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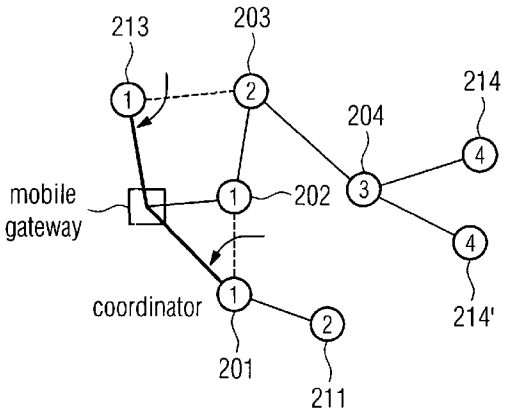
FIG 2B



(57) Abstract: The present invention provides a temporary network-reconfiguration method in a multi-hop wireless communication network, which method can carry out temporary reconfiguration of the network topology dynamically according to the difference between the geographic distance and the hop distance between network nodes serving as communication endpoints, so as to reduce the hop distance between the network nodes serving as communication endpoints, to shorten the communication delay in the multi-hop wireless communication network, to increase the utilization rate of wireless resources and to reduce the power consumption by the network nodes. The present invention achieves even more remarkable effects for a multi-hop wireless communication network that adopts a tree-structured topology and requires strictly low power consumption. At the mean time, the present invention provides a multi-hop wireless communication network capable of implementing the temporary network reconfiguration and corresponding network nodes.

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Description

Method, system and network nodes for network reconfiguration in a multi-hop wireless communication network

Technical field

The present invention relates to multi-hop wireless communication technology, and particularly to a temporary network reconfiguration method in a multi-hop wireless communication network, a corresponding system and network nodes.

Background art

In a multi-hop wireless communication network with network nodes at fixed positions, after each network node is energized, the network topology can be determined and subsequently kept constant, unless there is a failure of individual network node or a change in channel conditions leading to the reconfiguration of the network. In this case, specific application requirements and their influences on algorithm design (for example, the design of routing algorithm, the design of the algorithm for wake-up/sleep mechanism, etc.) must be taken into account in choosing basic topology type (such as star, network, tree) .

If some or all of the network nodes are mobile nodes, the network topology must be updated routinely to maintain the functionality of the network. In this case, the network comprises two types of network nodes: mobile network nodes such as the mobile gateway in a wireless sensor network (WSN) , and fixed network nodes, such as the wireless nodes in WSN. In view of this situation, it is in this field a crucial problem to seek a network-reconfiguration method that ensures both network functions and highly efficient network topology.

It is assumed here that a mobile network node (e.g., a mobile gateway) wants to communicate with its adjacent wireless nodes (whose positions are fixed) . If the network topology is of a tree-structure, the geographic distance between the mobile net-

work node and its communication counterpart may be significantly different from the hop-distance between them, for instance: the mobile network node is in communication with a wireless node which is geographically nearest to it, but the hop-distance between the wireless node and the mobile network node may be the longest in view of the tree-structured topology. Here, the so-called hop-distance means the logical distance between the network nodes according to the network's topological structure. Hereinbelow, a mobile gateway is taken as an example of the mobile network node, but said mobile network node can also be used as a data source or a sink node (that is, a spot where data is utilized in the network).

Fig. 1 shows the difference between the geographic distance and the hop distance between the network nodes in a multi-hop wireless communication network. As shown in Fig. 1, the network node represented by the box is a mobile network gateway, the network nodes represented by circles are wireless nodes, and the mobile network gateway and various wireless nodes make up a multi-hop wireless communication network, which network adopts a tree-structured topology structure. Among the various wireless nodes, the nodes 101, 102, 103, 104, 105, 106, 107, 108, 109 and 110 can be used not only as data sources, but also as the network coordinators for another wireless node, being responsible for transferring the communication between the wireless node and the network gateway, wherein one transfer by a network coordinator is also referred to as one hop. In the tree-structured topology shown in Fig. 1, a node 110 is a root node among the wireless nodes for communicating with the mobile gateway, the wireless nodes from 101 to 109 are sub-nodes under the root node 110, and other wireless nodes without being numbered are the leaf nodes in the tree-structured topology structure. As mentioned above, each wireless node serves as a network coordinator which has a communication transfer function and is capable of transferring the data of the wireless node serving as its leaf node or the data of its last hop wireless node to the next hop wireless node or mobile gateway according

to the tree-structured topology. The numerals (1, 2, 3, 4, 5, 6, 7, 8, 9 or 10) labelled on various wireless nodes represent the network coordinators' hop distance from the wireless node to the mobile gateway. For instance, the hop distance from the wireless node 110 to the mobile gateway is 1, the hop distance from the wireless node 106 to the mobile gateway is 5, and the hop distance from the wireless node 101 to the mobile gateway is 10. In this way, when the mobile gateway and the wireless node 101 are the communication endpoints in communication, the data of the wireless node 101 need to go through ten hops to reach the mobile gateway according to the tree-structured topology, so the wireless node 101 is the network node of largest hop distance from the mobile gateway, while it can be seen in Fig. 1 that the wireless node 101 is the network node of the smallest geographic distance from the mobile gateway.

Therefore, it can be seen that the communication between the mobile gateway and some of the wireless nodes will need to go through many hops due to the requirements of the topology structure of the network, and this can be different significantly from the actual geographic distance between the mobile gateway and the wireless nodes, thus leading to the disadvantages such as long data transferring delay in multi-hop wireless communication networks, high total power consumption of wireless nodes and low utilization rate of wireless resources.

Content of the present invention

A main object of the present invention is to provide a temporary network-reconfiguration method in a multi-hop wireless communication network, which method is capable of dynamically, temporarily reconfiguring the network topology according to the difference between the geographic distances and logical distances between network nodes, so as to shorten communication time delay in a multi-hop wireless communication network, to increase the utilization rate of wireless resources, and to reduce power consumption of the network nodes.

At the same time, the present invention also provides a multi-hop wireless communication network system, which is capable of implementing the temporary network reconfiguration, and corresponding network nodes.

The technical scheme of the present invention is realized as follows :

a method for temporary network reconfiguration in a multi-hop wireless communication network, wherein said network comprises a first network node and at least one second network node, said first network node communicates with each of the second network nodes according to the topology of the network; and wherein the method comprises:

said first network node detecting a second network node as a target node, wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is larger than or equal to a preset second threshold; and

said first network node establishing a temporary association with said target node, and communicating with said target node according to the temporarily reconfigured network topology.

Optionally, the temporary association established by said first network node with said target node comprises:

said first network node initiating a request for the temporary association to said target node; and

said first network node establishing the temporary association with said target node when said target node accepts said request for the temporary association.

When said at least one second network node comprises at least one network coordinator; said at least one second network node comprises at least one network coordinator; and the temporary association established by said first network node with said target node comprises:

said first network node initiating a request for temporary association with said target node to the network coordinator of said target node;
said network coordinator accepting said request for the temporary association, and instructing said target node to establish the temporary association with said first network node.

When said network topology is of a tree-structure, and said target node is a root node of a sub-tree comprising at least one sub-node; and the temporary association established by said first network node with said target node comprises:
said first network node requesting said target node for a temporary association with the target node and all the sub-nodes of the target node; and
said first network node establishing the temporary association with said the target node and all the sub-nodes of the target node when said target node accepts the request for the temporary association.

Alternatively, when said network topology is of a tree-structure, said target node is a root node of a sub-tree comprising at least one sub-node; and the temporary association established by said first network node with said target node comprises :
said first network node requesting the target node for the temporary association with the target node and some of the sub-nodes of the target node; and
said first network node establishing the temporary association with the target node and these sub-nodes of the target node when said target node accepts the request for the temporary association .

Preferably, the method of the present invention further comprises :
said first network node and said target node storing the network topology information prior to the temporary reconfigura-

tion when the temporary association between them is established; and
when the geographic distance between said first network node and said target node is greater than said first threshold, said first network node and said target node restoring to the network topology prior to the temporary reconfiguration according to said information stored thereby.

A multi-hop wireless communication network system, which system comprises a first network node and at least one second network node, said first network node and each of said second network nodes are respectively used to communicate with each other according to the topology of said network; and
said first network node is also used to detect one of the second network nodes as a target node, wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is greater than or equal to a preset second threshold; and
said first network node and said target node are respectively used to establish a temporary association with each other, and to communicate with each other according to a temporarily reconfigured network topology.

A first network node in a multi-hop wireless communication network, which first network node is used to communicate with at least one second network node in said network according to the topology of said network; and
the first network node is also used to detect one of the second network nodes as a target node, to establish a temporary association with the target node, and to communicate with the target node according to the temporarily reconfigured network topology; wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is greater than or equal to a preset second threshold.

Specifically, the first network node comprises :

a first unit, for detecting said target node; and

a second unit, for establishing a temporary association with said target wireless node detected by the first unit, and for communicating with said target node according to a temporarily reconfigured network topology.

Optionally, said second unit is used to initiate a request for the temporary association to said target node, and to establish the temporary association with said target node when said target node accepts the request for the temporary association.

When said at least one second network node comprises at least one network coordinator; said second unit is used to initiate a request for the temporary association with said target node to the network coordinator of said target node, and to establish the temporary association with the target node when the network coordinator accepts the request for the temporary association and informs the target node.

Optionally, when the topology of said network is of a tree-structure, and said target node is a root node of a sub-tree comprising at least one sub-node, said second unit is used to request said target node for the temporary association with the target node and all the sub-nodes of the target node, and to establish the temporary association with said target node and all the sub-nodes of the target node when said target node accepts the request for the temporary association.

Optionally, when the topology of said network is of a tree-structure, and said target node is a root node of a sub-tree comprising at least one sub-node, said second unit is used to request from the target node for the temporary association with the target node and some of the sub-nodes of the target node, and to establish the temporary association with the target node

and these sub-nodes of the target node when said target node accepts the request for the temporary association.

A second network node in a multi-hop wireless communication network, which second network node is used to communicate with a first network node in the network according to the topology of said network, and
said second network node is also used to receive a request for a temporary association from said first network node, to establish the temporary association with said first network node, and to communicate with said first network node according to a temporarily reconfigured network topology.

The present invention can be adapted to multi-hop wireless communication networks of various known network topological structures, for example, the multi-hop wireless communication networks adopting a star topology or a web topology, but the present invention has more remarkable effects in a multi-hop wireless communication network that adopts a tree-structured topology and strictly demands low power consumption.

Description of the drawings

Fig. 1 is a schematic diagram of the difference between the geographic distance and the hop distance between network nodes in a multi-hop wireless communication network.
Figs 2A and 2B are schematic diagrams of the temporary reconfiguration process in a network topology structure according to the particular embodiments of the present invention.

Embodiments

The technical solutions and technical effects of the present invention will be further described in detail below in conjunction with the attached drawings.

The main concept of the present invention is that, based on the network topology structure of a multi-hop wireless communication network, a mobile gateway serving as a communication end-

point dynamically initiates a temporary reconfiguration of the network topology structure according to the difference between the geographic distance and the logical distance to its communication counterpart, so as to match the geographic distance and the logic distance between two communication endpoints, thereby reducing the number of times for data to be transferred during a communication process, and shortening the communication time delay in the multi-hop wireless communication network .

Figs 2A and 2B are schematic diagrams of a temporary network-reconfiguration process in a multi-hop wireless communication network with tree-structured topology according to an embodiment of the present invention. Fig. 2A is the schematic diagram of the network topology structure before the temporary reconfiguration of the multi-hop wireless communication network. In this case, the network node represented by the box is the mobile gateway, the network nodes represented by circles are wireless nodes, and the mobile gateway and various wireless nodes form a multi-hop wireless communication network, which network adopts a tree-structured topology. Among the various wireless nodes, the nodes 201, 202, 203 and 204 can be used not only as data sources, but also as the network coordinators, and the wireless nodes 211, 213, 214 and 214' are leaf nodes in the tree-structured network topology; they are only used as data sources for transmitting data, and for communicating with the mobile gateway via the transfer by the corresponding network coordinators .

The mobile gateway is currently associated with one of the adjacent wireless nodes, which is used as a network coordinator, such as the wireless node 202 shown in Fig. 2A, that is, the wireless node 202 is the root node for communicating with the mobile gateway. The numbers (1, 2, 3 or 4) labeled on the various wireless nodes represent the hop distances between the wireless node and the mobile gateway. For example: the hop distance from the wireless node 202 to the mobile gateway is 1,

the hop distance from the wireless node 201 to the mobile gateway is 2, the hop distances from the wireless nodes 213, 211 and 204 to the mobile gateway are all 3, and the hop distances from the wireless nodes 214 and 214' to the mobile gateway are all 4. As can be seen in Fig. 2A, the geographic distances between the mobile gateway and wireless nodes 202, 201 and 213 are basically the same, while the hop distances between the mobile gateway and these three wireless nodes are different from one another, which are one hop, two hops and three hops respectively, obviously, there are big differences between the geographic distances and the hop distances between the mobile gateway and wireless nodes, and as to the wireless nodes 201 and 213, they have to go through several hops to communicate with the mobile gateway, thus causing unnecessary power consumption, and reducing the communication efficiency. In this case, the mobile gateway needs to initiate a temporary reconfiguration of network topology structure, so as to communicate with the wireless nodes having relatively close geographic distances with a hop distance as small as possible.

In this particular embodiment, the mobile gateway continuously or routinely detects a target node, which target node is a wireless node having a relatively small geographic distance but a relatively large hop distance from the mobile gateway. Here, a first threshold of the geographic distance and a second threshold of the logic distance (i.e., the hop distance) in the network topology structure can be preset, and when the geographic distance from a wireless node to the mobile gateway is less than or equal to the first threshold and the logic distance is larger than or equal to the second threshold, the mobile gateway can determine that this wireless node is a target node. The first threshold and the second threshold can be set according to the coverage area and specific application requirements by the mobile gateway. When a target node is detected, the mobile gateway initiates a temporary reconfiguration of the network topology structure, requests to establish a temporary association with the target node, so as to be able to communicate

with the target node according to the network topology structure after the temporary reconfiguration.

When the mobile gateway initiates the temporary reconfiguration of network topology structure, the mobile gateway can request directly to the target node for a temporarily associate, and it can also request to the current network coordinator of the target node for a temporary association with the target node. If the mobile gateway requests directly to the target node for the temporary association, the mobile gateway will establish a temporary association with the target node when the mobile node accepts the request for the temporary association. If the mobile gateway requests the network coordinator of the target node for the temporary association with the target node, the mobile gateway will establish the temporary association with the target node after the network coordinator accepts the request for the temporary association and instructs the target node to associate with the mobile gateway. After the network coordinator accepts the request for the temporary association, the network coordinator can also send information to the target node and the mobile gateway simultaneously, so that the mobile gateway establishes the temporary association with the target node upon receiving the information.

After the mobile gateway establishes the temporary association with the target node, the target node can become a temporary root node for communicating with the mobile gateway, so that when the target node sends data to the mobile gateway, there is no need for intermediate transfer via the network coordinator, therefore the hop distance between the mobile gateway and the wireless node that has a closer geographic distance from the mobile gateway is also reduced, and by way of such temporary reconfiguration the communication time delay in the multi-hop wireless communication network is reduced, and the utilization rate of wireless resources is increased.

Here, there are many methods for the mobile gateway to detect the target node; for example, it can be performed by detecting the power of the wireless signals transmitted by the wireless nodes or on the basis of the pre-configured geographic position information of various network nodes, and this is not limited in the present invention.

When a target node detected by the mobile gateway is a sub-node under the current network topology structure, that is, the target node itself is the network coordinator of another wireless node, or it is the root node of a sub-tree comprising at least one sub-node, provided that the mobile gateway also covers all the sub-nodes belonging to the target node, for further increasing the communication efficiency of the network, when the mobile gateway initiates the request to temporarily associate with the target node, it can also request to temporarily associate with all or some of the sub-nodes of the target node simultaneously; thus, when the target node accepts the request for the temporary association, the mobile gateway establishes the temporary association with the target node and all or some of the sub-nodes of the target node.

Fig. 2B shows a schematic diagram of the tree-structured network topology in Fig. 2A after a temporary reconfiguration. As shown in Fig. 2B, the target nodes detected by the mobile gateway comprise the wireless nodes 201 and 213. The mobile gateway requests directly to the wireless node 201 for a temporary association. At the same time, the mobile gateway also requests to the network coordinator wireless node 203 of the wireless node 213 for a temporary association with the wireless node 213.

After the wireless nodes 201 and 203 have accepted the above-mentioned request, the mobile gateway establishes the temporary association with the wireless nodes 201 and 213, and, the original association of the wireless nodes 201 and 203 with their network coordinator wireless nodes 202 and 203 can be temporar-

ily interrupted, so that the hop distance of the wireless nodes 201 and 213 having small geographic distances from the mobile gateway is also reduced accordingly. As shown in Fig. 2B, after the network topology structure is temporarily reconfigured, the hop distances of the nodes 201 and 213 become one hop, so that the communication between these wireless nodes and the mobile gateway will have shorter communication time delay, and at the same time less power consumption.

Furthermore, when the mobile gateway establishes a temporary association with the target node, it can store the information of network topology structure before the temporary reconfiguration, and when the mobile gateway continues moving and the geographic distance from the target node becomes larger than the first threshold, the mobile gateway and the target node can restore to the topology structure before the temporary network reconfiguration according to the stored information, thereby ensuring the normal operation of the multi-hop wireless communication network.

In the present embodiment, correspondingly, a multi-hop wireless communication network system for implementing the above temporary network reconfiguration can comprise a mobile gateway and at least one wireless node, which mobile gateway and the various wireless nodes are used to communicate with one another according to the network topology structure respectively. Said mobile gateway is also used to detect a wireless node as a target node, the geographic distance between the target node and the mobile gateway is less than or equal to the preset first threshold, and the logic distance between them is greater than or equal to the preset second threshold; and the mobile gateway is used to establish a temporary association with the target node and to communicate with the target node according to the network topology structure after the temporary reconfiguration. The wireless node serving as the target node is also used to accept a request from the mobile gateway for the temporary association, so as to establish the temporary association with

the mobile gateway, and to communicate with the mobile gateway according to the network topology structure after the temporary reconfiguration.

Particularly, said mobile gateway can comprise a first unit and a second unit, said a first unit, for detecting said target node; and a second unit, for establishing a temporary association with said target wireless node detected by the first unit, and for communicating with said target node according to a temporarily reconfigured network topology. Optionally, said second unit is used to initiate a request for the temporary association to said target node, and to establish the temporary association with said target node when said target node accepts the request for the temporary association. Alternatively, said second unit is used to initiate a request for the temporary association with said target node to the network coordinator of said target node, and to establish the temporary association with the target node when the network coordinator accepts the request for the temporary association and informs the target node .

Furthermore, when the topology of the multi-hop wireless communication network is of a tree-structure, and said target node is a root node of a sub-tree comprising at least one sub-node; and said second unit can also be used to request said target node for the temporary association with the target node and all or some of the sub-nodes of the target node, and to establish the temporary association with said target node and all or some of the sub-nodes of the target node when said target node accepts the request for the temporary association.

According to the present invention, a possible application situation of the above embodiment is for use as a working security monitoring system within a dangerous working area. In such a system, various sensor nodes (equivalent to wireless nodes) fitted with wireless modules are arranged in the working area (e.g., a mine field), which sensor nodes are responsible for

collecting sensing data relating to potentially dangerous environmental conditions (e.g., the concentration of a gas). Assuming that these sensor nodes are powdered by batteries, an operator can collect the sensing data of the sensor nodes by a mobile device (corresponding to a mobile gateway) . If there is a limit to the hop distance for communication between the mobile device and sensor nodes, if the mobile device can only communicate with the sensor nodes within a range of N hops and, otherwise, the sensed data by the sensor nodes will be discarded, then, by adopting the above embodiment according to the present invention it will reduce the hop distance of the sensor nodes, thereby enabling the mobile device to communicate with more sensor nodes and to improve the data acquisition results. At the same time, by adopting the present invention it will also make the communication between the mobile device and sensor nodes more efficient, and save the battery power in the sensor nodes .

What are described above are merely the preferable embodiments of the present invention, and they are not intended to limit the protective scope of the present invention. Any modification, equivalent substitution and improvement within the spirit and principle of the present invention are all comprised in the protective scope of the present invention.

Claims

1. A method for temporary network reconfiguration in a multi-hop wireless communication network, wherein said network comprises a first network node and at least one second network node, said first network node communicates with each of the second network nodes according to the topology of the network; and characterized in that the method comprises:
said first network node detecting a second network node as a target node, wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is larger than or equal to a preset second threshold; and
said first network node establishing a temporary association with said target node, and communicating with said target node according to the temporarily reconfigured network topology.

2. The method as claimed in claim 1, characterized in that the temporary association established by said first network node with said target node comprises:
said first network node initiating a request for the temporary association to said target node; and
said first network node establishing the temporary association with said target node when said target node accepts said request for the temporary association.

3. The method as claimed in claim 1, characterized in that said at least one second network node comprises at least one network coordinator; and the temporary association established by said first network node with said target node comprises:
said first network node initiating a request for temporary association with said target node to the network coordinator of said target node;
said network coordinator accepting said request for the temporary association, and instructing said target node to establish the temporary association with said first network node.

4. The method as claimed in claim 2, characterized in that said network topology is of a tree-structure, said target node is a root node of a sub-tree comprising at least one sub-node; and the temporary association established by said first network node with said target node comprises:
said first network node requesting said target node for a temporary association with the target node and all the sub-nodes of the target node; and
said first network node establishing the temporary association with said the target node and all the sub-nodes of the target node when said target node accepts the request for the temporary association.

5. The method as claimed in claim 2, characterized in that said network topology is of a tree-structure, said target node is a root node of a sub-tree comprising at least one sub-node; and the temporary association established by said first network node with said target node comprises:
said first network node requesting the target node for the temporary association with the target node and some of the sub-nodes of the target node; and
said first network node establishing the temporary association with the target node and these sub-nodes of the target node when said target node accepts the request for the temporary association .

6. The method as claimed in any one of claims 1 to 5, characterized in that the method further comprises:
said first network node and said target node storing the network topology information prior to the temporary reconfiguration when the temporary association between them is established; and
when the geographic distance between said first network node and said target node is greater than said first threshold, said first network node and said target node restoring to the net-

work topology prior to the temporary reconfiguration according to said information stored thereby.

7. A multi-hop wireless communication network system, which system comprises a first network node and at least one second network node, and said first network node and each of said second network nodes are respectively used to communicate with each other according to the topology of said network; and characterized in that,
said first network node is also used to detect one of the second network nodes as a target node, wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is greater than or equal to a preset second threshold; and
said first network node and said target node are respectively used to establish a temporary association with each other, and to communicate with each other according to a temporarily reconfigured network topology.

8. A first network node in a multi-hop wireless communication network, which first network node is used to communicate with at least one second network node in said network according to the topology of said network; and characterized in that,
the first network node is also used to detect one of the second network nodes as a target node, to establish a temporary association with the target node, and to communicate with the target node according to the temporarily reconfigured network topology; wherein the geographic distance between said target node and said first network node is less than or equal to a preset first threshold, and the logical distance between said target node and said first network node is greater than or equal to a preset second threshold.

9. The first network node as claimed in claim 8, characterized in that the first network node comprises:
a first unit, for detecting said target node; and

a second unit, for establishing a temporary association with said target wireless node detected by the first unit, and for communicating with said target node according to a temporarily reconfigured network topology.

10. The first network node as claimed in claim 9, characterized in that,
said second unit is used to initiate a request for the temporary association to said target node, and to establish the temporary association with said target node when said target node accepts the request for the temporary association.

11. The first network node as claimed in claim 9, characterized in that said at least one second network node comprises at least one network coordinator; and
said second unit is used to initiate a request for the temporary association with said target node to the network coordinator of said target node, and to establish the temporary association with the target node when the network coordinator accepts the request for the temporary association and informs the target node.

12. The first network node as claimed in claim 10, characterized in that the topology of said network is of a tree-structure, said target node is a root node of a sub-tree comprising at least one sub-node; and
said second unit is used to request said target node for the temporary association with the target node and all the sub-nodes of the target node, and to establish the temporary association with said target node and all the sub-nodes of the target node when said target node accepts the request for the temporary association.

13. The first network node as claimed in claim 10, characterized in that the topology of said network is of a tree-structure, said target node is a root node of a sub-tree comprising at least one sub-node; and

said second unit is used to request from the target node for the temporary association with the target node and some of the sub-nodes of the target node, and to establish the temporary association with the target node and these sub-nodes of the target node when said target node accepts the request for the temporary association.

14. A second network node in a multi-hop wireless communication network, which second network node is used to communicate with a first network node in the network according to the topology of said network, characterized in that,
said second network node is also used to receive a request for a temporary association from said first network node, to establish the temporary association with said first network node, and to communicate with said first network node according to a temporarily reconfigured network topology.

FIG 1

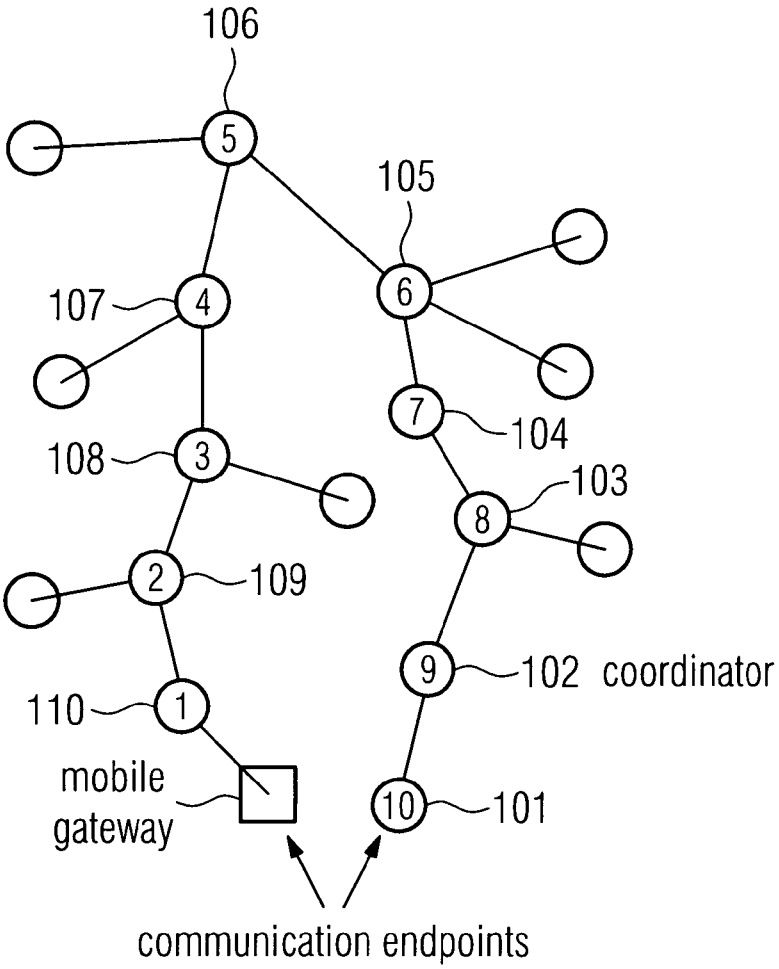

106
5
105
107
4
6
7
104
108
3
103
8
2
109
9
102 coordinator
110
1
mobile
gateway
10
101
communication endpoints

FIG 2A

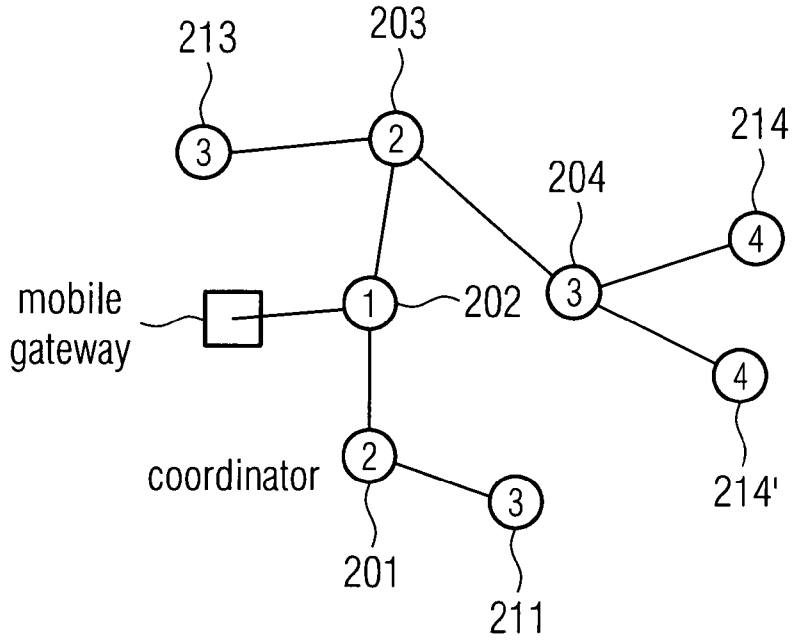
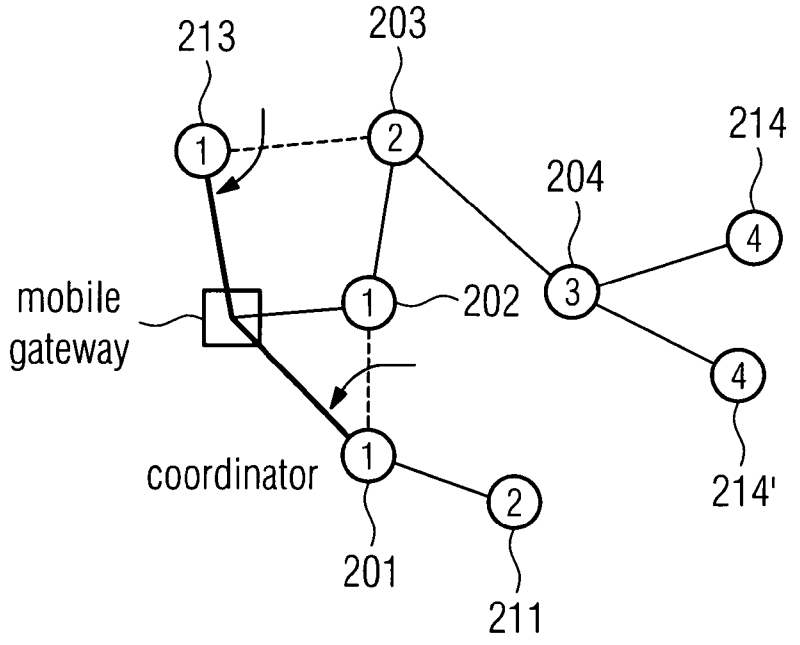

213
203
214
204
mobile
gateway
202
coordinator
214'
201
211

FIG 2B


213
203
214
204
mobile
gateway
202
coordinator
214'
201
211

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2008/064480

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/56

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

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 practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
X	US 7 106 703 Bl (BELCEA JOHN M [US]) 12 September 2006 (2006-09-12) column 5, line 16 - column 9, line 50	1-14
A	US 2005/015911 Al (HARTY ERIN D [US]) 27 January 2005 (2005-01-27) paragraphs [0008], [0012]	1-14
A	HAENGGI M: "Twelve reasons not to route over many short hops" VEHICULAR TECHNOLOGY CONFERENCE, 2004. VTC2004-FALL. 2004 IEEE 60TH LOS ANGELES, CA, USA 26-29 SEPT. 2004, PISCATAWAY, NJ, USA, IEEE, vol. 5, 26 September 2004 (2004-09-26), pages 3130-3134, XP010787450 ISBN: 978-0-7803-8521-4 the whole document	1-14

☐ Further documents are listed in the continuation of Box C

☒ See patent family annex

* Special categories of cited documents

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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'8' document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 March 2009	20/03/2009

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2008/064480

Patent document cited in search report	Publication date	Patent family member(s)	**Publication date**
US 7106703 B1	12-09-2006	NONE	
US 2005015911 A1	27-01-2005	NONE	