

A Case for Hybrid Content Distribution for Interactive Video-on-Demand

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Outline

- 1 Introduction
- 2 Delivery Methods
 - Push
 - Pull
 - Hybrid
- 3 Methodology
 - Variables
 - Metrics
- 4 Evaluation
 - Group size
 - Peer-to-Peer Usage
 - Additional Nodes
- 5 Conclusion

Introduction

- **Increasing demand** for high-bitrate interactive media results in **difficult issues** for **Content Distribution Networks (CDNs)**
- Approaches to content delivery can be **broadly categorised** into **push** and **pull**
- We investigate **problems** with these methods under **various delivery scenarios** using a custom simulation environment, and propose a **compromise**: a **hybrid push/pull** approach

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The Push Approach

- **Predetermined** segments are **pushed** to clients **regardless** of exactly what they require
 - **High degree of redundancy** to be exploited
 - Yet **little flexibility** for the user

Our model - TBCP periodic broadcast trees

- The Tree Building Control Protocol is a form of **Application-Level Multicast** (ALM) overlay that builds **efficient shortest-path trees**
- *“An Overlay Tree Building Control Protocol” - Mathy et al.*
- **Periodic broadcast** provides **quasi-Video-on-Demand** over **multiple multicast channels**

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- **Requests** for particular segments are **actively responded to**
 - Many clients consuming different sections of content - **good for interactivity**
 - Yet **costly** to handle clients **individually**

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- Simple **BitTorrent-like** overlay, optimised for streaming with common techniques
 - **Sliding window**
 - Increased frequency of **optimistic unchoking**

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Taking a Hybrid Push/Pull Approach

- Attempt to **gain the advantages** of both approaches, while **negating the disadvantages**
- **Push** most segments to clients, yet allow them to **pull** in those they require

Our model - ALM with P2P Patching

- Combines the previous approaches
- Clients use the **push** TBCP trees, but **patch** into them with the **pull** P2P approach

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Key variables

- **Audience size**

- Varied groups up to 500 clients considered

- **Nature of the content** (workload)

- Simple start-to-finish viewing
- Interactivity model - *“Characterising User Interactivity for Sports Video-on-Demand” - Brampton et al., NOSSDAV’07*

- **Network resources**

- Additional content nodes with varied placement

- **Peer-to-peer usage**

- **Artificial limitation** to show the increasing impact of mixing P2P with ALM

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Key metrics

- Several metrics considered to assess **network cost** and potential **user satisfaction**:
 - **Normalised network stress**
 - Total data exchanged on the network normalised to the worst case
 - **Average fraction of timely segments**
 - Segments received in time for playback per client against how many they actually required
 - **Segment utility**
 - Number of segments sent over network versus those used for playback

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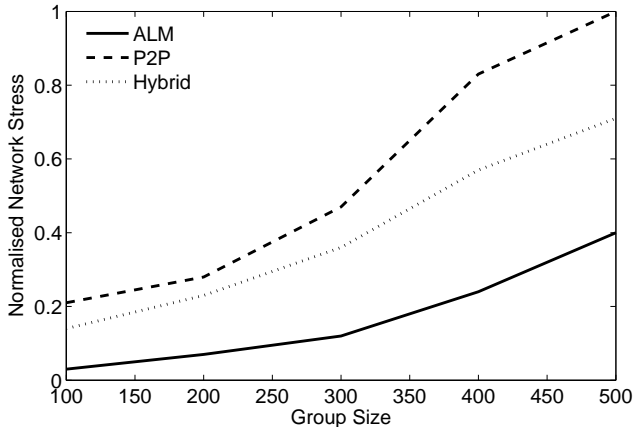
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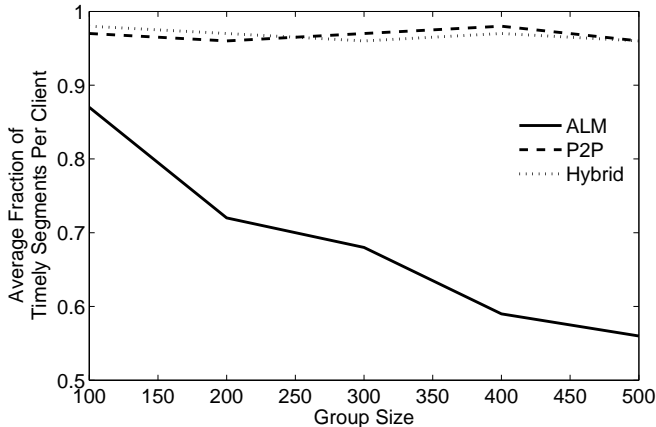
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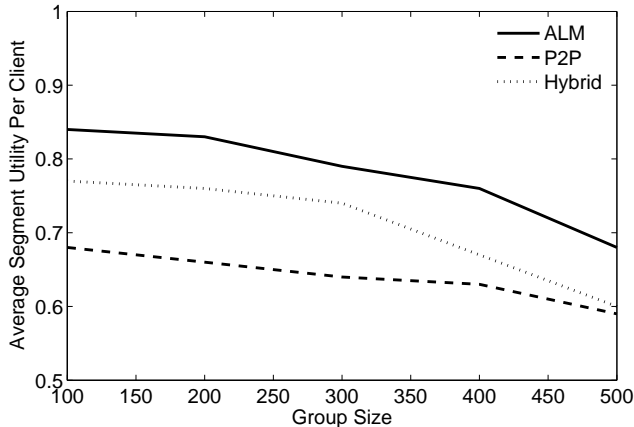
Normalised network cost of an interactive workload with varied group size



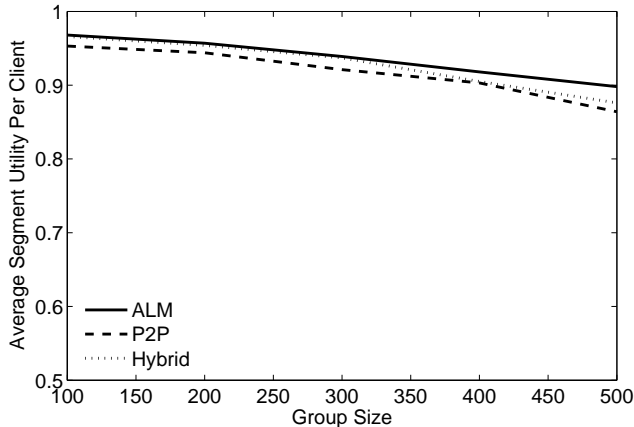
User satisfaction with an interactive workload and varied group size



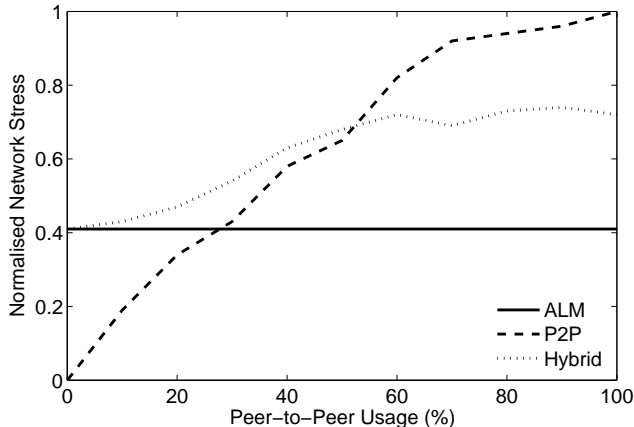
Segment utility for an interactive workload with varied group size



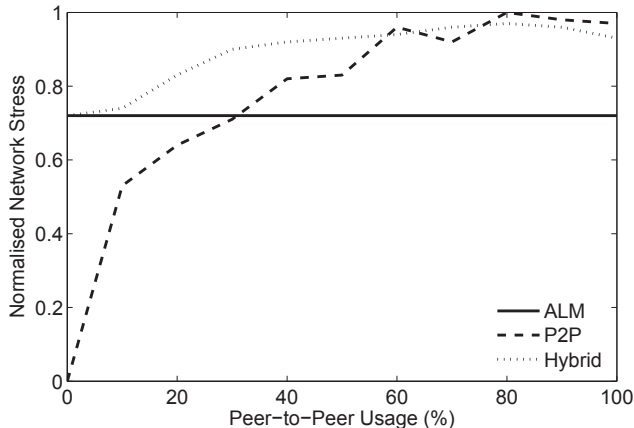
Segment utility for a start-to-finish workload with varied group size



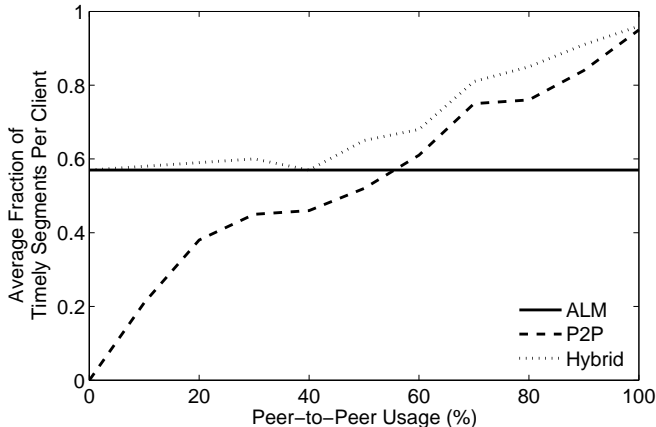
Network cost for an interactive workload with varied P2P usage



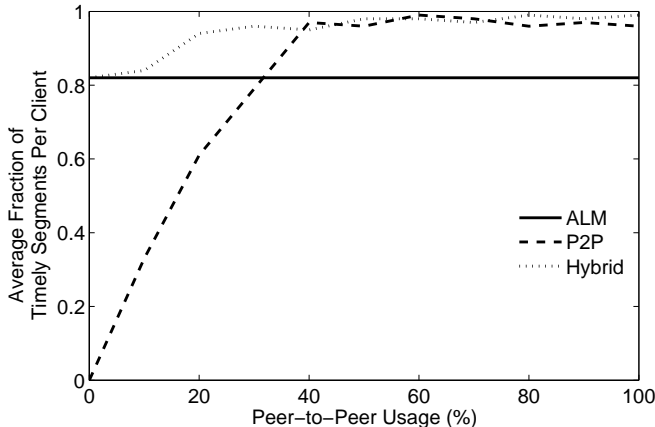
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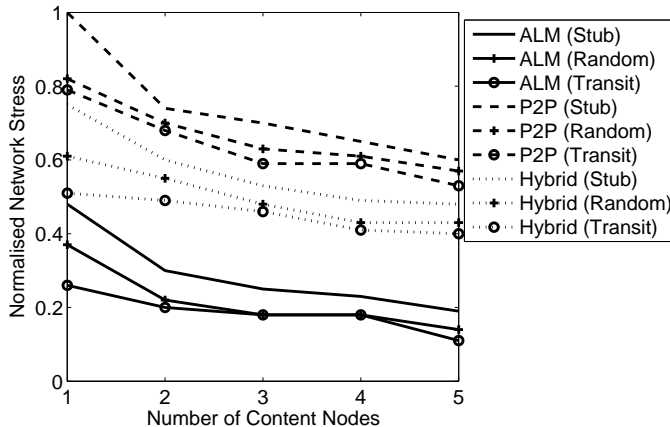
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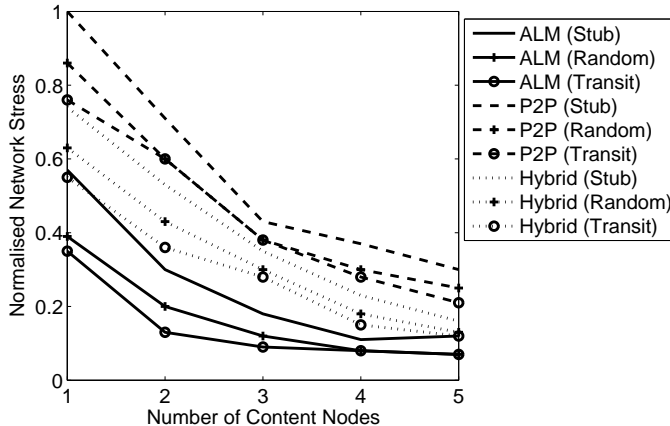
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Overall network stress with additional shared-content nodes



Overall network stress with additional redundant-content nodes



Conclusion

- For the workloads considered...
 - Pull (P2P) **works well for interactive content**, but is **network intensive**
 - Push (ALM) can be **more efficient**, but **struggles with interactivity and larger groups**
 - ...and a **hybrid approach** can offer a **good compromise**
 - **In all cases**, additional, well-placed **content nodes are beneficial**
- **Much potential** for future work in this field

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Thank you for listening.

Any questions?

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