

Discovery Algorithm for Network Topology Based on SNMP

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Abstract. Since computer network has become the basis of the information society, network topology has also become an important part of network management. The theory foundation of the network topology algorithm based on SNMP has been introduced in this paper, and the algorithms of network topology discovery based on SNMP have been mainly focused on. The algorithms in the network layer and link layer have been compared and expounded, and then the advantages and disadvantages of them have been summarized in the end.

Introduction

Network topology refers to the transmission media interconnect various equipment on physical layout; this means how to connect the equipment. Servers and workstations' network configuration and the mutual connection are both given during the topology network. Its main structures are star structure, loop structure, bus structure, distributed structure, tree structure, network structure, honeycomb structure, etc. The methods of network topology discovery always start from a given network. Using methods, such as SNMP, IP protocol commands and system detection technology, the interconnection between equipment and their relations within the scope the can be found.

Simple Network Management Protocol

Network topology is the result of network topology discovery, the whole network system with internal entities, various subnets connections; subnet interconnection relations between entities can all be shown in a graphical way intuitively and vividly. This can be proposed as Fig.1.

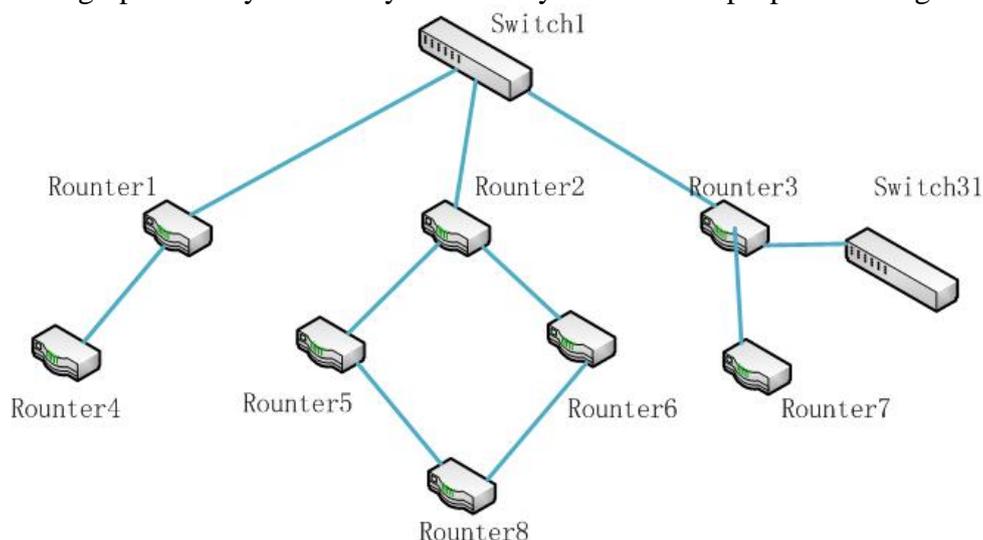


Fig.1 Network topology structure sample

SNMP (Simple Network Management Protocol), which is a kind of protocol on application layer [1], a part of the TCP/IP protocol family. It makes easy to transfer management information between the network management and agent, and SNMP enables network administrators to manage network

performance, find and solve network problems. Use SNMP management station can remotely manage all support this SNMP network devices, including monitor network status, modify the network device configuration and receive network events receive warnings.

The SNMP management model includes four key elements [2]: that is SNMP management workstation, SNMP Management agent, MIB(Management information base), and network management protocol. Fig.2 shows the relationship between the SNMP agent and management stations.

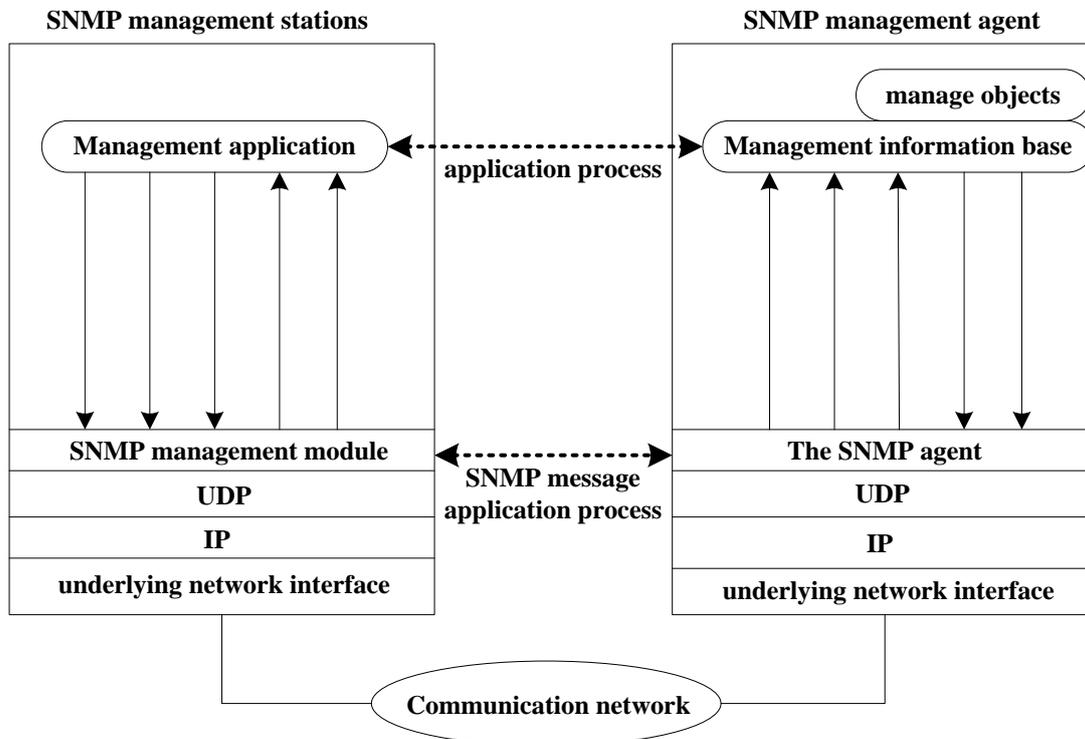


Fig.2 The relationship between the SNMP agent and management stations

Managers are the core of the network management system, which are usually separate devices. It can be a capacity-sharing system and responsible for the completion of each function of network management, such as network troubleshooting, network configuration and so on. It is usually located on a host node in the network.

In one network, the quantity of agents generally is more than one, some of the key platforms, such as hosts, bridges, routers and hubs etc., which can be equipped with SNMP, make these platforms enable access to station management. These key platforms are mainly located in the network devices on the network, such as routers and switches. Agents are responsible for monitoring the working conditions of the network components and the conditions of LAN where surrounding this part, focus on this main component and gather the information about the network surround it so we can use these messages to contribute to the topology. Managers should regularly take turns asking each agent in order to obtain information on their networks, and analysis the information which is concluded from the agents on this basis, and then take the appropriate measures for suitable conditions.

MIB is usually located on the appropriate agency. Network resource management method is to treat them as objects. The so-called object is a representation of a particular aspect of the managed resource properties. Collection of objects is called MIB. Between the management station and the agent is connected via SNMP network management protocol, SNMP protocol is an application layer protocol that uses UDP transport provides network services to transmit information.

Most of the network router, including layer 3 switches, is also support the SNMP protocol at this age. Because the proposed algorithm is used most widely, and found the topology more efficiency, and the overhead on the network load and system is also relatively small. Compared with the other

algorithms based on ICMP, OSPF and DNS, the discovery algorithms based on SNMP will occupy an important position in the field of topology discovery in the future.

Algorithm Theoretical Basis

Topology acquisition algorithm of network layer The work of a topology discovery system on network layer is to be accomplished through obtaining the data that network layer topology discovery needs firstly, inferring the current network connectivity devices from these data analysis secondly, and storing the data according to a certain format thirdly, finally, using some algorithms for topology display, to display the results in graphical form.

Since every two adjacent network nodes in net layer must save other information of each other [3], for the specify depth of a network, the topology discovery algorithm based on SNMP usually use a seed router to get all of the network segment from its routing table record, to get the router's IP address and related routing information of the port through the next-hop. And then it will continue to expand their search, until reach the depth of the user to specify [4]. Given a routing device as long as the IP address of any port as seed routing, specific network topology and event information for all routing devices within the depth of the host can be get.

While design the routing algorithm, the algorithm which is similar to the breadth-first search is always used. The algorithm in Fig.3 mainly use these three linked list: routing equipment list, topology information list, subnet information list.

Within the scope of the required depth, put the information of the routing device to be detected into the link list for the equipment to be detected, and delete the information after detection and process. Then put it in the corresponding topological information list. By retrieving the information list, we can conclude the routing devices connected subnet and all activities in the host information within the scope of the required depth. And the topology discovery can be formed by the information of routing table and address table which are defined using MIB in SNMP.

In the algorithm, we define three queues to release the network topology discovery based on SNMP. These are router queue, subnet queue and the connection queue, which is used to deposit found in the process of the router, subnet, and connection relationship. First initialize the Gateway routing equipment list, topology information list and subnet information list which are waiting for test. If you find a record ipRouteDest value of 0.0.0.0, which means the computer program set up the default gateway in this computer. If not, test and ensure the IpForwarding value of the default gateway, if the IpForwarding value is 1, it means that the equipment is a router.

Set the host's default gateway as the starting node to run the topology discovery, and access to the routing table. In the routing table of each item as ipRouteDest, if the corresponding ipRouteDest=4, put the routing address ipRouteNextHop into the routing queue. After that, put the connection between ipRouteNextHop and router into the link list. Else if the corresponding ifRouteDest=3, then put the iPRoueDest into the subnet queue, and store the connection between iPRouteDest and the router into the link list. Just show as the Fig.3.

Because the features of SNMP is simple and easy to implement, the management agreement has become the most popular network management protocol, and the protocol has become a de facto standard, the most widely used.

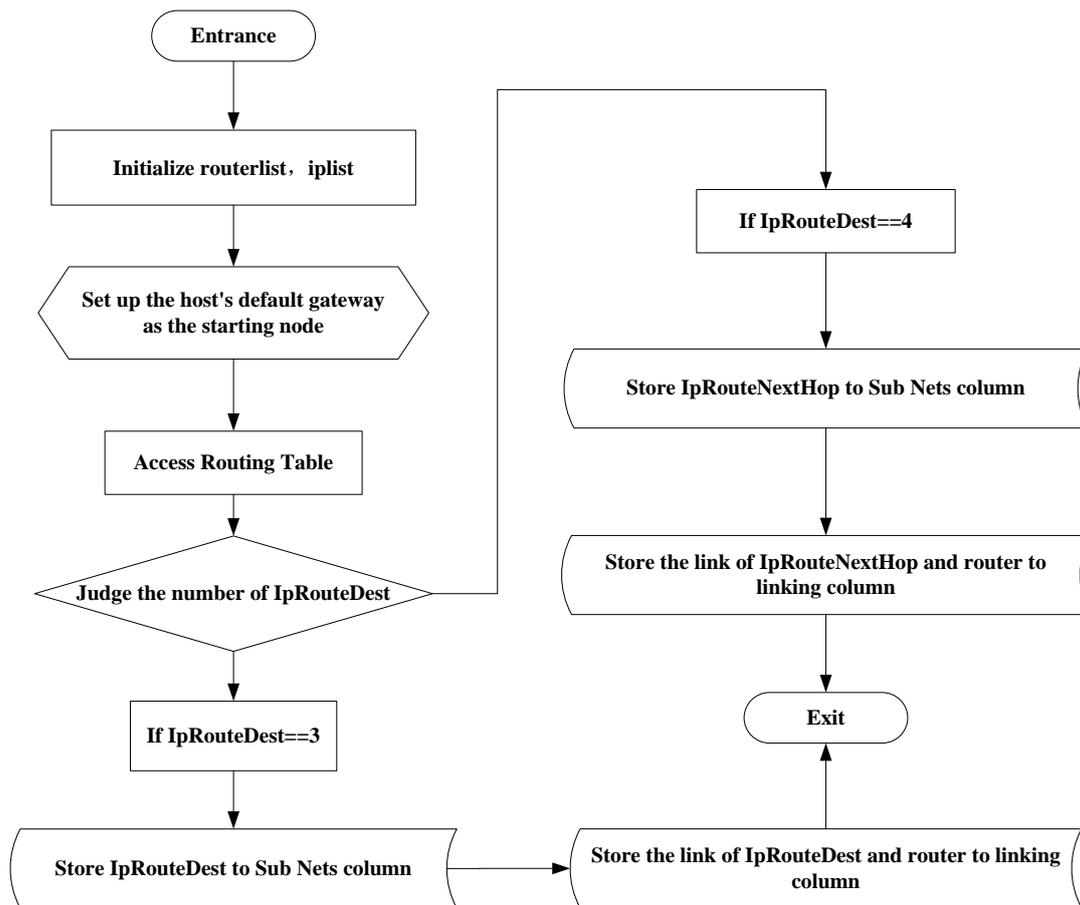


Fig.3 Discovery algorithm of the network layer

Topology acquisition algorithm of link layer Besides the net layer, people have also studied many algorithm of the topology information on the link layer [5-6]. Switches are the main part of the link layer nodes [7-8]. The relevant MIB module of network topology information has been defined by SNMP. The network topology discovery on link layer embodies three main aspects, including node detection, determine the connection between different switches, determine the connection between the hosts and switch.

The topology discoveries using SNMP on link layer are mainly based on two algorithms such as the switch forwarding list and the spanning tree protocol switch currently.

The topology discovery on link layer is divided into two major steps: The first step is to traverse the link layer node, whose main job is to collect a complete set of ARP, and FDB information as much as possible. Using SNMP to read ipNetToMediaTable router table, this table is stored in its ARP cache information, that is the ARP table, a link between the network layer and link layer device equipment can be judged by this table, and correspond subnet get nodes which might active. And table dot1dTpFdbTable is to store the physical address and port mapping table that means table FDB. FDB table is mainly used for determining the link-layer interconnect nodes.

The second step is to find the relationship between different link layer nodes, whose main job is analysis the connection of nodes using the data from first step. Find that some active node in the process of Ping and record the IP address of the active node. And then in the course of the subsequent temptation to supplement SNMP operations on the active node list, get topology.

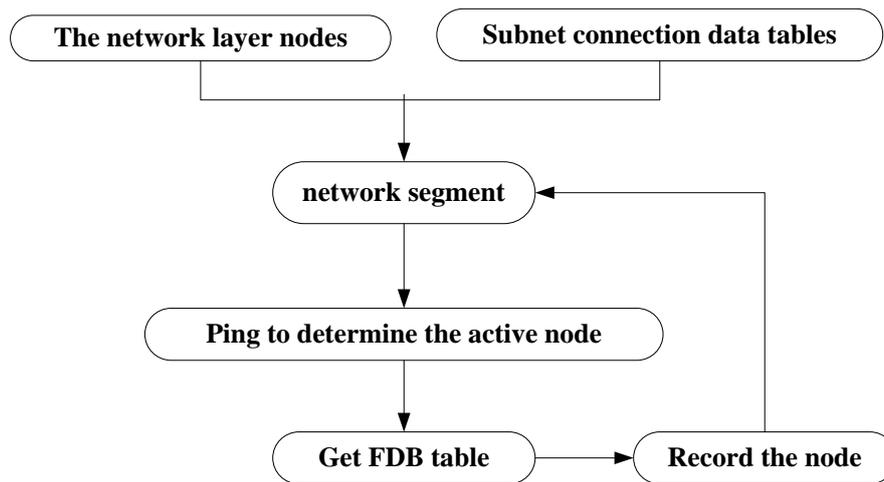


Fig.4 Discovery algorithm of the link layer

The Ping process in the literature called pretreatment process. In this paper, the node traversal process on link layer is divided into the following steps: First, by reading the existing network layer node and the table of connections subnet, analysis the presence of network segments. Second, Ping the address of the entire exist network segment and record the active nodes. Third, get the ARP table of network layer nodes and improve the active node list. Fourth, get the FDB table of active nodes in the list and store the connected nodes. And the fifth is two to four-step cycle until all the network processing is complete as Fig.4 follows.

Comparison

Compared with other types of network management system or management protocol, SNMP is easy to implement. And also has many advantages as follows.

1) SNMP is a connectionless protocol; by using the request packet and returning a response manner, SNMP sends messages between manage agent and administrator. It is not necessary to have to support other protocols and processes based on the connection modes. This mechanism reduces the burden of managing agents and is well controlled.

2) SNMP protocol has a lot of detailed documentation, Network industry on this protocol also has a more in-depth understanding, and these are the basis for the further development of the SNMP protocol and improvement.

3) SNMP protocol can be used to control a variety of devices. For example, telephone systems, environmental control equipment, as well as other access networks that may need to control equipment; this non-traditional equipment can be used by the SNMP protocol. So SNMP protocol has good portability and application integration prospects

4) Relative to other types of network management system or management protocol, most importantly, SNMP is easy to implement. A component of the management agent at runtime does not need a lot of memory space based on SNMP; therefore, there is no need of computing power to be too strong. SNMP protocol can generally be quickly developed in the target system, so it is prone to market new products or upgrades of old products.

Furthermore, the network management system is usually installed in a large network environment, including a large number of different types of networks and network devices. Therefore, in order to divide management responsibilities, the whole network should be divided into several user partitions, a network device satisfies the following conditions can be classified as the same SNMP partition: They may be provided for achieving the desired partition safety boundaries. This security model based information partition name (community string) has been supported in SNMP protocol; you can add it to a physical way on each network device selected partition.

Currently, SNMP protocol has been considered to be the preferred management protocol network equipment vendors, application developers and end users.

Summary

Network management is to maintain the normal operation of a network system, to make functions of the network system as has been designed to achieve the desired purpose. Today's network management system is not just to maintain the normal operation of the network, but also to collect network data and correlation to be analyzed, so that the network status of the indicators can be shown. According to these, managers can have data and evidence to judge, predict network failure, and know the optimization and improvement of network. With the development of the network, the importance of network management is increasingly being understood. For Internet network management needs, in order to meet the development needs of the network development, a management program applies to its own network should be proposed.

Network topology discovery is an important means and tool for network management, network topology provides a visual means to understand the global internet for network managers. To achieve the network topology graph generation, we must first construct network topology to search various information in flutter graph.

SNMP has become the de facto industry standard, appears with it's simple, easy to implement and extensive TCP / IP application infrastructure, and is supported by many manufacturers. Use SNMP protocol, you can get a more complete, accurate and intuitive description of the real network topology. However, the network topology process will also encounter many problems. For example, a node must support SNMP protocol and install SNMP agent, SNMP MIB must also be aware of community. So an unknown network topology discovery caused some limitations. In addition, at present, the link layer topology discovery algorithm in the country is a very challenging field. Algorithm has been developed and implemented failed to combine efficiency, accuracy, comprehensiveness and wide application together. Therefore, the field is still the focus that needs to continue in for the future research.

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