

Incentive-Informed Inter-Domain Multicast

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Motivation

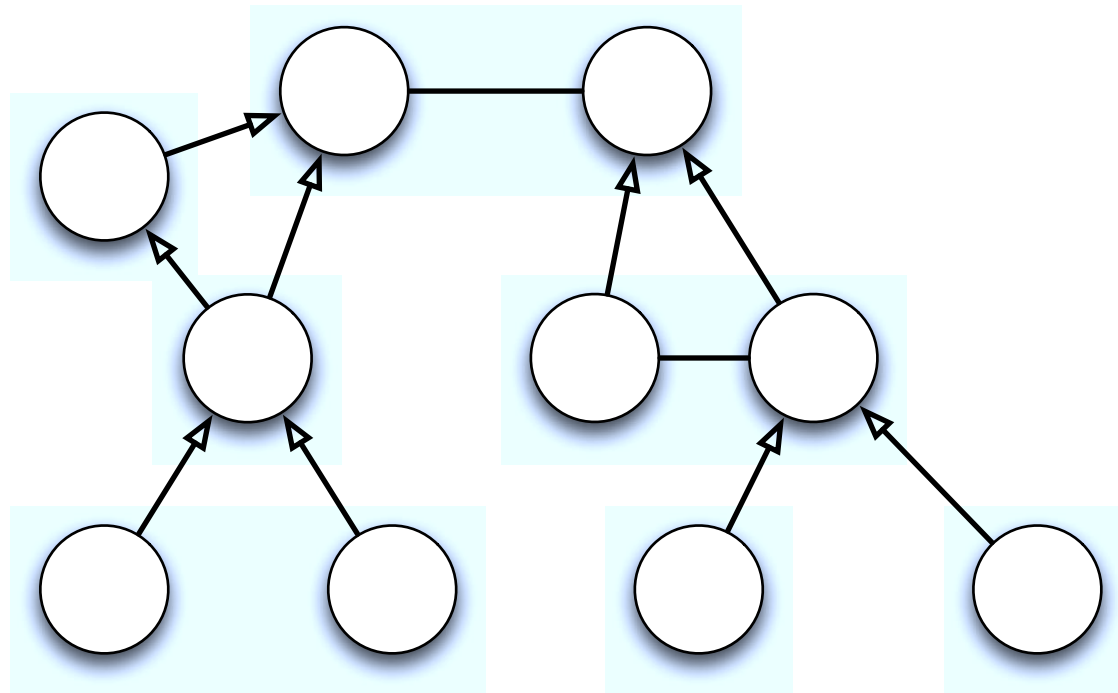
“The art of economics consists in looking not merely at the immediate but at the longer effects of any act or policy; it consists in tracing the consequences of that policy not merely for one group but for all groups.”

Henry Hazlitt: Economics In One Lesson, 1946

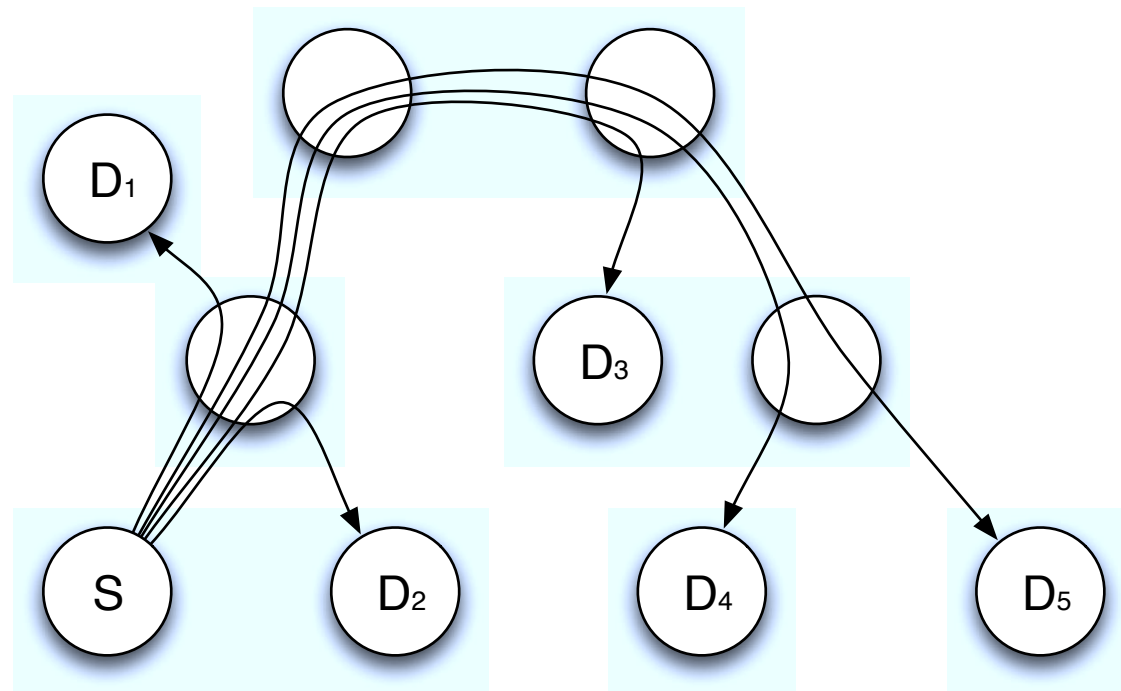
Introduction

- Multicast depends on the network to fork traffic to multiple destinations
- Cost and benefits fall on different domains
 - Compensation?
- Limit operation to local unicast incentives only
 - Derive a unicast-compatible multicast policy
- How effective can this be?

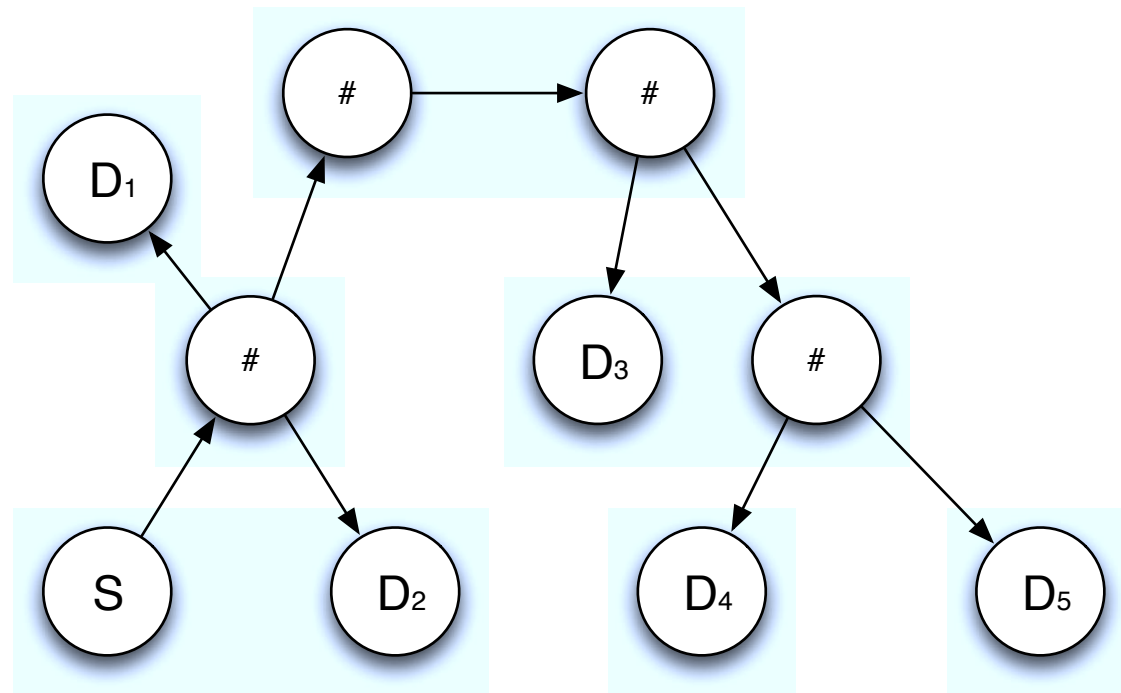
Inter-Domain Topology



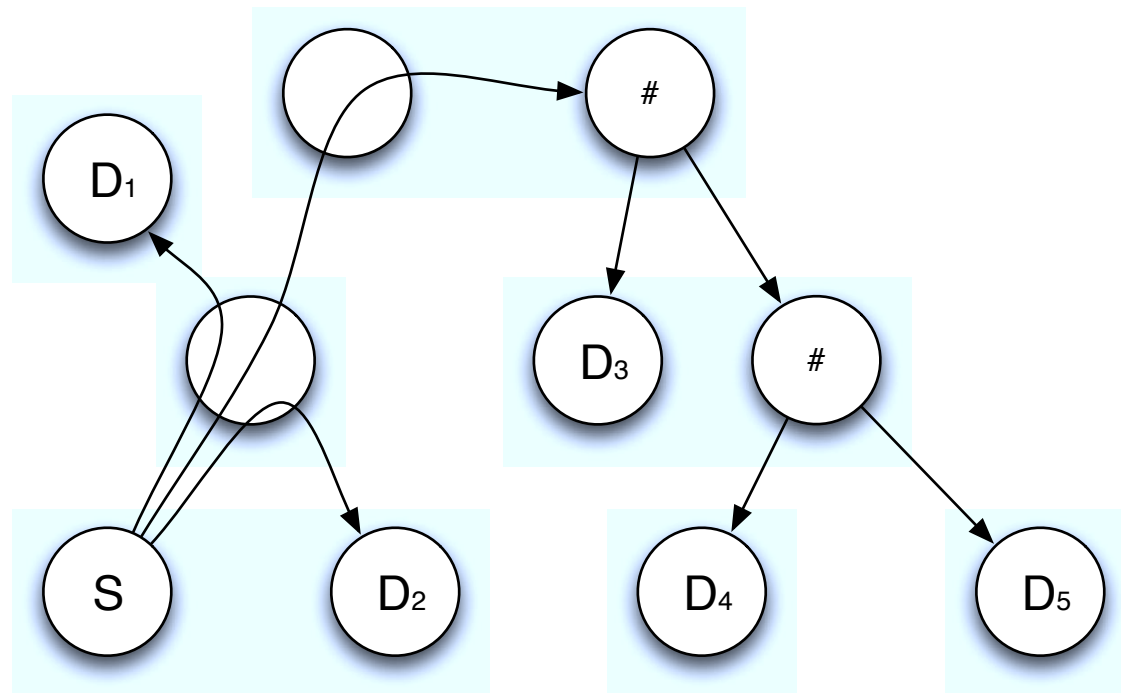
Unicast



Multicast



Incentive-Informed Inter-Domain Multicast

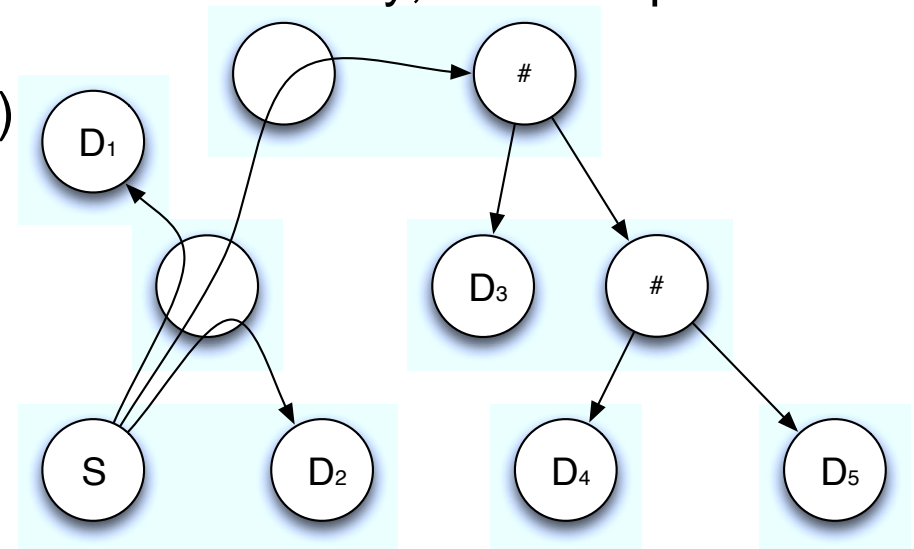


Assumptions

- Unicast addressing (like in REUNITE) or tunneling needed to bypass non-participating domains
- Single source multicast model assumed
 - Extensions to multiple sources possible
- No multicast-specific revenue
 - Existing unicast contracts apply
 - Multicast as a cost saving mechanism only
- Valley-free inter-domain paths, customer next-hop preference
- Application-level traffic demand the same for both unicast and multicast

Incentives

- Sources
 - Resource and transit cost saving
- Uphill Access and Transit Providers
 - Customer revenue maximized by NOT providing multicast service
- Downhill Transit and Access Providers
 - Transit cost savings, when considered individually, bottom-up
 - Incoming peering links: depends on the relationship (cost/balance)
- Destinations
 - Networks: capacity, transit costs
 - Nodes: no benefit



Unicast Compatible inter-Domain Multicast Policy

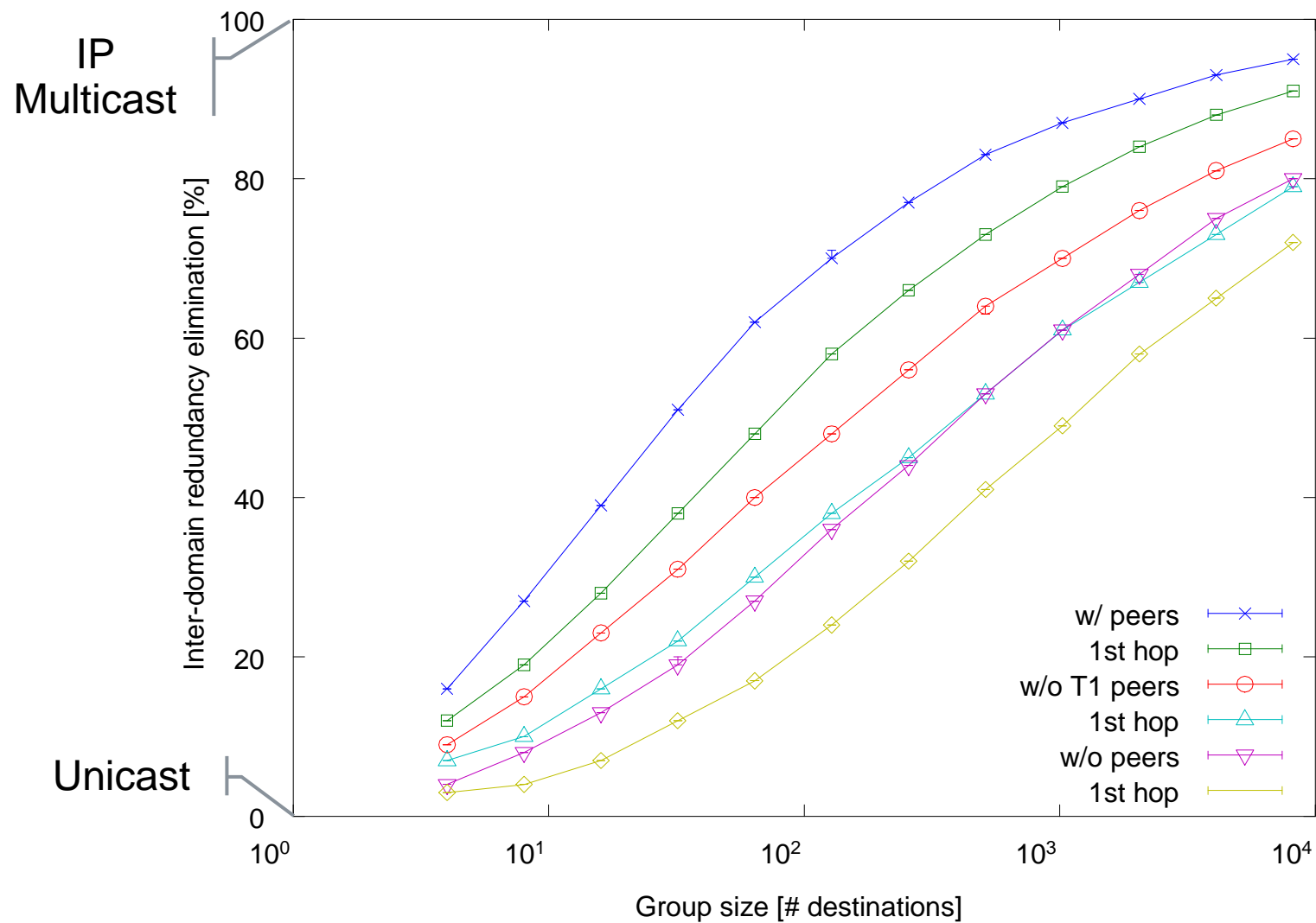
- Destinations send *multicast reception requests*
- Domain-level processing as follows:
 1. **Drop** requests in violation of unicast routing policy
 2. **Intercept** requests, whose next-hop towards the multicast source would be either *a provider link*, or *a peering or sibling link for which incoming traffic reduction is desirable*
 - Create a branching point if needed (e.g., more than 2 destinations)
 3. **Forward** all other requests (towards the multicast source)

Policy Evaluation

- CAIDA AS relationships dataset (08/10/2009)
- Random sources and destinations
 - Distribution observing measured utility rank correlations and power-law distributions
- Three different policies regarding multicast after peering links:
 1. Multicast branching after *all* peering links
 2. No multicast branching after Tier-1 peering links
 3. No multicast branching after *any* peering links
- Alternate topology with additional 10x peering links

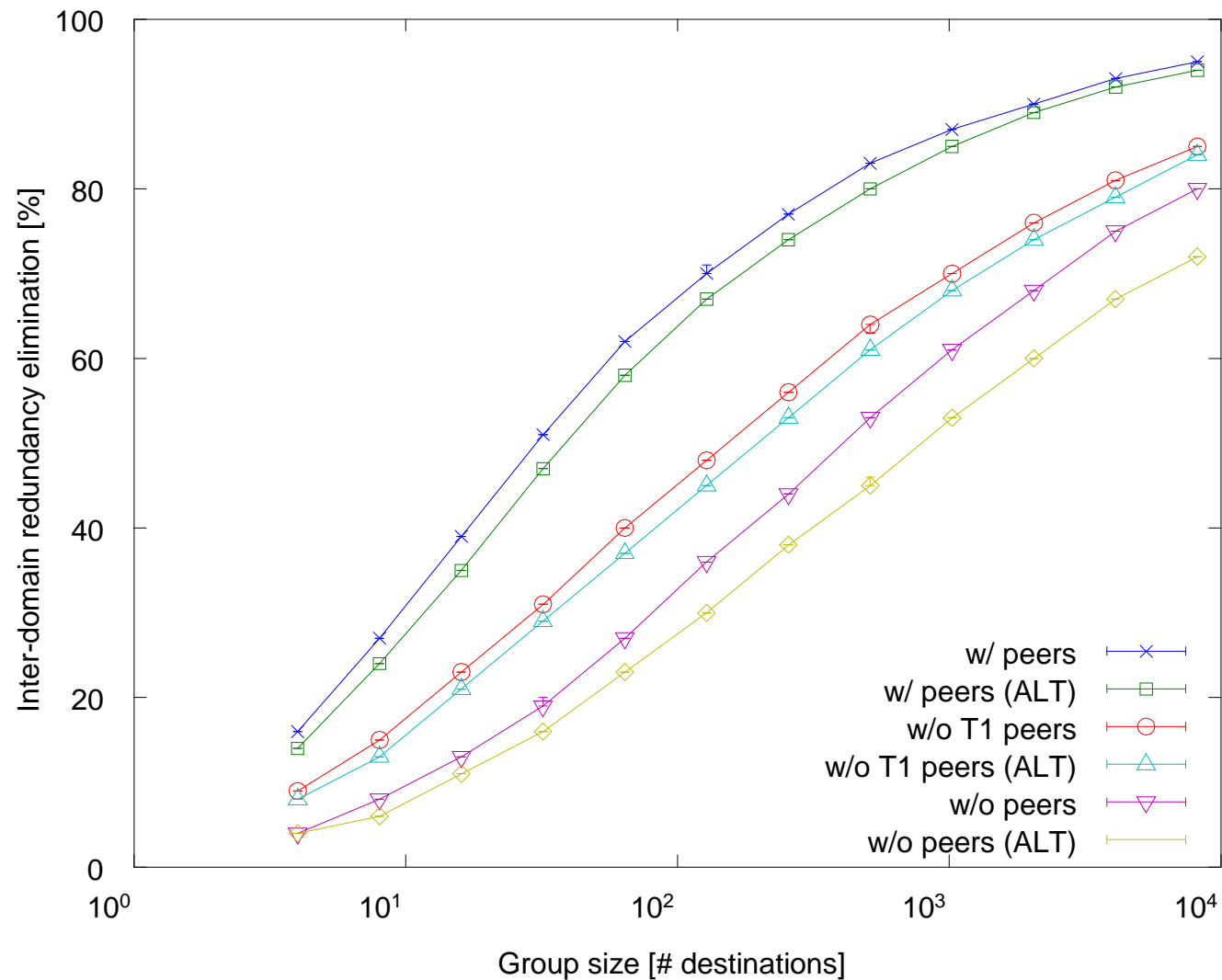
Evaluation Results

(N = 2000, CI = 95%).



Alternate Topology

(N = 2000, CI = 95%).

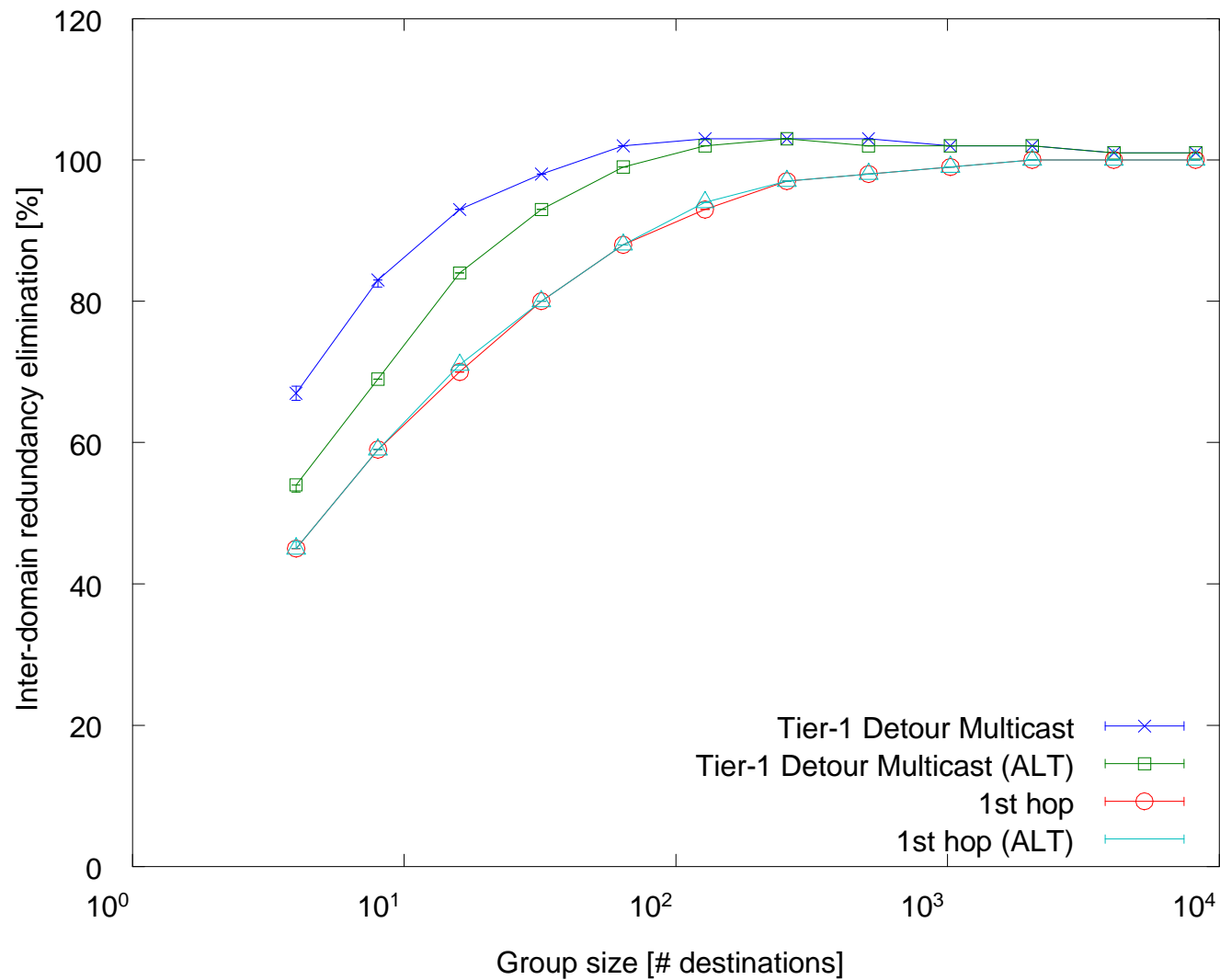


Tier-1 Detour Multicast

- As a block, transit providers are *better off without multicast*
- Tier-1 providers seem to be in a unique position to benefit from all additional network traffic
- Multicast as a free service
 - Sources send packets to multicast providers, who then fork the traffic to all destinations reachable via their customers
 - Downstream providers can also branch to limit the (new) transit load/cost

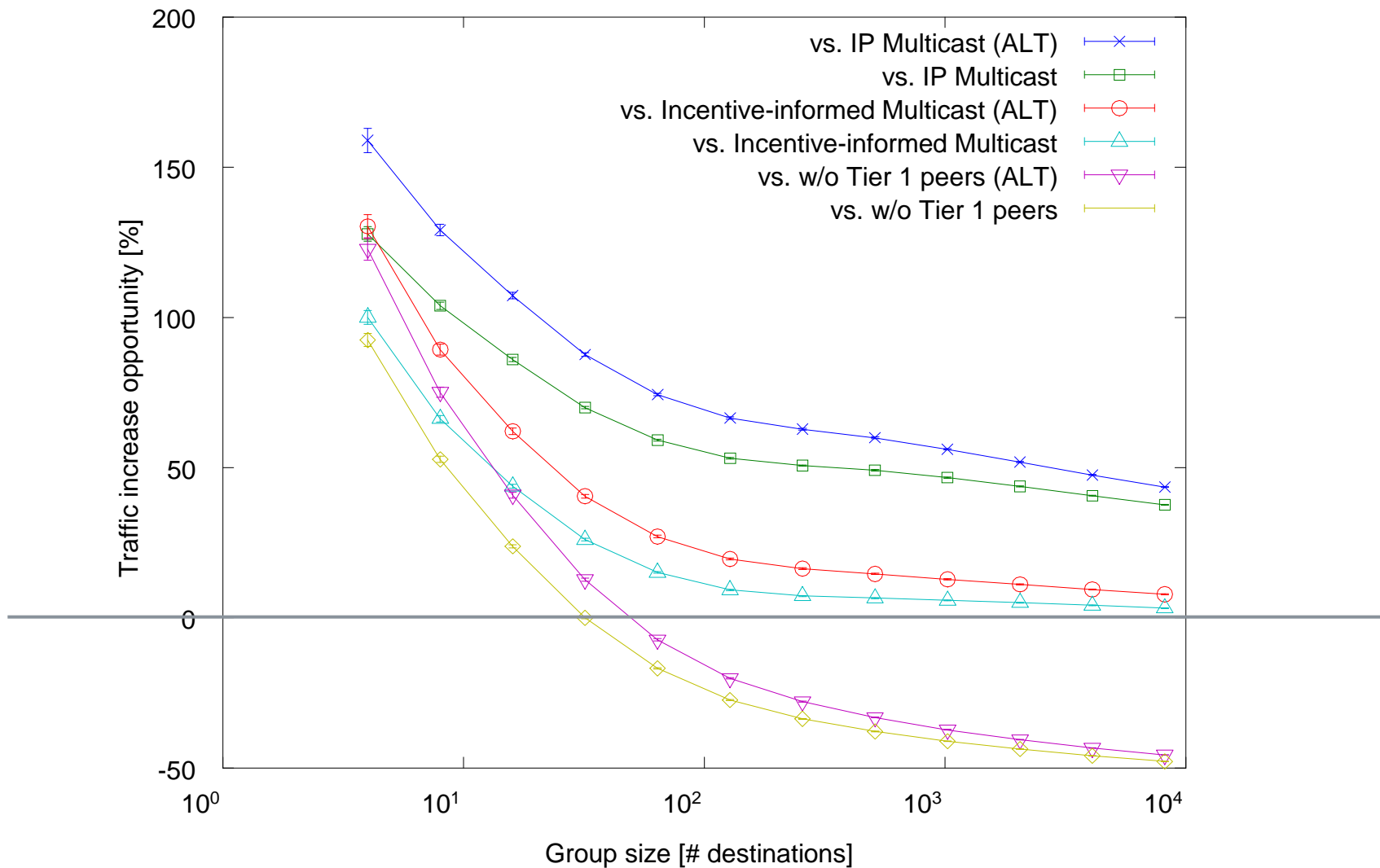
Tier-1 Detour Multicast Efficacy

(N = 2000, CI = 95%).



Tier-1 Detour Multicast Opportunity

(N = 2000, CI = 95%).



Conclusion

- Costs and benefits of multicast distribute unevenly along the inter-domain paths
 - Upstream domains lose customer revenue due to downstream multicast
 - Hop-by-hop operation starting from the destinations needed
 - Unicast delivery to by-pass non-participating domains
- Operation on local incentives in some cases very effective
 - Depends on the group size, peering policies
- Tier-1s could draw in some of the traffic lost to peering
 - Very effective for all group sizes
 - But not profitable in all cases

Bigger Questions

- Networking industry depends on traffic growth
 - What is the chance of standardizing anything that reduces network traffic levels?
- Is multicast needed?
 - A/synchronous use of content?
 - Feeding of content networks?
- What (classes of) applications will go non-invented w/o multicast?
 - We'd know, if multicast existed in practice...