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Communications system, especially for indoor use

Technical Field

5 The invention relates to a communications system, especially for indoor use, and an adapter device for such a system.

Prior Art

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 Communication networking is progressing continuously. On the one hand, users want to be available by telephone wherever possible and, on the other hand, it should also be possible to transmit data
15 by simple means from any location. To meet these demands, hand-held radio telephones have been developed which are capable of performing not only voice transmission but also data transmission. For the last-mentioned purpose, they are equipped with an infrared
20 interface so that, for example, a connection to a laptop computer can be established.

 However, transmitting data by means of a hand-held radio telephone is only of interest in special circumstances. Handling is still considered to be
25 complicated, as before. For the rest, most of the data are still being transmitted via permanently installed cables, seen statistically. For example, computer cables are laid in an office building in order to connect data processing devices.

30 The installation of new cables is associated with considerable costs. It has already been proposed to avoid such costs by using the lines of the power supply system, which already exist within each building, for signal transmission (keyword: PLC = Power
35 Line Communication). In practice, however, the problem is that not many devices are equipped for this type of transmission. Before such signal transmission can be



carried out, appropriate couplers must be installed. This is in no way a cheaper variant than laying computer cables, especially in an introductory phase.

5 Description of the Invention

It is the object of the invention to create a communications system for indoor use which allows inexpensive networking.

10 The way in which the object has been achieved is defined by the features of Claim 1. According to the invention, the communications system is designed in such a manner that, between two terminals, a point-to-point connection is established which comprises a
15 short-range radio link between at least one of the terminals and an adapter device and a PLC link, conducted via a power supply system, between the adapter device and the second terminal. (A short-range radio link is understood to be a radio link the range
20 of which does not significantly exceed the indoor range, i.e., for example, the size of a room, a floor or a building.)

The system according to the invention is very flexible and inexpensive to install. The adapter device
25 can be connected to any socket of the power supply system, that is to say exactly where it is needed. Components for short-range radio links can be produced today in large numbers and very inexpensively. Due to the point-to-point connection, it is also possible to
30 dispense with central control devices or call controllers ("base stations"). It is possible to maintain a number of connections by staggering them in time (which, in many cases, has the appearance of parallel communication for the user). Not least, it is
35 possible to achieve natural separation between radio zones which, for example, are not in the same room, due

to the fact that the range has been deliberately selected to be short.

The range of the radio link is preferably restricted essentially to supplying one room in the building. It should be shorter than 20 metres, e.g. about 10 metres. In this sense, a so-called "bluetooth" interface can be used, for example. However, interfaces having a longer range are also conceivable, such as IEEE 802.11 (wireless LAN) or "Hiperlan". It is quite easily possible to cover a plurality of adjoining rooms with these. ("Bluetooth" and "Hiperlan" are familiar and standardized interfaces.)

The PLC link connects two different rooms. I.e., as a rule, the two terminals are in different rooms of a building and are connected by means of a PLC system via the power supply lines. If the range of a radio link is restricted to one room, a system according to the invention is configured in such a manner that an adapter according to the invention is connected to the power supply system in each room (to be developed) of the building so that the devices located in this room can communicate with other devices arranged elsewhere. The second terminal does not need to be connected to the PLC backbone by radio technology. It is also possible to use a wire-connected electric coupling.

Naturally, it is not necessary for both devices to be accommodated within the same building. For example, the PLC system can also be open to the outdoor area so that it is possible to communicate with any device anywhere in the world preferably via the external power supply system (for example the outdoor PLC system implemented in this system). The connection between the indoor area and the outdoor area can be created by a so-called bridge and the gateway between the power supply system and any other network (e.g. a

fibre-optical WAN) can be created by a master station arranged in the area of the transformer station. The gateway between indoor and outdoor areas can also be designed as a gateway between two different transmission media (e.g. from PLC to telephone lines or to optical LANs).

The communications system according to the invention is particularly suitable for home automation. For example, kitchen appliances can be networked in a simple manner. A microwave oven which is equipped, for example, with a bluetooth interface, can be connected to the PLC backbone by the adapter device and can be switched on and off, for example, by a controller or a computer program. If the PLC system is suitably equipped, the kitchen appliance can also be operated by radio. For example, a telephone set can be mentioned which has a data interface to the PLC system. The user can call home, for example by means of his hand-held radio telephone, and, using a special code, can cause the telephone set to switch on the oven (via PLC link and bluetooth interface).

In the case of industrial companies, it would be conceivable to place radio receivers in the various buildings which receive long-range radio signals in a frequency band reserved for private data transmission and to couple these into the power supply system. In the machinery room, an adapter device plugged into a socket transfers the control commands to the machinery control via the short-range radio link.

Thus, the principle of the invention can be applied very widely in automation or remote control. It is thus not only a matter of networking computers and the like but also of providing a communication medium between a controller and executing device.

A device acting as adapter device for a communications system according to the invention will

be designed to be as small and simple as possible. It is distinguished by a transceiver for a short-range wireless link. It is coupled to the power supply system by means of a normal mains plug. The device is produced
5 as inexpensively as possible and is visually inconspicuous (i.e. not aesthetically irritating). With regard to investment, the device should appear to the user to be more like an extension cable instead of another telephone station. Thus, it should be possible
10 simply to buy the adapter device if the user considers this to be appropriate or necessary. No early planning and elaborate installation by a specialist (as is needed for the extension of a telephone network) is required.

15 According to a specially preferred embodiment, the adapter device has the form of a compact housing with integrally moulded mains supply. It can be plugged directly into a wall socket of the power supply system and does not need to be "set up" anywhere. The housing
20 accommodates e.g. a bluetooth interface circuit, a PLC interface circuit and a switching microcontroller.

It may be useful if the adapter device has at least one wall socket for a mains plug of any desired device. (The plug of the adapter device and the wall
25 socket correspond to the same standard here.) This prevents one of the wall sockets installed in the room being lost to any other use. During the weekly domestic cleaning, the housewife can plug the vacuum cleaner into the wall socket of the adapter device and does not
30 need to look somewhere else for another wall socket.

If the adapter device has a plurality of free wall sockets, it has, at the same time, the frequently needed function of a multiple adapter. For example, it is easily possible to integrate the adapter function
35 according to the invention into a connector strip of familiar design. Such a connector strip can be

connected to the wall socket, for example via a short cable, and has a plurality of wall sockets arranged in a row in an elongated housing. It is usually on the floor, where it does not cause any disruption (e.g. behind a desk).

In the embodiment mentioned above, having at least one wall socket for third devices, at least two lines designed for conducting power are provided between mutually corresponding contacts of the mains plug and the wall socket. According to a preferred embodiment, these lines have RF inductors which significantly attenuate signals in the range of more than 1 MHz (e.g. by at least 10 dB). Thus, it should not be possible for the communication signals to enter into a connected device unattenuated via the wall socket. The interference potential of the PLC system (which operates, e.g., in the range from 1 MHz to 30 MHz) should be minimized for other devices connected to the mains. (Naturally, conversely, interference originating from the third device can also be kept away from the power supply system and thus from the PLC system up to a certain extent in this manner). Naturally, the inductor must be appropriately adapted if communication is to take place below 1 MHz.

The detailed description below and the patent claims as a whole reveal other advantageous embodiments and combinations of features of the invention.

Brief Description of the Drawings

In the drawings used for explaining the illustrative embodiments:

Figure 1 shows a diagrammatic representation of an indoor communications system;

Figure 2 shows an example of an adapter device constructed in the manner of a multiple adapter;

Figure 3 shows an example of an adapter device constructed in the manner of an adapter plug;

Figure 4 shows a diagrammatic representation of the internal construction of an adapter device.

5 In principle, identical parts have the same reference symbols in the figures.

Ways of Carrying Out the Invention

10 Figure 1 diagrammatically shows a communications system in the indoor area. A building 1 has a conventional indoor power supply system 2 which, as usual, is attached to an external power supply system 3. Within the building 1, devices (e.g. a
15 desktop computer 21, a printer 23, a laptop computer 22, a domestic appliance 20 and/or a hand-held radio telephone 19) located in various rooms A to C can be connected by communications technology.

According to the invention, a PLC system for
20 transmitting the signals between the rooms, on the one hand, and a short-range radio interface for transmitting the signals from the devices to the PLC system within a room are provided.

A master 4 and two slaves 5, 6 are connected to
25 the power supply system 2 via mains sockets 7, 8, 9 and can exchange signals with one another in the frequency range from e.g. 1 to 40 MHz in this way. In the present example, the master 4 and the slave 6 are designed in the manner of an adapter device according to the
30 invention. I.e., they have a bluetooth interface 12 and, respectively, 13 for the short-range wireless communication with other devices in the same room. The slave 5, in contrast, only has one wire-connected data access 18 (e.g. RS232, IEC 488, Ethernet) for
35 connecting the desktop computer 21.

Furthermore, other devices are also attached in a conventional manner to the power supply system 2 via mains sockets 10, 11.

If then, for example, a document which is
5 stored on the laptop computer 22 is to be transmitted to the desktop computer 21, the corresponding data can be sent by the laptop computer 22 via its bluetooth interface 16 to the slave 6, from this via the power supply system 2 to the slave 5 and from this, finally,
10 to the desktop computer 21.

A file stored on the desktop computer 21 can be transmitted via the data connection 18 to the slave 5, from this via the power supply system 2 (PLC link) to the slave 6 and from there via the bluetooth interface
15 13 to the printer 23, which is also equipped with a bluetooth interface 17 (via radio link 46). In this manner, the printer 23 can be used as a network printer.

Naturally, it is also conceivable for the
20 printer 23 to be equipped internally with a coupler (which functionally corresponds to a slave) and for the data not to be received via the bluetooth interface 17 but directly via the said coupler.

The hand-held radio telephone 19 can be used,
25 for example, for sending an e-mail from the desktop computer 21. The e-mail, in turn, is passed by the desktop computer 21 to the slave 5 and from this into the power supply system 2. The master 4 sends the e-mail via its bluetooth interface 12 to the hand-held
30 radio telephone, which is also equipped with a bluetooth interface 14, that is to say via the radio link 45.

Similarly, e.g., the desktop computer 21 can control the domestic appliance 20. Although the latter
35 is connected to the power supply system 2 via a mains socket 10, it does not use this connection for

transmitting data. Instead, a bluetooth interface 15 is integrated in the control section (not shown).

It must be noted that these are always point-to-point connections. The master 4 does not carry out any central switching function (such as, e.g., a PBX in an indoor telephone network). Instead, it is only used for providing a channel in the power supply system 2 to the slaves on request.

In Figure 1, for example, the master 4 can be constructed as bridge to the external power supply system 3. Communications links can then be established to the outside world via the external power supply system 3. (As a rule, other frequencies are used in the outdoor area than in the indoor area so that a "translation" must be made by means of a bridge.)

However, the connection to the outside world can also be established via telephone lines (XDSL), television cable (CATV) or even via long-range radio. Thus, the indoor networking according to the invention is in no way self-contained but provides any desired access capability.

Figure 2 shows a first embodiment of the adapter device. It comprises a connector strip 24 which can be plugged into an installed wall socket or the like by means of the plug 26 via a power cable 25. The connector strip 24 can have a number of power sockets 27.1 to 27.4 and, if necessary, a power switch 28 in a manner known per se (in order to break the current on the connector strip in a conventional manner). At an end of the connector strip 24 facing away from the power cable 25, an adapter 29 is integrated into the housing. It exhibits a bluetooth interface and a PLC interface and thus provides for the communication with suitably constructed devices as explained by means of Figure 1. (The details of the adapter 29 are shown in Figure 4.)

A particularly preferred embodiment is shown in Figure 3. On one side of a housing 30, cuboid for example, a standard mains plug 31 and on the other (opposite) side a power socket 32 are constructed.

5 (This socket can correspond to the same standard as the main plug 31 but it does not need to.) The adapter 33 is accommodated in the housing 30, e.g. on the side next to the power socket 32.

10 The special characteristic of this embodiment consists in the compactness of the design. Plugs, sockets and interface electronics form a rugged, rigid unit. The adapter device can be plugged into a wall socket (which is installed at an easily reached location) without the wall socket being "occupied".

15 Figure 4 diagrammatically shows a circuit diagram of an adapter device 34. The mains plug 35 has, e.g., three contacts (P=Phase, N=Neutral, PE=Protective Earth) which are here shown as pins. The said three contacts are connected to corresponding contacts of the wall socket 36 via lines 39.1 to 39.3. Phase P and Neutral N of the mains plug 35 are directly connected to data accesses 37.1, 37.2 by means of lines 39.1, 39.2. The Phase P and the Neutral N of the wall socket 36 are also attached to the two said lines 39.1, 39.2.
20
25 However, the inductors 38.1, 38.2 produce RF isolation so that the PLC signals fed in via the data accesses 37.1, 37.2 cannot enter unattenuated into a device connected to the wall socket 36. The inductors 38.1, 38.2 can be formed by inductive elements which create a
30 noticeable attenuation (e.g. > 3dB) in the area of the signal frequencies used.

The PE contacts for the earthing are directly connected to one another without interposition of an inductance.

35 The data accesses 37.1, 37.2, which, at the same time, are used as power supply for the electronic

components of the adapter device 34, are connected to a PLC interface 40 which forms the interface to the PLC communications system. A subsequent microcontroller 41 provides for data exchange between PLC interface 40 and bluetooth interface 42. An antenna 43 integrated in the adapter device 34 sends and receives radio signals with a short range.

Radio signals which are received via the antenna 43 are converted to PLC signals and applied to the two phase and neutral lines of the power supply system. Conversely, PLC signals are coupled out at the data accesses 37.1, 37.2 and emitted as standard bluetooth radio signals by means of the antenna 43.

The circuit diagram shown in Figure 4 is equally suitable for the design embodiments shown in Figures 2 and 3. In the case of the connector strip 24, a number of power sockets 27.1 to 27.4 are simply connected in parallel to the lines 39.1, 39.2, 39.3. The inductors are not mandatory in this arrangement. They can be either provided at another place or can be left out completely. They are primarily of importance if sensitive devices (e.g. computers, stereos, measuring instruments) or interfering devices (vacuum cleaners etc.) must be connected to the wall socket.

The use of a bluetooth interface corresponds to a particularly advantageous embodiment, but it is quite easily possible and even appropriate in certain cases to use radio interfaces having a longer range (such as, e.g., IEEE 802.11 or Hiperlan).

The invention is not restricted to the illustrative embodiments shown. Various other versions are possible, especially with respect to design. The mains plug 31 and power socket 32, for example, do not need to be aligned on a common axis; neither do they need to be provided at opposite sides of the housing 30.

On consideration of Figure 2 it is clear that the invention could also be produced in an extension cable. The connector strip 24 would then be replaced by a single wall socket.

5 The adapter device according to Figure 4 could also be constructed in two parts. One part would contain the mains plug 35, wall socket 36 and inductors 38.1, 38.2. The other part would accommodate the electronic components (interface circuits and
10 microcontroller).

 Furthermore, the invention is not restricted to two-phase power supply systems. A preferred field of application could be, in particular, 3-phase systems in which there are a number of phase conductors. Under
15 certain circumstances, two adapters could also be used in one room (particularly if it is large). Naturally, not every room needs to contain an adapter device if the range of the radio link is not restricted to a single room (even if the building is completely
20 covered).

 In summary, it must be noted that the invention demonstrates an inexpensive way of communicating in the indoor area and also beyond this area. It is possible to connect stationary or mobile devices which have a
25 short-range radio interface with one another with little expenditure.

Patent Claims

1. Communications system, especially for indoor use, in which a point-to-point connection between two
5 terminals (19, 20, 21, 22, 23) comprises at least one short-range radio link from one terminal (22) to an adapter device (6) and a PLC link, conducted via lines of a power supply system (2), from the adapter device (6) to the second terminal (21).
- 10 2. Communications system according to Claim 1, characterized in that the short-range radio link has a range restricted to one room in a building (1) which is preferably < 20 metres, especially about 10 metres.
3. Communications system according to Claim 2,
15 characterized in that the radio link is constructed as bluetooth link.
4. Communications system according to one of Claims 1 or 2, characterized in that the PLC link connects at least two separate rooms (A, B, C) with one
20 another.
5. Communications system according to one of Claims 1 to 3, characterized in that it has a PLC bridge as gateway to a transmission medium in the outdoor area.
- 25 6. Communications system according to one of Claims 1 to 4, characterized in that one of the terminals is a domestic appliance (20).
7. Device as adapter device for a communications system according to Claim 1, characterized in that it
30 exhibits a transmitter for a short-range radio link in addition to a mains plug (35).
8. Device according to Claim 7, characterized in that the transceiver essentially comprises a bluetooth interface circuit (42), a PLC interface circuit (40)
35 and a switching microcontroller (41).

9. Device according to Claim 7 or 8, characterized in that, additionally, at least one socket (36) is provided for connecting a third device.

10. Device according to Claim 9, characterized in
5 that at least two inductors (38.1, 38.2) are provided for attenuating RF signals with respect to the socket (36).

11. Device according to one of Claims 7 to 10,
characterized in that the mains plug (35) and
10 transceiver are integrated in one compact housing (30).