An Implementation of Network Management System Using Dynamic Routing in the IMS

Jae-Hyoung Cho and Jae-Oh Lee
Electrical and Electronics Engineering Dept, KoreaTech, Korea
{tlsdl2, jolee}@kut.ac.kr

Abstract

Recently, according to increasing the network traffic in the IMS, the role of Network Management System (NMS) is very important because of limited network resource. It can perform two kinds of routing ways with the capability of static or dynamic routing. A dynamic routing way is more efficient than static routing one because it can make the flow of traffic changeful among nodes in the IMS. Therefore, in this paper, we suggest a management function of NMS, applying a dynamic routing algorithm for managing the CSCFs in the IMS. And then we analyze the algorithm by measuring the performance of PoC and presence service one of the prominent application services to be deployed in the IMS.

Keywords: IMS, PoC, Presence, SNMP, NMS

1. Introduction

The IP Multimedia Subsystem (IMS) is an architectural framework for delivering Internet Protocol (IP) multimedia to mobile users. As it is such a framework that provides access to the content of Internet and mobile services anywhere and anytime with guaranteed Quality of Service (QoS) and manageability. According to increasing use of the IMS and traffic of the IMS increases steadily, so the IMS need to manage network traffic related the IMS nodes. The IMS nodes are called Call Session Control Function (CSCF) that controls session establishment. If a CSCF is overloaded, it might have some problems such as traffic jam and system down. In order to solve these problems, the IMS needs to apply the routing algorithm that is able to control CSCFs. Because the traffic of the IMS is very fickle, it is desirable to make the NMS control the traffic flow among IMS nodes. Therefore we study a dynamic routing algorithm which is much more efficient than a static routing algorithm to manage the IMS nodes. In this paper, we suggest a dynamic routing algorithm to manage traffic among CSCFs. Also, we show the scenario that uses Push to talk over Cellular (PoC), one of application services, by applying the proposed algorithm and explain related works such as the structure of the IMS, PoC and routing way in the IMS. After that, we present the process of dynamic routing algorithm by deploying the service of PoC.

2. Related Works: PoC and Presence Service and Dynamic Routing

PoC is a walkie-talkie type of service. Users press (and hold) a button when they want to say something, but they do not start speaking until their terminal tells them to do so. There are several incompatible PoC specifications at present. Most of them are not based on the IMS, but consist of proprietary solutions implemented by a single vendor. As a result these PoC solutions generally cannot interoperate with equipment from other vendors. This situation prompted Open Mobile Alliance (OMA) to create the PoC working group to start working on the OMA PoC service. OMA’s PoC service is based on the IMS [2].
The presence service is able to indicate whether other users are online or not and if they are online, whether they are idle or busy [3]. In the SIP-based Presence architecture, each Presence User Agent (PUA) has a piece of information about the user, the presentity. All PUs send their pieces of information to a Presence Agent (PA). A watcher is an entity that requests (from the PA) presence information about a presentity or watcher information about his watchers. There are several types of watchers. A fetcher is a watcher that retrieves the current presentity’s presence information from the PA.

NMS is used to monitor and administer network resources. Effective planning for a NMS requires that a number of network management tasks be performed. NMS should discover the network inventory, monitor the health and status of devices and provide alerts to conditions that impact system performance. NMS systems make use of various protocols for the purpose they serve. Simple Network Management Protocol (SNMP) allows them to simply gather the information from the various devices down the network hierarchy. NMS software is responsible for identification of a problem, the exact source(s) of the problem, and solving them. They not only are responsible for the detection of faults, but also for collecting device statistics over a period of time [4]. The Figure 1 shows a dynamic SIP message flow using network management system (NMS). When there are many S-CSCF (a, b, c) in the IMS, NMS notifies routing address to I-CSCF and selects suitable S-CSCF (a or b or c). The NMS includes information such as performance of CSCF, routing algorithm and so on.

![Figure 1. The Structure of the NMS in the IMS](image)

3. An Implementation for a Dynamic Routing

The Figure 2 represents the structure of the Presence Service in detail. When SIP message accesses PresenceServer from the IMS, the roles of the PS accomplish to register presence information and upload registering information to ResourceList [5]. Pidfparser defines related to information (e.g., presence, location and status of device, user information) of user and entities using PIDF. ResourceList is implemented possible to store resource information of user and entities. Later on, it will be extended to interact with HSS for AAA and QoS. If the user that sends SUBSCRIBE message or PUBLISH message for registration is existence in ResourceList, PresenceManager re-uploads partly modified presence information or creates
PIDF document about presence. PresenceManager makes suitable SIP messages to process SIP messages from PresenceServer.

**Figure 2. The Structure of the Presence Service**

The Figure 3 describes the procedure of the PoC registration and INVITE message. After the `createRequest (Request.REGISTER, userSipURI, userSipURI)` has been finished, we need to create the method `clientTransation.sendRequest ()`.

Because a Dialog is initialized by an INVITE request in order to further run the media session between UAs. So the user presses call button to send an INVITE request to other users and waits for acceptance of the callee(s) [7].

**Figure 3. The Procedure of the PoC Registration and INVITE Message**

A NMS periodically gets the information of performance from CSCF agent. Basically SNMP based manager can get the performance related information from the agent periodically to perform the monitoring function. So the period value for monitoring can depend on the performance of CSCF’s agent [8]. So, NMS administrator should condignly adjust monitoring period value. When there are numerous CSCFs, it is possible to change the routing information in CSCF’s agent using SNMP Set message by analyzing the monitoring information related to CSCFs. Additionally, when the utilization(CPU and memory) is exceeded to limited value (Tm, Tc), CSCF’s agent must notify manager of Trap message.
And then the manager can store the received Trap message in Log_DB. In order to analyze the performance information of CSCFs, the manager must perform the following four steps:

**Step 1:** The manager obtains a list of CSCFs by using the management information from each CSCF and initializes/updates the agent information after performing SNMP Get_Operation to agents. The information includes CSCF ID, Type, IP address and state information of CSCF which are shown in Table 1.

Table 1. MIB of the CSCF

<table>
<thead>
<tr>
<th>CSCF_ID</th>
<th>CSCF_Class</th>
<th>CSCF_Name</th>
<th>IP</th>
<th>Port_Num</th>
<th>Status</th>
<th>SysUpTime</th>
<th>Description</th>
</tr>
</thead>
</table>

**Step 2:** The manager extracts the performance information from the agent. In this processing, the manager should go through authentication. If the manager succeeds with authentication, it can get the performance information from agent. But if the manager fails to authentication, it receives the Trap message from the agent. The manager looks up the information about a present running process by using hrSWRunPerfCPU and hrSWRunPerfMem field value. However, the manager needs whole of CPU utilization rate and memory utilization rate of CSCFs for the dynamic routing of SIP message. Therefore, the structure of performance information in the database of manager is shown in Table 2.

Table 2. Performance Information

<table>
<thead>
<tr>
<th>CSCF_ID</th>
<th>CSCF_Class</th>
<th>hrSWCPU</th>
<th>PerMem</th>
<th>CPU_Util</th>
<th>Mem_Util</th>
<th>Throughput</th>
<th>DelayTime</th>
<th>Description</th>
</tr>
</thead>
</table>

**Step 3:** In this step, the manager analyzes the performance of each CSCF. After finishing the step 2, the manager can preserve the performance information about CSCFs in the management database. The manager decides the priority order for SIP routing among CSCFs. And then, it renews and modifies the priority information in the management database which is depicted in Table 3.

Table 3. SCF Routing Information

<table>
<thead>
<tr>
<th>CSCF_ID</th>
<th>CSCF_Class</th>
<th>IP</th>
<th>Priority</th>
<th>OperStatus</th>
<th>Description</th>
</tr>
</thead>
</table>

**Step 4:** The manager selects the best CSCF for performing a dynamic routing among CSCFs. After finishing the step 3, the manager decides a CSCF with the highest priority field and configures the best CSCF using Set-Request message. Additionally, if the CSCF exceeds the defined value of agent's threshold (Tm, Tc), it notifies the manager of the Trap message that is stored into Log_Db. The information structure of Log_Db is shown in Table 4.

Table 4. Trap Information

<table>
<thead>
<tr>
<th>Log_ID</th>
<th>CSCF_ID</th>
<th>CSCF_Class</th>
<th>IP</th>
<th>TrapType</th>
<th>TrapInfo</th>
<th>Timestamp</th>
<th>Description</th>
</tr>
</thead>
</table>

The figure 4-(a) shows the GUI of P-CSCF in the IMS. Every CSCF is implemented in Java language using JAIN SIP 1.2, and the experiment is tested in the environment of 100Mbps LAN. The figure 6-(b) presents the GUI of S-CSCF, interfacing with the presence server. The S-CSCF maintains the information of registered users. Users can
access the presence server using SIP messages through the CSCFs which are selected in a dynamic routing algorithm. The figure 4-(c) presents the GUI of NMS manager. To get the performance information, the administrator should add the IP address of the CSCF’s agent. SNMP OID is the unique identifier for collecting performance information. CPU Utilization shows a coefficient of utilization about CPU, and Memory Utilization shows a coefficient of utilization about memory. The information of CSCF includes various information such as CSCF Agent’s IP, sysName, sysDesc (H/W and S/W information), sysUpDown(server operation), hrSystemUptime(recent initiation time), CPU_Utilization, Memory_Utilization and so on.

![Figure 4. The GUI of P-CSCF(a), S-CSCF including presence and PoC(b), and NMS manager(c)](image)

4. Summary

In this paper, we suggested dynamic routing algorithm to manage network traffic among CSCFs using SNMP in the PoC and PS. As a result, the proposal of a dynamic routing is better than static routing when network traffic converges on a CSCF. Later on, this study should include various elements (Fault, Configuration, Accounting, Performance, and Security) and the solution that can reduce the number of message between CSCFs and NMS for efficient network management. In the future network, the role of NMS will be more important and network traffic will increase in the IMS. Therefore dynamic routing algorithm will be essential in network management.

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References


Authors

Jae-Hyoung Cho

2006 Graduated from Electrical and Electronics Engineering Dept of KoreaTech, Korea (bachelor degree)

2008 Graduated from Electrical and Electronics Engineering Dept of KoreaTech, Korea (Master degree)

2008–present Electrical and Electronics Engineering Dept of KoreaTech, Korea (Doctor course)

Jae-Oh Lee

1987 Graduate from Computer Science of KwangWoon University, Korea (bachelor degree)

1989 Graduate from Computer Science of KwangWoon University, Korea (Master degree)

1993 Graduate from Computer Science of KwangWoon University, Korea (Doctor degree)

1994 ~ 1995 Cologne Institute for Information and Communication, Korea (Section Chief)

1995 ~ 2000 Korea Telecom, Korea (Senior Researcher)

1999 ~ 2002 WarePlus, Korea (Research Director)

2002 ~ present Electrical and Electronics Engineering Dept of KoreaTech, Korea (Professor)