              PMIPv6 inter-working with WiFi access authentication
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Abstract

   Proxy Mobile IPv6, the IETF's protocol for network-based mobility
   management, requires a completed and successful authentication of the
   mobile node before it is registered at the mobility anchor. This
   document describes inter-working between access authentication
   mechanisms, such as IEEE 802.1X, and the Proxy Mobile IPv6 protocol
   to enable trusted WiFi access to a network-based mobility management
   domain. Furthermore, the use of authentication method specific
   identifiers for unique identification of mobile nodes during setup
   and maintenance of their mobility session is described, following
   recommendations of related standards organizations, such as 3GPP and
   the WiMAX Forum.

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1. Introduction

   Proxy Mobile IPv6 (PMIPv6) [RFC5213] represents the IETF's protocol
   for network-based mobility management and is being deployed in
   various standards, such as the 3rd Generation Partnership Project
   (3GPP), to complement host mobility. According to the PMIPv6
   standard, mobile nodes (MN) do not require a secure interface to the
   mobility anchor (LMA), as there is no direct signaling for mobility
   management between the MN and the LMA, but the Mobility Access
   Gateway (MAG) sets up and maintains a mobility binding on the LMA on
   behalf of the host by means of a Proxy Binding Update (PBU).
   [RFC5213] requires a successful authentication of the MN before the
   MAG sends a PBU to the LMA to set up a mobility binding for the MN.
   Furthermore, it assumes the MAG to be informed about a mobile node
   identifier (MN-Identifier), which unambiguously identifies the MN
   during the mobility session. Such MN-Identifier can be a static
   identifier or a temporary identifier, which may be derived from a
   static identifier.

   This document intends to provide guidelines for PMIPv6 to inter-work
   with access authentication protocols which have been designed for
   IEEE 802-type of link technologies. Initial versions of this
   document focus on IEEE 802.1X and its recommendation to use the
   Extensible Authentication Protocol (EAP) [RFC3748]. Based on the
   procedure for general inter-working, more specific use cases are
   documented for discussion and reference. These use cases include the
   use of the Wireless LAN technology according to the IEEE 802.11
   standard to provide trusted access to 3GPP's packet core network. So
   far, WLAN has been considered as untrusted access being even provided
   by third parties and MNs connect through WLAN to the mobile operator
   network through an established secure tunnel. Stepping towards WLAN
   trusted access avoids the overhead of an established IPsec tunnel
   with a packet data gateway in the operator's core network, but
   requires inter-working between WLAN access authentication and the
   operator's authentication and identification mechanisms. In the
   context of trusted WLAN access and network-based mobility management,
   WLAN security is being used to protect traffic on the wireless link
   whereas the trust relationship between a MAG and the LMA is used to
   convey traffic through the operator's core network.

   The first version of this document discusses inter-working between
   IEEE 802.1X EAP and PMIPv6 as well as some specific use cases for
   trusted WLAN access in 3GPP's evolved packet core, which are based on
   recommended authentication schemes, such as EAP-AKA [RFC5448].
   Further use cases with different EAP authentication schemes as well
   as inter-working between PMIPv6 and web authentication will be added
   to future versions of this document. Prior to describing details of
   PMIPv6 inter-working with various access authentication schemes in

Section 4, Section 3 describes functional objectives to enable
trusted WLAN access to mobile operator networks and efficient inter-
working between WiFi access authentication and operators' mobility
management as well as policy and AAA infrastructure.

[2](#). **Conventions and 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 [[RFC2119](#)].

   This document uses the terminology of [[RFC5213](#)]. The following
   additional terms are used in the context of this draft:

   o AAA -- Authentication, Authorization and Accounting

   o EAP -- Extensible Authentication Protocol

   o PCC -- Policy and Charging Control

   o PMK -- Pairwise Master Key

3. **Functional Objectives**

   Major motivation and objective to document inter-working between WiFi
   access authentication and PMIPv6 is to describe complete system
   operation, message sequences and identification schemes for network-
   based mobility management using PMIPv6 including IEEE 802.11-based
   access as proven and widely accepted radio technology and associated
   authentication mechanisms. Inter-action between access
   authentication and mobility management allows the specification of
   missing components in [RFC5213], mainly referring to MAG operation
   being triggered by successful MN authentication and MN
   identification.

   The relevance of WiFi radio access is proven by various standards'
   initiative in specifying inter-working with IEEE 802.11-based
   technology. One example is the 3GPP's interest in supporting traffic
   offload to WLAN networks. Another example is the WiMax Forum's
   Network Architecture, which consider a WiFi-WiMAX inter-working
   function to enable access to the WiMAX network through WiFi radio
   access and to support handover between WiFi and WiMAX radio access.

   The PMIPv6 standard [RFC5213] assumes a completed and successful
   access authentication of MNs (or their subscriber) before the MAG
   registers the MN at an LMA by means of a PBU. One objective of this
   document is to analyze relevant access authentication schemes and to
   document the operation of PMIPv6 in dependency of these
   authentication mechanisms. The EAP procedure as IEEE 802.X
   recommendation is being considered most relevant at this time. Web-
   authentication is a further popular access authentication scheme,
   which can be analyzed and inter-working with PMIPv6 can be specified,
   even though manual subscriber inter-action during access
   authentication conflicts with automatic and seamless operation, e.g.
   during dual radio handover from 3GPP access to WiFi access.

   A further objective is to analyze the details of preferred
   authentication schemes, taking 3GPP and WiMAX Forum recommendations
   into account, and to document the use of common identifiers for
   access authentication and PMIPv6-based mobility management. Such
   identifier-specific inter-working must take further requirements,
   such as unique identification of a MN during the mobility session,
   into account. Some identifiers, which are generated during access
   authentication, are unique for an MN, but are not stable and valid
   beyond a certain radio access point. In such case, the MAG must use
   a different identifier or resolve such temporary identifier into a
   unique identifier which is valid beyond a single access point and
   MAG.

   A further goal is to analyze inter-working between access

authentication schemes and PMIPv6 during handover, which may also
imply a change in the radio access technology. Treatment of
authentication methods, keys and identifiers and associated inter-
working with PMIPv6 operation is documented.

Figure 1 depicts a high-level view of a WiFi network being integrated
into a mobile operator network as trusted access. Instead of using a
Security and Mobility Gateway, such as the 3GPP's Packet Data Gateway
(PDG), which terminates an IPsec tunnel with the UE, the system
relies on concatenated protected links between the UE and the WiFi
access network, as well as between the WiFi access network and the
LMA. The illustrated setup assumes a MAG function to be co-located
with the WiFi Access Point or a WiFi Controller (Ctrlr). Inter-
working between WiFi access authentication, PMIPv6 operation and the
operator network's AAA and PCC (Policy and Charging Control)
infrastructure is achieved by means of associated interfaces with the
LMA. Future extensions may consider a direct policy configuration
interface with the WiFi access network controller. This version of
the inter-working document does not assume a direct policy control
interface between the WiFi access network and the operator's PCC
system. If needed, the PMIPv6 protocol interface may be proposed to
convey associated information. Policy configuration in the WiFi
access network is considered out of scope of this documentation.

```
                                  +-------+  +-----+
                  (future option)  |Policy |  |     |
                            +. . . . . . +Control|  | AAA |
                            :          +---+---+  |     |
   +--+                     :              |       +-----+
   |MN|~~~~~~~              :              |          |
   +--+     +-II-+          :             +---+ +---+
            |WiFi|          :              | |
            | AP +---+    +---+---+        +-+-+-+
            +----+   |    | WiFi |  PMIPv6   |    +      +--------+
                 +----+ Ctrlr/+=============+ LMA |   /  Packet  \
       ~~~~      |    | MAG  |  tunnel    |   +---<    Data     >
       +-II-+    |    +-------+            +-----+   \ Network /
       |WiFi+---+                                     +--------+
       | AP |
       +----+


           WiFi access       Network-based
        <----security &---><------------------->
           L2 mobility         mobility
```

Figure 1: Integration of the WiFi radio technology to provide trusted
              access to mobile operator networks
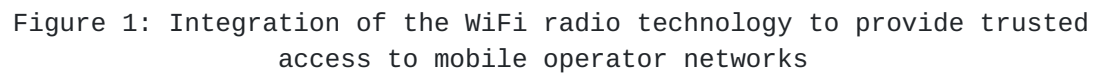
4. Inter-working with IEEE 802.1X EAP

4.1. General use with authentication against a RADIUS Server

   IEEE 802.1X recommends EAP for access authentication, which can make
   use of an Authentication Server using for example the RADIUS protocol
   between the Authenticator and the Authentication Server. [RFC3579]
   specifies RADIUS extensions to convey EAP attributes between an
   Authenticator and the RADIUS server. Figure 2 depicts general inter-
   working between PMIPv6 and IEEE 802.1X using EAP.

```
   +--+              +--------+              +---+     +------++------+
   |MN|              |WiFi CPE|              |LMA|     |RADIUS|| DHCP |
   +--+              |  MAG   |              +---+     |Server||Server|
    |                +--------+               |        +------++------+
    |                   |                     |           |      |
    |---EAPOL Start---->|                     |           |      |
    |<---EAP REQ[IDap]--|                     |           |      |
 (1)|--EAP RESP[IDmn]-->|-----RADIUS Access REQ[IDmn]---->|      |
    |<-EAP REQ[Method]--|<--RADIUS Access Chall[EAP REQ]--|      |
 (2)|-EAP RESP[Method]->|----RADIUS Access REQ[Method]--->|      |
    |<-EAP REQ[Method]--|<--RADIUS Access Chall[EAP REQ]--|      |
    |-EAP RESP[Method]->|----RADIUS Access REQ[Method]--->|      |
    |<---EAP SUCCESS----|<-RADIUS Access Accept[EAP SUC]--|      |
 (3)|               LMA                       |           |      |
    |             assigned                    |           |      |
 (4)|<----EAPOL-Key---->|                     |           |      |
 (5)|                   |----PBU[SSID,IDmn]-->|<------DHCP------->|
    |                   |<-----PBA[IPmn]------|           |      |
    |                   +=====IP tunnel=====+            |      |
 (6)|---DHCP Discover-->|----DHCP Discover--->|           |      |
    |<-DHCP Offer[IPmn]-|<--DHCP Offer[IPmn]--|           |      |
    |--DHCP REQ[IPmn]-->|---DHCP REQ[IPmn]...>|           |      |
 (7)|<-DHCP Ack[IPmn]---|<--DHCP Ack[IPmn]----|           |      |
    |                   |                     |           |      |
    |<------data--------+=====IP tunnel=====+--->- -     |      |
    |                   |                     |           |      |
```
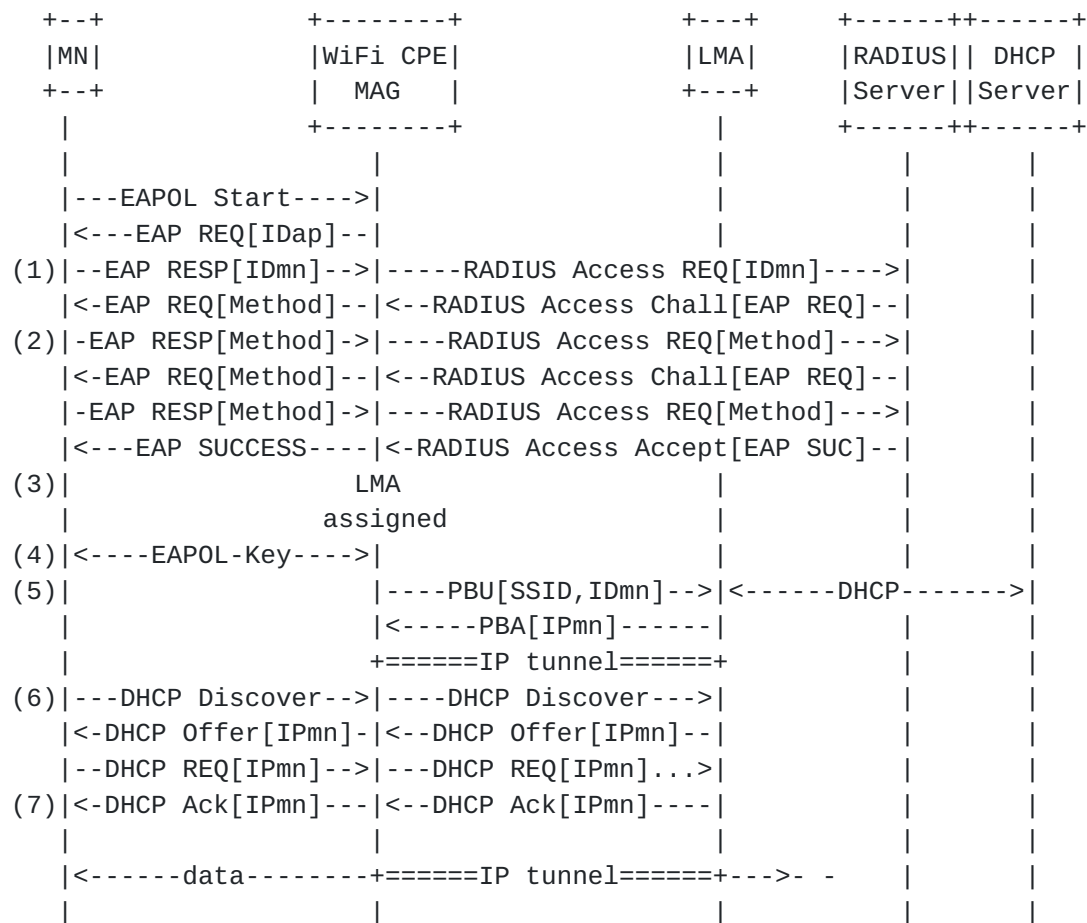
      Figure 2: PMIPv6 inter-working with WPA2-802.1X access authentication
                        against a RADIUS server

   After the MN has associated with a WiFi Access Point, the EAPOL
   procedure starts (1). EAP attributes are mapped by the WiFi AP/Ctrlr

   between EAPOL on the wireless link and RADIUS operation on the link
   towards the RADIUS server. The RADIUS server selects one or multiple
   authentication methods, which are performed with the MN in a
   challenge-response procedure (2). As a result of a successful EAP
   procedure, the RADIUS server may assign an LMA to the MN and signal
   the LMA identifier or the LMA IP address to the MAG function in the
   WiFi access network (3). The MN and the WiFi Access Point can now
   negotiate the Session Key to protect the wireless access (4). At
   that time, the MAG can take the EAP success as trigger to initiate
   the PBU registration of the MN with the LMA (5). The keys and
   identifiers being used and generated differ between the EAP and
   authentication method. In general, the MAG should not use the
   generated Session Key or security association identifier, as scope is
   limited to the the MN's association with the Access Point. More
   suitable is an identifier being negotiated during the authentication
   procedure with the RADIUS server, e.g. based on the Pairwise Master
   Key (PMK) or any identifier which derives from the PMK without
   including single Access Point specific information, such as the AP's
   MAC address. One example, which will be described in more detail in
   future versions of this document, is the use of the International
   Mobile Subscriber Identity (IMSI) to derive a NAI at the
   Authentication Server. This IMSI-based NAI is then used as MN-
   Identifier in the PBU. Such approach is being proposed in 3GPP for
   trusted access to the mobile operator network through non-3GPP type
   radio access networks [3GPP-TS23.402] [3GPP-TS33.402].

   As a result of the MN's registration, the LMA performs DHCP with a
   DHCP server to retrieve a valid IP address for the MN (IPmn). The
   assigned IP address is then signaled to the MAG in the PBA. The MN
   learns about this IP address from the DHCP procedure (6). After
   successful completion of the DHCP procedure (7), the MN can use the
   protected wireless link to communicate with the network
   infrastructure.

[5](). **Security Considerations**

   This document analyzes and documents inter-working between WiFi
   access authentication and PMIPv6 mobility management to enable
   trusted access to a mobile operator network which uses network-based
   mobility management. The document refers to standard operation of
   PMIPv6 [[RFC5213]()] as well as well accepted WiFi authentication
   mechanisms, such as EAP using a RADIUS server as authentication
   server, without introducing new messages or message sequences.
   Solely the inter-working of access authentication and PMIPv6 is
   described by means of message sequence charts. Furthermore, the use
   of identifiers, which are built during access authentication, for MN
   identification in the PMIPv6-based mobility management protocol is
   described. Hence, the documented inter-working should not introduce
   any new security threats.

6. IANA Considerations

This document is based on standardized protocols for WiFi access
authentication and network-based mobility management. No additional
protocol messages and options are specified so far in this document.

7. Normative References

   [3GPP-TS23.402]
               "3GPP TS 23.402; 3rd Generation Partnership Project;
               Technical Specification Group Services and System Aspects;
               Architecture enhancements for non-3GPP accesses (Release
               10)", <http://www.3gpp.org>.

   [3GPP-TS33.402]
               "3GPP TS 33.402; 3rd Generation Partnership Project;
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               Requirement Levels", BCP 14, RFC 2119, March 1997.

   [RFC3579]   Aboba, B. and P. Calhoun, "RADIUS (Remote Authentication
               Dial In User Service) Support For Extensible
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               Levkowetz, "Extensible Authentication Protocol (EAP)",
               RFC 3748, June 2004.

   [RFC5213]   Gundavelli, S., Leung, K., Devarapalli, V., Chowdhury, K.,
               and B. Patil, "Proxy Mobile IPv6", RFC 5213, August 2008.

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               Extensible Authentication Protocol Method for 3rd
               Generation Authentication and Key Agreement (EAP-AKA')",
               RFC 5448, May 2009.

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