(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 January 2001 (18.01.2001)

PCT

(10) International Publication Number
WO 01/05174 A1

(51) International Patent Classification[7]: H04Q 7/32

(21) International Application Number: PCT/US00/18842

(22) International Filing Date: 11 July 2000 (11.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/352,012 12 July 1999 (12.07.1999) US

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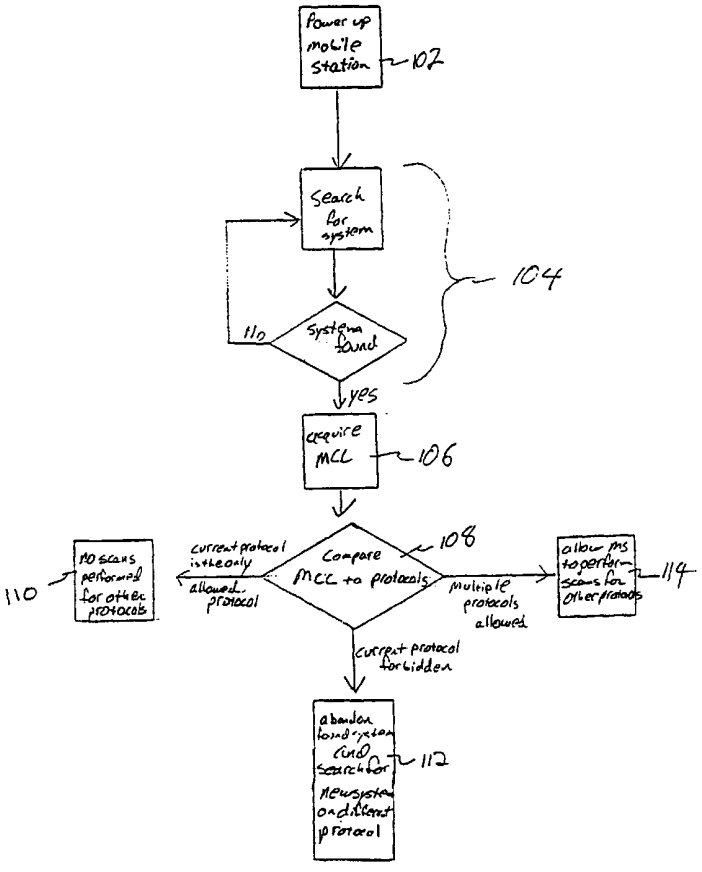
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: PROTOCOL UTILIZATION BASED ON MOBILE COUNTRY CODE



(57) Abstract: A method and system of protocol determination for a mobile station. A mobile station according to the disclosed embodiments can vary the manner in which it scans for systems and which protocol or protocols it scans for depending on the country in which the mobile station is located. In a disclosed embodiment, a mobile station, when activated, (102) differentiates between areas that require a particular protocol, for example, GSM, and areas that require a different protocol, for example, IS-136 (108). In another disclosed embodiment, a mobile station can search only for systems on a particular protocol, for example, GSM, in some countries and only for systems on a different protocol, for example, IS-136, in other countries (110). In another disclosed embodiment, a mobile station can search for the best system regardless of protocol or within a particular subset of protocols depending on the country (114).

WO 01/05174 A1

Published:
— *With international search report.*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Protocol Utilization Based on Mobile Country Code

Field of the Invention

This invention relates to mobile stations handling multiple systems and protocols and, more particularly to system and protocol selection based on the mobile station location.

Background of the Invention

In digital cellular systems, mobile stations typically scan for systems when activated or while registered on another system (background scanning). Unlike the operations of reselection or handoff, this scanning takes place on the mobile station without any assistance from the base station. Furthermore, this search takes place without any coordination between the mobile station and the base station.

There are currently several specifications which require background scanning. For example, Intelligent Roaming for ANSI 136 utilizes a database to determine the priority of a system. While registered on certain low priority systems, the mobile station must search for a system of higher priority. Another example is the Inter-Network Roaming Selection specification from GSM North America (GSM NA). This specification requires a priority database to determine the best system in AMPS and GSM 1900. While registered to a low priority system, the mobile station must search another protocol for a higher priority system. The ANSI-136 Intelligent Roaming and Inter-Network Roaming Selection specifications are the first of many specifications dealing with prioritized system selection requiring background scanning.

Currently, there is much development being done towards integrating GSM and IS-136. Each wireless operator has its own objectives to be met by a GSM/IS-136 mobile station. Some operators want the mobile station to utilize the most desirable system in either protocol within an area. Others want the mobile station to utilize only a specific protocol in one country (excluding all other protocols) and another specific protocol in another country (excluding all other protocols).

There are currently several areas utilizing both GSM and IS-136 systems. For example, the United States, Canada, and Hong Kong have co-existing GSM and IS-136 systems. Some operators want the mobile station to utilize only IS-136 in the United States and Canada and to utilize only GSM everywhere else. Other operators want the

mobile station to utilize the most desirable system of either protocol regardless of the location of the mobile station.

In order to ensure that the best system is always in use for a multi-protocol area (when the best of either protocols is used), a form of scanning one protocol while camped on the other must be performed in certain situations. However, this type of background scanning is generally not acceptable to an operator that is not interested operating in the other protocol. Moreover, this type of protocol search functionality is not desirable in places where only one (or not all) protocols allowed by the phone are in use. For example, in Europe there is no IS-136 system.

Additional general background, which helps to show the knowledge of those skilled in the art regarding the system context, and of variations and options for implementations, may be found in the following: TIA interim standard IS-136; and Brodsky, Wireless: The Revolution in Personal Telecommunications (1995); all of which are hereby incorporated by reference.

Summary of the Invention

The present application discloses a method and system of protocol determination for a mobile station. A mobile station according to the disclosed embodiments can vary the manner in which it scans for systems and which protocol or protocols it scans for depending on the country in which the mobile station is located. In a disclosed embodiment, a mobile station, when activated, differentiates between areas that require a particular protocol, for example, GSM, and areas that require a different protocol, for example, IS-136. In another disclosed embodiment, a mobile station can search only for systems on a particular protocol, for example, GSM, in some countries and only for systems on a different protocol, for example, IS-136, in other countries. In another disclosed embodiment, a mobile station can search for the best system regardless of protocol or within a particular subset of protocols depending on the country.

The various disclosed embodiments of the present application can provide several advantages. For instance, one or more of the disclosed embodiments can allow wireless providers with service agreements that differ by country to be accommodated with a single approach. Another advantage is that flexibility is given to a mobile station to select the best of the available protocols (or a subset thereof) in some areas and a single protocol in other areas. Another advantage is that a mobile station is given the ability to operate in a dual-mode (or greater) environment without regard to particular

paging protocols. Another advantage is that faster mobile station response upon activation, for mobile stations operating in two or modes, is enabled due to elimination of needless scanning and background scanning due to forbidden protocols.

Brief Description of the Drawings

The disclosed inventions will be described with reference to the accompanying drawings, which show important sample embodiments of the invention and which are incorporated in the specification hereof by reference, wherein:

Figure 1 depicts a flow chart illustrating the presently preferred embodiment.

Figure 2 depicts a block diagram of a mobile station that can make use of the disclosed embodiments.

Figure 3 depicts a block diagram of a cellular communications system suitable for implementing the disclosed embodiments.

Detailed Description of the Preferred Embodiments

The numerous innovative teachings of the present application will be described with particular reference to the presently preferred embodiment. However, it should be understood that this class of embodiments provides only a few examples of the many advantageous uses of the innovative teachings herein. In general, statements made in the specification of the present application do not necessarily delimit any of the various claimed inventions. Moreover, some statements may apply to some inventive features but not to others.

Various embodiments of the disclosed method and system will be described using a dual mode (GSM/IS-136) mobile station as an example. However, the disclosed method and system are not limited to mobile stations which are GSM and IS-136 capable or mobile stations with only two modes of operation.

The disclosed innovations make use of Mobile Country Codes (or MCCs). Each base station, whether GSM or IS-136, or some other wireless protocol, broadcasts a MCC which signifies the country in which the base station is located. The MCC is used by the mobile station to determine which country the mobile station is in. The protocol/MCC matching differentiates between areas that require a particular protocol, for example, GSM, and areas that require a different protocol, for example, IS-136. Once the MCC is known to the mobile station, it can determine which protocol or protocols are available for use. Matching the MCC to a protocol list allows the mobile station to dynamically alter its initial scanning and background scanning routines. Such routines are usually programs which are part of mobile station firmware or software.

Figure 1 depicts a flow chart illustrating the presently preferred embodiment. In the presently preferred embodiment, a mobile station is first powered up (Step 102). Upon power up, the mobile station searches for systems in its available protocols (typically GSM and IS-136) without restraint (Step 104). When a system is found, the mobile station acquires the MCC being broadcast by the system (Step 106). The mobile station then compares the MCC with a protocol list (Step 108). In the presently preferred embodiment, the list is kept internally at the mobile station and contains information which matches acquired MCCs to allowed protocols. This list dictates the protocol (or protocols) which can be utilized given the acquired MCC. The list can be implemented as a flat file listing allowed or disallowed protocols for each MCC, a pointer type structure which matches MCCs to a protocol table, a dynamically alterable or linked list, or any other information structure that allows protocol decisions to be derived based on an acquired MCC. If the current protocol is the only protocol allowed for the given MCC, according to the list, no scans (or background scans) will be performed in any other protocols (Step 110). If the current protocol is forbidden in the country indicated by the MCC, according to the list, the system supplying the code is abandoned and systems in another protocol are searched (Step 112). If the MCC indicates that, according to the list, more than one protocol is allowed, the mobile station may perform scans (including background scans) in both protocols to find the best system (Step 114). Differing criteria can be used to determine the best system. For example, signal strength, preferred/positive system, priority system, or other criteria can be used, according to the desires of a wireless provider can be used

The protocol list is typically kept in mobile station memory or Subscriber Information Module (or SIM) memory and ideally can be updated over the air or during mobile station software upgrades as well as through a mobile station user interface. Once the protocols available to the mobile station, based on its current location, are known, the routines and procedures for system scanning can be adjusted to suit the wireless providers desires. Dynamically altering the scanning routines of the mobile station can allow for system scans which are limited to particular protocols. For example, if only GSM systems are available in a particular country, scanning for systems on the IS-136 protocol can be eliminated. Once the mobile station crosses into a country that has IS-136 systems, the mobile station can scan for those systems as well (according to the agreements of the wireless provider and the protocol restrictions of the mobile station). A mobile station can also be configured to scan for the best

system regardless of protocol or for systems within a particular subset of protocols depending on the country.

In another embodiment, the mobile station, when activated (power-up), searches for systems on a default protocol. This default protocol can be established by the wireless provider and may depend on where the mobile station was purchased. For example, if the mobile station was purchased in the United States, the default protocol may be IS-136. The default protocol may also be dynamic, for example, the protocol of the last system on which the mobile station was registered.

Figure 3 depicts a block diagram of a cellular communications system suitable for implementing the disclosed embodiments. A cellular telephone system 10 has a plurality of mobile switching centers (MSC) 12, 14, 16, or mobile telephone switching offices (MTSO), that are connected to each other and to a public switched telephone network (PSTN) 18. Each of the mobile switching centers is connected to a respective group of base station controllers (BSC) 20, 22, 24. Each base station controller is connected to a group of individual base transceiver stations (BTS) 26, 28, 30. Each base transceiver station of the groups 26, 28, 30 defines an individual cell of the cellular telephone system.

Each base transceiver station of the groups 26, 28, 30 includes hardware and software functions required to communicate over communications channels of the system 10; and includes transmitters and receivers for communication with mobile telephone units. Each base transceiver station 26, 28, 30 also includes a plurality of individual standard receivers (StdR) 31 and scanning receivers (SR) 32 for scanning selected portions of the communications channel. Each base transceiver station 26, 28, 30 further includes digital multiplex equipment for transmission of audio traffic to its associated base station controller. It is the base transceiver stations 26, 28, 30, along with their associated base station controllers 20, 22, 24 and mobile switching centers, that transmit MCCs for use by a mobile station 33 and 200.

A plurality of digital mobile stations 33 is used with the system 10 for communication over the communications channel (or radio frequency traffic channel) with a particular base transceiver station of a particular cell in which the particular base transceiver station is located. According to the various disclosed embodiments, associated with each digital mobile station 33 is a scanning receiver 35 for scanning selected portions of the communications channel between the mobile unit 33 and the base transceiver station of serving and neighboring cells.

Each base station controller of the groups 20, 22, 24 implements audio compression/decompression, handles call establishment, disconnect, and handoff procedures, and allocates system resources between the individual base transceiver stations 26, 28, 30 associated with each of the base station controllers 20, 22, 24. More specifically, each base station controller performs handoff execution for transferring on-going communications from one cell to another within the group of base transceiver stations connected to the particular base station controller. Each base station controller communicates with its associated mobile switching center for effecting a handoff involving a cell or base transceiver station associated with a different base station controller. Each mobile switching center 12, 14, 16 processes all requests for calls, switching functions, as well as the mobility functions of registration, authentication and handoff.

Figure 2 depicts a block diagram of a mobile station 200 that can make use of the disclosed embodiments (like 33 and 35 described in Figure 1). The mobile station 200 includes, in this example:

A control head 202 containing an audio interface, i.e. a speaker 204 and microphone 206.The control head 202 generally includes a display assembly 208 allowing a user to see dialed digits, stored information, messages, calling status information, including signal strength, etc. The control head generally includes a keypad 210, or other user control device, allowing a user to dial numbers, answer incoming calls, enter stored information, and perform other mobile station functions. The control head also has a controller unit 234 that interfaces with a logic control assembly 218 responsible, from the control unit perspective, for receiving commands from the keypad 210 or other control devices, and providing status information, alerts, and other information to the display assembly 208;

A transceiver unit 212 containing a transmitter unit 214, receiver unit 216, and the logic control assembly 218. The transmitter 214 converts low-level audio signals from the microphone 206 to digital coding using a codec (a data coder/decoder) 220. The digitally encoded audio is represented by modulated shifts, for example, in the frequency domain, using a shift key modulator/demodulator 222. Other codes transmission utilized by the logic control assembly 218, such as station parameters and control information, may also be encoded for transmission. The modulated signal is then amplified 224 and transmitted via an antenna assembly 226;

The antenna assembly 226 contains a TR (transmitter/receiver) switch 236. The TR switch 236 is used to prevent simultaneous reception and transmission of a signal

by the mobile station 200. The antenna assembly also contains at least one antenna 238. Optionally, a different antenna may be coupled 240 to the antenna assembly.

A receiver unit which receives a transmitted signal via the antenna assembly 226. The signal is amplified 224 and demodulated 222. If the signal is an audio signal, it is decoded using the codec 220. The audio signal is then reproduced by the speaker 204. Other signals are handled by the logic control assembly 218 after demodulation 222; and

A logic control assembly 218 usually containing an application specific integrated circuit (or ASIC) combining many functions, such as a general purpose microprocessor, digital signal processor, and other functions, into one integrated circuit. The logic control assembly 218 coordinates the overall operation of the transmitter and receiver using control messages. The various disclosed embodiments make use of the logic control assembly to control scanning and evaluation of other base stations. Generally, the logic control assembly operates from a program that is stored in flash memory 228 of the mobile station. Flash memory 228 allows upgrading of operating software, software correction or addition of new features. Flash memory 228 is also used to hold user information such as speed dialing names and stored numbers. The various disclosed embodiments 242 typically utilize this or another section of the mobile station's internal memory. In certain mobile stations, a Subscriber Information Module (or SIM) is used to store mobile station parameters and configurations. In such mobile stations, SIM memory can be utilized by the various disclosed embodiments.

In addition to flash memory 228, the mobile station will typically contain read only memory (ROM) 230 for storing information that should not change, such as startup procedures, and random access memory (RAM) 232 to hold temporary information such as channel number and system identifier.

Modifications and Variations

As will be recognized by those skilled in the art, the innovative concepts described in the present application can be modified and varied over a tremendous range of applications, and accordingly the scope of patented subject matter is not limited by any of the specific exemplary teachings given.

For example, the disclosed embodiments determine the treatment of protocols based on a list. However, forms of comparison other than a list may be utilized to determine the treatment of protocols by the mobile station based upon Mobile Country Code. In addition, a partial list may be used with the absence of a Mobile Country Code

from the list dictating a default protocol preference that is either predetermined, contained within the list, or resident somewhere else in the mobile station or Subscriber Information Module.

For another example, the disclosed embodiments are described performing the initial system scan without protocol restraint. However, there could be other protocol restrictions from another source, or the initial scan protocols could be restricted by default, allowing a specific protocol to be used only after the Mobile Country Code has been determined.

As another example, the disclosed embodiments are described using the GSM and IS-136 protocols as examples. However, other protocols, including analog and CDMA type protocols, can utilize this method.

Furthermore, the disclosed embodiments do not need to be the only source of protocol restrictions. There could be other methods used in conjunction with the disclosed embodiments, having lower or higher precedence, to determine protocol utilization.

Claims

What is claimed is:

1. A method of searching systems in wireless communications, comprising the steps of:

searching for available base systems;

receiving a mobile country code from one of said available base systems; and

matching said mobile country code to a list of protocols available for wireless communications based on said mobile country code.

2. The method of Claim 1, further comprising limiting background scanning for other systems to said protocols available for wireless communications based on said mobile country code.

3. The method of Claim 1, further comprising the step of allowing said mobile station to perform background scans on systems using said protocols available for wireless communications based on said mobile country code.

4. The method of Claim 1, further comprising the step of searching for a new available base system within said protocols available for wireless communications based on said mobile country code.

5. The method of Claim 1, further comprising the step of abandoning said available base system when said available base system uses a forbidden protocol according to said protocols available for wireless communications based on said mobile country code.

6. The method of Claim 1 further comprising the step of limiting background scanning for other base systems to said protocols available for wireless communications based on said mobile country code.

7. The method of Claim 1, wherein said searching step is initially limited to searches only for said available base systems using a default protocol.

8. A method of searching systems in wireless communications, comprising the steps of:

powering up a mobile station;

searching for an available system;

acquiring a mobile country code from said available system; and

determining allowable protocols for said mobile station according to said mobile country code.

9. The method of Claim 8, further comprising the step of allowing said mobile station to perform background scans on systems using said allowable protocols.

10. The method of Claim 8, further comprising the step of searching for a new available system within said allowable protocols.

11. The method of Claim 8, further comprising the step of abandoning said available system when said available system uses a forbidden protocol according to said mobile country code.

12. The method of Claim 8, further comprising the step of limiting background scanning for other systems to said allowable protocols.

13. The method of Claim 8, wherein said mobile station initially searches only for available system using a default protocol.

14. The method of Claim 8, wherein said mobile station will register only on a system using one of said allowable protocols.

15. A mobile station, comprising:

a logic control assembly; and

a transceiver unit at least partially controlled by said control head;

wherein said logic control assembly determines allowable protocols according to a received mobile country code.

16. The mobile station of Claim 15, wherein said logic control assembly controls the operation of said transceiver unit to scan for base systems on allowable protocols according to said received mobile country code.

17. The mobile station of Claim 15, wherein a base system transmits said mobile country code.

18. The mobile station of Claim 15, wherein said received mobile country code is transmitted on a forbidden protocol.

19. The mobile station of Claim 15, further comprising a subscriber information module which stores information matching said mobile country code to said allowable protocols.

20. The mobile station of Claim 15, further comprising internal memory which stores information matching said mobile country code to said allowable protocols.

21. The mobile station of Claim 15, wherein said logic control assembly limits background scanning for other systems to said allowable protocols.

22. The mobile station of Claim 15, wherein said logic control assembly searches for a new available system within said allowable protocols.

23. The mobile station of Claim 15, wherein said logic control assembly abandons base stations using a forbidden protocol according to said received mobile country code.

24. The mobile station of Claim 15, wherein said logic control assembly initially searches only for systems using a default protocol.

25. The mobile station of Claim 15, wherein said logic control assembly will register only on a system using one of said allowable protocols.

26. A system of wireless base station and mobile station communication, comprising:
a base station transmitting a mobile country code; and
a mobile station which receives said mobile country code from said base station;
wherein said mobile station determines allowable protocols for wireless communications according to said received mobile country code.

27. The system of Claim 26, wherein said mobile station scans for base stations on allowable protocols.

28. The system of Claim 26, wherein said received mobile country code is transmitted on a forbidden protocol.

30. The system of Claim 26, wherein said mobile station stores information matching said mobile country code to said allowable protocols in a subscriber information module.

31. The system of Claim 26, wherein said mobile station stores information matching said mobile country code to said allowable protocols in internal memory.

32. The system of Claim 26, wherein said mobile station limits background scanning for other systems to said allowable protocols.

33. The system of Claim 26, wherein said mobile station searches for a new available system within said allowable protocols.

34. The system of Claim 26, wherein said logic mobile station abandons said base station when said base station uses a forbidden protocol according to said received mobile country code.

35. The system of Claim 26, wherein said mobile station initially searches only for systems using a default protocol.

36. The system of Claim 26, wherein said mobile station will register only on a system using one of said allowable protocols.

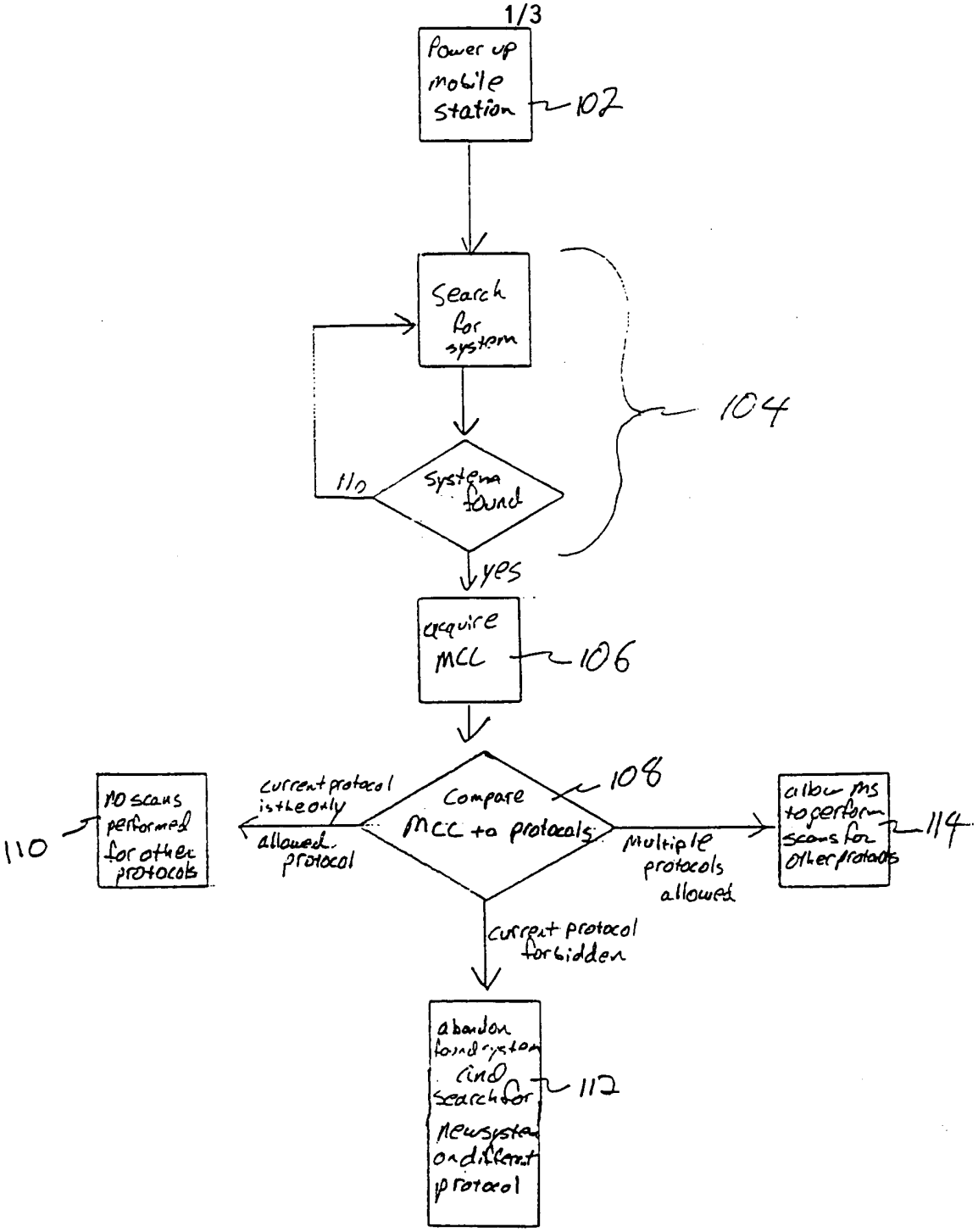
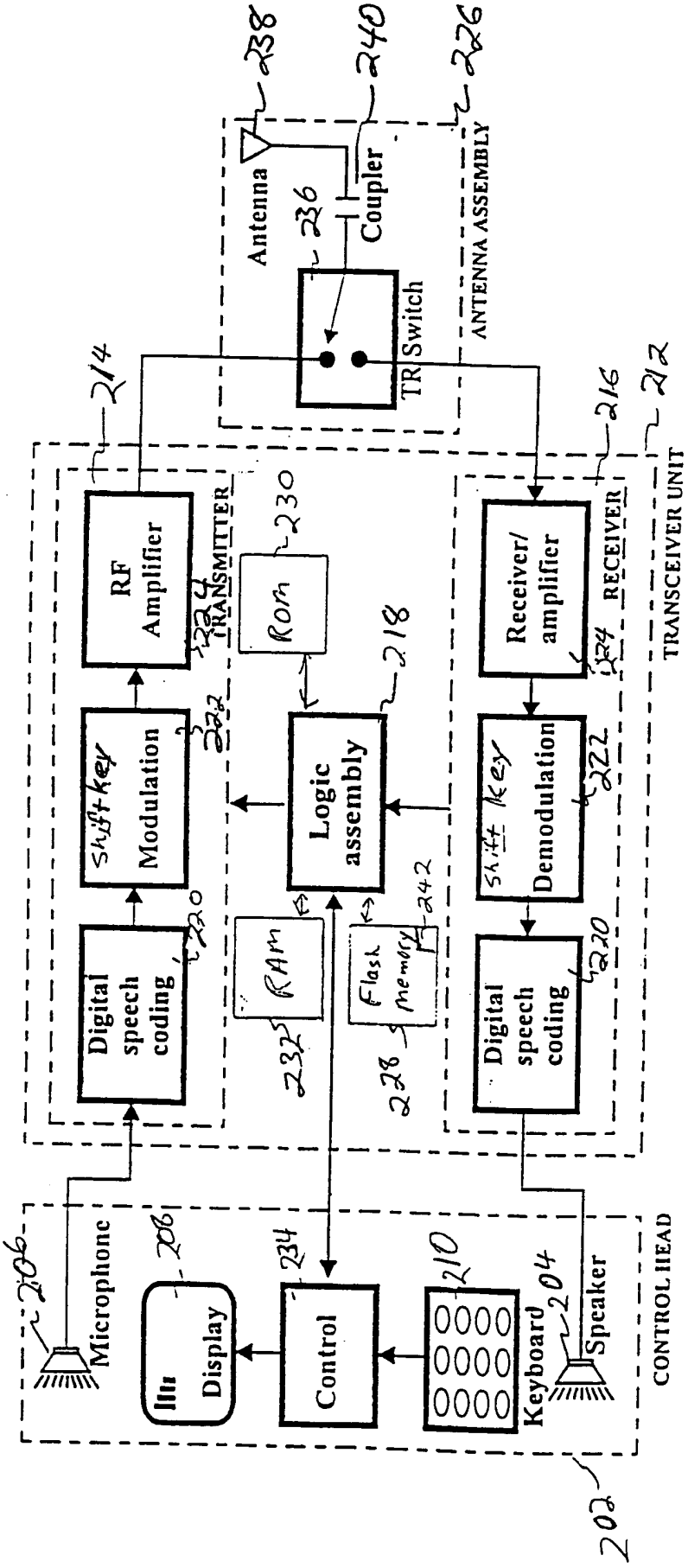

Power up mobile station
102
Search for system
104
110
System found
yes
Acquire MCC
106
Compare MCC to protocols
108
current protocol is the only allowed protocol
110
NO scans performed for other protocols
Multiple protocols allowed
allow MS to perform scans for other protocols
114
current protocol forbidden
abandon found system and search for new system on different protocol
112

Figure 1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Coupler
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212
RF Amplifier
TRANSMITTER
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230
ROM
218
Receiver/ amplifier
224
RECEIVER
TRANSCEIVER UNIT
shift key Modulation
232
Logic assembly
shift key Demodulation
222
Digital speech coding
220
RAM
232
Flash memory
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228
Digital speech coding
220
Microphone
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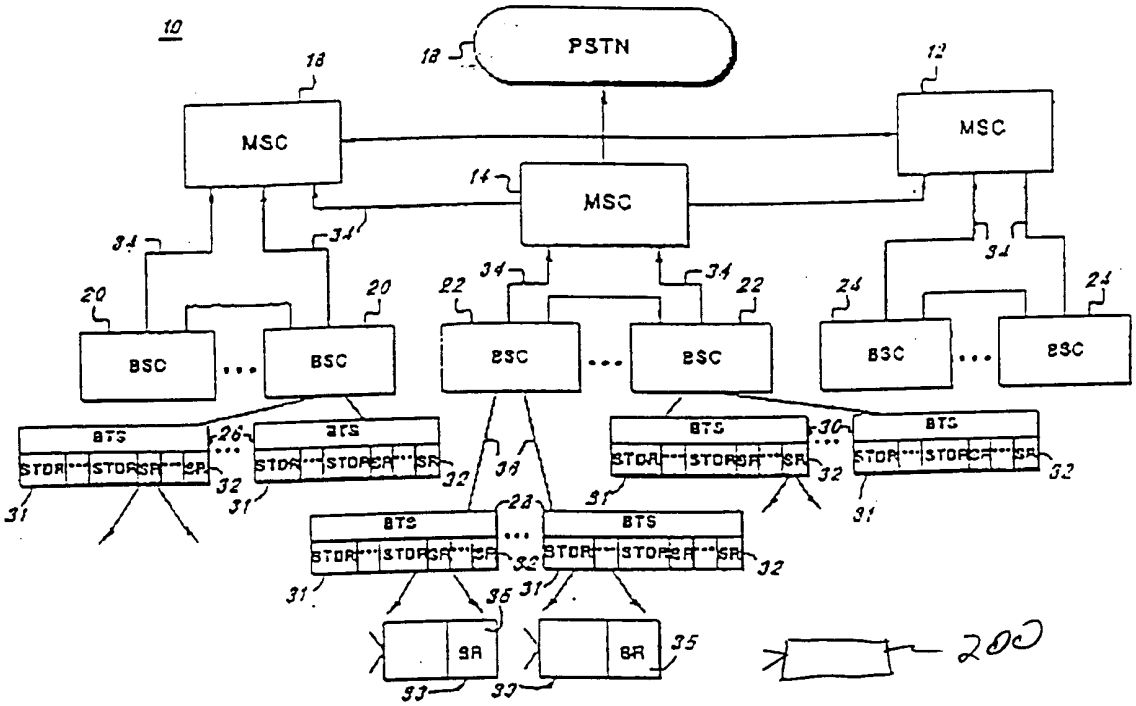
Display
206
234
Control
210
Keyboard
204
Speaker
CONTROL HEAD
202

Figure 2


10
PSTN
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STDR
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200

Figure 3

INTERNATIONAL SEARCH REPORT

Inte .onal Application No
PCT/US 00/18842

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/32

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 H04Q H04B

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2 325 820 A (NEC CORP.) 2 December 1998 (1998-12-02) abstract; figures 2,3 page 6, line 6 - line 27	1,8,15, 26
P,Y	EP 0 980 190 A (ROBERT BOSCH GMBH.) 16 February 2000 (2000-02-16) page 5, line 47 - line 48; table VI page 6, line 47 - line 57 page 8, line 17 - line 33	1,8,15, 26

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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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 October 2000	20/10/2000

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	Danielidis, S

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Inte onal Application No
PCT/US 00/18842

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter ɔnal Application No
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