Adaptive Bitrate & Congestion Control:
Together, they make the Internet a friendlier place

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Te-Yuan (T.-Y.) Huang (on behalf of many Netflix colleagues)
thuang@netflix.com

NETFLIX

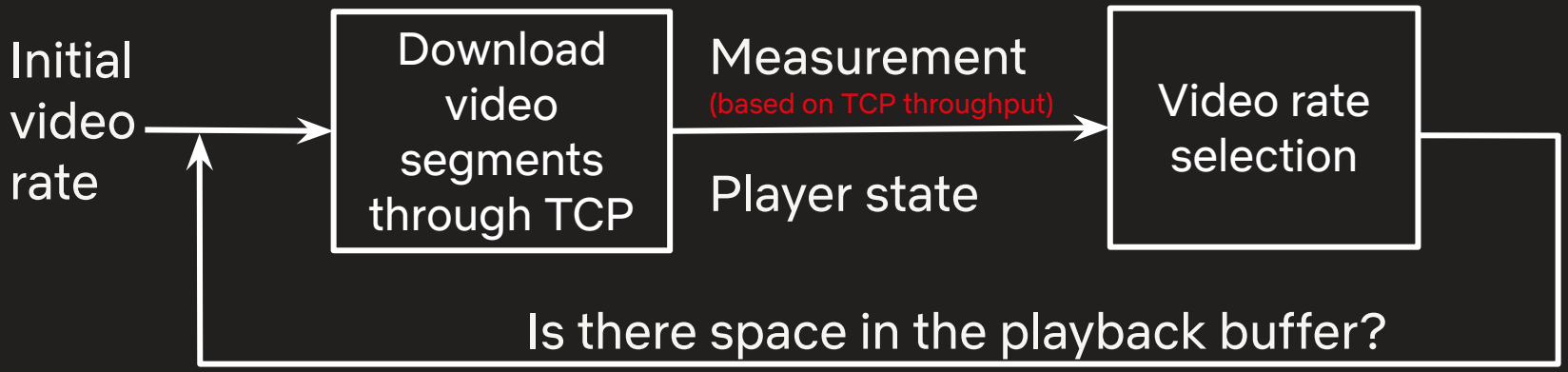
The takeaways of this talk

- Netflix is combining Adaptive Bitrate (ABR) and Congestion Control (CC)
  - ABR & CC **needs** to work together
  - Less bursty traffic, better QoE
- YouTube is experimenting with similar ideas
  - They also found it beneficial

Combining ABR & CC is good for everyone.

You should try it out.

How does ABR + CC work together today?



The decisions from ABR & CC intertwine with each other.

Confused, Timid, and Unstable: Picking a Video Streaming Rate is Hard

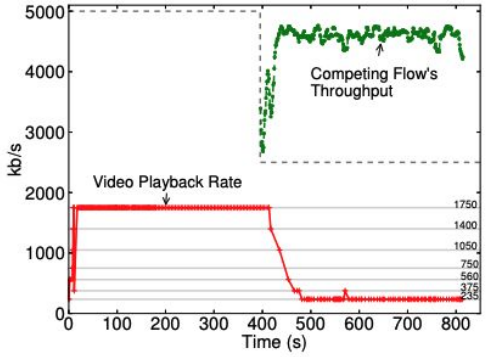
Te-Yuan Huang Nikhil Handigol Brandon Heller Nick McKeown Ramesh Johari
Stanford University
{huangty,nikhilh,brandonh,nickm,ramesh.johari}@stanford.edu

ABSTRACT

Today's commercial video streaming services use dynamic rate selection to provide a high-quality user experience. Most services host content on standard HTTP servers in CDNs, so rate selection must occur at the client. We measure three popular video streaming services – Hulu, Netflix, and Vudu – and find that accurate client-side bandwidth estimation above the HTTP layer is hard. As a result, rate selection based on inaccurate estimates can trigger a feedback loop, leading to undesirably variable and low-quality video. We call this phenomenon the *downward spiral effect*, and we measure it on all three services, present insights into its root causes, and validate initial solutions to prevent it.

Categories and Subject Descriptors

C.2.0 [**Computer Systems Organization**]: Computer-



They can interfere with each other;

IMC'12 / IRTF 87

Sammy: smoothing video traffic to be a friendly internet neighbor

Bruce Spang
Stanford University

Shravya Kunamalla
Netflix

Renata Teixeira
Netflix

Te-Yuan Huang
Netflix

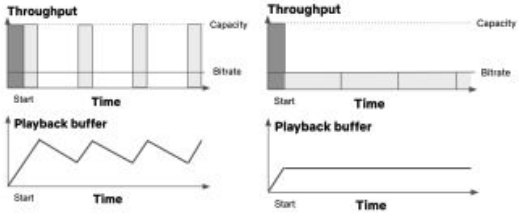
Grenville Armitage
Netflix

Ramesh Johari
Stanford University

Nick McKeown
Stanford University

ABSTRACT

On-demand streaming video traffic is managed by an adaptive bitrate (ABR) algorithm whose job is to optimize quality of experience (QoE) for a single video session. ABR algorithms leave the question of sharing network resources up to transport-layer algorithms. We observe that as the internet gets faster relative to video streaming rates, this delegation of responsibility gives video traffic a burstier on-off traffic pattern. In this paper, we show we can substantially smooth video traffic to improve its interactions with the rest of the internet, while maintaining the same or better QoE for streaming video. We smooth video traffic with two design principles:

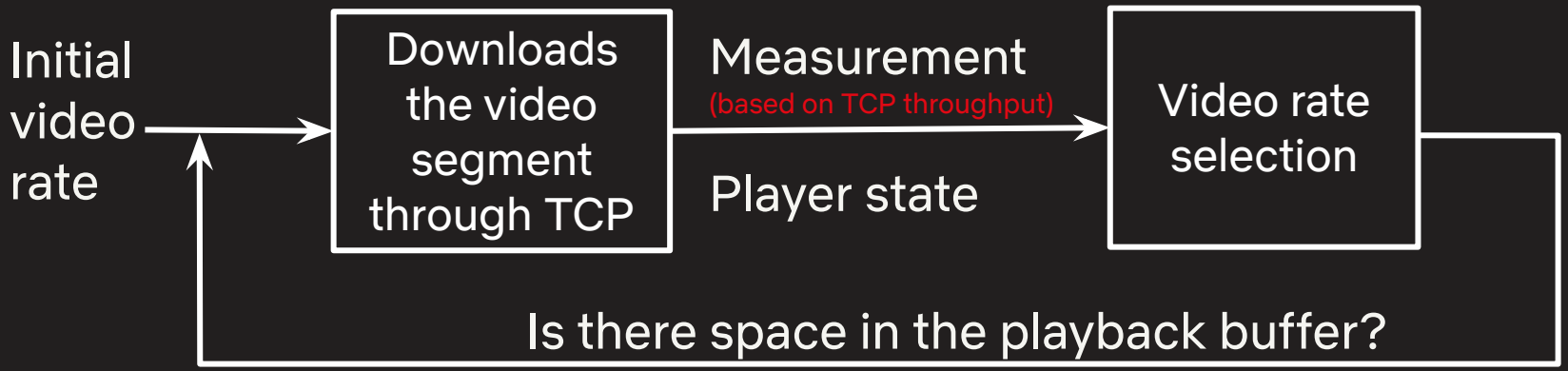


(a) Video traffic today. (b) Smoother, same QoE.

Combining them can achieve great things!

SIGCOMM'23

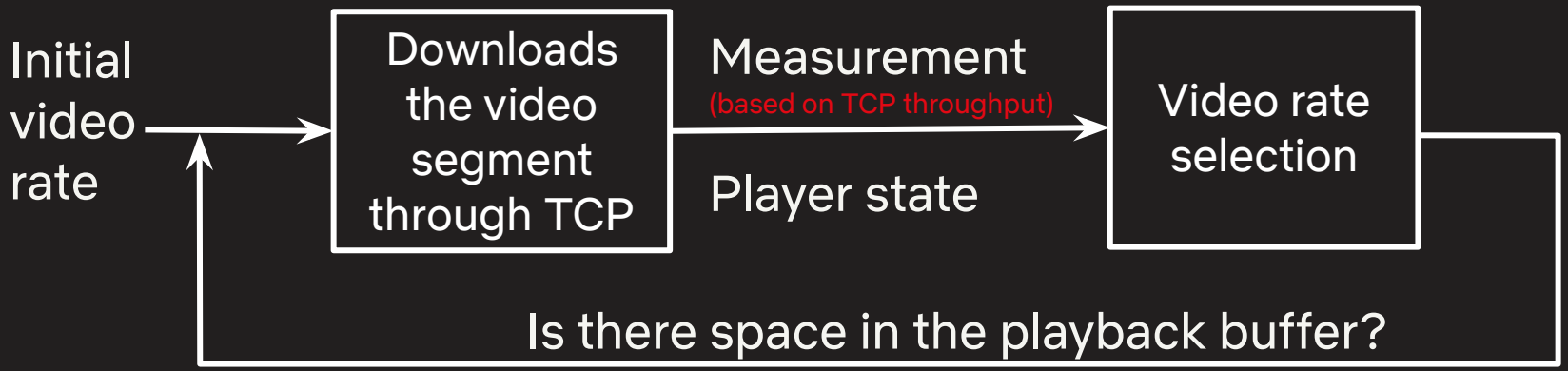
How does ABR + CC work together today?



What goes wrong in this picture?

How do we make it better?

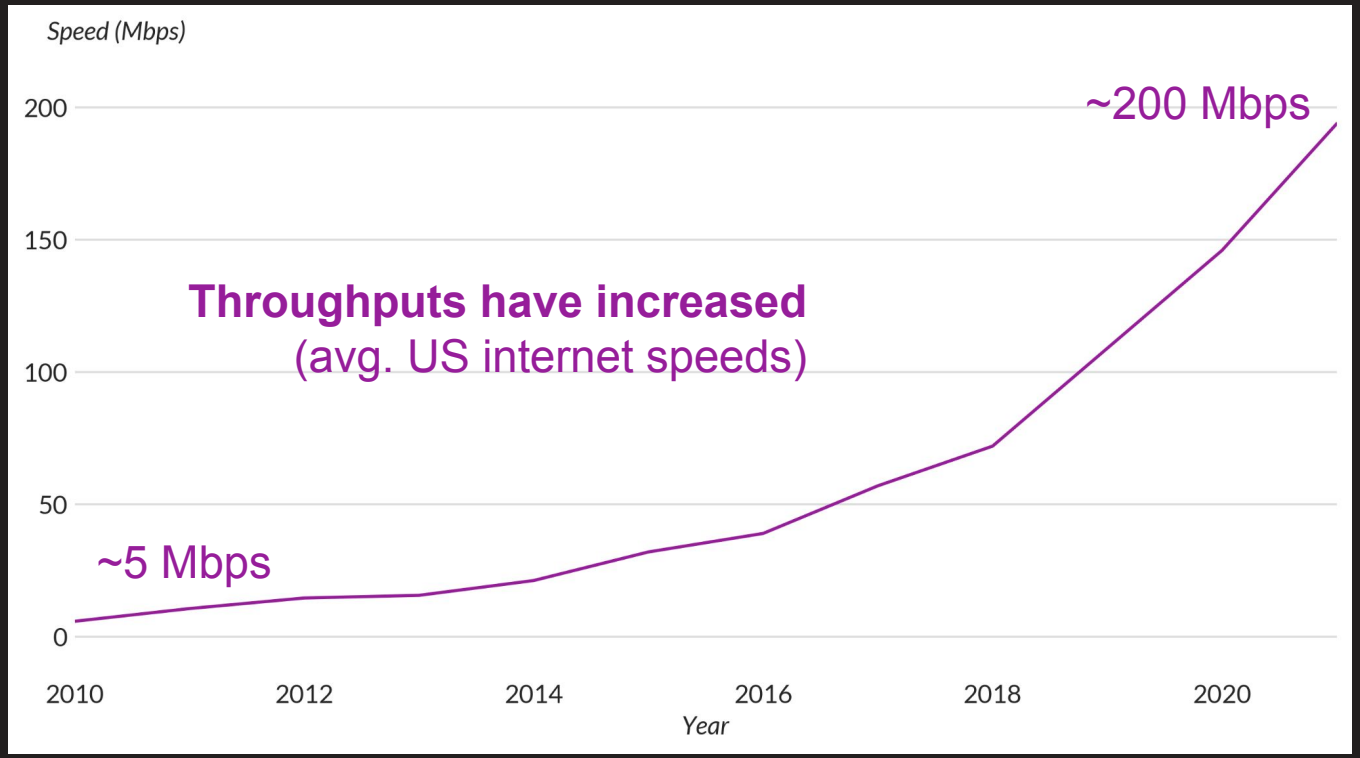
How does ABR + CC work together today?



TCP aims to fully utilize its fair share.

Download as fast as possible.

Video today is usually not throughput limited



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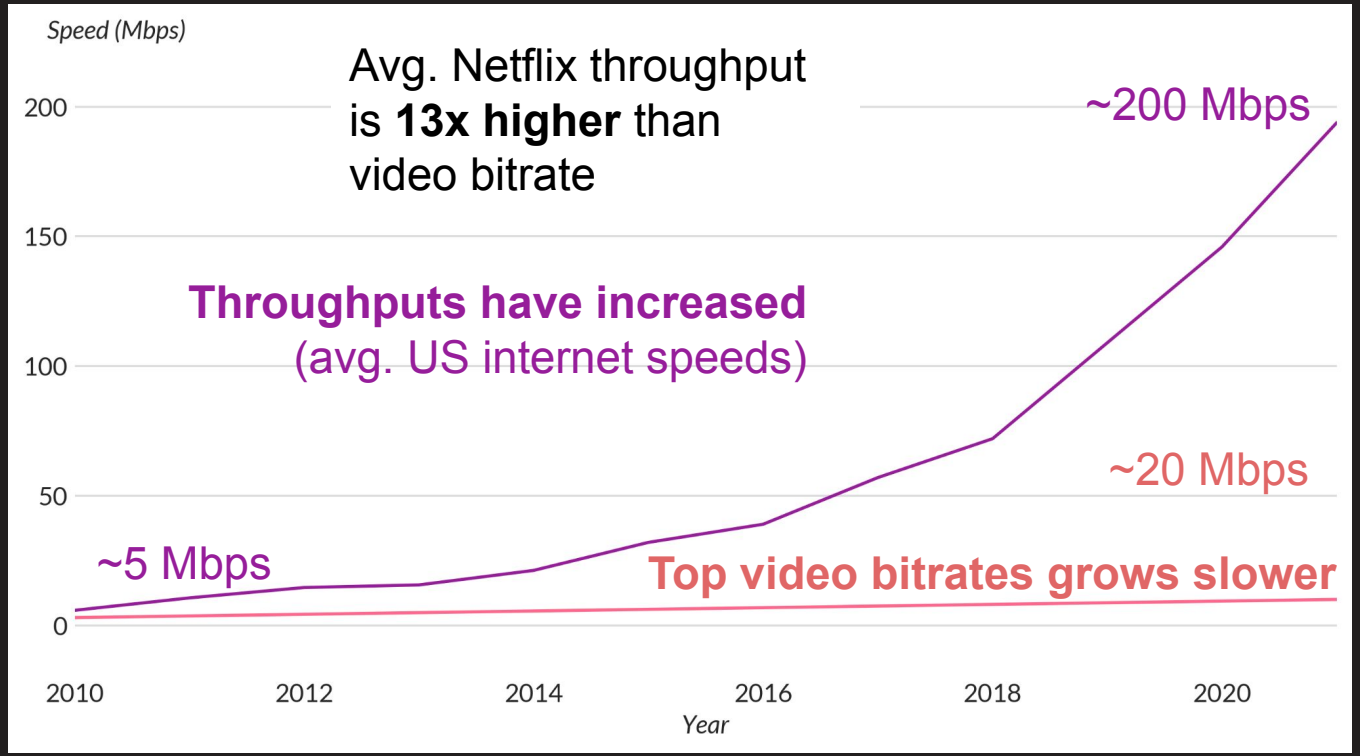
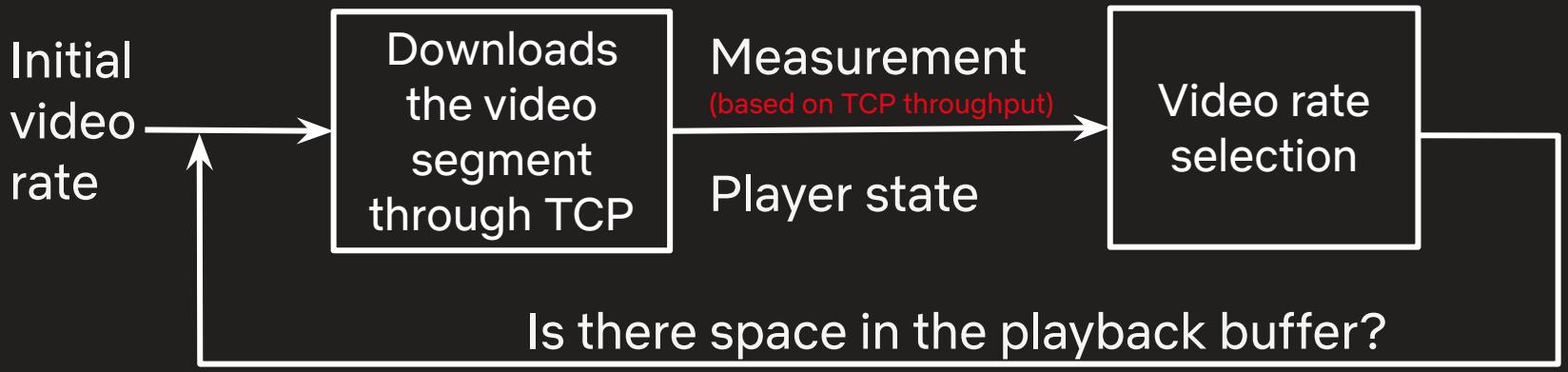


How ABR + CC works together today



Download as fast as possible.

\+

Limited playback buffer.

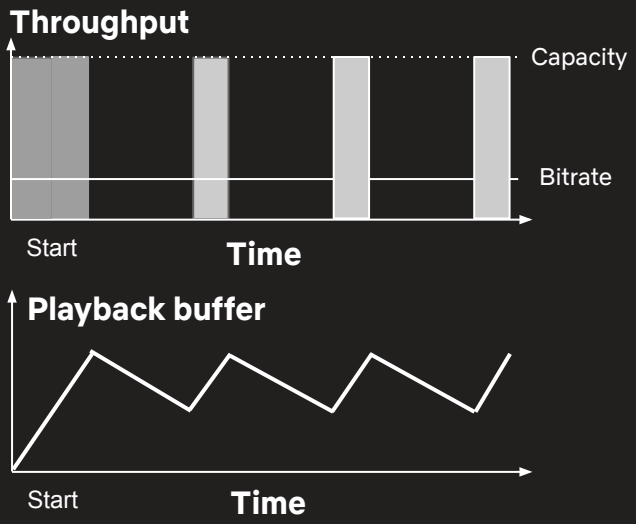
Throughput is often higher than video rate.

=

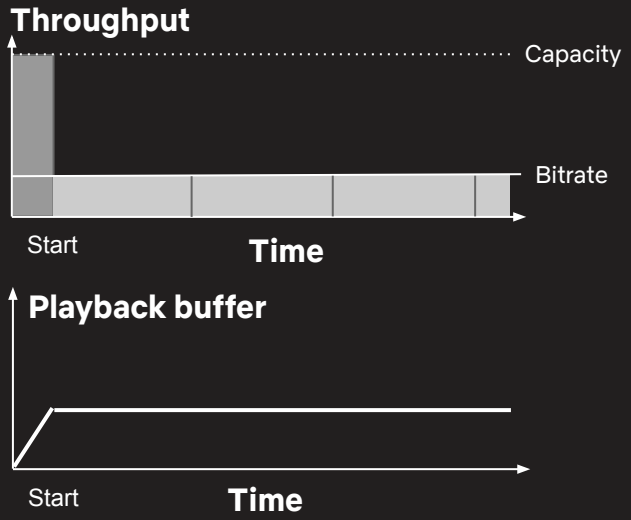
Bursty video traffic

Video traffic is bursty today, and it doesn't need to be.

Not smooth
(Video traffic today)



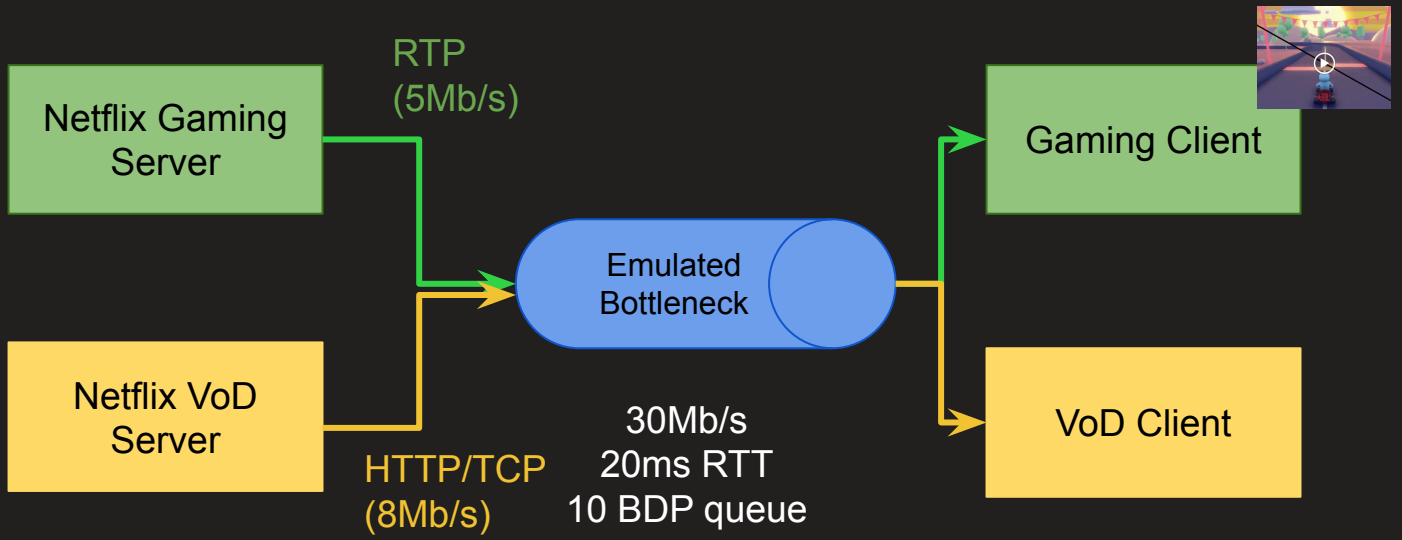
Ideally



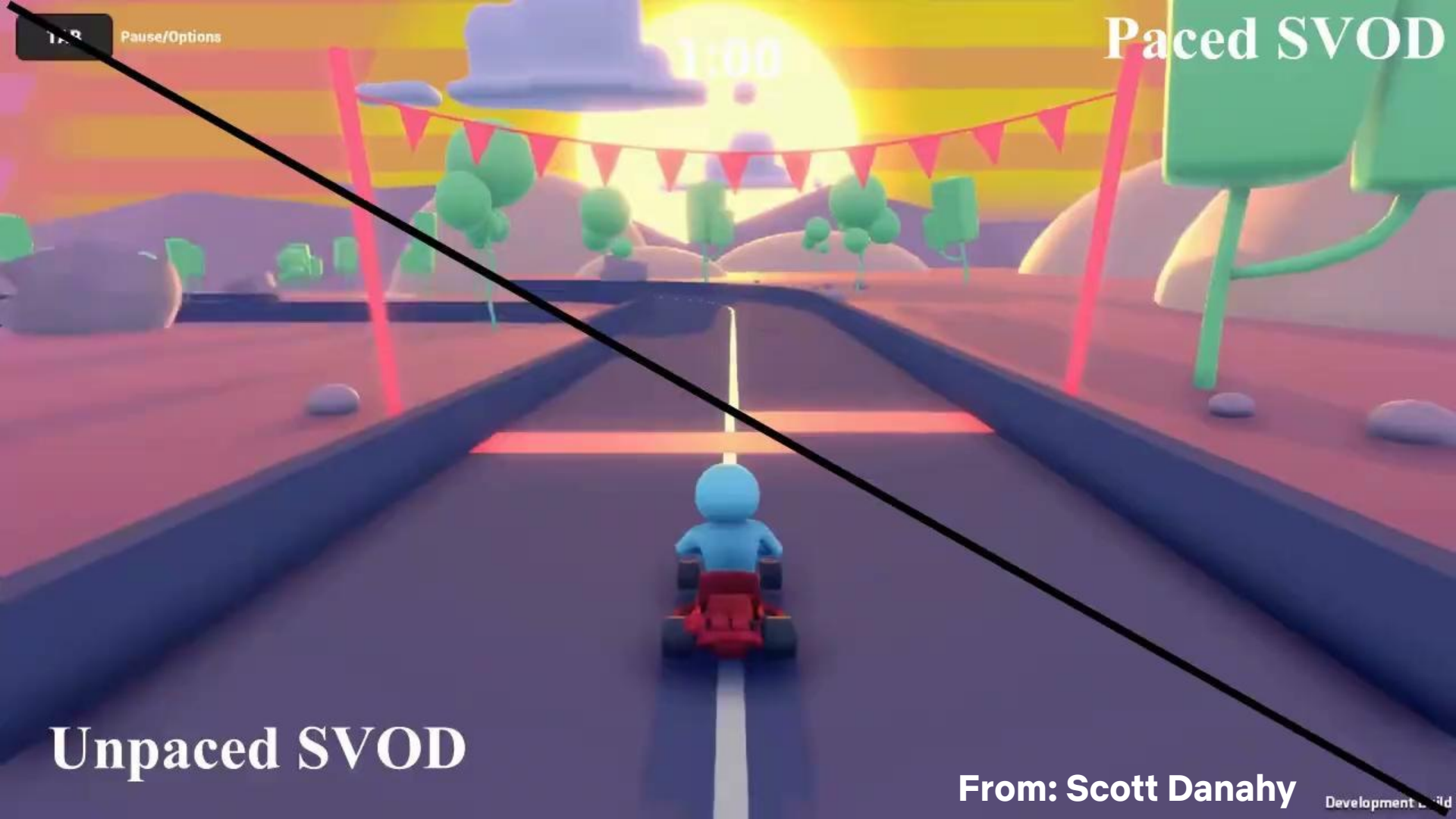
No queuing delay or packet loss

Smooth available bandwidth for others

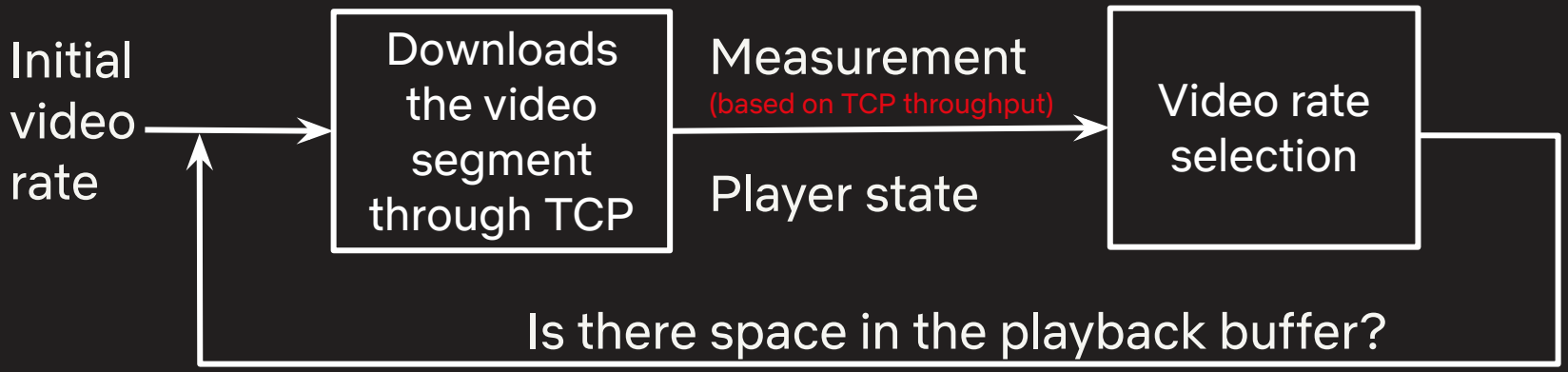
The impact of bursty traffic is visible



From: Scott Danahy


Pause/Options
1:00
Paced SVOD
Unpaced SVOD
From: Scott Danahy

How can the two logics help each other?



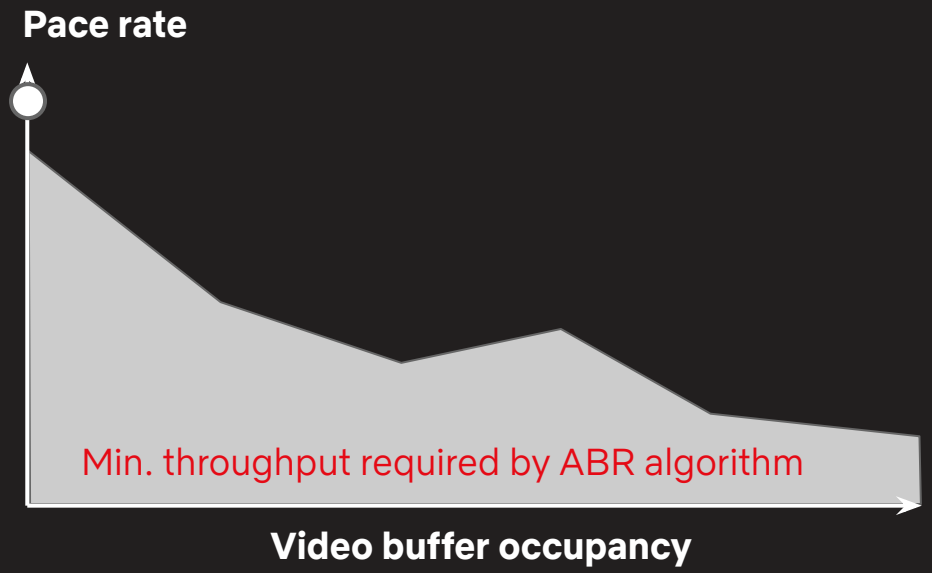
~~Download as fast as possible.~~

Download as fast as needed.

App-informed pacing

ABR should inform CC to pace based on the QoE needs

Just need enough throughput for ABR algorithm to pick highest bitrate



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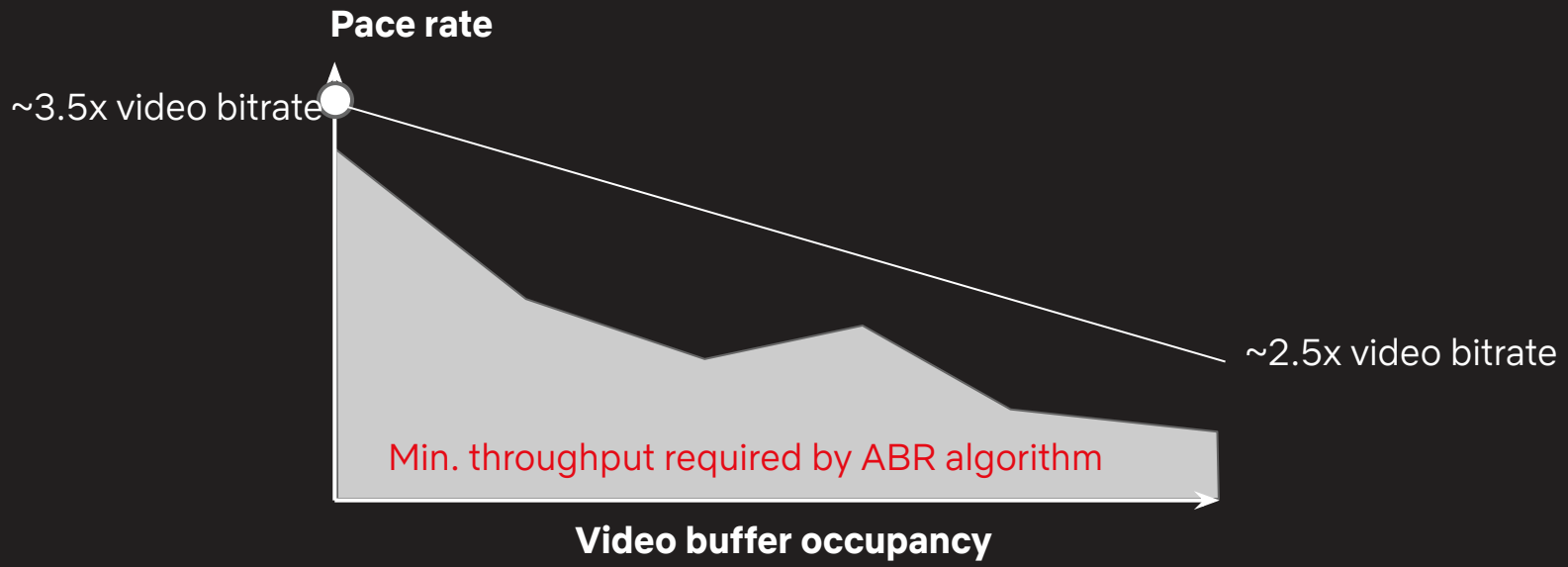

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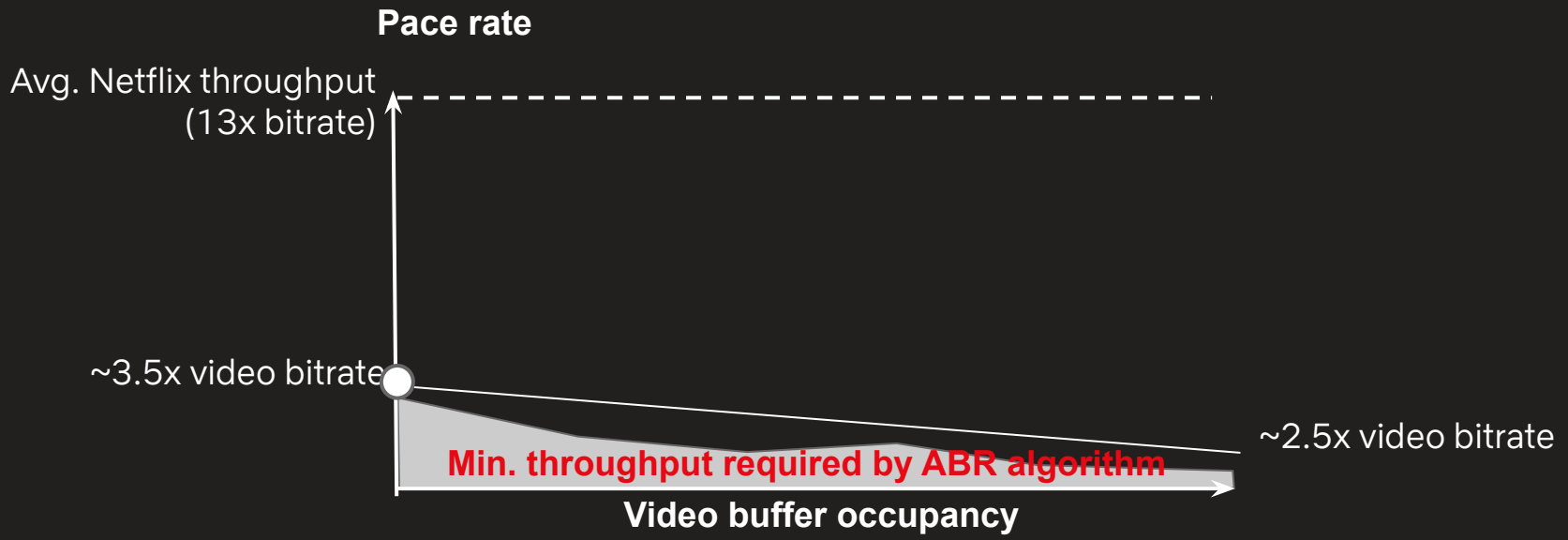

Large-scale experiments at Netflix

App-informed pacing reduces congestion-related metrics:

Metric	Results
Instantaneous Throughput	62% lower
Retransmissions	50% lower
Round-trip times	19% lower

All with QoE *improvements* (see paper for details)

Promising results towards combining ABR & CC

What now?

- YouTube is experimenting with similar techniques
- Netflix is in the process of rolling out app-informed pacing
  - Productization considerations:
    - Server CPU consumption
    - Mobile client power consumption
  - On track to fully productization soon
- Netflix and YouTube are working together to quantify some of the benefits

If you want to try it out,

Let’s chat!

Te-Yuan (TY) Huang / thuang@netflix.com