SLA Trading Strategies

Pertti Hölttä
Elisa Research
pertti.holtta@elisa.fi

Abstract

Implementing and offering other than best effort services in large scale IP networks, such as Internet, has been and still is one of the biggest challenges for network operators, (internet) service providers (I)SPs and vendors on route towards multiservice IP networks and internet. Service Level Agreements (SLAs) play an important role from providers´ and the customers´ business point of view while defining the negotiated and contracted service between the customer and the provider. SLA is much dependent on QOS parameters of the network service. Setting up of SLAs is nowadays very straightforward being static in nature and based on bilateral agreements between all participating domains. But the development is towards more dynamic provision of SLAs. SLA trading is the concept of exchanging and negotiating automatically the information of service provisioning, routing and pricing information between the providers [1].

This paper discusses the concept of SLA trading, its position in SLA framework and its strategic meaning for Internet economy and providers. SLA trading can be seen in the long term a key factor towards a market and business driven multiservice Internet evolution. Yet, there are some uncertainties in this evolution, like the lack of large scale real life experiences of multiservice IP networks and service offerings, not to mention the real life experience of SLA trading itself. But by planning and introducing a step by step SLA evolution roadmap starting from a static SLA offerings towards offerings based on dynamic SLA negotiation and trading, ISPs and network operators can make a smooth transition towards next generation multiservice Internet.

1 Introduction

SLAs have been used for a long time in telecom and datacom business as part of the service provision agreement between the customer and service provider or between the providers. SLA is defined as the documented result of a negotiation between a customer/consumer and a provider of a service that specifies the levels of availability, serviceability, performance, operation or other attributes of the service [2]. So far, most of the existing service provision mechanisms and the processes setting up SLAs are static in nature and performed manually in well controlled environments. The Internet, however, is expanding fast meaning an increasing number of interconnected ISPs and thus increased connectivity among ISPs. There is a demand for a more dynamic way of negotiating and trading SLAs so that the key players of Internet can build up business driven frameworks for overall service level management including efficient actions and processes for cooperation and competition.

In section 2 we give an on overview of the SLA framework and related QOS management procedures. In section 3 we present the concept of SLA trading and its use in the differentiated service architecture. Finally section 4 presents some experimental simulation results on SLA trading.

2 SLA framework

Several phases exist towards the market and business driven internet where SLA trading may be used. One example of the SLA evolution path is presented in Figure 1.

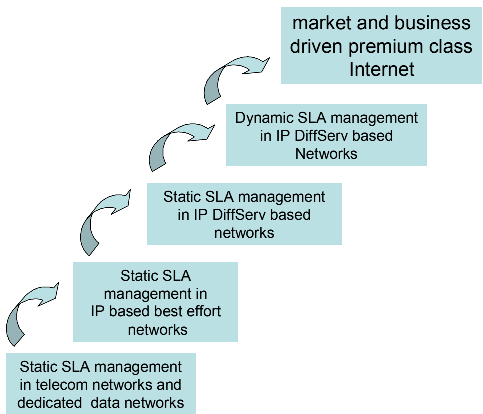

Figure 1 – Evolution of SLA management

2.1 Static SLA management in best effort IP networks

Today, most of the setups of SLAs are static in nature. This means that a SLA contract is made between two

human parties and its terms cannot be altered during its life time, without a human intervention.
SLAs are thus set up manually which is time consuming. Service providers or network operators set up contracts for transit or local traffic only (peering). Most of the SLA parameters between the peers refer to bandwith only and other services classes than best effort are seldom used. No QOS signaling between peers are needed.

Setting up multiple peers to enhance reliability or to exploit load balancing is difficult using protocols like BGP or RPSL only. Also prices refer to this static environment. Today, it is difficult for ISPs to react to changes of the market. Even simple peering agreements without financial compensation do not work [1].

2.2 Static SLA management in multiservice IP networks

Introducing other than best effort services in IP networks (eg. real time services like voice) requires some kind of procedures for service specific QOS management in networks. The internet industry has well accepted the concept of Differentiated Services Architecture (DiffServ) for implementing scalable service differentiation in the Internet and IP networks.

This architecture achieves scalability by aggregating traffic classification state which is conveyed by means of IP-layer packet marking using the DS field. Packets are classified and marked to receive a particular per-hop forwarding behavior on nodes along their path. Sophisticated classification, marking, policing, and shaping operations need only to be implemented at network boundaries or hosts. Network resources are allocated to traffic streams by service provisioning policies which govern how traffic is marked and conditioned upon entry to a differentiated services-capable network, and how that traffic is forwarded within that network. A wide variety of services can be implemented on top of these building blocks. [3].

DiffServ based solutions focus thus mainly on the core network and assume aggregated traffic flowing to and from the access network.

Especially in large scale IP networks like internet, multiservice networking requires some mechanism for handling QOS signaling and provision across the different network domains (inter-domain signaling). Bandwith Brokers (BB) are meant for this purpose while managing network resources for IP QOS services supported in the network and used by customers of the network services. A BB may be considered a type of policy manager in that it performs a subset of policy management functionality [4].

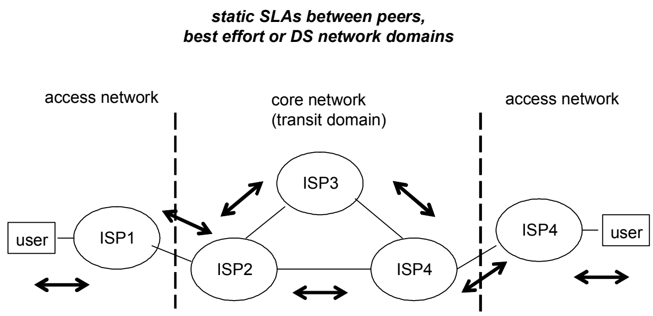

Figure 1 – Static SLA environment in best effort and multiservice IP networks

2.3 Dynamic SLA management

The wide deployment of market driven multiservice IP networks is much dependant of the development of dynamic service provision procedures, dynamic SLA management being a subset of that. Dynamic features are expected to better match the requirements of future business driven operational scenarios in internet.

Bandwith Brokers for DiffServ were introduced mainly with service provision in mind. However, they can provide a set of useful services:

- *Automated SLA negotiation*
- *Inter-domain path selection (routing)*
- *Service provision*

In [1], automated SLA negotiation is proposed to be included in bandwith brokers called decentralized agents. They exchange information about bandwith allocation between neighboring networks associated with these agents. An approach for SLA Traders can be achieved by integrating resource allocation, path selection and pricing information in these agents.

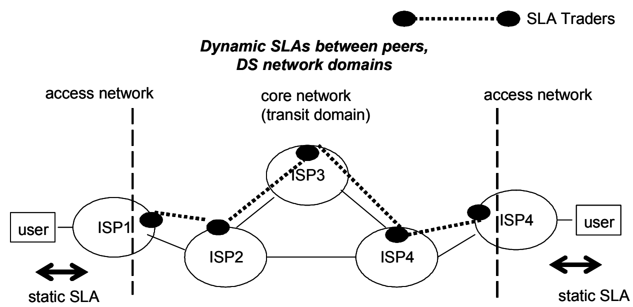

Figure 2 – Dynamic SLA management with SLA Traders

3 The concept of SLA Trading in Differentiated Service Architecture [1]

3.1 SLA Trading Principles

The main issue behind the concept of SLA trading is to increase the dynamics of SLA management in large scale networks in order to achieve market driven internet architecture. Detailed concept and procedures for SLA trading in Differentiated Service Architecture is presented in [1]. This chapter summarizes the basic principles.
SLA traders exchange and negotiate automatically information on service provisioning, routing and pricing information between peered ISPs (see Figure 2). Every SLA trader can buy and sell SLAs. To achieve end-to-end architecture that allows to extend marked based approach among ISPs to end-users, individual profiles and contracts need to be aggregated to serve as input fro SLA traders. Established contracts are stored in a table.

SLA trading protocols and and the traders itself may change from location to locations. SLAs include the destination of the "jumbo flow" to ensure end-to-end service. SLAs may also describe services that do not have an end-to-end signifigance. SLAs in each ISP include the following parameters:

- *A traffic description.* This includes support for defined PHBs (Per Hop Behavior) which is an externally observable forwarding behavior applied at a DS-compliant node to a DS behavior aggregate. It also includes a QOS vector (e.g bandwith and delay) for a specific traffic description.
- *A geographical scope* from the ISP´s network to some other destination network.
- *Duration* of the agreement.
- *Cost* of the agreement.

Signaling demand and supply between ISPs needs an appropriate protocol to transport SLA messages. Many alternatives are proposed, under development or already available: new BGP attributes, the Internet Open Trading Protocol (IOTP), RSVP extensions, BB transfer protocol, DIAMETER, COPS and SNMP. In [1] also a simple peer-to-peer protocol called SLATP (SLA Trading Protocol) is presented. Eeach SLATP data unit consists of a type (ask, bid, accept, reject, confirm), an AS hop count field and an SLA parameters as defined above. Figure 3 clarifies the concept of SLA trading protocol.

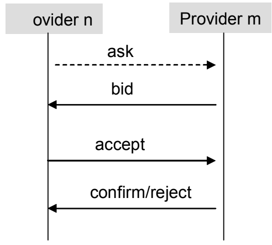

Figure 3 – SLA trading protocol sequence chart

3.2 Bid Generation and Pricing

SLA traders make bids, based on available resources, to other ISPs. More fine-grained SLA bids will be more probable of being accepted because of the boarder service palette, but will also involve more protocol overhead for communicating them. However, this is an optimization problem, which will drive for new and more efficient trading protocols.

The goal of the commercial ISPs is to maximize profit which is reflected in how SLATs will behave. The price of the sold services will be calculated to cover the costs of the ISP and to make profit. Because of the competition, an ISP will try to optimize the prize of the services.
The pricing strategy used in SLA trading is residual bandwith pricing. This function ensures that prices get higher the more the SLA or link recourses are used.

Competition is of primary importance to the SLA trading framework. If a provider has a much faster and less expensive link to a destination, it is better for global efficiency that its services are being preferred over the others.

3.3 Trading algorithms

Provision algorithm is the algorithm responsible for the determination of what resources are needed.

A passive provision algorithm does not wait for requests from its customers to select which resources to buy. An active provision algorithm tries to forecast future needs. It will then buy resources in advance.

Once an SLA trader knows it needs to buy some resources from one of its peers, it will have to select one of the bids and buy it. The selection of the bid is made on the bid´s value for the SLA trader and its price.

The SLA trader will also have to evaluate if the selected bid is worth buying using profitability analysis algorithm. This algorithm does evaluate if by buying that bid, money will be made through the selling of derived services. It is this algorithm which will also ensure that a SLA trader won´t build service loops.

4 Simulation results on SLA trading

[1] presents also how they integrated and implemented SLAT in DiffServ. They developed an experimental version of the SLA trading framework using a simulation environment.

Some findings of the results were:

- The basic finding was that an improvement of network utilization by up to 40% over a traditional, shortest-path routed inter-domain network for a wide range of network and traffic parameters, can be achieved.
- SLA traders have load balancing capabilities
- Competition among ISPs ensures the selection of the best bids from peers.
- The heterogeneity caused by local decisions and strategies has an great effect on the trading strategies. The order starting from the best implementation is: Profitable Trader (makes an profitable analysis), Trendy Trader (analysis of current usage of resources), Greedy Trader (buys all the bids), Null Trader (no service at all)
- SLA Trading fits best in core network, not in access network because the analysis of local objective for SLA parameters is hard.

5 Conclusions

Studies and simulation results have shown that concept of SLA trading could be used in the future for automated SLA management in DiffServ based networks. This could be one building block of market driven internet architecture especially in large scale core networks with several competing large ISPs. Yet there are several uncertainties with the use of this procedure, like the lack of real life experiences of large scale DiffServ networks and not to mention the real life experiments of SLA trading itself. Thus a careful transition strategy should be planned towards the dynamic use of SLA management.

References

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