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CA 2257208 C 2012/12/18

(11)(21) **2 257 208**

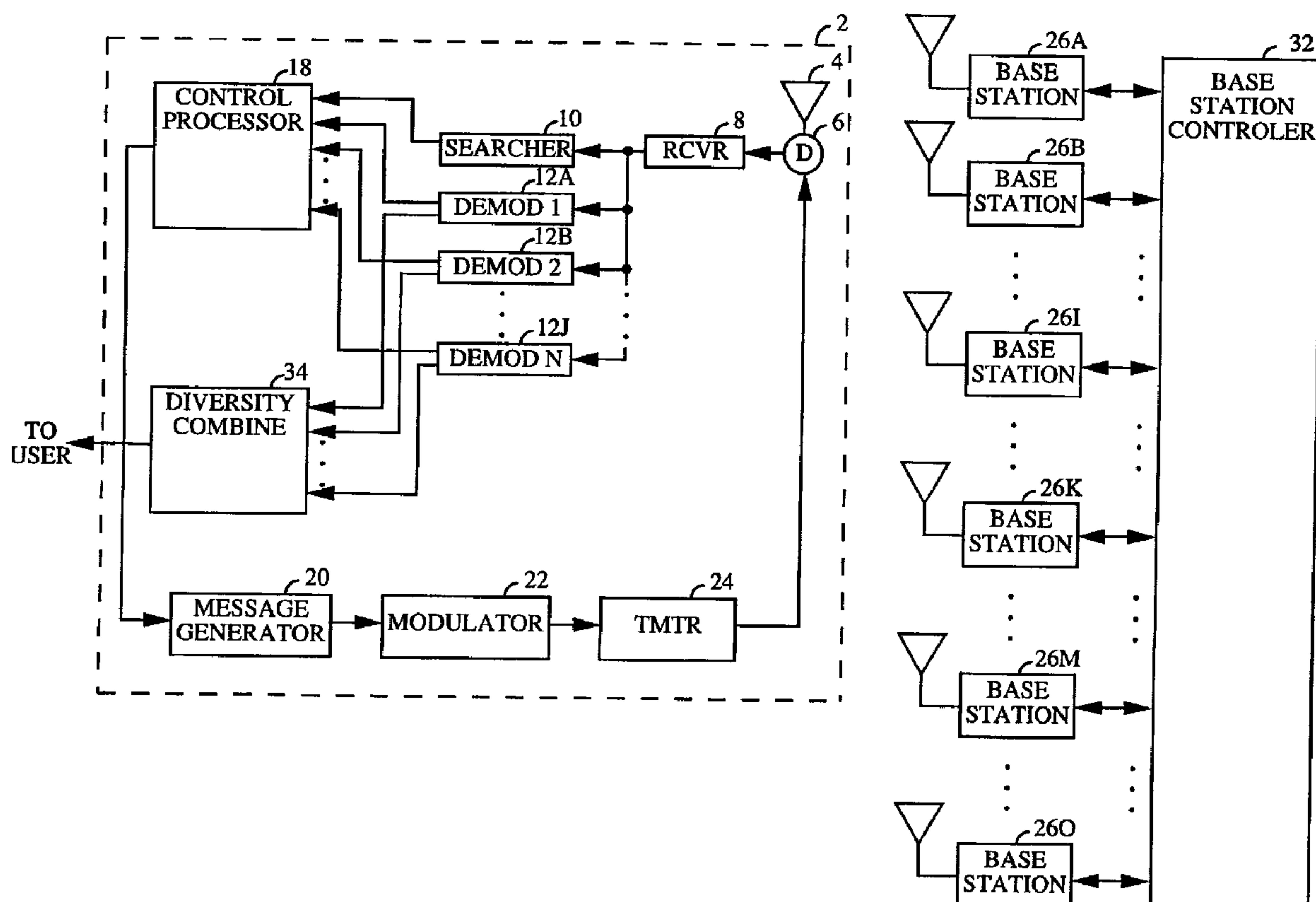
(12) **BREVET CANADIEN  
CANADIAN PATENT**

(13) **C**

(86) Date de dépôt PCT/PCT Filing Date: 1997/06/06  
(87) Date publication PCT/PCT Publication Date: 1997/12/11  
(45) Date de délivrance/Issue Date: 2012/12/18  
(85) Entrée phase nationale/National Entry: 1998/12/04  
(86) N° demande PCT/PCT Application No.: US 1997/009903  
(87) N° publication PCT/PCT Publication No.: 1997/047154  
(30) Priorité/Priority: 1996/06/07 (US08/660,436)

(51) Cl.Int./Int.Cl. *H04W 36/08* (2009.01),  
*H04B 7/26* (2006.01)  
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(54) Titre : PROCEDE ET APPAREIL POUR LE TRANSFERT AU REPOS DANS UN SYSTEME DE COMMUNICATION A ACCESS MULTIPLES  
(54) Title: METHOD AND APPARATUS FOR PERFORMING IDLE HANDOFF IN A MULTIPLE ACCESS COMMUNICATION SYSTEM



(57) Abrégé/Abstract:

A method and apparatus which permits handoffs while the mobile station (2) is in the system access state. This is achieved by providing for channel assignment messages to be sent over the paging channel of a plurality of base stations (26), which increases

**(57) Abrégé(suite)/Abstract(continued):**

the probability of one of the messages getting through. In addition, this assures the mobile station (2) will be able to handoff to a different base station (26) and have a traffic channel allocated to it on the new base station (26) without delay. In addition, a method and apparatus which permits the mobile station (2) to be directly assigned into a soft handoff state upon traffic channel assignment.

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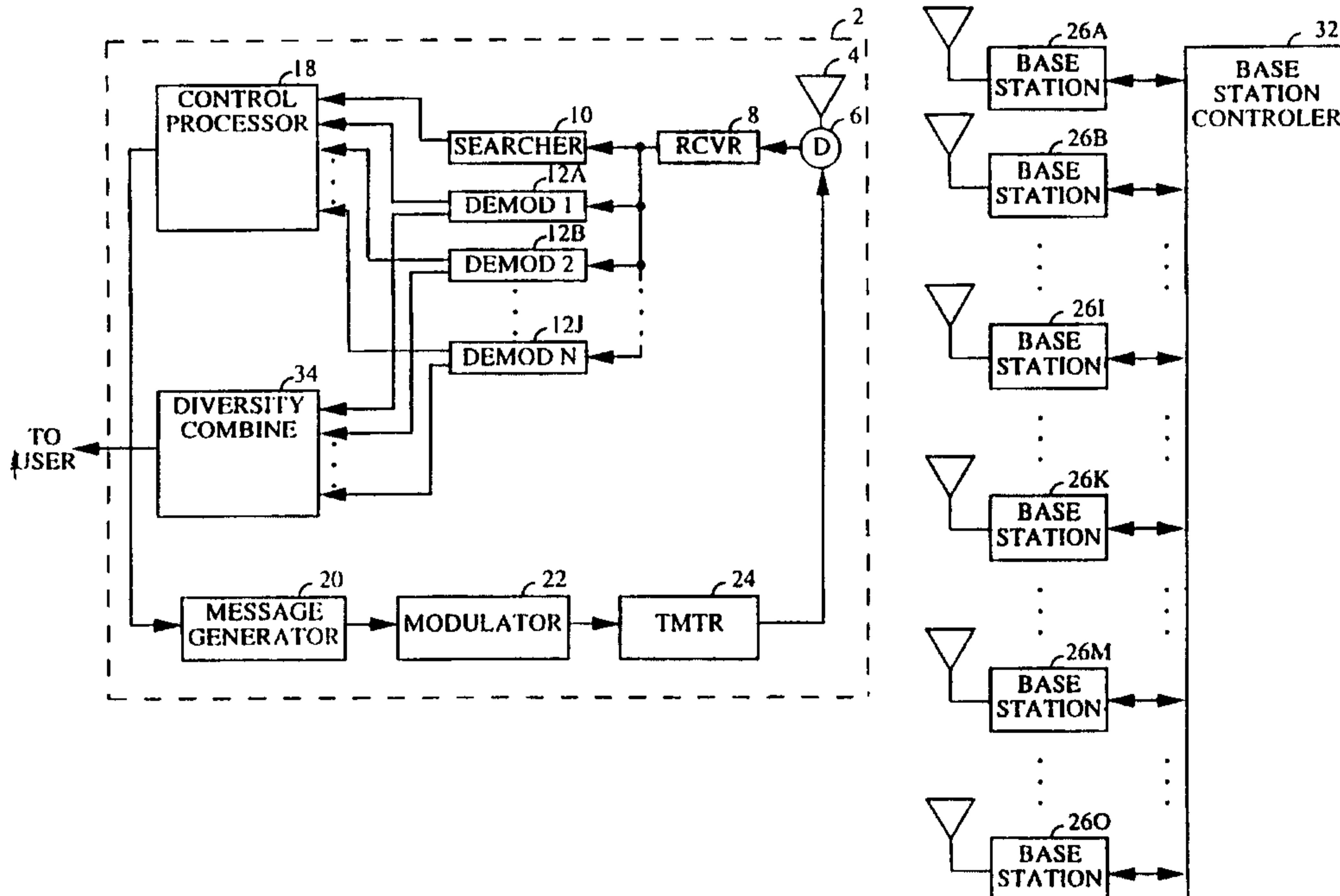
PCT

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International Bureau

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

(51) International Patent Classification <sup>6</sup> : H04Q 7/38, 7/36, H04B 7/26	A1	(11) International Publication Number: <b>WO 97/47154</b> (43) International Publication Date: 11 December 1997 (11.12.97)
(21) International Application Number: PCT/US97/09903		(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, UZ, VN, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).
(22) International Filing Date: 6 June 1997 (06.06.97)		
(30) Priority Data: 660,436 7 June 1996 (07.06.96) US		
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(72) Inventor: TIEDEMANN, Edward, G., Jr.; 4350 Bromfield Avenue, San Diego, CA 92121 (US).		<b>Published</b> <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>
(74) Agents: MILLER, Russell, B. et al.; Qualcomm Incorporated, 6455 Lusk Boulevard, San Diego, CA 92121 (US).		

(54) Title: METHOD AND APPARATUS FOR PERFORMING IDLE HANDOFF IN A MULTIPLE ACCESS COMMUNICATION SYSTEM



## (57) Abstract

A method and apparatus which permits handoffs while the mobile station (2) is in the system access state. This is achieved by providing for channel assignment messages to be sent over the paging channel of a plurality of base stations (26), which increases the probability of one of the messages getting through. In addition, this assures the mobile station (2) will be able to handoff to a different base station (26) and have a traffic channel allocated to it on the new base station (26) without delay. In addition, a method and apparatus which permits the mobile station (2) to be directly assigned into a soft handoff state upon traffic channel assignment.

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# METHOD AND APPARATUS FOR PERFORMING IDLE HANDOFF IN A MULTIPLE ACCESS COMMUNICATION SYSTEM

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## BACKGROUND OF THE INVENTION

10        **I. Field of the Invention**

The present invention relates to communication systems. More particularly, the present invention relates to a novel and improved method and apparatus for performing idle handoff in a multiple access communication system. In addition, the present invention relates to an improved method for assigning a traffic channel in a multiple access communication system. The invention also relates to a method for 15 reducing the number of required handoffs which occur while a mobile station is queued and waiting for a traffic channel in a multiple access communications system.

20        **II. Description of the Related Art**

Typically, communications systems prohibit handoffs while the mobile station is in a system access state. The system access state is the state in which communications are initiated either by the mobile station by means of transmissions over an access channel or by a base station by means 25 of transmissions over a paging channel. In the exemplary embodiment, messages are sent in accordance with a code division multiple access (CDMA) communication format, which is disclosed in detail in U.S. Patent No. 4,901,307 entitled "Spread Spectrum Multiple Access Communication System Using Satellite or Terrestrial Repeaters" and U.S. Patent No. 30 5,103,459 entitled "System and Method for Generating Waveforms in a CDMA Cellular Telephone System", both of which are assigned to the assignee of the present invention. The use of paging and access channels for call initiation is well known in the art and is detailed in TIA/EIA Interim Standard IS-95-A, entitled "Mobile Station-Base Station Compatibility Standard for Dual 35 Mode Wideband Spread Spectrum Cellular System".

One of the characteristics of CDMA systems is that the same frequency is reused in every cell. Diversity combining is a method by which a receiver receiving signals carrying the same information, combines those signals which are propagated through different paths to provide an improved

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estimate of the transmitted signal. A receiver design for taking advantage of the diversity signals carrying the same information but traveling through different propagation paths or transmitted by different transmitters is described in detail in U.S. Patent No. 5,109,390 entitled "Diversity Receiver 5 in a CDMA Cellular Telephone System", assigned to the assignee of the present invention.

Soft hand-off is a method by which a mobile station moving from one cell into another receives information from the base stations serving the two or more cells of the boundary area as long as the mobile station is 10 located near the boundary. The signals which are sent by the base stations are combined in the receiver of the mobile station by the diversity combining method mentioned above. A method and system for providing soft hand-off in a CDMA communication system, where a plurality of base stations are in communication with a mobile station at or near cell 15 boundaries is disclosed in U.S. Patent No. 5,101,501 entitled "Method and System for Providing a Soft Handoff in a CDMA Cellular Telephone System", and U.S. Patent No. 5,267,261, entitled "Mobile Station Assisted Soft Handoff in a CDMA Cellular Communication System," both of which are assigned to the assignee of the present invention. Hard handoff is, in contrast to 20 soft handoff, where a mobile station passing from one cell to another is dropped by the cell being exited prior to being picked up by the cell being entered.

The use of the same frequency in every cell and the use of soft handoff results in high CDMA system capacity. The reuse of the same frequency in the neighboring cell causes rather rapid changes in the forward 25 link signal to noise ratio near cell boundaries. This is because the cell being received by the mobile station may fade and the neighboring cell may increase in strength (anti-fade).

Generally, when the mobile station is receiving two cells, the received traffic channel energy per spreading chip to total spectral noise density for 30 the signal transmitted by cell 1 is given by equation (1) below:

$$\frac{E_{c-1}}{I_0} = \frac{\frac{E_{c-1}}{I_{or}}}{\frac{I_{or1}}{\hat{I}_{c,r1}} + \frac{I_{or2}}{\hat{I}_{or1}} + 1} \quad (1)$$

And the received traffic channel energy per spreading chip to total spectral noise density for the signal transmitted by cell 2 is given by equation (2) below:

$$5 \quad \frac{E_c}{I_o} 2 = \frac{\frac{E_c}{I_o} 2}{\frac{I_{oc}}{\hat{I}_{or2}} + \frac{\hat{I}_{or1}}{\hat{I}_{or2}} + 1} \quad (2)$$

where in equations (1) and (2)

10  $I_{oc}$  is the total thermal noise,

$\frac{E_c}{I_o} 1, \frac{E_c}{I_o} 2$  are the fraction of traffic channel power transmitted by cell 1 and cell 2 respectively, and

15  $\hat{I}_{or1}, \hat{I}_{or2}$  are the fraction of traffic channel power received at the mobile station from cell 1 and cell 2 respectively.

Consider  $I_{oc}$  to be small relative to  $\hat{I}_{or1}$  and  $\hat{I}_{or2}$ . When cell 1 fades relative to cell 2  $\hat{I}_{or1}$  becomes small relative to  $\hat{I}_{or2}$  (the ratio  $\frac{\hat{I}_{or2}}{\hat{I}_{or1}}$  becomes large). Thus,  $\frac{E_c}{I_o} 1$  becomes small. If the mobile station is not in soft handoff, then 20 this change in signal to noise ratio can cause problems. However, if the mobile station is in soft handoff with the neighboring cell, then the change in signal to noise ratio is not a problem because the mobile station is performing diversity combining of the forward traffic channels from both cells. While the first path given by  $\frac{E_c}{I_o} 1$  becomes small, the second path 25 given by  $\frac{E_c}{I_o} 2$  becomes large. Thus, fading by one cell increases the signal to noise ratio from the other cell.

Paging is a method of sending information to a mobile station indicating the initiation of mobile terminated service or to receive an indication of new overhead information. A method for initiating a base 30 station initiated call is described in detail in U.S. Patent No. 5,392,287, entitled "APPARATUS AND METHOD FOR REDUCING POWER CONSUMPTION IN A MOBILE COMMUNICATIONS RECEIVER" and in

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U.S. Patent No. 5,509,015. The present invention is equally applicable to mobile station initiated calls, the method for which is described in detail in U.S. Patent No. 5,544,196.

In a slotted paging system, a mobile station monitors the paging channel for a short predetermined interval of time and then does not monitor the paging channel again until the next predetermined time interval. In IS-95-A this method of periodically monitoring the paging channel is called slotted mode and the mobile station may monitor the paging channel for 80 ms. every 1.28 seconds. The period between monitoring intervals can be made longer as desired by the user. Before each predesignated time slot in which a mobile station may be paged, the mobile station wakes up (becomes active) and resynchronizes or improves its synchronization with the base station. The mobile station then monitors for pages or other messages in the slot. After some interval, the mobile station can become inactive and not monitor the paging channel until just before the next assigned slot.

Prior to the time when a mobile station is actively communicating traffic information with the mobile communication system and after the time when the mobile station has achieved timing synchronization with the communication system, the mobile station is in a state referred to as the idle state. In the idle state, the mobile station can receive messages, receive an incoming call, initiate a call, initiate registration, or initiate message transmission. When in the mobile station idle state, IS-95-A permits the mobile station to perform an idle handoff at any time other than the interval that the mobile station is required to be monitoring its assigned slot.

However, when the mobile station originates a call or receives a page, the mobile station enters the system access state to send an origination message or a page response message. While in the system access state, an IS-95-A mobile station does not operate in the slotted mode. This is called non-slotted operation. Specifically, the mobile station continually monitors the paging channel until directed by the base station to a different state or an error condition occurs permitting the mobile station to exit the system access state. The exemplary embodiment will be described in the context of the

origination operation and origination message, but the concepts directly apply to the mobile terminated call process and page response message. After the mobile station sends the origination message and receives an acknowledgment, the mobile station waits for a channel assignment 5 message, which indicates upon which channel traffic communications from the base station to the mobile station will be conducted.

Upon receipt of the channel assignment message, the mobile station tunes to the allocated traffic channel, receives information on the forward traffic channel, and begins to transmit on the reverse traffic channel. The 10 forward traffic channel is the channel upon which information from the base station to the mobile station is sent and the reverse traffic channel is the traffic channel upon which information from the mobile station to the base station is sent.

The interval between the time that the mobile station sends the 15 origination message and the time at which the mobile station receives the channel assignment message depends upon the implementation of the individual infrastructure vendor. It can range from less than one-half of a second to several seconds. Until the time that the mobile station receives the channel assignment message, the mobile station is in the system access 20 state.

The paging channel typically does not support soft handoff. Thus the issues of fading previously described occur. These are typically counteracted by having the radiated power of the paging channel higher than the traffic channel. Since one paging channel can handle the call origination and 25 termination of many traffic channels, the loss in capacity by this higher power is minimal. In order to support soft handoff on the paging channel, the system would essentially have to send the same information on the paging channel in all cells, thus dramatically reducing the overall capacity of the paging channel.

30 While in the idle state, the mobile station is permitted to perform handoffs. Typically, the mobile station performs a handoff whenever the received signal level from one cell gets sufficiently above another cell. This idle handoff is typically done before the mobile station begins monitoring the slot. However, there can be cases in which the mobile station is unable 35 to choose the correct cell before the slot begins and the mobile station must continue to monitor the existing cell. While in the system access state, the mobile station is not permitted to perform idle handoffs.

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However, when the mobile station is in the system access state there can be cases in which the change in signal to noise ratio,  $\frac{E_s}{I_o}$ , changes so fast that the message error rate becomes so high that mobile station cannot correctly receive the signaling messages sent on the paging channel. As a 5 result, the mobile station may not receive the channel assignment message. This means that the call origination was not successful. IS-95-A permits the mobile station to exit the system access state and return to the mobile station idle state, if it has not received any paging channel messages for one second. This means that the mobile station does not receive the channel assignment 10 message and the call origination was unsuccessful.

A similar problem exists when the mobile station is first assigned to the traffic channel. IS-95-A permits only a single base station to be assigned to the mobile station. If another cell is strong or becomes stronger, the mobile station may not be able to receive the forward traffic channel 15 successfully. As a result, the call may drop. The problem is that the mobile station is assigned to a traffic channel with a single active set member and is not in soft handoff.

Under IS-95-A, in order for the mobile station to enter into soft handoff, the following steps must occur. First, the mobile station detects 20 that the pilot of another base station is above a predetermined energy threshold value. Second, the mobile station sends a pilot strength measurement message. Third, the infrastructure sets up the handoff, and the infrastructure sends the handoff direction message to the mobile station. Depending upon the circumstances and the implementation, this may take 25 from a few hundred milliseconds to considerably more than one second.

Thus, soft handoff is generally supported in IS-95-A systems. However, soft handoff is not supported when the mobile station is in the system access state. Thus, there is a need for a system which permits 30 soft handoff while the mobile station is in the system access state to provide increased reliability in the system access process and other benefits.

## SUMMARY OF THE INVENTION

The present invention describes several modifications which can 35 improve operation on the paging and access channels. The first feature of the present invention is that it permits handoffs while the mobile station is in the system access state. This permits the mobile station to receive a base station whose signal-to-noise ratio is high so that the message error rate is

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low. This avoids having dropped call setups due to the inability to receive the paging channel. By permitting handoff, the base station needs to send the channel assignment message over the paging channel via a plurality 5 of base stations.

A second feature of the present invention is that it permits the infrastructure to know which base stations should send the channel assignment message to the mobile station. In addition, this assures the mobile station will 10 be able to handoff to a different base station and have a traffic channel allocated to it on the new base station without delay.

A third feature of the present invention is that it permits the infrastructure to know which base stations 15 should be in the mobile station's active set before the mobile station is assigned to the traffic channel. The active set is a set of base stations which are providing the strongest signals to the mobile station at a given time. This permits the infrastructure to determine, before the 20 mobile station is assigned to the traffic channel, whether there are sufficient resources to place the mobile station into soft handoff. This is useful because a mobile station near the cell boundary may immediately request to be placed into soft handoff after it is assigned to the traffic 25 channel. Furthermore, this minimizes call drops due to the rapid changes in signal-to-noise ratio mentioned previously.

In addition, coupled with the third feature of the present invention is the inclusion of multiple active set members in the channel assignment message, permitting the 30 mobile station to be assigned to a traffic channel in a soft handoff state.

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Finally the features presented above provide special utility in the priority access and channel allocation (PACA) operation which provides for users to gain access to limited communication resources in accordance with designated user priorities.

5 While the invention is described in terms of a CDMA system, the invention is applicable to any cellular or satellite communications system.

According to a first broad aspect, the invention 10 provides for a method used in a mobile communication system including a mobile station capable of communicating with a plurality of base stations, said method providing a channel assignment message to said mobile station, comprising the steps of: transmitting from a first base station to said mobile 15 station, wherein said mobile station is in a system access state, a list of base stations to which said mobile station is permitted to perform idle handoff; transmitting a channel assignment message from at least two of said plurality of base stations in said list of base stations to said mobile station; 20 and performing an idle handoff of said mobile station from said first base station to a second base station in the list of base stations, said idle handoff occurring during said mobile station's access of said communication system.

According to another aspect of the present invention, 25 there is provided a method used in a mobile communication system including a mobile station capable of communicating with a plurality of base stations, said method providing a channel assignment message to said mobile station, comprising the steps of: transmitting from a first base station to said mobile

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station, wherein said mobile station is in a system access state, a list of base stations to which said mobile station is permitted to perform idle handoff; transmitting a channel assignment message from at least two of said plurality of base stations in said list of base stations to said mobile station; and performing an idle handoff of said mobile station from said first base station to a second base station, said second base station being one of said at least two of said plurality of base stations in the list of base stations, said idle handoff occurring during said mobile station's access of said communication system.

According to another aspect of the present invention, there is provided a method for performing idle handoff comprising the steps of: measuring, at a mobile station in an idle state, received signal energies from a plurality of base stations; compiling, at said mobile station, a first set of base stations with received energies exceeding a predetermined threshold; determining a second set of said plurality of base stations with resources to provide communications to said mobile station; and performing an idle handoff by the mobile station in a system access state to a base station common to said first set and said second set.

According to still another aspect of the present invention, there is provided a method for transitioning a mobile station from an idle state to a soft handoff, comprising: transmitting a list containing identifiers of base stations to which the mobile station in a system access state is permitted to perform an idle handoff; transitioning the mobile station from an idle state to a soft handoff with a subset of the base stations identified in the list; and

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transmitting a traffic channel assignment message indicating traffic channel allocated by each base station of the subset of base stations identified in the list.

According to yet another aspect of the present invention, there is provided a method for transitioning a mobile station from an idle state to a soft handoff, comprising: measuring signal energies received from a plurality of base stations at a mobile station in an idle state; compiling a first list containing identifiers of base stations with received signal energies exceeding a predetermined threshold at the mobile station; determining a second list containing identifiers of base stations of the first list to which the mobile station in a system access state is allowed to perform an idle handoff; transitioning the mobile station from an idle state to a soft handoff with a subset of the base stations identified by the second list; and transmitting a traffic channel assignment message indicating traffic channel allocated by each base station identified by the second list.

According to a further aspect of the present invention, there is provided an apparatus for transitioning a mobile station from an idle state to a soft handoff, comprising: a plurality of base stations configured to: transmit a list containing identifiers of base stations to which the mobile station in a system access state is permitted to perform an idle handoff; and a mobile station configured to: transition from an idle state to a soft handoff with a subset of base stations identified in the list, wherein said plurality of base stations are further configured to: transmit a traffic channel assignment message indicating traffic channel allocated

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by each base station of the subset of base stations identified in the list.

According to yet a further aspect of the present invention, there is provided an apparatus for transitioning a mobile station from an idle state to a soft handoff, comprising: a processor; and a storage medium coupled to the processor and containing a set of instructions executable by the processor to: determine a first list containing identifiers of base stations with resources to provide communications to the mobile station; determine a second list containing identifiers of base stations of the first list to which the mobile station in a system access state is allowed to perform an idle handoff; and cause transition of the mobile station from an idle state to a soft handoff with a subset of base stations identified by the second list, wherein said processor causes transition of the mobile station from an idle state to a soft handoff with a subset of base stations identified by the second list by executing a set of instructions to: cause transmission of a traffic channel assignment message indicating traffic channel allocated by each base station identified in the second list.

According to one aspect of the present invention, there is provided an apparatus for performing idle handoff, comprising: means for measuring, at a mobile station in an idle state, received signal energies from a plurality of base stations; means for compiling, at the mobile station, a first set of the base stations with received energies exceeding a predetermined threshold; means for receiving a second set indicating the base stations with resources to provide communications to the mobile station; and means for performing

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an idle handoff by the mobile station in a system access state to a base station common to the first set and the second set.

According to another aspect of the present invention, there is provided an apparatus for performing idle handoff, 5 comprising: a searcher configured to measure received signal energies from a plurality of base stations; and a control processor configured to: compile a first set of the base stations with received energies exceeding a predetermined threshold; receive a second set indicating the base stations 10 with resources to provide communications to the apparatus; and perform an idle handoff in a system access state to a base station common to the first set and the second set.

According to another aspect of the present invention, there is provided a mobile station, comprising: an antenna 15 configured to receive signals; a control processor configured to: compile a first set of the base stations with received energies exceeding a predetermined threshold; receive a second set indicating the base stations with resources to provide communications to the apparatus; and perform an idle handoff in 20 a system access state to a base station common to the first set and the second set.

According to another aspect of the present invention, there is provided a computer-readable medium storing a program for performing idle handoff which comprises computer readable 25 instructions executable to: measure, at a mobile station in an idle state, received signal energies from a plurality of base stations; compile, at the mobile station, a first set of the base stations with received energies exceeding a predetermined threshold; receive, while the mobile station is in a system 30 access state, a second set of the base stations with resources

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to provide communications to the mobile station; and perform an idle handoff by the mobile station in the system access state to a base station common to the first set and the second set.

**BRIEF DESCRIPTION OF THE DRAWINGS**

5        The features, objects, and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify correspondingly throughout and wherein:

10       FIG. 1 is a block diagram of a mobile station communicating with a base station of a group of base stations;

FIG. 2 shows a layout of cells corresponding to base stations; and FIG. 3 shows the pilot  $E_c/I_0$  for a mobile station moving between two base stations.

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## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, upon power-up, mobile station 2 enters the system determination substate. A system determination processor (not 10 shown) selects a system upon which to perform an acquisition attempt and provides the necessary frequency information to receiver (RCVR) 8. Although not separately shown, the system determination processor could be implemented within control processor 18. Control processor 18 can be implemented in a microprocessor or microcontroller operating under 15 program control stored in memory.

In the exemplary embodiment, after having selected a system for system determination, mobile station 2 moves into the pilot acquisition substate in which it attempts to demodulate a pilot signal based on the acquisition parameters retrieved in the system determination substate.

20 In the exemplary embodiment, mobile station 2 attempts to acquire a CDMA pilot signal in accordance with the acquisition parameters. Signals (if present) are received at antenna 4 and passed through duplexer 6 to receiver 8. Receiver 8 down converts, amplifies the received signal, converts the analog signal to a digital representation and passes the signal to 25 searcher 10. Searcher 10 attempts to acquire a pilot signal by testing PN offsets. A PN offset is tested by demodulating the signal in accordance with the PN offset hypothesis and measuring the signal energy of the demodulated signal. Design and implementation of searcher hardware for 30 CDMA acquisition is known in the art and is described in detail in aforementioned U.S. Patent No. 5,109,390.

When searcher 10 detects a pilot signal with energy above a predetermined threshold value, mobile station 2 enters the Sync channel acquisition substate and attempts acquisition of the Sync channel. Typically, the Sync channel as broadcast by the base stations includes basic system 35 information such as the system identification (SID) and the network identification (NID), but most importantly provides timing information to mobile station 2. Mobile station 2 adjusts its timing in accordance with the Sync channel information and then enters the mobile station idle state.

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Upon successful acquisition of the Sync channel, mobile station 2 begins to monitor the paging channel in accordance with a predetermined paging format. Mobile station 2 demodulates a signal based on a predetermined Walsh sequence that is reserved for paging channel transmissions. For example say that the pilot signal that was acquired was transmitted by base station 26a, then mobile station 2 monitors the paging channel in accordance with timing information provided by the Sync channel and using a predetermined Walsh sequence. Base station 26a intermittently transmits overhead information on the paging channel.

10 In the exemplary embodiment, the overhead information includes a list known as the neighbor list. In IS-95-A, this list is provided to the mobile station 2 by base stations 26a-26n in the Neighbor List Message. This list is referred to herein as NGHBR\_LIST\_BASE. NGHBR\_LIST\_BASE is a list of base stations in the vicinity of base station 26a which may provide strong signals to mobile station 2 and thus are candidates for idle handoff. In the exemplary embodiment base stations 26a-26k in FIG. 1 correspond to cells 36a-36k in FIG. 2, respectively. Thus, base station 26a provides coverage to cell 36a.

20 Referring to FIG. 1, in the exemplary embodiment base stations 26b-26k are in NGHBR\_LIST\_BASE transmitted to mobile station 2. It should be noted that the present invention is equally applicable to the case where some of the base stations in the neighbor list are not controlled by the same base station controller (BSC) 32. Base station controller 32 is responsible for providing information between the base stations 26a-26o, for 25 selectively providing information from a main telephone switching office (MTSO) (not shown) to base stations 26a-26o and for providing the base stations 26a-26o with internally generated messages.

30 If the pilot signal acquired was transmitted by base station 26a, after receiving the overhead information, mobile station 2 may register with base station 26a by transmitting its mobile identification number (MIN) to base station 26a. Mobile station 2 then enters the idle state and monitors its allocated paging channel in the slotted paging mode after successful registration with base station 26a. If registration is not performed, the mobile station also enters the idle state and monitors, in the slotted paging mode, its allocated paging channel which is transmitted by base station 26a.

35 In slotted paging mode, base station 26a transmits any paging or signaling information directed to mobile station 2 at predetermined time intervals called time slots. In the exemplary embodiment, the time slots and paging channel are determined in accordance with a hashing function

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of the mobile identification number (MIN), which upon registration is known to base station 26a and mobile station 2.

In some embodiments of the present invention, base station 26a transmits to mobile station 2 a list of base stations to which mobile station 2 is permitted to 5 perform idle handoff while in the system access state. This list is referred to herein as LIST\_BASE. Base stations in LIST\_BASE are typically a subset of the base stations in NGHBR\_LIST\_BASE and would typically be using the same base station controller (BSC). So for example in FIG. 1 NGHBR\_LIST\_BASE may consist of all the base stations 26b-26k, but the 10 LIST\_BASE may consist of the subset of base stations 26b, 26c (not shown), 26g (not shown), and 26h (not shown).

The following description is in terms of a call origination and the discussion centers around the origination message. The same procedures apply to call termination with the page response message substituted for the 15 origination message.

When mobile station 2 originates a call via modulator 22 and TMTR 24, message generator 20 generates an origination message and transmits that message on the access channel. Message generator 20 can be implemented in a microprocessor programmed to carry out the functions described. Although illustrated as a 20 separate element message generator 20 could be implemented within control processor 18. That message is received and demodulated by base station 26a which the mobile station is currently monitoring. In response to receiving the origination message, each of the base stations in LIST\_BASE 26a-26i transmits a channel assignment message indicating a traffic channel 25 upon which communications will be conducted. It should be noted that typically the Walsh channel used for communications with a first base station in LIST\_BASE will not be the same Walsh channel used for communications with a second base station in LIST\_BASE. Because a plurality of base stations are sending the channel assignment message, the 30 mobile station 2 is free to perform an idle handoff while in the System Access state and after sending the origination message to any base station which is in LIST\_BASE and still be able to receive the channel assignment message.

In an alternative embodiment, mobile station 2 sends the origination 35 message to base station 26a and then waits for an acknowledgment of the origination message. Until the mobile station receives the acknowledgment, the mobile station is not permitted to perform a handoff. However, after the mobile station receives the acknowledgment, the mobile station is free to perform an idle handoff to any base station in LIST\_BASE.

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In another alternative embodiment, mobile station 2 sends the origination message using the procedures described in IS-95-A as described in detail in U.S. Patent No. 5,673,259. If an acknowledgment is not received from base station 26a within a predetermined timeout period, the mobile station increases its transmit power and attempts to send the message again. If mobile station 2 is unable to receive an acknowledgment from base station 26a after a certain number of attempts and another base station, base station for example 26b, is stronger, mobile station 2 is permitted to perform an idle handoff to base station 26b and restart the transmission of the origination message.

10 In one embodiment, each of base stations in LIST\_BASE transmits a channel assignment message only indicating a traffic channel for communication with that particular base station. In an alternative embodiment, each of base stations 26a-26i in LIST\_BASE transmits an identical Channel Assignment Message that indicates not only the traffic channel to be used for communications with that particular base station but also indicates the traffic channel to be used for communications with all base stations in LIST\_BASE. This would require the base stations 26a-26i in LIST\_BASE communicate the available traffic channels through base station controller 32. By providing channel assignment messages from a plurality of base stations, the success rate of the channel assignment process is greatly enhanced.

The above process permits the infrastructure to set up soft handoff and include more than one member of the Active Set in the Channel Assignment Message. Instead of first communicating with one base station and then moving into soft hand-off, it is thus possible for mobile station 2 to come up immediately in a soft handoff state and immediately receive traffic communication from two or more base stations. This speeds up the process of getting mobile station 2 into soft handoff, which improves performance of the system and minimizes call drops due to a low forward traffic channel signal to noise ratio.

In one embodiment of this process, the base station sets up soft handoff with all base stations in LIST\_BASE. In an alternative embodiment of this process, the base station sets up soft handoff with a subset of base stations in LIST\_BASE and sends the information in the channel assignment message necessary for mobile station 2 to enter into soft handoff.

This information includes the identities of this subset of base stations. In IS-95-A, the pilot PN offset identifies the base station.

The paging messages sent by base stations 26a-26i are received at antenna 4 of mobile station 2. The received message is then provided through duplexer 6 to receiver 8 where the received signal is down converted and amplified. The down converted messages are provided to demodulators 12a-12j which demodulate the received messages. Control processor 18 in accordance with information from searcher 10, selects the paging channel or channels that mobile station 2 will demodulate the incoming paging channel data. In one embodiment, demodulators 12a-12j monitor only one base station.

Searcher 10 in conjunction with control processor 18 determines that another base station is better. Then control processor 18 has the demodulators begin to demodulate the received signal from the other base station. Because mobile station 2 will receive an assignment message from more than one base station, mobile station 2 is free to perform an idle handoff while in the system access state. In another embodiment, mobile station 2 monitors all base stations in LIST\_BASE and demodulates signals identified in LIST\_BASE.

In a preferred embodiment, LIST\_BASE is not provided separately from the Neighbor List Message, but rather an indication is provided indicating which members of the neighbor list (NGHBR\_LIST\_BASE) are members of LIST\_BASE along with the Neighbor List Message. In the exemplary embodiment, one of the reserved values in the overhead message is used to indicate which of the systems specified in the Neighbor List Message are in LIST\_BASE. In the exemplary embodiment of an IS-95-A base station, the reserved values in the overhead message used to specify the members of LIST\_BASE are NGHBR\_CONFIG values in the Neighbor List Message.

In the exemplary embodiment, the IS-95-A Neighbor List Message includes the pilot PN offsets for base stations in the NGHBR\_LIST\_BASE and an indication of which base stations in the Neighbor List Message are in LIST\_BASE. The pilot PN sequence for the current base station is transmitted to provide a reference for mobile station 2 with which it can use to identify the other base station PN offsets.

As described above, all base stations in LIST\_BASE would be required to send channel assignment messages to mobile station 2. While this would permit mobile station 2 to handoff and thus increase the success rate of the

channel assignment process, it requires additional Paging Channel capacity for all call setups.

A modification of this procedure that would reduce the impact to the paging channel capacity is to have mobile station 2 send a list of pilots which 5 are above a predetermined power threshold. This list is referred to herein as LIST\_MOBILE. In one embodiment, searcher 10 demodulates pilot signals with a preference to the PN offsets of the base stations in the LIST\_BASE followed by the PN offsets of base stations in NGHBR\_LIST\_BASE and then 10 in accordance with the remaining PN offsets. A method for providing an optimized search prioritization is described in the aforementioned U.S. Patent No. 5,267,261.

In the exemplary embodiment, searcher 10 demodulates the received signals in accordance with a pilot PN offset and measures the energy of the demodulated pilot. The energy values are provided to control processor 18. 15 Control processor 18 compares the energy of the demodulated signal with a threshold value and compiles a list of PN offsets which are above that threshold. This list is referred to as LIST\_MOBILE. Once LIST\_MOBILE has been compiled it is transmitted on the access channel and is received by base station 26a which mobile station 2 is monitoring. In the exemplary 20 embodiment, LIST\_MOBILE is included in the origination message.

In another embodiment, LIST\_MOBILE is received by more than one of base stations 26a-26o. LIST\_MOBILE is provided to base station controller 32. In the preferred embodiment, the threshold used by mobile station 2 to determine whether to include a base station in LIST\_MOBILE is 25 sent as part of the overhead messages by base stations 26a-26o. In the preferred embodiment, this threshold could be the T\_ADD value sent in the IS-95-A System Parameter Message. This T\_ADD value is currently used by the IS-95-A mobile stations to determine whether to send the IS-95-A Pilot Strength Measurement Message on the traffic channel to the base station 30 indicating that the mobile station has detected a pilot exceeding T\_ADD.

FIG 3. illustrates the  $E_c/I_0$  for the IS-95-A pilot channel broadcast by base stations 26a and 26b as mobile station 2 moves away from base station 26a towards base station 26b. When mobile station 2 is fully within the coverage of base station 26a as indicated by region 38, the pilot channel of 35 base station 26b is below the T\_ADD level. Similarly, when mobile station 2 is fully within the coverage of base station 26b as indicated by region 41, the pilot channel of base station 26a is below the T\_ADD level. When mobile station 2 is in region 38, it does not report, in the origination message, base

station 26b. Similarly, when mobile station 2 is in region 41, it does not report, in the origination message, base station 26a.

When mobile station 2 is in region 39, the pilot  $E_c/I_0$  for base station 26b is above T\_ADD and the mobile station reports 26b in the origination message. Similarly, when mobile station 2 is in region 40, the pilot  $E_c/I_0$  for base station 26a is above T\_ADD and the mobile station reports 26a in the origination message. The preferred embodiment uses  $E_c/I_0$  as given in IS-95-A for these measures; however, alternative measures of signal strength or signal-to-noise ratio which are well known in the art are equally applicable.

In the preferred embodiment, mobile station 2 would be permitted to perform an idle handoff only to those base stations in both LIST\_MOBILE and LIST\_BASE. Call the set of base stations in both lists LIST\_BOTH. This has two advantages. First, the infrastructure need only send the Channel Assignment Message in those base stations identified by the mobile station as possible candidates for an idle handoff and which the mobile station is permitted to handoff. This is the set of base stations is given in LIST\_BOTH. This will significantly reduce the additional messaging that is required. Second, LIST\_MOBILE provides a list of pilots above T\_ADD to base station controller 32, which permits the infrastructure to identify which base stations should be a member of the mobile station's Active Set. Thus, if the base station controller 32 desires to set up soft handoff when the mobile station is assigned to a traffic channel, it only needs to set up soft handoff with those base stations in LIST\_MOBILE.

In an alternative embodiment, mobile station 2 sends to the base station in its origination message those base stations in LIST\_BOTH. This reduces the amount of information which needs to be sent from mobile station 2.

Furthermore, it permits the infrastructure to set up soft handoff and include more than one member of the Active Set in the Channel Assignment Message. The Channel Assignment Message would include the pilot PN offsets of base stations which are in the Active Set. It is possible for the mobile station 2 to come up immediately in a soft handoff state and immediately receive traffic communication from two or more base stations, instead of first communicating with one base station and then moving into soft hand-off which may not be possible due to capacity or other limitations.

For example, if mobile station 2 is in cell 36a near the boundary with cell 36b at location 37 as shown in FIG. 2, then LIST\_MOBILE will identify the pilot PN offsets of base station 26b. The channel assignment message

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that will be transmitted by both base station 26a and 26b will identify a traffic channel for use by mobile station 2 for dedicated communications between base stations 26a and 26b and mobile station 2. At least one of demodulators 12a-12j will be tuned to receive traffic channel information from base stations 26a and another one of demodulators 12a-12j will be tuned to receive traffic channel information from base stations 26b. A plurality of demodulators 12a-12j will begin demodulating the traffic channel signals transmitted by base stations 26a and 26b. The demodulated signals will be provided to diversity combiner 34 which combines the received signals to provide an improved estimate of the transmitted data.

There are several other items which are important to the present invention. The first is that mobile station 2 may not be allowed to perform the idle handoff until it receives the acknowledgment to a transmitted message or the timeout for receiving the acknowledgment has expired. This is to permit mobile station 2 to receive the acknowledgment to its access channel probes. It also permits the base station 26a to which the mobile station is sending its access channel probes to generate the acknowledgment rather than the acknowledgment being generated by base station controller 32. This has the advantage of reducing delay, thus making the call setup process faster. Furthermore, if mobile station 2 is in the System Access State and does perform an idle handoff after the acknowledgment timeout has expired, mobile station 2 must restart the Access Channel probe transmission procedures. This would be the same as if mobile station 2 transmitted a new origination message.

In an alternative embodiment, mobile station 2 may perform the idle handoff to base stations in LIST\_BASE before receiving the acknowledgment. However, this means that all base stations in LIST\_BASE would need to send the acknowledgment and thus base station controller 32 would need to be involved in generating the acknowledgments. In an modification of this alternative embodiment, the mobile station 2 may perform the idle handoff to base stations in LIST\_MOBILE before receiving the acknowledgment. Similarly, this means that all base stations in LIST\_MOBILE would need to send the acknowledgment and thus base station controller 32 would need to be involved in generating the acknowledgments.

In a preferred embodiment, the present invention provides for the contingency that the channel assignment message was transmitted by base station 26a but not received by mobile station 2. Base station 26a may have received the Origination Message, from mobile station 2, but mobile

station 2 may not have received the channel assignment message acknowledging the receipt of the Origination Message from base station 26a. Even absent receipt of the acknowledgment message, mobile station 2 may perform the idle handoff to, for example, base station 26b.

5       Base station 26b may be sending the Channel Assignment Message to mobile station 2, while the mobile station 2 is retransmitting the Origination Message. In the exemplary embodiment when an acknowledgment message is sent, an indication of which message is being acknowledged accompanies it. Mobile station 2 ignores the Channel

10      Assignment Message unless the indicator corresponds to the most recently sent Origination Message. The present invention presents several ways to correct this problem. An obvious one is to have the base station 26b use the same acknowledgment indicator as was in the Origination Message received by base station 26a. This can be done by passing the acknowledgment

15      indicator values from base station 26a to base station 26b through base station controller 32. In an alternative embodiment, mobile station 2 can stop transmitting an access probe if it receives the Channel Assignment Message and tune to the channel specified by the Channel Assignment Message.

20      In an improved embodiment, the Paging Channel configuration of all base stations to which mobile station 2 is allowed to handoff (base stations in LIST\_BASE) are the same. Base stations not supporting these capabilities would not be included in LIST\_BASE.

      The above scheme can also be used to support Priority Access and

25      Channel Allocation (PACA). The PACA feature is well known in the art and is described in detail in "TIA/EIA/IS-53-A Cellular Features Description". When PACA is invoked, mobile station 2 is given priority over other mobile stations in obtaining a Traffic Channel when a Traffic Channel is not available. Specifically, mobile station 2 sends an Origination

30      Message containing the PACA feature code and the dialed number. If a Traffic Channel is immediately available, mobile station 2 is assigned to the Traffic Channel. If a Traffic Channel is not immediately available and mobile station 2 is authorized to use PACA, the base station monitoring mobile station 2, say base station 26a, places mobile station 2's request into a

35      PACA queue. Alternatively, this PACA queue can be managed by base station controller 32. The position in the queue depends upon the priority of the PACA request and the age of the request. When a Traffic Channel becomes available, the request at the head of the PACA queue is assigned to the Traffic Channel.

When the mobile station 2's request is in a PACA queue, mobile station 2 may be sent periodic messages informing the user of mobile station 2 of the queue status. One issue with PACA is that the infrastructure needs to know the cell which mobile station 2 is currently using in order to 5 determine whether the channel is free. With most systems, this implies that mobile station 2 must register or resend the Origination Message every time mobile station 2 performs an idle handoff. Due to the abruptness of transitions between CDMA base stations, mobile station 2 may register or resend the Origination Message several times while crossing the boundary 10 between base stations. A second consideration with CDMA is that mobile station 2 may need to be placed into soft handoff soon after it is assigned to a Traffic Channel. Unless resources are available in multiple base stations to support the call, the assignment may not be successful.

With the modified Origination Message described above, mobile 15 station 2 indicates other base stations which should be in the mobile station's Active Set, the set of base stations from which mobile station 2 has detected strong pilot signals. In one embodiment, mobile station 2 sends LIST\_MOBILE and the base station determines LIST\_BOTH. In another embodiment, mobile station 2 sends LIST\_BOTH. This permits the 20 infrastructure to determine whether resources are free in all base stations needed for the PACA call. In order to reduce the rate of sending the Origination Message, the base stations in LIST\_BOTH are those which the mobile station can move without having to resend the Origination Message. When this feature is invoked, the infrastructure needs to send the queue 25 status information in all base stations in LIST\_BOTH. If mobile station 2 moves out of the coverage of the base stations in LIST\_BOTH, mobile station 2 resends the Origination Message.

The previous description of the preferred embodiments is provided to enable any person skilled in the art to make or use the present invention. 30 The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the 35 embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

**I CLAIM:**

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CLAIMS:

1. A method used in a mobile communication system including a mobile station capable of communicating with a plurality of base stations, said method providing a channel assignment message to said mobile station, comprising the steps of:

transmitting from a first base station to said mobile station, wherein said mobile station is in a system access state, a list of base stations to which said mobile station is permitted to perform idle handoff;

transmitting a channel assignment message from at least two of said plurality of base stations in said list of base stations to said mobile station; and

performing an idle handoff of said mobile station from said first base station to a second base station, said second base station being one of said at least two of said plurality of base stations in the list of base stations, said idle handoff occurring during said mobile station's access of said communication system.

20 2. The method recited in claim 1 wherein said list of base stations includes a list of active base stations, wherein an active base station is a base station to which said mobile station can only perform an idle handoff when the base station is designated.

25 3. The method recited in claim 2, wherein said list of base stations is not transmitted to said mobile station via a traffic channel.

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4. The method recited in claim 2, wherein said list of base stations is transmitted to said mobile station via an access or paging channel.

5. A method for performing idle handoff comprising the 5 steps of:

measuring, at a mobile station in an idle state, received signal energies from a plurality of base stations;

compiling, at said mobile station, a first set of base stations with received energies exceeding a predetermined 10 threshold;

determining a second set of said plurality of base stations with resources to provide communications to said mobile station; and

15 performing an idle handoff by the mobile station in a system access state to a base station common to said first set and said second set.

6. The method of claim 5 further comprising the step of transmitting a message indicative of said second set of base stations to said mobile station.

20 7. The method of claim 6 wherein said transmitting a message indicative of said second set of base stations to said mobile station comprises:

transmitting a message indicative of said second set of base stations from a single base station.

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8. The method of claim 6 wherein said transmitting a message indicative of said second set of base stations to said mobile station comprises:

transmitting a message indicative of said second set  
5 of base stations from two or more of said plurality of base  
stations.

9. The method of claim 6 further comprising:

transmitting a message indicative of the base  
stations in common with said first set of base stations and  
10 said second set of base stations from said mobile station.

10. The method of claim 5 further comprising transmitting a message indicative of said first set of base stations from said mobile station.

11. The method of claim 10 further comprising the step of  
15 transmitting a message indicative of the base stations in  
common with said first set of base stations and said second set  
of base stations.

12. The method of claim 11 wherein said message  
indicative of the base stations in common with said first set  
20 of base stations and said second set of base stations is  
transmitted from a single base station.

13. The method of claim 11 wherein said message  
indicative of the base stations in common with said first set  
of base stations and said second set of base stations is  
25 transmitted from two or more of said plurality of base  
stations.

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14. The method of claim 13 wherein said two or more of said plurality of base stations are the base stations in common with said first set of base stations and said second set of base stations.

5 15. A method for transitioning a mobile station from an idle state to a soft handoff, comprising:

transmitting a list containing identifiers of base stations to which the mobile station in a system access state is permitted to perform an idle handoff;

10 transitioning the mobile station from an idle state to a soft handoff with a subset of the base stations identified in the list; and

15 transmitting a traffic channel assignment message indicating traffic channel allocated by each base station of the subset of base stations identified in the list.

16. The method as claimed in claim 15 wherein said transmitting a traffic channel assignment message indicating traffic channel allocated by each base station of the subset of base station identified in the list comprises:

20 transmitting a traffic channel assignment message from each base station identified in the list.

17. The method as claimed in claim 15 wherein said transmitting a traffic channel assignment message indicating traffic channel allocated by each base station of the subset of base station comprises:

transmitting a traffic channel assignment message via a paging channel.

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18. The method as claimed in claim 15 wherein said transitioning the mobile station from an idle state to a soft handoff with a subset of base stations identified in the list comprises:

5 transitioning the mobile station from an idle state to a soft handoff with all base stations identified in the list.

19. A method for transitioning a mobile station from an idle state to a soft handoff, comprising:

10 measuring signal energies received from a plurality of base stations at a mobile station in an idle state;

compiling a first list containing identifiers of base stations with received signal energies exceeding a predetermined threshold at the mobile station;

15 determining a second list containing identifiers of base stations of the first list to which the mobile station in a system access state is allowed to perform an idle handoff;

20 transitioning the mobile station from an idle state to a soft handoff with a subset of the base stations identified by the second list; and

transmitting a traffic channel assignment message indicating traffic channel allocated by each base station identified by the second list.

20. The method as claimed in claim 19 wherein said 25 determining the second list containing identifiers of base stations of the first list to which the mobile station is allowed to perform an idle handoff comprises:

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determining a third list containing identifiers of base stations with sufficient resources to provide communications to the mobile station; and

5 forming the second list containing identifiers of base stations common to the first list and the third list.

21. The method as claimed in claim 19 wherein said determining the second list containing identifiers of base stations of the first list to which the mobile station is allowed to perform an idle handoff comprises:

10 determining the second list at the mobile station.

22. The method as claimed in claim 21 wherein said determining the second list at the mobile station comprises:

receiving the second list transmitted from at least one of said plurality of base stations at the mobile station.

15 23. The method as claimed in claim 19 wherein said determining the second list containing identifiers of base stations of the first list to which the mobile station is allowed to perform an idle handoff comprises:

determining the second list at a base station.

20 24. The method as claimed in claim 19 wherein said determining the second list containing identifiers of base stations of the first list to which the mobile station is allowed to perform an idle handoff comprises:

25 determining the second list at a base station controller.

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25. The method as claimed in claim 19 wherein said transmitting a traffic channel assignment message indicating traffic channel allocated by each base station identified by the second list comprises:

5 transmitting a traffic channel assignment message from each of the base stations identified in the second list.

26. The method as claimed in 19 wherein said transmitting a traffic channel assignment message indicating traffic channel allocated by each base station identified by the second list  
10 from a subset of the plurality of base stations comprises:

transmitting a traffic channel assignment message via a paging channel.

27. The method as claimed in claim 19 wherein said transitioning the mobile station from an idle state to a soft  
15 handoff with a subset of base stations identified by the second list comprises:

transitioning the mobile station from an idle state to a soft handoff with all base stations identified in the second list.

20 28. An apparatus for transitioning a mobile station from an idle state to a soft handoff, comprising:

a plurality of base stations configured to:

transmit a list containing identifiers of base stations to which the mobile station in a system access state  
25 is permitted to perform an idle handoff; and

a mobile station configured to:

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transition from an idle state to a soft handoff with a subset of base stations identified in the list,

wherein said plurality of base stations are further configured to:

5 transmit a traffic channel assignment message indicating traffic channel allocated by each base station of the subset of base stations identified in the list.

29. The apparatus as claimed in claim 28 wherein said plurality of base stations are configured to:

10 transmit a traffic channel assignment message if a base station from said plurality of base stations is identified in the list.

30. The apparatus as claimed in claim 28 wherein said plurality of base stations are further configured to:

15 transmit a traffic channel assignment message via a paging channel.

31. An apparatus for transitioning a mobile station from an idle state to a soft handoff, comprising:

a processor; and

20 a storage medium coupled to the processor and containing a set of instructions executable by the processor to:

25 determine a first list containing identifiers of base stations with resources to provide communications to the mobile station;

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determine a second list containing identifiers of base stations of the first list to which the mobile station in a system access state is allowed to perform an idle handoff; and

5 cause transition of the mobile station from an idle state to a soft handoff with a subset of base stations identified by the second list,

wherein said processor causes transition of the mobile station from an idle state to a soft handoff with a 10 subset of base stations identified by the second list by executing a set of instructions to:

cause transmission of a traffic channel assignment message indicating traffic channel allocated by each base station identified in the second list.

15 32. The apparatus as claimed in claim 31 wherein said processor and said storage medium are disposed in a base station controller.

33. The apparatus as claimed in claim 31 wherein said processor and said storage medium are disposed in a base 20 station.

34. The apparatus as claimed in claim 31 wherein said processor determines the second list containing identifiers of base stations of the first list to which the mobile station is allowed to perform an idle handoff by executing a set of 25 instructions to:

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accept a third list containing identifiers of base stations whose signal energies received at a mobile station in an idle state exceed a predetermined threshold; and

5 form the second list containing identifiers of base stations common to the first list and the third list.

35. The apparatus as claimed in claim 31 wherein said processor causes transmission of a traffic channel assignment message indicating traffic channel allocated by each base station identified by the second list by executing a set of 10 instructions to:

cause transmission of a traffic channel assignment message from each base station identified in the second list.

36. The apparatus as claimed in claim 31 wherein said processor causes transmission of a traffic channel assignment 15 message indicating traffic channel allocated by each base station identified by the second list from a subset of a plurality of base stations by executing a set of instructions to:

cause transmission of a traffic channel assignment 20 message via a paging channel.

37. The apparatus as claimed in claim 31 wherein said processor causes transition of the mobile station from an idle state to a soft handoff with all base stations identified by the second list.

25 38. The apparatus as claimed in claim 37 wherein the subset of base stations identified in the list comprises all base stations identified in the list.

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39. An apparatus for performing idle handoff, comprising:

means for measuring, at a mobile station in an idle state, received signal energies from a plurality of base stations;

5 means for compiling, at the mobile station, a first set of the base stations with received energies exceeding a predetermined threshold;

means for receiving a second set indicating the base stations with resources to provide communications to the mobile 10 station; and

means for performing an idle handoff by the mobile station in a system access state to a base station common to the first set and the second set.

40. The apparatus of claim 39, further comprising means 15 for transmitting a message indicative of the second set of the base stations to the mobile station.

41. The apparatus of claim 39, further comprising means for transmitting a message indicative of the first set of the base stations from the mobile station.

20 42. The apparatus of claim 41, further comprising means for transmitting a message indicative of the base stations in common with the first set of the base stations and the second set of the base stations.

43. The apparatus of claim 42, wherein the message 25 indicative of the base stations in common with the first set of the base stations and the second set of the base stations is transmitted from a single base station.

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44. The apparatus of claim 42, wherein the message indicative of the base stations in common with the first set of the base stations and the second set of the base stations is transmitted from a plurality of base stations.

5 45. The apparatus of claim 44, wherein the plurality of base stations are the base stations in common with the first set of the base stations and the second set of the base stations.

10 46. The apparatus of claim 40, wherein the means for transmitting a message indicative of the second set of the base stations to the mobile station comprises means for transmitting a message indicative of the second set of the base stations from a single base station.

15 47. The apparatus of claim 40, wherein the means for transmitting a message indicative of the second set of the base stations to the mobile station comprises means for transmitting a message indicative of the second set of the base stations from a plurality of base stations.

20 48. The apparatus of claim 40, further comprising means for transmitting a message indicative of the base stations in common with the first set of the base stations and the second set of base stations from the mobile station.

25 49. An apparatus for performing idle handoff, comprising:  
a searcher configured to measure received signal energies from a plurality of base stations; and  
a control processor configured to:

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compile a first set of the base stations with received energies exceeding a predetermined threshold;

receive a second set indicating the base stations with resources to provide communications to the apparatus; and

5 perform an idle handoff in a system access state to a base station common to the first set and the second set.

50. The apparatus of claim 49, further comprising a transmitter configured to transmit a message indicative of the first set of the base stations.

10 51. The apparatus of claim 49, further comprising a transmitter configured to transmit a message indicative of the base stations in common with the first set of the base stations and the second set of the base stations.

52. A mobile station, comprising:

15 an antenna configured to receive signals;

a control processor configured to:

compile a first set of the base stations with received energies exceeding a predetermined threshold;

20 receive a second set indicating the base stations with resources to provide communications to the apparatus; and

perform an idle handoff in a system access state to a base station common to the first set and the second set.

25 53. The mobile station of claim 52, further comprising a transmitter configured to transmit a message indicative of the first set of the base stations.

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54. The mobile station of claim 52, further comprising a transmitter configured to transmit a message indicative of the base stations in common with the first set of the base stations and the second set of the base stations.

5 55. A computer-readable medium storing a program for performing idle handoff which comprises computer readable instructions executable to:

measure, at a mobile station in an idle state, received signal energies from a plurality of base stations;

10 compile, at the mobile station, a first set of the base stations with received energies exceeding a predetermined threshold;

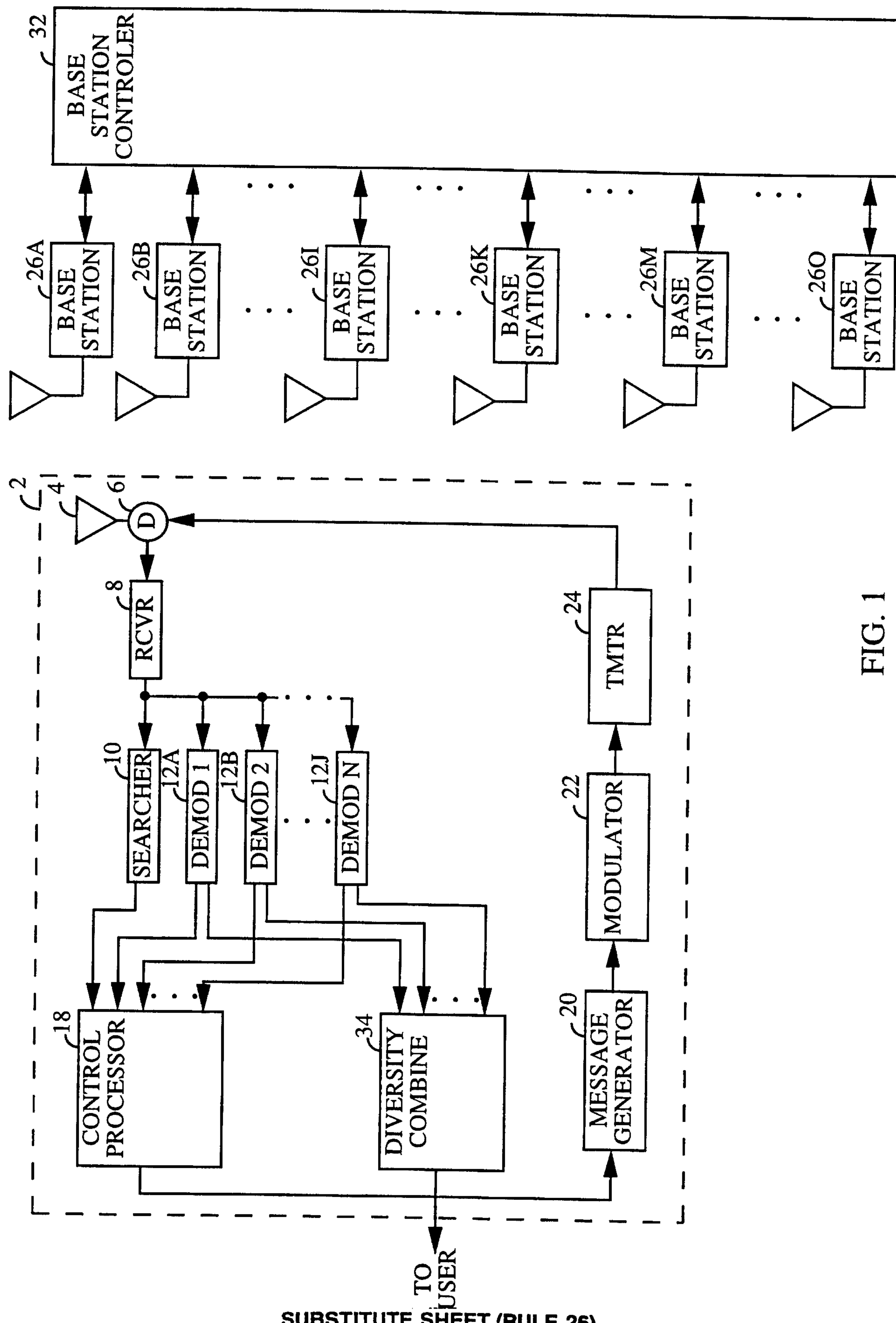
receive a second set of the base stations with resources to provide communications to the mobile station; and

15 perform an idle handoff by the mobile station in a system access state to a base station common to the first set and the second set.

56. The computer readable medium of claim 55, wherein the instructions are further executable to transmit a message 20 indicative of the first set of the base stations.

57. The computer readable medium of claim 55, wherein the instructions are further executable to transmit a message indicative of the base stations in common with the first set of the base stations and the second set of the base stations.

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# **SUBSTITUTE SHEET (RULE 26)**

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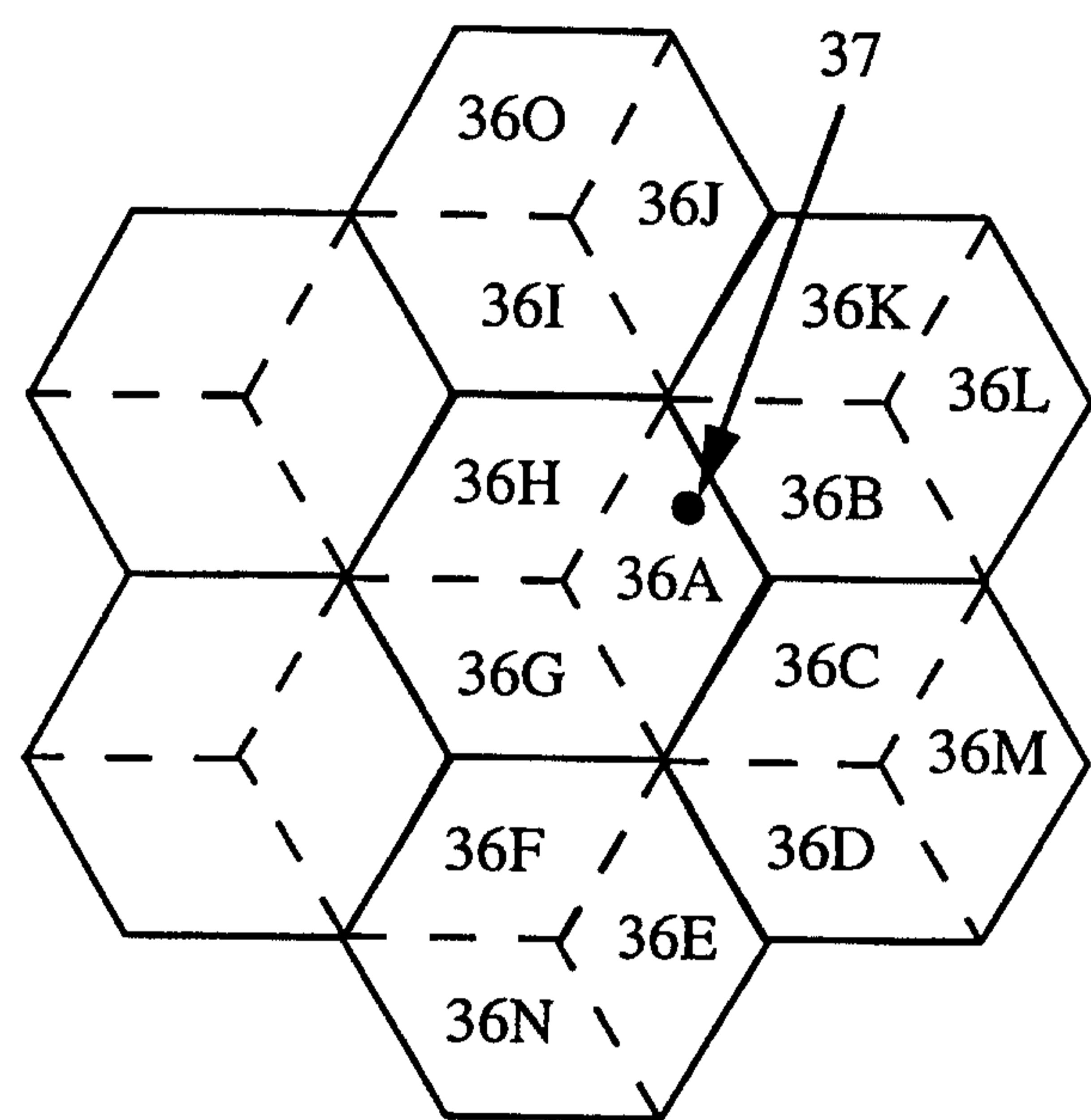


FIG. 2

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