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             MN Status Option for Proxy Mobile IPv6
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Abstract

   IP flow mobility enables the ability of movement of selected flows
   from one access technology to another. This document extends the
   Proxy Mobile IPv6 signaling to convey mobile node's status
   information that can be used by the network to decide when and how
   perform flow mobility. It also defines options allowing the network
   getting information about different mobile node capabilities, which
   might be considered to decide how to tackle the node's mobility.

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1. Introduction

   There are several use cases where it would be useful that the local
   mobility anchor (LMA) can decide to perform flow mobility from one
   access network to another, e.g., from 3GPP to WLAN or from WLAN to
   WiMAX. With current Proxy Mobile IPv6 specification [RFC5213], the
   LMA can only know the different access technologies the mobile node
   (MN) is attached to (this information is conveyed from the mobile
   access gateway to the local mobility anchor in the Access Technology
   Type option). No accurate information about the mobile node status
   (e.g., if it is in idle/power saving mode or experiencing low radio
   quality) is available at the LMA to aid it in the decision of when
   and how to perform flow mobility. It is therefore helpful to provide
   the LMA with additional information from the MN, so the LMA can
   trigger flow mobility actions with a lower risk of failure/data loss.
   This can be done by including mobile node status information in the
   signaling between the mobile access gateway and the local mobility
   anchor, and by enabling the mobile access gateway to update that
   information as needed.

   It is also useful to support the mobile access gateway to convey
   information to the local mobility anchor about specific capabilities
   of attached mobile nodes. These capabilities may include, for
   example, the support of a logical interface (to hide from the IP
   stack the existence of multiple physical interfaces, which may be
   simultaneously attached to different MAGs), the availability of a
   dual IPv4/IPv6 stack at the mobile node, etc.

   This document defines two new mobility options, the MN Capability
   Status option and the MN Connectivity Status option for Proxy Mobile
   IPv6 (PMIPv6), that can be used by the mobile access gateway (MAG)
   for carrying information to the local mobility anchor about the MN
   status with the correspondent access network and its capabilities.

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].

3. New MN status and capabilities options for PMIPv6

3.1. Overview

   In some Proxy Mobile IPv6 deployments, a mobile network (e.g., the
   one defined by the 3GPP) needs to support multiple access

technologies, and the local mobility anchor can be triggered to decide which access technology will be used to move a particular IP flow according to the operator preferences and local policy. To guarantee the success of the flow mobility procedure from one access technology to another, a critical piece of information to help the LMA is the current mobile node status at the different access networks it might be attached to.

The mobile access gateway is the right PMIPv6 network entity to detect the mobile node status using, in addition to the mechanisms defined in RFC5213 [RFC5213], any access network specific mechanism that is available to detect the connectivity status of the attached mobile node.

The MAG can provide the mobile node status information to the LMA as part of the signaling exchange between MAG and LMA. Namely, the MAG can periodically, or triggered by a particular event, update the MN status to the LMA. How the LMA use this information is outside the scope of this document.

3.2. Use case scenarios

The approach specified in this document provides additional benefits to some use cases involving flow mobility among multiple access technologies. These use case scenarios are illustrated next:
(a) The user is simultaneously attached and accessing some services from both WLAN and 3GPP networks, and for some time the network link connecting to the WLAN access network is going to be released for some purposes, such as scheduled maintenance. Triggered by that event, there are two choices the LMA can take to reallocate these IP flows, either to switch the affected flows to the 3GPP access, or to switch the flows to another WLAN access (if available). Without updated information about the status of the MN, the LMA can trigger an erroneous flow mobility decision (leading to a long delay and/or data losses), for example if a flow is moved to an network interface that is currently in idle state or perceiving a low signal quality.
(b) At residential areas, during night there are more people using WLAN, and less people using a cellular access, hence for the VoIP service it might be better to switch some users to the cellular access. On the other hand, during the day, there are less people on WLAN and more people using cellular, so it might be better to use the WLAN to offload the cellular network. The LMA can move flows according to policies, but without accurate knowledge of the MN status the flow handoff may suffer from delays, data loss or other performance problems.

      (c) The user is accessing some services from both WLAN and cellular,
           and an FTP IP flow is initiated which may cause the bandwidth
           resources to be insufficient. The LMA may consider changing the
           flows for VoIP service from the WLAN to the 3GPP access
           according to the operator polices and other factors (e.g., user
           preferences). If the LMA only has information about which
           networks the MN is connected, but not the real status/quality of
           each of them, it might be that the LMA incorrectly decides to
           move a flow (e.g., if the 3GPP radio link connecting between MN
           and MAG is poor) resulting in then long delay or data loss.

3.3. Solution

3.3.1. MAG considerations

   The MAG can retrieve the Mobile Node status from some other network
   elements, such as the Mobility Management Entity (MME) in 3GPP, the
   Paging controller in WiMAX, or the Access Point in WLAN. The MAG may
   periodically, or triggered by a specific event, update this
   information to the LMA, so that this information can be used as one
   of the factors to make the decision of flow mobility by the LMA. In
   particular, the MAG can also retrieve the radio quality of the MAG-MN
   link from other network elements (e.g., the eNB in 3GPP), and a
   threshold can be configured locally or downloaded (e.g., from the
   network management system) as the operator policies. As soon as the
   radio quality of the MAG-MN link drops below this threshold, the MAG
   updates this event to the LMA as a part of Mobile Node status
   information, which helps the LMA making the best decision of
   performing flow mobility.

   In addition, some Mobile Node capabilities information, such as
   logical interface support or dual-stack availability, can also be
   carried from the MAG to the LMA, helping to make a flow mobility
   decision. How the MAG obtains this capabilities information is out
   of scope of this document.

3.3.2. LMA considerations

   The LMA receives the mobile node status information from the MAG, and
   makes the decision of flow mobility for a specific IP flow according
   to the operator policies and other factors (e.g., user preferences
   and MN status). How the LMA uses this information is outside the
   scope of this document.

   We consider next the use case (a) of Section 3.2 as an example. If
   the WLAN infrastructure is scheduled for maintenance, the LMA can
   check the operator policies with other factors to decide which is the
   best candidate access network to move the flows that were using the

WLAN. One example of possible prioritized list could be the
following:
1. 3GPP access with MN status set to "connected".
2. Another available WLAN access infrastructure.
3. 3GPP access with MN status set to "idle".

In this case, if the MN status is "idle" in the 3GPP access network,
the LMA will hand off the mobile node to another WLAN access without
trying to wake up the mobile node and re-establish the link
connecting the MN and the MAG.

Another example is the following, in which the priority of each
access network is set in a different way:
1. 3GPP access with MN status set to "connected".
2. 3GPP access with MN status set to "idle".
3. Another available WLAN access infrastructure.

In this case, the LMA will first try to wake up the mobile node in
the 3GPP access and re-establish the link connecting the MN and the
MAG. If this procedure can be done successfully, the LMA will not
attempt to hand off the mobile node to another WLAN access, but it
will initiate the flow mobility to the 3GPP access.

3.4. Mobile Node Status and Capabilities Options

   This section defines extensions to the Proxy Mobile IPv6 [RFC5213]
   Protocol messages.

3.4.1. Mobile Node Capability Status Option

   A new option, called Mobile Node Capability Status Option, is defined
   to be included in the PMIPv6 signaling (e.g., PBU and PBA messages)
   exchanged between a local mobility anchor and a mobile access
   gateway. This option is used for conveying the mobile node's
   features support capability information. Its format is the
   following:

```
    0                   1                   2                   3
    0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   | MN-Ca-St Type |MN-Ca-St Lngth |        Reserved       |L|D|M|
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
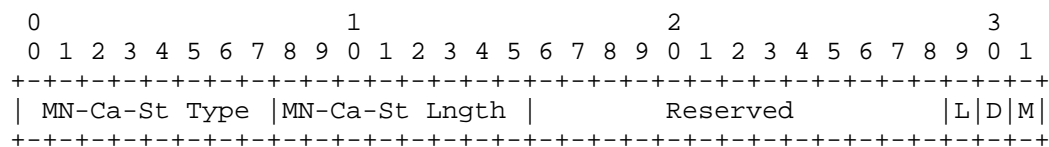
                   Figure 1: MN Capability Status Option

MN-Ca-St Type
   To be assigned by IANA.

MN-Ca-St Lngth
   8-bit unsigned integer indicating the length in octets of the
   option, excluding the type and length fields.

Reserved
   This field is unused for now. The value MUST be initialized to 0
   by the sender and MUST be ignored by the receiver.

L
   1-bit unsigned integer indicating the capability of supporting the
   logical interface feature by the mobile node. The value is set to
   1 when logical interface is supported by the mobile node,
   otherwise it is set to 0.

D
   1-bit unsigned integer indicating the IPv6/IPv4 Dual Stack support
   of the mobile node. The value is set to 1 when IPv6/IPv4 Dual
   Stack is supported by the mobile node, otherwise it is set to 0.

M
   1-bit unsigned integer indicating the Mobile IPv6 support of the
   mobile node. The value is set to 1 when Mobile IPv6 stack is
   supported by the mobile node, otherwise it is set to 0.

3.4.2. Mobile Node Connectivity Status Option

A new option, called Mobile Node Connectivity Status Option, is
defined to be included in the PMIPv6 signaling (e.g., PBU and PBA
messages) exchanged between a local mobility anchor and a mobile
access gateway. This option is used for conveying to the network the
mobile node's air link connectivity status information. Its format
is the following:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    | MN-Co-St Type | MN-Co-St Lngth|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
 |                     Reserved                     | MN status |R Q|
 +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```
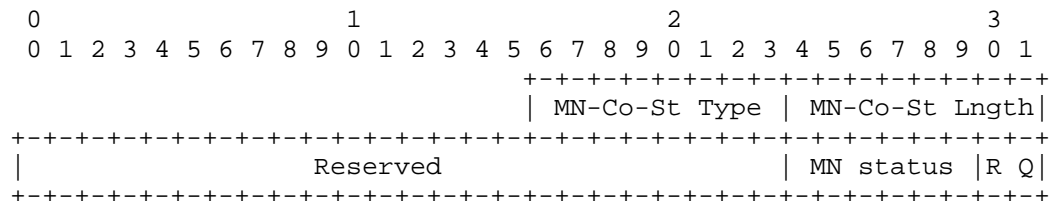
Figure 2: MN Connectivity Status Option

MN-Co-St Type
   To be assigned by IANA.

MN-Co-St Lngth
   8-bit unsigned integer indicating the length in octets of the
   option, excluding the type and length fields.

Reserved
   This field is unused for now. The value MUST be initialized to 0
   by the sender and MUST be ignored by the receiver.

MN status
   The status of the mobile node attached from a specific access
   network, such as WiFi, WiMAX and 3GPP. Currently the value of the
   MN status can be as follows:

   1: connected,

   2: disconnected,

   3: idle/power saving mode,

   4: reserved.

RQ
   This field is used to indicate when the radio quality of the
   MAG-MN link dropped below a certain threshold configured by the
   operators. The value can be set as follow:

   00: the radio quality of the MAG-MN link does not drop below the
   threshold,

   01: the radio quality of the MAG-MN link drops below the
   threshold.

   All other values are reserved.

4. Security Considerations

   TBD

5. IANA Considerations

   TBD

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    order):

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7. Normative References

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