LISP for the Mobile Network
draft-farinacci-lisp-mobile-network-01

Abstract

   This specification describes how the LISP architecture and protocols
   can be used in a LTE/5G mobile network to support session survivable
   EID mobility. A recommendation is provided to SDOs on how to
   integrate LISP into the mobile network.

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1. Introduction

   The LISP architecture and protocols [RFC6830] introduces two new
   numbering spaces, Endpoint Identifiers (EIDs) and Routing Locators
   (RLOCs) which provide an architecture to build overlays on top of the
   underlying Internet. Mapping EIDs to RLOC-sets is accomplished with
   a Mapping Database System. By using a level of indirection for
   routing and addressing, separating an address identifier from its
   location can allow flexible and scalable mobility. By assigning EIDs
   to mobile devices and RLOCs to the network nodes that support such
   mobile devices, LISP can provide seamless mobility.

   For a reading audience unfamiliar with LISP, a brief tutorial level
   document is available at [I-D.ietf-lisp-introduction].

   This specification will describe how LISP can be used to provide
   layer-3 mobility within and across an LTE [LTE401-3GPP] [LTE402-3GPP]
   and 5G [ARCH5G-3GPP] [PROC5G-3GPP] mobile network.

   The following are the design requirements:

1. Layer-3 address mobility is provided within a mobile network RAN
    supported by a pGW region (intra-pGW) as well as across pGW
    regions (inter-pGW).

2. UE nodes can get layer-3 address mobility when roaming off the
    mobile network to support Fixed Mobile Convergence [FMC].

3. Transport layer session survivability exists while roaming
    within, across, and off of the mobile network.

4. No address management is required when UEs roam. EID addresses
    are assigned to UEs at subscription time. EIDs can be reassigned
    when UE ownership changes.

5. The design will make efficient use of radio resources thereby not
    adding extra headers to packets that traverse the RAN.

6. The design can support IPv4 unicast and multicast packet delivery
    and will support IPv6 unicast and multicast packet delivery.

7. The design will allow use of both the GTP [GTPv1-3GPP]
    [GTPv2-3GPP] and LISP [I-D.ietf-lisp-rfc6830bis] data-planes
    while using the LISP control-plane and mapping system.

8. The design can be used for either 4G/LTE and 5G mobile networks
    and may be able to support interworking between the different
    mobile networks.

9. The LISP architecture provides a level of indirection for routing
    and addressing. From a mobile operator's perspective, these
    mechanisms provide advantages and efficiencies for the URLLC,
    FMC, and mMTC use cases. See Section 2 for definitions and
    references of these use cases.

The goal of this specification is take advantage of LISP's non-
disruptive incremental deployment benefits. This can be achieved by
changing the fewest number of components in the mobile network. The
proposal suggests adding LISP functionality only to eNodeB and pGW
nodes. There are no hardware or software changes to the UE devices
or the RF-based RAN to realize this architecture. The LISP mapping
database system is deployed as an addition to the mobile network and
does not require any coordination with existing management and
provisioning systems.

Similar ID Oriented Networking (ION) mechanisms for the 5G
[ARCH5G-3GPP] [PROC5G-3GPP] mobile network are also being considered
in other standards organizations such as ETSI [ETSI-NGP] and ITU

[ITU-IMT2020]. The NGMN Alliance describes Locator/ID separation an
enabler to meet Key Performance Indicator Requirements [NGMN].

2. Definition of Terms

xTR: Is a LISP node in the network that runs the LISP control-plane
   and data-plane protocols according to [I-D.ietf-lisp-rfc6830bis]
   and [I-D.ietf-lisp-rfc6833bis]. A formal definition of an xTR can
   be found in [RFC6830]. In this specification, a LISP xTR is a
   node that runs the LISP control-plane with the GTP data-plane.

EID: Is an Endpoint Identifier. EIDs are assigned to UEs and other
   Internet nodes in LISP sites. A formal definition of an EID can
   be found in [RFC6830].

UE EID: A UE can be assigned an IPv4 and/or an IPv6 address either
   statically, or dynamically as is the procedure in the mobile
   network today. These IP addresses are known as LISP EIDs and are
   registered to the LISP mapping system. These EIDs are used as the
   source address in packets that the UE originates.

RLOC: Is an Routing Locator. RLOCs are assigned to eNodeBs and pGWs
   and other LISP xTRs in LISP sites. A formal definition of an RLOC
   can be found in [RFC6830].

Mapping System: Is the LISP mapping database system that stores EID-
   to-RLOC mappings. The mapping system is centralized for use and
   distributed to scale and secure deployment. LISP Map-Register
   messages are used to publish mappings and LISP Map-Requests
   messages are used to lookup mappings. LISP Map-Reply messages are
   used to return mappings. EID-records are used as lookup keys, and
   RLOC-records are returned as a result of the lookup. Details can
   be found in [RFC6833].

LISP Control-Plane: In this specification, a LISP xTR runs the LISP
   control-plane which originates, consumes, and processes Map-
   Request, Map-Register, Map-Reply, and Map-Notify messages.

RAN: Radio Access Network where UE nodes connect to eNodeB nodes via
   radios to get access to the Internet.

EPC: Evolved Packet Core [EPS-3GPP] system is the part of the mobile
   network that allows the RAN to connect to a data packet network.
   The EPC is a term used for the 4G/LTE mobile network.

NGC: Next Generation Core [EPS-3GPP] system is the part of the 5G
   mobile network that allows the RAN to connect to a data packet
   network.

   GTP: GTP [GTPv1-3GPP] [GTPv2-3GPP] is the UDP tunneling mechanism
      used in the LTE/4G and 5G mobile network.

   UE: User Equipment as defined by [GPRS-3GPP] which is typically a
      mobile phone. The UE is connected to the network across the RAN
      to eNodeB nodes.

   eNodeB: Is the device defined by [GPRS-3GPP] which borders the RAN
      and connects UEs to the EPC in a 4G/LTE mobile network. The
      eNodeB nodes are termination point for a GTP tunnel and are LISP
      xTRs. The equivalent term in the 5G mobile network is "(R)AN" and
      "5G-NR", or simply "gNB". In this document, the two terms are
      used interchangeably.

   pGW: Is the PDN-Gateway as defined by [GPRS-3GPP] connects the EPC
      in a 4G/LTE mobile network to the Internet. The pGW nodes are
      termination point for a GTP tunnel and is a LISP xTR. The
      equivalent user/data-plane term in the 5G mobile network is the
      "UPF", which also has the capability to chain network functions.
      In this document, the two terms are used interchangeably.

   URLLC: Ultra-Reliable and Low-Latency provided by the 5G mobile
      network for the shortest path between UEs [NGMN].

   FMC: Fixed Mobile Convergence [FMC] is a term used that allows a UE
      device to move to and from the mobile network. By assigning a
      fixed EID to a UE device, LISP supports transport layer continuity
      between the mobile network and a fixed infrastructure such as a
      WiFi network.

   mMTC: Massive Machine-Type Services [mMTC] is a term used to refer
      to using the mobile network for large-scale deployment of Internet
      of Things (IoT) applications.

3. **Design Overview**

   LISP will provide layer-3 address mobility based on the procedures in
   [I-D.ietf-lisp-eid-mobility] where the EID and RLOCs are not co-
   located. In this design, the EID is assigned to the UE device and
   the RLOC(s) are assigned to eNodeB nodes. So any packets going to a
   UE are always encapsulated to the eNodeB that associates with the UE.
   For data flow from the UE to any EIDs (or destinations to non-LISP
   sites) that are outside of the EPC, use the RLOCs of the pGW nodes so
   the pGW can send packets into the Internet core (unencapsulated).

   The following procedures are used to incorporate LISP in the EPC:

   o UEs are assigned EIDs. They usually never change. They identify
      the mobile device and are used for transport connections. If
      privacy for EIDs is desired, refer to details in
      [I-D.ietf-lisp-eid-anonymity].

   o eNodeB nodes are LISP xTRs. They have GTP, and optionally LISP,
      tunnels to the pGW nodes. The eNodeB is the RLOC for all EIDs
      assigned to UE devices that are attached to the eNodeB.

   o pGW nodes are LISP xTRs. They have GTP, and optionally LISP,
      tunnels to the eNodeB nodes. The pGW is the RLOC for all traffic
      destined for the Internet.

   o The LISP mapping system runs in the EPC. It maps EIDs to RLOC-
      sets.

   o Traffic from a UE to UE within a pGW region can be encapsulated
      from eNodeB to another eNodeB or via the pGW, acting as an RTR
      [RFC6830], to provide data-plane policy.

   o Traffic from a UE to UE across a pGW region have these options for
      data flow:

      1. Encapsulation by a eNodeB in one region to a eNodeB in another
          region.

      2. Encapsulation by a eNodeB in one region to a pGW in the same
          region and then the pGW reencapsulates to a eNodeB in another
          region.

      3. Encapsulation by a eNodeB in one region to a pGW in another
          region and then the pGW reencapsulates to a eNodeB in its same
          region

o Note when encapsulation happens between a eNodeB and a pGW, GTP is
   used as the data-plane and when encapsulation between two eNodeBs
   occur, LISP can be used as the data-plane when there is no X2
   interface [X2-3GPP] between the eNodeB nodes.

o The pGW nodes register their RLOCs for a default EID-prefix to the
   LISP mapping system. This is done so eNodeB nodes can find pGW
   nodes to encapsulate to.

o The eNodeB nodes register EIDs to the mapping system for the UE
   nodes. The registration occurs when eNodeB nodes discover the
   layer-3 addresses of the UEs that connect to them. The eNodeB
   nodes register multiple RLOCs associated with the EIDs to get
   multi-homing and path diversity benefits from the EPC network.

o When a UE moves off a eNodeB, the eNodeB node deregisters itself
   as an RLOC for the EID associated with the UE.

o Optionally, and for further study for future architectures, the
   eNodeB or pGW could encapsulate to an xTR that is outside of the
   EPC network. They could encapsulate to a LISP CPE router at a
   branch office, a LISP top-of-rack router in a data center, a LISP
   wifi access-point, LISP border routers at a hub site, and even a
   LISP router running in a VM or container on a server.

The following diagram illustrates the LTE mobile network topology and
structure [LTE401-3GPP] [LTE402-3GPP]:

```
        (--------------------------------------------)
        (                                            )
        (                  Internet                  )
        (                                            )
        (--------------------------------------------)
               |                        |
               |                        |
        (---------|---------)    (---------|---------)
        (        pGW        )    (        pGW        )
        (                   )    (                   )
        (        EPC        )    (        EPC        )
        (                   )    (                   )
        (   eNodeB   eNodeB )    (   eNodeB   eNodeB )
        (---/--\-----/--\---)    (---/--\-----/--\---)
           /    \   /    \          /    \   /    \
          /      \ /      \        /      \ /      \
         /                \      /                  \
        /       RAN        \    /       RAN          \
       /                    \  /                      \
      (    UE      UE      UE ) (   UE       UE      UE  )
```
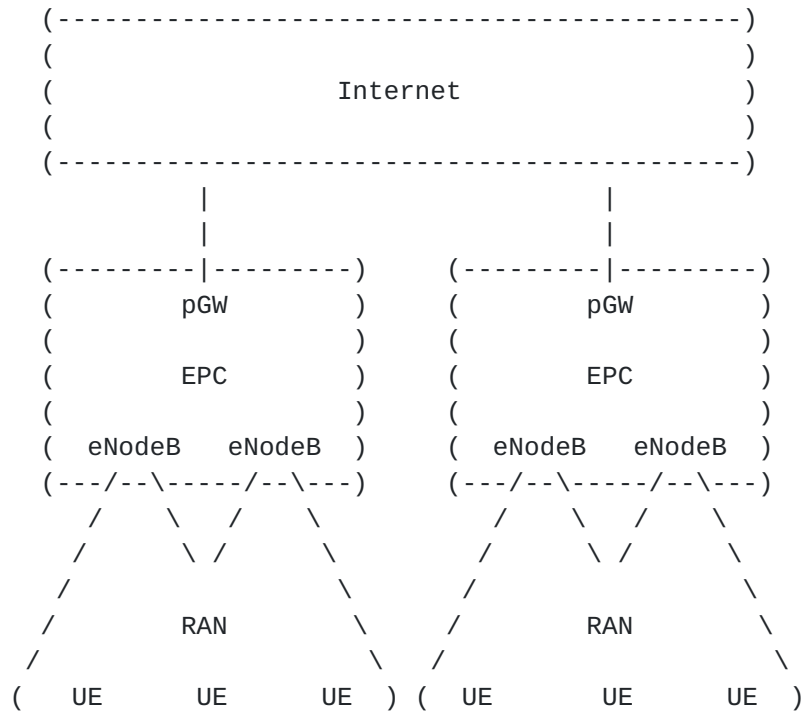
                LTE/5G Mobile Network Architecture

   The following diagram illustrates how LISP is used on the mobile
   network:

(1) IPv6 EIDs are assigned to UEs.
(2) RLOCs assigned to eNodeB nodes are [a1,a2], [b1,b2], [c1,c2], [d1,d2]
    on their uplink interfaces.
(3) RLOCs assigned to pGW nodes are [p1,p2], [p3,p4].
(4) RLOCs can be IPv4 or IPv6 addresses or mixed RLOC-sets.

```
               (---------------------------------------------)
               (                                             )
               (                    Internet                 )
               (                                             )
               (---------------------------------------------)
                         |                       |
                         |                       |
               (---------|---------)     (---------|---------)
               (        pGW        )     (        pGW        )
               (       p1 p2       )     (       p3 p4       )
               (                   )     (                   )
               (        EPC        )     (        EPC        )
               (                   )     (                   )
               (  a1  a2   b1  b2  )     (  c1  c2   d1  d2  )
               (  eNodeB   eNodeB  )     (  eNodeB   eNodeB  )
               (---/--\-----/--\---)     (---/--\-----/--\---)
                  /   \ /     \          /   \ /     \
                 /     \ /      \       /     \ /      \
                /               \      /               \
               /       RAN       \    /       RAN       \
              /                   \   /                   \
           (    UE      UE      UE  ) (  UE         UE       UE  )
      EIDs:    a::1    b::1    c::1      x::1      y::1      z::1
```
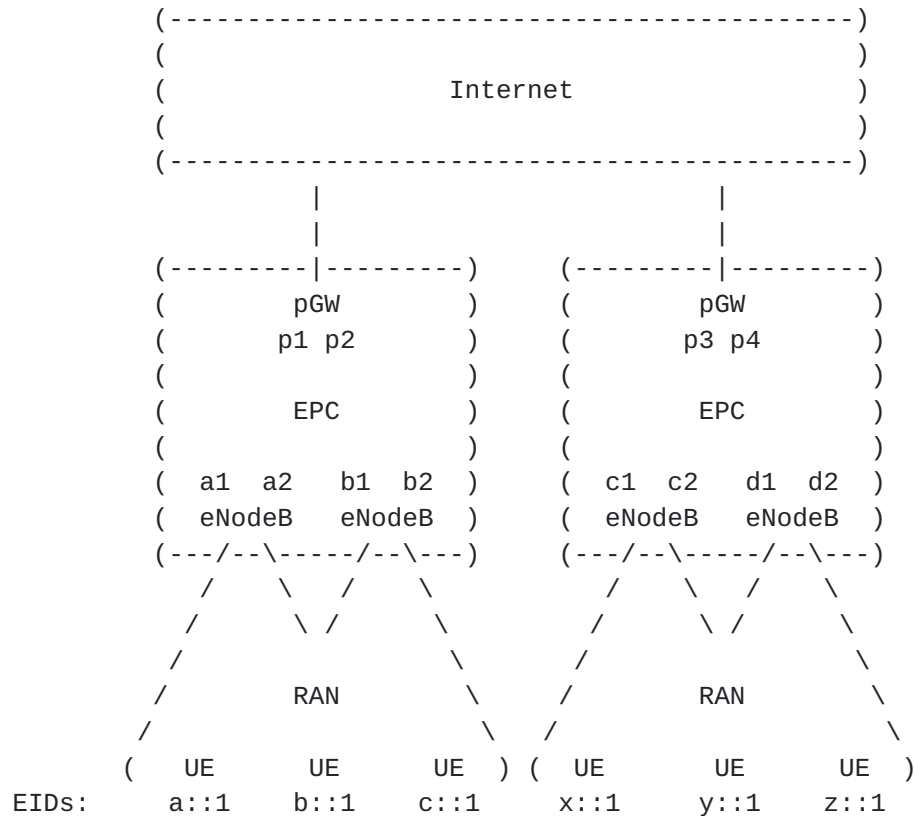
                   Mobile Network with EID/RLOC Assignment

The following table lists the EID-to-RLOC entries that reside in the LISP
Mapping System when the above UEs are are attached to the 4 eNodeBs:

```
EID-Record  RLOC-Record      Commentary                              Footnote
0::/0       [p1,p2,p3 p4]    eNodeBs encap to p1-p4 for Internet        (1)
                             destinations which are non-EIDs

a::1/128    [a1,a2]          pGWs load-split traffic to [a1,a2] for     (2)
                             UE a::1 and it can move to [b1,b2]

b::1/128    [a1,a2]          eNodeB tracks both UEs a::1 and b::1,       (3)
                             it can do local routing between the UEs

c::1/128    [b1,b2]          UE c::1 can roam to [c1,c2] or [d1,d2],     (4)
                             may use pGW [p1,p2] after move

x::1/128    [c1,c2]          UE x::1 can talk directly to UE y::1,       (5)
                             eNodeBs encap to each other

y::1/128    [d1,d2]          UE can talk to Internet when [d1,d2],       (6)
                             encap to pGW [p3,p4] or use backup [p1,p2]

z::1/128    [d1,d2]          UE z::1 can talk to a::1 directly           (7)
                             where [d1,d2] encaps to [a1,a2]
```

   (1) For packets that flow from UE nodes to destinations that are not
   in LISP sites, the eNodeB node use one of the RLOCs p1, p2, p3, or p4
   as the destination address in the outer encapsulated header.
   Encapsulated packets are then routed by the EPC core to the pGW
   nodes. In turn, the pGW nodes, then route packets into the Internet
   core.

   (2) Packets that arrive to pGW nodes from the Internet destined to UE
   nodes are encapsulated to one of the eNodeB RLOCs a1, a2, b1, b2.
   When UE, with EID a::1 is attached to the leftmost eNodeB, the EID
   a::1 is registered to the mapping system with RLOCs a1 and a2. When
   UE with EID c::1 is attached to the rightmost eNodeB (in the left
   region), the EID c::1 is registered to the mapping system with RLOCs
   ba and b2.

   (3) If UE with EID a::1 and UE with EID b::1 are attached to the same
   eNodeB node, the eNode node tracks what radio interface to use to
   route packets from one UE to the other. This is done in today's
   mobile network and needs to continue to do so.

   (4) If UE with EID c::1 roams away from eNodeB with RLOCs b1 and b2,
   to the eNodeB with RLOCs c1 and c2 (in the rightmost region), packets
   destined toward the Internet, can use any pGW. Any packets that flow

back from the Internet can use any pGW. In either case, the pGW is
informed by the mapping system that the UE with EID c::1 has new
RLOCs and should now encapsulate to either RLOC c1 or c2.

(5) When UE with EID x::1 is attached to eNodeB with RLOCs c1 and c2
and UE with EID y::1 is attached to eNodeB with RLOCs d1 and d2, they
can talk directly, on the shortest path to each eNodeB, when each
encapsulate packets to each other's RLOCs.

(6) When packets from UE with EID y::1 are destined for the Internet,
the eNodeB with RLOCs d1 and d2 that the UE is attached to can use
any exit pGWs RLOCs p1, p2, p3, or p4.

(7) UE with EID z::1 can talk directory to UE with EID a::1 by each
eNodeB they are attached to encapsulsates to each other's RLOCs. In
case (5), the two eNodeB's were in the same region. In this case,
the eNodeBs are in different regions.

The following abbreviated diagram shows a topology that illustrates
how a UE roams with LISP across pGW regions:


```
            (--------------------------------------------)
            (                                            )
            (                  Internet                  )
            (                                            )
            (--------------------------------------------)
                 |                        |
                 |                        |
            (---------|---------)    (---------|---------)
            (         pGW       )    (          pGW      )
            (        p1 p2      )    (         p3 p4     )
            (                   )    (                   )
            (         EPC       )    (          EPC      )
            (                   )    (                   )
            (  a1   a2   b1  b2 )    (  c1  c2    d1  d2 )
            (  eNodeB    eNodeB )    (  eNodeB    eNodeB )
            (---/--\-----/--\---)    (---/--\-----/--\---)
                /    \   /    \          /    \   /    \
               /      \ /      \        /      \ /      \
              /        \        \      /        \        \
             /    RAN    \      /     /    RAN    \        \
            /             \    /     /                      \
           (    UE    ----------------------------->  UE     )
              a::1                                     a::1
```
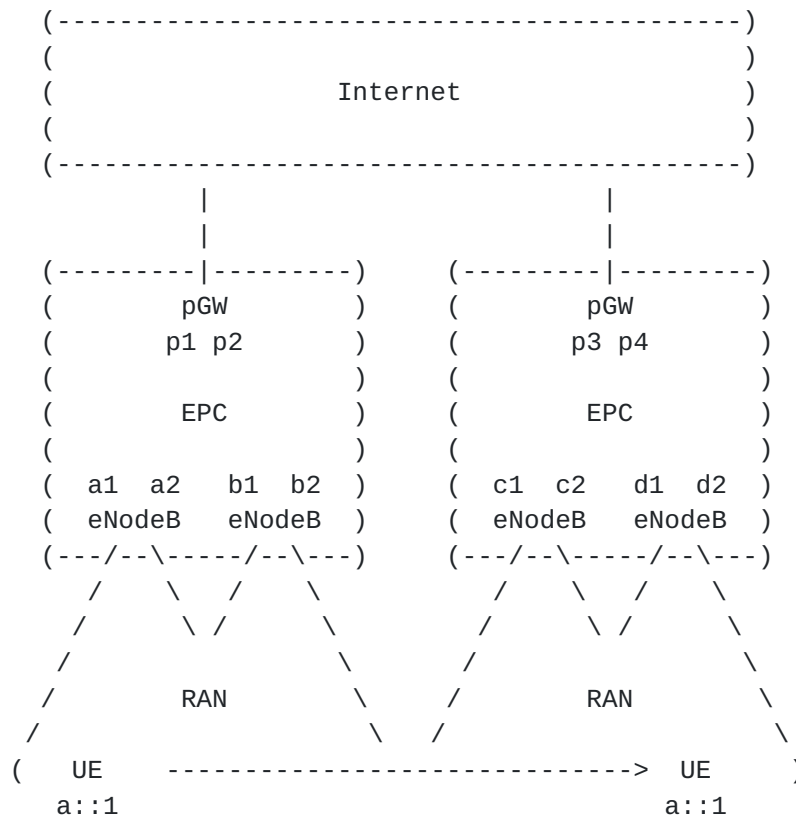
                    UE EID Mobility

The contents of the LISP mapping database before UE moves:

```
EID-Record  RLOC-Record        Commentary
0::/0       [p1,p2,p3,p4]      eNodeB [a1,a2] encaps to p1-p4 for Internet
                               destinations when a::1 on eNodeB [a1,a2]


a::1/128    [a1,a2]            Before UE moves to other pGW region
```

The contents of the LISP mapping database after UE moves:

```
EID-Record  RLOC-Record        Commentary
0::/0       [p1,p2,p3,p4]      eNodeB [d1,d2] encaps to p1-p4 for Internet
                               destinations when a::1 moves to eNodeB [d1,d2]


a::1/128    [d1,d2]            After UE moves to new pGW region
```

4. Addressing and Routing

   UE based EID addresses will be IPv6 addresses. It will be determined
   at a future time what length the IPv6 prefix will be to cover all UEs
   in a mobile network. This coarse IPv6 prefix is called an EID-prefix
   where more-specific EID-prefixes will be allocated out of it for each
   pGW node. Each pGW node is responsible for advertising the more-
   specific EID-prefix into the Internet routing system so they can
   attract packets from non-EIDs nodes to UE EIDs.

   An RLOC address will either be an IPv4 or IPv6 address depending on
   the support for single or dual-stack address-family in the EPC
   network. An RLOC-set in the mapping system can have a mixed address-
   family locator set. There is no requirement for the EPC to change to
   support one address-family or the other. And there is no requirement
   for the EPC network to support IPv4 multicast or IPv6 multicast. The
   LISP overlay will support both.

   The only requirement for RLOC addresses is that they are routable in
   the EPC and the Internet core network.

   The requirements of the LISP and GTP data-plane overlay is to support
   a layer-3 overlay network only. There is no architectural
   requirement to support layer-2 overlays. However, operators may want
   to provide a layer-2 LAN service over their mobile network. Details
   about how LISP supports layer-2 overlays can be found in
   [I-D.ietf-lisp-eid-mobility].

5. eNodeB LISP Functionality

   The eNodeB node runs as a LISP xTR for control-plane functionality
   and runs GTP for data-plane functionality. Optionally, the LISP
   data-plane can be used to establish dynamic tunnels from one eNodeB
   node to another eNodeB node.

   The eNodeB LISP xTR will follow the procedures of
   [I-D.ietf-lisp-eid-mobility] to discover UE based EIDs, track them by
   monitoring liveness, registering them when appear, and deregistering
   them when they move away. Since the eNodeB node is an xTR, it is
   acting as a layer-3 router and the GTP tunnel from the eNodeB node to
   the pGW node is realizing a layer-3 overlay. This will provide
   scaling benefits since broadcast and link-local multicast packets
   won't have to travel across the EPC to the pGW node.

   A day in the life of a UE originated packet:

   1. The UE node originates an IP packet over the RAN.

2. The eNodeB receives the packet, extracts the source address from
    the packet, learns the UE based EID, stores its RAN location
    locally and registers the EID to the mapping system.

3. The eNodeB extracts the destination address, looks up the address
    in the mapping system. The lookup returns the RLOC of a pGW node
    if the destination is not an EID or an RLOC eNodeB node if the
    destination is a UE based EID.

4. The eNodeB node encapsulates the packet to the RLOC using GTP or
    optionally the LISP data-plane.

It is important to note that in [I-D.ietf-lisp-eid-mobility], EID
discovery occurs when a LISP xTR receives an IP or ARP/ND packet.
However, if there are other methods to discover the EID of a device,
like in UE call setup, the learning and registration referenced in
Paragraph 2 can happen before any packet is sent.

6. pGW LISP Functionality

The pGW node runs as a LISP xTR for control-plane functionality and
runs GTP for data-plane functionality. Optionally, the LISP data-
plane can be used to establish dynamic tunnels from one pGW node to
another pGW or eNodeB node.

The pGW LISP xTR does not follow the EID mobility procedures of
[I-D.ietf-lisp-eid-mobility] since it is not responsible for
discovering UE based EIDs. A pGW LISP xTR simply follows the
procedures of a PxTR in [RFC6830] and for interworking to non-EID
sites in [RFC6832].

A day in the life of a pGW received packet:

1. The pGW node receives a IP packet from the Internet core.

2. The pGW node extracts the destination address from the packet and
    looks it up in the LISP mapping system. The lookup returns an
    RLOC of a eNodeB node. Optionally, the RLOC could be another pGW
    node.

3. The pGW node encapsulates the packet to the RLOC using GTP or
    optionally the LISP data-plane.

7. Compatible Data-Plane using GTP

Since GTP is a UDP based encapsulating tunnel protocol, it has the
same benefits as LISP encapsulation. At this time, there appears to

be no urgent need to not continue to use GTP for tunnels between a
eNodeB nodes and between a eNodeB node and a pGW node.

There are differences between GTP tunneling and LISP tunneling. GTP
tunnels are setup at call initiation time. LISP tunnels are
dynamically encapsulating, used on demand, and don't need setup or
teardown. The two tunneling mechanisms are a hard state versus soft
state tradeoff.

This specification recommends for early phases of deployment, to use
GTP as the data-plane so a transition for it to use the LISP control-
plane can be achieved more easily. At later phases, the LISP data-
plane may be considered so a more dynamic way of using tunnels can be
achieved to support URLLC.

This specification recommends the use of procedures from
[I-D.ietf-lisp-eid-mobility] and NOT the use of LISP-MN
[I-D.ietf-lisp-mn]. Using LISP-MN states that a LISP xTR reside on
the mobile UE. This is to be avoided so extra encapsulation header
overhead is NOT sent on the RAN. The LISP data-plane or control-
plane will not run on the UE.

8. Roaming and Packet Loss

Using LISP for the data-plane has some advantages in terms of
providing near-zero packet loss. In the current mobile network,
packets are queued on the eNodeB node the UE is roaming to or
rerouted on the eNodeB node the UE has left. In the LISP
architecture, packets can be sent to multiple "roamed-from" and
"roamed-to" nodes while the UE is moving or is off the RAN. See
mechanisms in [I-D.ietf-lisp-predictive-rlocs] for details.

9. Mobile Network LISP Mapping System

The LISP mapping system stores and maintains EID-to-RLOC mappings.
There are two mapping database transport systems that are available
for scale, LISP-ALT [RFC6836] and LISP-DDT [RFC8111]. The mapping
system will store EIDs assigned to UE nodes and the associated RLOCs
assigned to eNodeB nodes and pGW nodes. The RLOC addresses are
routable addresses by the EPC network.

This specification recommends the use of LISP-DDT.

10. Multicast Considerations

Since the mobile network runs the LISP control-plane, and the mapping
system is available to support EIDs for unicast packet flow, it can

also support multicast packet flow. Support for multicast can be
provided by the LISP/GTP overlay with no changes to the EPC network.

Multicast (S-EID,G) entries can be stored and maintained in the same
mapping database that is used to store UE based EIDs. Both Internet
connected nodes, as well as UE nodes, can source multicast packets.
The protocol procedures from [I-D.ietf-lisp-signal-free-multicast]
are followed to make multicast delivery available. Both multicast
packet flow and UE mobility can occur at the same time.

A day in the life of a 1-to-many multicast packet:

1. A UE node joins an (S,G) multicast flow by using IGMPv2 or
    IGMPv3.

2. The eNodeB node records which UE on the RAN should get packets
    sourced by S and destined for group G.

3. The eNodeB node registers the (S,G) entry to the mapping system
    with its RLOC according to the receiver site procedures in
    [I-D.ietf-lisp-signal-free-multicast]. The eNodeB does this to
    show interest in joining the multicast flow.

4. When other UE nodes join the same (S,G), their associated eNodeB
    nodes will follow the procedures in steps 1 through 3.

5. The (S,G) entry stored in the mapping database has an RLOC-set
    which contains a replication list of all the eNodeB RLOCs that
    registered.

6. A multicast packet from source S to destination group G arrives
    at the pGW. The pGW node looks up (S,G), gets returned the
    replication list of all joined eNodeB nodes and replicates the
    multicast packet by encapsulating the packet to each of them.

7. Each eNodeB node decapsulates the packet and delivers the
    multicast packet to one or more IGMP-joined UEs on the RAN.

11. Security Considerations

For control-plane authentication and authorization procedures, this
specification recommends the mechanisms in
[I-D.ietf-lisp-rfc6833bis], LISP-SEC [I-D.ietf-lisp-sec] AND LISP-
ECDSA [I-D.farinacci-lisp-ecdsa-auth].

For data-plane privacy procedures, this specification recommends the
mechanisms in [RFC8061] When the LISP data-plane is used. otherwise,
the EPC must provide data-plane encryption support.

12. IANA Considerations

   There are no specific requests for IANA.

13. SDO Recommendations

   The authors request other Standards Development Organizations to
   consider LISP as a technology for device mobility. It is recommended
   to start with this specification as a basis for design and develop
   more deployment details in the appropriate Standards Organizations.
   The authors are willing to facilitate this activity.

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Appendix B. Document Change Log

B.1. Changes to draft-farinacci-lisp-mobile-network-01.txt

   o Posted September 2017.

   o Explain each EID case illustrated in the "Mobile Network with EID/
      RLOC Assignment" diagram.

   o Make a reference to mMTC as a 3GPP use-case for 5G.

   o Add to the requirements section how mobile operators believe that
      using Locator/ID separation mechanisms provide for more efficient
      mobile netwowks.

   o Indicate that L2-overlays is not recommended by this specification
      as the LISP mobile network architeture but how operators may want
      to deploy a layer-2 overlay service.

B.2. Changes to draft-farinacci-lisp-mobile-network-00.txt

   o Initial draft posted August 2017.

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