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Logical Interface Support for multi-mode IP Hosts
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Abstract

A Logical Interface is a software semantic internal to the host operating system. This semantic is available in all popular operating systems and is used in various protocol implementations. The Logical Interface support is required on the mobile node operating in a Proxy Mobile IPv6 domain, for leveraging various network-based mobility management features such as inter-technology handoffs, multihoming and flow mobility support. This document explains the operational details of Logical Interface construct and the specifics on how the link-layer implementations hide the physical interfaces from the IP stack and from the network nodes on the attached access networks. Furthermore, this document identifies the applicability of this approach to various link-layer technologies and analyzes the issues around it when used in context with various mobility management features.

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1. Introduction

Proxy Mobile IPv6 [RFC5213] is a network-based mobility protocol. Some of the key goals of the protocol include support for multihoming, inter-technology handoffs and flow mobility support. The base protocol features specified in [RFC5213] and [RFC5844] allow the mobile node to attach to the network using multiple interfaces (simultaneously or sequentially), or to perform handoff between different interfaces of the mobile node. However, for supporting these features, the mobile node is required to be activated with specific software configuration that allows the mobile node to either perform inter-technology handoffs between different interfaces, attach to the network using multiple interfaces, or perform flow movement from one access technology to another. This document analyzes from the mobile node's perspective a specific approach that allows the mobile node to leverage these mobility features. Specifically, it explores the use of the Logical Interface support, a semantic available on most operating systems.

A Logical Interface is a construct internal to the operating system. It is an approach where the link-layer implementations hide the physical interfaces from the IP stack and from the network nodes on the attached access networks. This semantic is widely available in all popular operating systems. Many applications such as Mobile IP client [RFC6275] and IPsec VPN client [RFC4301] rely on this semantic for their protocol implementation and the same semantic can also be useful in this context. Specifically, the mobile node can use the logical interface configuration for leveraging various network-based mobility management features provided by the Proxy Mobile IPv6 domain [RFC5213].

The rest of the document provides the operational details of a Logical Interface on the mobile node and the inter-working between a mobile node using logical interface and network elements in the Proxy Mobile IPv6 domain when supporting some of the mobility management features. It also analyzes the issues involved with this approach and characterizes the contexts in which such usage is appropriate.

2. Terminology

All the mobility related terms used in this document are to be interpreted as defined in Proxy Mobile IPv6 specifications, [RFC5213] and [RFC5844]. In addition, this document introduces the following terms:

PIF (Physical Interface) - a network interface card attached to an an host providing network connectivity (e.g. an Ethernet card, a WLAN card, an LTE interface).

LIF (Logical Interface) - It is a virtual interface in the IP stack. It appears just as any other physical interface, provides similar semantics with respect to packet transmit and receive functions to the upper layers in the IP stack. However, it is only logical construct and is not a representation of an instance of any physical hardware.

VLL-ID (Virtual Link-layer ID) - a virtual link-layer address configured on the logical interface. This identifier can be randomly generated, or configured based on the link-layer address of one of the physical interface.

Sub-If (Sub Interface) - a physical interface that is part of a logical interface construct. For example, a logical interface may have been created abstracting two physical interfaces, LTE and WLAN. These physical interfaces, LTE and WLAN are referred to as sub-interfaces of that logical interface. In some cases, a sub-interface can also be another logical interface, such as an IPsec tunnel interface.

3. Hiding Link-layer Technologies - Approaches and Applicability

There are several techniques/mechanisms that allow hiding access technology changes or movement from host IP layer. This section classifies these existing techniques into a set of generic approaches, according to their most representative characteristics. Later sections of this document analyze the applicability of these solution approaches for supporting features such as, inter-technology handovers and IP flow mobility support for a mobile node in a Proxy Mobile IPv6 domain [RFC5213].

3.1. Link-layer Abstraction - Approaches

The following generic mechanisms can hide access technology changes from host IP layer:

o Link-layer Support - Certain link-layer technologies are able to hide physical media changes from the upper layers (see Figure 1). For example, IEEE 802.11 is able to seamlessly change between IEEE 802.11a/b/g physical layers. Also, an 802.11 STA can move between different Access Points within the same domain without the IP stack being aware of the movement. In this case, the IEEE 802.11 MAC layer takes care of the mobility, making the media change invisible to the upper layers. Another example is IEEE 802.3, that supports changing the rate from 10Mbps to 100Mbps and to 1000Mbps.

```
              Mobile Node
       +-----------------------+
       |        TCP/UDP        |            AR1        AR2
       +-----------------------+           +-----+    +-----+
       |          IP           |           | IP  |    | IP  |
       +-----------------------+           +-----+    +-----+
       |    Link Layer (L2)    |           | L2  |    | L2  |
       +-----+-----+-----+-----+           +-----+    +-----+
       | L1a | L1b | L1c | L1d |<--------->| L1d |    | L1b |
       +-----+-----+-----+-----+           +-----+    +-----+
                ^                                        ^
                |________________________________________|
```

Figure 1: Link layer support solution architecture

There are also other examples with more complicated architectures, like for instance, 3GPP EPC [TS23401]. In this case, a UE can move (inter-RA handover) between GERAN/UTRAN/E-UTRAN, being this movement invisible to the IP layer at the UE, and also to the LMA logical component at the PGW. The link layer stack at the UE (i.e. PDCP and RLC layers), and the GTP between the RAN and the SGW (which plays the role of inter-3GPP AN mobility anchor) hide

this kind of mobility, which is not visible to the IP layer of the UE (see Figure 2).

```
       ---------
       | Appl. |<----------------------------------------------------->
       ---------                                             ----------
       |       |<+ - - - - - - - - - - - - - - - - - - - - +>|        |
       |  IP   | . ----------------- . ------------------- . |   IP   |
       |       |<+>|     relay     |<+>|      relay      | . |        |
       --------- . ----------------- . ------------------- . ----------
       | PDCP  |<+>| PDCP | GTP-U  |<+>| GTP-U  | GTP-U  |<+>| GTP-U  |
       --------- . ----------------- . ------------------- . ----------
       | RLC   |<+>| RLC  | UDP/IP |<+>| UDP/IP | UDP/IP |<+>| UDP/IP |
       --------- . ----------------- . ------------------- . ----------
       | MAC   |<+>| MAC  |   L2   |<+>|   L2   |   L2   |<+>|   L2   |
       --------- . ----------------- . ------------------- . ----------
       |  L1   |<+>|  L1  |   L1   |<+>|   L1   |   L1   |<+>|   L1   |
       --------- . ----------------- . ------------------- . ----------
          UE     Uu      E-UTRAN     S1-U       SGW       S5/S8a  PGW
```

Figure 2: 3GPP LTE/EPC data plane architecture (GTP option)

- o Logical interface: this refers to solutions (see Figure 3) that logically group/bond several physical interfaces so they appear to the upper layers (i.e. IP) as one single interface (where application sockets bind). Depending on the OS support, it might be possible to use more than one physical interface at a time -- so the node is simultaneously attached to different media -- or just to provide a fail-over mode. Controlling the way the different media is used (simultaneous, sequential attachment, etc) is not trivial and requires additional intelligence and/or configuration at the logical interface device driver. An example of this type of solution is the Logical interface, which is defined in this document, or the bonding driver (a Linux implementation).

3.2. Applicability Statement

We now focus on the applicability of the above solutions against the following requirements:

- o multi technology support

- o sequential vs. simultaneous access

3.2.1. Link layer support

Link layer mobility support applies to cases when the same link layer technology is used and mobility can be fully handled at these layers. One example is the case where several 802.11 access points are deployed in the same subnet and all of them share higher layer resources such as DHCP server, IP gateway, etc. In this case the access points can autonomously (or with the help of a central box) communicate and control the STA association changes from one AP to another, without the STA being aware of the movement. This type of scenario is applicable to cases when the different points of attachment (i.e. access points) belong to the same network domain, e.g. Enterprise, hotspots from same operator, etc.

This type of solution does not typically allow for simultaneous attachment to different access networks, and therefore can only be considered for inter-access technology handovers, but not for flow mobility. Existing RFC 5213 handover hint mechanisms could benefit from link layer information (e.g. triggers) to detect and identify MN handovers.

Link layer support is not applicable when two different access technologies are involved (e.g. 802.11 WLAN and 802.16 WiMAX) and the same is true when the same access technology expands over multiple network domains. This solution does not impose any change at the IP layer since changes in the access technology occur at layer two.

3.2.2. Logical Interface

The use of a logical interface allows the mobile node to provide a single interface view to the layers above IP (thus not changing the IP layer itself). Upper layers can bind to this interface, which hides inner inter-access technology handovers or data flow transfers among different physical interfaces.

This type of solution may support simultaneous attachment, in addition to sequential attachment. It requires additional support at the node and the network in order to benefit from simultaneous attachment. For example special mechanisms are required to enable addressing a particular interface from the network (e.g. for flow mobility). In particular extensions to PMIPv6 are required in order to enable the network (i.e., the MAG and LMA) to deal with logical interface, instead to IP interfaces as current RFC5213 does. RFC5213 assumes that each physical interface capable of attaching to a MAG is an IP interface, while the logical interface solution groups several physical interfaces under the same IP logical interface.

It is therefore clear that the Logical Interface approach satisfies

the multi technology and the sequential vs: simultaneous access support.

4. Technology Use cases

The 3GPP has defined the Evolved Packet Core (EPC) for heterogeneous wireless access. A mobile device equipped with 3GPP and non-3GPP wireless technologies can simultaneously or sequentially connect any of the available devices and receive IP services through any of them. This document focuses on the simultaneous/sequential use of these technologies and on the use cases that derive.

As mentioned in the previous sections the Logical Interface construct is required to hide the specifics of each technology in the context of network based mobility (e.g. in PMIPv6 deployments). The LIF concept can be used with at least the following technologies: 3GPP access technologies (3G, LTE), WIMAX access technology and IEEE 802.11 access technology.

3GPP In most OS implementations the connection setup establishes a PPP interface through the IPCP and IPv6CP protocol [RFC5072]. In this case the PPP interface does not have any L2 address assigned and does not generate any ARP or ND message for layer two address resolution. Conversely recent implementations configure an ethernet alike interface at OS level hiding to the upper layers the PPP nature of the connection. It has been verified (Android platform) that in these cases the ethernet alike interface configures a random L2 MAC address and uses this address as source link layer address option carried in the ND messages. ARP is also run between the mobile device and the remote peer (the network is a /30 address space).

WIMAX In WiMAX system also, the connection between the mobile station (MS) and the access router (AR) is a point-to-point link. The MS auto configures an address based on the prefix advertised by the AR or is assigned an address via DHCPv6. The stateless address auto-configuration is performed as per [RFC4861] and the IPv6 address is formed by adding an IID to the prefix learnt from Router Advertisement. IPv6 packets sent or received by the MS are identified by specific IDs, by which the AR can map them to the corresponding tunnel in the network.

5. Logical Interface Functional Details

This section identifies the functional details of a logical interface and provides some implementation considerations.

On most operating systems, a network interface is associated with a physical device that offers the services for transmitting and receiving IP packets to the applications on the host. In some configurations, a network interface can also be implemented as a logical interface which does not have the inherent capability to transmit, or receive packets on a physical medium, but relies on other physical interfaces for such services. Example of such configuration is an IP tunnel interface.

General overview of a logical interface is shown in Figure 3. The logical interface allows heterogeneous attachment while leaving the change in the media transparent to the IP stack. Simultaneous and sequential network attachment procedures are possible enabling inter-technology and flow mobility scenarios.

```
                               +----------------------------+
                               |          TCP/UDP           |
        Session to IP    +---->|                            |
        Address binding  |     +----------------------------+
                         +---->|             IP             |
        IP Address       +---->|                            |
        binding          |     +----------------------------+
                         +---->|     Logical Interface      |
        Logical to       +---->|       IPv4/IPv6 Address    |
        Physical         |     +----------------------------+
        Interface        +---->|  L2  |  L2  |       |  L2  |
        binding                |(IF#1)|(IF#2)| ..... |(IF#n)|
                               +------+------+       +------+
                               |  L1  |  L1  |       |  L1  |
                               |      |      |       |      |
                               +------+------+       +------+
```

Figure 3: General overview of logical interface

From the perspective of the IP stack and the applications, a Logical interface is just another interface. In fact, the logical interface is only visible to the IP and upper layers when enabled. A host does not see any operational difference between a Logical and a physical interface. As with physical interfaces, a Logical interface is represented as a software object to which IP address configuration is bound. However, the Logical interface has some special properties which are essential for enabling inter-technology handover and flow-mobility features. Following are those properties:

1. The logical interface has a relation to a set of physical interfaces (sub-interfaces) on the host that it is abstracting. These sub-interfaces can be attached or detached from the Logical Interface at any time. The sub-interfaces attached to a Logical interface are not visible to the IP and upper layers.

2. The logical Interface may either use a virtual interface identifier independent of the interface identifiers of its sub-interfaces, or it may use the link-layer identifier from one of its sub-interfaces.

3. The logical interface has the path awareness with respect to the attached IP networks. For example, the logical interface may be bound to two IP networks, CAFE::/64 and BABA::/64, each of these prefixes may have been hosted on access networks attached through different sub-interfaces, WLAN and LTE. The logical interface has the path awareness with respect to IP network to sub-interface mapping.

4. The logical interface may be attached to multiple access technologies with different link MTU values. The adopted MTU value for the logical interface must be lowest MTU value across those access technologies.

5. The Transmit/Receive functions of the logical interface are mapped to the Transmit/Receive services exposed by the sub-interfaces. This mapping is dynamic and any change is not visible to the upper layers of the IP stack.

6. The logical interface adapts to the point-to-point link model.

7. The logical interface maintains IP flow information for each of its sub-interfaces. A conceptual data structure is maintained for this purpose. The host may populate this information based on tracking each of the sub-interface for the active flows.

5.1. Configuration of a Logical Interface

A host may be statically configured with the logical interface configuration, or an application such as a connection manager on the host may dynamically create it. Furthermore, the set of sub-interfaces that are part of a logical interface construct may be a fixed set, or may be kept dynamic, with the sub-interfaces getting added or deleted as needed. The specific details related to these configuration aspects are implementation specific and is outside the scope of this document.

5.2. MTU considerations for a Logical Interface

The link MTU (maximum transmission unit) value configured on a logical interface should be the lowest of the MTU values supported across any of the physical interfaces that are part of that logical interface construct. The MTU value should be configured as part of the logical interface creation on the host.

Furthermore, this value must be updated any time there is a change to the logical interface construct, such as when interfaces are added or deleted from the logical interface setup. Any time there is an inter-technology handover between two access technologies, the applications on the host bound to the IP address configuration on the logical interface will not detect the change and will continue to use the MTU value of the logical interface for the outbound packets, which is never greater than the MTU value on that supported access network. However, the access network may continue to deliver the packets conforming to the MTU value supported on that access technology and the logical interface should be able to receive those packets from the physical interface attached to that network. This approach of MTU configuration will ensure there is no IP packet fragmentation after inter-technology handovers.

5.3. Supported Link models for a logical interface

As per the base Proxy Mobile IPv6 specification [RFC5213] the media underneath the physical interface has to be bound to a point-to-point link [RFC5213]. Access technologies that provides a shared media (e.g., IEEE 802.11) can be supported as long as they provide a point-to-point link [RFC4861]. The details of how a shared media provides a point to point link are link layer specific and/or operational matters that are out of scope of this document. For example IEEE 802.11 media can provide a point-to-point link via the appropriate use of IEEE 802.1Q VLAN header where a distinct VLAN is configured between the MAG and each of the mobile node, or by the approach of MAG transmitting multicast packets as layer-2 unicast packets [RFC6085] and thereby preserving the point-to-point link properties on a shared link.

5.4. Link-layer Identifier Selection for a Logical Interface

The logical Interface may be configured to use the link-layer identifier from one of its sub-interfaces, or an identifier independent of the link-layer identifiers of the sub-interfaces. Following are the considerations.

- In access architectures where it is possible to adopt a virtual link-layer identifier and use it for layer-2 communications in any of the access networks, a virtual identifier (VLL-Id) may be used. The specifics on how that identifier is chosen is out side the scope of this document. This identifier may be used for all link-layer communications. This identifier may also be used as the interface identifier when generating IPv6 global or link-local addresses, based on Stateless Autoconfiguration [RFC4862]

- In access architectures, where the link-layer identifier is associated with a specific access technology, it will not be possible for the logical interface to adopt a virtual identifier and it use it across different access networks. In such networks, the logical interface must use the identifier of the respective sub-interface through which a packet is being transmitted. However, if more than one access technology domains that are part of the logical interface have such requirement, then the logical interface will not be able to support such configuration.

5.5. ND Considerations for Logical Interface

The following are the considerations related to supporting Neighbor Discovery [RFC4861] on a logical interface.

- Any Neighbor Discovery messages, such as Router Solicitation, Neighbor Solicitation Neighbor Advertisement messages that the host sends to a multicast destination address of link-local scope such as, all-nodes, all-routers, solicited-node multicast group addresses, using either an unspecified (::) source address, or a link-local address configured on the logical interface will be replicated and forwarded on each of the sub-interfaces under that logical interface. However, if the destination address is a unicast address and if that target is known to exist on a specific sub-interface, the packet will be forwarded only on that specific sub-interface and will not be replicated on all sub-interfaces.

- Any Neighbor Discovery messages, such as Router Advertisement, that the host receives from any of its sub-interfaces part of the logical interface, will be associated with the logical interface, i.e., in some implementations the packet will appear on the input interface of the logical interface.

- When using Stateless Address Autoconfiguraion [RFC4862] for generating IPv6 address configuration on the logical interface, the host may use any of the IPv6 prefixes received from the Router Advertisement messages that it received from any of its sub-interfaces.

o The response to a Neighbor Discovery message received for a unicast, link-specific multicast group address, will be sent on the same sub-interface path where the packet was received.

o When using DHCPv4 [RFC2131] for obtaining address configuration for the logical interface, the value in the chaddr field in the DHCP messages will be based on the link-layer identifier scheme chosen by the logical interface.

5.6. Provisioning Domain Considerations

The considerations related to the support of multiple provisioning domains in a multi-interface host is documented in [RFC6418]. These considerations specifically focus on the aspects related to DNS configuration. However, from the perspective of logical interface support, these considerations are not applicable, as the logical interface support is relevant only for a single provisioning domain. The key motivation for logical interface support is inter-technology handovers and the handovers are always in the context of a single provisioning domain.

5.7. Logical Interface Forwarding Conceptual Data Structures

The logical interface maintains the list of sub-interfaces that are part of the logical interface. This conceptual data strucure is called as the LIF Table. The logical interface also maintains the list of flows associated with a given sub-interface and this conceptual data structure is called as the PIF Table. Both of these data structures have to be associated with a logical interface, and are depicted in Figure 4

```
   LIF TABLE                           FLOW table
 +================================+   +==============================+
 | PIF_ID | FLOW RoutingPolicies |   | FLOW ID | Physical_Intf_Id  |
 |        | Home Network Prefix  |   +------------------------------+
 |        | Link Layer Address   |   | FLOW_ID | Physical_Intf_Id  |
 |        | Status               |   +==============================+
 +-------------------------------|
 | PIF_ID | FLOW RoutingPolicies |
 |        | Home Network Prefix  |
 |        | Link Layer Address   |
 |        | Status               |
 +-------------------------------+
 | ....   | ....                 |
 +================================+
```

Figure 4

The LIF table maintains the mapping between the LIF and each PIF associated to the LIF (refer to property #3, Figure 3). For each PIF entry the table should store the associated Routing Policies, the Home Network Prefix received in Router Advertisement, the configured link layer Address (as described above) and the Status of the PIF (e.g. active, not active). The method by which the Routing Policies are configured on the host is out of scope for this document.

The FLOW table allows the logical interface to properly route each IP flow over the right interface. The logical interface can identify the flows arriving on its sub-interfaces and associate them to those sub-interfaces. This approach is similar to reflective QoS performed by the IP routers. For locally generated traffic (e.g. unicast flows), the logical interface should perform interface selection based on the Flow Routing Policies. In case traffic of an existing flow is suddenly received from the network on a different sub-interface than the one locally stored, the logical interface should interpret the event as an explicit flow mobility trigger from the network and it should update the PIF_ID parameter in the FLOW table. Similarly, locally generated events from the sub-interfaces, or configuration updates to the local policy rules can cause updates to the table and hence trigger flow mobility.

6. Logical Interface Use-cases in Proxy Mobile IPv6

This section explains how the Logical interface support on the mobile node can be used for enabling some of the Proxy Mobile IPv6 protocol features.

6.1. Multihoming Support

A mobile node with multiple interfaces can attach simultaneously to the Proxy Mobile IPv6 domain. Each of the attachment links are assigned a unique set of IPv6 prefixes. If the host is configured to use Logical interface over the physical interface through which it is attached, following are the related considerations.

```
                                           LMA Binding Table
                                    +=================================+
                           +-----+  | HNP   MN-ID  CoA    ATT   LL-ID |
                           |LMA |   +=================================+
                           +-----+  | HNP-1  MN-1  PCoA-1  5    ZZZ  |
                            //\\    | HNP-2  MN-1  PCoA-2  4    ZZZ  |
                 +---------//--\\-----------+
                (         //    \\          )
                (        //      \\         )
                 +------//--------\\--------+
                       //          \\
               PCoA-1 //            \\ PCoA-2
                   +----+          +----+
            (WLAN) |MAG1|          |MAG2| (WiMAX)
                   +----+          +----+
                      \               /
                       \             /
                  HNP-1 \           / HNP-2
                         \         /
                          \       /
                     +-------+ +-------+
                     | if_1  | | if_2  |
                     |(WLAN) | |(WiMAX)|
                     +-------+-+-------+
                     |     Logical     |
        (LL-ID: ZZZ) |    Interface    | HNP-1::zzz/128
                     +-----------------| HNP-2::zzz/128
                     |       MN        |
                     +-----------------+
```

Figure 5: Multihoming Support

- o The mobile node detects the advertised prefixes from the MAG1 and MAG2 as the on link prefixes on the link to which the Logical interface is attached.

- o The mobile node can generate address configuration using stateless auto configuration mode from any of those prefixes.

- o The applications can be bound to any of the addresses bound to the Logical interface and that is determined based on the source address selection rules.

- o The host has path awareness for the hosted prefixes based on the received Router Advertisement messages. Any packets with source address generated using HNP_1 will be routed through the interface if_1 and for packets using source address from HNP_2 will be routed through the interface if_2.

6.2. Inter-Technology Handoff Support

The Proxy Mobile IPv6 protocol enables a mobile node with multiple network interfaces to move between access technologies, but still retaining the same address configuration on its attached interface. The protocol enables a mobile node to achieve address continuity during handoffs. If the host is configured to use Logical interface over the physical interface through which it is attached, following are the related considerations.

```
                                           LMA's Binding Table
                                    +================================+
                           +----+   | HNP   MN-ID  CoA   ATT   LL-ID |
                           |LMA |   +================================+
                           +----+   | HNP-1   MN-1  PCoA-1  5    ZZZ |
                            //\\                   (pCoA-2)(4) <-change
                 +---------//--\\-----------+
                (         //    \\           )
                (        //      \\          )
                 +------//--------\\--------+
                       //          \\
               PCoA-1 //            \\ PCoA-2
                   +----+          +----+
            (WLAN) |MAG1|          |MAG2| (WiMAX)
                   +----+          +----+
                      \               /
                       \    Handoff  /
                        \    ---->  / HNP-1
                         \         /
                          \       /
                     +-------+ +-------+
                     | if_1  | | if_2  |
                     |(WLAN) | |(WiMAX)|
                     +-------+-+-------+
                     |     Logical     |
        (LL-ID: ZZZ) |    Interface    | HNP-1::zzz/128
                     +-----------------|
                     |       MN        |
                     +-----------------+
```

Figure 6: Inter-Technology Handoff Support

o When the mobile node performs an handoff between if_1 and if_2, the change will not be visible to the applications of the mobile node. It will continue to receive Router Advertisements from the network, but from a different sub-interface path.

o The protocol signaling between the network elements will ensure the local mobility anchor will switch the forwarding for the advertised prefix set from MAG1 to MAG2.

o The MAG2 will host the prefix on the attached link and will include the home network prefixes in the Router Advertisements that it sends on the link.

6.3. Flow Mobility Support

For supporting flow mobility support, there is a need to support vertical handoff scenarios such as transferring a subset of prefix(es) (hence the flows associated to it/them) from one interface to another. The mobile node can support this scenario by using the Logical interface support. This scenario is similar to the Inter-technology handoff scenario defined in Section 6.2, only a subset of the prefixes are moved between interfaces.

Additionally, IP flow mobility in general initiates when the LMA decides to move a particular flow from its default path to a different one. The LMA can decide on which is the best MAG that should be used to forward a particular flow when the flow is initiated e.g. based on application policy profiles) and/or during the lifetime of the flow upon receiving a network-based or a mobile-based trigger.

As an example of mobile-based triggers, the LMA could receive input (e.g.by means of a layer 2.5 function via L3 signaling [RFC5677]) from the MN detecting changes in the mobile wireless environment (e.g. weak radio signal, new network detected, etc.). Upon receiving these triggers, the LMA can initiate the flow mobility procedures. For instance, when the mobile node only supports single-radio operation (i.e. one radio transmitting at a time), only sequential (i.e. not simultaneous) attachment to different MAGs over different media is possible. In this case layer 2.5 signaling can be used to perform the inter-access technology handover and communicate to the LMA the desired target access technology, MN-ID, Flow-ID and prefix.

7. IANA Considerations

This specification does not require any IANA Actions.

8. Security Considerations

This specification explains the operational details of Logical interface on an IP host. The Logical Interface implementation on the host is not visible to the network and does not require any special security considerations.

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11. References

11.1. Normative References

[RFC4861] Narten, T., Nordmark, E., Simpson, W., and H. Soliman, "Neighbor Discovery for IP version 6 (IPv6)", RFC 4861, September 2007.

[RFC4862] Thomson, S., Narten, T., and T. Jinmei, "IPv6 Stateless Address Autoconfiguration", RFC 4862, September 2007.

[RFC5213] Gundavelli, S., Leung, K., Devarapalli, V., Chowdhury, K., and B. Patil, "Proxy Mobile IPv6", RFC 5213, August 2008.

[RFC5844] Wakikawa, R. and S. Gundavelli, "IPv4 Support for Proxy Mobile IPv6", RFC 5844, May 2010.

11.2. Informative References

[RFC2131] Droms, R., "Dynamic Host Configuration Protocol", RFC 2131, March 1997.

[RFC4301] Kent, S. and K. Seo, "Security Architecture for the Internet Protocol", RFC 4301, December 2005.

[RFC5072] S.Varada, Haskins, D., and E. Allen, "IP Version 6 over PPP", RFC 5072, September 2007.

[RFC5677] Melia, T., Bajko, G., Das, S., Golmie, N., and JC. Zuniga, "IEEE 802.21 Mobility Services Framework Design (MSFD)", RFC 5677, December 2009.

[RFC6085] Gundavelli, S., Townsley, M., Troan, O., and W. Dec, "Address Mapping of IPv6 Multicast Packets on Ethernet", RFC 6085, January 2011.

[RFC6275] Perkins, C., Johnson, D., and J. Arkko, "Mobility Support in IPv6", RFC 6275, July 2011.

[RFC6418] Blanchet, M. and P. Seite, "Multiple Interfaces and Provisioning Domains Problem Statement", RFC 6418, November 2011.

[TS23401] "3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial Radio Access Network (E-UTRAN) access.", 2009.

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