                 ID Locator Split Based Solution for 5G Network
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Abstract

   In this memo, a generic network scheme based on ID / Locator
   separation architecture is proposed to satisfy the emerging new
   requirements of future networks.

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1 Introduction

With the emergence of various new communication services, there have been many new network communication needs, and also more and more new demands for network capability. For example, there are high mobility requirements, such as high-speed railway communications; low latency and high reliability, such as for industrial Internet production control process; low power consumption and low complexity of small data reported such as the mass of the sensor device access network. Another example, AR/VR communication needs end-to-end delay requirement of less than 20ms, excluding terminal and network side of the business processing delay, the network transmission delay requirements of less than 10ms , it needs to maintain business continuity while maintaining low latency as the AR / VR end-user moves.

In the field of wireless communication network, 5G wireless system researches also proposed to the mobile network a list of new design requirements in order to meet the needs of future communication, such as flexible mobility management solutions, multi-access, efficient use of network resources, efficient data transmission, ultra-low latency transmission, a large number of equipment access and so on.

The overall look at mass terminal access, ubiquitous mobility, low latency, high bandwidth, high reliability, low power consumption and low complexity, is to meet the basic characteristics of the new business network and requirements. Currently the IP address indicates both the identity and location of the end host. It doesn't support mobility and multiple accesses naturally. It is also inefficient in terms of route validity (referring to route aggregation with Locator), scalability, and security.

If the communication address and Identifier are separated, the connection can be established with any identifier, not limited by the communication address segment of the IP network. At the same time, the communication message is transmitted by any address, and is not affected the identifier of both ends of the communication. In this memo, a generic network scheme based on ID / Locator separation architecture is proposed to satisfy the following requirements of future networks:

(1) Ubiquitous mobility: the identifier is independent from network location and can cope with the change of network location.

(2) Low latency: select any optimal communication path, not subject to IP network segment restrictions, especially for the mobile communication.

(3) High reliability: one communication identifier could be mapped to multi-address, multi transmission path, which can be back up each other.

(4) High-bandwidth: multi-address, make full use of a variety of access technologies; multi-path, take full advantage of network bandwidth.

(5) Low-power and low complexity network, mass IOT device access and small data packet message transmission: transmission mechanism is simple, based on arbitrary identification of data transmission; simple signaling, transmission redundancy, to avoid heavy protocol stack and complex IP address allocation mechanism.

1.1 Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

2. Current Solution Analysis

This chapter makes a preliminary analysis of some existing mobility management protocols and protocols based on ID-Locator separation scheme.

2.1 GTP

GTP [TS29.060] is a 3GPP-defined tunneling protocol that provides mobility support in 3GPP network. GTP is an access-related L2 mobility management protocol; it supports mobility of 3GPP access technologies. But for non-3GPP access technology, such as WiFi access, through a special access adapter to access 4G EPC network. At the same time GTP is a local mobility protocol, and it does not support the user to switch the anchor after moving.

2.2 MIPv4/MIPv6

MIPv4 [RFC5944] and MIPv6 [RFC6275] are the Host Based mobility management protocol. RFC4830 analysis of the support of the routing optimization Host-based mobility management protocol several major issues: (1) User privacy disclosure: in case of routing optimization, the correspondent node can see the local IP changes, and it can track the location of the user; (2) Switching performance: end to end, long-distance communication, the location of the change of information to inform the end of a greater delay; (3) Low efficiency of air interface: IP over IP transmission format, the head in the

empty packet transmission load, transmission inefficient; (4)
Backward compatibility issue, need to modify the terminal to support
MIP protocol stack.

2.3 PMIPv6

PMIPv6 [RFC5213] migrates MIPv6 mobility management capabilities to
the edge of the network, through the network proxy. PMIP is a local
scope mobility management protocol, and it does not support the user
to move the anchor after the switch.

2.4 HIP

The HIP [RFC7401] protocol is a protocol that conforms to the idea of
ID Locator separation. It can support Host-based mobility and is more
secure than MIP. It has the same problem as MIP.

2.5 LISP

The main purpose of LISP [RFC6830] protocol design is to support the
scalability of IP network routing, and to collect the IP packets with
the same route through Locator to reduce the number of routes of
network devices and to support traffic engineering. LISP protocol
does not support network-side mobility; LISP extension protocol can
support Host-based mobility, and MIP, HIP with the same host mobility
issues;

2.6 ILNP

ILNP [RFC6740] protocol divide 128-bit long IPv6 address into two
parts, high 64-bit locator, and low 64-bit ID, this format can reduce
the header overload; the control plane is designed mainly through
enhancement of DNS protocol and ICMP protocol. ILNP protocol mainly
supports Host Based mobility; and through the DNS system to track the
user mobile location, it can not support high-speed mobile and
service continuity.

3 Design Principle

The ID Locator separation scheme in this document is designed to
adhere to the following design principles:

1. Providing high-performance, flexible, ubiquitous mobility support

2. Support IoT transmission characteristics, for example, large
connections, sleep, different levels of mobility.

3. Support multi-access

4. Delay performance requirements

5. Has good scalability

6. Minimize modifications to existing terminals. Supports legacy terminals.

7. Compatible with existing IP networks.

8. Support any form of ID forwarding, not only limit to the IP address compatible format.

9. Support multiple forwarding plane format, which can be selected flexible, such as LISP format or ILA format.

10. Access agnostic: the L3 network mobility is supported mainly, and can be compatible with a variety of L2 mobility technology.

11. Support the network based mobility, can be deployed in the terminal to support the host based mobility flexible.

4 Architecture Design

4.1 Architecture Overview

Based on the idea of ID-Locator separation, combining the above new design requirements, the following scheme architecture is proposed. The architecture contains the ID domain, that is, using the ID-Locator separation to communicate, also includes the IP domain, that is, the existing IP address-based communication.

```
                                      --------------------.
                                     |  IP Domain         |
                                     |                    |
                         +-------+   |           +-------+ |
                         |Ext DNS|--------------|IP host| |
                         +---|---+   |           +-.-----+ |
                             |       |             |      |
                             |       |             |      |
                             |       '-----------|--------
                             |                    |
    +------------------------------|-------------------------|--------+
    |   ID Domain                  |                          |        |
    |      +-----------------------+--'+                      |        |
    |      |              +----------+UCP|--------+        I5|        |
    |      |              | I4       +---+    I4 |           |        |
    |      |I2            |                       |           |        |
    |      |              |                       |           |        |
    |      |              |                      | +---------+        |
    |      |              |                      | |                  |
    | +--+----+   I1    +-+-+         I3         +'-|+  I1  +-------+ |
    | |ID host|--------|LPF|-------------------|LPF|------|ID host| |
    | +-------+        +---+                    +---+      +-------+ |
    |                                                               |
    +---------------------------------------------------------------+
```
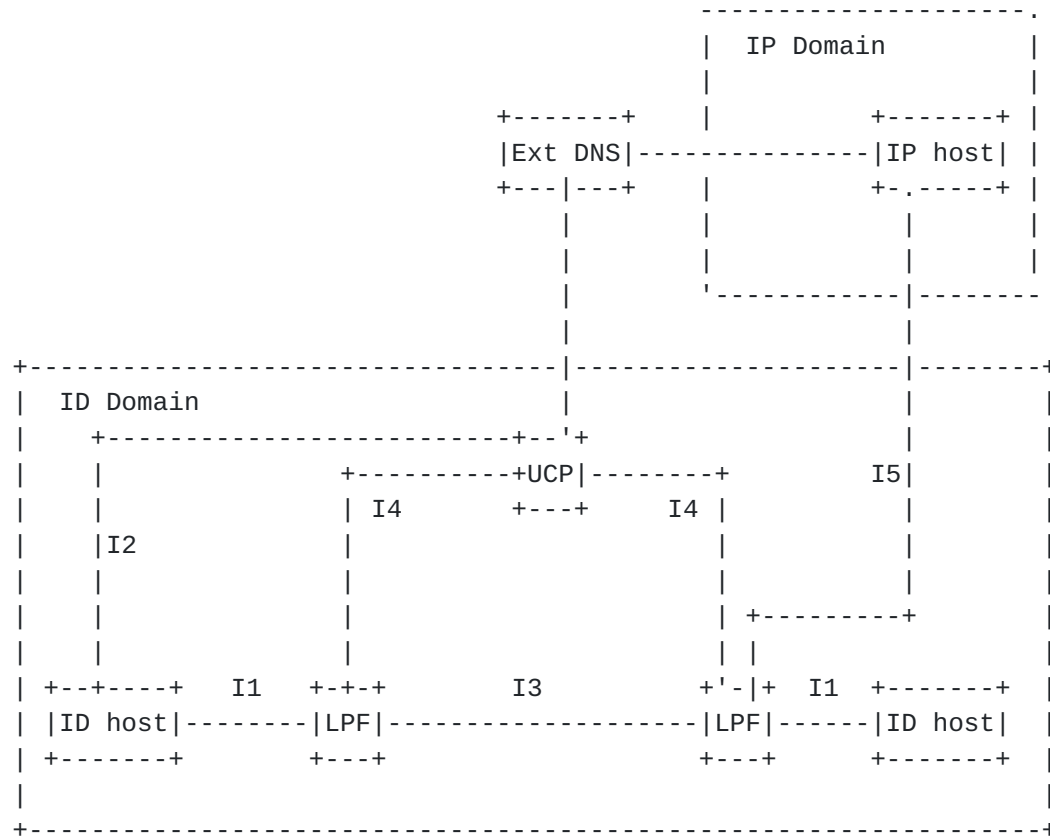
                      Figure 1: Architecture Overview

       Functionality Definitions:

       ID host

       The host that uses ID-based communication scheme, the ID hosts in ID
       domain communicate with each other through ID-based communication
       scheme. The ID host could be devices such as broadband mobile phones,
       IOT equipment, vehicles etc.

       UCP

       The universal control plane of the architecture. The ID-Locator
       mapping is maintained.

       LPF

Including user Locator allocation, Locator registration, user packet encapsulation and decapsulation and forwarding functions.

IP Host

The host that uses IP-based communication scheme, the IP hosts in IP domain communicate with each other through IP-based communication scheme. The IP host could be devices such as broadband mobile phones, IOT equipment, vehicles etc.

Ext DNS

Resolve host's forwarding ID by permanent ID.

4.2 Reference Point Definition

I1: ID registration, activation and motion detection.

I2: ID packets are received and transmitted on the L2 network.

I4: ID over Locator message reception and transmission.

I3: Locator Allocation Update, ID / Locator Association Mapping, ID / Locator Query Subscription.

I5: Interfaces between the ID domain and the IP domain.

4.3 Signaling and Data Flow Overview

4.3.1 Packet Forwarding Procedure

The process shows a normal data sending and receiving process.

```
      +--------+      +---+      +---+        +---+     +--------+
      |ID host1|      |LPF|      |UCP|        |LPF|     |ID host2|
      +--------+      +-.-+      +-.-+        +--.+     +---.----+
           |           |           |(1) ID and LOC Registration
           |           |           |<--------------------|
           |(2)resolve |           |            |         |
           |  peer ID  ||-------+|               |         |
           |------------>Ext DNS||              |         |
           |           |+-------+|              |         |
           |(3)ID packet|         |             |         |
           |------------>         |             |         |
           |           |(4)LOC   |              |         |
           |           |  query  |              |         |
           |           |--------->             |         |
           |           |(5)assign|             |         |
           |           | ID/LOC  |              |         |
           |           | mapping |              |         |
           |           <---------|              |         |
           |           |         |              |         |
           |           |(6)packet transmission|           |
           |           |---------------------->           |
           |           |         |             (7)packet  |
           |           |         |             | forward  |
           |           |         |             |--------->
           |           |         |             |         |
```
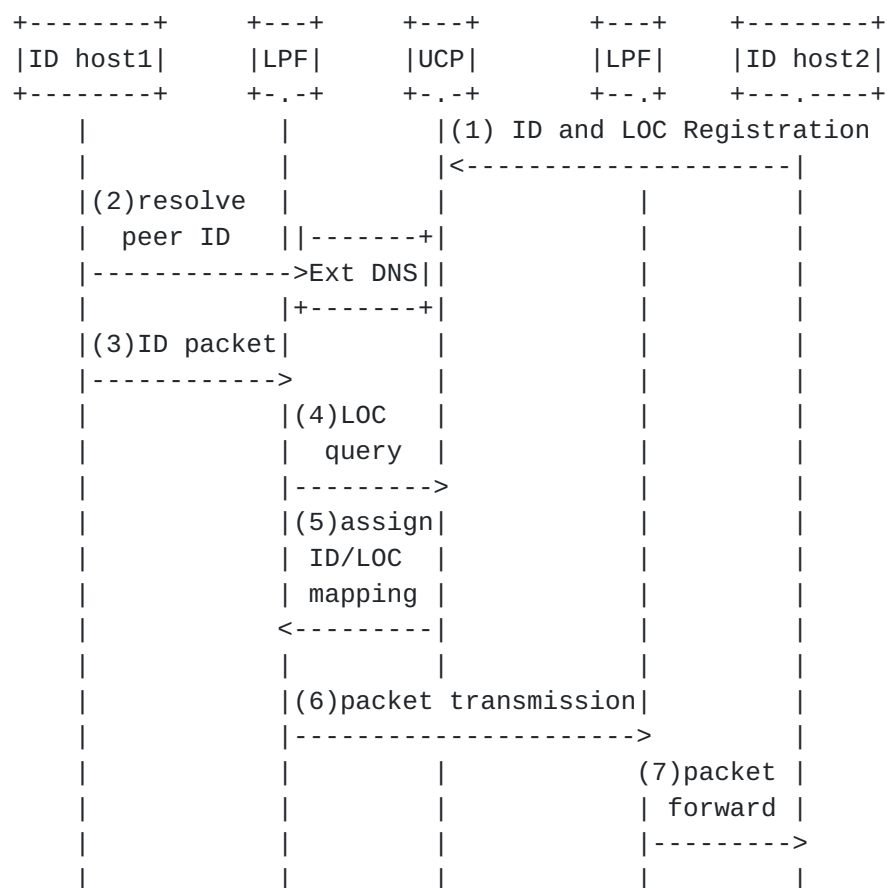
                  Figure 2: Packet Forwarding Procedure

     (1) Host1 registration ID and location information in UCP.

     (2) Resolve peer host's forwarding ID by permanent ID.

     (3) Encapsulate the ID packet and send it to the LPF;

     (4) The LPF receives the ID packet, searches for the ID / Locator
     mapping table (only for the first packet) according to the
     destination ID, sends the destination ID to the UCP, and searches for
     the ID / Locator mapping relationship.

     (5) The UCP allocates the LPF and the corresponding Locator based on
     the ID and location registration relation registered with the peer
     host and sends the ID / Locator mapping to the LPF.

     (6) The local LPF encapsulates the Locator + ID packet according to
     the ID / Locator mapping relationship and sends the packet to the
     peer LPF through IP routing.

     (7) Encapsulating the ID packet and forwarding to the host2.

4.3.2 **Handover Procedures**

   This subsection describes handover procedures that the host moves
   from SRC LPF to DEST LPF.

4.3.2.1 **Handover without routing optimization**

```
 +--------+   +-------+   +-------+      +---+  +--------+
 |ID host1|   |SRC LPF|   |DST LPF|      |UCP|  |ID host2|
 +---+----+   +---+---+   +---+---+      +-+-+  +----+---+
     |            |           |            |         |
     |(1) ID and  |           |            |         |
     | LOC regist.|           |            |         |
     |----------------------------------->|         |
     |           |(2)config  |            |         |
     |           | ID/LOC map.|           |         |
     |           |<--------------------|            |
     |           |(3)data forwarding path|          |
     |<-----------|<-------------------------------|
   +----+         |           |            |         |
   |Move|         |           |            |         |
   +----+         |           |            |         |
     |   (4)ID and LOC registration       |         |
     |----------------------------------->|         |
     |           |           |(5)config   |         |
     |           |           |ID/LOC map. |         |
     |           |           |<----------|          |
     |           |(6)indicate to redirect|          |
     |           |packets from SRC LPF to|          |
     |           |DEST LPF   |            |         |
     |           |<----------------------|          |
     |           |(7) redirect|           |         |
     |           |packets    |            |         |
     |           |---------->|            |         |
     |<----------------------|            |         |
     |           |           |            |         |
```

             Figure 3: Handover without routing optimization

   (1) Host1 registration ID and location information in UCP.

   (2) The UCP allocates the LPF and the corresponding Locator based on
   the ID and location registration relation registered with the peer
   host2 and sends the ID / Locator mapping to the LPF.

   (3) Data forwarding path from peer host2 to host1 through SRC LPF.

   (4) After host1 moves to a new DEST LPF, it re-registers ID and

locator information in UCP.

(5) UCP configures host1's ID-locator mapping in DEST LPF.

(6) UCP indicates SRC LPF to redirect packets for host1 from SRC LPF to DEST LPF.

(7) SRC LPF redirects received downlink packets to DEST LPF and the packets will be forwarded from DEST LPF to host1.

4.3.2.2 Handover with routing optimization

```
                                        +-----+
      +--------+   +-------+   +-------+   +---+ |Peer |  +--------+
      |ID host1|   |SRC LPF|   |DST LPF|   |UCP| |LPF  |  |ID host2|
      +---+----+   +---+---+   +---+---+   +-+-+ +-----+  +----+---+
          |            |           |         |       |        |
          |(1) ID and  |           |         |       |        |
          | LOC regist.|           |         |       |        |
          |--------------------------------->|       |        |
          |            |(2)config  |         |       |        |
          |            | ID/LOC map.|        |       |        |
          |            |<----------------------|     |        |
          |            |(3)data forwarding path|     |        |
          |<-----------|<---------------------------------------------|
       +----+          |           |         |       |        |
       |Move|          |           |         |       |        |
       +----+          |           |         |       |        |
          |   (4)ID and LOC registration     |       |        |
          |--------------------------------->|       |        |
          |            |           |(5)config |       |        |
          |            |           |ID/LOC map.|      |        |
          |            |           |<----------|      |        |
          |            |(6)indicate to redirect|      |        |
          |            |packets from SRC LPF to|      |        |
          |            |DEST LPF   |         |       |        |
          |            |<---------------------|       |        |
          |            |(7) redirect|         |       |        |
          |            |packets    |         |       |        |
          |            |---------->|         |       |        |
          |<----------------------|          |       |        |
          |            |           |(8)recofig ID/LOC mapping  |
          |            |           |<----------|-------->      |
          |            |(9)release ID/LOC mapping    |        |
          |            |<---------------------|       |        |
          |            |           |         |       |        |
          |            | (10) data forwarding |       |        |
          |<----------------------|<----------------------------|
```
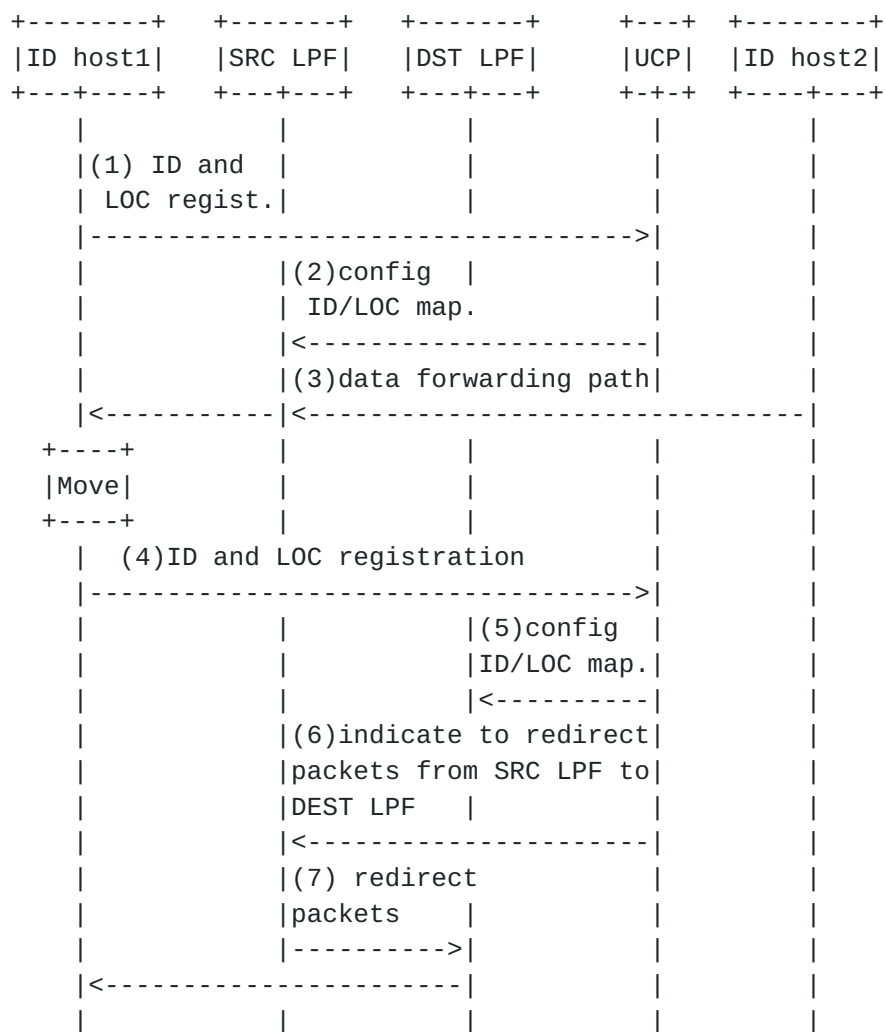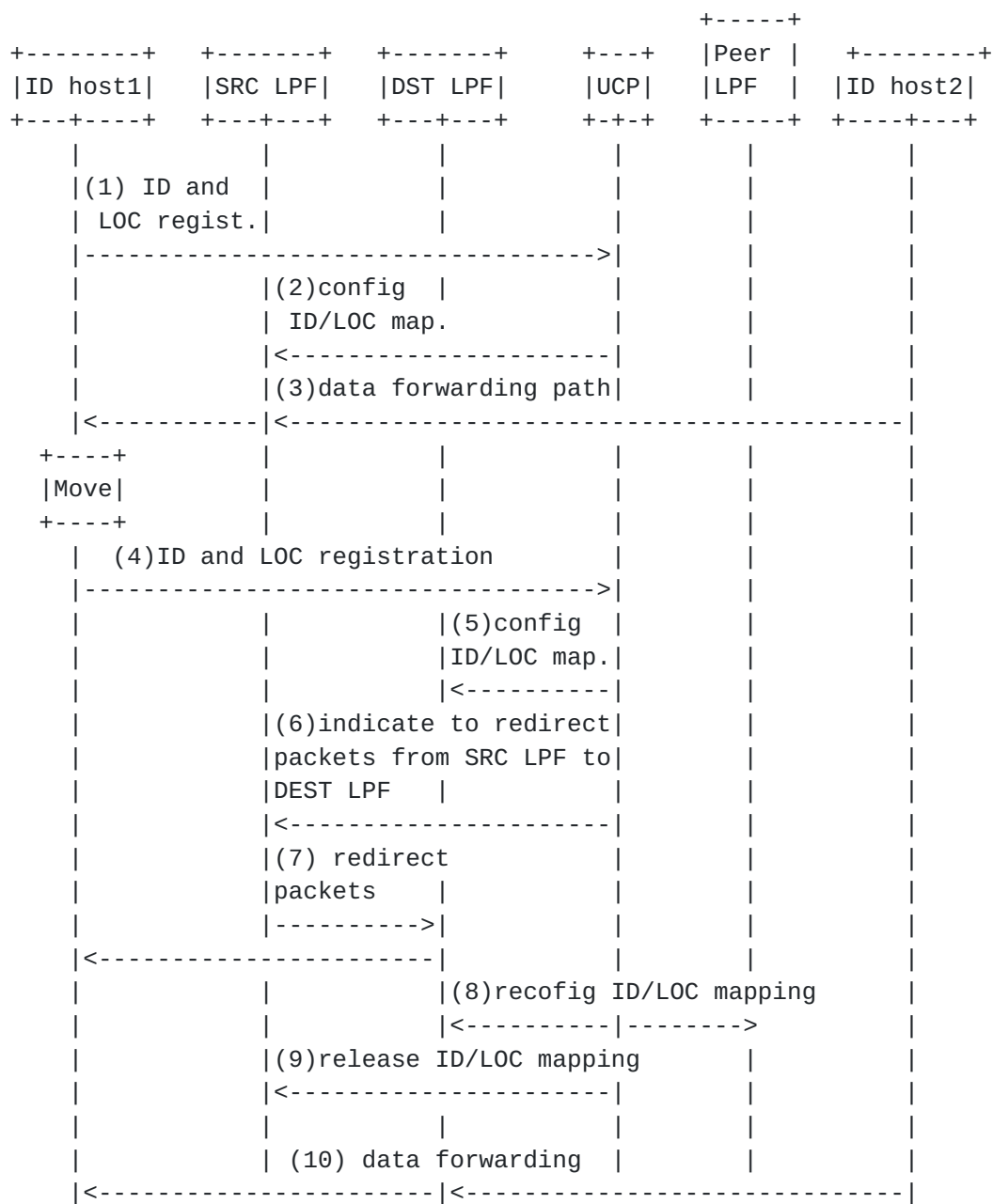
                   Figure 4: Handover with routing optimization

     (1) Host1 registration ID and location information in UCP.

     (2) The UCP allocates the LPF and the corresponding Locator based on
     the ID and location registration relation registered with the peer
     host2 and sends the ID / Locator mapping to the LPF.

     (3) Data forwarding path from peer host2 to host1 through SRC LPF.

(4) After UE moves to a new DEST LPF, it re-registers ID and locator information in UCP.

(5) UCP configures host1's ID-locator mapping in DEST LPF.

(6) UCP indicates SRC LPF to redirect packets for UE from SRC LPF to DEST LPF.

(7) SRC LPF redirects received downlink packets to DEST LPF and the packets will be forwarded from DEST LPF to host1.

(8) UCP reconfigure ID-locator mapping on peer LPF to indicate peer LPF forwarding packets directly to DEST LPF.

(9) Release ID-locator mapping on SRC LPF.

(10) Packets are forwarded directly from peer LPF to DEST LPF to host1.

4.3.3 Interconnection between ID Network and IP Network

This process shows how to communicate between an ID network and an IP network.

```
    +-------+      +---+      +---+     +-------+ +-------+
    |ID host|      |LPF|      |UCP|     |Ext DNS| |IP host|
    +---.---+      +-.-+      +-.-+     +---.---+ +---.---+
        |           |          |           |         |
        | (1)ID/LOC regist.    |           |         |
        |--------------------->|           |         |
        |           |          |(2)regis.  |         |
        |           |          | of IP for ID        |
        |           |          |   host    |         |
        |           |          |--------->|          |
        |           |(3)config. |          |          |
        |           |mapping relation     |          |
        |           |between ID and       |(3.1)query|
        |           |proxy IP addr.       |IP according
        |           |<--------|           |to ID     |
        |           |          |          |<---------|
        |           |   (3.2)sending IP packet       |
        |           |<-------------------------------|
        |(3.3) packet          |          |          |
        |with ID    |          |          |          |
        |<----------|          |          |          |
        |   (4.1) resolve peer's ID       |          |
        |------------------------------->|           |
        |(4.2)packet|          |          |          |
        |with ID    |          |          |          |
        |---------->|          |          |          |
        |           |   (4.3)sending IP packet       |
        |------------------------------------------->|
        |           |          |          |          |
```
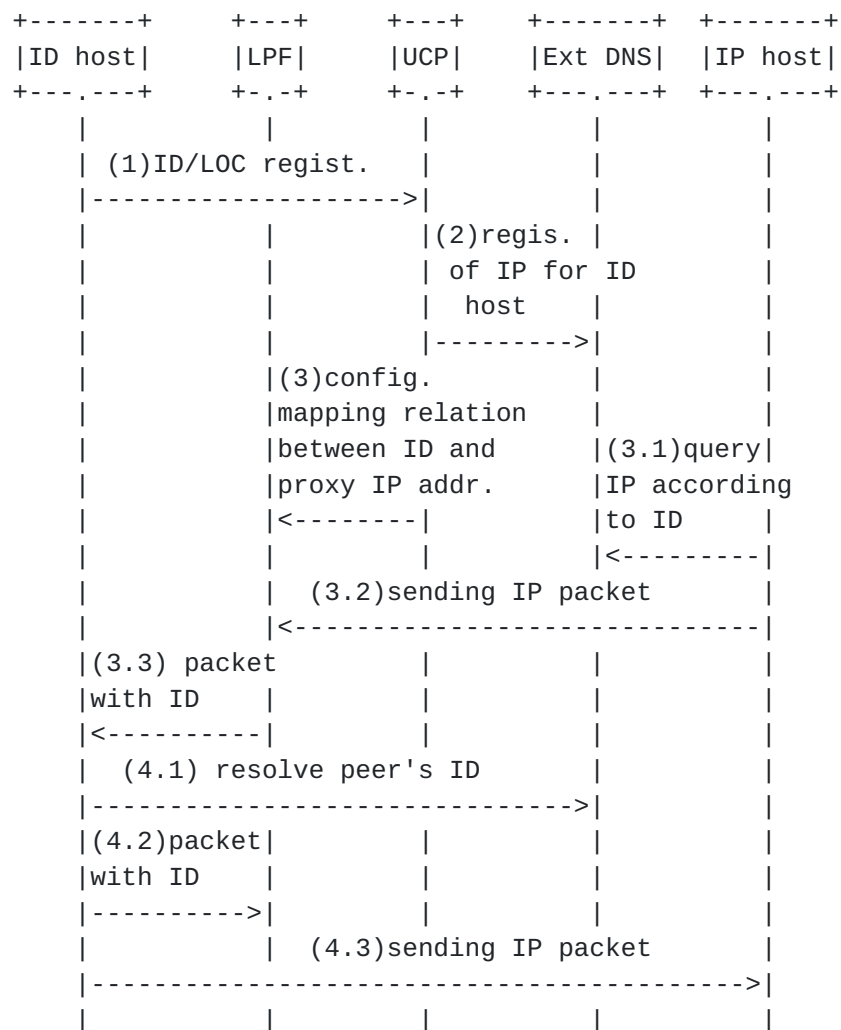
          Figure 5: Interconnection between ID Network and IP Network

    (1) ID host registers ID and ID location information.

    (2) The UCP allocates a designated IP address to each registered ID
    host as a proxy IP for interworking with the external IP network; and
    registers the relation between the ID and the IP in the DNS system;

    (3) Communication from IP-based host to ID-based host.

    (3.1) The UCP instructs the LPF to establish a mapping table between
    the ID and the IP, which acts as the proxy point for interworking
    with the IP network.

    (3.2) When an IP entity needs to communicate with an ID host, it
    first resolves the proxy IP from the DNS system and then communicates

with the ID host through the standard IP packet.

(3.3) The LPF receives the IP packet, finds the mapping relationship, de-encapsulates the packet, and re-encapsulates the ID packet header, and sends the packet to the destination ID host;

(4) Communication from ID host to IP host.

(4.1) ID host resolves the domain name of the remote end, and DNS returns the IP address of the remote end.

(4.2) If the peer ID is a standard IP address, it must be explicitly marked in the encapsulated packet so that the LPF can determine the difference.

(4.3) When the LPF receives a packet and determines that the peer end is an IP address, the LPF de-encapsulates ID packet. Packets are encapsulated with proxy IPs on the LPF and then sent to the remote end in the IP domain.

(4.4) If the ID host does not support DNS resolution, the LPF could finish the DNS procedure instead of ID host.

[5](#) Message Definition

TBD.

6 Security Considerations

TBD.

7 Privacy Considerations

TBD.

8 IANA Considerations

TBD.

9 Acknowledgements

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10   References

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across the Gn and Gp interface".

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