Optimization of Intra-AS Bandwidth Allocations

Master's Thesis Proposal

The Internet is an interconnection of autonomous systems (ASes). Each AS itself is again a network of routers, services, and end hosts (Figure 1.a). Traffic between two globally distributed end hosts or services usually needs to traverse multiple ASes. Because Internet traffic is only forwarded as best-effort (i.e., packets might be dropped if there is congestion) it can not be guaranteed that packets indeed arrive at their destination.

To provide better communication guarantees, several inter-domain bandwidth reservation systems have been proposed recently. Bandwidth reservation systems protect traffic on specific paths on the Internet from being dropped due to congestion, which can occur either naturally or be caused by DDoS attacks. An end host can for example make a reservation of 10 Mbps to a video sharing platform and thus profit from enhanced quality of service. To support such reservations, a transit AS must therefore know how much reservation traffic it can support between the border routers of its network. In the GLWP reservation system[1], every AS has an allocation matrix whose entries describe the maximum bandwidth that can be reserved between two border routers (Figure 1.b).

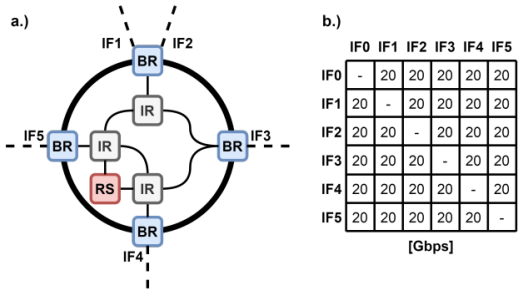

Figure 1: a.) Example intra-AS network. It consists of multiple internal routers (IRs) and infrastructure components such as a reservation service (RS). Communication with other ASes happens through border routers (BRs). A border router handles one or more interfaces (IFs), where each interface is connected through a link to another AS. b.) Example allocation matrix, assuming inter-domain link capacities of 100 Gbps. IF0 is an auxiliary interface representing communication from and to entities within the AS.

Naturally, an AS wants to maximize its allocation matrix entries. However, despite previous research in this area, it is not obvious how this matrix can be computed optimally for real networks. The goal of this project is to explore how to best allocate intra-AS capacities by solving optimization problems with several constraints introduced by real-world intra-AS networks.

Topics

- Optimization problems (e.g., linear programming, network flows)
- Routing protocols (e.g., OSPF, IS-IS, MPLS, Segment Routing)

Advisors

- Marc Wyss
- Cyrill Krähenbühl
- Prof. Adrian Perrig

[1] https://netsec.ethz.ch/publications/papers/2021_iwqos_glwp.pdf