(12) UK Patent Application (19) GB (11) 2 234 649 (13) A

(43) Date of A publication 06.02.1991

(21) Application No 8909672.1

(22) Date of filing 27.04.1989

(51) INT CL[5]
H04B 7/26, H04Q 7/04

(52) UK CL (Edition K)
H4L LDSX
H4K KYR
U1S S2213

(56) Documents cited
GB 2179823 A GB 2162404 A EP 0292182 A2
EP 0291068 A2 EP 0263666 A2 EP 0212761 A2
EP 0193316 A1 EP 0169726 A WO 88/06830 A1

(58) Field of search
UK CL (Edition J) H4K KYA KYR, H4L LDSX LECX
INT CL[4] H04B, H04Q

(71) Applicant
STC PLC

(Incorporated in the United Kingdom)

10 Maltravers Street, London, WC2R 3HA,
United Kingdom

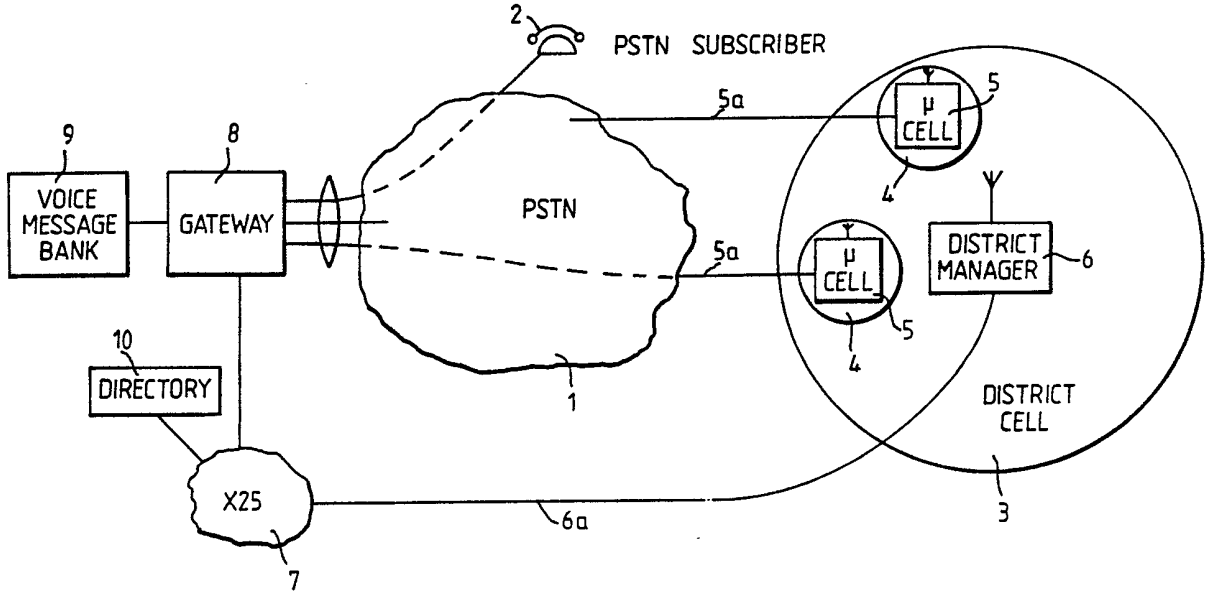
(72) Inventor
Peter Alan Ramsdale

(74) Agent and/or Address for Service
S M Dupuy
STC Patents, West Road, Harlow, Essex, CM20 2SH,
United Kingdom

(54) Personal communications systems

(57) In a system which enables both pocket/portable radio transmitter/receiver personal terminals and subscribers (2) of a fixed switching network 1 to initiate calls to the other, in contrast to the Telepoint system in which only the personal terminals within microcells 4 can initiate calls, voice traffic between the personal terminals and the network subscribers is via first communication means 5a, as is call set up from personal terminals to network subscribers. Calls initiated by network subscribers to personal terminals are offered thereto via separate communication means 6a by the transmission of paging signals (from a district manager controlling at least one microcell) which are appropriate to the location of the personal terminals. The required personal terminal then sets up the call through a microcell base. Location information is stored in a directory 10 and updated by signals output from a personal terminal when it perceives it has moved for example into or out of a particular microcell 4 and/or district cell 3. A gateway 8 may store voice messages for personal terminals outside any microcell for subsequent retrieval.

Fig .1.



GB 2 234 649 A

Fig .1.

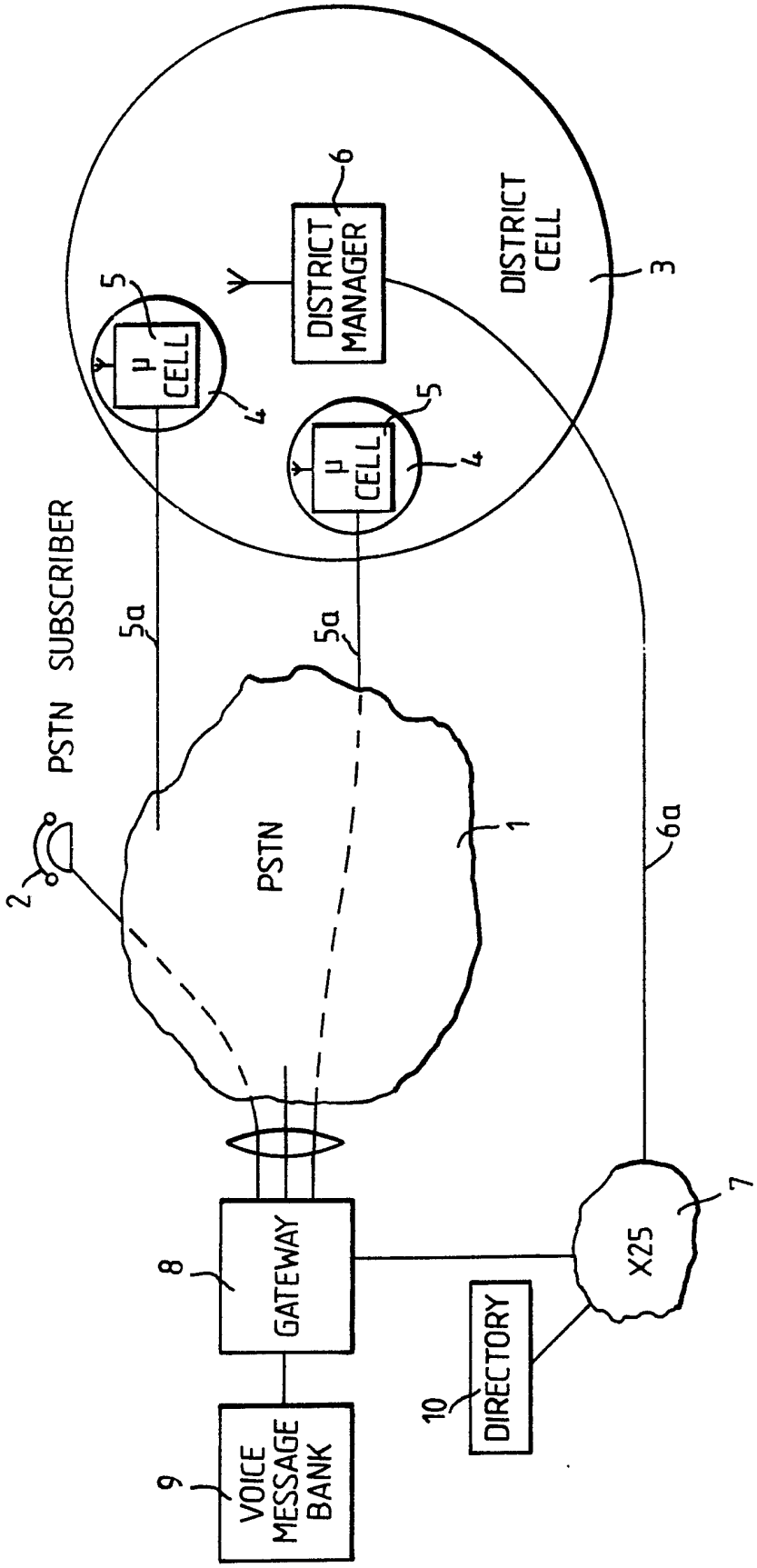

PSTN SUBSCRIBER
2
PSTN
1
5a
5a
DISTRICT CELL
3
DISTRICT MANAGER
6
6a
μ CELL
4
5
μ CELL
4
5
GATEWAY
8
X25
7
DIRECTORY
10
VOICE MESSAGE BANK
9

Fig.2.

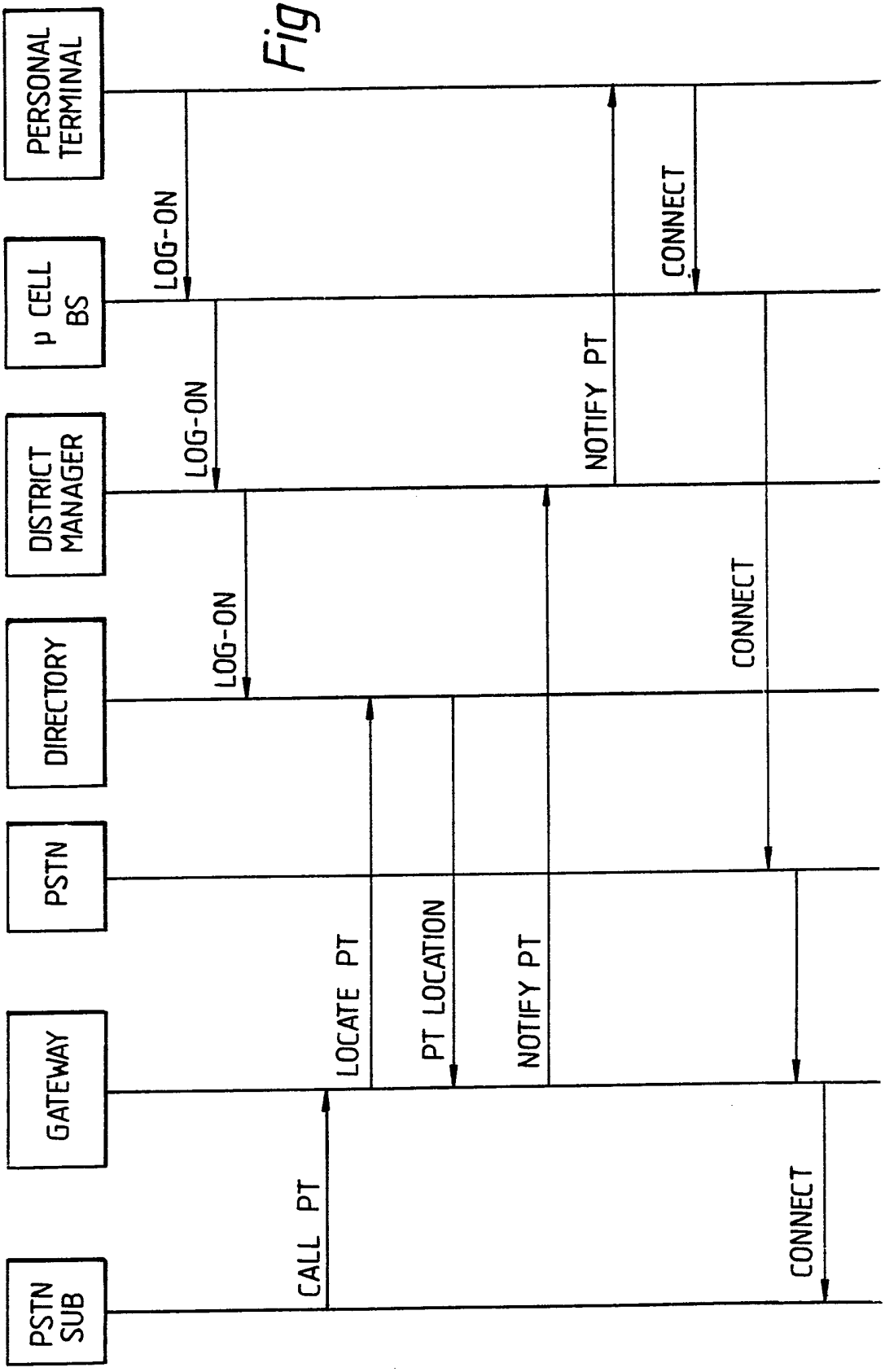

PERSONAL TERMINAL
μ CELL BS
DISTRICT MANAGER
DIRECTORY
PSTN
GATEWAY
PSTN SUB
LOG-ON
LOG-ON
LOG-ON
NOTIFY PT
CONNECT
CONNECT
LOCATE PT
PT LOCATION
NOTIFY PT
CALL PT
CONNECT

Fig . 3.

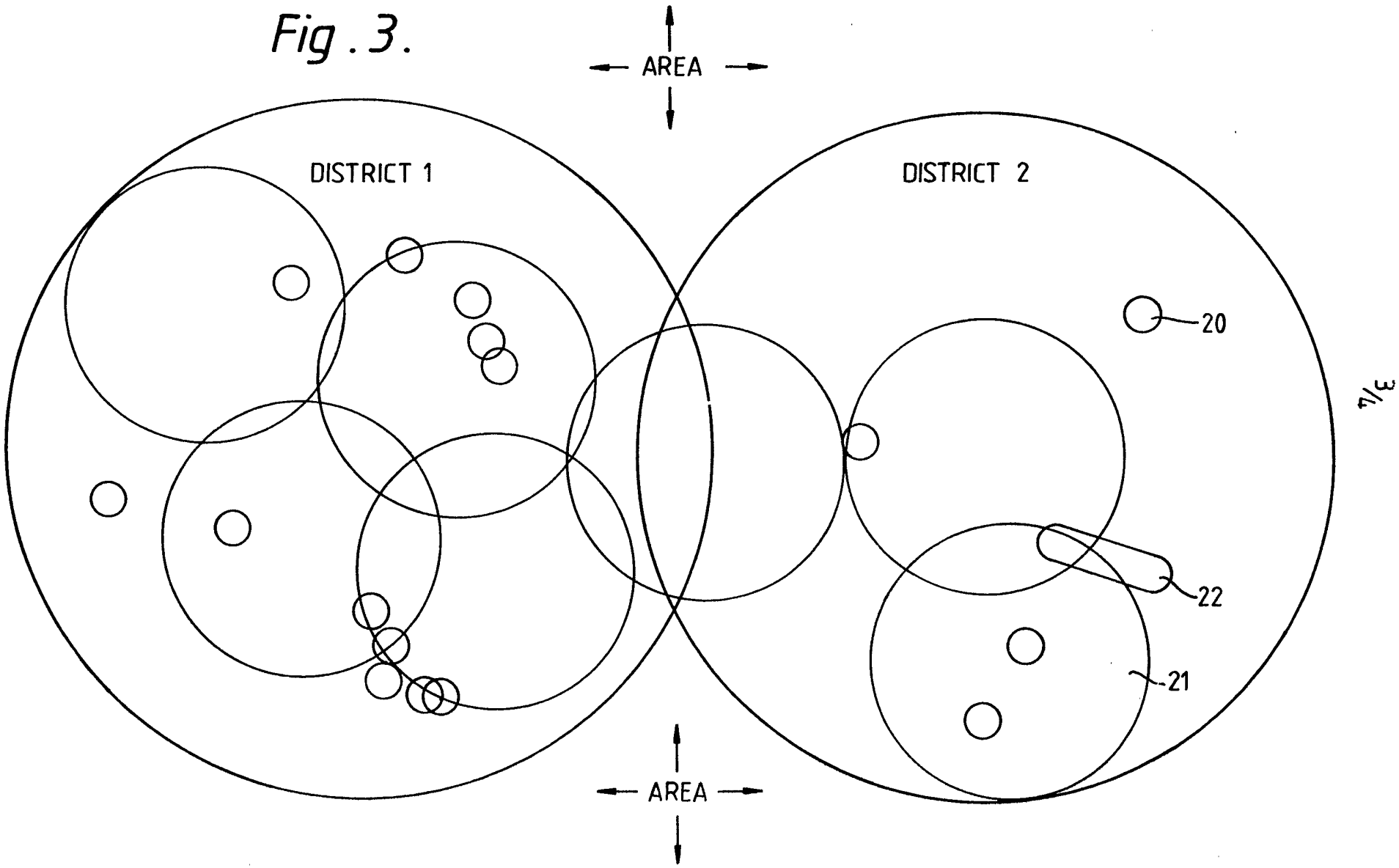
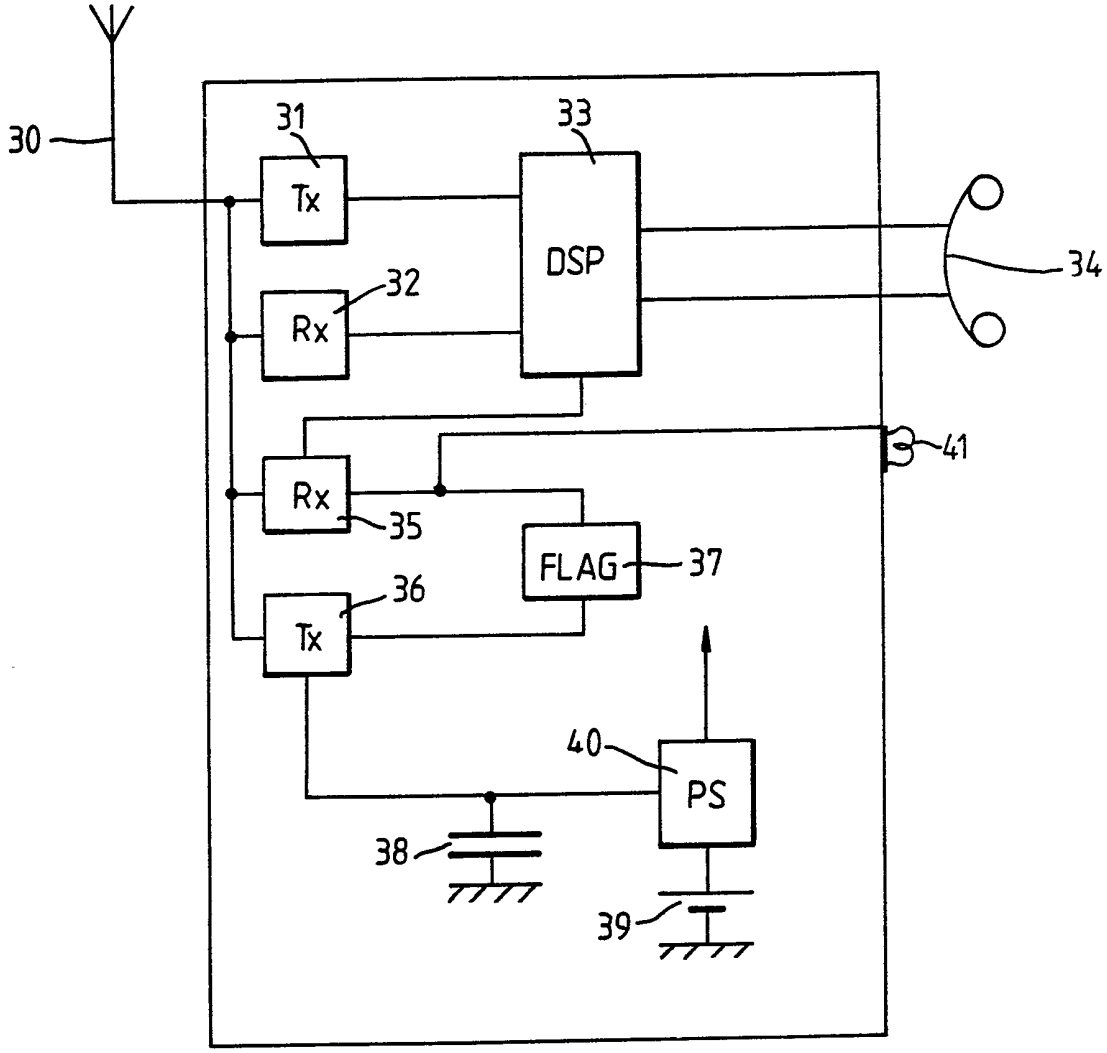


Fig .4.



P.A. Ramsdale 3

PERSONAL COMMUNICATIONS SYSTEMS.

This invention relates to personal communications systems and to elements therefor.

The term personal communications system is to be understood to mean a hand portable/pocket telephone system whereby persons with such devices can make calls and can be contacted wherever they are within predetermined regions which may be nationwide.

There are currently available various means which satisfy various requirements of hand portable/pocket telephone systems but there has yet to be suggested an economical and practical solution which would enable at least a large proportion of the population to be involved.

Cellular radio, cordless telephony and wide area paging are complementary approaches with different attributes. Each approach has shortcomings if used in isolation as a system to support pocket telephones. Cellular radio can provide nationwide coverage by a cost effective mixture of large and small cells matched to traffic demands but the personal terminals require large batteries in order to work in the larger cells. In addition, the dedicated fixed network of cellular radio carries considerable traffic in order to continually track mobile users. Cordless telephones are simple low

power radios capable of working over small distances within Telepoints or microcells. The bases of such cells are connected into the PSTN at network termination points as used by conventional fixed telephones. Cordless telephones offer only limited mobility and for public Telepoint use, current legislation does not allow calls to be received. Wide area paging provides a service to many users from a channel of minimal capacity. Simple call alerts or messages can be received anywhere within a large coverage area, although the limited capacity introduces delay.

The requirements of some users are well matched to the above systems but it will not be long before these systems are operating near to their capacity limits and therefore other systems or other versions of existing systems will be required. It is believed, however, that there are many existing users who would be better served by a new system and that such a new system could attract substantial numbers of new users if initial purchase and subsequent usage costs could be pitched at an attractive level.

Cellular radio currently operates at around 900MHz and in certain regional areas available traffic capacity is already insufficient at times. The British Government is proposing to release frequency channels in higher parts of the spectrum, for example in the range 1.7 to 2.3GHz and whilst this may alleviate capacity problems it would not reduce the high cost of cellular radio systems. Indeed it is considered that a nationwide cellular radio system at 2GHz will be more expensive compared with 900MHz implementations due to smaller maximum cell sizes and more expensive equipment. Furthermore, whilst cellular radio per se is excellent for highly mobile users, it carries wasteful network activity when users are stationary or their movements

are localised, since it is continually tracking the user by causing transmission back to the base for identification of the user's position. This results in drain of the user's battery at a rate which would be unacceptable for hand portable/pocket telephones, that would of necessity need to be small whilst being required to work for long periods between battery recharges.

According to one aspect of the present invention there is provided a personal communications system including pocket/portable radio transmitter/receiver personal terminals and a fixed switching network having associated subscribers, and wherein either the personal terminals or the network subscribers can initiate calls to one another, voice traffic between the personal terminals and the network subscribers being associated with first communication means and calls initiated by a said network subscriber to a said personal terminal being offered to the personal terminal via separate communication means.

According to another aspect of the present invention there is provided a pocket/portable radio transmitter/receiver personal terminal, for use with a personal communications system in which calls can be initiated by the personal terminal or a fixed switching network subscriber, comprising transmitting/receiving means and associated data processing means for call setting, voice traffic and receipt of paging signals, and receiving/transmitting means and associated data processing means for determining the location of the terminal within an area in response to received transmissions and transmitting information in response to location changes.

According to a further aspect of the present

invention there is provided a method of converting a Telepoint communications system, including plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, whereby calls can be initiated either by personal terminals when disposed in a microcell associated with a microcell base station or by the network subscribers, the method including the steps of overlaying an umbrella network on the Telepoint system, which umbrella network includes a plurality of district manager radio base stations each having a respective district cell associated therewith, each district cell having at least one microcell associated therewith, and a directory in which personal terminal location information is stored; causing the information in the directory to be updated in response to change in the location of the personal terminal based on its observations of microcell and/or district base station transmissions; and providing means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of the said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell the call is set up directly.

According to still another aspect of the present invention there is provided an overlay system for use in converting a Telepoint communications system, including a plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, for call initiation either by personal terminals when the latter are disposed in a microcell associated with a microcell base station or by the network subscriber, the overlay system including a plurality of district manager base stations each having a respective district cell associated therewith, each district cell having at least one said microcell associated therewith in use, a directory in which

personal terminal location information is stored, means for causing the information in the directory to be updated in response to change in location of the personal terminal based on its observations of microcell and/or district base station transmissions, and means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell to cause the call to be set up.

Embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 illustrates an embodiment of personal communication system to the present invention;

Fig. 2 indicates the steps involved in call set-up from a PSTN subscriber to a personal terminal using the network of Fig. 1;

Fig. 3 illustrates service coverage of an example of personal communication network;

Fig. 4 illustrates an embodiment of personal terminal in block diagram form.

The personal communication system with hand portable/pocket personal terminals with which the present invention is concerned is intended to operate at frequencies near to 2GHz or any other frequency capable of supporting radio communication calls of an economic size. The present invention proceeds from the realisation of the following, namely: (a) as mentioned above, nationwide cellular radio at 2GHz is not

suitable; (b) for personal terminals to be small and work for long periods between battery charges they should not carry voice traffic in cells larger than the microcells; (c) as with Telepoint, existing PSTN's or other fixed networks can provide all necessary interconnect, switching and intelligence functions, assuming appropriate access points are available,; and (d) although reciprocal paths and performance are necessary for real-time voice traffic communication, there are wide difference between outward and inward requirements for the other signals within a mobile network.

Furthermore, consideration of typical user communication requirements suggests that the bulk of the requirements can be provided by a suitable mixture of the complementary techniques (cellular radio, cordless telephony and wide area paging).

The solution proposed by the present invention separates the requirements of voice traffic channels and activities concerned with offering calls, as well as utilising an existing PSTN, or any other widespread fixed network, as fully as possible. Whereas voice traffic channels are only to be available when the personal terminal is within a microcell this is not considered to be a problem. Study of normal behaviour patterns suggests that well sited microcells can cover or be within rapid reach of most people who wish to participate in telephone conversation. As will be more apparent from the following description, the present invention involves the addition of a so-call umbrella network to the microcell and PSTN which enables calls to be offered and set up, or for user (personal terminal) status to be determined. The simplest form of umbrella network is a single wide area paging channel. However, by using a low capacity cellular virtual network more

functionality is possible.Unlike conventional cellular radio, it is proposed that location update activity be initiated solely by the personal terminals based on their knowledge of location changes.

These points will now be discussed in relation to Fig. 1 which shows a possible, but not the only, implementation, The personal communication network comprises a PSTN or other fixed network 1 having subscribers such as 2. A district cell 3 includes two, as drawn, microcells 4 associated with which are radio transmitter/receiver units (bases) 5, for example of the Telepoint type, which are coupled to the PSTN network 1 by lines 5a. Associated with the district cell is a district manager 6 which is a radio transmitter/receiver unit (base) and which is coupled, via line 6a to an X25 network 7, to a gateway 8 located at a PSTN access point. A voice message bank 9 is coupled to gateway 8, and a directory 10 is coupled to network 7. The so-called umbrella network includes district cells such as 3 and the associated district managers 6, which embrace several microcells. Calls from a personal terminal located in a microcell to a PSTN fixed subscriber 2 are made in the conventional manner (Telepoint) directly across the PSTN.

All calls to a personal terminal such as from a fixed PSTN subscriber 2 are initially routed to the gateway 8 which is able to hold the partially connected call. If the directory 10 indicates that the required personal terminal is within a microcell then a paging message is transmitted over the corresponding district cell by the associated district manager. The required personal terminal then sets up a call through any microcell base, across the PSTN to the gateway, and the initiating subscriber is simply connected with the required personal terminal across the gateway. This

sequence of events occurs if the directory knows the required terminal is in a particular district cell and within any microcell thereof, specific microcell information is not necessary. The sequence of events is summarised in Fig. 2.

In the case where the directory knows a terminal is in a particular district cell but out of range of any microcell thereof, only some form of paging is possible to alert the required personal terminal that he should move to within a microcell in order to make a call to the gateway and access a message left as a result of the initiating call. Tone paging uses the least capacity in the umbrella network. In these circumstances the calling subscriber will have been informed that the required personal terminal is not available directly but will be paged. The calling subscriber could be invited to leave a voice message on bank 9. As an alternative to leaving a voice message, if there is adequate capacity on the umbrella network a one-way voice message could be sent in real-time by the calling subscriber to the required personal terminal via the network 7 and the district manager. The calling subscriber will know that his message has been received by the personal terminal in this case although there can be no reply. Another possibility is that if the personal terminal had facilities for message or numeric pager mode, then a calling subscriber with suitable apparatus could directly input numeric data. However either setting up of a voice conversation or accepting a voice message for real-time or delayed transmission is considered to provide the clearest and simplest options to a fixed telephone subscriber.

In the case where the directory does not know where the required terminal is, or it knows it is in a large, low capacity, umbrella cell (area cell), tone

paging is the only possibility.

It will be apparent from the above that when a personal terminal is called, the partially connected calls are set up across the PSTN and hence could involve the full PSTN charges. However, in a similar situation, e.g. Mercury's use of the BT network, a PTO-PTO interconnect agreement has been reached and a similar agreement for the present system could achieve a charge reduction.

Calls made by a personal terminal to a PSTN subscriber go directly across the PSTN to the called subscriber and only incur the network changes of normal calls between fixed subscriber i.e. there is no routing via the gateway.

The directory is updated by signals received from the district manager or other umbrella cell bases. The personal terminal only transmits such updates when its status (position) is perceived to have changed based on observations of the microcell and/or district cell transmissions.

The district cell and microcells can work in the same frequency band, with the district cell achieving greater range by better antenna siting, higher base station power, lower signal to noise levels for low rate transmission and non-reciprocal path requirements.

The district cell base acts as a manager for several microcells as is apparent from the above description of Fig. 1. The use of radio channels as talk-through from a personal terminal via a microcell base to the district manager avoids the need for any wired connection to the microcell base other than to a PSTN access point.

With the system as illustrated in Fig. 1 calls effectively have to pass twice through the PSTN and this

may lead to excessive impairment of the voice signals. Normally when calls are re-routed by a PSTN, for example in the case of 0800 numbers, the call is subject to further switching in the trunk portion (4-wire low loss) of the network. There is actually no need to exit and re-enter the network via subscriber lines to an external gateway as implied in Fig. 1. An alternative is to design the gateway as if it were an ISPBX with digital connections to and from the nearest system X exchange with ISDN capability. This would give acceptable quality on the "double" calls and also have the advantage of direct dialling-in, so that concentrated traffic could be offered to the gateway over a limited number of channels, rather than a huge bundle of pairs (one for each subscriber to the service to give identity via path of entry).

Fig. 3 illustrates an example of a geographic arrangement for two districts covering a town and comprising umbrella district cells and traffic microcells. The umbrella network provides continuous coverage from large area cells with the district cells localising the call set up and location activity. Two sizes of microcell are shown. There are small microcells 20 which are equivalent to conventional Telepoint cells and large microcells 21, the different sizes being achieved by normal and special base antenna arrangements, respectively. Preference in establishing a voice traffic channel is given to the smaller cell size, using similar techniques to those for selecting between overlapping coverage from different Telepoint operators. Information within the signalling overhead forces a personal terminal to employ the preferred cell. The large microcells 21 are used to cover, for example, main roads, high density housing and industrial/trading estates. Microcell clusters, such as 22, can be used for shopping centres and crowded indoor complexes. Single microcells can, for example, serve

railway stations, bus stations, sports centres and small leisure/shop areas.

The small microcells 20 referred to above may comprise Telepoint type units which are wall mounted operating at 2GHz or other VHF/UHF band, and produce cells approximately 100-200 metres across with power levels that are acceptable healthwise. Similar units with higher gain antennas but the same power level and positioned at higher locations, such as the tops of blocks of flats, can achieve cells of the order of ten times wider than the small microcells, i.e. large microcells 21. Personal terminals can then work into the centre (base) of large or small microcells using the same power levels. In this way large coverage can be obtained from a small number of bases. At other points in the districts there will not be a lot of calls and since a personal terminal thereat can be paged, there is no need for further microcells.

It is desirable for the personal terminals to use the same air standard for voice traffic, as private domestic and business cordless systems. This enables the same handset to be called and used both on its personal number (portable) and at network termination point numbers (fixed locations) at the same time.

Specific details some of which have already been referred to and optional features of component parts of the system of the present invention will now be summarised.

With regard to the voice traffic channels as will be apparent from the above it is intended that transmission will be at the order of 2GHz with two-way call initiation, although existing 900MHz CAI CT-2 might form a possible basis. There can be various types of cells: single public microcells (similar to Telepoint); clusters of public microcells which will be treated by the network as a single unit; mobile public microcells/bases which can provide capacity where it is

required such as at sporting events, parades where crowds are to be expected; private microcells with public access, and if the above cells support the terminals of DECT (Digital European Cordless Telephone) or CT-2 then the same pocket phones can be used in private home and office cordless systems. Mobile microcells are possible since in microcells (as with Telepoint) frequency allocation will take place dynamically and so it is possible to rapidly install microcells without any network planning as required in cellular radio. Vehicle mounted bases can be deployed where required. There are a group of channels available and the terminal selects the quietest one and uses that, there being no pre-planning required. Such dynamic frequency allocation has the advantage of providing a far greater peak capacity than is available with cellular. In a small cell as many frequencies as there are PSTN lines can be allocated and thus a high peak capacity (high number of channels per megahertz per sqr. km) is achievable.

With regard to the microcell bases, the cost thereof should be kept as low as possible for an attractive system. This is achieved by having a single wired connection to a PSTN access point and employing a radio transceiver which is of Telepoint configuration with minimal enhancement. Larger than standard microcells are also required for the system but with the same air-specification for voice traffic. The greater range can be achieved by the use of gain antennas (colinear) and better sited (elevated) antennas for the bases of large microcells. The position of microcells is determined by the likely requirements of the majority of users, any gaps in coverage being consistent therewith. Each portable terminal has a unique handset number so that there is personal addressing. A person can thus be contacted by calling a single number. The caller will either be connected directly or asked to

leave a message. As a result the called person will be alerted to return the call or some other action. If the personal terminal is of the Telepoint basic type and the required personal terminal is at the location which has a fixed network termination point number then a personal terminal can be contacted either by use of the personal handset number or the termination point number.

The umbrella network may be considered as a cellular overlay. It functions to maintain the directory, offer calls and return personal terminal status information. The umbrella network is virtual, that is, it is built up from many different constituents including, say, free microcell traffic channels. Coverage is continuous but the functioning variable with position in relation to traffic channels. The system is in essence low capacity cellular. Urban (district) umbrella cells, which are larger than the traffic cells, operate at 2GHz or other UHF/VHF band. Large cells for nationwide coverage require lower frequency but a small bandwidth allocation only is required. Nested umbrella cells, can be used in a hierarchical fashion. As to paging, location and call set up, there is rapid response; call set-up/response from a personal terminal is forced; the system should be designed to be effective at up to 70mph, except for call set-up; there is an area, district hierarchy; there is variable precision of location; different types of paging are possible for users out of range of a microcell (i.e. tone, numeric, voice); handover requirements will be limited in contrast to cellular radio, and will not be necessary during a call (a user can make network movement in response to call fading due to moving to the edge of a coverage range); location updates for the network directory are initiated by the personal terminal based on movement or position knowledge, for example monitoring the existence of microcell transmission; the capacity of a district umbrella cell must be adequate

for management of all microcells in the district, although the physical location of the microcells can be varied to match new patterns of use within the district; the return channel (via the district manager) provides status (position) information but the response must involve a low energy requirement in order to conserve the battery of the personal terminal and a minimum number of bits should need to be transmitted; flash-gun capacitor charge techniques can be used to provide a peak output for the response, furthermore response may be to the base of a smaller cell than the locating cell i.e. in a nested arrangement. The umbrella system can overlay not just a Telepoint system of conventional form but also any forms of microcells or picocells (smaller than microcells) and more importantly large/small microcell traffic networks, where small microcells are disposed within large microcells, which traffic cells provide extreme flexibility.

With regard to the fixed network, the PSTN or other fixed network should be used for most voice traffic channels through network access points, ideally the directory is held as a server on the PSTN within the umbrella network connected via a network access point, the PSTN may be bypassed by leased lines between clusters of microcells where this is made economic by traffic volumes; the directory continually updates in response to the likely location of a personal terminal, location can be a specific microcell, a district embracing several microcells or more general; addressing is personal; points within or at a gateway to the fixed network must be capable of holding a call whilst the umbrella network is initiating a response from the personal terminal; the fixed network should provide simple information to fixed end callers relating to the status of the portable/personal terminal if the latter is not replying immediately i.e. to indicate paging in progress etc. The need for personal addressing is not

confined to users of mobile terminals. Mobility does not necessarily imply cordlessness. A user who is temporarily located in a particular ~~base~~ place could connect via a fixed or cordless telephone. An individuals calls could be transferred from one location to another by an extension of the directory functionality.

The personal terminal can be an enhanced cordless telephone. This would enable the terminals to work as a private domestic and business device as well as in the proposed "mobile" system. It is important that the requirements for interaction with the umbrella network do not complicate the personal terminal excessively. The additional tasks to be performed are the monitoring of transmissions for location purposes and the making of simple responses to inform the umbrella network of status (location). Fig. 4 illustrates in block diagram form the basic elements of a personal terminal. It includes an antenna 30, a transmitter 31, a receiver 32, a digital signal processor 33 coupled to handset means 34. These elements are as those in a cordless telephone. For the status function a location receiver 35, a location transmitter 36, a status flag 37 and a flash-gun capacitor 38 are required. The terminal further includes a battery 39 and a power supply unit 40 for supplying the appropriate voltages to the various elements of the unit. The signal processor 33 is coupled to the location receiver 35 for processing of the received inputs to determine location and set up a flag 37 accordingly, change of location being indicated as change of the flag. In order to indicate to the user when a terminal is within range of a base a light 41 is coupled to the location receiver and is illuminated when in range. Preferably the system includes some form of battery saving circuitry and the location receiver is only actuated intermittently, say every 30 seconds, to "sniff" the surroundings. If a status change is

observed and confirmed at the next monitoring instant, then action to advise the directory will take place by transmitting an appropriate signal from the location transmitter 36. The use of frequencies for the district cells near to or within microcell channel frequencies and similar channel bandwidths will minimise any changes necessary to the RF circuitry of Telepoint terminals. Such that a single receiver can replace 32 and 35 and a single transmitter can replace 31 and 36.

The system proposed above enables terminals to be contacted nationwide but only to have full capability in microcells which are principally located in crowded urban areas. Compared with cellular radio, higher user densities, smaller lower-power handsets and lower usage costs are possible, whilst unlike the cordless Telepoint system, two-way call initiation is provided. Thus the system involves the advantage of a pocket phone and the low running costs of a Telepoint type terminal but with two-way call initiation. An important factor in achieving this is providing the umbrella network (low capacity cellular virtual network) so that paging and location indicating functions can be carried out on separate paths to the real-time voice traffic communication. In effect, a Telepoint system (for example) is converted to a system in which call initiation is two-way by provision of the umbrella network which makes two-way calling automatic, that is the user does not have to affiliate himself to a Telepoint call, in contrast to the two-way calling version of Telepoint which is known as Telepoint plus.

It should be noted the single telephone number of the personal terminal can be used by a fixed subscriber and will always get through and initiate an appropriate form of action (two-way call in normal locations, message left elsewhere); the appropriate response being set up automatically.

CLAIMS

1. A personal communications system including pocket/portable radio transmitter/receiver personal terminals and a fixed switching network having associated subscribers, and wherein either the personal terminals or the network subscribers can initiate calls to one another, voice traffic between the personal terminals and the network subscribers being associated with first communication means and calls initiated by a said network subscriber to a said personal terminal being offered to the personal terminal via separate communication means.

2. A system as claimed in claim 1, including microcell radio base stations and microcells associated therewith, which base stations are connected to the switching network via respective lines, a plurality of voice traffic radio channels being available within each microcell, said lines and radio channels comprising said first communication means, and including an umbrella network comprising district manager radio base stations with district cells associated therewith, which district base stations are coupled to the switching network via respective lines, one or more microcells being associated with each district cell, the said separate communications means including the district cells and the respective lines coupling the district base stations to the switching network.

3. A system as claimed in claim 2 wherein the umbrella network further includes directory means in which personal terminal location information is stored, wherein the personal terminals are such as to cause the stored location information to be changed in response to change in their location, and wherein when a call to a said personal terminal is initiated by a said network subscriber a paging signal appropriate to the location of the said personal terminal as stored in the directory

is transmitted to alert the said personal terminal.

4. A system as claimed in claim 3, wherein when the said personal terminal is located within a microcell the paging signal is transmitted by the associated district base stations and causes the personal terminal to set up the call through the respective microcell base station to the switching network and thence to the said network subscriber.

5. A system as claimed in claim 3, wherein the said personal terminal is located within a district cell but out of range of a microcell the paging signal is transmitted by the associated district base station and alerts the said personal terminal to access a recorded message.

6. A system as claimed in claim 3, wherein when the said personal terminal is located within a district cell but out of range of a microcell the paging signal comprises a one-way voice message from the calling subscriber to the said personal terminal transmitted by the associated district base station.

7. A system as claimed in claim 3 wherein when the said personal terminal is not located within a district cell a wide area tone paging signal is transmitted.

8. A system as claimed in claim 3 wherein the said personal terminal has a numeric pager mode and wherein when the said personal terminal is located within a district cell but out of range of a microcell he paging signal is transmitted by the associated district base station and serves to produce a numeric message.

9. A system as claimed in claim 3 wherein the personal terminal communicates information as to changes in its location to the directory via the associated district base station and based on its observations of the microcell base station and district base station transmissions.

10. A system as claimed in claim 4 and including gateway means whereby a call initiated by a said network

subscriber to a said personal terminal is held when the said personal terminal is located within a microcell until the said personal terminal causes the call to be set up in response to the paging signal.

11. A system as claimed in claim 5 and including gateway means via which when a call initiated by a said network subscriber is to a personal terminal outside a microcell the calling subscriber is connected to a voice message bank and instructed to leave a message.

12. A system as claimed in any one of claims 2 to 11 wherein there are two sizes of microcells within a district cell small microcells being nested within large microcells, preference in a establishing voice traffic being given to the smaller microcell.

13. A system as claimed in claim 1 wherein the first communication means include arrangements of traffic cells, there being two sizes of traffic cells small cells being nested within large cells.

14. A system as claimed in any one of claims 2 to 12 and including at least one microcell radio base station whose position is movable in order to provide capacity where it is required.

15. A system as claimed in any one of the preceding claims wherein each personal terminal has a personal number associated therewith and wherein a personal terminal can be reached by either the personal number or the user's network termination point fixed number.

16. A system as claimed in any one of the preceding claims wherein a fixed or portable terminal user who is temporarily located in a particular place can connect via a fixed or cordless telephone.

17. A system as claimed in claim 16 as appendent to claim 3 wherein the directory is employed to transfer a user's calls from one location to another.

18. A system as claimed in claim 3 wherein the personal terminals include means to indicate to a user that he is within range of a microcell base station.

19. A system as claimed in claim 3 or claim 18 wherein the personal terminals include transmitting/receiving means and associated data processing means for call setting, voice traffic and receipt of paging signals and receiving/transmitting means and associated data processing means for terminal location detection and response to the directory of location changes.

20. A system as claimed in any one of the preceding claims and employing radio transmission at frequencies near to 2GHz or any other VHF/UHF band.

21. A pocket/portable radio transmitter/receiver personal terminal, for use with a personal communications system in which calls can be initiated by the personal terminal or a fixed switching network subscriber, comprising transmitting/receiving means and associated data processing means for call setting, voice traffic and receipt of paging signals, and receiving/transmitting means and associated data processing means for determining the location of the terminal within an area in response to received transmissions and transmitting information in response to location changes.

22. A personal terminal as claimed in claim 21 and for use within microcells associated with microcell radio base stations, and including means to indicate to a user that he is within range of a microcell base station.

23. A method of converting a Telepoint communications system, including plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, whereby calls can be initiated either by personal terminals when disposed in a microcell associated with a microcell base station or by the network subscribers, the method including the steps of overlaying an umbrella network on the Telepoint system, which umbrella network includes a plurality of

district manager radio base stations each having a respective district cell associated therewith, each district cell having at least one microcell associated therewith, and a directory in which personal terminal location information is stored; causing the information in the directory to be updated in response to change in the location of the personal terminal based on its observations of microcell and/or district base station transmissions; and providing means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of the said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell the call is set up directly.

24. An overlay system for use in converting a Telepoint system, including a plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, for call initiation either by personal terminals when the latter are disposed in a microcell associated with a microcell base station or by the network subscriber, the overlay system including a plurality of district manager base stations each having a respective district cell associated therewith, each district cell having at least one said microcell associated therewith in use, a directory in which personal terminal location information is stored, means for causing the information in the directory to be updated in response to change in location of the personal terminal based on its observations of microcell and/or district base station transmissions, and means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell to cause the call to be set up.

25. A personal communication system substantially

as herein described with reference to the accompanying drawings.

26. A personal terminal substantially as herein described with reference to Fig. 4 of the accompanying drawings.

27. A method of converting a communications system, including plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, whereby calls can be initiated either by personal terminals when disposed in a microcell associated with a microcell base station or by the network subscribers, there being two sizes of microcells, small microcells being nested within large micorcells, preference in establishing voice traffic being given to the smaller microcell, the method including the steps of overlaying an umbrella network on the system, which umbrella network includes a plurality of district manager radio base stations each having a respective district cell associated therewith, each district cell having at least one microcell associated therewith, and a directory in which personal terminal location information is stored; causing the information in the directory to be updated in response to change in the location of the personal terminal based on its observations of microcell and/or district base station transmissions; and providing means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of the said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell the call is set up directly.

28. An overlay system for use in converting a communications system, including a plurality of microcell radio base stations connected to a fixed switching network having associated subscribers, for call initiation either by personal terminals when the latter are disposed in a microcell associated with a

microcell base station or by the network subscriber, there being two sizes of microcells, small microcells being nested within large micorcells, preference in establishing voice traffic being given to the smaller microcell, the overlay system including a plurality of district manager base stations each having a respective district cell associated therewith, each district cell having at least one said microcell associated therewith in use, a directory in which personal terminal location information is stored, means for causing the information in the directory to be updated in response to change in location of the personal terminal based on its observations of microcell and/or district base station transmissions, and means whereby when a said network subscriber calls a said personal terminal a paging signal appropriate to the location of said personal terminal is transmitted to alert the said personal terminal and if the personal terminal is within a microcell to cause the call to be set up.

Published 1991 at The Patent Office, State House, 66/71 High Holborn, London WC1R 4TP. Further copies may be obtained from Sales Branch, Unit 6, Nine Mile Point, Cwmfelinfach, Cross Keys, Newport, NP1 7HZ. Printed by Multiplex techniques ltd. St Mary Cray, Kent