

Understanding the Impact of Video Quality on User Engagement

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2005: Beginning of Internet Video Era



100M streams first year

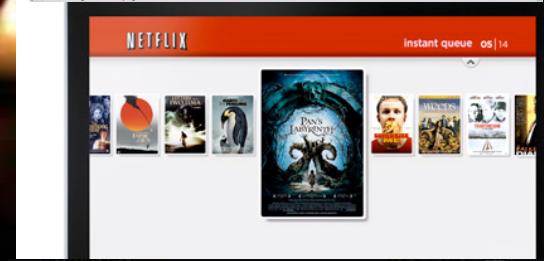
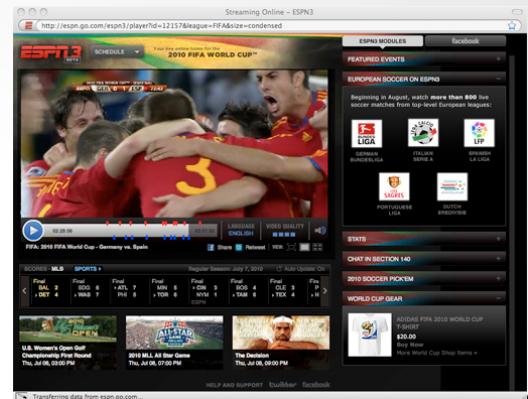


Premium Sports Webcast on Line



Zhang, SIGCOMM 2011

2006 – 2011: Internet Video Going Prime Time



2006

2007

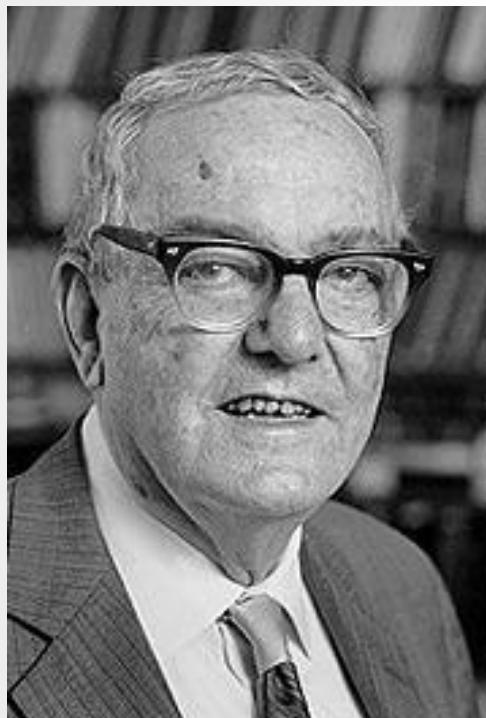
2008

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”

Zhang, SIGCOMM 2011

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

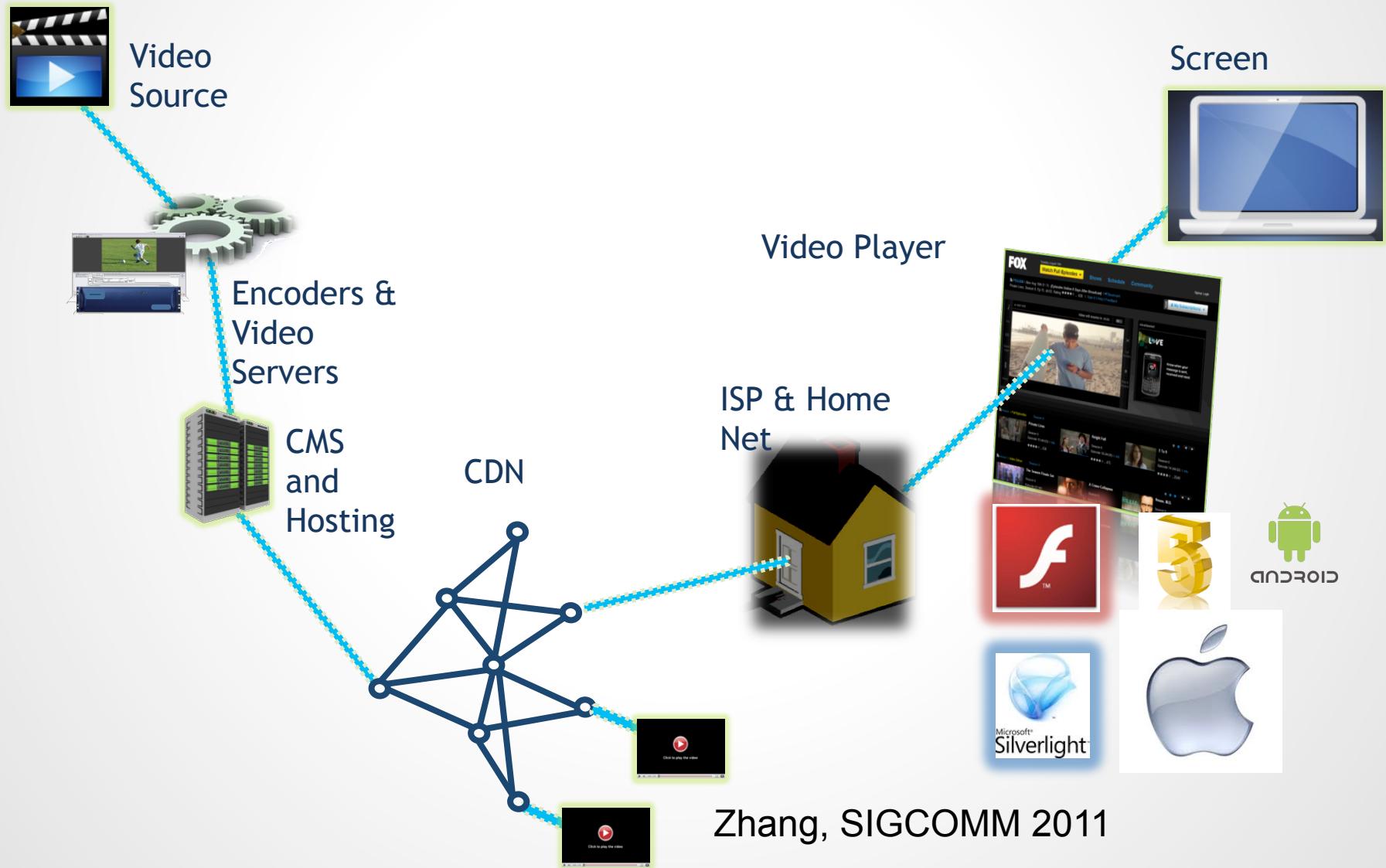
Highlights of Results

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

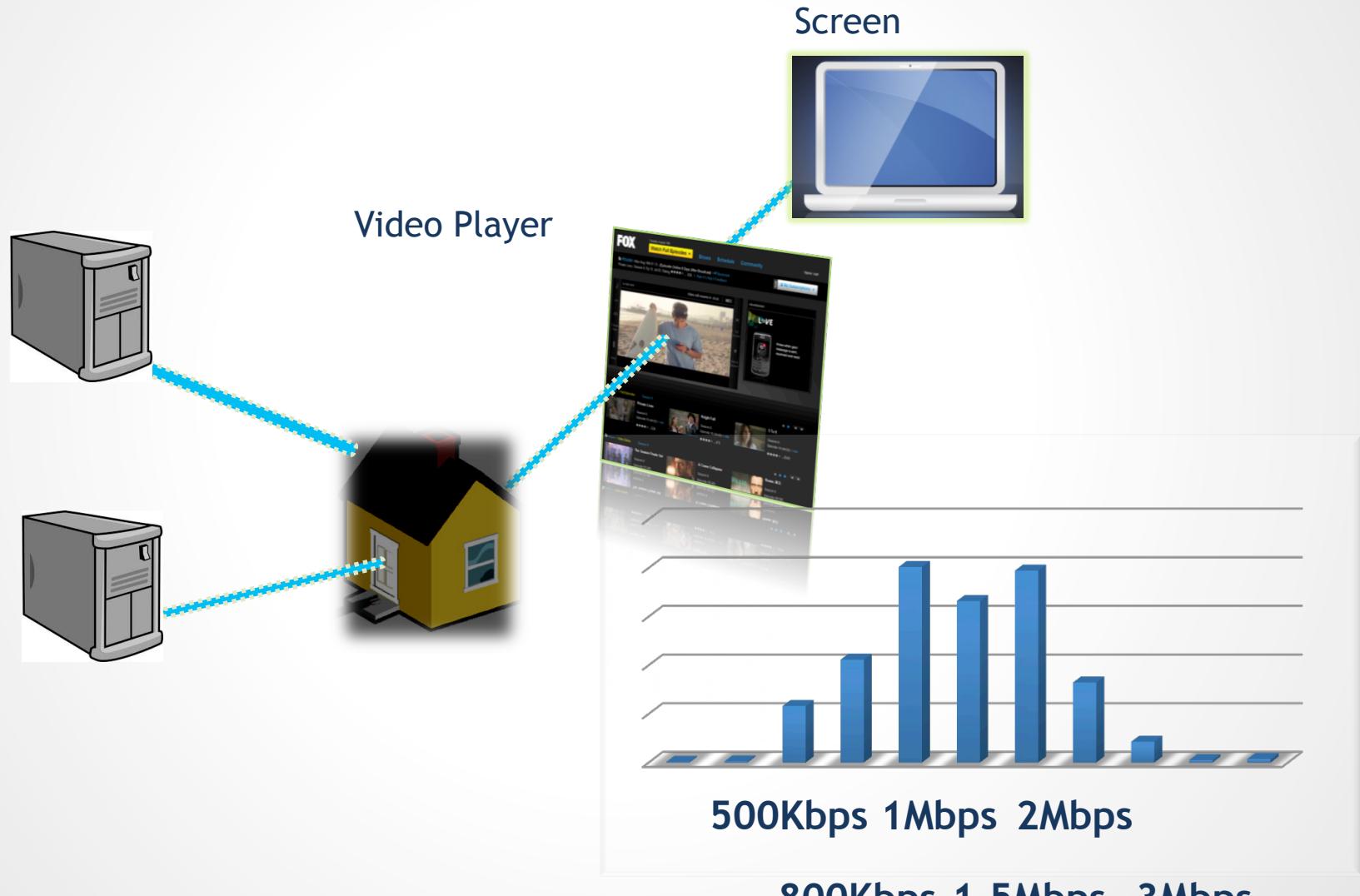
Outline

- ➊ Introduction
- ➋ Dataset and setup
- ➌ Selected results
- ➍ Concluding remarks

Internet Video Eco-System Today:

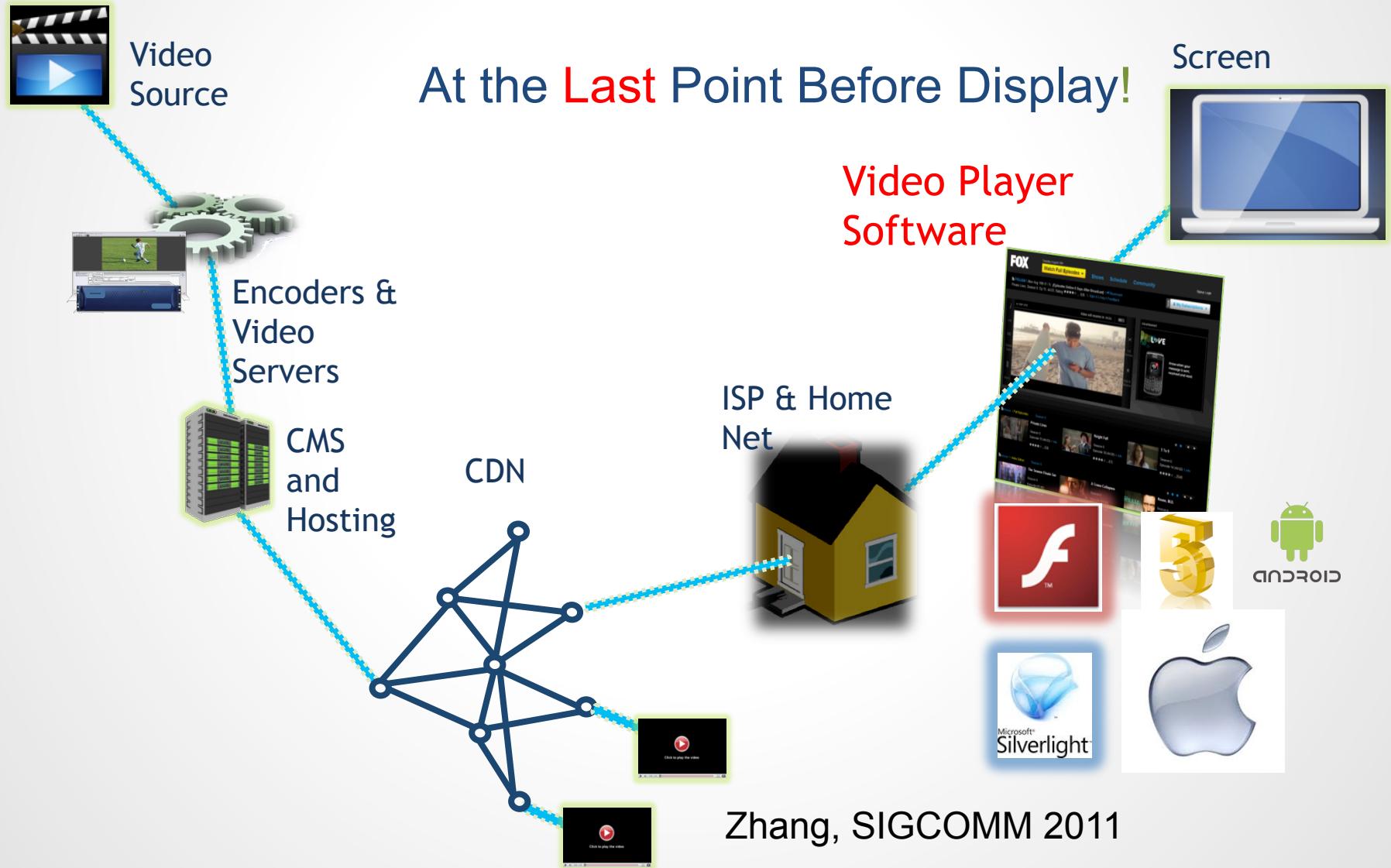


Adaptive Multi-Bit Rate & Multiple Servers For the Same Stream

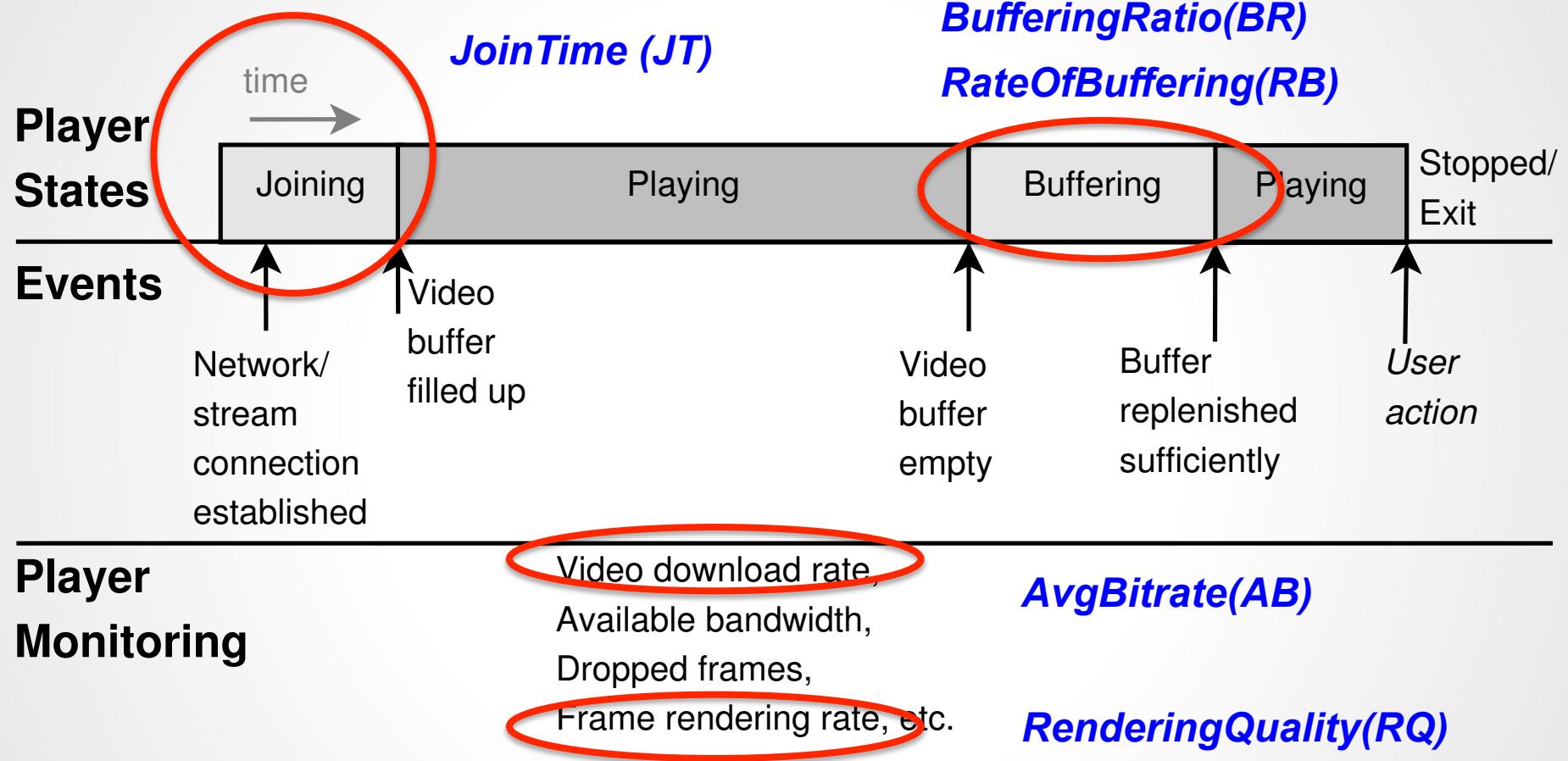


Zhang, SIGCOMM 2011

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

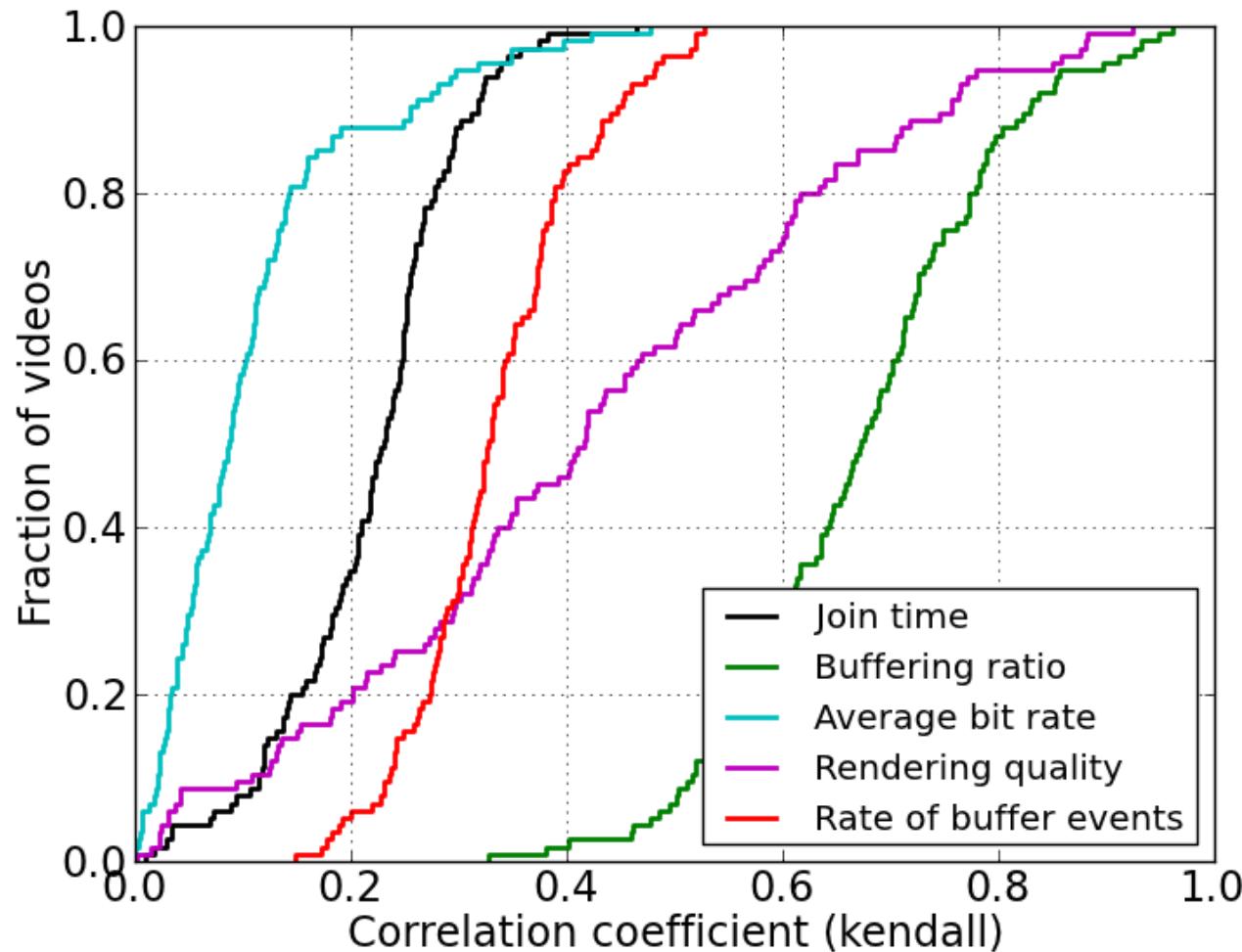
One week of data in Fall 2010 + FIFA world cup

	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

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



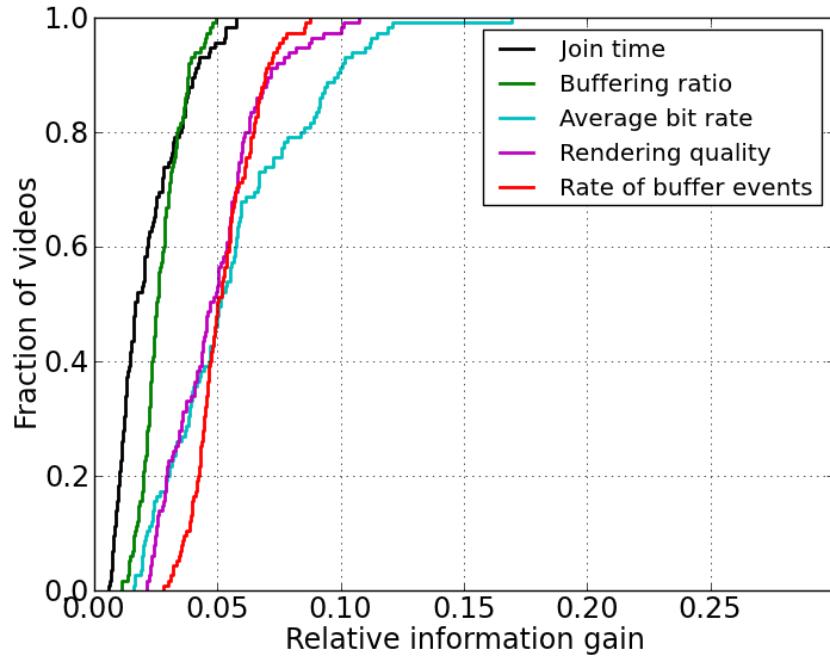
Buffering Ratio correlates with engagement the most

Bit Rate and Join Time not much?

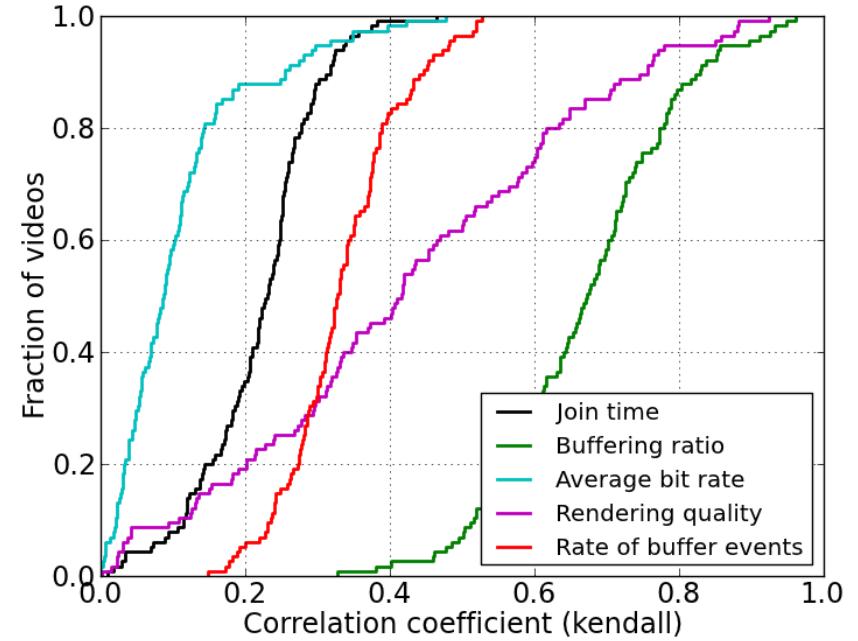
Zhang, SIGCOMM 2011

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

Information Gain



Correlation



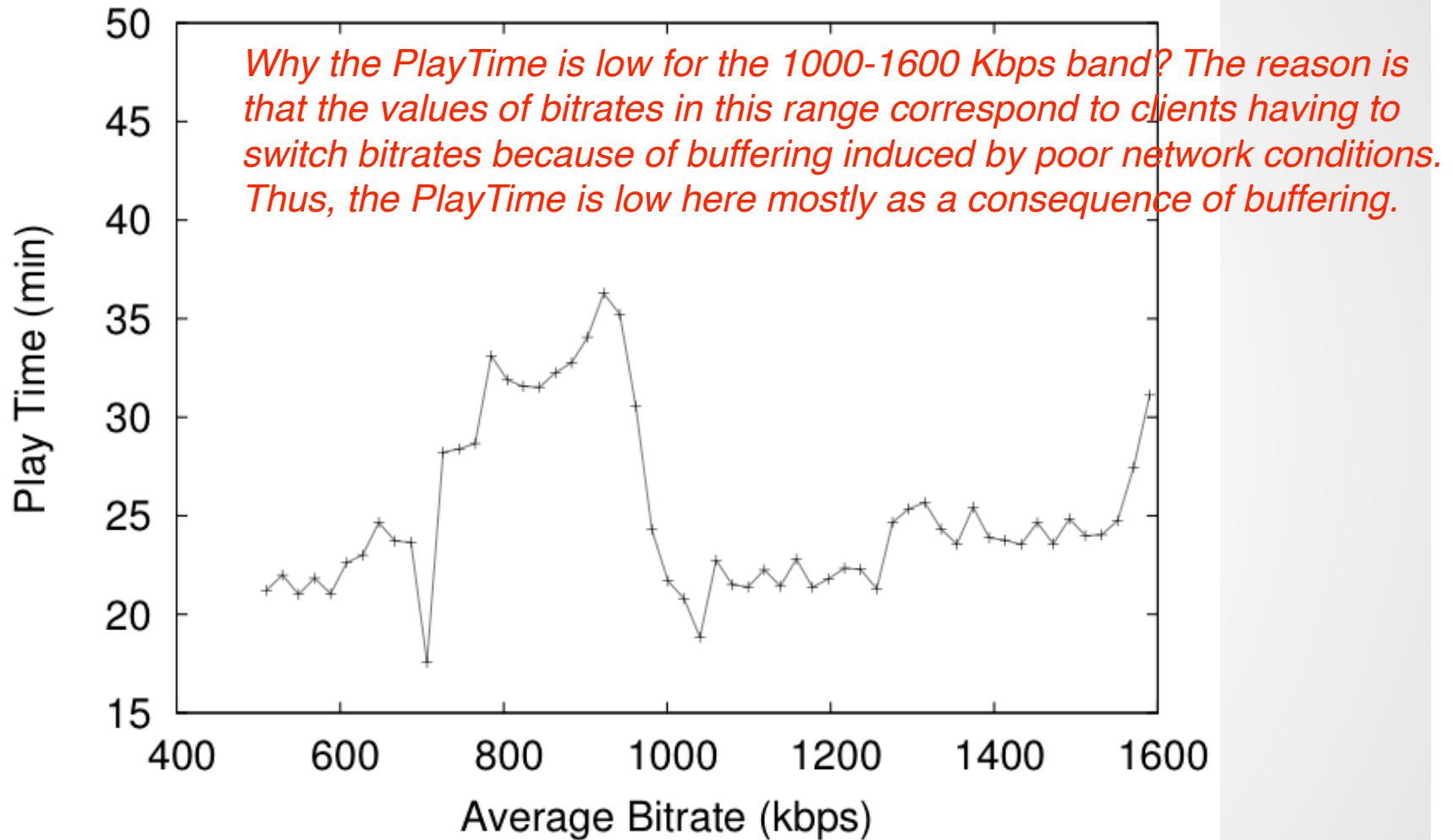
Bit Rate Gain High

Bit Rate Correlation Low

Why the Difference?

Zhang, SIGCOMM 2011

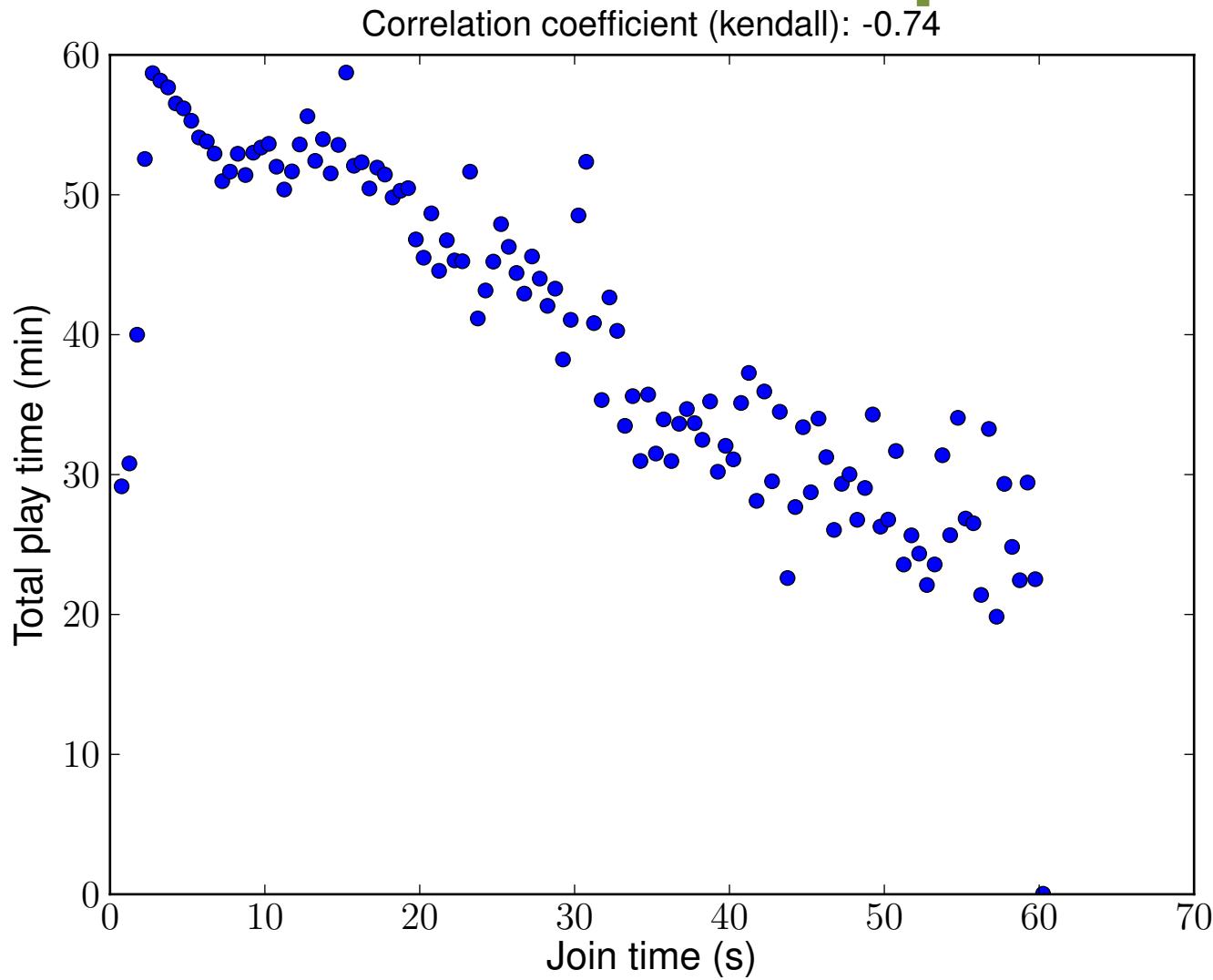
Engagement vs. Bit Rate for LVoD View Level



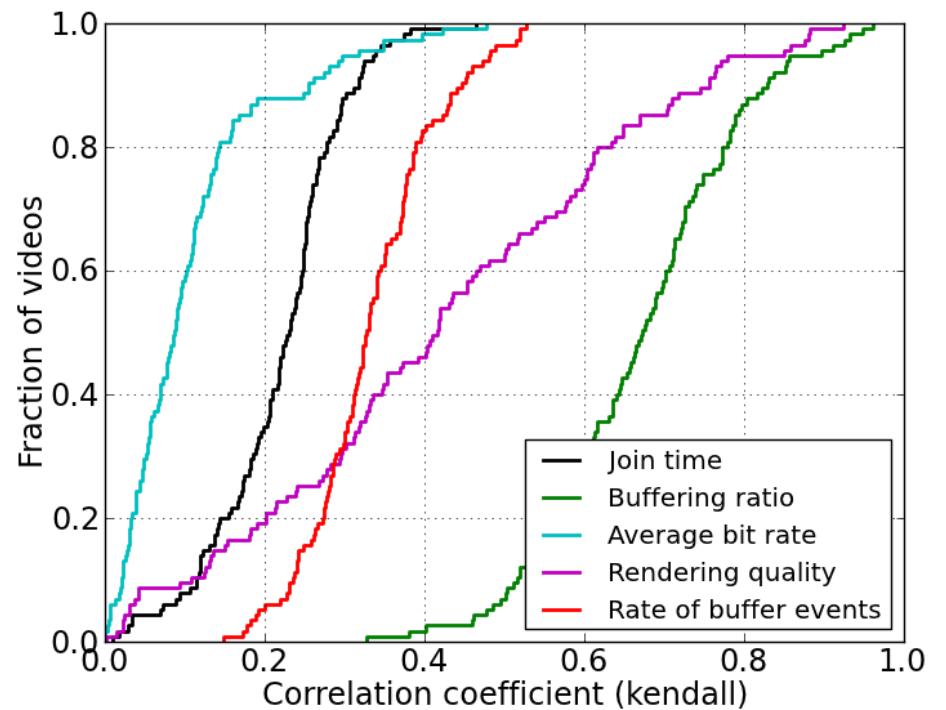
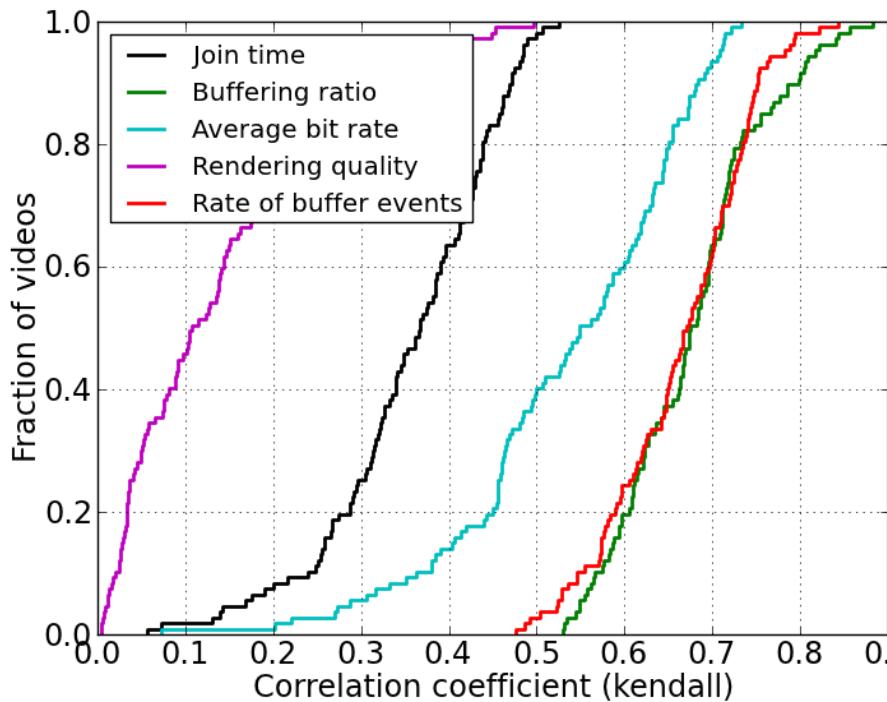
Non-monotone → Low Correlation

Zhang, SIGCOMM 2011

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



Live vs LVoD

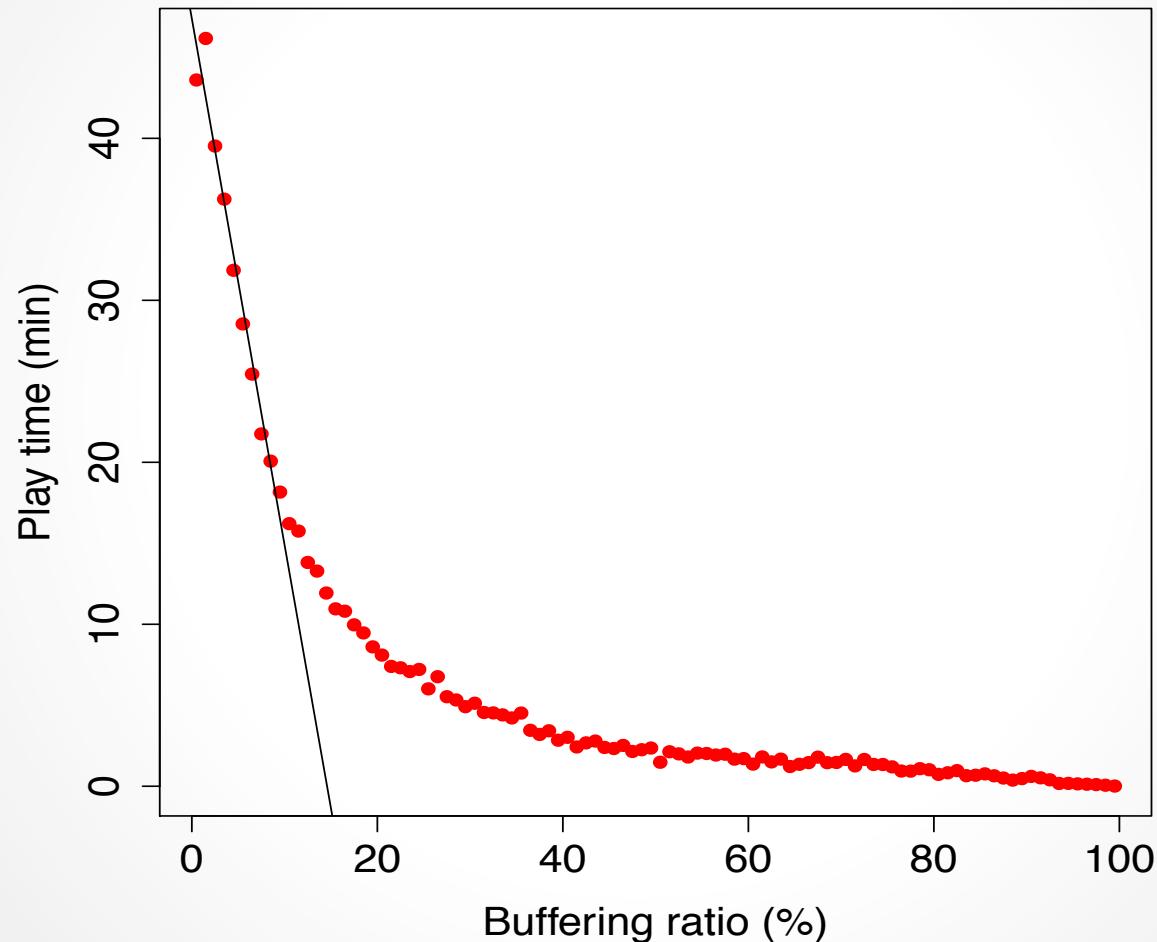


Buffering Ratio remains the most significant
Bitrate and **Rate of Buffering** matter much more for Live

Quantitative Impact:



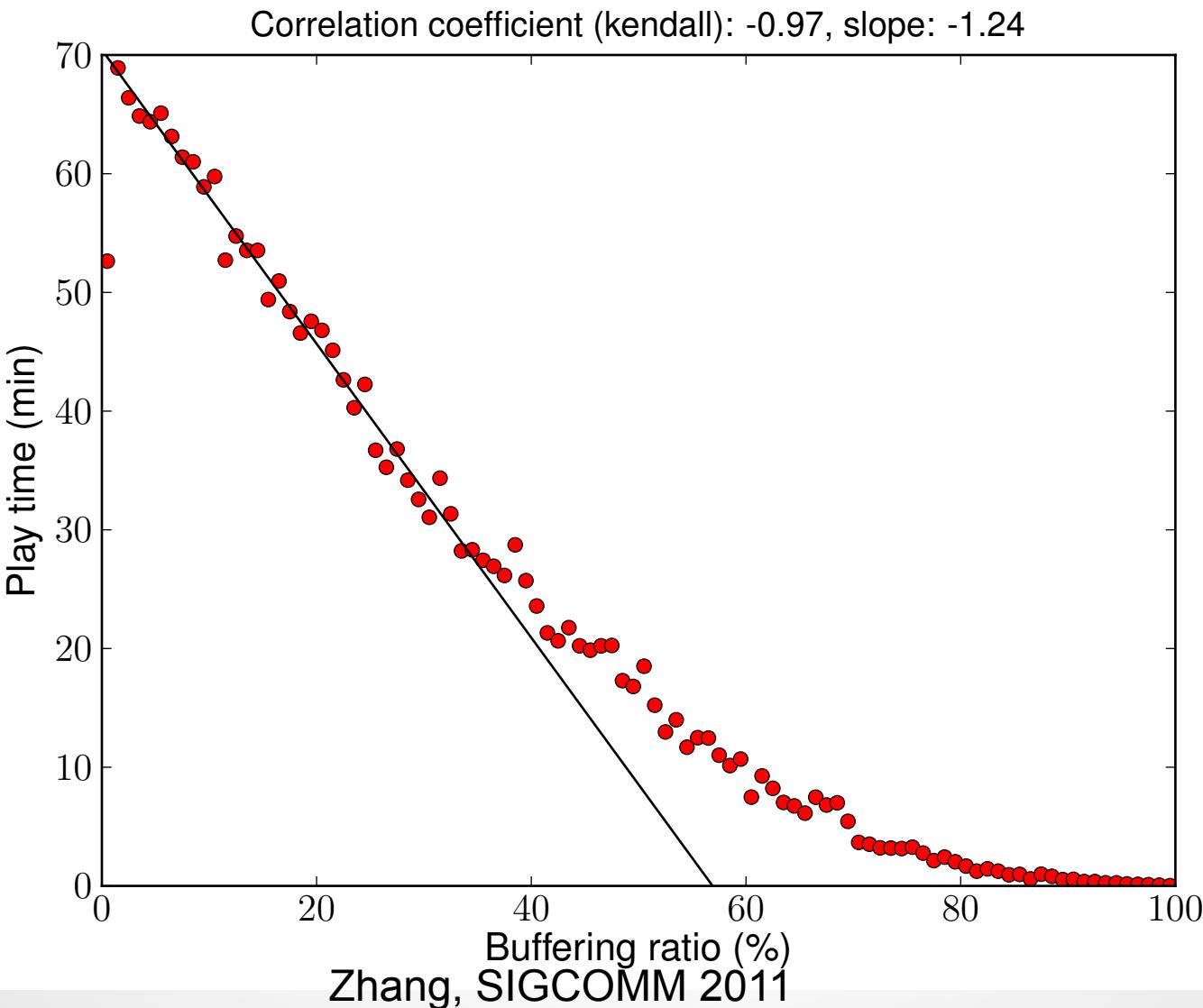
Correlation coefficient (kendall): -0.96, slope: -3.25



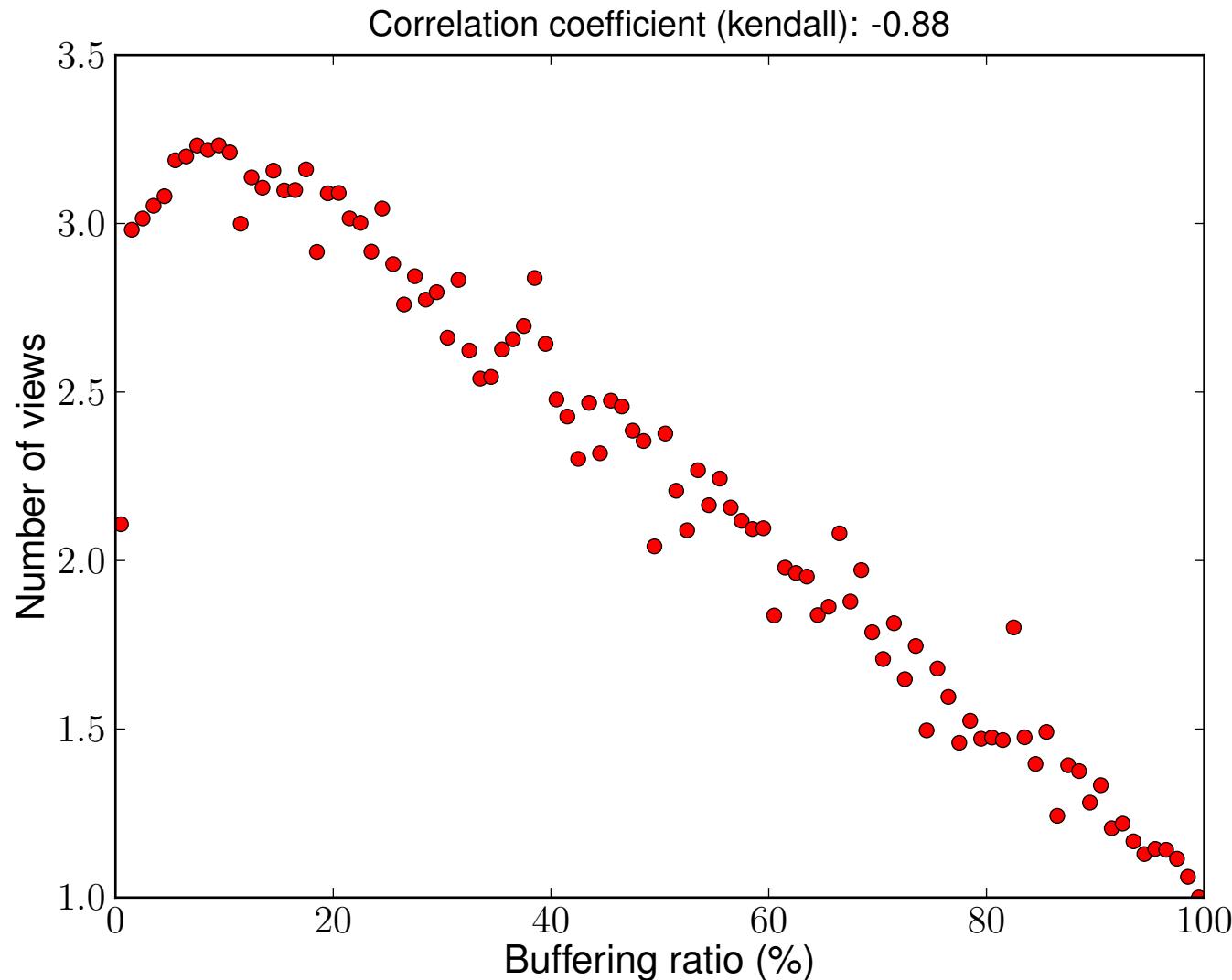
1% increase in buffering reduces engagement by 3 minutes

Zhang, SIGCOMM 2011

LVod Viewer level Play Time vs. Buffering Ratio:



LVoD Viewer level # of Views vs Buffering Ratio:



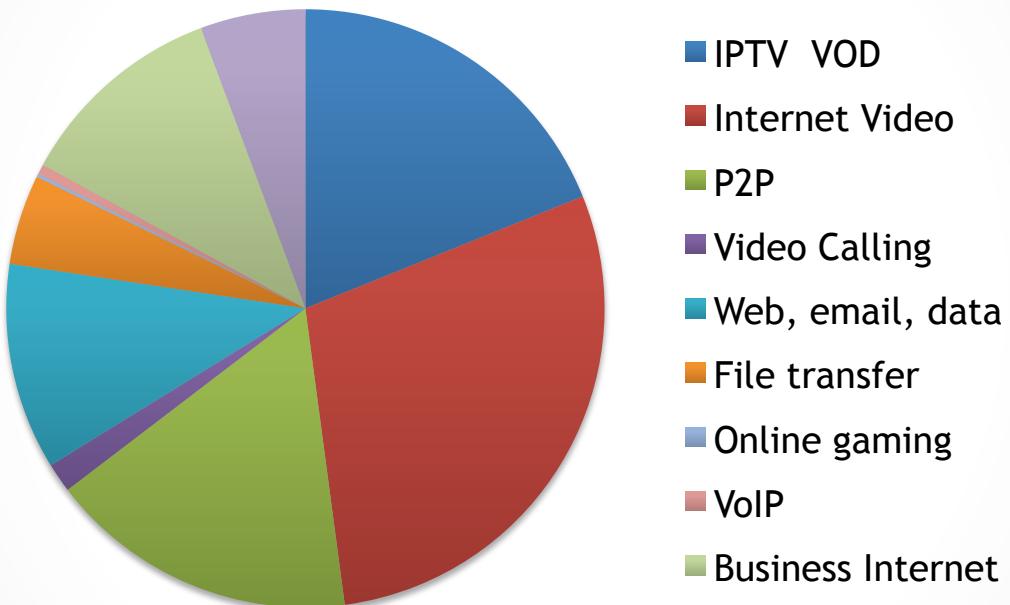
Low Buffering Ratio Is Good for Viewer Retention

Zhang, SIGCOMM 2011

Concluding Remarks

- ➊ First empirical analysis of video quality vs. engagement
 - 100% coverage measured at video player
 - Across sites, genres, metrics, granularity of engagement
- ➋ 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
- ➌ 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

2011 and Beyond: A World Full of Elephants



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

Video (100x traffic growth)

Other Applications (10 x traffic growth)

2011

2016

Zhang, SIGCOMM 2011