멀티캐스트 네트워크를 모니터하는 시스템의 설계 및 구현

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Multicast Routing Debugger (MRD) - A System to Monitor the Status of Multicast Network

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Abstract

IP Multicast can efficiently provide enormous bandwidth savings by enabling sources to send a single copy of a message to multiple recipients who explicitly want to receive the information. But due to the complexity of IP multicast and its fundamental differences from unicast, there are not very many tools available for monitoring and debugging multicast networks, and only a few experts understand the tools that do exist.

This thesis proposes a Multicast Routing Debugger (MRD) system that monitor the status of a multicast network. This system is aimed to multicast-related faults detection. In thesis, first, we define the set of information that should be monitored. Second, the method is developed to take out such information from multicast routers. Third, MRD system is prototyped to collect, process information from heterogeneous routers on a multicast network and to display the various status of the network comprehensively.

The prototype of MRD system is implemented and deployed. We perform experiments with several scenarios. Experimental results show we can detect various problems as information that we define is monitored. The MRD system is simple to use, web-based and intuitive tool that can monitor the status of a specific multicast network.

1. Introduction

The exponential growth of the Internet combined with multimedia content is increasing the average size of the data transfers and pushing bandwidth constraints to their limits. Unfortunately multicasting has been slow to catch on, except for the research-oriented Multicast Backbone [1][2]. There are a variety of reasons for the difficulties in widespread multicast deployment. One of largest current barriers is the difficulty in managing multicast traffic. Due to the complexity of IP multicast and its fundamental differences from unicast, there are not many tools available to assist in monitoring the various status such as member-subnets, connectivity, statistics and forwarding state in a multicast network in order to diagnose above problems. In this thesis, we introduce Multicast Routing Debugger (MRD) system.

The primary goal was to create a simple to use, web-based and intuitive tool that can monitor the status of a specific multicast network. The system would be able to collect information from heterogeneous multicast routers and process it online to give a current snapshot of the multicast network. The MRD system was implemented and deployed in the Asia-Pacific Advanced Network-Korea (APAN-KR)[3] research network.

2. Related Work

2.1 SNMP-based tool

SNMP-based tools provide the information to be queried to SNMP-enabled router and visualize it. This information should be defined in MIB of the router. Mstat[9] allows an SNMP-enabled router to be queried for information, including routing tables and packet statistics. Mtree[10] attempts to use cascading SNMP-enabled router queries to determine an entire multicast tree rooted at a given router. Mview[11] is a tool for visualization Mbone topology and monitoring and collecting performance information. SNMP-based multicast tools have limited value outside a particular administrative domain, because most multicast routers are not configured to respond to public SNMP queries. As a result, mstat, mtree, and mview are only useful for debugging and managing the local domain portion of a multicast group.

2.2 Multicast route tracing tool

Mtrace[4] is a tool designed to provide hop-by-hop path information for a specific source and destination. For a specific group, mtrace will tell a user hop-by-hop packet loss, multicast path and round trip information. The utility of mtrace is often limited by the multicast topology. Wheremulticast and unicast topologies are not aligned (as is the case in many multicast-enabled networks) mtrace may not function. The mtrace provides hop-by-hop path information between a source and a receiver, so several mtraces are issued in order to know the network status.

2.3 Multicast Reachability Monitor (MRM)

The MRM[5] is a network fault detection and isolation mechanism for administering a multicast routing infrastructure. An MRM based fault monitoring system consists of two types of components: an MRM manager that configures tests, collects and presents fault information, and MRM testers that source or sink test traffic. For monitoring the network status, MRM has an architecture involved by several routers and hosts. But the packet loss information provided by MRM Test Receivers lacks for more detailed fault detections.

3. Models

The MRD system, as shown in Figure 1 is divided into four components based on functionality. We describe four parts in more detail:

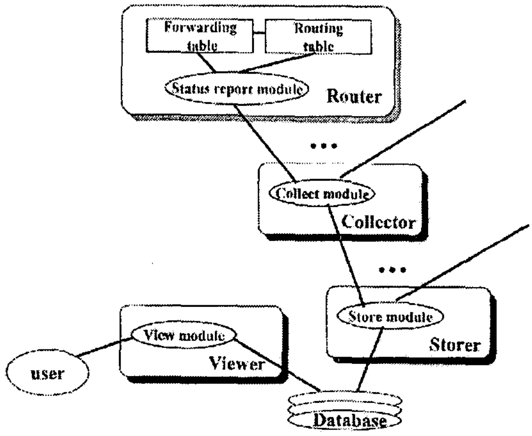

Figure 1. Basic Components

- <u>Status report module</u> accepts request and provides the status information obtained from a routing table and a forwarding table.
- <u>Collect module</u> does a request for the status report to one or more routers and gathers data from them.
- <u>Store module</u> stores the status information collected by one or more collectors in a database.

<u>View module</u> displays the multicast status based on the contents of the database on demand.

4. Design and Implementation

MRD system consists of five programs, which are four programs prototyped from four basic modules of model and an additional status request program. Figure 2 illustrates the process architecture of our system.

The MRD-capable mrouted program is responsible for multicast routing and status report method. To support status report method, we modified current mrouted source files, whose version is 3.9 beta 3.

The MRD program is responsible for doing request to MRD-capable mrouted program and making it available to users on the local host and remote host. Its functionalities are similar to Cisco's IP Multicast Routing commands.

Now MRD-capable mrouted and MRD support five commands to users. :

- show ip mroute
- show ip mroute active
- show ip mroute count
- show ip mroute summary
- show ip igmp groups

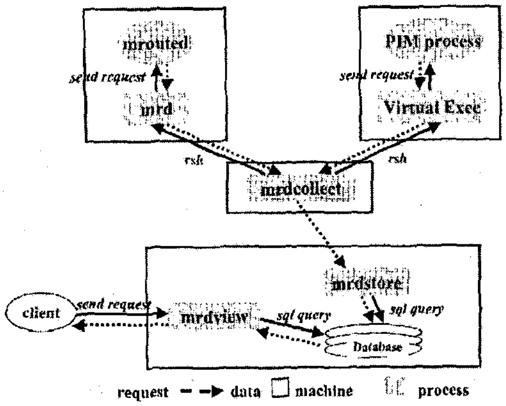

Figure 2. Process Architecture

The MRDcollect program is responsible for collecting data from MRD-capable mrouteds by executing MRD program and from Cisco' s router by executing Cisco's IP Multicast Routing commands. The MRDcollect is executed every 5 minutes. For reflecting the status of multicast network in time, it locates in one domain.

The MRDstore program is responsible for storing data collected by MRDcollect program in the database system. We use mSQL (Mini SQL) whose version is 2.0.11 made by Hughes Technologies[6] to make and query a database.

The MRDview program is responsible for displaying the status of multicast network based on sql query of the database system.

The MRDview is actually the set of Lite[6] scripts on W3-mSQL[6] in order to display the result of mSQL query on Web pages.

The MRDview consists of three Lite scripts, session.msql, reception.msql and forwarding.msql. The status which they display is as follows:

- Session Announcement Status
- Multicast Traffic Reception Status
- Multicast Forwarding Status

5. Experiment and Analysis

5.1 Experiment

We perform an experiment to measure the effect of our system. We show MRD usages based on scenarios and the various statistics. Based on our experimental results, we compare the related works with our system.

5.1.1 Testbed

Our testbed is an Asia-Pacific Advanced Network-Korea (APAN-KR). We choose Seoul-XP, Seoul-AP, Taejon-AP which are the backbone routers of APAN-KR as monitored routers. And the routers of Seoul National University (SNU[7]) and Korea Advanced Institute of Science and Technology (KAIST[8]) are selected since they have the most traffic on APAN-KR. Figure 3 illustrates our testbed.

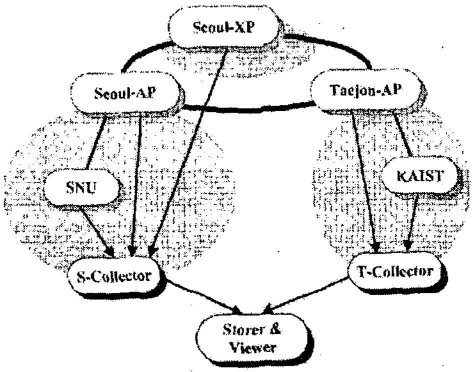

Figure 3. Testbed for experiments

5.1.2 Experimental Results

Scenario-based experiments

MRD system is used to detect various multicast-related problems based on various scenarios. These scenarios are as follows:

- " I can't see the IMJ-Channel 1."
- " I have some traffic but ..."
- " Where does traffic flow?"

The first scenario is to detect the session announcement problems. We could detect the problem, the session information wasn't announced. The second scenario is to detect the multicast traffic reception problems. We use the example, IMJ-Channel 1 session isn't announced at Seoul-AP for detecting this problem. We could find the reason of traffic reception problem.

The third scenario is to detect the forwarding problems. When the bursty traffic incomes, we wonder whether this traffic is justifiable or not.

5.2 Analysis

We compare the related works with MRD system based on experimental results. The comparison factors are the required information mentioned earlier, portability and scalability. SNMP-based tool provides all required information except session information. Since SNMP-enable router is required for SNMP-based tool, portability is middle. Scalability is also middle. Multicast route tracing tools provides the routing and forwarding information from source to receiver, hop-by-hop statistics. Since all routers support multicast route tracing, portability is high. Scalability is middle since where multicast and unicast topologies are not aligned (as is the case in many multicast-enabled networks) multicast route tracing tools may not function. Multicast Reachability Monitor provides packet loss information. Since Cisco's router supports Multicast Reachability Monitor, portability is middle. Scalability is also middle. Multicast Routing Debugger provides all required information. Since Cisco's router and Mrd-capable mrouted support Multicast Routing Debugger, portability is middle. Scalability is low, since routers in the static domain are monitored.

6. Conclusion

By reviewing commonly encountered multicast problems, we could define the information which should be monitored in order to detect the problems. Although there exist several types of multicast management tool, any tool isn't satisfied with these requirements. Our proposed system was designed to collect and process these required information from heterogeneous routers.

Our proposed system gave the various status of a multicast network with an easy to use, web-based and intuitive viewer tool. Since the status information was stored in a database system, it was comfortable to maintain and manage it. We could detect various multicast-related problems by using our system.

7. References

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