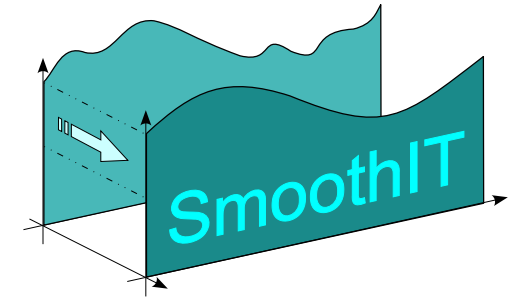


*Simple Economic Management Approaches of
Overlay Traffic in Heterogeneous Internet Topologies*



European Seventh Framework STREP FP7-2007-ICT-216259

Improving User's Quality of Experience for Overlay Applications

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2nd Japan Symposium on the Future Internet - Tokyo - October 13-14, 2009



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Measurements of P2P-based Streaming

- ❑ Test PC in Würzburg: mainly connections to peers in Europe
- ❑ P2P downloads video from peers world-wide and resembles video stream out of received pieces: **multi source download**



Why is ETM suitable for P2P?

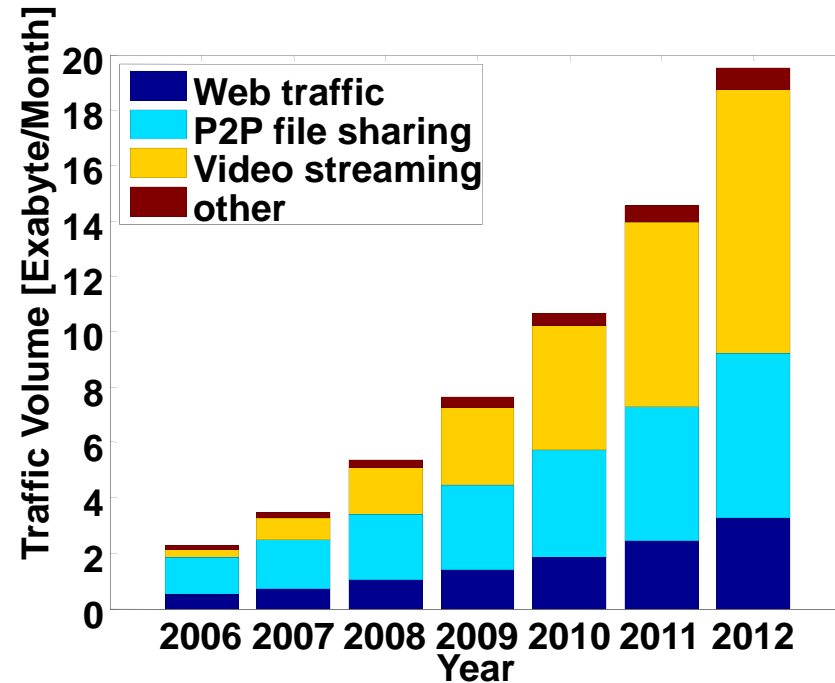
- Conventional traffic management not sufficient
 - peers are “wildly” connected in overlay → e2e links over several domains, independent of underlay network → different providers of sub-networks → **e2e-TM** difficult
 - many connections to provide one service, e.g. multi-source download for video streaming → **QoE** is composed of QoS of individual flows
 - **dynamics** of P2P systems, changing network topologies
- **Economic traffic management (ETM)**

- provide incentives for TripleWin
- overcomes information asymmetry
- traffic optimized inherently



Improving User's QoE via ETM

- Dominant applications in the Internet
 - P2P file sharing
 - video streaming



Source: Cisco Visual Networking Index – Forecast and Methodology, 2007–2012

- Quality of Experience (QoE): overall quality as perceived by the end user of an application
 - Download times for file sharing
 - Stalling times / video degradation for P2P streaming

Agenda

- BGP-based locality mechanism
- IoP caching mechanism
- Potential of ETM: QoE for video streaming

BGP-based Locality Mechanism

□ ISP

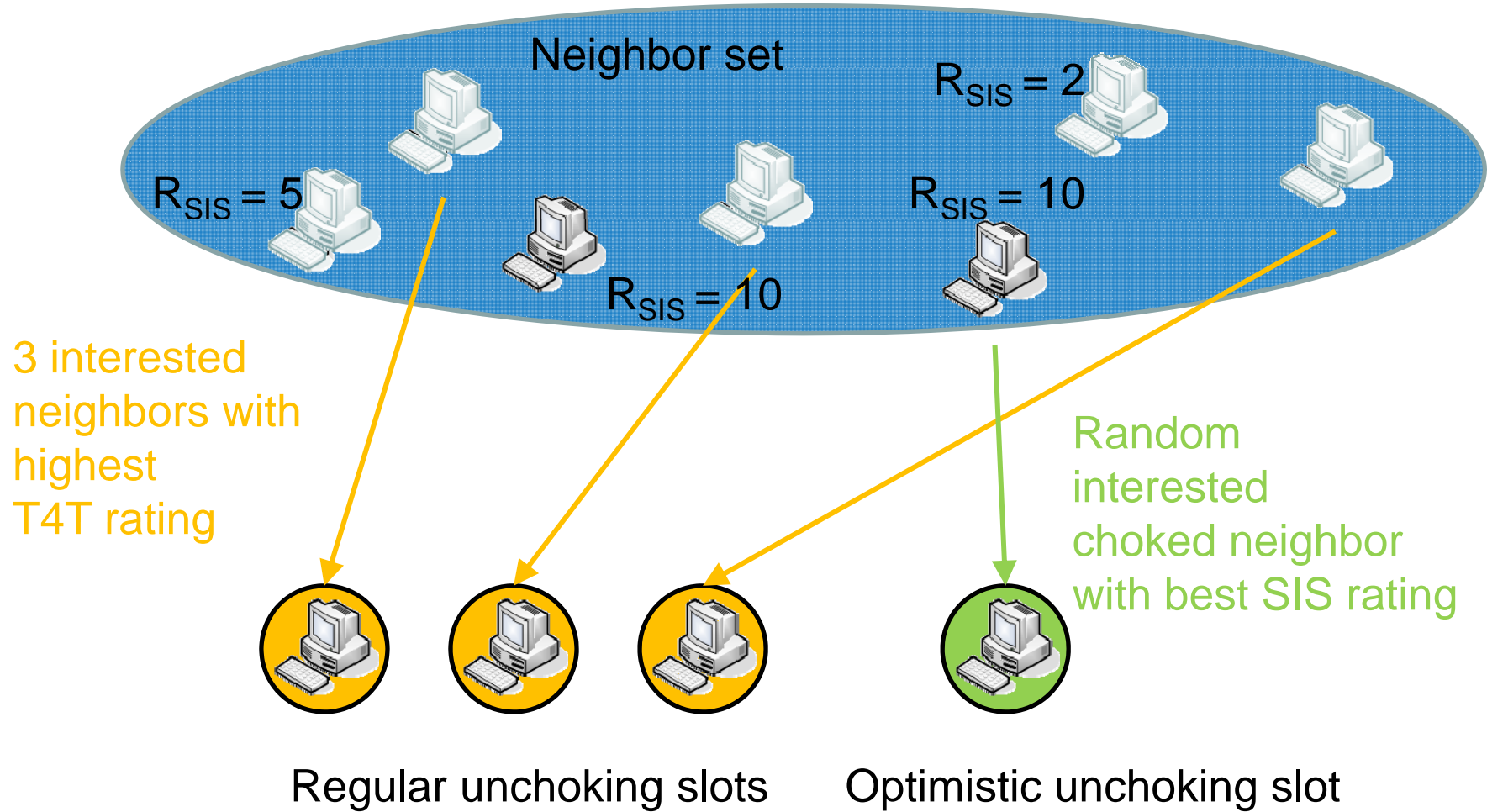
- provides information about “near” peers
- inter-domain traffic can be reduced → saves money
- information has to be provided, e.g. SIS network element → costs money

□ User / application

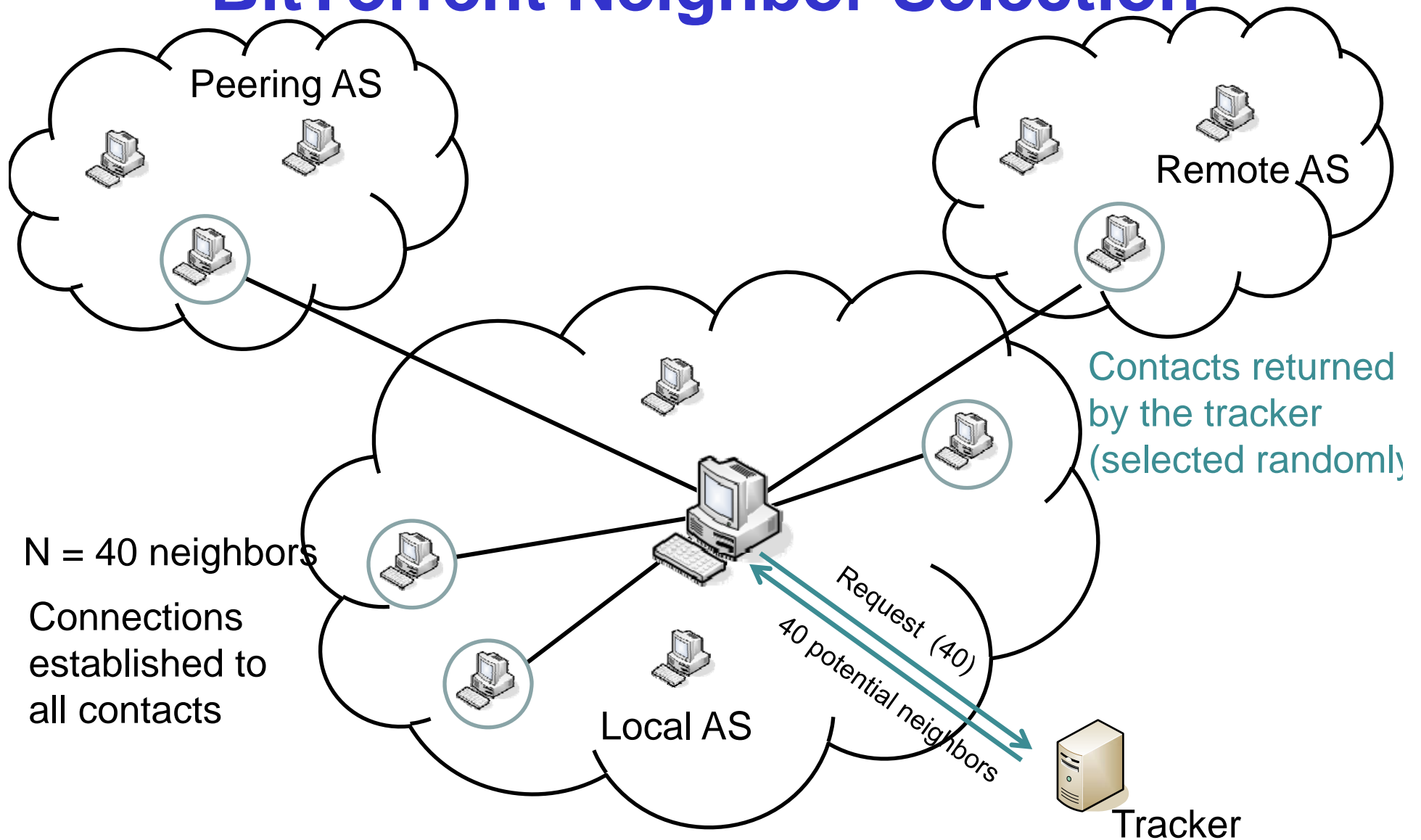
- Client selects “near” peers
- Downloading from “near” peers may overcome bottlenecks → throughput improved

S. Oechsner, F. Lehrieder, T. Hoßfeld, F. Metzger, K. Pussep, D. Staehle, Pushing the Performance of Biased Neighbor Selection through Biased Unchoking, 9th Int. Conf. on Peer-to-Peer Computing, Seattle, USA, Sep 2009.

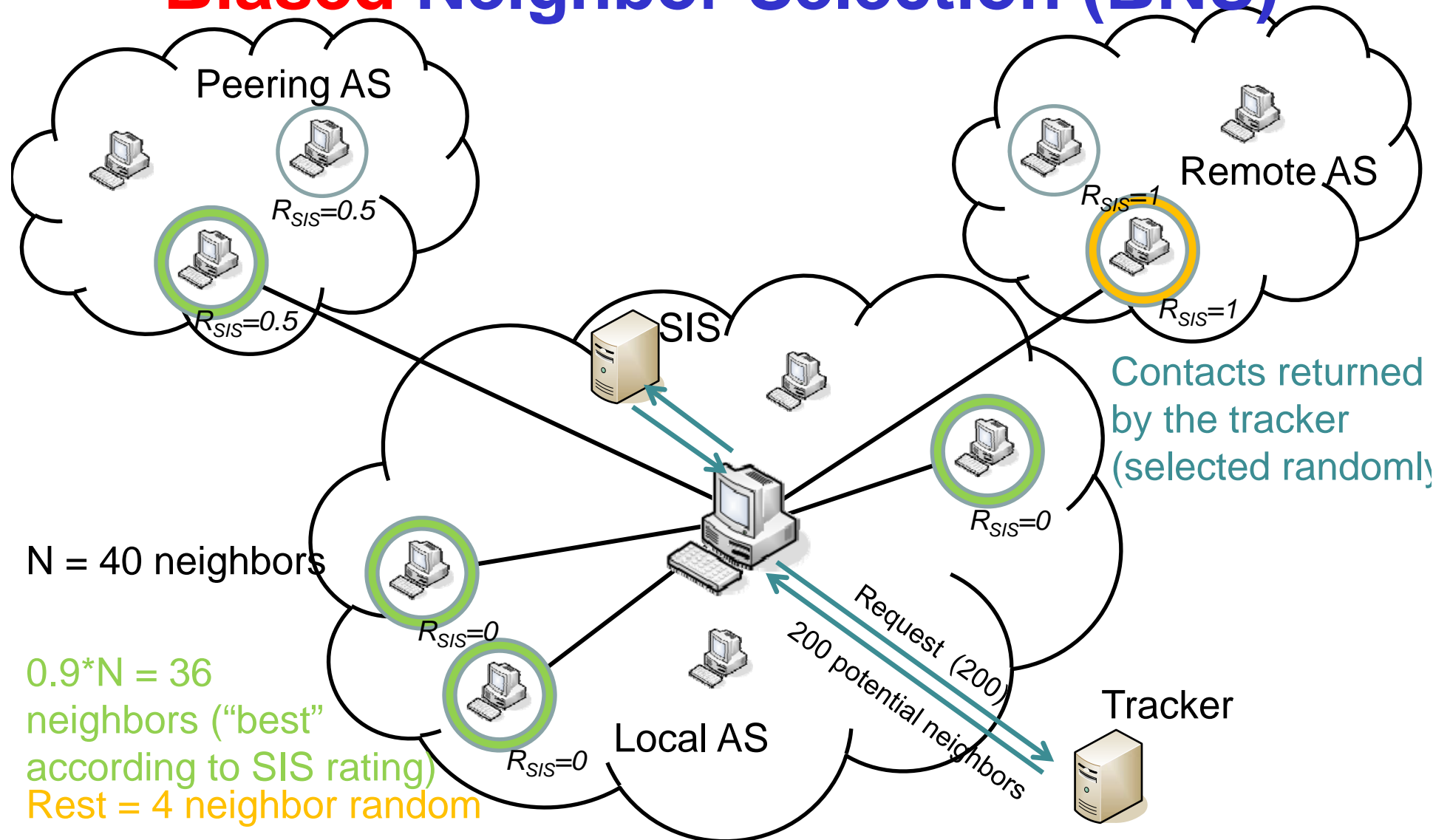
Biased Unchoking



BitTorrent Neighbor Selection



Biased Neighbor Selection (BNS)

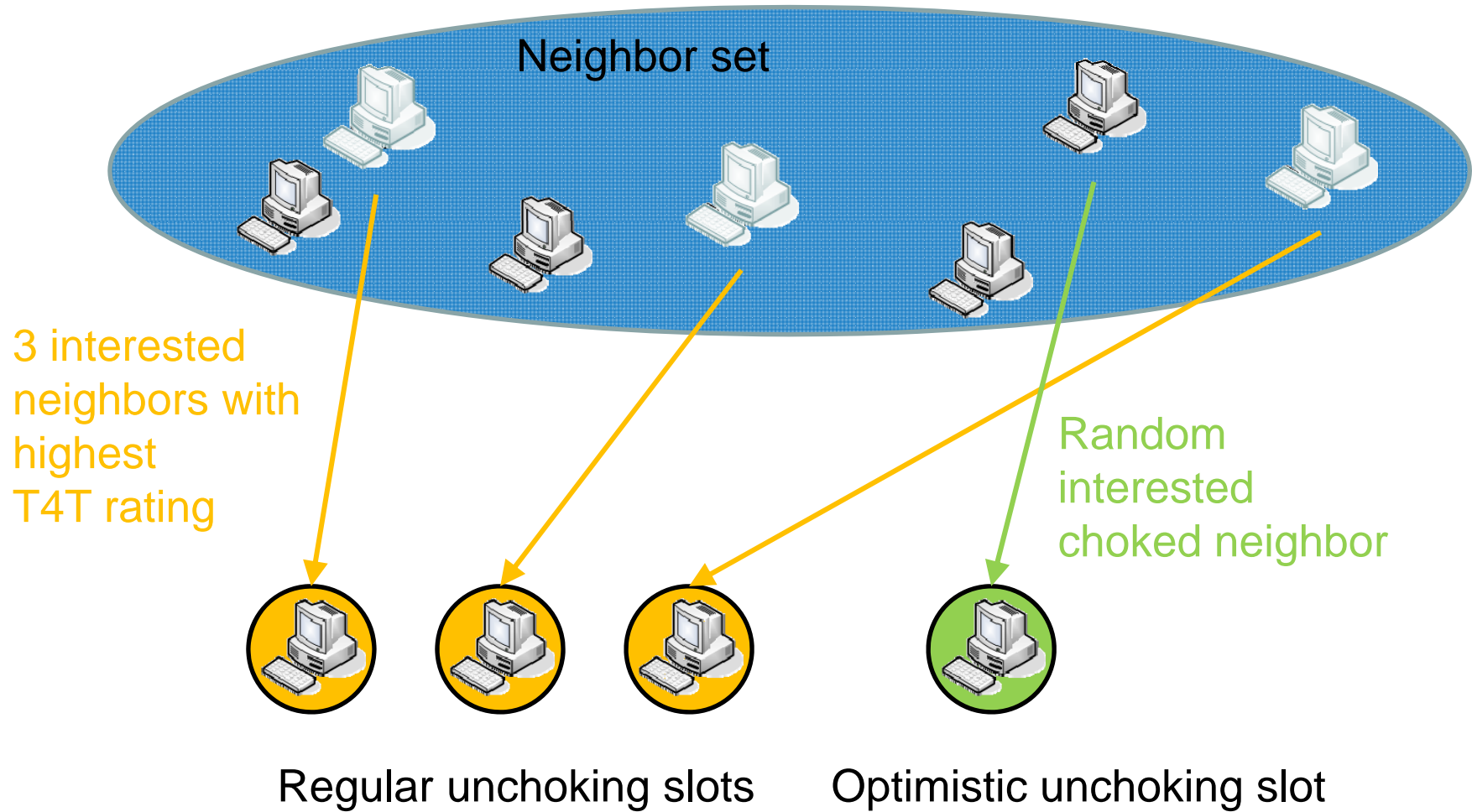


N = 40 neighbors

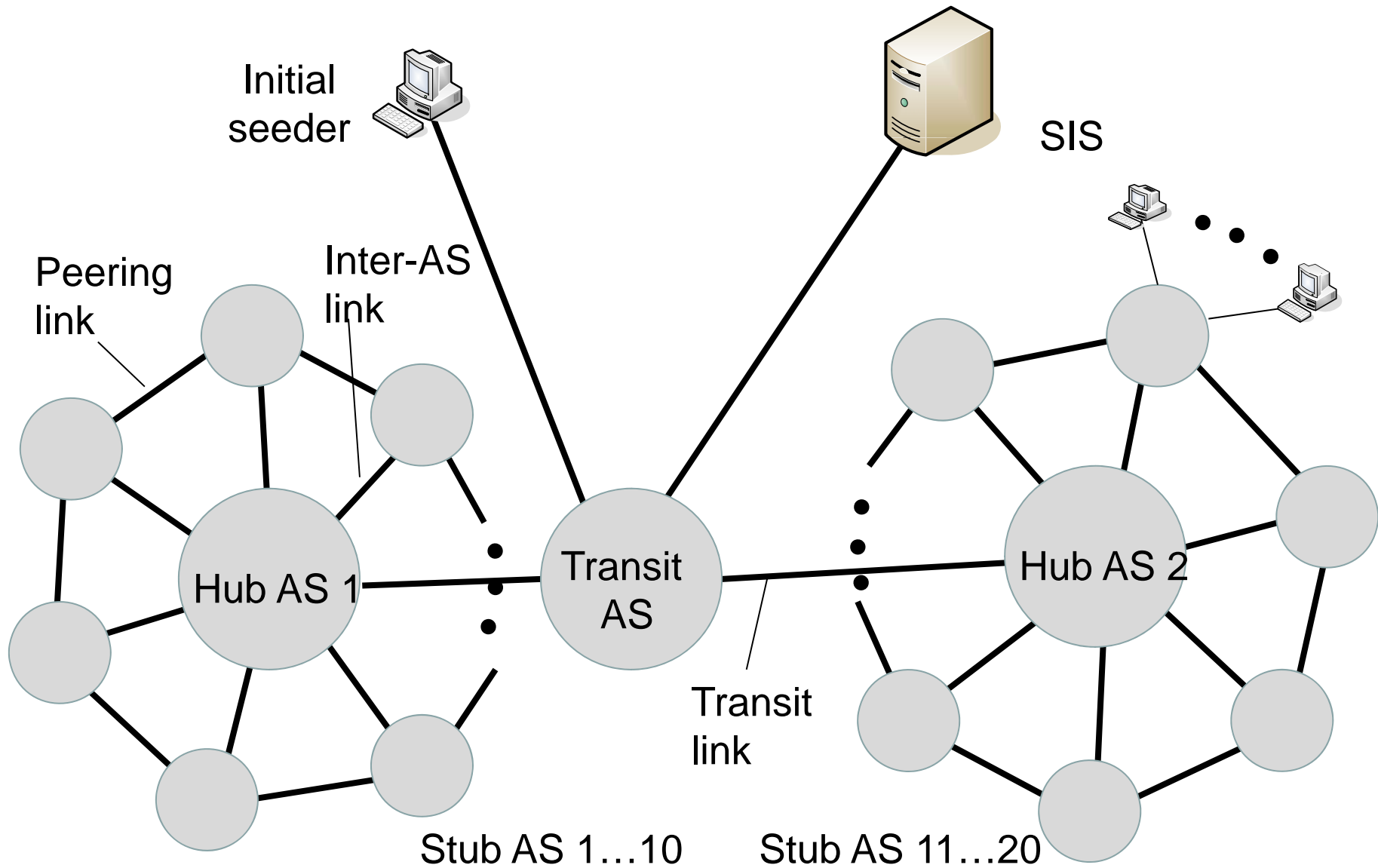
0.9*N = 36
neighbors ("best"
according to SIS rating)
Rest = 4 neighbor random

Very similar to proposal by Bindal et al. (ICDCS'06), P4P, ...

BitTorrent Unchoking



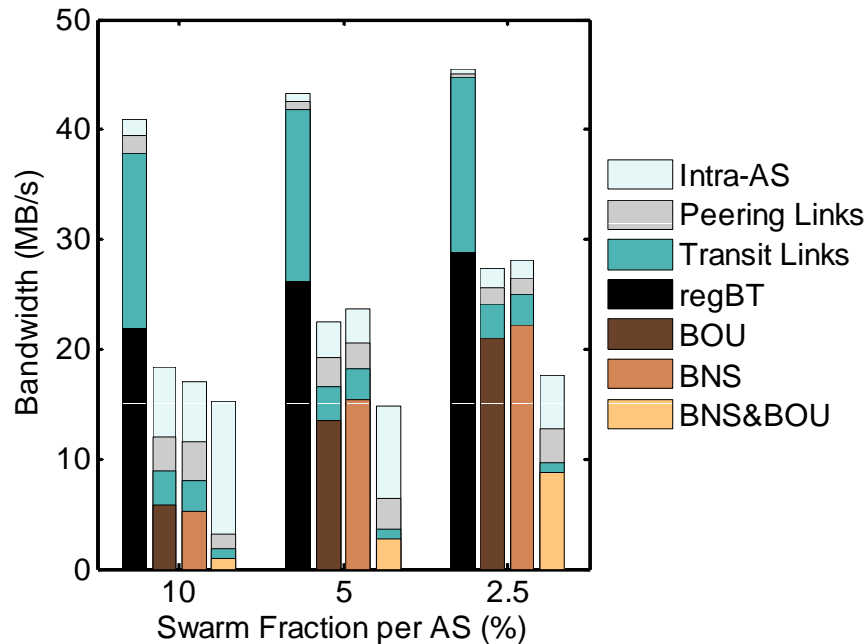
Simulated Network Topology



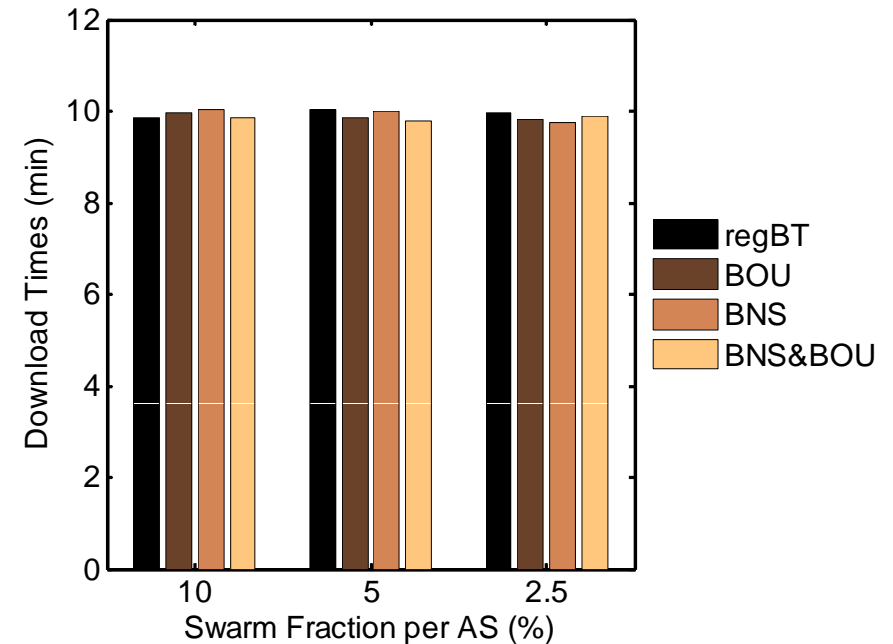
Experiment 1: Swarm Distribution

- ❑ Swarm distribution: fraction of peers per AS
- ❑ Influenced by the number of ASes
- ⇒ More peers per AS make locality more effective

Used inter-AS bandwidth



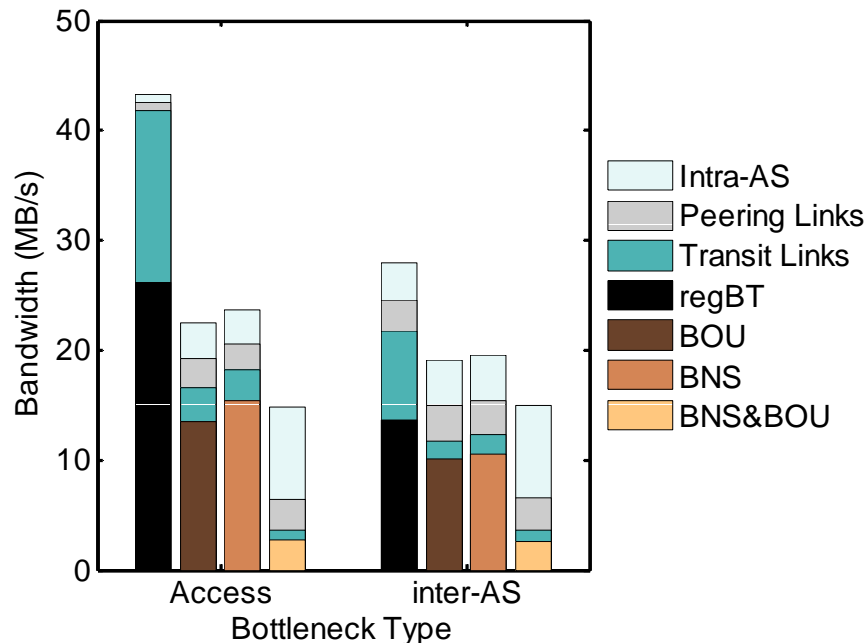
Download times



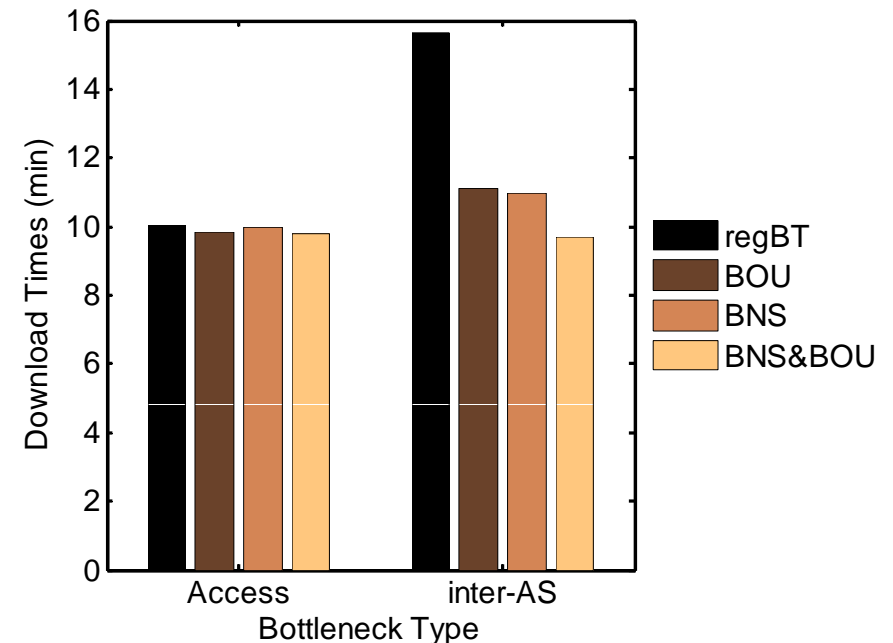
Experiment 2: Inter-AS Bottleneck

- Bandwidth limit on inter-AS link, exception transit
- ⇒ Reduced inter-AS bandwidth
- ⇒ Download times are much shorter with locality

Used inter-AS bandwidth



Download times



IoP Caching Mechanism

□ ISP

- installes caching element (IoP) → costs money
- inter-domain traffic can be reduced → saves money
- Increased upload capacity, but cache only uploads to local peers → better overlay performance

□ User / application

- Client additionally downloads from cache → throughput improved

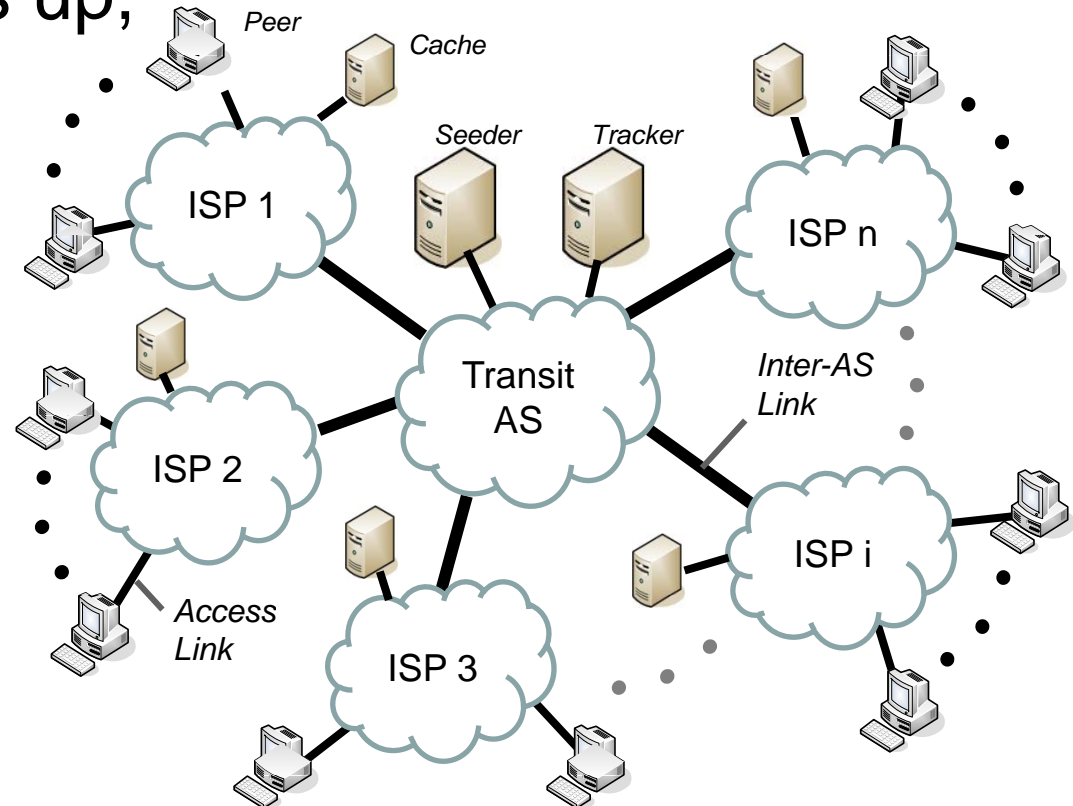
ISPeer project



Frank Lehrieder, György Dán, Tobias Hoßfeld, Simon Oechsner, Vlad Singeorzan, A Fluid Model of ISP Managed Caches for BitTorrent-Like Peer-to-Peer Systems, under review

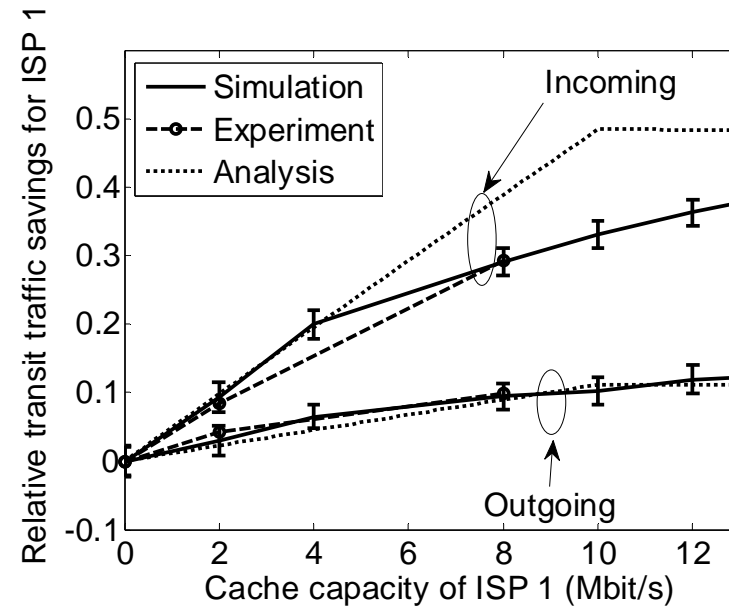
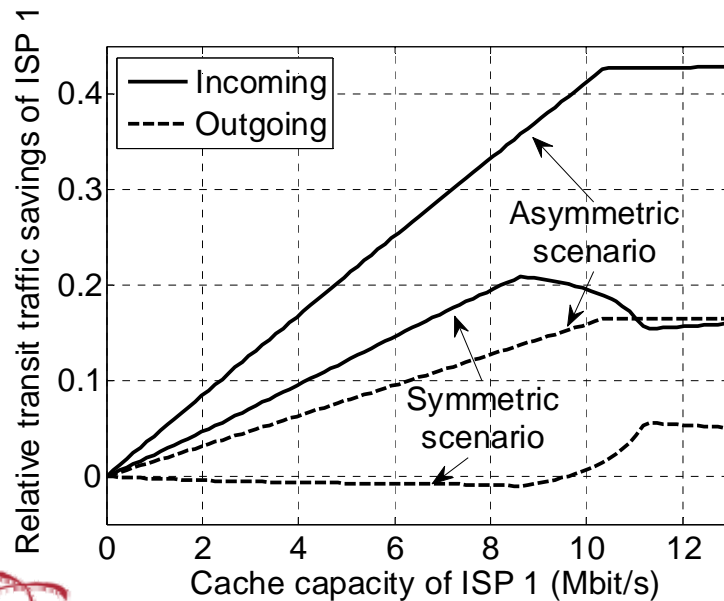
System Description

- Peers and caches located in n ISPs
- No inter-domain bottlenecks
- Access links: 1 Mbit/s up, 16 Mbit/s down
- Arrival- and departure process,
- “Patience” of peers
- Cache
 - Upload only to local peers
 - Upload capacity k_i



Impact on Inter-Domain Traffic

- Measurements in experimental facility
- Scenarios
 - Symmetric: 50% of the swarm in ISP 1, 50% in ISP 2
 - Asymmetric: 9% of the swarm in ISP 1, 91% in ISP 2



Analytical results

Validation



Potential of ETM: QoE for Streaming

- For multimedia applications, QoE is more complex
- Understanding of QoE and its impairment factors leads to appropriate ETM design
- ETM helps to improve QoE, e.g. gathering relevant information

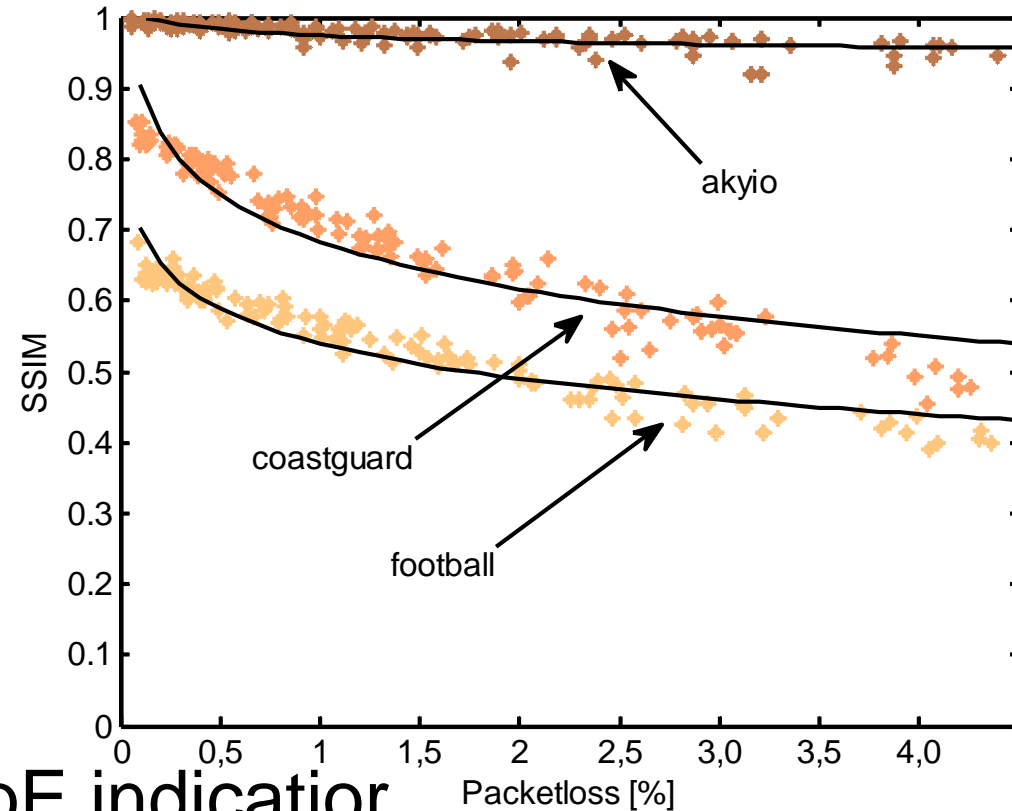


Thomas Zinner, Tobias Hoßfeld, Controlling QoE of Scalable Video Codecs for Future Video Streaming, QoE Workshop (Euro-NF), Paris, Sep. 2009

Influence of Content Type

- Content type
 - Akiyo: low motion
 - Coastguard: medium motion
 - Football: high motion

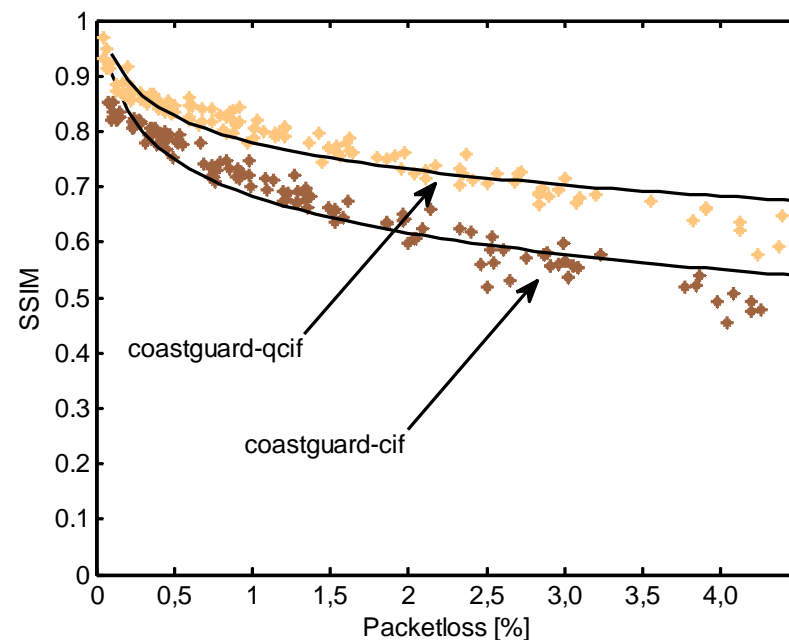
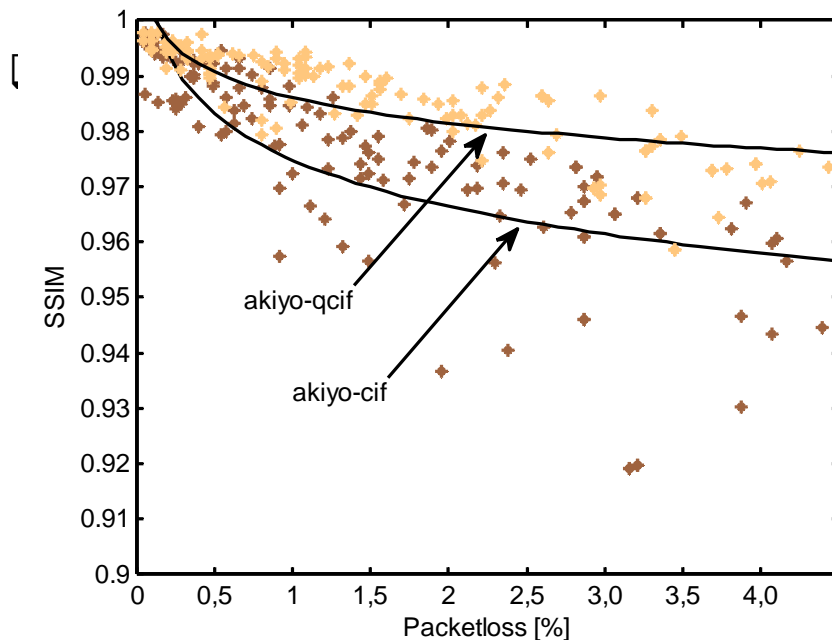
- CIF-Resolution
(344*288)



- SSIM as objective QoE indicator
- Dependence on packet loss
- Strong influence of the content type

Influence of Resolution

- Comparison of CIF and QCIF resolution for Akiyo and Coastguard



→ Strong influence of content and resolution

→ **ETM can utilize information to improve QoE**

Conclusions

- ❑ User's QoE can be improved by means of Economic Traffic Management

- ❑ Evaluation of SmoothIT ETM approaches shows benefits in case of
 - BitTorrent file sharing
 - P2P-based video streaming (*not shown in presentation*)

- ❑ ETM is innovative and robust concept which allows
 - for optimized traffic and for highly sophisticated QoE improvement
 - for future applications and services

Special Thanks to

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Thomas Zinner



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University of Zurich
Department of Informatics

