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Distributed mobility management deployment scenario and architecture
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Status of this Memo

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Abstract

This document discusses the deployment scenario of distributed mobility management. The purpose of this document is to trigger the discussion in the group to understnad the DMM deployment scenario and consideration from the operator's perspective.

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1. Introduction

Distributed mobility management aims at solving the centralized mobility anchor problems of the traditional mobility management protocol. The benefit of DMM solution is that the data plane traffic does not need to traverse the centralized anchoring point. This document discusses the potential deployment scenario of DMM. The purpose of this document is to help the group to reach consensus

regarding the deployment model of DMM and then develop the DMM solution based on the deployment model.

2. Conventions used in this document

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 [RFC2119].

2.1. Terminology

All the general mobility-related terms and their acronyms used in this document are to be interpreted as defined in the Mobile IPv6 base specification [RFC6275], in the Proxy mobile IPv6 specification [RFC5213], and in Mobility Related Terminology [RFC3753]. These terms include the following: mobile node (MN), correspondent node (CN), and home agent (HA) as per [RFC6275]; local mobility anchor (LMA) and mobile access gateway (MAG) as per [RFC5213], and context as per [RFC3753].

In addition, this draft introduces the following terms.

Location information (LI) function

is the logical function that manages and keeps track of the internet work location information of a mobile node which may change its IP address as it moves. The information may associate with each session identifier, the IP routing address of the MN, or of a node that can forward packets destined to the MN.

Forwarding management (FM)

is the logical function that intercepts packets to/from the IP address/prefix delegated to a mobile node and forwards them, based on internetwork location information, either directly towards their destination or to some other network element that knows how to forward the packets to their ultimate destination. With data plane and control plane separation, the forwarding management may be separated into a data-plane forwarding management (FM-DP) function and a control-plane forwarding management (FM-CP) function.

3. Deployment Scenario and Model of DMM

As discussed in the DMM requirement document, the centralized mobility management has several drawbacks. The main problem of the centralized mobility management protocols is that all the traffic need to anchor to a centralized anchor point. This approach does not

cause any problem in current mobile network deployment but in the scenario that will be discussed later in this document, centralized mobility management protocols will have many drawbacks and it is believed that DMM is more suitable in that scenario.

The main deployment scenario discussed in this document is divided into three scenarios. The first one is the network function virtualization scenario. In this scenario, the mobile core network's control plane function is centralized in the mobile cloud. Apparently, deploying the data plane function also in the same centralized mobile cloud is not optimized from the traffic forwarding's perspective. For the control plane The MME and PGW-F are implemented by NFV. For the dataplane the PGW-F/SGW-F can weither be implemented by NFV or lagacy devices. The second deployment scenario is the SIPTO/LIPA scenario which is discussed in 3GPP. In this scenario, DMM can provide optimized traffic offloading solution. The Third deploy scenario is the WLAN scenario. In this scenario, the AC is implemented in the cloud and the authentication status can maintained as the terminal move from one AP to another.

4. Network Function Virtualization Scenario

This section discusses network function virtualization scenario, the associated control - data plane separation and the possible mobility management functions to support this scenario.

4.1. Network function virtualization deployment architecture

The network function virtualization scenario is shown in Figure 1.

```
                    Mobile Cloud
             ...........
                  ('            ')
                (                )))
               (((  +-----------+ )))
              ((    |Mobile Core|    )))
              ((    |MME+P/SGW-C|    )))
              (((   +-----------+   )))
                 ('.............')
                                  |
                          | IP Transit Network
                      (.........)
                    (           )) MN-Internet communication
                   (           ^ ))
            ^ > > >(           ^  ))> > > > > > > > >
            ^       ((         ^  )                 v
            ^        (.........^.)                  v
            ^ +-------|     |  ^|                   v
            ^ |             |  ^+--------------+    v
            ^ |             |  < <             |    v  MN-MN communication
            ^ |             |    ^             |    v
      +--------------+    +--------------+    +--------------+
      |Access Network|    |Access Network|    |Access Network|
      |  PGW-F/SGW-F  |   |  PGW-F/SGW-F  |   |  PGW-F/SGW-F  |
      +--------------+    +--------------+    +--------------+
            ^                    ^                  v
            ^                    ^                  v
        +---------+         +---------+         +---------+
        |   MN     |        |    MN   |          |   MN     |
        +---------+         +---------+         +---------+
```

Figure 1: Network function virtualization deployment architecture

In this architecture, the mobile core include MME and PGW-F is located in the cloud data center, which can be the operator's private cloud using NFV. The access network cantains PGW-F/SGW-F is connected through an IP transit network. The PGW-F/SGW-F may also implement by NFV of small data center in convergence layer. The architecture of NFV based Mobile Core is shown in Figure 2.

```
   ---------------------------------     -------------------
   | ---------------------------- |     |   MANO LAYER      |
   | |        OSS/BSS LAYER     | |     |                   |
   | ---------------------------- |     |   -------------   |
   |               |              |     |   |Orchestrator|  |
   | ---------------------------- |     |   -------------   |
   | |      VNF LAYER           | |     |         |         |
   | | ---------       ------   | |     |   -------------   |
   | | |P/SGW-C|      |  MME |  | |-----|  |    VNFM    |   |
   | | ---------         ------   |     |   -------------   |
   | ---------------------------- |     |        |          |
   |               |              |     |        |          |
   | ---------------------------- |     |   -------------   |
   | |      NFVI LAYER          | |-----|  |     VIM     | |
   | ---------------------------- |     |   -------------   |
   ---------------------------------     -------------------
       Figure 2: NFV based Mobile Core Architecture
```

In Figure 2, the MANO layer contains Orchestrator, VNFM and VIM. The Orchestrator is in charge of top-down service and source monitor and fulfillment. VNFM is incharge of manage the VNFs. And VIM normally is the Openstack which provide management of the whole virtualization layer.

4.2. Control and data plane separation

The cloud based mobile core network architecture implies separation of the control and data planes. The control plane is located in the cloud and the data plane should be distributed. Otherwise, all the data traffic will go through the cloud which is obviously not optimized for the mobile node to mobile node communication. For the mobile node to Internet communication, the Internet access point is normally located in the metro IP transit network. In this case, the mobile node to Internet traffic should also go through the Internet access point instead of the mobile core in the cloud.

However, in some deployment scenario, the operator may choose to put the mobile core cloud in the convergence layer of IP metro network. In this case, the Internet access point may co-located with the mobile core cloud. In this case, the mobile node to Internet traffic may go through the mobile core cloud.

4.3. Mobility management architecture

Since the control plane and data plane are separated and the data plane is distributed, traditional mobility management cannot meet this requirement. Distributed mobility management or SDN based mobility management may be used in this architecture to meet the traffic forwarding requirement (e.g. MN to MN and MN to Internet traffic should not go through from the mobile core cloud.). The traditional mobility management functions is not separating the data plane from the control plane. Basic mobility management functions include location information (LI) function and Forwarding management (FM). The former is a control plane function. The latter can be separated into data plane forwarding management (FM-DP) and control plane forwarding management (FM-CP).

The data plane function is FM-DP, while the control plane functions include FM-CP and LI. Then the control plane functions in the cloud-based mobile core includes LI and FM-CP. They are of cause other functions in the control plane such as policy function. The

distributed data plane may have multiple instances of FM-DP in the network.

```
                core network controller

                     +---------+
                     |LI, FM-CP|
                     +---------+

     +-------+        +-------+        +-------+
     | FM-DP |        | FM-DP |        | FM-DP |
     +-------+        +-------+        +-------+
```

Figure 2: Mobility management functions with data plane - control plane separation under one controller When the control of the access network is separate from that of the core, there will be separate controllers as shown in Figure 3.

```
 Access network controller               Core network controller

          +---------+                             +---------+
          |LI, FM-CP|                             |LI, FM-CP|
          +---------+                             +---------+

   +-------+       +-------+               +-------+       +-------+
   | FM-DP |       | FM-DP |               | FM-DP |       | FM-DP |
   +-------+       +-------+               +-------+       +-------+
```

Figure 2: Mobility management functions with data plane - control plane separation with separate control in core and in access networks.

4.4. NFV based deployment architecture

Here is the deployment architecture in NFV.

```
             -------------             ------------
            | Yang Model  |           | Tosca Model|
             -------------             ------------
-------------------------------------------------------------------------
| [VNFO]              --------------------------------------------------- |
|  ------------      |  --------------------   ------------------------ ||
| |    NBI     |     | |  ----- ----- ----- | | ---------------------- |||
|  ------------      | |  |NSD| |FGD| |VLD| | ||VNFD(LI,FM-CP)(FD-DP) ||||
|                    | |  ----- ----- ----- | | ---------------------- |||
|  ------------      |  --------------------   ------------------------ ||
| | API Router|      |                  DataBase                        ||
|  ------------       ---------------------------------------------------|
|                                                                        |
|  ------------                                                          |
| |Core Engine|                                                          |
|  ------------                                                          |
-------------------------------------------------------------------------
      ------------      ------------     ------------
     |VNFM Driver|     |VIM Driver|     |PNF Driver|
      ------------      ------------     ------------
 ----------------------------------------------     -----------------
|   [VNFM]                                     |    |[PNF]          |
|   VNF Life cycle management;                 |    |   ------------ |
|   VNF configuration;                         |    |   |   OVS    | |
|   VNF update;                                |    |   ------------ |
|   VNF status monitor;                        |     -----------------
|   VNF Auto healing/Scale in/Scale out        |
 ----------------------------------------------
-----------------------------------------------------------------
|                           Vim                                 |
-----------------------------------------------------------------
   --------------------------------------------------
   |[VNF]  LI Slicing ; FM-CP Slicing; FD-DP Slicing |
   --------------------------------------------------
```

Figure 3 Deployment architecture

5. SIPTO deployment scenario

The Second deployment scenario is the SIPTO scenario which is discussed in 3GPP. DMM is believed to be able to provide dynamic anchoring. It allows the mobile node to have several anchoring points and to change the anchoring point according to the application requirement. In SIPTO scenario, the gateway function is located very near to the access network and to the user. If using current centralized mobility management, the traffic will need to tunnel back to the previous anchor point even when the mobile node has changed the point of attachment to a new one. Figure 3 shows the architecture of SIPTO.

```
                         +---------+
                         |   GGSN  |
                         +---------+
                             |
                             |
           ------------------------------------------
           |                 |             |         |
       +---------+    +---------+    +---------+   +---------+
       |   MSC   |    |   SGSN  |    |   MSC   |   |   SGSN   |
       +---------+    +---------+    +---------+   +---------+
           |             |    |         |    |          |
             ------------      ----------       ---------
                  |            |                  |
         <<<<<<<<<|     <<<<<<<|                  |>>>>>>>>>
                +---------+    +---------+     +---------+
                |   GGSN  |    |   GGSN   |    |   GGSN   |
                |    RNC  |    |    RNC   |    |    RNC   |
                +---------+    +---------+     +---------+
                   ^|                 |^            ^|
                   ^|                 |^            ^|
             ---------------          |^            ^|
            ^|             |^         |^            ^|
       +---------+     +---------+    +---------+   +---------+
       |  NodeB  |     |  NodeB  |    |  NodeB  |   |  NodeB  |
       +---------+     +---------+    +---------+   +---------+
           ^|             ^|                            ^|
       +---------+        +---------+              +---------+
       | Terminal|   ->   | Terminal|    -> ->     | Terminal|
       +---------+        +---------+              +---------
+
```

Figure 4 SIPTO Scenario

6. WLAN deployment scenario

The Third deployment scenario is the WLAN scenario. DMM can enable the AC in the cloud. The cloud AC and maintain the authentication and connection status. As the terminal move from one AP to another, it still can have the connection.

```
                    ...........
                  ('             ')
               (((  +-----------+ )))
              ((    |  Mobile AC |   )))
              (((   +-----------+   )))
                 ('.............')
                          |
```

```
                          | IP Transit Network
                      (.........)
                    (           ))
                   (            ))
                   (             ))
                   ((           )
                    (..........)
            +-----------------------------------+
            |                |                      |
            |                |                      |
            |                |                      |
      +----------+        +-----------+        +----------+
      |     AP     |        |     AP     |        |     AP     |
      +----------+        +-----------+        +----------+
         |                             |             |
      +---------+        +---------+            +---------+
      | Terminal|   ->   | Terminal|    ->     | Terminal|
      +---------+         +---------+           +---------+
                Figure 5 WLAN deployment scenario
```

7. Conclusion

This document discusses the deployment scenario of DMM. Three types of deployment scenario is discussed in this document. Further types of deployment scenario can be added to this document according to the progress of the group's discussion.

8. Security Considerations

N/A

9. IANA Considerations

N/A

10. Normative References

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12. Acknowledgments

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