

Practical, Real-time Centralized Control for CDN-based Live Video Delivery

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Why Video Delivery?

- Huge demand
- Pressure for higher and higher quality

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- Huge demand
 - ~60% of global internet traffic¹
 - Expected to reach 80-90% by 2019¹
- Pressure for higher and higher quality

¹Cisco Visual Networking Index: Forecast and Methodology, 2014 - 2019

Simple Solution?



Was this filmed
on a potato???

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Send everyone terrible quality video!
Very few bits over the network!

Why Video Delivery?

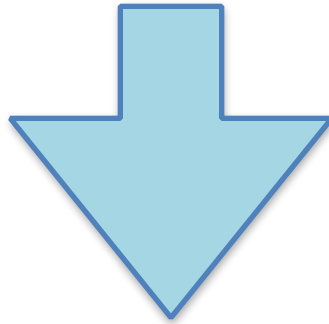
- Huge demand
 - ~60% of global internet traffic¹
 - Expected to reach 80-90% by 2019¹
- Pressure for higher and higher quality
 - “Quality of Experience”² \approx bitrate, buffering ratio, join time, ...

¹Cisco Visual Networking Index: Forecast and Methodology, 2014 - 2019

²Developing a Predictive Model of Quality of Experience for Internet Video. SIGCOMM '13.

Why Video Delivery?

- Huge demand
 - Exponential growth (double in 5 years¹)
- Pressure for higher and higher quality



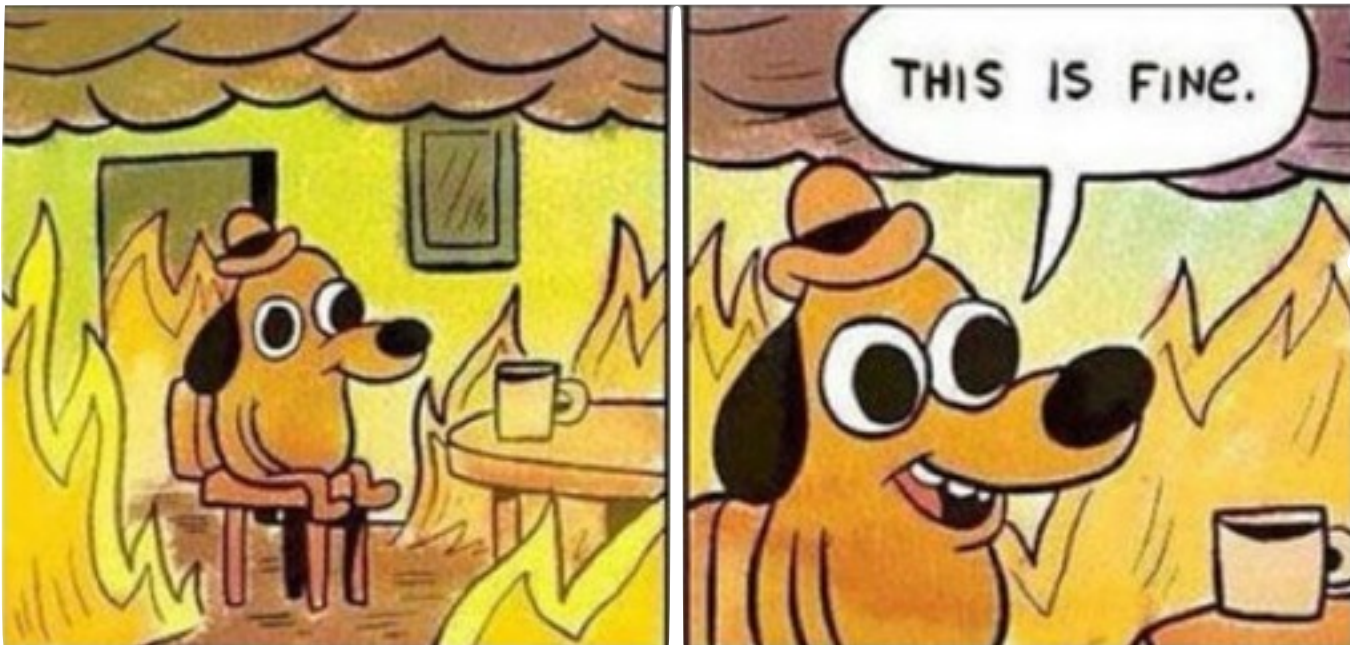
Hard problem

¹Cisco Visual Networking Index: Forecast and Methodology, 2014 - 2019

Why Video Delivery?

Hard problem (fun problem?)

60%+ of Internet traffic,
growing exponentially



Why Video Delivery?

Hard problem (fun problem?)

Do this all in real-time???

Live video delivery

Live Video Delivery

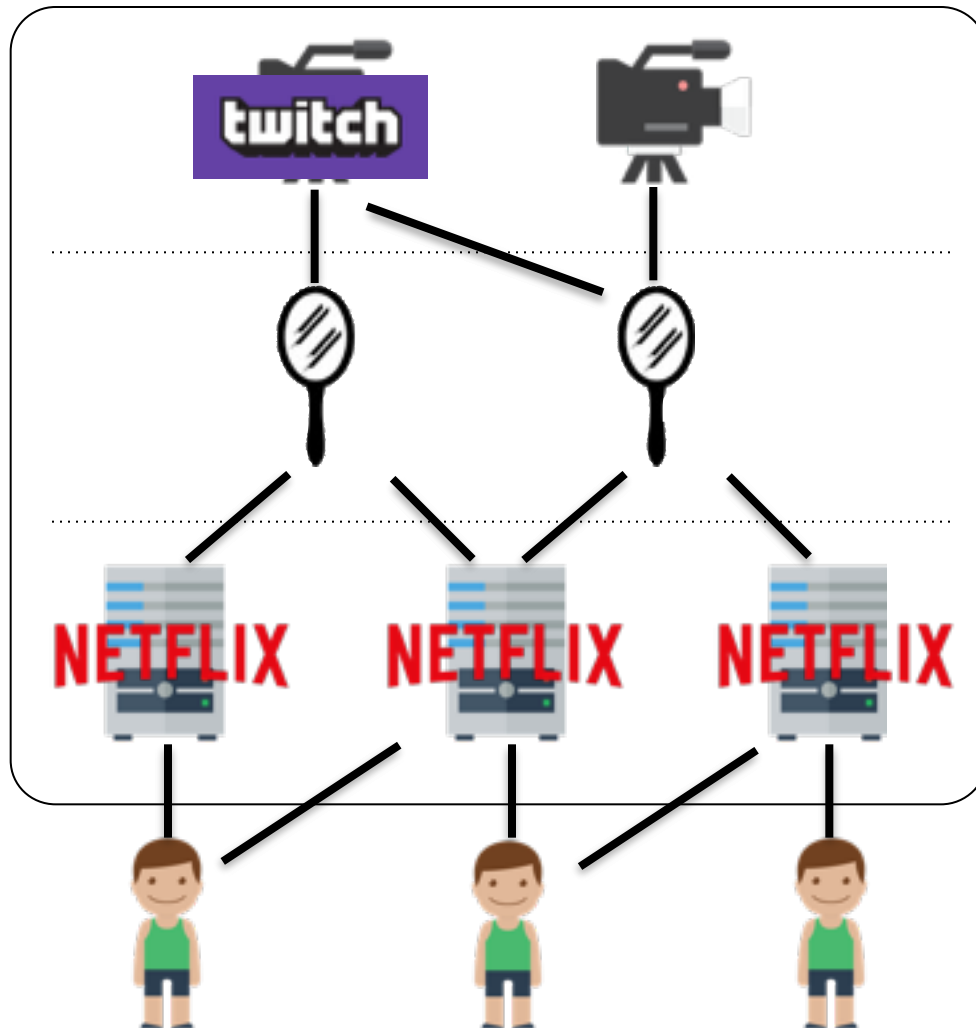
Video Delivery Network (VDN)

in

“Practical, Real-time Centralized Control for
CDN-based Live Video Delivery”

SIGCOMM '15

Live vs. Video-on-Demand (VoD)



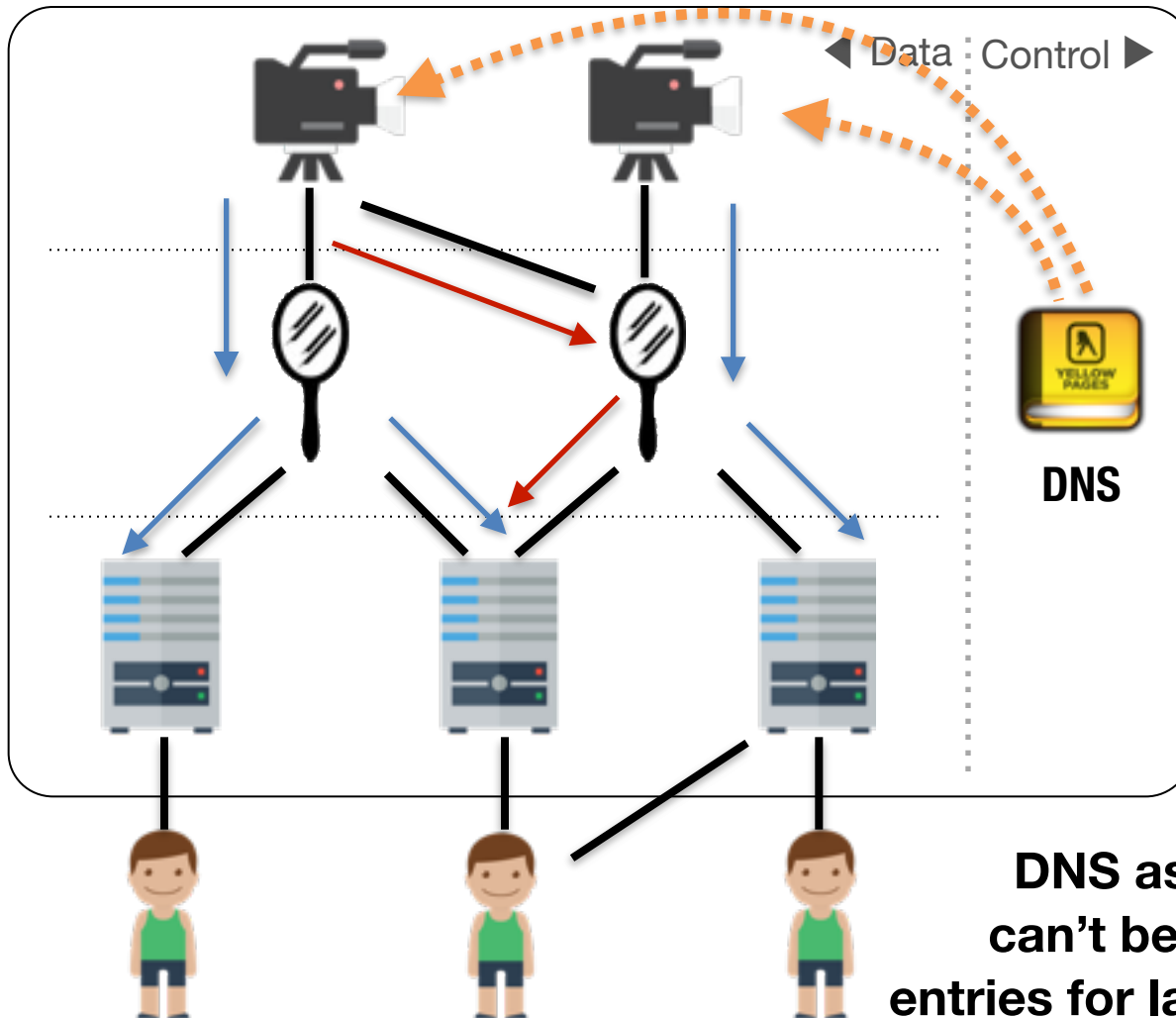
Live Video is Becoming Wildly Popular

- Commercial sports streams
 - **Single** World Cup stream = **40%** global Internet traffic¹
- User-generated streams (e.g., Twitch)
 - Users watch **150b min of live video per month**²
 - Amazon buys Twitch for ~**\$1Billion**

¹Sandvine. Global Internet Phenomenon Report: 1H 2015

²Twitch. <http://twitch.tv>

What's Broken Today?



**DNS as point of control:
can't be hammered on, so
entries for large video aggregates,
30 second update propagation**

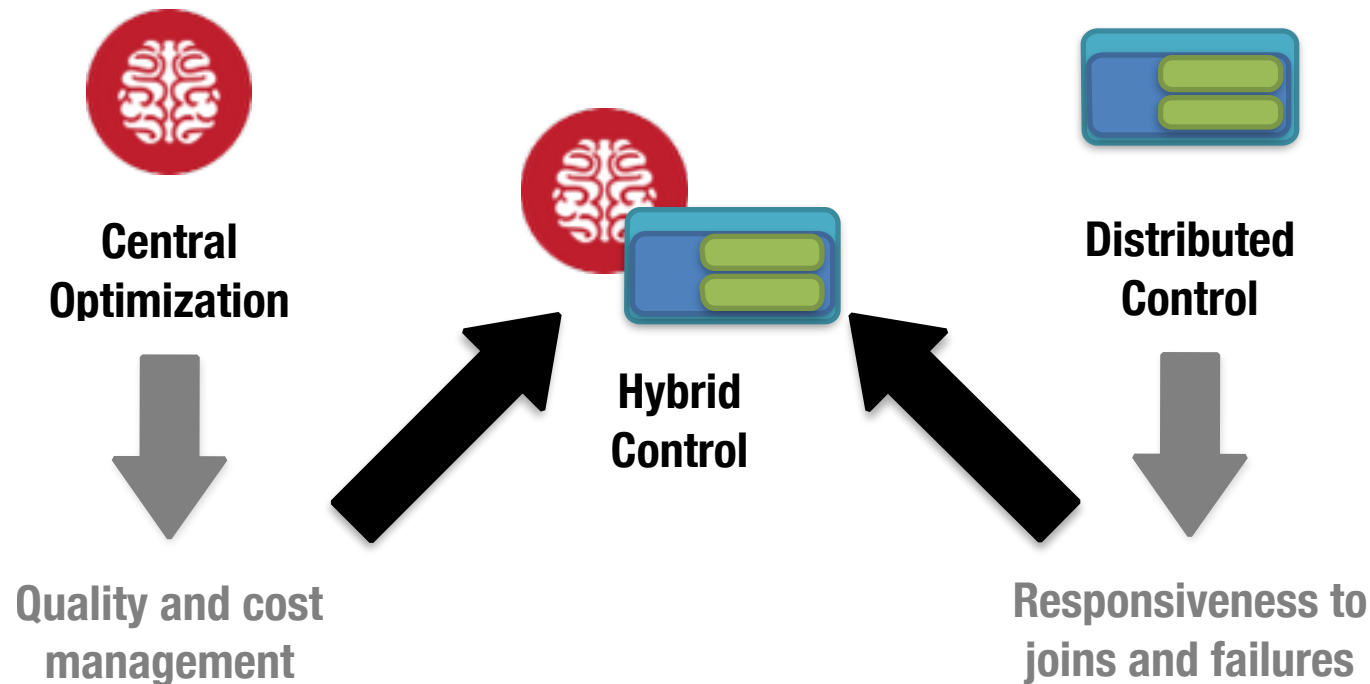
Problems with DNS-based CDN

Live Video Delivery

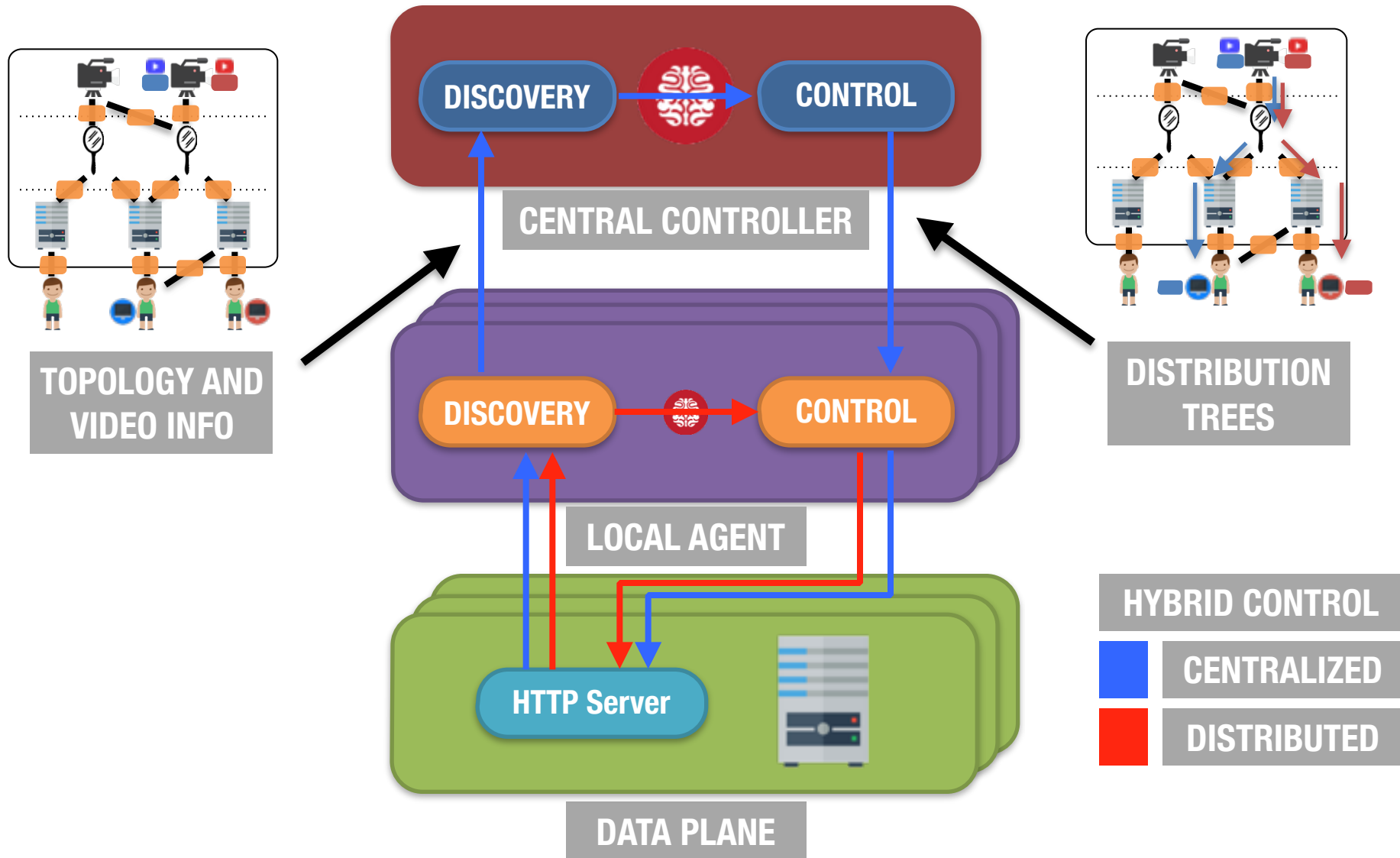
- Coarse control granularity
 - lower quality
 - higher delivery cost
- Slow updates
 - longer failure recovery
 - slower client joins

Our Contributions

- We design a video delivery network (**VDN**) to efficiently manage quality and cost, with high responsiveness



VDN at a High Level



Results Overview

Quality

CDN

1.0x

VDN

1.7x

Simulation using
Conviva traces,
modeling
user-generated content

Delivery Cost *(per request)*

CDN

2.0x

VDN

1.0x

Simulation using
Conviva traces,
modeling large
sports events

Join time

Centralized

7.0s

VDN

0.2s

Emulation using
small EC2 testbed

Summary

- Video delivery is hard
 - demand volume and need for quality
- Live video is even harder!
 - little to no caching
 - single source, millions of destinations
 - real-time
- VDN — a system for live video delivery
 - Centralized control = quality + cost
 - Distributed control = joins + failures

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