Dynamic Traffic Management for minimization of inter-domain traffic cost in the Inter-cloud Communication

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Abstract

Nowadays we are observing rapid movement of users towards the services based on the resources managed by cloud platforms. More and more data are exchanged and stored in clouds deployed in data centers (DC) [1]. New business models appear as a result of new relations between stakeholders, e.g., federation of Cloud Service Providers, or End-users offering resources (user-owned Nano Data Centers) for Content Delivery Providers. Moreover, mobility of users and services to offer the content and functionalities as close as possible with required level of QoE are the elements of a complex and still evolving ICT landscape. The network architectures and the network management methods have to follow all those changes and address new emerging requirements. The implementation of SDN (Software defined Network) and NFV (Network Functions Virtualization) concepts as well as intelligent data caching and prefetching exploiting social information, are promising directions. One of the solutions for the network management has been introduced in the SmartenIT project and described in this paper. The Dynamic Traffic Management (DTM) is a proposal for Internet service providers to minimize the of traffic exchanged between network domains.

Scenarios and Use-cases (the SmartenIT project)

The SmartenIT project (Socially-aware Management of New Overlay Application Traffic combined with Energy Efficiency in the Internet) targets at an incentive-compatible cross-layer network management for providers of overlay-based applications (e.g., cloud applications, content delivery, and social networks), network providers, and end-users [2]. To address the network management solutions to the relevant stakeholders the project defined a multi-provider and user centric environment with two respective scenarios: the Operator Focused Scenario (OFS) and the End-User Focused Scenario (EFS) [3]. The OFS is focusing only on the interactions among providers offering large scale infrastructures and resources (data center operators, cloud providers, service providers, Internet service providers, etc.). The EFS includes the end-user and his network equipment that can run as a Nano Data Center with functionalities like content caching and prefetching or share the resources like storage or Wi-Fi bandwidth with other stakeholders. SmartenIT proposed a set of management mechanisms for both scenarios and detailed use-cases to present the applicability of mechanisms for various stakeholders' requirements. The DTM is one of the SmartenIT network management mechanisms representing the OFS, addressed mainly to Internet service providers and with the goal to minimize the cost of inter-cloud inter-domain network IP transmission.

Dynamic Traffic Management Mechanism (DTM)

The principle of DTM mechanism is explained using the following simple use-case (Fig. 1). Let's assume that the network of ISP-A is multi-homed and the tariffs used on different inter-domain links differ. In such a case appropriate shifting of a portion of inter-domain traffic between them may

result in lowering total costs. The overall traffic on each inter-domain link is composed of two types of traffic: manageable and non-manageable (background). The former can be influenced by DTM. In this sample use-case the manageable traffic is constituted by all transfers between remote DCs. Without using DTM all traffic exchanged between DC-B and DC-A would follow a default BGP path and would traverse, e.g., link AB. When DTM is used, two tunnels (GRE or MPLS tunnels) are established between remote POIs (Point of Interconnect) through which DCs access the ISP's network. Tunnels pass different inter-domain links. ISP-A may select tunnel 1 or tunnel 2 for the inter-DC traffic and as result decide which inter-domain link is used. The decision on link selection is taken by DTM mechanism dynamically (e.g., every minute) according to the current situation and estimated cost of inter-domain traffic. Once the decision on switching the tunnel is taken, the SDN controller directs all new flows generated by the DC to recently selected tunnel. DTM is designed to operate with the tariffs based on total traffic volume or 95th percentile.

DTM consists of two main building blocks:

(1) an algorithm to find the optimal solution for traffic distribution to be achieved at the end of an accounting period. It makes a prediction for the next period and finds a better traffic distribution in which the ISP's cost is minimized.

(2) the compensation procedure determines how the traffic distribution should be influenced at a given moment to achieve the optimal solution at the end of the accounting period, i.e., dynamically decides on selection of inter-domain link.

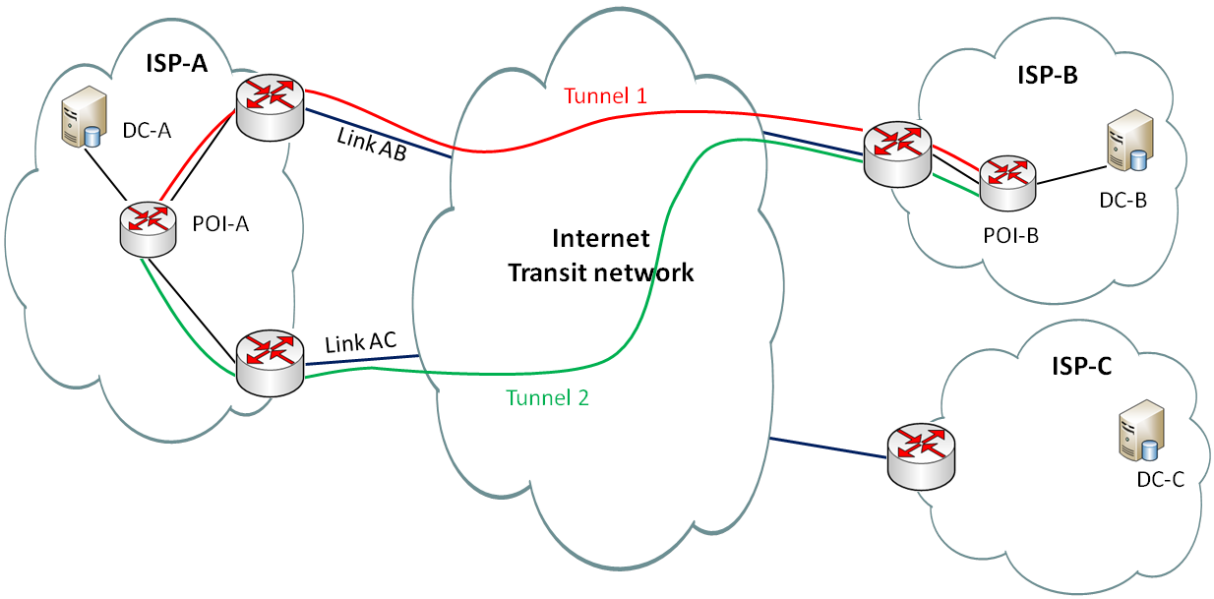

Fig. 1 The concept of using tunnels for controlling distribution of traffic between inter-domain links.

DTM Implementation and Evaluation

The DTM prototype implementing optimization for traffic volume based tariff is already finished. The architecture is composed of several components which have been developed using the Java language. Due to the inter-domain nature the DTM prototype can be easily deployed in a distributed manner which means that separate network domains contain the DTM prototype instances communicating with each other.

The performance evaluation of DTM uses simulations [4, 5] as well as trials conducted with SmartenIT prototype instances deployed in a testbed environment.

Future Plans

The implementation of DTM version for traffic management and cost optimization for 95th percentile rule based tariff is ongoing. The initial simulation based experiments showed a potential for further improvements of the algorithm. Also, the project consortium decided to integrate DTM with another management mechanism ICC (Inter-Cloud Communication) to add the functionality to manipulate the traffic that is delay-tolerant and may introduce an interface between the cloud service provider and the Internet service provider [6].

Acknowledgment

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Vitae

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