates.

Below are a few notable examples of delivery performance improvements since BRR was deployed (note that customers are anonymized for public-facing purposes):

Customer Performance

- One customer that uses multiple CDN services reported that Akamai moved into the top spot for US CDN performance thanks to a 5 Mbps increase in average throughput immediately following the BBR deployment.
- Another customer recognized a 5% - 18% improvement in average throughput across the global geographies in which it uses Akamai for video delivery.

DPO predictions



https://blogs.akamai.com/2019/12/akamai-improves-global-delivery-performance.html

CMAF

CMAF

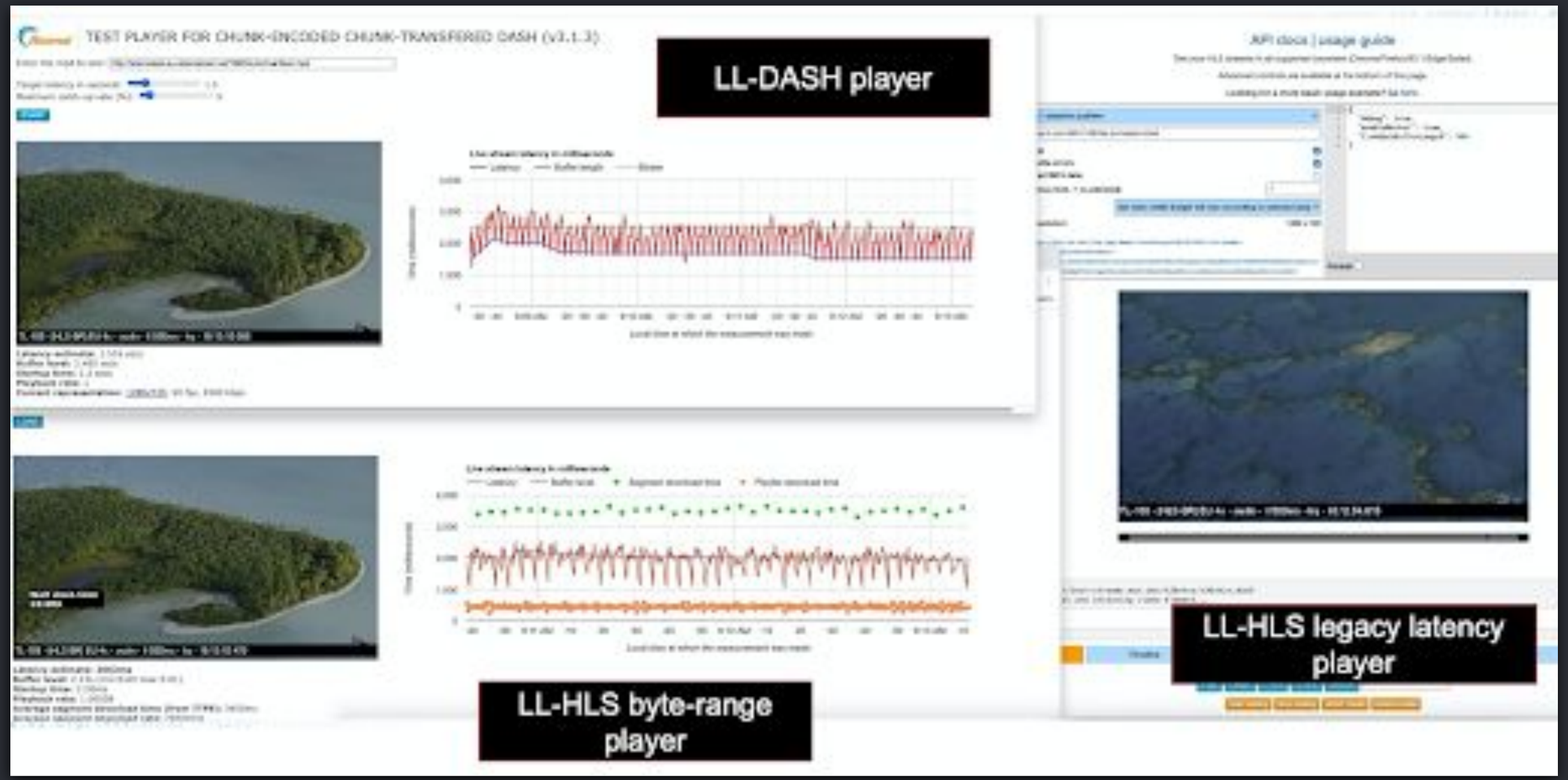
Common Media Application Format

Not only to reduce Latency..

- **Improved Cache Efficiency for HLS & DASH**
- **Faster Stream Startup Time**
- **Less Storage Cost**
- **Extended Buffer on the player** (compared to equivalent latency of legacy formats)
- **CENC & Last Codecs Compatible**

https://blogs.akamai.com/2020/09/cmaf-this-is-the-way.html

CMAF



Summary:

- Increased **cache efficiency** at origin and CDN distribution tiers, which increases performance and lowers operating costs

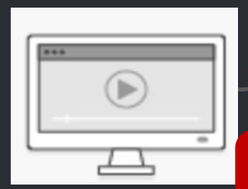
- **Interoperability** among four types of clients:
  1. low latency HLS clients
  2. standard latency HLS clients (also equivalent to LL-HLS clients scrubbing back from live)
  3. low latency DASH clients
  4. standard latency DASH clients

https://blogs.akamai.com/2020/11/using-ll-hls-with-byte-range-addressing-to-achieve-interoperability-in-low-latency-streaming.html

Anti-Piracy Posture

Attacks differ based on the pirate & motivation

Acquisition | Production | Distribution | Customer Experience



Credential Stuffing

MITMA

System Hacking

Signal hijacking

DRM key hacking

UID Theft

Content Theft

Corporate IT

Phishing

Direct to Consumer

VPN Transport

Cyberlockers & Torrent

Password Sharing / Theft

Illegal Streaming

Content Distributors

Screen recording

Internet Streaming Devices

Anti-Piracy Posture

A 360° Security Posture to combat piracy

PROTECT

DETECT

ENFORCE

Intelligence & Cooperation

https://blogs.akamai.com/2020/10/is-it-worth-it-to-defend-your-service-from-video-piracy.html

Anti-Piracy Posture

Provide a robust content protection solution to prevent content piracy, unauthorized access & maximize monetization opportunities for customers

01 USER AUTHENTICATION

User authentication using tokens to prevent unauthorized link sharing

02 GEO RESTRICTIONS

Protect content access from unauthorized regions and devices, incl. proxies and VPN

03 ANOMALY DETECTION

Identify anomalous request patterns that could indicate suspicious activity

04 DRM & MEDIA ENCRYPTION

Securing video delivery by using the market encryption standards

05 ACCESS REVOCATION

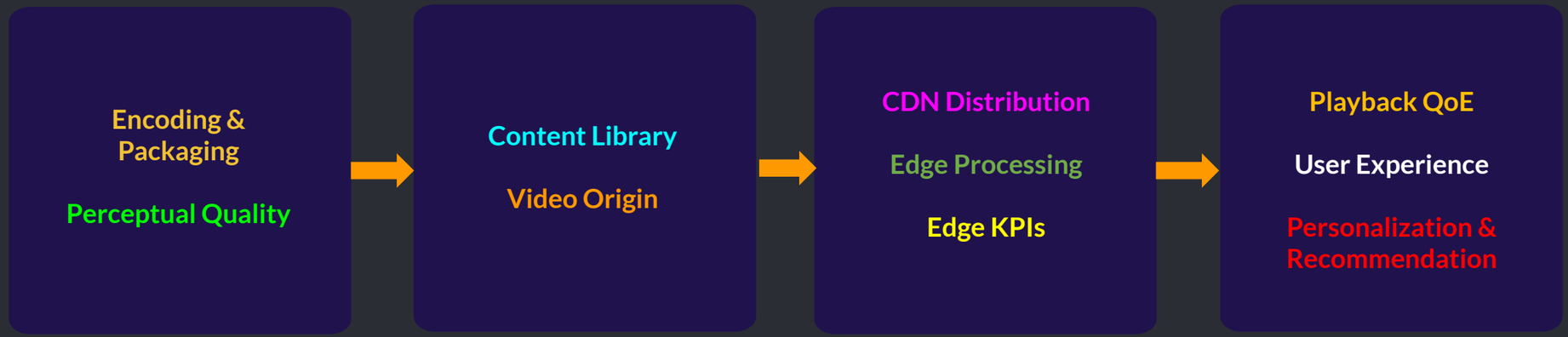
Programmatic way to revoke access to tokens in real time blocking illegit users

06 CONTENT WATERMARKING

Adding unique, imperceptible markers to determine the source of a content leak

https://blogs.akamai.com/2020/09/tackling-video-piracy-head-on.html

Logs, KPI, QoE

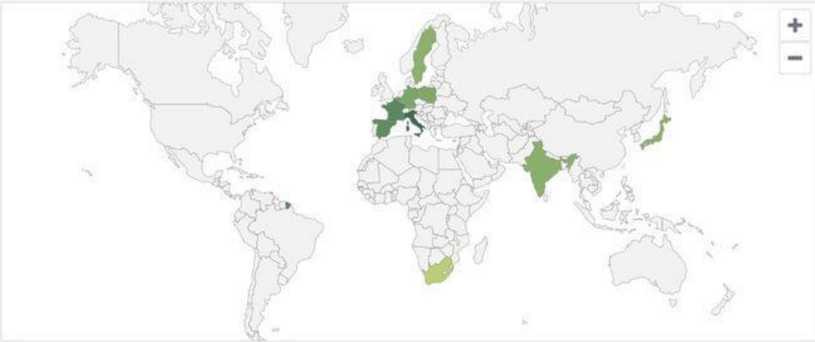


Each function for every box has its **own data**, and its **own KPIs**.
We can **combine** them together, for example:

- Knowing the **perceptual quality** of a encoded video when played back on a specific screen size, enables a higher knowledge of the **real QoE**.
- Data from the edge and from the player could be joined with perceptual quality measures to calculate better the **quality delivered** to every user on their current devices.
- Combine these KPIs with the **audience** analytics to have deeper insights about the user habits.
- Such information could be useful to better estimate QoE per single title and correlate it with abandon rate, churn or other **business and platform KPI**.

3rd Milan Video Tech Meetup: https://youtu.be/-Gx5SXr-TJ0

Logs, KPI, QoE

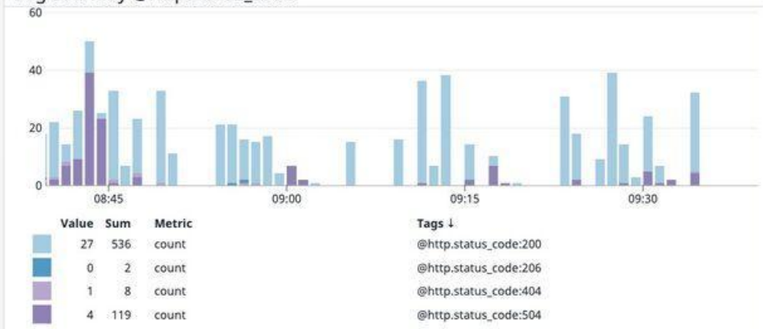


Requests

Log count by @http.url_details.p...

73.00	/HLS-test/3/segment4_3_av.ts
72.00	/HLS-test/master.m3u8
53.00	/HLS-test/3/segment8_3_av.ts
46.00	/HLS-test/2/segment1_2_av.ts
45.00	/HLS-test/3/index_3_av.m3u8
39.00	/HLS-test/3/segment2_3_av.ts
38.00	/HLS-test/2/index_2_av.m3u8
35.00	/HLS-test/3/segment3_3_av.ts
33.00	/HLS-test/2/segment2_2_av.ts
32.00	/HLS-test/3/segment5_3_av.ts
28.00	/HLS-test/3/segment1_3_av.ts
26.00	/HLS-test/3/segment10_3_av.ts
25.00	/HLS-test/3/segment6_3_av.ts
24.00	/HLS-test/3/segment7_3_av.ts
22.00	/HLS-test/3/segment9_3_av.ts
18.00	/HLS-test/2/segment3_2_av.ts
12.00	/HLS-test/2/segment5_2_av.ts
9.00	/HLS-test/2/segment6_2_av.ts
8.00	/HLS-test/2/segment10_2_av.ts
8.00	/HLS-test/2/segment4_2_av.ts
8.00	/favicon.ico
7.00	/HLS-test/2/segment8_2_av.ts
7.00	/HLS-test/2/segment9_2_av.ts
6.00	/HLS-test/2/segment7_2_av.ts

Log count by @http.status_code



Value	Sum	Metric	Tags ↓
27	536	count	@http.status_code:200
0	2	count	@http.status_code:206
1	8	count	@http.status_code:404
4	119	count	@http.status_code:504

Cardinality of @network.client.ip by @network.client....

3.00	ROME
2.00	KATOWICE
2.00	MUNICH
1.00	AUBERVILLIERS
1.00	BARCELONA
1.00	BRUSSELS
1.00	CAPETOWN
1.00	CHENNAI
1.00	FRANKFURT
1.00	HAMBURG
1.00	MADRID
1.00	STOCKHOLM
1.00	TOKYO

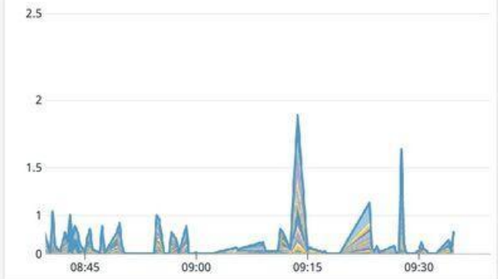
Cardinality of @network.client.ip by @network.nw

4.00	telefonica
3.00	fastweb
2.00	tim
2.00	upc
2.00	vodafone
1.00	dtag
1.00	francetelecom
1.00	softbank

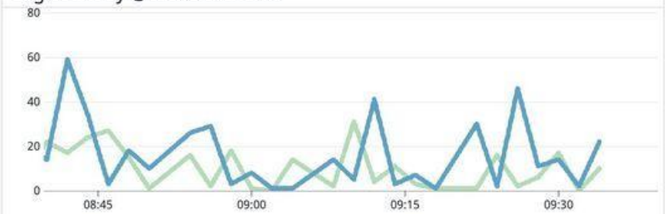
Cardinality of @network.client.ip by @network.throughput

Value	Min	Avg	Max	Metric	Tags ↓
1	0	0.58	3	cardinality:@network.client.ip	@network.throughput:low
1	0	0.79	2	cardinality:@network.client.ip	@network.throughput:vhigh

Avg of Download_Time_Metric over * by netperf.do...



Log count by @cache.cacheHit



Value	Min	Avg	Max	Metric	Tags ↓
10	0	10.44	31	count	@cache.cacheHit:0
22	1	16.16	59	count	@cache.cacheHit:1

HTTP.USERAGENT_DETAILS.DEVICE.BRAND	↓ CLIENT IP	HTTP.USERAGENT
Apple	16	12
Samsung	2	3
Spider	1	1

HTTP.USERAGENT_DETAILS.OS.FAMILY	↓ CLIENT IP	HTTP.USERAGENT
Mac OS X	12	9
iOS	6	3
Windows	2	1
Other	2	2
Android	2	3

HTTP.USERAGENT_DETAILS.BROWSER.FAMILY	↓ CLIENT IP	HTTP.USERAGENT
Chrome	10	5
Safari	6	4
Mobile Safari	6	3
Chrome Mobile	2	2
curl	1	1

Feb 04 09:34:33.705
{"duration":96000000,"cache":{"cacheHit":"1","cacheH":"0/0/0/0/0","cacheable":"1","cacheStatus":"1","cacheStats":"179/179"},"netPerf":

Feb 04 09:34:25.882
{"duration":36000000,"cache":{"cacheHit":"1","cacheH":"0/0/0/0/0","cacheable":"1","cacheStatus":"1","cacheStats":"179/179"},"netPerf":

Feb 04 09:34:22.464
{"duration":722000000,"cache":{"cacheHit":"1","cacheH":"0/0/0/0/0","cacheable":"1","cacheStatus":"4","cacheStats":"0/0"},"netPerf":

Feb 04 09:34:21.700
{"duration":764000000,"cache":{"cacheHit":"1","cacheH":"0/0/0/0/0","cacheable":"1","cacheStats":"0/0"},"netPerf":

Feb 04 09:34:21.274
{"duration":420000000,"cache":{"cacheHit":"0","cacheH":"0/2441478/0/0/0","cacheable":"1","cacheStats":"0/2440804"},"netPerf":

Feb 04 09:34:19.884
{"duration":1385000000,"cache":{"cacheHit":"1","cacheH":"0/0/0/0/0","cacheable":"1","cacheStats":"0/0"},"netPerf":

Feb 04 09:34:18.699
{"duration":1177000000,"cache":{"cacheHit":"0","cacheH":"0/1728210/0/0/0","cacheable":"1","cacheStats":"0/1727532"},"netPerf":

Feb 04 09:34:18.454
{"duration":230000000,"cache":{"cacheHit":"0","cacheH":"0/2158724/0/0/0","cacheable":"1","cacheStats":"0/2158052"},"netPerf":

Feb 04 09:34:17.278
{"duration":1180000000,"cache":{"cacheHit":"0","cacheH":"0/1683088/0/0/0","cacheable":"1","cacheStats":"0/1682412"},"netPerf":

Feb 04 09:34:16.784
{"duration":531000000,"cache":{"cacheHit":"0","cacheH":"0/2498629/0/0/0","cacheable":"1","cacheStats":"0/2497956"},"netPerf":

Feb 04 09:34:16.440
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6th Milan Video Tech Meetup: https://youtu.be/ab9NZldL7ZY

Logs, KPI, QoE

Web Application Video Ecosystem - Common Media Client Data (CTA-5004)

Media player clients can convey information to Content Delivery Networks (CDNs) with each object request. This information can be useful in log analysis, QoS monitoring and delivery optimization. This document outlines a simple means by which every media player can communicate data with each media object request and have it received and processed consistently by every CDN.

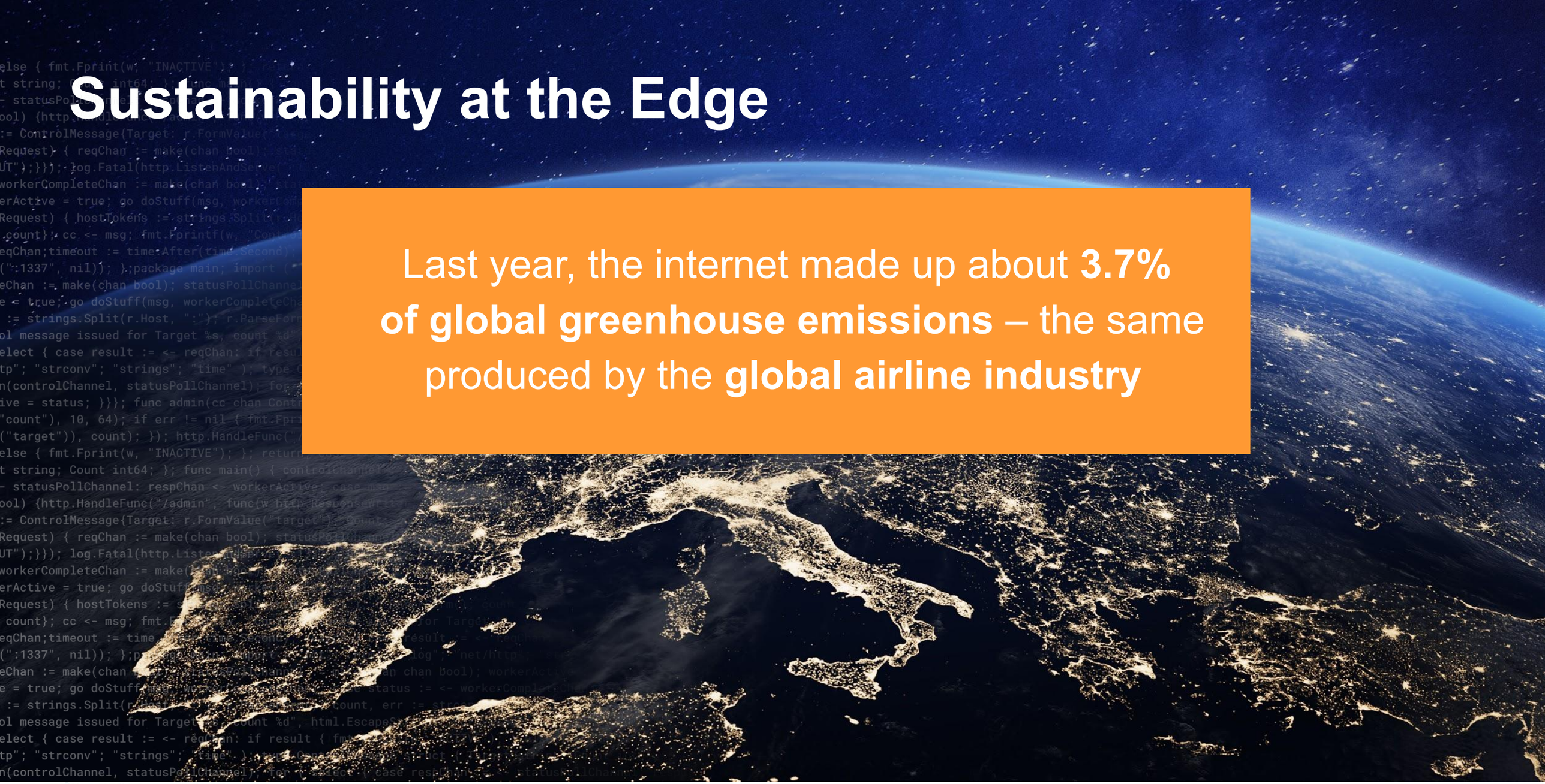
CMCD is a defined set of structured **key-value pairs**, communicating mutually beneficial **media related** information from a **player to a CDN** via either custom headers, query arg or JSON object.

This can be common to all CDNs.

https://shop.cta.tech/products/web-application-video-ecosystem-common-media-client-data-cta-5004

Sustainability at the Edge

Last year, the internet made up about **3.7% of global greenhouse emissions** – the same produced by the **global airline industry**



Today, we have...

30%

Reduced the energy need of our Network

50%

Powered our Network with 50% renewable energy

2020

Maintained emissions below 2015 levels

100%

Recycled all e-waste

Summary
10 Innovations, at the Edge

1. Secure the connections
2. Security Posture
3. Offload the Origin
4. Have Alternatives
5. IPV6 Adoption
6. HTTP2 and HTTP3
7. Anti-Congestion Algorithms
8. CMAF
9. AntiPiracy Posture
10. Logs, KPI, QoE

...and Green Akamai

Grazie!