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Anchor-less Mobility Management Solution
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Abstract

This memo discusses an anchor-less mobility management solution based on ID/Locator split scheme, especially for VM handoff scenario in MEC network.

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1 Introduction

With the development of network technology, there are more and more services sensitive to network latency, for example, interactive VR, tactile Internet, remote control, automatic drive etc. Also low latency has become an important requirement in 5G network design. For service with low latency requirements, the network needs to meet its end-to-end latency requirements.

The MEC (Multi-access Edge Computing) sinks computing and storage capacity to the edge of the network. The MEC server is deployed at the edge of the network and applications could be deployed in the MEC server. This allows the MN to access the required services in close proximity without having to traverse through the core network, thereby reducing the end-to-end RTT, and satisfying latency requirements. One of the basic MEC deployment scenarios is shown in Figure 1:

```
+--+           +---+       +---+     +----------+
|MN|-----------|UP1|       |UP3|-----|MEC Server|
+--+           +---+       +---+     +----------+

               +---+       +---+     +----------+
               |UP2|       |UP4|-----|MEC Server|
               +---+       +---+     +----------+
```

Figure 1: MEC Deployment Architecture

In order to meet the low latency requirements of network services, an alternative approach is to deploy services with low latency requirements in the MEC system. The MEC architecture is an effective means of addressing low latency requirements by deploying the application in an MEC server close to the terminal equipment.

Application instance runs in a MEC server, and the service connection

is established between application runs on MN and application instance runs on MEC server. When the MN moves in the MEC server's coverage area, in order to ensure continuity of the service, the connectivity between MN application and mobile edge application needs to be maintained. As MN moves further away from the location of the mobile edge application, there could be an increased latency between the MN and the mobile edge application. Due to this reason or others (e.g. network congestion), for some mobile edge applications, it might become necessary to relocate the application instance, i.e. relocating the application instance to a new MEC server near to MN's current location, in order to satisfy the latency requirements, when the application instance is relocated the service continuity need to

be maintained. [GS_MEC003]

For instance, when the MN runs interactive VR (Virtual Reality) service, in order to guarantee the high bandwidth and low latency requirement of the VR's service, the MEC server is used to provide service for the MN, that is, the MEC server starts a VM (Virtual Machine) running the VR service for MN, when the MN moves far away from the original MEC server, if the nearest MEC server is available, the VM will be migrated to the new MEC server, and ensuring continuity of VR service. The case where the VM relocation follows MN's mobility is also referred as VM handoff [Ha2015].

This memo analyzes the mobility scenario of the correspondent node following the MN to avoid the redundancy of the route redundancy, and a mobility management solution based on the ID/Locator split scheme is provided.

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 Mobility Management Gap Analysis

In the DMM, the on-demand mobility scheme [ODMM] is proposed, in which the network provides IP session continuity and IP address reachability based on application requirements. If the application requires both session continuity and IP address reachability, the

application chooses to use a fixed IP address; if the application needs IP session continuity but does not need IP address reachability, then the application will use Session-lasting IP Address; if the application neither need IP session continuity nor IP address reachability, then non-persistent IP Address will be used.

On-demand mobility scheme separate applications need IP session continuity from applications don't need IP session continuity , and then the network provides applications with different types of session continuity support based on this separation: for a application that does not require session continuity support, session continuity is not provided, and a new IP address is allowed to be used when the MN moves, in this way the routing redundancy problem could be avoided; for an application that needs session continuity support from the network, the network side sustains the IP address used by the MN during the movement of the MN, so that the IP address used by the application is not changed, however, this approach provides session continuity while also introduces routing redundancy for application traffic. The on-demand approach does not address the

mobility requirements in the VM handoff scenario described earlier.

The fundamental cause for the route redundancy is the dual attributes of the IP address: the network location attribute and the session identification attribute. The two communication sides use IP addresses to identify the session, so in order to maintain session continuity the IP addresses need keep the same, but because IP address also determines network location, when the IP address keeps the same the service traffic flows back to the IP address's IP anchor, which leads to routing redundancy problem.

3 Mobility Solution Based on ID/Locater Split

ID/Locator separation scheme separate ID attribute from Locator attribute in one IP address, it can be a good choice to solve the routing redundancy problem caused by mobility.

In this memo, the architecture of network-based mobility management solution based on the concept of ID/Locator split is discussed which is also align with DMM working group's existing CP-UP separation architecture. Figure 2 illustrates an overview of the mobility solution architecture.

```
                      +-------------+
                      |Control Plane|
                      +-|-|---|----|+
                        | |   |    |
                        | |   |    |              _MEC server
                     +--+ |   |    |           ,''   `-.
                     |    |   |    |         /'
    +--+           +-|-+  |   |   +|--+     .'  +--+     |
    |MN|-----------|UP1|  |   |   |UP3|---------|VM|     |
    +--+           +---+  |   |   +---+        +--+    /
     |              LOC1  |   |  LOC3         `.  |   ,'
     |               +----+   +----+            ` |--'
     V               |             |              V__
    +--+           +-|-+          +|--+        ,''   `-.
    |MN|-----------|UP2|          |UP4|---------+--+
    +--+           +---+          +---+     .'  |VM|     |
                    LOC2         LOC4       |   +--+     |
                                                       /
                                              `.      ,'
                                                ``___'
                                                   MEC server
```

Figure2: Mobile Management Architecture Based on ID/Locator Separation

UP1 to UP4 are data plane functions. They are responsible for the

management of Locator, packet encapsulation and decapsulation, packet forwarding, signaling interaction with Control Plane (for example, ID/Locator relationship update).

The Control Plane is responsible for maintaining the mapping of ID/Locator and configuring the ID/Locator to the corresponding UP to control UP's processing of the packet.

In order not to modify the existing mobile terminal, the two sides of communication in the scheme still use the 5-tuple to identify the session. It is assumed that the IP addresses used by the MN and CN in the communication are IP-mn and IP-cn respectively. During communication, IP-mn and IP-cn only act as IDs, which are used to identify sessions, but are not used as locators. UP1 to UP4 is responsible for allocating Locator for MN and CN.

When the MN is located at UP1, a communication connection is established with MN's correspondent node VM , at which time the VM accesses UP3. The packet between MN and the VM is transmitted through the tunnel established between UP1 and UP3, where the outer header of the tunnel uses the locator assigned by UP1 and UP3.

```
                      +-------------+
                      |Control Plane|
                      +-|----------|+
                        |          |
                        |          |              _MEC server
                     +--+          |           ,''   `-.
    IP-mn            |             |         /'  IP-vm
    +--+           +-|-+          +|--+     .'  +--+     |
    |MN|-----------|UP1|##########|UP3|---------|VM|     |
    +--+           +---+          +---+        +--+    /
                    LOC1         LOC3         `.      ,'
                                               ` ___'
```

Figure3: Communication Connection before Movement Occurs

When the MN moves to UP2, the communication between the MN and the VM adopts the make-before-break mode. The MN communicates with the VM instance located at the UP3 position until the VM instance completely relocated to the UP4 position. During this period, packets are transmitted through tunnels between UP2 and UP3. The outer header of the tunnel uses the locators assigned by UP2 and UP3.


```
                       +-------------+
                       |Control Plane|
                       +-|-|--------|+
                         | |        |
                         | |        |              _MEC server
                      +--+ |        |           ,''   `-.
    IP-mn             |    |        |         /'  IP-vm
     +--+           +-|-+  |       +|--+     .'  +--+     |
```

```
     |MN|-----------|UP1|  |   ####|UP3|---------|VM|     |
     +--+           +---+  |   #   +---+        +--+    /
      |              LOC1  |   #  LOC3         `.      ,'
      |               +-----+  #                 ` ---'
      V               |        #
     +--+           +-|-+      #
     |MN|-----------|UP2|#######
     +--+           +---+
    IP-mn            LOC2
```

Figure4: Communication Connection during Movement

When the VM instance has been relocated to UP4 position, the MN will communicate with the VM instance at the UP4 position. That is, the communication path will be switched from UP2 to UP3. In this case, it is necessary to set up a temporary path between UP3 and UP4 and forward previous in-transit packets from UP3 to UP4, the temporary path will be released after all the packets has been forwarded to UP4.


```
                       +-------------+
```

```
                       |Control Plane|
                       +-|-|---|----|+
                         | |   |    |
                         | |   |    |
                      +--+ |   |    |
                      |    |   |    |
                    +-|-+  |   |   +|--+
                    |UP1|  |   |   |UP3|
                    +---+  |   |   +--$+
                     LOC1  |   | LOC3 $
                      +-----+ +-----+ $
    IP-mn             |             | $            V__
     +--+           +-|-+          +|-$+        ,''   `-.
     |MN|-----------|UP2|##########|UP4|---------+--+
     +--+           +---+          +---+     .'  |VM|     |
                     LOC2          LOC4      |   +--+     |
                                                IP-vm   /
                                               `.      ,'
                                                 ``___'
                                                    MEC server
```

Figure5: Communication Connection after Movement

NOTE: The interaction signaling between Control Plane and User Plane is TBD.

4 Relations with Existing DMM Solutions

TBD.

5 Security Considerations

TBD.

6 IANA Considerations

TBD.

7 References

7.1 Normative References

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[ODMM]

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