

# Understanding the Impact of Video Quality on User Engagement

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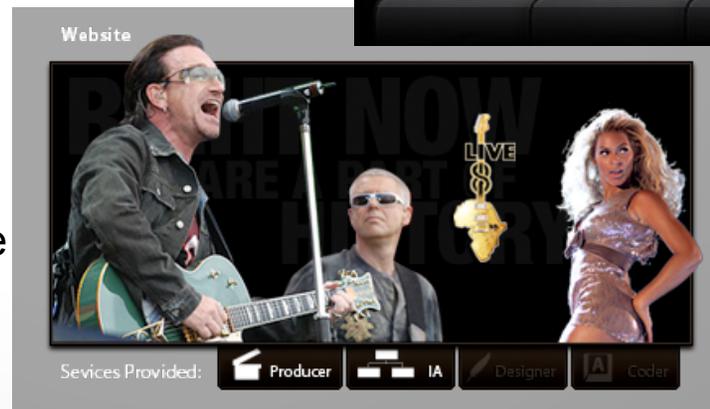
# 2005: Beginning of Internet Video Era



100M streams first year

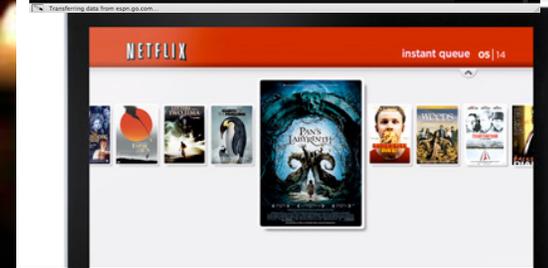
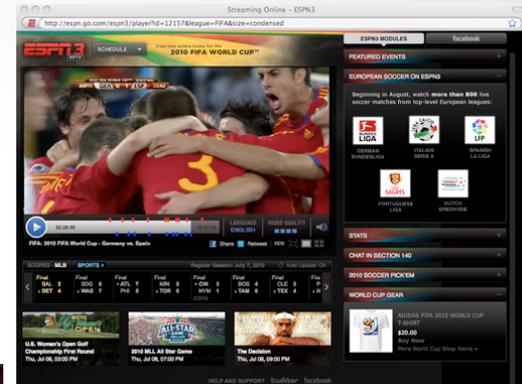


Premium Sports Webcast on Line



Zhang, SIGCOMM 2011

# 2006 – 2011: Internet Video Going Prime Time



2006

2007

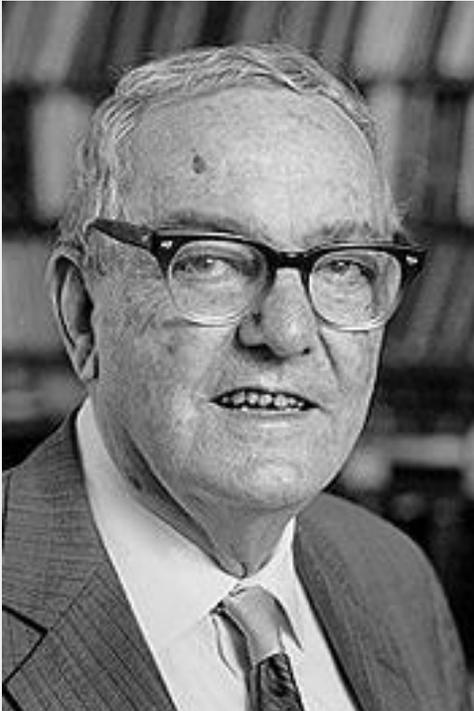
2008

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:

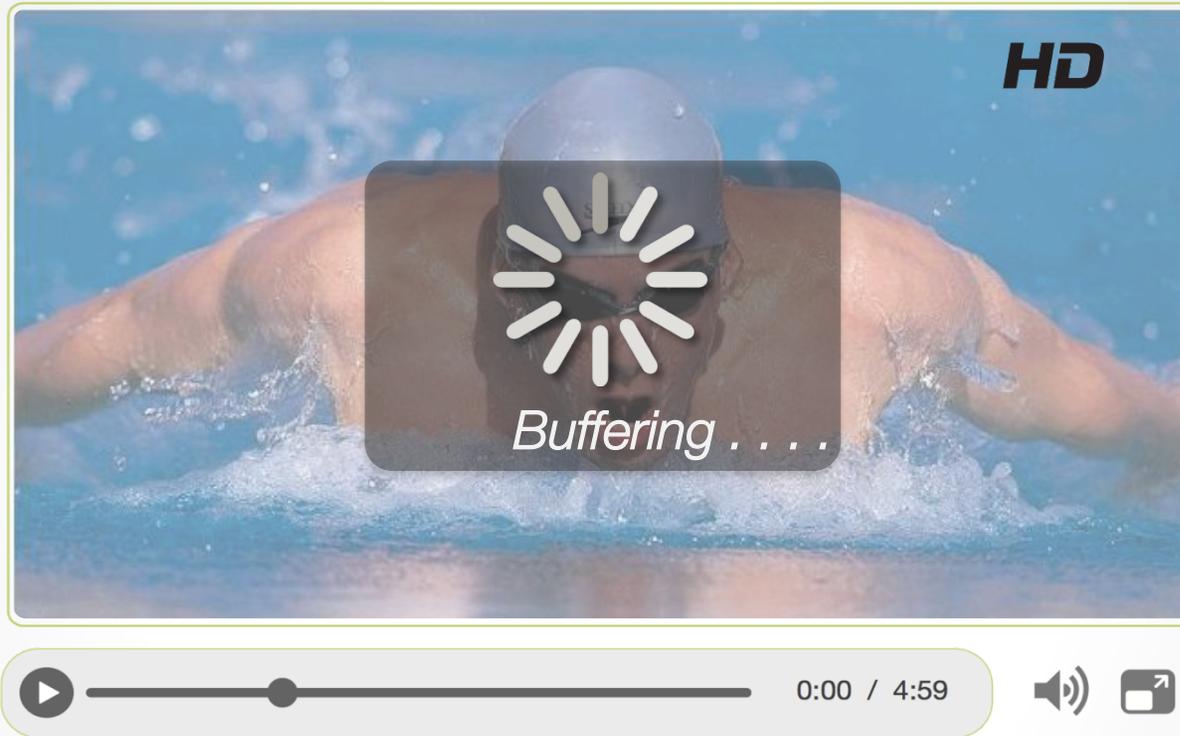


Content & Personal Taste  
Impact significantly



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

# 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



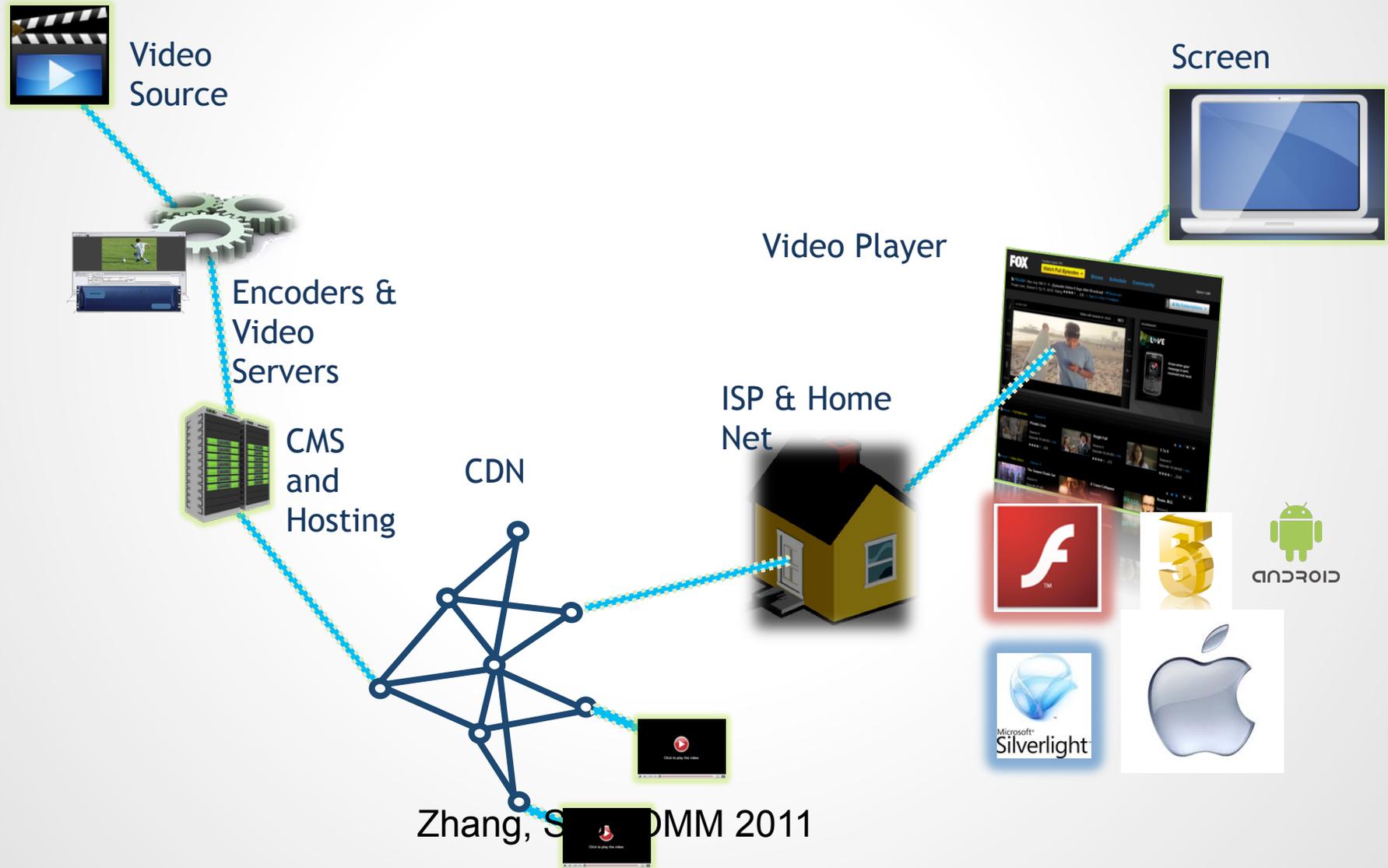
# Highlights of Results

- 🔌 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

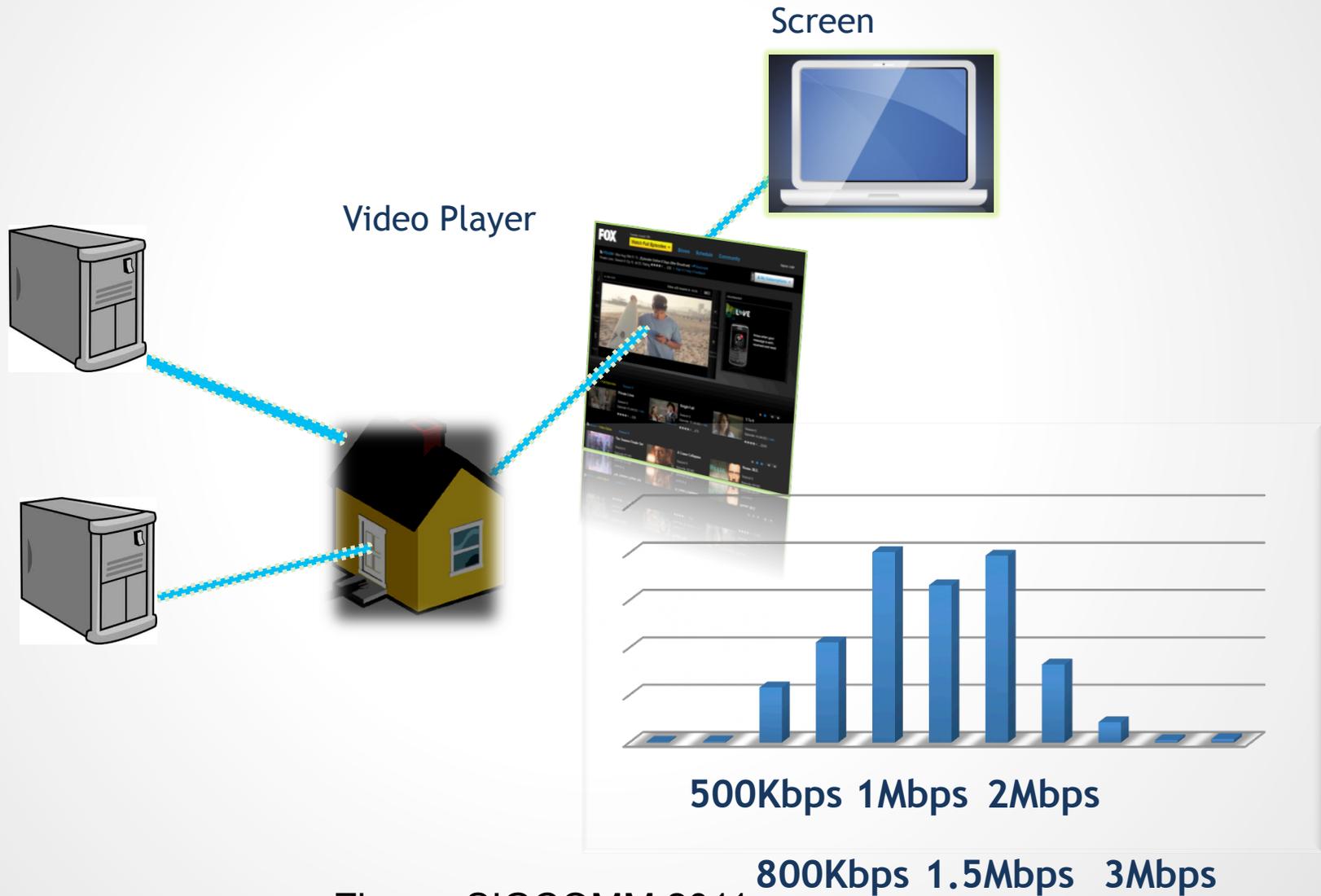
# Outline

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

# Internet Video Eco-System Today:

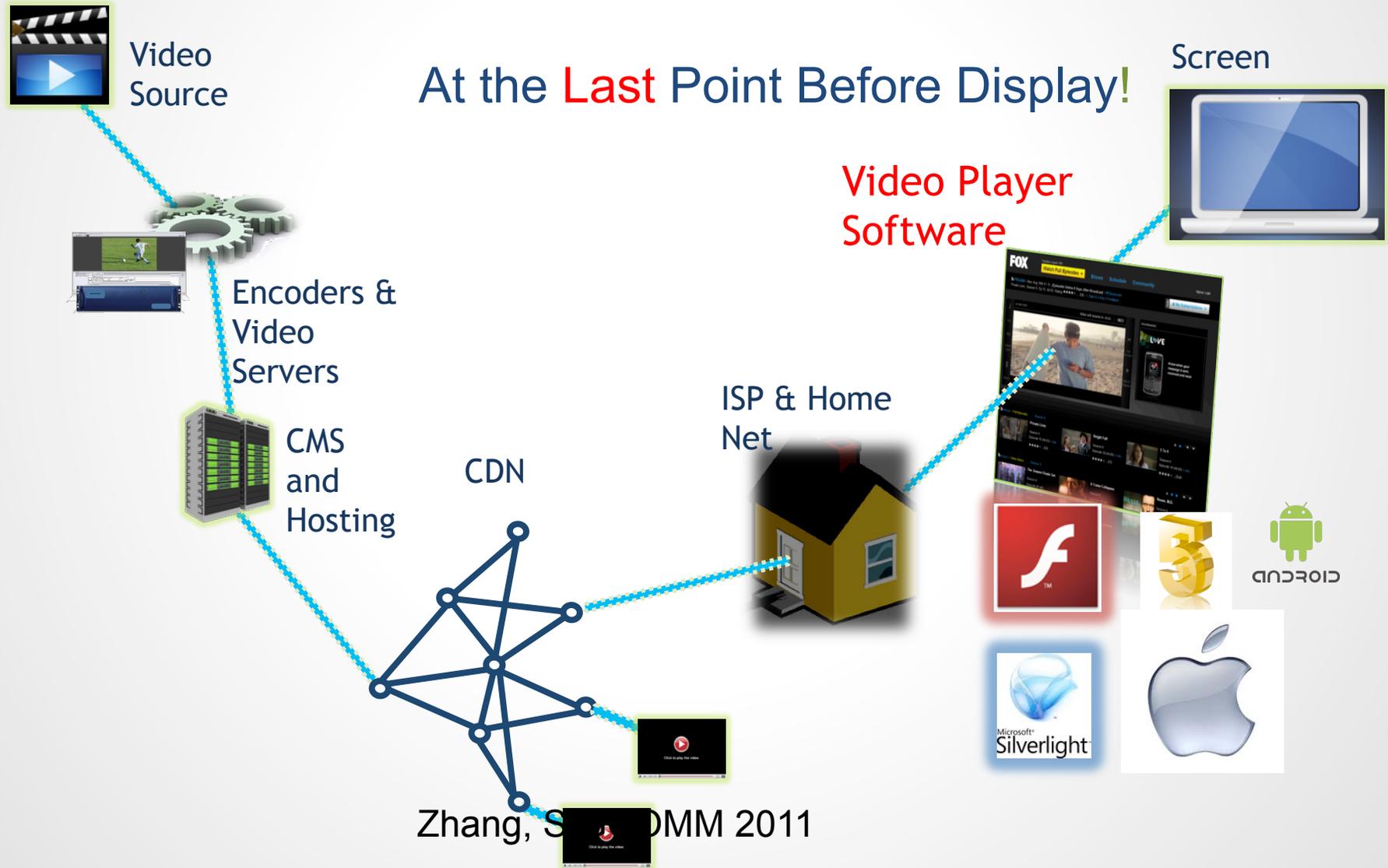


# Adaptive Multi-Bit Rate & Multiple Servers For the Same Stream

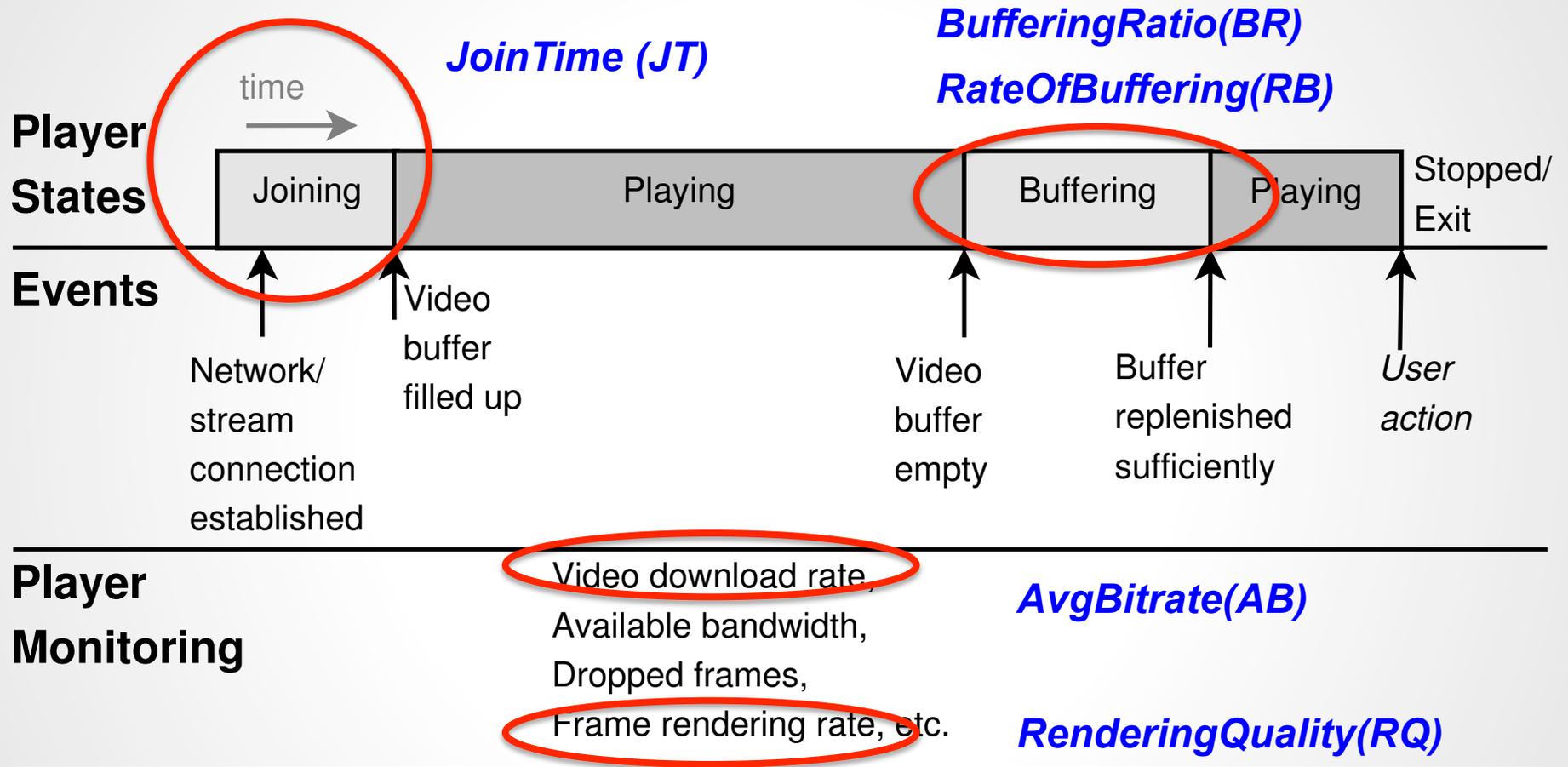


Zhang, SIGCOMM 2011

# 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

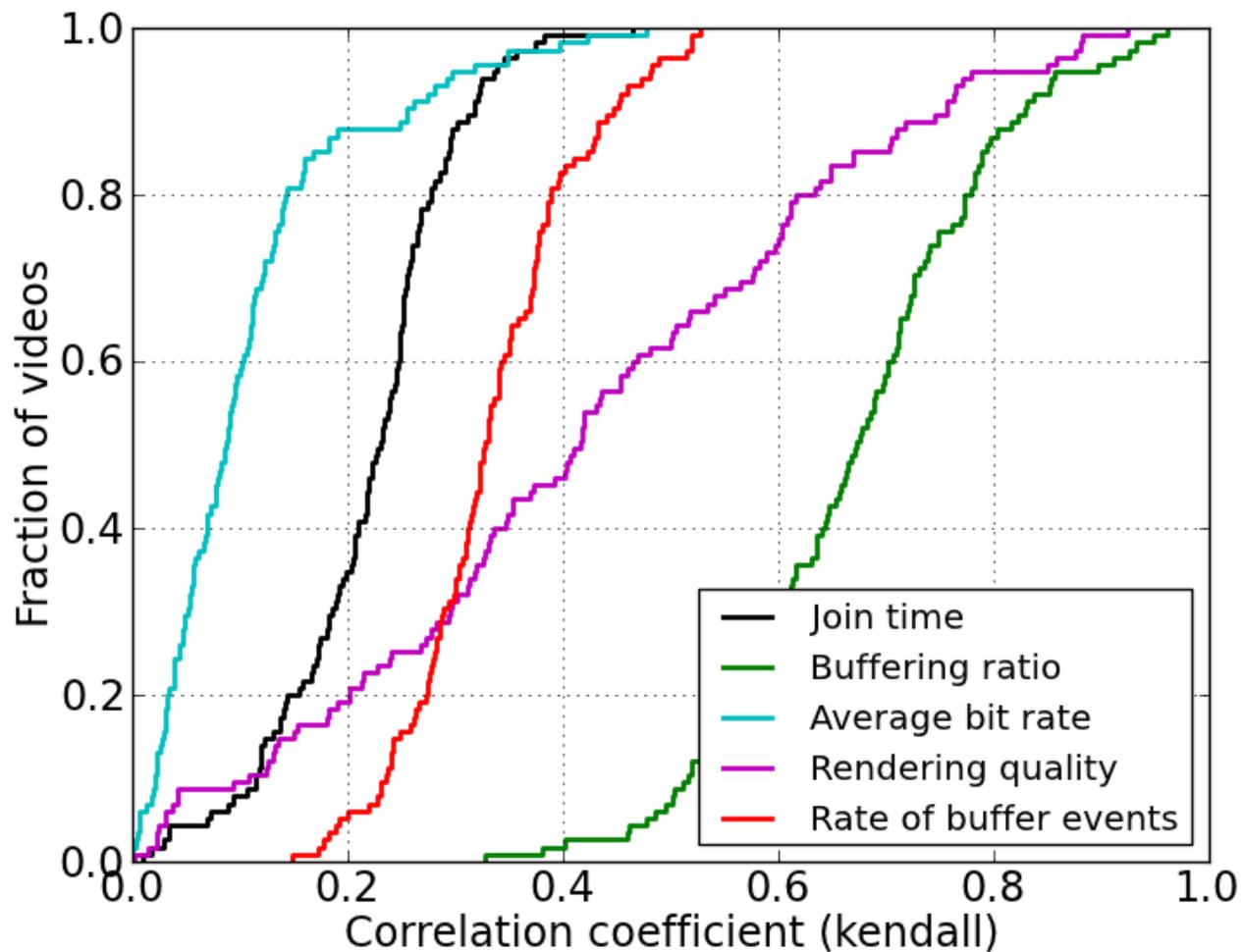
Premium content providers in US  
Diverse platforms and optimizations

Zhang, SIGCOMM 2011

# 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



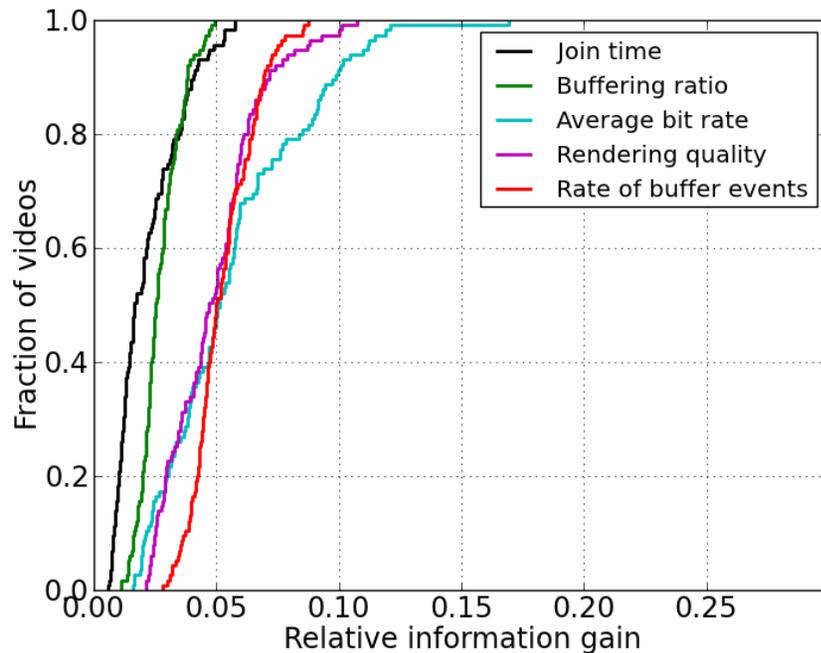
**Buffering Ratio** correlates with engagement the most

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

Zhang, SIGCOMM 2011

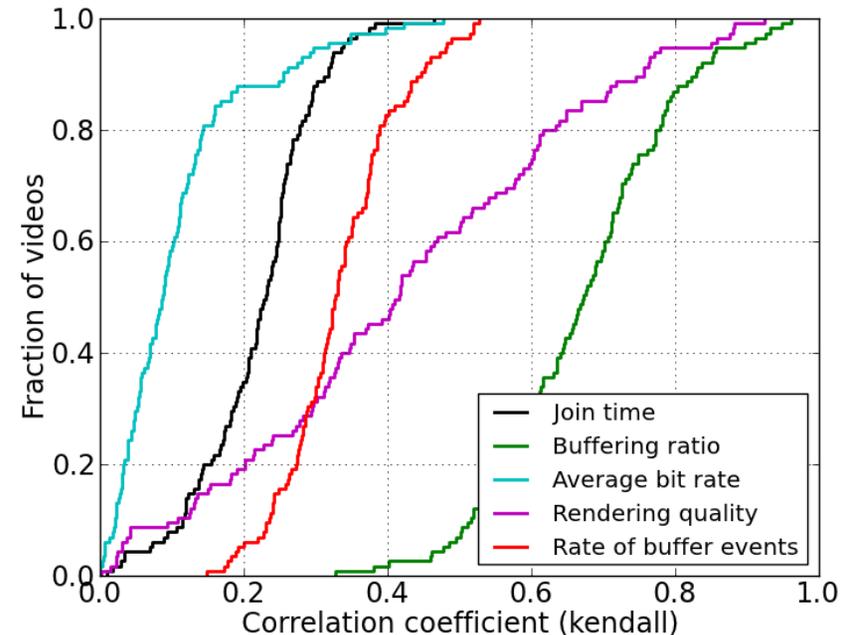
# Seeing the World via Two Lenses: (LVoD View level)

## Information Gain



**Bit Rate Gain High**

## Correlation

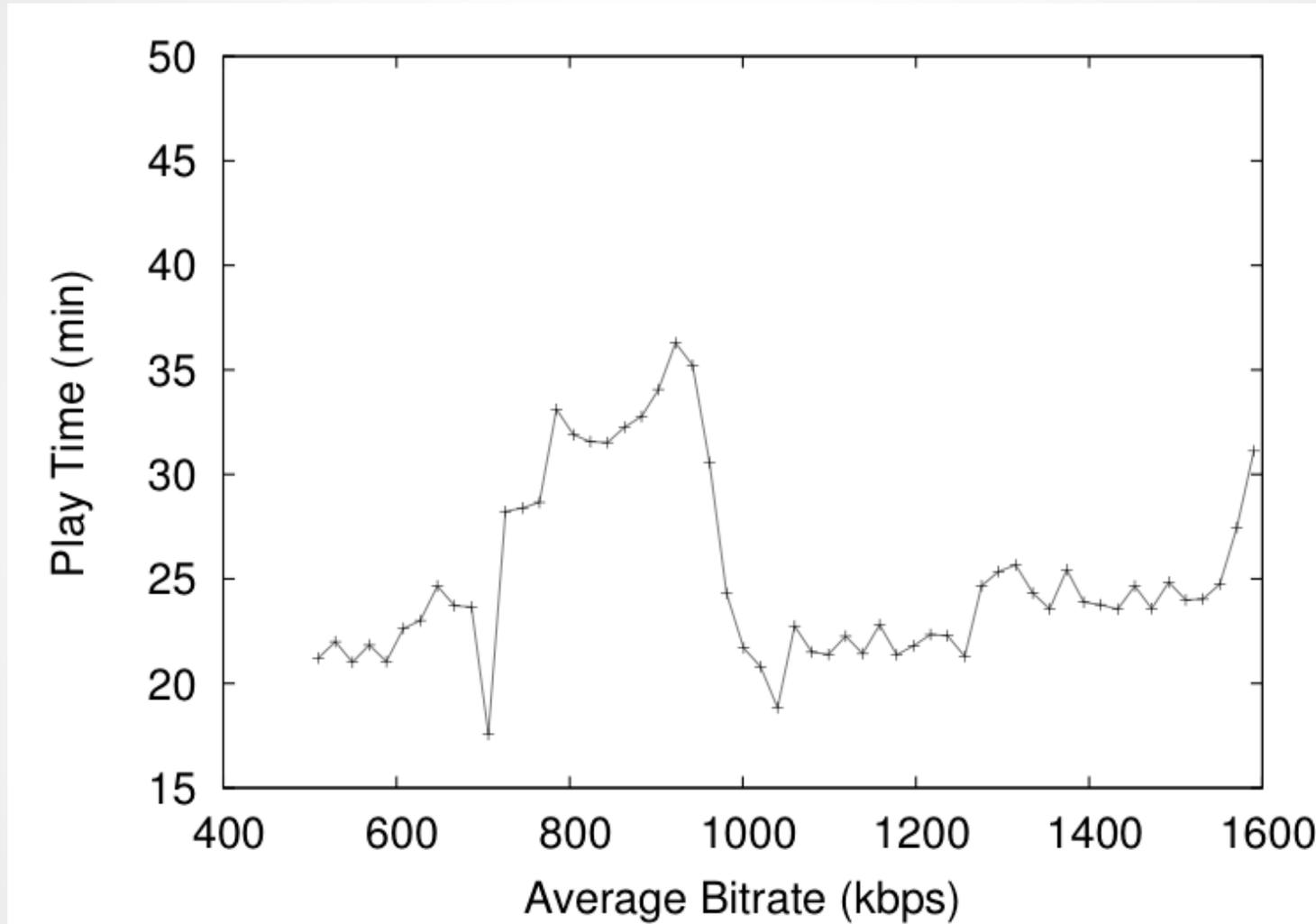


**Bit Rate Correlation Low**

### Why the Difference?

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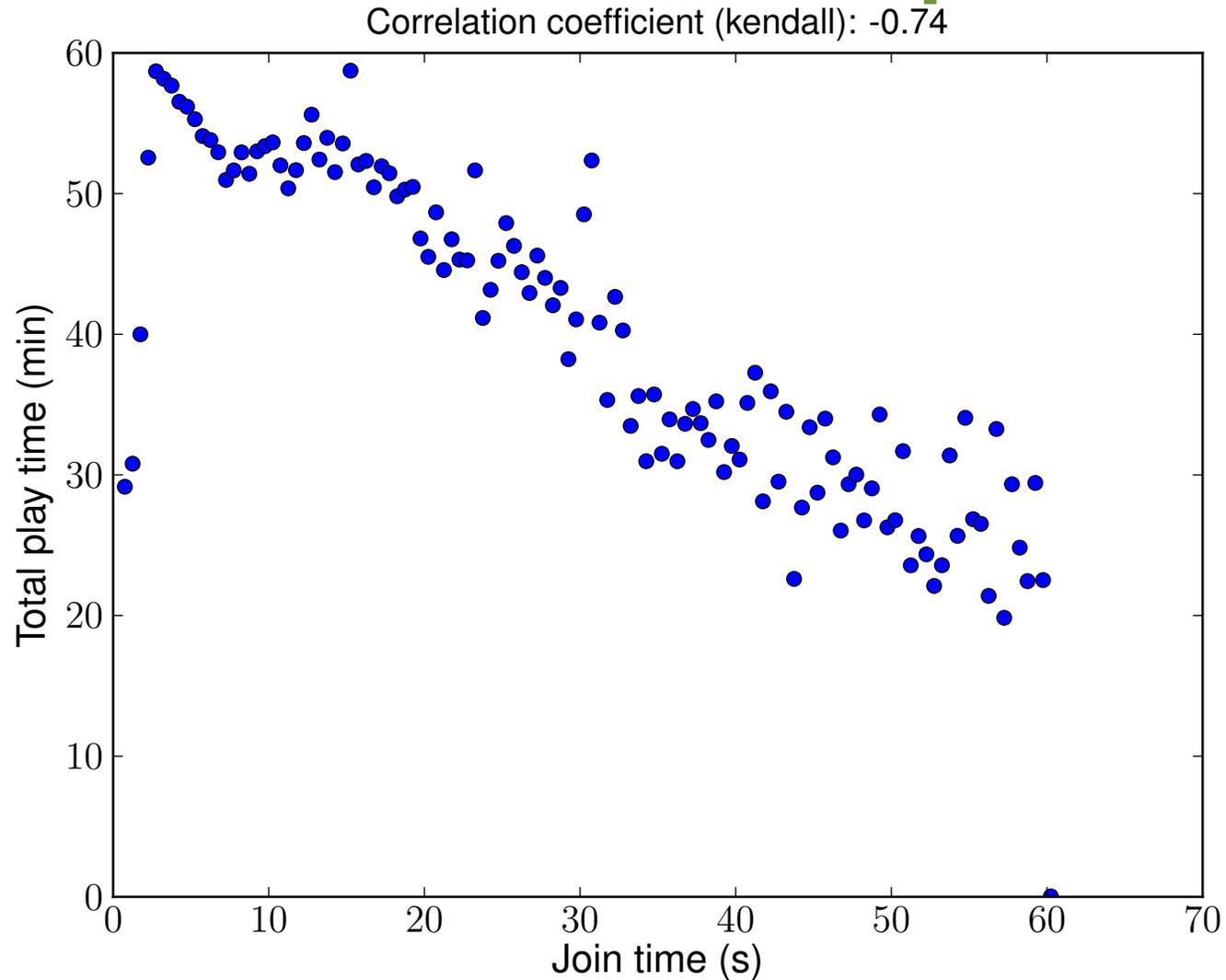
# Engagement vs. Bit Rate for LVoD View Level



Non-monotone → Low Correlation

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



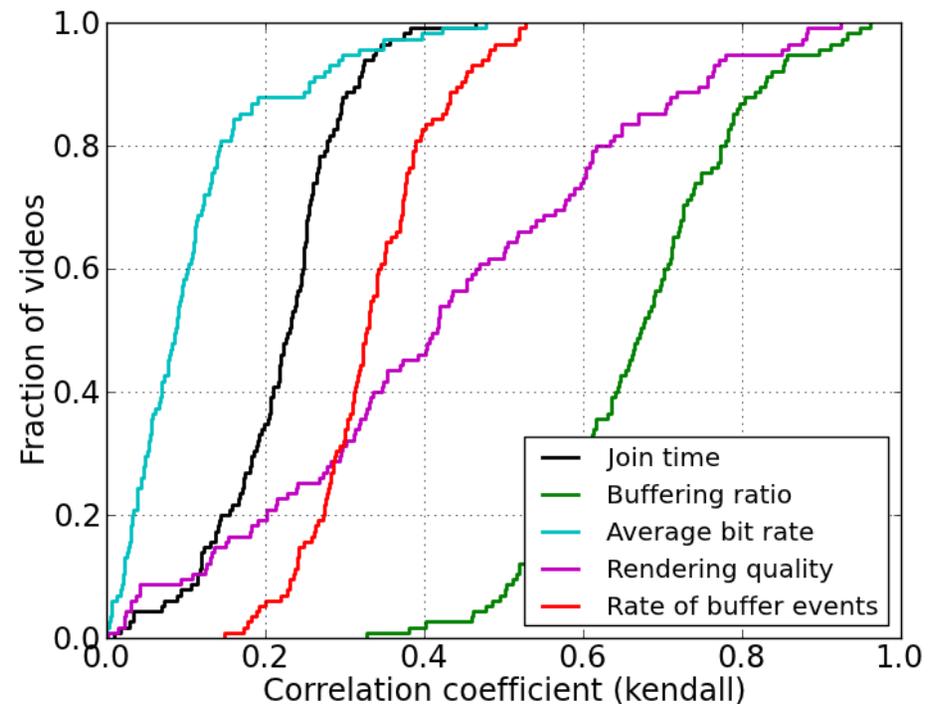
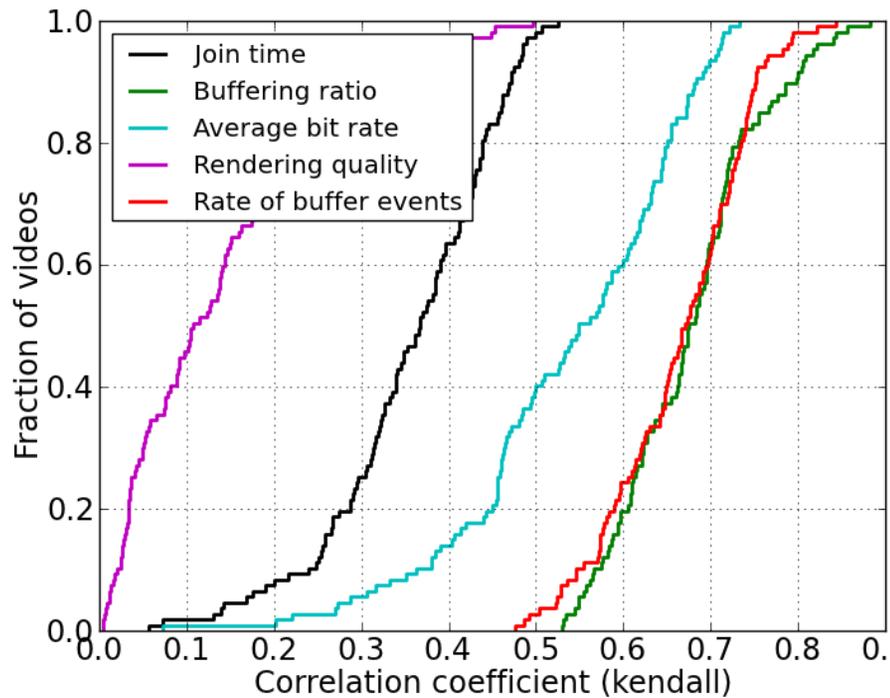
Join time is critical for user retention

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Live

vs

LVoD

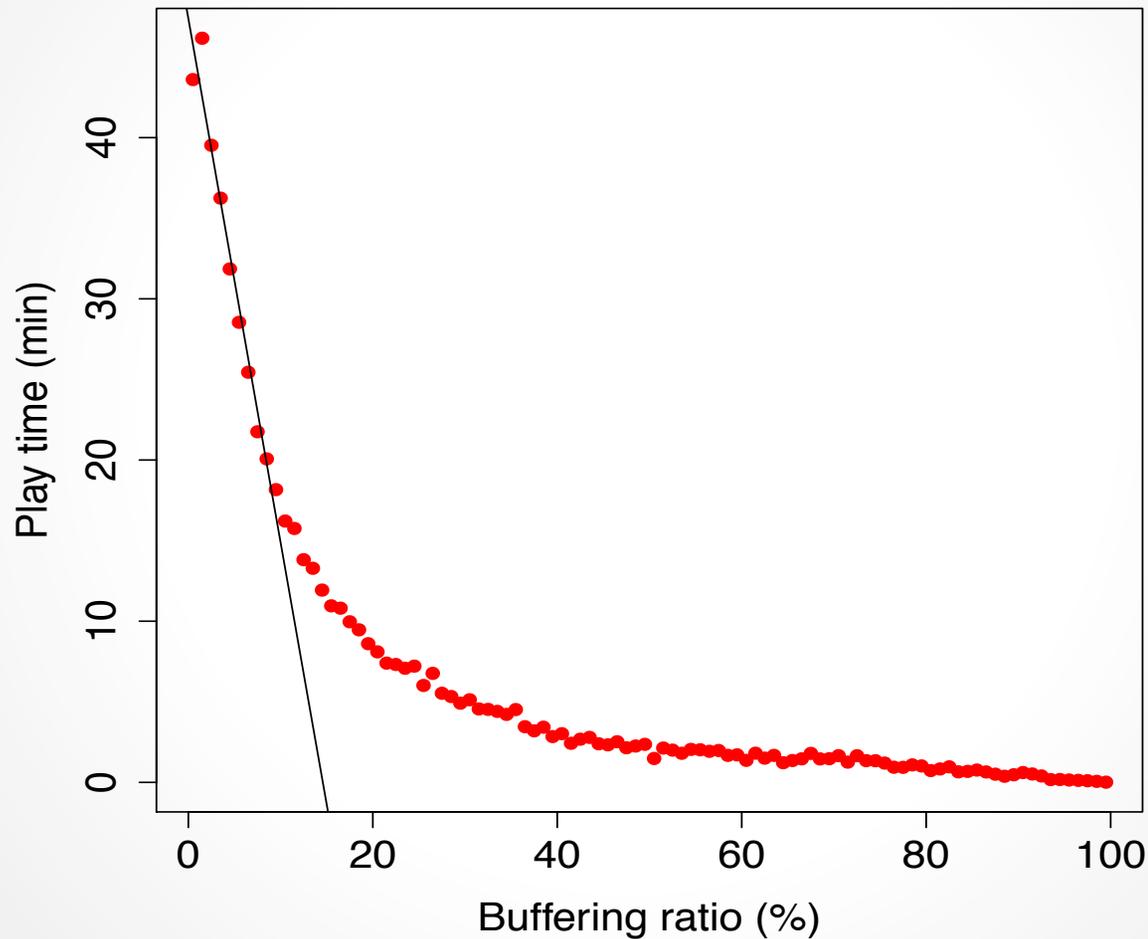


**Buffering Ratio** remains the most significant  
**Bitrate** and **Rate of Buffering** matter much more

# Quantitative Impact:



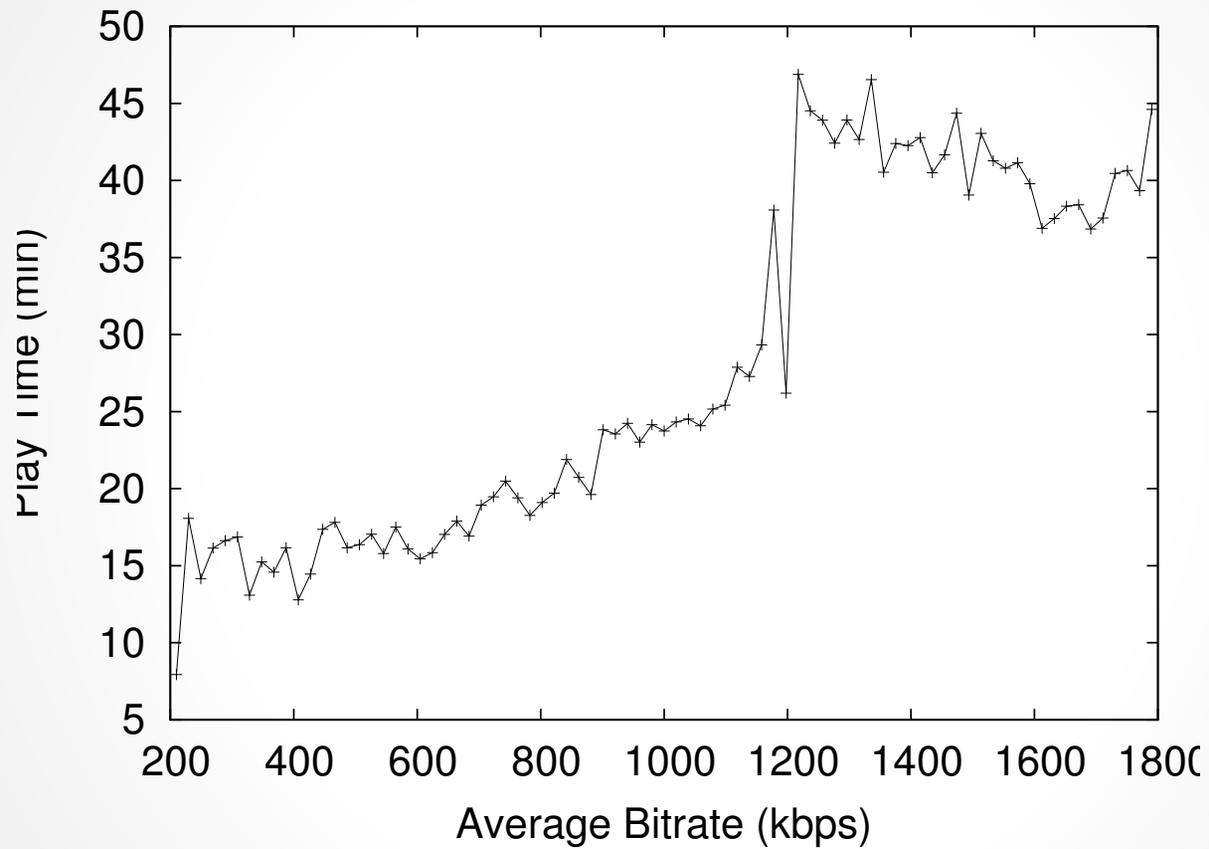
Correlation coefficient (kendall):  $-0.96$ , slope:  $-3.25$



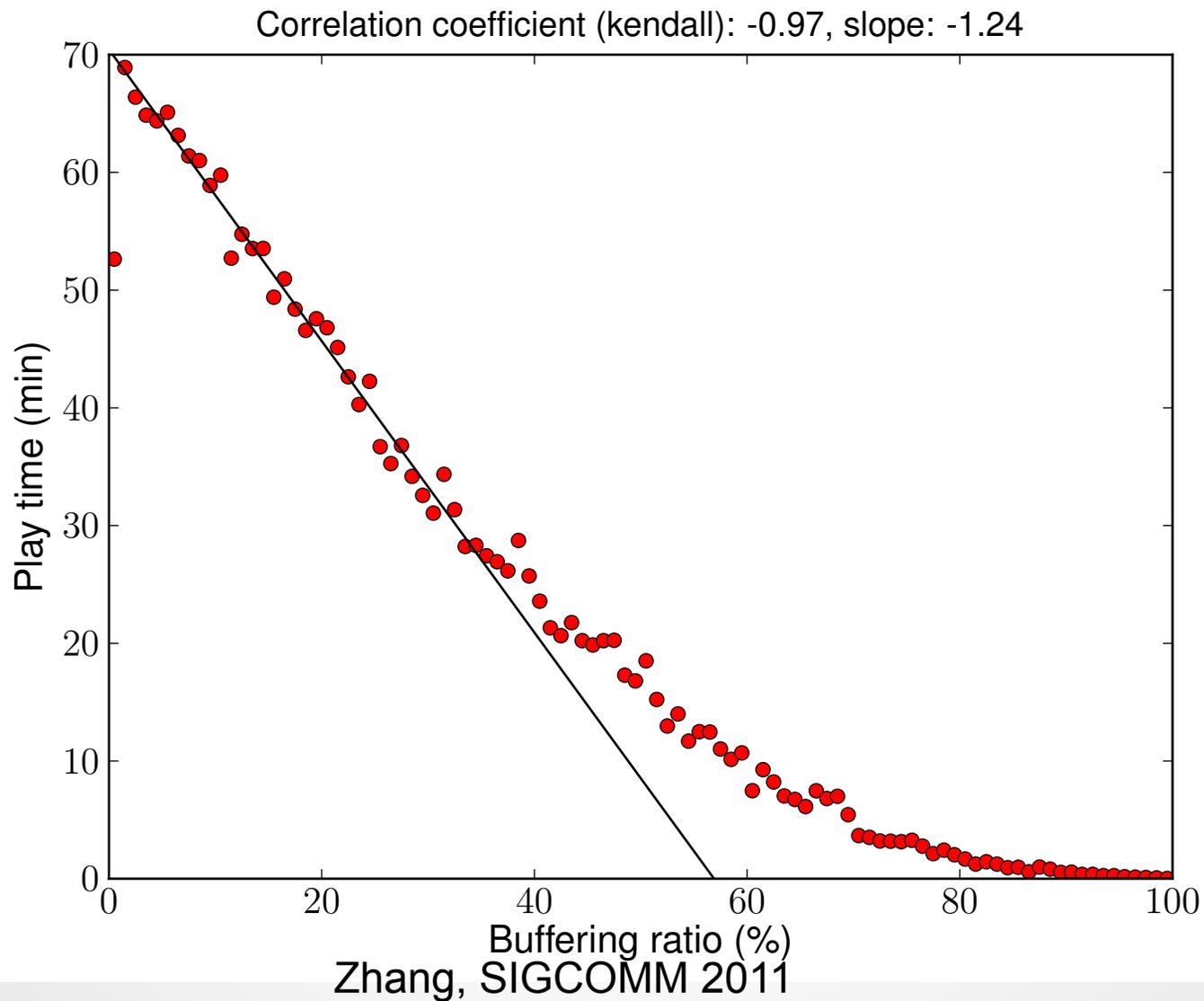
1% increase in buffering reduces engagement by 3 minutes

Zhang, SIGCOMM 2011

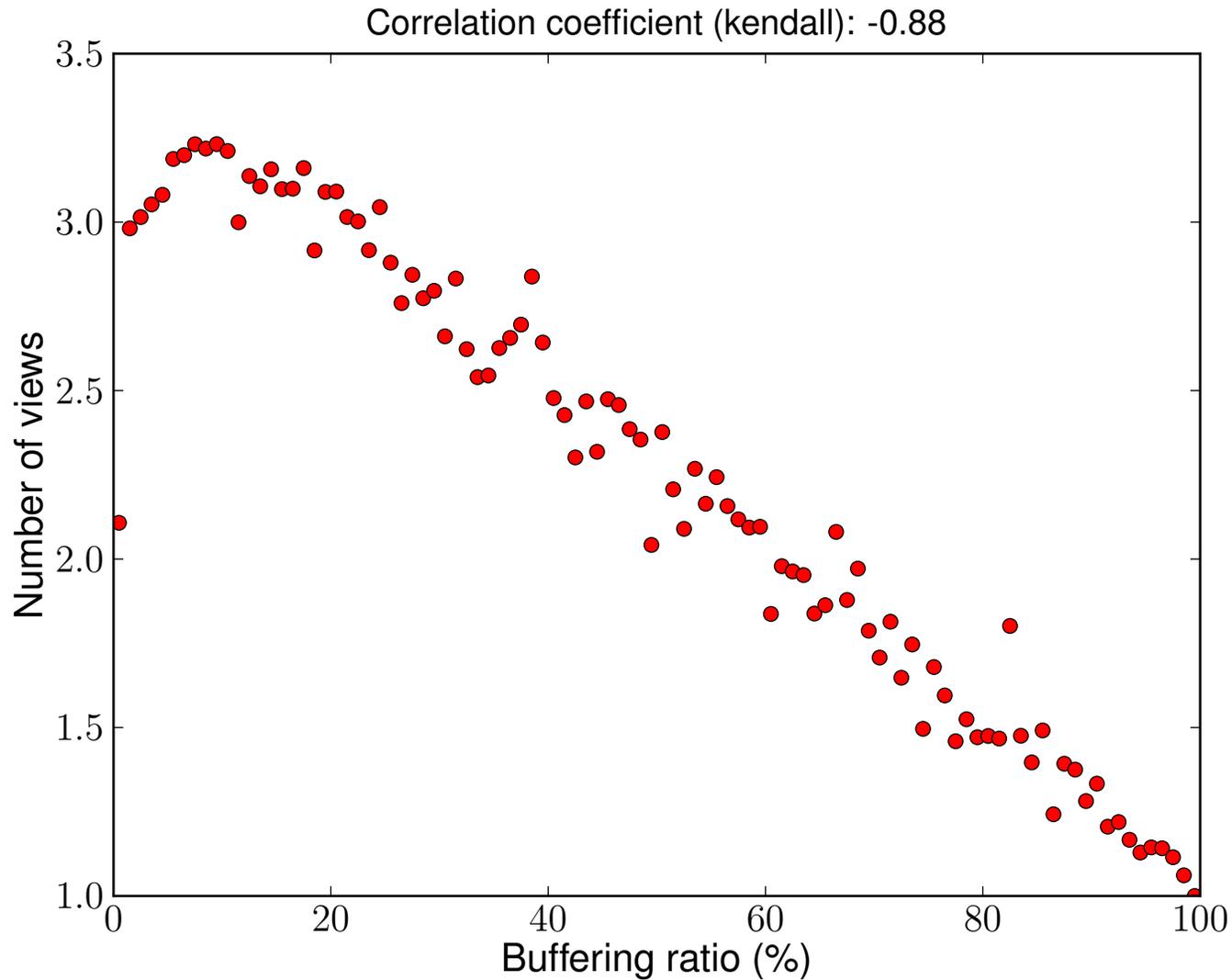
# Engagement vs. Bit Rate for Live View Level



# LVod Viewer level Play Time vs. Buffering Ratio:



# LVoD Viewer level # of Views vs Buffering Ratio:



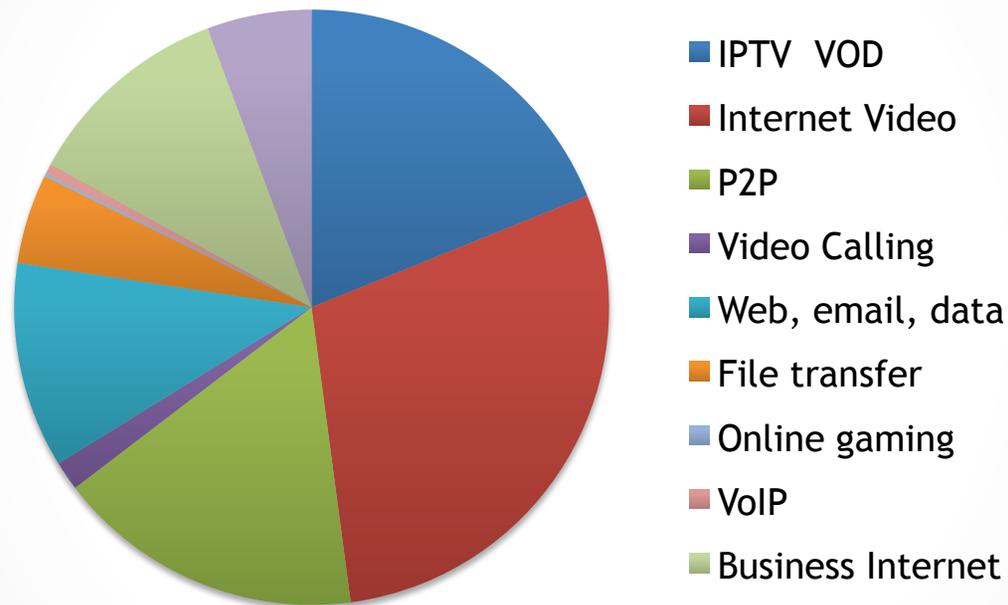
Low Buffering Ratio Is Good for Viewer Retention

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# 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

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# 2011 and Beyond: A World Full of Elephants



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

