Survey on Various Inter-Domain Traffic Engineering Technologies

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Abstract

The optimal flows across the Internet have led to the hurried progression of Internet which has occasioned in the momentous deviations in the Internet scalability and resiliency and in the proliferation in the routing table sizes. The crusade from Internet routing to hierarchical routing and by announcing two-level hierarchical routing between edge networks and transit networks deliver a new way of Internet traffic engineering. This paper pronounces various technologies of Internet inter-domain traffic engineering which aims at achieving deployability. The transit-edge hierarchical routing is done by unscrambling the routing locator from the terminal identifier by exchanging the large traffic volumes by providing edge-to-edge load balancing centered on locator and path ranking costs. The separation is accomplished by LISP. The load-balanced multiple forwarding paths are permitted when the information is swapped between neighboring nodes. The purpose of the paper is to provide a survey on various inter-domain traffic engineering technologies for the Internet scalability improvement.

Keywords: **Scalability, Resiliency, Autonomous System, Routing Locator, Traffic Engineering.**

1. Introduction

The significant fluctuations in the inter-domain inter-connection strategies have substantial ongoing consequences for backbone engineering which designs in the Internet-scale applications and research. Internet traffic engineering is an essential aspect of network design that can be used for governing the packet flow inside an IP network which leads to the performance assessment of IP networks. Improving network integrity and survivability by the process of routing can be considered as the resolution of traffic engineering which enables the reliable network operation. The Border Gateway Protocol (BGP) deploys the attributes that are accompanying with the BGP decision process that partially accomplishes the needs of the Internet service providers whereas the Locator/Identifier Separation Protocol (LISP) separates the locator and identifier in which identifiers are locally routable and locators are globally routable. Each locator is capable of providing a diverse path between the two identifiers. The routing table size can be reduced as well as the Internet scalability and resiliency can be upgraded by means of transit-edge hierarchical routing [1].

The main intention of inter-domain traffic engineering is to balance the traffic and dropping the cost of carrying the traffic. The autonomous system's connectivity can be maintained by customer-to-provider relationship and peer-to-peer relationship [2]. In addition to this, the traffic that are entering and leaving the network should be optimized. The outbound traffic can be controlled by choosing the route for the corresponding destination. This can be made possible by focusing on the local preference attribute for ranking the routes which shows how the packet crosses the transit ISP. The inward traffic can be controlled by announcing different route advertisements [2] based on the selective advertisements and by indicating the ranking among the different route advertisements that it sends. This can be achieved by focusing on the discriminator attribute that is used for sending packets towards a particular destination in which autonomous system is multi connected to each other. The inter-domain topology can be studied by the consideration of tier-1 ISP.

2. Locator/Identifier Separation Protocol Technology

Damien Saucez and Luigi Iannone reports the tremendous increase in the routing table size made a new way of redesigning the internet. The successful proposal is LISP which provides a mapping system that permits a given identifier to associate a set of locators and each locator offers a diverse path between two identifiers in which the locator refers to a node attachment point and identifier specify the connection endpoint. The Endpoint IDentifier (EIDs) recognizes end systems and comprises of IP addresses that are locally routable. The Routing LOCator (RLOCs) traces EIDs in the internet topology and contains of IP addresses that are globally routable. The communication is enabled among EIDs, LISP channels containers in the core internet from the RLOC of the source EID to the RLOC of the destination EID. The packet is being sent from the source EID to the destination EID and the sender creates a standard IP packet with EIDs as the source and the destination addresses which is advanced to the borer router of the source for channeling. The mapping comrades an EID prefix to a list of <RLOC, priority, weight> tuples [3]. RLOCs with the highest priority are taken and weight is used for load balancing. LISP is deployed in the internet for experiencing the steady growth. The alteration in the dynamics and the steadiness of the mapping query interval overlaps with the LISP network mark mapping switchover.

The design goals of building a new protocol are incremental deployability, limited number of affected boxes, non-disruptive namespace, core network transit and middle box traversal [4]. To fulfill these design goals three principles such as address role separation, encapsulation and mapping has to be considered. The address role separation is achieved by splitting the IP addresses into two groups such as the Routing LOCators (RLOCs) and the Endpoint Identifiers (EIDs). RLOCs are allocated to the border routers from the RLOCs space of Internet Service Providers whereas EIDs are allocated in the blocks extracted from the EID space to the stub network which is similar to edge networks that carries network from and to it. The encapsulation is the process of wrapping or packing up of data and it is done by the border routers of the packet's source site while the decapsulation operation is supported out by border routers of the packet's destination site. LISP outlines a front-end toward the mapping system which bind EIDs with RLOCs consists of two types of servers such as map servers and map resolvers. LISP offers the benefits of Locator/ID split paradigm while being incrementally deployable. The tremendous growth enables the routing and addressing infrastructure to face unforeseen scalability issues.

The association of locators to a particular identifier is the main objective of the address separation which leads to the new dimension to traffic engineering. This leads to the selection of best locator by controlling both incoming and outgoing packet flows. The router-based solution that is mainly designed for stub autonomous system is the LISP which is supported by border routers. The host addresses are called EIDs and LISP enabled routers are called RLOCs which are allocated by providers. The path selection mechanism reflects the operator requirements with respect to traffic engineering. The ISP-driven informed path selection is based on three modules such as Path Information Collector (PIC), Knowledge Base (KB) and Decision Engine (DE) [5]. PIC will collect information such as administrative information and measurement information. The attributes that are translated by PIC are stored in KB and it is similar to the database that combines several attributes of various paths. These paths are composed by DE for selecting the best one. Cost function is proposed by DE and it returns the cost of {source, destination} pair and lower the cost is better the path. The rankings are done with the help of cost function which return a value that denotes a path. The main reason behind the usage of cost function is that they can be gathered to form a complex function. LISP can be considered as the possible key to better scale the internet architecture. Since more number of locators can be attached to a particular identifier, it will result in the increase in the number of paths that are available between identifiers.

3. Multi-Protocol Label Switching Technology

Richard Douville and *etal* demonstrated the Generalized Multiprotocol Label Switching (GMPLS) technology that can be deployed for traffic engineering purpose where an inter Autonomous System (AS) Quality of Service (QoS) mechanism [14] is put forward to support inter-domain services. The inter-AS GMPLS-Traffic Engineering is an extension of the GMPLS traffic engineering technology which enables automatic provisioning of inter-domain traffic engineering [15] facilities. The GMPLS technology allows Label-Switched Paths (LSP) connection [13] which allows the possibility of routing explicitly by verifying resource availability, switching capability and end-to-end or sub path protection possibility [6]. Resource Reservation Protocol which is a signaling protocol is used for establishing GMPLS traffic engineering LSPs. For the application of important traffic engineering and security policies at the provider boundaries a common service plane is required. The inter-AS traffic engineering service is characterized by the parameters such as the address of head and tail routers, source and destination AS numbers, unidirectional or bidirectional direction and by means of bandwidth.

The inter-AS traffic engineering is the outcome of composition of service elements such as edge sender, edge destination and the transit where the edge sender declares routing from the head router of the sender AS toward an access router of adjacent AS and edge destination promises routing from an access router of the destination AS toward the end router and the transit declares routing from an access router of the AS toward an access router of the next AS. The service elements are characterized by the parameters such as local AS number, nature of the service and the maximum bandwidth. The functional elements required to automate the inter-AS GMPLS service composed of network layer, management layer and the service layer. For the establishment of inter-AS GMPLS service, initially the service elements have to be identified which is followed by the composition of same in which the AS chain of the LSP is determined. Service instantiation validates the availability of service elements combining the AS chain and service activation activates the service establishment. The inter-AS path is calculated and the inter-AS path is signaled by means of service signaling. The GMPLS traffic engineering technology supports the real time and interactive services which is deployed within provider boundaries.

4. Border Gateway Protocol Technology

X. Misseri and *etal* reports the internet possesses a very large path diversity which has been identified as essential for network robustness [11] and traffic engineering. The interconnected AS exchange the route information with the BGP. The lack of scalability because of BGP decision process is the main issue and based on this issue Map-and-Encap scheme [7] is proposed to take the advantage of path diversity. The encapsulation in the Map-and-Encap enables traffic refraction whereas mappings are used in the control plane to govern the refraction. Every BGP speaker totals the decision process to extract the best route for transit networks as the propagation of the diversity to neighbors facing scalability issues. The Map-and-Encap scheme permits a fine tuning of outbound traffic without any synchronization with its ISPs for ensuring high degree of connectivity for multihomed-AS. ISP can manage the mappings by ensuring path diversity to its customers. The tremendous amount of routes is a tradeoff between path diversity and routing overhead. The stability of routes does not significantly alter path diversity and they are essential for the scalability and the robustness.

The core-edge separation scheme on internet inter-domain routing is made possible by starting with the separation of stub ASes from transit ASes on routing system. This is done by examining the reduction in the BGP routing tables [12] and the growth of transit networks. After the separation the AS-level topological hierarchies of internet have to be decomposed. The decomposition will estimate the effect of core-edge separation [8]. The routing table size can be reduced by means of core-edge separation deployment. The real internet routing data can be used to analyze the impact of core-edge separation and it can improve the internet scalability. The movement of separation points in the upward direction will result in the growth of numbers of blocked prefixes and separation points. The one prefix can be mapped and the size of mapping between the blocked prefixes and separation points can be increased.

The interconnection of several autonomous system networks constitute the internet and the AS use BGP in order to exchange routing information between neighbors as well as to implement interconnection policies. The AS-level graph contains node and link in which a node represents an AS and a link represents BGP decision between ASes. Either by passively monitoring several backbone routing tables or by actively discovering the topology using trace route tool we can draw the AS-level graph [9]. The route deviations that affect internet routing can succeed the inter-domain routing protocol’s stability and the level of path diversity in the internet core. Each BGP router receive multiple announces of its IP network addresses from its neighbors towards the same destination network in which it select the best path by means of local preference and smallest AS hop count. While characterizing the AS-level multipath routing two performance factors such as width and delta are considered. The width determines the number of different paths used to reach the destination and delta determines the AS-hop difference between shortest and largest path. AS-level route deviations occur when a BGP router receives a better AS-path that the one used for the destination. With more available paths, the internet reliability can be increased with the help of AS-level multipath routing.

5. Conclusion

The purpose of this paper is to compare various inter-domain traffic engineering technologies based on protocols. The paper discusses three technologies of inter-domain traffic engineering. A mapping system is provided by LISP that allows a given identifier to associate a set of locators. The MPLS technology allows resource availability and switching capability whereas the BGP does not enable traffic engineering responsibilities. It includes load balancing across several links to AS neighborhood and traffic direction to diverse neighbor. The small number of autonomous system can contribute to a large fraction of the traffic which includes the incoming and the outgoing by the ISPs. The characteristics of inter-domain traffic can be analyzed on the basis of measurements from ISPs and a small number of sources are responsible for large fraction of traffic. The inter-domain traffic engineering approach shows transit path diversity and routing stability that can be achieved in terms of resiliency.

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