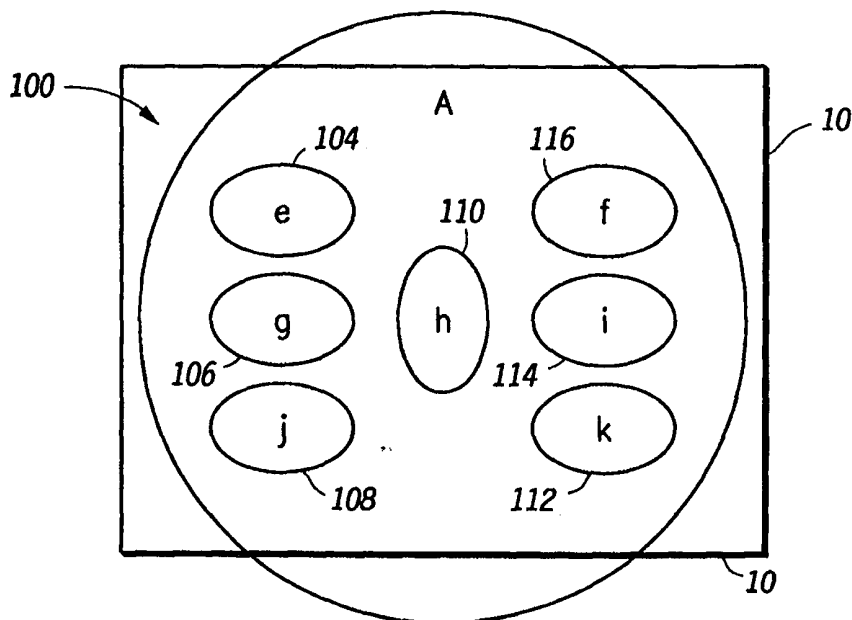




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : H04Q 7/36	A1	(11) International Publication Number: WO 00/11900 (43) International Publication Date: 2 March 2000 (02.03.00)
(21) International Application Number: PCT/US99/12452 (22) International Filing Date: 4 June 1999 (04.06.99) (30) Priority Data: 09/136,236 19 August 1998 (19.08.98) US (71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US). (72) Inventors: PICHA, Dean, M.; 146 Belaire Drive, Buffalo Grove, IL 60089 (US). GILLILAND, Dennis, W.; 1344 Saddlebrook Road, Bartlett, IL 60103 (US). BIELAT, David, J.; 2021 Aspen Drive, Algonquin, IL 60102 (US). (74) Agents: HAAS, Kenneth, A. et al.; Motorola Inc., Intellectual Property Dept., 1303 East Algonquin Road, Schaumburg, IL 60196 (US).		(81) Designated States: BR, JP, KR, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i>

(54) Title: WIRELESS COMMUNICATION SYSTEM AND METHOD OF ASSIGNING COMMUNICATION RESOURCES

**(57) Abstract**

A layered wireless communication system (100) includes a coverage cell (102) and a plurality of traffic cells (104-116). The traffic cells (104-116) are assigned a single traffic channel carrier and do not include a broadcast channel carrier. The coverage cell frequency hops on the traffic channel carriers, and the traffic cells listen at the appropriate times to an uplink signal from a mobile. Mobiles are assigned communication resources in traffic cells returning reports indicating that the mobile is sufficiently well received in the traffic cell.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon	KR	Republic of Korea	PL	Poland		
CN	China	KZ	Kazakhstan	PT	Portugal		
CU	Cuba	LC	Saint Lucia	RO	Romania		
CZ	Czech Republic	LI	Liechtenstein	RU	Russian Federation		
DE	Germany	LK	Sri Lanka	SD	Sudan		
DK	Denmark	LR	Liberia	SE	Sweden		
EE	Estonia			SG	Singapore		

WIRELESS COMMUNICATION SYSTEM AND METHOD OF ASSIGNING COMMUNICATION RESOURCES

Cross-reference to Related Applications

The present application is related to commonly assigned United States Patent Application, attorney docket no. CE03772R, entitled "Layered Wireless Communication System and Method" filed of even date herewith, the disclosure of which is hereby expressly incorporated herein by reference.

Field of the Invention

The present invention relates generally to wireless communication systems, and more particularly, to a wireless communication system having a layered configuration and a method of allocating communication resources in a layered wireless communication system.

Background of the Invention

Wireless communication systems, for example cellular radiotelephone systems, are well known. These systems provide communication services utilizing radio frequency transmission techniques between land based radio transceiver stations, or base stations, and mobile radio transceivers, or mobiles. Each of the base stations and the mobiles thus include a radio transceiver for communicating voice, data, or other information utilizing a communication resource, i.e., a radio link, and a standard communication protocol. For example, several such protocols for cellular radiotelephony are the Narrowband Advanced Mobile Phone System (NAMPS), the Advanced Mobile Phone System (AMPS), the Global System for Mobile Communications (GSM), the Personal Digital Communications (PDC), the United States Digital Cellular (USDC), or the Code Division Multiple Access (CDMA) protocols.

A common feature of these wireless communication systems is that a large geographic area is divided into smaller areas (“cells”), which are serviced by a base station. The use of cells to subdivide the large geographic area permits enhanced geographic coverage with efficient use of radio frequency resources. For example, radio frequency resources assigned to one cell may be reused in cells located a sufficient distance from this cell without the resources interfering. During the design and implementation of a cellular communication system, careful planning is undertaken to assign communication resources to cells to

ensure sufficient capacity, i.e., to assign a sufficient number of resources to handle an anticipated number of calls at a given time within the cell, and to ensure that communication resources assigned to one cell do not cause unacceptable levels of interference in adjacent or neighboring cells.

5 The ever increasing popularity of cellular systems with their users has created a need to increase system capacity. An advantage of the cellular system in providing greater capacity is that cell sizes may be reduced, by limiting the transmission power of the base stations and mobiles, permitting increased reuse of communication resources. Greater reuse of communication resources in a given
10 geographic area equates to increased capacity.

 One type of cellular system utilizing particularly small cell sizes is referred to as a "picocellular" system including very small geographic sized "picocells." Picocellular systems find particularly advantageous use as in-building cellular radiotelephone systems. Implementing wireless communication systems within a
15 building poses numerous problems because of the building topology. The picocellular systems require a high degree of optimization to successfully interact with the surrounding "macrocellular" environment, as well as to provide the highest quality of service to the in-building users. Perhaps the largest optimization effort is due to the installation of the many required base stations, one each for each picocell. Each picocell requires assignment of a broadcast
20 carrier including a broadcast control channel for supplying "coverage" in the picocell, and the assignment of traffic carriers for handling the call traffic within the cells. The broadcast control channel is utilized by the base station and the mobiles to request and establish service, i.e., to make and complete calls. Once
25 service is established, the mobile is assigned a traffic channel resource on which the call is conducted.

 The broadcast control channel is referred to as a dedicated channel. That is, its signal characteristics, e.g., carrier, transmission power, timing, etc., are necessarily fixed. However, fixing certain characteristics of the broadcast control
30 channel, i.e., its carrier and power, limit the potential for reusing this carrier within the cellular communication system. For example, it is known to use frequency hopping techniques in order to provide statistically enhanced carrier reuse. However, with the broadcast carriers fixed for each cell, these carriers are typically unavailable for reuse in the frequency hopping plan. In addition, the
35 transmit power of the broadcast control channel requires substantial geographic

spacing of cells reusing the associated broadcast carrier thus exacerbating the optimization problem particularly in the picocellular environment. The amount a cell size may be reduced is further limited by the time it requires the mobile to acquire the broadcast control carrier. If the cell sizes are too small, the mobile
5 may not be able to adequately acquire a cell's broadcast control carrier before moving into another cell.

In the above-referenced United States Patent Application, it is proposed to provide a system in which certain of the cells in a layered picocell system and/or a layered microcell / macrocell system are designated as "traffic zones" or traffic
10 cells. The traffic cells are not allocated a broadcast control channel. Coverage cells are provided and include a broadcast control channel. The coverage cells are utilized primarily to provide coverage and not to provide capacity. Service requests are received within one of the coverage cells, and a communication resource is preferentially allocated from a traffic cell, if possible, otherwise a
15 communication resource is allocated from the coverage cell.

One reason why a communication resource may not be allocated from a traffic cell is that the mobile's location within the traffic cell may not be sufficiently determined to allow a resource allocation. The system of the above-referenced patent is robust in that should a resource allocation fail, an alternative
20 resource allocation strategy is provided. Still, more efficient utilization of communication resources may be achieved if the traffic cell communication resources are more fully utilized.

One prior proposal for identifying cells from which communication resources may be allocated provides for the cell base station receiver retuning to the specified frequency on the specified time slot that the mobile is assigned. The
25 cell base station then reports the uplink signal strength to a control entity. If any of the cells report a signal level which qualifies to provide service, the control entity will assign a traffic channel resource from this cell to service the mobile. For example, in one approach measurements may be made while the mobile is
30 communicating on a dedicated control channel. This case requires at least one carrier at the cell to be configured with the same dedicated control channel configuration to listen to the mobile on this control channel, either with a dedicated configuration or retuned to the configuration. A second approach is to monitor the random access channel during a channel request. This case requires a
35 timeslot be configured the same as the random access channel. Either of these

proposals will typically require at least two receiver elements and/or fast retuning receivers. Providing additional receiver capability adds not only to the expense of the base station but also to its physical size. For picocellular applications in particular, it is very desirable to keep the size of the base station equipment as small as possible at least for placement and aesthetic reasons, and because of the number of required base stations the cost as low as possible. In picocellular applications specifically, and other applications more generally, redundant or retunable receivers present cost and space penalties.

Thus there is a need for a wireless communication system and a method for assigning communication resource in the wireless communication system which takes full advantage of the statistical capacity enhancement of frequency hopping, provides mobile location determination and does so with low cost, small footprint base stations.

Brief Description of the Drawings

FIG. 1 is a diagram illustrating a layered wireless communication system in accordance with a preferred embodiment of the present invention.

FIG. 2 is a chart illustrating traffic cell resources and coverage cell resources and illustrating an allocation of traffic cell resources in accordance with a preferred embodiment of the present invention.

FIG. 3 is a chart similar to FIG. 2, and further illustrating traffic cell resources and coverage cell resources with a number of active calls.

FIG. 4 is a flow chart illustrating a method of allocating resources in accordance with a preferred embodiment of the present invention.

FIG. 5 is a flow chart further illustrating the method of allocating resources in accordance with a preferred embodiment of the present invention.

Detailed Description of the Preferred Embodiments

The present invention is described in terms of several preferred embodiments directed to layered cellular communication systems. Such systems include in-building picocellular environments as well as a microcell /macrocell environments. It will be appreciated that the present invention will have application apart from the preferred embodiments described herein, and the description is provided merely to illustrate and describe the present invention and it should in no way be taken as limiting of the present invention.

Referring to FIG. 1, wireless communication services are provided in a geographic area 10, utilizing a plurality of cells. The geographic area is preferably an interior and immediate surrounding portions of a building, an area of a city or town, an airport, or any geographic area over which wireless communication services are desired. Coverage of area 10 is provided by a wireless communication system 100 including a coverage cell 102. The primary purpose of coverage cell 102 is to provide coverage and not to provide the required system capacity. It will be further appreciated that additional coverage cells such as shown and described in the above-referenced commonly assigned United States patent application may be provided without departing from the fair scope of the present invention. Wireless communication system 100 further includes "traffic zones" defined by a plurality of traffic cells, individually cell 104, cell 106, cell 108, cell 110 cell 112, cell 114 and cell 116, which are distributed through area 10. Traffic cells 104 - 116 are arranged to provide capacity. In accordance with the present invention, cells 104 - 116 also allow reuse of communication resources, i.e., reuse of the radio frequencies/carriers available for providing wireless communication services. It should also be noted from the outset that communication resource and communication channel are used to refer to a physical link between the base station and the mobile. For example, in a time division multiplexed (TDM) system such as GSM or USDC, a communication channel is one of a number of time slots on a particular carrier. In a code division multiplexed (CDM) system such as PCS or CDMA, a communication channel is a spreading code on a particular carrier. For the TDM system, therefore, the broadcast control channel is a fixed time slot on a fixed carrier within a cell. A traffic channel is one of a plurality of time slots available on one or more traffic channel carriers assigned to a cell and the otherwise available time slots on, for example, the broadcast carrier.

As will be described more fully below, cell 102 includes a broadcast carrier for providing a broadcast communication channel. Each of cells 104 - 116 preferably include only a single traffic channel carrier and do not include a broadcast channel carrier. While presently not preferred due to a size and cost restrictions, it will be appreciated that additional traffic channel carriers may be provided in cells 104 - 116. Additionally, cells 104 - 116 are preferably not provided retuning capability. As is well known, cells 102 - 116 include a suitable base station or base station system at least including a radio frequency transmitter

and receiver and an antenna structure for communicating on its assigned traffic carrier. Furthermore, the respective base stations may be coupled to a base station controller or similar device but are at least coupled to a mobile switching center, which controls the operation of the respective base stations for assigning
5 communication resources. Cell 102 is also arranged to operate at substantially higher power than cells 104 - 116, and accordingly, the relative size of cell 102 is larger than the size of cells 104 - 116. Cells 104 - 116 are thus contained within the coverage area of cell 102, and as used herein, cell 102 defines an upper layer while cells 104 - 116 define a lower layer of wireless communication system 100.
10 Additionally, it will be appreciated that one or more mobile radiotelephones ("mobile") operates within area 10, and particularly, within the coverage area of one or more of cells 102 - 116. For example, a mobile within cell 104 is likewise located within cell 102.

With reference to FIG. 2, five traffic cells, e.g., traffic cells 104 - 110, are
15 respectively allocated carriers, i.e. frequencies, F(1) 120, F(2) 122, F(3) 124 and F(4) 126. Traffic cell 112 is also allocated carrier F(1), designated 128, in a reuse configuration. Each traffic cell 104 - 112 is assigned a single carrier and, as noted, is not provided with carrier/frequency retuning capability. Coverage cell 102 is allocated two carriers, respectively designated carrier 130 and carrier 132,
20 and further includes retuning capability. One of these carriers may be reserved for dedicated use as a dedicated control channel carrier, e.g., the broadcast carrier. It will also be appreciated that coverage cell 102 may be assigned additional carriers without departing from the fair scope of the present invention. Wireless
25 communication system 100 is configured as a TDM system, and therefore, each of carriers 120 - 132 have associated therewith a plurality of time slots designated 0 - 7. In accordance with the preferred embodiments of the present invention, carriers 130 and 132 are arranged to frequency hop among carriers F(1) - F(4), in each of time slots 0 - 7. The frequency hopping sequence within each time slot 0 - 7, and respectively for each of carrier 130 and carrier 132, is illustrated by the legend f_i ,
30 f_j , f_k , f_m . When a timeslot in any of carriers 120 - 132 is allocated to a mobile such designation is indicated using legend 134. When traffic cells 104 - 112 are reporting uplink signal strength for a respective time slot such reporting is indicated using legend 136. As shown in FIG. 2, a single call is active. As will be described, it originated in time slot 0 of carrier 132 of coverage cell 102 and was
35 assigned to time slot 7 of carrier 120. FIG. 3 similarly illustrates several call

assignments to each of traffic cells 104 - 112 as well as to coverage cell 102.

With reference then to FIG. 4, and continued reference to FIG. 2 and FIG. 3, a method 200 of allocating communication resources in accordance with a preferred embodiment of the present invention is shown. Method 200 begins at
5 step 202 with a channel request from a mobile. The channel request is received within coverage cell 102 and a coverage cell communication resource is assigned. Preferably, the lowest level time slot on a coverage carrier is assigned. As shown in FIG. 2, with time slot 0 being available on either carrier 130 or carrier 132, time slot 0 of carrier 132 is assigned to the mobile. Coverage cell 102, and/or a control
10 entity, informs each of traffic cells 104 - 112 of the frequency hopping sequence and that a call is assigned in a particular time slot, namely time slot 0 of carrier 132. As shown in FIG. 2, with a call assigned in time slot 0 of coverage carrier 132 each of traffic cells 104 - 112 monitors at the appropriate time, i.e., during the appropriate time slot and when carrier 132 is tuned to the traffic cell carrier in
15 accordance with the hopping sequence, and measures signal strength of an uplink signal from the mobile, step 206. Of course some other signal characteristic may also or additionally be measured without departing from the fair scope of the present invention.

If a traffic cell reports a sufficiently high signal strength, thus indicating
20 that the mobile is located within the traffic cell, step 208, the highest available time slot on the traffic cell carrier is assigned to the mobile, step 210. The assignment is graphically illustrated by arrow 138 in FIG. 2 with the mobile being assigned time slot 7 of carrier 120. If a suitable traffic cell is not identified, each of the traffic cells continue to monitor during the appropriate time periods and to
25 report the mobile signal strength to coverage cell 102 or the control entity.

With the assignment made, the communication resource assigned in coverage cell 102 is released, step 212. Also, because the mobile is now assigned to time slot 7 of carrier 120, the hopping sequence is modified, step 214. To avoid creating an interference condition due to the coverage cell frequency
30 hopping, when a mobile is assigned a communication resource in a traffic cell the traffic cell carrier is removed from the hopping sequence for that time slot. This is illustrated in FIG. 2 by the extended arrow 140, and the modification of the associated hopping sequence for time slot 7 to omit carrier 120, i.e., f_1 .

Referring to FIG. 3, a plurality of mobiles are assigned communication
35 resources on carriers 120, 122 and 128. Additionally, mobiles are assigned to

time slots 0 of coverage cell carriers 130 and 132 and to time slot 1 of coverage carrier 132. Accordingly, each of the traffic cells monitor in time slot 0 and time slot 1 at the appropriate time and report accordingly signal strength. Additionally, the hopping sequences for time slots 4 - 7 are modified accordingly given the assignment of mobiles therein.

When a mobile assigned a traffic cell communication resource completes its call, that communication resource becomes available for use. It is desirable from a traffic channel packing standpoint to keep assigned resources in the traffic cells in the highest level time slots and assigned resources in the coverage cell in the lowest level time slots. This provides several advantages, including it ensures that the lower time slots are available for the required monitoring thus maximizing the number of monitoring traffic cells. It also takes full advantage of frequency hopping in the coverage cell by providing the longest possible hopping sequence in the lowest time slots. With reference to FIG. 5, method 200 further includes a background processing portion 216. Background processing portion 216 runs continuously to "clean up" communication resource assignments as mobiles complete calls within the traffic cells and begins at step 218. Upon detecting the release of a traffic cell communication resource, step 220, a check is made to determine if assignments to higher time slots should be performed, step 222. If not, the clean up process returns to step 218. Otherwise, communication resources are reassigned to move mobiles into the higher level time slots within the traffic cells, step 224.

As discussed and shown in FIG. 2 and FIG. 3, carriers are preferably reused within the traffic cells. This is possible because the traffic cells operate at reduced power as compared to the coverage cell carriers and interference between traffic cells is avoided. As noted above, to further reduce the potential for interference, the coverage cell hopping sequence is accordingly modified when a traffic cell channel assignment is made. Additionally, the coverage cell may be segmented and the traffic cells oriented to reduce potential interference between traffic cells, and likewise, between other cells in the remainder of the communication system, which is contemplated to contain additional cells, coverage cells and the like.

Of course, in the foregoing discussion, the coverage cell must be capable of synthesizing each of the traffic cell carrier frequencies and the coverage cell carrier frequency. If the coverage cell is not capable of retuning fast enough, it is

preferred to reserve lower time slots for measurement purposes until the traffic load reaches a point that the lower time slots are required. The above described clean up process 216 assists in ensuring the lower time slots remain available for measurement. Then, if the retune period is for example one time slot, time slots 0
5 - 2 may be reserved for measurement. Time slot 0 is used to retune from a first frequency to a second frequency, time slot 1 is used to measure the signal strength of the second frequency, and time slot 2 is used to retune back to the first frequency or another frequency to monitor and so on.

An alternate preferred embodiment of the present invention is particularly
10 well suited for use where in fact the traffic cells include receivers capable of fast retuning. Such traffic cells may include multiple receivers wherein a first is tuned to the traffic channel carrier frequency and a second is tuned and/or retuned, as necessary, to monitor broadcast control channel carrier frequencies. Switching between the two receivers provides a fast retune capability. Still, in other
15 embodiments, a single receiver may be adapted for retuning quickly enough to monitor a first frequency in a first time slot and a second frequency in a second time slot. In either embodiment, the traffic cell may "listen" on a broadcast control channel frequency at appropriate times, as informed by the coverage cell or other control entity, and on the traffic channel frequency during time slots on
20 which active calls are assigned. Implementations of such receivers, either multiple receivers and/or fast retuning single receivers, are known in the art.

Given such a configuration for the traffic cells, all time slots within the traffic cells are configured as traffic channels, and consistent with the preferred embodiments of the present invention, the traffic cells do not include a broadcast
25 control channel. All calls will originate within coverage cell 102, and all calls are now first assigned a traffic channel resource within coverage area 102. After the call is assigned in coverage area 102, a request is made to each of the traffic cells 104 - 116, providing carrier frequency, time slot and sub-channel information of the assigned call. Each of the traffic cells begin "listening" for the call on the
30 frequency and the time slot. A check may be made to first determine if the time slot is idle within the particular traffic cell. Listening occurs by retuning the traffic cell receiver, either actual retuning of the traffic cell receiver and/or switching between multiple receivers, to the particular frequency during the particular time slot, measuring signal strength of the mobile signal, and reporting
35 the measured signal strength to the coverage cell and/or control entity. Of course,

other signal characteristics may be measured and reported. If a suitable traffic cell is identified, i.e., a traffic cell reports sufficiently strong signal strength from the mobile, a reassignment of the call to a traffic channel from the traffic cell is made.

5 It is contemplated that reassignments of calls within traffic cells to other time slots may be made in order to free time slots allowing traffic cell monitoring. It is further contemplated that traffic cell to traffic cell reassignments may be made using a similar technique wherein traffic cells with idle time slots monitor calls assigned to traffic channels in other traffic cells to determine an alternate suitable traffic cell. If an alternate suitable traffic cell is identified, an alternate
10 traffic cell traffic channel is assigned from the alternate suitable traffic cell.

As with the other embodiments of the present invention, it is again preferred to maintain call assignments in the coverage cell in the lowest time slots while biasing calls in the traffic cells to higher time slots to ensure the time slots will be idle in the traffic cells. This results in maximizing the number of traffic
15 cells monitoring the coverage cell carrier. Also, in this embodiment of the invention since the coverage cell carrier does not hop through the traffic cell carriers interference introduced to the external network is minimized.

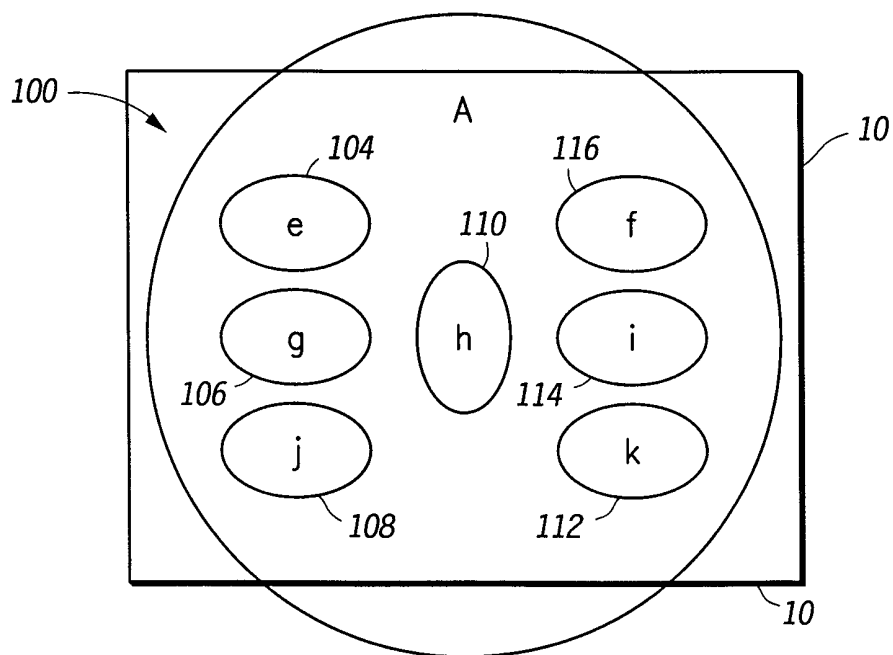
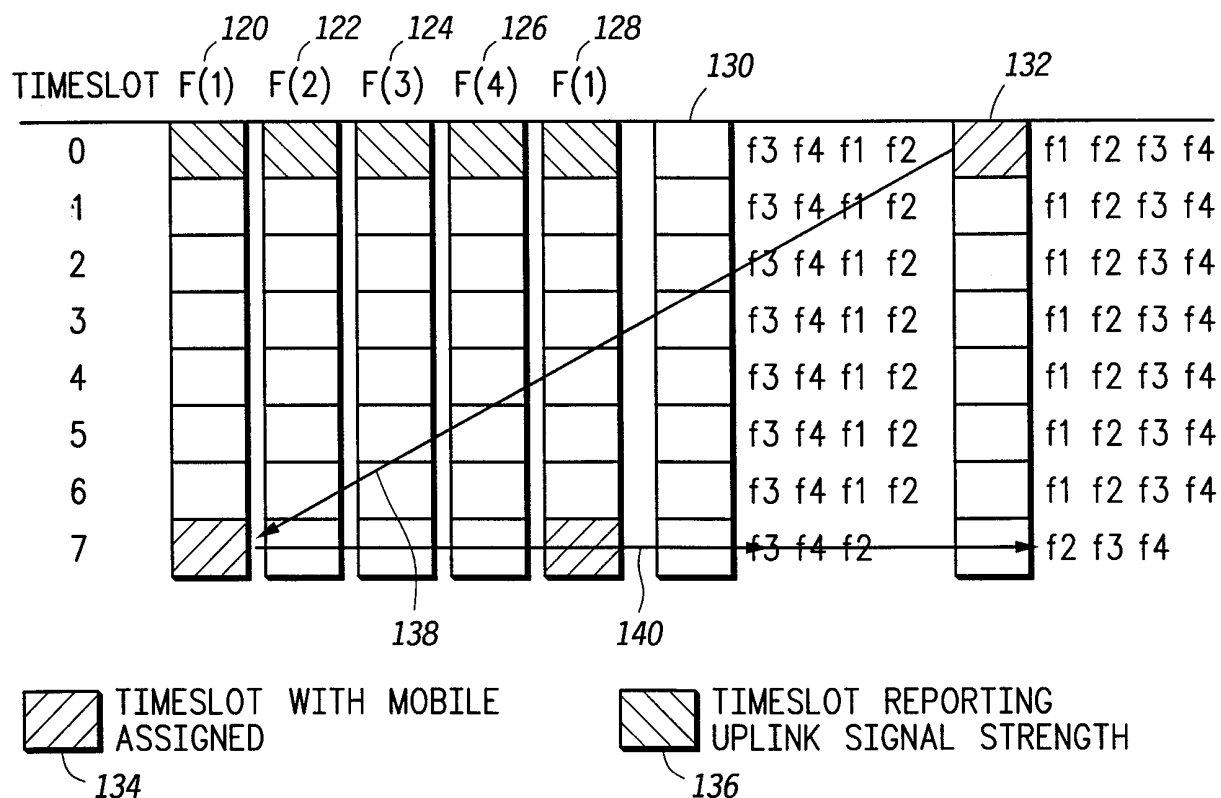
As is appreciated from the foregoing discussion the requirement of providing a broadcast channel in each cell is eliminated as is the requirement of
20 retuning traffic cells in order to perform resource allocation. Still further, the capacity enhancing capability of frequency hopping is advantageously employed. Many additional changes and modifications could be made to the invention without departing from the fair scope and spirit thereof. The scope of some changes is discussed above. The scope of others will become apparent from the
25 appended claims.

We claim:

1. A wireless communication system comprising:
5 a coverage cell arranged to receive an uplink signal from a mobile on a plurality of traffic channels in accordance with a hopping sequence;
a plurality of traffic cells, each traffic cell assigned a portion of the traffic channels and arranged to monitor the uplink mobile signal in its portion of the traffic channels in accordance with the hopping sequence; and
10 whereby, a traffic channel is assigned to the mobile from one of the plurality of traffic cells reporting a sufficient characteristic of the uplink signal.
2. The wireless communication system of claim 1, wherein the traffic channel comprises one of a time slot and a spreading code.
- 15 3. The wireless communication system of claim 1, wherein the traffic channel comprises a highest time slot of a plurality time slots.
4. The wireless communication system of claim 1 comprising one of a time division multiplexed system and a code division multiplexed system.
- 20 5. A method for assigning communication resource in a wireless communication system comprising:
receiving within a coverage cell a channel request from a mobile located in
25 the coverage cell;
assigning a coverage communication resource to the mobile within the coverage cell, the coverage communication resource subject to a hopping sequence;
monitoring in each of a plurality of traffic cells, and in accordance with the
30 hopping sequence, an uplink signal from the mobile on the coverage communication resource;
identifying a traffic cell from the plurality of traffic cells; and
assigning a traffic communication resource from the traffic cell to the
mobile.
- 35 6. The method of claim 5, the step of monitoring comprising measuring a signal strength of the uplink signal.
- 40 7. The method of claim 5, each traffic cell being assigned one of a plurality of traffic carriers, the hopping sequence comprising a frequency hopping sequence between each of the plurality of traffic carriers, and the step of monitoring comprising:
monitoring within a traffic cell the uplink signal during a hopping
45 sequence period associated with the one of a plurality of traffic carriers assigned

to the traffic cell.

8. A method for assigning communication resources in a wireless communication system comprising the steps of:
- 5 receiving within a coverage cell a channel request from a mobile located in the coverage cell;
assigning a coverage cell traffic channel to the mobile within the coverage cell;
providing carrier and time slot information associated with the coverage
10 cell traffic channel to each of a plurality of traffic cells located substantially within the coverage cell;
for each traffic cell, listening on the coverage cell traffic channel and measuring a signal characteristic;
reporting the signal characteristic measured at each traffic cell to a control
15 entity;
determining a suitable traffic cell; and
reassigning the mobile to a traffic cell traffic channel from the suitable traffic cell.
- 20 9. The method of claim 8, wherein the step of for each traffic cell, listening on the coverage area traffic channel and measuring a signal characteristic further comprises determining a time slot availability within the traffic cell.
- 25 10. The method of claim 8, further comprising the step of reassigning an active traffic channel assignment to provide a time slot availability.

**FIG. 1****FIG. 2**

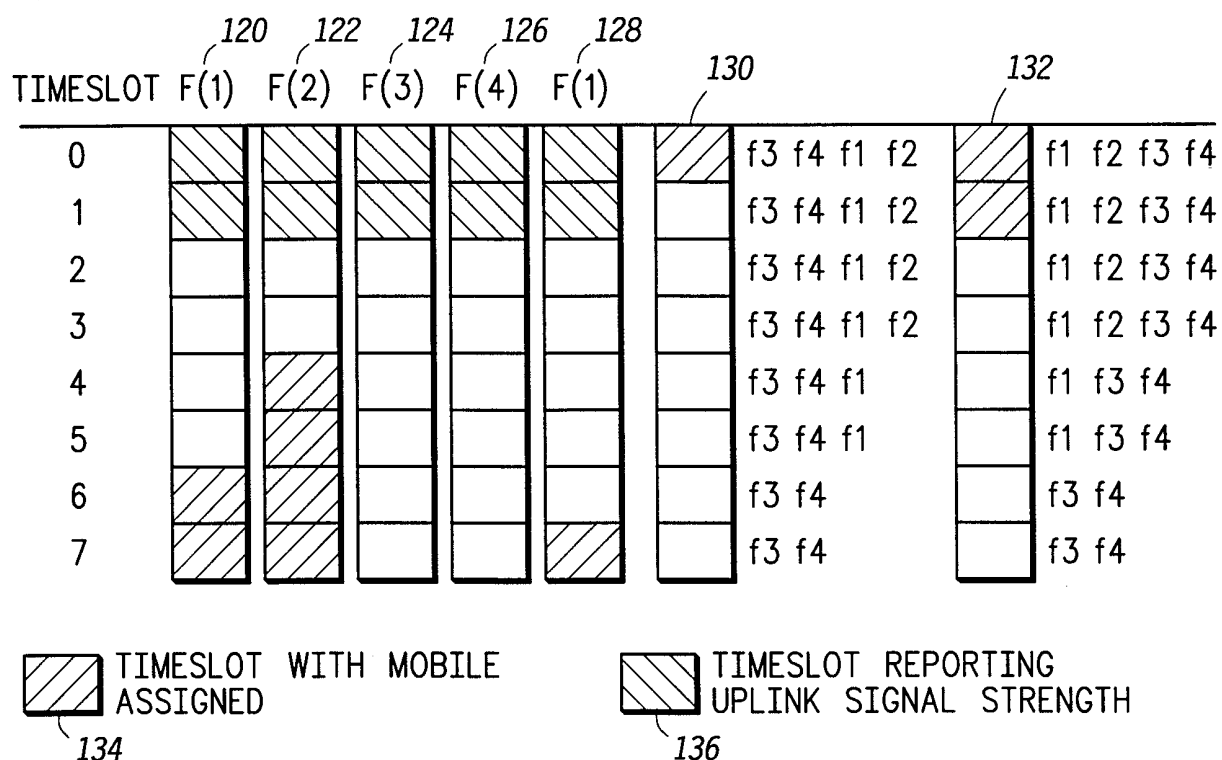


FIG. 3

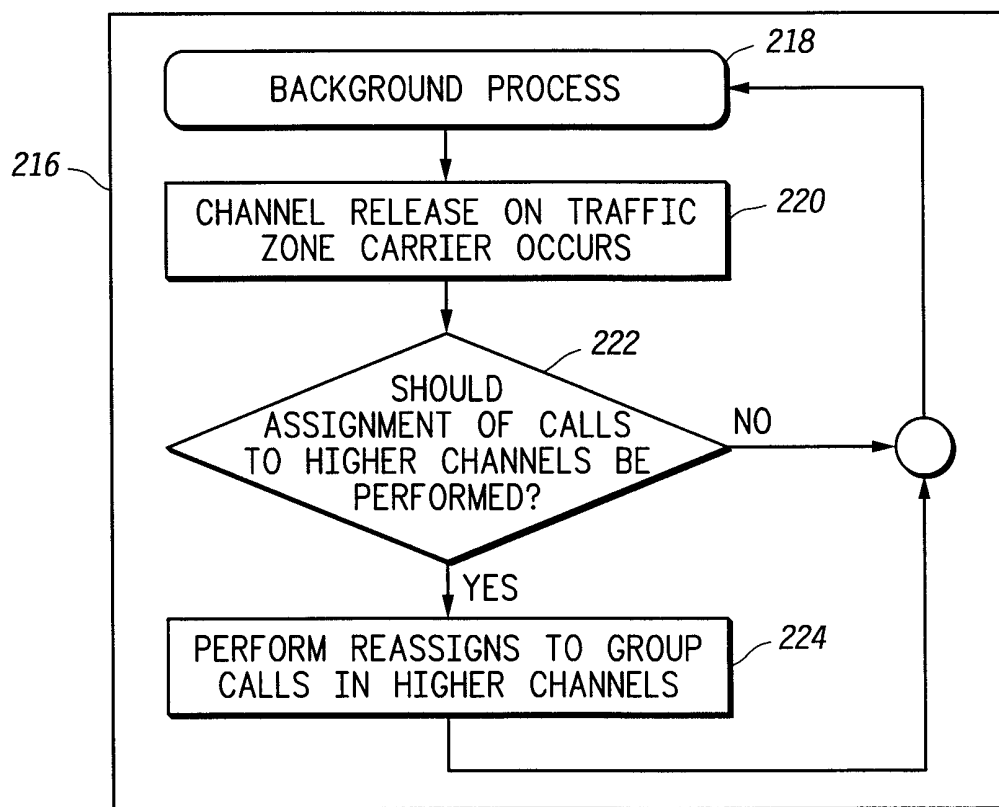
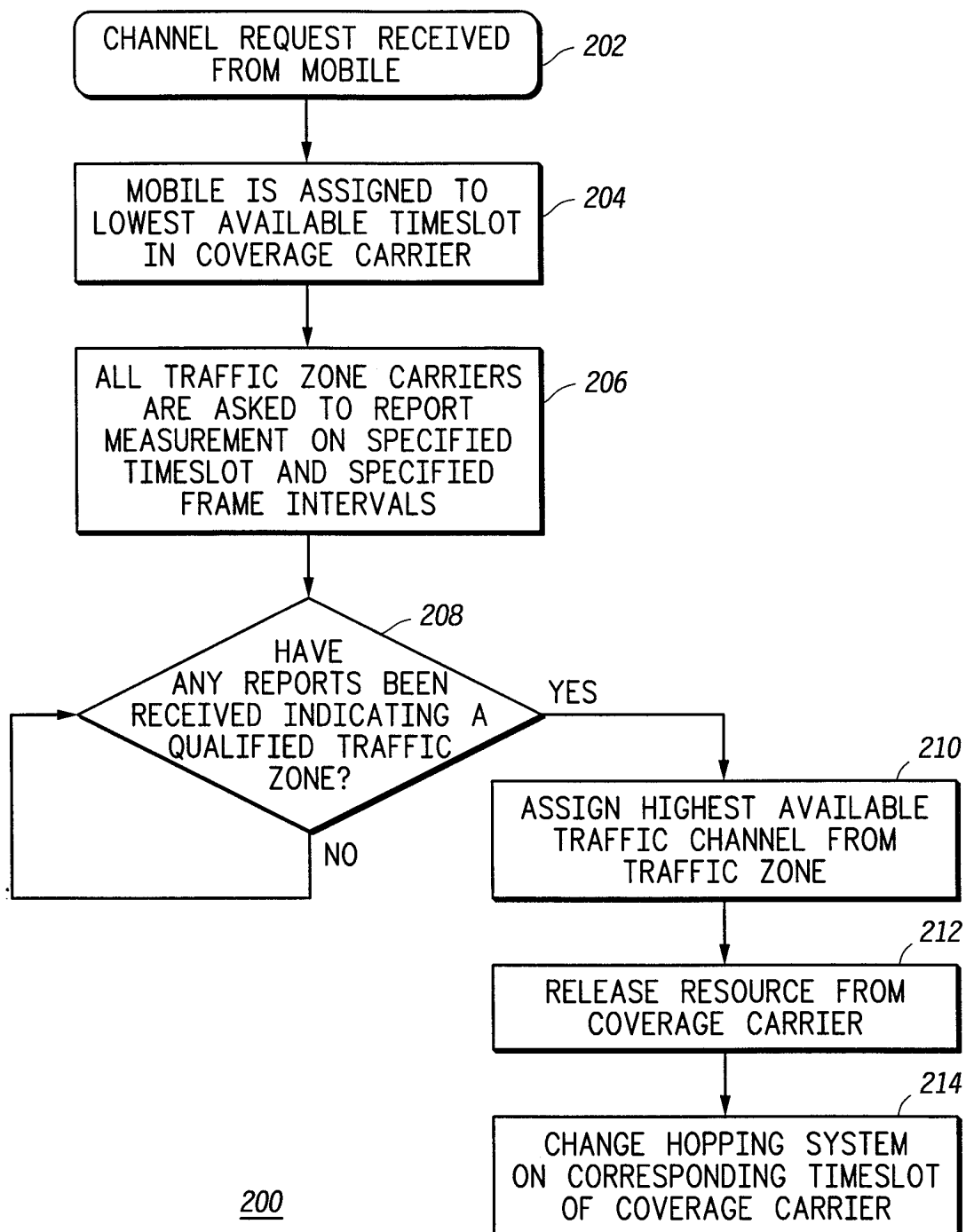


FIG. 5

**FIG. 4**

INTERNATIONAL SEARCH REPORT

 International application No.
PCT/US99/12452

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) : H04Q 7/36 US CL : 455/449, 450 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) U.S. : 455/449, 450, 443, 444, 452, 453, 434, 511, 513, 515, 524, 525, 62; 370/330, 337, 436, 437 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched NONE Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) APS		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,357,559 A (KALLIN et al.) 18 October 1994, col. 2, lines 57-63, col. 3, lines 15-24, col. 4, line 11 through col. 5, line 56.	1-10
Y	US 5,581,548 A (UGLAND et al.) 03 December 1996, Figs. 4, 5, 7.	1-10
A	US 5,546,443 A (RAITH et al.) 13 August 1996, entire document.	1-10
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents "A" document defining the general state of the art which is not considered to be of particular relevance "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 12 JULY 1999	Date of mailing of the international search report 17 AUG 1999	
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer LESTER KINCAID <i>James R. Matthews</i> Telephone No. (703) 306-3016	