An economic and algorithmic model for QoS provisioning in a BGP interdomain network

Dominique Barth Loubna Echabbi
Chahinez Hamlaoui
PRiSM, Université de Versailles Saint-Quentin,
45 Av. des Etats Unis, 78000 Versailles, France

Sandrine Vial
LaMI, CNRS UMR 8042, Université d'Evry,
523, Place des Terrasses 91000 Evry, France

The objective of this work is to give the main principles of an algorithmic model of a BGP (Border Gateway Protocol) interdomain network including some QoS satisfaction mechanisms. This model is based on resources provisioning giving guarantees in terms of bandwidth and delay. We consider that QoS resources are located on autonomous systems (AS) and not on links. Each BGP route proposed by an AS to one of its neighbors is also characterized by the maximal guaranteed delay and by the maximal available bandwidth. We classically consider two parts in a BGP network:

- the Peer-to-Peer Level that is over-dimensioned and in which no resource provisioning is done.
- the Costumer-to-Provider Level in which AS have economic relations to obtain QoS guarantees.

Figure 1 is an example of such a network.

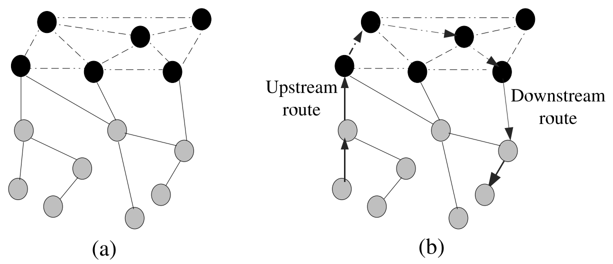

Figure 1: (a) a BGP network (b) a BGP route

We deal here with possible evolutions of BGP to manage and ensure quality of services in an economic and selfish interdomain networks [1]. We consider here resource provisioning on selected routes. As it has been proposed in different versions of q-BGP (see for example the conclusions of project MESCAL [2]), we also consider that routes are characterized by the available QoS on it. But, since we consider an heterogeneous and selfish interdomain network, it seems to be not realistic to consider many specific QoS parameters. Indeed, each AS could have its own private way to satisfy QoS and will not give all informations on it to other ASs. Thus, we consider here an effective bandwidth logic [3] . Available bandwidth and maximal delay are the only informations on routes that we will consider. The relation between bandwidth, delay and the specific QoS guarantees required by a class of services in an AS will be held by the control access: a route that an AS will reserve will be a *tube* of given size and length crossing various ASs. An AS will choose the way it fills the trafic in each tube it creates. The only guarantee an intermediate AS has to give is to respect as possible the received packets sequencing and the jitter in each tube.

Thus, a route announced by an AS A to an AS B will be characterized by the list of crossed ASs, the available bandwidth A can buy on it and some informations on the price for each unit of bandwidth. About bandwidth allocation on routes we consider two situations:

- If A is a peer-to-peer node, it does not do bandwidth reservation. The price the neighbor of A has to pay to A is the cost for each unit of traffic crossing A on this route from B and B will have to pay for. In Figure 1, these links appears in dotted lines.
- If A is a customer-provider node, then it can sell to each of its neighbours (in the two levels) a part of the capacity which it is the owner on the route. Thus, neighbors of A pay A for a resource provisionning on the routes that A proposes. In Figure 1, these links appears in plain lines.

This difference is due to the fact that the peer level is classically overdimensionned and must manage too many routes and communication to be able to manage resource allocation. In opposite, the customer-provider nodes have economic relations together and are interested in QoS for their final users.

Moreover, to limit and control the propagation of allocation and control message in the network, we consider here that an AS can only "sell something it has first buy" (stock model) and not " buy it when one neighbour asks for".

In this presentation, we will propose a new global model to manage QoS over BGP in a selfish and economic context. This model is based on graph theory, distributed algorithm and game theory. We will also propose new SLA protocols to manage QoS between connected ASs. Based on this model, we will then give some first simulation analysis for different traffic scenario, developped on the plateform OMNET++. We consider that each operator has first an estimation of the trafic based on previous periods. Then, the tested strategies have to adapt the decisons of the ASs to the new trafic situation.

References

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