

METHOD FOR CONFIGURING AND/OR CONTROLLING HOME AUTOMATION
TERMINALS

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The present invention relates a method for configuring and/or controlling home automation end devices.

Home automation end devices are, for example, switches or dimmers that can be controlled (by radio) or other actuators. This term can likewise be understood as
10 sensors that are used in home/building automation. Examples of this are brightness sensors, humidity sensors, or wind sensors.

Home automation can be performed by combining different end devices, for example, the lights can be switched on and/or the roller shutters can be lowered at
15 predetermined times by means of automatic switches. It is likewise possible to automatically extend a sunshade if the exposure to the sun is too strong, for example. The end devices are typically configured by means of a control device (e.g. by means of a smartphone) in order, for example, to set when a roller shutter
20 is to be lowered.

Home automation end devices are therefore used in different scenarios of use, whereby it becomes necessary to enable a flexible use of the end devices. In these different scenarios of use, a simple and smooth configuration of the end
25 devices has to be ensured in each case. In addition, the end devices have to be as inexpensive as possible.

It is therefore the underlying object of the invention to provide a method for configuring home automation end devices that allows the flexible use of end
30 devices that can be manufactured cost-effectively.

This object is satisfied in accordance with the invention by a method having the features of claim 1.

- 5 In accordance with the invention, a method for configuring and/or controlling home automation end devices is specified, wherein the method comprises the steps:
- establishing a wireless point-to-point connection between a control device and at least one home automation end device;
 - performing a data communication between the control device and the end
10 device by means of the point-to-point connection in order to configure and/or to control the end device;
 - switching the end device to cancel the point-to-point connection and to establish a wireless connection with a mesh network; and
 - performing a data communication between the end device and a hub of the
15 mesh network by means of the mesh network in order to configure and/or to control the end device.

In accordance with the invention, the end device is therefore able to first provide a point-to-point connection (PTP connection – via Bluetooth, for example) for its
20 configuration and/or control and subsequently to cancel the point-to-point connection and instead to establish a connection with a mesh network (for example, a ZigBee network) in order then to enable the configuration and/or the control by means of the mesh network.

25 In accordance with the invention, it is made possible in this manner to cover different scenarios of use. Thus, the point-to-point connection can, for example, be used when only one or a few end devices are to be configured and/or controlled, wherein the control device then in each case establishes a single connection with the respective end device (by means of a respective point-to-point connection),
30 whereby each individual end device is then configured and/or controlled by means

of the point-to-point connection. If a large number of end devices are present, it is possible to "switch" to the mode of the mesh network, whereby, by means of the mesh network, all the end devices included in the network can be configured and/or controlled (by means of the mesh network).

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The configuration and/or control by means of a point-to-point connection is in particular suitable for so-called "device kits" or "room kits" that in particular allow the automation of a single function or of a single room. However, the configuration and/or control by means of the mesh network is in contrast provided for so-called "house kits" in which the end devices are distributed over a complete building. It is then, for example, possible by means of the mesh network to view a plurality of end devices as an association, wherein e.g. movements are determined by means of a motion sensor and the air quality is determined by means of an air quality sensor, wherein a control or a control command (e.g. venting and/or switching on a fan) can then be derived from the obtained information of the association.

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The method in accordance with the invention makes it possible through the transition from the point-to-point connection to the mesh network that, for example, previously purchased end devices, which have so far "only" been configured by means of a point-to-point connection, can be received in the mesh network to enable a cost-effective expansion of the mesh network in this manner.

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In accordance with the invention, it is moreover of advantage that by canceling the point-to-point connection before establishing the connection with the mesh network, the end device only, for example, has to have a single radio module, wherein the radio module can then be configured both for establishing the point-to-point connection and for establishing the connection with the mesh network. The integration of different hardware for the point-to-point connection or for the mesh network can hereby be avoided, whereby the end devices used can be manufactured cost-effectively and thus economically.

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The invention thus provides a flexible solution that places low hardware demands on the end devices.

- 5 It is understood that a single end device is usually spoken of here that is, for example, configured and/or controlled via the point-to-point connection or the mesh network. However, the method in accordance with the invention can also be used simultaneously or consecutively for a plurality of end devices.
- 10 The hub of the mesh network can serve to coordinate and/or to initiate a communication within the mesh network. The control device can in particular communicate with the hub of the mesh network to configure and/or to control the end device, wherein the data necessary for the configuration and/or control of the end device is transmitted from the control device to the hub and subsequently from
- 15 the hub to the end device. The hub can additionally have a network connection/Internet connection that allows the data necessary for the configuration and/or control of the end device to also be transmitted to further remote end devices or other hubs (or to be received from such hubs).
- 20 The configuration of the end device in particular refers to the transmission of a desired behavior, for example, by communicating switching times, switching intervals, data to be transmitted, data to be received and the like to the end device. The control of the end device in particular refers to the transmission of control commands to be executed in real time, for example, the switching on of a switch.
- 25 After the switch from the point-to-point connection to the connection with the mesh network, it is naturally also possible to cancel or to terminate the connection with the mesh network and to re-establish the point-to-point connection with the control device. The control device can then configure and/or control the end device by
- 30 means of the point-to-point connection in that a data communication is performed.

Advantageous further developments of the invention can be seen from the description, from the Figures, and from the dependent claims.

5 In accordance with a first advantageous embodiment, at a point in time, the end device respectively either only maintains and/or uses the wireless point-to-point connection or only maintains and/or uses the wireless connection with the mesh network. Radio hardware of the end device can thereby be used for both the point-to-point connection and the mesh network. Accordingly, the end device can only
10 have exactly one transmitter and exactly one receiver or exactly one transceiver.

In accordance with a further advantageous embodiment, the hub receives a configuration and/or a control of the end device performed at the control device from the control device and transmits the configuration and/or the control
15 commands to the end device. For example, the control device can be used to set, for a switch, the points in time at which a switching process is triggered. The configuration/control of the end device performed in this way is then transmitted from the control device, e.g. via WLAN, to the hub. An implementation of the received configuration and/or of the received control commands is then preferably
20 performed in the hub, and indeed such that the configuration/control can be transmitted to the end device by means of the mesh network (for example, via ZigBee). The end device finally applies the received configuration and/or the received control commands so that the end device performs the configured/commanded switching processes at the respective desired times.

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In accordance with a further advantageous embodiment, the end device uses a software-defined radio (SDR) to establish the wireless point-to-point connection and the wireless connection with the mesh network. The same software-defined radio is in particular used to establish the wireless point-to-point connection and
30 the wireless connection with the mesh network (in each case with a different

software configuration). A software-defined radio in particular designates a transceiver in which a portion, and preferably the main portion, of the signal processing is implemented by means of software or is at least influenced by software.

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The end device preferably uses a PTP software image to establish the wireless point-to-point connection and a mesh software image to establish the wireless connection with the mesh network. The software images preferably each include the data which the software-defined radio requires to be able to correspondingly communicate by means of a point-to-point connection or a mesh network. Due to the use of the software-defined radio in the end device, the switching from the point-to-point connection and the establishing of the connection with the mesh network are particularly easy since only the PTP software image has to be replaced with the mesh software image in the end device. As soon as the mesh software image is used in the software-defined radio, a wireless point-to-point connection cannot be established; however, it is then in return possible to establish a connection with the mesh network.

A point-to-point connection is to be understood as a data communication in which only exactly two participants communicate with each other. In a mesh network, in contrast, a plurality of participants can also in each case communicate with a plurality of other participants. It may also be possible in the mesh network that at least some of the participants are configured to forward data packets to the data communication. In this way, participants of the mesh network that are not arranged in a direct radio range with respect to one another can also communicate with one another. In short, a respective participant (e.g. an end device or the hub) is connected to one or more other participants, wherein the transmitted information is preferably forwarded from participant to participant until it reaches the destination.

In accordance with a further advantageous embodiment, the PTP software image and the mesh software image are both stored in the end device. Alternatively or additionally, the mesh software image (and/or also the PTP software image) is transferred by means of the point-to-point connection to the end device. Further
5 alternatively or additionally, the PTP software image (and/or also the mesh software image) is transferred by means of the mesh network to the end device.

If both images are stored in the end device, the currently required software image can be executed in each case, e.g. by means of the software-defined radio. For
10 example, the end device can comprise a data memory (e.g. a flash memory) in which the PTP software image and the mesh software image are stored. In addition to these two software images, a factory setting software image can also be stored that allows the end device to be reset to its delivery state.

15 The data memory and the software-defined radio can each be designed as integrated circuits that are connected by means of an SPI bus (Serial Peripheral Interface Bus). The respective required software image can then be transmitted by means of the SPI bus to the software-defined radio and can be used there to establish the wireless point-to-point connection or to establish the wireless
20 connection with the mesh network. Naturally, other possibilities of data transmission, for example the use of the I²C bus, are also conceivable in addition to the SPI bus.

If only the PTP software image is initially stored in the end device to enable the
25 wireless point-to-point connection, the mesh software image can thus e.g. be transmitted from the control device to the end device by means of the point-to-point connection. The mesh software image can then in the end device be loaded into the data memory or directly into the software-defined radio and can be executed. For example, before the transmission of the mesh software image to the
30 end device, the control device can search in a database (for example, on a server

of the provider) for the latest version of the mesh software image and can download this latest version. The advantage hereby results that the mesh software image is up-to-date in each case. It is also possible for the control device to transmit an updated version of the PTP software image and/or an updated version of the mesh software image to the end device, if required. The transmission of the updated version can take place both by means of the point-to-point connection and by means of the mesh network.

Together with the transmission of the respective software image, a first configuration of the end device can also take place at the same time. For example, desired parameters of the end device can be written directly into the respective software image for this purpose. The parameters to be set or the configuration to be set can then in particular be accordingly changed or adapted in the control device.

Furthermore, the already mentioned return to the point-to-point connection is also possible by using the PTP software image again instead of the mesh software image.

After the switch to another software image (that is from the PTP software image to the mesh software image or vice versa), a restart (reboot) of the end device or at least of the software-defined radio is preferably performed.

In accordance with a further advantageous embodiment, the setting of the end device relating to the point-to-point connection and/or to the connection with the mesh network is stored in the control device and/or in the hub.

The storage of the settings of the end device can, for example, take place before the installation of the mesh software image and/or before the installation of the PTP software image in order to save the configuration or settings of the point-to-

point connection and/or of the connection with the mesh network. The advantage can hereby be achieved that, on the return to e.g. the point-to-point connection, the settings can be transferred from the control device back to the end device, so that a pairing with a Bluetooth device can, for example, be maintained. The control
5 device can either store the stored settings locally and/or can e.g. transfer them to a server of the provider. A storage in the hub and/or a forwarding of the settings by means of the hub to a server of the provider are also possible.

In accordance with a further advantageous embodiment, the hub communicates
10 with the control device by means of a wireless data connection after the end device has been switched to a connection with the mesh network, with the wireless data connection using a communication protocol different from the mesh network. In addition to the communication protocol, the wireless data connection between the control device and the hub can also differ by the frequencies, radio
15 standards and/or transmission powers used. For example, the hub can communicate with the control device by means of WLAN (WiFi), Bluetooth, Bluetooth Low Energy (BLE) and the like. The hub can accordingly be used as a "bridge" (bridge/gateway), wherein the hub preferably translates control commands and/or data for the configuration and/or control of the end device in
20 such a manner that they can be transmitted to the end device by means of the mesh network.

In accordance with a further advantageous embodiment, settings of the hub are stored in the control device and/or in a separate memory, with the stored settings
25 being loaded into the replaced hub on a replacement of the hub. The settings of the hub can, for example, be transmitted to the control device by means of the wireless data connection. Alternatively or additionally, the hub can also have an Internet connection and can e.g. store its settings on a server of the provider (this means in the "cloud"). A replacement of the hub is then advantageously possible
30 in a smooth manner and in particular in an automated manner.

In accordance with a further advantageous embodiment, the point-to-point connection is a Bluetooth Low Energy (BLE) connection and/or the mesh network is a ZigBee network. The advantage of the BLE connection is in particular a very low power consumption, on the one hand. On the other hand, BLE can also be dynamically switched between power saving modes and data transmission modes, wherein the data rates provided by BLE are suitable for home automation. The ZigBee network can, for example, comprise a single hub and a single end device or also one or more hubs together with a plurality of end devices. The end devices can be configured to forward data so that data can also be transmitted to end devices that cannot be reached directly from the hub.

In accordance with a further advantageous embodiment, the end device automatically switches back and forth between the point-to-point connection and the connection with the mesh network, in particular if the end device does not receive any data for longer than a predetermined period of time. If the end device, for example, does not receive any data for more than one hour, more than one day or more than two days, it can be assumed that the point-to-point connection or the mesh network is no longer required. In this case, the end device can switch on its own to the respective other connection type. It hereby, for example, becomes possible that the end device automatically joins the mesh network after a longer inactivity of the point-to-point connection.

Alternatively, the control device can respectively cause the end device to switch back and forth between the point-to-point connection and the connection with the mesh network. It is understood that an automatic switching back and forth is in particular possible when both the PTP software image and the mesh software image are stored in the end device.

A further subject of the invention is a hub for home automation, wherein the hub is designed

- to communicate with a home automation end device by means of a wireless mesh network,
- 5 - to communicate with a control device by means of a wireless data connection, and
- to receive settings performed at the control device from the control device and to transmit them to the end device.

10 The hub can in particular have two separate radio modules (e.g. transceivers) of which one performs the communication with the wireless mesh network and the other communicates with the control device by means of the wireless data connection. The wireless data connection can e.g. be a connection by means of WLAN (Wifi), Bluetooth or Bluetooth Low Energy (BLE).

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The invention further relates to an end device for home automation, wherein the end device comprises a transmission and reception system (e.g. a transceiver) that transmits data either by means of a wireless point-to-point connection or by means of a mesh network. The end device can e.g. be a switch, a dimmer, a
20 sensor or a KNX gateway.

The end device can be configured to automatically join the mesh network.

Furthermore, the end device can be configured to establish the wireless point-to-point connection and the connection with the mesh network by means of the same
25 transmission and reception hardware (that is by means of the same transceiver). Accordingly, the end device can comprise exactly one transceiver.

Finally, the invention relates to a system for home automation that comprises at least one end device for home automation; a control device; and a hub of a mesh
30 network. The system is configured

- to establish a wireless point-to-point connection between the control device and the at least one end device;
- to perform a data communication between the control device and the end device by means of the point-to-point connection in order to configure and/or to control the end device;
- to switch the end device in order to cancel the point-to-point connection and to establish a wireless connection with the mesh network; and
- to perform a data communication between the end device and the hub by means of the mesh network in order to configure and/or to control the end device.

The above statements on the method in accordance with the invention accordingly apply to the hub in accordance with the invention, to the end device in accordance with the invention, and to the system in accordance with the invention. This in particular applies with respect to advantages and preferred embodiments.

The invention will be described in the following purely by way of example with reference to the drawings. There are shown:

Fig. 1 an exemplary system for home automation in a schematic view; and

Fig. 2 the transition from a communication by means of a point-to-point connection to a communication by means of a mesh network in a schematic view.

Fig. 1 shows a system 10 for home automation. The system 10 comprises a plurality of end devices that are, for example, represented as switches 12 in the Figures. The system furthermore comprises a control device in the form of a

smartphone 14; and a hub 16. An app 18 that serves to configure and/or to control the switches 12, and thus the end devices, is executed on the smartphone 14.

The smartphone 14 comprises a Bluetooth Low Energy (BLE) transceiver 20 and a
5 WLAN transceiver 22.

The hub 16 likewise comprises a WLAN transceiver 22 and a ZigBee transceiver 24.

10 A software-defined radio (SDR) 26 is in each case provided as a radio module in the switches 12. In addition, a respective memory module 28 that stores a PTP software image 30 and a mesh software image 32 is arranged in the switches 12. If the PTP software image 30 is activated, the switch 12 is able to communicate with the smartphone 14 by means of Bluetooth Low Energy. However, if the mesh
15 software image 32 is activated, the switch 12 is in each case able to communicate with the hub 16 by means of ZigBee. In the communication by means of ZigBee, the switches 12 are additionally configured to forward data from the hub 16 to more remote switches 12.

20 The different forms of communication by means of Bluetooth Low Energy, ZigBee and WLAN are shown schematically in Fig. 1 by means of BLE connections 34, ZigBee connections 36, and WLAN connections 38.

Fig. 2 shows the smartphone 14 that communicates with the switches 12 by
25 means of BLE connections 34 in each case. The smartphone 14 also communicates by means of a BLE connection 34 with a KNX gateway 40, this means with a further end device that is a gateway for a field bus for building automation/house automation. The KNX gateway 40 also comprises an SDR 26. The left side of Fig. 2 therefore relates to a scenario of use with a few end devices

that are configured and/or controlled by means of a point-to-point connection (e.g. a "room kit").

If the transition to a larger number of end devices is now to take place (e.g. within
5 a "house kit" – see the right-hand side of Fig. 2), i.e. if the BLE connections 34 are
to be replaced with ZigBee connections 36, a command is sent from the
smartphone 14 to the switch 12 and to the KNX gateway 40 to cancel the BLE
connections 34 and to switch to the ZigBee connections 36. In the SDRs 26, the
mesh software image 32 is then used in each case to be able to communicate by
10 means of the ZigBee connections 36.

After the switch to the ZigBee connections 36, the smartphone 14 connects to the
hub 16. The WLAN connection 38 is used for this connection. The hub 16 then
communicates with the switches 12 and with the KNX gateway 40 by means of the
15 ZigBee connections 36. A configuration/control of the switches 12 and of the KNX
gateway 40, which is performed on the smartphone 14, is then first transmitted to
the hub 16 by means of the WLAN connection 38 and is subsequently transmitted
from the hub 16 to the switches 12 and to the KNX gateway 40 by means of the
ZigBee connections 36.

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Due to the use (shown by way of example here) of the SDRs 26, a switching
between the BLE connections 34 and the ZigBee connections 36 is possible
without further ado and in a short time so that a flexible use of the system 10 is
made possible.

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Reference numeral list

	10	system
	12	switch
5	14	smartphone
	16	hub
	18	app
	20	BLE transceiver
	22	WLAN transceiver
10	24	ZigBee transceiver
	26	SDR
	28	memory module
	30	PTP software image
	32	mesh software image
15	34	BLE connection
	36	ZigBee connection
	38	WLAN connection
	40	KNX gateway

Claims

- 5 1. A method for configuring and/or controlling home automation end devices (12, 40), wherein the method comprises:
- establishing a wireless point-to-point connection (34) between a control device (14) and at least one home automation end device (12, 40);
 - performing a data communication between the control device (14) and the
 - 10 end device (12, 40) by means of the point-to-point connection (34) in order to configure and/or to control the end device (12, 40);
 - switching the end device (12, 40) to cancel the point-to-point connection (34) and to establish a wireless connection with a mesh network (36); and
 - performing a data communication between the end device (12, 40) and a
 - 15 hub (16) of the mesh network by means of the mesh network (36) in order to configure and/or to control the end device (12, 40).
2. A method in accordance with claim 1,
- 20 characterized in that,
- at a point in time, the end device (12, 40) respectively either only maintains and/or uses the wireless point-to-point connection (34) or only maintains and/or uses the wireless connection with the mesh network (36).
3. A method in accordance with claim 1 or claim 2,
- 25 characterized in that
- the end device (12, 40) uses a software-defined radio (SDR) (26) to establish the wireless point-to-point connection (34) and the wireless connection with the mesh network (36).
- 30 4. A method in accordance with at least one of the preceding claims,

characterized in that
the end device (12, 40) uses a PTP software image (30) to establish the
wireless point-to-point connection (34) and a mesh software image (32) to
establish the wireless connection with the mesh network (36).

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5. A method in accordance with claim 4,
characterized in that
the PTP software image (30) and the mesh software image (32) are both
stored in the end device (12, 40);

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and/or
in that the mesh software image (32) is transmitted to the end device (12,
40) by means of the point-to-point connection (34).

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6. A method in accordance with at least one of the preceding claims,
characterized in that
settings of the end device (12, 40) relating to the point-to-point connection
(34) and/or to the connection with the mesh network (36) are stored in the
control device (14) and/or in the hub (16).

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7. A method in accordance with at least one of the preceding claims,
characterized in that
the hub (16) communicates with the control device (14) by means of a
wireless data connection (38) after the end device (12, 40) has been
switched to a connection with the mesh network (36), with the wireless data
connection (38) using a communication protocol different from the mesh
network.

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8. A method in accordance with at least one of the preceding claims,
characterized in that

settings of the hub (16) are stored in the control device (14) and/or in a separate memory, with the stored settings being loaded into the replaced hub on a replacement of the hub (16).

- 5 9. A method in accordance with at least one of the preceding claims, characterized in that
the hub (16) receives a configuration and/or a control of the end device (12, 40) performed at the control device (14) from the control device (14) and transmits it to the end device (12, 40).

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10. A method in accordance with at least one of the preceding claims, characterized in that
the point-to-point connection is a Bluetooth Low Energy (BLE) connection (34); and/or in that the mesh network is a ZigBee network (36).

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11. A method in accordance with at least one of the preceding claims, characterized in that
the end device (12, 40) automatically switches back and forth between the point-to-point connection (34) and the connection with the mesh network (36), in particular if the end device (12, 40) does not receive any data for
20 longer than a predetermined period of time.

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12. A system (10) for home automation comprising at least one end device (12, 40) for home automation; a control device (14); and a hub (16) of a mesh
25 network, wherein the system (10) is configured
- to establish a wireless point-to-point connection (34) between the control device and the at least one end device (12, 40);
- to perform a data communication between the control device (14) and the end device (12, 40) by means of the point-to-point connection (34) in order
30 to configure and/or to control the end device (12, 40);

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- to switch the end device (12, 40) in order to cancel the point-to-point connection (34) and to establish a wireless connection with the mesh network (36); and
 - to perform a data communication between the end device (12, 40) and the
- 5 hub (16) by means of the mesh network (36) to configure and/or to control the end device (12, 40).