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On-demand Interdomain Path Building Protocol

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Abstract

Ill structured interdomain routing protocol makes interdomain route selection uncontrollable. To solve this problem, an on-demand interdomain path building protocol(OIPBP) is proposed in this paper. The main characteristic of OIPBP is that routers can lay control over the path selection process of their downstream nodes and customize the routes according to their own requirements. In order to achieve this goal, we extend BGP by adding more policies options into routing advertisements, and the inserted policies can be referred by the intermediate nodes when selecting paths. We verify OIPBP has good performance by experiments.

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Keywords: interdomain routing, OIPBP, BGP, path selection

1. Introduction

There are two reasons that make interdomain routing uncontrollable. First, ASes can only get the routes advertised by other ASes. BGP is taken as the de facto interdomain routing protocol for the Internet. BGP gives each AS significant flexibility in deciding which routes to select and export. However, the available routes depend on the composition of the local policies in the downstream ASes, limiting the control each AS has over path selection. Second, in the intradomain routing, the management complexity of the networks arises mainly due to the interaction of ever increasing functionalities, and their required state information, with the distributed nature of routing design, in which each router independently computes and maintains the state required for its operation. Some research has been done to improve the controllability of Internet routing in recent years. For improving the controllability of interdomain routing, source routing[1-3],overlay networks[4] and multi-path routing[5-8] are proposed. For improving the controllability of intradomain, routing logically centralized intradomain control fashion such as RCP[9-10] and 4D[11-12] are proposed and studied in recent years. This paper is our initial effort in improving the controllability of interdomain routing of the Internet.

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Internet consists of thousands of independently administered domains (or Autonomous Systems) that rely on the Border Gateway Protocol (BGP) to learn how to reach remote destinations. Although BGP allows ASes to apply a wide range of routing policies, the protocol requires each router to select a single "best" route for each destination prefix from the routes advertised by its neighbors. This leaves many ASes with little control over the paths that the traffic takes. For example, an AS might want to avoid paths traversing a bad performance AS. Figure 1 is an example of this situation, where the source node S hopes to have a primary path SAD and another backup path not traversing node A for high reliability to destination D. These paths should exist since SAD and SBCEFD don't conflict with any network policy, however, S can't receive all these two paths because CEFD is filtered in node C by BGP's shortest-path rule.

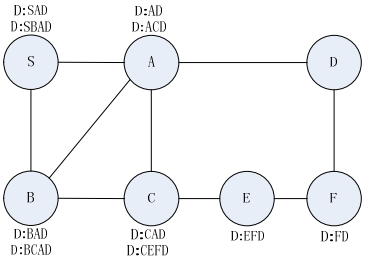

Fig. 1. BGP routing

Recent researches have considered several alternatives ways to interdomain routing over BGP, including source routing, overlay networks and interdomain multipath routing. In source routing, stub ASes have complete topology of the whole network and picks the entire path that packets traverse[1 – 3]. In overlay networks, packets can travel through intermediate hosts to avoid performance or reliability problems on the direct path[4]. The main idea of multi-path routing is to distribute more routes information, the way to achieve this goal is keeping BGP unchanged and extending BGP to transmit multi paths for one destination address. However, these techniques all have obvious shortcomings. The lack of control for ISPs is a significant impediment to the eventual adoption of source routing. In addition, both source routing and overlay networks may not scale to the size of the Internet. Multi-path proposal is limited to backup[8] or the success rate is unsatisfying. Instead, we explore a solution where downstream nodes are capable of control upstream ASes to select routes according to their requirements.

For simplicity, in the rest of the paper we use node representing AS of Internet, source node denoting the packets sender and also the starting point of the path, destination node denoting the receiver of packets and also the terminal of the path. Our solution is motivated by the fact about today's interdomain routing system: 1) At this stage, the routes provided by BGP are enough for most nodes in the Internet; 2) A small part of nodes has the diverse performance requirements and each router selects and advertises a single route for each prefix is not flexible enough. The main reason of the unsatisfying fact is that the downstream nodes just transmit the "shortest" path, which can't always represent the requirements of upstream nodes. This paper hopes to extend current BGP to a new protocol in which the upstream nodes are capable of laying control over the path selection of downstream nodes. Since current BGP can satisfy most nodes' need, we do not hope to change the logic framework of BGP much. Because the available routes of upstream nodes are decided by the downstream nodes in BGP, if the upstream nodes hope the downstream nodes to select paths according to their own needs, the requirements of the upstream nodes must be submitted to the downstream nodes before path selection.

The main idea of this paper is as follows: BGP is used to ensure the reachability of the source nodes and destination nodes. Based on this any source node that needs to build special paths sends the request to the corresponding destination node and the destination node starts an extra network convergence process to help the source build the satisfying paths. Our main contributions are as follows: 1) we extend BGP to a new protocol called P-BGP(Policy-based BGP) whose significant characteristic is more policy options are added into the routing