Improving Routing Performance and Resource Allocation of Overlay Routing Relay Nodes

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ABSTRACT

Overlay routing improves TCP performance and delay between peer to peer. In this we are considering the imaginary path if there is no physical path between the nodes that decreases the delay and increases the TCP performance. In earlier days also we are using overlay routing including schemes like BGP routing etc. But in those days they didn't consider the optimization of paths and TCP performance. In this paper we rigorously study the optimization problem and TCP throughput. In this paper, we rigorously study this optimization problem. We show that it is NP-hard and derive a nontrivial approximation algorithm for it, where the approximation ratio depends on specific properties of the problem at hand. We examine the practical aspects of the scheme by evaluating the gain one can get over several real scenarios. The first one is BGP routing, and we show, using up-to-date data reflecting the current BGP routing policy in the Internet, that a relative small number of less than 100 relay servers is sufficient to enable routing over shortest paths from a single source to all autonomous systems (ASs), reducing the average path length of inflated paths by 40%. We also demonstrate that the scheme is very useful for TCP performance improvement (results in an almost optimal placement of overlay nodes) and for Voice-over-IP (VoIP) applications where a small number of overlay nodes can significantly reduce the maximal peer-to-peer delay.

Keywords: Autonomous Systems (ASs); Voice-over-IP (VoIP)

I. INTRODUCTION

Overlay routing has been planned in recent years as an effective thanks to accomplish sure routing properties, without going into the long and tedious method of standardization and world readying of a replacement routing protocol. For example, overlay routing was wont to improve protocol performance over the net, wherever the most plans is to interrupt the end-to-end electric circuit into smaller loops. This needs those nodes capable of playing protocol Piping would be gift along the route at comparatively tiny distances. Different examples for the use of overlay routing square measure come like West Chadic and Detour, wherever overlay routing is employed to boost reliableness. Yet another example is that the thought of the "Global-ISP" paradigm introduced [1], wherever AN overlay node is employed to cut back latency in BGP routing. In order to deploy overlay routing over the particular physical infrastructure, one has to deploy and manage overlay nodes that will have the new additional practicality. This comes with a non eligible value each in terms of capital and operational prices. Thus, it is vital to check the bean work one gets from raising the routing metric against this value [2].

In order to deliver the overlay routing across over the actual physical infrastructure, someone needs to deliver and manage overlay nodes that will have the new extra functionality and with a non-negligible cost both in terms of capital and operating costs. Thus, it is important to study the benefit one gets from improving the routing metric against this cost. In this paper, we concentrate on this point and study the minimum number of infrastructure nodes that need to be added in order to maintain a specific property in the overlay routing [3]. In the shortest-path routing across over the Internet BGP-based routing example, this question is mapped with the minimum number of relay nodes that are needed in order to make the routing between a group of autonomous systems (ASs) use the underlying shortest path within them, In TCP performance , this may finds the minimal number of relay nodes needed in order to make sure that for each TCP connection, there is a path within the connection endpoints for which every predefined round-trip time (RTT), there is an overlay node capable of TCP Piping. Regardless of the specific conclusion in mind, we define a general optimization problem called the Overlay Routing Resource Allocation (ORRA) problem and study its complexity which turns out that the problem is NP-hard, and we present a non trivial approximation algorithm for it. Note that if we are only interested in improving routing properties between a single source node and a single destination [4, 5], then the problem becomes easy, and determining the optimal number of nodes becomes trivial since the potential candidate for overlay placement is less, and assignment would be good.

In the shortest-path routing over the Internet BGP-based routing example, the question is mapped to: What is the minimum number of relay nodes that are needed in order to make the routing between a groups of autonomous systems (ASs) use the underlying shortest path between them? In the TCP performance example, this may translate to: What is the minimal number of relay nodes needed in order to make sure that for each TCP connection, there is a path between the connection endpoints for which every predefined roundtrip time (RTT), there is an overlay node capable of TCP Piping [7].

Regardless of the specific implication in mind, it define a general optimization problem called the Overlay Routing Resource Allocation (ORRA) problem and study its complexity .It turns out that the problem is NP-hard, and It present a nontrivial approximation algorithm for it. Note that they are only interested in improving routing properties between a single source node and a single destination, then the problem is not complicated, and finding the optimal number of nodes becomes trivial since the potential candidate for overlay placement is small, and in general any assignment would be good. However, when it considers one-to-many or many-to-many scenarios, then a single overlay node may affect the path property of many paths, and thus choosing the best locations becomes much less trivial [6].

By testing this algorithm in three specific such cases, where It have a large set of source–destination pairs and the goal is to find a minimal set of locations, such that using overlay nodes in these locations allows to create routes (routes are either underlay routes or routes that use these new relay nodes) such that a certain routing property is satisfied. Note that the algorithmic model we use assumes a full knowledge of the underlying topology, the desired routing scheme, and the locations of there quires end points. In general, the algorithm is used by the entity that needs the routing improvement and carries the cost of establishing and maintaining overlay nodes, using the best available topology information [8]. For example, in the VoIP case, the VoIP application is establishing the overlay nodes, and thus the application can gain by using our approach. The main contributions of this paper are as follows.

• We develop a general algorithmic framework that can be used in order to deal with efficient resource allocation in overlay routing.

• We develop a nontrivial approximation algorithm and prove its properties.

• We demonstrate the actual benefit one can gain from using our scheme in three practical scenarios, namely BPG routing, TCP improvement, and VoIP applications.

II. RELATED WORK

Using overlay routing to improve network performance is motivated by many works that studied the in efficiency of varieties of networking architecture sand applications. Analyzing a large set of data, explore the question: How ―good‖ is Internet routing from a user's perspective considering round-trip time, packet loss rate, and bandwidth? They showed that in 30%–80% of the cases, there is an alternate routing path with better quality compared to the default routing path. The authors show that TCP performance is strictly affected by the RTT. Thus, breaking a TCP connection into low-latency sub connections improves the overall connection performance [9]. And also in many cases, routing paths in the Internet are inflated, and the actual length (in hops) of routing paths between clients is longer than the minimum hop distance between them. Using overlay routing to improve routing and network performance has been studied before in several works. The routing in efficiency in the Internet and used an overlay routing in order to evaluate and study experimental techniques improving the network over the real environment. While the concept of using overlay routing to improve routing scheme was presented in this work, it did not deal with the deployment aspect sand the optimization aspect of such infrastructure. Here mainly focuses on relay placement problem, in which relay nodes should be placed in an intra domain network [10].

An overlay path, in this case, is a path that consists of two shortest paths, one from the source to a relay node and the other from the relay node to the destination. The objective function in this work is to find, for each source– destination pair, an overlay path that is maximally disjoint from the default shortest path. This problem is motivated by the request to increase the robustness of the network in case of router failures. They introduce a routing strategy, which replaces the shortest-path routing that routes traffic to a destination via predetermined intermediate nodes in order to avoid network congestion under high traffic variability. The first to actually study the cost associated with the deployment of overlay routing infrastructure.

Considering two main cases, resilient routing, and TCP performance, they formulate the intermediate node placement as an optimization problem, where the objective is to place a given number intermediate nodes in order to optimize the overlay routing and suggested several heuristic algorithms for each application. Following this line of work, the resource allocation problem in this paper as a general framework that is not tied to a specific application, but can be used by any overlay scheme. Moreover, unlike heuristic algorithms, the approximation placement algorithm presented in our work, capturing any overlay scheme, ensures that the deployment cost is bounded within the algorithm approximation ratio [11].

Node placement problems have been studied before in different contexts in many works, considering web cache and web server placement .overlay node placement is fundamentally different from these placement problems where the objective is to improve the routing using a different routing scheme rather than pushing the content close to the clients. Roy et al. were the primary to really study the price related to the readying of overlay routing infrastructure Considering two main cases, resilient routing, and transmission control protocol performance [15], they formulate the intermediate node placement as associate optimization drawback, wherever the target is to put a given number intermediate nodes so as to optimize the overlay routing, and prompt many heuristic algorithms for every application. Following this line of labor, we have a tendency to study this resource allocation drawback during this paper as a general framework that's not tied to a specific application, however is employed by any overlay scheme. Moreover, not like heuristic algorithms, the approximation placement algorithmic rule bestowed in our work, capturing any overlay theme, ensures that the readying value is delimited within the algorithmic rule approximation quantitative relation. Node placement issues are studied before in several contexts in several works [12, 13], considering net cache and net server placement. However, as stated in, overlay node placement is basically totally different from these placement issues wherever the target is to enhance the routing employing a totally different routing theme instead of pushing the content near the shoppers [14].

III. PROPOSED SYSTEM

In this paper, we concentrate on this point and study the minimum number of infrastructure nodes the need to be added in order to maintain a specific property in the overlay routing. In the shortest-path routing cross over the Internet BGP based routing example, the question of what is the minimum number of relay nodes that are needed in order to make the routing between a groups of autonomous systems (ASs) use the underlying shortest path between them. In the TCP performance, this may translate to the minimal number of relay nodes needed in order to make sure that for each TCP connection, there is the path between the connection endpoints for which every predefined round-trip time(RTT),and there is the overlay node capable of TCP Piping .Regardless of the specific conclusion in mind, we define the general optimization problem called as Overlay Routing Resource Allocation (ORRA) problem and It turns out the NP-hard, also we present a nontrivial approximation algorithm for it.

Given a graph describing a network, let be the set of routing paths that is derived from the underlying routing scheme, and let be the set of routing paths that is derived from the overlaying routing scheme. Note that both and can be defined explicitly as a set of paths, or implicitly, e.g., as the set of shortest path switch respect to a weight function over the edges. Given a pair of vertices denote by the set of overlay paths. Given a graph, a

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set of source–destination pairs (where), a set of underlay paths, and a set of overlay paths, find a subset of vertices such that, covers.

Using the assumption that single-hop paths are always sin the set is a trivial feasible solution to the ORRA problem. For instance, consider the graph depicted in Fig. 1, in which the underlying routing scheme is minimum hop count, and the overlay in grouting scheme is the shortest path with respect to the edge length. In this case, the underlay path between and is, while the overlay path between them should be or similarly, the underlay path between and is while the overlay path between them should be or. Deploying relay nodes on and implies that packets from two can be routed through the concatenation of the following underlay paths and while packets from to can be routed through the concatenation of the following underlay paths and .Thus, is a feasible solution to the corresponding ORRA problem. I fall the nodes have an equal weight, and then one may observe that this is also an optimal solution.

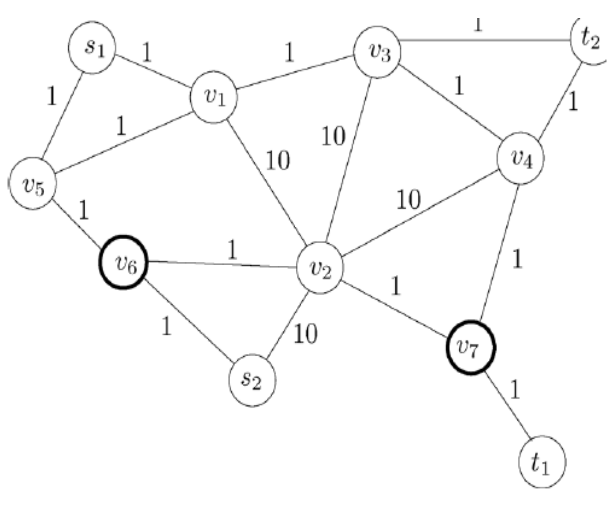
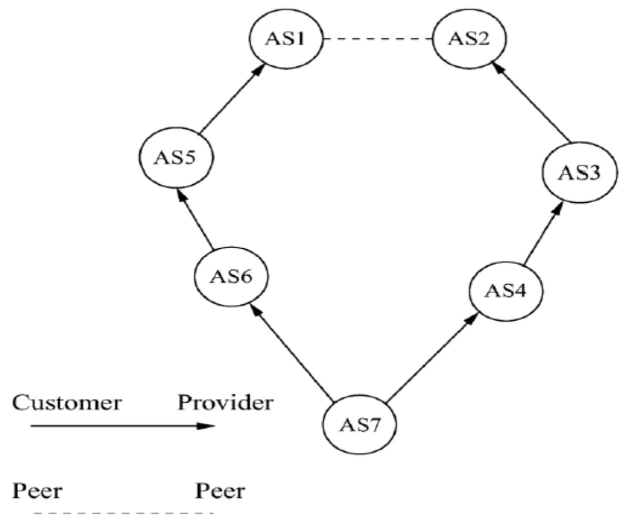


Figure 1. Overlay routing example: Deploying relay server on and enables overlay routing.

BGP Routing Scheme: BGP is a policy-based inter domain routing protocol that is used to determine the routing paths between autonomous systems in the Internet. In practice, each AS is an independent business entity and the BGP routing policy reflects the commercial relationships between connected Ass. A customer–provider relationship between ASs means that one AS (the customer) pays another AS (the provider) for Internet connectivity, a peer–peer relationship between ASs means that they have mutual agreement to serve their customers, while a sibling–sibling relationship means that they have mutual-transit agreement (i.e., serving both their customers and providers). These business relationships between ASs induce a BGP export policy in which an AS usually does not export its providers and peers routes to other providers and peers. The authors showed that this route export policy indicates that routing paths do not contain so-called valleys or steps. In other words, after traversing a provider–customer or a peer–peer link, a path cannot traverse a customer–provider or a peer-peer link. This routing policy may cause, among other things, that data packets will not be routed along the shortest path. While routing which an AS usually does not export its providers and peers routes to other providers and peers. Some researchers showed that this route export policy indicates that routing paths do not contain so-called valleys or steps. In other words, after traversing a provider–customer or a peer–peer link, a path cannot traverse a customer–provider or a peer-peer link. This routing policy may cause, among other things, that data packets will not be routed along the shortest path. For instance, consider the AS topology graph depicted in Fig.2. In this example, a vertex represents an AS, and an edge represents a peering relationship between

ASs. While the length of the physical shortest path between AS6 and AS4 is two (using the path AS6, AS7, AS4), this is not a valid routing path since it traverses a valley. In this case, the length of the shortest valid routing path is five (using the path AS6, AS5, AS1, AS2, AS3, AS4). In practice, using real data gathered from 41 BGP routing tables, Gao and Wand showed that about 20% of AS routing paths are longer than the shortest AS physical paths.

While routing policy is a fundamental and important feature of BGP, some application may require to route data using the shortest physical paths.3 In this case, using overlay routing, one can perform routing via shortest paths despite the policy. In this case, relay nodes should be deployed on servers located in certain carefully chosen ASs. Considering such a scenario, the corresponding ORRA instance consists of the AS topology graph, the set of valid routing paths derived from the BGP routing algorithm, which is the underlay paths, and the set of shortest physical paths that is the overlay paths. The set of source–destination pairs may be different from one instance to another, and it may include one-to-many, many-to-many, or a combination thereof. The fact that the overlay routing scheme is the set of the shortest physical paths simplifies the execution of the algorithm, and finding a minimal Overlay Vertex Cut required in Step 4 of the algorithm becomes less complex as finding a Vertex Cut separating two nodes.



Advantages of Proposed System

- We are only interested in improving routing properties between a single source node and a single destination, then the problem is not complicated, and finding the optimal number of nodes becomes trivial since the potential candidate for overlay placement is small, and in general any assignment would be good.
- When we consider one-to-many scenarios, then a single overlay node may affect the path property of many paths, and thus choosing the best locations becomes much less trivial.

Conclusion:

While using overlay routing to improve network performance was studied in the past by many works both practical and theoretical, very few of them consider the cost associated with the deployment of overlay infrastructure. In this paper, It addressed fundamental problem developing an approximation algorithm to the problem. Rather than considering a customized algorithm for a specific application or scenario, it suggests a general framework that fits a large set of overlay applications. Considering three different practical scenarios, it evaluates the performance of the algorithm, showing that in practice the algorithm provides close-to-optimal results. Many issues are left for further research. One interesting direction is an analytical study of the vertex cut used in the algorithm. It would be interesting to find properties of the underlay and overlay routing that assure a bound on the size of the cut. It would be also interesting to study the performance of our framework for other routing scenarios and to study issues related to actual implementation of the scheme.

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