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**Multihoming extension of PMIPv6 using 2-level Prefix Model  
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Abstract

This document discusses the use of multiple interfaces in mobile host. Especially, Horizontal handover and flow handover in 2-level prefix model are resolved.

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## **1. Introduction**

Proxy Mobile IPv6 (PMIPv6) is a network-based mobility management protocol. In here, Mobile Host (MH) does not know the changes of network access caused by MH movement. That is, Mobile Access Gateways (MAGs) and Local Mobility Anchors (LMAs) support the whole mobility management. However, they do not define the protocol procedures for supporting multiple interfaces and flow handover in MH.

This document clarifies the types of handover, and describes the protocol procedures about multihoming extension of PMIPv6 in 2-level prefix model.

## **2. Types of handover**

Even though this classification is not common, this document describes the types of handover to understand the protocol procedures easily.

- o Inter-access Handover (IAHO)
- o Inter-interface Handover (IIHO)
- o Partial Flow Handover (PFHO)
- o Full Flow Handover (FFHO)

First, Inter-access Handover (IAHO) occurs between MAGs. That is, MN's interface is not changed. The attached MAG is only changed.



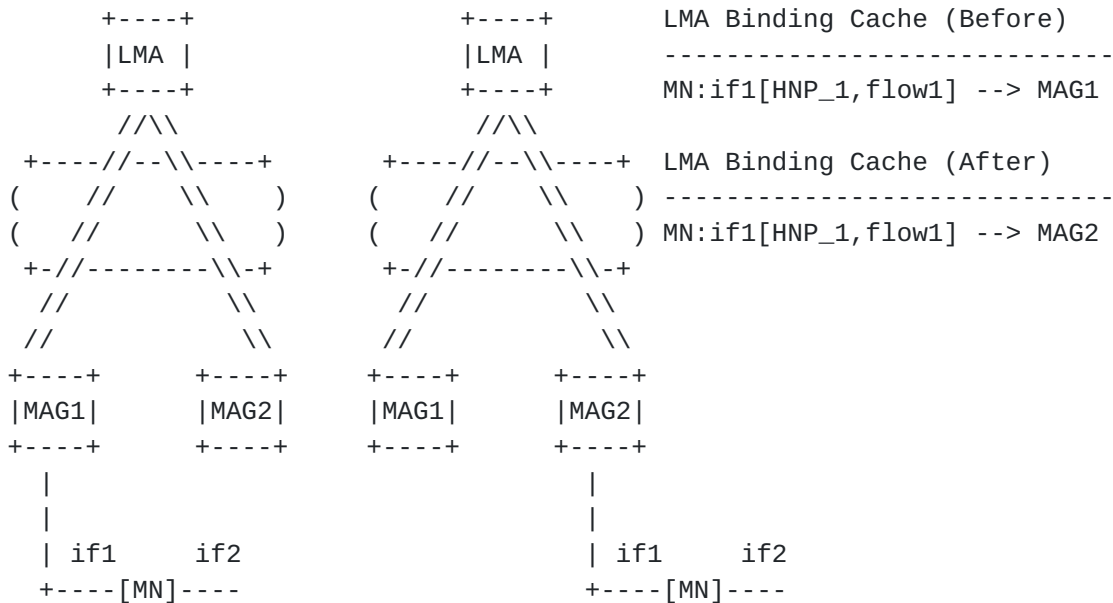


Figure 1: Inter-access Handover(IAHO)

Secondly, Inter-interface Handover (IIHO) considers the MH with multiple interfaces. IIHO occurs among multiple interfaces in the same MH. In this case, original interface will be broken by some reasons. Therefore, all flow under control of original interface will be moved to the other interface.

The IAHO and IIHO in LMA processing are same in case of the MH with logical interface. That is, the HNP is assigned to logical interface only. The MAC address of logical interface is informed to LMA. LMA does not know the existence of multiple interfaces.



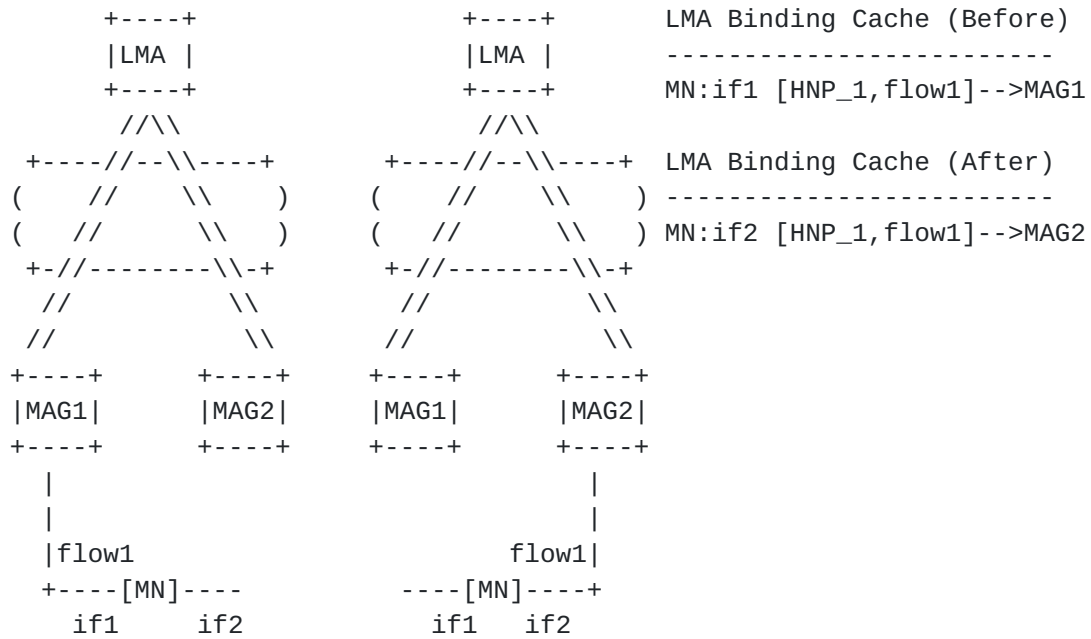


Figure 2: Inter-interface Handover(IIHO)

Lastly, Partial and Full Flow Handover (PFHO/FFHO) are used in case of simultaneous attachment between MAGs in MH with multiple interfaces. PFHO means partial transfer among application flows. FFHO means all flow transfer from one interface to the other. The difference between IIHO and FFHO is the policy of keeping the mobility session on the original interface. FFHO keeps the mobility session because of the possibility of reverse flow handover. So, original information in LMA or MAG will be kept for some time with idle(I) flag.

In this document, new prefix model will be used to support the flow handover. The next section will describe in detailss.





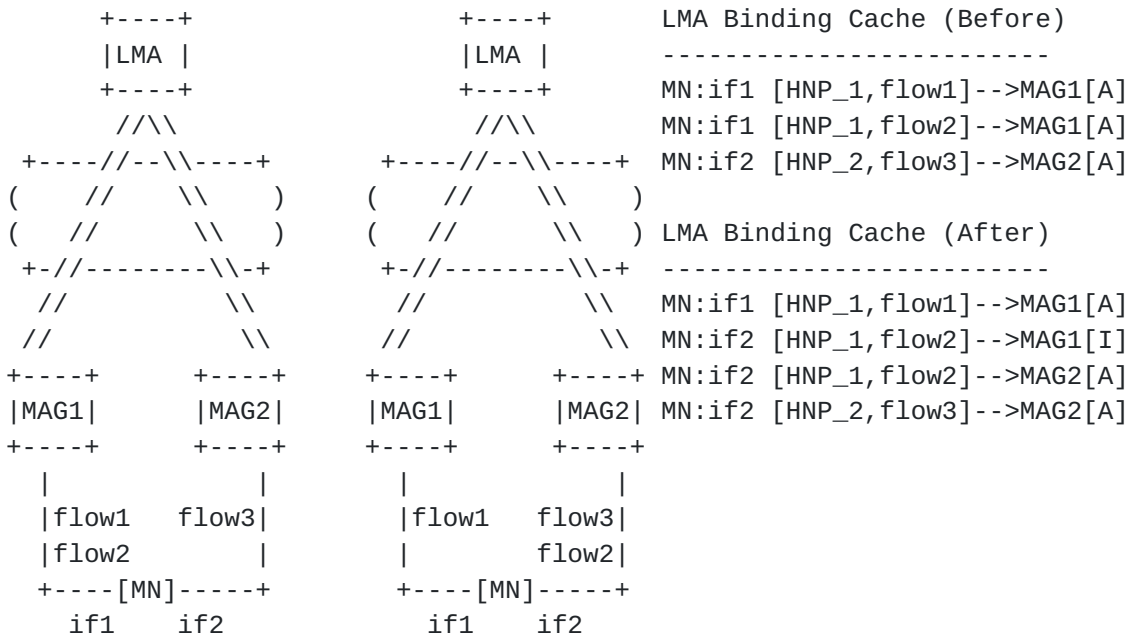


Figure 3: Partial Flow Handover(PFHO)

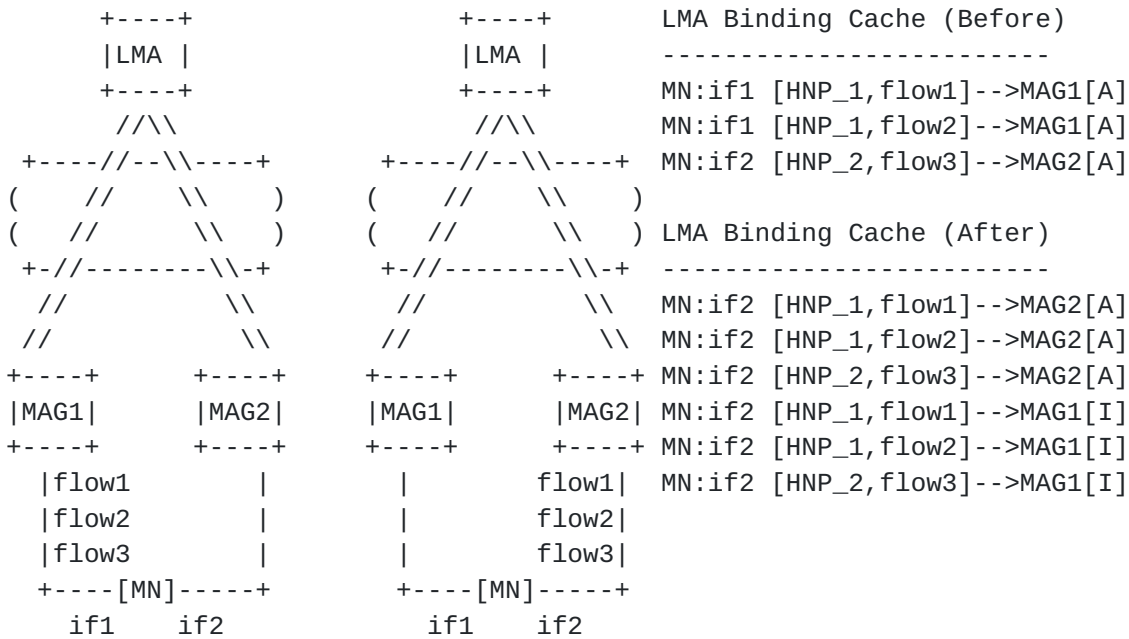


Figure 4: Full Flow Handover (FFHO)

### 3. New 2-level prefix model

This document defines and uses 2-level prefix model like the following figure. In here, pref\_A1 and pref\_B1 are called by level 1



prefix. It is allocated and managed by LMA. Especially, pref\_A1 is a permanent prefix, which is indicated by flag(P). It is used to support inter-interface and inter-access handover. And logical interface will use the permanent prefix.

On the other hand, pref\_B1 is a temporal prefix, which is indicated by flag(T). If the distinguished prefix ranges are assigned for permanent and temporal prefixes in each, these flags may be not required. It is used to support flow handover. pref\_B1 will be allocated by LMA to MAGs before initiation of mobility session. Each MAG already knows the other's temporal prefixes. And then, pref\_01, called by level 2 prefix, will be allocated for MH. Pref\_01 will be allocated and managed by each MAG or LMA. Basically MAG is better for distribution of load for flow management.

```

+-----+-----+-----+-----+
| 2-level | For_LMA | For_MAG | Flag |
+=====+=====+=====+=====+
| level 1 | pref_A1 | x      | P   |
+-----+-----+-----+-----+
| level 1 | pref_B1 | -      | T   |
+-----+-----+-----+-----+
| level 2 | pref_B1 | pref_01 | T   |
+-----+-----+-----+-----+

```

Figure 5: 2-level Prefix Model

In the following section, HNP\_x(P) and HNP\_x\_y(T) notation will be used. In here, x means interface identifier and y means level 2 prefix identifier and P/T is flag, which distinguishes the prefix. As mentioned before, P means permanent prefix and T means temporal prefix. The following examples will be used in this document.

- o HNP\_1(P) = pref\_A1 (e.g., 2002:1:1:0::/64)
- o HNP\_2(P) = pref\_A2 (e.g., 2002:1:2:0::/64)
- o HNP\_1(T) = pref\_B1 (e.g., 2002:2:1:0::/64)
- o HNP\_2(T) = pref\_B2 (e.g., 2002:2:2:0::/64)
- o
- o HNP\_1\_1(T) = pref\_B1 + pref\_01 (e.g., 2002:2:1:1::/64)
- o HNP\_2\_1(T) = pref\_B2 + pref\_01 (e.g., 2002:2:2:1::/64)

In here, there are 2 types of prefixes: permanent and temporal. The



permanent prefix without the part of level 2 prefix will be allocated to the logical interface in order to support inter-technology handover. If we do not consider the logical interface concept, the type of services will be checked to use the proper prefix. Even though the quality of service will be decreased during MH movement, we do not want to support the handover and flow mobility. In that case, we will use the permanent prefixes. In other case, we will use the temporal prefixes.

#### **4. New 2-level flow identifier model**

There are 2 types of flow identifier(FID). These flow ids are managed separately in MN, MAG and LMA. That is, the uniqueness of flow ids are satisfied just in each node.

- o Input FID (IFID) = level-1 flow id(IFID1) + level-2 flow id(IFID2)  
or none
- o output FID(OFID) = level-1 flow id(OFID1) + level-2 flow id(OFID2)  
or none

After PBU and PBA exchange, level-1 input flow ids are exchanged between MAGs and LMA. And then, level-2 flow ids are allocated according to emerging each data flow. After the receiving RA messages, MH gets level-1 flow id from MAG. On the other hand, MAG makes level-1 flow id after the recognizing L2 attachment or the first data receiving form MH. And then level-2 flow ids are allocated during the data transmission.

MH decides and forwards the data from logical interface to physical interfaces by referring flow ids. And then, MAG and LMA just decides and forwards the service flow by using output flow ids.

#### **5. Usage scenarios for the 2-level prefix model**

This document considers the MH with multiple interfaces, each interface of whose has multiple prefixes. This section describes the simultaneous use and horizontal handover in 2-level prefix model.

##### **5.1. Scenario 1 - simultaneous attachment**

This scenario considers the nearly same attachment of multiple interfaces.



**5.1.1. Initial Stage in scenario 1**

Initial attachment procedures of each interface are operated independently. The following functions will be performed between MH and MAG or between MAG and LMA.

- o The mobility session for all interfaces in MH
- o Prefix allocation and maintenance in LMA and MAG
- o Flow id generation and Distribution in LMA

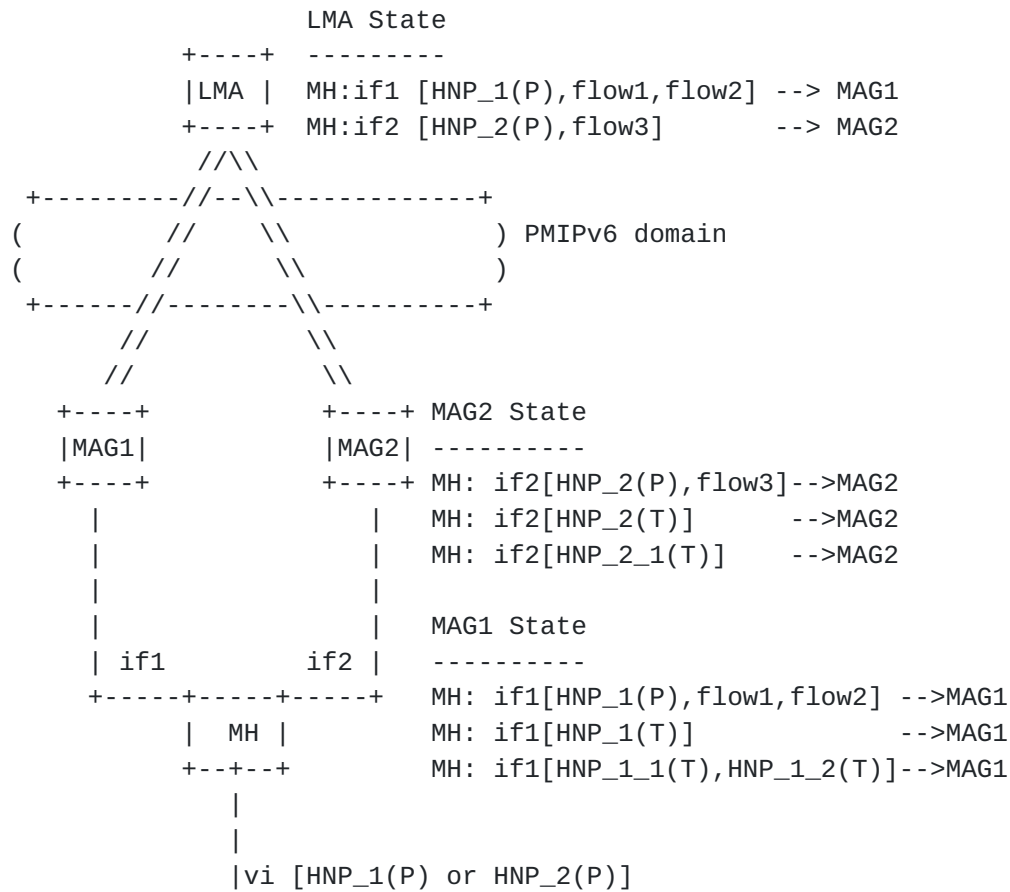


Figure 6: Scenario 1 - Initial Stage

The initial attach procedures are following:

1. The if1 will be attached the network through MAG1.





2. MAG1 sends the PBU to the LMA. In here, HI option is 1 (initial attachment).
3. LMA allocates the HNP\_1(P) for if1 of MH. LMA sends PBA with HNP\_1(P) option.
4. MAG1 sends RA message with HNP\_1(P) and HNP\_1\_1(T). In here, HNP\_1(P) has been obtained from PBA message. HNP\_1\_1(T) will be allocated by MAG1 using HNP\_1(T) prefix, which had been distributed from LMA.
5. MH configures the HNP\_1(P) and HNP\_1\_1(T) to the if1.
6. The if2 also does the above procedures. After then, MH configures the HNP\_2(P) and HNP\_2\_1(T) to the if2.
7. MH allocates HNP Address for logical Interface (LI). HNP\_1(P) or HNP\_2(P) is randomly selected. In here, we suppose that HNP\_1(P) was selected.
8. Application services will be started. For example, VoIP and web services have been started through if1. IPTV service has been also started through if2. In here, VoIP service has been assigned to flow1 by LMA. The flow1 is flow identifier for VoIP service. flow2 for web service and flow3 for IPTV service is also assigned by LMA.
9. If we have the policy that only LI has the HNPs, the procedure 5 and 6 are not required. And the HNP assigned in LI is shown to all application services.

#### **5.1.2. Second Stage in scenario 1**

After initial stage, the following handover will be occurred in according to network changes or user requirement.

- o Inter-access Handover from MAG1 to MAG2
  - \* MH: if1 is attached to network through the MAG2.
  - \* MAG1: After receiving L2 hints, new tunnel may be configured between MAG1 and MAG2. This tunnel is used to transfer the data, which are targeted to if1 through MAG1.
  - \* MAG2: MAG2 sends PBU with HI(3) to the LMA.
  - \* LMA: After receiving the PBU with HNP\_1(P), all MAG1-related entries will be changed to the MAG2. In addition, LMA sends



the PBA to MAG2 with HNP\_1(P).

- \* MAG2: After receiving the PBA, new BULE with if1 will be added.

- o Inter-interface Handover from if1 and if2

- \* MH: No action.

- \* MAG1: After receiving L2 hints, new tunnel may be configured between MAG1 and MAG2. This tunnel is used to transfer the data, which are targeted to if1 through MAG1.

- \* MAG2: MAG2 sends PBU with HI(2) to the LMA.

- \* LMA: After receiving the PBU with HNP\_1(P) from MAG2, all MAG1-related entries will be changed to the MAG2. LMA sends the PBA with HNP\_1(P).

- \* MAG2: After receiving the PBA, new BULE with HNP\_1(P) will be added.



LMA State (Before)

-----

MH:if1 [HNP\_1(P),HNP\_1(T)]--> MAG1  
 MH:if2 [HNP\_2(P),HNP\_2(T)]--> MAG2

LMA State (After)

-----

MH:if1 [HNP\_1(P),HNP\_1(T)] --> MAG1  
 MH:if1 [HNP\_1\_1(T),HNP\_1\_2(T)]--> MAG1  
 MH:if2 [HNP\_2(P),HNP\_2(T)] --> MAG2  
 MH:if2 [HNP\_2\_1(T),HNP\_2\_2(T)]--> MAG2

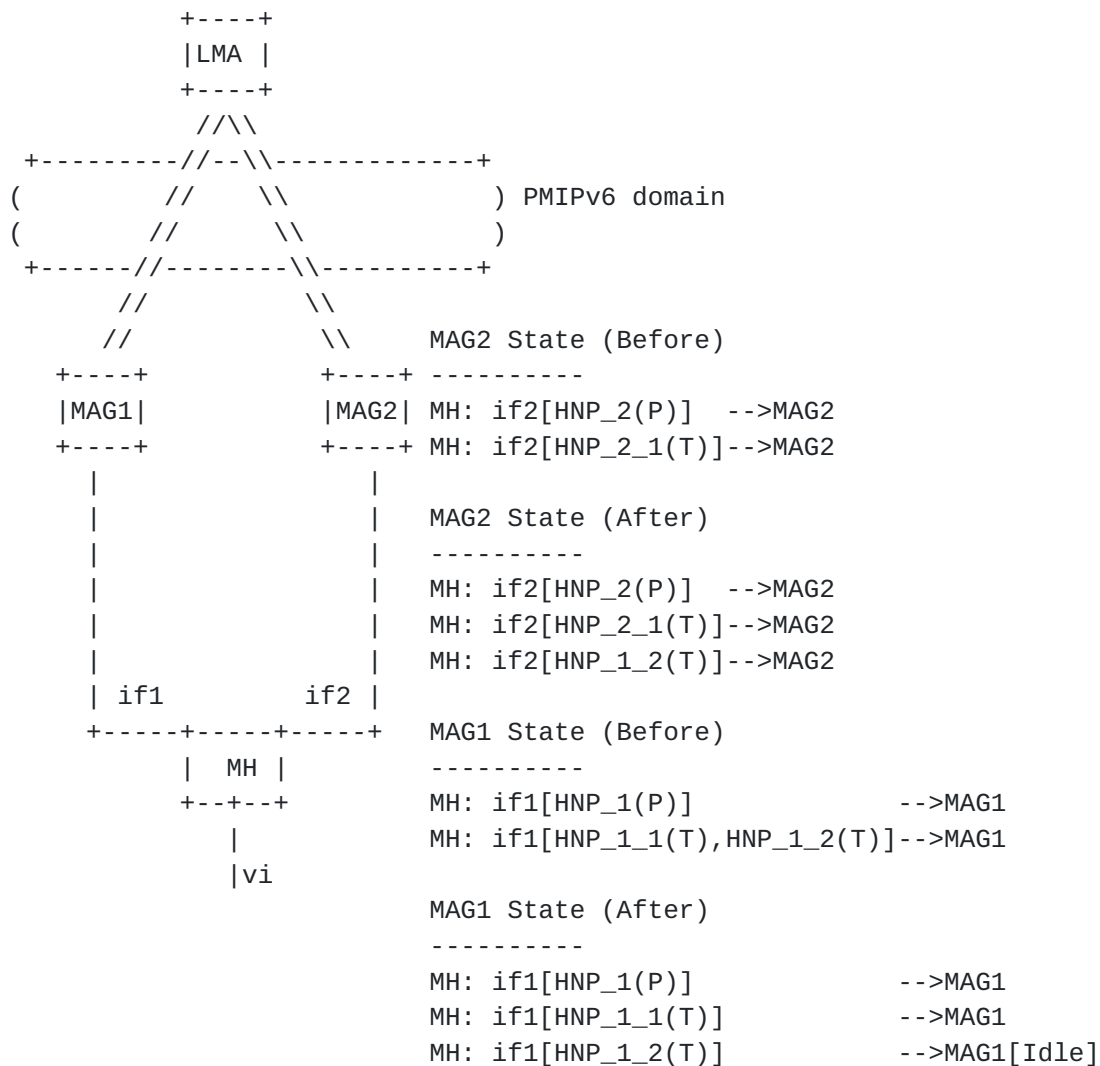


Figure 7: Scenario 1 - Second Stage: PFHO



- o Partial Flow Handover using temporal prefixes

- \* MH: VoIP service is using HNP\_1\_1(T) as flow identifier. HNP\_1\_2(T) for Web service and HNP\_2\_1(T) for IPTV service are used. In this scenario, Web service will be transferred from if1 and if2.
- \* MAG1: After receiving the L2 hints, MAG1 and MAG2 know the user requirement about the partial flow handover.
- \* MAG2: MAG2 sends the PBU with HI(5). In addition, PBU has a HNP option. In HNP option, HNP\_1\_2(T) will be included in order to inform the flow handover.
- \* LMA: After receiving the PBU(HI=5) with HNP option, LMA updates the BCE using HNP option. That is, LMA knows the change of web service flow.
- \* MAG2: After receiving the PBA, MAG2's BULE will be changed.

- o Full Flow Handover using temporal prefixes

- \* MH: HNP\_1\_1(T) for VoIP service, HNP\_1\_2(T) for Web service and HNP\_2\_1(T) for IPTV service are used as the flow identifier. In this scenario, all services from if1 will be transferred to if2.
- \* MAG1: After receiving the L2 hints, MAG1 and MAG2 maybe know the user requirement about the full flow handover.
- \* MAG2: MAG2 sends the PBU with HI(5). In addition, PBU has the HNP options. In HNP options, HNP\_1\_1(T) and HNP\_1\_2(T) will be included in order to inform the full flow handover. In here, the aggregated HNP\_1(T) for HNP\_1\_1(T) and HNP\_1\_2(T) will be included in PBU.
- \* LMA: After receiving the PBU(HI=5) with HNP options, LMA updates the BCE using HNP options. That is, LMA knows the transfer of all service flows. In this case, original mobility session for if1 will be kept in order to support the reverse partial or full flow handover.
- \* MAG2: After receiving the PBA, MAG2's BULE will be changed.





**5.2. Scenario 2 - Sequential attachment**

This scenario considers the sequential attachment of multiple interfaces in MH.

**5.2.1. Initial stage in scenario 2**

A interface will be attached to the network. The following functions will be performed between MH and MAG and LMA.

- o The mobility session for one interface
- o Prefix Allocation and Maintenance in LMA and MAG
- o Flow id Generation and Distribution in LMA

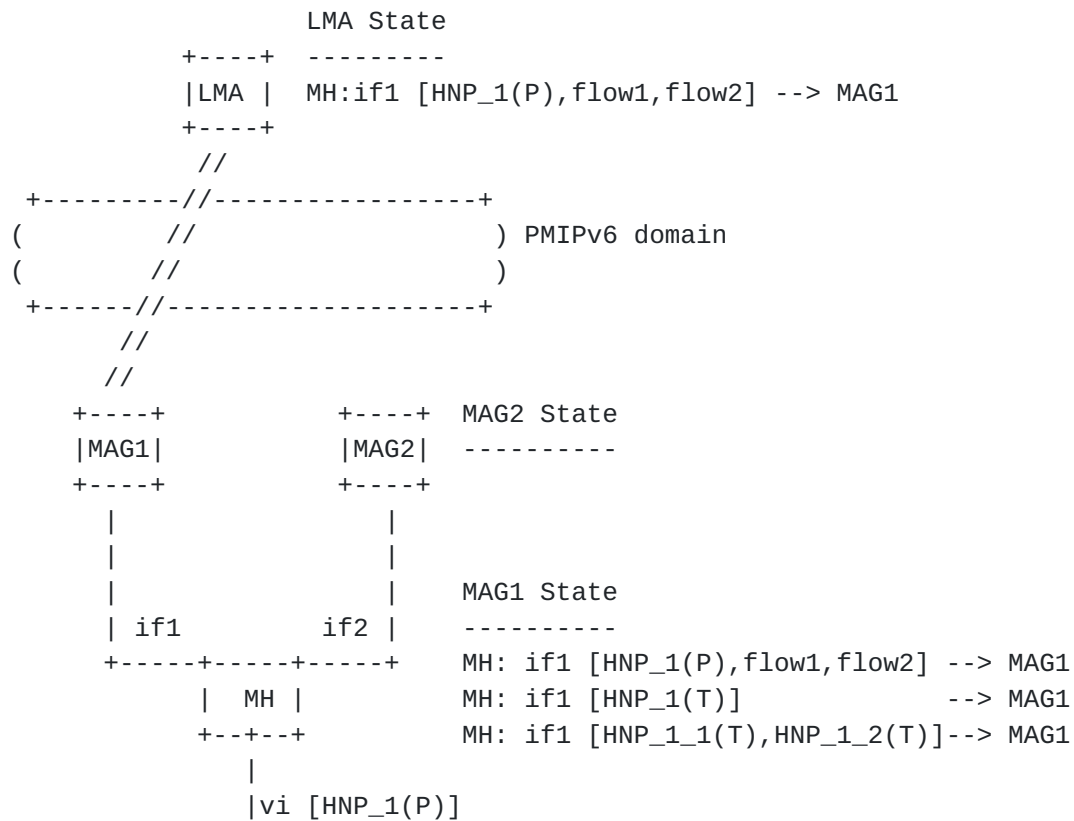


Figure 8: Scenario 2 - Initial Stage

TBD.



**5.2.2. Second stage in scenario 2**

After initial stage, the other interfaces will be attached to the network. The following functions will be performed between MH and MAG and LMA.

- o Initial attachment of the other interface
- o Inter-access Handover
- o Partial Flow Handover
- o Full Flow Handover

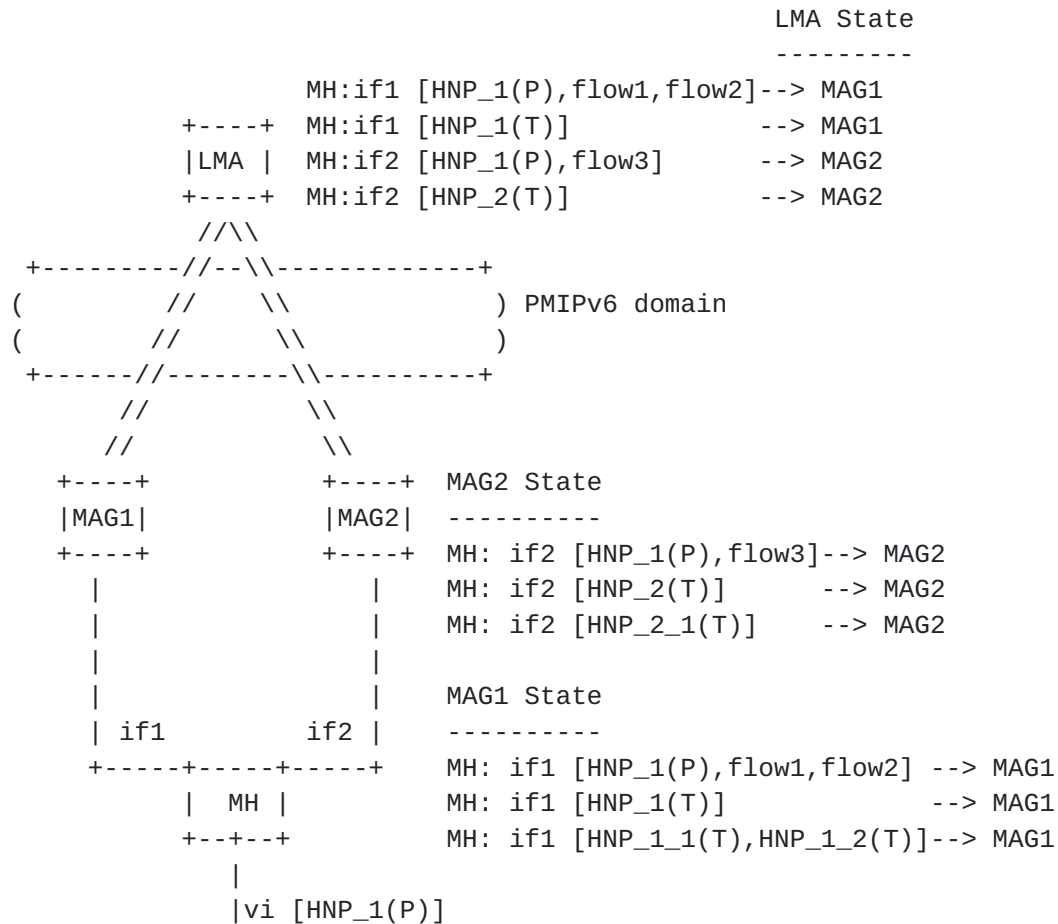


Figure 9: Scenario 2 - Second Stage

TBD.



### **5.2.3. Third stage in scenario 2**

After second stage, Inter-interface handover will be occurred generally. The other functions will be same alike that of the second state.

- o Inter-access Handover
- o Inter-interface Handover
- o Partial Flow Handover
- o Full Flow Handover

TBD.

## **6. IANA Considerations**

IANA considerations are not required.

## **7. Security Considerations**

TBD.

## **8. References**

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