第 XII 部

IP マルチキャストに関する運用・応用アプリケーション開発

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第 1 章 Introduction

Multimedia streaming has been one of the most popular applications in the Internet. To provide high quality multimedia streaming content to a large number of the Internet users, a quality adaptation mechanism for streaming applications and defining operational conditions to deploy IPv4/v6 multicast in the Internet are necessary for distributing the future media in the Internet. M6bone Working Group in the WIDE Project has been focusing on multimedia streaming applications and IPv4/IPv6 multicast deployment in the Internet.

We have been maintaining and promoting IP multicast capable networks in the global Internet. We also submitted Internet-Drafts to the IETF. The following chapters introduce the contributions and the primary outputs.

第 2 章 Inter-AS Multicast Streaming in Total Solar Eclipse 2009

The partial or total solar eclipse was visible in Japan on July 22th 2009. NAOJ (National Astronomical Observatory of Japan) shot the total solar eclipse at IWOJIMA which was the umbra path place. They provided the video to a lot of TV broadcasting productions and other research institute. Video data was carried by internet broadband satellite system (WINS). We also received it and encoded to the MPEG2-TS and H.264 to redistribute by IP multicast. We prepared IPv4 and IPv6 Any Source Multicast streaming, IPv4 used Glop and IPv6 used Embedded-RP addressing rule. We created the web page to gather the access log, and lead subscribers to join the multicast group using VLC web plugin scripts.

2.1 Analysis of the Web Access and Operational Problem

There are two web pages to provide the IPv4 and IPv6 multicast streaming. Figure 2.1 is country code using geoiplookup. 659 unique subscribers accessed on the Web page using IPv4, and most of subscribers are from Asia cause of timezone.

However, this figure doesn't indicate how many subscribers could receive the video traffic. Basically, multicast reachability check tools are not installed at subscribers' operating system such as ssmping/asmping. Web server could recognize which address family subscribers used to access the web pages, but it couldn't find if subscribers had multicast connectivity and which address family multicast was reachable.

However, subscribers usually access the web page via domain name, don't care which IP version using. In unicast, address family independent services are provided, and some technologies are defined such as *getaddrinfo* system call. In multicast, it is difficult in current technology or protocol. The well known IPv4 multicast Prefix which is defined by IANA is recorded in *mcast.net* second level domain. Basically, the domain name of multicast IP address for personal use is not defined. The reason are, no reverse lookup delegation policy for the GLOP or personal use prefix, no AAAA records in the *mcast.net*, no standard representation technique about SSM[43], etc. ... IPv4 only, IPv6 only or dual stack network will be provided in the future. IP multicast should support address family independent service too.

We had been operated dual IPv4 and IPv6

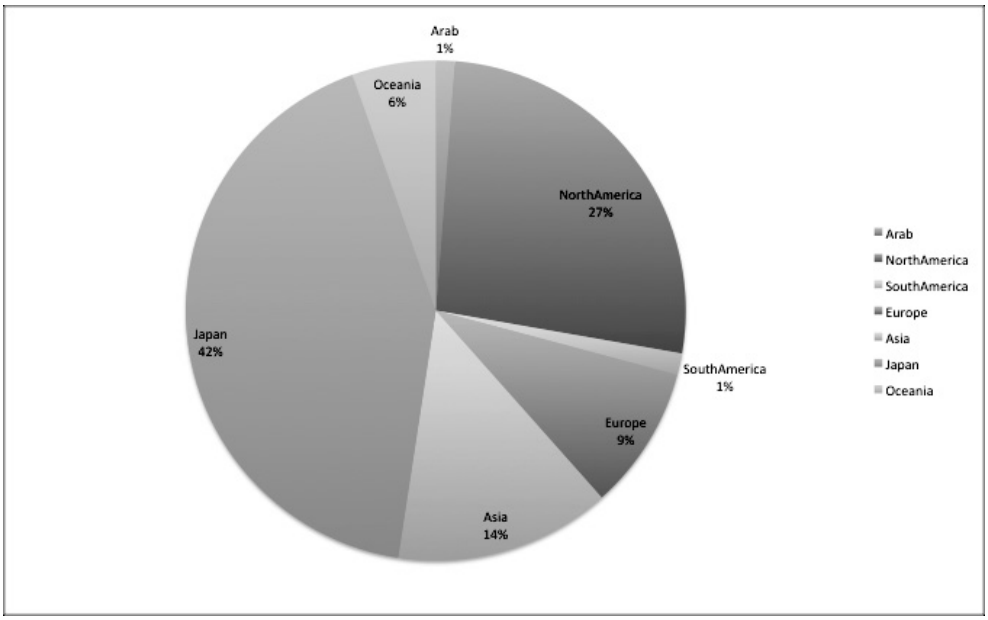

Fig. 2.1. IPv4 Web Access Analysis

multicast environment, we also provided some dual stack streaming. We just announced IP address for the partitipates, and provided connectivity check tools before, but we thought it's not enough to avoid connectivity problem. We will continue to discuss connectivity check tool and application interface for the future environment.

第 3 章　Contributions for the IETF

3.1 Lightweight IGMPv3 and MLDv2 Protocols

An IP multicast protocol architecture requires host-and-router communication, in order for multicast router to maintain active multicast routing tree. The Internet Group Management Protocol (IGMP) for IPv4 and the Multicast Listener Discovery (MLD) for IPv6 are the standard protocols for the host-and-router communication. When a data receiver wants to join or leave multicast sessions, it notifies the multicast group address by sending an IGMP/MLD join or leave message to the upstream multicast router.

IGMP version 3 (IGMPv3) and MLD version 2 (MLDv2) implement source filtering capabilities. An IGMPv3 or MLDv2 capable host can send IGMPv3/MLDv2 messages to its upstream router to notify which multicast channels the host wants to subscribe and unsubscribe. An IGMPv3 or MLDv2 capable router then can learn sources which are of interest or which are of not interested for a particular multicast address.

The multicast filter-mode improves the ability of the multicast receiver to express its desires. It is useful to support one-to-many multicast communications known as SSM by specifying interesting source addresses with INCLUDE mode. However, practical applications do not use EXCLUDE mode to block sources very often, because a user or application usually wants to specify desired source addresses, not undesired source addresses. It is generally unnecessary to support the filtering function that blocks sources.

We proposed simplified versions of IGMPv3 and MLDv2, named Lightweight IGMPv3 and Lightweight MLDv2 (or LW-IGMPv3 and LW-MLDv2)[63]. LW-IGMPv3 and LW-MLDv2 support both traditional many-to-many communications and SSM communications without

a filtering function that blocks sources. Not only are they compatible with the standard IGMPv3 and MLDv2, but also the protocol operations made by hosts and routers or switches (performing IGMPv3/MLDv2 snooping) are simplified to reduce the complicated operations. LW-IGMPv3 and LW-MLDv2 are fully compatible with the full version of these protocols (i.e., the standard IGMPv3 and MLDv2).

LW-IGMPv3 and LW-MLDv2 protocol specification will be Proposed Standard RFC in the first half of 2010.

3.2 Mtrace Version 2

From operator's perspective, lack of effective monitoring tools limits the IP multicast deployment activities. To monitor unicast routing path, the unicast traceroute program has been used to trace a path from one machine to another. The key mechanism for unicast traceroute is the ICMP TTL exceeded message, which is specifically precluded as a response to multicast packets. On the other hand, the multicast traceroute facility that allows the tracing of an IP multicast routing paths is not standardized but needed. We specified the new multicast traceroute facility to be implemented in multicast routers and accessed by diagnostic programs. The new multicast traceroute, mtrace version 2 or mtrace2[12], can provide additional information about packet rates and losses that the unicast traceroute cannot, and generally requires fewer packets to be sent.

The proposed draft supports both IPv4 and IPv6 multicast traceroute facility. The protocol design, concept, and program behavior are same between IPv4 and IPv6 mtrace2. Mtrace2 messages are carried on UDP, whereas the packet formats of IPv4 and IPv6 mtrace2 are different (but similar) because of the different address family.

We have been enhancing the mtrace2 functions to make it fully worthful. One of the major changes of the latest version is that the current mtrace2 encodes TLV fields in mtrace2 messages. For instance, mtrace2 response can encode not only Mtrace2 Standard Response Block, which includes common router's information, but also Mtrace2 Augmented Response Block, which includes extended vendor or protocol specific information. This is useful for future's extension.

Mtrace2 specification has been accepted as the IETF MBONED working group draft, and at the end of this year, Working Group Last Call was invoke at 76th IETF in Hiroshima.

3.3 Multicast Mobility

Multimob (Multicast Mobility) Working Group was established at 76th IETF in Hiroshima, and it provides guidance for supporting multicast in a mobile environment. This Working Group aims specific goal which are how multicast can be supported in a Proxy Mobile IPv6 environment and IGMPv3/MLDv2 in mobile environments.

Basic IGMP and MLD protocol use General Query to check who still wants to subscribe specific group, and all IP multicast traffic mapps Ethernet Broadcast to delive all nodes which are in same network segment. In Mobile Network, mobile nodes have limitation for the battery, and network resource is shared and narrow. Thus, many sleeping device are resumed by General Query, and limtied network bandwidth is wasted.

We started to write Internet Drafts which are IGMP/MLD optimization, extention and PMIPv6 multicast extension to resolve above problems. Our proposal are published on Internet Draft[11], and it will revise and continue to discuss in IETF.

第4章 Conclusion

M6bone WG has been working for IP multicast deployment and conducted various research towards its further use. In this year, we studied advanced research topics and had operational

experience in the global native multicast networks. Protocol standardization is also our important task for fulfilling the future demand. Our future work would improve current research solutions and much relate to the fundamental issues being required in various multimedia streaming services including future Internet TV. The other hands, mobility issue is also an important topic in order to provide the content delivery for many mobile users. Providing IP multicast stability and robustness should be also convinced in our future work.