ISP Friendly or Foe?
Making P2P Live Streaming ISP-aware

Fabio Picconi and Laurent Massoulie

Appeared in ICDCS'09

Outline

- Background
- Design of ISP-friendly Scheme
  - Design Principles and Rationale
  - Overlay Construction
  - Dynamic Unchoke
- Problems
- Emulation and Experiment

Background

- Current P2P systems: network agnostic → generating large volumes of unnecessary inter-ISP traffic
- Recent work has shown the benefits of ISP-awareness on file sharing applications → How about living streaming?
- Optimizing P2P live streaming systems is harder to design: data diffusion in short delays

Design of ISP-friendly Scheme

Design Principles and Rationale

[Principles]

1. Simplicity and low diffusion delays over traffic optimality
2. Decentralized mechanisms based on local peer decisions
3. Mesh-based systems
4. Using tracker to keep lists of active peers and network cost between two IP addresses

Design of ISP-friendly Scheme

Design Principles and Rationale

[Rationale (Mechanisms)]

1. Randomized two-level overlay construction : Primary overlay and secondary overlay

   peer selection strategy

2. Dynamic unchoke for secondary overlay links

Design of ISP-friendly Scheme

Overlay Construction

- Each peer keeps two peer lists:
  - **subset of random peers;**
  - **subset of random low-cost peers.**
- Half connection attempts to peers from the random peer list; half to peers from low-cost peer list.
- Whether to build an edge (connection)?

  primary overlay links: network cost and upload or download rate

  secondary overlay links: upload or download rate.

Design of ISP-friendly Scheme

Dynamic Unchoke of Secondary Overlay Links

- how to adapt secondary receive rate:
  - Early starvation signals (ESS): a peer generates an ESS whenever a chunk has not been received half-way to the deadline.
  - Given an interval T_{noess}, during this time:

1. if ESS is observed, increase secondary rate
2. if no ESS is observed, decrease secondary rate

Problems

- How to decide whether to create an edge after connection attempts is not clearly described;
- How to realize unchoke algorithms is not clearly described.

Emulation and Experiment

- Test Topologies:

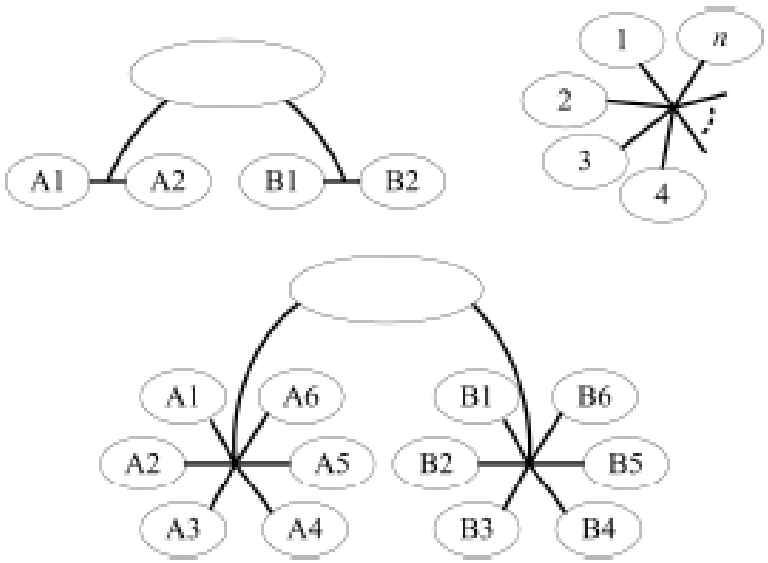


Figure 1. Test topologies: 2+2 (top left), n-clique (top right), and 6+6 (bottom)

		fraction of peers within the group
A1	B1	46.5%
A2	B2	21.4%
A3	B3	18.6%
A4	B4	6.0%
A5	B5	5.0%
A6	B6	2.5%

Table 1. ISP popularity (6+6 topology).

2+2 and N-clique:

clients are distributed uniformly in the groups;

Emulation and Experiment

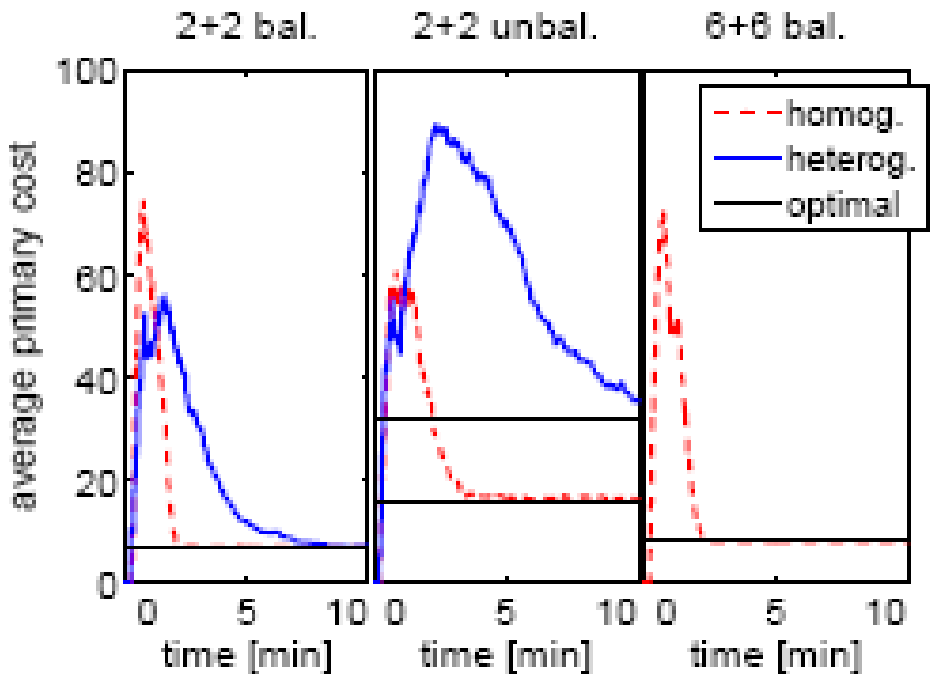
- Bandwidth Distribution in the Topologies:

topol.	intra-group	intra-ISP	upload capacities [kbps]	
			ISP A1,B1	ISP A2,B2
2+2	balanced	homog.	1000	1000
	balanced	heterog.	128-4000	128-4000
2+2	unbalanced	homog.	1500	500
	unbalanced	heterog.	1000-4000	128-384
			all ISPs	
6+6	balanced	homog.	1000	
n-clique	balanced	homog.	1000	

Table 2. Test scenarios.

Network Emulation

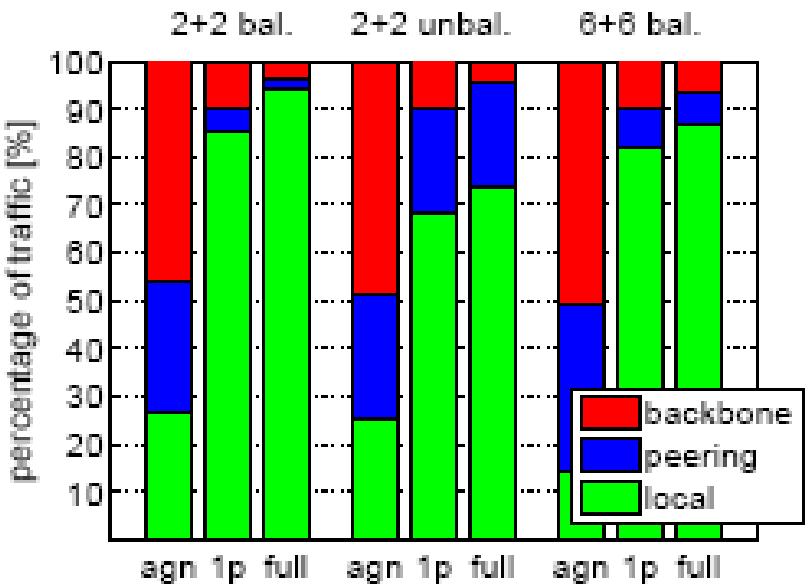
- The convergence of primary overlay links



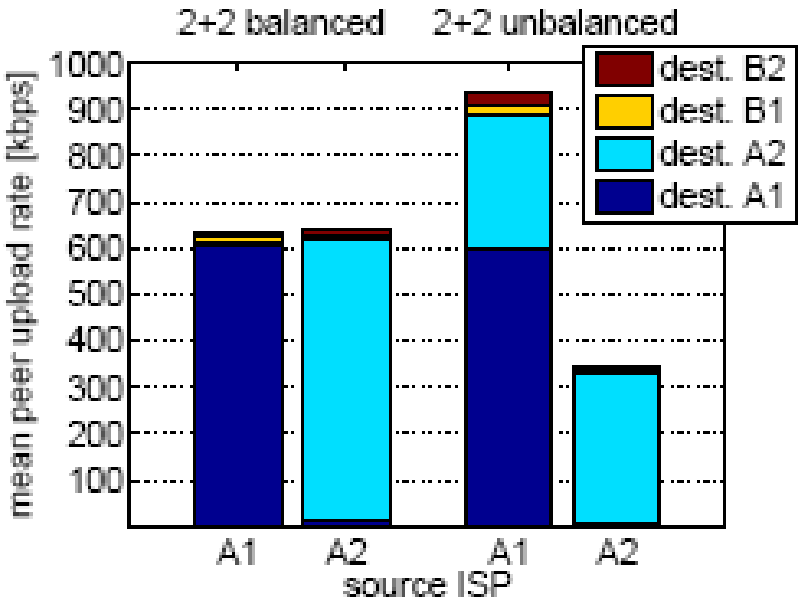
(a) primary overlay cost

Network Emulation

- Traffic pattern:



(b) inter-domain traffic (homog.)



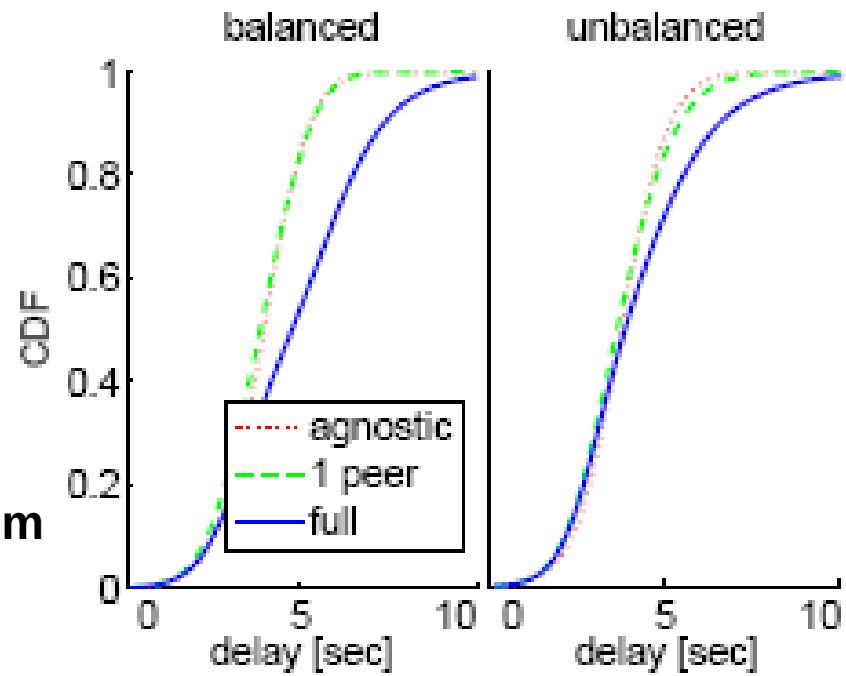
(c) traffic detail (full, homog.)

agn: ISP-agnostic network;

1p: a secondary of only a single peer without rate limiting

Network Emulation

- Delay distribution

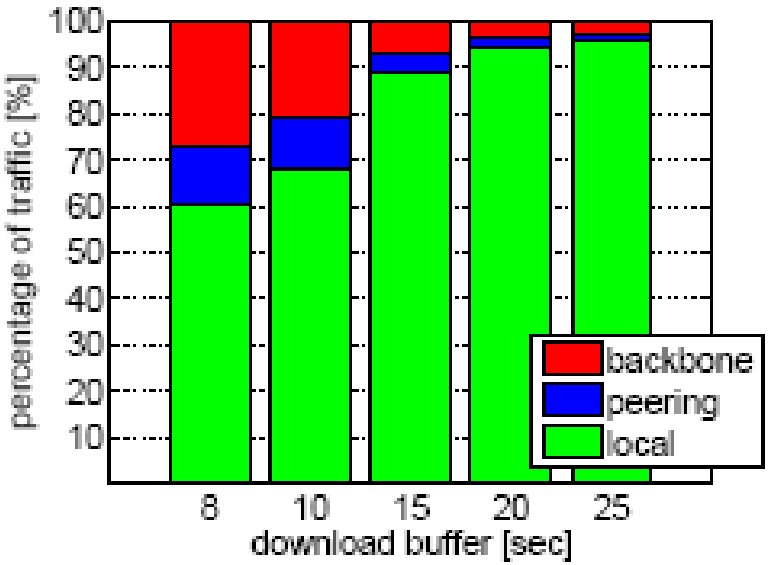


(a) delay distribution (homog.)

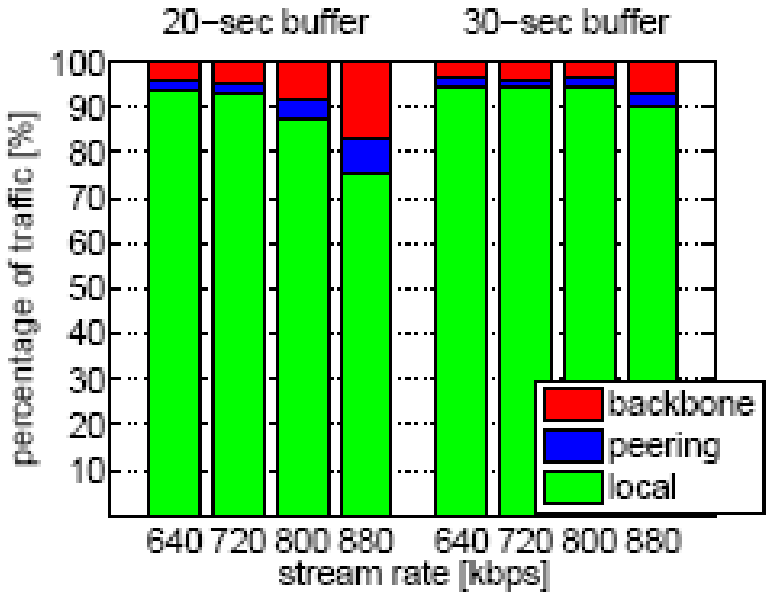
The unchoke mechanism increases the diffusion delay to the mid-buffer position

Network Emulation

- Impact of buffer size, stream rate, time to trigger ESS (use 2+2 balanced homogeneous scenario)



(b) delay trade-off



(c) impact of stream rate

Buffer size's , stream rate's impact on traffic pattern

Network Emulation

Mid-buffer vs. quarter-buffer

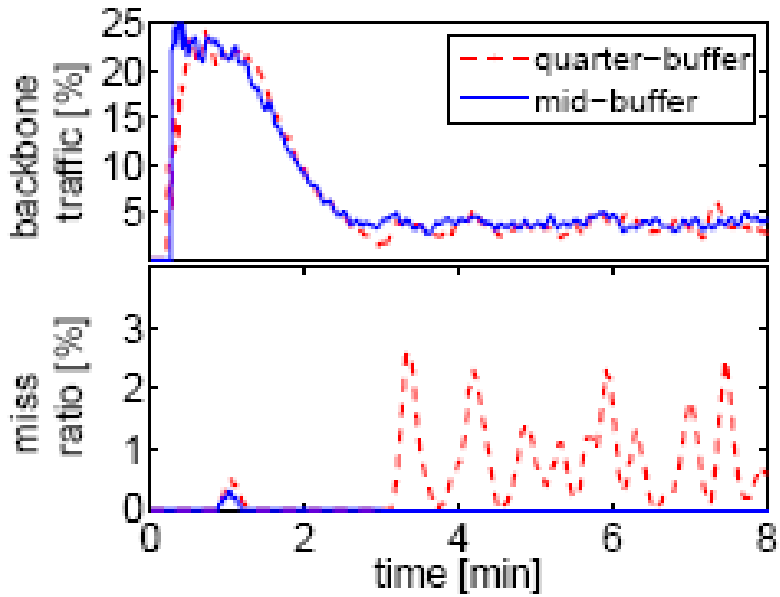
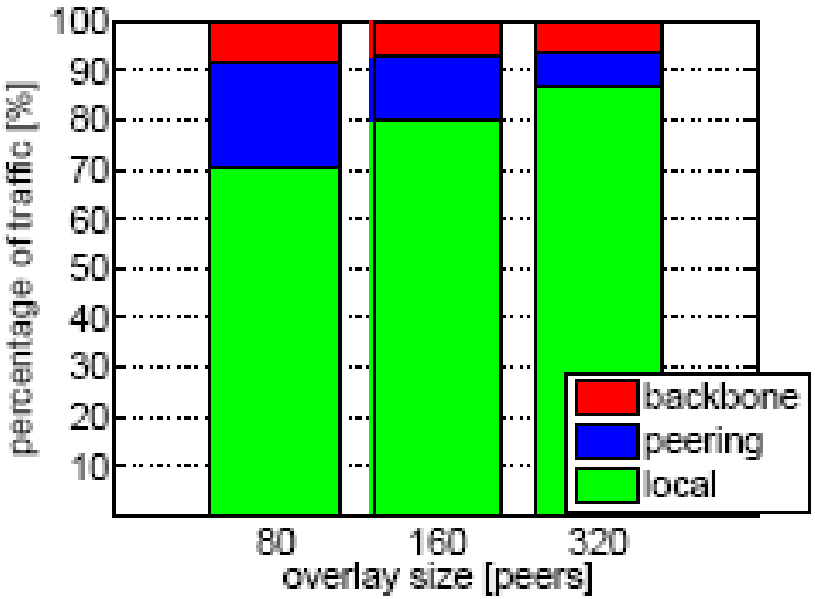


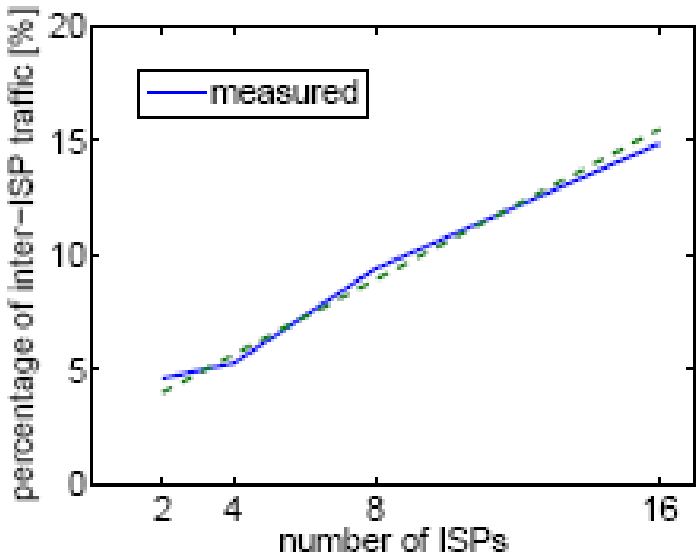
Figure 5. unchoke based on quarter-buffer misses are too close to the deadline, producing periodic chunk misses.

Network Emulation

- Impact of number of peers and ISPs



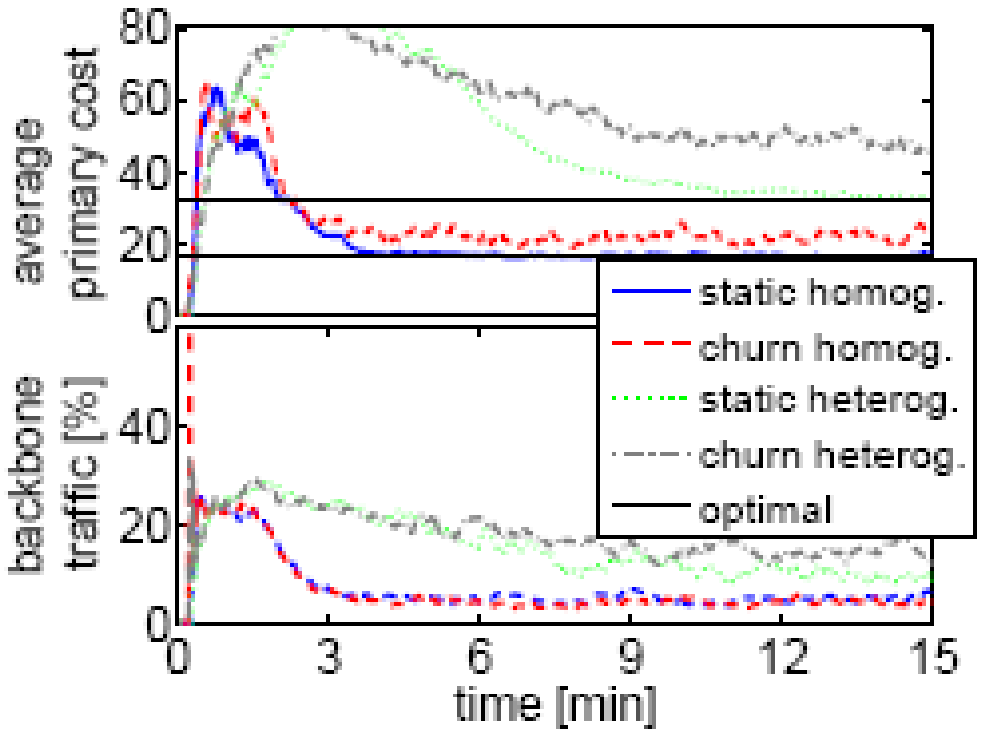
(c) overlay size (6+6 balanced homog.)



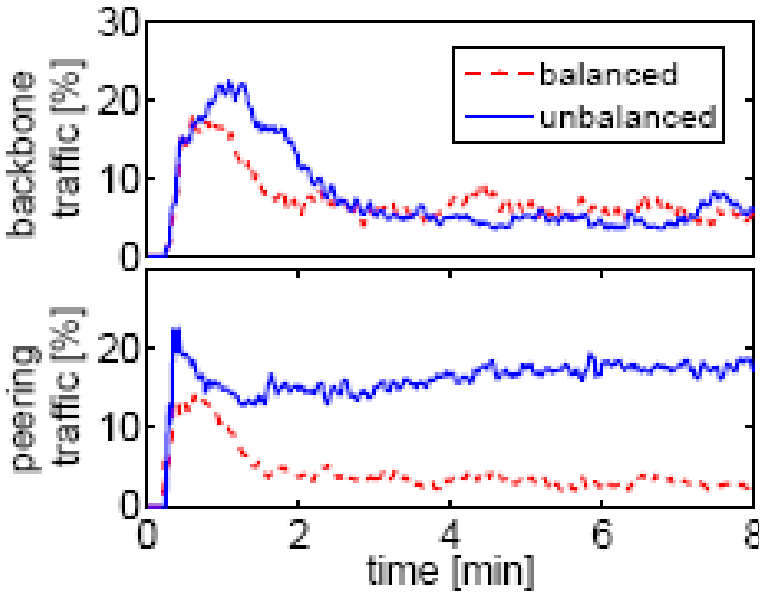
(a) number of ISPs (n-clique topol.)

Network Emulation

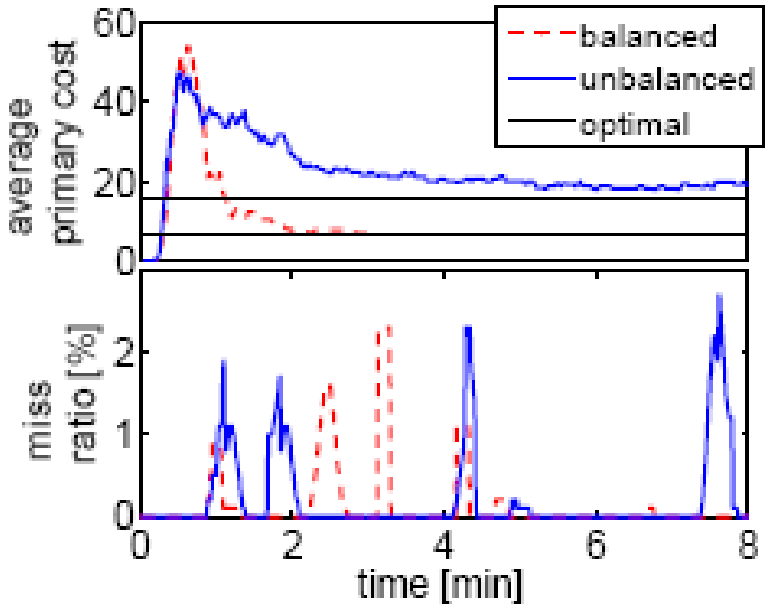
- Impact of churn:



Planetlab Experiments



(b) traffic (Planetlab)



(c) primary cost and miss ratio (Planetlab)

2+2 homogeneous scenarios

Thank You!