Benefits of negotiated interdomain traffic engineering

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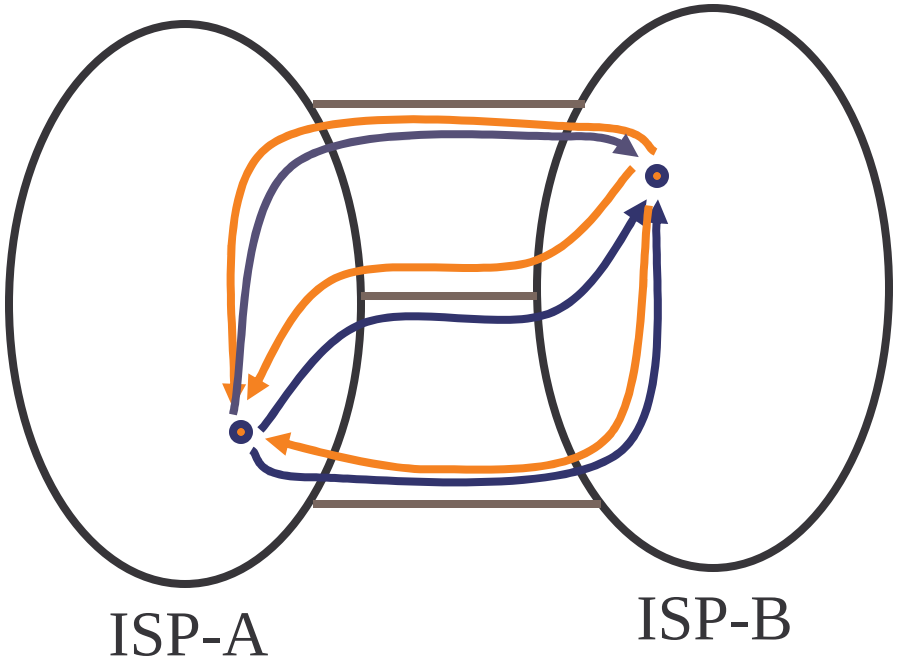
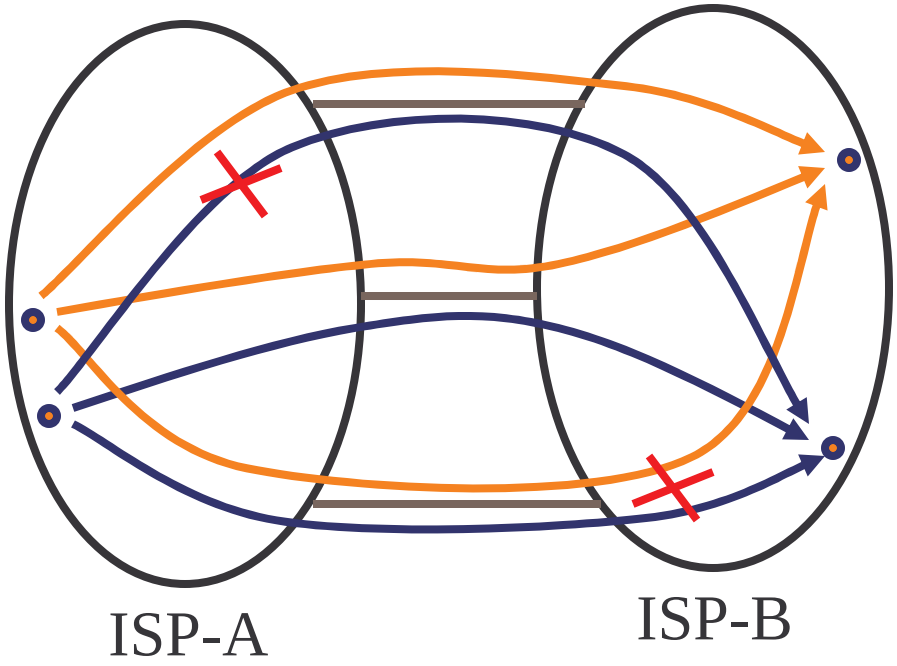
Problem

- Interdomain routing decisions are based on very little information about other networks
  - poor performance
  - instability, oscillations
  - tedious, error-prone management

Example of poor performance



Example of oscillation



Current methodology

- Whenever interdomain routing changes need to be made
  - tweak-n-pray
  - call ahead
  - determine a mutually agreeable set of routing changes

An alternative

- Automated negotiation
  - under real-world constraints
  - as good or better than manual negotiation
  - minimize manual firefighting
- We've looked at two-ISP negotiation so far
  - high-level methodology
  - evaluation of the potential benefit

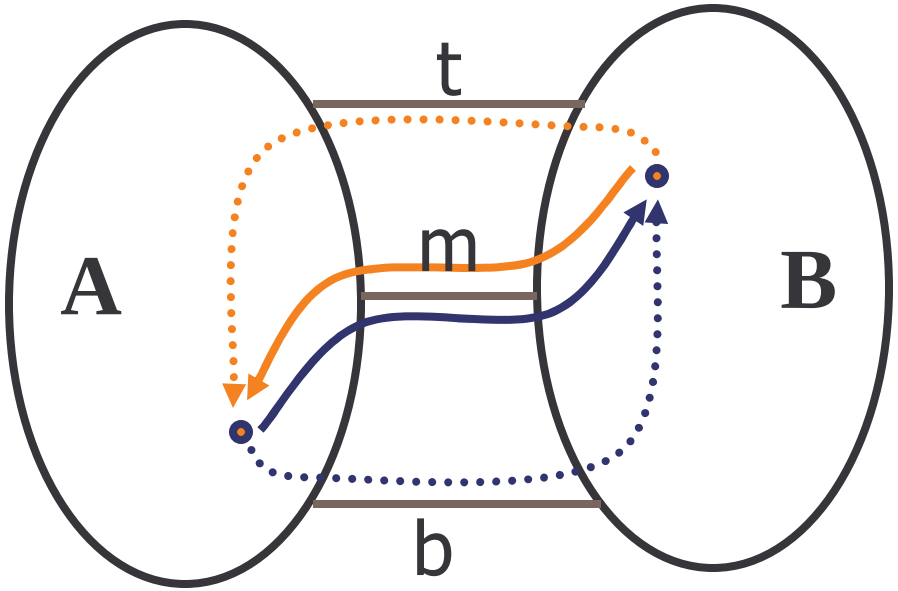
Constraints on inter-ISP negotiation

- Controlled information disclosure
  - ISPs are competing entities
- Support for different optimization criteria
  - different ISPs have different objectives
- Flexible outcomes
  - different ISP pairs have different relationships

Simplified negotiation methodology

1. Assign a numeric preference (like MEDs) to each routing option for each flow
   - each ISP uses its own criteria
2. Exchange preference lists
3. Take turns to propose routing options
   - find good compromises
   - reassign preferences if needed
4. Stop when one of the ISP wants to

Example of negotiation



- A and B negotiate for 2 flows

	Aà B	Bà A
t	(-6, 6)	(0, 0)
m	(-1, 4)	(4, -1)
b	(0, 0)	(6, -6)

- Trade small sacrifices for bigger gains such that both ISPs win

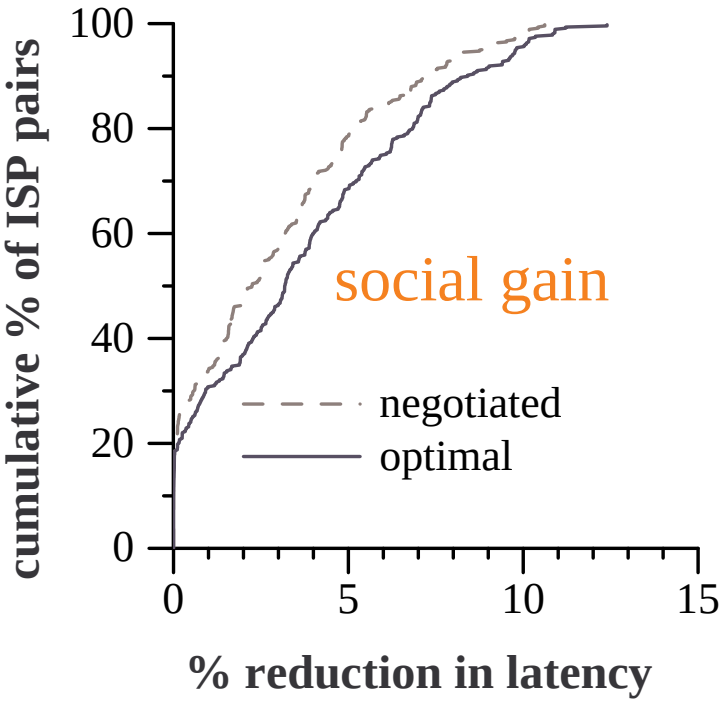
Evaluation

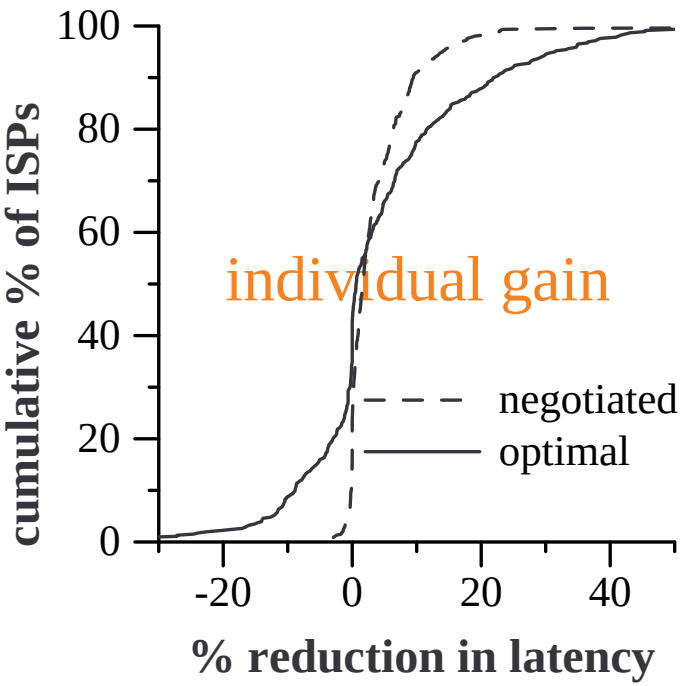
- Compare three routing methodologies
  1. default: early-exit, selfish
  2. optimal: globally best across the two ISPs
  3. negotiated
- Dataset: 65 measured PoP-level ISP topologies; synthetic traffic models
- Evaluate latency reduction and hotspot avoidance

Experiment 1: Latency reduction

- Higher latency
  - ⇒ poorer performance
  - ⇒ more resource usage ⇒ costlier
- Measure latency of traffic when routed using the three routing mechanisms
  - default, optimal, negotiated

Results: Latency reduction





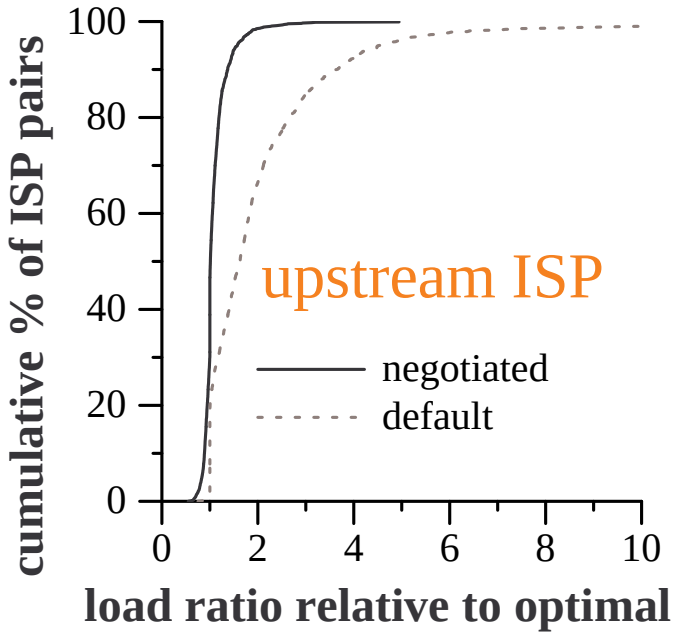
- Small latency reduction
  - Q: is this valuable?
- Individual ISPs can lose with the optimal
- Negotiation is win-win

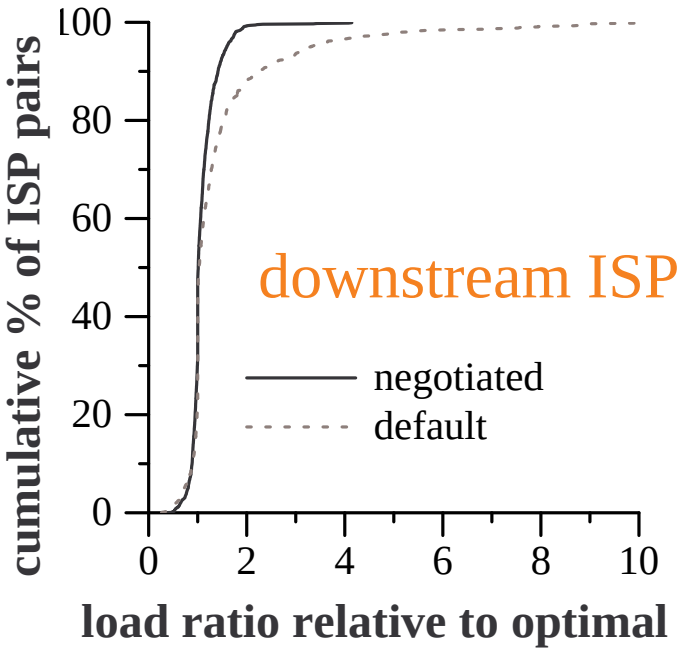
Experiment 2: Hotspot avoidance

- Sudden changes (failures, DoS attacks) can cause short-term overload
  - fighting these is a major time sink

1. Assume that a peering link failed
2. Reroute flows traversing the failed link
3. Measure the potential for overload using max multiplicative increase in link load

Results: Hotspot avoidance





- Default routing tends to overload certain links
- Negotiation reduces the possibility of hotspots
  - fewer problems for the operators to resolve

Summary

- Interdomain routing decisions are based largely on local information
  - poor performance, instability
  - tedious, error-prone management
- Automated negotiation can help
- Feedback:
  - would you use it to talk to your neighbors?
  - www.cs.washington.edu/research/networking/negotiation