ISP-friendly peer-to-peer live streaming

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draft-picconi-alto-p2p-streaming-00

IETF-77, Anaheim, CA

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Outline

- motivation
- ISP-friendly live streaming
- cost models

Motivation

- several studies on topology-aware overlays
  - P4P [Xie et al.]
  - Ono [Choffnes et al.]
  - Oracle [Aggarwal et al.]
- however, locality optimizations can degrade performance
  - peers with slow uplinks may form slow groups [Choffnes et al.]

Motivation

- P2P live streaming is more fragile than BitTorrent
  - ensure minimum download rate
  - deliver video chunks within short deadlines
- our contribution [ICDCS'09 paper]
  - new mechanism to reduce costly traffic in P2P live streaming
  - avoid degradations in video quality
  - decentralized algorithm

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Design

- two mechanisms
  - overlay construction
  - dynamic download rate on costly links

Overlay construction

- directed
  - peers connect as uploaders, downloaders, or both
- bandwidth-aware
  - maximum out-degree proportional to upload capacity
- cost-aware

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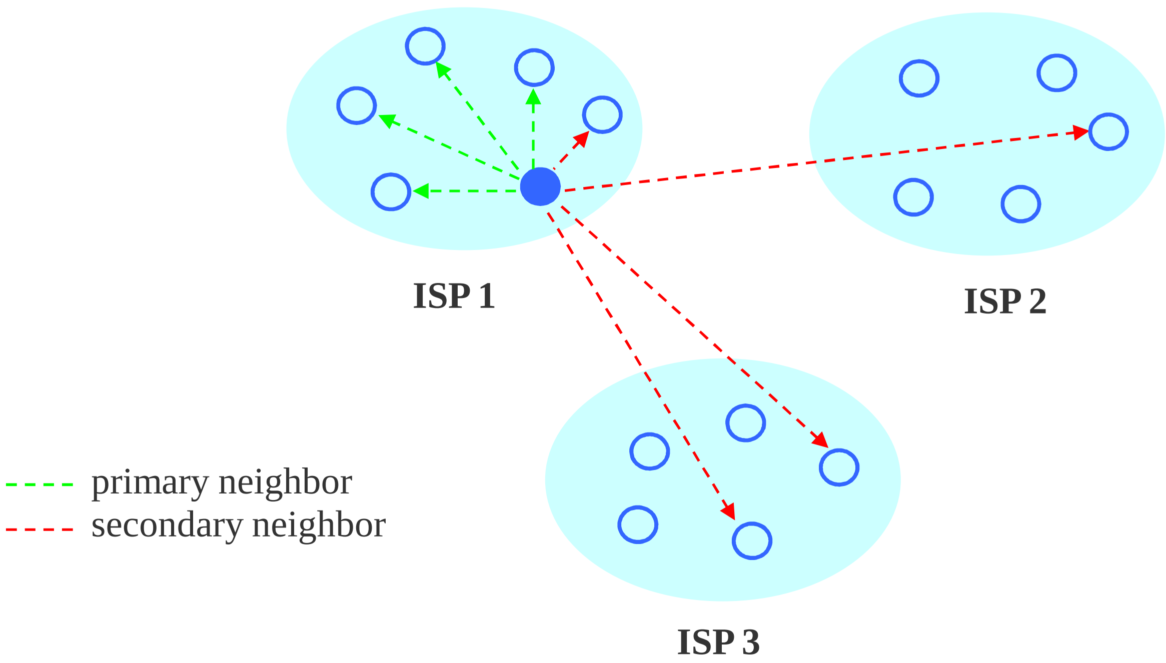
Overlay construction (cont'd)

- each client maintains two neighbor sets
  - primary neighbors: peers with low network cost
  - secondary neighbors: peers chosen at random



how much bandwidth should be allocated to secondary neighbors?

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Secondary download rate

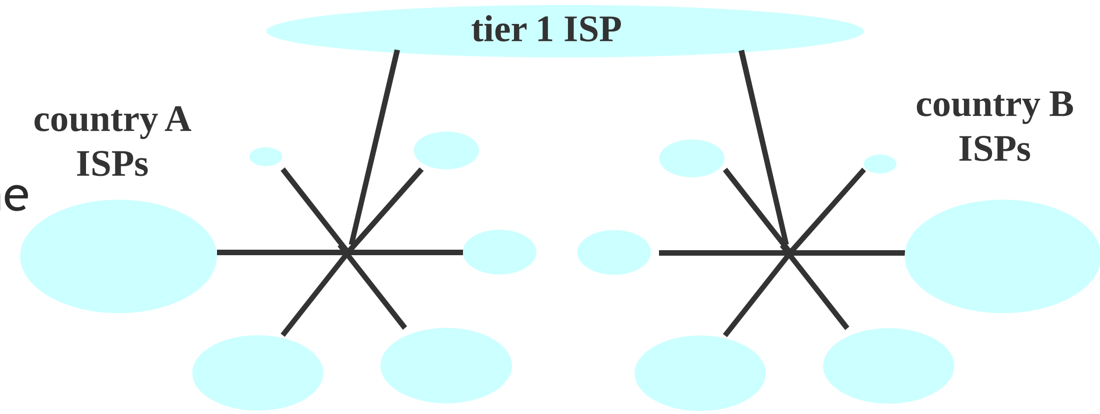
- each peer limits its download rate from secondary neighbors

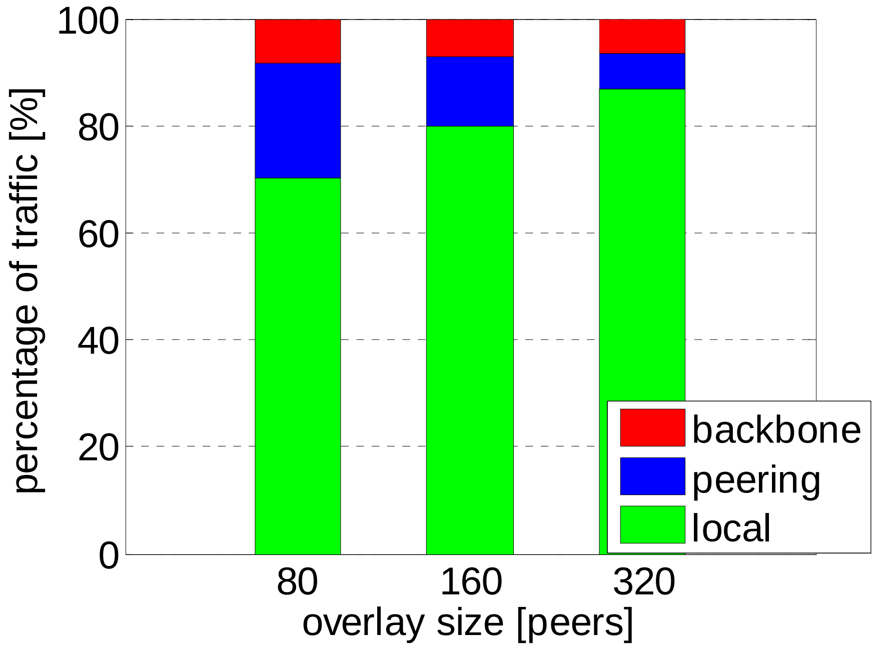
- rate periodically adjusted according to local chunk buffer
  - if buffer is near starvation → download rate is increased
  - if buffer is full → download rate is decreased

- rationale
  - look for the minimum secondary rate that fills local buffer

Prototype experiments

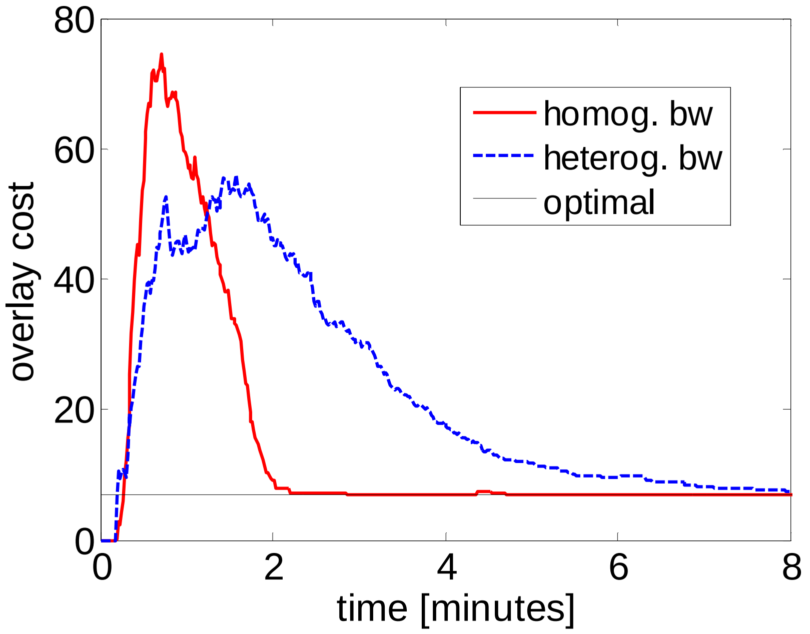
- emulated topology
- simple cost model
  - local ISP < peering < backbone
- inter-ISP traffic decreases for larger overlays
- content popularity is usually Zip-like → a few popular channels generate most of the traffic in the system
- global system efficiency should be high





Prototype experiments (cont'd)

- overlay converges quickly to minimum-cost configuration



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Cost models

- symmetric/bidirectional/numerical (assumed in the paper)
  - endpoints agree on numerical cost
  - same cost for both directions
  - can compute minimum-cost overlay
  - our prototype converges quickly to optimal overlay

- asymmetric/unidirectional/numerical
  - each endpoint uses its own cost
  - cost depends on direction
  - can still compute minimum cost overlay
  - our design can be easily adapted
    - peer selects neighbors according to their own cost

Cost models (cont'd)

- ordinal
  - primary neighbors selected in the same way
  - however, no optimal cost overlay
  - possible research direction: find stable allocation
    - no two peers would replace one of their neighbors with each other

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Conclusions

- new design for ISP-friendly P2P live streaming
  - two-layer overlay (directed, bandwidth-aware)
  - dynamic rate limit on costly-links
  - drastically reduces inter-ISP traffic without degrading quality

- impact of cost model
  - our scheme can be extended to consider
    - asymmetric numerical costs
    - ordinal costs
  - ordinal costs require new benchmark for overlay construction
    - stable allocation is a possible idea to explore

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