

Understanding the Impact of Video Quality on User Engagement

Florin Dobrian Vyas Sekar Ion Stoica Hui Zhang

Asad Awan

Dilip Joseph

Aditya Ganjam



Carnegie Mellon



2005: Beginning of Internet Video Era



100M streams first year

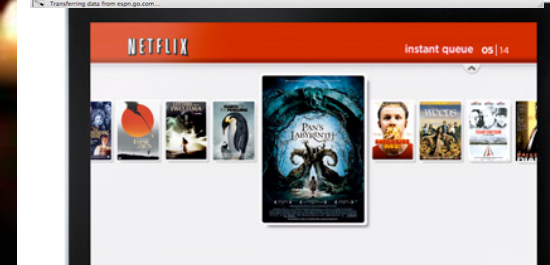


Premium Sports Webcast on Line



Zhang, SIGCOMM 2011

2006 – 2011: Internet Video Going Prime Time



2006

2007

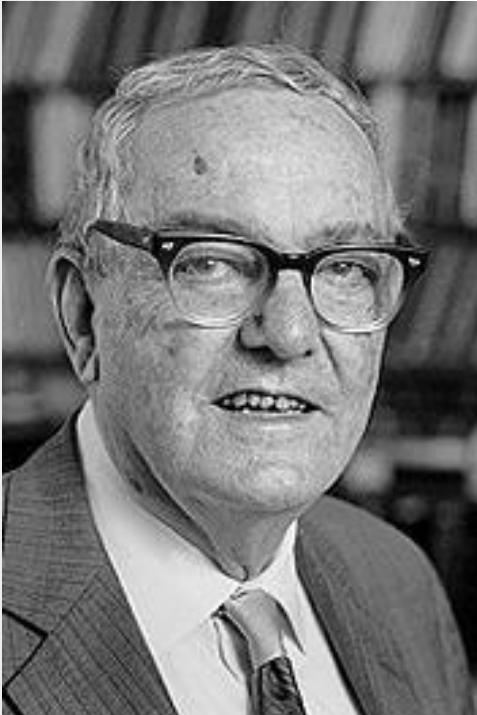
2008

2009

2010

2011

Herb Simon Attention Economics



Overabundance of information
implies a scarcity of user attention!

Onus on content publishers to
increase engagement

What Impacts Engagement?

What is understood:

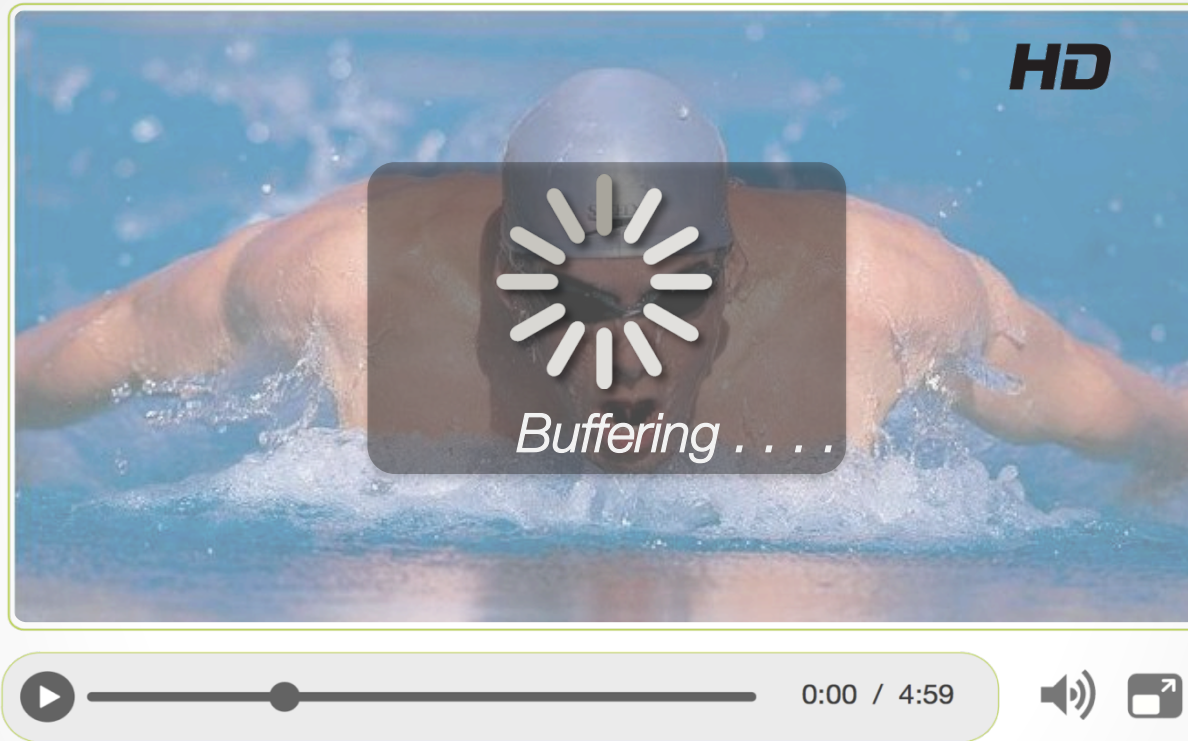


Content & Personal Taste
Impact significantly



What is NOT Understood: how much does quality matter?
“Compelling Content, even fuzzy, can capture the attention of the world”

Given the same video (content), Does **Quality** Impact **Engagement**?



- What are the most critical metrics?
- Do these critical metrics differ across genres?
- How much does optimizing a metric help?

Overview of the Paper

Empirical study of video quality vs. engagement

- 🕒 A week of data from multiple premium video sites &
 - Full census measurement from video player
- 🕒 Three genres: Live, LVoD, SVoD
- 🕒 Five quality metrics
 - Buffering Ratio
 - Rate of Buffering
 - Join time
 - Rendering Quality
 - Average Bit Rate
- 🕒 Two granularities: view/viewers



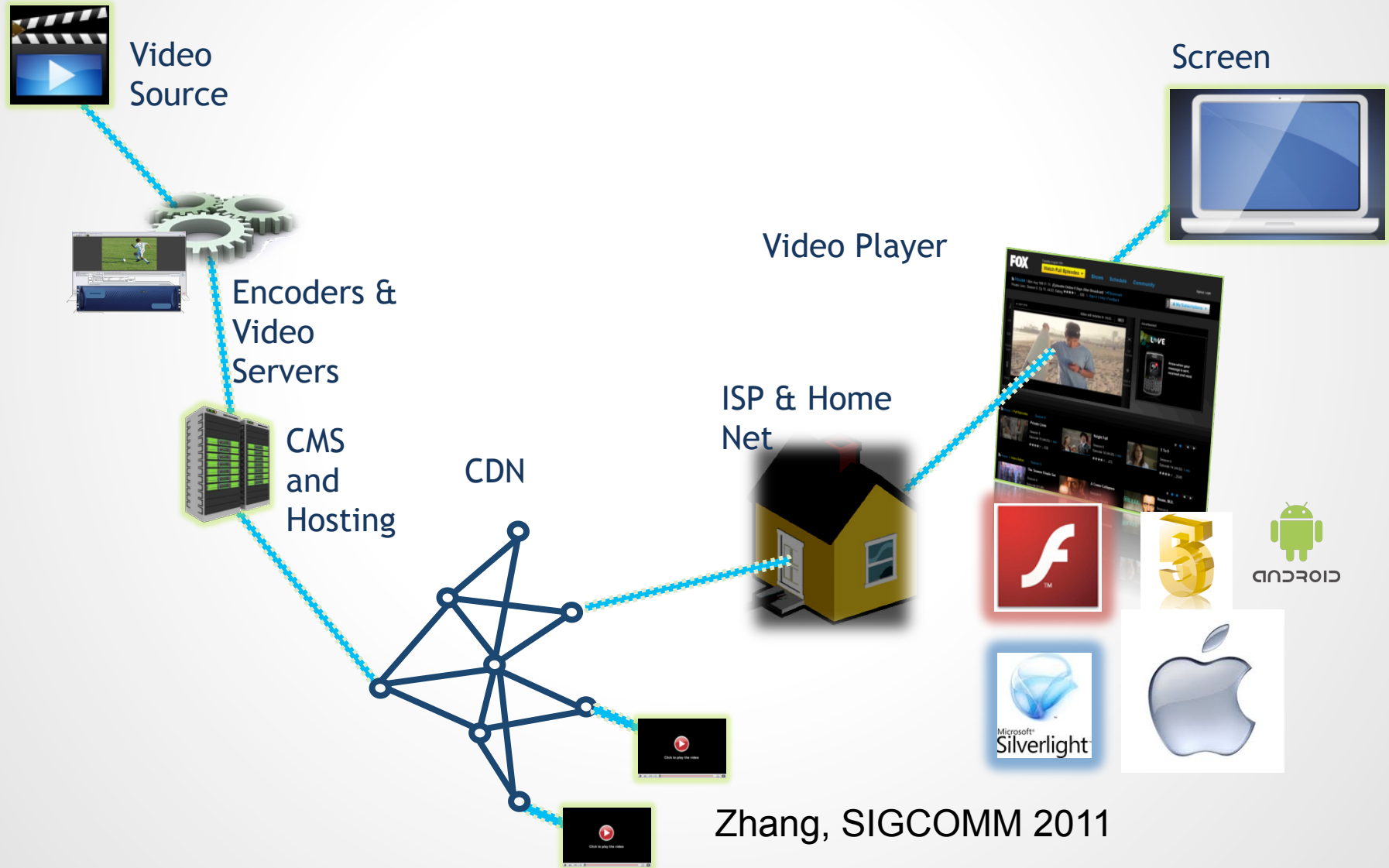
Highlights of Results

- 🔌 Quality has substantial impact on engagement
- 🔌 Buffering ratio is most critical across genres
 - Highest impact for live:
1% increase in buffering reduces 3min play time
- 🔌 Bitrate and Buffering Rate also important for live
- 🔌 Join time impacts engagement at viewer level but not view level
- 🔌 Many interesting dependencies
 - Need context , multiple “lenses” to extract dependencies

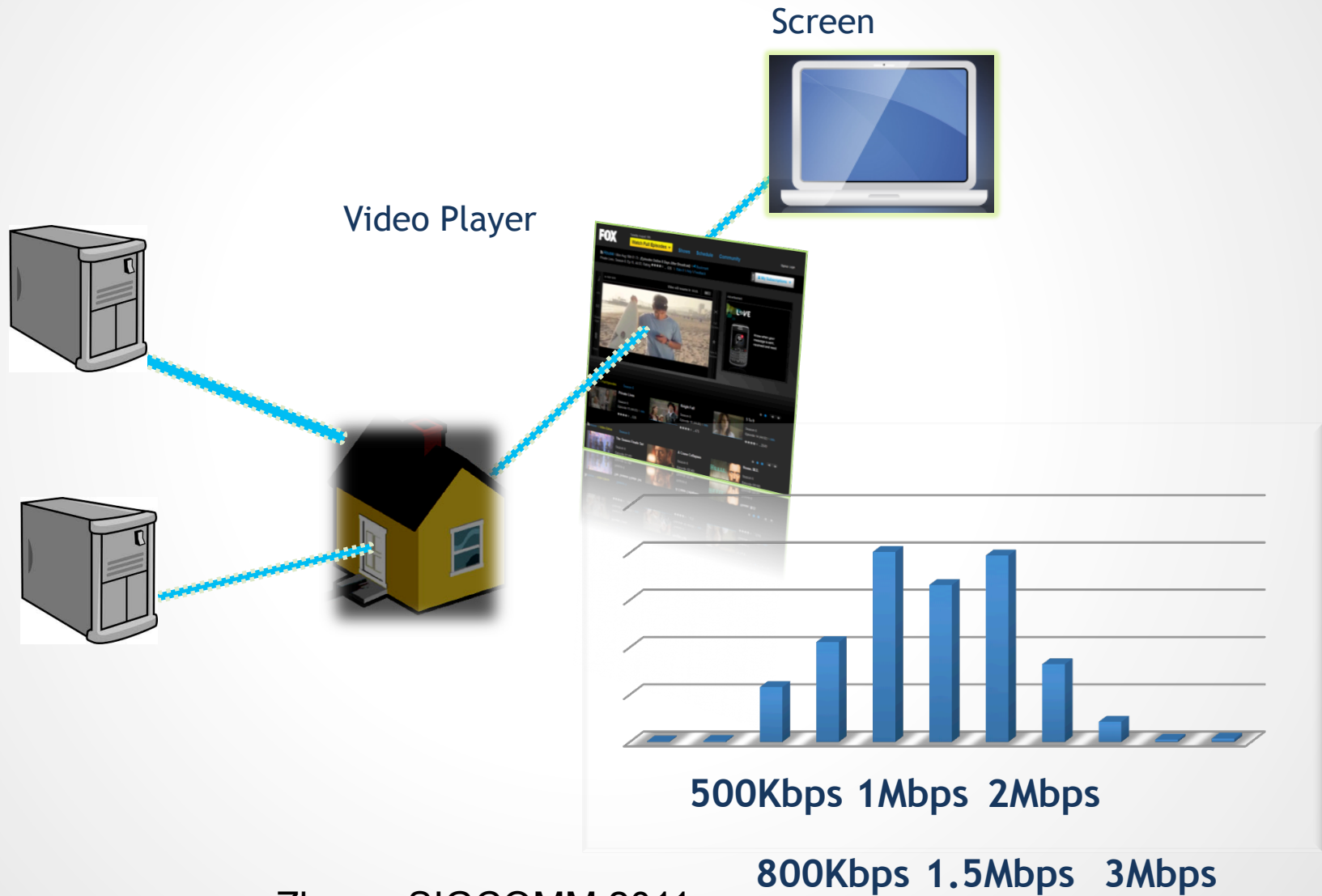
Outline

- ① Introduction
- ② Dataset and setup
- ③ Selected results
- ④ Concluding remarks

Internet Video Eco-System Today:

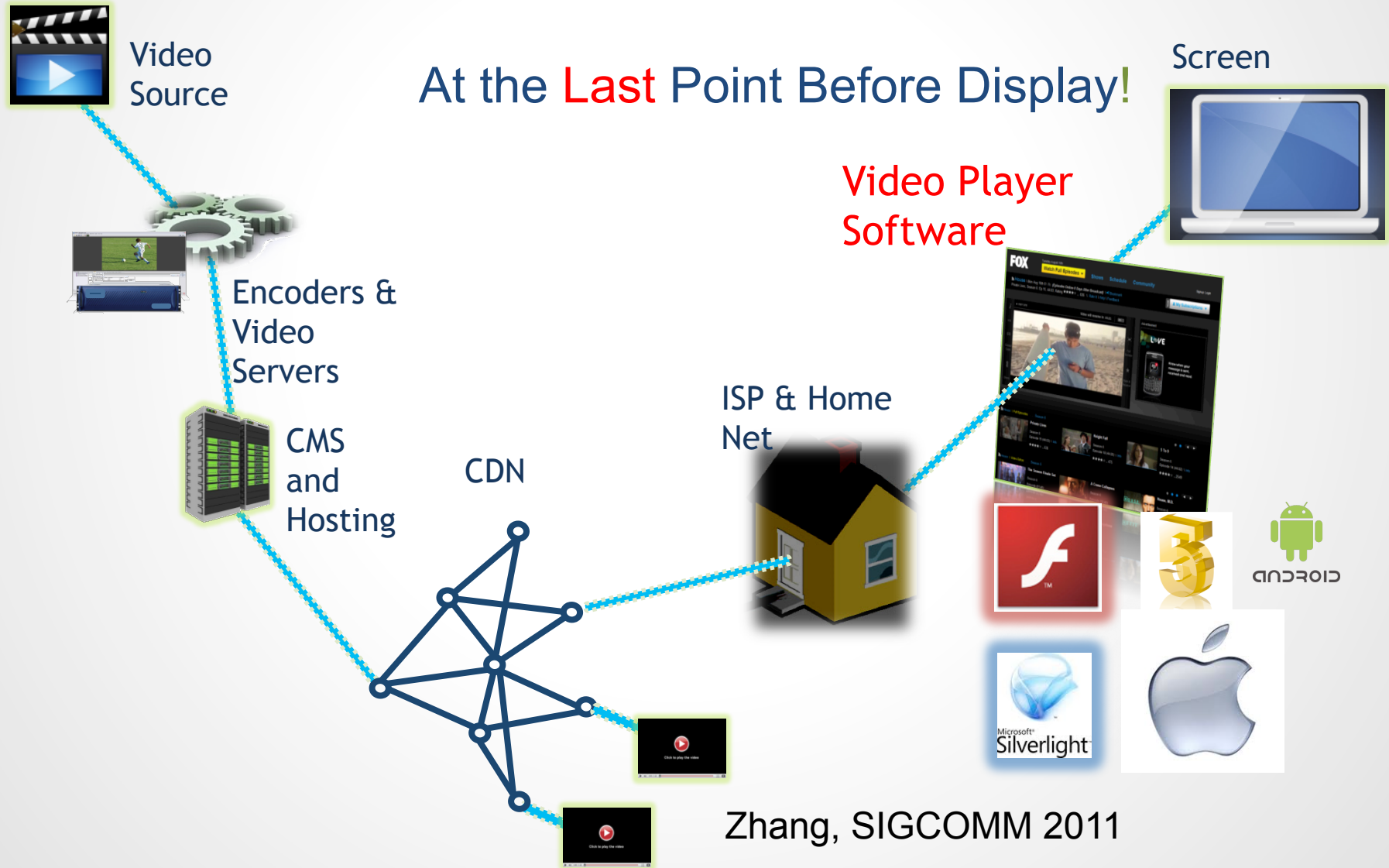


Adaptive Multi-Bit Rate & Multiple Servers For the Same Stream

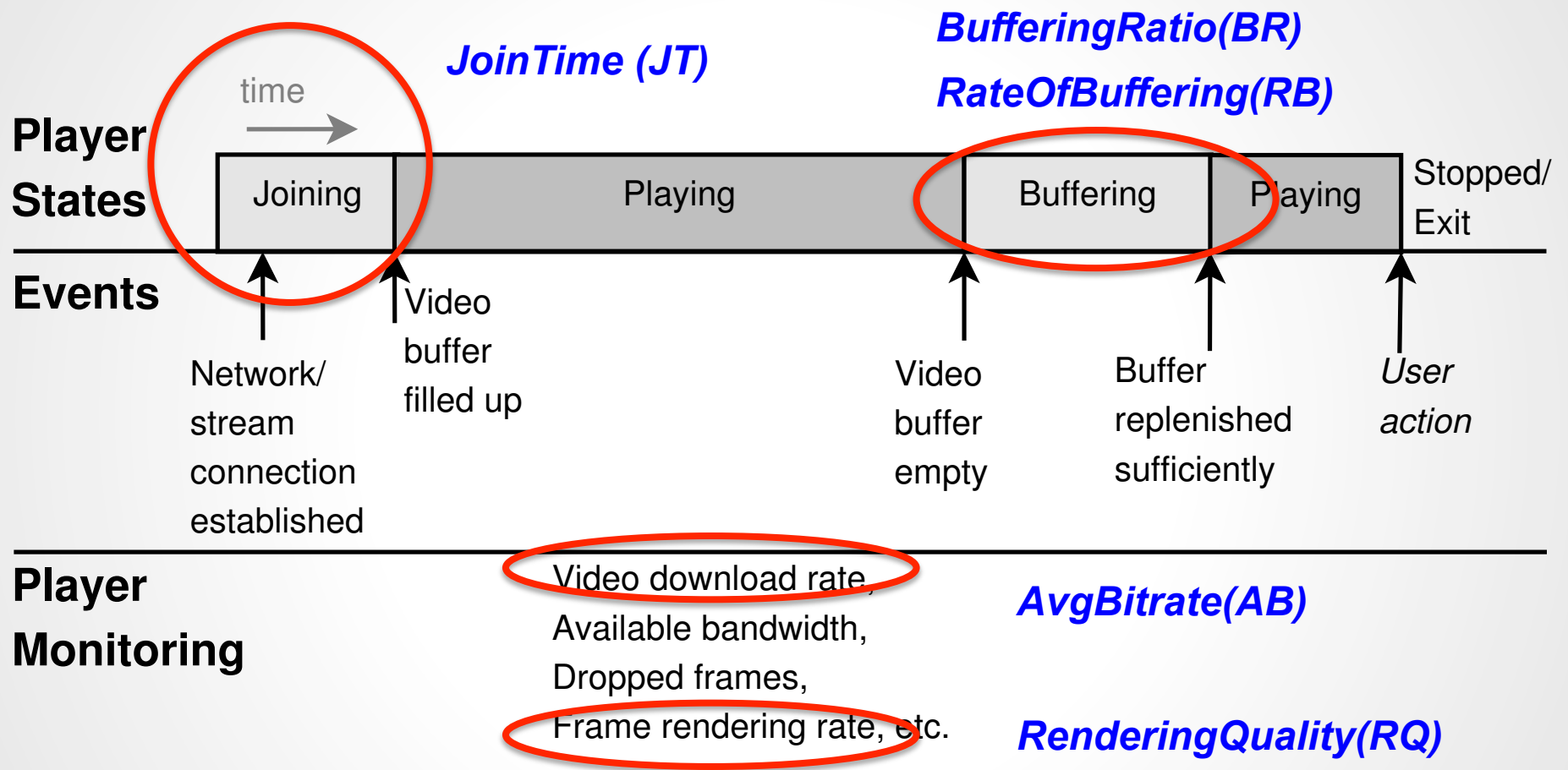


Zhang, SIGCOMM 2011

Where to Measure Video Quality?



Video Player Instrumentation



Quality Parameters **NOT** Available in ISP or CDN

Zhang, SIGCOMM 2011

Engagement Metrics

View-level

- Play time of a video session

Viewer-level

- Total play time by a viewer in a period of time
- Total number of views by a viewer in a period of time

Content Genres

One week of data in Fall 2010 + FIFA world cup

	Dataset	# videos	# viewers (100K)
2-5 mins e.g., trailers	SVoDA	43	4.3
	SVoDB	53	1.9
35-60 mins TV episodes	LVoDA	115	8.2
	LVoDB	87	4.9
Live sports	LiveA	107	4.5
	LiveB	194	0.8
	FIFA	3	29

Premium content providers in US
Diverse platforms and optimizations

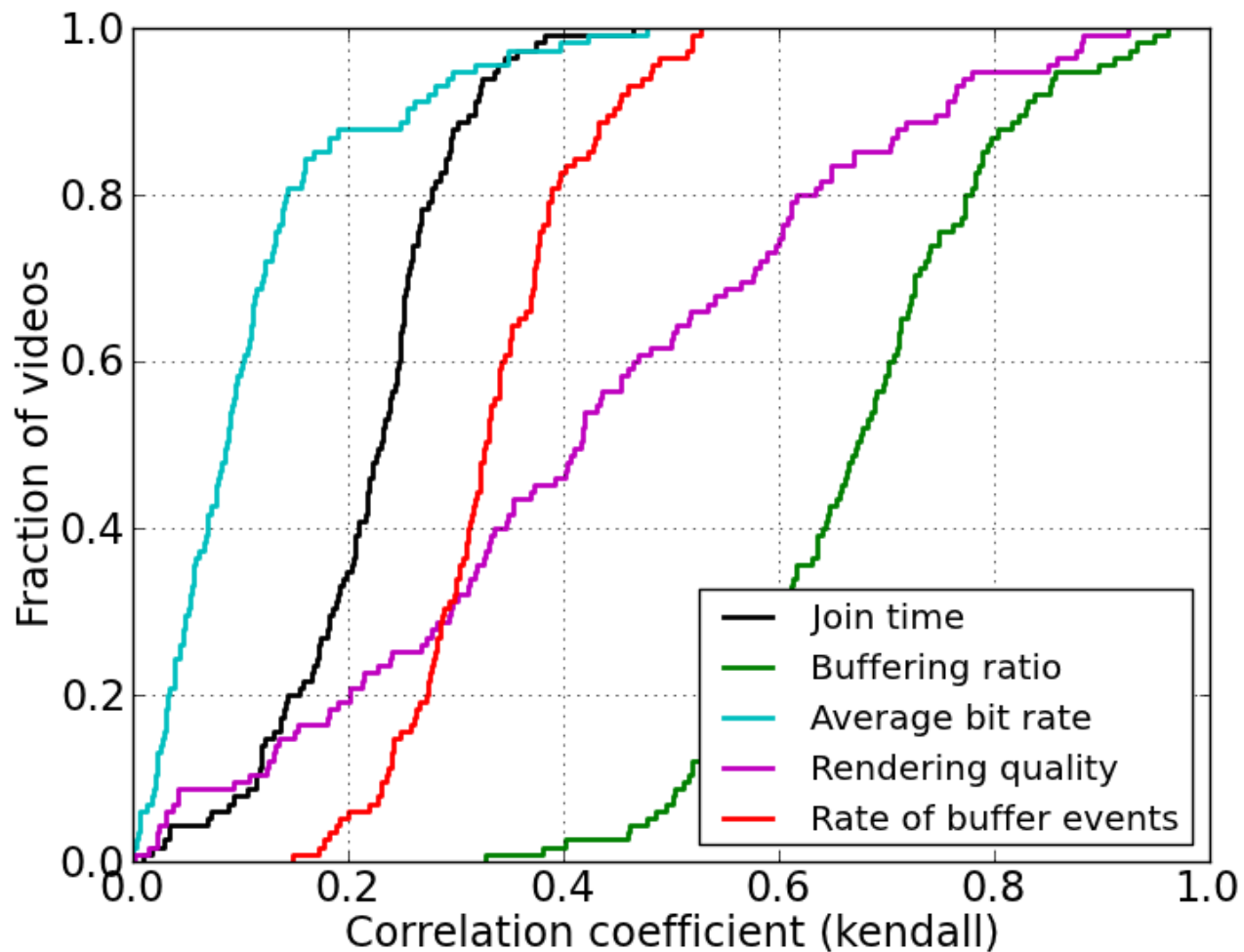
High-level questions & Analysis Techniques

Which metrics matter most? → (Binned) Kendall correlation

Are metrics independent? → Information gain

How do we quantify the impact? → Linear regression

LVoD at View Level

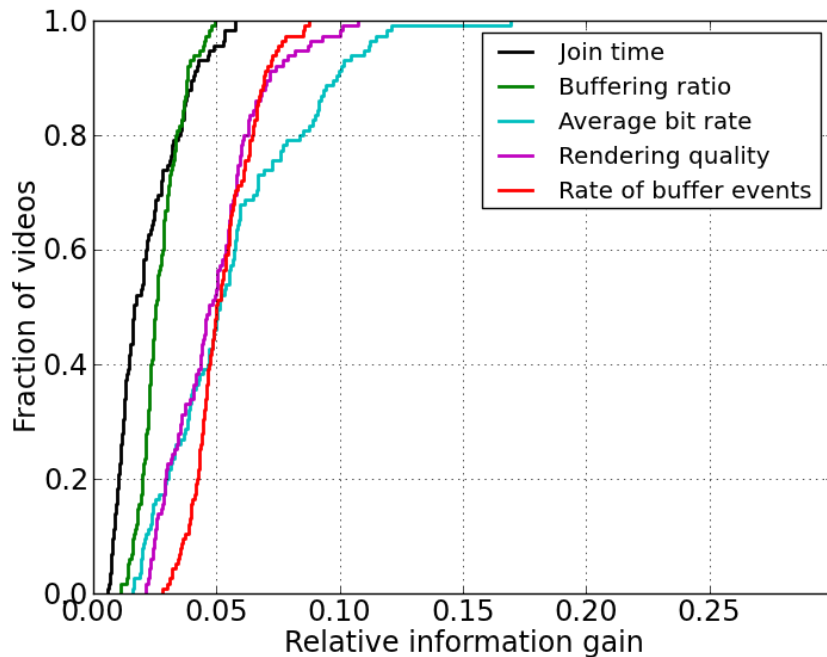


Buffering Ratio correlates with engagement the most

Bit Rate and **Join Time** not much?

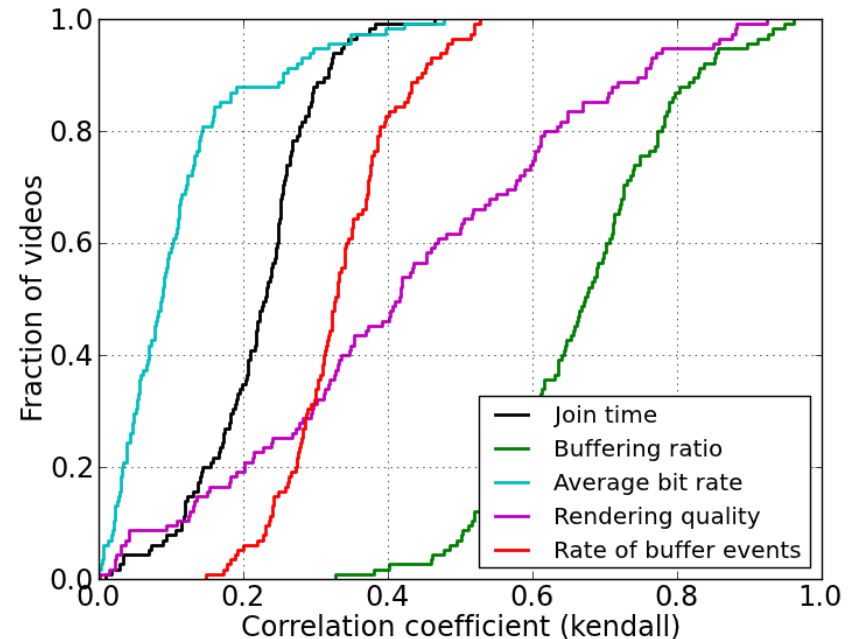
Seeing the World via Two Lenses: (LVoD View level)

Information Gain



Bit Rate Gain High

Correlation

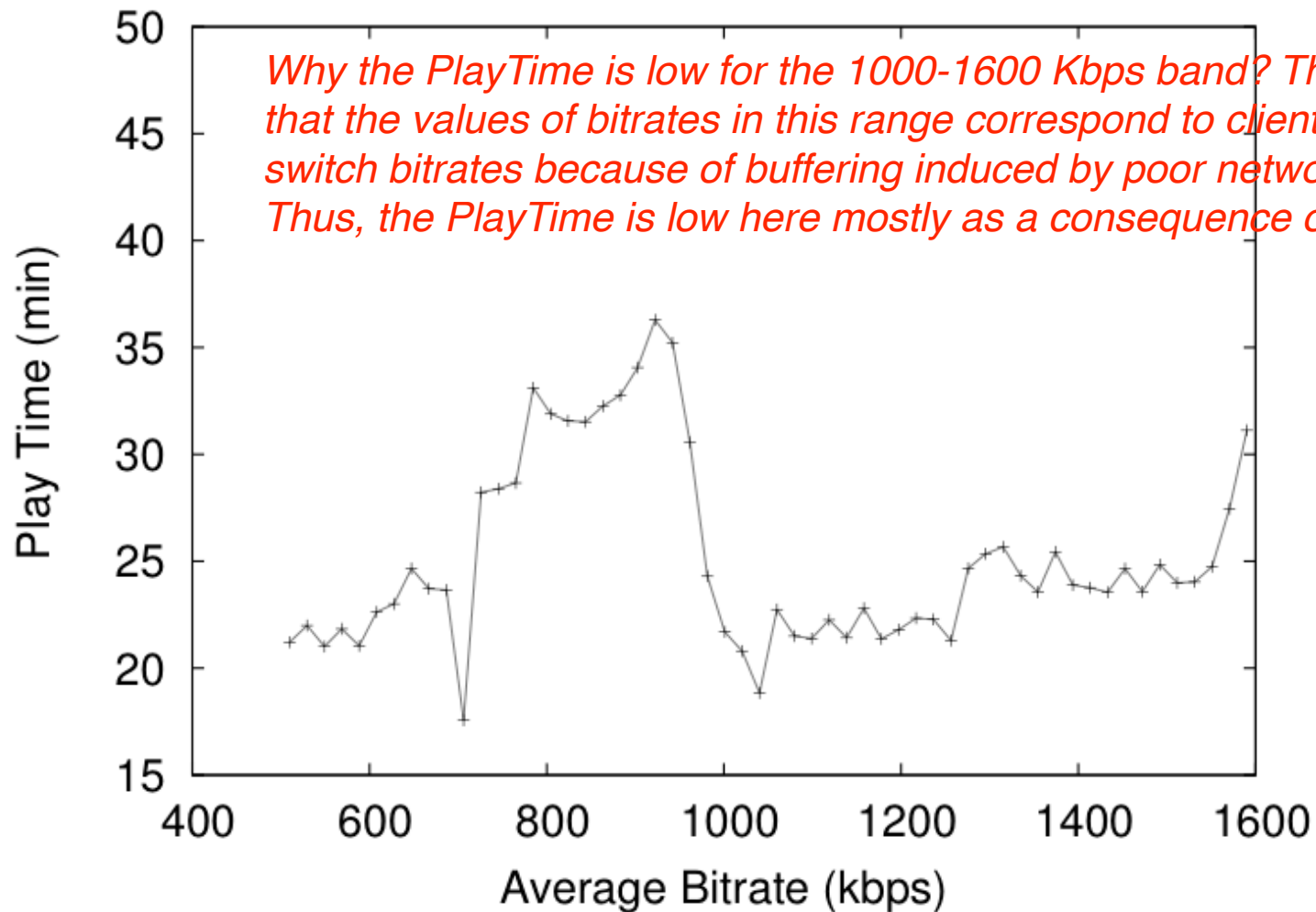


Bit Rate Correlation Low

Why the Difference?

Zhang, SIGCOMM 2011

Engagement vs. Bit Rate for LVoD View Level

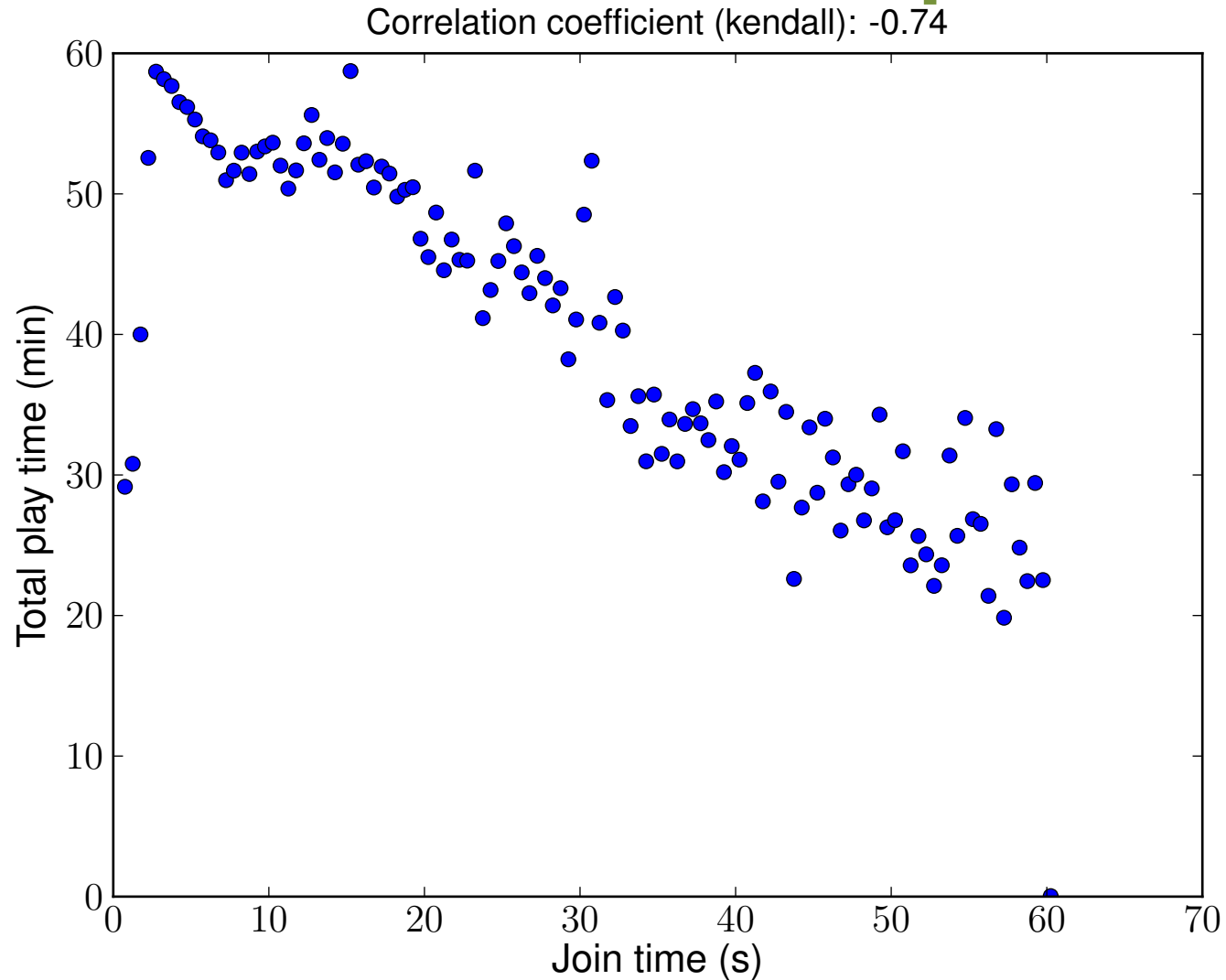


Why the PlayTime is low for the 1000-1600 Kbps band? The reason is that the values of bitrates in this range correspond to clients having to switch bitrates because of buffering induced by poor network conditions. Thus, the PlayTime is low here mostly as a consequence of buffering.

Non-monotone → Low Correlation

Zhang, SIGCOMM 2011

Join Time Analysis at Viewer Level (same viewer across multiple views)

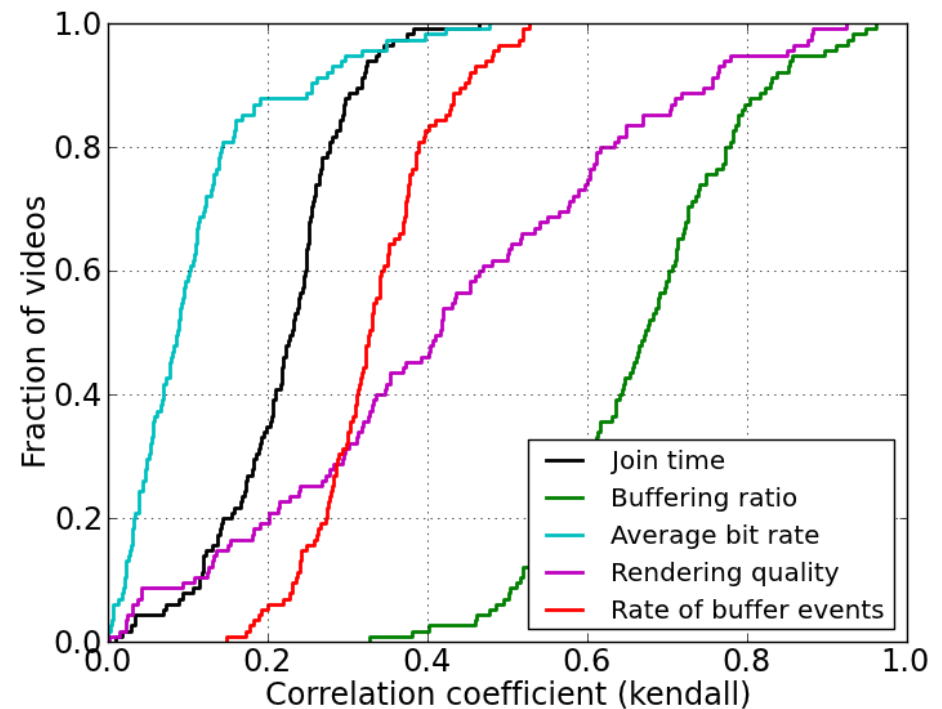
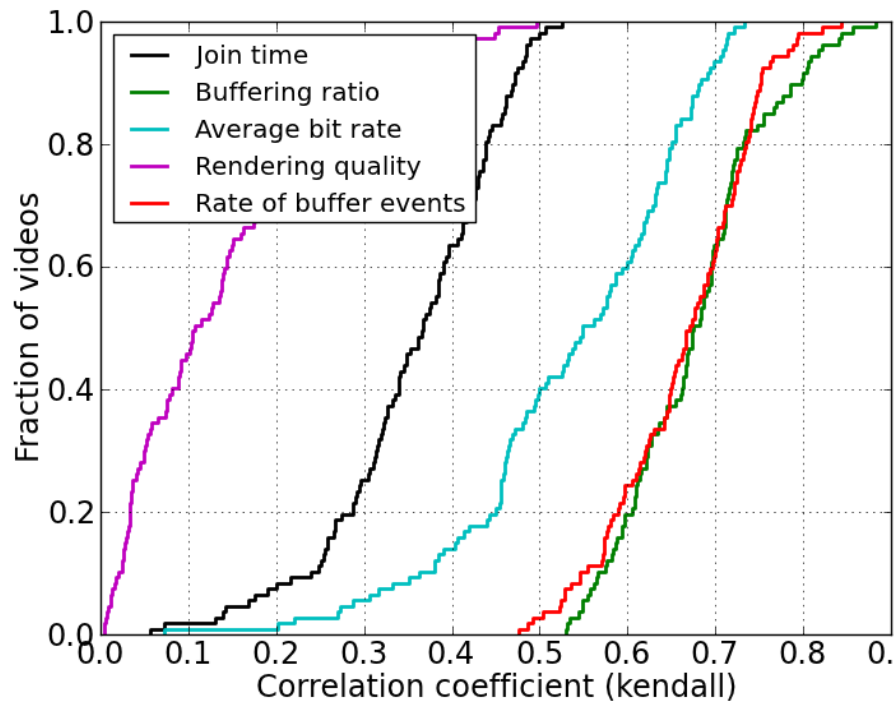


Zhang, SIGCOMM 2011 Join time is critical for user retention

Live

vs

LVoD

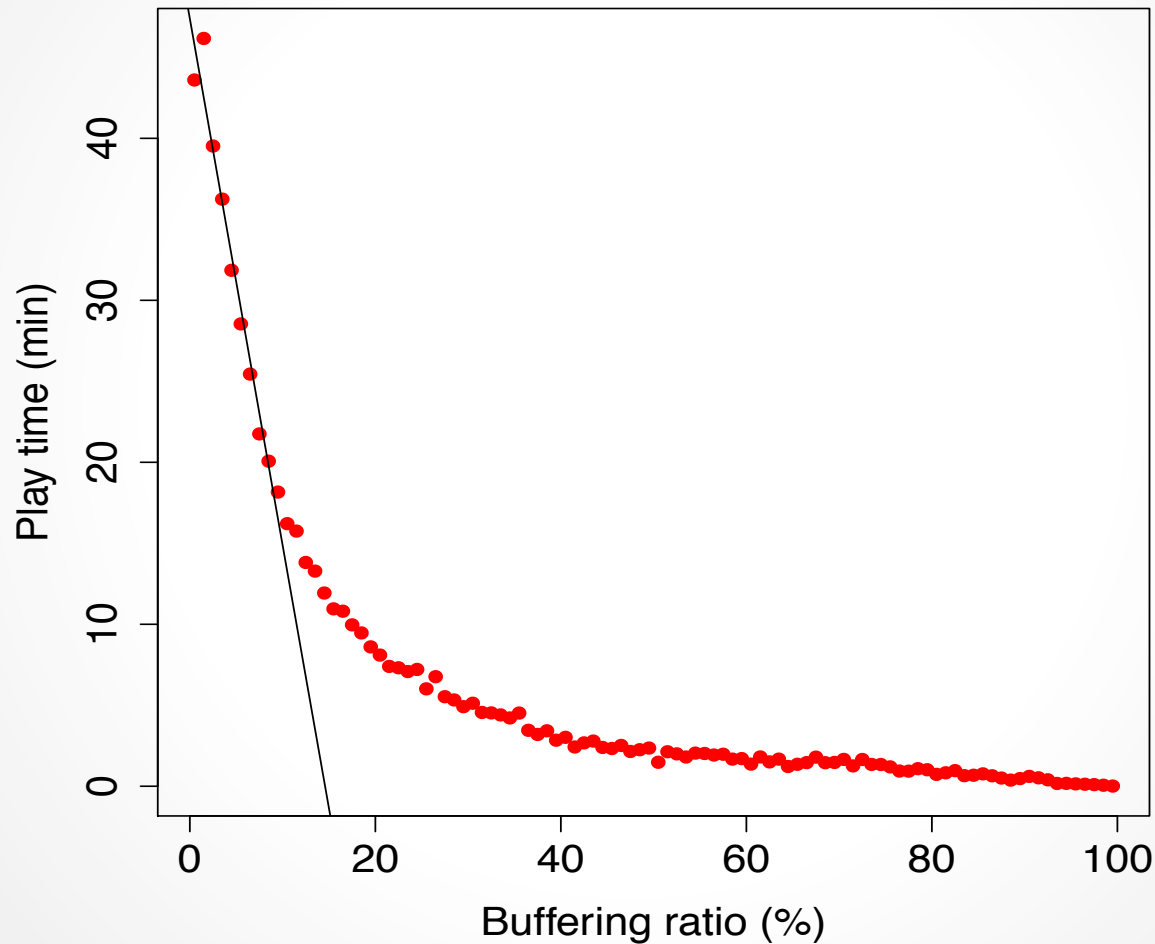


Buffering Ratio remains the most significant
Bitrate and **Rate of Buffering** matter much more for Live

Quantitative Impact:



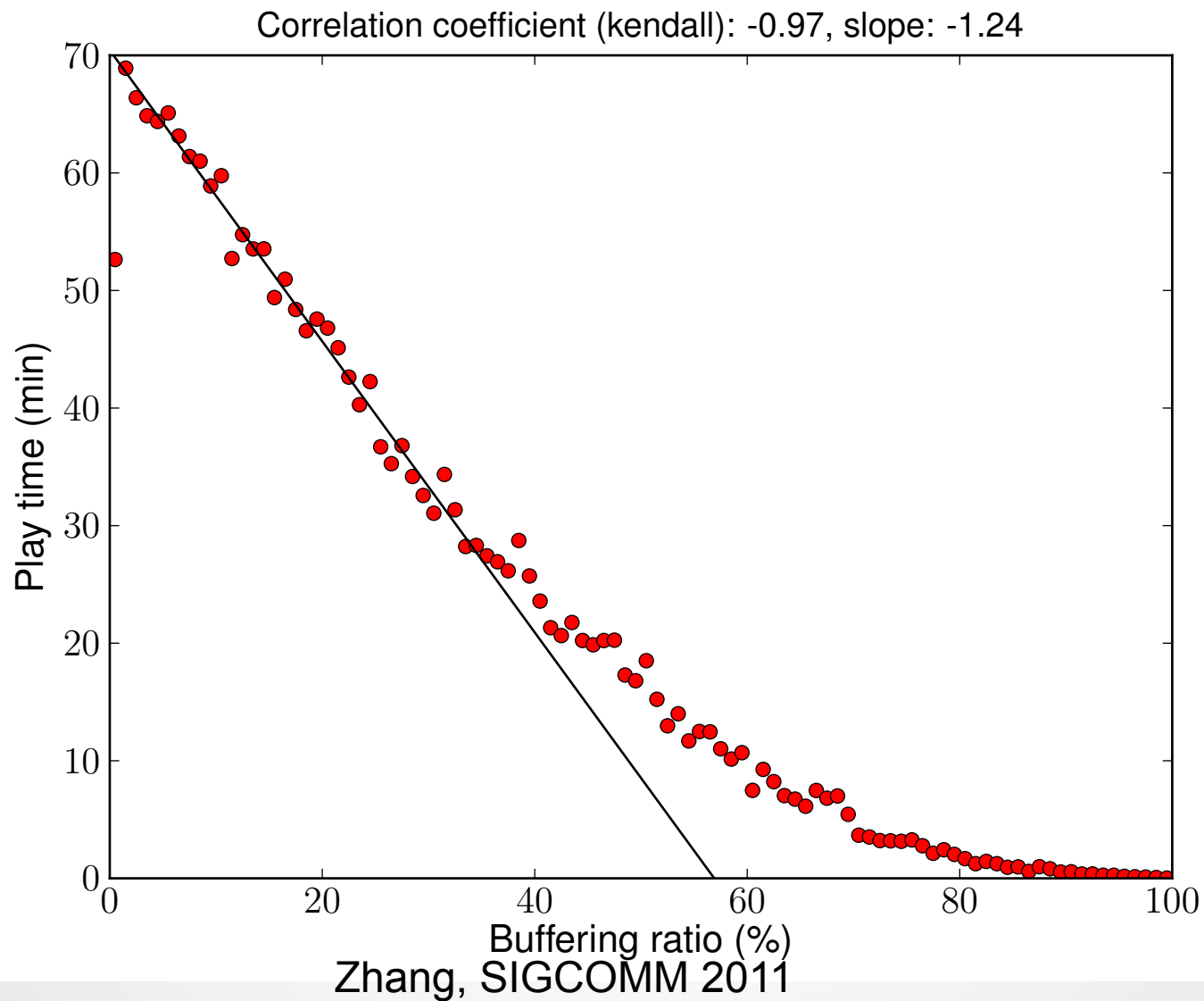
Correlation coefficient (kendall): -0.96 , slope: -3.25



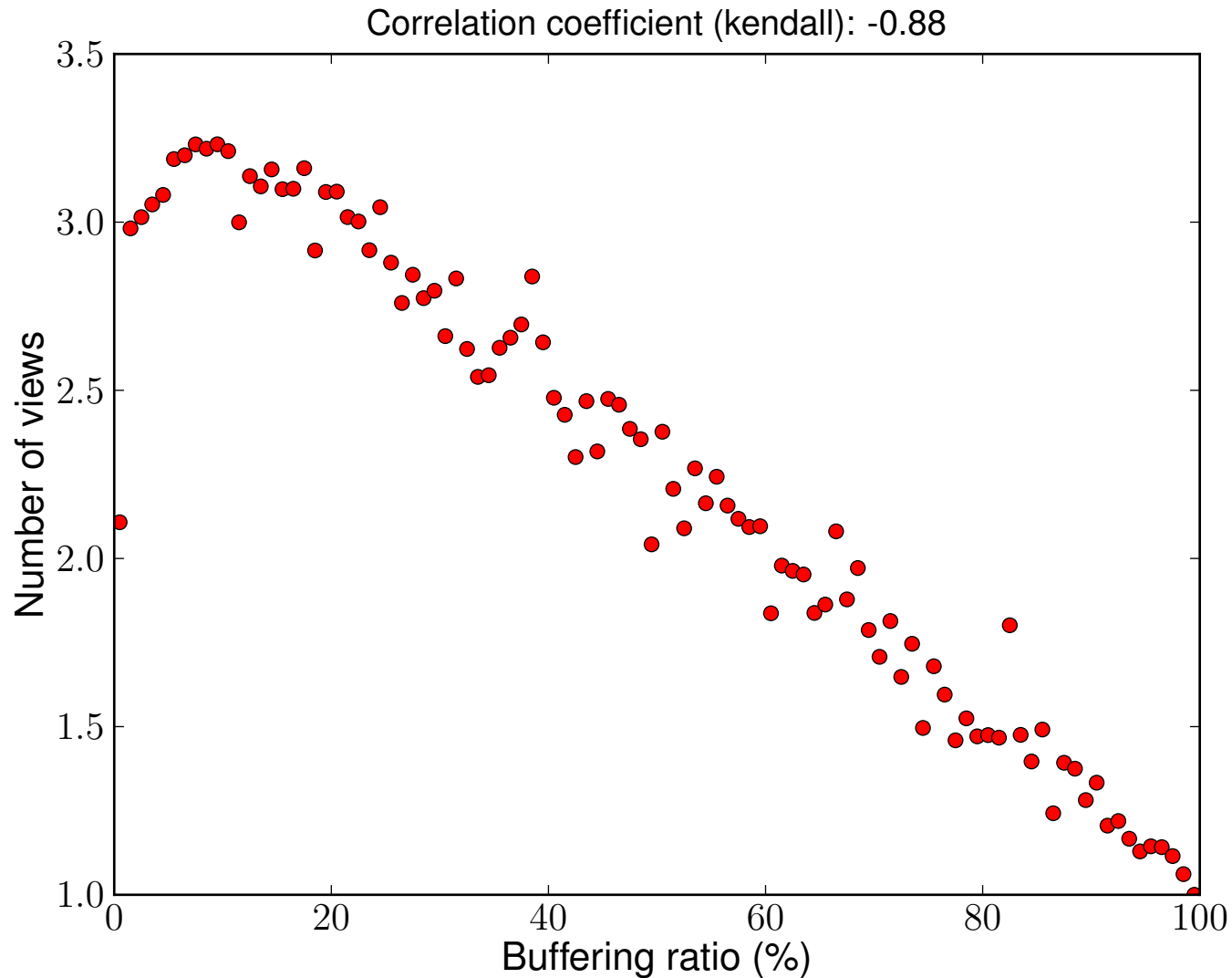
1% increase in buffering reduces engagement by 3 minutes

Zhang, SIGCOMM 2011

LVod Viewer level Play Time vs. Buffering Ratio:



LVoD Viewer level # of Views vs Buffering Ratio:



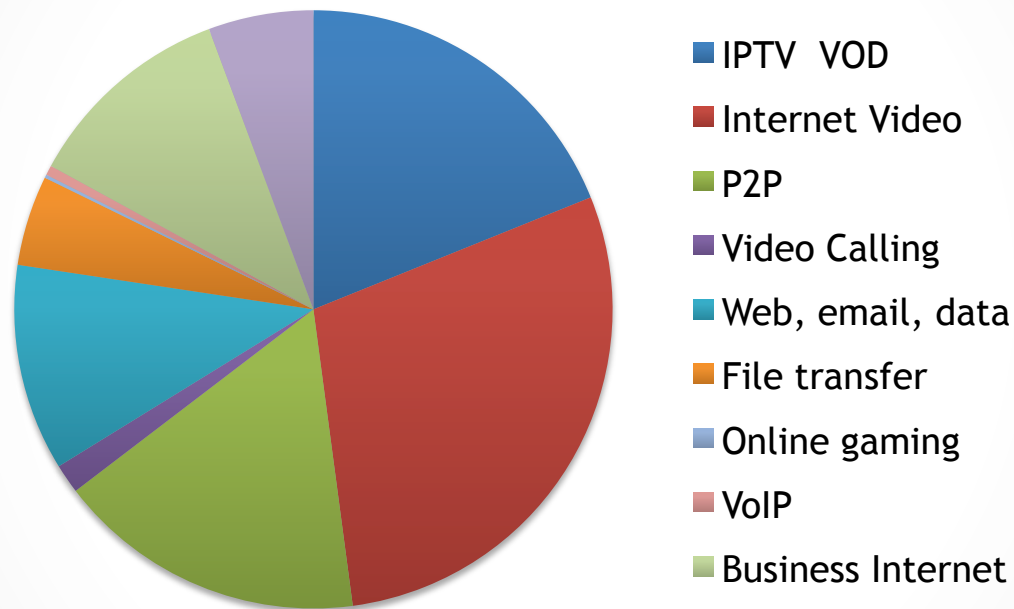
Low Buffering Ratio Is Good for Viewer Retention

Zhang, SIGCOMM 2011

Concluding Remarks

- Ⓢ First empirical analysis of video quality vs. engagement
 - 100% coverage measured at video player
 - Across sites, genres, metrics, granularity of engagement
- Ⓢ Video quality does impact engagement
 - Buffering ratio most important metric
 - Live video engagement even more sensitive to quality
 - Need to look at both viewer and view level engagement impact
- Ⓢ Video quality presents opportunity and challenge
 - Follow the traffic: 60% Internet traffic today, will be more than 95% in near future → elephants will stepping on each other's toes!
 - Premium video will be consumed via lean back experience on big screens → zero tolerance for poor quality?

2011 Internet Traffic Distribution



66% Internet Traffic is Video

Source: Akamai

Zhang, SIGCOMM 2011

2011 and Beyond: A World Full of Elephants



What Does It Mean For the Internet
If 95% Traffic is Video?

