Collaborative Video Streaming in Future Networks

Extended Abstract

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The problem(s)

- Traditional, multicast-based, video streaming solutions based on traditional view of TV broadcasting
  - Single producer, many consumers
  - Good for popular content, and mass distribution of *same* content
- However…
  - Web 2.0 is here, and *users* generate much content
    - Production and consumption patterns change dramatically
  - Most (99%) videos are not “popular”, i.e., very few people consume each video
    - No benefit in multicasting non-popular videos

Furthermore…

- A typical multicast system uses distribution trees
  - Ill-suited to handle churn
- Future networks likely to be more ad-hoc in nature
  - Churn will be the norm, not the exception

- Summing up:
  - Current tree-based solutions not likely to be sufficient for VoD

Mesh-based P2P systems

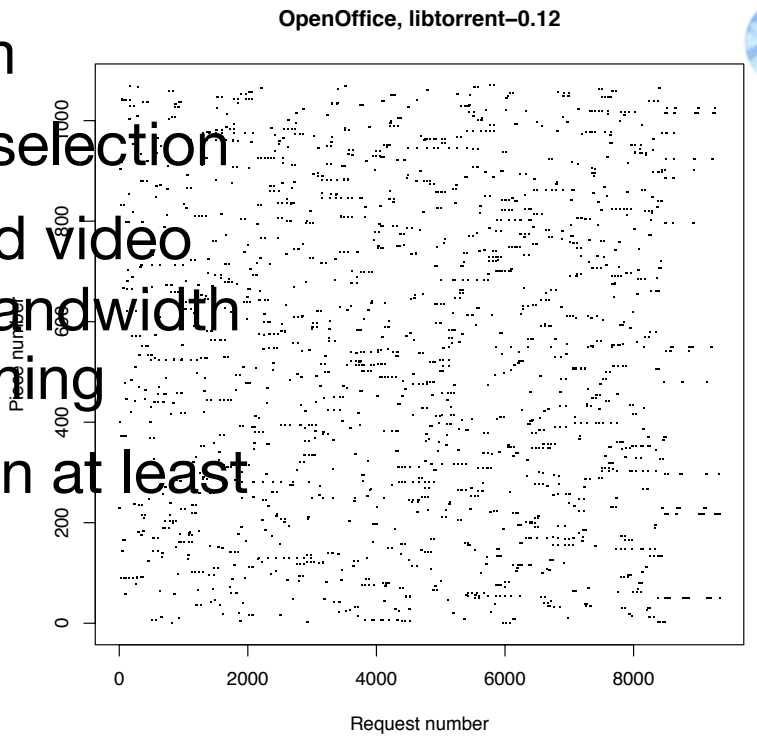
- Major contributor to current Internet bandwidth use
  - Large user base
- Quintessential example:
  - BitTorrent content distribution system
- Efficient content distribution using swarming
- Originally for distributing large files, but several extensions for streaming video exist

BitTorrent Features

- Segmentation
  - Streams partitioned into discrete segments with associated checksums
  - Peers exchange buffer maps, indicating what segments they carry
- Rudimentary incentive mechanism
  - Tit-for-tat exchange of segments
  - Distrust scheme, as opposed to trust scheme
  - Reciprocation decreases distrust
- Peers act as partial caches
- Deployment!

One Problem Solved

- Segment download order is random
- Problem solved by smart segment selection
- Simulation studies show BT-enabled video streaming uses only about 2% of bandwidth compared to equivalent Web streaming
- So, using BT as a distributor, we can at least provide a streaming service!



Challenge

- Changing production & consumption patterns
  - cf. youtube,vimeo, et al.
  - How to map the centralised cloud structure of these networks into the p2p nature of BitTorrent?
    - Is it even useful?
    - Adobe Stratus
  - Take popularity into account?

Challenge

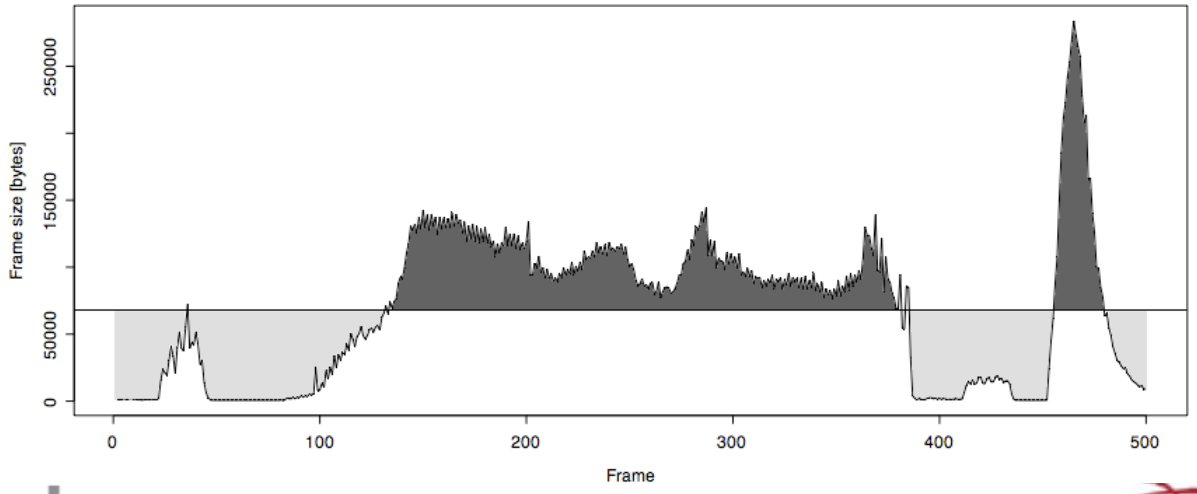
- Device & access heterogeneity
  - Different capabilities of devices, how to distribute load w.r.t.
    - Storage (caching, pre-fetching)
    - Processing (transcoding, etc)
    - Relaying
  - Access capabilities
    - How to gracefully adapt content to available bandwidth
  - Mobility?

Challenge

- Peer selection and reputation
  - Which peers?
    - Data availability and willingness to share is no longer enough;
  - Which access?
  - Account for physical proximity, network proximity, “social proximity”?
  - Encounter network concepts useful?

Challenge: Video is ugly

- Statistical characteristics for video are typically not very nice for the network
  - Smoothing and pre-fetching can help out, but is difficult to perform in low-bandwidth environments
  - Given enough bandwidth, it is however possible to outperform IPMC w.r.t. bandwidth utilization



Challenge

- Extending the incentive mechanism
  - Current analysis assume two-player game using bandwidth as cost variable.
  - More variables must be taken into account, e.g., timely delivery.
  - Must capture group dynamics, making two-player assumption invalid

Summing up

- Mesh file sharing networks have some nice properties useful for video, but there are still open issues:
  - Segment selection
  - Peer selection
  - Incentive mechanisms

Thank you for your time!

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