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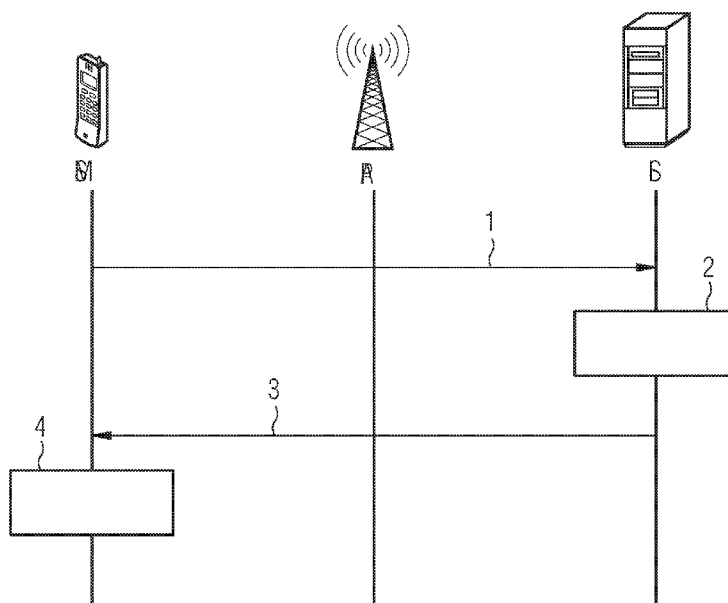
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(57) Abstract: A method of fitting a message response to a frame size comprises preparing a query message to send from a user device to a network; allocating priority levels to each information element in the message and providing the information elements and their allocated priority levels in the message. The message is sent to the network; and at the network, a maximum permitted frame size for a response is determined and the response is prepared. The size of the response is compared with the maximum frame size. If the size of the response exceeds the maximum frame size, the number of information elements in the response is reduced by removing information elements having lowest priority until the response is within the maximum permitted frame size; and the filtered response is sent.

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MESSAGE ADAPTATION

This invention relates to a method of fitting a message response to a frame size, in particular in the context of IEEE 802.21.

5 Information prioritisation and dynamic information management are popular research areas. Many general solutions have been found for problems such as filtering of information gathered from a database and managing of such information in order to adapt them to particular system requirements. However, a solution for the problems of information prioritisation and information filtering according to their priority has not
10 been presented in the context of the IEEE 802.21 standardisation.

The IEEE 802.21 standardisation group aims to define a Media Independent Handover Function (MIHF) that allows a mobile station (MS) to query the networks available in the MS area and what features these networks support. In the context of MSs supporting IEEE 802.11 radio interfaces, the MIHF network discovery query
15 messages are transported via a Generic Advertisement Service (GAS) protocol. A proposal has been presented, where by frame size made available by GAS for transporting MIHF network discovery messages will be limited according to network capabilities and operator's needs.

The limit on the GAS frame size may affect the amount of information
20 exchanged via MIHF during the network discovery process. The integrity of this information may also be affected if the original MIHF messages are truncated due to lack of space in the GAS frame. Such frame size limitation is likely to affect the MIHF query response messages, which might contain all the instances of the information found in the information server (IS), requested by the MS via MIHF query messages.

25 At present, the IEEE 802.21 standard does not provide any tool to adapt the MIHF messages to the size limit imposed by the underlying GAS protocol. This means that MIHF messages may be much larger than the GAS frame, therefore resulting in truncation. Also, this means that the information encapsulated in GAS frames is not chosen according to its importance, but only according to how the information is
30 arranged in the IS and selected by the IS parser.

In accordance with the present invention, a method of fitting a message response to a frame size comprises preparing a query message to send from a user device to a network; allocating priority levels to each information element in the

message and providing the information elements and their allocated priority levels in the message; sending the message to the network; and at the network, determining a maximum permitted frame size for a response; preparing the response; comparing the size of the response with the maximum frame size; if the size of the response exceeds
5 the maximum frame size, reducing the number of information elements in the response, by removing information elements having lowest priority until the response is within the maximum permitted frame size; and sending the filtered response.

The present invention allocates priority levels to each information element and for a response, where a maximum frame size has been set, the number of information
10 elements can be reduced, by removing information elements having the lowest priority until the response is within the maximum frame size, then the filtered response is sent.

Preferably, the step of reducing the number of information elements comprises filtering out the information elements having the lowest priority; and repeating the comparison and filtering steps for increasing levels of priority until the response is
15 within the maximum frame size limit.

Alternatively, reducing the number of information elements comprises determining the number of bytes available in the maximum frame size and filtering out sufficient information elements, to fit the response within the maximum frame size.

Preferably, reducing the number of information elements further comprises
20 reducing the number of instances of information elements having the same priority level.

Preferably, the user device sends a further message requesting the filtered out instances of the information elements.

Preferably, the maximum number of further messages relating to the same
25 query message is limited to a predetermined value.

Preferably, the query message is transported via a generic advertisement service protocol.

Preferably, the query message forms part of a media independent handover function.

30 An example of a method of fitting a message response to a frame size according to the present invention will now be described with reference to the accompanying drawings in which:

Figure 1 illustrates message exchange between a mobile station and an information server; and,

Figure 2 shows a table of information elements instances available in a database at an information server.

5

Fig. 1 illustrates a communication system comprising a user device in this case a mobile station (MS) and a network comprising an access point (AP) and a network information server (IS). A media independent handover function MIHF at the MS sends an MIH query message 1 to the IS in order to discover a number of parameters for each network available in the MS hot spot. In this example, the parameters are subscription service provider network (SSPN), service set identifier (SSID), extended service set ID (ESSID), quality of service (QoS) capability, service name and service type. Other combinations of parameters may be requested, although SSPN, SSID and ESSID are essential in most of 802.11 network discovery processes involving response messages sent according to 802.21 specifications

Assuming that the information parameters listed are available in a database in the IS for five instances, i.e. five operators provide connectivity in the hotspot where the MS is located, as shown in Fig. 2 and also assuming that the GAS maximum frame size is $\text{Frame}_{\text{Max}}$, then the MIHF in the MS assigns priority levels for each requested information field. The allocation of priority levels depends upon the status of the MS, so that for a mobile user, the priority level for a particular IE may be different as compared with a static user of the MS. Although systems other than 802.21 have considered allocation of priority, this has been on the basis of a fixed pre-allocation, rather than having MS able to do the allocation according to its status.

In this example it can be seen that six different priority levels have been assigned for the six different parameters, with priority 6 being the lowest level of priority and level 1 the highest. Similarly, instance level 5 is the lowest instance level and instance 1 the highest. The MIHF in the IS is able to retrieve a maximum GAS frame size via information exchange with the GAS protocol and to adapt the MIH query response message, so as to fit it into the maximum GAS frame size. The IS checks whether the query response is larger than the maximum GAS frame size and if it is, the IS filters out information fields. The adaptation may be done in an iterative way,

30

or it can be done as a straight calculation of the available frame size and the number of elements that can fit in this.

Knowing the maximum GAS frame size, the MIHF at the IS calculates the size of the full query response message and compares it against the $\text{Frame}_{\text{Max}}$ value. For the
5 iterative process, if $\text{Frame}_{\text{Max}}$ is smaller than the response size, the MIHF formulates a new response, not including the priority 6 information elements (lowest priority elements). If this response is still larger than the $\text{Frame}_{\text{Max}}$ value, then the MIHF formulates a new response, not including the priority 5 information elements. This process continues until the response size is less than, or equal to the $\text{Frame}_{\text{Max}}$ value.
10 The MIH query response 3 is then sent.

Since in most of the cases the SSPN, SSID and ESSID are essential pieces of information in most of 802.11 network discovery processes involving response messages sent according to 802.21, these information fields cannot be filtered out in the process of query response size reduction. For this reason, a priority threshold is defined
15 and set to 3. The priority threshold states that information fields with a priority number lower than, or equal to 3 cannot be filtered out from the query response message. The threshold value is defined and made available to the MIHF according to the specific circumstances of the example.

If the priority threshold is reached during the filtering process and if the MIHF
20 query response is still larger than $\text{Frame}_{\text{Max}}$ then the MIHF starts filtering out instances of the whole set of information required, i.e. rows in Table 1. This filtering process is carried out until a new threshold is reached: the instance threshold. The instance threshold specifies the information instance after which no more filtering can be applied. With reference to Table 1, this is the row after which no more rows can be
25 filtered out. In this example, this is set at instance 2, so that the user still has a choice of network service provider at a particular hot spot. Both the priority threshold and the instance threshold are set in such a way that the query response size, resulting from the maximum level of filtering, has to fit into the maximum GAS frame size.

The MS checks 4 if the information received is sufficient and if the information
30 received by the MIHF at the MS is considered to be insufficient for the process of network selection a new query message is submitted to the IS requesting the information filtered out from the previous response. The query messages derived as a consequence of the query response size reduction are limited in number, i.e. a

maximum number of derived queries is fixed. The MIHF at the MS does not exceed this limit and the MIHF at the IS does not respond to queries exceeding such a limit.

The present invention provides priority levels to the information fields required in query messages from the MIHF in the MS to the MIHF in the IS. The MIHF is
5 enabled in the IS to check the maximum GAS frame size in order to understand if the query response message derived by the MIHF in the IS is larger than the maximum GAS frame size. The MIHF is enabled in the IS to filter out low priority information, as well as instances of the information found in the database, in order to reduce the MIHF query response message to the maximum GAS frame size. The MIHF is enabled
10 in the MS to send a new query message if the information filtered out by the MIHF in the IS is considered to be essential. A limit is set for the number of consecutive query messages sent by the MIHF at the MS as the consequence of filtering performed.

The main advantages gained by adopting the described invention are that information element prioritisation in the MIH query message is enabled, so as to enable
15 query response size reduction and to prevent unwanted truncation or discarding of important information which would result from simply setting a maximum response size and blindly sending that part of the data which fitted within the size limit. Thresholds are fixed to avoid filtering out of information essential for network selection, as well as to avoid large number of following queries to be sent to the IS.

20 Information element prioritisation allows situations to be avoided where the whole set of information found in the IS database is larger than the maximum GAS frame size and part of this information needs to be arbitrarily selected and discarded. Fixed thresholds ensure that the instances of information groups delivered to the MS contain the essential information needed to identify available networks and also allows
25 fixing of a limit to the number of queries derived from the process of information filtering, which might cause network congestions if delivered in large numbers.

CLAIMS

1. A method of fitting a message response to a frame size; the method comprising preparing a query message to send from a user device to a network; allocating priority
5 levels to each information element in the message and providing the information elements and their allocated priority levels in the message; sending the message to the network; and at the network, determining a maximum permitted frame size for a response; preparing the response; comparing the size of the response with the maximum frame size; if the size of the response exceeds the maximum frame size,
10 reducing the number of information elements in the response, by removing information elements having lowest priority until the response is within the maximum permitted frame size; and sending the filtered response.
2. A method according to claim 1, wherein the step of reducing the number of
15 information elements comprises filtering out the information elements having the lowest priority; and repeating the comparison and filtering steps for increasing levels of priority until the response is within the maximum frame size limit.
3. A method according to claim 1, wherein reducing the number of information
20 elements comprises determining the number of bytes available in the maximum frame size and filtering out sufficient information elements, to fit the response within the maximum frame size.
4. A method according to any preceding claim, wherein reducing the number of
25 information elements further comprises reducing the number of instances of information elements having the same priority level.
5. A method according to claim 4, wherein the user device sends a further message requesting the filtered out instances of the information elements.
30
6. A method according to claim 5, wherein the maximum number of further messages relating to the same query message is limited to a predetermined value.

7. A method according to any preceding claim, wherein the query message is transported via a generic advertisement service protocol.
8. A method according to any preceding claim, wherein the query message forms
5 part of a media independent handover function.
9. A method according to any preceding claim, wherein the priority levels allocated to each information element are dependent upon the status of the user device.
- 10 10. A method according to any preceding claim, wherein the network is an IEEE
802.21 network.

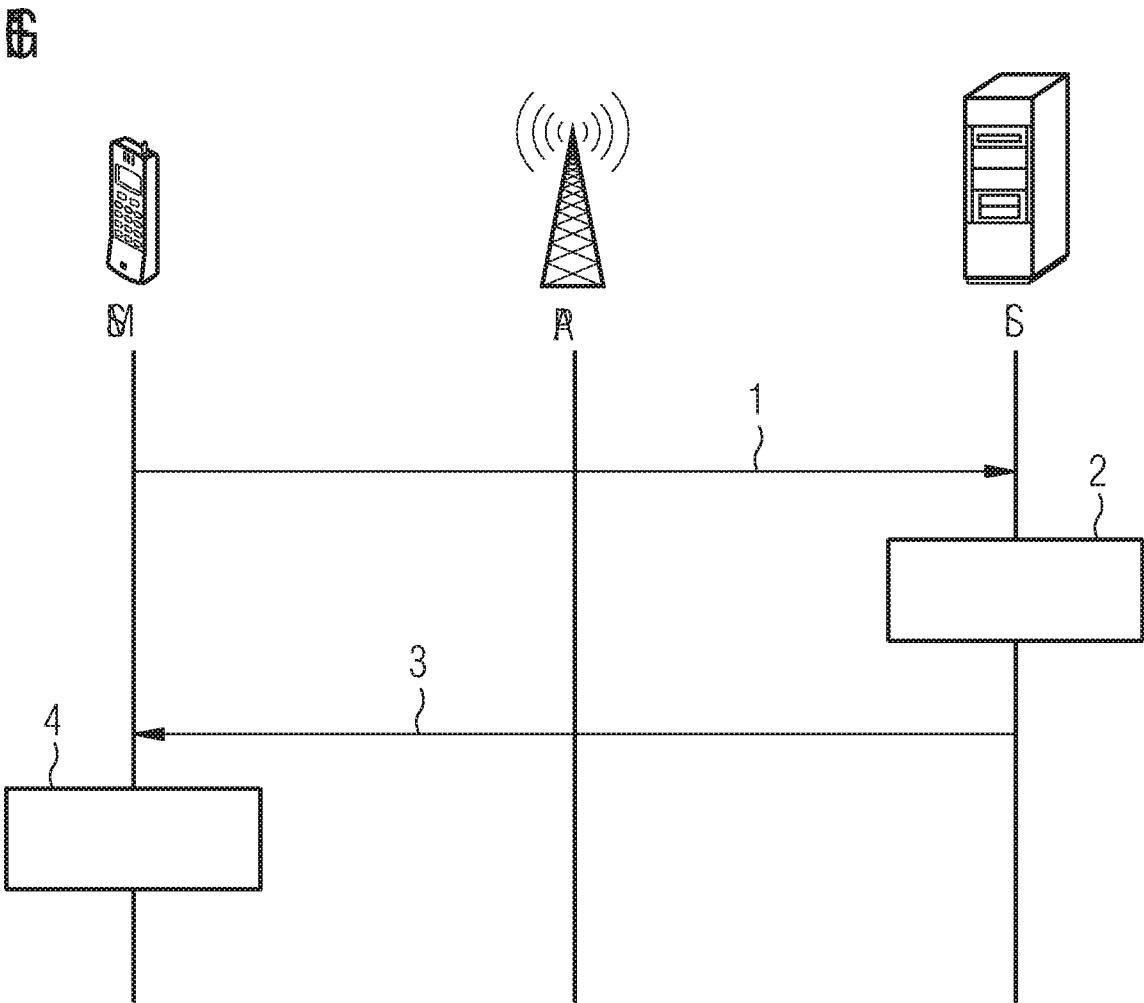


FIG 2

	Priority1	Priority2	Priority3 (Priority threshold)	Priority4	Priority5	Priority6
Instance1	SSPN1	SSID1	ESSID1	QoS Capability1	Service Name1-1 Service Name1-2 Service Name1-3	Service Type1-1 Service Type1-2 Service Type1-3
Instance2 (Instance Threshold)	SSPN2	SSID2	ESSID2	QoS Capability2	Service Name2-1 Service Name2-2 Service Name2-3	Service Type2-1 Service Type2-2 Service Type2-3
Instance3	SSPN3	SSID3	ESSID3	QoS Capability3	Service Name3-1 Service Name3-2	Service Type3-1 Service Type3-2
Instance4	SSPN4	SSID4	ESSID4	QoS Capability4	Service Name4-1	Service Type4-1
Instance5	SSPN5	SSID5	ESSID5	QoS Capability5	Service Name5-1 Service Name5-2	Service Type5-1 Service Type5-2