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An IPv6/IPv4 Multicast Translator based on IGMP/MLD Proxying (mtp)

<[draft-ietf-ngtrans-mtp-03.txt](#)>

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Abstract

In the stage of the transition from IPv4 to IPv6 it is necessary that IPv4 nodes and IPv6 nodes can communicate directly. This memo proposes a mechanism which enables such direct communication for multicast, in addition to that for unicast defined in [[SIIT](#)] and [[NAT-PT](#)].

1. Introduction

It is expected that lots of IPv4 nodes will remain, for their success, for a long time even after the transition to IPv6 starts. On the other hand IPv6-only nodes will appear, for cost reasons or as a result of exhaustion of the IPv4 address space, before IPv4 nodes disappear. Therefore, it is highly desirable to develop a mechanism which enables direct communication between IPv4 nodes and IPv6 nodes, in order to advance the transition smoothly. [[SIIT](#)] and [[NAT-PT](#)] have already proposed such mechanisms, but they are applied only to unicast communication, not to multicast. So it is necessary to provide another mechanism for multicast.

This memo describes an entire scheme of multicast communication between IPv4 nodes and IPv6 nodes. The scheme is composed by a multicast translator and an address mapper who are located at the site boundary between IPv4 and IPv6. It is not necessary to modify IPv4 nodes and IPv6 nodes.

This memo uses the words defined in [[IPV4](#)], [[IPV6](#)], and [TRANS-MECH].

2. Components

This section describes components needed for the mechanism.

The system consists of a multicast translator, and an address mapper. In order to allow IPv4 nodes and IPv6 nodes to directly communicate using multicast, they need to be installed on the site boundary between IPv4 and IPv6. Figure 1 illustrates the network system interconnected by them.

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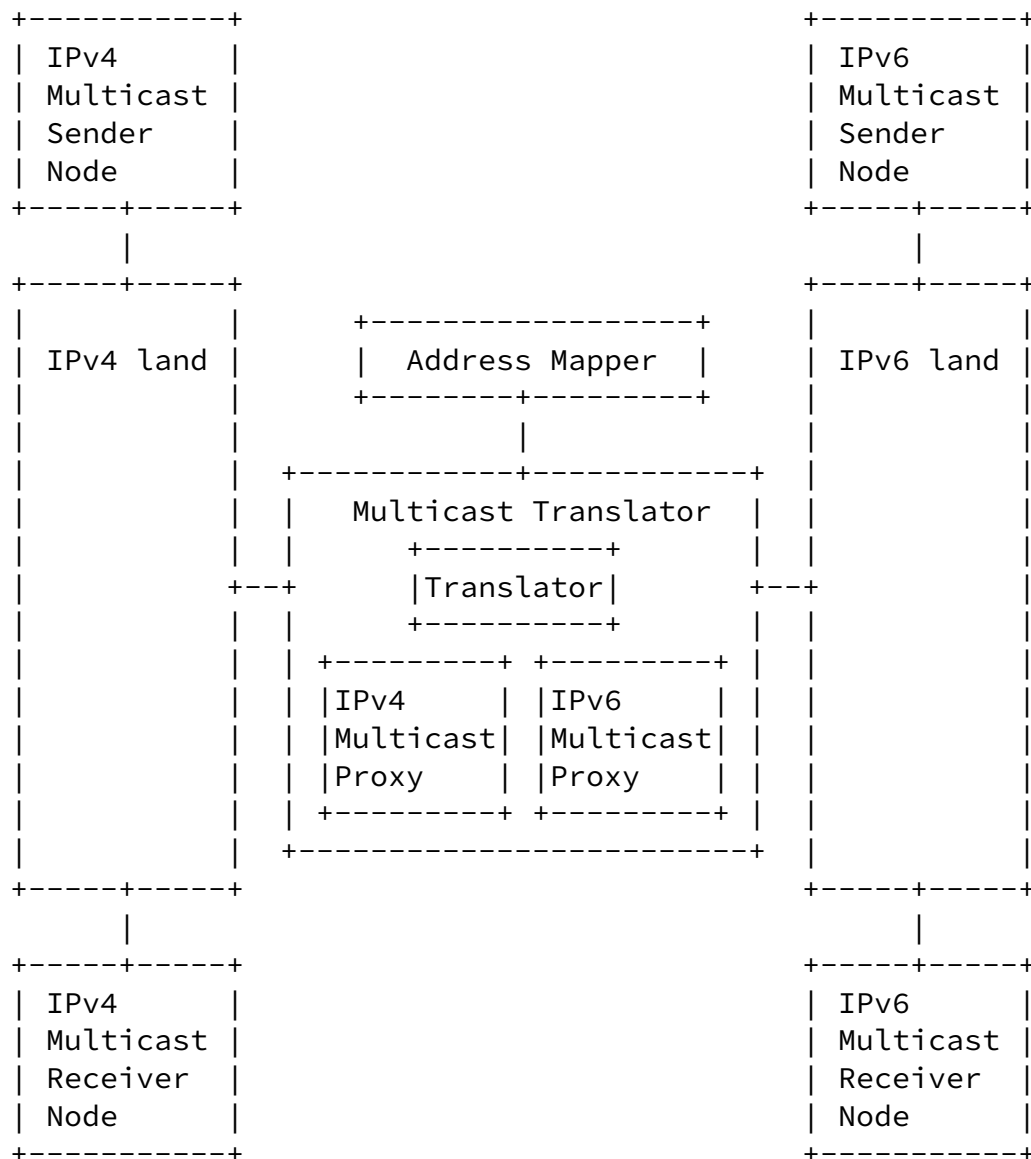


Figure. 1 Network system

[2.1](#) Multicast Translator

It locates between an IPv4 land and an IPv6 land, and translates IPv4 multicast packets into IPv6 multicast packets and vice versa. It consists of the following three sub-components.

- (1) Translator

It is a component which translates IPv4 multicast packets into IPv6 multicast packets and vice versa. There are several translation types.

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o Gateway

It terminates data bound for an IPv4 multicast group at application layer, and relays the data to an IPv6 multicast group and vice versa.

o Header conversion router

When receiving IPv4 multicast packets, it converts the IPv4 headers into IPv6 headers, fragments the IPv6 packets if necessary, and then forwards the packets. Likewise, when receiving IPv6 multicast packets, it converts the IPv6 headers into IPv4 headers, and then forwards the IPv4 packets.

(2) IPv4 Multicast Proxy

It joins IPv4 multicast groups as a proxy of IPv6 receiver nodes. Thereby it receives packets bound for the IPv4 multicast groups, and then hands the packets to the translator.

(3) IPv6 Multicast Proxy

It joins IPv6 multicast groups as a proxy of IPv4 receiver nodes. Thereby it receives packets bound for the IPv6 multicast groups, and then hands the packets to the translator.

[2.2](#) Address mapper

It maintains each unicast address spool for IPv4 and IPv6. The IPv4 spool, for example, consists of private addresses [[PRIVATE](#)] bound for the multicast translator. An example of the IPv6 spool is IPv6 address space assigned to virtual IPv6 organization on the IPv4 land.

NOTE: The IPv4 spool is used for temporary IPv4 addresses of IPv6 sender nodes (or IPv6 receiver nodes) in the IPv4 land. Also the IPv6 spool is used for temporary IPv6 addresses of IPv4 sender nodes (or IPv4 receiver nodes) in the IPv6 land. So the mtp should advertise IPv4/IPv6 unicast routes for them so that packets to them can be delivered to the mtp and also RPF check (RPF: Reverse Path Forwarding) can work well.

Also, it maintains a mapping table which consists of pairs of an IPv4 address and an IPv6 address. When the translator (or the IPv4 Proxy or the IPv6 Proxy) requests it to assign an IPv6 address corresponding to an IPv4 address (an IPv4 source address), it selects a proper IPv6 address out of the table, and returns the address to the translator. When there is not a proper entry for an IPv4 unicast address, it selects and returns an IPv6 unicast address out of the spool, and registers a new entry into the table. When there is not a proper entry for an IPv4 multicast group address (an IPv4 destination address), it registers a new entry, which consists of the IPv4 multicast group address and that of IPv6 corresponding to the IPv4 address, into the table. The IPv6 address is a special type of one proposed in this memo. See [section 4](#).

NOTE: The translator translates packets between IPv4 and IPv6 according to the table. The scheme of the above address mapping is conformable to NAT-PT; IPv4 addresses are mapped to IPv6 addresses one to one. In addition, there may be another scheme which follows NAPT-PT, but in that case there can be a limitation in the system. For example, if an IPv4 sender node's address is mapped to a single registered IPv6 address and its TCP/UDP port, then IPv6 receiver node cannot communicate with the IPv4 sender node in unicast except via this TCP/UDP port. Because it does not have a mapping table except for that TCP/UDP port, and the translator would fail in translating IPv6 into IPv4 in case of the TCP/UDP port.

When the translator (or the IPv4 Proxy or the IPv6 Proxy) requests it to assign an IPv4 address corresponding to an IPv6 address, it works like the above.

[3.](#) Interaction Examples

This section explains communication from one IPv4 multicast sender node to one or more IPv6 multicast receiver nodes, and communication from one IPv6 multicast sender node to one or more IPv4 multicast receiver nodes, respectively.

[3.1](#) Communication from IPv4 to IPv6

The following subsection explains communication from one IPv4 multicast sender node, called "sender4", to one or more IPv6 multicast receiver nodes, called "receiver6."

Preceding the communication, the administrator of the multicast translator carries out the setup to translate IPv4 multicast packets, which are sent by "sender4", into IPv6. According to the direction of the administrator, the IPv4 multicast proxy joins the IPv4 multicast group as a proxy of "receiver6", and then registers a new entry, which consists of the IPv4 multicast group address and that of IPv6 corresponding to the IPv4 address, into the mapping table. The IPv6 address is a special type of one proposed in this memo, and takes the structure which is identified by a prefix of `ffxy::/96` and holds the IPv4 address in the low-order 32-bits. See [section 4](#).

NOTE: In order to make MTP applicable to the Source-Specific Multicast(PIM-SSM), MTP needs to show IPv6 addresses corresponding to IPv4 multicast Senders to an IPv6 Receiver, in addition to IPv6 addresses corresponding to IPv4 multicast addresses available; MTP can know IPv4 multicast addresses available and their Senders' addresses as one of IPv4 Receivers. For example, MTP obtains IPv4 multicast addresses available and their Senders' addresses via an IPv4 SAP(an IPv4 SDR). MTP shows the IPv4 multicast addresses and the corresponding IPv6 multicast addresses, and the Senders' addresses and the corresponding IPv6 unicast addresses on its web. An IPv6 Receiver looks at its web and gets the IPv6 multicast address and the IPv6 Senders' address.

The communication is triggered by "sender4." "sender4" sends an IPv4 multicast packet.

When the packet arrives at the multicast translator, the IPv4 multicast proxy receives it and hands it to the translator. The translator tries to translate it into an IPv6 packet but does not know how to translate the IPv4 source address and the IPv4 destination address. So the translator requests the mapper to tell mapping entries for them.

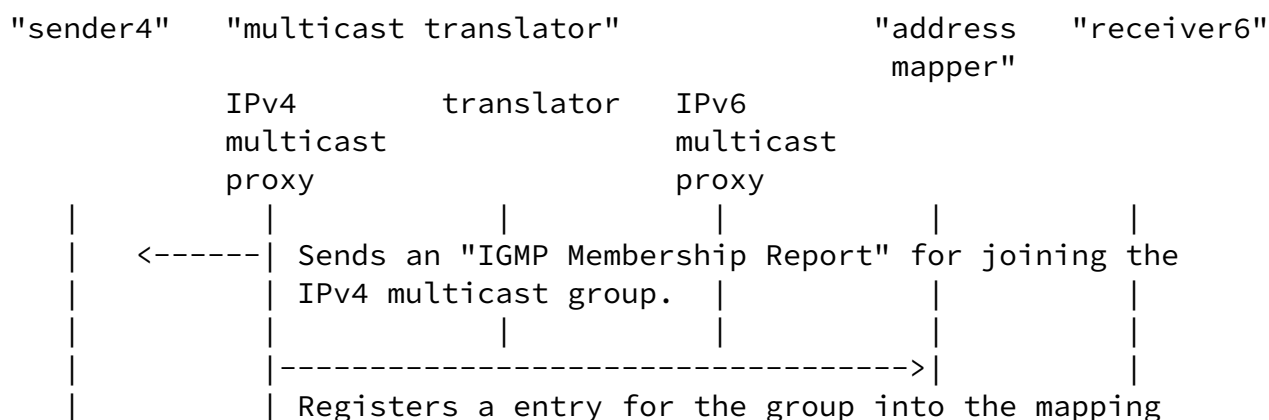
The mapper checks its mapping table with each of them and finds only a mapping entry for the IPv4 destination address.

But there is not a mapping entry for the IPv4 source address, so the mapper selects an IPv6 address out of the IPv6 spool and registers a new entry, which consists of the IPv4 address and the IPv6 address, into the mapping table. And then the mapper returns the IPv6 destination address and the IPv6 source address to the translator.

After that the translator translates the packet to IPv6, fragments it if necessary, and forwards it. Note: The translation from the IPv4 source address to the IPv6 source address is unicast one.

Finally it arrives at "receiver6."

Figure 2 illustrates the interaction communicating from IPv4 to IPv6.



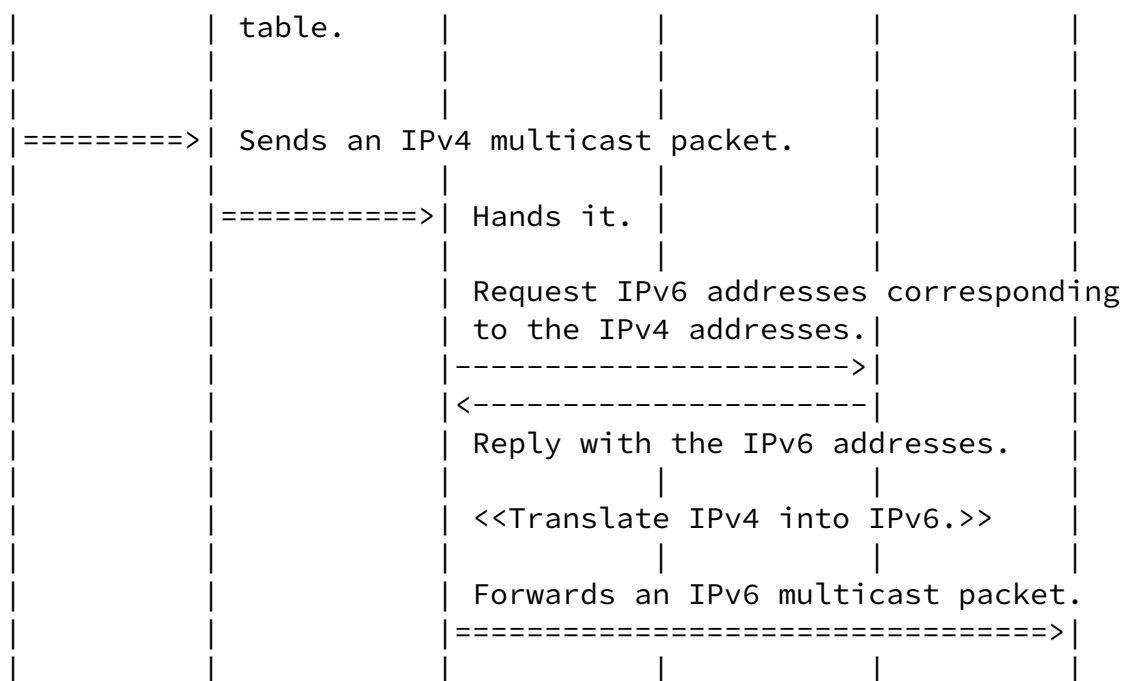


Figure. 2 The interaction communicating from IPv4 to IPv6.

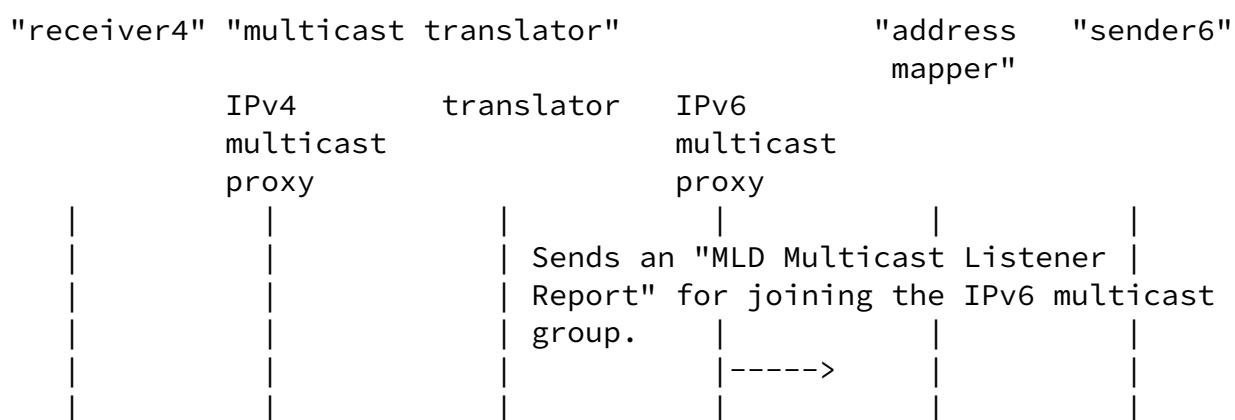
[3.2](#) Communication from IPv6 to IPv4

The following subsection explains communication from one IPv6 multicast sender node, called "sender6", to one or more IPv4 multicast receiver nodes, called "receiver4."

Preceding the communication, the administrator of the multicast translator carries out the setup to translate IPv6 multicast packets, which are sent by "sender6" to a special type of IPv6 address proposed in this memo, into IPv4. In the case, the IPv6 multicast proxy joins the IPv6 multicast group as a proxy of "receiver4", and then registers a new entry, which consists of the IPv6 multicast group address and that of IPv4 corresponding to the IPv6 address, into the mapping table. The IPv4 address is the low-order 32-bits of the IPv6 address.

Subsequent interaction is symmetric to the case described in Section 3.1.

Figure 3 illustrates the interaction communicating from IPv6 to IPv4.



The flag (x) is set to 0 when an IPv4 multicast address is a permanently-assigned ("well-known") multicast address by the global-internet-numbering-authority, otherwise is set to 1. Note: MTP needs to have a list of "well-known" addresses, and the list must be configurable by the MTP administrator.

The scope (y) is translated according to the mapping between an IPv4 multicast prefix and an IPv6 scope value described in [RFC2365](#) [[RFC2365](#)].

[5.](#) Protocol Translation Details

Protocol Translation Details described in [[NAT-PT](#)], including TCP/UDP/ICMP Checksum Update, are associated to MTP. See [[NAT-PT](#)].

Also the influence on RTP/RTCP of a translator investigated in Section 7 of [RFC1889](#) [[RTP](#)] is associated to MTP. See [[RTP](#)].

[6.](#) Applicability and Limitations

This section considers applicability and limitations.

[6.1](#) Applicability

The multicast translator based on the mechanism locates at the site boundary between IPv4 and IPv6, and allows them to communicate directly. Therefore, the mechanism can be useful during a long term, until IPv4 nodes disappear after IPv6-only nodes appear.

It can be applicable to small-scale network systems, and to the extent of division networks in intranets where its administrator can operate the setup easily on demand by receivers.

It cannot be applicable to large-scale network systems like world-wide Internet as it stands because it needs the setup by its administrator. In order to apply it to large-scale network systems, it needs developing a new standard protocol between multicast

translators and receivers for carrying out the setup automatically

on demand by receivers.

In order to apply it to large-scale network systems, it is necessary to automate the setup which the administrator carries out according to the requests of the receivers. That is, the receivers directly call on the IPv4 multicast proxy (or the IPv6 multicast proxy) to join in the group which they want to receive. The interaction can be carried out by some protocols. For example, using http makes it possible to do proper user authentication, and allows to encrypt the interaction data by security mechanism such as SSL. But to define a specific protocol for the interaction is out of scope of this memo.

[6.2](#) Limitations

(1) Applications

In common with [\[NAT\]](#) and [\[NAT-PT\]](#), IP conversion needs to translate IP addresses embedded in application layer protocols. So MTP needs ALGs for their translation.

(2) Topology

The topology is limited to a tree, and there can be one mtp per group. If more than one mtps exist per group, receiver nodes may receive the same packets doubly.

Note that mtp is recognized to be one of IPv4 receiver nodes by IPv4 sender nodes, and is recognized to be pseudo IPv6 sender nodes by IPv6 receiver nodes. Also note that mtp is recognized to be one of IPv6 receiver nodes by IPv6 sender nodes, and is recognized to be pseudo IPv4 sender nodes by IPv4 receiver nodes. Since IPv4 multicast domain and IPv6 multicast domain are completely separated, mtp can be applicable to multicast routing protocols regardless of Rendezvous Point (RP), i.e. PIM-SM (using RP) or PIM-DM (not using RP) is applicable.

[7](#). Security considerations

Header conversions of AH [\[AH\]](#) and ESP [\[ESP\]](#) may be cryptographically impossible in header conversion router approach. It is a big disadvantage. On the other hand it will be possible to use both AH and ESP in proxy gateway approach.

8. References

- [SIIT] Erik Nordmark, "Stateless IP/ICMP Translation Algorithm (SIIT)", [RFC 2765](#), February 2000.
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- [IPV6] S. Deering and R. Hinden, "Internet Protocol, Version 6 (IPv6) Specification", [RFC 2460](#), December 1998.
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- [PRIVATE] Y. Rekhter, B. Moskowitz, D. Karrenberg, G. J. de Groot and E. Lear, "Address Allocation for Private Internets", [RFC1918](#), February 1996.
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- [AH] Kent, S. and R. Atkinson, "IP Authentication Header", [RFC 2402](#), November 1998.
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11. Changes

This memo has the following changes.

Since [draft-ietf-ngtrans-mtp-02.txt](#):

- 1) Added a note about application to the Source-Specific Multi-

cast(PIM-SSM) to "3.1 Communication from IPv4 to IPv6."

2) Added the "well-known addresses" list had to be configurable by the MTP administrator to "4 Addressing for IPv4/IPv6

multicast communication."

3) Added the influence on RTP/RTCP of a translator to "5 Protocol Translation Details."

Since [draft-ietf-ngtrans-mtp-01.txt](#):

- 1) Corrected the flag value, and specified that MTP needs a list of "well-known" addresses, in "4 Addressing for IPv4/IPv6 multicast communication."
- 2) Added protocol translation details including TCP/UDP/ICMP Checksum Update, in "5. Protocol Translation Details."
- 3) Specified the necessity for ALG in "6.2 (1) Applications."

Since [draft-ietf-ngtrans-mtp-00.txt](#):

- 1) Added description of temporary address mapping scheme from the viewpoint of RPF checks and bi-directional communication to "2.2 Address mapper."
- 2) Added the correspondence of IPv4 and IPv6 about a scope and a flag to "4. Addressing for IPv4/IPv6 multicast communication."
- 3) Added topological issues to "5.2 Limitations."

Since [draft-tsuchiya-imp-00.txt](#):

- 1) Updated Applicability and Limitations. Extended applicability to large-scale network systems.
- 2) Added [[AH](#)] and [[ESP](#)] to References.

