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MIP Extension for Ethernet Service transport Support
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Ethernet In MIPv4

May 2009

Abstract

The IP Mobility Protocol [[RFC3344](#)] enables a mobile node maintain IP connectivity when it changes its location. However, it is not enough to enable the node to maintain L2 connectivity between mobile node and Ethernet service provider in order to support Ethernet service transport. This document describes "Ethernet Service Transport" mobility option for mobile IPv4 that is intended to assist home agent tunnel Ethernet packets from the home link to the FA on the foreign link during the datagram delivery process.

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1. Introduction

The IP Mobility Protocol[RFC3344] enables a mobile node maintain IP connectivity when it changes its location. However, in some mobile IPv4 scenarios, enabling the node maintain its L2 connectivity is required to support forwarding Ethernet frames between mobile node and Ethernet service provider (e.g. ASP), i.e. "Ethernet Service Transport" support.

The capability to support Ethernet service can facilitate mobility service providers to provide IP services as well as Ethernet services concurrently over the same infrastructure within the same mobility service subscription. For example:

- o Provide end to end Ethernet connectivity from the mobile node across access network to the ASP providing Ethernet services (e.g. connectivity to DSL network with PPPoE).
- o Ethernet service support within the access network, e.g., node movement from one Ethernet segment to another within the same access network. It allows transport Ethernet frame between mobile node and the mobility anchor(e.g. FA).
- o Provide Ethernet aggregation for the public access service which imposes Ethernet frame to pass through ISP-head end to enable accounting and enforce security policies.

This document describes Ethernet extension mobility option for mobile IPv4 that is intended to assist home agent to tunnel Ethernet frame on the home link to the FA in the foreign link during datagram delivery process after the binding registration procedure. Ethernet service support for mobile IPv4 may affect the home agent routing decision, home address assignment policies and tunnel setup mechanism. Support of Ethernet does not require a new network architecture or any new functional entities in the network. The support of Ethernet Services is smoothly integrated into the Mobile network architecture

and Ethernet services can be operated parallel to the IP Services in the same network.

[2.](#) Terminology

The keywords "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [[RFC2119](#)].

The document uses the terminology specified in [[RFC3344](#)], In addition, this document defines the following:

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Ethernet service transport

Ethernet support for Mobile IPv4 that assists home agent to tunnel Ethernet frame on the home link to the FA in the foreign link during datagram delivery process after the binding registration procedure.

GRE Extension

GRE Encapsulation support for Mobile IPv4 that is used to differentiate between difference Ethernet services or flows.

[3.](#) Scenarios for MIP based Ethernet Services

In this section, four use cases are listed that are identified for Ethernet service transport support.

[3.1.](#) Hybrid services transport

The figure 1 shows coexistence of IP services and Ethernet service for the same mobile node in the same access network. In this scenario, the ASP providing Ethernet service contains the bridging function for forwarding Ethernet frames between MN and the Ethernet Service provider while the MSP (Mobile service Provider) provides IP service (e.g., Internet) delivered between the foreign agent or mobile node and the home agent through the same access network to the same mobile node. When Mobile IP is applied for dynamic tunnel management between the foreign agent or the mobile node and the home

Agent, the GRE based tunnel enables the transport of Ethernet frames in the payload. The Ethernet frames are forwarded based on the MN MAC address.

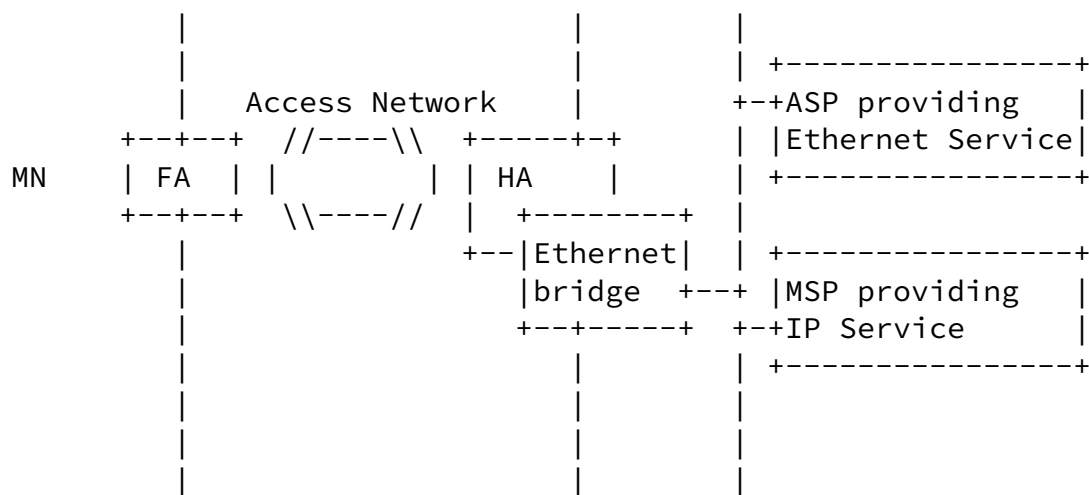
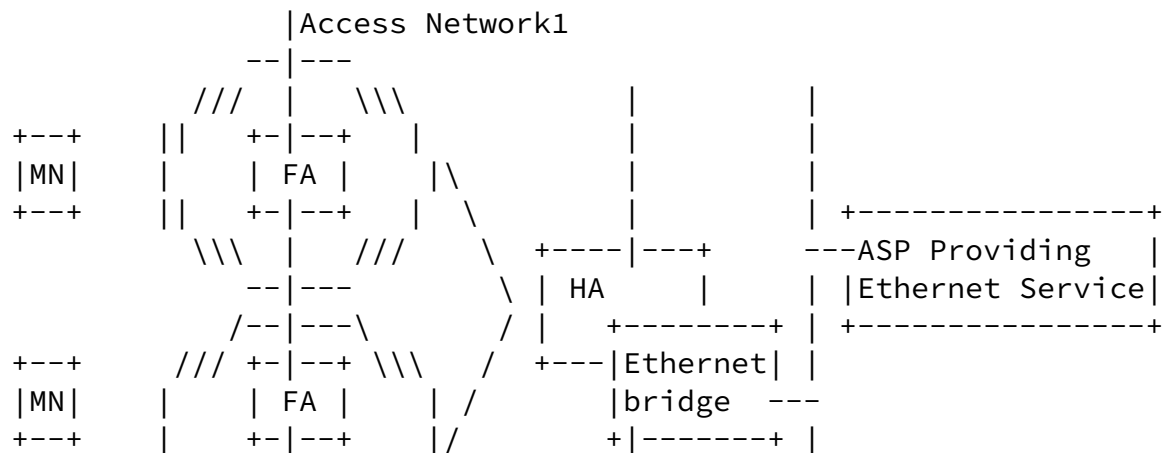
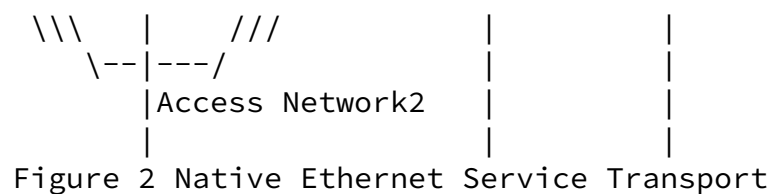


Figure 1 Coexistence of IP services and Ethernet services for the same access network

3.2. Native Ethernet Service Transport

Figure 2 shows native Ethernet service transport over various access networks in which it allows node movement from one Ethernet segment to another within the same access network or across various access networks. The Ethernet frames are distinguished by the bridging function at the HA based on VSE(Vendor Specific Extension) or host port and transport them over IP based tunnels between the foreign agent or Mobile node and the home agent.





3.3. VLAN Tag Support

Figure 3 shows VLAN Tag Support. VLAN-IDs are used in many different ways for segregating traffic of Ethernet services in the access network. The L2FW function in the FA SHALL support the flexible use of the VLAN-IDs by providing the following capabilities for each of the service flows:

In downstream direction towards the MN:

The L2FW SHALL be able to remove VLAN tags if present.

In upstream direction from the MN:

The L2FW SHALL be able to insert VLAN tags and assign priority bits in the VLAN tags.

Also the Ethernet bridge in the HA SHALL support VLAN tags process in bidirection towards or from the FA.

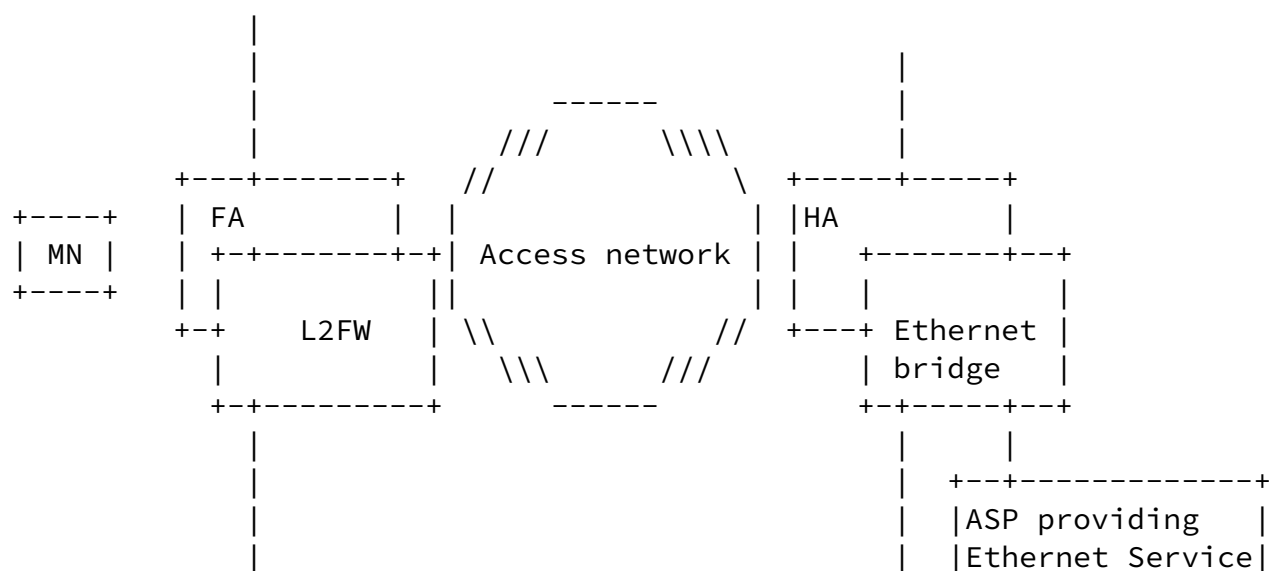


Figure 3 VLAN Tags Support

3.4. Multi-Host Support

Figure 4 shows multi-host support. In the multi-host scenarios, there are multiple devices connected to a bridge behind MR or RG. In this sense, the MR/RG is not the end system but contains a bridge forwarding to end systems behind the MR/RG, the downlink Ethernet frames contain destination MAC addresses other than the MR or RG MAC address, the Ethernet bridge attached to the home agent can learn the MAC addresses of the hosts behind the MR and establish binding between these MAC addresses and FA CoA when those hosts become active and start sending uplink frames.

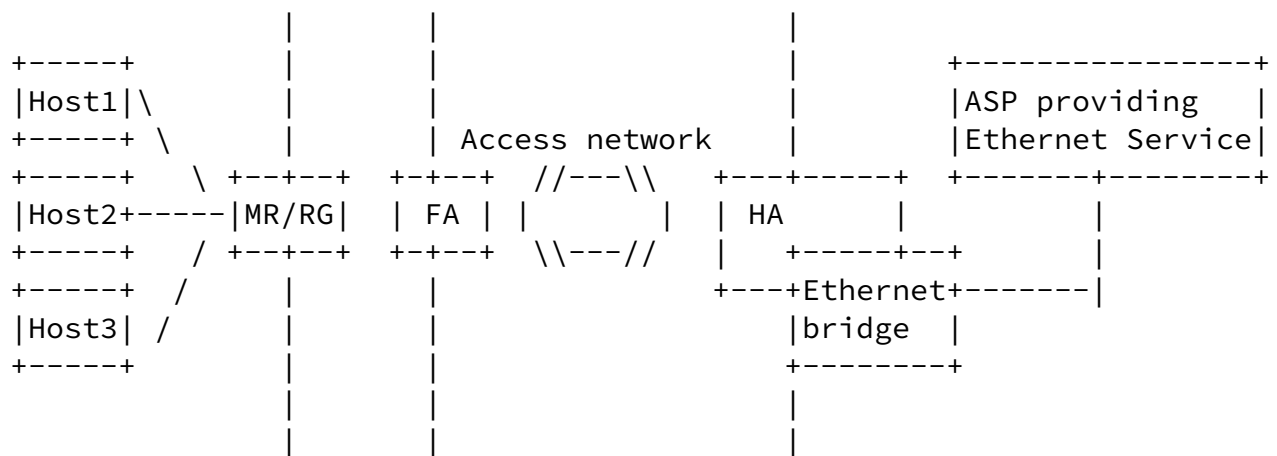


Figure 4 Multi-Host Support

4. Processing Consideration

4.1. GRE Encapsulation Support

[RFC2003] allows IP in an IP encapsulation which can be used to tunnel traffic between the FA and the HA. However, this encapsulation method is not enough to identify the destination of packets of a specific flow within an IP-in-IP tunnel.

[RFC2890] describes one generic routing encapsulation method which can be used to distinguish different flows in terms of GRE key. Thus, GRE encapsulation is one best way to differentiate between different Ethernet services or flows, i.e., during binding registration procedure, the message exchange between the FA and the HA will be used to negotiate downlink and uplink GRE keys which is used for marking downlink and uplink traffic for a specific flow.

4.2. Ethernet Service Transport Support

In order to support Ethernet service delivery in mobile IPv4 scenario, the communication between the MN and the home agent needs to be modified to support Ethernet frame transport. Ethernet frame can be transported over IP tunnel between the foreign agent and the home agent. During registration procedure, the MN or FA on behalf of MN sends Registration Request message to the home agent with MN's MAC address included in the Ethernet transport mobility option and MN's port included in the VSE option, meanwhile the FA will bind MN's MAC address, GRE key to the FA CoA in its own registration tables. Upon receiving Registration Request, the home agent will establish binding among MN's MAC address, port, GRE key and the FA CoA in its own registration tables. It can also learn the MAC addresses of the hosts behind the MN and establish binding between these MAC addresses and FA CoA in its own registration tables when those hosts become active and send some uplink frames. After successful registration, the home agent will start capturing the Ethernet frames on the home link destined to the registered MN's MAC address based on the host port or VSE containing MN port and forward those frames to the FA via GRE tunnel.

5. Mobile Node Consideration

If the mobile node is capable of supporting Ethernet service, it should be authenticated for network access and authorized for the specific Ethernet service. After that, a set of pre-provisioned service flows for Ethernet service and IP service can be created, admitted and activated between the MN and the foreign agent.

6. Foreign Agent Consideration

6.1. Extension to registration tables for the Foreign Agent

Every foreign agent maintains a registration table for each currently attached mobile node, as explained in [section 3.8.1](#) of the mobile IPv4 specification [[RFC3344](#)]. To support this specification, the conceptual registration table data structure must be extended with the following additional fields:

The MN's MAC address

The MN's MAC address used to bind with FA CoA during binding registration procedure and tunnel Ethernet frame to MN's MAC address. such as Loss of HA-HELLO, Monitored Server Failure by the Active HA, Routing Peer/ Link Failure. Each LMA should exchange HA-HELLO (can be renamed as LMA-HELLO) for failure detection.

The host MAC addresses behind MN

The host MAC addresses behind MN used to bind with FA CoA when learning those from uplink frames received from hosts behind MN.

The MN's GRE key

The MN's GRE key assigned by the FA and the HA and used to distinguish the destination of packets of a specific flow which include uplink GRE key and downlink GRE key.

6.2. Foreign Agent Operation

In the foreign agent care-of address mode[RFC3344], during binding registration procedure, the FA starts the establishment of a dynamic tunnel by sending or forwarding the Registration Request message to the indicated HA. The Registration Request will contain the MN's NAI[RFC2794], IPv4 home address field will be set to all zeros and the MN's MAC address will be included in the new MIPv4 extension called Ethernet extension. When the FA forwards the Registration Request to the home agent with MN's MAC address carried in the Ethernet extension mobility option, it will bind MN's MAC address, GRE key to the FA CoA in its own registration tables. Also it requests GRE encapsulation to differentiate between difference Ethernet services or flows. In addition to setting Wu Expires September 3, 2009 [Page 7] Internet-Draft MIP Extension for Ethernet Service Support March 2009 the G flag in Registration Request message, the FA will allocate the GRE key and will include it in the GRE extension.

Upon receiving a frame tunneled by home agent on the home link after binding registration, the FA will identify the MN to which the frame must be delivered. The FA will not use the data from the inner packet header (i.e. MAC addresses) to identify the corresponding MN. The received GRE key will be used to identify the MN to which the encapsulated payload must be delivered. This is advantageous in case that there are multiple Ethernet devices connected to a bridge behind the MN.

[7.](#) Home Agent Consideration

[7.1.](#) Extension to registration tables for the Home Agent

Every home agent maintains a registration table for each currently attached mobile node, as explained in [section 3.8.1](#) of the mobile IPv4 specification [[RFC3344](#)]. To support this specification, the conceptual registration table data structure must be extended with the following additional fields:

The MN's MAC address

The MN's MAC address used to bind with FA CoA during binding registration procedure and tunnel Ethernet frame to MN MAC address.

The host MAC addresses behind MN

The host MAC addresses behind MN used to bind with FA CoA when learning those from uplink frames received from hosts behind MN.

The MN's GRE key

The MN's GRE key assigned by the FA and the HA and used to distinguish the destination of packets of a specific flow which include uplink GRE key and downlink GRE key.

[7.2.](#) Home Agent Operation

When the home agent receives the Registration Request message from the the foreign agent, it will bind the MN's MAC address contained in the Ethernet extension to the FA CoA(i.e., IP address of FA). It will also save the received GRE key as part of its mobility binding context. Home agent will also allocate its own GRE key and send it to FA in MIP Registration Reply.

After successful registration, the home agent will start capturing the Ethernet frames on the home link destined to the registered MN's

MAC address and forwarding those frames to the FA via GRE tunnel. The home agent must include the FA's GRE key in the GRE packet header. In some cases, the bridge attached to the home agent can learn the MAC addresses of the hosts behind the MN and establish binding between these MAC addresses and FA CoA when those hosts become active and send some uplink frames. Having learnt the address(es) behind the MN, the bridge behind the home agent would start tunneling the frames on the home link destined to those MAC addresses over the established GRE tunnel, tagging the tunneled packets with the GRE key associated with the MN. Upon receiving frame in the uplink direction from the foreign agent, the home agent will use the received GRE key (instead of the source address from the inner header) to find the corresponding mobility context.

8. Message Format

8.1. Ethernet Extension Mobility Option

A new mobility option, the Ethernet Extension mobility option, is defined for use in the Registration Request and Registration Reply messages exchanged between the foreign agent and the home agent. This option can be used for the home agent and the foreign agent to identify the MN to which the frame must be delivered.

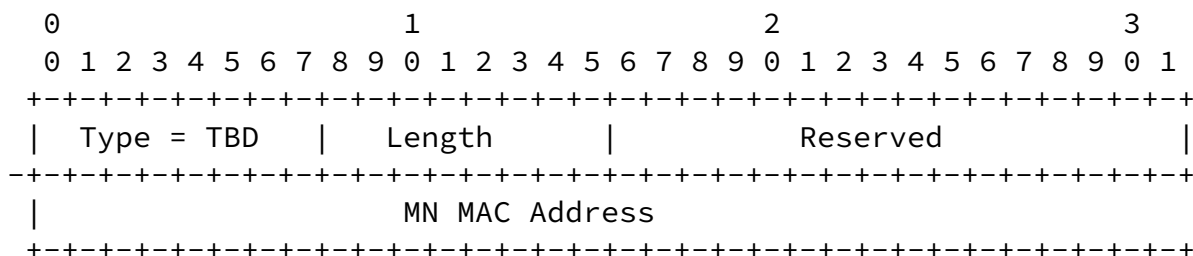


Figure 3 Ethernet Extension Mobility Option

8.2. Vendor specific Extension Option

A VSE option is defined in the Registration Request and Registration Reply message. This option can be used to distinguish between IP

service and Ethernet service or between different Ethernet services. The VSE can contain MN port and/or additional service parameters, which is outside the scope of this document.

[8.3.](#) GRE Extension option

The details are defined in section 5 of [\[draft-yegani-gre-key-extension\]](#).

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[9.](#) Security Considerations

The Ethernet Extension Mobility Option and the functionalities in this document are protected by the Authentication Extensions described in[RFC3344]. The FA needs to have a security association with the HA to register the MN's IP address. The security association can be provisioned by the administrator, or dynamically derived.

[10.](#) IANA considerations

TBA

[11.](#) References

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