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- (54) **Title:** METHOD OF COMMISSIONING DEVICES OF A LIGHTING SYSTEM TO A GROUP OF DEVICES, A COMMISSIONING DEVICE AND A LIGHTING SYSTEM

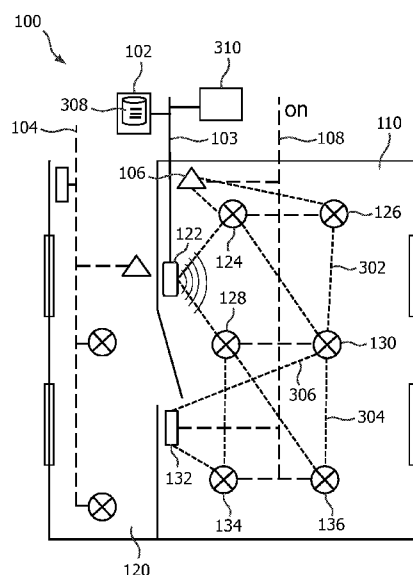


FIG. 3

- (57) **Abstract:** A method of commissioning devices of a lighting system (100) to a group of devices, a commissioning device (310) and a lighting system (100) are provided. The lighting system (100) comprises a set of lighting, sensor and/or switching devices which have a network interface for connecting to a first network. The lighting system (100) also comprises a gateway device (122) connected between the first network and a second network (103). The network node (102) is coupled to the first and/or second network. According to the method, a subset of devices of the lighting system receive power at a particular moment in time and, thus, are switched on simultaneously, resulting in, via a stage of connecting the devices to the first network, a logging of an identification of the switched on devices at the network node. A group address is assigned to the group of devices which are logged by the network node within a predetermined time interval starting at or after the particular moment in time.



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Method of commissioning devices of a lighting system to a group of devices, a commissioning device and a lighting system

FIELD OF THE INVENTION

The invention relates to a method of commissioning devices of a lighting system to a group of devices. The invention further relates to a commissioning device and to a lighting system.

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BACKGROUND OF THE INVENTION

Published patent application US2011/0025469A1 relates to a lighting system in which a plurality of lighting devices and switches are connected to a shared network-based infrastructure. The switches and lighting devices may communicate with each other via the shared network and the switches may, for example, send messages to the lighting devices to switch on and switch off the lighting devices. In such a lighting system a problem exists with respect to the commissioning of specific lighting devices to specific switches. For example, a group of lighting devices in a specific office has to be commissioned to a switch in the same specific office such that when a user touches the switch, the specific lighting devices switch on or switch off. The same commissioning may be required when a sensor with a network module is present at specific places and the sensor is used to detect the presence of people or to detect the level of daylight. For example, in a corridor, a sensor may detect the presence of people and in response to the detection of people the lighting devices in the corridor must be switched on. US2011/0025469 discloses a method of commissioning specific lighting devices to specific switches and/or sensors. According to the cited document, after installing all the hardware, a person visits all spaces of a building and in each room the person reads for every device (lighting device / sensor) the unique identifiers of the devices. Thereby, the person collects information on the inventory of the different spaces of the building. Based on the unique identifiers, specific devices are commissioned to each other. The reading of the unique identifiers may be performed by a 'reading device' which reads RFID tags or which connects to each individual device which is in its vicinity.

A problem with the cited patent application is that a person is involved in the commissioning and that the person has to visit all spaces in the building and has to read the unique identifiers of all devices. To be able to distinguish between individual lighting

devices, the person has to get close to each individual lighting device, which may also be difficult if the lighting devices are arranged at a relatively high ceiling. Thus, this kind of commissioning costs a lot of time and is user unfriendly.

5 SUMMARY OF THE INVENTION

It is an object of the invention to provide a device and a method for commissioning devices of a lighting system to groups of devices, which device and method are more user-friendly.

A first aspect of the invention provides a method of commissioning devices of
10 a lighting system to a group of devices. A second aspect of the invention provides a commissioning device. A third aspect of the invention provides a lighting system. A fourth aspect of the invention provides a computer program product. Advantageous embodiments are defined in the dependent claims.

A method of commissioning devices of a lighting system to a group of devices
15 in accordance with the first aspect relates to a lighting system which comprises a set of devices which comprise a network interface to connect to a first network and to communicate with other devices in the first network. Each device is identifiable by a unique identification within the set of devices. The lighting system comprises a gateway device to provide a gateway between the first network and a second network. The lighting system further
20 comprises a network node to log identifications of devices of the first network. The method comprises the stages: i) providing, at a particular moment in time, power to a subset group of the set of devices of the lighting system to switch on all the devices of the subset; ii) connecting the devices of the subset to the first network, iii) logging, at the network node, an identification of the devices which are connected to the first network, and iv) assigning a
25 group address to the group of devices of which an identification has been logged during a predetermined time interval starting at or starting after the particular moment in time.

In most lighting systems which are installed in buildings (like office buildings, warehouses, shopping centers), the devices of the lighting system which are present in a single room or space are coupled to a single segment of the mains power providing network.
30 For example, in warehouses lighting devices of a single row are connected to a single segment of the mains power providing network. For example, in an office building the lighting devices of a single room are coupled to one safety fuse. In general, those segments are controllable independently of each other. By providing power via a single segment, all

devices coupled to the segment are switched on. Thus, by means of a single action at a particular moment in time, a subset of the set of devices can be switched on.

The devices of the lighting system have a network interface and the devices execute a network communication protocol which connects them to the first network. For example, the device announces its presence to other nodes connected to the network, or the devices execute a DHCP protocol to obtain a valid network address (within an IP network). The lighting system also comprises a gateway device which is a gateway, or, in other words, an interconnection, between the first network and a second network. The gateway also comprises a network interface which is capable of connecting to the first network; thus, the gateway is a node in the first network.

In the lighting system, a network node is available which logs an identification of all devices which become part of the first network. The network node may be directly connected to the first network or indirectly connected to the wireless network via the second network and the gateway. The network node may be the gateway, but may also be another device. In many network protocols, devices announce themselves and a central node, for example the gateway, or a router, or a DHCP sever, maintains a list of nodes present in the first network such that, for example, the gateway can transfer messages addressed to the devices of the first network from the second network to the first network (and vice versa). Thus, as soon as devices of the lighting system are switched on and connect to the first network, the devices are registered on a list in e.g. the gateway device, or logged by another node. After the particular moment in time at which the devices are switched on and soon after they are connected to the first network, their identification is logged. Thus, within a predefined time interval (following the moment of time at which the devices were switched on) the devices are logged. In the stage of logging, the identification of the devices is logged. The identification is unique for every device and may be, for example, a network address of the devices or an address of a physical (network) interface of the devices. In other embodiments, the devices may have a unique name and the names of the devices are logged by the network node.

Subsequently, a group address is assigned to the group of devices which are logged by the network node within the predetermined time interval. The time interval directly follows the particular moment in time when the devices of the subset of devices were switched on, or starts after a predetermined time interval after the particular moment in time. The group address is a network address which may be used to send a message to all devices of the group. Thus, by creating a relation between the group address and the devices which

were logged during the predetermined time interval, the devices are commissioned to a particular group of devices. Hence, the group of devices may be identified by the group address. A user of the method of commissioning devices to a group of devices, or a user of a commissioning device (as disclosed in later embodiments), or a manufacturer of a commissioning device, defines how long the predetermined time interval is. It must be sufficiently long to allow the logging of the devices of the group which are simultaneously switched on. A starting moment of the predetermined time interval may be the moment in time at which power is provided to the subset of devices or the starting moment may be after the particular moment in time.

The devices of the lighting system are, for example, luminaires with a lighting device, sensor devices and switch devices. The sensor devices sense, for example, the level of received daylight, or detect, for example, the presence of people. The switching devices are, for example, the switches which are often arranged at the wall in the immediate neighborhood of a door and which are used by a person to switch on or off the lighting devices of the room in which the switch is located. The sensor devices and switch devices are part of the lighting system and may share the information they detected or the received control information with other devices in the lighting system.

The method of commissioning devices of a lighting system to a group of devices is, in particular, a user-friendly method. A user only has to switch on a mains power connection to a subset of devices which are arranged in a separate space or subspace of a building, or which have to form a group. After this particular action, the devices of the subset of the lighting system automatically connect to the first network and, on the basis of the automatic logging of their identification in the network node, the information of the devices of the subset (and, consequently, of the group) is automatically registered. The user does not have to visit every space in the building in order to obtain the identifications of the individual devices. These identifications are automatically registered and by influencing the time interval during which the identifications are registered, by switching on devices of the subset at a particular moment in time, the information of the subset is automatically collected, and by assigning a group address, the devices are commissioned to a group of devices. Thus, the number of actions to be performed by a user is relatively small and the method is performed automatically, and, thus, is user-friendly. On top of that, the method of commissioning takes less time than the known methods and, thus, costs are reduced.

In the context of the invention, the term 'commissioning to a group' means that the devices are appointed or assigned to a group. It is further to be noted that the term

“gateway” is not used in a limited meaning. Instead of the term ‘gateway device’ the terms ‘router’ or ‘network switch’ may be read. In the context of the document it is important that the gateway device is an active device which connects different networks or different segments of networks and that the gateway device receives data packets from the different networks and forwards them to another one of the different networks if this is necessary.

Optionally, the network interface is a wireless interface which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network. The first network is a wireless network and the second network is a wired network. The step of connecting the devices of the subset to the first network comprises forming a wireless network between the devices which have been switched on.

The devices of the lighting system have a wireless interface and the devices execute a wireless communication protocol which is capable of automatically forming a wireless network. Sometimes such an automatically formed network is referred to by the term “ad hoc network”. The execution of the wireless communication protocol to automatically form the wireless network starts when the devices are switched on and relevant parts of the protocol may be repeated over time to discover new neighbors. The devices are capable of finding neighbors and connecting to the neighbors. The links between neighbors form the communication infrastructure of the wireless network. The lighting system also comprises a gateway device which is a gateway, or, in other words, an interconnection, between the wireless network and a wired network. The gateway also comprises a wireless interface which is capable of automatically forming the wireless network with other devices and, thus, the gateway becomes a node in the wireless network. In many network protocols which provide wireless network-forming capabilities, a gateway may maintain a list of nodes present in the wireless network, such that the gateway can transfer messages addressed to the devices of the wireless network from the wired network to the wireless network.

In the foregoing, a neighbor discovery capability of the devices of the lighting system is introduced as a part of the capability of the devices to form a wireless network. The term ‘neighbor’ must be interpreted as a neighbor in a network topology, which means that two neighbors may communicate with each other via their respective wireless interfaces without intervention of another device. In the context of this invention ‘neighbor’ does not necessarily mean that these devices are close to each other in the physical reality.

According to the method, a wireless network is formed between the devices which have been switched on at the particular moment in time. It is to be noted that the

forming of the network does not necessarily mean that only devices which are switched on at the particular moment in time are member of the wireless network. Also devices which were already switched on and which were already registered at the network node may be part of the wireless network. For example, if a wireless network is already available between devices which are already switched on, the devices which are switched at the particular moment in time may join the already formed wireless network (whereby they form a sort of sub-network).

In the current optional embodiment, the devices have a wireless network interface, however, in general, the embodiments of the invention are not limited to devices with a wireless network interface. In other optional embodiments, the first network is an Ethernet network and the network interface is an Ethernet network interface. If the first network is an Ethernet network, the first network may also be a segment of an Ethernet network and the gateway may be formed by a router between the Ethernet network and other networks or may be formed by a network switch placed between different segments of an Ethernet network. In an alternative embodiment, each device of the lighting system comprises a network interface which is able to communicate with other devices via the power network to which the device is coupled - for example, communication takes place via the mains power network, or, in case of a low voltage network, via the low voltage power lines.

In the context of wireless networks, the term 'gateway' may be used for the device which forms the interconnection between the wireless network and the wired network. In this context, other terms used for the gateway device are 'wireless router', 'edge router', or just 'router' for short.

Optionally, the devices of the lighting system have a wireless interface which is configured to communicate on the basis of one of the protocols of IPv6LOWPAN, ZigBee, Bluetooth or IEEE 802.15.4. These protocols are well capable of forming ad hoc wireless networks. Further, they are designed to provide a low-cost, low-power wireless communication solution. It is to be noted that in alternative embodiments, the carrier of the wireless network does not consists of radio waves, but may be based on light. For example, a lighting device may comprise a wireless network interface which is capable of modulating information in the light emitted by the lighting device and which comprises a light sensor for receiving information coded in light emitted by other lighting devices. Optionally, the method of commissioning devices of a lighting system to a group of devices further comprises the stages of i) distributing the group address to the devices of the group of devices and ii) registering, at the devices of the group of devices, the group address. The distribution

of the group address and the registration of the group address may be necessary in specific applications and/or network protocols. If the devices of a particular group know their group address, they are capable of intercepting and receiving messages addressed to the group, and, thus, to them. Otherwise, it may be difficult, in certain applications and network protocols, to send a message to all the devices of the group in one message. It is to be noted that in certain network structures and protocols it may be possible that the gateway distributes messages addressed to a certain group address or to the nodes of the group by directly addressing the individual devices of the group. The registering of the group address at the group devices may include storing the group address at the devices of the group such that, if the power were switched off, the group address would still be available at the devices to prevent that the method of commissioning the devices has to be performed once again after a period during which the power was switched off.

Optionally, the identification of the devices is a network address of the devices.

Optionally, the step of registering the group address further comprises registering the group address at a server coupled to the first network or to the second network. The registering at the server optionally comprises the registering of a name coupled to the group of devices. It may be advantageous if a central server knows the group address as well. For example, when a central domain name server is present, when a resource directory is present on a server, or when a central power management system is present, it is useful to have this information on these types of servers / systems to be able to map group names to group addresses or to centrally control the lighting conditions in certain spaces / rooms of a building.

Optionally, the gateway device comprises the network node.

Optionally, the method of commissioning devices of a lighting system to a group of devices further comprises the stage of communicating lighting control information among the devices of the group of devices, wherein the devices of the group of devices are addressed via the group address. Using the group address to communicate lighting control information is a very effective way of distributing the lighting control information to all devices of the group. It means that the device or network node which generates the lighting control information only needs to know the group address and does not need to know which devices are part of the group.

According to a second aspect of the invention, a commissioning device is provided for commissioning devices of a lighting system to a group of devices. The lighting

system comprises a set of devices. The devices comprise a network interface which is configured to connect to a first network and which is configured to communicate with other devices in the first network. At least within the set of devices, each device is identifiable by a unique identification. The lighting system comprises a gateway for providing a gateway
5 between the first network and the second network and comprises a network node being configured to log identifications of devices of the first network. The commissioning device comprises a network interface, an identification obtainer and a group address generator. The network interface is able to connect to the network node and to devices of the first network. The identification obtainer is capable of obtaining a list of identifications of devices logged
10 by the network node during a predetermined time interval. The group address generator generates a group address for the devices logged by the network node during a predetermined time interval that starts at or after a moment in time when devices of a subset of the set of devices were switched on.

The commissioning device is a tool which may be used by a person who
15 installs and maintains the lighting system, or by a person who manages the systems of a building. The commissioning device comprises the features and means to commission the devices to a group of devices. When the user has the commissioning device he only has to switch on a subset of the set of devices of the lighting system and the commissioning to groups is performed automatically. This is experienced as a user-friendly and cost-effective
20 way of commissioning devices to a group of devices.

The commissioning device according to the second aspect of the invention provides the same benefits as the method according to the first aspect of the invention and has similar embodiments with similar effects as the corresponding embodiments of the method.

25 Optionally, the commissioning device further comprises a group address distributor for distributing the generated group address to the devices of the group of devices. As discussed previously, it is advantageous if the devices themselves also know the group address of the group to which they are assigned.

30 Optionally, the network interface of the commissioning device is a wireless interface which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network. Here, the first network is the wireless network and the second network is a wired network.

According to a third aspect of the invention, a lighting system is provided which comprises a set of devices, a gateway device and a network node. The plurality of

devices is selected from lighting devices, switch devices, sensor devices. The devices comprise a network interface which is configured to connect to the first network and which is configured to communicate with other devices in the first network. Within the set of devices each device is identifiable by a unique identification. The gateway device is configured to form a gateway between the first network and a second network. The network node is configured to log identifications of devices of the first network.

The features and elements introduced in the lighting system according to the third aspect of the invention have already been discussed previously and provide the same effects as the previously discussed embodiments of the method and the commissioning device. The lighting system may have similar embodiments as the embodiments of the previously discussed embodiments of the method and the commissioning device.

Examples of lighting devices, switch devices and sensor devices have been discussed previously and the discussed examples may be part of the lighting system according to the third aspect of the invention.

Optionally, the network interface of the device of the system is a wireless interface which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network. Here, the first network is the wireless network and the second network is a wired network.

Optionally, the lighting system further comprises a segmented power providing means. The segmented power providing means is arranged to provide power to subsets of the set of devices, wherein, when power is provided to a segment of power providing means, the devices of a subset being connected to the segment are switched on. The segmented power providing means is an effective means to switch on a group of devices of the lighting system such that these devices may form a wireless network, and their identification may be logged, and a group address may be commissioned to the devices of the subgroup. It is to be noted that the segmented power providing means may be a segmented power providing means to provide mains power. In another embodiment, the devices of the lighting system operate at a low voltage, for example, 24 volt DC or 48 volt DC, and the segmented power providing means provides low-voltage power to the devices of the lighting system.

Optionally, the lighting system further comprises the commissioning device according to the second aspect of the invention.

Optionally, when the lighting system comprises at least one lighting device, the at least one lighting device comprises a sensor for detecting movement of people in the

area and/or for measuring the amount of received light. Such a sensor in the lighting device may have the benefit that the lighting device may start emitting light on the basis of the information obtained by the sensor and, since the lighting device comprises a network interface and the lighting device is commissioned to a group of devices, the information may be distributed to the other lighting devices of the group such that the other lighting devices may also decide to start the emission of light.

Optionally, at least one device of the set of devices is configured to distribute lighting control information to other devices, based on a group address. A switch device may, for example, distribute lighting control information "please, emit light" to the other devices and the other devices, when they are lighting devices, may start the emission of light when they receive this lighting control information. The switch device transmits the lighting control information in a message which comprises the group address of the group of devices. The network protocols used in this invention distribute such messages automatically to all the devices, and all devices which belong to the group use the received information to control their light emission. In an optional embodiment, a plurality of devices of the set of devices are configured to distribute lighting control information to other devices, based on a group address. In another optional embodiment, all devices of the set of devices are configured to distribute lighting control information to other devices, based on a group address.

Optionally, the lighting control information comprises information from the sensor or is based on information from the sensor. As discussed previously, the lighting device may distribute sensor information to other devices in the group. Further, the lighting device itself may generate lighting control information on the basis of the sensor information and distribute this to other devices in the group. According to an example, when the lighting device comprises a sensor for detecting the presence of people, the lighting device may generate the message "start to emit light" when the presence of a person is detected.

According to a fourth aspect of the invention, a computer program product is provided enabling and/or causing a processor to carry out the method according to the first aspect of the invention. The computer program product may be stored on a storage device, such as an optical disk or non-volatile memory. The computer program product is not necessarily stored at one specific location and may be distributed over different devices of the lighting system.

In summary, the application relates to a method of commissioning devices of a lighting system to a group of devices, and a commissioning device and a lighting system are provided. The lighting system comprises a set of lighting, sensor and/or switching devices

which have a network interface for connecting to a first network. The lighting system also comprises a gateway device connected between the first network and a second network. The network node is coupled to the first and/or second network. According to the method, a subset of devices of the lighting system receive power at a particular moment in time and, thus, are switched on simultaneously, causing, via a stage of connecting the devices to the first network, an identification of the switched on devices to be logged at the network node. A group address is assigned to the group of devices which are logged by the network node within a predetermined time interval starting at or after the particular moment in time.

These and other aspects of the invention are apparent from and will be elucidated with reference to the embodiments described hereinafter.

It will be appreciated by those skilled in the art that two or more of the above-mentioned options, implementations, and/or aspects of the invention may be combined in any way deemed useful.

Modifications and variations of the system, the method, and/or of the commissioning device, which correspond to the described modifications and variations of the system, the method, and/or of the commissioning device, can be carried out by a person skilled in the art on the basis of the present description.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 schematically shows a lighting system according to the third aspect of the invention,

Fig. 2 schematically shows a method of commissioning devices of a lighting system to a group of devices,

Fig. 3 schematically shows, in the drawing of the lighting system, an automatically formed wireless network and a commissioning device which may be used to execute the method according to the first aspect of the invention,

Fig. 4a schematically shows a lighting device,

Fig. 4b schematically shows a commissioning device according to the second aspect of the invention.

It should be noted that items denoted by the same reference numerals in different Figures have the same structural features and the same functions, or are the same signals. Where the function and/or structure of such an item have been explained, there is no necessity for repeated explanation thereof in the detailed description.

The Figures are purely diagrammatic and not drawn to scale. Particularly for clarity, some dimensions are exaggerated strongly.

DETAILED DESCRIPTION

5 Fig. 1 schematically shows a lighting system 100 according to the third aspect of the invention. The lighting system 100 is drawn in a floor-plan of a portion of a building. The portion of the building comprises a corridor 120 and a room 110. The corridor has two windows 116 through which daylight may enter the corridor 120. The room 110 also has two windows 128.

10 The lighting system 100 comprises a set of devices, such as sensor devices 106, 114, switch devices 112, 132, and lighting devices 116, 118, 124, 126, 128, 130, 134, 136. All devices of the lighting system comprise a wireless interface which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network. Within the set of devices each
15 device is identifiable by a unique identification. Lighting devices 116, 118, 124, 126, 128, 130, 134, 136 further comprise a light emitter, switch devices 112, 132 further comprise a switch arranged to be operated by a person, and sensor devices 114, 106 further comprise a sensor. The sensor may be used to detect presence of people or the amount of light that impinges on the sensor device. For example, sensor device 106 detects whether the amount of
20 light in the room 110 is too low and the sensor device 106 may be used in the lighting system to automatically switch on lighting devices 124, 126, 128, 130, 134, 136 in the room 110 when the amount of light detected by the sensor device 106 is not high enough. For example, sensor device 114 detects the presence of people in the corridor 120 and this information may be used in the lighting system to automatically switch on lighting devices 116, 118 in the
25 corridor 120 when a person is detected. Switch device 112 is present at the wall of the corridor 120 and may be operated by a person to indicate that the lights of the corridor may be switched off, for example, when the person is leaving the floor or the building. Switch device 132 is present in the immediate vicinity of a door between the corridor 120 and the room 110, so that a person who enters the room 110 can manually switch on the lighting
30 device 124, 126, 128, 130, 134, 136 in the room 110 and a person who leaves the room 110 can manually switch off the lighting devices 124, 126, 128, 130, 134, 136 in the room 110.

The lighting system 100 further comprises a gateway device 122 which forms a gateway between a wireless network and a wired network 103. The gateway device 122 is present in the room 110; alternatively, in the context of the invention the gateway device 122

could also be present in the corridor. The lighting system 100 further comprises a network node 102 which logs identification of devices of the lighting system 100 which are connected to a wireless network (to which the gateway is able to connect). The network node 102 may comprise a database, or a file stored on a disk, in which the logging is performed. In an optional embodiment, the features and functions of the network node 102 are integrated in the gateway device 122.

The lighting system 100 further comprises segments 104, 108 of the mains power distribution network of the building. A first segment 104 of the mains power network provides power to a first subset of devices 112, 114, 116, 118 of the set of devices of the lighting system. The devices of the subset are present in the corridor 120. In other words, when the first segment does not provide power, all devices of the first subset (which are the devices in the corridor) are switched off. A second segment 108 of the mains power network provides power to a second subset of devices 106, 124, 126, 128, 130, 132, 134, 136. The devices of the second subset are present in the room 110.

All the devices 106, 112, 114, 116, 118, 124, 126, 128, 130, 132, 134, 136 start, upon being switched on, searching with their wireless interface for neighboring devices on the basis of a neighbor discovery protocol. Neighbor does not necessary imply that the devices are close to each other in the corridor 120 or in the room 110. The term 'neighbor' means that the devices which find each other are neighbors in a formed network topology.

The gateway device 122 has also a wireless network interface which also executes the neighbor discovery protocol and, hence, the gateway device 122 will also become part of the wireless network. In a practical embodiment, the strength of the wireless signals of the wireless interfaces of the devices is sufficient to communicate information through walls of the building, such as the wall between the room 110 and the corridor 120. Thus, when all devices 106, 112, 114, 116, 118, 124, 126, 128, 130, 132, 134, 136 are operating (which means, they receive mains power), a wireless network is formed between all said devices 106, 112, 114, 116, 118, 124, 126, 128, 130, 132, 134, 136, and the gateway device 122 is also a node in the wireless network. The wireless network provides communication channels between all devices, and via the gateway device 122 a communication channel is provided between all devices 106, 112, 114, 116, 118, 124, 126, 128, 130, 132, 134, 136 of the wireless network and devices connected to the wired network 103. It is to be noted that the network topology of the wireless network is not fixed and may change over time. There may be some random factors which determine which neighbor is discovered first. Furthermore, the network topology may be optimized over time by specific algorithms.

For example, on the wired network 103 the Internet Protocol is run, which may be the IPv4 version or the IPv6 version. Examples of protocols, which may be run by the devices which have to become part automatically of the wireless network, are 6LOWPAN, ZigBee, Bluetooth or IEEE 802.15.4. 6LOWPAN is an acronym of IPv6 over Low Power

5 Personal Area Networks, which means that it is a protocol which is based on the IPv6 Internet Protocol standard and is especially designed to be used by low-power devices which have to form a wireless network within a specific area. In the 6LOWPAN standardization organization, a neighbor discovery protocol has been proposed and it is expected that in the near future the neighbor discovery protocol becomes a part of the 6LOWPAN standard.

10 ZigBee is a specification of a high level communication protocol which may be used by small, low-power digital radios which are based on the IEEE 802 standard for personal area networks (which may be the IEEE 802.15.4 standard). The ZigBee standard also includes a neighbor discovery protocol. The IEEE 802.15.4 standard specifies the physical layer and media access control of low-rate wireless personal area networks.

15 Alternatively, the devices 106, 112, 114, 116, 118, 124, 126, 128, 130, 132, 134, 136 comprise a network interface for connecting to a wired network, such as an Ethernet network. The gateway device 122 and/or the network node 102 is/are also connected to the wired network and may, for example, be a router in the network or be a network switch between different segments of an Ethernet network. When devices 106, 112, 114, 116, 118,

20 124, 126, 128, 130, 132, 134, 136 are switched on (via the reception of power), they connect to the Ethernet network and identify themselves to other network devices. This identifying results in the logging of their identification at the network node 102.

Fig. 2 schematically shows a method 200 of commissioning devices of a lighting system to a group of devices. The lighting system to which the devices belong is, for

25 example, a lighting system such as discussed in the context of Fig. 1. The method 200 comprises the steps of: i) providing 202 at a particular moment in time power to a subset of devices of the lighting system to switch on all the devices of the subset, ii) connecting 204 the devices of the subset to the first network, iii) logging 206, at the network node, an identification of the devices which are switched on, and iv) assigning 208 a group address to

30 the group of devices of which an identification has been logged during a predetermined time interval starting at or after the particular moment in time. Optionally, the first network is a wireless network and the network interface of the devices comprises a wireless network interface which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network,

and the step of connecting to the first network comprises forming a wireless network between the devices which have been switched on. Optionally, the following steps are performed as well: v) distributing 210 the group address to the devices of the group of devices, vi) registering 212, at the devices of the group of device, the group address, and optionally vii) communicating 214 lighting control information between the devices of the group of devices, wherein the devices of the group of devices are addressed by the group address.

The method 200 will be further discussed with reference to Fig. 3. Fig. 3 schematically shows, in the drawing of the lighting system 100, a wireless network and a commissioning device 310 which is used when executing the method 200 according to the first aspect of the invention (Fig. 2). The different features of the lighting system 100 have already been discussed in the context of Fig. 1. In the example of Fig. 3, the first segment 104 of the mains power network is not connected to the mains power and does not provide power to the first subset of devices (which are the devices in the corridor 120). The second segment 108 of the mains power network has been switched on at a particular moment in time and provides power to the second subset of devices 106, 124, 126, 128, 130, 132, 134, 136, which are the devices in the room 110. When the devices of the second subset receive power, they switch on and start a neighbor discovery protocol, such that together with other devices in their neighborhood they form a wireless network. For example, lighting device 130 found lighting device 126, lighting device 136 and switch device 132 and the neighbor discovery protocol formed a network link 302 between the lighting devices 130 and 126, a network link 304 between the lighting devices 130 and 136, and a network link 306 between the lighting device 130 and the switch device 132. Several other possibly established network links are drawn between the devices 106, 124, 126, 128, 130, 132, 134, 136 in the room 110 and the gateway device 122. These links form the network topology and it can be seen that, for example, in the network topology the switch device 132 is a neighbor of lighting device 130 and a neighbor of lighting device 134. The formed wireless network connects all devices 106, 124, 126, 128, 130, 132, 134, 136 of the second subset such that they can communicate information between them, and the network is also connected to the gateway device 122 such that information may be communicated between the gateway device 122 and the devices 106, 124, 126, 128, 130, 132, 134, 136 in the wireless network, and, thus, between the wired network and the devices 106, 124, 126, 128, 130, 132, 134, 136 in the wireless network. Each one of the devices 106, 124, 126, 128, 130, 132, 134, 136 has a specific identification, such as a network address or an address of the physical wireless interface. The identification is used to address specific devices in the wireless network.

The gateway device 122 has to know which devices 106, 124, 126, 128, 130, 132, 134, 136 are present in the wireless network, so that it can forward data packets addressed to the devices 106, 124, 126, 128, 130, 132, 134, 136 of the wireless network. The network protocol provides features, as a result of which the gateway device 122 becomes aware of the devices 106, 124, 126, 128, 130, 132, 134, 136 in the wireless network. It may also be the case that other nodes in the (wired) network 103 receive the identifications of the devices 106, 124, 126, 128, 130, 132, 134, 136 in the wireless network. In Fig. 3, such a node is the network node 102, which has a database or a file on a disk in which the identifications of the devices are logged when such devices become part of the wireless network. Thus, the network node 102 comprises a list 308 with identifications of devices which are members of the wireless network. The list may also comprise timestamps which indicate at which moment in time the respective device became connected to the wireless network. In another embodiment, the network node 102 comprises another list with identifications of devices, in which only the identifications of devices are listed which became part of the wireless network during the last predetermined minutes - such a list is continuously updated by the network node 102. Optionally, the network node 102 and the gateway 122 are the same device. If they are not the same device, then the way in which the network node 102 becomes aware of devices connected to the wireless network strongly depends on the used network protocol. It may be that the network node 102 is informed by the gateway 122, or it may be that devices transmit broadcast messages in which they identify themselves, etc.

In Fig. 3, a commissioning device 310 has been coupled to the wired network 103. In another optional embodiment, the commissioning device 310 may be directly connected to the wireless network (in the case that the commissioning device 310 also has a network interface which is capable of finding a neighboring device). In an embodiment, the commissioning device 310 may connect to the network node 102 via the wired network 103 and read the list with logged devices. In an embodiment, the commissioning device 310 reads the list with logged devices shortly before power of the second segment 108 of the mains power network is switched on and the commissioning device 310 reads the list for the second time after a predefined time interval. In this embodiment, the commissioning device is able to make a list of devices which were logged during the predetermined time interval and, thus, became member of the newly formed wireless network. In another embodiment, the commissioning device 310 obtains a list from the network node 102 in which the identifications of the devices are accompanied by a timestamp which indicates at or around which moment in time the respective devices became part of the wireless network. In this

embodiment, the timestamps may be used to detect which devices became part of the wireless network in a predetermined time interval following the switching on of the devices coupled to the second segment 108 of the main power network. The predetermined time interval may start at or after the moment at which the power of the first segment 108 of the mains power network was switched on. The length of the predetermined time interval must be sufficient to allow the logging of all identifications of the devices coupled to the first segment 108 of the mains power network at the network node 102. For example, in a practical embodiment, the predetermine time interval is at least 5 minutes, or, in another embodiment, at least 7 minutes.

If the commissioning device 310 has been able to determine which devices became part of the wireless network during the predefined time interval, the commissioning device 310 generates a group address for, and assigns it to, the devices which became part of the wireless network during the predefined time interval. The group address is an address which may be used according to the network protocol to address a group of devices by using one address. The specific format of the group address strongly depends on the used network protocol. The moment in time that the group address is assigned to the group of devices which became part of the wireless network during the predetermined interval of time, determines that the commissioning of the respective devices to the group is completed.

In an optional embodiment, the commissioning device 310 distributes the group address via the wired network 103 and the wireless network to the devices which are part of the group. This distribution may be performed by sending to all the devices of the group an individually addressed message with the information of the group address. Subsequently, in an optional embodiment, the devices register the group address in their network interface or a storage means such that it can intercept messages which are addressed to the group. In an embodiment, the group address is permanently stored in the device such that when the device does not receive power for some time, the group address is still present in the device to prevent that the method of commissioning must be performed after each period of time that the power has been switched off.

It is to be noted that, in the example of Fig. 3, it is suggested that the commissioning device is a separate device. In other embodiments, the commissioning device may be integrated with the network node 102 and/or the gateway device 122. The functionality of the commissioning device 310 may be programmed in a computer program which is run by a device which is coupled to the wired network 103 or the wireless network. For example, the computer program may be run on a tablet computer or a mobile phone.

When the commissioning device is a separate device, it may be a device which is carried by a person who installs lighting systems and who configures those systems such that only persons who understand the method of commissioning can initiate the commissioning of the devices and such that they may monitor the commissioning method and check the results of the commissioning method.

In another additional embodiment, an additional server (not shown) may be present in the wired or wireless network at which the group address is also registered by the commissioning device. For example, when a Domain Name Server (DNS) is present in the network, the group address may be registered at the DNS server together with a name assigned to the group (for example, address x + "lighting_room_110").

Subsequently, servers and/or devices which are coupled to the wired network 103 or which are directly coupled to the wireless network may communicate information to all devices of a group by using the group address. For example, the switch device 132 may communicate to all devices of the group that someone has switched the switch to a "light on" position and that, thus, all lighting devices 124, 126, 128, 130, 134, 136 of the group of devices must switch on their light emitter. In another example, the light sensor 106 senses that relatively bright light is present in the room 110, for example, as a result of sunlight. In such a case, the light sensor 106 may communicate to all devices in the group that the lighting level should be reduced.

When, at a later moment in time, the power of the first segment 104 of the main power providing network is switched on, the devices of the first subset (which are the devices in the corridor 120) start to form a wireless network. The gateway device 122 will also be a member of this wireless network because wireless signals are, in general, transmitted through the walls of an office building. Other network links between the devices in the room 110 and the corridor 120 may be established as well. Identifications of the devices of the corridor 120 will also be logged by the network node 102 in a time interval following the moment in time when the power of the first segment 104 was switched on. This makes it possible to use the method of the invention to assign a group address to the devices of the corridor 120. A user of the commissioning device 310 first has to switch on the power of the second segment 108 of the mains power providing network and initiate the execution of the method of commissioning devices to a specific group such that the devices of the room 110 are commissioned to a first group. When this step is finished, the user switches on the power of the first segment 104 of the mains power providing network and initiates the

subsequent steps of the method of commissioning devices to a specific group such that the devices of the corridor 120 are commissioned to a second group.

Fig. 4a schematically shows a lighting device 400. The lighting device at least comprises a light emitter and a wireless interface 406/402. The wireless interface 406/402 comprises an antenna 402 for transmitting and receiving wireless signals and a wireless network signal processing unit 406 which processes all data transmitted by or received by the antenna 402. The wireless network signal processing unit 406 at least comprises an identification 408 which is a unique identification belonging to the lighting device 400. The identification 408 is, for example, a physical address of the network interface 406/402. The wireless network signal processing unit 406 may further comprise a network formation unit (not shown) which is configured to run a neighbor discovery protocol and to form a wireless network with discovered neighbors. The network formation unit may be implemented in hardware or may be a computer program product which is run by a processor (not shown). The wireless network signal processing unit 406 may further comprise a group address storage 404 in which a received group address is stored. The wireless interface 406/402 is coupled to the light emitter 414 such that light control information received via the wireless interface 406/402 is used to control the light emitter 414. It is to be noted that the wireless interface 406/402 may also perform other functions which are part of the network protocol that is being used in the wireless network. An exemplary other function is the routing of data packets through the wireless network. The lighting device 400 may further comprise a communication unit 410 which is configured to create and post data messages for other devices (in the wireless or wired network) and which is configured to receive data messages and interpret them. In an optional embodiment of the lighting device 400, the lighting device 400 comprises a sensor 416. The sensor 416 may be a sensor which detects the amount of (day-) light available in the direct neighborhood of the lighting device 400. This sensor may be used to decide whether the light emitter 414 must be switched on and the information sensed by the sensor may be shared with other devices via the wireless network, for example, in a data message which comprises the group address. The sensor 416 may also be a sensor which detects the presence or movements of people. This sensor information may be used to decide whether the light emitter 414 must be switched on and this information may be shared with other devices via the wireless network. In another optional embodiment, the sensor senses the level of light available and detects the presence of people. The sensor 416 may be coupled to all other elements of the lighting device such that the light emitter may be controlled with the sensor information and such that sensor information, or lighting control

information deducted from the sensor information, may be shared with other devices in the wireless network (or in the wired network - via the gateway device).

Alternatively, the lighting device comprises a wired network interface which is configured to connect to a wired network, such as, for example, an Ethernet network. In yet another embodiment, the network interface comprises a modulator which modulates the light emitted by the light emitter 414 on the basis of information that must be transmitted, and the network interface comprises a light sensor for receiving modulated light emitted by other devices of the lighting system together with a demodulator for obtaining transmitted information out of the received modulated light.

Fig. 4b schematically shows a commissioning device 450 according to the second aspect of the invention. The commissioning device 450 comprises a network interface 454/451/452 which is at least configured to connect to the network node (which has been discussed previously) and to the previously discussed devices of the wireless network. The network interface 454/451/452 may comprise a wired network connector 451 for connecting to the wired network and/or a wireless network antenna 452 such that the commissioning device 450 can communicate with the network node via the wireless network. The network interface 454/451/452 further comprises a network signal processing unit 454 which processes all data transmitted by or received via the network connector 452 and/or the antenna 452.

The commissioning device 450 further comprises an identification obtainer 456 which is configured to obtain a list of identifications of devices which are logged by the network node. According to previously discussed embodiments, this may include obtaining a list which also includes timestamps which indicate at which particular moment in time the respective devices were logged or at which moment in time it became part of the wireless network. This may also include obtaining, at two different moments in time, a list with identifications of the devices such that the commissioning device 450 may deduct which devices were logged and became part of the wireless network in the predetermined time interval between the two different moments in time.

The commissioning device 450 further comprises a group address generator for generating a group address for the devices which were logged by the network node during a predetermined time interval. The generated group address is an address in accordance with the network protocol that is being used to communicate with the device of the wireless network, and an address which may be used according to the network protocol to address all devices of the group by a single message containing the group address.

In an optional embodiment, the commissioning device 450 comprises a group address distributor 458 which is configured to distribute the generated group address to all the devices of the group. This group address distributor 458 generates, for example, a plurality of messages addressed to the individual devices of the group and the messages
5 comprise information on the generated group address.

It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims.

In the claims, any reference signs placed between parentheses shall not be
10 construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The invention may be implemented by means of hardware comprising several distinct elements, and by means of a suitably programmed computer. In the device claim enumerating several
15 means, several of these means may be embodied by one and the same item of hardware. 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.

CLAIMS:

1. A method (200) of commissioning devices of a lighting system (100) to a group of devices, the lighting system (100) comprising a set of devices, which devices comprise a network interface for connecting to a first network and which network interface is configured to communicate with other devices in the first network, and each device is
5 identifiable by an identification (ID), the lighting system (100) further comprising a gateway device (122) for providing a gateway between the first network and a second network (103), and the lighting system (100) also comprising a network node (102) being configured to log identifications of devices of the first network, the method (200) comprising the steps of
 - providing (202), at a particular moment in time, power to a subset of the set of
10 devices to switch on all the devices of the subset,
 - connecting (204) the devices of the subset to the first network,
 - logging (206), at the network node (102), the identification (ID) of the devices which are connected to the first network, and
 - assigning (208) a group address to the group of devices of which the
15 identification (ID) has been logged during a predetermined time interval starting at or starting after the particular moment in time.
2. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to claim 1, wherein
 - 20 - the network interface comprises a wireless interface (402/404) which is configured to automatically form a wireless network with neighboring devices and which is configured to communicate with other devices in the wireless network,
 - the first network is a wireless network and the second network (103) is a wired network (103),
 - 25 - the step of connecting (204) the devices of the subset to the first network comprises forming a wireless network between the devices which have been switched on.
3. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to claim 2, wherein the devices of the lighting system (100) have

a wireless interface which is configured to communicate on the basis of one of the protocols of IPv6LOWPAN, ZigBee, Bluetooth or IEEE 802.15.4.

4. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to any one of the preceding claims, further comprising the steps of

- distributing (210) the group address to the devices of the group of devices,
- registering (212) the group address at the devices of the group of devices.

5. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to claim 4, wherein the step of registering (212) the group address at the devices of the group of devices further comprises registering the group address at a server coupled to the first network or to the second network (103), the registering at the server optionally comprising the registering of a name coupled to the group of devices.

6. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to any one of the preceding claims, wherein the gateway device (122) comprises the network node (102).

7. A method (200) of commissioning devices of a lighting system (100) to a group of devices according to any one of the preceding claims, further comprising the step of

- communicating (214) lighting control information between the devices of the group of devices, wherein the devices of the group of devices are addressed via the group address.

8. A commissioning device (310, 450) for commissioning devices of a lighting system (100) to a group of devices, the lighting system comprising a set of devices, which devices comprise a network interface which is configured to connect to a first network and which is configured to communicate with other devices in the first network, each device being identifiable by an identification (ID), the lighting system (100) further comprising a gateway device (122) for providing a gateway between the first network and a second network (103), and the lighting system (100) also comprising a network node (102) being configured to log identifications (ID) of devices of the first network, the commissioning device (310, 450) comprising:

- a network interface (451/452/454) for connecting to the network node (102) and to devices of the first network,
 - an identification obtainer (456) for obtaining a list of identifications (ID) of devices logged by the network node (102),
 - 5 - a group address generator (460) for generating a group address for the devices logged by the network node (102) during a predetermined time interval that starts at or after a moment in time at which devices of a subset of the set of devices were switched on.
9. A commissioning device (310, 450) according to claim 8, further comprising
- 10 - a group address distributor (458) for distributing the generated group address to the devices of the group of devices.
10. A lighting system (100) comprising
- a set of devices comprising devices selected from lighting devices (116, 1168, 15 124, 126, 128, 130, 134, 136), switch devices (112, 132), and sensor devices (114, 106), the devices comprising a network interface which is configured to connect to a first network and which is configured to communicate with other devices in the first network, each device is identifiable by an identification (ID),
 - a gateway device (122) for forming a gateway between the first network and a 20 second network (103),
 - a network node (102) for logging identifications (ID) of devices of the first network,
 - a commissioning device (310, 450) according to claim 8.
- 25 11. A lighting system (100) according to claim 10, further comprising
- a segmented power providing means for providing power to subsets of the set of devices, wherein, when power is provided to a segment (104, 108) of the segmented power providing means, the devices of a subset being connected to the segment are switched on.
- 30 12. A lighting system (100) according to claim 10, wherein, when the lighting system (100) comprises at least one lighting device (116, 118, 124, 126, 128, 130, 134, 136), the at least one lighting device (116, 118, 124, 126, 128, 130, 134, 136) comprising a sensor (416) for detecting movement of people in the vicinity of the lighting device and/or for measuring the amount of received light.

13. A lighting system (100) according to claim 10, wherein at least one device of the devices of the set of devices is configured to distribute lighting control information to other devices, based on a group address.

5

14. A lighting system (100) according to claim 12 and 13, wherein the lighting control information comprises information from the sensor (416) or is based on information from the sensor (416).

10 15. A computer program product enabling a processor to carry out the method (200) of claim 1.

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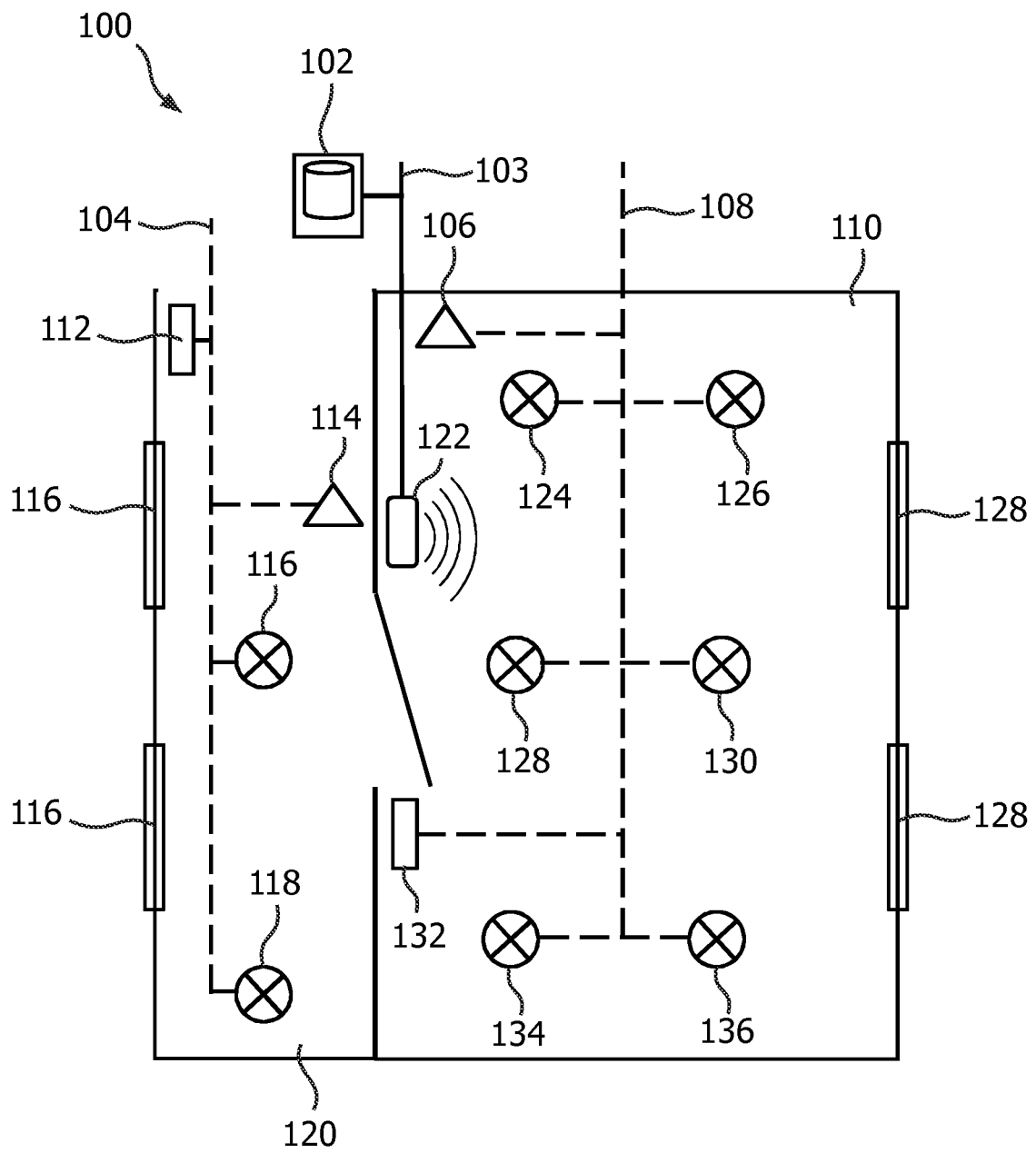


FIG. 1

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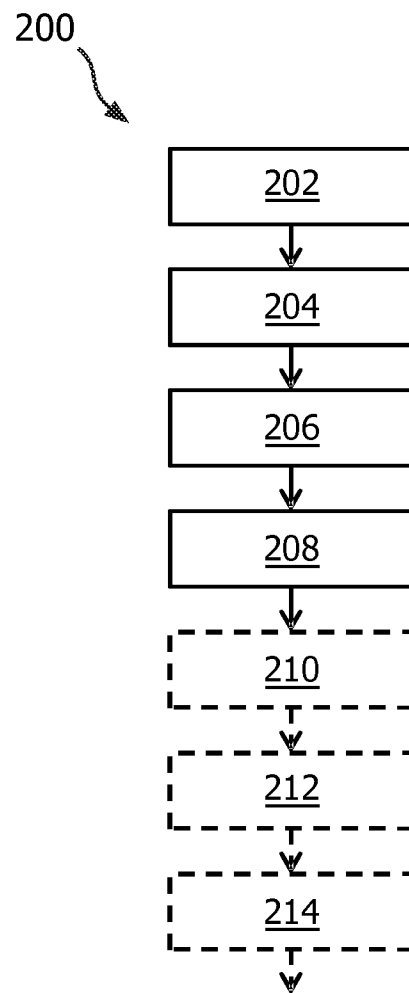


FIG. 2

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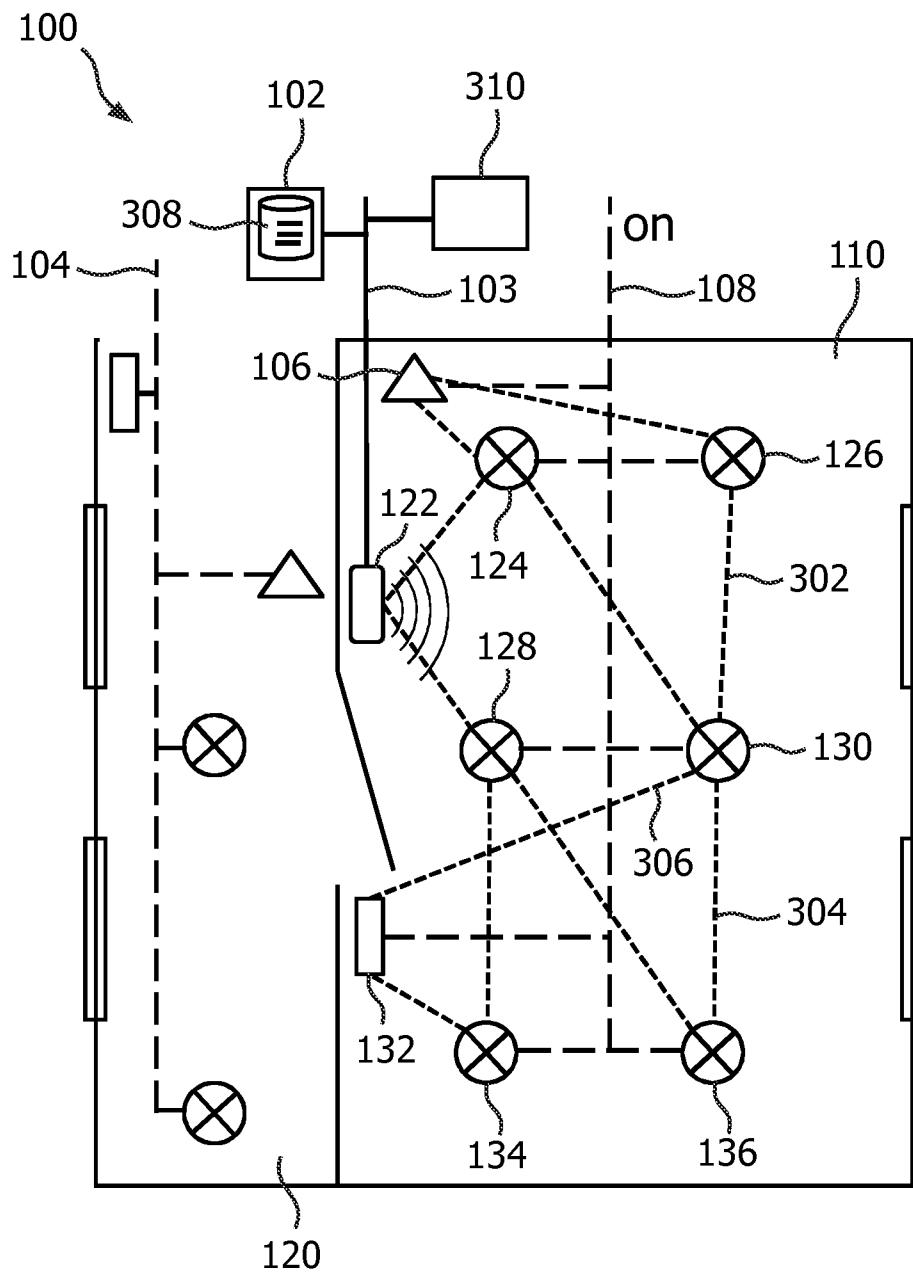


FIG. 3

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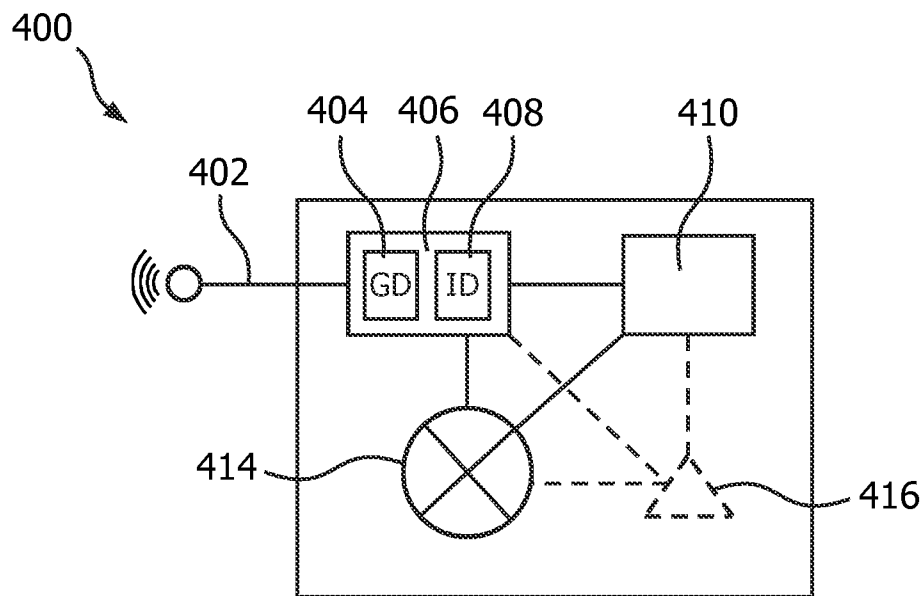


FIG. 4a

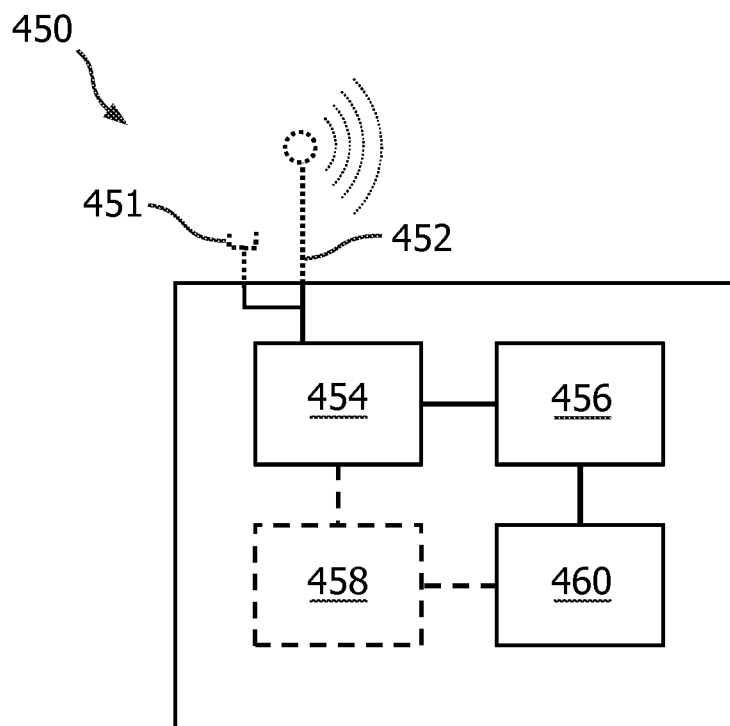


FIG. 4b

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/059176

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B37/02
ADD. H04L12/28

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 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)

EP0-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011/172844 A1 (CHOONG JASON YEW CHOO [US] ET AL) 14 July 2011 (2011-07-14) abstract paragraph [0001] - paragraph [0002] paragraph [0008] - paragraph [0009] paragraph [0026] paragraph [0030] - paragraph [0032] paragraph [0033] paragraph [0039] - paragraph [0041] paragraph [0043] - paragraph [0047] paragraph [0048] paragraph [0051] paragraph [0067]	1-15
X	US 2006/109203 A1 (HUBER ANDREAS [DE] ET AL) 25 May 2006 (2006-05-25) the whole document ----- -/--	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"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

14 January 2014

Date of mailing of the international search report

20/01/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/059176

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/032226 A1 (LYS IHOR A [US]) 19 February 2004 (2004-02-19) abstract paragraph [0003] paragraph [0008] - paragraph [0010] paragraph [0017] - paragraph [0021] paragraph [0026] paragraph [0028] - paragraph [0030] -----	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/059176

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