

"A cordless telephony system, and a base station and a handset in such a system"

The present invention relates to a cordless telephony system comprising at least one base station for communicating with at least one handset, which system uses an infrastructure of a wide area paging network for initiating servicing of incoming calls to handsets. In such a cordless telephony system a handset and a base station can simply be a
5 wireless local loop replacement of a plain old telephone in a switched telephone network, or the base station can be a wireless extension of a private automatic branch exchange, or the base station can be a Telepoint radio station which is connected to the switched telephone network. Also, a number of base stations, covering relatively small areas, can form a business network. With a system like a DECT (Digital European Cordless
10 Telecommunications) system, even a handover of a call between cells covered by base stations can be done.

The present invention further relates to a base station and to a handset for use in such a system.

15

A known service in a cordless telephony system in which a base station is installed in public places by a Public Telecommunications Operator is a so-called Telepoint service, enabling any subscriber to the Telepoint service to gain access to the public switched telephone network. The base station itself has a limited coverage range, a few hundred
20 meters for instance. Such a Telepoint service, and further a cordless business system, and a seamless handover process are described in the handbook "Cordless Telecommunications in Europe", W.H. Tuttlebee, Springer-Verlag, 1990, pp. 91-101. In a Telepoint cordless telephone system, in which a Telepoint base station is connected to an analog or to a digital telephone line, charging can be done via a telephone card from which call units are deduced
25 when calling, via a credit card and an authentication procedure, or the like, supplied by the Network operator. A problem with Telepoint systems is that usually only outgoing calls can be made by a cordless handset's subscriber. The European Patent Application EP 0 212 761 gives a solution to this problem. In EP 0 212 761, a mobile communications system is described which is a combined cordless telephony and wide area paging system, the

communications system allowing roaming of handsets over a large area covered by the wide area paging system. A wide area paging system typically operates with 200 km cells in the VHF band (Very High Frequency). Herein, the handsets have a built-in message pager to accommodate incoming calls to a handset, when the handset is in-range of a base station, which is not dedicated to the handset. When a call from a fixed network subscriber or from another handset to the handset, a so-called incoming call, has to be serviced, a simulcast paging system transmits a paging message to the message pager in the handset, the paging message comprising a calling subscriber's number and a called subscriber's number. In case of a call from fixed network subscriber, the handset receiving and decoding the paging message searches for the nearest in-range base station, either automatically, on the basis of the decoded calling subscriber's number, or after the called subscriber has keyed-in the calling subscriber's number on a dialling keyboard on an alert through the paging message. When such a base station has been found, and a radio channel is available, a usual call set-up procedure is initiated as is applied for outgoing calls from the handset for which the incoming call is intended. In case of a call from another handset, a more complicated procedure is carried out. First, the calling handset locks to a base station, and dials the called handset. Then, the paging server transmits a paging message to the called handset, the message including an ID-code (Identification Code) of the base station to which the calling handset is locked. Thereafter, the same procedure is followed as applied for a calling fixed network subscriber. For achieving an even greater mobility, the base stations in this known system are attached to mobiles of a cellular mobile radio communications system, thus allowing roaming during a call. In the known system no standard cordless telephone handsets, having only a cordless telephone transceiver, can be applied, because the handsets in EP 0 212 761 require a paging receiver in addition to the cordless telephone transceiver. Furthermore, such a paging receiver increases the costs of a cordless telephone handset. In the system described in EP 0 212 761, an additional problem arises from the call charging of incoming calls, it being proposed to base call charging on the rate of discharge of the batteries fitted in the cordless telephone. This requires uniquely shaped batteries to be supplied by a PTT authority as a sole supplier. Other proposed charging methods to be applied in large company's systems require base stations with special company codes.

It is an object of the present invention to provide a cordless telephony system having Telepoint type base stations to allow servicing of incoming calls to handsets

coupled with such non-dedicated base stations, which system is relatively simple and inexpensive. It is a further object to apply practically standard handsets in such a cordless telephony system. It is still a further object of the present invention to provide a relatively simple call charging method for incoming calls in such a system.

5 To this end the cordless telephony system according to the present invention is characterised in that a base station is coupled to a paging receiver for receiving paging messages from a paging server coupled to a switched telephone network, which messages comprise an incoming call subscriber's number, and in that the base station and/or an handset to which an incoming call is to be forwarded comprise call set-up means for
10 setting up the incoming call on the basis of the incoming call subscriber's number. It is achieved that a smaller number of paging receivers are required, i.e. only in base stations such as in Telepoint base stations or in base stations which are coupled to PABXs (Private Automatic Branch Exchanges). When the base station supports a paging protocol, which is the case with a DECT base station, this protocol can be used for forwarding the calling
15 subscriber's number. Otherwise a private paging protocol is necessary. The call charging can be done as follows. The incoming call is charged by the calling party if not free of charge (a free calling number). The outgoing call (or recall) is normally charged by the called party by the following procedures. The bill is directly booked from a telephone card in the mobile. The billing pulses from the PSTN are detected in the base station and are translated to a
20 charging amount booked from the telephone card. The telephone card is provided by the network provider. Or, the bill is booked from a credit amount stored in the mobile. The credit amount is loaded from a credit card provider by a separate call for credit. The access procedures to the host of the credit card provider is provided by the base. Or, a normal credit card is used. The credit card check is part of the locking procedure to the base. The
25 bill will be charged after finishing the call by transmitting the charging information from the base to the host of the service provider. If the base establishes a recall automatically, the recall should be charged by the calling party because the called party cannot decide whether he will answer the call or not. This is only possible if the calling party is registered at the apging server and the active base will transfer the charging amount to the server while
30 releasing the call.

In an embodiment of a cordless telephony system according to the present invention, the base station comprises a transmitter which is arranged for transmitting a received paging message to the handset, when the handset is locked to the base station, and the set-up means are comprised in the handset so as to set-up an outgoing call to an incoming

call subscriber on the basis of the incoming call subscriber's number. It is achieved that the handset transforms an incoming call to an outgoing call.

In another embodiment of a cordless telephony system according to the present invention, the call set-up means are comprised in the base station so as to set-up an incoming call connection to the incoming call subscriber, and the base station comprises a transmitter which is arranged for transmitting a call set-up paging message to the handset for setting up a wireless connection to the handset so as to complete the incoming call set-up. It is achieved that first a connection is made from the base station to the calling fixed network subscriber so that the calling subscriber can be alerted that a connection to the called subscriber is being set-up. This is done because the total connection time could exceed a time period that is felt unnatural by the calling subscriber so that the calling subscriber might disconnect.

Further embodiments are claimed in the dependent claims, such as automatic or manual call set-up after reception of the transparently transmitted paging message or the paging receiver and the base station being comprised in a single housing. In a preferred embodiment of the cordless telephony system according to the present invention, the system is a DECT system combined with a message pager system such as a POCSAG (Post Office Code Standardisation Advisory Group) system, or the like. The DECT system itself can be a micro-cellular system supporting handovers, as described on pp. 92-93, and p. 274 of said handbook of Tuttlebee, for instance. The base station may comprise storage means for storing incoming paging messages, and may comprise a modem for automatic host connection for charging and authentication. The handset may comprise storage means for storing paging messages if a call is not answered immediately. The paging messages, namely, are repeated if not answered or the handset gets a message while waiting only and can get the necessary information by an enquiry procedure.

The present invention will now be described, by way of example, with reference to the accompanying drawings, wherein

Fig. 1 schematically shows a cordless telephony system according to the present invention,

Fig. 2 shows a base station in a cordless telephony system according to the present invention,

Fig. 3 shows a handset in a cordless telephony system according to the present invention,

Fig. 4 shows a frame structure in a cordless telephony system according to the present invention,

5 Fig. 5 shows a paging message in a cordless telephony system according to the present invention, and

Fig. 6 shows a flowchart for a base station procedure in a cordless telephony system according to the present invention.

10 Throughout the figures the same reference numerals are used for the same features.

Fig. 1 schematically shows a cordless telephony system 1 according to the present invention comprising base stations BS1 and BS2 which are connected to a switched
15 telephone network like a public switched telephone network PSTN, and base stations BS3 and BS4 which are coupled to the network PSTN via a private automatic branch exchange PABX. The switched network can either be analog as the shown network PSTN or can be digital such as an ISDN (Integrated Services Digital Network). The network PSTN can also be a private network. The cordless telephony system 1 further comprises handsets HS1, HS2,
20 and HS3. The cordless telephony system can be an analog system, but preferably is a digital system such as a DECT system. In case of a DECT cordless telephony system, seamless handover for handsets is supported, such as described in the European Patent Application EP 0 576 079. The cordless telephony system 1 uses an infrastructure of a simulcast wide area paging network comprising paging transmitters PT1, PT2, and PT3, and a paging server PS,
25 the paging transmitters PT1, PT2, and PT3 covering large cells C1, C2, and C3, respectively, and the cell having a diameter of 200 km, for instance. Such a wide area paging network, supporting a Standard like the POCSAG Standard, is well-known *per se*, and is not described in detail here. Further shown in Fig. 1 is a fixed network subscriber's telephone T1. The base stations BS1 and BS2 support a public Telepoint service such as
30 described in said handbook of Tuttlebee, the base stations BS1 and BS2 not being dedicated to a particular handset. The present invention concerns servicing of incoming calls to a handset coupled to a Telepoint servicing base station or an otherwise non-dedicated base station, such as servicing an incoming call from the fixed network subscriber's telephone T1 or from the handset HS3, when locked to one of the shown base stations BS3 and BS4 of the

business system formed by the exchange PABX and the base stations BS3 and BS4, to the handset HS1, when locked to the base station BS1. The present invention thus supplies a simple replacement for public call-boxes *inter alia*, which can be installed easily.

Fig. 2 shows the base station BS1 in the cordless telephony system 1 according to the present invention. The base station BS1 is a non-dedicated DECT base station supporting a Telepoint or a Telepoint like service. The base station BS1 comprises a cordless telephone CT as shown above a dashed line dl and a paging receiver PR as shown below the dashed line dl. The cordless telephone CT is coupled to the paging receiver PR. The cordless telephone CT and the paging receiver PR preferably are comprised in the same housing. The cordless telephone CT comprises a transceiver 10 which is controlled by a burst mode controller 11, and further a line interface 12 for coupling the base station to the network PSTN, and a microcontroller 13 for controlling the transceiver 10, the burst mode controller 11, and the line interface 12. The burst mode controller 11 can be an IC (Integrated Circuit) of type PCD5041 performing the so-called DECT Physical Layer and the DECT MAC (Medium Access Control) Layer time critical functions *inter alia*. For a more detailed description of such a burst mode controller 11, referred is to a Data Sheet of the IC type PCD5041, July 1993, pp. 1-65. The microcontroller 13 is a programmed device comprising ROM and RAM (not shown), implementing the functionality of a DECT Standard such as to locking to a handset, setting up a call and so on. For a more detailed description of the functionality of a DECT system, which is not the subject of the present invention, referred is to the DECT Standard. The microcontroller 13 is further coupled to a locked-list memory 14 in which subscriber information of handset's subscribers, such as a subscriber's number, are stored of handsets which are locked to the base station BS1. To this a DECT base station always has at least one active carrier to which a handset can lock when in idle mode. The paging receiver PR, a POCSAG message paging receiver for instance, comprises a receiver front-end 15 and a paging message decoder 16. According to the present invention, the decoder 16 is coupled to the microcontroller 13 in the cordless telephone CT. The cordless telephone CT has a receiving/transmitting antenna A1, and the paging receiver PR has a receiving antenna

Fig. 3 shows the handset HS1 in the cordless telephony system 1 according to the present invention. The handset HS1 is a DECT handset and is locked to the Telepoint base station BS1, whereby the locked-list memory 14 in the base station BS1 contains the handset's subscriber number. The handset HS1 comprises a zero-IF (Intermediate Frequency) receiver 20 which is coupled to a receive/transmit switch 21 at input side,

and to a burst mode controller 22 at output side. The receive/transmit switch 21 is coupled to a receiving/transmitting antenna A3. The burst mode controller 22 is further coupled to an ADPCM (Adaptive Differential Pulse Code Modulator) Codec 23 for compressing/expanding digitised speech. The handset HS1 further comprises a transmitter 24 which is coupled to the burst mode controller 22 at input side, and to the receive/transmit switch 21 at output side. A voltage controlled oscillator in the handset HS1 is coupled to the zero-IF receiver 20, and to the transmitter 24 via a synthesizer 26. A prescaler in the handset HS1 is coupled to the oscillator 25 and to the synthesizer 26. The handset HS1 comprises a microcontroller 27 connected to a stored program ROM 28 and a RAM 29, which microcontroller 27 is coupled to the burst mode controller 22 and to the ADPCM Codec 23. The microcontroller 27 has analog and digital I/O (Input/Output) interfaces (not shown in detail) for coupling it to a keyboard 30 for keying-in dialling information *inter alia*, and a display 31 for displaying message *inter alia*. In an embodiment of the present invention, the display 31 display the fixed network subscriber's number as transparently transmitted by the base station BS1, for allowing an incoming call to be answered by dialling the fixed network subscriber on the basis of its displayed subscriber's number. In another embodiment of the present invention, the transparently transmitted fixed network subscriber's number is automatically stored into a usually present dialling memory (not shown) so as to allow the handset HS1 to automatically answer the incoming call. In Fig. 3, the arrow 32 indicated digital speech in two directions.

Fig. 4 shows a frame structure FR in the cordless telephony system according to the present invention, which is a DECT frame structure FR having twelve time slots from a base station to handsets, indicated with BS to HS, and having twelve time slots from handsets to the base station. In Fig. 4 it is assumed that the handset HS1 is locked to the base station BS1, and that, when in call mode, time slots TS4 and TS16 convey traffic from the base station BS1 to the handset HS1, and traffic from the handset HS1 to the base station BS1, respectively. Further shown is the ADPCM Codec 23 as coupled to an output speech buffer SB1 for buffering ADPCM output to the time slot TS4, and to an input speech buffer SB2 for buffering ADPCM input from the time slot TS16, when the incoming call is being serviced.

Fig. 5 shows a POCSAG paging message PM in the cordless telephony system 1 according to the present invention, comprising synchronisation information SY, as usual, an address AS, a separation sign SE, and data DT. In the given example, the fixed network subscriber, which is the calling subscriber with subscriber number SUBA and which operates the telephone T1, dials the paging server PS and supplies a called subscriber's

number SUBB, which is the handset's HS1 subscriber's number, to the paging server PS. For the handset HS1, the call is an incoming one. In Germany, for instance, the paging server has pre-dial number 190. In the wide area paging message PM, the called subscriber's number SUBB forms the paging address AS, and the calling subscriber's number SUBA, as
5 supplied by the paging server PS, form a part of the data DT, which may comprise other free-format text information TXT. The data DT, the calling subscriber's number SUBA and the text TXT, thus are transparent information for a receiving party of this information, in the present invention the paging receiver PR in the base station BS1. Upon reception of the paging message PM, the decoder 16 in the paging receiver PR decodes the paging message
10 PM. The decoder 16 supplies both the calling subscriber's number SUBA and the called subscriber's number SUBB to the microcontroller 13, together with any further free-format text such as the text TXT. The microcontroller matches the called subscriber's number SUBB with its locked-list. Upon matching, the base station BS1 transmits the transparent information in the paging message PM, i.e. the calling subscriber's number and any text
15 TXT, to the called subscriber's handset HS1. The called subscriber's handset HS1 either automatically transforms the incoming call to an outgoing call via its dialling memory, or alerts the called subscriber via the display 31 so that the called subscriber can key-in the calling subscriber's number SUBA. In a DECT cordless telephony system such a paging by the base station BS1, i.e. transmitting the calling subscriber's number SUBA and any text to
20 the handset HS1, can be done in a so-called CISS-message (Call Independent Supplementary Service) as described in the ETSI (European Telecommunication Standards Institute) DECT Standard pr ETS 175-5, March 1992, Part 5, "Network Layer", Chapter 5.3, pp. 33-34, thus rendering the specification of a novel protocol unnecessary. In other cordless telephony system, not having such an option, a private protocol must be specified, requiring
25 modification of the handset HS1 too.

Fig. 6 shows a flowchart for a base station procedure in the cordless telephony system 1 according to the present invention for handling the paging message PM received from the paging server PS. The procedure starts from idle mode as indicated in block 40. In block 41 an incoming call is received from a fixed network subscriber. In block
30 42 it is tested whether or not the called handset's subscriber number is in the locked-list memory 14. If so, in block 43 the base station transmits the CISS message as described with respect to Fig. 5 to the called handset's subscriber.

In an alternative embodiment, the base station BS1 first dials the fixed network's subscriber operating the telephone T1. When a connection is made to this

subscriber having the subscriber's number SUBA, this subscriber gets an auditive message like "connection is being made, please, hold the line" or "the requested subscriber is being called". Then, the base station BS1 pages the called subscriber so that the connection can be completed.

CLAIMS:

1. A cordless telephony system (1) comprising at least one base station (BS1, BS2, BS3, BS4) for communicating with at least one handset (HS1, HS2, HS3), which system (1) uses an infrastructure of a wide area paging network (PS, PT1, PT2, PT3) for initiating servicing of incoming calls to handsets, characterised in that a base station (CT; BS1, BS2) is coupled to a paging receiver (PR) for receiving paging messages (PM) from a paging server (PS) coupled to a switched telephone network (PSTN), which messages (PM) comprise an incoming call subscriber's number (SUBA), and in that the base station and/or an handset to which an incoming call is to be forwarded comprise call set-up means for setting up the incoming call on the basis of the incoming call subscriber's number (SUBA).
- 10 2. A cordless telephony system (1) according to claim 1, wherein the base station (BS1) comprises a transmitter (CT) which is arranged for transmitting a received paging message to the handset (HS1), when the handset is locked to the base station, and the set-up means (27) are comprised in the handset so as to set-up an outgoing call to an incoming call subscriber on the basis of the incoming call subscriber's number (SUBA).
- 15 3. A cordless telephony system (1) according to claim 2, wherein the call set-up means (27) are arranged for automatically setting up the outgoing call.
4. A cordless telephony system according to claim 2, wherein the handset comprises a keyboard (30) for keying-in dialling information, and display means (31) for displaying a received incoming call subscriber's number (SUBA) to an operator of the handset (SUBB), the call set-up means (27) setting up the outgoing call when the operator has keyed-in the incoming call subscriber's number (SUBA) as the dialling information.
- 20 5. A cordless telephony system (1) according to claim 1, wherein the call set-up means (13) are comprised in the base station (BS1) so as to set-up an incoming call connection to the incoming call subscriber (SUBA), and the base station (BS1) comprises a transmitter (CT) which is arranged for transmitting a call set-up paging message (CISS) to the handset for setting up a wireless connection to the handset so as to complete the incoming call set-up.
- 25 6. A cordless telephone system (1) according to claim 5, wherein the base station (BS1) submits a waiting message ("please, hold the line") to the incoming call

subscriber (SUBA) so as to inform the incoming call subscriber that a call set-up is being completed.

7. A base station (BS1) for use in a cordless telephony system (1) in which at least one base station (BS1, BS2, BS3, BS4) can communicate with at least one handset (HS1, HS2, HS3), the system (1) using an infrastructure of a wide area paging network (PS, PT1, PT2, PT3) for initiating servicing of incoming calls to handsets, characterised in that the base station (CT; BS1, BS2) is coupled to a paging receiver (PR) for receiving paging messages (PM) from a paging server (PS) coupled to a switched telephone network (PSTN), which messages (PM) comprise an incoming call subscriber's number (SUBA), and in that the base station and/or an handset to which an incoming call is to be forwarded comprise call set-up means for setting up the incoming call on the basis of the incoming call subscriber's number (SUBA).

8. A base station (BS1) according to claim 7, comprising a subscriber's number memory (14) for storing subscriber's numbers of handsets (HS1) which are locked to the base station (BS1).

9. A base station (BS1) according to claims 7 or 8, wherein the base station (CT; BS1) and the paging receiver (PR) are comprised in a single housing.

10. A base station (BS1) according to claim 9, wherein the base station (BS1) is a digital station comprising a cordless telephone transceiver (10, 11) and a microcontroller (13) for controlling the transceiver (10, 11), and the paging receiver (PR) comprises a decoder (16) which is coupled to the microcontroller (13), whereby a received incoming call subscriber's number (SUBA) is submitted to the cordless telephone transceiver (10,11) via the microcontroller (13).

11. A base station according to any one of the claims 7 to 10, comprising storage means for storing incoming paging messages.

12. A base station according to any one of the claims 7 to 11, comprising a modem for automatic host connection for charging and authentication.

13. A handset (HS1) for use in a cordless telephony system (1) in which at least one base station (BS1, BS2, BS3, BS4) can communicate with at least one handset (HS1, HS2, HS3), the system (1) using an infrastructure of a wide area paging network (PS, PT1, PT2, PT3) for initiating servicing of incoming calls to handsets, characterised in that the handset (HS1) comprises call set-up means (27) for setting up an outgoing call to an incoming call subscriber (SUBA), when the incoming call subscriber intends to call the handset's subscriber (SUBB), on the basis of an incoming call subscriber's number (SUBA)



received in a paging message (PM) from a base station (CT; BS1) which is coupled to a paging receiver (PR) for receiving paging messages (PM) from a paging server (PS) coupled to a switched telephone network (PSTN).

14. A handset according to claim 13, comprising storage means for storing
5 paging messages if a call is not answered immediately.

