A Load Balancing Approach for Adaptive Bitrate Streaming in ICN

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Information Centric Networks (ICN)





- Content Distribution Networks (CDN)
- DNS Load Balancing
- TCP Termination point

- Send Interest
- Custodian/Cache replies with content
- Inherent Load Balancing

Motivation



Motivation



Load Balancing



Load Balancing - Simulation



- ndnSIM 2.0 [1], based on NS-3
- Default LRU cache
- 10 independent clients on *R₅*, 100 interests per second

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$$L_p = 0, L_B = 1$$

Crosstraffic C₁, C₂, Poisson process

[1] S. Mastorakis, A. Afanasyev, I. Moiseenko, and L. Zhang, "ndnSIM 2.0: A new versior of the NDN simulator for NS-3," Technical Report NDN-0028, NDN, January 2015 6

Load Balancing - Multiple Custodians



- Remove right branch for single server case
- *R*₁-*S*₁ capacity 10
 Mbps
- Segment retrieval time = reception of content – send of interest request

Load Balancing - Caching



Load Balancing - Interests Sent



UMassAmherst Load Balancing - Multi-sourcing effect



- Video split in segments
- Different download rates
- How to determine quality to request next segment?

Adaptive BitRate (ABR) Streaming



- Single video split into segments 2s, 4s, 6s, 8s, 10s
- Each segment in multiple qualities SVC or AVC
- Client should receive optimal quality for smooth playback
- Rate-Based, Buffer Based and Hybrid adaptation schemes

[2] Image based on: http://www2.alcatel-lucent.com/techzine/tcp-from-data-tostreaming-video/

UMassAmherst Multimedia Streaming Performance over NDN



- Multiple sources per segment
- Varying round trip times
- NDNFS [3] Metadata per segment
- Contents requested sequentially

[3] NDNFS: An NDN Friendly File System - http://named-data.net/wp-content/uploads/ 2014/10/ndn-tr-27-ndnfs.pdf 12

UMassAmherst GENI: Infrastructure



ABR over NDN – GENI Testbed



- Measurements performed in real-world GENI testbed
- NDN over Ethernet
- Impact of content size
- Estimating available bandwidth



[4] NDN-Traffic Generator: <u>https://github.com/named-data/ndn-traffic-generator</u> 15

Oscillation



- Multi-sourcing content
- Disjoint paths
- Segment transfer times are smeared average of oscillating content transfer times



- Investigated load balancing in NDN
- Substantially reduces segment retrieval time
- Real-world testbed experiments of native NDN over Ethernet
- Two-layered version of oscillation problem in case of multi-sourcing