Insertion of ISP-owned Peers (IoPs)

Cache capacity allocation strategies & Cost-benefit analysis

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Outline

- Our context
- Economic Traffic Management
- Insertion of ISP-owned Peers
- Swarm selection strategies
  - Simulation setup & results
- Economic view
  - Cost-benefit analysis

The Internet Ecosystem:
Current and Future

- Many players acting simultaneously …
  - Customers/Users
  - Providers
    - ISPs
    - Application providers
    - Over-the-top providers
    - Content providers
    - …

- … with conflicting interests → leading to ***tussles***

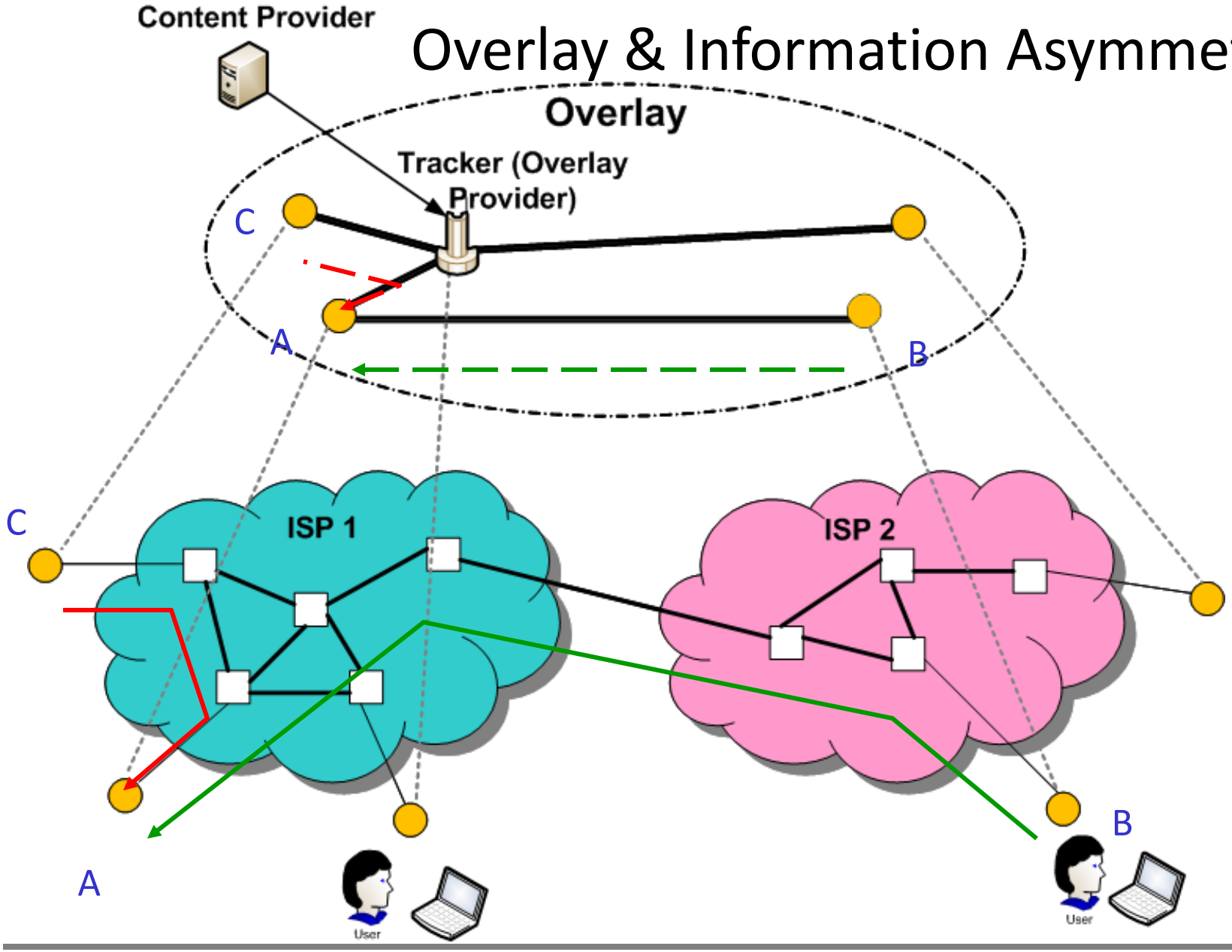
Overlays & Information Asymmetry

- Popular peer-to-peer (P2P) and other overlay applications; generate *significant* and *increasing* volumes of traffic

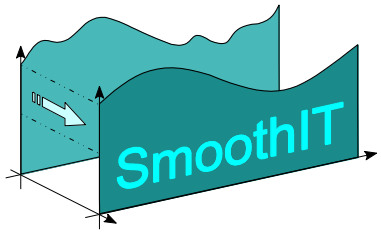
- ***Information asymmetry***
  - The underlay does *not* take into account the ovelay requirements
  - The overlay is built *independently* of the underlay network

- Conventional Traffic Engineering (TE) *not suitable* for overlay traffic, leads to traffic oscillations:
  - Higher costs for the ISP
  - Lower quality for application provider & users

Overlay & Information Asymmetry



Economic Traffic Management*



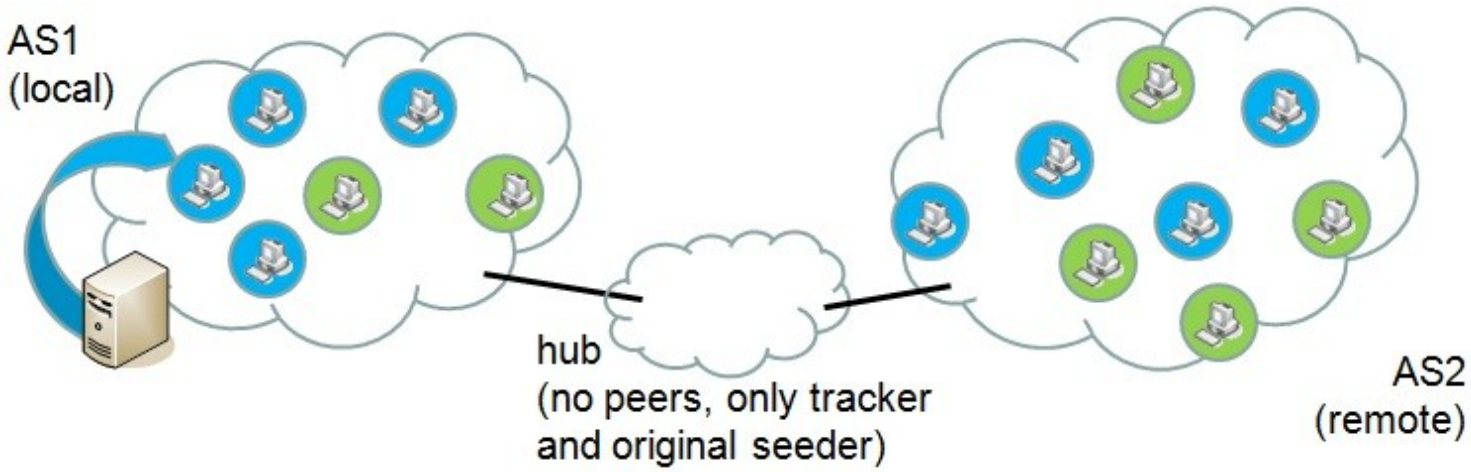
- Employs mechanisms based on the *incentives* of players

- Objective:
  - To bridge the information gap between overlay and underlay
  - To lead the system to a situation mutually beneficially for all: ISP, user, application provider →"***TripleWin***"

- ETM mechanisms deal with Information Asymmetry:
  - Alternative peer selection mechanisms based on proximity information
  - *Provision of extra resources e.g. offering caching in the overlay*

* The SmoothIT project: http://www.smoothit.org

ETM mechanism: Insertion of IoP(s)



- ISP-owned Peer:
  - Resourceful entity
  - Acts as an overlay peer
  - Controlled by the ISP
  - Transparent & non-interceptive cache
  - Exploits overlay self-organizing mechanisms
- Impact:
  - Significant improvement of peers' performance
  - Reduction of incoming traffic
- Innovation:
  - Transparency, no interception required
  - Variety of policies

Swarm Selection*

Question

- Which swarms should the IoP join to become more effective?

Study

- What is the impact of various overlay factor on inter-AS traffic and users‘ performance?

- How these influential factors can be combined?

* Cache Capacity Allocation to Overlay Swarms, I. Papafili, G.D.Stamoulis, F. Lehrieder, B. Kleine, S. Oechsner, 5th International Workshop on Self-Organizing Systems (IWSOS‘11), Karlsruhe, Gernamy, February 2011

Simulation setup (i)

Topology

- Simple 2-AS topology: AS1 & AS2
- IoP *always* inserted in AS1 serving *only* swarm A

Overlay factors

- File size (default value: 150 MB)
- Mean inter-arrival time (default: 100.0 s)
- Mean seeding time (default: 600.0 s)

Simulation scenarios	Single-wise investigation		
	A	***B***	***C***
Modified for Swarm A	File Size: 50 MB	meanIAT: 300.0 s	meanST: 200.0 s

Simulation setup (ii)

- Metrics of interest
  - Inter-AS traffic of AS1 incoming and/or outgoing
  - Peers' performance in terms of download time

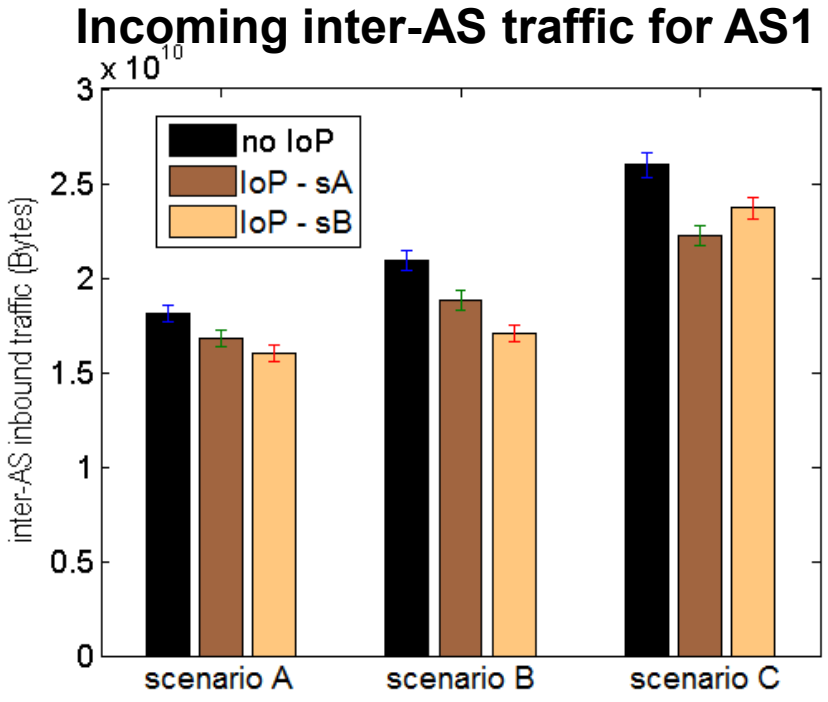
- Underlay
  - Homogeneous scenario
  - Peers' bandwidth: 16384/1024 kbps
  - Original seeder's bandwidth: 10240 kbps up
  - IoP's bandwidth: 51200 kbps up&down

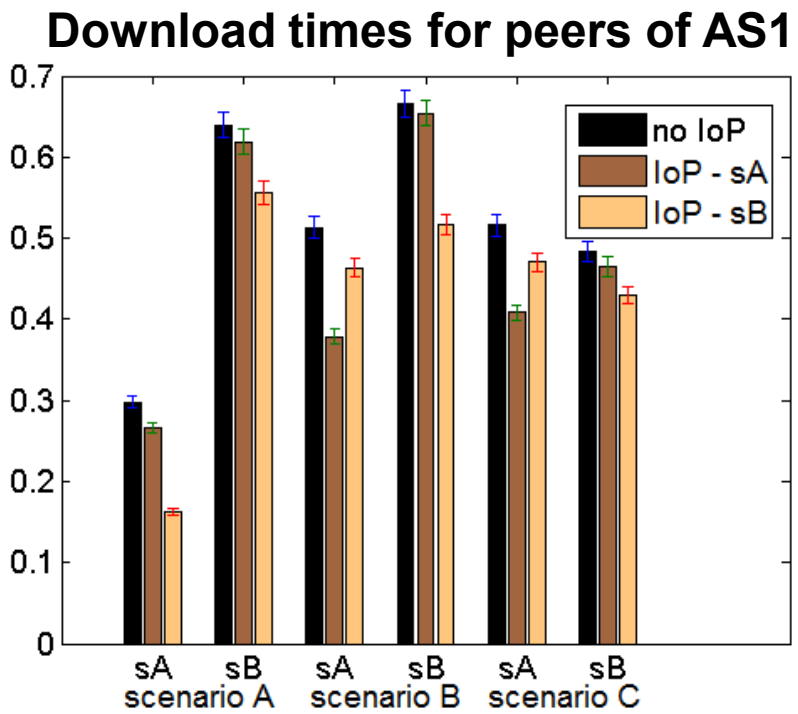
- SmoothIT-Simulator* for ProtoPeer** platform

* SmoothITSimulator v3.0, http://protopeer.epfl.ch/wiki/BitTorrent

** ProtoPeer, http://protopeer.epfl.ch/index.html

Single-wise investigation: scenarios A, B, C





- IoP's impact is more significant when it joins the swarm with higher capacity needs!
- However, the peers of the other swarm have also benefit

Cost-Benefit Analysis (CBA)

Objective

- Estimate whether the IoP insertion is beneficial for an ISP in monetary terms

* A Cost-Benefit Analysis for Economic Traffic Management, S. Soursos, D. Staehle, G.D. Stamoulis, 7th International Workshop on Advanced Internet Charging and QoS Technology, ICQT'11, Paris, France, October 2011 (submitted)

Assumptions and Projections

- Cost categories
  - Equipment
  - Installation
  - Operation
  - Maintenance

- … considering an average-size ISP

Assumptions and Projections

- Transit prices (*source: Dr. Peering*)
  - Contract between an ISP and its higher Tier
  - Transit unit prices follow a continuously decreasing trend
  - Use of the 95-th percentile metric as charging scheme
  - Calculations for a 4-year period

- Internet and Overlay Traffic (*source: Cisco*)
  - P2P percentage: 2-3% annual reduction
  - P2P absolute volume: 16% annual growth
  - Global Internet traffic volume: 34% annual growth

Methodology

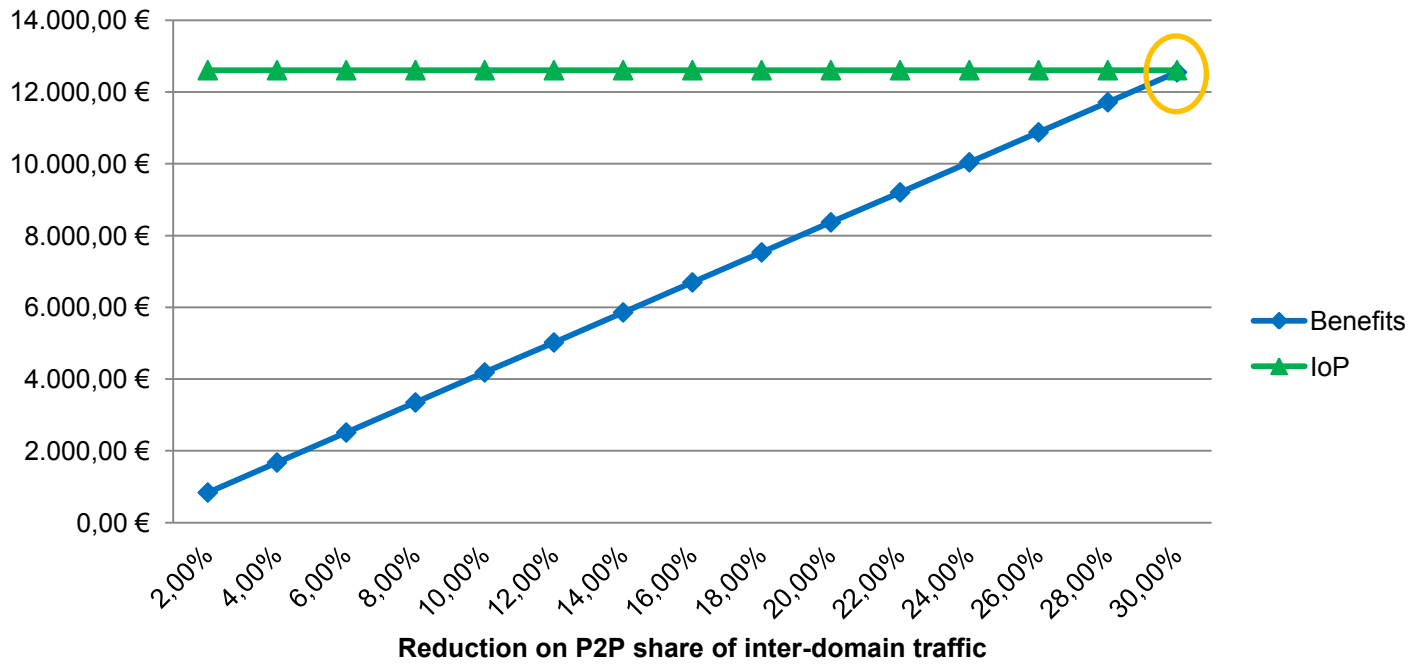
- Estimate monthly costs per machine
- Estimate number of machines required per year

- Decide on initial inter-domain link capacity (4Gbps)
- Decide on link utilization (75%)
- Estimate P2P share of inter-domain traffic
- Calculate savings (in Mbps)
  - Per given reduction of P2P traffic

- Estimate break-even points

*Costs and link capacity evolution are considered over 4 years (2011-2014)

Total costs (2011-2014)



- Worst case: IoP joins all swarms → higher IoP costs
- Break-even point: 30% traffic reduction

Summary

Swarm Selection

- Considerable impact of all three factors on ISP's inter-domain traffic and users' QoE
- Next step: Definition of one rule to combine all factors an to perform both swarm selection and IoP's bandwidth allocation among the selected swarms

Cost-Benefit Analysis

- IoP is able to achieve reduction of inter-domain traffic so as to meet the break-even requirements

Thank you for your attention!

Questions?