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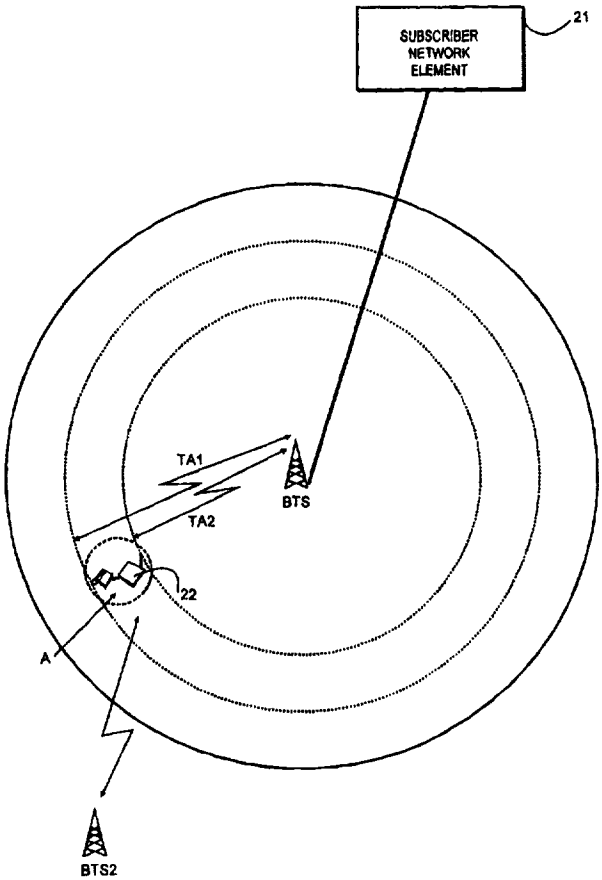
(57) Abstract

It has not been possible to monitor the movements of the terminal device in an area smaller than a cell in systems in which part of the subscriber connection is formed by a radio connection between the terminal device and the base station. However, in some cases, it is preferable to restrict mobility of the terminal device to a limited area within a cell. This is possible by measuring a value comparable to the signal propagation time between the terminal device and at least one base station. The value can be the timing advance between the terminal device and the base station or it can consist of the differences in the signal propagation times between the terminal device and several base stations. The value is compared to the reference value and, on the basis of the comparison, it is deduced whether the terminal device is in the area allowed for it. The method can be used, in addition to monitoring the location of the terminal device, in such a way that the user creates one or several allowed areas, such as home and a summer cottage. A lower tariff can be applied for calls made from these areas than for calls made in other parts of the network. The invention is suitable for use in both a cellular network and in a so-called WLL network, which implement wireless subscriber connections.



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METHOD FOR DETERMINATION OF SUBSCRIBERS POSITION AND ZONE DEPENDENT TARIFF

Field of the invention

The invention relates to a method for monitoring mobility of a terminal in a system in which part of the subscriber connection is formed by a radio connection between the radio unit of the terminal and the base station. The system may be a cellular mobile phone system, but the specific application field is a radio system with a wireless subscriber connection comprising base stations and wireless terminals of restricted mobility into which are connected subscriber devices, which can be an ordinary telephone used in a fixed network.

Background of the invention

In fixed networks, a subscriber line network is formed by taking the twin cables coming from various subscriber devices to a cross-connection device and by connecting the cables coming from various cross-connection devices into another cross-connection device, which is connected to an exchange by means of a cable. The signalling interface between the switch and the subscriber lines is standardized and it can be an interface for 2-wired analog subscriber lines, a multiplexer interface in accordance with the CCITT V2 recommendation or a message-based multiplexer interface in accordance with the ETSI V5.1 recommendation. The subscriber lines are the most expensive part in building a network and also in its maintenance.

When building a telephone network, the installation of subscriber lines between the exchange and the subscriber devices is not only expensive but also takes a considerable amount of time. Especially in rural areas, the costs per subscriber connection may be substantial. One solution for lowering the costs is replacing the fixed subscriber loop between the exchange and the subscriber device with a radio connection. In this case the subscriber device of a fixed network is connected to a terminal, which includes a radio transceiver and converts an audio frequency signal to a radio frequency signal and sends it via radio path to the base station and correspondingly converts a received radio frequency signal to an audio frequency signal understood by the terminal.

This kind of solution can be based entirely on an analog or digital cellular system containing a mobile services switching centre, in which system

the terminals are connected to a base station, or it can be a modified cellular system from which some network elements have been removed and in which some functions have been simplified. Together these solutions are referred to in this application as a WLL system (Wireless Local Loop System).

A WLL system can be built by using the structural elements of an existing cellular system. A mobile phone system can be an analog or a digital system. In this case the signalling in the WLL system conforms to the signalling in the applied system, the base stations are the standard base stations of the applied system, and the radio part of a terminal is similar to the radio part of a mobile station, or the terminal may be a mobile station of the mobile phone system as such, in which case the terminal and the subscriber device (phone) have been combined into one physical device. An important component of the WLL system is an access node, which connects the subscribers to a standard local exchange. In a pure cellular system the access node is a mobile services switching centre and in an applied system it is a network element described later in this document. The subscriber network element converts the signalling of the WLL system, for example, the signalling of an analog NMT system or a digital GSM system, into signalling suitable for a fixed network (for example, PSTN) and correspondingly adapts the signalling of the fixed network for the interface of the WLL network.

The principle of a WLL system is illustrated in Figure 1. A wireless fixed terminal T comprises a radio unit equipped with an antenna and a telephone adapter 4, which connects a standard subscriber device 5 to the terminal. The subscriber device can be a normal telephone, a fax machine or a modem. It is connected to the terminal by inserting a standard plug into the adapter connection of the terminal. The user can use the subscriber device 5 just as it would be used in a normal fixed network, even though the main part of the subscriber line connection is formed by a radio connection between the terminal T and the Base Transceiver Station (BTS) 2 or 3. The subscriber device can also be a normal mobile station 6 to which the WLL has been adapted. Each base station can serve several subscriber devices. The base stations are connected to a special access node 1, which in turn is connected to a standard telephone switch.

The access node 1 is connected to the local switch with an open V2 or V5.1 multiplexer connection, which uses a 2 Mbps PCM system. If the local switch only supports a 2-wire interface, the network element is connected to

the switch with a multiplexer with the purpose of converting the V2 signalling into an analog 2-wire subscriber connection interface.

The signalling between the network element and the base stations connected to it is the signalling of an applied mobile phone network, but it has been modified in such a manner that the functions typical of a cellular network, such as cell handover and roaming, are not possible. This means that the subscriber must stay within the assigned coverage area. The routing of incoming and outgoing calls is based on the subscriber file of the access node. The operation of the access node corresponds to the operation of a concentrator: the call is routed from the subscriber connection to the switch and the analyzing, calculation, etc. of the numbers is carried out in the switch.

According to what has been stated above, the WLL network can be based on some digital mobile phone systems. In these systems the mobile station must measure the strength of the received signal and the strength of the broadcast channels (BCCH) of neighbouring base stations and calculate the bit error ratio, which describes the quality of the received signal. It must report the measurement results periodically, for example, in the GSM system the results can be transmitted twice per second. In a WLL application the terminal can, and usually does, perform the same measurements that the mobile station does, although the measurements concerning handover are unnecessary.

In digital time division cellular systems the transmission is carried out in bursts in time slots. In order to prevent overlapping of successive bursts, each burst ends with a safety period of a certain length. A safety period is required because mobile stations transmitting on the same broadcast channel but in different time slots are an arbitrary distance from the base station, which means that the time it takes for the radio waves to travel from the base station to the mobile station varies between different time slots. Because of this, the length of the bursts transmitted within time slots must be slightly shorter than the time slot to ensure that when the base station receives the transmission the bursts of different time slots do not overlap. In order to make the security period as short as possible, the system has been defined in such a way that the base station dynamically adjusts the transmission time of each mobile station on the basis of the bursts it receives from the mobile station. The base station gives the mobile station a so-called timing advance TA on the basis of which the mobile station adjusts the starting time of the transmission. In the

GSM system the value of the timing advance can be between 0 and 233 μs, which means, taking into consideration the length of the time slot, that a mobile station using the maximum timing advance can be at a 35 km distance from the base station. The security period is defined so that, within the timing of the transmission/reception frame, the base station measures the time difference between the burst it has transmitted and the burst it has received from the mobile station and counts the timing advance on the basis of this and sends the timing advance to the mobile station twice per second.

In a mobile phone network all cells are equal as regards the basis of call charging, which means that there is no way of offering the subscriber any other basis of call charging than the time of the day or a certain pair of numbers. In the former, a special billing parameter, which enables calls made from the number connected to the parameter to be invoiced at less than the normal rate at times when the mobile phone network has less users and, correspondingly, more than the normal rate when the mobile phone network is heavily loaded. This parameter makes the basis of call charging time dependent. In the latter, the call is a so-called home call, which means that a call between a mobile station and A sfixed subscriber terminal is invoiced at less than the normal rate. When defining the basis of charging, it has not been possible to consider in real time the distance between the calling subscriber and the called subscriber or the location of the called subscriber. Special bases of charging have not been available for calls within certain cells or for calls between certain cells.

Solutions for these problems have been presented in the applicant's patent applications FI-946091 and FI-946092. In accordance with these applications, one cell or a group of several cells in a mobile phone network is defined as a group of special cells. Cells of a group can be located in different exchange areas. When forming a call, the exchange analyses whether the location cell of the calling subscriber and/or the location cell of the called subscriber belong to a group of special cells. If the location cells of the calling subscriber and the called subscriber are on different exchange areas, the applications also describe a way to transfer information about the location cell of the called subscriber to the exchange of the calling subscriber before making the speech connection. A subscriber group formed by subscriber numbers can also be defined. In this way different call rates can be defined on

the basis of whether the subscribers are in a group of special cells and/or whether the subscriber numbers belong to a subscriber group.

The second application differs from the first one in that, during the establishing of the call, a service control point SCP located in an intelligent network analyses whether the location cell of the calling subscriber and/or the location cell of the called subscriber belong to a group of special cells. The service control point SCP then applies to the call a special basis of calculation defined for the group. When the location cells of the calling subscriber and the called subscriber are in different exchange areas, information about the location cell of the called subscriber is transferred to the service control point connected to the mobile services switching centre of the calling subscriber either directly or in a message conforming to the signalling between the mobile services switching centres.

The above-mentioned previous patent applications of the applicant make it possible to define one or several special cells for the mobile services subscriber. These cells are so-called home cells and calls made to and from these cells are less expensive than calls in other parts of the network. This principle is suitable also for the subscribers in the WLL system in which a subscriber has been assigned a home cell and moving from one cell to another has been prevented by disabling of the handover function.

Even though it is possible to define a home cell for a subscriber of a mobile phone network and of a WLL system, there remains the problem that the area of a cell is the smallest local unit. This means that it is not possible to restrict an area allowing less expensive calls to an area smaller than a cell. This problem concerns especially those mobile subscribers who do not have a fixed network telephone at all, but who would prefer the calls made from home or from some other defined location, such as a summer cottage, to be billed at a rate lower than normal. Additionally, in some cases in the WLL system the operator could want to restrict the mobility of a WLL terminal to an area smaller than a cell and to prevent mobility outside of this area. It would also be preferable to be able to select only certain terminals and to restrict their mobility within a cell.

Thus, the objective of this invention is a method which can be used to define an area smaller than a cell for a subscriber device and to monitor in real time whether or not the subscriber device is in this special defined area. The area definition should be made by the operator or the subscriber should at

least be able to define the cell which the special area belongs to. The cell can be a normal cell of a mobile phone network or it can be a cell of a WLL system. Another objective is to create a method which enables less expensive calls for the subscriber on an area smaller than a cell and selected by the subscriber.

The set objectives can be obtained with the definitions presented in the independent claims.

Summary of the invention

In accordance with the basic idea of the invention, a value comparable to the approximate distance between the terminal and the base station communicating with the terminal and thus comparable to the signal propagation time is defined several times during the connection. The value may be the signal propagation time directly or it may be a factor comparable to it in practice. In the digital time division systems, the value comparable to the distance is the existing calculation of the timing advance value. In CDMA systems the delay time difference between the pilot signals of two base stations can be estimated by correlating their spreading codes. In analog systems the signal propagation time is defined, for example, on the basis of a signal used for handover decisions, the signal being transmitted by the base station to the terminal and the terminal returning it. If the system does not contain suitable existing signals for calculating the propagation time, they must be created separately.

In accordance with the first embodiment, the value comparable to the signal propagation time is compared to the reference value(s) set for the terminal and saved in the network beforehand, the reference value(s) defining an allowed area smaller than a cell. If the network notices that the value or its change exceed the allowed limits, it assumes that the terminal has left the allowed area and proceeds in a pre-defined manner. This could be, for example, disconnecting, giving a voice announcement, changing the call tariff, etc. This embodiment is especially suitable for restricting the mobility of WLL terminals.

In accordance with the second embodiment, the terminal itself activates the value measurement process. The activation can be carried out, for example, once and the resulting value is saved permanently to the network database. The activation can be carried out whenever desired and the result of the activation updates the result of the previous activation. In

both cases the network carries out, as a response to the activation, the measurement of the value and saves the cell identifier and the value to the database. When the terminal is moving, the network constantly estimates its distance from the base station and does not react as long as the change in the value stays within the allowed limits. In this way an allowed area is formed within a cell and the terminal itself has activated the area. If the change in the value exceeds the allowed limits, the network assumes that the terminal has left the allowed area and proceeds in a pre-defined manner. The manner can be a manner conforming to the first embodiment. The second embodiment is especially suitable for a cellular mobile phone system enabling the subscriber to define the area for calls with lower tariffs. Only one area at a time or several allowed areas can be accepted.

In accordance with the preferred embodiment the signal propagation times between the terminal and several base stations are measured and used for calculating the more exact location of the terminal.

Brief description of the drawings

The invention is described more closely with reference to the accompanying drawings, in which

Figure 1 shows the principle of the WLL system,
Figure 2 shows a cell which has a WLL terminal and
Figure 3 illustrates the second embodiment.

Detailed description of the invention

The principle of the invention and the first embodiment are described using the WLL system as an example, but the same principle can, of course, be applied to any cellular mobile phone system. In that case the terminal is a normal mobile station of the system and the base station is connected to the mobile services switching centre via a base station controller.

In Figure 2, the cell formed by the radio coverage of the base station BTS is shown as a circle. Within the cell a subscriber line connection is formed from the radio connection between the WLL terminal 22 and the base station BTS, which is connected via a fixed line to the network element 21. Normally, the terminal is comparable to a fixed device and it and the

subscriber device connected to it are located inside the house. The terminal can be, for example, a fixed telephone or a fax machine. The terminal is not allowed to leave the cell area. Leaving has been prevented by disabling handover between cells in the WLL system. In the present systems, the terminal can move freely within the cell. When a digital WLL system is in question, the network calculates constantly, on the basis of the time difference between the burst it has sent to the WLL terminal from the base station and the burst it has received from the terminal, the timing advance TA, which is a numerical value.

Let us assume that the operator wants to restrict mobility of the WLL subscriber device to the area A. In accordance with the invention, on the basis of the value comparable to the distance between the WLL terminal 22 and the base station BTS which is connected to the terminal, the value being in this case the signal propagation time, the system determines whether the mobile station has left the allowed area. Because the signal propagation time is comparable to the above-mentioned timing advance TA, this value can be used directly to monitor the movements of the terminal. Within the allowed area, in the area nearest to the base station BTS, the timing advance would be about TA1 and in the area farthest from the base station the timing advance would be about TA2. This fact is utilized so that the network compares the timing advance TA it has measured to the timing advance values TA1 and TA2 saved in the information of the terminal in question. If, in the comparison, TA1<TA <TA2 is true, the network does not react in any way. If, in the comparison, TA<TA1 or TA>TA2 is true, the system proceeds in a pre-defined manner. For example, an alarm can be given to the network, calling can be prevented, a voice announcement can be given to the subscriber or another, higher call tariff can be introduced, etc.

The same result can be obtained by causing the network to monitor changes in the timing advance of the subscriber device. The timing advance TA_{ref} measured in the normal location of the subscriber device and saved in the network database can be used as a reference and if the change ΔT exceeds the pre-defined limit, the system proceeds in a pre-defined manner. The limit could be, for example, $\frac{TA2 - TA1}{2}$.

The value TA1 is used by terminal, which are at a distance of radius R' from the base station BTS and the value TA2 is used by terminal which are at a distance of radius R" from the base station. When these two values are used for monitoring the movements of the terminal, the result is that the terminal can move, without the control mechanism in accordance with the invention reacting, in the area of the cell limited by these radii, that is, in a ring-shaped area. In practice, because of the terrain, the allowed area is not entirely ring-shaped.

The timing advance information in question for the terminal can be saved in a subscriber database, which is in a pure cellular system located in the home location register HLR and in a WLL system based on a cellular system it is located in the subscriber network element.

By changing the above-mentioned limits TA1 and TA2 the ring-shaped area in which the terminal is allowed to move can be changed.

It is preferable to use the timing advance in the method in accordance with the invention, because in digital time division systems it is calculated anyway, which makes it possible to use this numerical value as such. If the WLL system or a digital cellular system has a function which makes it possible for the mobile station to also return bursts to base stations other than the one with which it is connected, that is, if it can communicate with neighbouring base stations, this feature can be used in monitoring the mobility of the terminal. It has been suggested that a feature should be added, for example, in the GSM system, to enable the network to also measure the signal propagation time between the mobile station and the neighbouring base stations in order to determine the timing advance. In this case each neighbouring base station would transmit a burst, which the mobile station would return to the base station in question. The propagation time is calculated on the basis of the difference between the transmission and reception times. If the network already has this kind of function or if it will be implemented, the signal propagation times can be used to calculate, by using known radio location methods, the location of the WLL terminal or the mobile station reasonably accurately. In this case it is enough to know signal propagation times for three base stations.

The invention has been described above in a WLL environment operating in accordance with the digital time division principle. Monitoring in accordance with the invention requires the measuring of the signal

propagation time between the terminal and the base station. In an analog WLL environment a so-called colour signal can be used. In analog cellular systems, such as AMPS, TACS and NMT, the base station generates (on the command of the mobile services switching centre) a continuous control signal during a call and transmits it to the mobile station. In the NMT system the control signals are approximately in the 4000 Hz range. The mobile station returns the signal to the base station, which estimates the received signal and decides, on the basis of the estimation, whether the transmission quality makes it necessary to change the connection to some other base station (handover) or to disconnect the call. The measure of the quality is the integrated signal-to-noise ratio within a certain time period.

This control signal can be used in the method in accordance with the invention. Because the base station transmits a signal in a certain frequency and the terminal returns the signal to the base station, means for calculating the signal propagation time between the terminal and the base station are added to the network. These means are preferably a suitable program. The calculated propagation time is compared to the setting values, as described above in connection with the digital system, or the change in the propagation time is monitored. If the propagation time is above or below the setting values or the change in the propagation time is above the allowed value, the system proceeds in a pre-defined manner.

In a CDMA (Code Division Multiple Access) system time slots are not used and thus no timing advance is calculated. However, the invention can be applied in a mobile phone system or a WLL system which has been adapted to the CDMA system, because in the CDMA cellular system it is relatively easy to measure the difference between the propagation times of two so-called pilot signals. Each base station transmits its own pilot signal, which have individual spreading codes. The mobile station or the WLL terminal receives the pilot signals transmitted by several base stations and by correlating the pilot signals of two base stations (BTS1 and BTS2) the difference between the propagation times of the signals between the mobile station and the base stations can be directly measured, that is, TA1-TA2 can be measured. This fact is well known in the field. In practice, the measurement can be done as part of the reception algorithm. If major changes in this time difference are not allowed, that is, there is only a certain allowed change, the allowed operating area of the mobile station or the WLL

terminal can be strictly limited. The result of this is an allowed area within a cell.

The second embodiment of the invention is described in reference to Figure 3. The figure shows a typical cellular network in which the base stations BS are connected to their base station controllers BSC, which in turn are connected to the mobile services switching centre MSC of which there are two in the figure, MSC1 and MSC2, which means that it has two exchange areas.

Mobile station 1 can be connected to the network in any of the network cells and the price of the call is always the same in traditional networks. However, a mobile services subscriber whose home is, for example, in the cell a of location area 11, might want to have lower call rates when using the mobile station at home. In accordance with the second embodiment of the invention, this is enabled by creating area A around the subscriber's home and calls made from this area are invoiced at a lower tariff. The area A is defined, as described previously, on the basis of the value comparable to the distance between the mobile station 1 and the base station BTS2, in the TDMA system on the basis of the timing advance. The timing advance value TA can be used for directly monitoring mobility of the mobile station. If the system in question is a CDMA system, the pilot signals transmitted by the base stations 2 and 6 are used for defining the area.

The area definition can be carried out in several ways. First, it is possible to carry out a separate measurement in the allowed area when the subscriber purchases a mobile station. In this measurement the timing advance to the base station 2 is determined or pilot signals can be used to determine the difference in propagation times between the signals coming from the base stations 2 and 6. The timing advance value/difference in propagation times and the identifier of cell a are saved in the subscriber information in the home location register HLR. In this case the location of the allowed cell area cannot be changed without making new measurements. Second, it is possible to arrange in the network a function which, as a response to a message sent by the mobile station, saves the current timing advance value and cell identifier to the home location register. The user can form the message by keying in a certain code or the message transmission can be programmed so that pressing a certain key transmits the message

automatically. In this case it is easy to change the location of the allowed area.

The latter case is especially preferable when several allowed areas are required. When the subscriber goes, for example, to the summer cottage which is located in the cell h of the exchange area of centre MSC2, the subscriber carries out the above-mentioned registration and the new timing advance and cell identifier are saved in the home location register. Now the subscriber can make calls at a lower tariff within the allowed area B. The new subscriber information can replace the old information or a certain number of allowed areas with lower tariffs can be allowed, such as home, summer cottage, work, etc.

In both cases the network compares, at the beginning of the call, the cell identifier and the measured timing advance to the subscriber information saved in the home location register. If they show that the mobile station is at home, that is, in the allowed area A, a lower tariff is used for invoicing the calls. If this is not the case or if the timing advance value or its change exceeds the pre-defined limit during the call, the system interprets the situation so that the subscriber has left home and the call tariff can be increased. When the subscriber has left the cell area, there is no need to monitor the signal propagation delay.

The method in accordance with the invention can be used to restrict mobility of the terminal to a considerably smaller area than one cell. Restricting mobility makes it easier to design the network frequencies and it enables the use of invoicing zones smaller than one cell. Within the scope protected by the claims, it is possible to have different embodiments of the invention, the common factor for these being the defining of the value comparable to the distance between the terminal and the base station.

Claims

1. A method for monitoring mobility of a terminal in a system in which part of the subscriber connection is formed by a radio connection between the terminal and the base station, characterized in that for each terminal whose location is to be determined:

- a value comparable to the signal propagation time between the terminal and at least one base station is measured,

- the value is compared to the reference value and based on the result of the comparison it is determined whether the terminal is within the allowed area.

2. A method in accordance with claim 1, characterized in that, in a time division system, a value comparable to the propagation time is formed by using the timing advance value of the terminal transmission, the value being calculated on the basis of the burst sent by the base station, which the terminal device communicates with, to the terminal and returned by the terminal.

3. A method in accordance with claim 1, characterized in that, in a time division system, a value comparable to the propagation time is formed by calculating the difference between the propagation times of the signals between the terminal and the base station, which the terminal communicates with, and between the terminal and at least one neighbouring base station.

4. A method in accordance with claim 1, characterized in that, in a spread spectrum system (CDMA), a value comparable to the propagation time is formed in such a way that the terminal receives pilot signals from the base station, which it communicates with, and from at least one neighbouring station and calculates the difference between the propagation times by correlating the signals.

5. A method in accordance with claim 1, characterized in that when the measured comparable value falls within a pre-defined range, the terminal is deduced to be located within the area allowed for it.

6. A method in accordance with claim 5, characterized in that when the measured comparable value falls outside a pre-defined range, the terminal is deduced to be located outside the area allowed for it and the proceeding actions are carried out in a pre-defined manner.

7. A method for defining the basis of calculating the price of a call in a system in which part of the subscriber connection is formed by a radio connection between the terminal located in a cell and the base station of the cell, c h a r a c t e r i z e d in that

- a value comparable to the signal propagation time between the terminal and at least one base station is measured and the value and the cell identifier are saved in the subscriber database, in which case the value and the identifier define for the terminal an allowed area smaller than the area of the cell in question,

- when forming a call, the above-mentioned value is measured again and this value and the identifier of the current cell are compared to the values saved in the subscriber database,

- if the comparison shows that the terminal device is within the area allowed for it, a special basis for calculation is used for the call.

8 A method in accordance with claim 7, c h a r a c t e r i z e d in that, in a time division system, a value comparable to the propagation time is formed by using the timing advance value of the terminal transmission, the value being calculated on the basis of the burst sent by the base station, which the terminal communicates with, to the device and returned by the terminal.

9. A method in accordance with claim 7, c h a r a c t e r i z e d in that, in a time division system, a value comparable to the propagation time is formed by calculating the difference between the propagation times of the signals between the terminal and the base station, which the terminal communicates with, and between the terminal and at least one neighbouring base station.

10. A method in accordance with claim 7, c h a r a c t e r i z e d in that, in a spread spectrum system (CDMA), a value comparable to the propagation time is formed in such a way that the terminal receives pilot signals from the base station, which it communicates with, and from at least one neighbouring station and calculates the difference between the propagation times by correlating the signals.

11. A method in accordance with claim 7, c h a r a c t e r i z e d in that the value comparable to the signal propagation time between the terminal and at least one base station and the cell identifier are saved permanently in the subscriber database.

12. A method in accordance with claim 7, characterized in that the value comparable to the signal propagation time between the terminal and at least one base station and the cell identifier are saved to the subscriber database as a response to the activation made by the user of the terminal enabling the user to form the allowed area within the desired cell.

13. A method in accordance with claim 12, characterized in that the user can form several allowed areas in a network.

14. A method in accordance with claim 7, characterized in that the special basis for calculation applies a lower call tariff than that which is used for calls outside the allowed area.

15. A method in accordance with claim 7, characterized in that the value comparable to the signal propagation time between the terminal and at least one base station is measured and the comparison is carried out several times during a call in which case the calculation basis for the call price changes when the user leaves the allowed area.

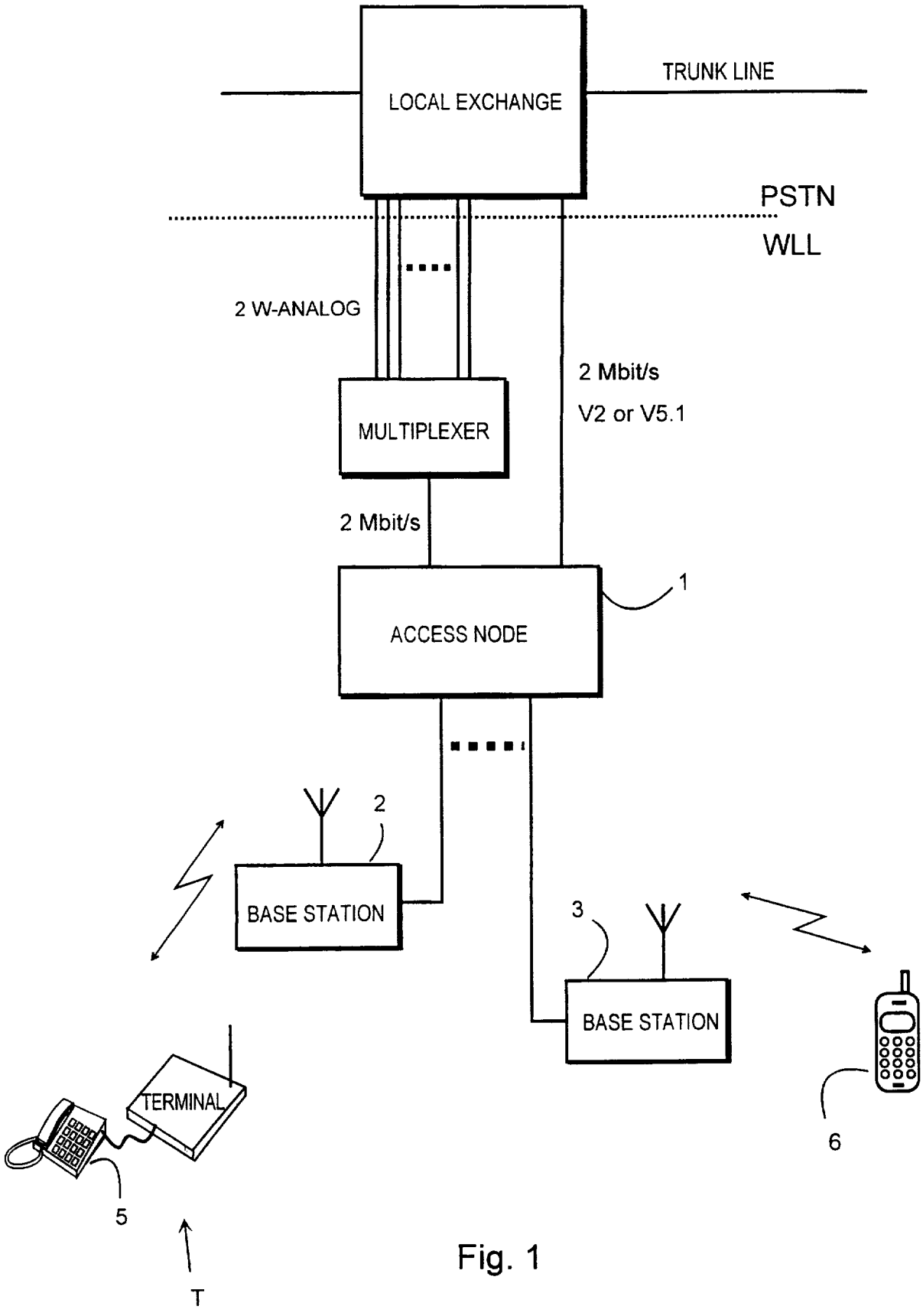
LOCAL EXCHANGE
TRUNK LINE
PSTN
WLL
2 W-ANALOG
2 Mbit/s
V2 or V5.1
MULTIPLEXER
2 Mbit/s
1
ACCESS NODE
2
BASE STATION
3
BASE STATION
TERMINAL
5
6
T

Fig. 1

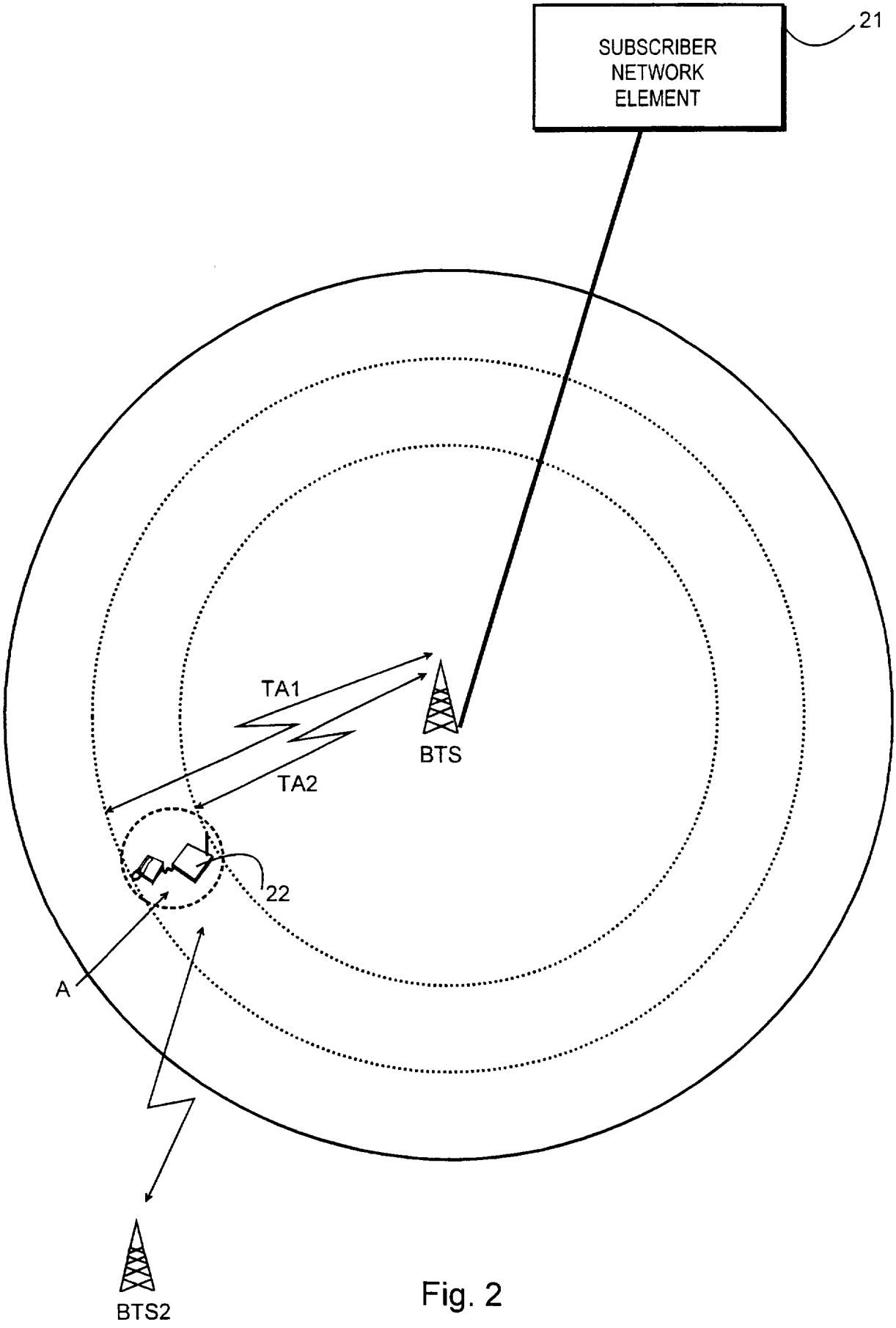

Fig. 2

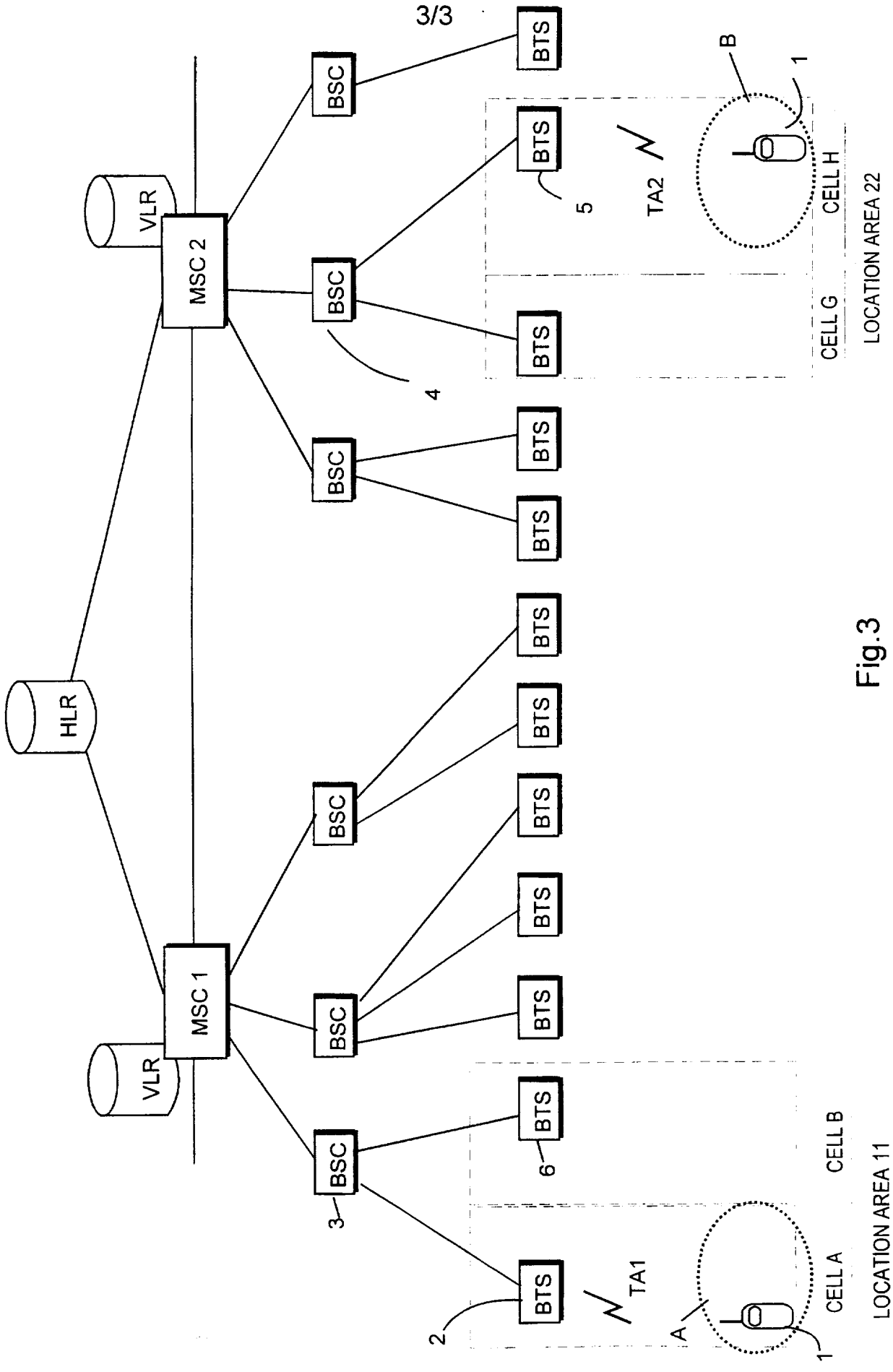
HLR
VLR
MSC 1
VLR
MSC 2
BSC
BTS
TA1
TA2
A
B
1
2
3
4
5
6
CELL A
CELL B
CELL G
CELL H
LOCATION AREA 11
LOCATION AREA 22

Fig.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00499

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04Q 7/38 // G01S 1/24, H04Q 7/34, G01S 5/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H04Q, G01S

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPIL, EDOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y	--	12,13
Y	EP 0705046 A2 (US WEST TECHNOLOGIES, INC.), 3 April 1996 (03.04.96), page 6, line 20 - line 25; page 12, line 3 - line 14; page 20, line 48 - line 58, figure 8	12,13
A	page 1, line 49 - page 2, line 5; page 2, line 39 - line 50, page 8, line 10-15, page 14, line 30-36	1-11,14,15
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 January 1998	30 -01- 1998
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Martin Ek Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00499

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	EP 0568824 A2 (US WEST, INC.), 10 November 1993 (10.11.93), column 2, line 42 - line 46, claims 1, 17,32,33, abstract	7,14,15

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Information on patent family members

07/01/98

International application No.
PCT/FI 97/00499

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