

HLSaaS: High-Level Video Streaming as a Service

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Video Streams

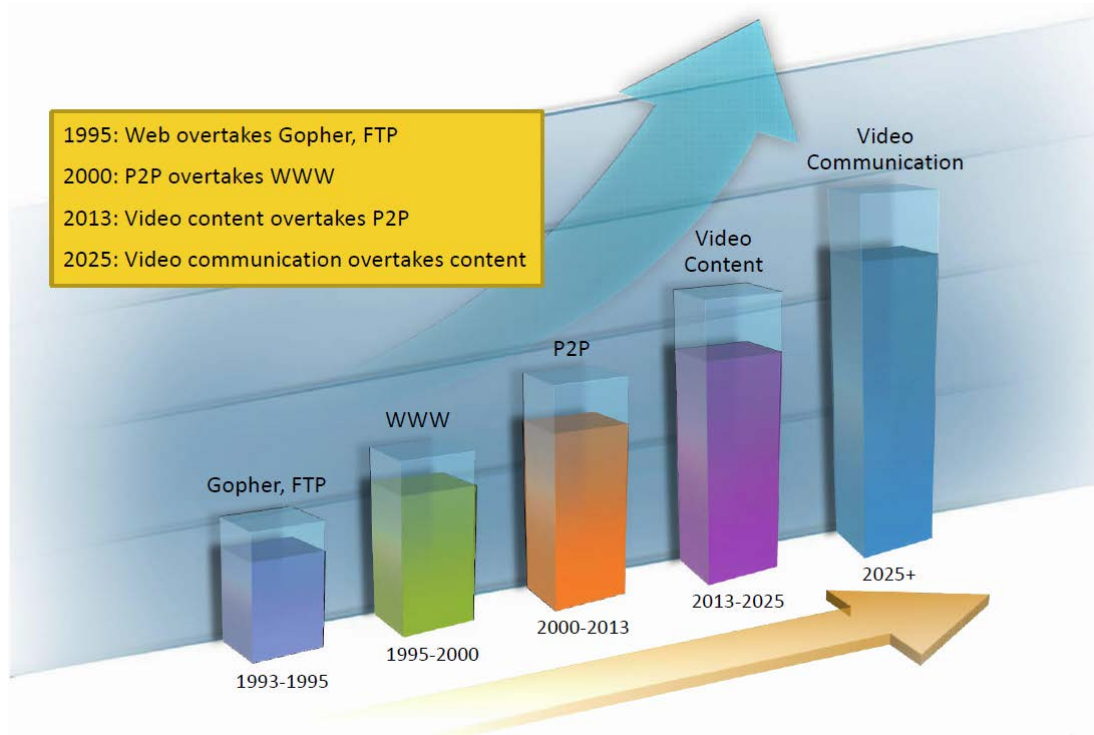


Streaming Providers



Client Devices





- Video streaming constitutes approximately **64%** of all the U.S. Internet traffic in 2014 [1].
- Cisco estimates that the streaming traffic will increase to **80%** by 2019 [2].

[1] G. I. P. Report, "<https://www.sandvine.com/trends/global-internet-phenomena/>," accessed Oct. 1, 2015.

[2] C. V. N. Index, "Forecast and methodology, 2014-2019," 2015.

Basic Video Streaming: Video On-Demand vs Live-Streaming

Video On Demand (VOD)



Live Streaming



High-Level Video Streaming Services: Viewer Requirements

- Alice wants to remove the inappropriate contents from videos dynamically for her kids!



High-Level Video Streaming Services: Publisher Requirements

- Bob wants to blur accidentally captured entities in the video
- Bob wants to watermark videos with his company logo



High-Level Video Streaming Services: Streaming provider requirements

- Convert (transcode) videos based on the client devices characteristics



Challenges in Providing High-Level Video Streaming

- Video processing is computationally expensive
- Video processing has to be done in a real-time manner
- To address these challenges stream providers are becoming reliant on cloud services

- Storage solutions
- Hardware failover
- Networking infrastructure



- Video contents
- Customer experience



Challenges in Utilizing Clouds

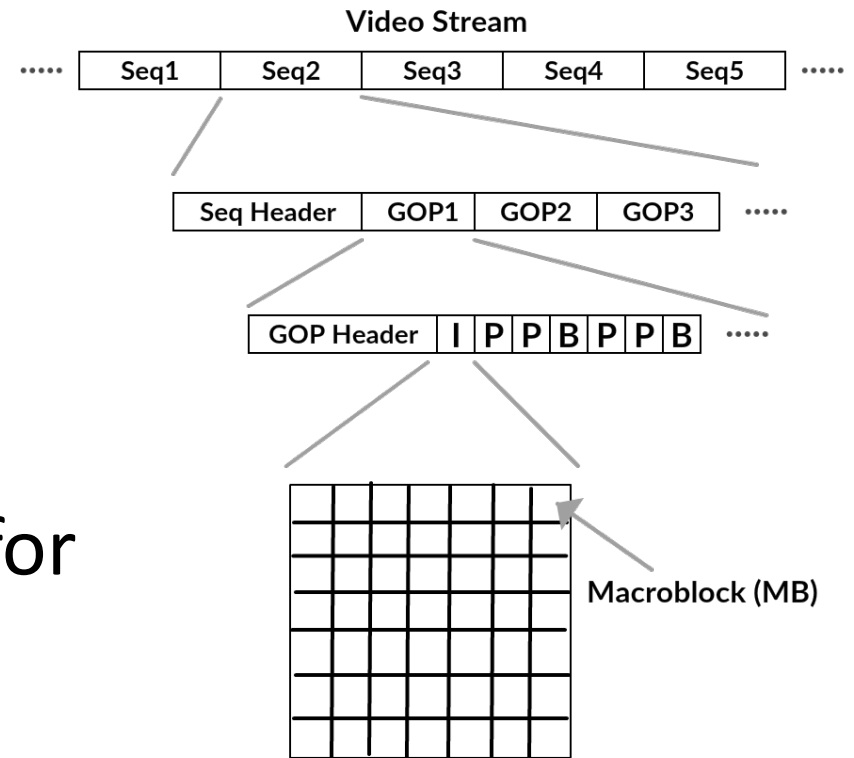
- Minimum cost while maintaining QoS
- What are the QoS demands?
 1. No delay in the stream (minimum drop rate)
 - Video processing task should complete within individual deadlines
 - In live streaming missing deadline dropped
 2. Minimum start up delay
 - Users judge the quality based on the startup delay

HLSaaS Architecture

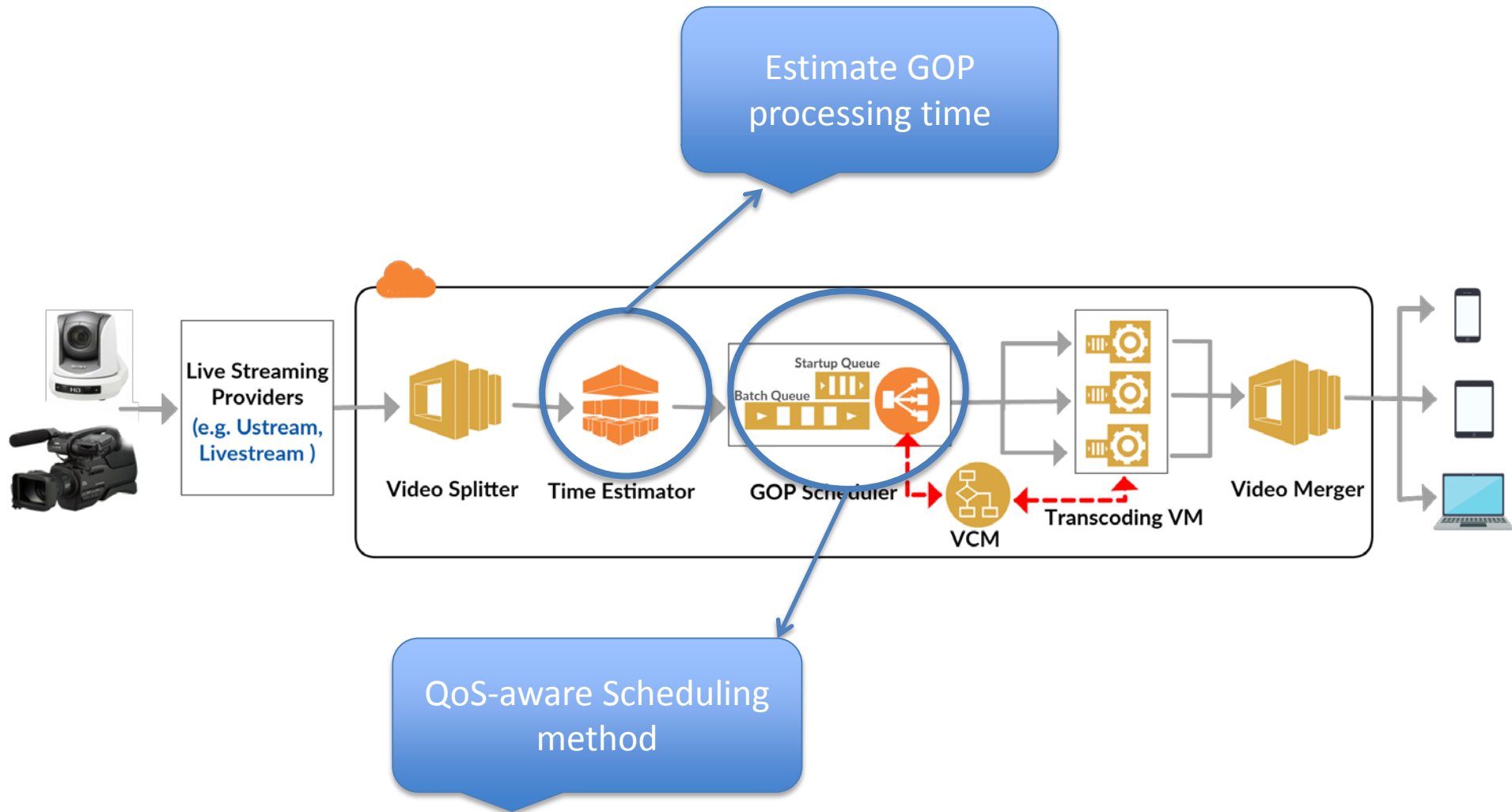
- Accepts any high-level video processing request
- It allocates resources from cloud
 - Based on the requested high-level video processing service
 - Based on the workload
- Maintains QoS
- Incurs minimum cost to the provider

Structure of Video Streams

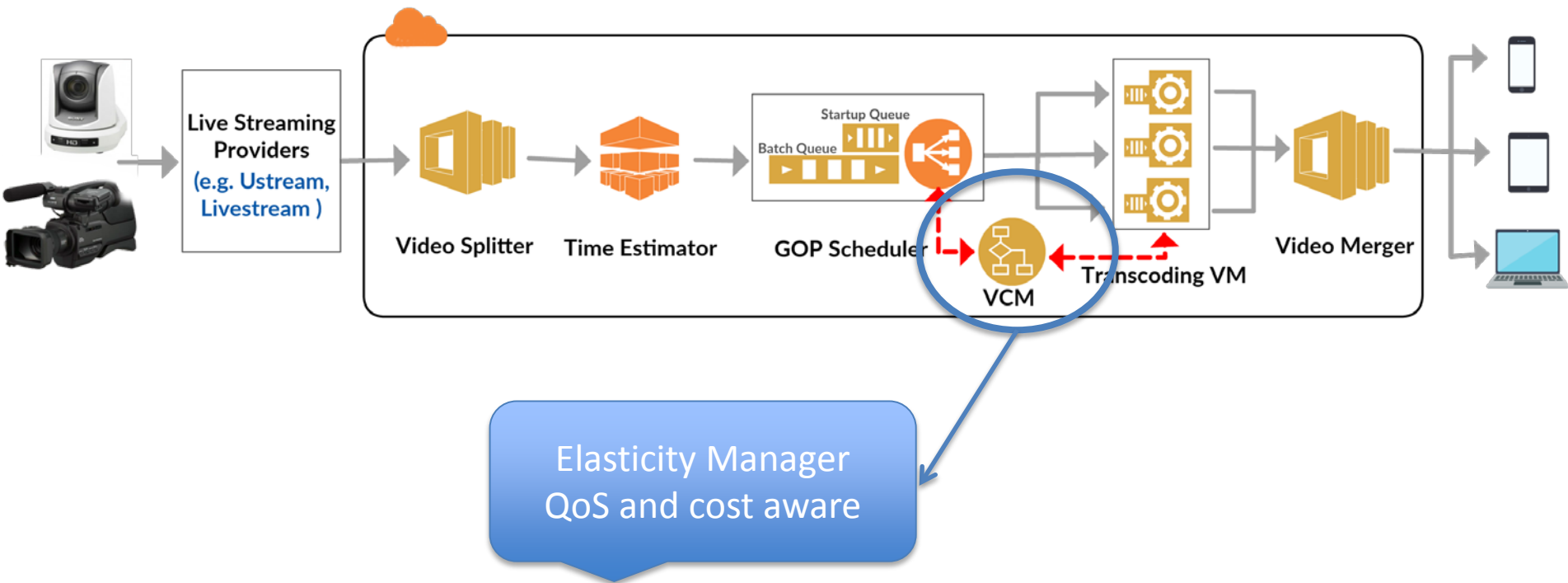
- Videos are streamed as a sequence of segments
- Group Of Pictures (GOP)
- The unit we consider for processing



HLSaaS Architecture



HLSaaS Architecture



Work Completed*:

On-Demand Transcoding of Video Streams

- Focusing on the stream provider request

- Video transcoding:
 - Converting the video stream to match the characteristics of client devices



- Examples: resolution, codec, bit-rate, frame rate

* CVSS: Cost-efficient and QoD-aware Video Streaming Using Cloud Services, Accepted in IEEE/ACM CCGrid '16 conference

Netflix Solution for Transcoding: Pre-Transcode

The Netflix logo, consisting of the word "NETFLIX" in white, bold, sans-serif capital letters with a black drop shadow, set against a red rectangular background.

- 5 regional catalogs
- 4 formats supported today
 - 1 VC-1, 3 H.264
 - Multiple bit rates per format
- 10's of 1000's of hours of content
- Several petabytes of S3 storage

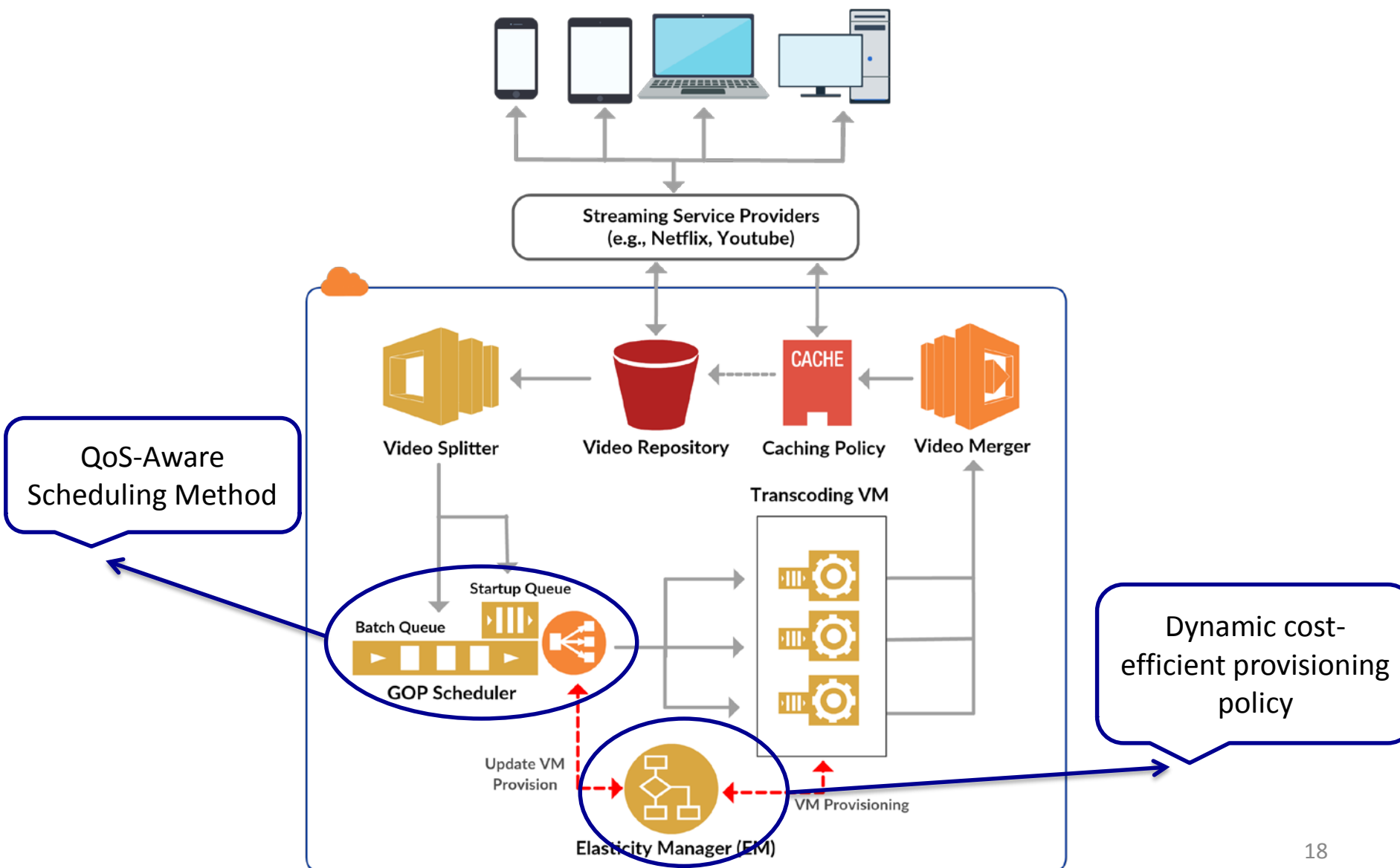


Long Tail Property of Video Streaming

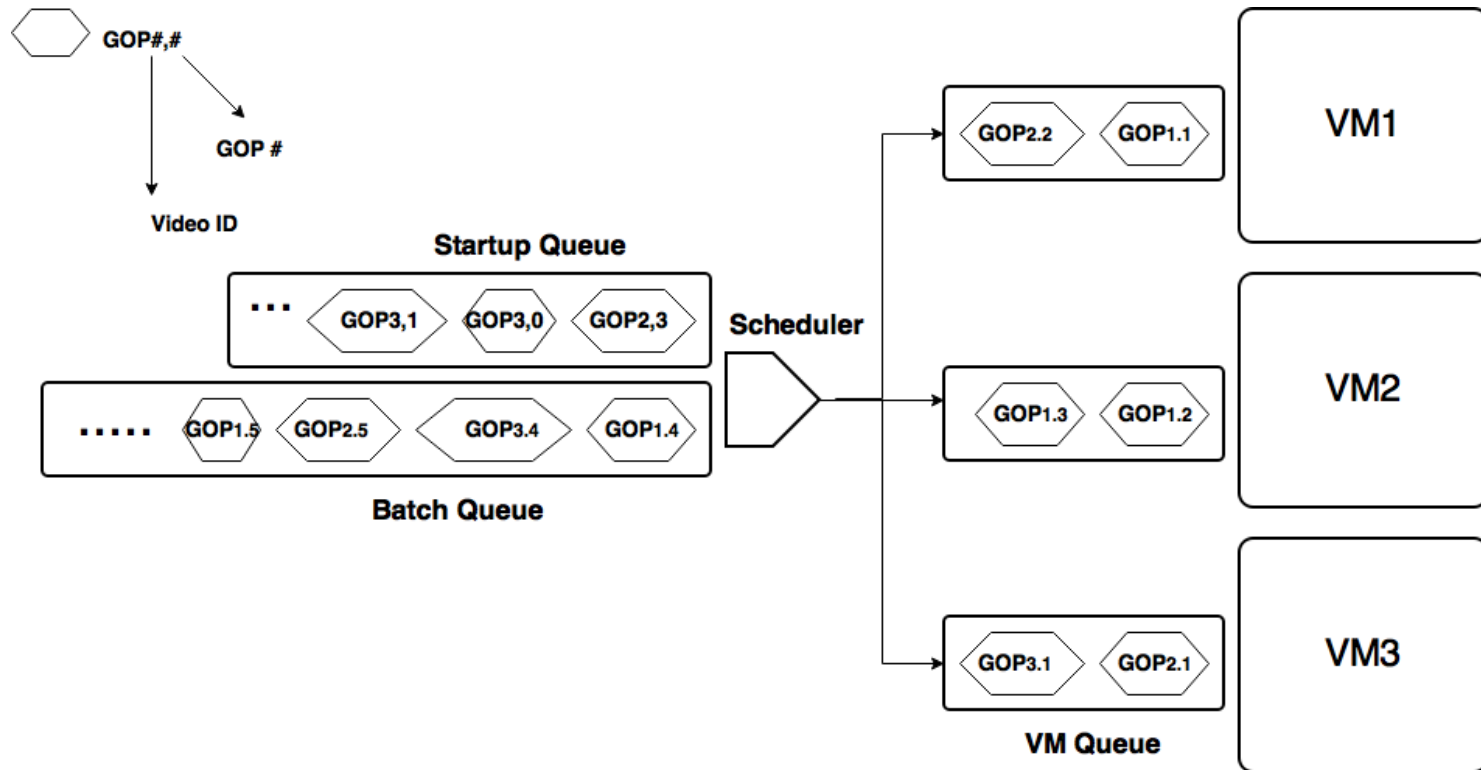


- We do not need to pre-transcode all videos
- Pre-transcode just for the “*trendy*” videos
 - The rest can be transcoded “*lazily*”!

HLSaaS Architecture



QoS-Aware Scheduling Method



Step1: Search for the shortest completion time VM.

Step2: Insert GOP from startup queue in front of the GOP in the batch queue.

Step3: Check if the GOP in the batch queue will miss deadline or not.

Dynamic Cost-Efficient Provisioning Policy

I. Periodic Provisioning Policy

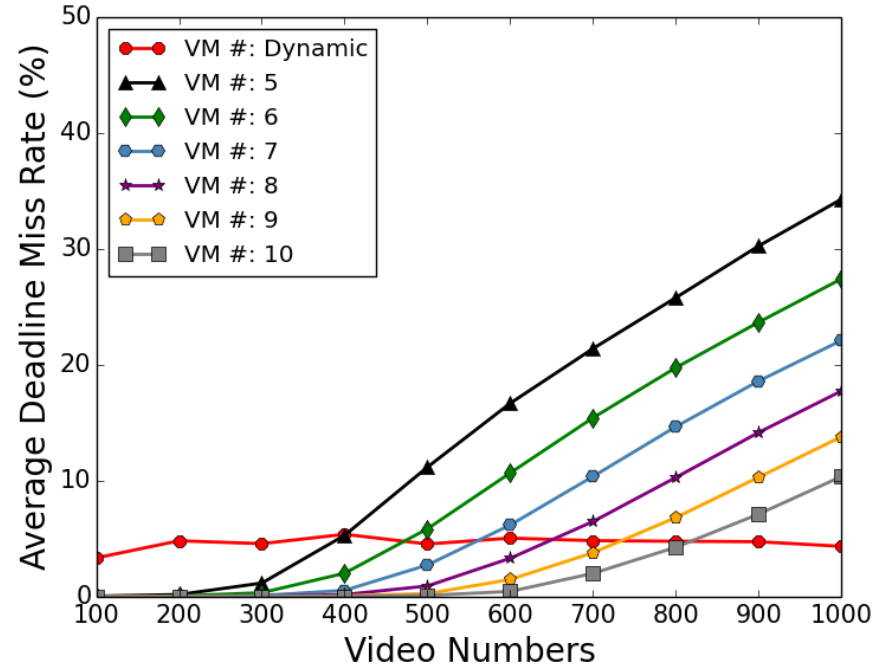
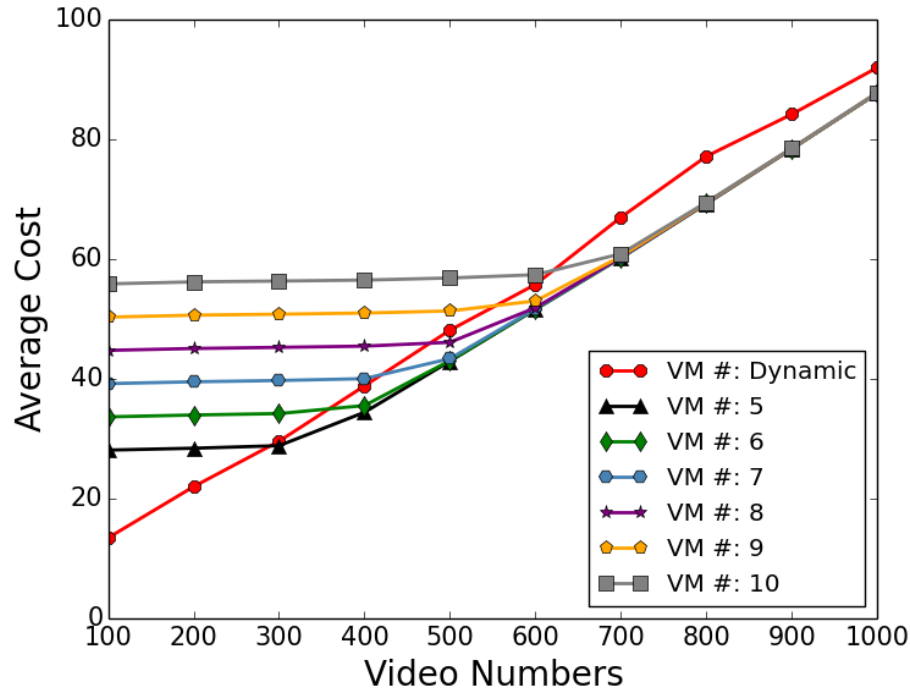
$$\alpha < \text{deadline miss rate} < \beta$$

II. Remedial Provisioning Policy

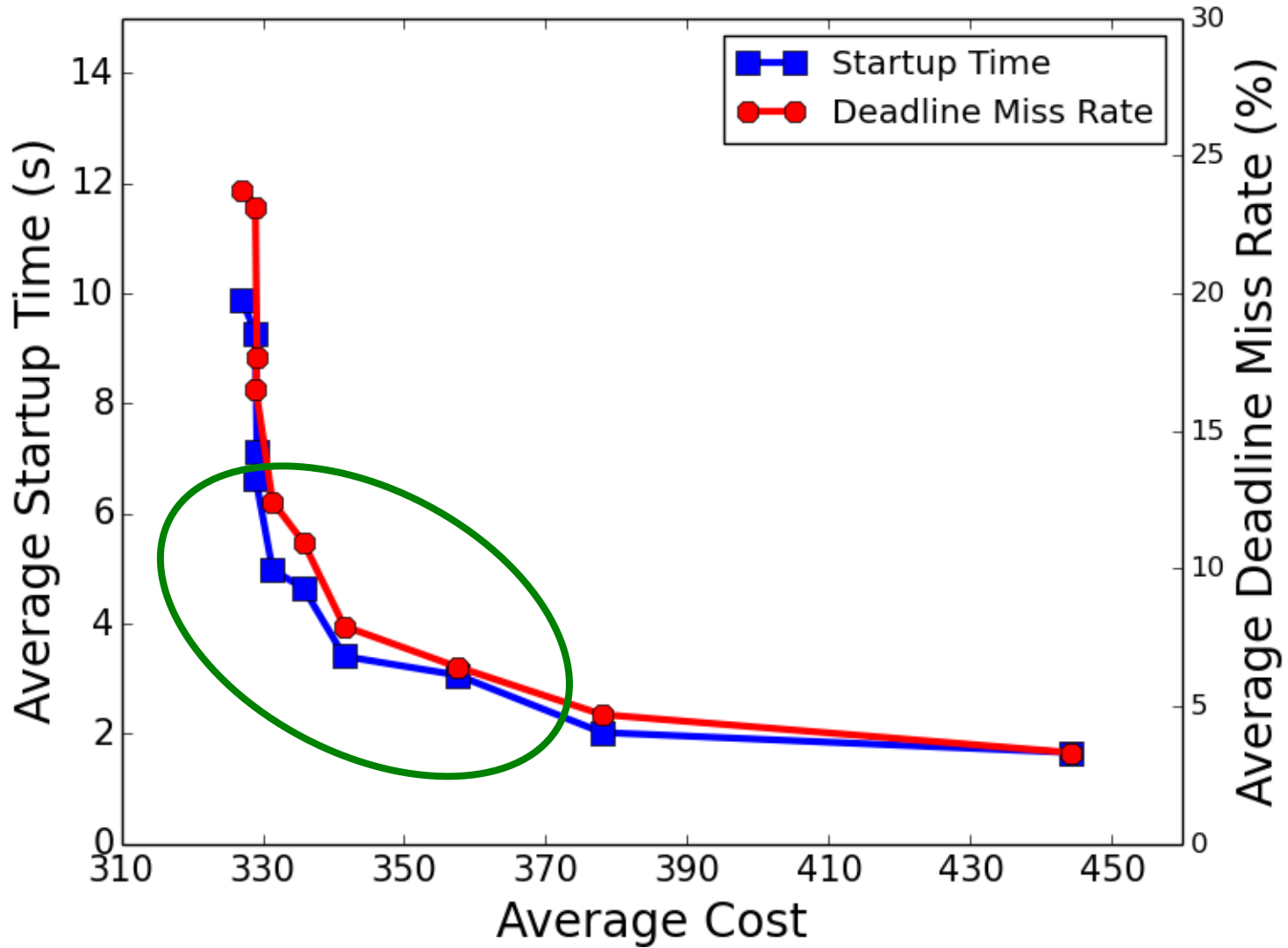
- We quickly determine the workload intensity using startup queue

Performance Evaluation

❖ Our dynamic system keeps the QoS violation constantly low and Stable in compare with static method.



❖ Our method save the cost when the system is not oversubscribed.



Future Directions

1. Different video types have affinities with various services offered by cloud providers
 - Creating a heterogeneous VM cluster!
2. Mixing the idea of HLSaaS with Content Delivery Networks (CDN)
3. Support live streaming and VOD in one system
 - Schedule within a single pool of tasks

Thank You!

Questions?

