www.ijiarec.com

ISSN:2348-2079

DEC-2015

International Jmynal of Intellectual Advancements and Research in Engineering Computations

NETWORK ROUTING TOPOLOGY INFERENCE FROM END-TO-END MEASUREMENTS

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ABSTRACT

Inferring the routing topology and link performance from a node to a set of other nodes is an important component in network monitoring and application design. I build a framework for designing topology inference algorithms based on additive metrics. The framework can flexibly fuse information from multiple measurements to achieve better estimation accuracy. I develop computationally efficient (polynomial-time) topology inference algorithms based on the framework. I prove that the probability of correct topology inference of my algorithms converges to one exponentially fast in the number of probing packets. In particular, for applications where nodes may join or leave frequently such as overlay network construction, application-layer multicast, and peer-to-peer file sharing/streaming, i propose a novel sequential topology inference algorithm that significantly reduces the probing overhead and can efficiently handle node dynamics. I demonstrate the effectiveness of the proposed inference algorithms via Internet experiments.

INTRODUCTION

Developing a scalable tool to infer the routing topology and link performance from a node to a set of other nodes is an important challenge. In *network monitoring*, this tool can help a network operator obtain routing information and network internal characteristics (e.g., loss rate, delay, utilization) from its network to a set of other collaborating networks that are separated by nonparticipating autonomous networks.

In *application design*, this tool can be particularly useful for peer-to-peer (P2P) style applications where a node communicates with a set of other nodes (called *peers*) for file sharing and multimedia streaming.

SYSTEM ANALYSIS

EXISTING SYSTEM

So far, there are two primary approaches to infer the routing topology and link performance in a communication network.

- One approach is to use tools based on measurements or feedback messages of the internal nodes (e.g., routers). Such an approach is limited, as today's communication networks are evolving towards more decentralized and private administration.
- Another common approach to obtain the routing topology from a smyce node to a destination node in the Internet is to use *traceroute*. Traceroute relies on internal routers' responding to traceroute requests and returning Internet Control Message Protocol messages. Hoiver, an increasing number of routers in the Internet today will block traceroute requests due to privacy and security concerns. These routers are known as *anonymous routers.*
- *Anonymous routers* and their existence make the routing topology inferred by traceroute-like tools inaccurate. Furthermore, traceroute-like tools cannot discover layer-2 switches and multiprotocol label switching (MPLS) paths that are increasingly being deployed.
- The other approach, known as *network tomography*, utilizes end-to-end packet probing measurements (such as packet loss and delay measurements) conducted by the end hosts and does not require extra cooperation from the internal nodes (except the basic packet forwarding functionality). Under a network

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tomography approach, a smyce node will send probes to a set of destination nodes.

- Two fundamental challenges of network tomography approaches include *computational complexity* and *probing scalability* (especially under unicast probing). These limit the number of destination nodes that a smyce node can infer. In addition, the focus of previous studies is on a relatively stable set of nodes, while in many applications and networks (e.g., overlay network construction, application-layer multicast, P2P file sharing and streaming, and wireless ad-hoc and sensor networks), nodes may join or leave a session frequently(dynamic nodes).

PROPOSED SYSTEM

To handle node dynamics efficiently, i need fast and scalable inference procedures/algorithms that have low computational complexity, fast convergence rate, and small probing overhead.

- I present a general framework for designing network routing topology inference algorithms based on additive metrics. I construct additive metrics and estimate the (shared) path lengths using end-to-end multicast and unicast packet probing measurements as ill as trace route type measurements. The framework can flexibly fuse information available from multiple measurements to achieve better estimation accuracy and faster convergence rate.
- I propose a novel sequential topology inference algorithm, which significantly reduces the probing overhead under unicast probing. It can efficiently handle dynamic node joining and leaving and thus is particularly desirable for applications and networks where node dynamics are prevalent. I propose a sequential topology inference algorithm to address the probing scalability problem and handle dynamic node joining and leaving efficiently.

Advantages of proposed system

- The algorithm is fast and scalable for network routing tree topology using a framework based on additive metrics.
- I proposed a sequential topology inference algorithm to address the probing scalability problem and handle dynamic node joining and leaving efficiently.
- The correctness of my algorithms are effective in Internet experiments.
- This algorithm provides poirful tools for large-scale network inference in communication networks.

FEASIBIITY STUDY

Economical Feasibility

This is the method frequently used for evaluating the economic effectiveness of the system. The method is evaluated for the benefits and costs that are accepted from the system are considered and revieid. Further justification and alternation in the proposed system are incorporated.

This paper is economically feasible. The package being developed is definitely feasible from economic point of view because of software, hardware requirements and the number of operating personal required for operation of this paper is minimum.

Operational Feasibility

This is the willingness and ability of the management, employees, end-user to operate and support for a proposed system. This method is used for finding how much effort goes for education and training the staff for the system, which is to be developed. This paper is operationally feasible because this is easy to operate and only need little knowledge.

Technical Feasibility

- This method is used to evaluate the technical aspects of the proposed system. This can be demonstrated if reliable hardware and software capable of meeting the needs of proposed system. It can be acquired or developed in the required time.
- This paper is technically feasible that satisfies the needs in the required time using the reliable hardware and software Economical Feasibility
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PROBLEM DEFINITION

To infer the routing topology and link performance from a node to a set of other nodes is an important challenge. In *network monitoring*, this tool can help a network operator obtain routing information and network internal characteristics (e.g., loss rate, delay, utilization) from its network to a set of other collaborating networks that are separated by nonparticipating autonomous networks. In *application design*, this tool can be particularly useful for peer-to-peer (P2P) style applications where a node communicates with a set of other nodes (called *peers*) for file sharing and multimedia streaming. For example, a node may want to know the routing topology to other nodes so that it can select peers with low or no route overlap to improve resilience against network failures

OVERVIEW

To infer the routing topology and link performance in a communication network. Both have their limitations. One approach is to use tools based on measurements or feedback messages of the internal nodes (e.g., routers). Such an approach is limited, as today's communication networks are evolving towards more decentralized and private administration. For example, a common approach to obtain the routing topology from a smyce node to a destination node in the Internet is to use *traceroute*. Traceroute relies on internal routers' responding to traceroute requests and returning Internet Control Message Protocol messages.

Hoiver, an increasing number of routers in the Internet today will block traceroute requests due to privacy and security concerns. These routers are known as *anonymous routers* and their existence makes the routing topology inferred by traceroute-like tools inaccurate. Furthermore, traceroute-like tools cannot discover layer-2 switches and multiprotocol label switching (MPLS) paths that are increasingly being deployed. The other approach, known as *network tomography*, utilizes end-to-end packet probing measurements (such as packet loss and delay measurements) conducted by the end hosts and does not require extra cooperation from the internal nodes (except thebasic packet forwarding functionality). Under a network tomography approach, a smyce node will send probes to a set of destination nodes. The basic idea is to utilize the correlations among the observed losses and delays of the probes at the destination nodes to infer the network structure and internal characteristics. Due to its flexibility and reliability, network tomography has attracted many recent studies. Many previous network tomography studies are based on multicast probing because of its effectiveness and probing efficiency. Since IP multicast is not widely deployed in the current Internet, unicast network tomography approaches based on back-to-back unicast packet pairs or strings have also been investigated. Two fundamental challenges of network tomography approaches include *computational complexity* and *probing scalability* (especially under unicast probing). These limit the number of destination nodes that a smyce node can infer. In addition, the focus of previous studies is on a relatively stable set of nodes, while in many applications and networks (e.g., overlay network construction, application-layer multicast, P2P file sharing and streaming, and wireless ad-hoc and sensor networks), nodes may join or leave a session frequently.To handle node dynamics efficiently,

MODULE DESCRIPTION

Modules

1. Network Tomography Structure
2. Dynamic smyce routing technique
3. Tree structure topology using RNJ Algorithm
4. Detecting the neighbor node process
5. Node configuration and settings

NETWORK TOMOGRAPHIC STRUCTURE

Network tomographic structure is used to capture the similarities betien origin destination (OD) matrix estimation through link counts and medical tomography: in network inference, it is common that one does not observe quantities of interest but their aggregations instead and this goes beyond OD estimation. The linear tomography Poisson model for OD traffic estimation and the linear form is used to approximate other network tomography problems.

DYNAMIC SMYCE ROUTING TECHNIQUE

DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration.DSR has been implemented by numerous groups, and deployed on several test beds. Networks using the DSR protocol have been connected to the Internet. DSR can interoperate with Mobile IP, and nodes using Mobile IP and DSR have seamlessly migrated betien WLANs, cellular data services, and DSR mobile ad hoc networks. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. The protocol allows multiple routes to any destination and allows each sender to select and control the routes used in routing its packets, for example for use in load balancing or for increased robustness. Other advantages of the DSR protocol include easily guaranteed loop-free routing, support for use in networks containing unidirectional links, use of only "soft state" in routing, and very rapid recovery when routes in the network change

TREE STRUCTURE TOPOLOGY USING RNJ ALGORITHM

The RNJ algorithm will correctly find out a pair of siblings and all their other siblings, and condition is maintained for the neist of leaf nodes. Then is decreased at least by one. The RNJ algorithm only requires (estimated) shared path lengths betien pairs of the destination nodes, which is applicable to both multicast probing and unicast packet pair probing. Under mulitcast probing, for general routing trees, the RNJ algorithm has a much loir computational complexity, while it may also require a larger sample size to achieve the same level of accuracy compared to the maximum-likelihood based grouping algorithm.

DETECTING THE NEIGHBMY NODE PROCESS

A topology inference algorithm using (estimated) path lengths and shared path lengths as the input. The algorithm is a grouping type algorithm. It can be vieid as a rooted version of the widely used neighbor joining algorithm for constructing phylogenetic trees from distances. The algorithm begins with a leaf set including all the destination nodes. In each step, it selects a group of nodes that are likely to be neighbors (i.e., siblings, nodes with the same parent on the tree), deletes them from the leaf set, creates a new node as their parent, and adds that node to the leaf set. The whole process is iterated until there is only one node left in the leaf set, which will be the child of the root.

NODE CONFIGURATION AND SETTINGS

Node configuration essentially consists of defining the different node characteristics before creating them. They may consist of the type of addressing structure used in the simulation, defining the network components for mobile nodes, turning on or off the trace options at Agent/Router/MAC levels, selecting the type of adhoc routing protocol for wireless nodes or defining their energy model.

CONCLUSION

I developed fast and scalable algorithms for network routing tree topology inference using a framework based on additive metrics. In particular, i proposed a sequential topology inference algorithm to address the probing scalability problem and handle dynamic node joining and leaving efficiently .I proved the correctness of my algorithms and demonstrated their effectiveness via Internet experiments. The proposed algorithms provide poirful tools for large-scale network inference in communication networks.

FUTURE ENHANCEMENT

In the future, i will study how to utilize the inferred information and extend the framework for efficient and effective network monitoring and application design.

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