Simple Economic Management Approaches of Overlay Traffic in Heterogeneous Internet Topologies

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SmoothIT Overlay Management Architecture

UZH, DoCoMo, TUD, AUEB, PrimeTel, AGH, ICOM, UniWue, TID

Peter Racz, UZH

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- Summary
Motivation

- P2P applications and traffic
  - Significant and increasing amount of P2P traffic
  - Suboptimal peer selection due to information asymmetry
    - Underlay topology, incl. routing metrics and values, unknown to overlay
    - Overlay requirements, incl. traffic characteristics, unknown to underlay

- Consequence
  - Non-optimized overlay traffic in the underlay
    - Higher costs in underlay
    - Lower QoS in overlay
  - Conventional traffic management techniques not suitable

- Goal of the SmoothIT project
  - Bridge overlay with underlay
  - Apply Economic Traffic Management (ETM)
  - Optimize traffic and achieve win-win situation for all parties
Example: Locality-unaware Overlay

Candidates: 1, 2, … 9
List of Peers: 4, 5, 7, 9
Example: Locality-aware Overlay

Candidates: 1, 2, ..., 9
List of Peers: 1, 2, 3, 4

SIS: SmoothIT Information Service
SmoothIT Objectives

- **Structure Internet-based overlay networks** to be efficient and optimal for users, overlay providers, and ISPs leading to the “win-win-win” (triple win) situation
  - Investigate, design, and apply specialized economic theory for decentralized network-efficient Internet-based overlay services in multi-domain scenarios, including wireless access
  - Develop an optimized incentive-driven signaling approach for defining (theory) and delivering (technology) economic signals in support of cooperating and competing providers

- **Operator-orientation**: demonstrating key results through a strong focus on ISP and telecom requirements (e.g., NN)
- **Implementation-orientation**: design, prototype, and validate the networking infrastructure (real-life test-bed)
Triple Win in Detail

- Management of **overlay networks** based on a collaboration between the overlay provider and the network (underlay) provider in support of the user (information is the key)
  - Cost and investment recovery for operators

- Incentives for **operators**
  - Reduce overlay traffic and inter-domain traffic, reduce costs
  - Keep overlay services (boost flat rate tariffs; keep customers)
  - Avoid to be on an overlay block list and “make money” with transport
    [http://www.azureuswiki.com/index.php/Bad_ISPs](http://www.azureuswiki.com/index.php/Bad_ISPs)

- Incentives for **overlay providers**
  - Active role in traffic management increases service quality
  - Increased user base due to better performing services

- Incentives for **user**
  - Increased service quality, *e.g.*, in terms of reliability, RTT, bandwidth
Solution Concepts

- **Agreements** between overlay provider and operator
  - *E.g.*, active caching: the operator provides explicit local caches for overlay content

- **Locality promotion**
  - Operator provides information about how to achieve best quality in overlay, *e.g.*, operator prioritizes alternative peer interconnections

- **QoS/QoE differentiation** *(application-awareness)*
  - Operator knows overlay application traffic (labels, deep packet inspection) and applies application-aware traffic management
Key Requirements

- Incentive-compatibility and traffic optimization
  - Provide incentives for all parties to achieve triple win
- Support of different overlay applications over a common interface
- Interface supporting various optimization schemes
  - E.g., different kinds of applications, high throughput, low delay, free/premium service
- Inter-domain support
- QoS support for network services
- Mobile network support
  - Node mobility, shared medium, heterogeneity of node and link capacities
- Easy deployment
  - In overlay applications and in ISPs’ networks
- Extensibility
  - New applications, new metrics
- Scalability, efficiency, and robustness
- Security
- Standard compliance
SmoothIT Information Service (SIS)

- Deployment of SIS components in the ISPs’ network
  - To convey information between overlay and underlay
- Client-Server architecture
- Overlay applications interact with SIS in order to select „better“ peers
  - Reducing costs of ISPs
  - Improving QoE of users
SIS Architecture

- **SIS**
  - Contains ETM logic
  - Aggregates information and calculates preference values

- **Metering**
  - Collects information from the network, e.g., BGP routing, topology

- **QoS Manager**
  - Performs QoS provisioning
  - Support of QoE schemes

- **Security**
  - Authentication and authorization

- **Config DB**
  - Stores various information about the network, e.g., topology, capacity
SIS Protocol

- Between SIS and overlay appl.
- Stateless request-response interaction scheme
- Application-independent
- Basic preference information service
  - Request: list of identifiers/peers (IP addresses)
  - Reply: list with preference values
- Optional further parameters
  - Per message or per parameter e.g., application type, desired QoS, capacity, locality, pricing information, peer availability
Possible Implementation

- Protocol selection criteria
  - Platform independence
  - Language independence
  - Standard compliance
  - Maturity and stability
  - Availability of parser libraries in different languages
  - Simplicity, ease of use for overlay applications
  - Efficiency, low protocol overhead
  - Human-readability
  - Formal and verifiable definition of message format

- Candidates
  - Web Service (SOAP + XML)
  - REST
  - JSON
  - YAML
  - Google protocol buffers
  - HTTP-based custom protocol
Summary

- Management of overlay traffic is necessary
  - Large amount of traffic
  - High costs for ISPs

- SmoothIT Information Service
  - Deployed in the network of ISPs
  - Provide information to overlay applications
  - Optimize traffic and achieve win-win situation
Thank you for your attention!

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