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General Frame Work to Improve the Networks Performance by Providing a Resource Allocation Technique to Overlay Network Using Logical Nodes

Nagaraj[1] and Vinayak Biradar[2]

[1] Student (M.Tech) Department of Computer Science & Engineering, BKIT Bhalki, Karnataka, India
[2]Department of Computer Science & Engineering, BKIT Bhalki, Karnataka, India

Abstract–*Overlay networks creates a virtual topology on top of the physical topology, in other words it is application specific computer networks build on top of another network can be through of an being connected by logical links. Such a logical links corresponds to a path in the under laying network. An obvious example of these networks is the peer-to-peer networks, which runs on top of the internet. Overlay networks have no control over the packet when routing through overlay source / destination nodes. Overlay networks gives the permission to route the packet to destination even the address not known in advance. We have a problem in finding the minimum number of overlay nodes such that the required quality of service is to e provided.*
In this paper, we had study this optimization problem. We also evaluated some other real modules. The first is path-vector routing here we are reducing the average path length of inflected path by 35%.The second is TCP performance improvement using overlay nodes. The Third is IP Telephony applications using overlay networks.

Index Terms*: Overlay Networks, TCP, Peer-to-peer Networks*

1. INTRODUCTION

The overlay routing has been implemented for to gain a quality of services in networks so that we allocated resources for to transmit a data (packet) from source to destination using a logical links or logical nodes.

The overlay routing is used for improving a path-vector routing by using a minimum number of intermediate resources and also we improve the performance of TCP by using these nodes and other application oriented service called IP Telephony. I order to build overlay routing on top of the network so we need to manage the overlay infrastructure for that need to face some complexity.

In this paper we concentrate on this maintains cost matter so that we choose minimum intermediate resources and providing a quality on the service. The TCP is a transport layer protocol a reliable service by using an automatic repeat request (ARQ).TCP provides congestion control, using a sliding window scheme. As a connection oriented protocol, TCP requires a connection to be established between each two applications. After establishing a path connection, TCP delivers packet in the sequence and in byte stream. Path-vector routing is used to send information to each of a router neighbors, and then each router builds up a routing database. IP telephony uses packet-switched networks to carry voice traffic in addition to data traffic. The basic scheme of IP telephony starts with pulse code modulation.

2. RELATED WORK

Using overlay routing to improve network performance is motivated by many works that studied the inefficiency of vari-1This phenomenon is due to the fact that we want shortest paths. When we consider different metrics, for example bounded delay (as discussed in the third scenario), this affect is much smaller, and the gain in the many-to-many case is also significant. eties of networking architectures and applications. In [1], 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. In [4], [5], and [6], the authors show that 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. In [3], the authors studied the routing inefficiency 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 aspects and the optimization aspect of such infrastructure. A resilient overlay network (RON), which is architecture for application-layer overlay routing to be used on top of the existing Internet routing infrastructure, has been presented in [1]. Similar to our work, the main goal of this architecture is to replace the existing routing scheme, if necessary, using the overlay infrastructure. This work mainly focuses on the overlay infrastructure (monitoring and detecting routing problems, and maintaining the overlay system), and it does not consider the cost associated with the deployment of such system. In [2], the authors study the relay placement problem, in which relay nodes should be placed in an intradomain network. 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. The authors 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. Were 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, we study this 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.

3. MODEL AND PROBLEM DEFINITION

Given a graph G=(V,E) describing a network, let P_u be the set of routing paths that is derived from the underlying routing scheme, and let P_0 be the set of routing paths that is derived from the overlaying routing scheme. Note that both P_u and P_0 can be defined explicitly as a set of paths, or implicitly, e.g., as the set of shortest paths with respect to a weight function W: E→R over the edges. Given a pair of vertices s, t Є V, denote by $P^{s,t}_0$ the set of overlay paths between s and t.

Definition : Given a graph G=(V,E), a pair of vertices (s, t), a set of underlay paths P_u, a set of overlay paths $P^{s,t}_0$, and a set of vertices U & V. For instance, consider the graph depicted in Fig. 1, in which the underlying routing scheme is minimum hop count, and the overlaying routing scheme is the shortest path with respect to the edge length. In this case, the underlay path between s1 and s3 is (s1, n1, n3, n5, n7, s3) while the overlay path between them should be (s1, v1, v4, v6, v7, v8, s3). Similarly, the underlay path between s2 and s3 is (s2, n3, n4, n6, n7, s3), while the overlay path between them should be (s1, v2, v3, v5, v6, v8, s3). Deploying relay nodes on v6 and v7 implies that packets from s1 to d1can be routed through the concatenation of the following underlay paths (s1, v1), (v4, v6, v7) and (v8, s3), while packets from s2 to d2 can be routed through the concatenation of the following underlay paths (s2, v2), (v3, v5, v6), and (v8, s3). Thus, U= {v6, v7} is a feasible solution to the corresponding Resources Placement problem.

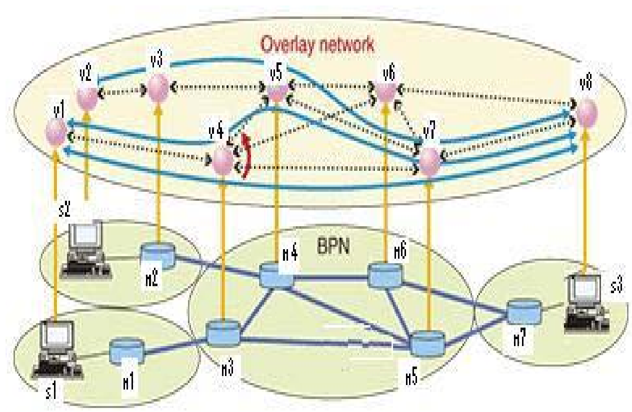

Fig. 1: Overlay networks.

4. THE RESOURCES PLACEMENT PROBLEM

The recursive algorithm RP (G= (V, E), W, Pu, Po, U), shown at the top of the next page, receives an instance of the *RP* problem (a graph, a nonnegative weight function W over the vertices, a set of underlay and overlay paths P_u and P_o, respectively) and a set of relay nodes U and returns a feasible solution to the problem. The set of relay nodes in the first call is empty (i.e.U=Φ). At each iteration, the algorithm picks vertices with weight that is equal to zero until a feasible set is obtained (steps 1 and 2 of the algorithm). Thus, since at each iteration at least one vertex gets a weight that is equal to zero with respect to (steps 5–7), then in the worst case the algorithm stops after |V| iterations and returns a feasible set. In Step 9, unnecessary vertices are removed from the solution, in order to reduce its cost. While this step may improve the actual performance of the algorithm, it is not required in the approximation analysis below and may be omitted in the implementation.

Algorithm RP (G= (V, E), W, Pu, Po, U)
1. v Є V\ U, if w(v)=0 then U← {v}
2. If U is a feasible solution returns U
3. Find a pair (s,t) Є Q not covered by U
4. Find a (minimal) Overlay Vertex Cut V1 (V1 ∩ U= Φ) with respect to (s, t)
5. Set Є=minv Є v1 w(v)

6. Set w1(v)=v€ V1 , otherwise 0.
7.∀v set w2(v)=w(v) –w1(v)
8.RP(G,W2,Pu,Po,U)
9. ∀v € U if U\ {v} is a feasible solution then set U= U\ {v}
10. Returns U

5. CASE STUDY AND EXPERIMENTAL RESULTS

In this section, we examine the actual use and the resulting performance of the *RP* algorithm in three practical scenarios.

6. PATH-VECTOR ROUTING

BGP is a policy-based interdomain 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.

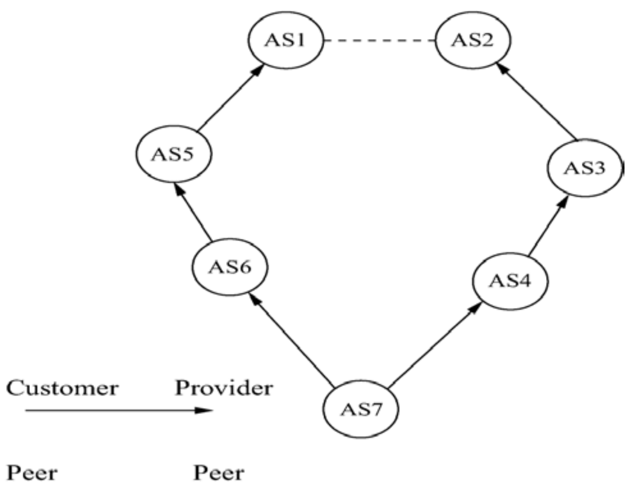

Fig. 2: Path-Vector outing. The shortest valid path between AS6 and AS4 is longer than the shortest physical path between them

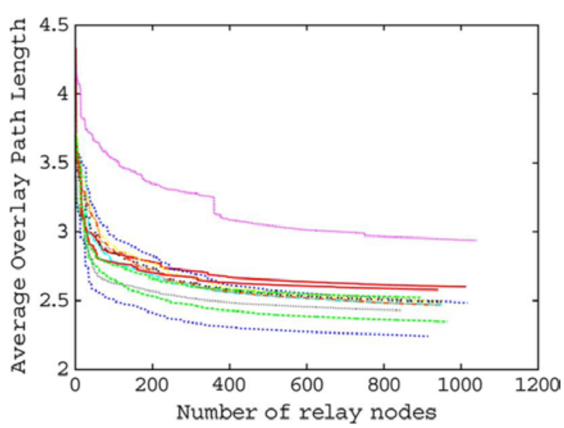

Fig. 3: Average path length versus number of relay nodes, Path-Vector Routing scenario. Each line represents a single source.

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, 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.

7. TCP PERFORMANCE

Using overlay routing to improve TCP performance has been studied in several works in recent years [1], [7]. In particular, the TCP protocol is sensitive to delay, and there is a strict correlation between TCP throughput and the RTT. Thus, it may be beneficial to break high-latency TCP connections into a few concatenated low-latency subconnections. In this case, the set of relay nodes is used as subconnection endpoints, and the objective is to bound the RTT of each one of these subconnections. For instance, assuming that each link in the network depicted in Fig. 4 has a similar latency, the TCP connection between and can be broken using the relay node located in into two subconnections (between and , and between and) reducing the maximum.

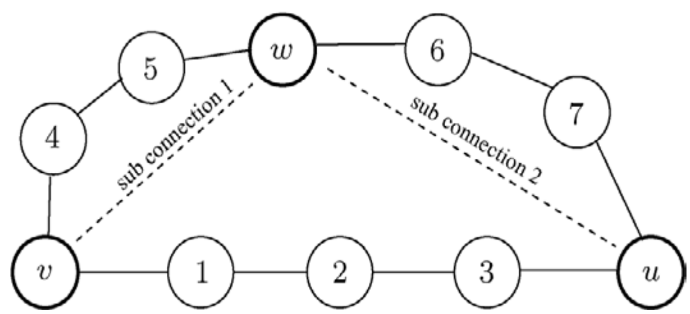

Fig. 4: Breaking a TCP connection into two subconnections reducing the maximum RTT.

8. IP TELEPHONY

While shortest path is a common routing scheme, it may not optimize the routing delay between network clients. In this case, the service of delay sensitive applications may be harmed. VoIP, for example, is a network technology that uses the Internet to carry voice signals. VoIP applications such as Skype, Google Talk, and others are becoming more and more popular offering IP telephone services for free. By its nature, the quality of VoIP calls is sensitive to network delay, and a considerable amount of effort is put in, in order to reduce the delay between clients in order to achieve better quality. In particular, while a one-way delay of 150 ms is noticeable by most users but in most cases is acceptable, a one-way delay over 400 ms is unacceptable. In peer-to-peer overlay networks, routing is normally done using the underlying IP routing scheme, however one can use our overlay routing scheme to improve end-to-end latency. For example, one may perform routing via bounded delay paths despite the underlying shortest-path routing scheme; in this way, routing will be done using overlay nodes along paths where the overall delay is no more than say 200 ms if such a path exists, and otherwise along a path with the minimal possible delay.

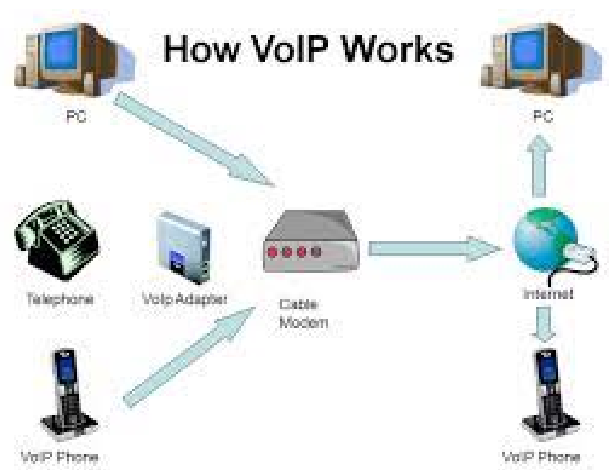

Fig. 4: Structure of IP Telephony.

9. CONCLUSION

While using overlay routing to improve network performance was studied in the past by any works both practical and theoretical, very few of them consider the resource allocation with the deployment of overlay infrastructure. In this paper, we addressed this fundamental problem developing a resource placement algorithm to the problem. Rather than considering a customized algorithm for a specific application or scenario, we suggested a general framework that fits a large set of overlay applications. Considering three different practical scenarios, we evaluated 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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