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Techniques for improving performance in managed overlays network

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Abstract. During the last years, overlay networks have become one of the most prominent tools for Internet research and development. With overlay networks networking users, developers and application users can easily design and implement their own communication environment and protocols on top of the Internet. It is network on the top of existing network provide additional services. It is a virtual network of nodes and logical links on the top of existing network but the network defines addressing, routing and service model for communication b/w hosts. Some applications in which overlay networks are distributed systems such as cloud computing, peer-to-peer networks, and client-server applications. It is used in designing own environment like data routing and file sharing management. In this paper we will discuss various parameters which effect the performance of managed overlays.

Keywords: Overlay, RouteSeer, Division Streaming, SON

1. Introduction

There are two broad types of overlay networks: peer-to-peer networks and infrastructure overlay networks. A peer-to-peer network (p2p) is a highly dynamic environment governed by the churn of the peer nodes. Compared with highly dynamic p2p, an infrastructure overlay has much better connectivity, higher persistence and availability. Moreover, it is typically managed by a single administrative entity. Therefore, infrastructure overlays are the most effective in fully realizing the potential benefits of overlay routing. When we talk about performance of managed overlays which include service overlays and centralized overlays, i.e., networks in which all nodes have knowledge of the entire overlay. Global knowledge of the nodes can be used to design overlays based on node capabilities while managed overlays with dedicated nodes offer the possibility of network design by carefully placing nodes in the underlying network. [1].

2. RouteSeer

To fully realize the potential of overlay routing under the constraints of deployment costs in terms of hardware, network connectivity and human effort, it is critical to carefully place infrastructure overlay nodes to balance the trade-off between performance and resource constraints. RouteSeer is used to solve the problem of overlay node placement and Maximal Disjoint Path problem. It place intermediate nodes by examining the routing tables at the overlay nodes. RouteSeer can substantially increase the protection of overlay links [1]. An overlay link is called resilient if there exist an intermediate overlay node through which a connection can be established even if there is a failure in the underlying network links between the overlay nodes. RouteSeer is used to design the manage overlay network to evaluate the performance of path protection scheme using network characteristics such as packet loss and latency. RouteSeer is an algorithm to place nodes in service overlays to create resilient paths between overlay nodes. It examines local routing information at the overlay nodes to place a few intermediate nodes such that the overlay links are protected by a disjoint path through an intermediate node. Much prior work has been devoted to the problem of link selection and network maintenance, with an assumption that the overlay nodes are given (e.g., [4, 5, 60, 7]). RouteSeer is used in node placement problem. Node placement clearly constrains the ability of the overlay to meet a particular performance. Node placement can be done in two phase. In first phase place overlay nodes called client proxies "close" to the clients. For placing nodes or services in proximity to clients has been done in [10, 12]. In second phase the placement of other overlay nodes such that links between client proxies are protected. An alternate disjoint overlay path exists for each direct path between client proxies. This is illustrated in figure

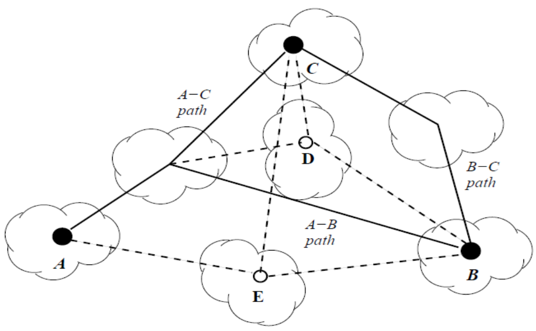

Fig. 1. Intermediate node placement example

Nodes A, B and C are client proxies and the direct paths between nodes A, B and C are shown using solid lines while the dotted lines indicate overlay paths. Using node

D as an intermediate node provides protection to the direct path between B and C but not to paths A–B and A–C as the path A–D shares common links with both paths. On the other hand, using node E as an intermediate node provides protection to all paths between A, B and C.2 Based on measurements, a set of intermediate node locations can be chosen. One approach to identifying intermediate nodes involves active measurements between potential node locations, with the objective of minimizing the number of shared network links [9, 8].These approaches require that the overlay network provider already have access to the full set of potential node locations, since this is needed to conduct the measurements. RouteSeer is based on the simple idea of examining routing tables at a few locations in the network to place the nodes. Technique proposed by [1] can examine the entire network topology, rather than a limited set of locations, for potential overlay node locations while requiring much less active probing of the network than previous proposals. It first examines the information provided by routing tables at the set of client proxies of the service overlay.

2.1 RouteSeer Algorithm

Following factors must be taken into consideration when placing the overlay nodes. Overlay network will be useful to clients if the placement of the overlay nodes should reflect the locations of the clients. Nodes providing service to the clients should be close to them. Client nodes connect to the overlay network for short periods of time. RouteSeer takes a three-step approach to placing overlay nodes in the network.

2.1.1 Client Proxies

The use of client proxies frees the clients from running any routing protocol to discover the routes to destination nodes. Place special overlay nodes, called Client Proxies or CPs, close to the clients of the overlay network. Close means the number of hops, latency or any metric that the overlay application requires. Client proxies act on behalf of the clients that connect to them. Problem space problem can also be reduced from finding resilient paths between each pair of clients to finding resilient paths between each pair of client proxies. Some methods have proposed by Krishnamurthy and Wang [10] or Barford et al. [12] to place the client proxies.

2.1.2 Get potential locations

RouteSeer next attempts to place intermediate overlay nodes to provide path diversity for the paths between client proxies. There are two assumptions:

1. The network layer uses shortest path routing when forwarding packets.
2. Network paths are symmetric, i.e., the path from a node i to a node j is the same as the path from j to i.

To get the potential location it uses Reachability table and forwarding table. The forwarding tables at each of the proxies are represented in the usual manner by tuples of the form <address prefix, next hop>. Each next hop in the table corresponds to one of the network layer. Forwarding tables is used to generate a reachability table where the entries are of the form next hop, address prefix.

2.1.3 Compute feasible locations:

Once the set Aij is created for a pair of client proxies, we store this information in a table called the Global Address Table (GAT). At the end of this process, each entry in the GAT contains the number of paths for which the address prefix is a potential location of an overlay node. The address prefixes from the GAT which are copied to S (the set of paths stored in the corresponding row in the GAT) form the available address prefixes from which the next address prefix is to be selected. The algorithm works in the following manner: iteratively, the address prefixes in S are ranked in order of the number of client proxy paths for which the address prefixes are potential overlay node locations. The highest ranking address prefix p is removed from S and added to SA. Since p is a potential location for a set of client proxy pairs which no longer have to be considered by the remaining address prefixes, all remaining address prefixes that also are potential locations for these pairs have their counts decremented. This process is repeated K times to extract K address prefixes.

2.2 Parameter effect the performance of RouteSeer

The RouteSeer algorithm uses the routing table information to create a snapshot of the local network topology in order to place the overlay nodes. The routing table can be both static and complete, i.e., the entries do not change and the entire routing table for all client proxies is available. Clearly, the routing table of an AS can change due to many external factors such as route advertisements, failures and withdrawals. It can also change due to decisions made at the AS such as Intelligent Route Control (IRC) for load balancing, pricing decisions and performance. The completeness of the routing tables available for use in RouteSeer is not guaranteed. The routing tables available may have entries for only a subset of ASes and some of these maybe wrong as well. This scenario is shown in Figure 2 in which the path from CPi to CPj (shown by the solid line) is protected by the indirect path (shown by the dotted line) through overlay node Ok. A route change in CPi's AS switches the network path to Ok onto the link a used by the direct path to CPj. Such a route change negates the effect of the overlay node and leaves the direct path to the destination unprotected. For our purposes, we call only those routing changes that remove protection from a protected direct path as failures. There are cases when a routing change does not affect the protection offered, for example, if the direct path was not protected or if there exists more than one indirect path and the routing change only affected one of them. We also do not consider the routing changes that because the direct path to fail as the indirect path provides protection for this scenario. Changes in routes due to external factors such as failures in the network cannot be controlled or predicted. For this reason, a proactive approach to dealing with these failures is better for minimizing service interruption.

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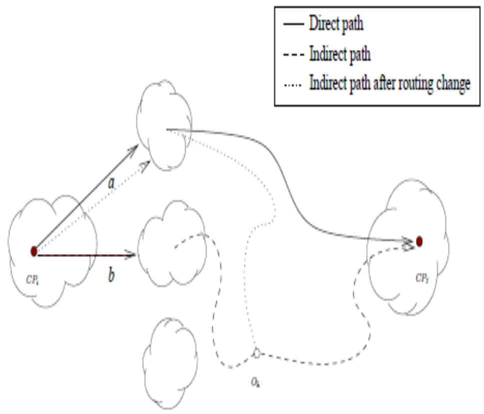

Fig. 2. A routing change removes protection of path between client proxies *CPi* and *CPj* through overlay node Ok

We envision one of two proactive approaches being taken for this: either by ensuring that each direct path is protected by two or more indirect paths that are themselves disjoint from each other, which may not be possible in many cases or by adopting a probabilistic approach described next. In this approach, the RouteSeer algorithm is run after an "observation" period during which the probabilities of using different access links to reach a particular destination are measured. Once this period is over, when running the RouteSeer algorithm the address prefixes in Global Address Table (GAT) are marked according to the probabilities of using the particular access links to reach them rather than just being a potential location or not. When computing the feasible locations, the weight of each address prefix is computed by adding together the partial weights rather than the number of paths for which the address prefix is a potential overlay location. As part of future work, we intend to evaluate these approaches to handling failures.

2.3 Incomplete Routing Information

A straightforward approach to dealing with partial routing information is to attempt to recover the missing information through an extensive series of probes. For example, to construct the AS level routing information of a particular location, a series of AS-level trace routes can be performed to all routable ASes in the Internet. This set of ASes can be obtained by examining the routing tables available at repositories such as Route Views. Once the set of trace routes is collected, the AS-level routing tables can be constructed based on the number of next-hop ASes that appear in the traces. Clearly, this method requires time and resources to perform but the results can be reasonably accurate barring route changes that happen during the measurement period and the errors that appear in mapping IP addresses to their corresponding ASes. We intend to conduct a measurement study to quantify these errors and their effects on RouteSeer.

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3. Time Division Streaming

TDS applied to overlays used for streaming real-time content similar to the End System Multicast overlay called Narada [3]. In some research it has been mostly ignored the effect of serial access to this link and its effects on overlay construction and use but in some research it is proved that the effect of this serialization can be significant when constructing overlays for delay-sensitive data. TDS allows each overlay link to, in turn send large blocks of data through the access link. It is proved that overlays constructed using TDS can substantially reduce the average delay experienced in receiving data by the nodes in the overlay [1].

4. Note Placement in SON (Service overlay network)

In SON topology design has great impact on deploying and deciding the location of nodes. Two novel optimization models are proposed [2] based on mathematical programming that take into account the individual requirements of the end-users, the connectivity between overlay nodes and the management of the traffic flows. Two different Service Overlay Network design formulations: the first, called Full-Coverage SON Design model (FCSD), minimizes the total network cost while assuring full coverage of all end-users. The second formulation, called Revenue-Maximization SON Design model (RMSD), maximizes the total network revenue, choosing which users to serve based on the revenue generated by their subscription to the SON services and the cost necessary to cover them. The Full-Coverage SON Design model (FCSD) minimizes the total network cost while assuring full coverage of all network users. The objective of the model is to reduce the total Service Overlay network cost, including installation costs and the costs related to the connection of overlay nodes, users' access and egress costs. Next constraint is to provide full coverage of all TPs (Test Points, which generate traffic towards one or more Destination Nodes (DNs), and feasible positions where overlay nodes can be installed (Candidate Sites, CSs) [11].Another is that coherence constraints assuring respectively that a TP i can be assigned to CS j only if an overlay node is installed in j and if i can be connected to j. The total flow on the link between overlay nodes j and i do not exceed the capacity of the link itself. All overlay nodes that the ingress traffic serviced by such network device does not exceed the capacity of the link used for the access. Flow between node j and the destination node k to zero if node j is not connected to k. This model is NP-hard since it includes the set covering and the multi commodity flow problems as special cases. The Revenue-Maximization SON Design model (RMSD) maximizes the total network revenue, choosing which users to serve based on the revenue generated by their subscription to the SON services and the cost necessary to the SON provider to cover them.

5. Conclusion

In this paper we describe the techniques to improve the performance of overlay network. For better performance Overlay networks provide facility to design and implement their own communication environment and protocol for users but performance depend upon many factors and each factor have its own importance. Node placement which is critical issue can be solved by RouteSeer which use routing table to place the intermediate node. We have discussed various steps used by RouteSeer to place the node. Time Division Streaming reduces the average delay in receiving data by nodes. Service overlay network has great importance in designing topology. Two formulations FCSD and RMSD are discuss. One ensures full coverage but minimizes the total network and other maximizes the revenue. To get the improved performance of overlay network one should concentrate on all the aspects affecting the overlay.

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