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(54) Title: TELEPHONE SYSTEM

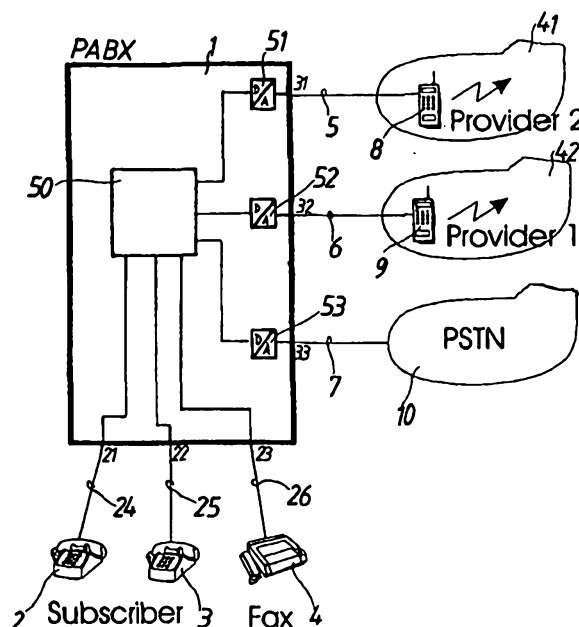
(54) Bezeichnung: TELEPHONSYSTEM

(57) Abstract

The invention relates to a telephone system which has a private branch exchange (1) comprising at least one switching node, two or more extension outlets (21, 22, 23) for extension terminals (2, 3, 4) and at least one exchange line output (31, 32, 33; 34). Said switching nodes connect the extension outlets (21, 22, 23) to the at least one exchange line output (31, 32, 33; 34), one or more of the exchange line outputs (31, 32, 33; 34) each being connected to a wire telephone network (10) by an exchange line (7) and one or more other exchange line outlets (31, 32) each being connected to a transceiving device (8, 9) by an exchange line (5, 6), in a known manner. Said transceiving device (8, 9) can be connected to a cellular telephone network (41, 42).

(57) Zusammenfassung

Telephonsystem mit einer Nebenstellenanlage (1), die zumindest einen Schaltknoten, zwei oder mehrere Nebenstellen-Ausgänge (21, 22, 23) für Nebenstellen-Endgeräte (2, 3, 4) und zumindest einen Amtsleitungs-Ausgang (31, 32, 33; 34) umfaßt, über welchen Schaltknoten die Nebenstellen-Ausgänge (21, 22, 23) mit dem zumindest einen Amtsleitungs-Ausgang (31, 32, 33; 34) verbindbar sind, wobei ein oder mehrere der Amtsleitungs-Ausgänge (31, 32, 33; 34) jeweils über eine Amtsleitung (7) mit einem drahtgebundenen Telephonnetzwerk (10) verbunden sind, und wobei ein oder mehrere weitere Amtsleitungs-Ausgänge (31, 32) in an sich bekannter Weise jeweils über eine Amtsleitung (5, 6) mit einer Sende- und Empfangsvorrichtung (8, 9) verbunden sind, die mit einem Funktelefon-Netzwerk (41, 42) verbindbar ist.



Telephone system

The invention relates to a telephone system with a private branch exchange which comprises at least one switching node, two or more extension ports for extension terminal devices and at least one exchange line port, via which switching node the exchange ports can be connected to the at least one exchange line port, one or more of the exchange line ports being respectively connected via an exchange line to a public wire-bound telephone network, and the private branch exchange being connected to at least one transceiver device.

EP 0 802 693 A2 has disclosed a method for connecting base stations of radio-operated mobile units according to the DECT standard to ISDN private branch exchanges, the mobile units being provided with all the features of the private branch exchange. In addition to the base stations there are wire-bound subscribers, which are also connected to extension ports and which constitute a nonpublic telephone network which is connected via exchange line ports of the private branch exchange and exchange lines to a public telephone network.

In addition, US 5 355 402 discloses the setting up of a connection between different private branch exchanges without using a wire-bound telephone network. To do this, a cellular base station of a first private branch exchange is arranged in the reception area of another cellular base station of a second private branch exchange, permitting wireless connection between the two base stations. This makes it possible to avoid the need to lay a transmission line between the private branch exchanges, which may possibly be costly. The condition for the method of operation is the overlapping of the radio coverage areas of two cellular base stations.



Known telephone systems of the type mentioned at the beginning are used to perform automatic connection of extension users to the wire-bound public telephone network. The appearance of private or partially privatised network operators in the cellular phone field has also resulted in the last few years in large differences in call tolls, which become particularly significant if a wire-bound telephone subscriber makes a call to a cellular phone subscriber, because there is virtually a doubling-up of two toll systems. However, because the operators of cellular phone networks are under considerable competitive pressure, call tolls have also been divided into different application groups. One result of these efforts is, for example, the reduction of call tariffs if two cellular phone subscribers of the same operator telephone one another.

The object of the invention is therefore to avoid the abovementioned disadvantages and to specify a telephone system of the type mentioned at the beginning with which a reduction in tolls can be achieved in the case of call connections between a wire-bound subscriber and a cellular phone subscriber.

Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art in Australia on or before the priority date of the claims herein.

According to a first aspect of the invention there is provided a telephone system with a private branch exchange which includes at least one switching node, two or more extension ports for extension terminal devices and at least one exchange line port via which switching node the exchange ports can be connected to the at least one exchange line port, one or more of the exchange line ports being respectively connected via an exchange line to a public wire-bound telephone network and the private branch exchange being connected to at least one transceiver device wherein the transceiver device or devices is/are each assigned to and can each be connected to a public cellular phone network and wherein the transceiver device or devices is/are each connected directly to the private branch exchange via an exchange line and one of the further exchange line ports.

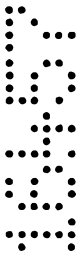


According to embodiments of the invention the transceiver device or devices is/are assigned in each case to one public cellular phone network and can be connected to it, and the transceiver device or devices is/are connected directly to the private branch exchange, in each case via one exchange line and

5 one of the other exchange line ports.

In this way, it is possible to make an advantageous selection of outgoing calls in that call connections which are directed to wire-bound subscribers are switched via that exchange line which is connected to a switching office of the public, wire-bound telephone network while calls which are directed to cellular

10 phone subscribers are routed automatically via an exchange line which is connected



to a transceiver device, via which a connection can be made to a cellular phone network. In this way, the lower tariff which is provided for calls between two cellular phone subscribers can be used without the extension user having to provide a separate cellular phone for this purpose. Moreover, the extension user does not have to do anything other than select the correct subscriber number on his extension terminal device. Within the scope of the application, such terminal devices are understood here to be all possible embodiments, which can also be used for nonverbal communication, like a fax device.

According to a further embodiment of the invention, the transceiver device can be formed by a fixed cellular phone unit (FCT) which is assigned to a private network operator and to which a device for voice compression and decompression is assigned. In this way, the extension user can automatically benefit from the reduced-toll call connections to other cellular phones of the same network operator, the device for voice compression and decompression enabling better use to be made of the transmission bandwidth of the fixed cellular phone unit.

In a further development of the invention there may be provision for the at least one further exchange line to be formed by a digital exchange line with digital interfaces at its ends.

This simplifies the circuit complexity both at the extension and in the transceiver device, because the digital/analog conversion is eliminated and the data can be transmitted directly in digital form.

According to one variant of the invention, the at least one digital exchange line can preferably be an ISDN line with ISDN interfaces. The standardized design of such an exchange line permits a cost-effective implementation.

It has proven particularly advantageous here if signaling on the digital exchange line takes place in

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digital form, in which case digital services such as SMS, COLP, CLIP or the like can be transmitted to the exchange terminal device.

In this way, various functional features which
5 are customary for a cellular phone, for example SMS (short message service) for transmitting messages which can be displayed at the receiver end and displaying the caller subscriber number (CLIP) and the called subscriber number (COLP) or the like, can also be
10 provided for use by the extension user.

Modern digital private branch exchanges have a comprehensive integrated text message system. With this text message system, the keypad of any extension terminal device can be used to send text messages (for
15 example "please call back") to other extension terminal devices with a corresponding display. The significant expansion of such a private branch exchange by the system according to the invention consists therefore in the fact that these messages can be sent not only
20 internally but also to external cellular phones on which these messages can be displayed. For this purpose, the cellular phone subscriber is entered as a receiver of the message. This receiver of the message also recognizes the sender of the message because the
25 sender's name and subscriber number including the national dialing code and local dialing code can also be transmitted at the same time. The subscriber number which is specified may be that of the transceiver device together with the appropriate extension number.

30 The message receiver can then call back or also have a message sent to the sender because the subscriber number has also been communicated in the address header which was transmitted at the same time, and appropriate use can be made of the subscriber
35 number. The message is forwarded by the private branch exchange. The extension terminal device indicates that there is an incoming message, for example by means of a



signaling light or a call signal, after which the user can read the message on his display.

Furthermore, by virtue of the digital signaling on the digital exchange line as against an analog exchange line, the digital/analog or analog/digital converters which would otherwise be necessary and which need to be provided at the junction between the digital private branch exchange and the analog exchange line can be dispensed with.

10 Furthermore, the digital transmission on the exchange line prevents quality impairment due to signal damping from taking place.

According to a particularly preferred variant of the invention, the signaling can be carried out in accordance with the ISDN protocol or in accordance with an expanded or reduced ISDN protocol. The standards which have already been defined for the transmission of data and calls and for the supplementary services provided in ISDN and GSM terminal devices can thus be effectively used.

According to one further feature of the invention there may be provision for the transceiver device to be arranged at a different location than the private branch exchange, preferably at a location with good radio reception.

In this way, the transceiver device may be arranged at a location which ensures the best possible radio reception. This is to be recommended whenever locating it within or in the vicinity of the private branch exchange results in a significant impairment of the call traffic or data traffic.

Usually, a compression and decompression device with which the voice or data signals which are to be transmitted can be compressed is located in every cellular phone unit in order to increase the number of transmitted calls and thus permit better use of the transmission channels.



So that the exchange lines which are provided for connection to the transceiver devices can then be reduced in number, it is possible to provide, in accordance with another variant of the invention, that the voice compression and decompression device which is assigned to the transceiver device is arranged within the private branch exchange, and that the port of the device for voice compression and decompression is
 5 connected to the extension-end-digital interface.

In this way, up to 9 calls can be transmitted simultaneously via an exchange line or via an interface with a customary compression rate of 13.3 kbit/s, so that fewer interfaces overall are required. The resulting elimination of interfaces allows the
 10 expenditure in terms of installation and maintenance to be reduced the expenditure in terms of equipment is also inherently lowered.

A further object of the invention consists in disclosing a method for connecting a terminal device of a private branch exchange in a telephone system to at least one public wire-bound telephone network and at least one public cellular phone network, which
 15 method allows a reduction in phone tolls to be achieved.

According to a second aspect of the invention there is provided a method for connecting a terminal device of a private branch exchange in a telephone system to at least one public wire-bound telephone network and at least one public cellular phone network wherein, within the private branch exchange firstly the subscriber number which
 20 is dialed using one of the extension terminal devices or the part of said number which characterizes the respective cellular phone network is compared with stored numbers or part of numbers which are each assigned an exchange line and the connection is then switched via the exchange line assigned to the subscriber number or to the part of the number to the respective cellular phone network said exchange line being connected
 25 directly to a transceiver device which is assigned to the respective cellular phone network.

According to embodiment of the invention within the private branch exchange, firstly the subscriber number which is dialed using one of the extension terminal devices or the part of said number which characterizes the respective cellular phone network is
 30 compared with stored numbers or parts of numbers which are each assigned an exchange line, and the connection is then switched via the exchange line which is assigned to the subscriber number or to the part of the number to the respective cellular phone network, said exchange line being connected directly to a transceiver device which is assigned to the respective cellular phone network.

In this way, depending on the dialed subscriber number, the connection which is
 35 the most favourable in



terms of the dialed subscriber can be set up to one of the provided exchange lines.

In a further embodiment of the invention there may be provision that when a subscriber number which characterizes a cellular phone network operator is dialed, the extension terminal device which is dialing is switched via a cellular phone unit assigned to this network operator and via the exchange line which is connected to the cellular phone unit.

When a cellular phone subscriber is dialed in this way, the connection is automatically set up via a fixed cellular phone unit assigned to the respective network operator, as a result of which a respectively low call tariff is charged.

According to a further variant of the invention there may be provision that when a stored subscriber number or parts of the subscriber number whose associated subscriber is connected to a further private branch exchange which can be dialed both via a wire-bound telephone network and via a cellular phone network is/are dialed, the extension terminal device which is dialing is connected to the dialed extension terminal device via one of the cellular phone units assigned to the dialed subscriber number or to parts of it, and via the exchange line which is connected to said cellular phone unit.

As a result, specific subscribers who are known also to be accessible via a cellular phone can be connected not only via the wire-bound telephone network when their subscriber number corresponding to said wire-bound telephone network is dialed, but can also be connected via a cellular phone network, permitting a correspondingly low call tariff to be obtained. One possible embodiment consists, for example, in equipping the control center of a company and its branches with telephone systems according to the invention, so that the switching method according to the invention can be applied.



The invention is explained in detail below with reference to the exemplary embodiments illustrated in the drawings, in which:

Figure 1 shows a block circuit diagram of an embodiment of the telephone system according to the invention;

5 Figure 2 shows a block circuit diagram of a further embodiment of the telephone system according to the invention;

Figure 3 shows a block circuit diagram of a further embodiment of the telephone system according to the invention;

10 Figure 4 shows a block circuit diagram of an embodiment of a cellular phone unit, and

Figure 5 shows a block circuit diagram for switching subscriber terminal devices in the manner of the invention.

15 Figure 1 illustrates a telephone system with a digital private branch exchange 1 to which subscriber terminal devices, such as analog or digital telephone apparatuses 2, 3 and a transmission device 4, for example a fax unit, are connected via extension ports 21, 22 and 23, which are connected to a switching network 50 which contains one or more switching nodes. The terminal devices 2, 3 and 4 can be connected to three exchange line ports 31, 32 and 33 via the switching network 50.

20 The number of subscriber terminal devices and available exchange lines is dependent on the size of the private branch exchange and is not subject to any restriction in all the exemplary embodiments according to the invention.

In order to convert the digital signals coming from the switching network 50 into analog line signals,



bidirectional digital/analog converters 51, 52, 53 are interconnected in order to permit the signals coming from the terminal devices 2, 3, 4 and transmitted to them to be transmitted on analog exchange lines 5, 6 and 7.

The exchange line 7 is connected to the public wire-bound telephone network 10 via a switching office so that outgoing and incoming calls can be switched via said office. To permit them to be distinguished, the further exchange lines 5 and 6 are each connected to a transceiver device 8, 9, which can each be connected to one public cellular phone network 41, 42. The transceiver device can be formed here by means of a fixed cellular phone unit 8, 9 which is assigned to a private network operator. In this respect, Fig. 4 shows the inner structure of such cellular phone units which are designated as FCT (Fixed Cellular Terminals). The respective exchange line 5, 6 (Fig. 1), 50, 60 (Fig. 2) and 70 (Fig. 3) which is connected to the cellular phone unit is connected, in the interior of the cellular phone unit (Fig. 4), via an interface to a subscriber circuit 82 which corresponds to a switching office circuit and via which the calls coming from one or more subscribers are forwarded to a cellular unit 84 and transmitted via an antenna 83. In the receiver device, the received signals are accordingly directed to the subscriber circuit 82 and the exchange line 5, 6, 50, 60, 70 via the transmitter 84.

Both voice and additional data services can be transmitted via the subscriber circuit 82. If the FCT unit contains a plurality of transmitter and receiver components, a plurality of calls can be transmitted simultaneously, also enabling simultaneous connections to two or more network operators to be set up.

A computer 85 with a maintenance interface permits appropriate configuration of the cellular phone unit, which is supplied via a power supply unit 80 and a backup battery 81.

Calls can then be selected within the private branch exchange, in a way which enables particular savings in terms of tariffs, by means of the three exchange line connections 5, 6 and 7 (illustrated in Fig. 1), which are positioned one next to the other. In wire-bound networks, the tolls for switching a call to a cellular phone subscriber are particularly high. Thus, for example, the first telephone call tariff is always charged for this in Austria. In recompense, the private cellular phone network operators provide the possibility of making calls particularly cost-effectively from one cellular phone to another within such a network. The invention exploits this toll advantage in that when a subscriber number which is associated with a cellular phone network is dialed, the private branch exchange does not connect the exchange line to the wire-bound network but rather connects it to a transceiver device of the cellular phone network which corresponds to the dialed subscriber number. This connection is not apparent to the extension user, but the call can be made at the lower tariff, which may even be less than the toll for a call from one wire-bound subscriber to the other.

The correct assignment of the respectively desired calls can thus enable a considerable reduction in tolls to be achieved.

Fig. 2 shows a further embodiment of the invention in which, instead of the analog exchange line between the exchange line ports 31, 32 and the cellular phone units 8, 9, there is in each case a digital exchange line 50, 60 with digital interfaces 61, 62 at its ends.

As a result, the analog/digital converters 51, 52 of the embodiment according to Fig. 1 can be dispensed with. The digital exchange lines according to Fig. 2 are embodied as ISDN lines 50, 60 with ISDN- U_{k0} interfaces 61, 62, and the signaling takes place in a digital form, so that digital services such as SMS,

COLP, CLIP or the like, which are otherwise only available in ISDN networks or for cellular phones, can be transmitted to the extension terminal device 2, 3, 4 and transmitted by it.

5 Signaling is advantageously carried out here in accordance with the ISDN protocol or in accordance with an expanded or reduced ISDN protocol, the standardized channel partitioning into 2 B channels (64kbit/s each) and one D channel (16 kbit/s) being implemented.

10 The digital exchange lines thus permit different display possibilities (SMS, COLP, CLIP or the like) of a digital private branch exchange to be used, even for externally operated cellular phone terminal devices. The ISDN protocol of the digital extension is
15 converted into the GSM radio protocol within the cellular phone units 8, 9.

 The transceiver devices 8, 9 can preferably be arranged here at a different location than the private branch exchange, preferably at a location with good
20 radio reception. The private branch exchange will thus possibly be arranged in cellar rooms and the cellular phone units 8, 9 will possibly be arranged in a roof area in order to be able to permit good radio contact with the cellular phone networks 41, 42.

25 In the exemplary embodiment according to Fig. 3, the number of exchange lines for the separate cellular network connection has been reduced to one. This produces the immediate advantage that it is also necessary to lay just one exchange line 70.

30 This is achieved in that the voice compression and decompression device 66 which is assigned to the transceiver device and which is otherwise provided, for example, in the cellular phone units 8, 9 (Fig. 2) is arranged within the private branch exchange 1. The port
35 of the voice compression and decompression device 66 is connected here to the digital interface 64 at the extension end, said digital interface 64 being itself connected to the single digital exchange line 70. In

this way, a plurality of call or data connections (currently up to nine with GSM) can be connected via the one interface 64 by virtue of the compression previously carried out.

5 A precondition for embodying the invention according to Fig. 3 is a fixed cellular phone (FCT) unit 39 via which the connection to two or else also to a plurality of cellular phone networks 41, 42 can be set up. For this purpose, a plurality of transceiver
10 devices, even for different cellular phone networks, are combined in one unit, a digital interface being provided for connection to the exchange line. Such an FCT unit is shown, for example, in Fig. 4.

 The process of connecting an extension terminal
15 device is carried out in a telephone system according to the invention (illustrated by way of example in Figs. 1, 2 and 3) as follows. Within the private branch exchange, the subscriber number dialed using one of the extension terminal devices 2, 3, 4 or the part of said
20 number which characterizes the network operator is firstly compared with stored numbers or parts of numbers which are each assigned an exchange line 5, 6, 7, 50, 60, 70, and then the connection is made via the exchange line 5, 6, 7; 50, 60; 70 which is assigned to
25 the subscriber number or to the part of the number.

 In this way, the code 0664 which characterizes the cellular phone network operator can be assigned, for example, to the exchange line 5 and to the fixed cellular phone unit 8 in Fig. 1. If an extension user
30 then uses his terminal device to dial a subscriber number with this code, the respective terminal device is connected via the cellular phone unit 8 assigned to this network operator, and via the exchange line 5 which is connected to the cellular phone unit 8.

35 This enables automatic assignment to the correct cellular phone network to be carried out. However, further applications can also be carried out with the telephone system according to the invention,

one of which, which is suitable for making telephone calls cost-effectively between a company headquarters and a branch of the company, is shown in Figure 5. Terminal devices 2, 3, 4 and 2', 3', 4' are provided in the private branch exchange 1 of the company headquarters and in a further private branch exchange 1' of a branch of the company. In conventional systems, the connection will be made between a terminal device at the headquarters 1 and a terminal device at the branch 1' via the wire-bound telephone network 10. In contrast, providing telephone systems according to the invention at the headquarters and at the branch allows company-internal calls to be connected automatically via a cellular phone network 41, 42. For this purpose, all the suitable branch numbers and the number of the headquarters are stored in the private branch exchanges 1, 1'. These are checked for correspondence with the dialed subscriber number before the connection is set up.

When a stored subscriber number or parts of it are dialed, for example the subscriber number of the branch whose associated subscriber, for example 2', is connected to the private branch exchange 1', the extension terminal device 2 which is dialing is connected to the dialed extension terminal device 2' via one of the cellular phone units 8', 9' assigned to the dialed subscriber number or to parts of it, and via the exchange lines 50', 60' which are connected to said cellular phone units 8', 9'. In this way, the call which would otherwise be connected via the wire-bound network 10 is diverted automatically to one of the cellular phone networks 41, 42 and a saving in terms of tolls is thus made possible.

"Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A telephone system with a private branch exchange which includes at least one switching node, two or more extension ports for extension terminal devices and at least one exchange line port via which switching node the exchange ports can be connected to the at least one exchange line port, one or more of the exchange line ports being respectively connected via an exchange line to a public wire-bound telephone network and the private branch exchange being connected to at least one transceiver device wherein the transceiver device or devices is/are each assigned to and can each be connected to a public cellular phone network and wherein the transceiver device or devices is/are each connected directly to the private branch exchange via an exchange line and one of the further exchange line ports.
2. A telephone system as claimed in claim 1, wherein the transceiver device is formed by a fixed cellular phone unit which is assigned to a private network operator and to which a device for voice compression and decompression is assigned.
3. A telephone system as claimed in claim 1 or 2, wherein the at least one further exchange line is formed by a digital exchange line with digital interfaces at its ends.
4. A telephone system as claimed in claim 3, wherein the at least one further digital exchange line is an ISDN line with ISDN- U_{k0} interfaces.
5. The telephone system as claimed in claim 3 or 4, wherein a signaling operation on the digital exchange line takes place in digital form, it being possible for digital services such as SMS, COLP, CLIP or the like to be transmitted to the extension terminal device.
6. The telephone system as claimed in one of claims 3, 4 or 5, wherein the signaling is carried out in accordance with the ISDN protocol or in accordance with an expanded reduced ISDN protocol.



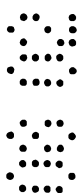
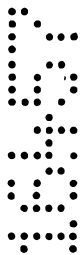
7. The telephone system as claimed in one of claims 1 to 6, wherein the transceiver device is arranged at a different location than the private branch exchange, preferably at a location with good radio reception.

8. The telephone system as claimed in one of claims 2 to 7, wherein the device, assigned to the transceiver device for voice compression and decompression is arranged in the private branch exchange and wherein the port of the device for voice compression and decompression is arranged in the private branch exchange and wherein the port of the device for voice compression and decompression is connected to the digital interface at the extension end.

9. A method for connecting a terminal device of a private branch exchange in a telephone system to at least one public wire-bound telephone network and at least one public cellular phone network wherein, within the private branch exchange firstly the subscriber number which is dialed using one of the extension terminal devices or the part of said number which characterizes the respective cellular phone network is compared with stored numbers or part of numbers which are each assigned an exchange line and the connection is then switched via the exchange line assigned to the subscriber number or to the part of the number to the respective cellular phone network said exchange line being connected directly to a transceiver device which is assigned to the respective cellular phone network.

10. The method as claimed in claim 9, wherein when a subscriber number which characterizes a cellular phone network operator is dialed, the extension terminal device which is dialing is switched via a cellular phone unit assigned to this network operator and via the exchange line which is connected directly to the cellular phone unit.

11. The method as claimed in claim 9, wherein when a stored subscriber number or parts of the subscriber number whose associated subscriber is connected to a further private branch exchange which can be dialed both via a wire-bound telephone network and via a cellular phone network is/are dialed, the extension terminal device which is dialing is connected to the dialed extension



terminal device via one of the cellular phone units assigned to the dialed subscriber number or to parts of it, and via the exchange line which is connected to said cellular phone unit.

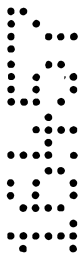
12. A system substantially as herein described with reference to any one of Figures 1 to 5.

13. A method substantially as herein described with reference to any one of Figures 1 to 5.

DATED this 13th day of August, 2002

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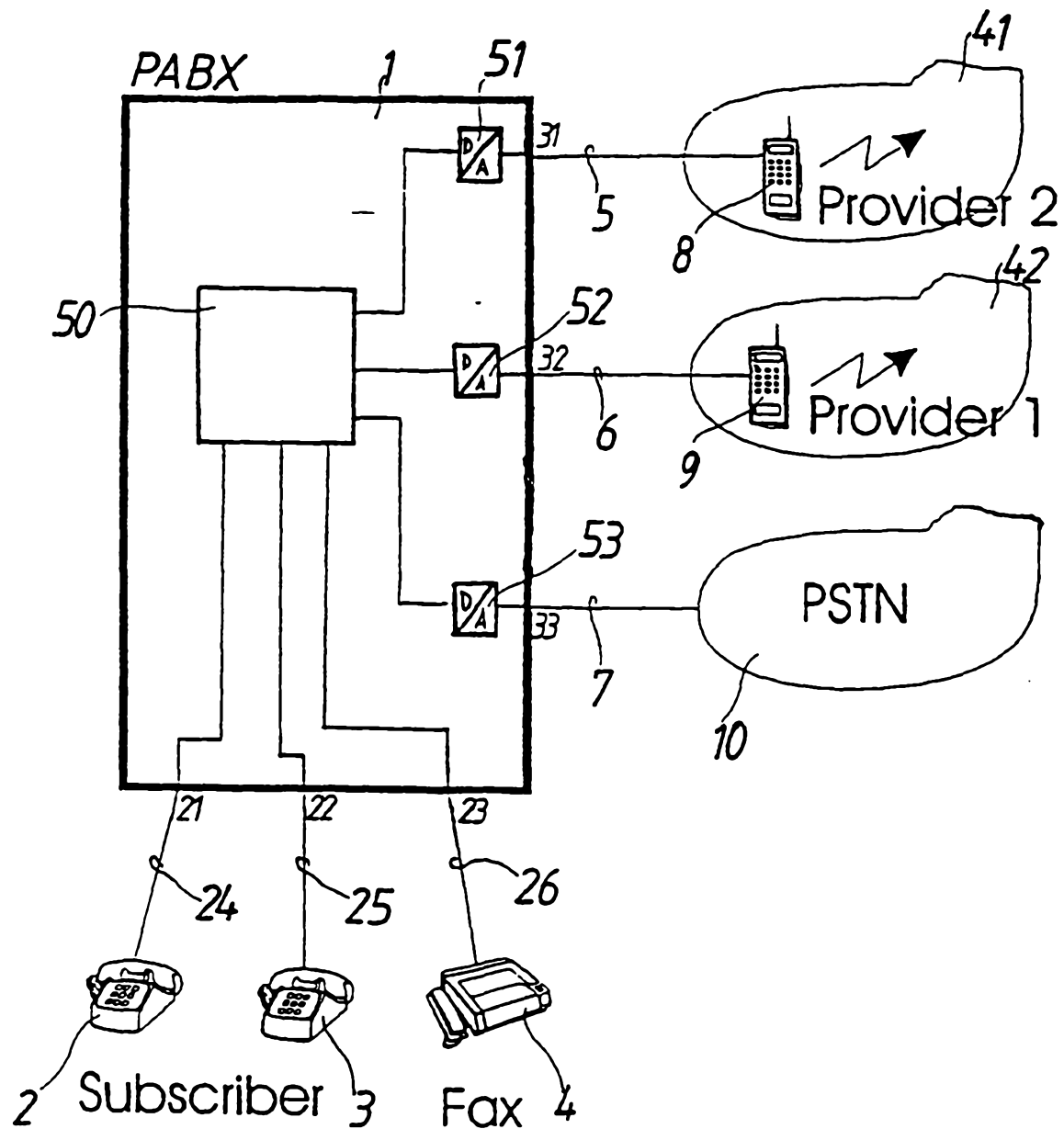


FIG. 1

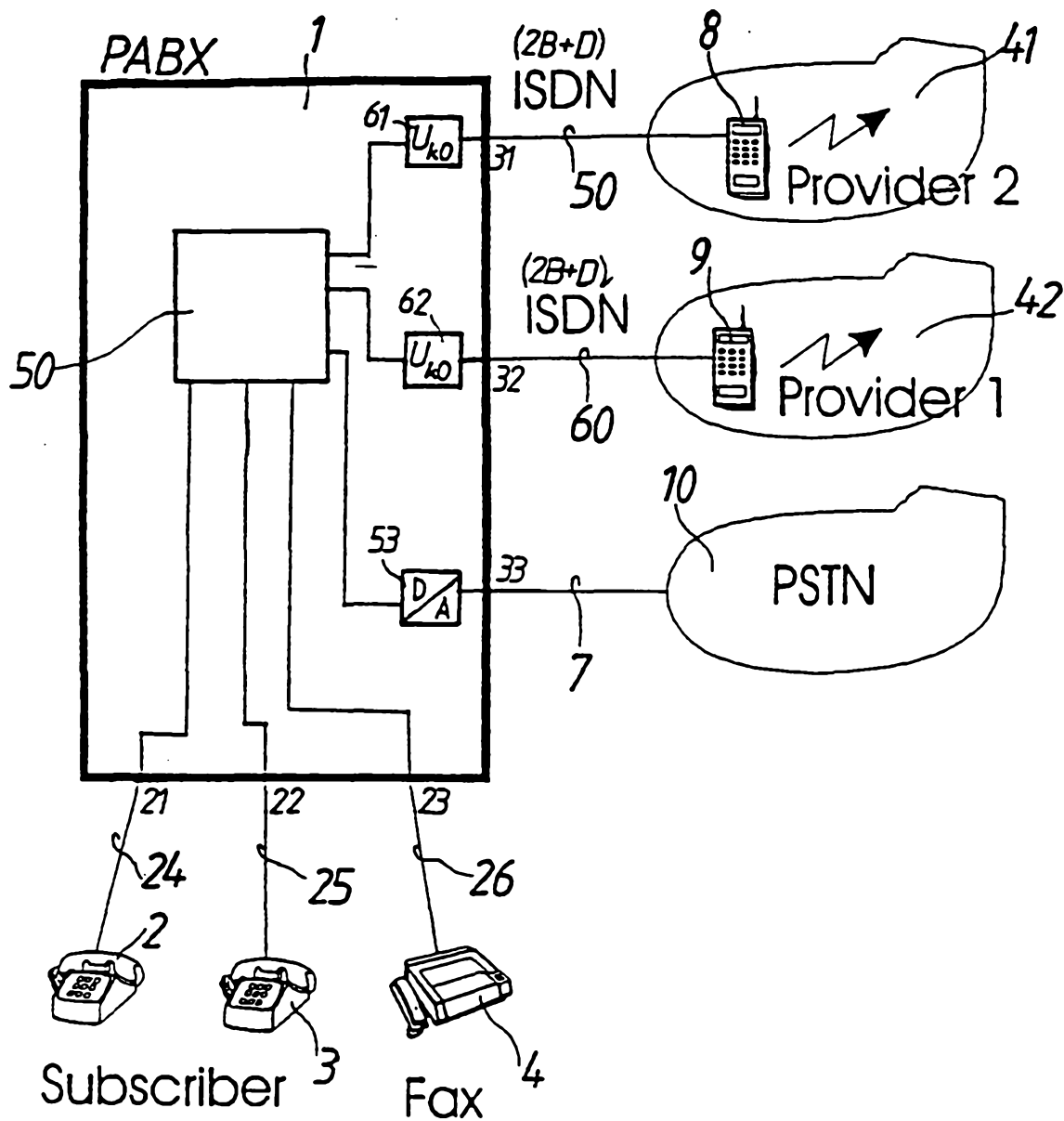


FIG. 2

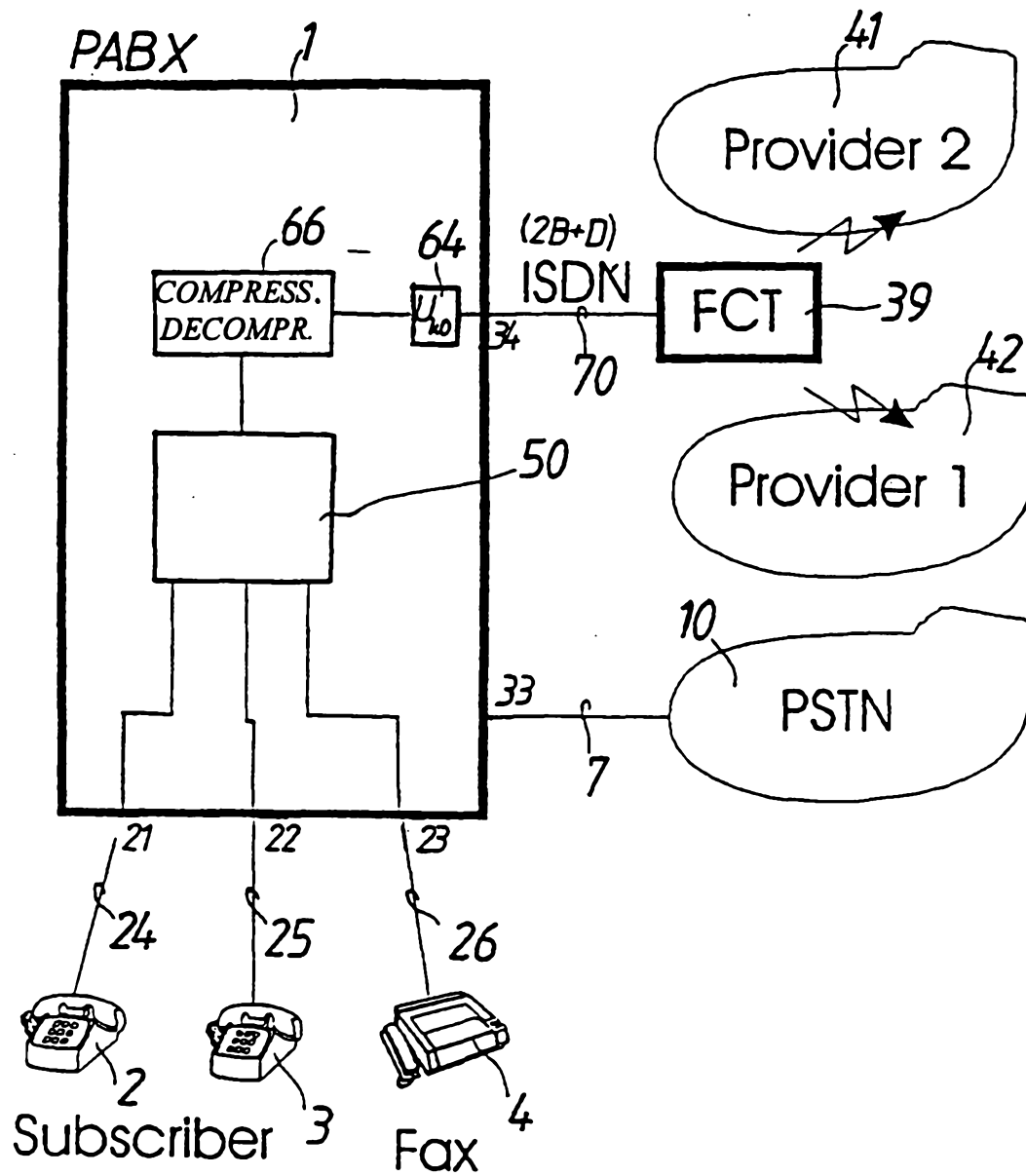


FIG. 3

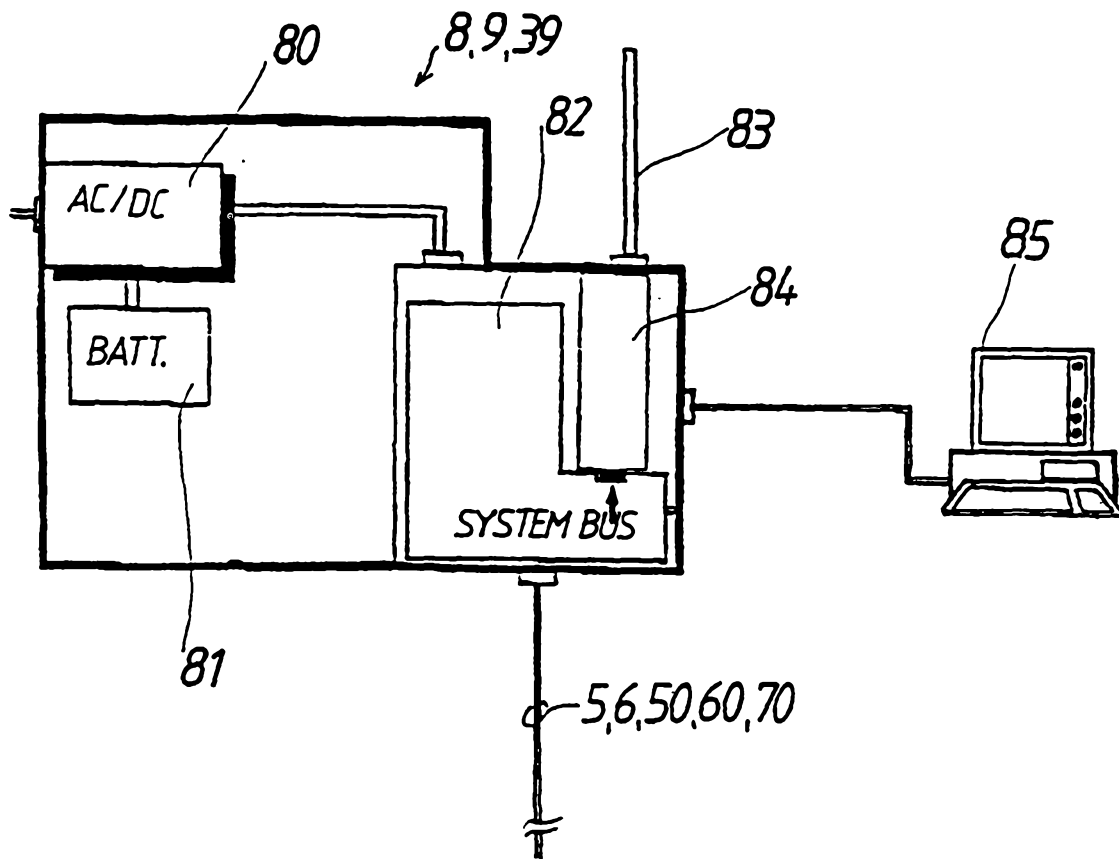


FIG. 4

