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Service invocation admission control algorithm for multi-domain IP environments

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Abstract

One approach to solve the end to end (E2E) quality of services (QoS) problem of multimedia services delivery over multi-domain IP heterogeneous network infrastructures in a scaleable manner is the establishment of long term QoS enabled aggregated pipes. To allow dynamism, the actual service invocation of these pipes can be made as a separate action from the pipes subscription. This paper proposes a service invocation admission control algorithm that can be applied to aggregated IP pipes taking into account new service requests and the actual utilization of the domain resources of the subscribed pipes.

Keywords: Admission control; Heterogeneous networks; Invocation; Service management; SLA/SLS; Subscription

1. Introduction

In an end-to-end audio-visual chain of a next generation network is going to involve several entities such as *Service Providers* (*SP*), *Content Providers* (*CP*), *Network Providers* (*NP*), *Content Consumers* (*CC*), *Access Providers* (*AP*), *Brokers/Resellers*, etc. The transport of multimedia content from CPs' content servers (CS), through several heterogeneous IP autonomous domains, to potential CCs at a desired level of QoS raises a significant scalability problem. The establishment of logical long-term QoS-enabled pipes at an aggregation level over underlying heterogeneous IP multi-domains could constitute a scalable mechanism towards an end-to-end multimedia content delivery with QoS guarantees [1–5]. The pipes are logically established through negotiation of *Service Level Agreement/Specification* contracts between SPs (*pSLA/pSLS*).

The pipe construction is initiated by a SP, based on its knowledge about location of CPs/CSs and location of potential customers. SP makes a request for a pipe to involved NPs. The relationship between SP and NPs could be a star, a hub or a

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cascaded peering one [3,4]. The latter is more scalable because the SP does not need to interact with all NPs in the chain, but only with the first one situated at the ingress of the desired path. Each pSLS request contains all desired QoS parameters (e.g., bandwidth, delay, jitter, loss rate, etc.). The pipes are requested by SPs and they are agreed between SP/NP, NP/NP, etc. This is called the *subscription* phase. The actual network resources allocation at the underlying network elements for these pipes can be done immediately at the time of subscription, or later, based on agreed explicit or implicit requests signaled by the SP. This action is called aggregate pipe *service invocation*.

Note that we make a clear distinction between subscription and invocation of the aggregated pipes and individual user service subscription and/or invocation. After the installation of the aggregated pipes in the network domains, SP is able to offer services for individual flows. The aggregated capacities are "sold" in a retail manner, to many customers, through individual contracts *customer-SLA/SLS (cSLA/cSLS)* between SP and each interested customer.

Focusing on the aggregated pipe invocation phase, this phase is the one in which the actual QoS enabled aggregated pipe is installed at SP request in the network elements of each involved NP in the pipe chain. The amount of requested SP resources may be those previously agreed in *pSLS* contracts, or may have different values (less or even more if over-subscription is allowed). Therefore an invocation-level Admission Control (AC) is necessary in each domain, taking into account the service requests and the actual utilization of the underlying domain resources.

This paper proposes such an AC algorithm for *pSLS* based pipes invocation. Starting from previous other approaches, [1,2,6,7,10], it is proposed and studied a modified AC, flexible and scalable, policy driven and having a simple implementation.

The paper is organized as follows. Section 2 briefly discusses the pSLS invocation framework where the proposed AC algorithm could be applied. Section 3 presents the proposed service invocation admission algorithm and Section 4 concludes the paper.

2. pSLS invocation framework

Fig. 1 depicts a high level view of Traffic Trunks (TTs). Each TT belongs to a QoS class of service (QC). TTs are considered distinctly for intra and inter-domain paths/links. An intra-domain TT can be defined from an input I/F of an ingress router up to an output I/F of an egress router. An inter-domain TT can be defined from an output I/F of an egress router up to an input I/F of an ingress router of the next domain.

The intra-domain TT constitutes an abstraction of resources allocated for this TT between an ingress and egress point of this domain, no matter the intra-domain path is. On an inter-domain link, we suppose that we have one TT per QC.

The pSLS invocation framework that is deploying in the context of the IST FP6-IP ENTHRONE project [3,4] is depicted in Fig. 2. The *pSLS Invocation Handler* (*pSLS_IH*) has the role to activate the *pSLSs*, at request of SP, after the *pSLSs* have been agreed and subscribed.

To process a new pSLS invocation request, an Admission Control (AC) algorithm has to consider the following information: *subscription information* (read from the pSLS repository) for the QoS class in question; *invocation request parameters* for an already agreed pSLS pipe belonging to a certain QoS class; *previous invocation parameters* of the

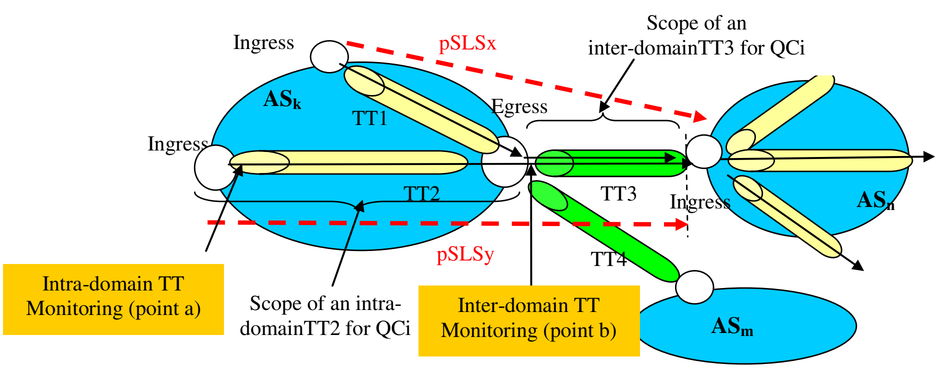

Fig. 1. Scopes of intra and inter-domain traffic trunks.