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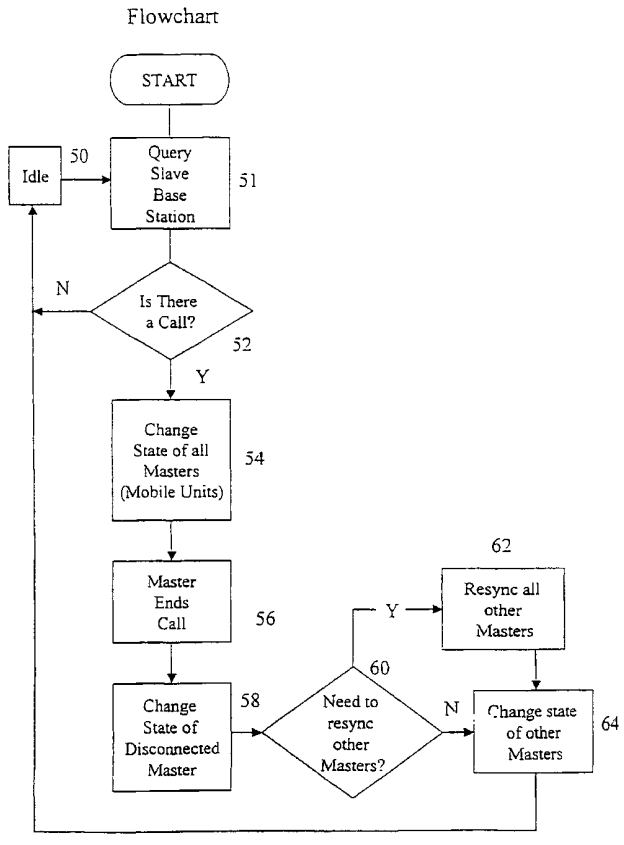
(54) Title: METHOD AND SYSTEM FOR COORDINATING MASTER MOBILE UNITS WITH A SLAVE BASE STATION



(57) Abstract: A method is disclosed for coordinating master mobile units with a slave base station comprising four steps. In step one, a plurality of mobile units (14-17) is provided. In step two, a single fixed base station (12) for communicating with each of the mobile units (14-17) is provided. In step three, one or more of the mobile units (14-17) is established as a master. In step four, the base station (12) is established as a slave to each of the mobile unit masters (14-17). In another embodiment of the present invention, a system for coordinating master mobile units with a slave base station is disclosed. The system comprises one or more mobile units (14) having control logic (19) to establish one or more of the mobile units (14) as a master controller. The system also comprises a base station (12) having response logic (13) for coordinating with each of the master mobile units (14).

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METHOD AND SYSTEM FOR COORDINATING MASTER MOBILE UNITS WITH A SLAVE BASE STATION

TECHNICAL FIELD OF THE INVENTION

This invention relates generally to wireless communications and more particularly to a method and system for coordinating master mobile units with a slave base station.

BACKGROUND OF THE INVENTION

In conventional mobile systems there is generally a single base station supporting a plurality of mobile units or hand sets. The base station in such systems remains in a fixed location and acts as the master with all of the mobile units acting as slaves. The fixed master base station controls and selects the transmission attributes for establishing and maintaining the communication links with each of the mobile units. One function of the base station is to synchronize the mobile units with the base station so that all units utilize the same transmission attributes on each of the various communication links in response to a periodic synchronization signal from the base station.

It is known to utilize the base station as a master to control the communication link between the base station and the mobile units in the time domain. The fixed base station controls the communication links by broadcasting parameters relating to the transmission characteristics that are used by all of the mobile units. Those parameters generally include frequency and time basis information. Such a system requires each of the mobile units to constantly update the time basis by scanning the usable frequency spectrum for synchronization signals. This type of system requires each mobile unit to operate in a receive mode for large periods of time. Some mobile units may suffer from problems such as battery drainage from high power consumption as a result. This problem frustrates users and has been a long standing challenge to the developers of mobile communication devices.

Therefore, a need has arisen for a new method and system for synchronizing mobile units in a mobile communication system that overcomes the disadvantages and deficiencies of the prior art.

SUMMARY OF THE INVENTION

In accordance with the present invention, a method and system for coordinating master mobile units with a slave base station is disclosed that establishes a mobile unit as a master controller to a fixed slave base station.

In one embodiment of the present invention, a method is disclosed for coordinating master mobile units with a slave base station comprising four steps. First, a plurality of mobile units is provided. Second, a single base station for communicating with each of the mobile units is provided. In the third step, one or more of the mobile units is established as a master. In step four, the base station is established as a slave to each of the mobile unit masters.

In another embodiment of the present invention, a system for coordinating master mobile units with a slave base station is disclosed. The system comprises one or more mobile units. Each of the mobile units has control logic to establish the mobile unit as a master controller. The system also comprises a fixed base station having response logic for coordinating with the master mobile unit.

In yet another embodiment, a system for coordinating master mobile units with a slave base station is disclosed. The system comprises a plurality of mobile units. Each mobile unit has control logic to establish each mobile unit as a master controller. The system also comprises a base station having response logic for coordinating with each of the mobile units.

A technical advantage of the present invention is the ability to automatically establish one or more mobile units as a master in a mobile communication system. The base station can coordinate with one or more of the mobile units.

Other technical advantages should be apparent to one of ordinary skill in the art in view of the specification, drawings, and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, the objects and advantages thereof, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIGURE 1 is a block diagram of one embodiment of a mobile communication system in accordance with the present invention.

FIGURE 2 is a diagram of request frames used by each master mobile unit coordinated coordinating with a base station in accordance with the present invention.

FIGURE 3 is a flowchart for a method for coordinating mobile units in a mobile communication system utilizing the teachings of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1 through 3 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is a block diagram of one embodiment of a wireless or cordless mobile communication system in accordance with the present invention, indicated generally at 10. System 10 comprises a base station 12, which can support communication with a plurality of mobile units or handsets 14-17 using radio signals. Base station 12 and mobile units 14-17 are coupled via an air interface through which radio signals travel. While four mobile units have been shown for illustrative purposes, it should be understood by those` skilled in the art that additional mobile units can be added without departing from the spirit of the invention. Each of the plurality of mobile units 14-17 may be coupled to base station 12 via a corresponding individual communication link 14a-17a to support communication using radio frequencies. Base station 12 is operable to communicate with mobile units 14-17 using radio signals, many methods and protocols for which are known to those skilled in the art. Base station 12 may be any platform that remains locationally fixed, and mobile units 14-17 may be any mobile device operable to communicate with base station 12. For example, base station 12 may be a server platform or any modem that supports communication with a plurality of personal digital assistants (PDA).

To establish communication between each of the plurality of mobile units 14-17 and base station 12 on individual communication links 14a-17a, each mobile unit has control logic 19 to establish the mobile unit as a master controller. Consequently, base station 12 has response logic 13 for synchronizing base station 12 to each of the plurality of mobile units 14-17. The operation of such logic is discussed in conjunction with FIGURES 2-3. Such logic may be implemented in a variety of technologies known to those skilled in the art. For example, such logic may be implemented in software, firmware or hardware. Furthermore, such logic may be changed dynamically to varying conditions encountered by system 10. In this way, system 10 can maintain communications between base station 12 and mobile units 14-17 by using the most appropriate logic. System 10 may also comprise digital or analog technology, or a combination thereof.

FIGURE 2 is a diagram of request frames used by each master mobile unit coordinating with a base station in accordance with the present invention. As shown, the timeline comprises a plurality of request frames 41-44 each having a frame length. In this embodiment, each request frame has a predetermined frame length of 500 milliseconds. Each frame follows immediately after the previous frame in the time domain. In the embodiment of FIGURE 2, four mobile units 14-17 are associated with the entire timeline and are used during that timeline for synchronizing base station 12 to each of the four mobile units. Thus, the timeline for this embodiment has a duration of two seconds. As shown in FIGURE 2, a new request frame 45 for mobile unit 14 is begun immediately after request frame 44 for mobile unit 17 is complete, thus beginning a new timeline of two seconds. The method for communications between each of the plurality of mobile units in system 10 and base station 12 is discussed in further detail in conjunction with FIGURE 3.

FIGURE 3 is a flowchart for a method for coordinating master mobile units with a slave base station in a mobile communication system utilizing the teachings of the present invention. In general, the method of FIGURE 3 includes the steps of a mobile unit waiting to connect to a call coming from base station 12, in an idle state. The method also includes the steps of a mobile unit querying the base station, connecting a call from the base station to the mobile unit, changing the state of a plurality of mobile

units, ending the call to that disconnecting mobile unit, and changing the state of the disconnecting mobile unit. The method further comprises the step of re-synchronizing the plurality of mobile units to the base station, if necessary, and changing the state of the other mobile units in the system.

The method of FIGURE 3 comprises a number of steps, beginning with step 50. The plurality of mobile units 14-17 waits in an idle state. At step 51, a mobile unit, such as mobile unit 14, queries base station 12. In this embodiment, such a query includes the mobile unit requesting from the base station whether the base station has new information, such as an incoming call, for that mobile unit. If no new information is available, that mobile unit returns to an idle state.

Such a query can be communicated from the mobile unit to base station 12 by many methods known to those skilled in the art. In this embodiment for example, the mobile unit sends a signal containing a request code or request data to base station 12. Other embodiments may use synchronizing patterns or identification codes. Base station 12 responds with an acknowledgement signal that indicates, in this case, that base station 12 has no incoming calls for that mobile unit, and that base station 12 is in sync with that mobile unit. Other acknowledgement signals may indicate, for example, a call transfer. In this embodiment, this exchange takes place within the request frame, as shown in FIGURE 2, for that mobile unit, in this case 500 milliseconds.

In the case that base station 12 does have an incoming call for that mobile unit, base station 12 will, in the request frame, send a signal at step 54 to mobile unit 14. Such a signal indicates that mobile unit 14 needs to change its state to one where it may receive the incoming call. In this embodiment, before mobile unit 14 is connected to base station 12 with the current incoming call, the other mobile units 15-17 are placed in a sleep state at step 54. By placing the other mobile units in such a state, they do not disturb base station 12 with a request during their respective request frames. Mobile units 15-17 may be placed in such a sleep state during their respective request frame. For example, referring to FIGURE 2, should mobile unit 14 be informed that it is to receive an incoming call during request frame 41, base station 12 will indicate to mobile unit 14 that it should change its state to receive the incoming call at step 54. During the subsequent request frames 42-44, base station 12 will respond to the other mobile units' respective

requests for information by indicating that they should change their state to sleep. Then, during the next following request frame 45 from mobile unit 14, base station 12 will respond to the request for the incoming call from mobile unit 14 by connecting mobile unit 14.

Mobile unit 14 then remains in constant contact with base station 12 for the duration of the call until the call is disconnected at step 56. Mobile unit 14 will send a disconnect message to base station 12 indicating that it is disconnecting from the call at step 56. In this embodiment, base station 12 will then send an acknowledgement signal that mobile unit 14 should return to an idle state, at step 58.

After mobile unit 14 has disconnected, at step 60, mobile units 15-17 may need to resynchronize themselves to base station 12 after their time spent in a sleep state. In this embodiment, mobile units 15-17 remain in a sleep state for the duration of the call connected to mobile unit 14. Such a sleep state can be implemented by a variety of methods. One such method includes each mobile unit remaining in a sleep state for a pre-determined time, for example, two seconds. Each mobile unit then will become active for a resync period in order to synchronize its internal time frame clock with that of base station 12. Many methods for synchronizing base station 12 to each of the mobile units, including bit synchronizing, are known to those skilled in the art. During this active state, each mobile unit may determine whether the carrier used by system 10 is active, i.e., mobile unit 14 has not disconnected the call. Many methods for determining such activity are known to those skilled in the art. In this embodiment, each mobile unit may measure the signal strength of the carrier.

During this process, each of the mobile units 15-17 maintains its own internal time frame clock so as to remain on its respective request frame schedule. Thus, for example, after mobile unit 14 has been informed that it is to receive the incoming call during request frame 41 at step 54, mobile units 15-17 are respectively informed to change their states to sleep. From this point until mobile unit 14 has disconnected, each of the respective mobile units 15-17 will sleep for two seconds, then become active for the resync period. Such a schedule in this embodiment corresponds to the request frame schedule as described in FIGURE 2. Thus, after mobile unit 14 has disconnected, base

station 12 will be sent a query from the mobile unit associated with that request frame. If there has been no clock drift, then that mobile unit need not resynchronize itself with base station 12.

On the other hand, should there have been clock drift, that mobile unit should resynchronize itself to base station 12 after its time spent in the sleep state. In this embodiment at step 62, mobile units 15-17 will, in their respective request frames, send a request to base station 12. Base station 12 responds with data each mobile unit needs to resynchronize with base station 12, in this case by sending each respective mobile unit a trim value. Such a trim value is data calculated in base station 12 for each mobile unit 15-17. These trim values may be used by each mobile unit 15-17 to appropriately reset its clock in order to resynchronize with base station 12. For example, a trim value may be a measure of time by which mobile unit 15 is offset from base station 12. Thus, mobile unit 15 would subtract this trim value from its internal clock period to resynchronize with base station 12. Base station 12 then sends an acknowledgement signal that changes mobile units 15-17 state back to idle at step 64. Such a trim value may be sent as a single value during a single request frame, or incrementally sent during successive request frames for that mobile unit.

It is within the scope of the invention to utilize other implementations for the method shown in FIGURE 2. For example, each of the plurality of mobile units 14-17 may operate utilizing a different carrier frequency. In this case, base station 12 needs to store a value indicating the last active carrier frequency used by each of master mobile units 14-17. Base station 12 will then respond to each respective mobile unit 14-17 using this carrier frequency. Similarly, each mobile unit will communicate with base station 12 utilizing this carrier frequency.

Thus, when mobile unit 14 receives an incoming call from base station 12 at step 52, it is not necessary for the other sets of plurality of mobile units 15-17 to be placed in a sleep state at step 54. In this case, when the other mobile units 15-17 send requests during their respective request frames 42-44 to base station 12, base station 12 simply does not respond during the remainder of the call. This permits the incoming call between mobile unit 14 and base station 12 to remain uninterrupted on its own carrier frequency. When mobile unit 14 ends the call at step 56, mobile unit 14 is returned to

idle state at step 58. Then, at step 60, base station 12 need not resynchronize to mobile units 15-17 by completing step 62. Base station 12 will then respond to mobile units 15-17 at step 64 in their respective request frames, utilizing the last active carrier for each of the respective mobile units. Mobile units 15-17 then remain in idle state.

It is also within the scope of the invention for the other mobile units 15-17 to change their state to a receive state at step 54. Such a receive state, in contrast to a sleep state, requires mobile units 15-17 to operate for the duration of the incoming call to mobile unit 14 in a receive mode. Then, at step 58 after mobile unit 14 disconnects with base station 12, mobile units 15-17 do not need to resynchronize themselves to base station 12 at steps 60-62. Instead, at step 64 during their respective request frames 42-44, mobile unit 15-17 will receive a signal from base station 12, in response to their requests, to change their states back to idle.

While the invention has been particularly shown and described by the foregoing detailed description, it will be understood by those skilled in the art that various other changes in form and detail may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A system for coordinating master mobile units with a slave base station comprising:

a) one or more mobile units having control logic to establish one of the mobile units as a master mobile unit; and

b) a fixed base station having response logic to coordinate with each of the master mobile units.

2. The system of Claim 1, wherein each of the mobile units is capable of acting as a master mobile unit and the response logic is operable to coordinate with each of the master mobile units.

3. The system of Claim 2, wherein each of the master mobile units communicates with the base station on a different carrier frequency.

4. The system of Claim 2, wherein the base station is operable to communicate to the master mobile units data capable of synchronizing each of the master mobile units with the base station.

5. The system of Claim 2, wherein the master mobile units communicate with the base station in a sequence.

6. The system of Claim 2, wherein coordinating the base station with each of the master mobile units is performed in a predetermined time period.

7. The system of Claim 2, wherein coordinating the base station with each of the master mobile units changes the state of each of the master mobile units.

8. A method for coordinating master mobile units with a slave base station comprising:

a) providing a plurality of mobile units;

b) providing a single base station for communicating with each of the mobile units;

c) establishing one or more of the mobile units as a master; and

d) establishing the base station as a slave to any mobile unit master.

9. The method of Claim 8, wherein communicating with each of the mobile units is done on a different carrier frequency.

10. The method of Claim 8, wherein communicating with each of the mobile units is done in sequence.

11. The method of Claim 8, wherein establishing one or more of the mobile units as a master includes querying the base station by one or more of the mobile units to determine whether there is an incoming call for one of the mobile units.

12. The method of Claim 8, wherein establishing the base station as a slave includes the base station responding to a query by one or more of the mobile units with an acknowledgement signal.

13. The method of Claim 8, wherein the master mobile units are personal digital assistants.

14. A method for coordinating master mobile units with a slave base station comprising:

a) sending a query from one or more master mobile units to a fixed slave base station;

b) establishing an active communication link between the slave base station and one of the master mobile units in response to the query;

c) sending a message to the slave base station from the master mobile unit to deactivate the active communication link between the slave base station and the master mobile unit; and

d) synchronizing the master mobile units to the slave base station in response to a request from the master mobile units.

15. The method of Claim 14, wherein establishing an active communication link between the slave base station and one master mobile unit is done on a unique carrier frequency.

16. The method of Claim 14, wherein sending a query from one of the master mobile units to a slave base station is done in sequence.

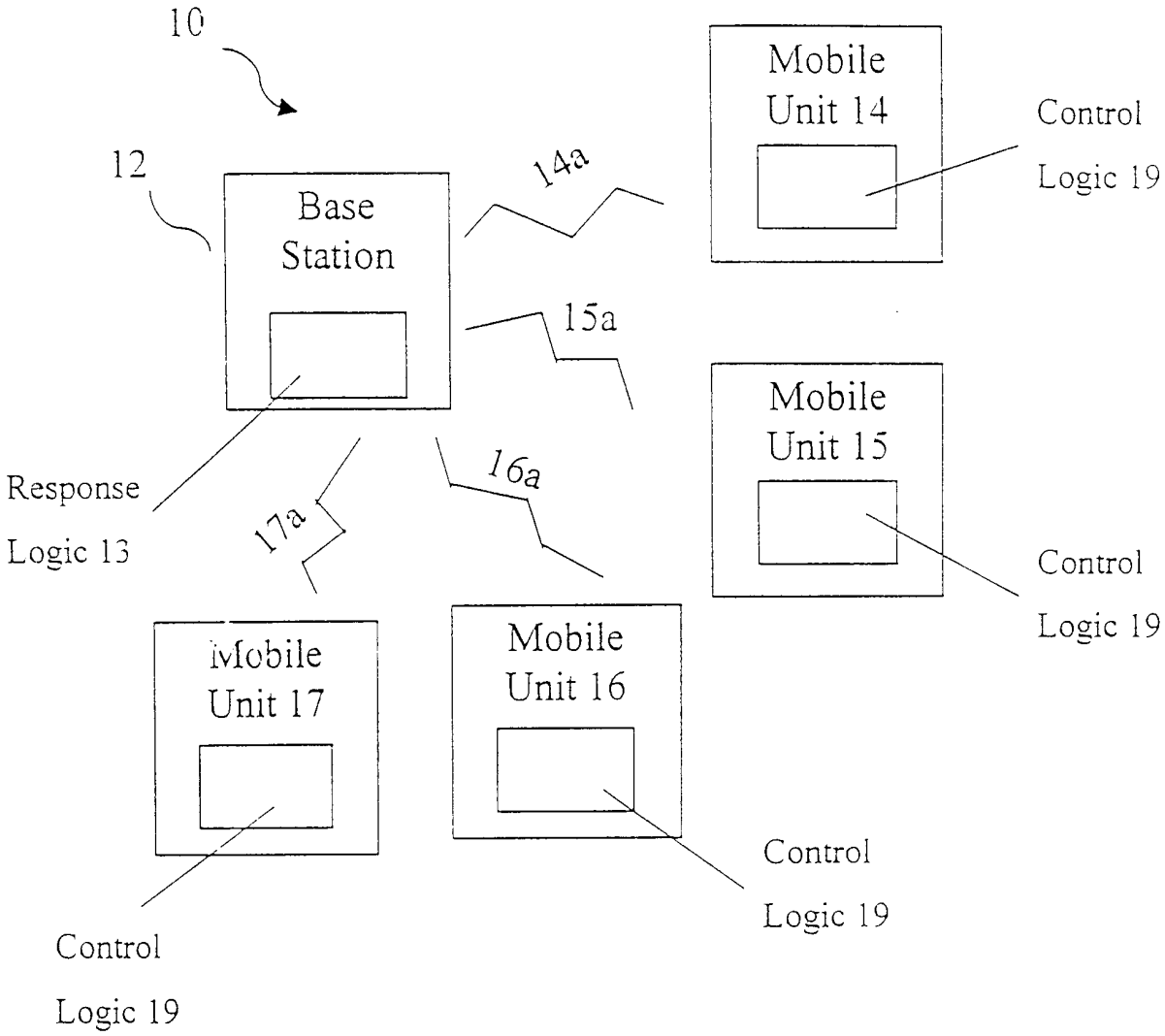
17. The method of Claim 14, wherein synchronizing the base station to one of the master mobile units comprises sending a trim value to one of the mobile units.

18. The method of Claim 14, further comprising performing steps (a)-(d) in a predetermined time period.

19. The system of Claim 14, wherein coordinating the base station with one of the master mobile units changes the state of the mobile unit.

20. The system of Claim 14, wherein one of the master mobile units transmits a signal to the base station requesting new information.

FIGURE 1


10
12
Base Station
14a
15a
16a
17a
Response Logic 13
Mobile Unit 14
Control Logic 19
Mobile Unit 15
Control Logic 19
Mobile Unit 16
Control Logic 19
Mobile Unit 17
Control Logic 19

Flowchart

FIGURE 2

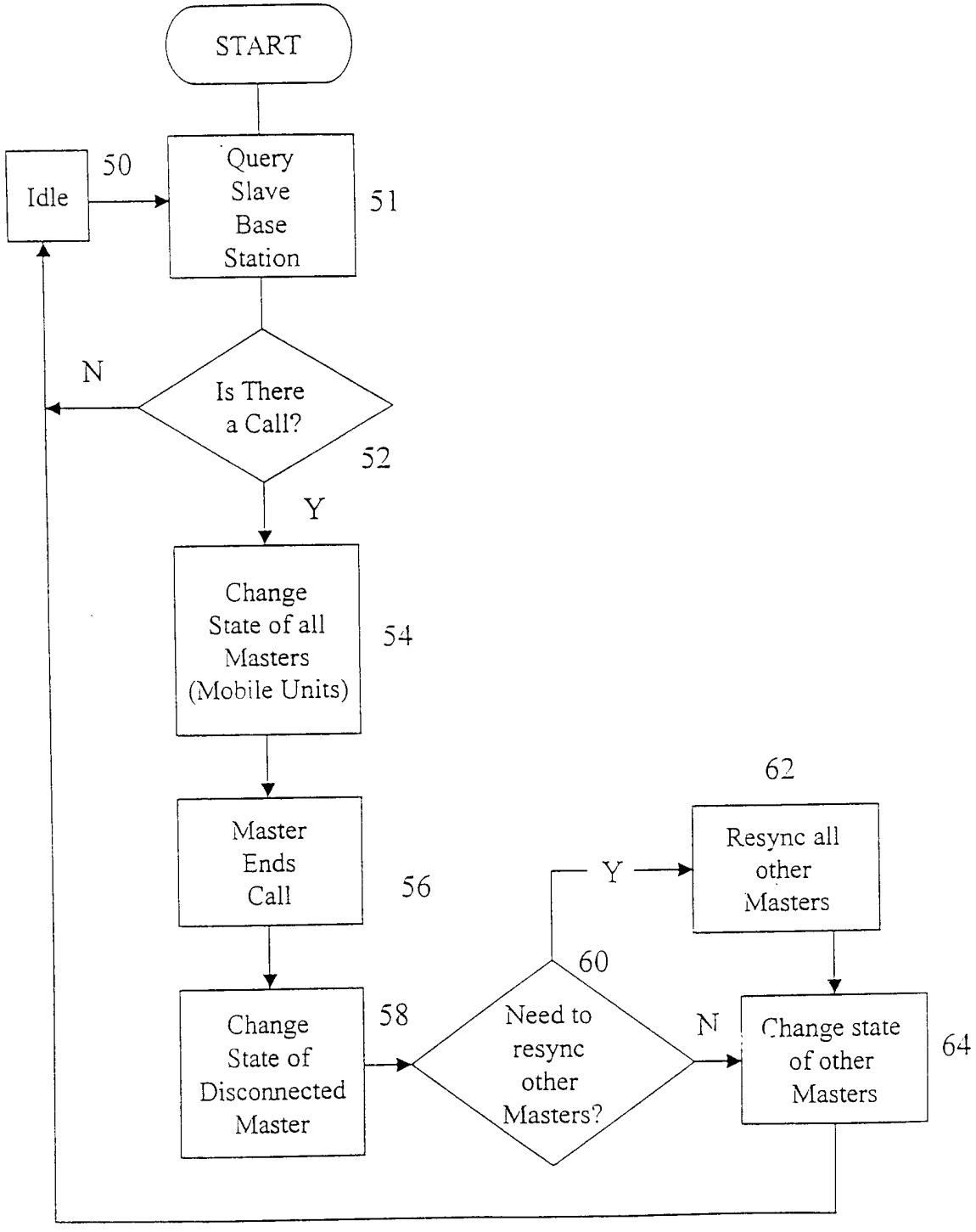
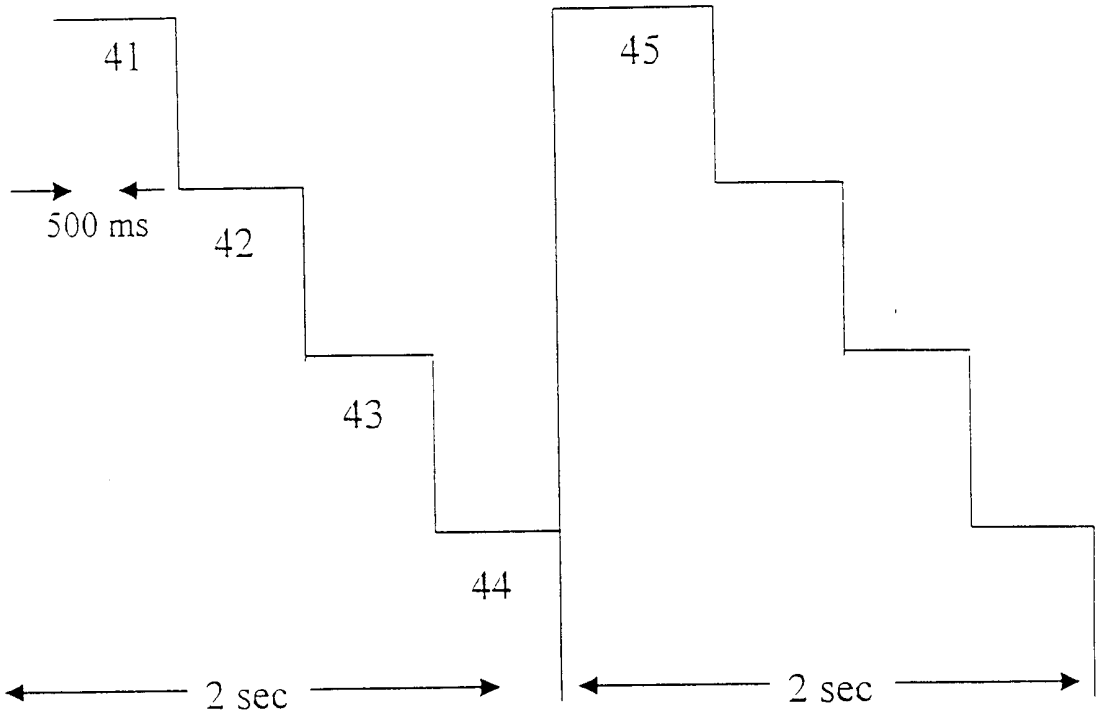


FIGURE 3



INTERNATIONAL SEARCH REPORT

Interr nal Application No
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A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L12/28 H04L12/56

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)
IPC 7 H04L H04Q

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
WPI Data, PAJ, EPO-Internal, INSPEC

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Y		5,6,10
A		3,4,9,14

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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
8 September 2000	18/09/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Vaskimo, K

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