Network Characteristics of Video Streaming Traffic

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Video Streaming in the Internet

- 25-40% of all Internet traffic
- Netflix and YouTube dominant sources
- We report three different streaming strategies
- We study the impact of these strategies

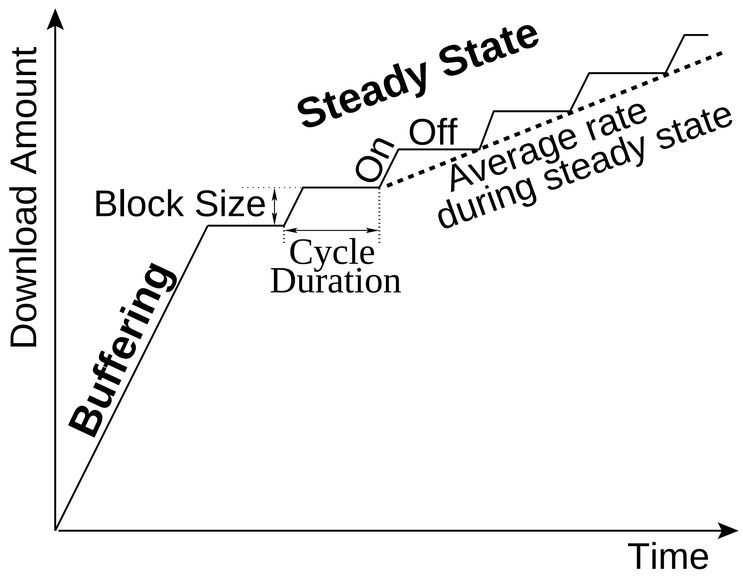
Containers

YouTube		NETFLIX
Adobe Flash	HTML5	Microsoft Silverlight

Applications used for Viewing Videos

Web Browsers			Mobile Applications	
Internet Explorer	Mozilla Firefox	Google Chrome	iOS (native)	Android (native)

Phases during Video Streaming



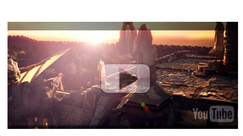
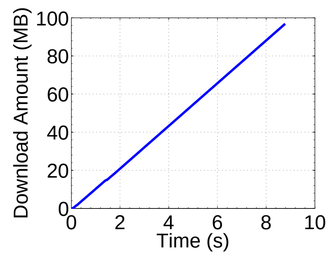
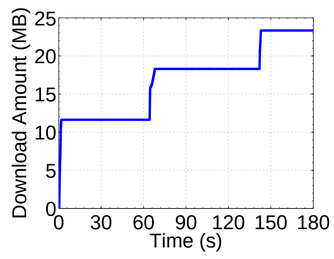
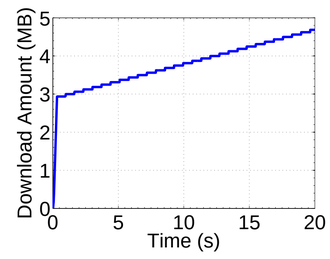
Buffering Phase: Data transfer rate limited to the **end-to-end available bandwidth**

Steady State Phase: Average download rate slightly larger than **video encoding rate**

Dataset and Methodology

- YouTube videos - 5000 Flash, 3000 HTML5, and 2000 HD for web browsers; 50 for mobile applications
- Netflix - 200 for web browsers and 50 for mobile applications
- Measurement Location: Four sites for YouTube - Two in France and Two in USA. Two sites in USA for Netflix.

Streaming Strategies Identified

Strategy	No ON-OFF Cycles (No)	Long ON-OFF Cycles (Long)	Short ON-OFF Cycles (Short)
Sample Video	 		
Engineering Complexity	No complex engineering	Explicit support on server and/or client side	
TCP Friendly	Yes - like a TCP file transfer	Yes - like periodic TCP file transfers	Unknown because traffic is not ack-clocked
Receive buffer footprint	Large - tries to fill the receive buffer	Moderate - periodically tries to fill the receive buffer	Small footprint
Amount of unused bytes on user interruptions	Large amount	Moderate amount	Small amount

YouTube Streaming Strategies

Container	Flash	HTML5				
Application	Any Web Browser	IE9	Firefox	Chrome	iOS (native)	Android (native)
Strategy	Short	Short	No	Long	Combination	Long
Buffering Amount	40 s of playback	Up to 15 MB	Video Size	Up to 15 MB	40 s of playback or up to 20 MB	Up to 10 MB
Block Size	64 kB	256 kB	–	5 MB to 8 MB	64 kB	2 MB to 6 MB

Netflix Streaming Strategies

Container	Silverlight	Silverlight for Mobile Devices?	
Application	Any Web Browsers	iOS (native)	Android (native)
Strategy	Short	Short	Long
Buffering Amount	30 MB to 150 MB	10 MB to 20 MB	35 MB to 45 MB
Block Size	0.5 MB to 2 MB	0.5 MB to 3 MB	4.5 MB to 6 MB

Impact of User Interruptions According to Our Model

On interruptions due to lack of interest

- Download rate close to video encoding rate desirable
- Small block size is desirable

When there are no interruptions

- The streaming strategy has no impact on the traffic due to video streaming

Conclusion

- Streaming strategy depends on the type of application and container
- Migration from one strategy to another can have a non-negligible impact on the traffic due to video streaming
  Raw File Transfer vs Periodic Buffering vs No Ack Clock

Open Questions for CCN community

- Should CCN nodes be aware of the underlying streaming strategy used?
- What is the optimal streaming strategy for CCN?
- Is there an optimal caching strategy for a given streaming strategy?
- What is the impact of user interruptions on CCN caches?