Distributed Mobility Anchoring
draft-ietf-dmm-distributed-mobility-anchoring-13

Abstract

   This document defines distributed mobility anchoring in terms of the
   different configurations and functions to provide IP mobility
   support. A network may be configured with distributed mobility
   anchoring functions for both network-based or host-based mobility
   support according to the needs of mobility support. In a distributed
   mobility anchoring environment, multiple anchors are available for
   mid-session switching of an IP prefix anchor. To start a new flow or
   to handle a flow not requiring IP session continuity as a mobile node
   moves to a new network, the flow can be started or re-started using
   an IP address configured from the new IP prefix anchored to the new
   network. If the flow needs to survive the change of network, there
   are solutions that can be used to enable IP address mobility. This
   document describes different anchoring approaches, depending on the
   IP mobility needs, and how this IP address mobility is handled by the
   network.

   This Internet-Draft will expire on September 27, 2019.

Table of Contents

1. Introduction

   A key requirement in distributed mobility management [RFC7333] is to
   enable traffic to avoid traversing a single mobility anchor far from
   an optimal route. This document defines different configurations,
   functional operations and parameters for distributed mobility
   anchoring and explains how to use them to avoid unnecessarily long
   routes when a mobile node moves.

Companion distributed mobility management documents are already
addressing the architecture and deployment
[I-D.ietf-dmm-deployment-models], source address selection
[I-D.ietf-dmm-ondemand-mobility], and control-plane data-plane
signaling [I-D.ietf-dmm-fpc-cpdp]. A number of distributed mobility
solutions have also been proposed, for example, in
[I-D.seite-dmm-dma], [I-D.ietf-dmm-pmipv6-dlif],
[I-D.sarikaya-dmm-for-wifi], [I-D.yhkim-dmm-enhanced-anchoring], and
[I-D.matsushima-stateless-uplane-vepc].

Distributed mobility anchoring employs multiple anchors in the data
plane. In general, control plane functions may be separated from
data plane functions and be centralized but may also be co-located
with the data plane functions at the distributed anchors. Different
configurations of distributed mobility anchoring are described in
Section 3.1.

As a Mobile Node (MN) attaches to an access router and establishes a
link between them, a /64 IPv6 prefix anchored to the router may be
assigned to the link for exclusive use by the MN [RFC6459]. The MN
may then configure a global IPv6 address from this prefix and use it
as the source IP address in a flow to communicate with its
correspondent node (CN). When there are multiple mobility anchors
assigned to the same MN, an address selection for a given flow is
first required before the flow is initiated. Using an anchor in a
MN's network of attachment has the advantage that the packets can
simply be forwarded according to the forwarding table. However,
after the flow has been initiated, the MN may later move to another
network which assigns a new mobility anchor to the MN. Since the new
anchor is located in a different network, the MN's assigned prefix
does not belong to the network where the MN is currently attached.

When the MN wants to continue using its assigned prefix to complete
ongoing data sessions after it has moved to a new network, the
network needs to provide support for the MN's IP address -- and
session continuity, since routing packets to the MN through the new
network deviates from applying default routes. The IP session
continuity needs of a flow (application) determines how the IP
address used by this flow has to be anchored. If the ongoing IP flow
can cope with an IP prefix/address change, the flow can be
reinitiated with a new IP address anchored in the new network. On
the other hand, if the ongoing IP flow cannot cope with such change,
mobility support is needed. A network supporting a mix of flows both
requiring and not requiring IP mobility support will need to
distinguish these flows.

2. **Conventions and Terminology**

   All general mobility-related terms and their acronyms used in this
   document are to be interpreted as defined in the Mobile IPv6 (MIPv6)
   base specification [RFC6275], the Proxy Mobile IPv6 (PMIPv6)
   specification [RFC5213], the "Mobility Related Terminologies"
   [RFC3753], and the DMM current practices and gap analysis [RFC7429].
   These include terms such as mobile node (MN), correspondent node
   (CN), home agent (HA), home address (HoA), care-of-address (CoA),
   local mobility anchor (LMA), and mobile access gateway (MAG).

   In addition, this document uses the following terms:

   Home network of a home address: the network that has assigned the
      HoA used as the session identifier by the application running in
      an MN. The MN may be running multiple application sessions, and
      each of these sessions can have a different home network.

   Anchoring (of an IP prefix/address): An IP prefix, i.e., Home
      Network Prefix (HNP), or address, i.e., HoA, assigned for use by
      an MN is topologically anchored to an anchor node when the anchor
      node is able to advertise a connected route into the routing
      infrastructure for the assigned IP prefix. The traffic using the
      assigned IP address/prefix must traverse the anchor node. We can
      refer to the function performed by IP anchor node as anchoring,
      which is a data plane function.

   Location Management (LM) function: control plane function that keeps
      and manages the network location information of an MN. The
      location information may be a binding of the advertised IP
      address/prefix, e.g., HoA or HNP, to the IP routing address of the
      MN or of a node that can forward packets destined to the MN.

      When the MN is a mobile router (MR), the location information will
      also include the mobile network prefix (MNP), which is the
      aggregate IP prefix delegated to the MR to assign IP prefixes for
      use by the mobile network nodes (MNNs) in the mobile network.

      In a client-server protocol model, location query and update
      messages may be exchanged between a Location Management client
      (LMc) and a Location Management server (LMs), where the location
      information can be updated to or queried from the LMc.
      Optionally, there may be a Location Management proxy (LMp) between
      LMc and LMs.

With separation of control plane and data plane, the LM function
is in the control plane. It may be a logical function at the
control plane node, control plane anchor, or mobility controller.

It may be distributed or centralized.

Forwarding Management (FM) function: packet interception and
forwarding to/from the IP address/prefix assigned for use by the
MN, based on the internetwork location information, either to the
destination or to some other network element that knows how to
forward the packets to their destination.

This function may be used to achieve traffic indirection. With
separation of control plane and data plane, the FM function may
split into a FM function in the data plane (FM-DP) and a FM
function in the control plane (FM-CP).

FM-DP may be distributed with distributed mobility management. It
may be a function in a data plane anchor or data plane node.

FM-CP may be distributed or centralized. It may be a function in
a control plane node, control plane anchor or mobility controller.

3. Distributed Mobility Anchoring

3.1. Configurations for Different Networks

We next describe some configurations with multiple distributed
anchors. To cover the widest possible spectrum of scenarios, we
consider architectures in which the control and data planes are
separated, as described in [I-D.ietf-dmm-deployment-models].

3.1.1. Network-based DMM

Figure 1 shows a general scenario for network-based distributed
mobility management.

The main characteristics of a network-based DMM solution are:

o There are multiple data plane anchors, each with a FM-DP function.
o The control plane may either be distributed (not shown in the
   figure) or centralized (as shown in the figure).
o The control plane and the data plane (Control Plane Anchor -- CPA
   -- and Data Plane Anchor -- DPA) may be co-located or not. If the

CPA is co-located with the distributed DPAs, then there are
multiple co-located CPA-DPA instances (not shown in the figure).

o An IP prefix/address IP1 (anchored to the DPA with IP address
   IPa1) is assigned for use to a MN. The MN uses this IP1 address
   to communicate with CNs (not shown in the figure).

o The location management (LM) function may be co-located or split
   (as shown in the figure) into a separate server (LMs) and a client
   (LMc). In this case, the LMs may be centralized whereas the LMc
   may be distributed or centralized.

```
                   _____  Network
             ___/            _____
            /       +-----+             \___
           (        |LMs  |    Control       \
          /         +-.---+    plane          \
         /   +--------.---+    functions        \
        (    |CPA:    .  |    in the             )
        (    |FM-CP, LMc  |    network            )
        (    +------------+                        \
       /          . .                               \
      (           .    .                             )
      (           .        .                          )
      (           .            .                       \
       \    +------------+ +------------+Distributed  )
        (   |DPA(IPa1):  | |DPA(IPa2):  |DPAs         )
        (   |anchors IP1 | |anchors IP2 |           _/
         \  |FM-DP       | |FM-DP       | etc.     /
          \ +------------+ +------------+         /
           \___                Data plane  _____/
              _____          functions  /
                    _____/


        +------------+
        |MN(IP1)     | Mobile node attached
        |flow(IP1,..)| to the network
        +------------+
```
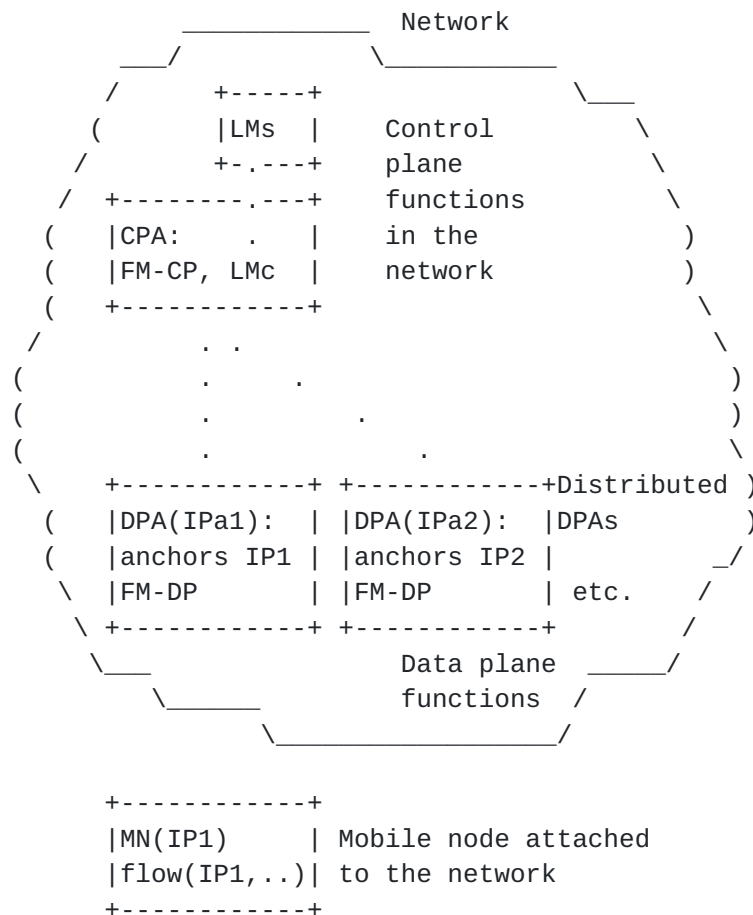
                Figure 1: Network-based DMM configuration

3.1.2. Client-based DMM

Figure 2 shows a general scenario for client-based distributed
mobility management. In this configuration, the mobile node performs
Control Plane Node (CPN) and Data Plane Node (DPN) mobility
functions, namely the forwarding management and location management
(client) roles.

```
          +-----+
          |LMs  |
          +-.---+
  +--------.---+
  |CPA:    .   |
  |FM-CP, LMp  |
  +-----------+
       . .
        .     .
         .       .
          .        .
  +-----------+ +------------+ Distributed
  |DPA(IPa1): | |DPA(IPa2):  | DPAs
  |anchors IP1| |anchors IP2 |
  |FM-DP      | |FM-DP       |  etc.
  +-----------+ +------------+

  +------------+
  |MN(IP1)     |Mobile node
  |flow(IP1,..)|using IP1
  |FM,    LMc  |anchored to
  +------------+DPA(IPa1)
```
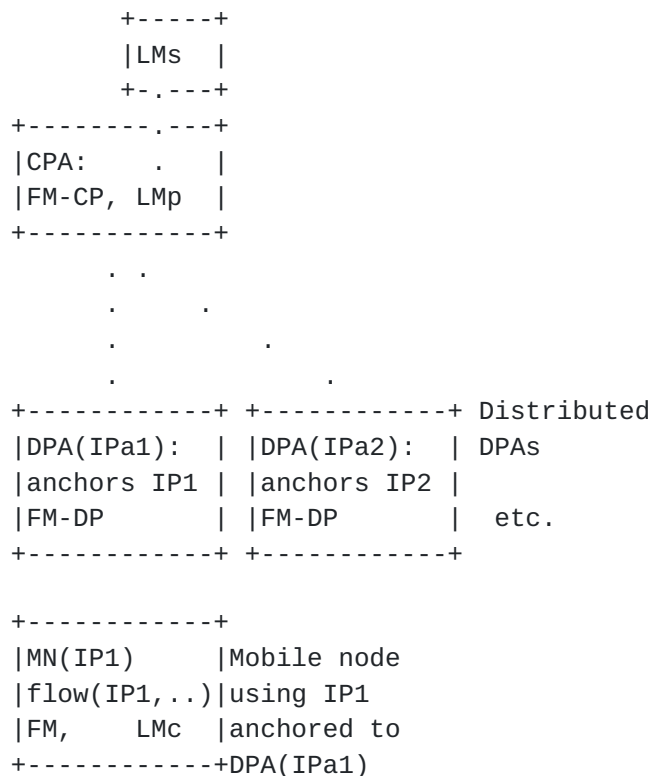
             Figure 2: Client-based DMM configuration

4. **IP Mobility Handling in Distributed Anchoring Environments -
    Mobility Support Only When Needed**

   IP mobility support may be provided only when needed instead of being
   provided by default. Three cases can be considered:

   o Nomadic case: no address continuity is required. The IP address
      used by the MN changes after a movement and traffic using the old
      address is disrupted. If session continuity is required, then it
      needs to be provided by a solution running at L4 or above.

   o Mobility case, traffic redirection: address continuity is
      required. When the MN moves, the previous anchor still anchors
      the traffic using the old IP address, and forwards it to the new
      MN's location. The MN obtains a new IP address anchored to the
      new location, and preferably uses it for new communications,
      established while connected at the new location.

   o Mobility case, anchor relocation: address continuity is required.
      In this case the route followed by the traffic is optimized, by
      using some means for traffic indirection to deviate from default
      routes.

   A straightforward choice of mobility anchoring is the following: the
   MN's chooses as source IP address for packets belonging to an IP

flow, an address allocated by the network the MN is attached to when the flow was initiated. As such, traffic belonging to this flow traverses the MN's mobility anchor [I-D.seite-dmm-dma] [I-D.ietf-dmm-pmipv6-dlif].

The IP prefix/address at the MN's side of a flow may be anchored to the access router to which the MN is attached. For example, when a MN attaches to a network (Net1) or moves to a new network (Net2), an IP prefix from the attached network is assigned to the MN's interface. In addition to configuring new link-local addresses, the MN configures from this prefix an IP address which is typically a dynamic IP address. It then uses this IP address when a flow is initiated. Packets from this flow addressed to the MN are simply forwarded according to the forwarding table.

There may be multiple IP prefixes/addresses that an MN can select when initiating a flow. They may be from the same access network or different access networks. The network may advertise these prefixes with cost options [I-D.mccann-dmm-prefixcost] so that the mobile node may choose the one with the least cost. In addition, these IP prefixes/addresses may be of different types regarding whether mobility support is needed [I-D.ietf-dmm-ondemand-mobility]. A MN will need to choose which IP prefix/address to use for each flow according to whether it needs IP mobility support or not.

4.1. Nomadic case (no need of IP mobility): Changing to new IP prefix/ address

When IP mobility support is not needed for a flow, the LM and FM functions are not utilized so that the configurations in Section 3.1 are simplified as shown in Figure 3.

```
   Net1                                            Net2

   +---------------+                               +---------------+
   |AR1           |          AR is changed         |AR2           |
   +---------------+            ------->            +---------------+
   |CPA:          |                                |CPA:          |
   |--------------|                                |--------------|
   |DPA(IPa1):     |                                |DPA(IPa2):     |
   |anchors IP1   |                                |anchors IP2   |
   +---------------+                               +---------------+


   +..............+                               +---------------+
   .MN(IP1)       .          MN moves             |MN(IP2)       |
   .flow(IP1,...) .          =======>             |flow(IP2,...)  |
   +..............+                               +---------------+
```
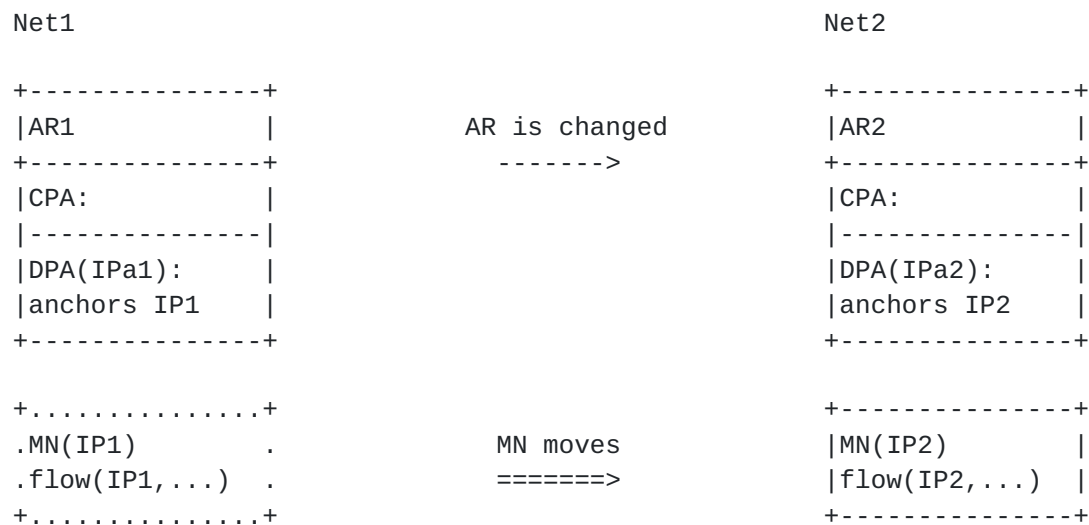
                 Figure 3: Changing to a new IP address/prefix

   When there is no need to provide IP mobility to a flow, the flow may
   use a new IP address acquired from a new network as the MN moves to
   the new network.

   Regardless of whether IP mobility is needed, if the flow has not
   terminated before the MN moves to a new network, the flow may
   subsequently restart using the new IP address assigned from the new
   network.

   When IP session continuity is needed, even if a flow is ongoing as
   the MN moves, it may still be desirable for the flow to change to
   using the new IP prefix configured in the new network. The flow may
   then close and then restart using a new IP address configured in the
   new network. Such a change in the IP address of the flow may be
   enabled using a higher layer mobility support which is not in the
   scope of this document.

   In Figure 3, a flow initiated while the MN was using the IP prefix
   IP1 -- anchored to a previous access router AR1 in network Net1 --
   has terminated before the MN moves to a new network Net2. After
   moving to Net2, the MN uses the new IP prefix IP2 -- anchored to a
   new access router AR2 in network Net2 -- to start a new flow.
   Packets may then be forwarded without requiring IP layer mobility
   support.

   An example call flow is outlined in Figure 4. A MN attaches to AR1,
   which sends a router advertisement (RA) including information about
   the prefix assigned to MN, from which MN configures an IP address
   (IP1). This address is used for new communications, for example with
   a correspondent node (CN). If the MN moves to a new network and

attaches to AR2, the process is repeated (MN obtains a new IP
address, IP2, from AR2). Since the IP address (IP1) configured at
the previously visited network is not valid at the current attachment
point, and any existing flows have to be reestablished using IP2.

```
 MN                        AR1                AR2                       CN
  |MN attaches to AR1:  |                  |                           |
  |acquires MN-ID and profile             |                           |
  |--RS---------------->|                  |                           |
  |                     |                  |                           |
  |<----------RA(IP1)---|                  |                           |
  |                     |                  |                           |
Assigned prefix IP1     |                  |                           |
IP1 address configuration                 |                           |
  |                     |                  |                           |
  |<-Flow(IP1,IPcn,...)-+--------------------------------------------->|
  |                     |                  |                           |
  |MN detaches from AR1 |                  |                           |
  |MN attaches to AR2   |                  |                           |
  |                     |                  |                           |
  |--RS------------------------------->|                              |
  |                     |                  |                           |
  |<-------------RA(IP2)-------------|                                 |
  |                     |                  |                           |
Assigned prefix IP2     |                  |                           |
IP2 address configuration                 |                           |
  |                     |                  |                           |
  |<-new Flow(IP2,IPcn,...)-----------+--------------------------->|
  |                     |                  |                           |
```
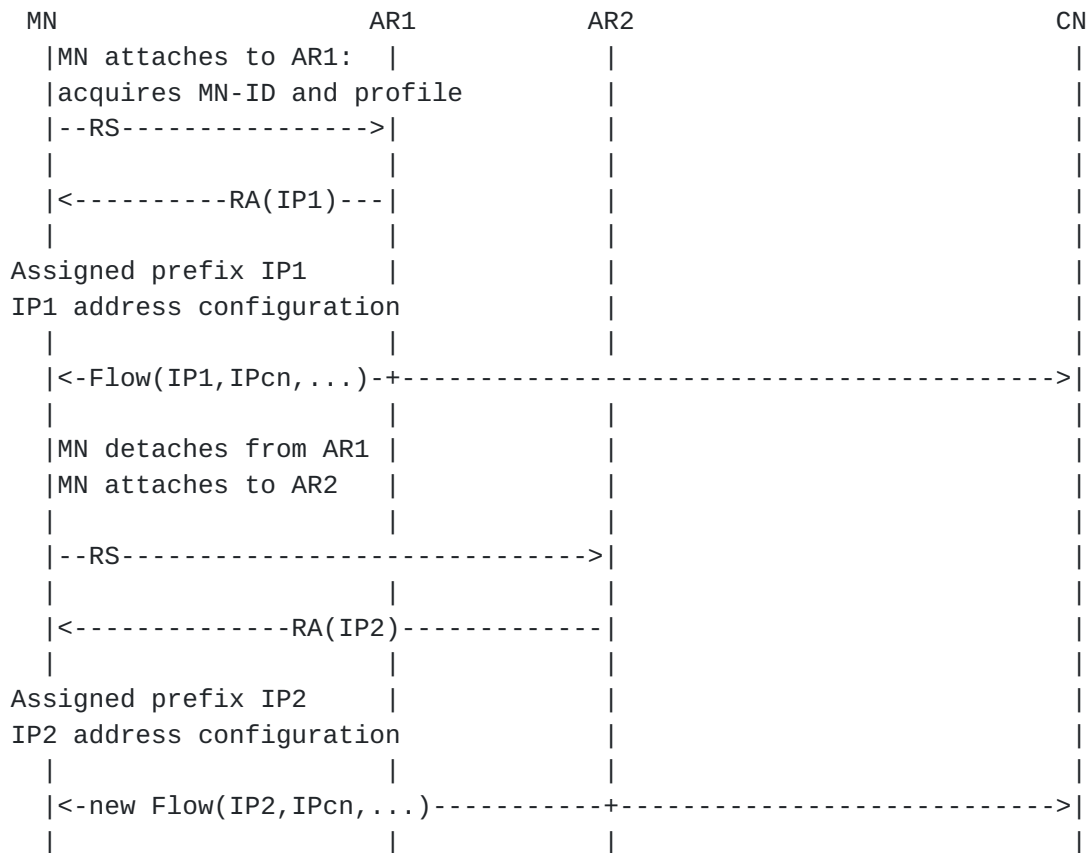
        Figure 4: Re-starting a flow with new IP prefix/address

4.2. Mobility case, traffic redirection

   When IP mobility is needed for a flow, the LM and FM functions in
   Section 3.1 are utilized. There are two possible cases: (i) the
   initial anchor remains the anchor and forwards traffic to a new
   locator in the new network, and (ii) the mobility anchor (data plane
   function) is changed but binds the MN's transferred IP address/
   prefix. The latter enables optimized routes but requires some data
   plane node that enforces rules for traffic indirection. Next, we
   focus on the first case. The second one is addressed in Section 4.3.

   Mobility support can be provided by using mobility management
   methods, such as the several approaches surveyed in the academic
   papers ([Paper-Distributed.Mobility],
   [Paper-Distributed.Mobility.PMIP] and
   [Paper-Distributed.Mobility.Review]). After moving, a certain MN's

traffic flow may continue using the IP prefix from the prior network
of attachment. Yet, some time later, the application generating this
traffic flow may be closed. If the application is started again, the
new flow may not need to use the prior network's IP address to avoid
having to invoke IP mobility support. This may be the case where a
dynamic IP prefix/address, rather than a permanent one, is used.
Packets belonging to this flow may then use the new IP prefix (the
one allocated in the network where the flow is being initiated).
Routing is again kept simpler without employing IP mobility and will
remain so as long as the MN which is now in the new network does not
move again to another network.

```
   MN                      AR1              AR2                      CN
    |MN attaches to AR1:   |                |                        |
    |acquires MN-ID and profile             |                        |
    |--RS---------------->|                |                        |
    |                     |                |                        |
    |<----------RA(IP1)---|                |                        |
    |                     |                |                        |
  Assigned prefix IP1     |                |                        |
  IP1 address configuration               |                        |
    |                     |                |                        |
    |<-Flow(IP1,IPcn,...)-+------------------------------------------>|
    |                     |                |                        |
    |MN detaches from AR1 |                |                        |
    |MN attaches to AR2   |                |                        |
    |                     |                |                        |
    |--RS------------------------------->|                        |
    | (some IP mobility support solution)                         |
    |<-------------RA(IP2,IP1)---------|                        |
    |                     |                |                        |
    |                      +<-Flow(IP1,IPcn,...)---------------------->|
    |                      +<===========>+                        |
    |<-Flow(IP1,IPcn,...)-------------->+                        |
    |                     |                |                        |
  Assigned prefix IP2     |                |                        |
  IP2 address configuration              |                        |
    |                     |                |                        |
  Flow(IP1,IPcn) terminates               |                        |
    |                     |                |                        |
    |<-new Flow(IP2,IPcn,...)-----------+---------------------------->|
    |                     |                |                        |
```
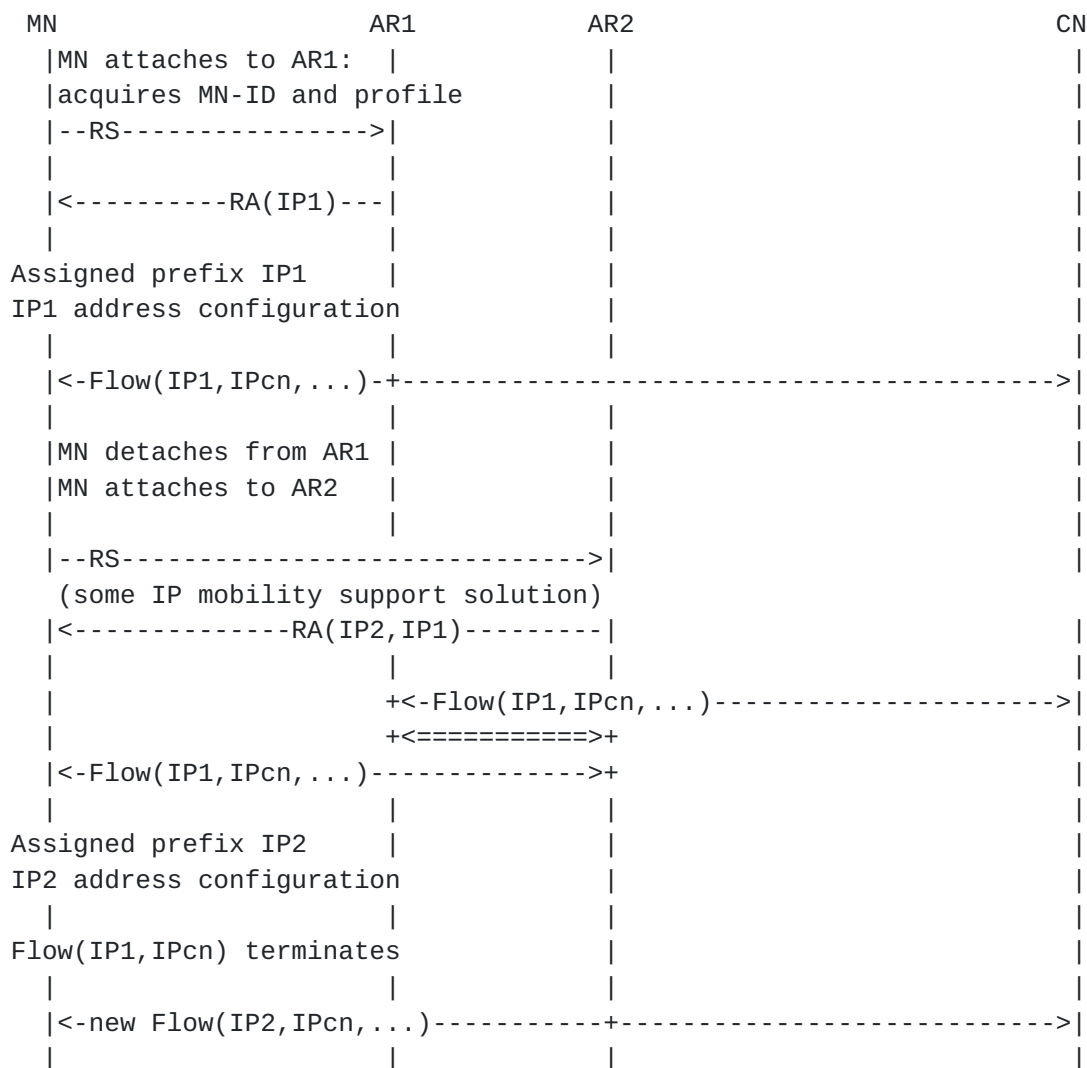
        Figure 5: A flow continues to use the IP prefix from its home network
                    after MN has moved to a new network

An example call flow in this case is outlined in Figure 5. In this
example, the AR1 plays the role of FM-DP entity and redirects the

traffic (e.g., using an IP tunnel) to AR2. Another solution could be
to place an FM-DP entity closer to the CN network to perform traffic
steering to deviate from default routes (which will bring the packet
to AR1 per default routing). The LM and FM functions are implemented
as shown in Figure 6.

```
Net1                                               Net2


+---------------+                                  +---------------+
|AR1            |                                  |AR2            |
+---------------+                                  +---------------+
|CPA:           |                                  |CPA:           |
|               |                                  |LM:IP1 at IPa1 |
|---------------|      IP1 (anchored to Net1)      |---------------|
|DPA(IPa1):     |      is redirected to Net2        |DPA(IPa2):     |
|anchors IP1    |            ======>                |anchors IP2    |
+---------------+                                  +---------------+


+..............+                                  +---------------+
.MN(IP1)       .              MN moves             |MN(IP2,IP1)    |
.flow(IP1,...) .              ======>              |flow(IP1,...)  |
.              .                                  |flow(IP2,...)  |
+..............+                                  +---------------+
```
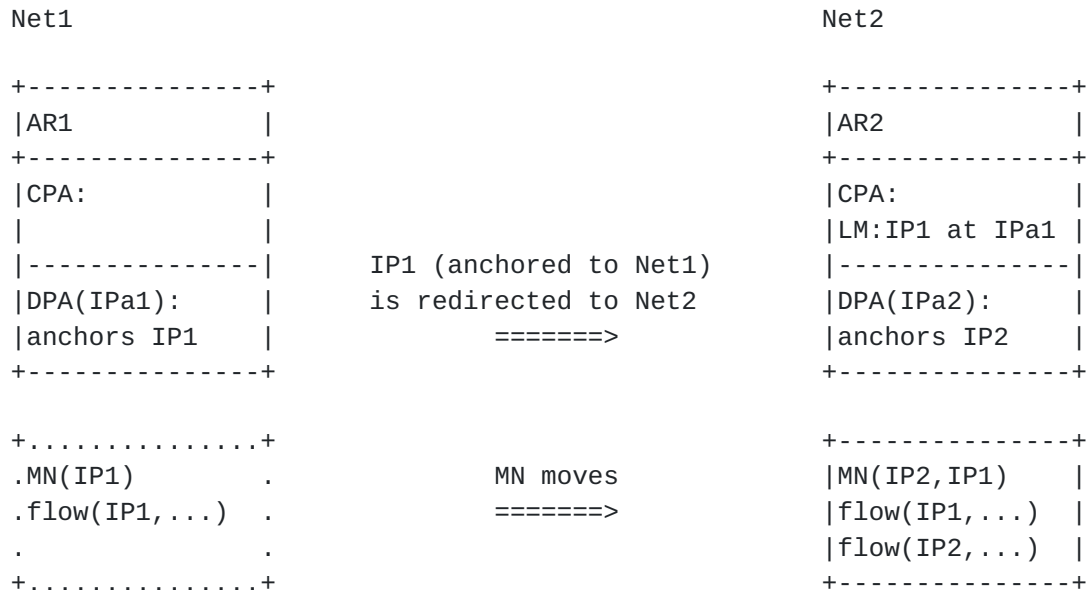
                   Figure 6: Anchor redirection

Multiple instances of DPAs (at access routers), which are providing
IP prefixes to the MNs, are needed to provide distributed mobility
anchoring in an appropriate configuration such as those described in
Figure 1 (Section 3.1.1) for network-based distributed mobility or in
Figure 2 (Section 3.1.2) for client-based distributed mobility.

4.3. Mobility case, anchor relocation

We focus next on the case where the mobility anchor (data plane
function) is changed but binds the MN's transferred IP address/
prefix. This enables optimized routes but requires some data plane
node that enforces rules for traffic indirection.

IP mobility is invoked to enable IP session continuity for an ongoing
flow as the MN moves to a new network. Here the anchoring of the IP
address of the flow is in the home network of the flow (i.e.,
different from the current network of attachment). A centralized
mobility management mechanism may employ indirection from the anchor
in the home network to the current network of attachment. Yet it may
be difficult to avoid using an unnecessarily long route (when the
route between the MN and the CN via the anchor in the home network is
significantly longer than the direct route between them). An

alternative is to move the IP prefix/address anchoring to the new
network.

The IP prefix/address anchoring may move without changing the IP
prefix/address of the flow. Here the LM and FM functions in Figure 1
in Section 3.1 are implemented as shown in Figure 7.

```
Net1                                              Net2


+---------------+                                +---------------+
|AR1            |                                |AR2            |
+---------------+                                +---------------+
|CPA:           |                                |CPA:           |
|LM:IP1 at IPa1 |                                |LM:IP1 at IPa2 |
|   changes to  |                                |               |
|   IP1 at IPa2 |                                |               |
|---------------|                                |---------------|
|DPA(IPa1):     | IP1 anchoring effectively moved|DPA(IPa2):     |
|anchored IP1   |            ======>             |anchors IP2,IP1|
+---------------+                                +---------------+


+..............+                                +---------------+
.MN(IP1)       .            MN moves            |MN(IP2,IP1)    |
.flow(IP1,...) .            ======>             |flow(IP1,...)  |
+..............+                                +---------------+
```
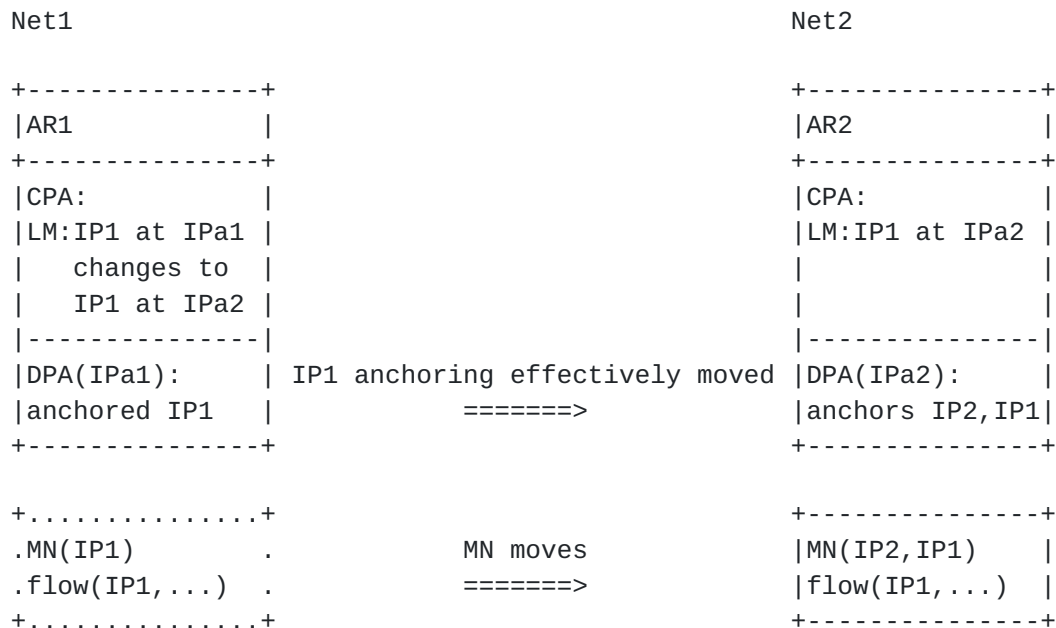
                       Figure 7: Anchor mobility

As an MN with an ongoing session moves to a new network, the flow may
preserve IP session continuity by moving the anchoring of the
original IP prefix/address of the flow to the new network.

One way to accomplish such a move is to use a centralized routing
protocol, but such a solution may present some scalability concerns
and its applicability is typically limited to small networks. One
example of this type of solution is described in
[I-D.ietf-rtgwg-atn-bgp]. When a mobile associates with an anchor
the anchor injects the mobile's prefix into the global routing
system. If the mobile moves to a new anchor, the old anchor
withdraws the /64 and the new anchor injects it instead.

5. Security Considerations

Security protocols and mechanisms are employed to secure the network
and to make continuous security improvements, and a DMM solution is
required to support them [RFC7333].

In a DMM deployment [I-D.ietf-dmm-deployment-models] various attacks such as impersonation, denial of service, man-in-the-middle attacks need to be prevented.

6. IANA Considerations

This document presents no IANA considerations.

7. Contributors

Alexandre Petrescu and Fred Templin had contributed to earlier versions of this document regarding distributed anchoring for hierarchical network and for network mobility, although these extensions were removed to keep the document within reasonable length.

This document has benefited from other work on mobility support in SDN network, on providing mobility support only when needed, and on mobility support in enterprise network. These works have been referenced. While some of these authors have taken the work to jointly write this document, others have contributed at least indirectly by writing these drafts. The latter include Philippe Bertin, Dapeng Liu, Satoru Matushima, Pierrick Seite, Jouni Korhonen, and Sri Gundavelli.

Valuable comments have been received from John Kaippallimalil, ChunShan Xiong, Dapeng Liu and Fred Templin. Dirk von Hugo, Byju Pularikkal, Pierrick Seite have generously provided careful review with helpful corrections and suggestions. Marco Liebsch and Lyle Bertz also performed very detailed and helpful reviews of this document.

8. References

8.1. Normative References

[RFC3753]   Manner, J., Ed. and M. Kojo, Ed., "Mobility Related
            Terminology", RFC 3753, DOI 10.17487/RFC3753, June 2004,
            <https://www.rfc-editor.org/info/rfc3753>.

[RFC5213]   Gundavelli, S., Ed., Leung, K., Devarapalli, V.,
            Chowdhury, K., and B. Patil, "Proxy Mobile IPv6",
            RFC 5213, DOI 10.17487/RFC5213, August 2008,
            <https://www.rfc-editor.org/info/rfc5213>.

[RFC6275]   Perkins, C., Ed., Johnson, D., and J. Arkko, "Mobility
            Support in IPv6", RFC 6275, DOI 10.17487/RFC6275, July
            2011, <https://www.rfc-editor.org/info/rfc6275>.

   [RFC7333] Chan, H., Ed., Liu, D., Seite, P., Yokota, H., and J.
              Korhonen, "Requirements for Distributed Mobility
              Management", RFC 7333, DOI 10.17487/RFC7333, August 2014,
              <https://www.rfc-editor.org/info/rfc7333>.

   [RFC7429] Liu, D., Ed., Zuniga, JC., Ed., Seite, P., Chan, H., and
              CJ. Bernardos, "Distributed Mobility Management: Current
              Practices and Gap Analysis", RFC 7429,
              DOI 10.17487/RFC7429, January 2015,
              <https://www.rfc-editor.org/info/rfc7429>.

8.2. Informative References

   [I-D.ietf-dmm-deployment-models]
              Gundavelli, S. and S. Jeon, "DMM Deployment Models and
              Architectural Considerations", draft-ietf-dmm-deployment-
              models-04 (work in progress), May 2018.

   [I-D.ietf-dmm-fpc-cpdp]
              Matsushima, S., Bertz, L., Liebsch, M., Gundavelli, S.,
              Moses, D., and C. Perkins, "Protocol for Forwarding Policy
              Configuration (FPC) in DMM", draft-ietf-dmm-fpc-cpdp-12
              (work in progress), June 2018.

   [I-D.ietf-dmm-ondemand-mobility]
              Yegin, A., Moses, D., and S. Jeon, "On Demand Mobility
              Management", draft-ietf-dmm-ondemand-mobility-17 (work in
              progress), February 2019.

   [I-D.ietf-dmm-pmipv6-dlif]
              Bernardos, C., Oliva, A., Giust, F., Zuniga, J., and A.
              Mourad, "Proxy Mobile IPv6 extensions for Distributed
              Mobility Management", draft-ietf-dmm-pmipv6-dlif-04 (work
              in progress), January 2019.

   [I-D.ietf-rtgwg-atn-bgp]
              Templin, F., Saccone, G., Dawra, G., Lindem, A., and V.
              Moreno, "A Simple BGP-based Mobile Routing System for the
              Aeronautical Telecommunications Network", draft-ietf-
              rtgwg-atn-bgp-01 (work in progress), January 2019.

   [I-D.matsushima-stateless-uplane-vepc]
              Matsushima, S. and R. Wakikawa, "Stateless user-plane
              architecture for virtualized EPC (vEPC)", draft-
              matsushima-stateless-uplane-vepc-06 (work in progress),
              March 2016.

    [I-D.mccann-dmm-prefixcost]
              McCann, P. and J. Kaippallimalil, "Communicating Prefix
              Cost to Mobile Nodes", draft-mccann-dmm-prefixcost-03
              (work in progress), April 2016.

    [I-D.sarikaya-dmm-for-wifi]
              Sarikaya, B. and L. Li, "Distributed Mobility Management
              Protocol for WiFi Users in Fixed Network", draft-sarikaya-
              dmm-for-wifi-05 (work in progress), October 2017.

    [I-D.seite-dmm-dma]
              Seite, P., Bertin, P., and J. Lee, "Distributed Mobility
              Anchoring", draft-seite-dmm-dma-07 (work in progress),
              February 2014.

    [I-D.yhkim-dmm-enhanced-anchoring]
              Kim, Y. and S. Jeon, "Enhanced Mobility Anchoring in
              Distributed Mobility Management", draft-yhkim-dmm-
              enhanced-anchoring-05 (work in progress), July 2016.

    [Paper-Distributed.Mobility]
              Lee, J., Bonnin, J., Seite, P., and H. Chan, "Distributed
              IP Mobility Management from the Perspective of the IETF:
              Motivations, Requirements, Approaches, Comparison, and
              Challenges", IEEE Wireless Communications, October 2013.

    [Paper-Distributed.Mobility.PMIP]
              Chan, H., "Proxy Mobile IP with Distributed Mobility
              Anchors", Proceedings of GlobeCom Workshop on Seamless
              Wireless Mobility, December 2010.

    [Paper-Distributed.Mobility.Review]
              Chan, H., Yokota, H., Xie, J., Seite, P., and D. Liu,
              "Distributed and Dynamic Mobility Management in Mobile
              Internet: Current Approaches and Issues", February 2011.

    [RFC6459] Korhonen, J., Ed., Soininen, J., Patil, B., Savolainen,
              T., Bajko, G., and K. Iisakkila, "IPv6 in 3rd Generation
              Partnership Project (3GPP) Evolved Packet System (EPS)",
              RFC 6459, DOI 10.17487/RFC6459, January 2012,
              <https://www.rfc-editor.org/info/rfc6459>.

Authors' Addresses

H. Anthony Chan (editor)
Huawei Technologies
5340 Legacy Dr. Building 3
Plano, TX 75024
USA

Email: h.a.chan@ieee.org

Xinpeng Wei
Huawei Technologies
Xin-Xi Rd. No. 3, Haidian District
Beijing, 100095
P. R. China

Email: weixinpeng@huawei.com

Jong-Hyouk Lee
Sangmyung University
31, Sangmyeongdae-gil, Dongnam-gu
Cheonan 31066
Republic of Korea

Email: jonghyouk@smu.ac.kr

Seil Jeon
Sungkyunkwan University
2066 Seobu-ro, Jangan-gu
Suwon, Gyeonggi-do
Republic of Korea

Email: seiljeon@skku.edu

Carlos J. Bernardos (editor)
Universidad Carlos III de Madrid
Av. Universidad, 30
Leganes, Madrid 28911
Spain

Phone: +34 91624 6236
Email: cjbc@it.uc3m.es
URI: http://www.it.uc3m.es/cjbc/