MUSLIN: A Multi-Source Live Streaming System

Towards a higher quality of experience, fairly shared, without any extra infrastructure cost

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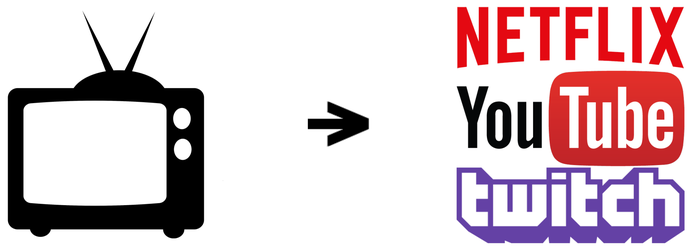
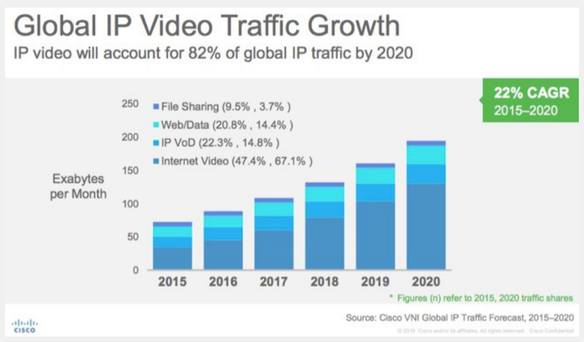
PROGRESS

State of the Art - How is video content currently streamed and consumed?

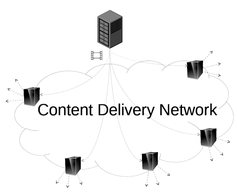
Contents consumption schemes evolve...





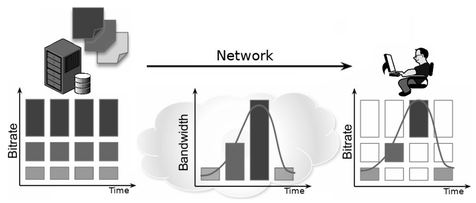
... but the infrastructures fail to deliver!

Making content available: Content Delivery Networks



The CDN paradigm is to provision replica content servers near end-users to withstand the demand. Then, clients are routed to the nearest server, which minimizes latency and lowers the congestion. However, servers can get overloaded, and some clients might receive a poor QoE or not have access to the content.

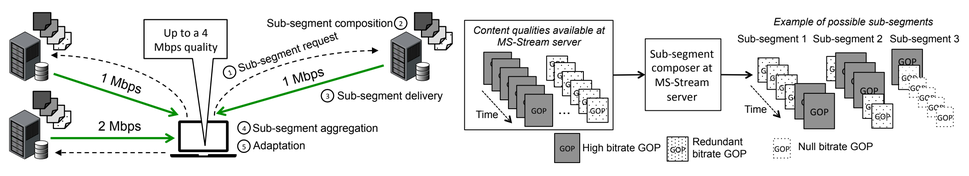
Delivering content: Dynamic Adaptive Streaming over HTTP



The DASH standard aims at delivering uninterrupted video content through HTTP traffic. During the streaming session, the client dynamically changes video quality to adjust to the network available bandwidth.

Background - MS-Stream: Multi-Source Adaptive Streaming over HTTP

MS-Stream protocol extends the **DASH** standard by enabling the use of multiple servers to **aggregate bandwidth** over various links while being **resilient** to impairments. It was published in several journals and conferences, and won many prizes such as IEEE ICME DASH-IF Grand Challenge.



J. Bruneau-Queyreix, M. Lacaud, D. Négru et al., "QoE enhancement through cost-effective adaptation decision process for multiple-server streaming over HTTP", IEEE International Conference on Multimedia and Expo, 2017

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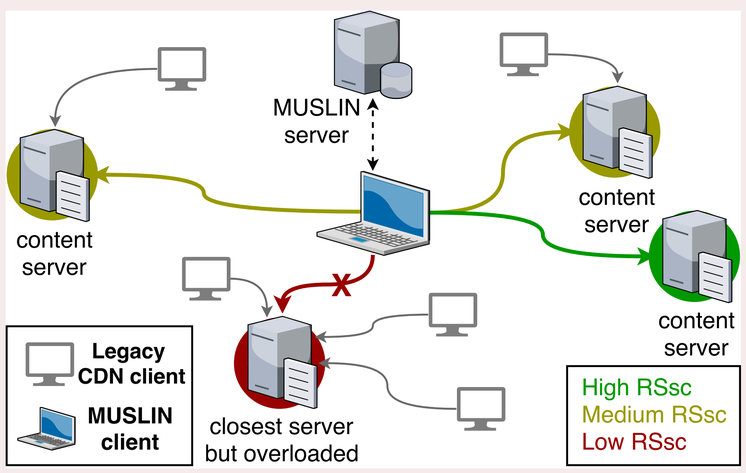
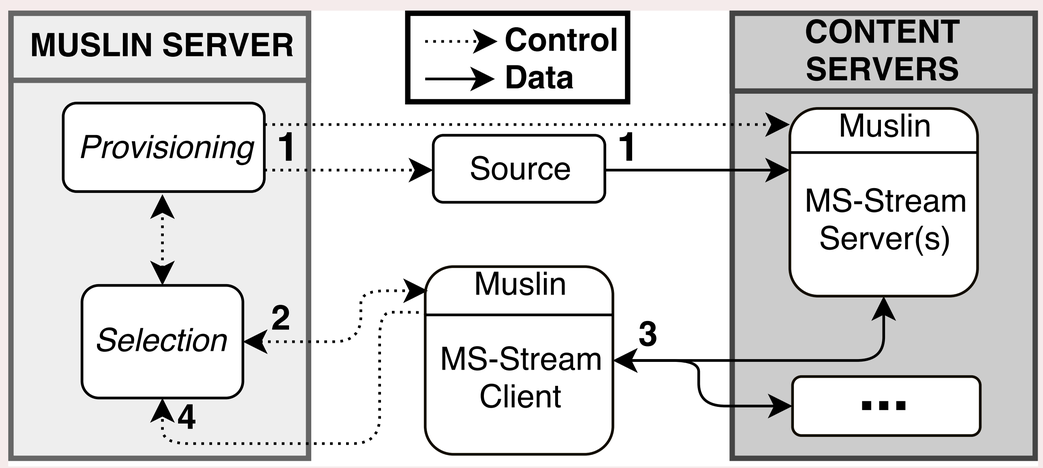


`Muslin` relies on clients feedbacks to provision and advertise servers to the users in real-time.

1. Content replication
2. Server advertising
3. Content delivery
4. Clients feedbacks

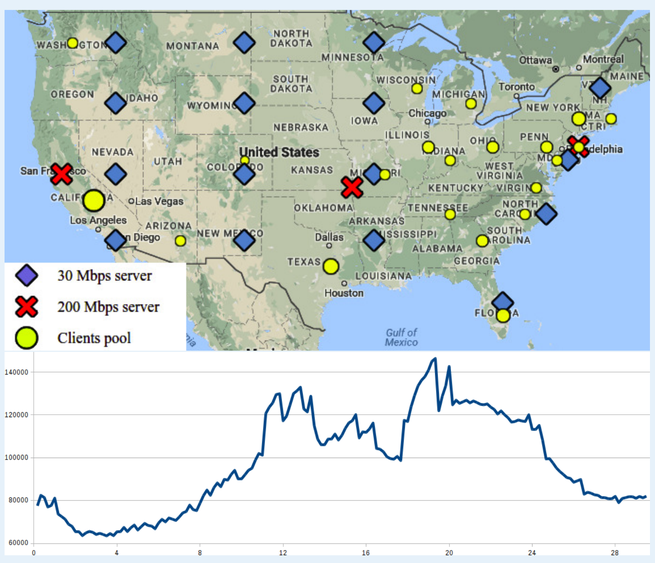
- `Muslin` assigns servers to clients using a Ranking Score RS_{sc}, computed for each client and server, based on feedbacks.

$$RS_{sc} = ((1 - GD_{sc}) * (1 - FR_s) * OBW_s)^{\frac{1}{3}}$$



S. Da Silva, J. Bruneau-Queyreix, M. Lacaud, D. Négru, L. Réveillère, "MUSLIN: High QoE Through Fair Multi-Source Live Streaming", ACM Multimedia Systems (MMSys), Packet Video Workshop + Demo Track, 2018 (submitted)

Evaluation methodology



Provisioning: `Muslin` vs *Geographical oracle* (aware of the exact audience and their locations)
Selection: `Muslin` vs *CDN* (closest), *Random* and *Round Robin*
Delivery: MS-Stream

- 16 servers (30 Mbps bandwidth)
- 3 servers (200 Mbps bandwidth)
- 21 client pools locations

A real audience trace was used to re-stream a one-day event multiple times (over 10 000 h of evaluations).

Results

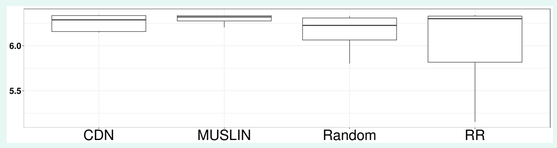


Figure: Displayed bitrate (Mbps)

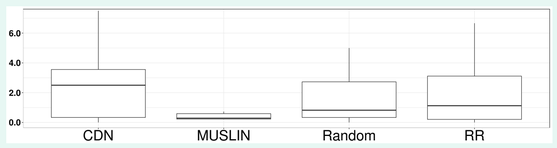


Figure: Quality changes (per minute)

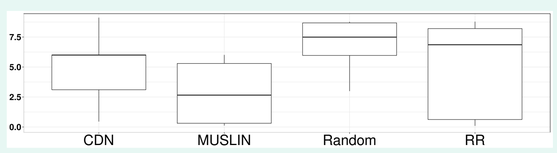


Figure: Network overhead (%)

QoE metric	CDN	`Muslin`	Random	RR
Bitrate	0.7727	0.9610	0.5952	0.4685
Quality changes	0.4551	0.9485	0.5408	0.4660
Rebufferings	0.6952	0.9095	0.5179	0.6452

Table: QoE fairness (F index)

Compared to a best-case CDN setup:

- + 19.6% bitrate fairness
- + 52% quality changes fairness
- + 23.6% rebuffering fairness

- + 100 kbps median displayed bitrate
- - 2.5 quality changes per minute
- - 3.5% network overhead
- 0 rebufferings