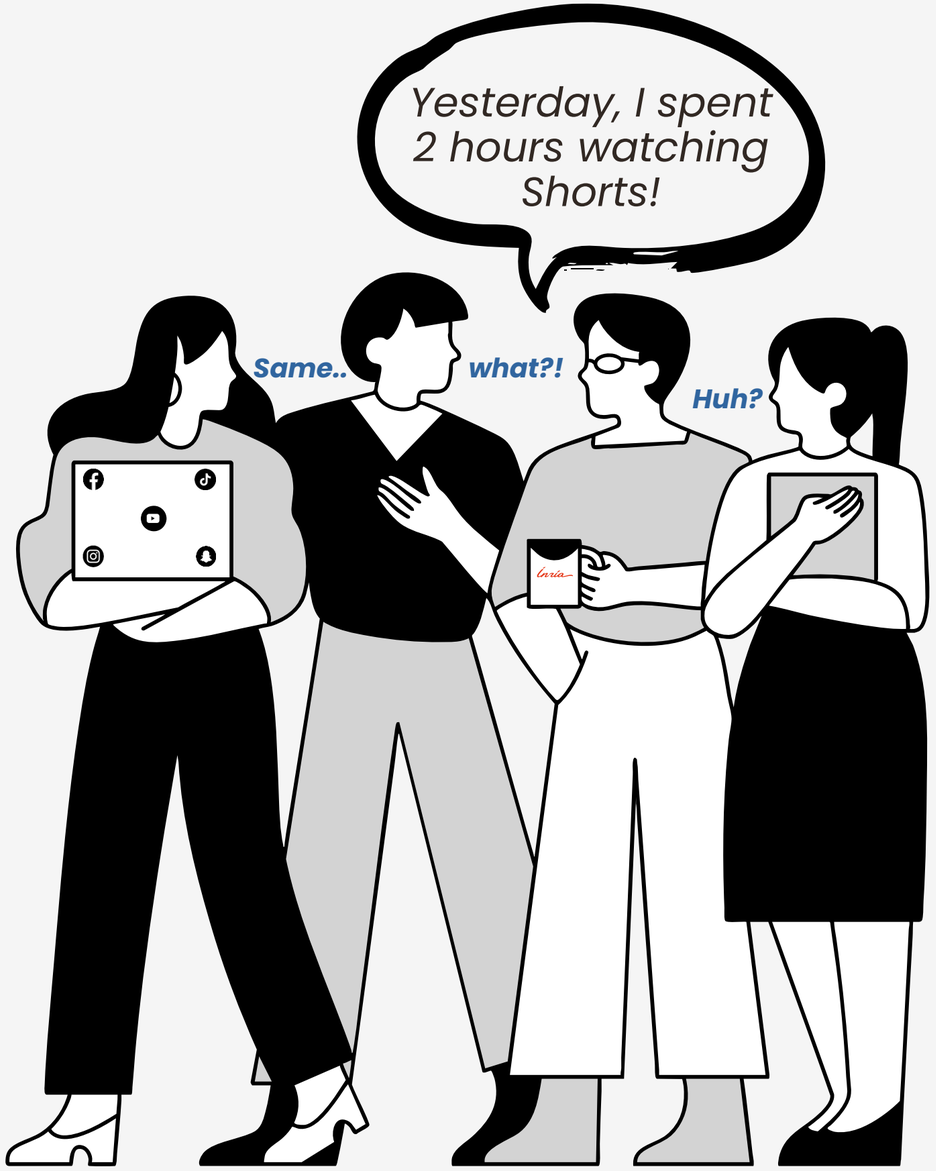
GreenDays 2026

10 & 11 March - Sophia Antipolis



SCROLLING ISN'T FREE!

Data Waste in Short-Form Video Streaming

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OVERVIEW

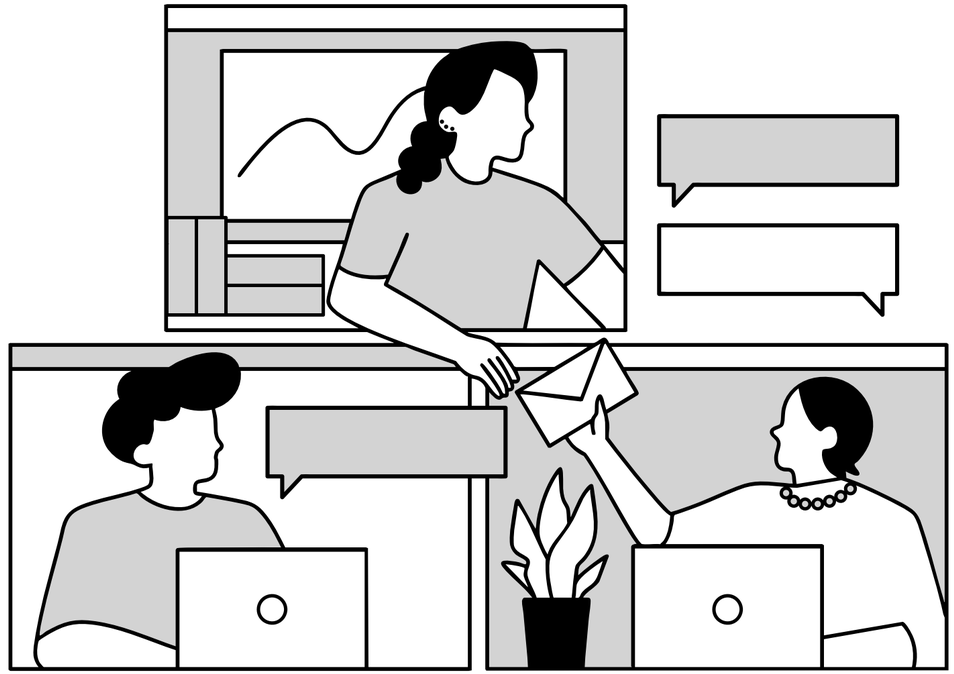
- INTRODUCTION
- MOTIVATIONS
- OBJECTIVES
- METHODOLOGY
- RESULTS
- CONCLUSION

INTRODUCTION

- Short-form video dominates mobile traffic **(~80%)**.
- More than **one billion** users watch short videos every month.
- The global short-video platform market is **expected to double** between 2022 and 2030 [1].

MOTIVATIONS

- **70%** of global internet traffic comes from video streaming.
- Rising demand for **ultra-HD content** and real-time apps strains energy and network resources.
- Efficient, **QoE-aware network design** is crucial for **sustainable** digital growth.



MOTIVATIONS - CASE STUDY

Why YouTube?

- YouTube is the **biggest video platform** in the world.
- YouTube Shorts gets over **70 billion views** every day.
- More than 2 billion people watch Shorts each month (2025) [2].
- It is a **popular** and **well-established platform** with a powerful recommendation system.

OBJECTIVES

Platform Characteristics

Study how **algorithm-driven** feeds, **fast swiping**, and **preloading** contribute to data waste.

Video Traffic Effectiveness

Measure how much of the video is actually watched versus skipped or swiped **(data waste)**.

Green Streaming

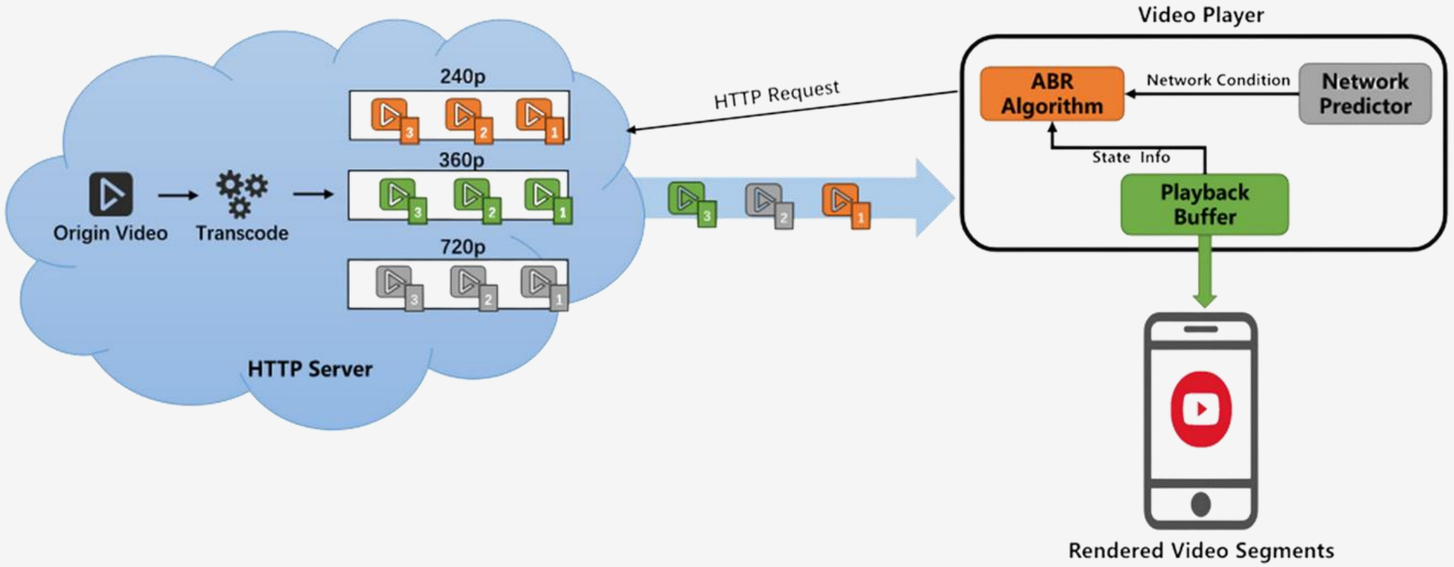
Optimize **resource usage** in B5G networks for applications like video streaming and cloud gaming, while ensuring high **QoE**.

METHODOLOGY - PLATFORM CHARACTERISTICS

YouTube Shorts: Chosen as a real-world example to analyze streaming inefficiencies.

1. Streaming Protocol

In video delivery, the two main streaming protocols are DASH (Dynamic Adaptive Streaming over HTTP) and HLS (HTTP Live Streaming).

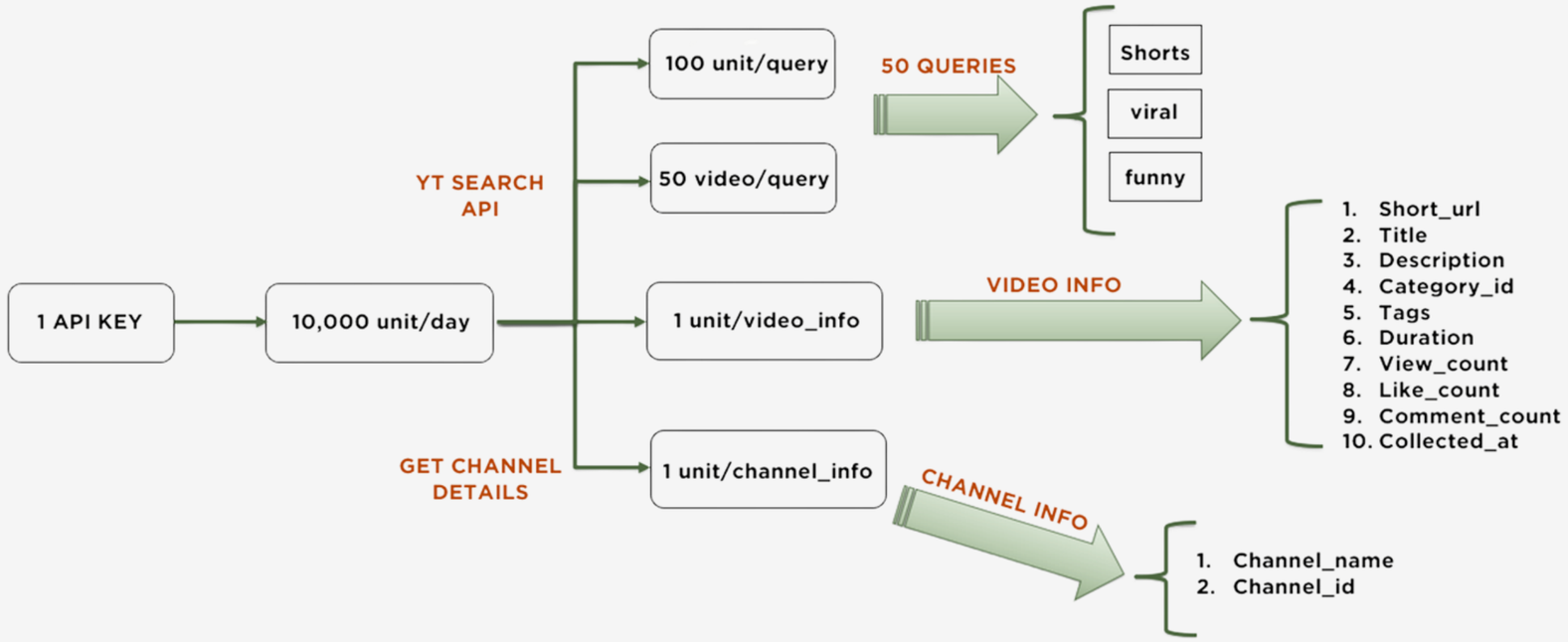


METHODOLOGY - PLATFORM CHARACTERISTICS

2. Data Collection

- To compile a representative dataset, we used the YouTube Data API, querying with 50 trending TikTok.

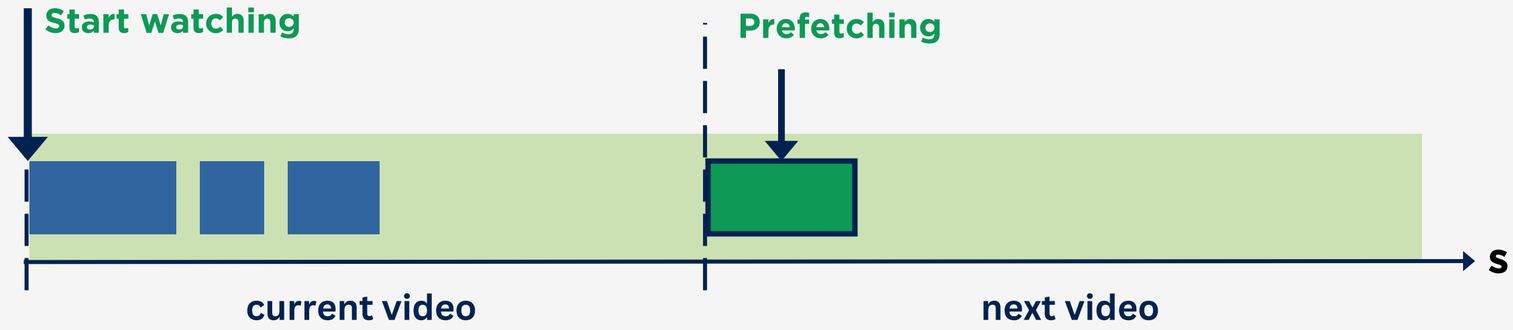
- To date, we have **100K videos** distributed across **15** predefined YouTube **categories**, with durations ranging from **0 to 180 seconds.**



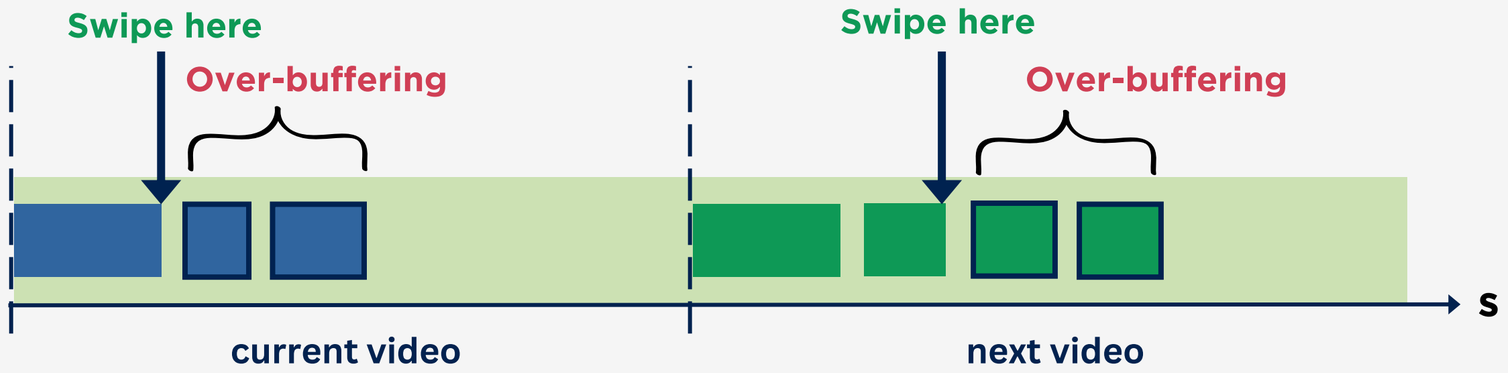
METHODOLOGY - PLATFORM CHARACTERISTICS

3. Buffer Behavior Analysis

Prefetching
“Next-One Strategy”



Over-Buffering



METHODOLOGY - PLATFORM CHARACTERISTICS

3. Buffer Behavior Analysis

- Streaming protocols **prefetch multiple segments** for smooth playback, but in short-form video this causes **over-buffering** because users skip quickly.

- Short-form platforms download videos very quickly, often finishing before the viewer reaches the midpoint.

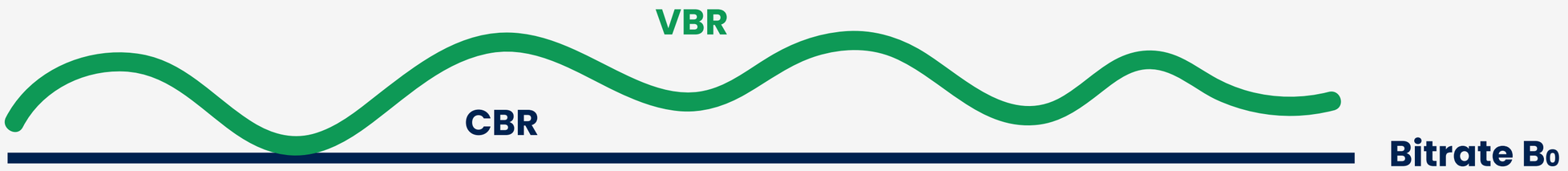
- This enables smooth transitions but wastes data when users swipe early.

METHODOLOGY - PLATFORM CHARACTERISTICS

4. Bitrate Distribution and VBR Encoding

- YouTube Shorts use **content-aware encoding** strategies, resulting in Variable Bitrate (VBR) streams where segment sizes fluctuate with scene complexity, motion, and visual detail.

- This variability is especially noticeable in YouTube Shorts, where **segment sizes** can vary widely even within a single video.



METHODOLOGY - VIDEO TRAFFIC EFFECTIVNESS

User Behavior and Data Consumption

- Short-form video consumption is dominated by **rapid swiping behavior**.
- As a result, **much of the downloaded data is never watched** ⟶ This leads to unnecessary bandwidth and energy consumption.
- Metric

Data Wasted = Data Downloaded - Data Watched

METHODOLOGY - GREEN STREAMING

Prefetching and Download Policies

- We implement segment-level download policies in a **controlled DASH player** to **reduce data waste.**

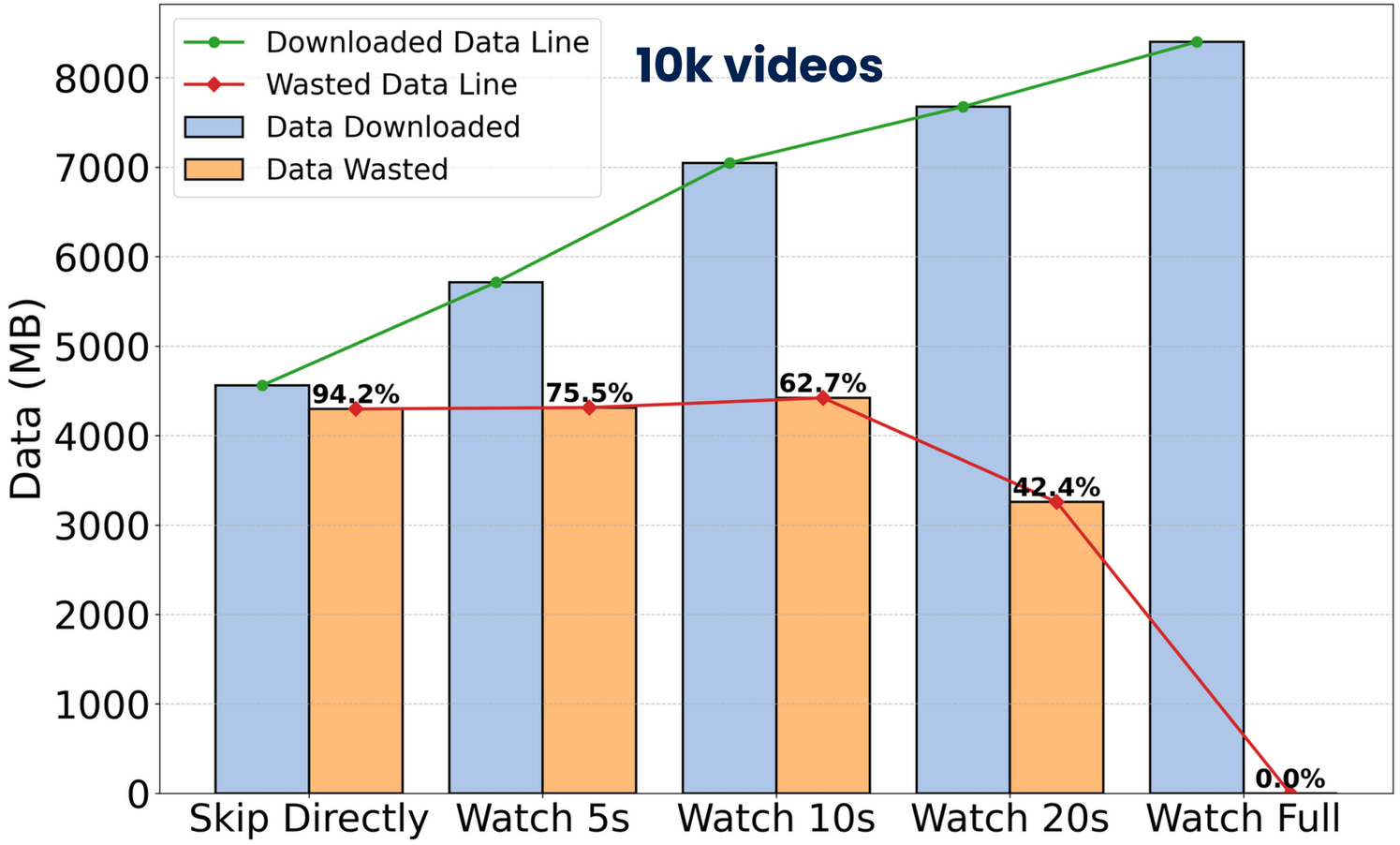
1. **Policy A:** Limit prefetching of the next video.
2. **Policy B:** Use a lower bitrate for the first segment of the current video.
3. **Policy C:** Restrict maximum buffer size to prevent over-buffering.

- Policies are also tested in combination to evaluate cumulative effects on wasted data.

RESULTS

1. DATA WASTE AND USER BEHAVIOR

- User **swiping behavior** is systematically simulated at **5 different watch times.**
- For each scenario, data **downloaded**, **watched** and **wasted** are computed.



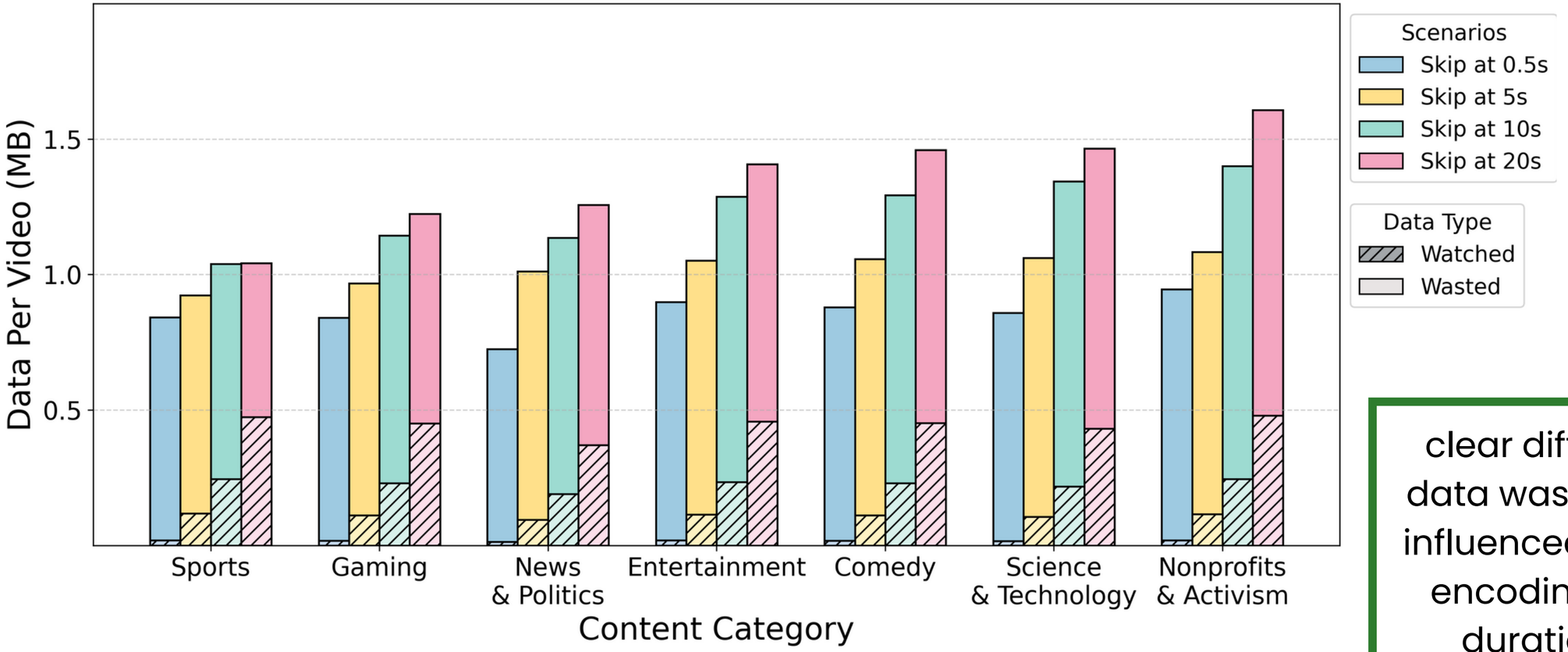
when users swipe within the first few seconds, **60–90%** of downloaded data is never watched due to **aggressive prefetching**.

These results highlight the need for adaptive buffering strategies that account for user behavior to reduce unnecessary bandwidth use.

RESULTS

2. DATA WASTE ACROSS CONTENT CATEGORIES

- We study **7 high-bitrate** Shorts categories with up to **50** videos each.
- We measure downloaded vs. wasted data under different swiping behaviors.

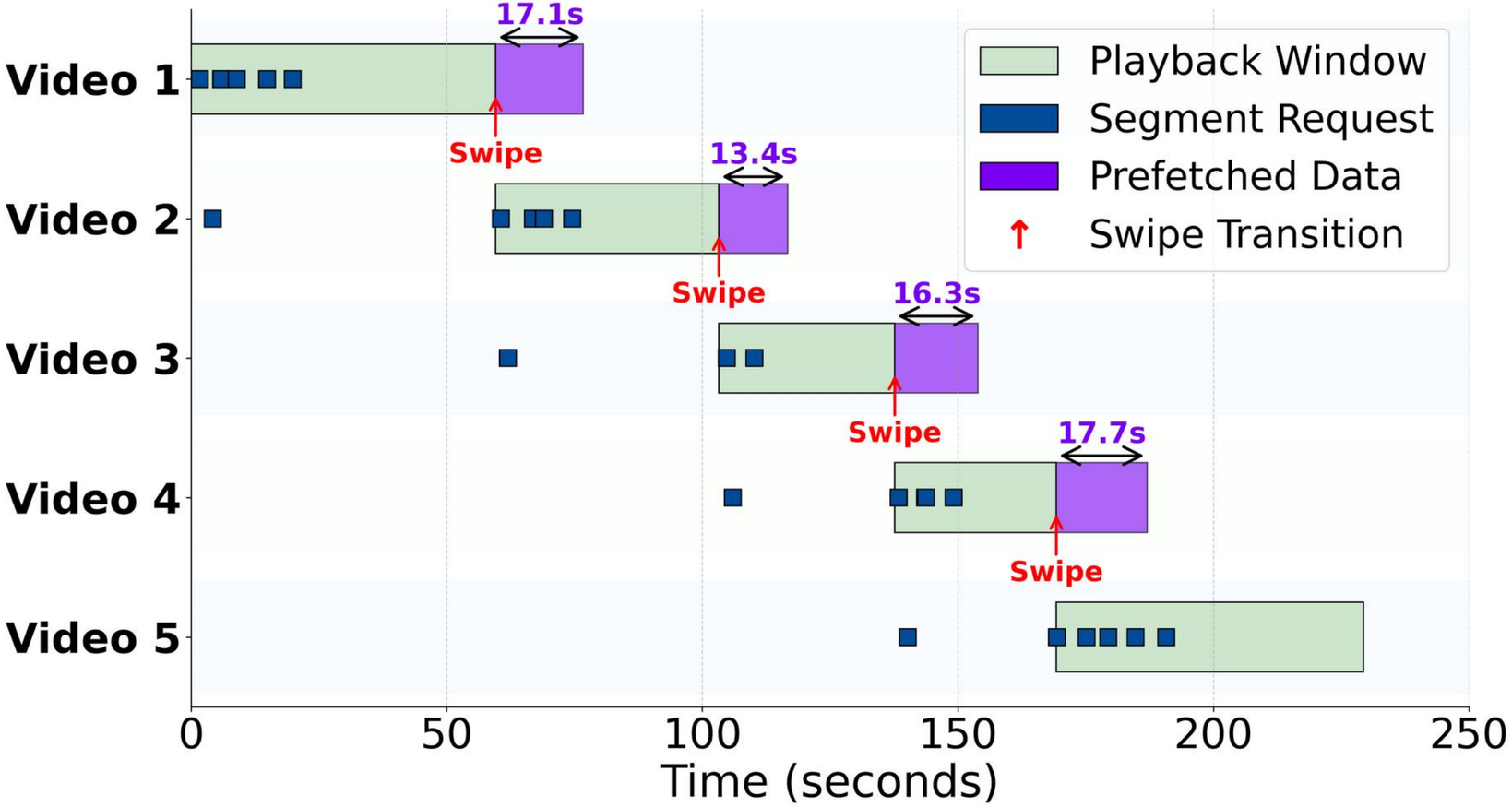


clear differences in average data waste across categories, influenced by motion intensity, encoding complexity, video duration, and resolution

RESULTS

3. BUFFER SIZE EVOLUTION OVER TIME

- Segment requests for five fully watched videos of the same length.



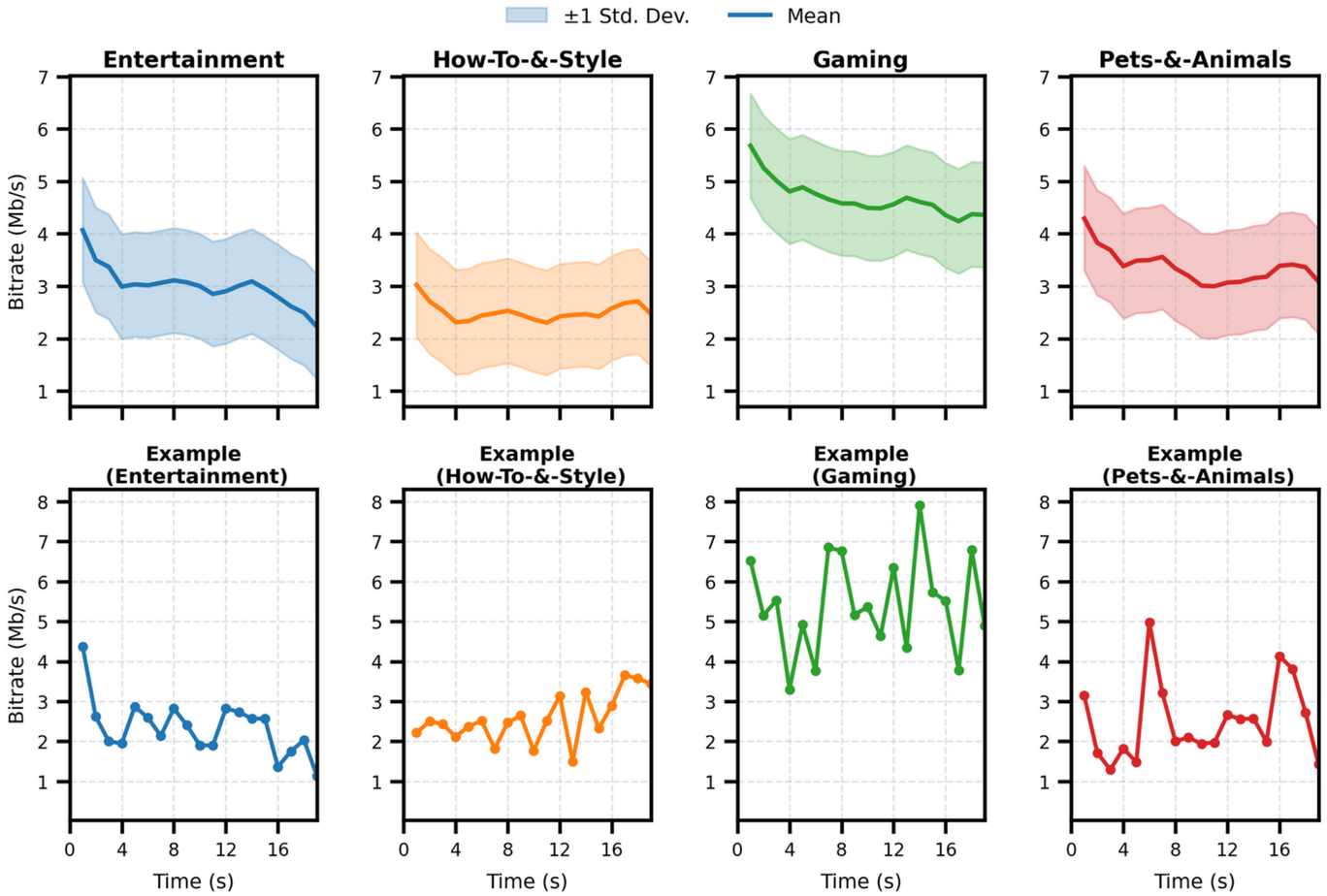
YouTube Shorts **downloads the full video rapidly**, often before the user has watched half of it, and **begins prefetching the next video.**

This "**Next-One**" approach helps seamless transitions but increases data waste when users swipe early.

RESULTS

4. BITRATE VARIABILITY IN SHORT-FORM VIDEOS

- Short-form platforms use **VBR encoding,** causing segment sizes to fluctuate with **content complexity**.



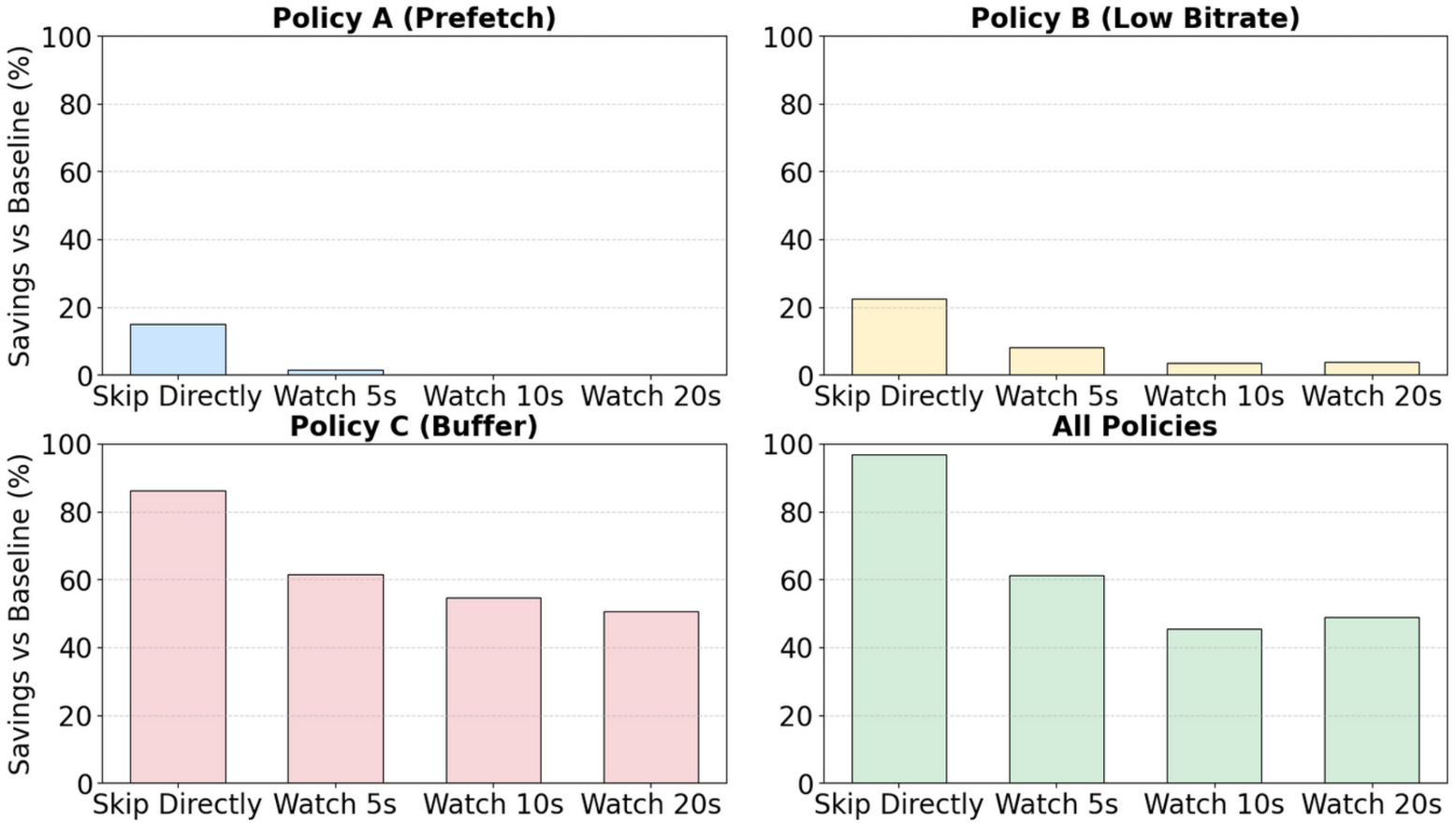
Categories differ significantly: **Gaming** has high bitrates, while **How-to & Style** is simpler and lower-bitrate.

Video bitrates are **front-loaded**, with **early segments higher in quality**.

RESULTS

5. IMPACT OF SEGMENT-LEVEL POLICIES ON DATA WASTE

- All policies were evaluated under the same viewing scenarios defined earlier (0.5 s, 5 s, 10 s, and 20 s), using a controlled dash.js-based environment.



Scenario	Policy A	Policy B	Policy C	All
Skip Directly	14.96	22.43	86.08	96.69
Watch 5s	1.48	8.18	61.52	61.11
Watch 10s	-2.52	3.65	54.75	45.51
Watch 20s	-2.94	3.94	50.68	48.90

Controlling buffer growth is the most effective lever for reducing data waste, while **prefetch** and **bitrate-based** policies provide complementary benefits

CONCLUSION

- *Mobile streaming should prioritize data efficiency and sustainability, not just smooth playback.*
- *Aligning delivery with user behavior, especially rapid swipes, can reduce wasted data and energy use.*

01

Analysis of **10,000+** YouTube Shorts sessions reveals that **aggressive prefetching** + **rapid swiping** can waste up to **90%** of downloaded data.

02

Data waste varies by **content category, video length**, and **segment-level buffering behavior**, with longer and higher-bitrate videos exhibiting the highest waste.

03

Policy-driven strategies are effective for improving short-form streaming efficiency.

THANK YOU!

SCAN ME

Let’s improve video streaming efficiency!