

Achieving High, Fairly Shared Quality of Experience

MUSLIN: MULTI-SOURCE LIVE STREAMING

S. Da Silva, J. Bruneau-Queyreix, M. Lacaud, D. Négru, L. Réveillère

Simon **Da Silva**



Tuesday June 12, 2018

Plan

Background

- Context

- Problem statement

- Our idea

MUSLIN

- Server provisioning

- Server advertising

- Implementation

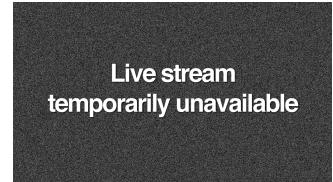
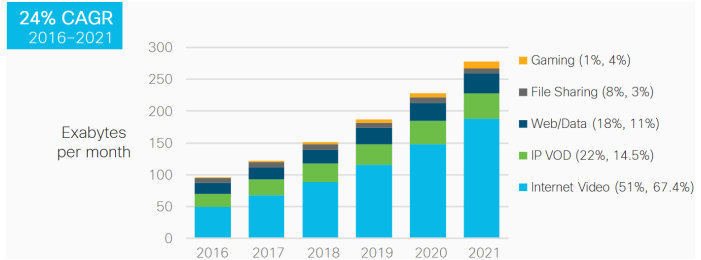
Evaluation

- Setup

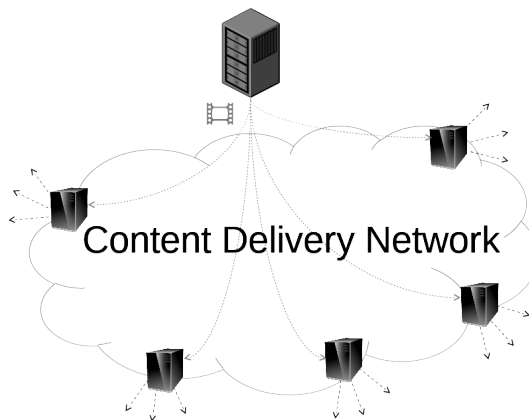
- Results

- Conclusion

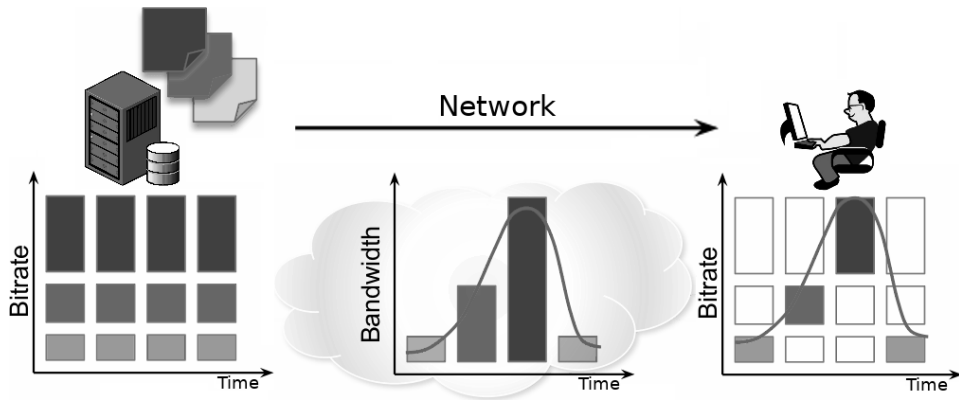
Video content consumption evolves...



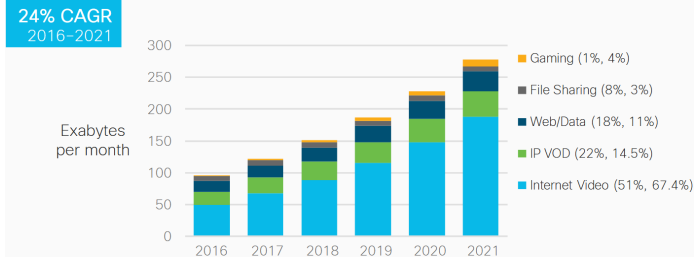
Content Delivery Networks (CDN)



HTTP Adaptive Streaming (HAS)

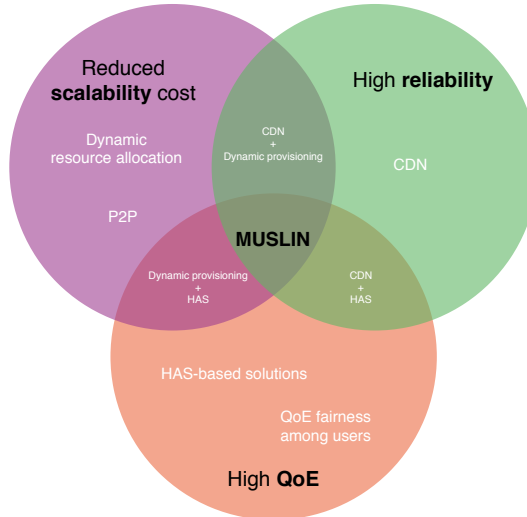


Video content consumption evolves... but the infrastructure fails to deliver!

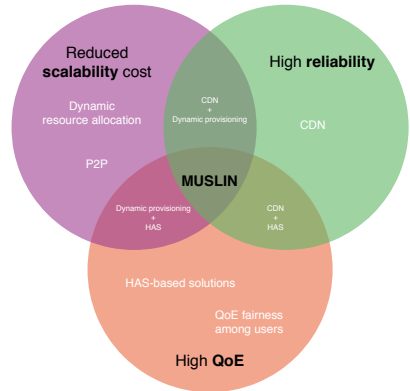
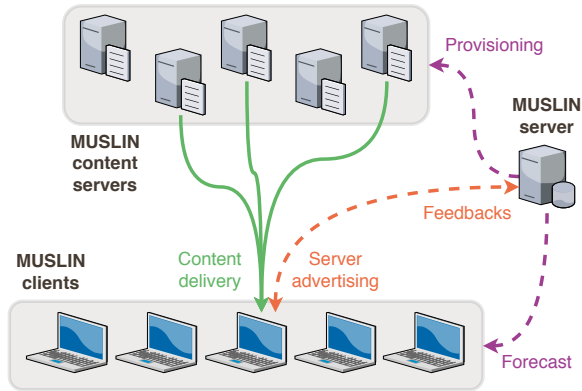


Live stream
temporarily unavailable

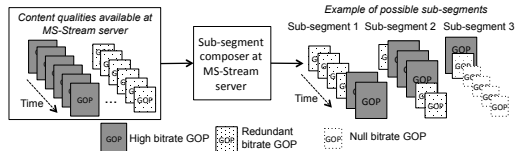
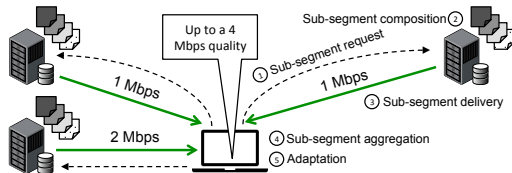
Problem statement



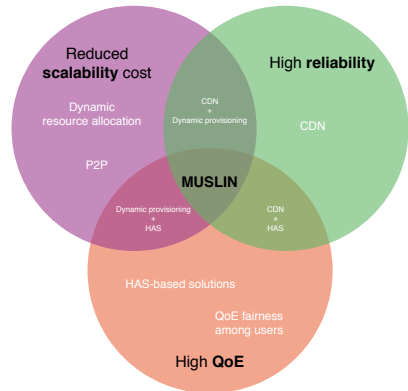
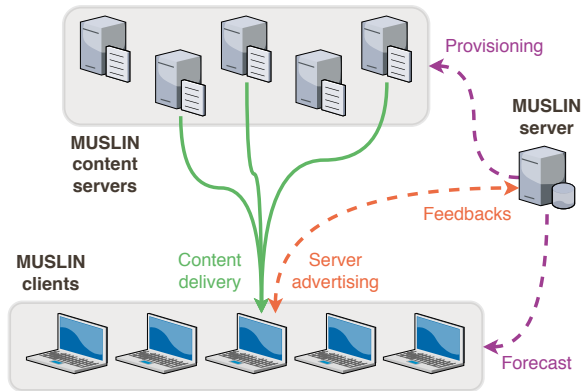
MUSLIN: Multi-Source Live Streaming



Multi-Source Streaming over HTTP



MUSLIN: Multi-Source Live Streaming



Server provisioning

1. Audience forecast

- ▶ Current audience
- ▶ Past trend

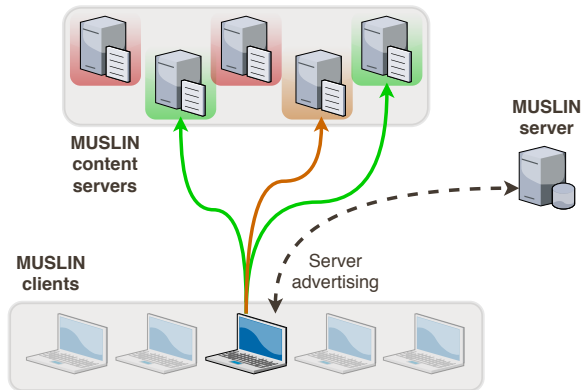
2. Throughput estimation

- ▶ Target quality
- ▶ Network bandwidth overhead
- ▶ Average video bitrate
- ▶ Failure rate

3. Provisioning decision (Server Ranking Score RS_s)

- ▶ Clients location
- ▶ Server failure rate
- ▶ Observed bandwidth

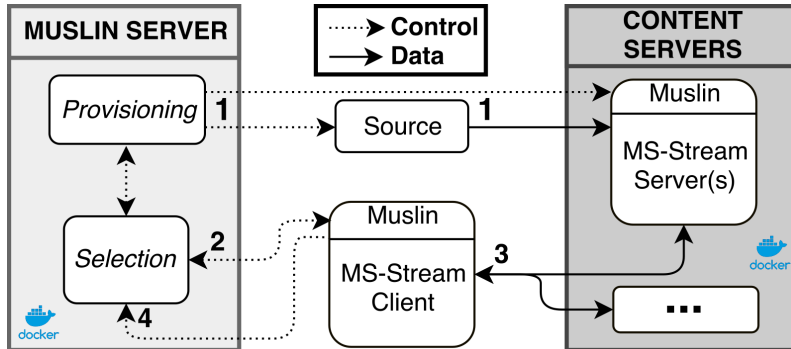
Server advertising



Muslin Ranking Score RS_{sc} :

- ▶ Server - client distance
- ▶ Server failure rate
- ▶ Observed bandwidth

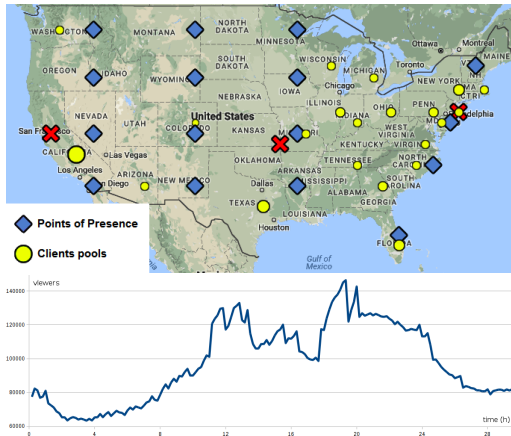
Implementation and scalability



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

Feedback request probability: $Pr = \min(1, N/v_t)$

Evaluation setup



- ▶ 16 Points of Presence (30 Mbps)
- ▶ 21 client pools locations

Table: Evaluated policies

Provisioning and Forecast	Selection	Delivery
Muslin	Muslin	MS-Stream
Geographical oracle	CDN	MS-Stream
Geographical oracle	Random	MS-Stream
Geographical oracle	Round Robin	MS-Stream

0.3 - 6.4 Mbps video

Actual live audience trace

Evaluation results

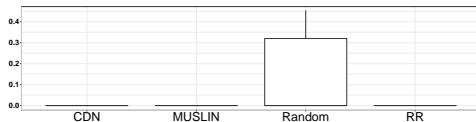


Figure: Rebufferings (per minute)

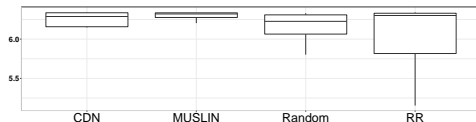


Figure: Displayed bitrate (Mbps)

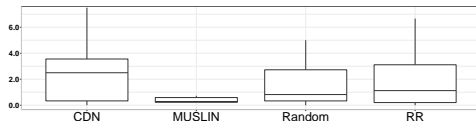


Figure: Quality changes (per minute)

Compared to a best-case CDN setup (geographical oracle):

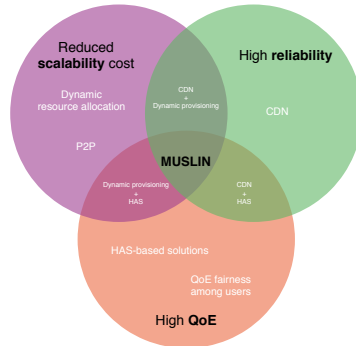
- ▶ 0 rebufferings
- ▶ + 1.6% displayed bitrate
- ▶ - 625% quality changes
- ▶ - 18% provisionned server time

QoE fairness (F index [1]):

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

[1] T. Hoßfeld et al.
Definition of QoE Fairness in Shared Systems.
IEEE Communications Letters (2017)

Conclusion and Future Work



- ▶ Dynamic content replication
- ▶ RS_{SC} -based server advertising
- ▶ Multiple-Source Streaming
- ▶ Real-time clients feedbacks

Plan

Background

- Context

- Problem statement

- Our idea

MUSLIN

- Server provisioning

- Server advertising

- Implementation

Evaluation

- Setup

- Results

- Conclusion