Project 3: Simulation of BGP Routing

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1 Overview

Traffic engineering (TE) is a network management technique deployed in intra- and inter-area routing to improve the network efficiency by explicitly steering the traffic through a routed or switched network to achieve performance goals such as delay minimization, throughput maximization, etc.

The Internet presents a hierarchical topology consisting of the interconnection of multiple administrative domains referred to as Autonomous Systems (ASs) which contract their neighbor domain(s) for data delivery services to achieve end-to-end QoS and use the Border Gateway Protocol (BGP) peering to exchange network reachability information and achieve traffic engineering over connections across the area boundaries using appropriate routing policies.

An additional level of hierarchy is introduced in the Internet by subdividing a routing domain into sub-domains referred to as areas where each edge area (area located at the the periphery of the routing domain) is attached to a backbone area used as transit area for the traffic exchanged within the routing domain. Such an extra level of hierarchy introduces scalability by enabling single domains to grow larger without overburdening the intra-domain routing protocols [1].

2 The Border Gateway Protocol (BGP) Simulation

The Internet community has depicted several issues associated with BGP. These include (1) the scaling problem occurring in IBGP full mesh configuration (2) instabilities resulting from misbehaved routes and oscillation and (3) routing inefficiencies resulting from the application of policies. These problems are typically solved using (1) BGP confederations (2) BGP Route Reflexion (3) BGP Route Flap Dampening and (4) BGP Policy applications. BGP confederations and Route Reflexion have been proposed to solve the scaling problem in full mesh IBGP configuration. Route Flap Dampening is used to solve the problem of instability while specific policies may be applied to increase the routing efficiency in BGP.

- **BGP confederations.** In BGP confederation, each AS is divided into smaller sub-ASes containing each a few tens of routers. Inside each sub-AS, a full mesh of IBGP sessions are established between the routers of the sub-AS and special eBGP sessions are used between the sub-ASes.

- **BGP Route Reflexion.** In Route Reflexion, BGP speaking routers are subdivided into route reflectors and route reflector clients. A route reflector is a special BGP router which redistributes over iBGP sessions routes that it has received over some iBGP sessions. It has two types of iBGP peers: its client-peers and its non-client peers which are typically other route reflectors.

- **BGP Route Flap Dampening.**, Route Flap Dampening is a mechanism which is used to decrease the Internet instability by (1) assigning a penalty to a route, each time the route flaps and (2) suppressing that route upon recurrent flaps causing the accumulated penalty to reach a pre-specified limit.

- **BGP Policies application.** BGP policies may be applied in several ways including the use of (1) route maps (2) access list (3) community lists and (4) as-path lists.

BGP++ [4] is a C++ implementation of BGP in NS-2. It has been built from the GNU Zebra daemon [5] which supports BGPv4 [6] as well as other routing protocols. BGP++ uses a command language which is similar to the command language used by CISCO in its ios operating systems. It also includes examples/scenarios which are based on case studies found in CISCO BGP page.

This project builds upon the examples presented by BGP++ to design new scenarios in BGP routing. The new scenarios consist of designing different inter-domain topologies and running new BGP examples (confederations, reflection, flap dampening and policies) using these topologies. The BGP++ code as well as the examples will be given. This code includes a C++ portion which does not need any adaptation and some OTCL scripts which need to be rewritten.

References

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[2] H,M Deitel, P,J Deitel, “Java How to Program”,*Prentice Hall PTR, Four edition, ISDN 01 30 341517*, 2002.

[3] W.R Stevens, “Unix Network Programming, Interprocess Communications”,*Prentice Hall PTR, Volume2, Second edition, ISDN 0-13-081081-9*, 1998.

[4] BGP++, *http://www.ece.gatech.edu/research/labs/MANIACS/BGP++*.

[5] GNU Zebra daemon, *http://www.zebra.org/zebra/BGP.html*.

[6] Y. Rekhter and T. LI, “A border gateway protocol 4 (BGP-4)” *RFC1771*, March 1995.