Design and Benefit Analysis of Edge-to-Edge Bailout Forward Contracts for

Single-Domain Internet Services

Aparna Gupta

Rensselaer Polytechnic Institute, Troy, NY

Abstract:

Despite the huge success of the Internet in providing basic communication services, the Internet architecture needs upgrades to provide end-to-end QoS services to its customers. Currently, a user or an enterprise that needs end-to-end bandwidth guarantees between two arbitrary points in the Internet for a short period of time has no way of expressing its needs. To allow these much needed basic QoS services we propose a single-domain edge-to-edge (g2g) dynamic capacity contracting mechanism, where a network customer can enter into a bandwidth contract on a g2g path at a future time, at a predetermined price. For practical and economic viability, such forward contracts must involve a bailout option to account for bandwidth becoming unavailable at service delivery time, and must be priced appropriately to enable ISPs manage *risks* in their contracting and investments.

Our design allows ISPs to advertise point-to-point different prices for each of their g2g paths instead of the current point-to-anywhere prices, allowing for better end-to-end paths, temporal flexibility and efficiency of bandwidth usage. In this paper, we first consider the question of how such dynamic g2g forward contracts should be defined and priced so that they result in high revenue while remaining practical and economically viable. In particular, we compare point-to-anywhere linear pricing based contracts against point-to-point contracts with nonlinear spot prices. We then compare these schemes with inclusion of a point-to-point forward contracting mechanism with a bailout option for the provider, in case bandwidth becomes unavailable at service delivery time. Our study, conducted on the basis of simulation results on realistic Rocketfuel topologies, reveals the exact nature of the trade-offs between increased pricing complexity and better performance due to improved predictability. The g2g bailout forward contracts (BFCs) are priced taking into account correlations between different contracts due to correlated demand patterns and overlapping paths. We evaluate the forward contracts in terms of key network performance metrics like fraction of bailouts, revenue earned by the provider, and adaptability to link failures.

Bio:

Dr. Gupta’s research interest is in mathematical modeling and optimization, risk management and financial engineering. In her research projects, she has developed pricing schemes and risk management for Internet Quality of Service guarantees, enterprise risk management framework for long-term service agreements, and financial decision support for long-term financial and risk management decisions. Dr. Gupta has published several articles in leading operations research, applied mathematics and financial engineering journals. Dr. Gupta is currently a faculty in the Lally School of Management and Technology at Rensselaer Polytechnic Institute. She received her doctorate from Stanford University in Scientific Computing and Computational Mathematics.