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Network Overlay Delay Avoidance by Virtual Routing

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Abstract

The process of delivering delay-sensitive data to a group of receivers with minimum latency. This latency consists of the time that the data spends in overlay links as well as the delay incurred at each overlay node, which has to send out a piece of data several times over a finite- capacity network connection. The latter part is a significant portion of the total delay, yet it is often ignored or only partially addressed by previous multicast algorithms. Analyze the actual delay in multicast trees and consider building trees with minimum-average and minimum- maximum delay. The NP-hardness of these problems and prove that they cannot be approximated in polynomial time to within any reasonable approximation ratio. The present a set of algorithms to build minimum-delay multicast trees that cover a wide range of application requirements min- average and min-max delay, for different scales, real-time requirements, and session characteristics. The conduct comprehensive experiments on different real-world datasets, using various overlay network models. The results confirm that our algorithms can achieve much lower delays and up to orders-of-magnitude faster running times than previous related approaches.

Keywords: Multicast trees, minimum latency, overlay networks.

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1. Introduction

Overlay networks have been the subject of significant research and practical interest recently. The initial motivation for overlay networks was mainly due to the following three shortcomings of the IP routing infrastructure (referred to as the native network). First, to deal with the slow fault recovery and routing convergence of BGP, overlay networks can bypass broken paths by rerouting traffic through intermediate overlay nodes. The detection of broken paths by overlay nodes can be quickly performed through active probing. Second, the IP routing model is basically a “one-size-fits-all” service, providing the same route independent of performance requirements. Instead, overlay networks can offer different routes to the same destination, depending on the performance metric (e.g., delay, throughput, loss rate). Third, the fact that inters domain IP routing is largely determined by ISP commercial policies often results in suboptimal paths.

Overlay networks can provide better end-to- end performance by routing through intermediate overlay nodes, essentially forcing the flow of traffic in end-to-end paths that would otherwise not be allowed by ISP policies. Over the last few years much has been learnt about overlay networks. To name some major steps, the Resilient Overlay Network (RON) was the first wide-scale overlay implementation and test bed, over which several measurement studies have been performed. Those studies showed the fault recovery and performance benefits of overlay routing. Another research thread focused on enhanced services that can be provided by overlay networks, such as multicasting, end-to-end QoS, secure overlay services, and content delivery. Overlay path selection algorithms, focused on QoS- aware routing, have been studied in. The impact of the overlay topology on the resulting routing performance was studied in; suggesting that knowledge of the native network topology can significantly benefit the overlay construction.

Overlay networks rely heavily on active probing, raising questions about their scalability and long term viability. For instance, Nakao et al. argue that independent probing by various overlay networks is untenable, and that a “routing underlay” service is needed that will be shared by different overlays . The high cost of overlay network probing was the motivation for the tomography-based monitoring scheme reported. More recently, a comparison between overlay networks and multi homing has been reported in suggesting that multihoming may be capable to offer almost the same performance benefits with overlay networks, but in a much simpler and more cost-effective way. Furthermore, an ongoing debate focuses on the “selfishness” of overlay routing, and on the potential performance inefficiency and instability that it can cause. It is clear that there is still much to be learnt about overlay networks, and that the key debates on the scalability, efficiency, and stability of overlay networks have to be addressed before their wider- scale deployment.

Overlay networks that has been largely unexplored previously, namely, the use of available bandwidth measurements in the path selection process. Previous work on overlay routing assumed that the only information that can be measured or inferred about the underlying native network is related to delays, loss rate, and sometimes TCP throughput. The problem with these metrics is that they are not direct indicators of the traffic load in a path: delays can be dominated by propagation latencies, losses occur after congestion has already taken place, while measurements of TCP throughput can be highly intrusive and they can be affected by a number of factors.

First focus on two algorithms that represent two different and general approaches: proactive and reactive routing. The former attempts to always route a flow in the path that provides the maximum available, so that the flow can avoid transient congestion due to cross traffic (and overlay traffic) fluctuations. The latter reroutes a flow only when the flow cannot meet its throughput requirement in the current path, and there is another path that can provide higher available. The routing algorithms are compared in terms of efficiency, stability, and safety margin.

The reactive routing has significant benefits in terms of throughput and stability, while proactive routing is better in providing flows with a wider safety margin. Hybrid routing scheme that combines the best features of the previous two algorithms. The effect of several factors, including network load, traffic variability, link-state staleness, number of overlay hops, measurement errors, and native sharing effects. Some of our results are rather surprising. For example, we show that a significant measurement error, even up to 100% of the actual available value, has a negligible impact on the efficiency of overlay routing. Also, that a naive overlay routing algorithm that ignores native sharing between overlay paths performs equally well with an algorithm that has a complete view of the native topology and of the available in each native link. The main contribution of is not a novel routing algorithm or a new available measurement technique, but an investigation of the applicability of available estimation in dynamic overlay.

2. Minimum Delay in Overlays

Minimum delay delivery of data in overlay networks is a fundamental problem for several distributed applications. Consider a delay-sensitive event notification system in which an event generated at a node needs to be signalled to a large group of monitoring nodes with minimum latency. Two problems of minimizing the average and the maximum delay in multicast trees, and we prove their NP-hardness as well as their in approximability to within any reasonable ratio. That is, no polynomial- time approximation algorithm. NP-complete to find various forms of degree-bounded trees, such as one with minimum total distance or one with minimum distance to the farthest receiver. NP-hardness of these problems and prove that they cannot be approximated in polynomial time to within any reasonable approximation ratio. The present a set of algorithms to build minimum-delay multicast trees that cover a wide range of application requirements min-average and min-max delay.

This is incredibly useful for companies that may have files that require access by multiple employees daily. By utilizing networking, those same files could be made available to several employees on separate computers simultaneously, improving efficiency. First consider two overlay path selection schemes: proactive overlay routing and reactive overlay routing. In both schemes, a flow will be initially routed on the path that provides the maximum headroom. With the proactive algorithm, the flow is switched to the path that appears to have the maximum headroom at the end of each path update period. Note that due to potential staleness in the link-state information, that path may not actually be the best choice. With the reactive algorithm, on the other hand, the flow stays at its current path if it has achieved its max-rate limit. Otherwise, the flow is “unsatisfied” and it is routed on the path with the maximum headroom; that path may be the same with the previously used path.

The intuition behind proactive routing is that the maximum headroom path can provide a flow with a wider safety margin to avoid transient congestion due to traffic load variations, measurement errors, and stale link-state. The intuition behind reactive routing is that a flow should stay at its current path if it is already satisfied, leading to fewer path changes and more stable overlay routing.

3. Reduce Data Delivering Delay

Multicasting technology uses the minimum network resources to serve multiple clients by duplicating the data packets at the closest possible point to the clients. This way at most only one data packets travels down a network link at any one time irrespective of how many clients receive this packet. Traditionally multicasting has been implemented over a specialized network built using multicast routers. This kind of network has the drawback of requiring the deployment of special routers that are more expensive than ordinary routers.

One of the most challenging tasks in overlay networks in the management of node dynamics. In overlay networks, nodes can join and leave the network at their will. In traditional multicast networks deployed using multicast routers, node dynamics is not a major concern as the infrastructure is considered to be stable and only the leaf or end nodes join and leave the network. The churn of end nodes will not affect any other client node as they are not dependant on each other.

Using overlay networks for multicasting presents a new challenge as the end nodes are required to play a dual role of clients as well as forwarding agents to other client nodes downstream. Node dynamics will have different effects on the end user applications depending on the type of application. Real time applications will be more affected by node dynamics than non-real time applications due to the disruptions resulting from such dynamics.

4. Conclusion and Future work

Delivering data to a group of receivers with minimum delay in an overlay network. We show that multicast routing algorithms that simply find a shortest-path tree can result in large delays as they only minimize the link-by link cost, ignoring the important delay incurred at high-degree nodes in the tree. The problems of minimizing the average and the maximum delay in a multicast tree. The set of algorithms that heuristically create multicast trees with minimum delays: For each of the two min-sum and min-max delay cases, we design a delay-efficient algorithm, and a tree adaptation algorithm to update a previous tree in nearly zero time, instead of rebuilding a new one from scratch. The collection of these algorithms supports a wide range of application requirements: overlays from tens to a few thousand nodes as well as different real-time requirements and session characteristics. Two different real-world datasets on overlays created. Our results confirm that our algorithms can achieve significantly lower delays and smaller running times than previous minimum-delay multicast algorithms.

In the future work, the sender transmit the data to the receiver at the same time copy of the data also transmit to the all the other nodes in mesh topology. If any problem occurs in receiver side or current transaction path means, the system only send the ACK to the sender and no data resending process. But the data automatically transmitted by the neighbour node of the receiver.

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