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FILING RECEIPT



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Date Mailed: 12/17/2007

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 60/985,537**

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Early Publication Request: No

Title

METHOD AND APPARATUS FOR PROVIDING CELL RE-SELECTION

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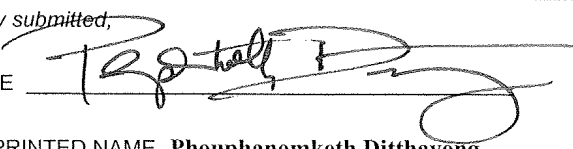
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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

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ENCLOSED APPLICATION PARTS (check all that apply)					
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☒ Drawing(s) Number of Sheets		9		☒ Other (specify)	
				9 pages of Appendix (5 pages text, 4 pages figures)	
☐ Application Data Sheet. See 37 CFR 1.76					
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)					
☐ Applicant claims small entity status. See 37 CFR 1.27.					
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.					
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Respectfully submitted,			Date		
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Attorney Docket No.: 01057-1255
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Patent

UNITED STATES PROVISIONAL PATENT APPLICATION

FOR

METHOD AND APPARATUS FOR
PROVIDING CELL RE-SELECTION

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METHOD AND APPARATUS FOR PROVIDING CELL RE-SELECTION

DESCRIPTION

TECHNICAL FIELD

[0001] Various exemplary embodiments of the invention relate generally to transmission control in a communication system.

BACKGROUND

[0002] Radio communication systems, such as a wireless data networks (e.g., Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) systems, spread spectrum systems (such as Wideband Code Division Multiple Access (WCDMA) networks), Time Division Multiple Access (TDMA) networks, Orthogonal Frequency Division Multiplexed (OFDMA) networks, spatially multiplexed networks, WiMAX (Worldwide Interoperability for Microwave Access), etc.), provide users with the convenience of mobility along with a rich set of services and features. This convenience has spawned significant adoption by an ever growing number of consumers as an accepted mode of communication for business and personal uses. To promote greater adoption, the telecommunication industry, from manufacturers to service providers, has agreed at great expense and effort to develop standards for communication protocols that underlie the various services and features. One area of effort involves cell re-selection when a mobile device moves from one cell to another cell. Traditionally, such movement involves unnecessarily reserving network resources – i.e., wasting network capacity.

[0003] Therefore, there is a need for an approach for providing an efficient cell re-selection procedure, in the context of existing and developing standards.

SUMMARY

[0004] According to certain embodiments of the invention, an approach provides for notification by a user equipment (UE) to a current base station within one radio coverage area of the UE's move to another radio coverage area (e.g., cell). Alternatively, according to other

embodiments, when resources are dedicated to the UE, the UE is restricted from performing re-selection of the coverage area.

[0005] Still other aspects, features, and advantages of the invention are readily apparent from the following detailed description, simply by illustrating a number of particular embodiments and implementations, including the best mode contemplated for carrying out the invention. The invention is also capable of other and different embodiments, and its several details can be modified in various obvious respects, all without departing from the spirit and scope of the invention. Accordingly, the drawings and description are to be regarded as illustrative in nature, and not as restrictive.

DESCRIPTION OF DRAWINGS

[0006] The embodiments of the invention are illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings:

[0007] FIGS. 1A-1D are, correspondingly, a diagram of a communication system capable of providing efficient cell re-selection process, and flowcharts of cell re-selection processes, according to various exemplary embodiments of the invention;

[0008] FIG. 2 is a diagram of a communication system and associated architecture capable of providing efficient cell re-selection , in which the system of FIG. 1A can operate, according to various exemplary embodiments of the invention;

[0009] FIG. 3 is a diagram of an exemplary high speed random access channel (HS-RACH) procedure for supporting cell-reselection, according to various exemplary embodiments;

[0010] FIG. 4 is a diagram showing usage of Enhanced Dedicated Channel (E-DCH) as a RACH shared channel, according to various exemplary embodiments;

[0011] FIG. 5A and 5B are diagrams of simulation results relating to HS-RACH capacity, according to various exemplary embodiments;

[0012] FIG. 6 is a diagram of hardware that can be used to implement an embodiment of the invention; and

[0013] FIG. 7 is a diagram of exemplary components of a mobile station capable of transmitting scheduling information, according to an embodiment of the invention.

DETAILS

[0014] An apparatus, method, and software for providing efficient cell re-selection procedure. In the following description, for the purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the embodiments of the invention. It is apparent, however, to one skilled in the art that the embodiments of the invention may be practiced without these specific details or with an equivalent arrangement. In other instances, well-known structures and devices are shown in block diagram form in order to avoid unnecessarily obscuring the embodiments of the invention.

[0015] Although the embodiments of the invention are discussed with respect to a wireless network compliant with a 3GPP WCDMA or UTRAN (UMTS (Universal Mobile Telecommunications System) Terrestrial Radio Access Network)) architecture, it is recognized by one of ordinary skill in the art that the embodiments of the inventions have applicability to any type of packet based communication system and equivalent functional capabilities.

[0016] FIGs. 1A-1D are, correspondingly, a diagram of a communication system capable of providing efficient cell re-selection process, and flowcharts of cell re-selection processes, according to various exemplary embodiments of the invention. As shown in FIG. 1A, one or more user equipment (UEs), of which one is shown, communicates with a base station, which is part of an access network (e.g., WCDMA (Wideband Code Division Multiple Access), HSPA (High Speed Packet Access), WiMAX, 3GPP LTE (or E-UTRAN or Beyond 3G, 4G), etc.). In WCDMA, for example, cell re-selection logic on the network side can be deployed in the radio network controller (RNC) (or radio resource controller (RRC)). This base station is denoted a “current base station.” Under the 3GPP terrestrial radio access network architecture (as shown in FIG. 2), the base station denoted as a Node B or an enhanced Node B (eNB). The UE can be any type of mobile stations, such as handsets, terminals, stations, units, devices, multimedia tablets, Internet nodes, communicators, Personal Digital Assistants or any type of interface to the user (such as “wearable” circuitry, etc.).

[0017] The base stations, in an exemplary embodiment, use WCDMA (Wideband Code Division Multiple Access) as the uplink and downlink transmission scheme. Under this scenario, the UE communicates with the current base station associated with one coverage area (e.g., cell), and then moves to another coverage area, which is served by a new base station. The UE and the base stations utilize a coverage area re-selection logic (e.g., cell re-selection logic) to allow the UE to maintain logical connection to the network when entering a new cell area. Of particular note, the UE may notify the current base station of the movement to the new cell. Accordingly, the current base station can timely release dedicated resources. This process is more fully described with respect to FIGs. 1B-1D.

[0018] Traditionally, in a cell-re-selection procedure, the UE does not provide any indication to the Node B of current cell about moving to a new cell. UE would simply start a cell update (“CELL_UPDATE”) procedure in the new cell by sending a CELL_UPDATE message on a transport channel (e.g., R’99 RACH).

[0019] According to certain embodiments, an Enhanced Dedicated Channel (E-DCH) is utilized as a data transmission channel in the CELL_FACH (cell forward access channel) state. E-DCH resources for the UE (resources handled by the Node B of the cell UE is connected to) in the cell can be allocated for a relatively long time when comparing to a traditional CELL_FACH access method using at most 20 ms long random access channel. During this allocation, the UE may want to change a cell based on a cell re-selection criteria (e.g., defined by the standard). If the UE utilizes the traditional cell re-selection mechanism, the Node B of the current cell is not notified. Consequently, the UE would change the cell, and the Node B would unnecessarily maintain E-DCH resources of this UE.

[0020] In recognition of the above problem, a cell re-selection procedure is provided to permit the UE to notify the current base station of movement to another coverage area. Two approaches are described: FIGs. 1B and 1C present the first approach, and FIG. 1D depicts the second approach.

[0021] As seen in FIG. 1B, the UE initiates a cell re-selection procedure. Thereafter, the UE sends an indication of the move to the current base station. In other words, when the UE has E-DCH resources allocated to it in CELL_FACH state with enhanced uplink in use (i.e., Node B

has allocated E-DCH resources) and when UE wants to change cell, the UE will indicate to the Node B of current cell that it plans to release E-DCH resources from the current cell. The Node B can then acknowledge this indication.

[0022] In an exemplary embodiment, the Node B can utilize a hybrid Automatic Repeat Request (ARQ) (HARQ) scheme. Automatic Repeat Request (ARQ) is a retransmission mechanism used on the link layer if the transmission was not received successfully. HARQ, which combines ARQ protocols with forward-error-correction (FEC) schemes, provides a sound error-control technique for wireless links. This mechanism permits the receiver to indicate to the transmitter that a packet or sub-packet has been received incorrectly, and thus, requests the transmitter to resend the particular packet(s). Further in HARQ technique the receiver can utilize information received with the failed transmission attempt in combination with the retransmission when reconstructing the transmitted packet

[0023] The indication can be sent, for example, in a MAC (Medium Access Control) -e header to the current Node B. After sending the indication and (optionally) receiving acknowledgement, the UE will release the dedicated resources used for transmission and perform CELL_UPDATE into the new cell.

[0024] Using the above approach, the current Node B can know when UE wants to release resources, for example, when UE wants to change a cell in CELL_FACH state when UE has E-DCH resources in CELL_FACH state. However, it is noted that in a UTRAN system, in order to facilitate inter-frequency or inter-radio access technology measurements, compressed mode or a similar technique would have to be always active in CELL_FACH state because UTRAN has no means to initiate Compressed mode when UE has E-DCH resources in CELL_FACH state. Intra-frequency measurements however, can be performed normally.

[0025] On the network side (or Node B side), upon receiving the indication, as shown in FIG. 1C, the Node B acknowledges receipt of the notification. Subsequently, the dedicated resources (e.g., E-DCH resources) are immediately released to be available for some other UE. These resources have been previously allocated using a resource allocation logic within the Node B, for instance.

[0026] In a second approach (FIG. 1D), when the UE has E-DCH resources in CELL_FACH state (Node B has allocated E-DCH resources), the UE is not allowed to perform cell re-selection as long as it has E-DCH resources reserved. After the UE has released (also Node B has released) the resources, the UE can perform cell re-selection – e.g., via a traditional cell reselection logic and using the CELL_UPDATE procedure. In other words, the UE in CELL_FACH state typically runs its reselection logic; however, when the UE is transmitting over E-DCH or is running the HS-RACH procedure, in general the UE will not perform reselection until the resources are released. This approach would address the inter-frequency and inter-radio access technology measurement problem without a need for introducing a compressed mode or similar technique.

[0027] By way of example, the communication system of FIG. 1A utilizes an architecture compliant with the WCDMA/HSPA, UMTS terrestrial radio access network (UTRAN), as next described.

[0028] FIG. 2 is a diagram of a radio communication system capable of providing efficient cell re-selection process, according to an exemplary embodiment of the invention. As shown, a user equipment (UE) communicates with a base station, which under the 3GPP architecture is denoted as a Node B. The UE can be any type of mobile stations, such as handsets, terminals, stations, units, devices, or any type of interface to the user (such as “wearable” circuitry, etc.). By way of example, the communication system of FIG. 1A utilizes an architecture compliant with the WCDMA/HSPA. The WCDMA Radio Access Network provides connectivity between a terminal and the core network. The WCDMA network provides a core network that can support multiple access technologies.

[0029] As seen in FIG. 2 the UMTS network includes three interacting domains: Core Network (CN), UMTS Terrestrial Radio Access Network (UTRAN), and User Equipment (UE). The core network can provide such functions as switching, routing and transit for user traffic. The UTRAN provides the air interface access method for the User Equipment. Control equipment for base stations (i.e., Node-B) is referred to as the Radio Network Controller (RNC).

[0030] Base station (i.e., Node-B) handles the radio transmission and reception to and from a terminal over the radio interface (Uu). It is controlled from the RNC via the Iub interface. It is

noted that under this architecture one base station can handle one or more cells. The RNC controls WCDMA radio access network functions, connecting the WCDMA radio access network to the core network (CN) via the Lu interface. The serving RNC has overall control of a terminal that is connected to WCDMA radio access network. The controlling RNC has the overall control of a particular set of cells and their associated base stations. The main service offered by WCDMA RAN is the Radio Access Bearer (RAB). Both the conversational and streaming RABs require a certain reservation of resources in the network, and are primarily for real-time services. The RAB is characterized by certain Quality of Service (QoS) parameters, such as bit rate and delay.

[0031] By way of example, a physical layer (e.g., Layer 1) offers transport channels to the MAC layer. There are different types of transport channels with different characteristics of the transmission. Common transport channels can be shared by multiple terminals, for example, FACH (Forward Access Channel), RACH (Random Access Channel), DSCH (downlink Shared Channel), BCH (Broadcast Channel), PCH (Paging Channel).

[0032] According to certain embodiments, E-DCH is utilized as a RACH shared channel.

[0033] FIG. 3 is a diagram of an exemplary high speed random access channel (HS-RACH) procedure for supporting cell-reselection, according to various exemplary embodiments. By way of example, High Speed Random Access Channel (HS-RACH) or Fast E-DCH access can be used as a transport channel in the CELL_FACH (Forward Access Channel) state instead of RACH. The HS-RACH concept is explained as follows:

[0034] (1) Determination of UL interference level for open loop power control;

[0035] (2) R'99 (3GPP R99) random access procedure with power ramp-up using specific HS-RACH access slots and/or signatures indicated in SIB (System Information Block);

[0036] (3) Acquisition Indication and Resource Assignment;

[0037] (4) Start of inner loop power control in UL, e.g., on DPCCCH (Dedicated Physical Control Channel);

[0038] (5) Start of inner loop power control in DL, e.g., on F-DPCH (Forward Dedicated Physical Channel);

[0039] (6) Start of UL data transmission, e.g., on E-DPDCH (Enhanced Dedicated Physical Data Channel) /E-DPCCH (Enhanced Dedicated Physical Control Channel);

[0040] (7) Subsequent data rate grant (update of initial data rate grant) and Collision detection and resolution;

[0041] (8) ACK (Acknowledgement) /NACK (Negative Acknowledgement) of UL data on E-HICH (E-DCH Hybrid ARQ (Automatic Repeat Request) Indicator Channel);

[0042] (9) ACK/NACK of DL data and CQI (Channel Quality Indication) for DL link adaptation, e.g., on HS-DPCCH; and

[0043] (10) Mechanisms at end of data transmission, end of HS-RACH resource allocation period, collision detection, etc.

[0044] The E-DCH resources are now described.

[0045] In Release 99 the RACH channel data rates are very low and the setup times from CELL_FACH to CELL_DCH are considerable. This leads to considerable longer delays than needed for medium size packets. Using HSUPA (High Speed Uplink Packet Access) physical channel in CELL_FACH state will enhance the data rates in that state considerably. The data transfer in CELL_FACH with the enhanced data rate can continue, except for a small gap, during the switching to CELL_DCH, thus enabling the user data transmission to start during the CELL_FACH to CELL_DCH setup, thus hiding from user the fact that the setup takes some time.

[0046] The high speed RACH (HS-RACH) concept is illustrated in FIG. 4. The existing physical channels are utilized as shared channels: one or several uplink E-DPDCH and E-DPCCH are used as shared channels; one or several sets of downlink L1 feedback channels are used as shared channels. Those channels carry power control (F-DPCH), retransmission requests (ACK/NACK) and capacity allocations (E-AGCH).

[0047] HS-RACH capacity is simulated, and FIGs. 5A and 5B provide the results. In the simulations, it is assumed that there are a total of 2500 uploads per cell per hour. Each user is assumed to stay 500 ms on HS-RACH before moving to Cell_DCH state. It would be possible to start the operation with single HS-RACH and then later upgrade the capacity according to the traffic needs. The simulations also show that if 4 signatures are in place, the collision probability is negligible <0.01% with the loading used in the simulations.

[0048] One of ordinary skill in the art would recognize that the processes for providing notifications in a cell re-selection procedure may be implemented via software, hardware (e.g., general processor, Digital Signal Processing (DSP) chip, an Application Specific Integrated Circuit (ASIC), Field Programmable Gate Arrays (FPGAs), etc.), firmware, or a combination thereof. Such exemplary hardware for performing the described functions is detailed below with respect to FIG. 6.

[0049] FIG. 6 illustrates exemplary hardware upon which various embodiments of the invention can be implemented. A computing system 600 includes a bus 601 or other communication mechanism for communicating information and a processor 603 coupled to the bus 601 for processing information. The computing system 600 also includes main memory 605, such as a random access memory (RAM) or other dynamic storage device, coupled to the bus 601 for storing information and instructions to be executed by the processor 603. Main memory 605 can also be used for storing temporary variables or other intermediate information during execution of instructions by the processor 603. The computing system 600 may further include a read only memory (ROM) 607 or other static storage device coupled to the bus 601 for storing static information and instructions for the processor 603. A storage device 609, such as a magnetic disk or optical disk, is coupled to the bus 601 for persistently storing information and instructions.

[0050] The computing system 600 may be coupled via the bus 601 to a display 611, such as a liquid crystal display, or active matrix display, for displaying information to a user. An input device 613, such as a keyboard including alphanumeric and other keys, may be coupled to the bus 601 for communicating information and command selections to the processor 603. The input device 613 can include a cursor control, such as a mouse, a trackball, or cursor direction keys, for communicating direction information and command selections to the processor 603 and for controlling cursor movement on the display 611.

[0051] According to various embodiments of the invention, the processes described herein can be provided by the computing system 600 in response to the processor 603 executing an arrangement of instructions contained in main memory 605. Such instructions can be read into main memory 605 from another computer-readable medium, such as the storage device 609. Execution of the arrangement of instructions contained in main memory 605 causes the

processor 603 to perform the process steps described herein. One or more processors in a multi-processing arrangement may also be employed to execute the instructions contained in main memory 605. In alternative embodiments, hard-wired circuitry may be used in place of or in combination with software instructions to implement the embodiment of the invention. In another example, reconfigurable hardware such as Field Programmable Gate Arrays (FPGAs) can be used, in which the functionality and connection topology of its logic gates are customizable at run-time, typically by programming memory look up tables. Thus, embodiments of the invention are not limited to any specific combination of hardware circuitry and software.

[0052] The computing system 600 also includes at least one communication interface 615 coupled to bus 601. The communication interface 615 provides a two-way data communication coupling to a network link (not shown). The communication interface 615 sends and receives electrical, electromagnetic, or optical signals that carry digital data streams representing various types of information. Further, the communication interface 615 can include peripheral interface devices, such as a Universal Serial Bus (USB) interface, a PCMCIA (Personal Computer Memory Card International Association) interface, etc.

[0053] The processor 603 may execute the transmitted code while being received and/or store the code in the storage device 609, or other non-volatile storage for later execution. In this manner, the computing system 600 may obtain application code in the form of a carrier wave.

[0054] The term “computer-readable medium” as used herein refers to any medium that participates in providing instructions to the processor 603 for execution. Such a medium may take many forms, including but not limited to non-volatile media, volatile media, and transmission media. Non-volatile media include, for example, optical or magnetic disks, such as the storage device 609. Volatile media include dynamic memory, such as main memory 605. Transmission media include coaxial cables, copper wire and fiber optics, including the wires that comprise the bus 601. Transmission media can also take the form of acoustic, optical, or electromagnetic waves, such as those generated during radio frequency (RF) and infrared (IR) data communications. Common forms of computer-readable media include, for example, a floppy disk, a flexible disk, hard disk, magnetic tape, any other magnetic medium, a CD-ROM, CDRW, DVD, any other optical medium, punch cards, paper tape, optical mark sheets, any other physical medium with patterns of holes or other optically recognizable indicia, a RAM, a PROM,

and EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave, or any other medium from which a computer can read.

[0055] Various forms of computer-readable media may be involved in providing instructions to a processor for execution. For example, the instructions for carrying out at least part of the invention may initially be borne on a magnetic disk of a remote computer. In such a scenario, the remote computer loads the instructions into main memory and sends the instructions over a telephone line using a modem. A modem of a local system receives the data on the telephone line and uses an infrared transmitter to convert the data to an infrared signal and transmit the infrared signal to a portable computing device, such as a personal digital assistant (PDA) or a laptop. An infrared detector on the portable computing device receives the information and instructions borne by the infrared signal and places the data on a bus. The bus conveys the data to main memory, from which a processor retrieves and executes the instructions. The instructions received by main memory can optionally be stored on storage device either before or after execution by processor.

[0056] FIG. 7 is a diagram of exemplary components of a mobile station (e.g., handset) capable of operating in the system of FIG. 1, according to an embodiment of the invention. Generally, a radio receiver is often defined in terms of front-end and back-end characteristics. The front-end of the receiver encompasses all of the Radio Frequency (RF) circuitry whereas the back-end encompasses all of the base-band processing circuitry. Pertinent internal components of the telephone include a Main Control Unit (MCU) 703, a Digital Signal Processor (DSP) 705, and a receiver/transmitter unit including a microphone gain control unit and a speaker gain control unit. A main display unit 707 provides a display to the user in support of various applications and mobile station functions. An audio function circuitry 709 includes a microphone 711 and microphone amplifier that amplifies the speech signal output from the microphone 711. The amplified speech signal output from the microphone 711 is fed to a coder/decoder (CODEC) 713.

[0057] A radio section 715 amplifies power and converts frequency in order to communicate with a base station, which is included in a mobile communication system (e.g., systems of FIG. 7A or 7B), via antenna 717. The power amplifier (PA) 719 and the transmitter/modulation circuitry are operationally responsive to the MCU 703, with an output from the PA 719 coupled

to the duplexer 721 or circulator or antenna switch, as known in the art. The PA 719 also couples to a battery interface and power control unit 720.

[0058] In use, a user of mobile station 701 speaks into the microphone 711 and his or her voice along with any detected background noise is converted into an analog voltage. The analog voltage is then converted into a digital signal through the Analog to Digital Converter (ADC) 723. The control unit 703 routes the digital signal into the DSP 705 for processing therein, such as speech encoding, channel encoding, encrypting, and interleaving. In the exemplary embodiment, the processed voice signals are encoded, by units not separately shown, using the cellular transmission protocol of Code Division Multiple Access (CDMA), as described in detail in the Telecommunication Industry Association's TIA/EIA/IS-95-A Mobile Station-Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System; which is incorporated herein by reference in its entirety.

[0059] The encoded signals are then routed to an equalizer 725 for compensation of any frequency-dependent impairments that occur during transmission through the air such as phase and amplitude distortion. After equalizing the bit stream, the modulator 727 combines the signal with a RF signal generated in the RF interface 729. The modulator 727 generates a sine wave by way of frequency or phase modulation. In order to prepare the signal for transmission, an up-converter 731 combines the sine wave output from the modulator 727 with another sine wave generated by a synthesizer 733 to achieve the desired frequency of transmission. The signal is then sent through a PA 719 to increase the signal to an appropriate power level. In practical systems, the PA 719 acts as a variable gain amplifier whose gain is controlled by the DSP 705 from information received from a network base station. The signal is then filtered within the duplexer 721 and optionally sent to an antenna coupler 735 to match impedances to provide maximum power transfer. Finally, the signal is transmitted via antenna 717 to a local base station. An automatic gain control (AGC) can be supplied to control the gain of the final stages of the receiver. The signals may be forwarded from there to a remote telephone which may be another cellular telephone, other mobile phone or a land-line connected to a Public Switched Telephone Network (PSTN), or other telephony networks.

[0060] Voice signals transmitted to the mobile station 701 are received via antenna 717 and immediately amplified by a low noise amplifier (LNA) 737. A down-converter 739 lowers the

carrier frequency while the demodulator 741 strips away the RF leaving only a digital bit stream. The signal then goes through the equalizer 725 and is processed by the DSP 705. A Digital to Analog Converter (DAC) 743 converts the signal and the resulting output is transmitted to the user through the speaker 745, all under control of a Main Control Unit (MCU) 703 -- which can be implemented as a Central Processing Unit (CPU) (not shown).

[0061] The MCU 703 receives various signals including input signals from the keyboard 747. The MCU 703 delivers a display command and a switch command to the display 707 and to the speech output switching controller, respectively. Further, the MCU 703 exchanges information with the DSP 705 and can access an optionally incorporated SIM card 749 and a memory 751. In addition, the MCU 703 executes various control functions required of the station. The DSP 705 may, depending upon the implementation, perform any of a variety of conventional digital processing functions on the voice signals. Additionally, DSP 705 determines the background noise level of the local environment from the signals detected by microphone 711 and sets the gain of microphone 711 to a level selected to compensate for the natural tendency of the user of the mobile station 701.

[0062] The CODEC 713 includes the ADC 723 and DAC 743. The memory 751 stores various data including call incoming tone data and is capable of storing other data including music data received via, e.g., the global Internet. The software module could reside in RAM memory, flash memory, registers, or any other form of writable storage medium known in the art. The memory device 751 may be, but not limited to, a single memory, CD, DVD, ROM, RAM, EEPROM, optical storage, or any other non-volatile storage medium capable of storing digital data.

[0063] An optionally incorporated SIM card 749 carries, for instance, important information, such as the cellular phone number, the carrier supplying service, subscription details, and security information. The SIM card 749 serves primarily to identify the mobile station 701 on a radio network. The card 749 also contains a memory for storing a personal telephone number registry, text messages, and user specific mobile station settings.

CONCLUSION

[0064] Therefore, according to an exemplary embodiment, a method comprises detecting movement from a first coverage area to a second coverage area. The method also comprises sending an indication to a base station within the first coverage area about the movement. The method further comprises performing a coverage area selection procedure for the second coverage area.

[0065] According to one aspect of the exemplary embodiment, the coverage areas are cells.

[0066] According to another aspect of the exemplary embodiment, the method further comprises releasing resources of a transport channel upon receiving acknowledgement of the indication from the base station.

[0067] According to another aspect of the exemplary embodiment, the transport channel is a high speed random access channel (HS-RACH) or an enhanced dedicated channel (E-DCH).

[0068] According to another aspect of the exemplary embodiment, the method further comprises receiving an acknowledgement of the indication using a hybrid Automatic Repeat Request (ARQ) (HARQ) scheme.

[0069] According to another exemplary embodiment, an apparatus comprises coverage area re-selection logic configured to detect movement from a first coverage area to a second coverage area. The coverage area re-selection logic is further configured to send an indication to a base station within the first coverage area about the movement, and to perform a coverage area selection procedure for the second coverage area.

[0070] According to another aspect of the exemplary embodiment, the apparatus is a user equipment.

[0071] According to another exemplary embodiment, a method comprises receiving an indication from a user equipment of movement from a first coverage area to a second coverage area. The method also comprises acknowledging the received indication. The method further comprises releasing resources allocated to the user equipment.

[0072] According to another exemplary embodiment, an apparatus comprises logic configured to receive an indication from a user equipment of movement from a first coverage

area to a second coverage area. The logic is further configured to acknowledge the received indication, and to release resources allocated to the user equipment.

[0073] According to one aspect of the exemplary embodiment, the apparatus is a base station.

[0074] According to another exemplary embodiment, a method comprises allocating resource to a user equipment. The method also comprises determining whether the user equipment is in a coverage area re-selection state. The method further comprises restricting execution of a coverage area re-selection procedure if the user equipment is in a coverage area re-selection state and is currently assigned with dedicated uplink transmission resources.

[0075] According to yet another exemplary embodiment, an apparatus comprises resource allocation logic configured to allocate resource to a user equipment.

[0076] According to yet another exemplary embodiment, an apparatus comprises coverage area re-selection logic configured to determine whether the user equipment is in a coverage area re-selection state, and an execution of a coverage area re-selection procedure is restricted if the user equipment is in a coverage area re-selection state and is currently assigned with dedicated uplink transmission resources.

[0077] While the invention has been described in connection with a number of embodiments and implementations, the invention is not so limited but covers various obvious modifications and equivalent arrangements, which fall within the purview of the appended claims. Although features of the invention are expressed in certain combinations among the claims, it is contemplated that these features can be arranged in any combination and order.

APPENDIX

[0078] FIGs. 10A and 10B are diagrams of different cellular mobile phone systems capable of supporting various embodiments of the invention. FIGs. 10A and 10B show exemplary cellular mobile phone systems each with both mobile station (e.g., handset) and base station having a transceiver installed (as part of a Digital Signal Processor (DSP)), hardware, software, an integrated circuit, and/or a semiconductor device in the base station and mobile station). By way of example, the radio network supports Second and Third Generation (2G and 3G) services as defined by the International Telecommunications Union (ITU) for International Mobile Telecommunications 2000 (IMT-2000). For the purposes of explanation, the carrier and channel selection capability of the radio network is explained with respect to a cdma2000 architecture. As the third-generation version of IS-95, cdma2000 is being standardized in the Third Generation Partnership Project 2 (3GPP2).

[0079] A radio network 1000 includes mobile stations 1001 (e.g., handsets, terminals, stations, units, devices, or any type of interface to the user (such as “wearable” circuitry, etc.)) in communication with a Base Station Subsystem (BSS) 1003 through a relay station (RS) 1004. According to one embodiment of the invention, the radio network supports Third Generation (3G) services as defined by the International Telecommunications Union (ITU) for International Mobile Telecommunications 2000 (IMT-2000).

[0080] In this example, the BSS 1003 includes a Base Transceiver Station (BTS) 1005 and Base Station Controller (BSC) 1007. Although a single BTS is shown, it is recognized that multiple BTSs are typically connected to the BSC through, for example, point-to-point links. Each BSS 1003 is linked to a Packet Data Serving Node (PDSN) 1009 through a transmission control entity, or a Packet Control Function (PCF) 1011. Since the PDSN 1009 serves as a gateway to external networks, e.g., the Internet 1013 or other private consumer networks 1015, the PDSN 1009 can include an Access, Authorization and Accounting system (AAA) 1017 to securely determine the identity and privileges of a user and to track each user’s activities. The network 1015 comprises a Network Management System (NMS) 1031 linked to one or more

databases 1033 that are accessed through a Home Agent (HA) 1035 secured by a Home AAA 1037.

[0081] Although a single BSS 1003 is shown, it is recognized that multiple BSSs 1003 are typically connected to a Mobile Switching Center (MSC) 1019. The MSC 1019 provides connectivity to a circuit-switched telephone network, such as the Public Switched Telephone Network (PSTN) 1021. Similarly, it is also recognized that the MSC 1019 may be connected to other MSCs 1019 on the same network 1000 and/or to other radio networks. The MSC 1019 is generally collocated with a Visitor Location Register (VLR) 1023 database that holds temporary information about active subscribers to that MSC 1019. The data within the VLR 1023 database is to a large extent a copy of the Home Location Register (HLR) 1025 database, which stores detailed subscriber service subscription information. In some implementations, the HLR 1025 and VLR 1023 are the same physical database; however, the HLR 1025 can be located at a remote location accessed through, for example, a Signaling System Number 7 (SS7) network. An Authentication Center (AuC) 1027 containing subscriber-specific authentication data, such as a secret authentication key, is associated with the HLR 1025 for authenticating users. Furthermore, the MSC 1019 is connected to a Short Message Service Center (SMSC) 1029 that stores and forwards short messages to and from the radio network 1000.

[0082] During typical operation of the cellular system, BTSs 1005 receive and demodulate sets of reverse-link signals from sets of mobile units 1001 conducting calls, Internet sessions or other communications. Each reverse-link signal received by a given BTS 1005 is processed within that station. The resulting data is forwarded to the BSC 1007. The BSC 1007 provides call resource allocation and mobility management functionality including the orchestration of soft handoffs between BTSs 1005. The BSC 1007 also routes the received data to the MSC 1019, which in turn provides additional routing and/or switching for interface with the PSTN 1021. The MSC 1019 is also responsible for call setup, call termination, management of inter-MSC handover and supplementary services, and collecting, charging and accounting information. Similarly, the radio network 1000 sends forward-link messages. The PSTN 1021 interfaces with the MSC 1019. The MSC 1019 additionally interfaces with the BSC 1007, which in turn communicates with the BTSs 1005, which modulate and transmit sets of forward-link signals to the sets of mobile units 1001.

[0083] As shown in FIG. 10B, the two key elements of the General Packet Radio Service (GPRS) infrastructure 1050 are the Serving GPRS Supporting Node (SGSN) 1032 and the Gateway GPRS Support Node (GGSN) 1034. In addition, the GPRS infrastructure includes a Packet Control Unit PCU (1036) and a Charging Gateway Function (CGF) 1038 linked to a Billing System 1039. A GPRS the Mobile Station (MS) 1041 employs a Subscriber Identity Module (SIM) 1043. Under this scenario, a relay station (RS) 1044 provides extended coverage for the MS 1041.

[0084] The PCU 1036 is a logical network element responsible for GPRS-related functions such as air interface access control, packet scheduling on the air interface, and packet assembly and re-assembly. Generally the PCU 1036 is physically integrated with the BSC 1045; however, it can be collocated with a BTS 1047 or a SGSN 1032. The SGSN 1032 provides equivalent functions as the MSC 1049 including mobility management, security, and access control functions but in the packet-switched domain. Furthermore, the SGSN 1032 has connectivity with the PCU 1036 through, for example, a Fame Relay-based interface using the BSS GPRS protocol (BSSGP). Although only one SGSN is shown, it is recognized that that multiple SGSNs 1031 can be employed and can divide the service area into corresponding routing areas (RAs). A SGSN/SGSN interface allows packet tunneling from old SGSNs to new SGSNs when an RA update takes place during an ongoing Packet Data Protocol (PDP) context. While a given SGSN may serve multiple BSCs 1045, any given BSC 1045 generally interfaces with one SGSN 1032. Also, the SGSN 1032 is optionally connected with the HLR 1051 through an SS7-based interface using GPRS enhanced Mobile Application Part (MAP) or with the MSC 1049 through an SS7-based interface using Signaling Connection Control Part (SCCP). The SGSN/HLR interface allows the SGSN 1032 to provide location updates to the HLR 1051 and to retrieve GPRS-related subscription information within the SGSN service area. The SGSN/MSC interface enables coordination between circuit-switched services and packet data services such as paging a subscriber for a voice call. Finally, the SGSN 1032 interfaces with a SMSC 1053 to enable short messaging functionality over the network 1050.

[0085] The GGSN 1034 is the gateway to external packet data networks, such as the Internet 1013 or other private customer networks 1055. The network 1055 comprises a Network Management System (NMS) 1057 linked to one or more databases 1059 accessed through a

PDSN 1061. The GGSN 1034 assigns Internet Protocol (IP) addresses and can also authenticate users acting as a Remote Authentication Dial-In User Service host. Firewalls located at the GGSN 1034 also perform a firewall function to restrict unauthorized traffic. Although only one GGSN 1034 is shown, it is recognized that a given SGSN 1032 may interface with one or more GGSNs 1033 to allow user data to be tunneled between the two entities as well as to and from the network 1050. When external data networks initialize sessions over the GPRS network 1050, the GGSN 1034 queries the HLR 1051 for the SGSN 1032 currently serving a MS 1041.

100861 The BTS 1047 and BSC 1045 manage the radio interface, including controlling which Mobile Station (MS) 1041 has access to the radio channel at what time. These elements essentially relay messages between the MS 1041 and SGSN 1032. The SGSN 1032 manages communications with an MS 1041, sending and receiving data and keeping track of its location. The SGSN 1032 also registers the MS 1041, authenticates the MS 1041, and encrypts data sent to the MS 1041.

100871 FIG. 11 shows an exemplary enterprise network, which can be any type of data communication network utilizing packet-based and/or cell-based technologies (e.g., Asynchronous Transfer Mode (ATM), Ethernet, IP-based, etc.). The enterprise network 1101 provides connectivity for wired nodes 1103 as well as wireless nodes 1105-1109 (fixed or mobile), which are each configured to perform the processes described above. The enterprise network 1101 can communicate with a variety of other networks, such as a WLAN, a WiFi or a WiMax network 1111 (e.g., IEEE 802.11, IEEE 802.16), a cdma2000 cellular network 1113, a telephony network 1116 (e.g., PSTN), or a public data network 1117 (e.g., Internet, or Intranet).

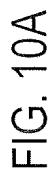
100901 In this example (FIG. 12), the base station 1203 and the UE 1201 can communicate in system 1200 using Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Wideband Code Division Multiple Access (WCDMA), Orthogonal Frequency Division Multiple Access (OFDMA) or Single Carrier Frequency Division Multiple Access (FDMA) (SC-FDMA) or a combination of thereof. In an exemplary embodiment, both the uplink and the downlink can utilize WCDMA. In another exemplary embodiment, uplink utilizes SC-FDMA while downlink utilizes OFDMA. The system 1200 provides for uplink transmission that can allow for power-efficient UE transmission to maximize coverage by utilizing single-carrier frequency-division multiple access with dynamic bandwidth. The system 1200 can adopt

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Patent

OFDM for broadcast services, especially the services the information is transmitted from several (synchronized) base stations to UEs 1201.

APPENDIX



APPENDIX

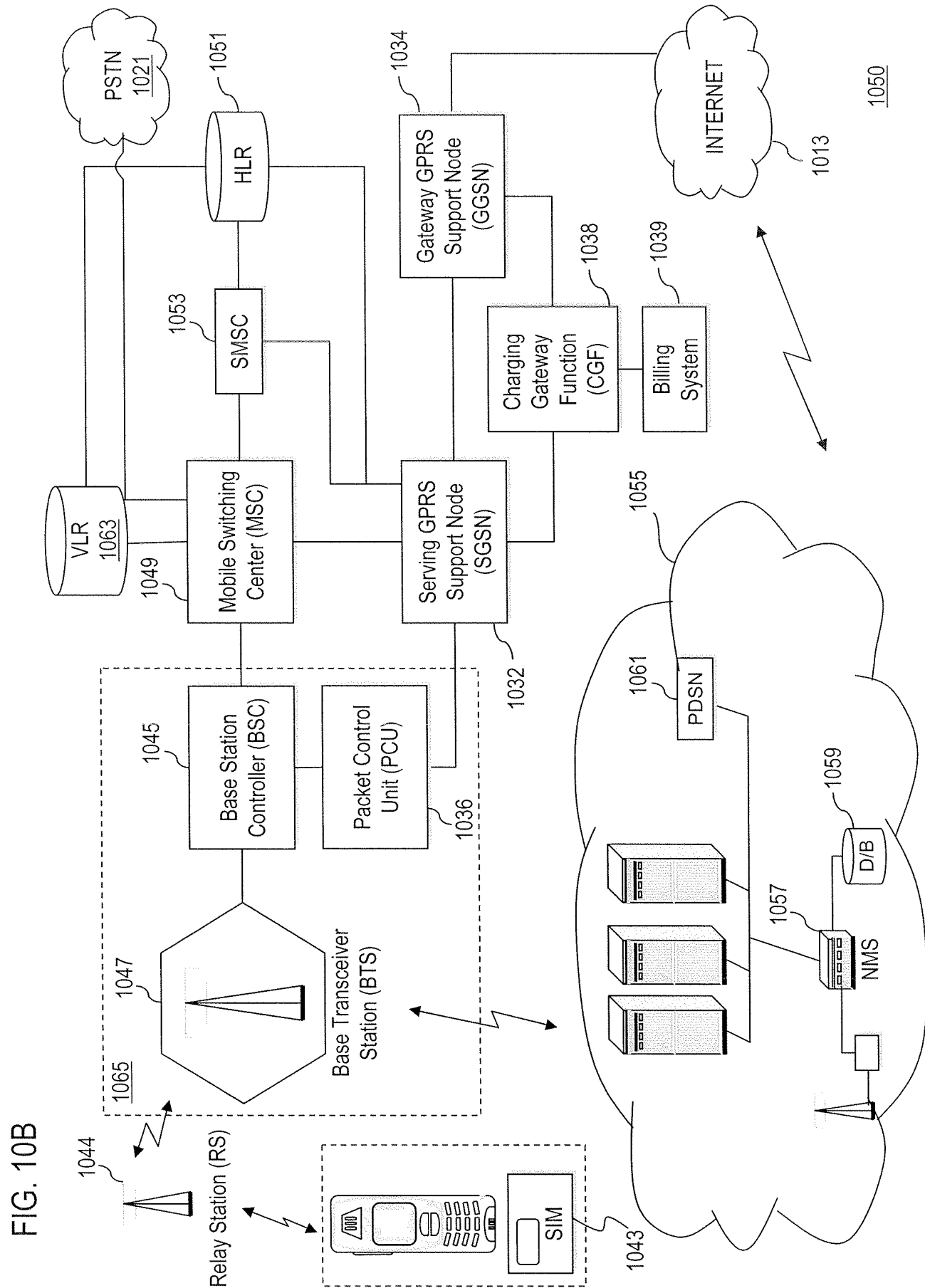
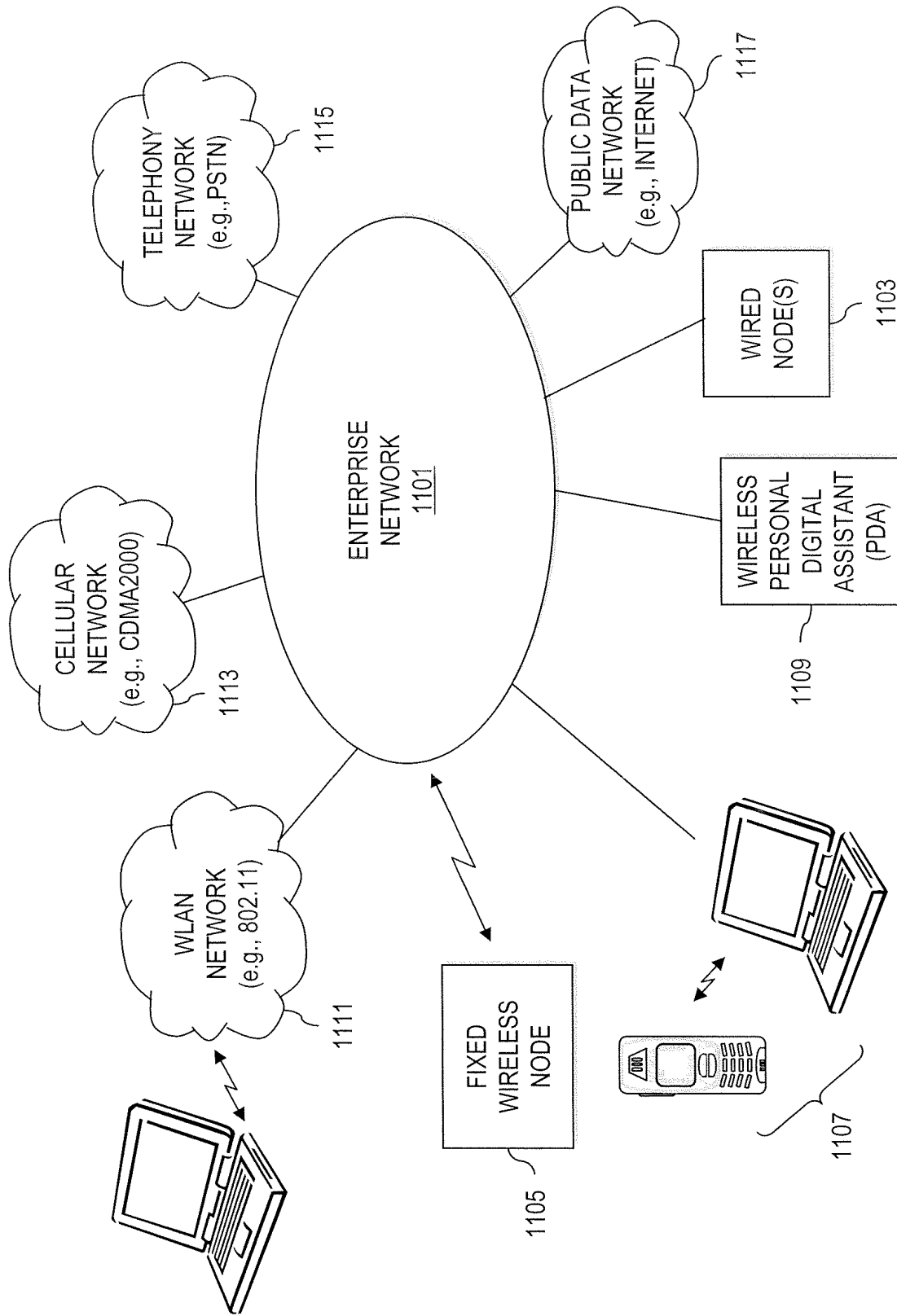


FIG. 10B

APPENDIX

FIG. 11



APPENDIX

FIG. 12

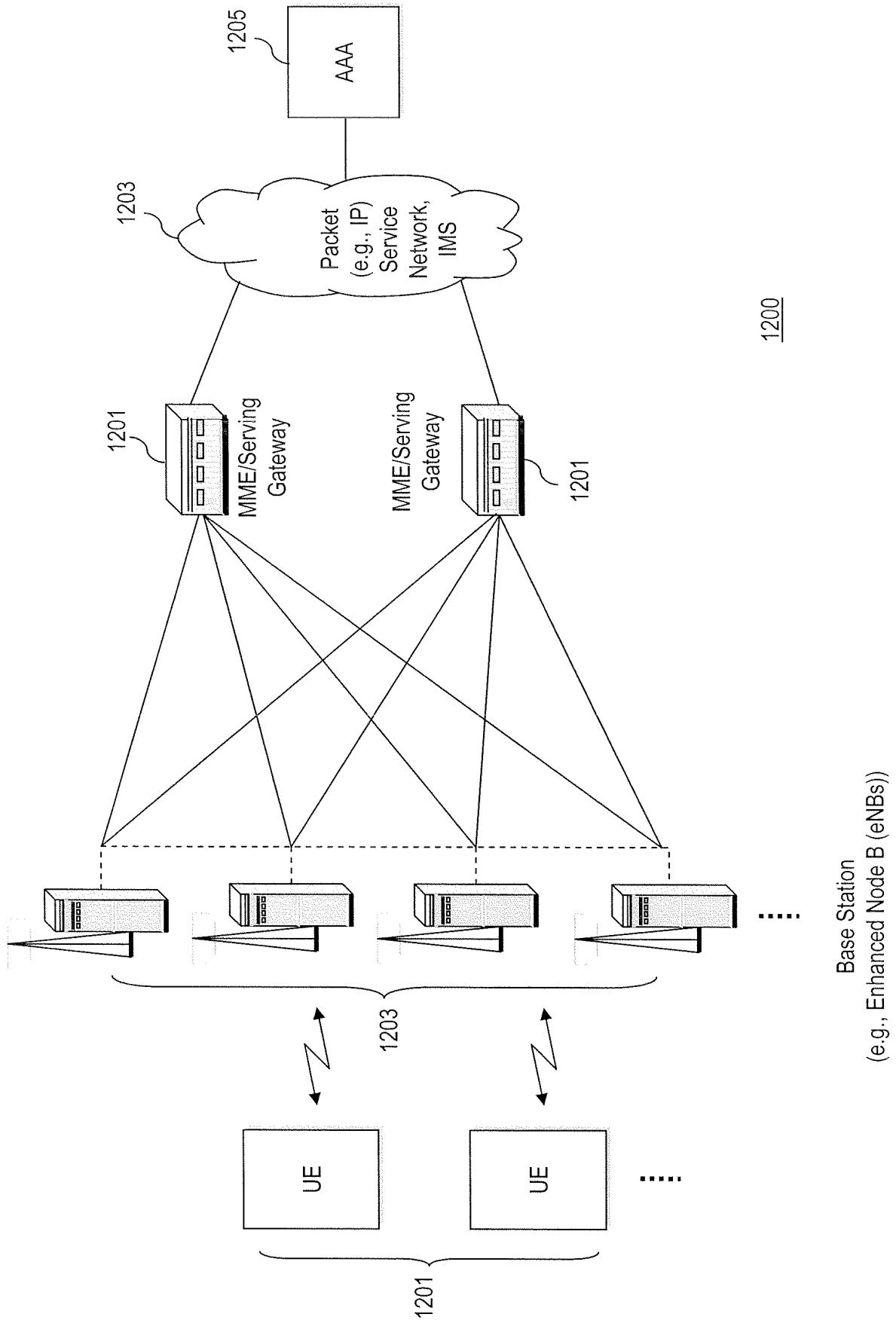


FIG. 1A

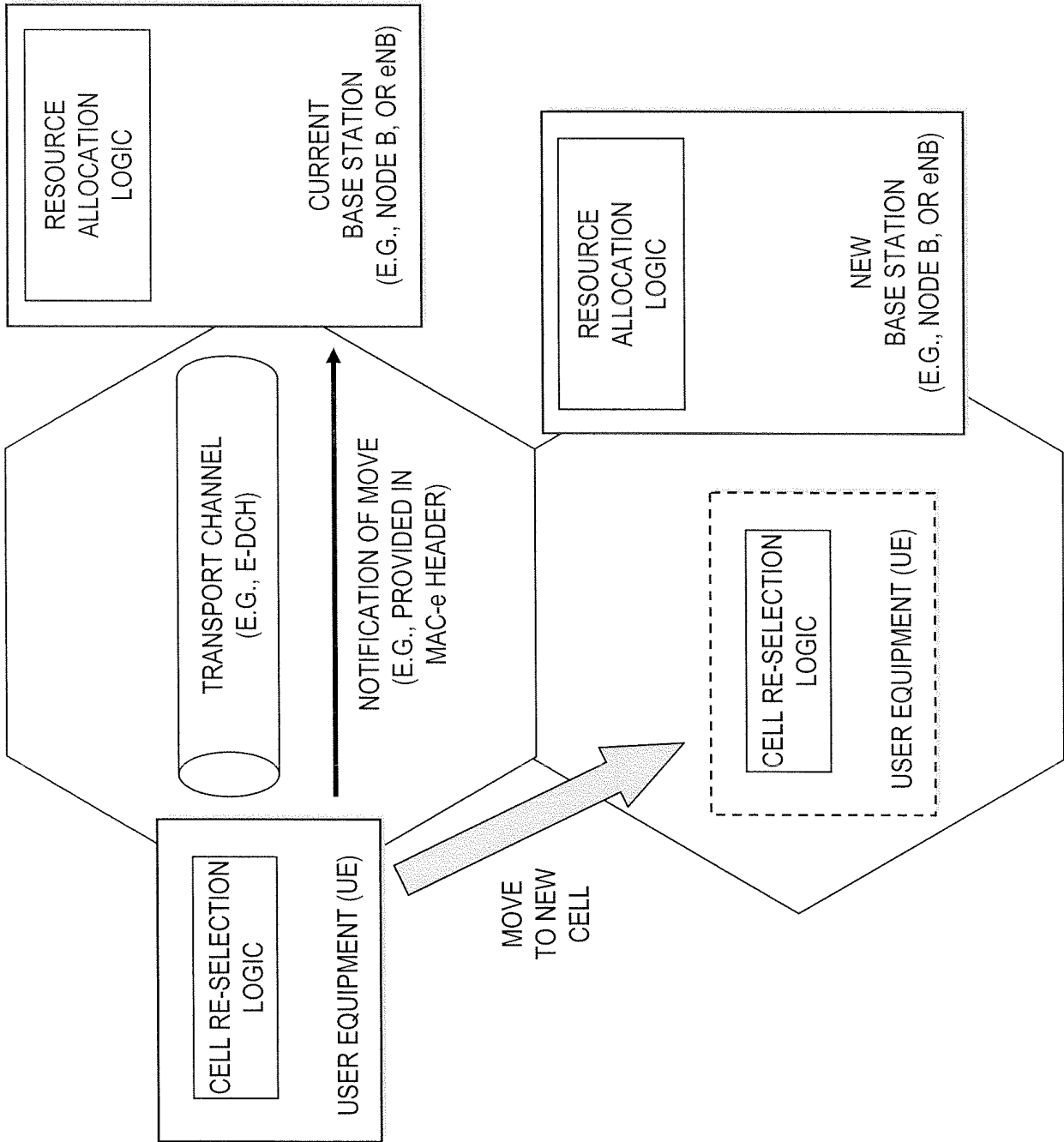


FIG. 1B

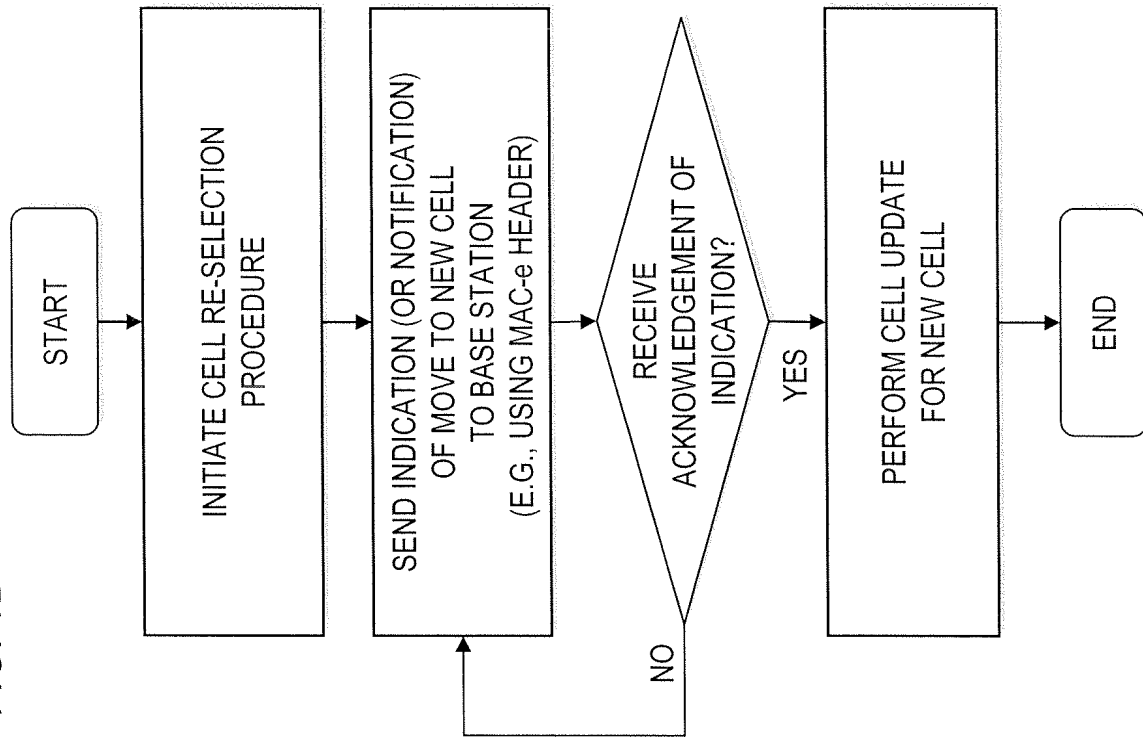


FIG. 1C

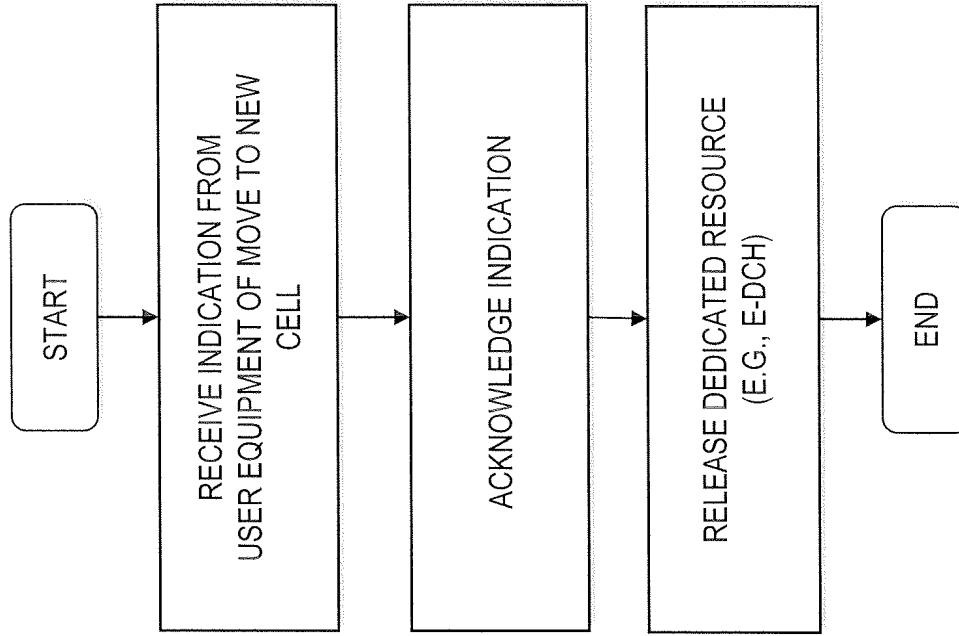


FIG. 1D

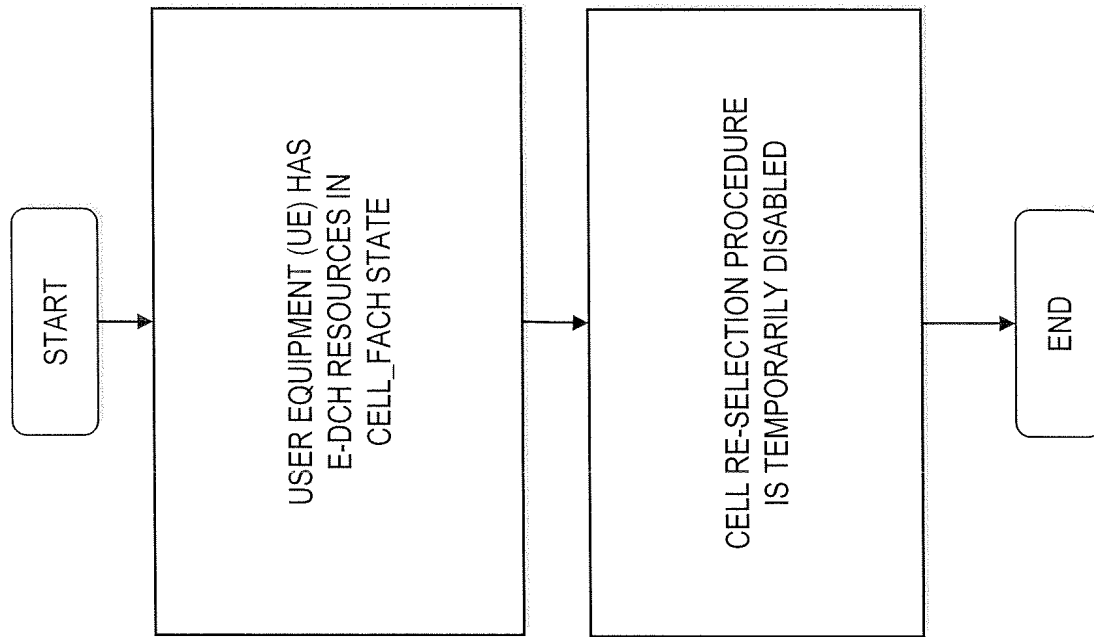


FIG. 2

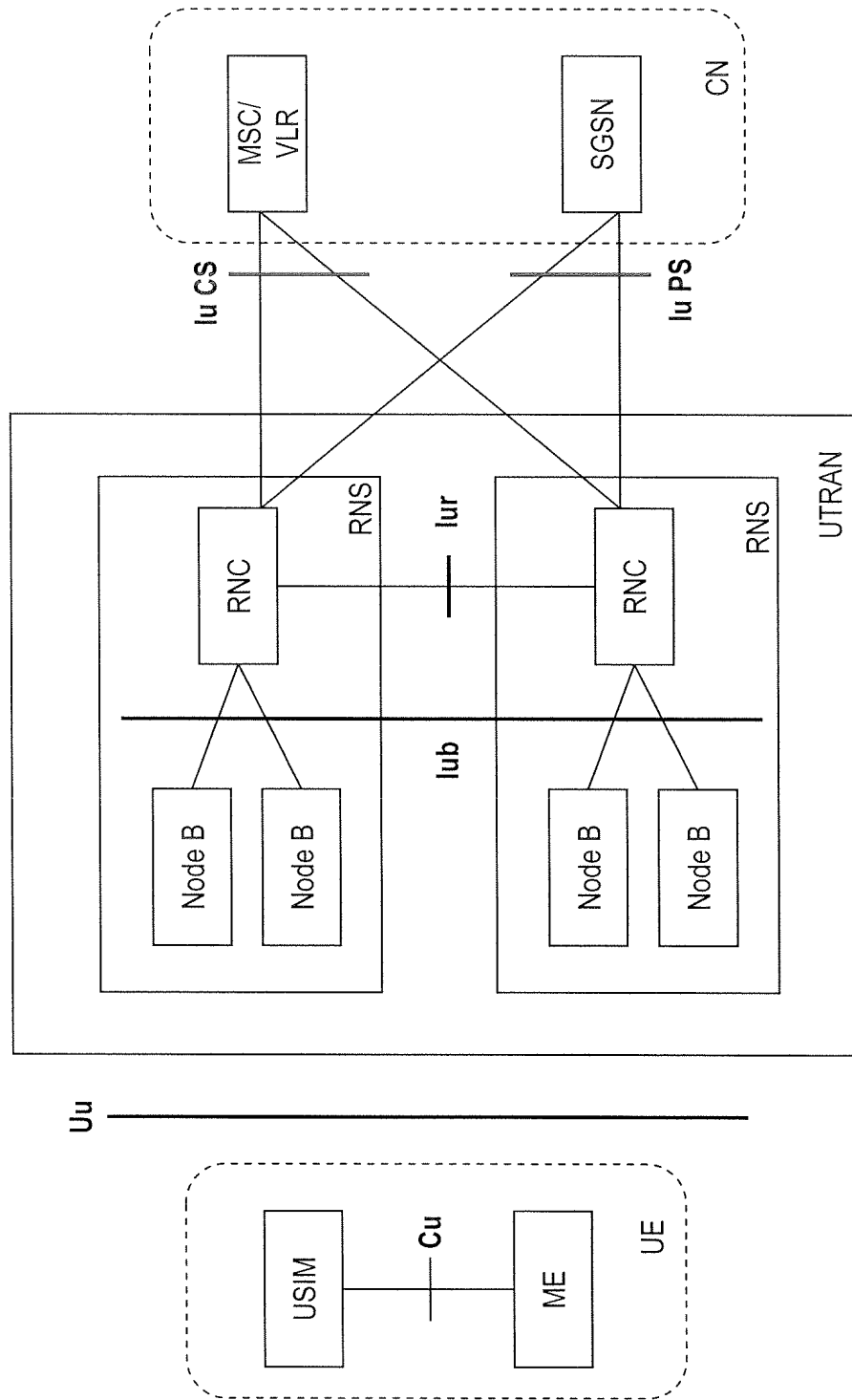


FIG. 3

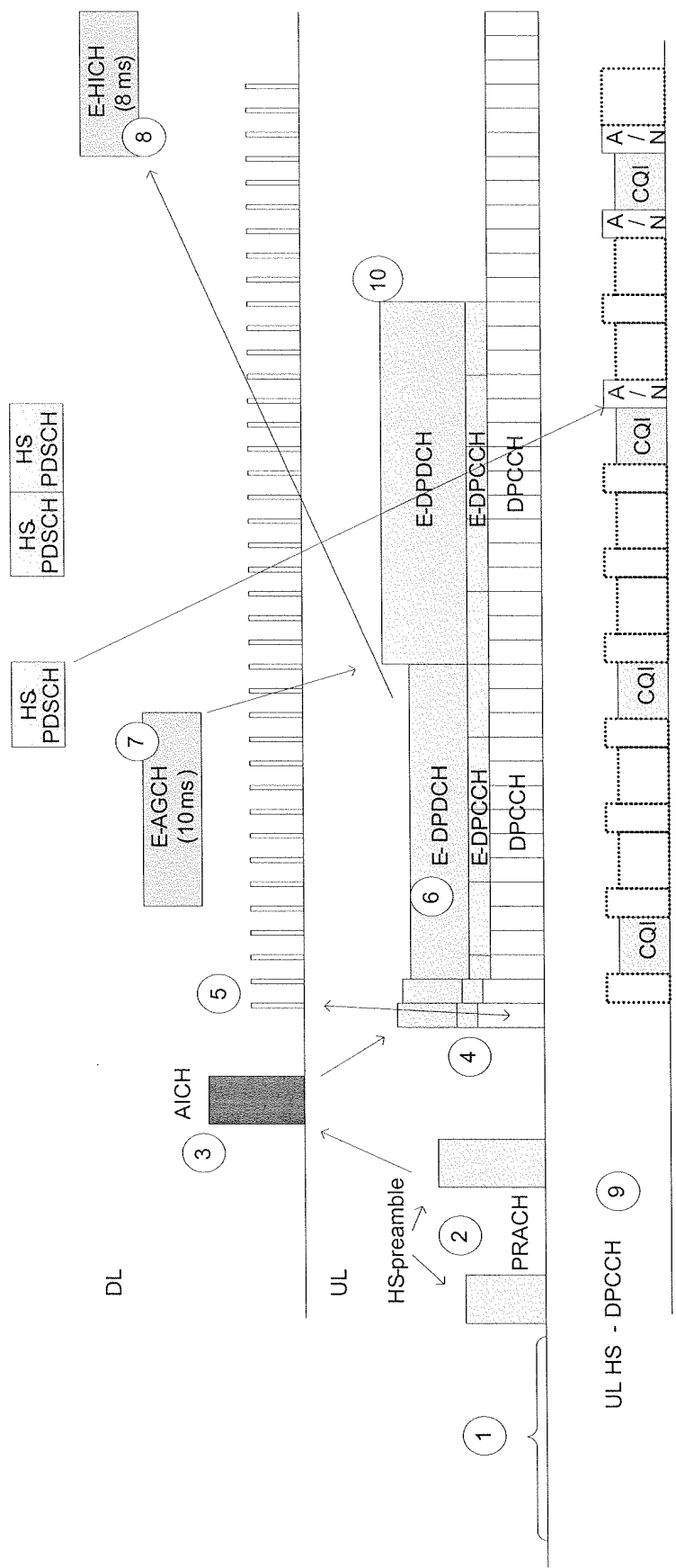
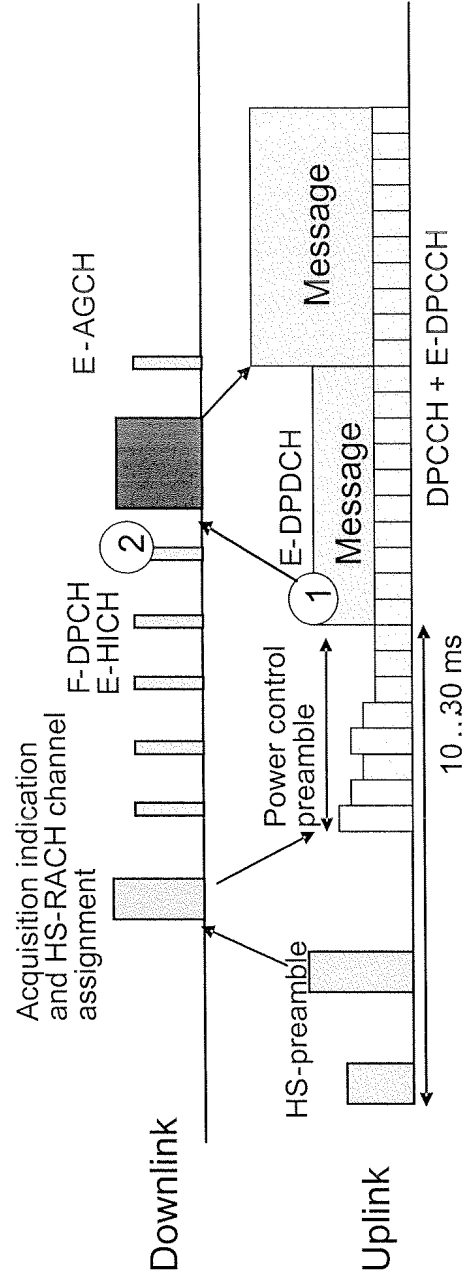
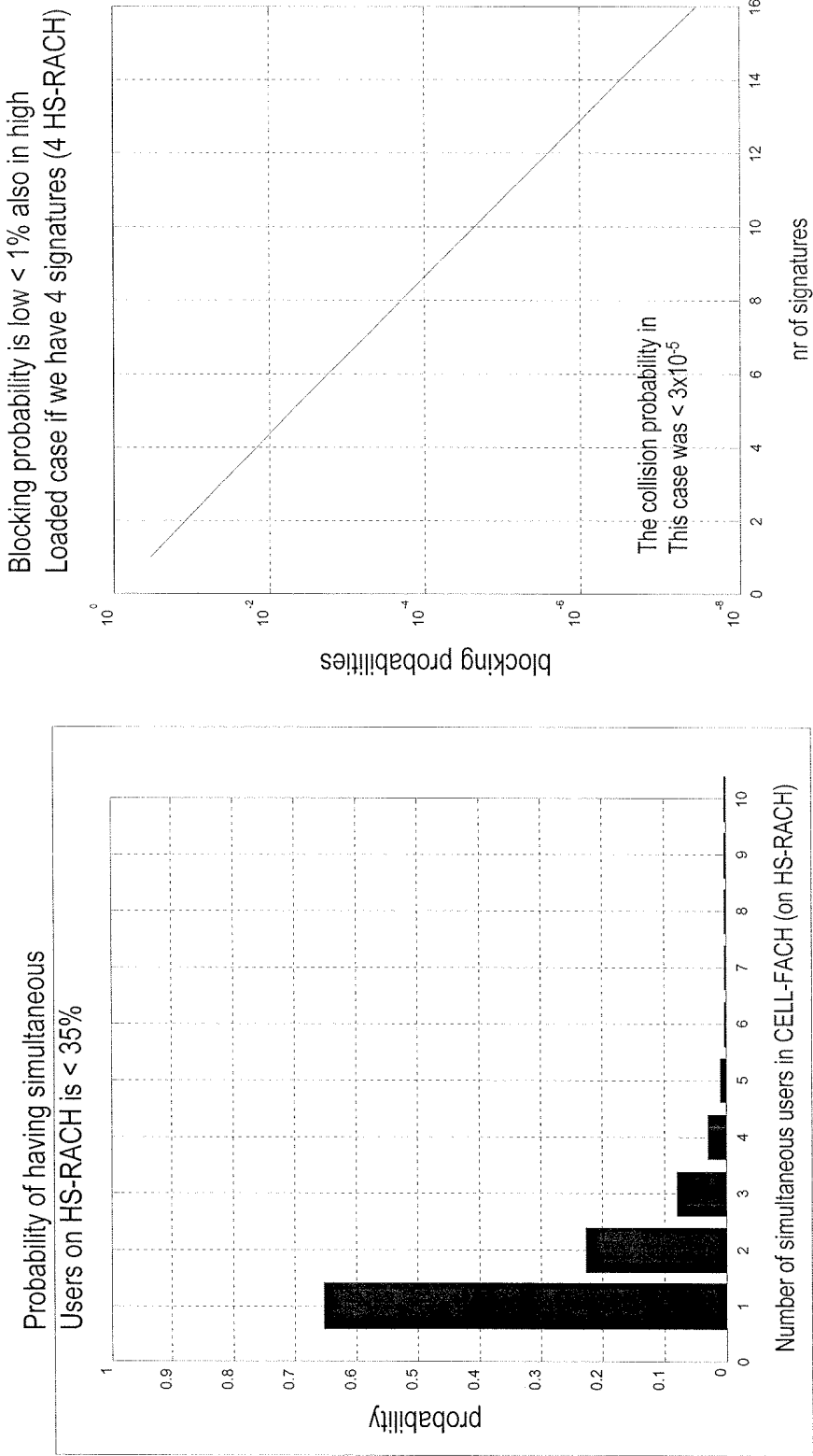


FIG. 4



- ① = One or several E-DPCH channels reserved for HS-RACH common usage
- ② = L1 feedback carried on downlink common channels

FIG. 5A

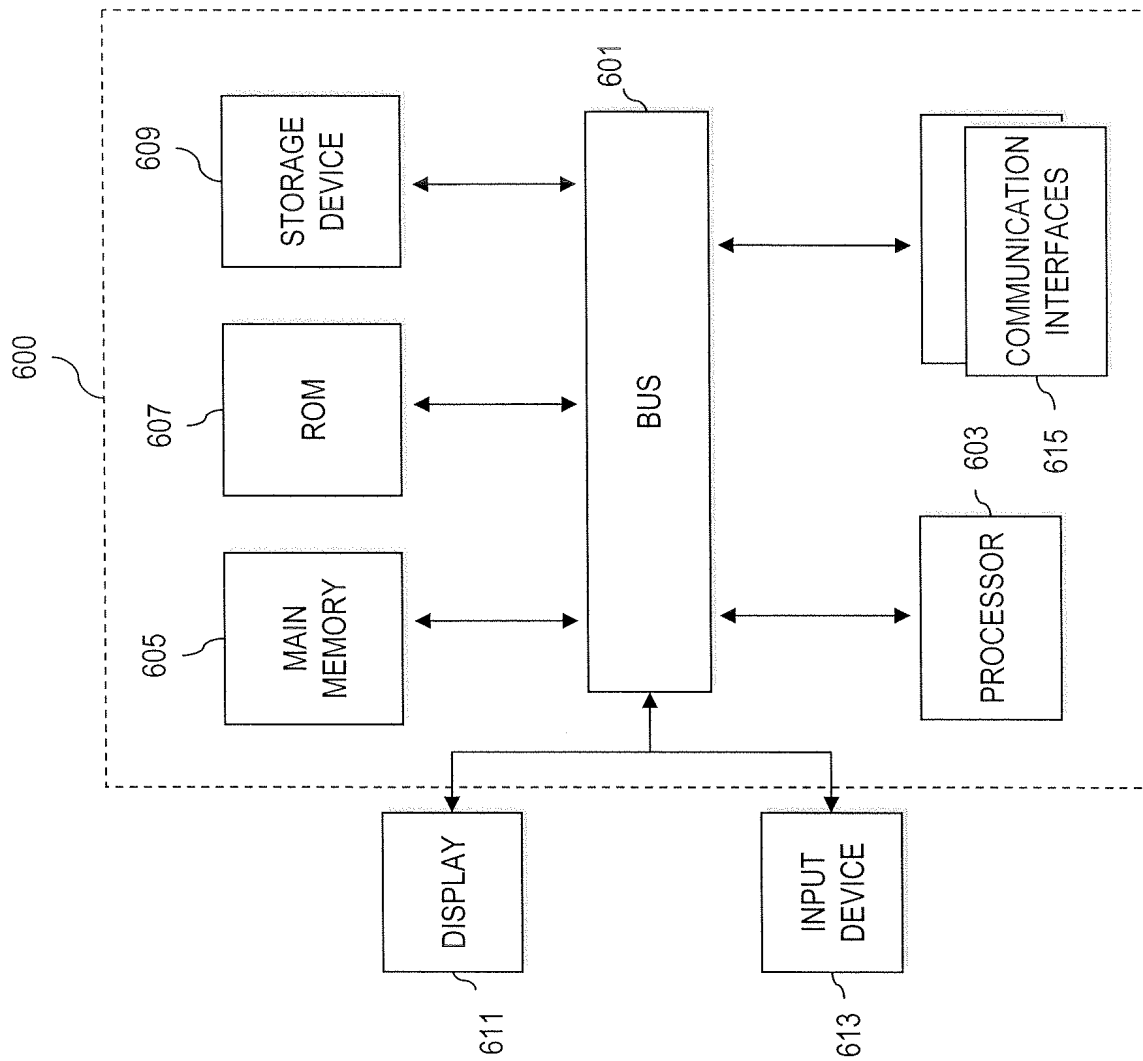


Conclusions

- collision probability very low < 0.01%
- Blocking probability is low if we have 1-4 HS-RACH

FIG. 5B

FIG. 6



The block diagram illustrates the architecture of a mobile station 701. The system is divided into several functional blocks and interfaces:

- Baseband Processor (715):** A dashed box containing the core RF processing components:
 - Demodulator (741):** Receives signals from the antenna (717) through the Duplexer (721) and the LNA (737).
 - Down-Converter (739):** Connected to the Demodulator (741) and the Synthesizer (733).
 - Synthesizer (733):** Provides frequency reference to the Down-Converter (739) and the Up-Converter (731).
 - Up-Converter (731):** Connected to the Synthesizer (733) and the PA (719).
 - Modulator (727):** Receives data from the DSP (705) and the RF Interface (729).
 - Duplexer (721):** Manages the flow of signals between the antenna (717) and the baseband processor.
 - PA (719):** Amplifies signals for transmission through the antenna (717).
- Baseband Interface (729):** Connects the RF Interface to the Modulator (727) and the Demodulator (741).
- Equalizer (725):** Receives signals from the Demodulator (741) and provides equalized signals to the Modulator (727).
- DSP (705):** The Digital Signal Processor, which handles baseband processing and is connected to the MCU (703) and the ASIC BACKPLANE.
- MCU (703):** The Microcontroller Unit, which manages the overall operation of the mobile station and is connected to the DSP (705), MEMORY (751), and various user interfaces.
- MEMORY (751):** Provides storage for the mobile station's data and programs.
- ASIC BACKPLANE:** A central interconnect that links the DSP (705), MCU (703), and the baseband processor (715).
- User Interfaces and Peripherals:**
 - Keyboard (747):** For user input.
 - Display (707):** For visual output.
 - SIM Card (749):** A Subscriber Identity Module card, shown in a dashed box, used for network authentication.
 - Battery Interface & Power Control (720):** Manages the power supply for the mobile station.
- Audio Path (709):** A dashed box containing:
 - AUDIO INTERFACE (713):** Connects the DSP (705) to the CODEC.
 - CODEC (723):** Contains the **ADC (743)** and **DAC (745)**.
 - Antennas (711):** Two external antennas are shown connected to the CODEC.

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Filing Date:				
Title of Invention:		METHOD AND APPARATUS FOR PROVIDING CELL RE-SELECTION		
First Named Inventor/Applicant Name:		Sami-Jukka Hakola		
Filer:		Phouphanomketh Ditthavong/Anna McClure		
Attorney Docket Number:		01057-1255		
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Provisional Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Provisional application filing	1005	1	210	210
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
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First Named Inventor/Applicant Name:	Sami-Jukka Hakola
Customer Number:	30671
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Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
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