

Economic Traffic Management (ETM): Scenarios and Architecture Design

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The project consortium.

October 2008



Outline

- Motivation and Example Scenario
- Requirements
- Self-organization and ETM
- Incentives to Participate in ETM
- SmoothIT Architecture Design
- Summary

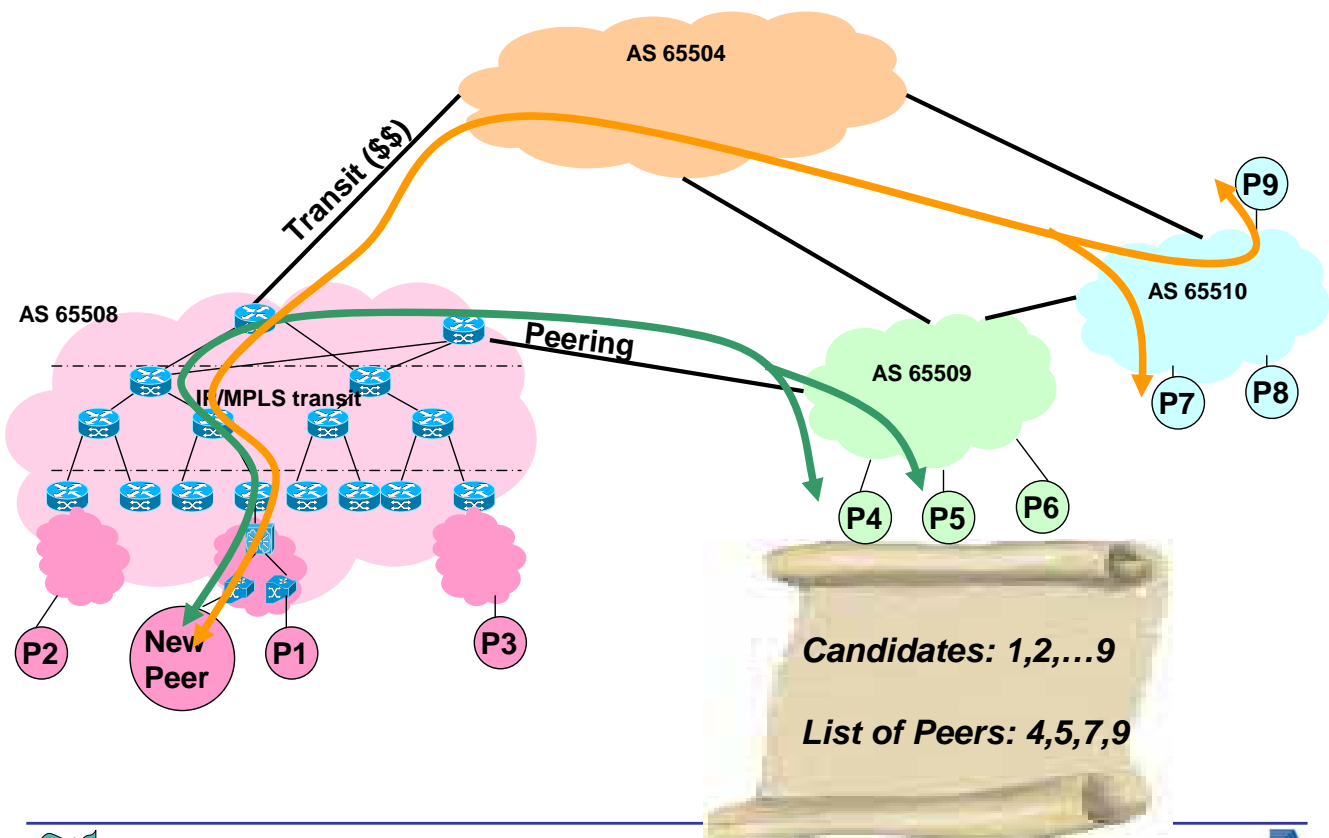


Motivation

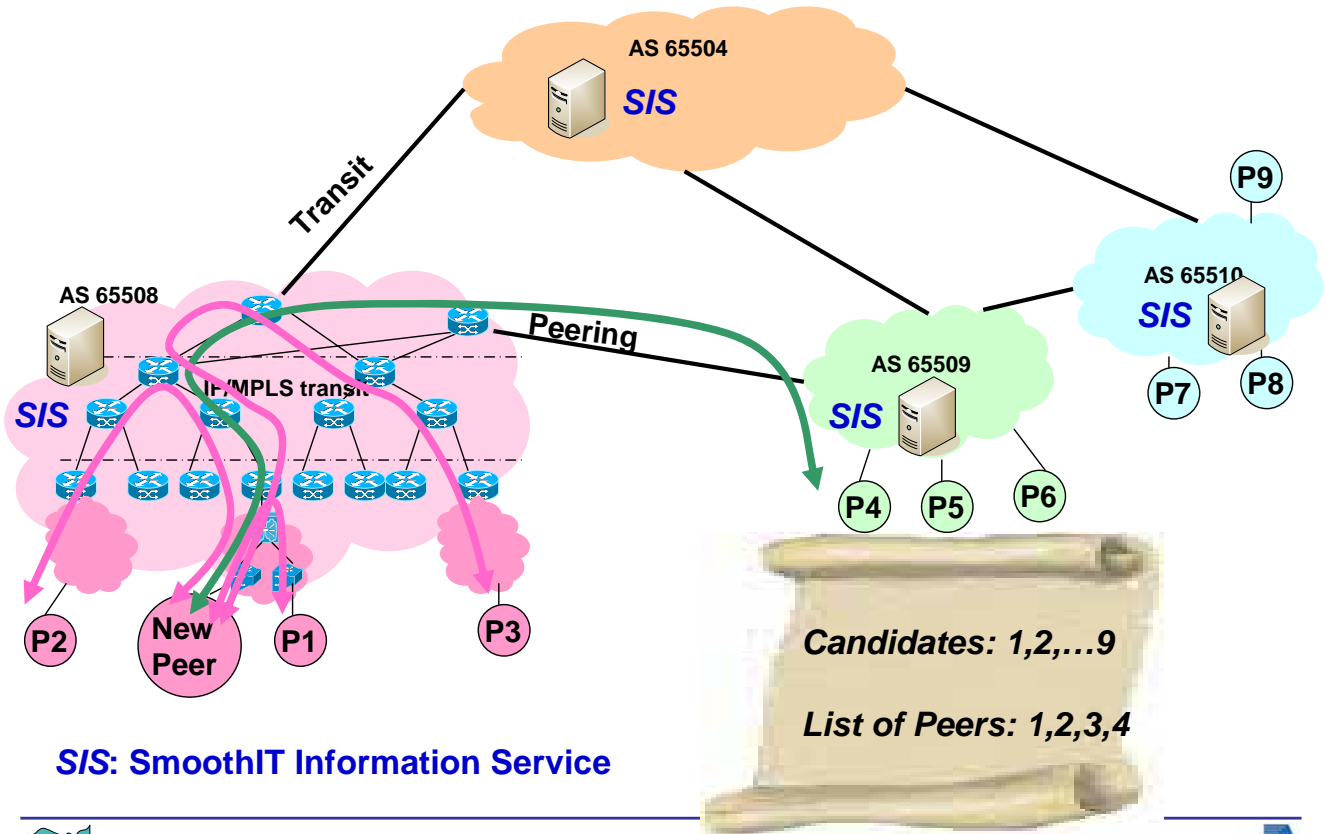
- P2P applications and traffic
 - Significant and increasing amount of P2P traffic
 - Suboptimal peer selection due to information asymmetry
 - Underlay topology, incl. routing metrics and values, unknown to overlay
 - Overlay requirements, incl. traffic characteristics, unknown to underlay
- Consequence
 - Non-optimized overlay traffic in the underlay
 - Higher costs in (a) underlay
 - Lower QoS in (b) overlay and for (c) application providers
 - 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-win situation for all parties



Example: Locality-unaware Overlay



Example: Locality-aware Overlay



Requirements Analysis

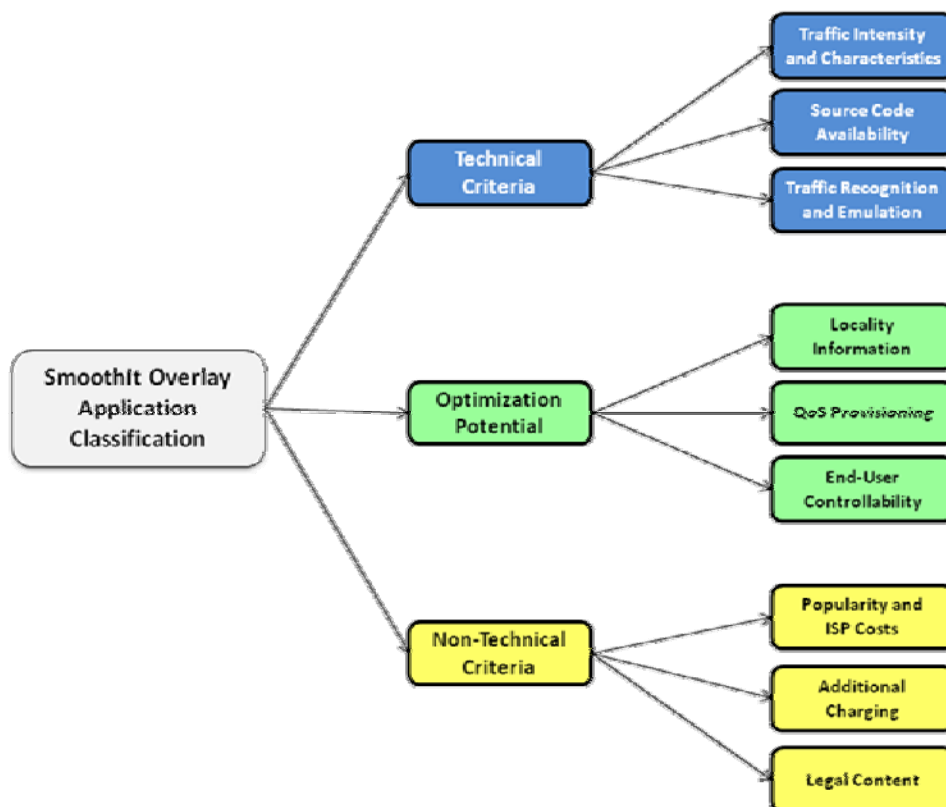


Requirements

- SmoothIT provided an overview
 - on overlay applications describing their features and traffic characteristics
 - on technical, economic, and functional aspects of overlay applications within SmoothIT
- SmoothIT identified high-level requirements for the SmoothIT architecture based on **technical** and **economic** discussions
- SmoothIT classified overlay applications
- SmoothIT selected overlay application to be implemented for internal trial



Classification Criteria



Classification: Overlay Application Services

	source code availability	traffic intensity	traffic recognition	end-user controllability	utilization of QoS	utilization of locality	popularity	legal contents	ISP costs	additional charging	opportunities	overall
Year 2008												
File sharing	4	5	3	5	2	5	5	2	5	1	5	42
P2P VoD	2	3	3	2	4	5	3	4	3	3	3	35
P2P Live TV	2	3	3	2	5	5	3	5	3	3	2	36
P2P VoIP	1	2	3	1	4	1	5	5	1	1	1	25
P2P Gaming	1	1	3	1	1	1	1	1	1	5	1	17
CDN	1	4	5	1	4	4	5	3	3	2	1	33
Year 2010												
File sharing	4	5	3	5	2	5	5	2	5	1	5	42
P2P VoD	4	4	3	3	4	5	4	4	4	3	4	42
P2P Live TV	4	5	3	3	5	5	5	5	5	3	4	47
P2P VoIP	1	2	3	1	4	1	5	5	1	1	1	25
P2P Gaming	2	3	3	2	4	2	3	5	3	5	2	34
CDN	1	4	5	1	4	4	5	3	3	2	1	33
<i>Weights</i>	1	1	1	1	1	1	1	1	1	1	1	
	technical criteria			optimization			non-technical criteria					



Classification: Specific Overlay Applications

	source code availability	traffic intensity	traffic recognition	end-user controllability	utilization of QoS	utilization of locality	popularity	legal contents	ISP costs	opportunities	overall	
eDonkey	3	5	3	5	1	5	5	3	4	4	38	
BitTorrent	3	5	3	5	1	5	5	3	4	5	39	
Gnutella	3	3	3	5	1	5	2	3	4	3	32	
Wuala	3	3	3	3	1	5	1	3	4	1	27	
Chordella	5	1	5	4	1	5	1	5	1	5	33	
Jbost	1	4	3	1	3	5	2	5	3	3	30	
PPLive	1	4	3	1	3	5	1	3	5	3	29	
PeerCast	5	4	3	3	5	5	2	3	2	3	35	
End System	5	4	3	3	5	5	1	3	1	3	33	
FreeCast	5	4	3	3	5	5	1	3	1	3	33	
Nodezilla	5	4	3	3	5	5	1	3	1	3	33	
Zattoo	1	4	3	1	5	5	1	5	4	3	32	
SopCast	1	4	3	1	5	5	3	3	4	3	32	
Skype	1	1	2	1	5	1	5	5	1	1	23	
Hamachi	1	1	5	1	4	1	2	4	2	1	22	
Akamai	1	4	4	1	5	5	1	5	3	1	30	
<i>Weights</i>	1	1	1	1	1	1	1	1	1	1		
	technical criteria			optimization			non-technical criteria					



Self-Organization Mechanisms for Economic Traffic Management



Results of Analysis

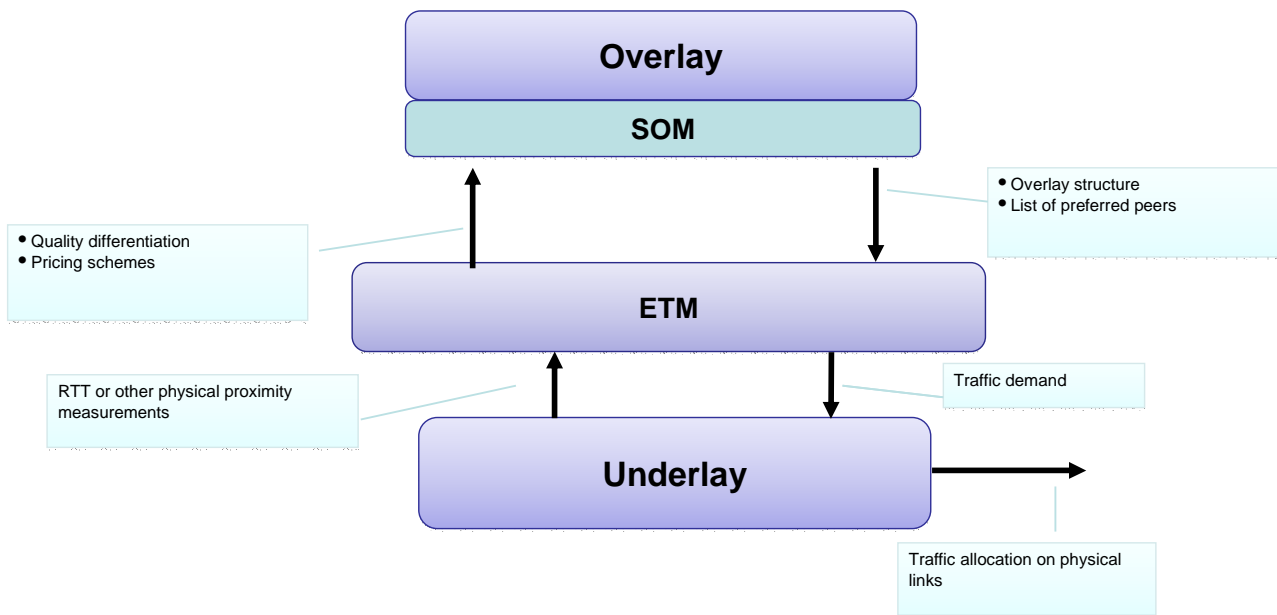
- Relationship Self-organization (SO) and Economic Traffic Management (ETM)
 - How to use SO mechanisms to achieve ETM?

- Overview on SO mechanisms (SOM)
 - Overview on overlay types
 - Overview on existing SOMs
 - Which SOMs are used in which overlays?

- Other (related) mechanisms to apply ETM



Relationship SOM – ETM



- Use of SOMs to influence overlay behavior to achieve ETM goals



SOMs and ETM in SmoothIT

- SOMs try to optimize overlay performance
- SmoothIT approach: provide better information and incentives so that this optimization benefits both the overlay and the underlay
- Peers should be able to make a selfish decision
 - SOM might be changed, but is still controlled by the user



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
 - Cost and investment recovery for operators
- ❑ Incentives for **operators**
 - Monetary: reduce overlay traffic and inter-domain traffic
 - Traffic management: less congested links, better performance
 - Reputation: keep customers, distinguish from other operators
- ❑ Incentives for **overlay providers**
 - Performance: Active role in traffic mgmt increases service quality
 - Reputation: increased user base due to better performing services
- ❑ Incentives for **user**
 - Performance: Increased service quality, e.g., reliability, RTT, BW
 - Monetary: lower price for network access



SmoothIT Architecture Design

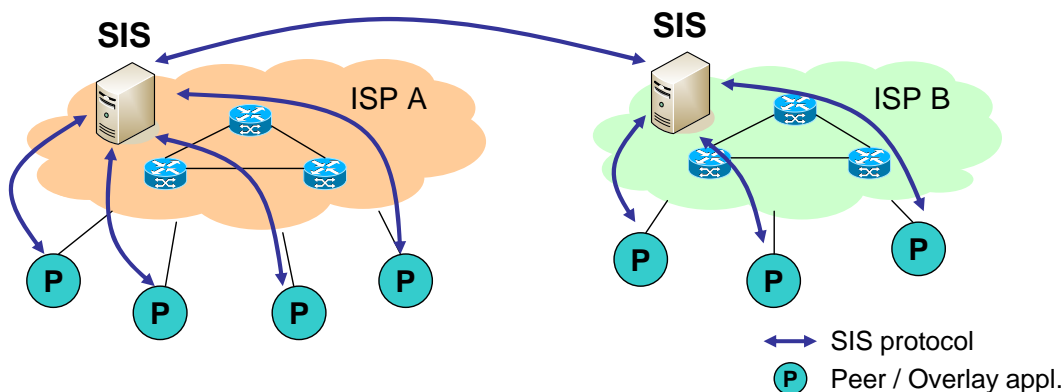


Solution Concepts

- ISP-owned peer
 - **Agreements** between overlay provider and operator
 - *E.g.*, active caching: the ISP provides explicit local caches for content
 - **No change** in the overlay application
 - Overlay application dependent and **legality** issues
- ISP-managed information service
 - **Locality promotion** and **QoS/QoE differentiation**
 - Operator provides information about how to achieve best quality in overlay, *e.g.*, operator prioritizes alternative peer interconnections
 - Application-aware traffic management
 - **Wide range** of incentives
 - Requires **changes** in the overlay application
- Distributed ETM
 - Routers perform ETM autonomously
 - Scalability, robustness but may be more difficult to deploy



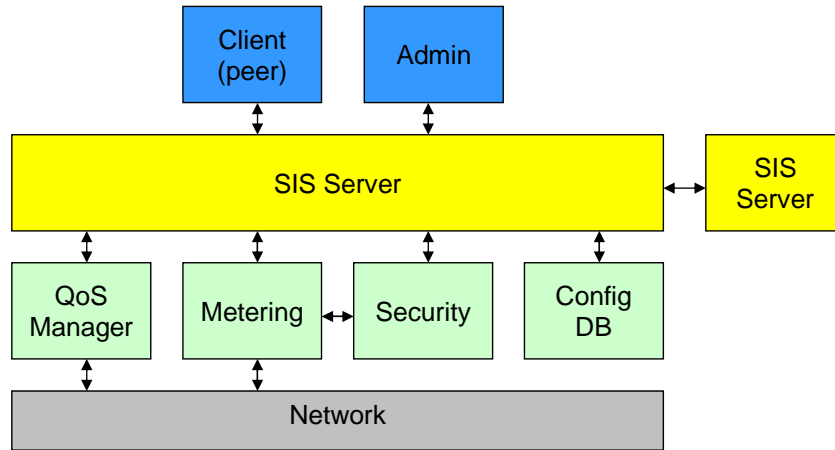
SmoothIT Information Service (SIS)



- 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



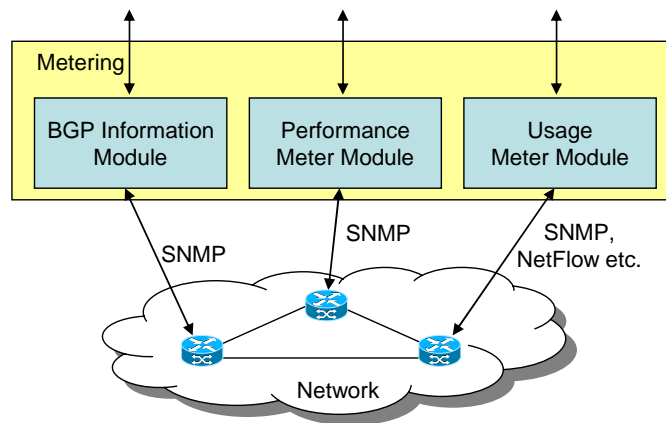
SIS Architecture



- SIS Server
 - 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
 - ISP policies and information about the network, e.g., topology, capacity



Metering



- BGP information module
 - Gather locality information for inter-domain connections
- Performance meter module
 - Passive or active measurement
 - E.g., load on links, packet loss, latency
- Usage meter module
 - Network resource usage metering (data volume)



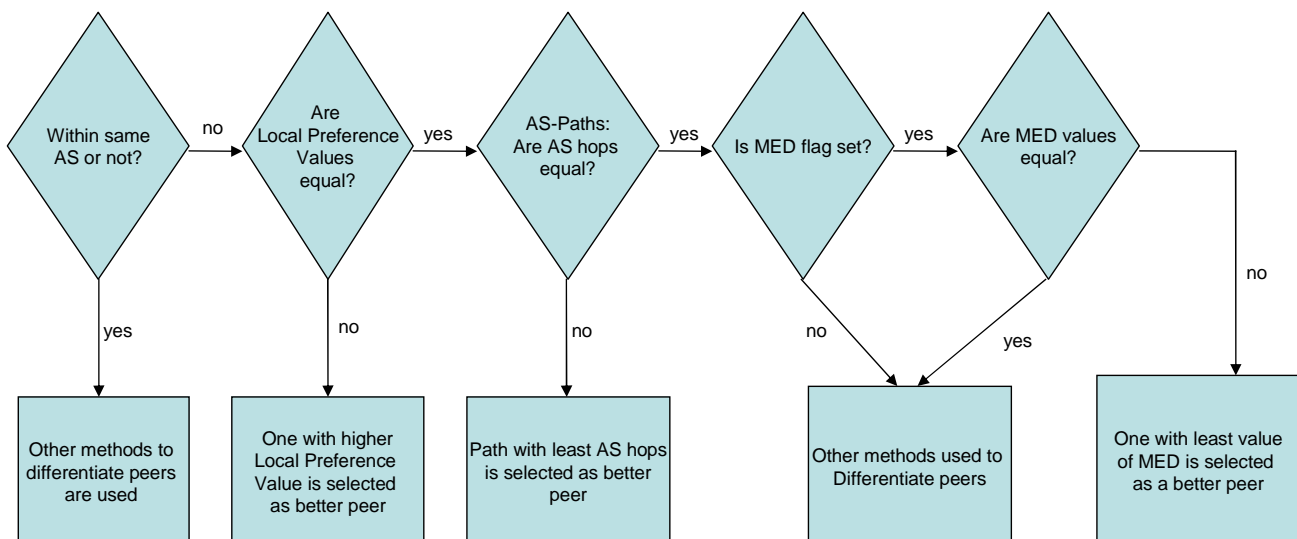
BGP Information Module

- ❑ Collects BGP routing information
 - Reads the routing table over SNMP
- ❑ Provides locality information
 - Based on BGP attributes
- ❑ BGP attributes
 - Assigned to each route and influence the route selection
 - Local Preference
 - Defines the exit point to an AS
 - Distributed among routers in an AS
 - Route with highest local preference is selected
 - AS Path
 - Defines the AS hops to the destination
 - Route with least AS hops is selected
 - Multi Exit Discriminator (MED)
 - Defines the preference for an entry point to an AS
 - Route with lowest MED is selected



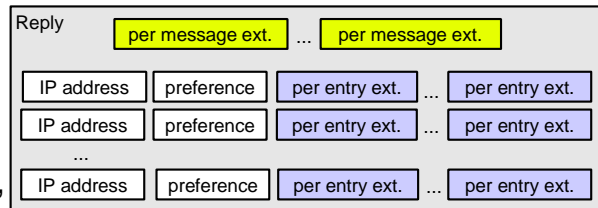
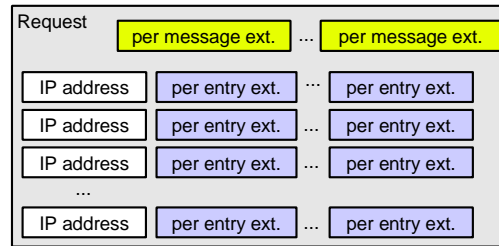
SIS Server – Peer Ranking

- ❑ Peer ranking in the SIS server
 - Based on BGP information
 - Ordered list of peers



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



Status and Summary



Status and Summary

- ❑ Dedicated management of overlay traffic is necessary
 - Due to smoothing large amounts of overlay traffic
 - Due to the minimization of high(er) costs for ISPs

- ❑ Detailed requirements analysis undertaken
- ❑ SOM and ETM relations clarified
- ❑ SmoothIT architectural design in progress
 - SmoothIT Information Service (SIS)
 - Deployed in networks of ISPs
 - Provides information to overlay applications
 - Optimizes traffic and achieves the Triple Win situation

- ❑ SmoothIT participates in ALTO and covers socio-economic aspects of communications



Thank you for your attention!

Thanks to all SmoothIT's project partners:

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



DOCOMO Euro-Labs



University of Zurich
Department of Informatics



PRIMETEL
Total Communication



Telefonica

