Discovery of Network Resources for Better Quality of Service

G.K.Viju, Mohammed Jassim Mohammed, Khalid Ahmed Ibrahim

Abstract— ***Knowledge of physical topology of an Internet Protocol (IP) network is very important to a number of critical network management tasks like reactive-proactive resource management, event correlation and root cause analysis. Thus automatically discovering the physical topology is necessary. The present work is mainly concentrated on discovering Physical Topology (ie, layer 2) as well as layer 3 topology in heterogeneous IP networks. This mainly relies on Simple Network Management Protocol Management Information Base (SNMPMIB) information that is widely supported by IP networks and requires no modifications to the operating system software running on elements or hosts.***

Index Terms—Network Resources, Quality of Service, Internet Protocol, Communication Network,.

I. INTRODUCTION

Discovering of network resources refers to the characterization of the physical connectivity relationships that exist among entities in a communication network. Discovering the physical layout and interconnections of network elements is a requirement to many critical network management tasks, including reactive and proactive resource management, server siting, event correlation, and root-cause analysis. Full physical map of the network enables a proactive analysis of the impact of link and device failures. Early identification of critical failure points allows the network manager to improve the survivability of the network

Most systems either feature an IP mapping functionality for automatically discovering routers and IP subnets and generating a network layer (i.e., ISOlayer-3) topology showing the router-to-router interconnections and router interface-to-subnet relationships, or require that switches from different IP subnets are not directly connected. Discovering a layer-3 topology is relatively easy provided that standard routing information is available, because routers must be explicitly aware of their layer-3 neighbors in order to perform their basic function.

Unfortunately, layer-3 topology covers only a small fraction of the interrelationships in an IP network, since it fails to capture the complex interconnections of layer-2 network elements (e.g., switches and bridges) belonging to different IP subnets. As more switches are deployed to provide more bandwidth through subnet micro segmentation, the portions of the network infrastructure that are invisible to a layer-3 mapping will continue to grow.

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Prof. G.K.Viju, Professor, Department of Computer Science, College of Engineering, Karary University, Khartoum, Sudan.

Dr. Mohammed Jassim Mohammed Jassim, Assistant Professor, College of Science and Information Technology, Iraq.

Dr.Khalid Ahmed Ibrahim, Assistant Professor, Department of Computer Science, College of Engineering, Karary University, Sudan.

Under such conditions, it is obvious that the network manager's ability to troubleshoot end-to-end connectivity or assess the potential impact of link or device failures in switched networks will be severely impaired.

The lack of automated solutions for capturing physical (i.e., layer-2) topology [1] information means that network managers are routinely forced to manually input such information for each management tool that they use. Given the dynamic nature and the ever-increasing complexity of today's IP networks, keeping track of topology information manually is a daunting (if not impossible) task. This situation clearly mandates the development of effective, general-purpose algorithmic solutions for automatically discovering the up-to-date physical topology of an IP network. An additional challenge in the design of such algorithms is dealing with the lack of established, industry-wide standards on the topology information maintained locally by each network element, and the diversity of elements and protocols present in today's multi-vendor IP networks.

Discovering physical topology needs to deal with three fundamental difficulties.

1) Limited local information. The algorithm should make only *minimal assumptions* about the availability of information at the elements; that is, it should only utilize information that most managed elements are most likely to maintain locally. Furthermore, since layer-2 elements are not explicitly aware of their immediate physical neighbors, inferring physical interconnections at layer-2 is definitely not straightforward.
2) Transparency of elements across protocol layers. The algorithm should correctly establish interconnections between network elements operating at different layers of the ISO protocol stack. This is not trivial, since layer-2 elements in switched IP subnets recomplete transparent to the layer-3 router(s) directing traffic in and out of the subnets.
3) Heterogeneity of network elements. The discovery algorithm should be able to gather topology information from heterogeneous network elements, making sure that the relevant data collected in the elements of different vendors are accessed and interpreted correctly.

SNMP-based algorithms for automatically discovering layer-3 map are featured in many common network management tools. It is well known that most portions of LAN topology are formed by layer-2 devices (e.g., switches/bridges). The proposed system using SNMP works perfectly when each *switched domain* (i.e., collection of switched IP subnets connected to the "outside world" through one or more layer-3 routers) consists of a *single* switched subnet and the element address forwarding tables are *complete*; that is, they contain the full set of MAC addresses in the subnet reachable from each element interface. Switched domains usually comprise *multiple subnets* with elements of different subnets often directly connected to each other. Thus the proposed discovery system extends the approach to multiple subnets that identifies a small set of candidate network graphs which is guaranteed to contain the correct topology

Switched domain is a set of maximal set of switches such that there is a path in-between every pair of switches in S involving only switches in S.Maximal subset contains any two nodes within a subset, which can communicate with each other without involving a router. These do not discover edges between interfaces that are not active.

II. MATERIALS AND METHODOLOGIES

The first step in constructing a system for discovering the network resources is to find the routers present in the network. To discover the routers this system uses the spanning tree algorithm this system discovers different types of network elements. These rely solely on standard information routinely collected in SNMP MIBs of elements and they require no modifications of the os software running on the elements. Main challenge of our system is how to 'stitch' such local information together to identify interconnected switch interfaces and come up with a complete physical topology. Our system has to gather the necessary information by accessing and interpreting MIB variables stored in vendor specific private MIBs or custom designed files.

The main protocol used here is SNMP [6].

- The Simple Network Management Protocol *(SNMP)* is an application layer protocol for exchange of management information between network devices.
- An SNMP-managed network consists of three key components:
  1. Managed devices
  2. Agents
  3. Network-managementsystems (NMSs).

1. A managed device is a network node that contains an SNMP agent and that resides on a managed network.
2. An agent is a network-management software module that resides in a managed device.
3. An NMS executes applications that monitor and control managed devices.

III. HOW IT WORKS

Each node in the network has one of four basic types. They are router, switch, hub and host. First the system discovers the User interface and then discovers the network resources. The database contains information about each network node and its interfaces that were active during the discovery process. It also contains the information on interconnections among the nodes. The process gathers the information in a consistent manner from network elements MIBs [2] using SNMP commands and system files. Along with the collected information the resource discovery process stores the time at which data collection was performed and the data source from which the information was extracted.

Using this information among the nodes the switches information is collected in the next level. After that the router in formations are discovered. This system thus discovers the network resources completely and after this they are controlled and monitored.

IV. COMPARISON WITH EXISTING SYSTEM

The existing system discovers only logical topology ignoring layer-2 topology. The logical 3 (i.e) logical topology includes discovering of events and changes among the network elements. This completely ignores the discovery of network elements such as switches and bridges. This constitutes the layer 2 topology. Also the existing system targets only on specific product families.

The existing system does not discover the interconnections between the network elements. Layer 3 covers only a small fraction of the interrelationships in an IP network, since it fails to capture the complex interconnections of layer 2.Under such conditions the network should be able to trouble shoot end-to-end connectivity. So in the existing system the device failures in switched domain are severely impaired.

In our proposed system we are mainly concentrating on discovering the layer-2 topology (i.e.) discovery of network resources such as switches and bridges. Thus the proposed system discovers the physical topology and works better than the existing systems and it overcomes the drawbacks of the existing system.

V. CONCLUSION

Automatic discovery of physical topology information plays a crucial role in enhancing the manageability of modern networks. Despite the importance of the problem, earlier research and commercial network management tools have typically concentrated on either: 1) discovering logical (i.e., layer-3) topology, which implies that the connectivity of all layer-2 elements (e.g., switches and bridges) is ignored; or 2) proprietary solutions targeting specific product families. In this proposed system, we have developed novel, practical algorithms for discovering physical topology in networks. The practicality of our solution stems from the fact that it relies solely on local ip address information routinely collected in the SNMP MIBs of routers and switches. The main algorithmic challenge we have addressed is how to cleverly "stitch" that information together into a complete layer-2 LAN topology. Our algorithms can handle switched domains comprising one or more subnets. The results clearly validate our methodology, demonstrating the accuracy and practicality of the proposed algorithms.

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AUTHORS PROFILE

Dr.G.K.Viju, Professor, received his PhD (Software Engineering) in 2006, presently working with Karary University, Khartoum, Sudan. He published 6 books and a number of Research Papers in National & International Journals and Conferences. His Research interests are in Software Engineering, Digital Image Processing and Computer Networks.

Dr.Mohammed Jassim Mohammed Jassim, received is PhD in 2007,an Assistant Professor in the College of Science and Information Technology, Iraq. He published 9 Research Paper in International Journals, participated in 7 International Conferences and translated 12 books from Russian to Arabic.

Dr.Khalid Ahmed Ibrahim is the Chairman of Computer Science Department in Karary University. He received his PhD in Information Security in 2007 and his research interests are Database & Information Security.

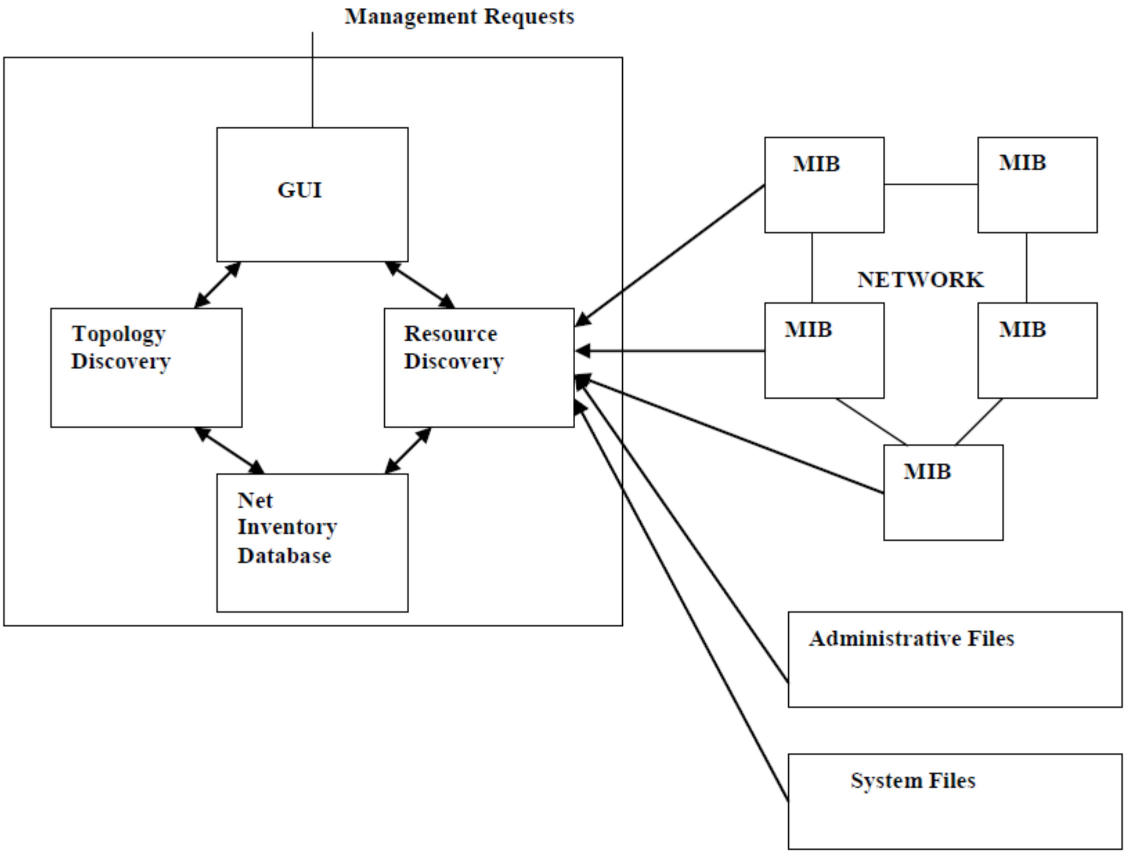

Figure 1: System architecture for Net Inventory System

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