Which CDN to Download From? A Client and Server Strategies

MHV 2023

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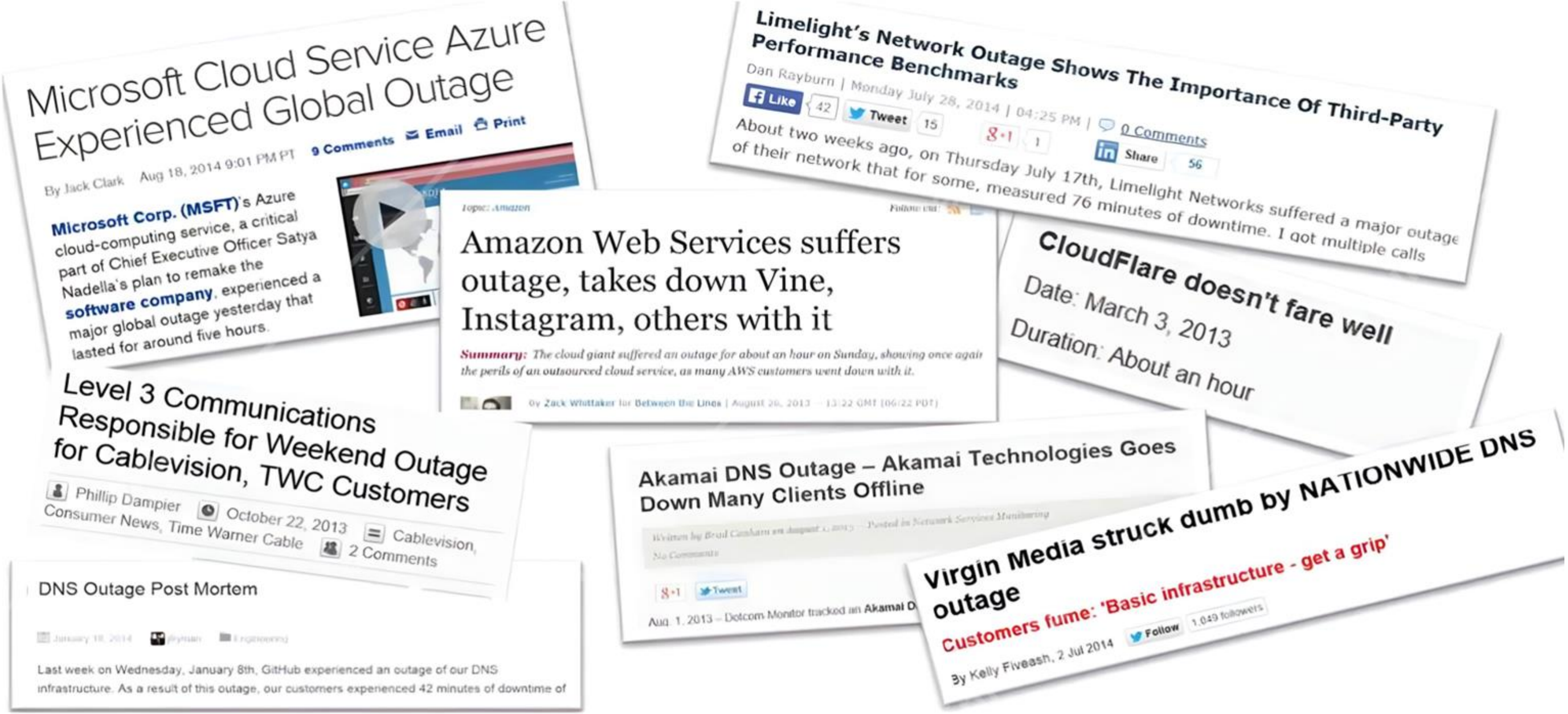
CDNs are not 100% Reliable

Video delivery companies want to detect events and automatically protect their users in real-time



Microsoft Cloud Service Azure Experienced Global Outage

By Jack Clark Aug 18, 2014 9:01 PM PT 9 Comments Email Print

Microsoft Corp. (MSFT)'s Azure cloud-computing service, a critical part of Chief Executive Officer Satya Nadella's plan to remake the **software company**, experienced a major global outage yesterday that lasted for around five hours.

Limelight's Network Outage Shows The Importance Of Third-Party Performance Benchmarks

Dan Rayburn | Monday July 28, 2014 | 04:25 PM | 0 Comments

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About two weeks ago, on Thursday July 17th, Limelight Networks suffered a major outage of their network that for some, measured 76 minutes of downtime. I got multiple calls

Topic: Amazon Follow via:

Amazon Web Services suffers outage, takes down Vine, Instagram, others with it

Summary: *The cloud giant suffered an outage for about an hour on Sunday, showing once again the perils of an outsourced cloud service, as many AWS customers went down with it.*

by Zack Whittaker for Between the Lines | August 26, 2013 -- 13:22 GMT (06:22 PDT)

CloudFlare doesn't fare well

Date: March 3, 2013

Duration: About an hour

Level 3 Communications Responsible for Weekend Outage for Cablevision, TWC Customers

Phillip Dampier October 22, 2013 Cablevision, Consumer News, Time Warner Cable 2 Comments

DNS Outage Post Mortem

January 18, 2014 [illegible] Engineering

Last week on Wednesday, January 8th, GitHub experienced an outage of our DNS infrastructure. As a result of this outage, our customers experienced 42 minutes of downtime of

Akamai DNS Outage – Akamai Technologies Goes Down Many Clients Offline

Written by Brad Canham on August 1, 2013 — Posted in Network Services Monitoring

No Comments

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Aug. 1, 2013 – Dotcom Monitor tracked an **Akamai D**

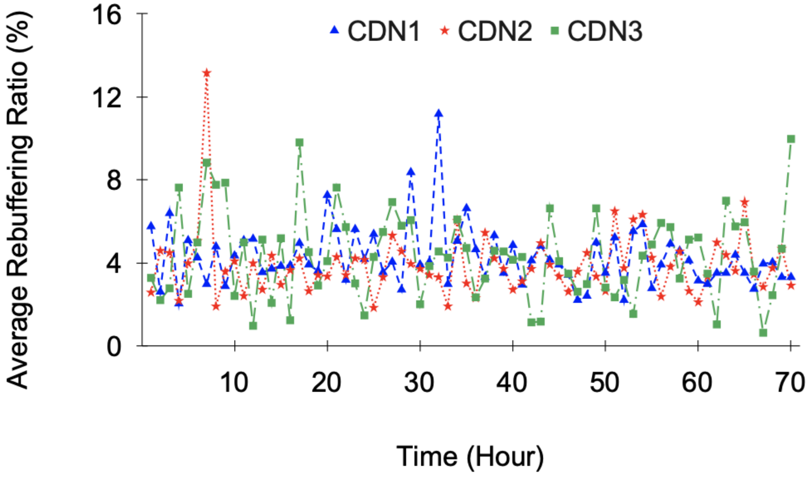
Virgin Media struck dumb by NATIONWIDE DNS outage

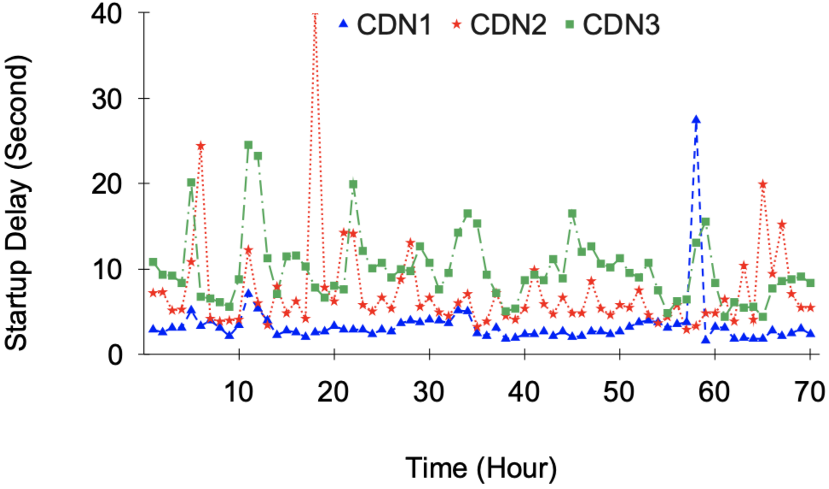
Customers fume: 'Basic infrastructure - get a grip'

By Kelly Fiveash, 2 Jul 2014 Follow 1,049 followers

Availability is not always perfect (Single CDN)

Player performance with three major CDNs within a given geographical region





Takeaway

relying on a single CDN solution increases the chances of experiencing more rebuffering and significant startup delays, both of which can lead to a poor user experience.

Issues with single CDN

Facts and statistics: technical and business

60% users suffer from poor quality

A single instance of rebuffering cost $85,000

75% customers bail when quality is bad within 4 minutes

5% ad revenue loss per 1% users facing rebuffering

* https://newsroom.accenture.com/news/sixty-percent-of-global-consumers-are-frustrated-with-navigating-content-on-streaming-video-services-according-to-accenture-report.htm

Solution: Multi-CDN

Multi-CDN benefits vs. Single CDN

Stack capacity: Increased reliability and redundancy

- Multiple CDNs means more PoPs and interconnection
- Traffic is distributed across multiple CDNs
  - reducing the risk of downtime
  - ensuring that viewers can access content even if one CDN experiences issues

Improved performance & Setup different CDN vendors

- Select different CDN vendors that not behave identical to potential service interruptions or QoE degradation factors
- Allow selection between multiple CDNs based on their performance and location
  - faster startup delay,
  - reduced buffering,
  - better QoE

Better cost-effectiveness

- Reduce costs by leveraging multiple CDNs (high-cost, mid-cost, low-cost), e.g., reduce traffic volume from high cost CDN
- Avoid overpaying for a single CDN solution

Increased scalability

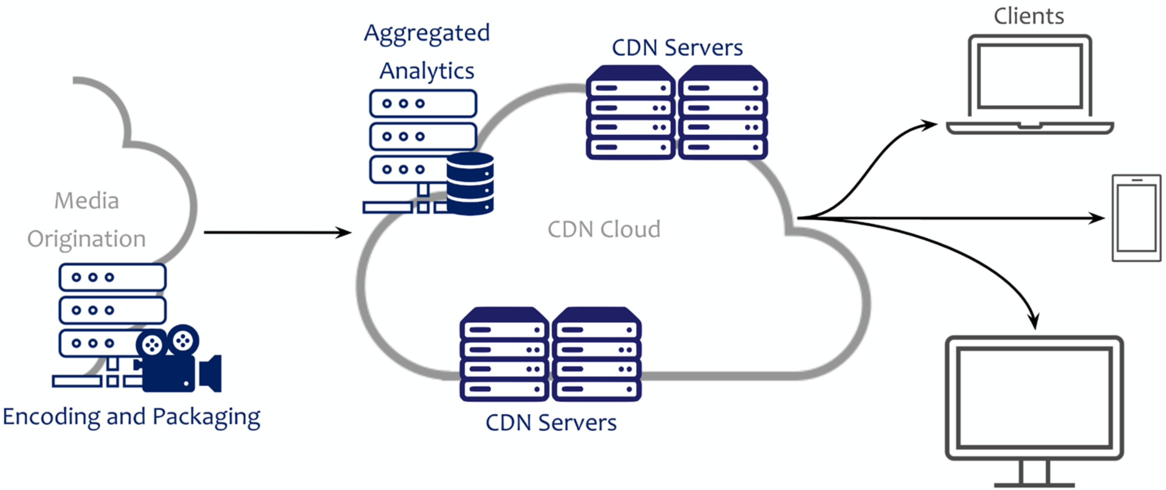
- Meet increasing demand without being limited by the capacity of a single CDN

How Can Multi-CDN Optimize QoE

Increase redundancy by using multiple CDNs without a single point of failure

Use best performing CDN

Dynamic switching to select best CDN at start, mid-stream and simply by player adaptive streaming logic (manifest file)



Dynamic Switching (CDN Selector): Existing Solutions

Four categories: DNS-based, on-the-fly manifest rewrite, client-based, and server-based

Approach	Key idea	Advantages	Weaknesses
DNS-based	Use DNS to route client requests to the best-performing CDN based on real-time performance data or based on rules (e.g. business, round robin, etc)	+ Easy to implement & practical & cost effective + act as a good traffic load balancer	- DNS caching can result in suboptimal routing and increased latency - High switching delays (> 5m)
On-the-fly manifest rewrite	Use a proxy between players and CDNs to re-writ the manifest in real-time (basedURL) based on reported real-time performance data from CDNs	+ Enable midstream switching improves QoE	- Error-prone due to manifest re-writing - Midstream switching is not completely seamless & takes time

* Data collection can be done through CMCD (client-to-CDN) and CMSD (CDN-to-client)

* Heuristics: QoE metrics (startup delay, rebuffering, latency, bitrate, etc), network conditions, CDN performance metrics, business rules

* the choice of solution will depend on factors like the complexity of the application, the desired level of control over CDN selection and performance, and the available resources for implementation and management

* https://www.muvi.com/blogs/multi-cdn-switching-in-streaming-businesses

Dynamic Switching (CDN Selector): Existing Solutions

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Approach	Key idea	Advantages	Weaknesses
Client-side	Player decides the best CDN based on latest statistics (bandwidth, rebufferings, etc): heuristic-rule vs. learning-rule	+ Real-time decision based on client statistics + Fine-grained control over CDN selection + Easy to detect cheating CDN	- Requires client-side integration, which can be complex - Can result in increased resource consumptions - Content provider lose control
Server-side	A master CDN or centralized server (content steering) selects the best CDN: heuristic-rule vs. learning-rule	+ Centralized control over CDN selection & performance + Easy to implement + Enable midstream switching improves QoE	- Requires additional infrastructure and management overhead - May result in increased server-side resource consumption - Real-time decision (many clients) - Understand collected data and data accuracy ?

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Other Alternative (Idea): Context-aware Hybrid solution

Key idea

- Combining advantages of existing solutions to provide a comprehensive dynamic switching strategy
- Collect data from all the entities involved in the delivery pipeline in a analytic server
  - Origin statistics
  - CDNs statistics
  - Players statistics

Client-side

- Collect QoE-related metrics such as bitrate selected, rebuffering durations, bitrate switch, startup delay, etc
- Using CMCD and/or side-channel

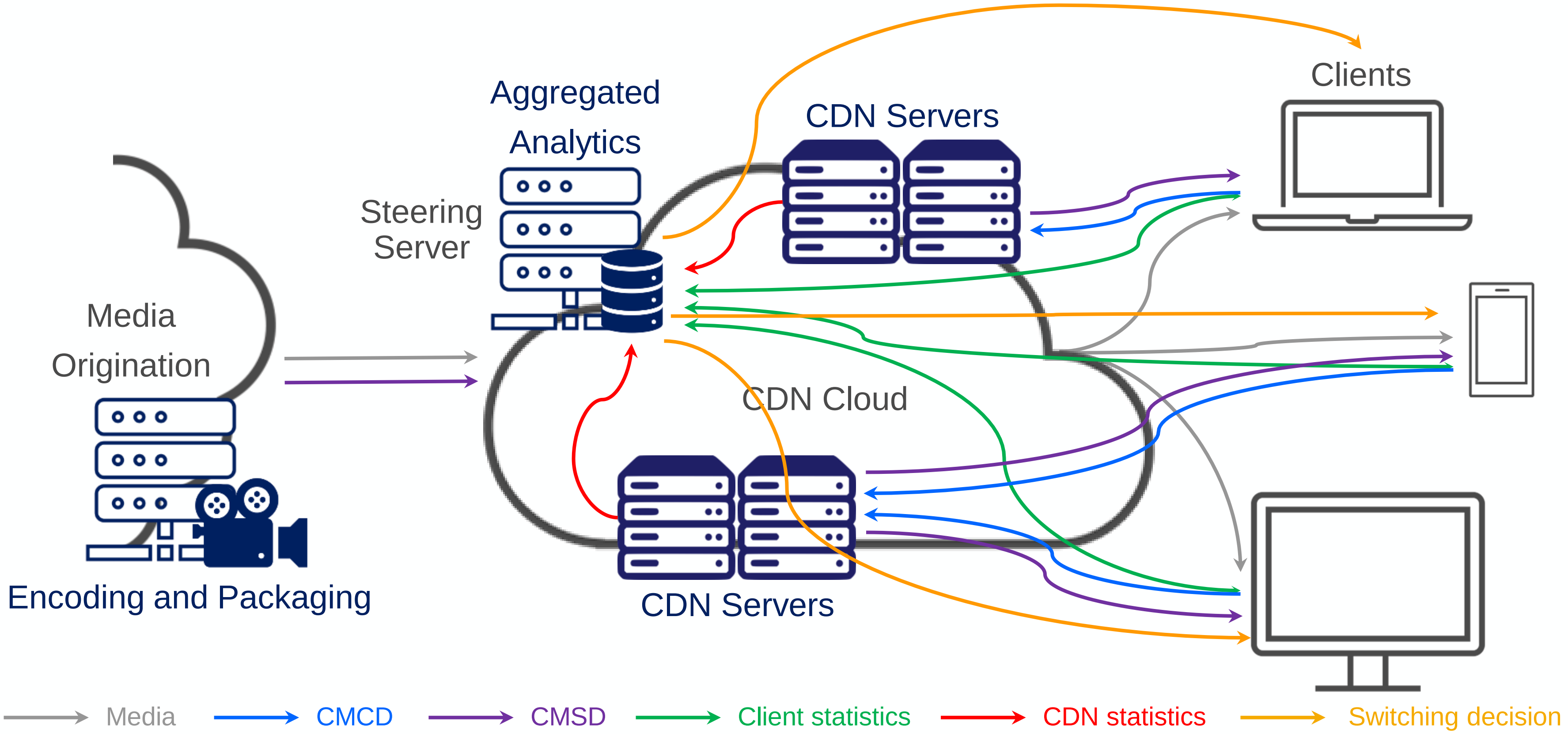
Server-side

- Collect CDN statistics such as bits delivered, caching metrics, response/delivery delays, etc. using CMSD or side-channel
- Collect origin-server statistics such as bits pulled and response/delivery delays using CMSD, etc.

Centralized server (Steering server)

- Gathering all statistics and understand them
- Implement a real-time rule to decide the best CDN to switch to: heuristics-based, learning-based, or both
- Send CDN switching decisions to the clients

Other Alternative (Idea): Context-aware Hybrid solution



What is Missing/Next? (Work in progress)

A unified framework and metrics to compare and evaluate existing CDN switching strategies

Extensive experiments covering heterogeneous environments (clients, CDNs, origin, network conditions, content types, VoD or Live, etc.)

Demonstrating the capabilities and practicality of each strategy

Implementing a proof-of-concept end-to-end system that conforms with existing video delivery pipeline and standardization bodies

- ➔ Players implementation (dash.js, hls.js, etc)
- ➔ CDNs implementation
- ➔ Origin implementation
- ➔ Encoding and packaging formats

Thank you

SCAN ME

Reach out to me for any questions or possible collaboration

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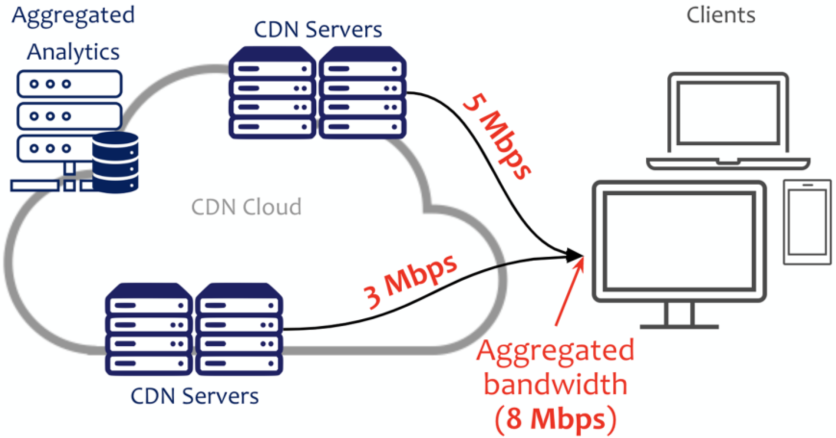
Other Alternative: Parallel Multi-CDN

Key idea

- Leveraging existing CDNs pool servers in parallel.
- Download the imminently required segment from the best performing CDN (highest throughput)
- Use manifest to report existing CDNs
- Require a detection and prevention strategy for unhealthy CDNs (client-, server-, or both)



Multipath capabilities

- The aggregate bandwidth from multiple paths
- Fault-tolerance
- Robustness through path diversity

Example

- The available bandwidth from two CDNs servers is 5 Mbps and 3 Mbps
- The players should be able to play a video quality equivalent to 8 Mbps (the aggregated bandwidth)

Cons

- It can be track to implement: require player modification
- It might increase energy consumption at the client