Abstract: The invention relates to methods and devices for handling an extended proxy information item. Hence using of a proxy information sequence number associated to the extended proxy information item avoids a misinterpretation of outdated messages with proxy information items. The invention can be used for proxy mesh gates of mesh networks.
Description

Methods and Devices for Handling an Extended Proxy Information Item

The invention relates to methods and devices for handling an extended proxy information item, whereby the devices are based on nodes and or proxy mesh gates of a wireless mesh network.

In recent years the standard IEEE 802.11s (IEEE - Institute of Electrical and Electronics Engineers) was developed that defines a usage of a mesh network topology with nodes / mesh stations in the mesh network serving as relay for propagation of messages. In order to connect such a mesh network to external station located outside the mesh network proxy mesh gates are implemented at the border of the mesh network that forward messages from outside to inside the mesh network and vice versa. The mesh proxy gate may change the message content such as address translation or protocol translation.

A draft D11.0 of the IEEE 802.11s standard defines for WLAN mesh networks (WLAN - Wireless Local Area Network) a proxy information and so-called proxy update PXU and proxy update confirmation PXUC elements. Proxy information consists of a proxy MAC address of the proxy mesh gate and an external MAC address of the external station, together with an optional lifetime of this proxy information. By using the proxy update PXU and proxy update confirmation PXUC elements the proxy information is made available to other nodes in the mesh network, whereby the other nodes are informed which external addresses can be reached through which (proxy) mesh gate.

The proxy mesh gate G1 that proxies an external MAC address E1 can send a corresponding proxy update element. However some other mesh station M1 in the wireless mesh network might send this proxy information about the external MAC address of the external station and the proxy MAC address of the proxy
mesh gate G1 too, see Figure 1. Dashed lines show communication connection, such as WLAN mesh links.

However a mesh station M1 might not have received a proxy update element from the mesh proxy gate G1 that changed the proxy information about the mesh proxy gate G1 and external MAC address El (for instance, the deletion of the proxy information), so the mesh station might send a proxy update element with outdated proxy information on the mesh proxy gate G1 and external MAC address El. A recipient of both proxy update elements cannot recognize the wrong chronological order and will reestablish the proxy information, which is not correct.

In the current draft a specification of the proxy update element defines a field called PXU Sequence Number (8 bit long). However, it is used only as a proxy update identifier, which identifies the received proxy update element in a proxy information confirmation (PXUC) element that is sent in order to acknowledge the receipt of the proxy update element.

The messages of the path selection protocol HWMP (HWMP - Hybrid Wireless Mesh protocol) of IEEE 802.11s can also contain proxy information. It always contains a HWMP sequence number, but this sequence number is only used as sequence number for the forwarding information, not for the proxy information.

Hence it is an object to provide methods and devices that prevent wrong setting of proxy information in a mesh network.

This objective is solved by the independent claims. Specific solutions of the invention are solved by the dependent claims.

The invention relates to a method for generating an extended proxy information item in a mesh network,
- the mesh network with nodes formed as a proxy mesh gate and/or a mesh station,
for signaling an external MAC address of an external station located outside the mesh network via a proxy MAC address of the proxy mesh gate (Gl),
for a specific MAC address pair defined by the proxy address and by the external MAC address, comprising:
- Detecting a change in a connection of the external station with the proxy mesh gate;
- Generating, if the change is detected, a proxy information sequence number either (i) by incrementing an existing proxy information sequence number for the specific MAC address pair by at least one, or (ii) by using a sequence number of a message or an element coded by the standard Hybrid Wireless Mesh Protocol, whereby this sequence number is higher than a sequence number of a previously generated message or element coded by the standard Hybrid Wireless Mesh Protocol;
- Generating the extended proxy information item by:
  - a first field (F1) indicating an addition or deletion of the connection, a presence of a third field (F3) and a presence of a fifth field (F5),
  - a second field (F2) covering the external MAC address (EMACA);
  - a third field (F3) covering the proxy MAC address (PMACA), the presence of the third field (F3) is indicated by the first field (F1);
  - a fourth field (F4) covering the proxy information sequence number (PISN);
  - a fifth field (F5) covering a proxy information lifetime (PILIFE), the presence of the fifth field (F5) is indicated by the first field (F1).

In the context of this description a term proxy information, as known from a standard IEEE 802.11s, is called proxy information item. Furthermore an extended proxy information is called extended proxy information item. The term MAC is used in the description as an abbreviation of Media Access Control, as specified e.g. by IEEE 802.3-2002 section 4.1.4.
It is an advantage of this method that misinterpretation of messages covering the outdated proxy information item can be avoided. This means that a reliability of proxy information item available at nodes in the mesh network can be enhanced as a forwarding of frames to a wrong proxy mesh gate due to outdated proxy information item is prevented.

The proxy information sequence number is incremented for a generation of PXU elements (PXU – proxy update) with proxy information, e.g. for the IEEE 802.11s standard, especially if a lifetime of the proxy information item is included. Another case that leads to an increment of the proxy information sequence number relates to PXUs that related to proxy information to be deleted by the respective nodes of the mesh network. In the case the proxy information sequence number is determined for a specific MAC address pair for the first time, the proxy information sequence number can be set to a pre-defined or arbitrary number.

When using a dedicated fourth field in the enhanced proxy information item the proxy information sequence number is generated by incrementing an existing proxy information sequence number. In the case that the sequence number of the element of message of the standard Hybrid Wireless Mesh Protocol HWMP is used no dedicated fourth field is generated in the extended proxy information item but the sequence number is used as the proxy information sequence number. Also in this case when a new element or message coded by HWMP is sent the sequence number of the new element or message is incremented compared with a sequence number of a previously sent HWMP element or message. This means that the extended proxy information item can be distinguished from previously generated extended proxy information items due to the higher proxy information sequence number.
The invention further relates to a method for receiving and executing information of an extended proxy information item in a mesh network,
- the mesh network) with nodes formed as a proxy mesh gate and/or a mesh station,
- for signaling an external MAC address of an external station located outside the mesh network via a proxy MAC address of the proxy mesh gate (Gl),
- for a specific MAC address pair defined by the proxy address and by the external MAC address,
comprising:
Receiving the extended proxy information item;
Executing an addition or deletion of a connection of the external station with the proxy mesh gate, indicated by the extended proxy information item, by the node, if a proxy information sequence number of the extended proxy information item is larger than an existing proxy information sequence number of the specific MAC address pair.

It is an advantage of this method that misinterpretation of messages covering outdated proxy information item can be avoided. This means that a reliability of proxy information item available to nodes in the mesh network can be enhanced as a forwarding of frames to wrong proxy mesh gates due to outdated proxy information is prevented. According to the previous description the proxy information sequence number is extracted either from the fourth field of the proxy information item or from the sequence number of the message or element coded by the HWMP standard. A proxy information sequence number that was received by a previous element or previous message coded by HWMP or as a fourth field of a previous proxy information element is set and used as the existing proxy information sequence number.

In an optional enhancement of the described methods it is beneficial to transmit or receive the extended proxy information item as part of an element or message coded by a standard Hybrid Wireless Mesh Protocol. By using the standard Hy-
brided Wireless Mesh Protocol a cost and resource-effective implementation and execution of the invention can be provided.

The invention further relates to a proxy mesh gate for generating an extended proxy information item in a mesh network (MNET),
- the mesh network with nodes formed as a proxy mesh gate and/or a mesh station,
- for signaling a proxy MAC address of an external station located outside the mesh network via a proxy MAC address of the proxy mesh gate,
- for a specific MAC address pair defined by the proxy address and by the external MAC address,
comprising:
- First unit for detecting a change in a connection of the external station with the proxy mesh gate;
- Second unit for generating, if the change is detected, a proxy information sequence number is generated either (i) by incrementing an existing proxy information sequence number for the specific MAC address pair or (ii) by using a sequence number of a message or an element coded by the standard Hybrid Wireless Mesh Protocol, whereby this sequence number is higher than a sequence number of a previously generated message or element coded by the standard Hybrid Wireless Mesh Protocol;
- Third unit for generating the extended proxy information item by:
  - a first field indicating an addition or deletion of the connection, a presence of a third field and a presence of a fifth field,
  - a second field covering the external MAC address;
  - a third field covering the proxy MAC address, the presence of the third field is indicated by the first field;
  - a fourth field covering the proxy information sequence number;
  - a fifth field covering a proxy information lifetime, the presence of the fifth field is indicated by the first field.
It is an advantage of this proxy mesh gate that misinterpretation of messages covering outdated proxy information can be avoided. This means that a reliability of proxy information available to nodes in the mesh network can be enhanced as a forwarding of frames to wrong proxy mesh gates due to outdated proxy information is prevented. Further advantages are described by the corresponding method.

The proxy information sequence number is incremented for a generation of PXU elements (PXU - proxy update) with proxy information item, e.g. for the IEEE 802.11s standard, especially if a lifetime of the proxy information item is included. Another case that leads to an increment of the proxy information sequence number relates to PXUs that relate to proxy information item to be deleted by the respective nodes of the mesh network. In the case the proxy information sequence number is determined for a specific MAC address pair for the first time, the proxy information sequence number can be set to a pre-defined or arbitrary number. The same applies for using the sequence number of the HWMP as the proxy information sequence number.

The proxy mesh gate can further be enhanced by a fourth unit for transmitting the extended proxy information item as part of an element or message coded by a standard Hybrid Wireless Mesh Protocol. By using the standard Hybrid Wireless Mesh Protocol a cost and resource-effective implementation and execution of the invention can be provided.

Finally a part of the invention is a node for receiving and executing information of an extended proxy information item in a mesh network,
- the mesh network with nodes formed as a proxy mesh gate and/or a mesh station,
- for signaling an external MAC address of an external station located outside the mesh network via a proxy MAC address of the proxy mesh gate,
- for a specific MAC address pair defined by the proxy address and by the external MAC address, comprising:

First unit for receiving the extended proxy information item;
Second unit for executing an addition or deletion of a connection of the external station with the proxy mesh gate, indicated by the extended proxy information item, if a proxy information sequence number of the extended proxy information item is larger than an existing proxy information sequence number of the specific MAC address pair.

It is an advantage of the node that a misinterpretation of messages covering outdated proxy information can be avoided. This means that a reliability of proxy information items available to nodes in the mesh network can be enhanced as a forwarding of frames to wrong proxy mesh gates due to outdated proxy information items is prevented.

The node may further be enhanced by a third unit for receiving the extended proxy information item as part of an element coded by a standard Hybrid Wireless Mesh Protocol. By using the standard Hybrid Wireless Mesh Protocol a cost and resource-effective implementation and execution of the invention can be provided.

The invention is described by the aid of the following figures:

Fig. 1 Proxy information exchanged in a mesh network according to the present state of the art;
Fig. 2 Proxy information exchanged according to an example of the invention;
Fig. 3 Setup of an extended proxy information element;
Fig. 4 Proxy mesh gate according to the present invention;
Fig. 5  Node in a mesh network according to the present invention.

Elements with the same functionality are labeled by identical reference signs.

In the context of this description a term proxy information, as known from a standard IEEE 802.11s, is called proxy information item. Furthermore an extended proxy information is called extended proxy information item. The term MAC is used in the description as an abbreviation of Media Access Control, as specified e.g. by IEEE 802.3-2002 section 4.1.4 (IEEE - Institute of Electrical and Electronics Engineers) e.g. to be used in Ethernet protocol as MAC address.

Figure 2 shows a first example of the invention. A mesh network MNET covers three proxy mesh gates G1, G2, G3 that transmit messages from outside the mesh network to the inside and vice versa. Furthermore the mesh network covers a mesh station STA that may represent a laptop of a user within the mesh network. The second and third proxy mesh gate G2, G3 and the mesh station STA are also known as other mesh stations M1. In general the proxy mesh gates and the mesh station are also known as nodes of the mesh network.

At a point in time the first proxy mesh gate G1 recognizes an external station El that can be used to send messages to or from. In order to allow the other mesh stations M1 to send messages to the external station El the first proxy mesh gate G1 informs at least one of the other mesh stations M1 about the external station. Hence the first proxy gate G1 forms an extended proxy information item EPI based on the following fields F1, ..., F5, see also Fig. 3:

Field Description
F1 Flags, see description below;
F2  External MAC (media access control) address EMACA of the external station El, e.g. a 48-bit MAC address;

F3  Proxy MAC address PMACA of the first proxy gate Gl, e.g. a 48-bit MAC address;

F4  Proxy information sequence number PISN, e.g. an unsigned integer value;

F5  Proxy information lifetime, e.g. unsigned integer value; it is set to the time for which the other mesh station STA, Ml receiving the extended proxy information item considers this proxy information to be valid; the proxy information lifetime is measured in TUs (TU - Time Units);

The field F1 defines specific flags indicating specific functionalities of the extended proxy information item EPI:

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>It is set to 1 if the proxy information is to be deleted, and set to 0 otherwise. This bit is also known as &quot;Delete subfield&quot;.</td>
</tr>
<tr>
<td>1</td>
<td>This so called &quot;Originator Is Proxy&quot; subfield indicates that the originator of the extended proxy information item EPI is the proxy mesh gate of this proxy information when set to 1. In this example a value of 1 signals the first proxy mesh gate Gl. If it is set to 1 the extended proxy information item EPI does not contain field F3. If this subfield is 0 than the proxy MAC address is present.</td>
</tr>
<tr>
<td>2</td>
<td>This bit indicates whether the extended proxy information item EPI contains lifetime information of the proxy information, when set to 1.</td>
</tr>
<tr>
<td>3-7</td>
<td>Reserved.</td>
</tr>
</tbody>
</table>

In the present example the fields are set as follows:
F1 = 0000.0110 (binary form) (delete flag not set, extended proxy information item is added; the first mesh proxy gate is the originator, field F3 not used; lifetime field F5 used)

F2 = OxOFFFA100AA00BA (field F2 is a 48 bit MAC address)
F3 - not present
F4 = 376 (coded as unsigned integer)
F5 = 5000

When the proxy information sequence number PISN is set for the first time any arbitrary number can be used, e.g. 376.

Then the extended proxy information item EPI is sent to the mesh station STA and the second proxy mesh gate G2. These other mesh stations perform the following steps:

- if it does not have proxy information for the proxy mesh gate-external MAC address pair that is called specific MAC address pair SMACAP, it creates this proxy information and sets the proxy mesh gate, the external MAC address, the proxy information sequence number, and the proxy information lifetime to the values as received in the extended proxy information item EPI with this proxy information
- if it does have proxy information for the specific set, it updates this proxy information only if the proxy information sequence number of the received proxy information is larger than the proxy information sequence number of the stored proxy information. The stored proxy information is also known as existing proxy information EPISN.

Now the respective other mesh station knows that the external station can be reached under a certain external MAC address and via the first proxy mesh gate G1.

Next a second extended proxy information item EPI2 is generated by the first proxy mesh gate, because the external station is no longer present, e.g. it was a mobile device that
moved away from the mesh network. The second extended proxy information item EPI2 is generated as follows:

\[ F_1 = 0000.0011 \] (binary form) (delete flag set; the first mesh proxy gate is the originator, field F3 not used; no lifetime information flag set, field F5 not used)

\[ F_2 = \text{OxOFFFA100AA00BA} \] (field F2 is a 48 bit MAC address)

F3 - not present

F4 = 377 (coded as unsigned integer)

F5 - not present

In order to discover the latest extended proxy information the proxy information sequence number PISN is incremented e.g. by one or any arbitrary positive value compared to a existing proxy information sequence number that was used in the previous extended proxy information item. Hence PSNI = 376 + 1 = 377.

This second extended proxy information item EPI2 for the specific MAC address pair is transmitted to the second and third proxy mesh gates and the mesh station.

When the second extended proxy information item EPI2 is received by the other mesh stations and the recipient has a valid proxy information for the specific MAC address pair stored, it compares the existing proxy information sequence number with the proxy information sequence number received. If the proxy information sequence number received is higher than the existing proxy information sequence number it will delete the proxy information for the specific MAC address pair. Otherwise no deletion will be performed.

If one of the other mesh stations M1 receives an proxy information element with extended proxy information item to be deleted, it may or has still to record the deleted proxy information so that it is able to compare the proxy information sequence number with other received extended proxy information items for this proxy mesh gate-external MAC address pair
in order to determine whether the received proxy information is newer or older than the deletion.

This can be best achieved by extending the stored extended proxy information item with a Delete flag indicating whether the extended proxy information item is valid (added) or invalid (deleted). It is set according to the Delete flag for the extended proxy information item in the received proxy update element PXU.

Next in time the second proxy mesh gate G2 sends the extended proxy information item EPI covering as proxy information sequence number PISN = 376 to the third proxy mesh gate G3. The proxy mesh gate G3 does not update its stored proxy information for the specific MAC address pair based on the received extended proxy information item, because the received proxy information sequence number 376 is not larger than the stored (existing) = proxy information sequence number 377. Hence the third proxy mesh gate G3 retains the correct proxy information for the specific MAC address pair and does not accept the wrong proxy information on the specific MAC address pair contained in the recent extended proxy information item from the second proxy mesh gate G2.

In another example the proxy information is transmitted using a HWMP of a standard IEEE 802.11 (HWMP - Hybrid Wireless Mesh Protocol; IEEE - Institute of Electrical and Electronics Engineers). When e.g. the mesh station STA receives proxy information of the extended proxy information items in a HWMP element (address extension is available), it does the following:

- if the mesh station does not have proxy information for the proxy mesh gate-external MAC address pair (the proxy mesh gate is for instance the Originator Mesh STA address or the Target Mesh STA address, the external MAC address is for instance the Originator External Address or the Target External Address), it creates this proxy information and sets the proxy mesh gate, the external MAC ad-
dress, the proxy information sequence number, and the proxy information lifetime to the corresponding values as received in the HWMP element with this proxy information according to the existing rules. The proxy information sequence number is set to the HWMP sequence number from the received HWMP element.

- if it does have proxy information for the proxy mesh gate-external MAC address pair, it updates this proxy information only if the HWMP sequence number of the received HWMP element with the proxy information is larger than the proxy information sequence number of the stored proxy information.

The method steps described above may be implemented in software, whereby the software may be stored on a memory device such as a CDROM and may be executed by a processor unit. Data may be received or sent via an 10 unit that is connected to the processor unit. In addition the processor unit may be connected to a memory unit for storing intermediate data and/or instruction of the software.

The invention further covers the proxy mesh gate for generating an extended proxy information item in the mesh network with the following units as shown in Fig. 4:

- First unit U1 for detecting a change in a connection of the external station E1 with the proxy mesh gate Gl;
- Second unit U2 for generating, if the change is detected, a proxy information sequence number PISN either (i) by incrementing an existing proxy information sequence number EPISN for the specific MAC address pair SMACAP by at least one or (ii) by using a sequence number of a message of element coded by the standard Hybrid Wireless Mesh protocol, whereby this sequence number is higher than a sequence number of a previously generated message or element coded by the standard Hybrid Wireless Mesh Protocol;
- Third unit U3 for generating the extended proxy information item EPI by:
- a first field F1 indicating an addition or deletion of the connection, a presence of a third field F3 and a presence of a fifth field F5,
- a second field F2 covering the external MAC address EMACA;
- a third field F3 covering the proxy MAC address PMACA, the presence of the third field F3 is indicated by the first field F1;
- a fourth field F4 covering the proxy information sequence number PISN;
- a fifth field F5 covering a proxy information lifetime PILIFE, the presence of the fifth field F5 is indicated by the first field F1.

The proxy mesh gate may cover further a fourth unit U4 for transmitting the extended proxy information item EPI, EPI2 as part of an element coded by a standard Hybrid Wireless Mesh Protocol and/or a fifth unit U5 for setting the proxy information sequence number by a sequence number of the element coded by a standard Hybrid Wireless Mesh Protocol.

The units U1, ..., U5 may be connected via a bus BUS to exchange data among each other and/or with a processor PROZ and memory unit MEM. Furthermore the units, the processor and the memory may receive or transmit data via an 10 module 10.

The other mesh station or node G2, G3, M1 for receiving and executing information of an extended proxy information item EPI, EPI2 in a mesh network MNET may contain the following units:
First unit Z1 for receiving the extended proxy information item EPI;
Second unit Z2 for executing an addition or deletion of a connection of the external station E1 with the proxy mesh gate G1, indicated by the extended proxy information item EPI, by the node G2, G3, M1 only, if a proxy information sequence number PISN of the extended proxy information item
EPI, EPI2 is larger than an existing proxy information sequence number EPISN of the specific MAC address pair SMACAP.

In addition the mesh station or node may cover a third unit Z3 for transmitting the extended proxy information item EPI, EPI2 as part of an element coded by a standard Hybrid Wireless Mesh Protocol. Furthermore the mesh station or node may contain a fourth unit Z4 for executing additional functions of the respective node as described before.

The units Z1, ..., Z4 may be connected via a bus BUS to exchange data among each other and/or with a processor PROZ and memory unit MEM. Furthermore the units, the processor and the memory may receive or transmit data via an IO-module 10.
Patent claims

1. Method for generating an extended proxy information item (EPI, EPI2) in a mesh network (MNET),
   - the mesh network (MNET) with nodes formed as a proxy mesh gate (Gl) and/or a mesh station (M1),
   - for signaling an external MAC address (EMACA) of an external station (El) located outside the mesh network (MNET) via a proxy MAC address (PMACA) of the proxy mesh gate (Gl),
   - for a specific MAC address pair (SMACAP) defined by the proxy address (PMACA) and by the external MAC address (EMACA),
   - comprising:
     - Detecting a change in a connection of the external station (El) with the proxy mesh gate (Gl);
     - Generating, if the change is detected, a proxy information sequence number (PISN) either (i) by incrementing an existing proxy information sequence number (EPISN) for the specific MAC address pair (SMACAP) by at least one, or (ii) by using a sequence number of a message or an element coded by the standard Hybrid Wireless Mesh Protocol, whereby this sequence number is higher than a sequence number of a previously generated message or element coded by the standard Hybrid Wireless Mesh Protocol;
     - Generating the extended proxy information item (EPI) by:
       - a first field (F1) indicating an addition or deletion of the connection, a presence of a third field (F3) and a presence of a fifth field (F5),
       - a second field (F2) covering the external MAC address (EMACA);
       - a third field (F3) covering the proxy MAC address (PMACA), the presence of the third field (F3) is indicated by the first field (F1);
       - a fourth field (F4) covering the proxy information sequence number (PISN);
- a fifth field (F5) covering a proxy information lifetime (PILIFE), the presence of the fifth field (F5) is indicated by the first field (F1).

2. Method for receiving and executing information of an extended proxy information item (EPI, EPI2) in a mesh network (MNET),
- the mesh network (MNET) with nodes formed as a proxy mesh gate (G1) and/or a mesh station (M1),
- for signaling an external MAC address (EMACA) of an external station (E1) located outside the mesh network (MNET) via a proxy MAC address (PMACA) of the proxy mesh gate (G1),
- for a specific MAC address pair (SMACAP) defined by the proxy address (PMACA) and by the external MAC address (EMACA),
comprising:
Receiving the extended proxy information item (EPI, EPI2);
Executing an addition or deletion of a connection of the external station (E1) with the proxy mesh gate (G1), indicated by the extended proxy information item (EPI, EPI2), by the node (G2, G3, M1), if a proxy information sequence number (PISN) of the extended proxy information item (EPI, EPI2) is larger than an existing proxy information sequence number (EPISN) of the specific MAC address pair (SMACAP).

3. Method according to claim 1 or 2, comprising:
Transmitting or receiving the extended proxy information item (EPI, EPI2) as part of a message of an element coded by a standard Hybrid Wireless Mesh Protocol.

4. Proxy mesh gate (G1) for generating an extended proxy information item (EPI, EPI2) in a mesh network (MNET),
- the mesh network (MNET) with nodes formed as a proxy mesh gate (G1) and/or a mesh station (M1),
- for signaling an external MAC address (EMACA) of an external station (El) located outside the mesh network (MNET) via a proxy MAC address (PMACA) of the proxy mesh gate (Gl),
- for a specific MAC address pair (SMACAP) defined by the proxy address (PMACA) and by the external MAC address (EMACA), comprising:
  - First unit (U1) for detecting a change in a connection of the external station (El) with the proxy mesh gate (Gl);
  - Second unit (U2) for generating, if the change is detected, a proxy information sequence number (PISN) either (i) by incrementing an existing proxy information sequence number (EPISN) for the specific MAC address pair (SMACAP) by at least one, or (ii) by using a sequence number of a message or an element coded by the standard Hybrid Wireless Mesh Protocol, whereby this sequence number is higher than a sequence number of a previously generated message or element coded by the standard Hybrid Wireless Mesh Protocol;
  - Third unit (U3) for generating the extended proxy information item (EPI, EPI2) by:
    - a first field (F1) indicating an addition or deletion of the connection, a presence of a third field (F3) and a presence of a fifth field (F5),
    - a second field (F2) covering the external MAC address (EMACA);
    - a third field (F3) covering the proxy MAC address (PMACA), the presence of the third field (F3) is indicated by the first field (F1);
    - a fourth field (F4) covering the proxy information sequence number (PISN);
    - a fifth field (F5) covering a proxy information lifetime (PILIFE), the presence of the fifth field (F5) is indicated by the first field (F1).

5. Proxy mesh gate (Gl) according to claim 4, comprising:
Fourth unit (U4) for transmitting the extended proxy information item (EPI, EPI2) as part of a message or an element coded by a standard Hybrid Wireless Mesh Protocol.

6. Node (G2, G3, Ml) for receiving and executing information of an extended proxy information item (EPI, EPI2) in a mesh network (MNET),
- the mesh network (MNET) with nodes formed as a proxy mesh gate (Gl) and/or a mesh station (Ml),
- for signaling an external MAC address (EMACA) of an external station (El) located outside the mesh network (MNET) via a proxy MAC address (PMACA) of the proxy mesh gate (Gl),
- for a specific MAC address pair (SMACAP) defined by the proxy address (PMACA) and by the external MAC address (EMACA),

comprising:
First unit (Z1) for receiving the extended proxy information item (EPI, EPI2);

Second unit (Z2) for executing an addition or deletion of a connection of the external station (El) with the proxy mesh gate (Gl), indicated by the extended proxy information item (EPI, EPI2), if a proxy information sequence number (PISN) of the extended proxy information item (EPI, EPI2) is larger than an existing proxy information sequence number (EPISN) of the specific MAC address pair (SMACAP).

7. Node (G2, G3, Ml) according to claim 8, comprising:

Third unit (Z3) for receiving the extended proxy information item (EPI, EPI2) as part of an element or message coded by a standard Hybrid Wireless Mesh Protocol.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/56
ADD. H04W84/02 H04W84/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED
Minimum documentation searched (classification system followed by classification symbols)
H04L H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal , PAJ, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tr>
<td>X</td>
<td>&quot;IEEE P802.11s/DII 2.0 Draft STANDARD for Informati on Technology Telecommuni cations and informati on on exchange between systems Local and metropolitan area networks Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 10: Mesh Networking&quot;, 1 April 1 2011 (2011-04-01), pages 1-349, XP55036118, Retrieved from the Internet: URL: <a href="http://ieeexpl.or">http://ieeexpl.or</a> g/ieee.org/xpl/mostRecentIssue.jsp?punumber=5756331 [retrieved on 2012-08-22] cited in the application on page 69, line 23 - page 71, line 16 page 278, line 32 - page 280, line 43</td>
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Further documents are listed in the continuation of Box C.

See patent family annex.

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" later document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

Date of the actual completion of the international search
23 August 2012

Date of mailing of the international search report
30/08/2012

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