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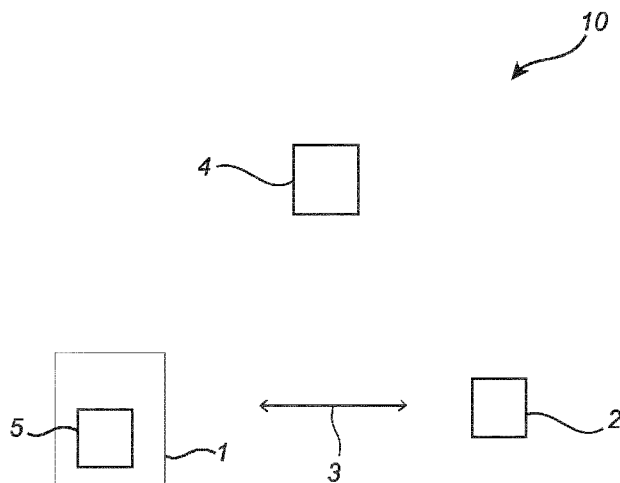


Fig. 1

(57) Abstract: A method performed by a controller to communicate with a node device in a wireless network comprising an access point, wherein the node device is configured to periodically be in a wake-up state while at other times be in a sleep state, wherein the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state. The controller receives a beacon message from the access point, and, upon receipt of the beacon message, transmits a command message, the command message including a command to control operation of the device.

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A METHOD PERFORMED BY A CONTROLLER TO COMMUNICATE WITH A NODE DEVICE

TECHNICAL FIELD

The present invention relates to a method performed by a controller to communicate with a node device in a wireless network comprising an access point. The present invention further relates to the controller.

5

BACKGROUND

In lighting systems, a controller may be configured to control operation of one or more lighting devices in the lighting system, wherein wireless local area network (WLAN) channels may be used for communication of control signaling from the controller to the lighting device(s). WLAN channels may be accessed using the IEEE (Institute of Electrical and Electronics Engineers) 802.11 protocols, for example. The IEEE 802.11 standard provides several distinct radio frequency bands for use in Wi-Fi communications, such as, for example, the 2.4 GHz range, with each range being divided into several channels. For example, in the 2.4 GHz range, fourteen channels are designated. The controller may be referred to as a remote control (e.g., for the user), and may operate on power from a battery in the controller. If a lighting device in the lighting system enters a power saving mode or 'sleep' mode (e.g., a Wi-Fi power save mode), wherein at least reception communication capabilities of the lighting device may be momentarily turned off, it may be required by the controller – in order for the controller to control operation of a lighting device by transmission of control signaling to the lighting device – to send the control signaling as a relatively large number of messages (e.g., packets) to the lighting device over an extended period of time to ensure that the control signaling is received by the lighting device. This may be detrimental to the power level of a battery of the controller, and by the controller having to send a relatively large number of messages to the lighting device, the power of the controller's battery may be reduced relatively fast. Thus, in order to ensure effective communication of control signaling from the controller to the lighting device(s), the power consumption of the controller may become relatively high.

US2017223807A1 discloses a cloud connected lighting system may include a wireless lighting network of coordinated lighting devices and a bridge to provide connectivity to external devices such as a cell phone, home automation system or security system. It further discloses an RF remote control sends control command to wireless lighting module upon user pressing a button on the controller. The communication channel between the remote control and the wireless lighting module either randomly generated, or input by a user.

SUMMARY

In view of the above, a concern of the present invention is to provide means for providing effective communication of, e.g., control signaling, from a controller to a node device which may be controlled or controllable by the controller while keeping the power consumption of the controller relatively low. The node device may for example comprise a lighting device, which may be included in a lighting system.

According to a first aspect of the present invention, a method is provided. The method is performed by a controller to communicate with a node device in a wireless network comprising an access point. The node device is configured to periodically be in a wake-up state while at other times be in a sleep state and the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, wherein each of said beacon messages includes a network identifier of the wireless network via which the beacon message is transmitted. The controller comprises a memory in which it is stored a network identifier of a wireless network, and a channel identifier of a wireless channel for communication between the controller and the node device. The method comprises the controller receiving a beacon message from the access point. If the network identifier included in the received beacon message matches the network identifier stored in the controller's memory, the controller, upon receipt of the beacon message, transmits a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory, the command message including a command to control operation of the node device.

According to a second aspect of the present invention, a controller is provided. The controller is configured to communicate with a node device in a wireless network comprising an access point, wherein the node device is configured to periodically be in a wake-up state while at other times be in a sleep state and the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in

which the node device is in the wake-up state and the sleep state, wherein each of said beacon messages includes a network identifier of the wireless network via which the beacon message is transmitted. The controller comprises a memory in which it is stored a network identifier of a wireless network, and a channel identifier of a wireless channel for communication between the controller and the node device. The controller is configured to receive a beacon message from the access point. The controller is configured to, if the network identifier included in the received beacon message matches the network identifier stored in the controller's memory, upon receipt of the beacon message, transmit a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory, the command message including a command to control operation of the node device.

The wake-up state of the node device may be a state in which transmission and reception communication capabilities of the node device are turned on. The sleep state of the node device may be a state in which at least the transmission and reception communication capabilities of the device are turned off.

In the memory of the controller is might further be stored a previously determined indication of the duration of the periods of time during which the node device is in the wake-up state.

The controller may be communicatively couplable with the node device via at least one wireless channel of a wireless local area network (WLAN), which may be based on the IEEE (Institute of Electrical and Electronics Engineers) 802.11 protocols, for example. However, it is not necessary for the controller to be communicatively couplable with the node device via at least one wireless channel of a WLAN. In fact, the controller may now 'know' the network credentials of a WLAN which the node device may join. The controller and the node device may communicate by means of a 'private' protocol, and the controller may not join the WLAN.

By the access point being configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, and the controller being configured to, upon receipt of the beacon message (e.g., upon sensing or determining that the beacon message has been received), transmit a command message, the time instants or periods of time when the controller sends command messages may be (e.g., indirectly) temporally aligned (e.g., matching/corresponding in time) with the periods of time during which node device is in the wake-up state, whereby a relatively high chance of successfully transmitting the command message (e.g., including one or more packets) to the node device can be achieved.

It is to be understood that the access point may, in principle, comprise any device capable of communication (e.g., wireless communication) with other devices such as the controller, and which device is capable of performing the herein described functionalities of the access point, e.g., transmission of beacon messages as described herein. Thus, while
5 reference is made herein to an “access point”, it could instead be referred to another entity capable of performing the herein described functionalities of the access point, e.g., transmission of beacon messages as described herein.

For example, in the context of a WLAN based on the IEEE 802.11 standards, the said beacon messages transmitted by the access point with the said periodicity may
10 correspond to, e.g., beacons or beacon frames transmitted by the access point and which include a delivery traffic indication message (DTIM). The time intervals between transmission of beacons or beacon frames including a DTIM may be defined by the so-called DTIM interval, and the periods of time during which the node device is in the wake-up state – which may be referred to as awake periods – may match the DTIM interval. Therefore,
15 using the fact that the awake periods of the node device are periodic and match the DTIM interval, the time instants or periods of time when the controller sends command messages may be (e.g., indirectly) temporally aligned (e.g., matching/corresponding in time) with the periods of time during which the node device is in the wake-up state by sensing or determining that one of said beacon messages has been received.

20 The wireless channel for communication between the controller and the node device may be the same as a wireless channel for communication between the node device and the access point.

The command message may include one or more sub-messages transmitted in a first period of time, wherein each of the sub-message(s) may include the command, and the
25 duration of the first period of time may be at least a portion of the duration of the period of time during which the node device is in the wake-up state. Transmission of the one or more sub-messages transmitted in such a first period of time (e.g., having such a duration) may further facilitate achieving a relatively high chance of successfully transmitting the command message to the node device (e.g., a relatively high chance that the command message is
30 actually received by the node device), with only one or a few sub-messages needed to be transmitted. By such configurations, the amount of signaling from the controller to the node device required to ensure a relatively high chance of that control signaling from the controller is actually received by the node device may be kept relatively low. Thus, by means of the method and the controller according to the first and second aspects of the present invention,

respectively, effective communication of, e.g., control signaling, from the controller to the node device may be achieved while still keeping the power consumption of the controller relatively low.

The node device may comprise or be comprised in a lighting device
5 configured to controllably emit light. The command included in the command message may be a command to control emission of light from the lighting device.

The controller may be configured to obtain, or has previously obtained, an indication of the periodicity with which the access point is configured to periodically transmit the said beacon messages. This may entail that the periodicity with which the access point is
10 configured to periodically transmit the said beacon messages is predefined or preconfigured in the controller (e.g., having been previously stored in a (the) memory of the controller). In alternative or in addition, the periodicity with which the access point is configured to periodically transmit the said beacon messages may have been signaled to the controller (e.g., by the access point). For example, the periodicity with which the access point is configured
15 to periodically transmit the said beacon messages may be part of and/or be defined or have been defined by an upper layer protocol.

The network identifier of a (or the) wireless network stored in the controller's memory and/or the network identifier which may be included in each of said beacons may for example, in the context of a WLAN based on the IEEE 802.11 standards, a service set
20 identifier (SSID).

As indicated in the foregoing, the controller may be configured to check if the network identifier included in a received beacon message matches the network identifier stored in the controller's memory. In the context of a WLAN based on the IEEE 802.11 standards, this may mean that the controller may be configured to check if a SSID which may
25 be included in the beacon message matches a SSID which may be stored in the memory of the controller.

The node device, if receiving a sub-message of the one or more sub-messages, may (e.g., be configured to) transmit an acknowledgement message on the wireless channel corresponding to the channel identifier. Thus, method may comprise, or the controller may be
30 configured for, receiving an acknowledgement message on the wireless channel corresponding to the channel identifier from the node device, the acknowledgement message being sent by the node device in response to receiving a sub-message of the one or more sub-messages from the controller.

Each of the said beacon messages may further an indication of the said periodicity with which the beacon messages are transmitted by the access point. If the controller, after the first sub-message of the one or more sub-messages included in the command message has been transmitted and after lapse of a period of time corresponding to the time between transmission of successive beacon messages determined from the indication of the said periodicity, has not yet received any acknowledgement message, the controller may (e.g., be configured to), upon lapse of said period of time, re-transmit the command message via the wireless channel corresponding to the channel identifier stored in the controller's memory.

The said network identifier, and the said channel identifier, and possibly also the said previously determined indication of duration of the periods of time during which the node device is in the wake-up state may have been previously determined by the carrying out of a pairing process to establish a relationship between the controller and the node device for wireless communications via the wireless network. Such a pairing process may for example include the controller transmitting a so-called binding command to the node device using a multi-packet method, and the node device, after having received the binding command, transmitting an acknowledgement message, which acknowledgement message may include an identifier of a wireless network the node device is using, an identifier of at least one wireless channel the node device is using, and possibly an indication of duration of the periods of time during which node device is in the wake-up state. The controller may then receive the acknowledgement message and store the mentioned information included in the acknowledgement message in the memory of the controller.

If, after a selected number N of re-transmissions of the command message, wherein $N \geq 1$, the controller has not yet received any acknowledgement message, the controller may (e.g., be configured to) re-do a pairing process to re-determine a network identifier of the wireless network used for communication between the access point and the node device, and a channel identifier of the wireless channel used for communication between the controller and the node device, and possibly an indication of duration of the periods of time during which the node device is in the wake-up state. Subsequently, the controller may (e.g., be configured to) replace the network identifier, the channel identifier and possibly the indication of duration stored in the memory of the controller with the re-determined network identifier, channel identifier and possibly indication of duration, respectively.

In case the command message includes several, or a plurality of, sub-messages, the sub-messages may be transmitted successively over the first period of time. The command message may include at least three sub-messages and possibly at most ten sub-messages. The command message may for example include between three to five sub-
5 messages.

The duration of the first period of time may exceed the duration of the period of time during which the node device is in the wake-up state.

The controller may be configured to selectively be in a state in which its transmission and reception communication capabilities are turned on or in a state in which
10 the transmission communication capability of the controller is turned off while the reception communication capability of the controller is turned on. The controller, prior to receiving the beacon message from the access point, may (e.g., be configured to) be in the state in which the transmission communication capability of the controller is turned off while the reception communication capability of the controller is turned on. The controller may (e.g., be
15 configured to) upon receipt of the beacon message from the access point, enter the state in which its transmission and reception communication capabilities are turned on. By such configurations, the power consumption of the controller may be kept relatively low.

The wireless network may be defined by a group of entities in the wireless network in which the controller, the node device and the access point may be included, and
20 wherein each of said beacon messages transmitted by the access point further includes an indication that there is buffered data at the access point destined for several entities of the group of entities (e.g., for entities of the group other than the access point). In the context of a WLAN based on the IEEE 802.11 standards, the indication that there is buffered data at the access point destined for several entities of the group of entities may correspond to a DTIM.

As mentioned, the node device is configured to periodically be in a wake-up state while at other times (e.g., at all other times) be in a sleep state. The sleep state may be referred to as a power saving state or mode, or an idle state or mode. In such as power saving or idle state or mode of the node device, the node device may turn off at least its transmission and reception communication capabilities. The node device may include a power source (e.g.,
25 a battery), and in the power saving or idle state or mode of the node device, the node device may shut down power from the power source to the elements of the node device which enable the transmission and reception communication capabilities of the node device (e.g., including one or more radio frequency antennas).

As also mentioned, the controller may be configured to selectively be in a state in which its transmission and reception communication capabilities are turned on or in a state in which the transmission communication capability of the controller is turned off while the reception communication capability of the controller is turned on. The state of the controller in which (e.g., at least) the transmission capability of the controller is turned off while the reception communication capability of the controller is turned on may be referred to as a power saving state or mode. In such a power saving state or mode of the controller, the controller may hence turn off at least its transmission communication capability. The controller may include a power source (e.g., a battery), and in the power saving or idle state or mode of the controller, the controller may shut down power from the power source to (e.g., at least) the elements of the controller which enable the transmission communication capability of the controller (e.g., including one or more radio frequency antennas).

For example, the periods of time during which the node device is in the wake-up state and the periods of time therebetween during which the node device is in the sleep state may be alternatingly occurring. The periods of time during which the node device is in the wake-up state may be (e.g., about) 10 ms and the periods of time therebetween during the node device is in the sleep state may be (e.g., about) 90 ms. Thus, in each 100 ms time period, the node device may be in a wake-up state or mode for (e.g., about) 10 ms and in a sleep state or mode for (e.g., about) 90 ms. By such a configuration, the power consumption of the node device may be kept relatively low.

According to a third aspect of the present invention, a system is provided. The system comprises a controller according to the second aspect of the present invention and a node device configured to periodically be in a wake-up state while at other times be in a sleep state. The controller is configured to communicate with the node device in a wireless network comprising an access point configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, wherein each of said beacon messages includes a network identifier of the wireless network via which the beacon message is transmitted. The controller is configured to receive a beacon message from the access point. The controller is configured to, if the network identifier included in the received beacon message matches the network identifier stored in the controller's memory, upon receipt of the beacon message, transmit a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory, the command message including a command to control operation of the node device.

As indicated, the node device may be communicatively coupled or couplable with the controller, and the controller may be configured to control operation of the node device and may be communicatively couplable with the node device via at least one wireless channel. To that end, each or any node device and/or the controller may comprise one more
5 transmit and/or receive elements such as one or more radio frequency antennas in order to provide each or any node device and/or the controller with a capability to communicate with, e.g., the controller and the node device, respectively. Further, each or any node device and/or the controller may comprise one or more processors configured to cooperate with the one more transmit and/or receive elements to perform transmission and reception as described
10 herein as well as to carry out any other operation as described herein. Similarly, the access point may comprise one more transmit and/or receive elements such as one or more radio frequency antennas in order to provide the access point with a capability to communicate with, e.g., the controller and/or the node device, respectively. Further, the access point may comprise one or more processors configured to cooperate with the one more transmit and/or
15 receive elements to at least perform transmission of beacon messages as described herein. The one or more processors of the node device, the controller and/or the access point may for example comprise a central processing unit (CPU), a digital signal processor (DSP), one or more microprocessors, an Application Specific Integrated Circuit (ASIC), a Field Programmable Gate Array (FPGA) circuit, any other type of integrated circuit (IC), a state
20 machine, or the like.

According to another aspect of the present invention, a computer-readable storage medium is provided, on which computer-readable storage medium a computer program product is stored. The computer program product is configured to, when executed in one or more processors of a controller according to the second aspect of the present
25 invention, cause the controller to perform a method according to the first aspect of the present invention.

According to yet another aspect of the present invention, a computer program product is provided. The computer program product is configured to, when executed in one or more processors of a controller according to the second aspect of the present invention,
30 cause the controller to perform a method according to the first aspect of the present invention. To that end, the computer program product may be configured to, when executed in one or more processors of a controller according to the second aspect of the present invention, cooperate with any transmit and/or receive element(s) of the controller to perform any

receiving and/or transmitting step comprised in a method in accordance with the first aspect of the present invention.

Further objects and advantages of the present invention are described in the following by means of exemplifying embodiments. It is noted that the present invention relates to all possible combinations of features recited in the claims. Further features of, and advantages with, the present invention will become apparent when studying the appended claims and the description herein. Those skilled in the art realize that different features of the present invention can be combined to create embodiments other than those described herein.

10 BRIEF DESCRIPTION OF THE DRAWINGS

Exemplifying embodiments of the invention will be described below with reference to the accompanying drawings.

Fig. 1 is a schematic view of a system according to an embodiment of the present invention.

15 Fig. 2 is a schematic flowchart of a method according to an embodiment of the present invention.

All the figures are schematic, not necessarily to scale, and generally only show parts which are necessary in order to elucidate embodiments of the present invention, wherein other parts may be omitted or merely suggested.

20

DESCRIPTION WITH REFERENCE TO THE DRAWINGS

The present invention will now be described hereinafter with reference to the accompanying drawings, in which exemplifying embodiments of the present invention are shown. The present invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments of the present invention set forth herein; rather, these embodiments of the present invention are provided by way of example so that this disclosure will convey the scope of the invention to those skilled in the art. In the drawings, identical reference numerals denote the same or similar components having a same or similar function, unless specifically stated otherwise.

30 Figure 1 is a schematic view of a system 10 according to an embodiment of the present invention.

The system 10 comprises a controller 1 and a node device 2 configured to periodically be in a wake-up state while at other times be in a sleep state. The controller 1 is configured to communicate with the node device 2 in a wireless network comprising an access

point 4 configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device 2 is in the wake-up state and the sleep state, wherein each of the said beacon messages includes a network identifier of the wireless network via which the beacon message is transmitted. The controller comprises a memory 5 in which it is stored a network identifier of a wireless network, and a channel identifier of a wireless channel, schematically indicated at 3, for communication between the controller 1 and the node device 2.

The controller 1 is configured to receive a beacon message from the access point 4.

The controller 1 is configured to, if the network identifier included in the received beacon message matches the network identifier stored in the controller's 1 memory 5: upon receipt of the beacon message, transmit a command message via the wireless channel corresponding to the channel identifier stored in the controller's 1 memory 5. The command message includes a command to control operation of the node device 2. The command message may include one or more sub-messages transmitted in a first period of time, wherein each of the sub-message(s) includes the command. The duration of the first period of time may be at least a portion of the duration of the period of time during which the node device 2 is in the wake-up state.

Figure 2 is a schematic flowchart of a method 20 according to an embodiment of the present invention. The method 20 is performed by a controller to communicate with a node device in a wireless network comprising an access point. The controller may for example be a controller 1 in accordance with the system 10 described in the foregoing with reference to Figure 1. The node device is configured to periodically be in a wake-up state while at other times be in a sleep state and the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, wherein each of said beacon messages includes a network identifier of the wireless network via which the beacon message is transmitted. The controller comprises a memory in which it is stored a network identifier of a wireless network, and a channel identifier of a wireless channel for communication between the controller and the node device.

The method 20 comprises, at 21, the controller receiving a beacon message from the access point.

At 26, it is checked (e.g., by the controller) if the network identifier included in the beacon message received at 21 matches the network identifier stored in the controller's

memory. If the network identifier included in the beacon message received at 21 does not match the network identifier stored in the controller's memory, the method 20 may then end. If the network identifier included in the beacon message received at 21 matches the network identifier stored in the controller's memory, the controller, upon receipt of the beacon message, at 22, transmits a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory. The command message includes a command to control operation of the node device. The command message may include one or more sub-messages transmitted in a first period of time, wherein each of the sub-message(s) includes the command. The duration of the first period of time may be at least a portion of the duration of the period of time during which the node device is in the wake-up state.

In accordance with the embodiment of the present invention illustrated in Figure 2, the controller may receive, at 23, an acknowledgement message on the wireless channel corresponding to the channel identifier from the node device, with the acknowledgement message being sent by the node device in response to receiving a sub-message of the one or more sub-messages from the controller.

In accordance with the embodiment of the present invention illustrated in Figure 2, each of the said beacon messages may include an indication of said periodicity with which the beacon messages are transmitted by the access point. At 27, it may be determined whether the controller, after the first sub-message of the one or more sub-messages included in the command message has been transmitted and after lapse of a period of time corresponding to the time between transmission of successive beacon messages determined from the indication of said periodicity, has received any acknowledgement message. If the controller, after the first sub-message of the one or more sub-messages included in the command message has been transmitted and after lapse of a period of time corresponding to the time between transmission of successive beacon messages determined from the indication of said periodicity, has received an acknowledgement message, the method 20 may then end.

If the controller, after the first sub-message of the one or more sub-messages included in the command message has been transmitted and after lapse of a period of time corresponding to the time between transmission of successive beacon messages determined from the indication of said periodicity, has not yet received any acknowledgement message, the controller may, at 24, re-transmit the command message via the wireless channel corresponding to the channel identifier stored in the controller's memory.

The said network identifier, and the said channel identifier, and possibly a previously determined indication of duration of the periods of time during which the node

device is in the wake-up state may have been previously determined by the carrying out of a pairing process to establish a relationship between the controller and the node device for wireless communications via the wireless network.

In accordance with the embodiment of the present invention illustrated in Figure 2, at 28, it may be determined whether, after a selected number N of re-transmissions of the command message, wherein $N \geq 1$, the controller has not yet received any acknowledgement message. If the controller has then received an acknowledgement message, the method 20 may then end.

If, after the selected number N of re-transmissions of the command message, the controller has not yet received any acknowledgement message, the controller may, at 25, re-do a pairing process to re-determine a network identifier of the wireless network used for communication between the access point and the node device, and a channel identifier of the wireless channel used for communication between the controller and the node device, and possibly an indication of duration of the periods of time during which the node device is in the wake-up state, and replace the network identifier, the channel identifier and possibly the indication of duration stored in the memory of the controller with the re-determined network identifier, channel identifier and possibly indication of duration, respectively. The method 20 may then end.

In conclusion, a method is disclosed, the method being performed by a controller to communicate with a node device in a wireless network comprising an access point, wherein the node device is configured to periodically be in a wake-up state while at other times be in a sleep state, wherein the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state. The controller receives a beacon message from the access point, and, upon receipt of the beacon message, transmits a command message, the command message including a command to control operation of the device.

While the present invention has been illustrated in the appended drawings and the foregoing description, such illustration is to be considered illustrative or exemplifying and not restrictive; the present invention is not limited to the disclosed embodiments. Other variations to the disclosed embodiments can be understood and effected by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the appended claims, the word “comprising” does not exclude other elements or steps, and the indefinite article “a” or “an” does not exclude a plurality. The mere fact that certain measures are recited in mutually different dependent claims does not indicate

that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. A method (20) performed by a controller (1) to communicate with a node device (2) in a wireless network comprising an access point (4), wherein the node device (2) is configured to periodically be in a wake-up state while at other times be in a sleep state and the access point (4) is configured to periodically transmit beacon messages with a periodicity
5 matching the periods of time in which the node device (2) is in the wake-up state and the sleep state, each of said beacon messages including a network identifier of the wireless network via which the beacon message is transmitted, the method comprising:

obtaining said network identifier and a channel identifier of a wireless channel for communication between the access point (4) and the node device (2) by carrying out of a
10 pairing process with the node device (2);

storing the network identifier of the wireless network, and the channel identifier of the wireless channel (3) for communication between the access point and the node device (2) in a memory (5),

the method further comprising:

15 the controller (1) receiving (21) a beacon message from the access point (4);

if the network identifier included in the received beacon message matches the network identifier stored in the controller's memory:

the controller (1), upon receipt of the beacon message, transmitting (22) a command message via the wireless channel corresponding to the channel identifier stored in
20 the controller's memory, the command message including a command to control operation of the node device (2).

2. A method according to claim 1, further comprising the step of:

obtaining an indication of duration of the periods of time during which the
25 node device is in the wake-up state by carrying out the pairing process.

3. A method according to claim 1 or 2, wherein the command message includes one or more sub-messages transmitted in a first period of time, wherein the duration of the

first period of time is at least a portion of the duration of the period of time during which the node device (2) is in the wake-up state.

4. A method according to claim 3, further comprising:

5 receiving (23) an acknowledgement message on the wireless channel corresponding to the channel identifier from the node device (2), the acknowledgement message being sent by the node device (2) in response to receiving a sub-message of the one or more sub-messages from the controller (1).

10 5. A method according to claim 3 or 4, wherein each of said beacon messages further includes an indication of said periodicity with which the beacon messages are transmitted by the access point (4), and wherein the method further comprises:

if the controller (1), after the first sub-message of the one or more sub-messages included in the command message has been transmitted and after lapse of a period
15 of time corresponding to the time between transmission of successive beacon messages determined from the indication of said periodicity, has not yet received any acknowledgement message, the controller (1), upon lapse of said period of time, re-transmitting (24) the command message via the wireless channel corresponding to the channel identifier stored in the controller's memory.

20 6. A method according to claim 5, wherein the said network identifier and the said channel identifier have been previously determined by the carrying out of a pairing process to establish a relationship between the controller and the node device (2) for wireless communications via the wireless network, and wherein the method further comprises:

25 if, after a selected number N of re-transmissions of the command message, wherein $N \geq 1$, the controller has not yet received any acknowledgement message, the controller re-doing (25) a pairing process to re-determine a network identifier of the wireless network used for communication between the access point (4) and the node device (2), and a channel identifier of the wireless channel for communication between the controller (1) and
30 the node device (2), and replace the network identifier and the channel identifier stored in the memory of the controller (1) with the re-determined network identifier and channel identifier, respectively.

7. A method according to any one of claims 3-6, wherein if the command message includes a plurality of sub-messages, the sub-messages are transmitted successively over the first period of time.

5 8. A method according to any one of claims 3-7, wherein the duration of the first period of time exceeds the duration of the period of time during which the node device is in the wake-up state.

9. A method according to any one of claims 1-8, wherein the controller is
10 configured to selectively be in a state in which its transmission and reception communication capabilities are turned on or in a state in which the transmission communication capability of the controller is turned off while the reception communication capability of the controller is turned on, and wherein the controller, prior to receiving the beacon message from the access point, is in the state in which the transmission communication capability of the
15 controller is turned off while the reception communication capability of the controller is turned on, and wherein upon receipt of the beacon message from the access point, the controller enters the state in which its transmission and reception communication capabilities are turned on.

20 10. A method according to any one of claims 1-9, wherein the wireless network is a Wi-Fi network.

11. A controller (1) configured to communicate with a node device (2) in a wireless network comprising an access point (4), wherein the node device (2) is configured to
25 periodically be in a wake-up state while at other times be in a sleep state and the access point is configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, each of said beacon messages including a network identifier of the wireless network via which the beacon message is transmitted, wherein the controller is configured to:
30 obtain said network identifier and a channel identifier of a wireless channel for communication between the access point (4) and the node device (2) by carrying out of a pairing process with the node device (2);

store the network identifier of the wireless network, and the channel identifier of the wireless channel (3) for communication between the access point and the node device (2) in a memory (5),

receive a beacon message from the access point; and

5 if the network identifier included in the received beacon message matches the network identifier stored in the controller's memory, upon receipt of the beacon message, transmit a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory, the command message including a command to control operation of the node device.

10 12. A controller according to claim 11, wherein the command message includes one or more sub-messages transmitted in a first period of time, wherein the duration of the first period of time is at least a portion of the duration of the period of time during which the node device is in the wake-up state.

15 13. A controller according to claim 12, wherein the controller is further configured to receive an acknowledgement message on the wireless channel corresponding to the channel identifier from the node device, the acknowledgement message being sent by the node device in response to receiving a sub-message of the one or more sub-messages from
20 the controller.

14. A system (10) comprising:
a controller (1) according to any one of claims 11-13;
a node device (2) configured to periodically be in a wake-up state while at

25 other times be in a sleep state; and
wherein the controller is configured to communicate with the node device in a wireless network comprising an access point (4) configured to periodically transmit beacon messages with a periodicity matching the periods of time in which the node device is in the wake-up state and the sleep state, each of said beacon messages including a network
30 identifier of the wireless network via which the beacon message is transmitted;

wherein the controller is configured to receive a beacon message from the access point;

wherein the controller is configured to, if the network identifier included in the received beacon message matches the network identifier stored in the controller's memory:

upon receipt of the beacon message, transmit a command message via the wireless channel corresponding to the channel identifier stored in the controller's memory, the command message including a command to control operation of the node device.

- 5 15. A computer program product configured to, when executed in one or more processors of a controller (1) according to any one of claim 11-13, cause the controller to perform a method according to any one of claims 1-10.

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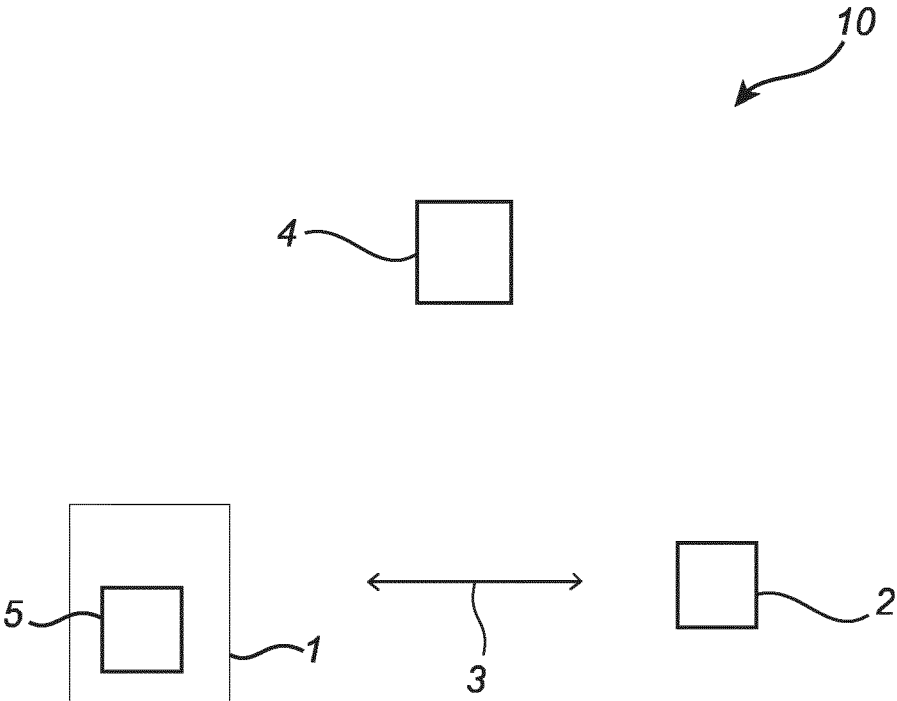
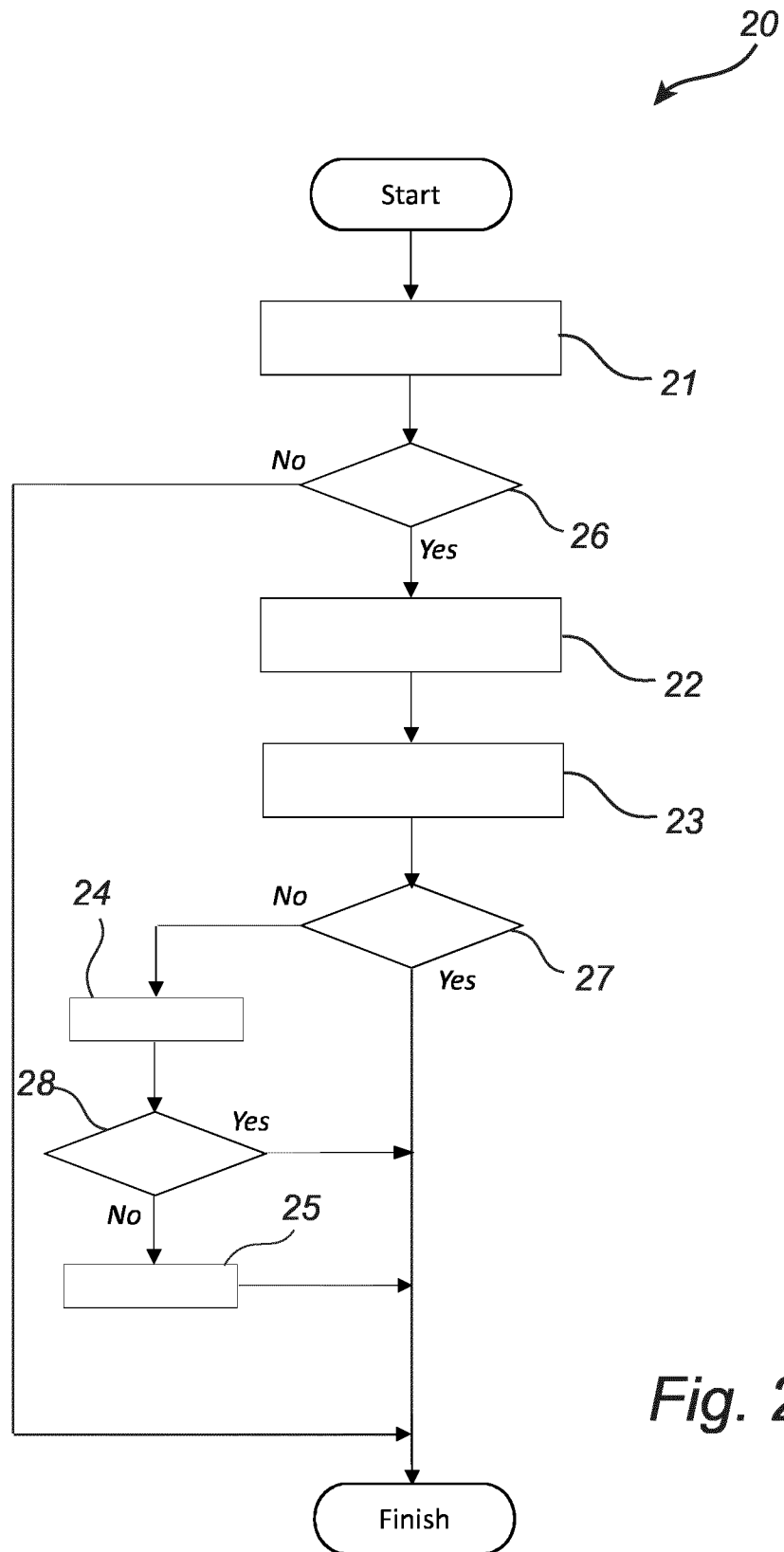


Fig. 1

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*Fig. 2*

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2024/087595

A. CLASSIFICATION OF SUBJECT MATTER INV. H04W52/02 H05B47/19 ADD.		
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) H04W H05B 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		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017/223807 A1 (RECKER MICHAEL V [US] ET AL) 3 August 2017 (2017-08-03) abstract paragraph [0152] - paragraph [0239] figures 1-19 figures 38-67 claims 1-21 -----	1 - 15
A	US 2018/007516 A1 (GE XIAODONG [CN] ET AL) 4 January 2018 (2018-01-04) the whole document ----- - / - -	1 - 15
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "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" 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 "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 "X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 28 February 2025		Date of mailing of the international search report 14/03/2025
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Niederholz, Jürgen

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2024/087595

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PREGIZER FLORIAN ET AL: "Energy consumption of IEEE 802.11 connected consumer electronic devices", 2013 IEEE THIRD INTERNATIONAL CONFERENCE ON CONSUMER ELECTRONICS & BERLIN (ICCE-BERLIN), IEEE, 9 September 2013 (2013-09-09), pages 168-172, XP032549131, DOI: 10.1109/ICCE-BERLIN.2013.6698008 the whole document -----	1 - 15

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Information on patent family members

International application No
PCT/EP2024/087595

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