Bill-and-Keep peering

Gireesh Shrimali; Sunil Kumar

Peering arrangements between Internet Service Providers (ISPs), in which providers agree to carry traffic originating from a peer, are common in the Internet. A common contractual peering agreement between smaller ISPs is "Bill-and-Keep", where no money changes hands between the peers. This paper first investigates a situation when ISPs who have access to a transit ISP capable of handling their traffic for a fee, decide to peer incurring some fixed peering cost. Using a simple model it is shown that Bill-and-Keep peering is the fair and efficient outcome if the transit ISP charges for both inbound and outbound traffic and transit charges as well as costs of peering are symmetric. Next, complementarity between providers at the operational level, as measured by improvement in quality of service (QoS), is analyzed using an idealized model. Assuming that each provider incurs costs, or degradation in QoS, from its traffic traversing its own as well as the peer's links and chooses the amount of traffic to send on its peers' links in its self-interest, the Nash equilibria of the resulting one shot game and then of an infinitely repeated game are analyzed. For the one-shot game, it is established that, while it is not possible for all the providers to be worse off, it is certainly possible for all of them to be better off. An intuitive sufficient condition for each of the providers to be better off in Nash equilibrium is then derived. Further, it is shown that providers that are better off in the one-shot game can cooperate using threat strategies in an infinitely repeated game and can each be even better off. Coalition formation between peers as a dynamic process is also investigated and some examples and conjectures on some preliminary findings are provided. Finally, the policy implications of the findings are discussed.

*To read the Full paper, please contact Arun_Kumar@isb.edu