Proposal on Application Layer Multicast, Based on a Ring Shaped Route

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I. Introduction

With increasing opportunities for transmitting large capacity data such as media content distribution, it has become more and more important to utilize network resources efficiently. As a means of solving this issue, we can name a system called ”multicast system” by which the same information can be received by multiple end nodes simultaneously. Although ”IP multicast”can realize a multicast in the IP layer, its popularization is considered to be difficult since it is necessary to replace routers. Accordingly, a system called ALM (Application Layer Multicast) has been drawing attention.

As an example of the existing ALM systems, Narada [2] is a system where a multicast tree is created by using a pre-established mesh-type overlay network. ALMI [3] is a type of ALM with tree-shaped distribution routes composed of session members and a session controller. However, In both Narada and ALMI, senders are fixed in advance and unless routes are regenerated, arbitrary end nodes in the same group cannot become multicast senders. In the case of Narada, transmission efficiency of packets is determined at the stage of creating a mesh-type network, but no physical route is taken into consideration there. Meanwhile, in the case of ALMI, although it can improve the route efficiency by utilizing RRT (Round Trip Time) by way of ICMP echo, there are cases where efficiency improvement cannot be made since there is a possibility that ICMP messages are blocked by firewalls. Accordingly, we propose in this paper a multicast system in which a route is connected in a ring shape. In our proposed system, NTMobile [1] is used for the sake of communication between end nodes, at the time of creating a route. NTMobile is a technology to simultaneously realize communication mobility and connectivity. By using this NTMobile, a multicast system is realized in which a physical route is considered and yet, transmission sources are not limited.

II. Proposed Method

In our proposed method, GMS (Group Management Server) is introduced for the purpose of managing group members and creating a route. GMS, after carrying out the grouping of end nodes, lines up group members in a ring shape. It has features that any member can start multicast transmission and that the load on all end nodes is the same. Furthermore, by lining up group members in the order of IP addresses, we can realize ALM which considers a physical route. For communication between end nodes, NTMobile which can realize end-to-end communication, is used. By this method, we can realize both grouping and multicast that are independent of the types of IP addresses.

A. NTMobile

NTMobile is a technology that can realize a flat network which is transparent to the difference among IPv4 global, IPv4 private, and IPv6 networks. At the time of starting communication, a device called DC (Direction Coordinator) and end nodes create an end-to-end tunnel route, by mutually signaling. As all the communication is conducted by way of tunnel communication, there is no influence from the change of IP addresses during communication.

B. Grouping by GroupManagementServer

Figure 1 shows the grouping procedure by GMS. GMS manages information about the group and creates, delivers and renews the group key. Grouping is completed when the same group key is shared among the group members. As the information to manage the group, GMS keeps a group ID, information about group members (FQDN and IP addresses), and members’ log-in status. Table I shows concrete examples of information held by GMS. In this Table, n2, n3 and n6 are end nodes behind NAT devices, and n1, n4 and n7 are such end nodes that have either IPv4 addresses only, IPv6 addresses only, or both of them. The *status* in the table indicates whether the application is running or not.

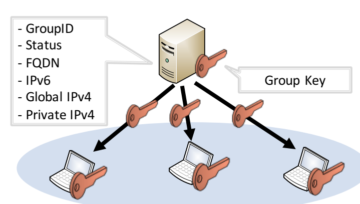

Fig. 1. Grouping procedure by GMS.

C. Method of generating a Ring Route

Fig. 2 shows the ring route of our proposed method. GMS sorts group members in the order of IP addresses, based on the information about the members which GMS holds. As the route creation procedure at that occasion, GMS first sorts the end nodes that have IPv6 addresses only, based on the addresses. Next, it sorts other end nodes based on global IPv4 addresses. In the case where multiple end nodes exist behind

TABLE I
INFORMATION RETAINED BY GMS.

id	status	fqdn	global IPv6	global IPv4	private IPv4
a	ON	n2		203.0.113.1	192.168.1.2
a	ON	n4	2001:db8::a:a		
a	ON	n1		192.0.2.10	
a	ON	n3		203.0.113.1	192.168.1.3
b	ON	n6		192.0.2.10	102.168.1.2
b	OFF	n7	2001:db8::a:b	203.0.113.2	

the same NAT, the sorting is made based on the private IPv4 addresses, and they are arranged in succession. When the above-mentioned route creation processing is applied to the members whose group id is “a” in Table I, they are rearranged as shown in Table II.

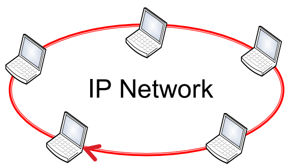

Fig. 2. Ring route of our proposed method.

TABLE II
ARRANGEMENT OF GROUP MEMBERS AFTER THE ROUTE CREATION.

fqdn	global IPv6	global IPv4	private IPv4
n4	2001:db8::a:a		
n1		192.0.2.10	
n2		203.0.x113.1	192.168.1.2
n3		203.0.113.1	192.168.1.3

D. Multicast route creation procedure

Fig.3. shows the procedure to create a multicast route. NTM1, on behalf of group members, requests GMS to start the multicasting. GMS determines the route in accordance with the ring-route creating procedure. Then, GMS provides each group member with FQDN of the end node which is the next destination of the ring-shaped route. NTM end node, upon receipt of the route instruction, creates a tunnel route for the multicasting, by making NTMobile signaling with the next destination based on the information received. When all the NTM end nodes have created tunnels in the same way, a ring-shaped tunnel route is completed between NTM1 and NTM4.

III. EVALUATION

We made a qualitative evaluation among IP multicast, existing ALMs and our proposed method. Table III shows the comparison among them. In this comparison, qualitative evaluation was performed from the following viewpoints.

1) Whether a dedicated router is required.
2) Whether a physical route is taken into consideration.
3) Whether recreation of a route is required, when there exist multiple senders.

In Item 1), while dedicated routers are required for the IP multicast, normal routers are used for the existing ALMs and

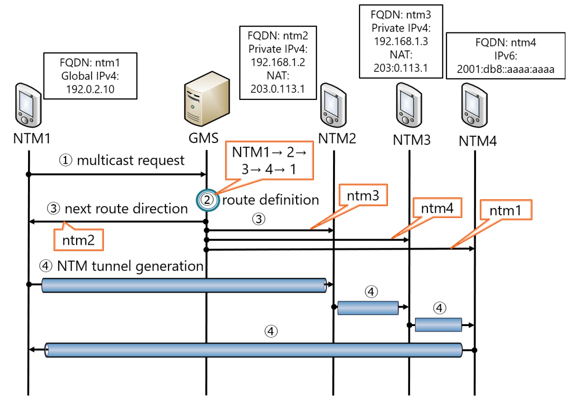

Fig. 3. Multicast route creating procedure.

TABLE III
COMPARISON WITH THE EXISTING TECHNOLOGY.

	IP Multicast	Existing ALM	Proposal
1)No dedicated router is required	×	○	○
2)Consideration of a physical path	○	×	○
3)No requirement for path regeneration	○	×	○

our proposed method, as packets are reproduced and forwarded by each end node. In Item 2), while a physical route is taken into consideration in the cases of IP multicast and our proposed method, such is difficult in the case of the existing ALMs. In Item 3), while a route needs to be recreated if and when the sender changes in the case of the existing ALMs, any end node can become a packet sender in the cases of our proposed method and IP multicast. Our proposed method is thought to be useful for chatting services where large-size files can also be forwarded, or when group members want to share files, since the bandwidth consumed by each end node is fair.

IV. CONCLUSION

In this paper, we have proposed a ring-shaped multicast method using GMS as a means of realizing ALM. It was shown that any end node can become a sender and also that a route can be created in recognition of the physical network. We plan hereafter to examine the situation if and when any of the group members has left the group without notice, and we will also proceed with GMS's implementation.

REFERENCES

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