Multicast Routing Debugger (MRD)

A system to monitor status of multicast network

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Introduction

• IP Multicast efficiently can provide enormous bandwidth savings.
  – still, variety of reasons for the difficulties in widespread multicast deployment [Diot01]

• Much of effort being devoted to multicast is focused on [Almeroth99]
  – developing multicast protocols
  – maintaining reasonable quality connectivity in the Mbone [Casner94]
  – evolving the MBGP multicast infrastructure [LaMaster98]

• There are not many tools available to assist in managing multicast traffic. [Sarac01][Almeroth99][Radhika99]
Background: IP Multicast

multicast group
224.2.172.238

source

receiver

IGMP

Routing protocol

Multicast Packets

Prune Message
Motivation

1. The set of information is defined

2. We need the multicast network management system to support heterogeneous kinds of routers.

3. mrouted doesn’t support any tools to provide its status information.
Related Work

SNMP-based tool [mview]

Multicast route tracing tool [Fenner00]

Multicast Reachability Monitor [Almeroth00]
## Requirement

The information needed by all problems:

<table>
<thead>
<tr>
<th>Routing information</th>
<th>(source, incominginterface, RPF neighbor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forwarding information</td>
<td>(source, group, forwardinginterface)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Problem</th>
<th>Required Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session Announcement</td>
<td><strong>Session Information</strong></td>
</tr>
<tr>
<td></td>
<td>(session, source, list of groups)</td>
</tr>
<tr>
<td>Traffic reception</td>
<td><strong>IGMP Group</strong></td>
</tr>
<tr>
<td></td>
<td>(group, member)</td>
</tr>
<tr>
<td>Multicast router</td>
<td><strong>Statistics</strong></td>
</tr>
<tr>
<td></td>
<td>(packets per second, bit per second)</td>
</tr>
<tr>
<td></td>
<td><strong>IGMP Group</strong></td>
</tr>
<tr>
<td></td>
<td>(group, member)</td>
</tr>
<tr>
<td></td>
<td><strong>Reverse Path First (RPF) Failure</strong></td>
</tr>
</tbody>
</table>
Problem Definition

• need to detect various multicast-related problems by monitoring status and traffic of multicast network

• Challenges of Multicast Monitoring
  – Anonymity of group and use of UDP
    • anyone can send data to a multicast group and/or join and receive data from the group
    • senders and receivers may not be known to each other
  – Dynamic group changes
    • reachability monitoring requires additional mechanism. There can be no implicit way of knowing the group members
  – Ex) ping
    • Unicast : test bi-directional reachability btw users
    • Multicast : source doesn’t know from whom and from how many group members to expect responses
System Overview

Model

Connectivity Cloud

Regional Network

Local Network

Collector

Storer

Database

Viewer

System Architecture Lab
Basic components

Model

- Router
  - Forwarding table
  - Routing table
  - Status report module

- Collector
  - Collect module

- Viewer
  - View module

- Storer
  - Store module

- Database

- User
## Database Schema

### Routing Table

<table>
<thead>
<tr>
<th>Router</th>
<th>Source</th>
<th>InVif_Name</th>
<th>InVif_Type</th>
<th>InVif_RemoteAddr</th>
<th>RPF_Nbr</th>
</tr>
</thead>
</table>

### Forwarding Table

<table>
<thead>
<tr>
<th>Router</th>
<th>Source</th>
<th>Group</th>
<th>Pruned</th>
<th>ForwVif_Name</th>
<th>ForwVif_Type</th>
<th>ForwVif_RemoteAddr</th>
<th>State</th>
</tr>
</thead>
</table>

### IGMP_Group Table

<table>
<thead>
<tr>
<th>Router</th>
<th>Group</th>
<th>If</th>
<th>Member</th>
</tr>
</thead>
</table>

### Statistics Table

<table>
<thead>
<tr>
<th>Router</th>
<th>Source</th>
<th>Group</th>
<th>pps</th>
<th>bps</th>
<th>Pkts</th>
<th>Bytes</th>
<th>RPFfailed</th>
</tr>
</thead>
</table>

### SDR Table

<table>
<thead>
<tr>
<th>Router</th>
<th>Session</th>
<th>Source</th>
<th>Media</th>
<th>Group</th>
<th>TTL</th>
</tr>
</thead>
</table>
Design

Process Architecture

- mrouted
- PIM process
- Virtual Exec
- mrdcollect
- mrdview
- mrdstore
- Database

request -> data

client

send request

rsh

sql query
Testbed

Storer & Viewer

S-Collector

Seoul-AP

Seoul-XP

Taejon-AP

KAIST

SNU

T-Collector
MRD Usage

1. Scenarios
   - “I can’t see the IMJ-Channel 1”
   - “I have some traffic but ...”
   - “Where does traffic flow?”

2. Statistics
   - packet per second, kbits per second
   - average packet size
   - source distribution, local member distribution
Scenario 1: “I can’t see the IMJ-Channel 1”
Scenario 2: “I have some traffic but ...”

**Experiment**

Multicast Routing Debugging Viewer on APAN-KR

Choose a multicast group and a router which you want to see the reception.

**Multicast Group:**

224.2.127.254

**Router:**

- tpr-sxp.kr.apan.net (203.255.248.1, Seoul)
- sap-tap.kr.apan.net (203.255.248.174, Seoul)
- tap-kaist.kr.apan.net (203.255.248.234, Taejeon)
- gw.kaist.kr.apan.net (192.249.24.1, KAIST)
- gwmm.apan.snu.ac.kr (147.46.14.1, SNU)

**Sources and RPF neighbors of Group 224.2.127.254 at Seoul-AP**

<table>
<thead>
<tr>
<th>Source</th>
<th>pps</th>
<th>kbps</th>
<th>RPF neighbor</th>
</tr>
</thead>
<tbody>
<tr>
<td>128.58.39.153/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>128.111.52.10/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>128.223.83.33/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>128.223.214.33/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>130.240.21.197/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>130.240.64.20/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>131.182.10.250/32</td>
<td>0</td>
<td>0</td>
<td>Seoul-XP</td>
</tr>
<tr>
<td>147.46.14.34/32</td>
<td>0</td>
<td>0</td>
<td>SNU</td>
</tr>
<tr>
<td>147.46.14.35/32</td>
<td>0</td>
<td>0</td>
<td>SNU</td>
</tr>
<tr>
<td>147.46.14.39/32</td>
<td>0</td>
<td>0</td>
<td>SNU</td>
</tr>
<tr>
<td>147.46.14.44/32</td>
<td>0</td>
<td>0</td>
<td>SNU</td>
</tr>
<tr>
<td>158.165.1.26/32</td>
<td>0</td>
<td>0</td>
<td>SNU</td>
</tr>
</tbody>
</table>

Route has been **pruned**.

Expect Seoul-XP
NASA TV - Broadcast from NASA HQ(audio) 224.2.233.103/17262
Places all over the world (video) - 224.2.172.238
Places all over the world (audio) - 224.2.213.113
## Analysis

<table>
<thead>
<tr>
<th>Tool</th>
<th>Factor</th>
<th>Scope of Monitoring</th>
<th>Portability</th>
<th>Scalability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Session</td>
<td>Forwarding</td>
<td>Routing</td>
</tr>
<tr>
<td>SNMP-based Tool</td>
<td></td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Multicast Route Tracing Tool</td>
<td></td>
<td>X</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>MRM</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>MRD</td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>
Conclusion

- A Multicast Routing Debugger system was proposed and a prototype has been implemented.

- We could detect the multicast-related problems by monitoring status of APAN-KR network with this system.

Future work
Reference


Reference (Cont’d)


http://noc.kr.apan.net

