A Study of Multicast using the Multiprotocol Label Switching

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Multicasting technologies are attracting a great deal of interest as a result of vast Internet growth and diversification of requirements for the information delivery. There are various studies and developments of multicasting technologies. Especially, The IP Multicast is a well-known multicasting technology, which can improve a network resource utilization. In case of one-to-many communication, there are many cases that an efficient use of network resources is required. A principal purpose of the IP Multicast technology is a reducing wastes of network resources. However, requirements for multicast applications are not only reducing wastes of network resources, but also reducing a jitter, reducing a latency, enhancement of reliabilities, and so on. Currently, to fulfill such various multicast application requirements, various multicasting technologies along the framework of the IP Multicast are proposed. However, the framework for the IP Multicast assumes that the only one monolithic routing plane, and it is not sufficient for fulfilling various multicast application requirements.

The principal purpose of our study is to realize a multicasting mechanism that can fulfill various multicast application requirements. In this paper, we pointed out that there are some cases that the problem can be solved by change routing mechanisms, which is corresponding to specific multicast application requirements. Then, we proposed **MRP-MC (Multi Routing Plane Multicast)** as a new multicasting model, which can fulfill various multicast application requirements simultaneously. In case of the traditional multicasting model, packets will be delivered along the multicast distribution tree established by a multicast routing mechanism. In case of the MRP-MC multicasting model, a traditional distribution tree or a traditional multicast routing mechanism is regarded as a one virtual routing and delivery plane, and multiple planes co-exists in a network domain simultaneously. The MRP-MC fulfills various multicast application requirements

by handling plural of virtual planes as one mechanism. A packet in a MRP-MC domain will be classified and mapped to a appropriate virtual plane, at the ingress router of the MRP-MC domain. The packet mapped to the specified virtual plane will be distributed along the distribution tree on the selected virtual plane.

To realize MRP-MC model, a definite separation of a routing mechanism and a packet delivery mechanism is indispensable. Further more, a packet delivery mechanism that can allow existence of multiple routing mechanisms is also indispensable. In our study, we focused on the MPLS (Multiprotocol Label Switching) technology that has characteristics required.

The MPLS technology is attracting a great deal of interest as a technology that can reduce a load of routers. In case of the IP forwarding, a particular router will typically consider two packets be in the same forwarding equivalent class if they share the same address prefix in that router's routing table. In case of the MPLS forwarding, looking up for router's forwarding tables is done just once at the ingress router of the MPLS domain. Transit routers only forward packets by using labels mapped to forwarding equivalent classes. Therefore, in case of the MPLS forwarding, router's process is reduced and network performance is enhanced. But the remarkable feature of the MPLS technology is not only reducing of load of routers, but also the definite separation of a routing mechanism and a packet delivery mechanism. We focused on the definite separation of a routing mechanism and a packet delivery mechanism.

In this paper, we demonstrated how to realize the MRP-MC using the MPLS technology. Especially, we discussed about two extensions for the MPLS mechanism, which are the extension of the MPLS routing mechanism to support MRP-MC routing plane and the extension of the MPLS packet distribution mechanism to support MRP-MC packet forwarding. In this paper, we described that how to support multicast packet distribution in the MPLS technology and how to realize plural virtual planes using MPLS technology. We proposed the MRP-MC extended NHLFE and the MRP-MC extended virtual network interface. The NHLFE is a part of packet forwarding tables of the MPLS mechanism. We implemented the support of multicast distribution using the MPLS technology by using the MRP-MC-extended NHLFE and the MRP-MC-extended virtual network interface. Also, we proposed the MRP-MC-extend LDP. An LDP is a label distribution protocol. In the MPLS architecture, the purpose of label distribution protocol is distribution of the mapping of a label and a characteristic of a packet. We implemented support of virtual planes by using the MRP-MC extend LDP.

In this paper, we described a way to implement the MRP-MC using an existing MPLS implementation. We choose the AYAME MPLS implementation as the basic mechanism of the MRP-MC. The AYAME is the MPLS implementation, which aims at study and research of the MPLS technology or the technology using MPLS. We implemented the MRP-MC implementation by extending the AYAME implementation to support a packet forwarding mechanism of the MRP-MC mechanism and to support a label distribution control of the MRP-MC mechanism.

In this paper, we have intentionally focused on a stable state of the MRP-MC model. This is a basic study of realizing flexible routing mechanisms. Future research shall include discussions of transitive and dynamic nature of the MRP-MC mode. For example, process

of reaching the state must be studied, control and administration support is another example. Automation of configuration of virtual planes or dynamic modification of metric of path seems to be a serious problem. Also, a complete implementation of the MRP-MC based on the AYAME, and new applications using MRP-MC.