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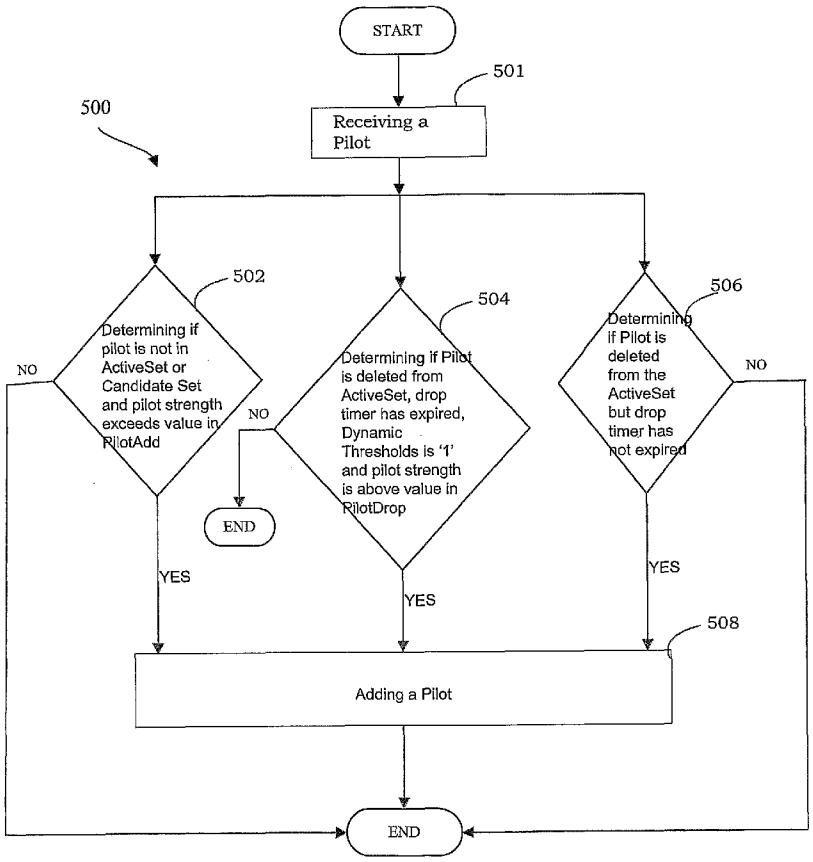
(54) Title: CANDIDATE SET MANAGEMENT IN A WIRELESS COMMUNICATION SYSTEM



(57) Abstract: A method and apparatus for Candidate Set management is provided, comprising receiving a pilot signal and determining if the pilot signal is not already in an Active set or Candidate set and determining if the strength of the pilot signal exceeds a value specified by PilotAdd. A method and apparatus for Candidate Set management are further provided, comprising receiving a pilot signal and determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop. A method and apparatus for Candidate Set management are further provided, comprising receiving a pilot signal and determining if the pilot signal is deleted from an Active set but a drop timer of the pilot signal has not expired.

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CANDIDATE SET MANAGEMENT IN A WIRELESS COMMUNICATION SYSTEM

CLAIM OF PRIORITY UNDER 35 U.S.C. §119

[0001] The present Application for Patent claims priority to Provisional Application Ser. No. 60/731,126, entitled "METHOD AND APPARATUS FOR PROVIDING MOBILE BROADBAND WIRELESS LOWER MAC", filed October 27, 2005, assigned to the assignee hereof, and expressly incorporated herein by reference.

BACKGROUND

Field

[0002] The present disclosure relates generally to wireless communication, and more particularly to method and apparatus for Candidate set management.

Background

[0003] Wireless communication systems have become a prevalent means by which a majority of people worldwide have come to communicate. Wireless communication devices have become smaller and more powerful in order to meet consumer needs and to improve portability and convenience. The increase in processing power in mobile devices such as cellular telephones has lead to an increase in demands on wireless network transmission systems. Such systems typically are not as easily updated as the cellular devices that communicate there over. As mobile device capabilities expand, it can be difficult to maintain an older wireless network system in a manner that facilitates fully exploiting new and improved wireless device capabilities.

[0004] Wireless communication systems generally utilize different approaches to generate transmission resources in the form of channels. These systems may be code division multiplexing (CDM) systems, frequency division multiplexing (FDM) systems, and time division multiplexing (TDM) systems. One commonly utilized variant of FDM is orthogonal frequency division multiplexing (OFDM) that effectively partitions the overall system bandwidth into multiple orthogonal subcarriers. These subcarriers may also be referred to as tones, bins, and frequency channels. Each subcarrier can be

modulated with data. With time division based techniques, each subcarrier can comprise a portion of sequential time slices or time slots. Each user may be provided with a one or more time slot and subcarrier combinations for transmitting and receiving information in a defined burst period or frame. The hopping schemes may generally be a symbol rate hopping scheme or a block hopping scheme.

[0005] Code division based techniques typically transmit data over a number of frequencies available at any time in a range. In general, data is digitized and spread over available bandwidth, wherein multiple users can be overlaid on the channel and respective users can be assigned a unique sequence code. Users can transmit in the same wide-band chunk of spectrum, wherein each user's signal is spread over the entire bandwidth by its respective unique spreading code. This technique can provide for sharing, wherein one or more users can concurrently transmit and receive. Such sharing can be achieved through spread spectrum digital modulation, wherein a user's stream of bits is encoded and spread across a very wide channel in a pseudo-random fashion. The receiver is designed to recognize the associated unique sequence code and undo the randomization in order to collect the bits for a particular user in a coherent manner.

[0006] A typical wireless communication network (*e.g.*, employing frequency, time, and/or code division techniques) includes one or more base stations that provide a coverage area and one or more mobile (*e.g.*, wireless) terminals that can transmit and receive data within the coverage area. A typical base station can simultaneously transmit multiple data streams for broadcast, multicast, and/or unicast services, wherein a data stream is a stream of data that can be of independent reception interest to a mobile terminal. A mobile terminal within the coverage area of that base station can be interested in receiving one, more than one or all the data streams transmitted from the base station. Likewise, a mobile terminal can transmit data to the base station or another mobile terminal. In these systems the bandwidth and other system resources are assigned utilizing a scheduler.

[0007] The signals, signal formats, signal exchanges, methods, processes, and techniques disclosed herein provide several advantages over known approaches. These include, for example, reduced signaling overhead, improved system throughput, increased signaling flexibility, reduced information processing, reduced transmission

bandwidth, reduced bit processing, increased robustness, improved efficiency, and reduced transmission power.

SUMMARY

[0008] The following presents a simplified summary of one or more aspects in order to provide a basic understanding of such aspects. This summary is not an extensive overview of all contemplated aspects, and is intended to neither identify key or critical elements of all aspects nor delineate the scope of any or all aspects. Its sole purpose is to present some concepts of one or more aspects in a simplified form as a prelude to the more detailed description that is presented later.

[0009] According to an embodiment, a method is provided for Candidate set management, the method comprising receiving a pilot signal and determining if the pilot signal is not already in an Active set or a Candidate set and determining if the strength of the pilot signal exceeds a value specified by a PilotAdd

[0010] According to another embodiment, a computer readable medium is described having a first set of instructions for receiving a pilot signal, a second set of instructions for determining if the pilot signal is not already in an Active set or a Candidate set and a third set of instructions for determining if the strength of the pilot signal exceeds a value specified by PilotAdd.

[0011] According to yet another embodiment, an apparatus operable in a wireless communication system is described which comprises means for receiving a pilot signal and means for determining if the pilot signal is not already in an Active set or a Candidate set and means for determining if the strength of the pilot signal exceeds a value specified by PilotAdd.

[0012] According to an embodiment, a method is provided for Candidate set management, the method comprising receiving a pilot signal and determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop.

[0013] According to another embodiment, a computer readable medium is described having a first set of instructions for receiving a pilot signal and a second set of instructions for determining if the pilot signal is deleted from an Active set, if a drop

timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop.

[0014] According to yet another embodiment, an apparatus operable in a wireless communication system is described which comprises means for receiving a pilot signal and means for determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop.

[0015] According to an embodiment, a method is provided for Candidate set management, the method comprising receiving a pilot signal and determining if the pilot signal is deleted from an Active set, but a drop timer of the pilot signal has not expired.

[0016] According to another embodiment, a computer readable medium is described having a first set of instructions for receiving a pilot signal and a second set of instructions for determining if the pilot signal is deleted from an Active set but a drop timer of the pilot signal has not expired.

[0017] According to yet another embodiment, an apparatus operable in a wireless communication system is described which comprises means for receiving a pilot signal and means for determining if the pilot signal is deleted from an Active set but a drop timer of the pilot signal has not expired.

[0018] To the accomplishment of the foregoing and related ends, the one or more aspects comprise the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth in detail certain illustrative aspects of the one or more aspects. These aspects are indicative, however, of but a few of the various ways in which the principles of various aspects may be employed and the described aspects are intended to include all such aspects and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Fig. 1 illustrates aspects of a multiple access wireless communication system;

[0020] Fig. 2 illustrates aspects of a transmitter and receiver in a multiple access wireless communication system;

[0021] Figs. 3A and 3B illustrate aspects of superframe structures for a multiple access wireless communication system;

[0022] Fig. 4 illustrates aspect of a communication between an access terminal and an access network;

[0023] Fig. 5A illustrates a flow diagram of a process used by the access terminal; and

[0024] Fig. 5B illustrates one or more processors configured for Candidate set management.

DETAILED DESCRIPTION

[0025] Various aspects are now described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more aspects. It may be evident, however, that such aspect(s) may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to facilitate describing one or more aspects.

[0026] Referring to Fig. 1, a multiple access wireless communication system according to one aspect is illustrated. A multiple access wireless communication system 100 includes multiple cells, e.g. cells 102, 104, and 106. In the aspect of Fig. 1, each cell 102, 104, and 106 may include an access point 150 that includes multiple sectors. The multiple sectors are formed by groups of antennas each responsible for communication with access terminals in a portion of the cell. In cell 102, antenna groups 112, 114, and 116 each correspond to a different sector. In cell 104, antenna groups 118, 120, and 122 each correspond to a different sector. In cell 106, antenna groups 124, 126, and 128 each correspond to a different sector.

[0027] Each cell includes several access terminals which are in communication with one or more sectors of each access point. For example, access terminals 130 and 132 are in communication base 142, access terminals 134 and 136 are in communication with access point 144, and access terminals 138 and 140 are in communication with access point 146.

[0028] Controller 130 is coupled to each of the cells 102, 104, and 106. Controller 130 may contain one or more connections to multiple networks, e.g. the Internet, other packet based networks, or circuit switched voice networks that provide information to, and from, the access terminals in communication with the cells of the multiple access wireless communication system 100. The controller 130 includes, or is coupled with, a scheduler that schedules transmission from and to access terminals. In other aspects, the scheduler may reside in each individual cell, each sector of a cell, or a combination thereof.

[0029] As used herein, an access point may be a fixed station used for communicating with the terminals and may also be referred to as, and include some or all the functionality of, a base station, a Node B, or some other terminology. An access terminal may also be referred to as, and include some or all the functionality of, a user equipment (UE), a wireless communication device, terminal, a mobile station or some other terminology.

[0030] It should be noted that while Fig. 1, depicts physical sectors, i.e. having different antenna groups for different sectors, other approaches may be utilized. For example, utilizing multiple fixed "beams" that each cover different areas of the cell in frequency space may be utilized in lieu of, or in combination with physical sectors. Such an approach is depicted and disclosed in co-pending US Patent Application Serial No. 11/260,895, entitled "Adaptive Sectorization in Cellular System."

[0031] Referring to Fig.2, a block diagram of an aspect of a transmitter system 210 and a receiver system 250 in a MIMO system 200 is illustrated. At transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to transmit (TX) data processor 214. In an aspect, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

[0032] The coded data for each data stream may be multiplexed with pilot data using OFDM, or other orthogonalization or non-orthogonalization techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on one or

more particular modulation schemes (e.g., BPSK, QSPK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed on provided by processor 230.

[0033] The modulation symbols for all data streams are then provided to a TX processor 220, which may further process the modulation symbols (e.g., for OFDM). TX processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

[0034] At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254. Each receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

[0035] An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The processing by RX data processor 260 is described in further detail below. Each detected symbol stream includes symbols that are estimates of the modulation symbols transmitted for the corresponding data stream. RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 218 is complementary to that performed by TX processor 220 and TX data processor 214 at transmitter system 210.

[0036] RX data processor 260 may be limited in the number of subcarriers that it may simultaneously demodulate, e.g. 512 subcarriers or 5 MHz, and such a receiver should be scheduled on a single carrier. This limitation may be a function of its FFT range, e.g. sample rates at which the processor 260 may operate, the memory available

for FFT, or other functions available for demodulation. Further, the greater the number of subcarriers utilized, the greater the expense of the access terminal.

[0037] The channel response estimate generated by RX processor 260 may be used to perform space, space/time processing at the receiver, adjust power levels, change modulation rates or schemes, or other actions. RX processor 260 may further estimate the signal-to-noise-and-interference ratios (SNRs) of the detected symbol streams, and possibly other channel characteristics, and provides these quantities to a processor 270. RX data processor 260 or processor 270 may further derive an estimate of the "operating" SNR for the system. Processor 270 then provides channel state information (CSI), which may comprise various types of information regarding the communication link and/or the received data stream. For example, the CSI may comprise only the operating SNR. In other aspects, the CSI may comprise a channel quality indicator (CQI), which may be a numerical value indicative of one or more channel conditions. The CSI is then processed by a TX data processor 278, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

[0038] At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and processed by a RX data processor 242 to recover the CSI reported by the receiver system. The reported CSI is then provided to processor 230 and used to (1) determine the data rates and coding and modulation schemes to be used for the data streams and (2) generate various controls for TX data processor 214 and TX processor 220. Alternatively, the CSI may be utilized by processor 270 to determine modulation schemes and/or coding rates for transmission, along with other information. This may then be provided to the transmitter which uses this information, which may be quantized, to provide later transmissions to the receiver.

[0039] Processors 230 and 270 direct the operation at the transmitter and receiver systems, respectively. Memories 232 and 272 provide storage for program codes and data used by processors 230 and 270, respectively.

[0040] At the receiver, various processing techniques may be used to process the N_R received signals to detect the N_T transmitted symbol streams. These receiver processing techniques may be grouped into two primary categories (i) spatial and space-time

receiver processing techniques (which are also referred to as equalization techniques); and (ii) "successive nulling/equalization and interference cancellation" receiver processing technique (which is also referred to as "successive interference cancellation" or "successive cancellation" receiver processing technique).

[0041] While Fig. 2 discusses a MIMO system, the same system may be applied to a multi-input single-output system where multiple transmit antennas, e.g. those on a base station, transmit one or more symbol streams to a single antenna device, e.g. a mobile station. Also, a single output to single input antenna system may be utilized in the same manner as described with respect to Fig. 2.

[0042] The transmission techniques described herein may be implemented by various means. For example, these techniques may be implemented in hardware, firmware, software, or a combination thereof. For a hardware implementation, the processing units at a transmitter may be implemented within one or more application specific integrated circuits (ASICs), digital signal processors (DSPs), digital signal processing devices (DSPDs), programmable logic devices (PLDs), field programmable gate arrays (FPGAs), processors, controllers, micro-controllers, microprocessors, electronic devices, other electronic units designed to perform the functions described herein, or a combination thereof. The processing units at a receiver may also be implemented within one or more ASICs, DSPs, processors, and so on.

[0043] For a software implementation, the transmission techniques may be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. The software codes may be stored in a memory (e.g., memory 230, 272x or 272y in FIG. 2) and executed by a processor (e.g., processor 232, 270x or 270y). The memory may be implemented within the processor or external to the processor.

[0044] It should be noted that the concept of channels herein refers to information or transmission types that may be transmitted by the access point or access terminal. It does not require or utilize fixed or predetermined blocks of subcarriers, time periods, or other resources dedicated to such transmissions.

[0045] Referring to Figs. 3A and 3B, aspects of superframe structures for a multiple access wireless communication system are illustrated. Fig. 3A illustrates aspects of superframe structures for a frequency division duplexed (FDD) multiple access wireless

communication system, while Fig. 3B illustrates aspects of superframe structures for a time division duplexed (TDD) multiple access wireless communication system. The superframe preamble may be transmitted separately for each carrier or may span all of the carriers of the sector.

[0046] In both Figs. 3A and 3B, the forward link transmission is divided into units of superframes. A superframe may consist of a superframe preamble followed by a series of frames. In an FDD system, the reverse link and the forward link transmission may occupy different frequency bandwidths so that transmissions on the links do not, or for the most part do not, overlap on any frequency subcarriers. In a TDD system, N forward link frames and M reverse link frames define the number of sequential forward link and reverse link frames that may be continuously transmitted prior to allowing transmission of the opposite type of frame. It should be noted that the number of N and M may be vary within a given superframe or between superframes.

[0047] In both FDD and TDD systems each superframe may comprise a superframe preamble. In certain aspects, the superframe preamble includes a pilot channel that includes pilots that may be used for channel estimation by access terminals, a broadcast channel that includes configuration information that the access terminal may utilize to demodulate the information contained in the forward link frame. Further acquisition information such as timing and other information sufficient for an access terminal to communicate on one of the carriers and basic power control or offset information may also be included in the superframe preamble. In other cases, only some of the above and/or other information may be included in this superframe preamble.

[0048] As shown in Figs. 3A and 3B, the superframe preamble is followed by a sequence of frames. Each frame may consist of a same or a different number of OFDM symbols, which may constitute a number of subcarriers that may simultaneously utilized for transmission over some defined period. Further, each frame may operate according to a symbol rate hopping mode, where one or more non-contiguous OFDM symbols are assigned to a user on a forward link or reverse link, or a block hopping mode, where users hop within a block of OFDM symbols. The actual blocks or OFDM symbols may or may not hop between frames.

[0049] Fig. 4 illustrates communication between an access network 404 and an access terminal 402 for Candidate set pilot management. Using a communication link

and based upon predetermined timing, system conditions, or other decision criteria, the access terminal and the access network communicate with each other. The communication link may be implemented using communication protocols/standards such as World Interoperability for Microwave Access (WiMAX), infrared protocols such as Infrared Data Association (IrDA), short-range wireless protocols/technologies, Bluetooth® technology, ZigBee® protocol, ultra wide band (UWB) protocol, home radio frequency (HomeRF), shared wireless access protocol (SWAP), wideband technology such as a wireless Ethernet compatibility alliance (WECA), wireless fidelity alliance (Wi-Fi Alliance), 802.11 network technology, public switched telephone network technology, public heterogeneous communications network technology such as the Internet, private wireless communications network, land mobile radio network, code division multiple access (CDMA), wideband code division multiple access (WCDMA), universal mobile telecommunications system (UMTS), advanced mobile phone service (AMPS), time division multiple access (TDMA), frequency division multiple access (FDMA), orthogonal frequency division multiple (OFDM), orthogonal frequency division multiple access (OFDMA), orthogonal frequency division multiple FLASH (OFDM-FLASH), global system for mobile communications (GSM), single carrier (1X) radio transmission technology (RTT), evolution data only (EV-DO) technology, general packet radio service (GPRS), enhanced data GSM environment (EDGE), high speed downlink data packet access (HSPDA), analog and digital satellite systems, and any other technologies/protocols that may be used in at least one of a wireless communications network and a data communications network.

[0050] The access terminal 402 estimates the strength of the Forward Channel transmitted by each sector in its neighbourhood. The estimate is based on measuring the strength of the forward Pilot Channel, henceforth referred to as a pilot signal. When the Active Set Management protocol is in Connected state, the access terminal 402 uses pilot signal strength to decide when to generate a PilotReport message. When the protocol is in Idle state, the access terminal 402 uses pilot signal strength to decide which sector's Control Channel it has to monitor.

[0051] The pilot sets that support the Active Set management process are - *Active Set, Candidate Set, Neighbor Set and Remaining Set.*

[0052] The set of pilots associated with sectors currently serving the access terminal 402 are included in the *Active Set.* When a connection is open, a sector is considered to be serving the access terminal 402 when there is a MACID assigned to the access terminal in that sector. When the connection is not open, a sector is considered to be serving the access terminal 402 when the access terminal 402 is monitoring that sector's control channel for page reception and distance based registration. Parameters for Active set member sectors in connected state are sent as part of the ActiveSetAssignment message, and placed in the public data of the Active Set Management protocol.

[0053] The pilot signals that are not in the *Active Set* but are received by the access terminal 402 with sufficient strength to indicate that the sectors transmitting them are good candidates for inclusion in the *Active Set* comprise the *Candidate Set*

[0054] The set of pilots that are not in either one of the two previous sets, but are likely candidates for inclusion in the *Active Set,* comprise the *Neighbor Set* .

[0055] The set of all possible pilots on the current channel assignment, excluding the pilots that are in any of the three previous sets, comprise the *Remaining Set.*

[0056] At any given instant a pilot in the current channel is a member of exactly one set. The access terminal maintains all four sets and the access network maintains the *Active Set.*

[0057] The access terminal 402 will continually search for pilots in the connected state and whenever it is monitoring any channel in the Idle state. The access terminal 402 will search for pilots in all pilot sets. The access terminal should use the same search priority for pilot signals in the *Active Set and Candidate Set.* In descending order of search rate, the access terminal 402 will search the pilot signals in the *Active Set* and *Candidate Set,* then will search the pilot signals in the *Neighbor Set,* and lastly will search the pilot signals in the *Remaining Set.*

[0058] The access terminal 402 will measure the strength of every pilot signal it searches. The strength estimate formed by the access terminal 402 will be computed as the ratio of received pilot energy per chip, E_C, to tptal received spectral density, I_o,(signal and noise). The access terminal 402 will place the measured ratios in its public data.The public data of the Overhead Message Protocol also contains this measured value, 1.5. In addition, the access terminal 402 will also measure the received

power(RxPower) in dBm from each acquisition pilot at the antenna input and place the result in the public data. If the access terminal 402 has more than one receiving antenna, the power will be averaged across all antennas. If a pilot is not being measured, the RxPower will be assumed to be negative infinity. The access terminal 402 should update the measured power every superframe.

[0059] For performing Candidate set management, the access terminal 402 supports a maximum Candidate set size of $N_{ASMPCandidate}$ pilots. The access terminal 402 will add a pilot to the Candidate set if one of the following condition is met :

a. Pilot is already in the Active Set or Candidate Set and strength of the pilot exceeds the value specified by PilotAdd.
b. Pilot is deleted from the Active set, its pilot drop timer has expired, DynamicThresholds is '1', and the pilot strength is above threshold specified by PilotDrop.
c. Pilot is deleted from the Active Set but its pilot drop timer has not expired.

[0060] Fig. 5A illustrates a flow diagram of process 500, according to an embodiment. At 501, a pilot is received at the access terminal 402. At 502, determination is done as to if the pilot signal is not in an Active Set or a Candidate Set and the pilot signal strength exceeds the value in PilotAdd. In an embodiment, the pilot is added to the Candidate set, at 508, if it is determined that the pilot is not in the Active Set or the Candidate Set and the pilot strength exceeds the value in PilotAdd. At 504, determination is done as to if the pilot signal is deleted from the Active set, if its pilot drop timer has expired, if a DynamicThresholds is '1', and if the pilot signal strength is above threshold specified by PilotDrop. In an embodiment, the pilot is added to the Candidate Set, at 508, if it is determined that the pilot signal is deleted from the Active set, if its pilot drop timer has expired, if the DynamicThresholds is '1', and if the pilot signal strength is above the threshold specified by the PilotDrop. At 506, determination is done as to if the pilot signal is deleted from the Active Set but drop timer has not expired. In an embodiment, the pilot signal is added to the Candidate Set, at 508, if it is determined that the pilot signal is deleted from the Active Set but the drop timer has not expired.

[0061] Fig. 5B illustrates a processor 550 for Candidate Set management. The processor referred to may be one or more electronic devices, and may comprise one or more processors configured to generate the permutation. Processor 551 is configured for receiving a pilot at the access terminal 402. Processor 552 is configured for determining if the pilot is not in Active Set or Candidate Set and the pilot strength exceeds the value in PilotAdd. In an embodiment, processor 558 is configured for adding the pilot signal to the Candidate set, if it is determined that the pilot signal is not in Active Set or Candidate Set and the pilot signal strength exceeds the value in PilotAdd. Processor 554 is configured for determining if the pilot signal is deleted from the Active set, its pilot drop timer has expired, DynamicThresholds is '1', and the pilot signal strength is above threshold specified by PilotDrop. In another embodiment, processor 558 is configured for adding the pilot signal to the Candidate Set, if it is determined that the pilot signal is deleted from the Active set, its pilot drop timer has expired, the DynamicThresholds is '1', and the pilot signal strength is above the threshold specified by the PilotDrop. Processor 556 is configured for determining if the pilot signal is deleted from the Active Set but drop timer has not expired. In yet another embodiment, processor 558 is configured for adding the pilot signal to the Candidate Set, if it is determined that the pilot signal is deleted from the Active Set but the drop timer has not expired. The functionality of the discrete processors 552 to 558 depicted in the figure may be combined into a single processor 560. A memory 562 is also coupled to the processor 560.

[0062] In an embodiment, an apparatus is described which comprises means for receiving a pilot signal at the access terminal 402. Further, a means is provided for determining if the pilot signal is not in Active Set or Candidate Set and the pilot signal strength exceeds the value in PilotAdd. In an embodiment, a means is provided for adding the pilot signal to the Candidate set, if it is determined that the pilot signal is not in Active Set or Candidate Set and the pilot signal strength exceeds the value in PilotAdd. A means is provided for determining if the pilot signal is deleted from the Active set, its pilot drop timer has expired, DynamicThresholds is '1', and the pilot signal strength is above threshold specified by PilotDrop. In another embodiment, a means is further provided for adding the pilot signal to the Candidate Set, if it is determined that the pilot signal is deleted from the Active set, its pilot drop timer has

expired, the DynamicThresholds is '1', and the pilot signal strength is above the threshold specified by the PilotDrop. A means is also provided for determining if the pilot signal is deleted from the Active Set but drop timer has not expired. In yet another embodiment, a means is provided for adding the pilot signal to the Candidate Set, if it is determined that the pilot signal is deleted from the Active Set but the drop timer has not expired. The means described herein may comprise one or more processors.

[0063] Furthermore, embodiments may be implemented by hardware, software, firmware, middleware, microcode, or any combination thereof. When implemented in software, firmware, middleware or microcode, the program code or code segments to perform the necessary tasks may be stored in a machine readable medium such as a separate storage(s) not shown. A processor may perform the necessary tasks. A code segment may represent a procedure, a function, a subprogram, a program, a routine, a subroutine, a module, a software package, a class, or any combination of instructions, data structures, or program statements. A code segment may be coupled to another code segment or a hardware circuit by passing and/or receiving information, data, arguments, parameters, or memory contents. Information, arguments, parameters, data, etc. may be passed, forwarded, or transmitted via any suitable means including memory sharing, message passing, token passing, network transmission, etc.

[0064] Various modifications to these aspects will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other aspects. Thus, the description is not intended to be limited to the aspects shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

CLAIMS

We claim:

1. A method for Candidate set management in a wireless communication system, characterized in that:

receiving a pilot signal;

determining if the pilot signal is not already in an Active set or a Candidate set; and

determining if the strength of the pilot signal exceeds a value specified by a PilotAdd.

2. The method as claimed in claim 1, characterized in that adding the pilot to the Candidate set if the pilot signal is not already in the Active set or the Candidate set and if the strength of the pilot signal exceeds the value specified by the PilotAdd.

3. A computer-readable medium including instructions stored thereon, characterized in that:

a first set of instructions for receiving a pilot signal;

a second set of instructions for determining if the pilot signal is not already in an Active set or a Candidate set; and

a third set of instructions for determining if the strength of the pilot signal exceeds a value specified by PilotAdd.

4. An apparatus operable in a wireless communication system, characterized in that:

means for receiving a pilot signal; and

means for determining if the pilot signal is not already in an Active set or a Candidate set; and

means for determining if the strength of the pilot signal exceeds a value specified by PilotAdd.

5. The apparatus as claimed in claim 4, characterized in that having means for adding the pilot signal to the Candidate set if the pilot signal is not already in the Active set or the Candidate set and if the strength of the pilot signal exceeds the value specified by the PilotAdd.

6. A method for Candidate set management in a wireless communication system, characterized in that:

receiving a pilot signal; and

determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop.

7. The method as claimed in claim 6, characterized in that adding the pilot signal to the Candidate set if the pilot signal is deleted from the Active set, if a drop timer of the pilot signal has expired, the DynamicThresholds value is '1' and the pilot signal strength is above the threshold specified by the PilotDrop.

8. A computer-readable medium including instructions stored thereon, characterized in that:

a first set of instructions for receiving a pilot signal; and

a second set of instructions for determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop

9. An apparatus operable in a wireless communication system, characterized in that:

means for receiving a pilot signal; and

means for determining if the pilot signal is deleted from an Active set, if a drop timer of the pilot signal has expired, if a DynamicThresholds value is '1' and if the pilot signal strength is above a threshold specified by PilotDrop .

10. The apparatus as claimed in claim 9, characterized in that having means for adding the pilot signal to the Candidate set if the pilot signal is deleted from the Active set, if a drop timer of the pilot signal has expired, the DynamicThresholds value is '1' and the pilot signal strength is above the threshold specified by the PilotDrop.

11. A method for Candidate set management in a wireless communication system, characterized in that:

receiving a pilot signal; and

determining if the pilot signal is deleted from an Active set, but a drop timer of the pilot signal has not expired.

12. The method as claimed in claim 11, characterized in that adding the pilot signal to a Candidate set if the pilot signal is deleted from the Active set but the drop timer of the pilot signal has not expired.

13. A computer-readable medium including instructions stored thereon, characterized in that:

a first set of instructions for receiving a pilot signal; and

a second set of instructions for determining if the pilot signal is deleted from an Active set but a drop timer of the pilot signal has not expired.

14. An apparatus operable in a wireless communication system, characterized in that:

means for receiving a pilot signal; and

means for determining if the pilot signal is deleted from an Active set but a drop timer of the pilot signal has not expired.

15. The apparatus as claimed in claim 14, characterized in that having for adding the pilot signal to a Candidate set if the pilot signal is deleted from the Active set but the drop timer of the pilot signal has not expired.

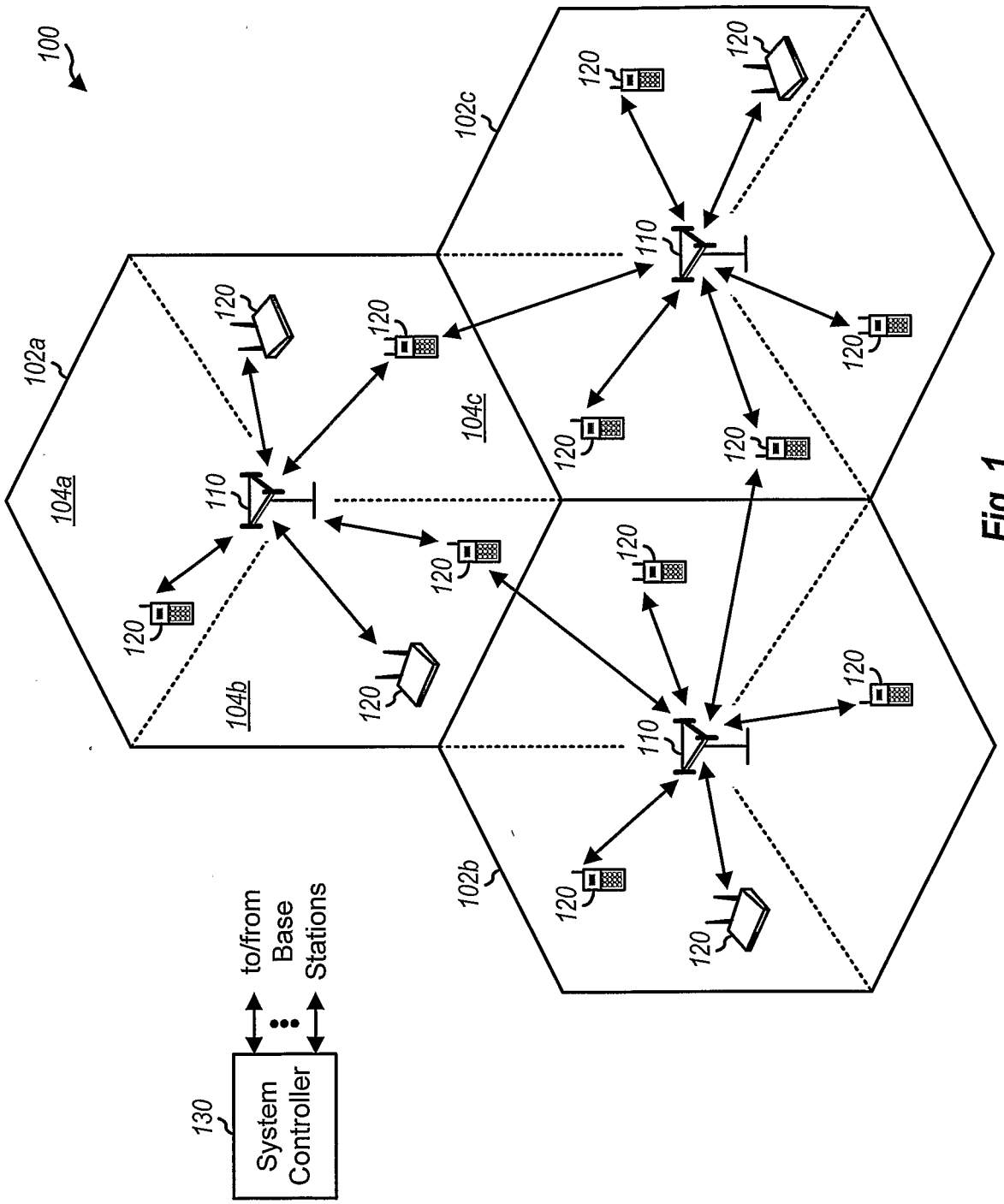
100
102a
102b
102c
104a
104b
104c
110
120
130
System Controller
to/from Base Stations

Fig. 1

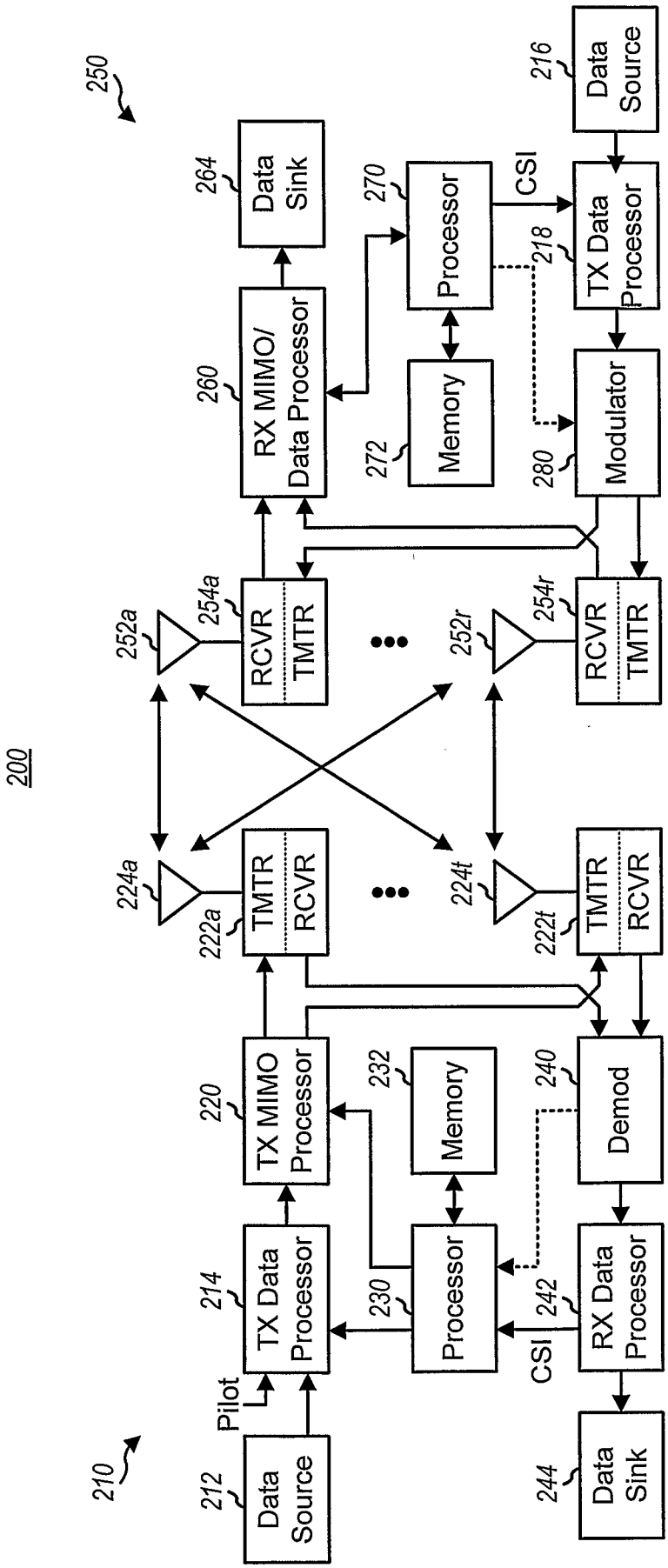
200
210
212
Data Source
Pilot
214
TX Data Processor
220
TX MIMO Processor
222a
TMTR
RCVR
224a
224t
222t
TMTR
RCVR
230
Processor
232
Memory
240
Demod
242
RX Data Processor
CSI
244
Data Sink
252a
254a
RCVR
TMTR
252r
254r
RCVR
TMTR
250
260
RX MIMO/ Data Processor
264
Data Sink
270
Processor
CSI
218
TX Data Processor
216
Data Source
272
Memory
280
Modulator

Fig 2

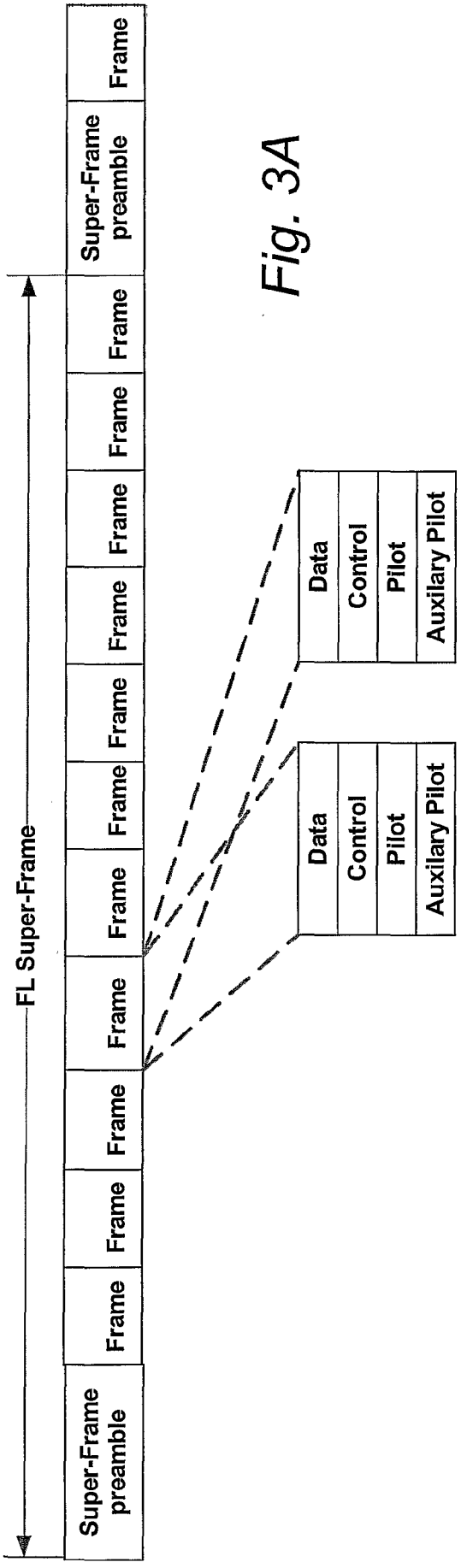
FL Super-Frame
Super-Frame preamble
Frame
Data
Control
Pilot
Auxilary Pilot
Block Hopping mode
Symbol Rate Hopping mode

Fig. 3A

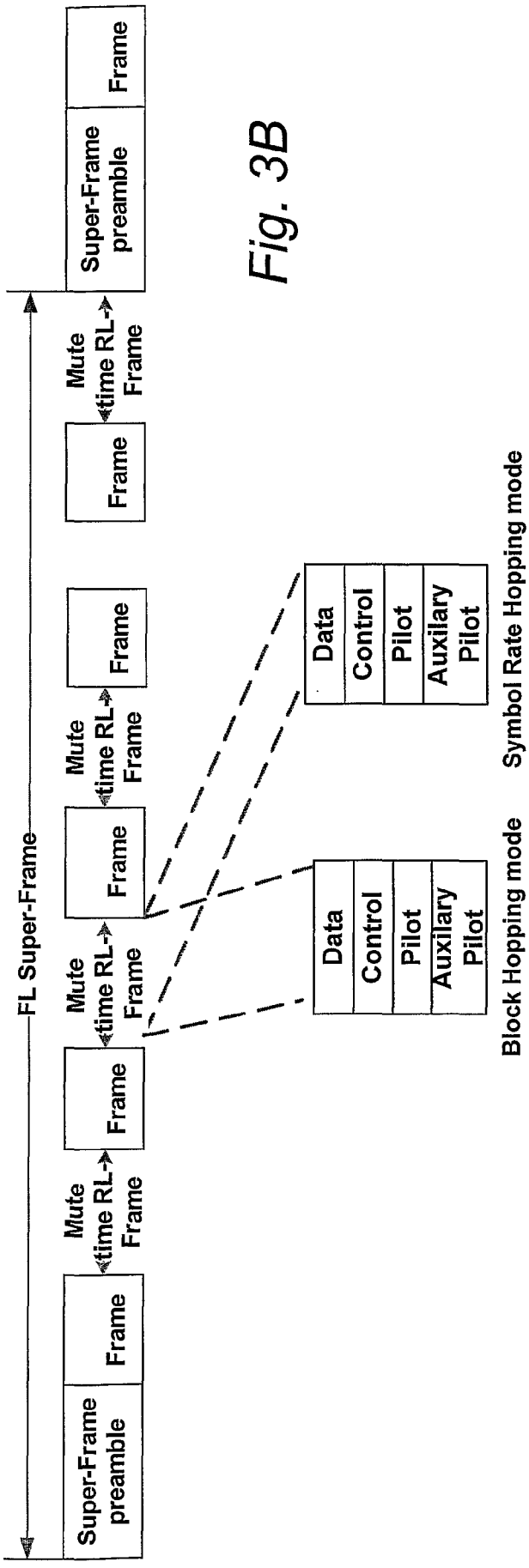
FL Super-Frame
Super-Frame preamble
Frame
Mute time RL-> Frame
Data
Control
Pilot
Auxilary Pilot
Block Hopping mode
Symbol Rate Hopping mode

Fig. 3B

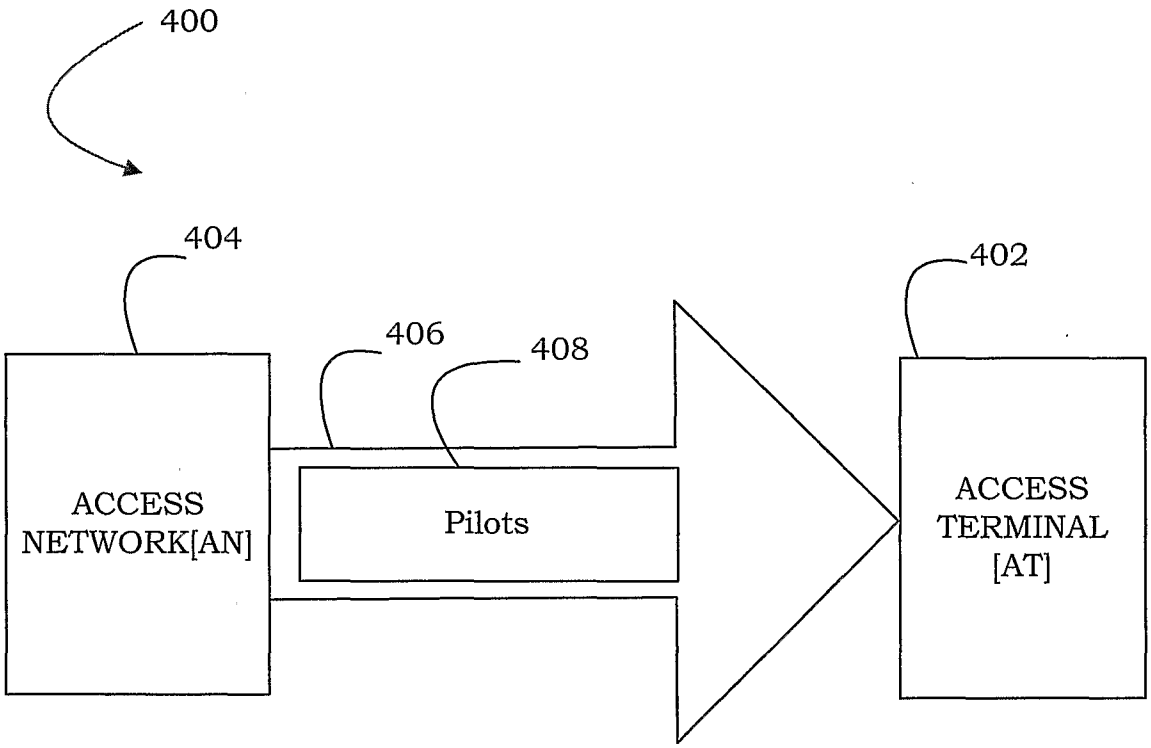
400
404
406
408
402
ACCESS NETWORK[AN]
Pilots
ACCESS TERMINAL [AT]

Fig. 4

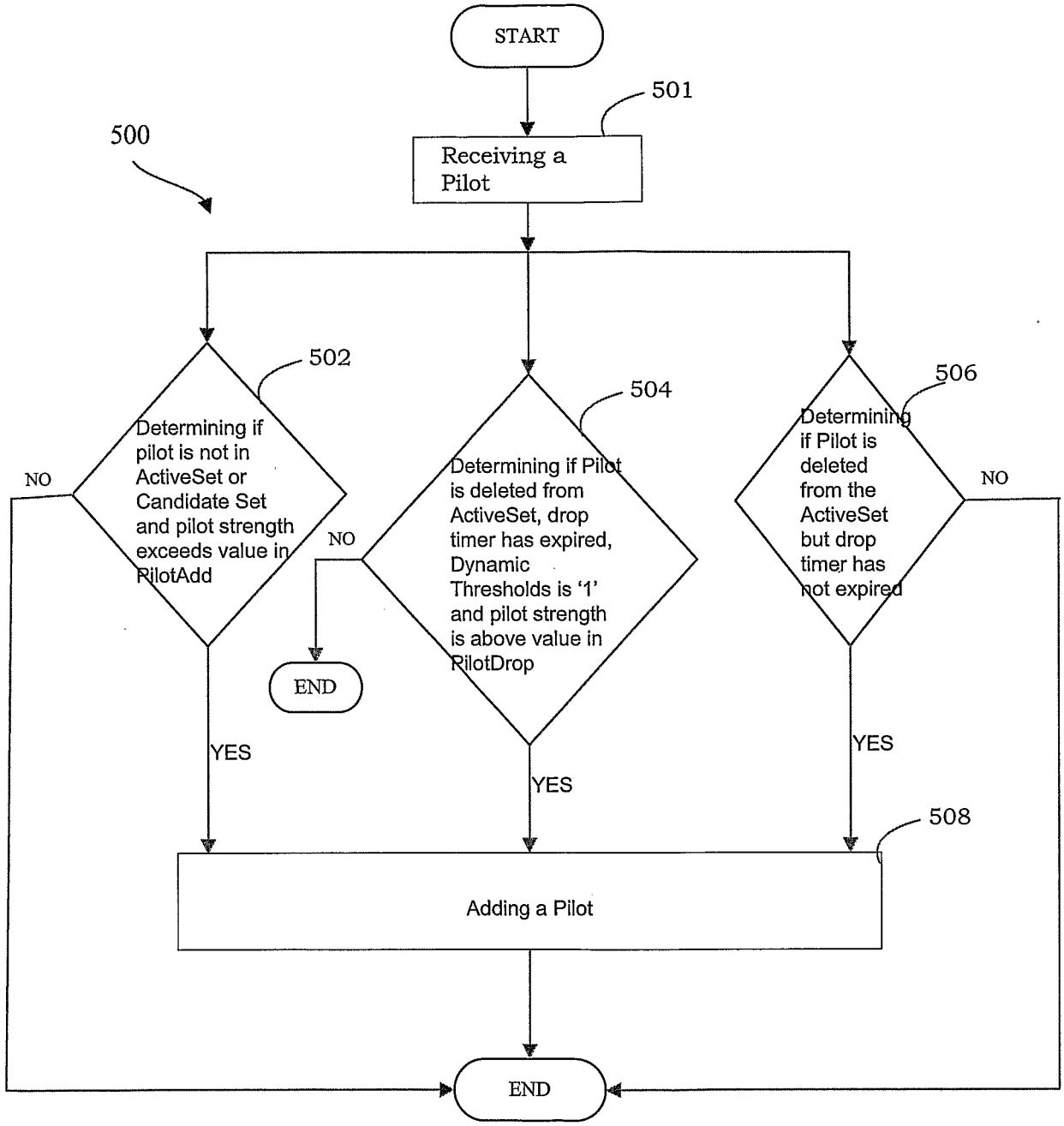
START
501
500
Receiving a Pilot
502
Determining if pilot is not in ActiveSet or Candidate Set and pilot strength exceeds value in PilotAdd
NO
YES
504
Determining if Pilot is deleted from ActiveSet, drop timer has expired, Dynamic Thresholds is '1' and pilot strength is above value in PilotDrop
NO
END
YES
506
Determining if Pilot is deleted from the ActiveSet but drop timer has not expired
NO
YES
508
Adding a Pilot
END

Fig. 5A

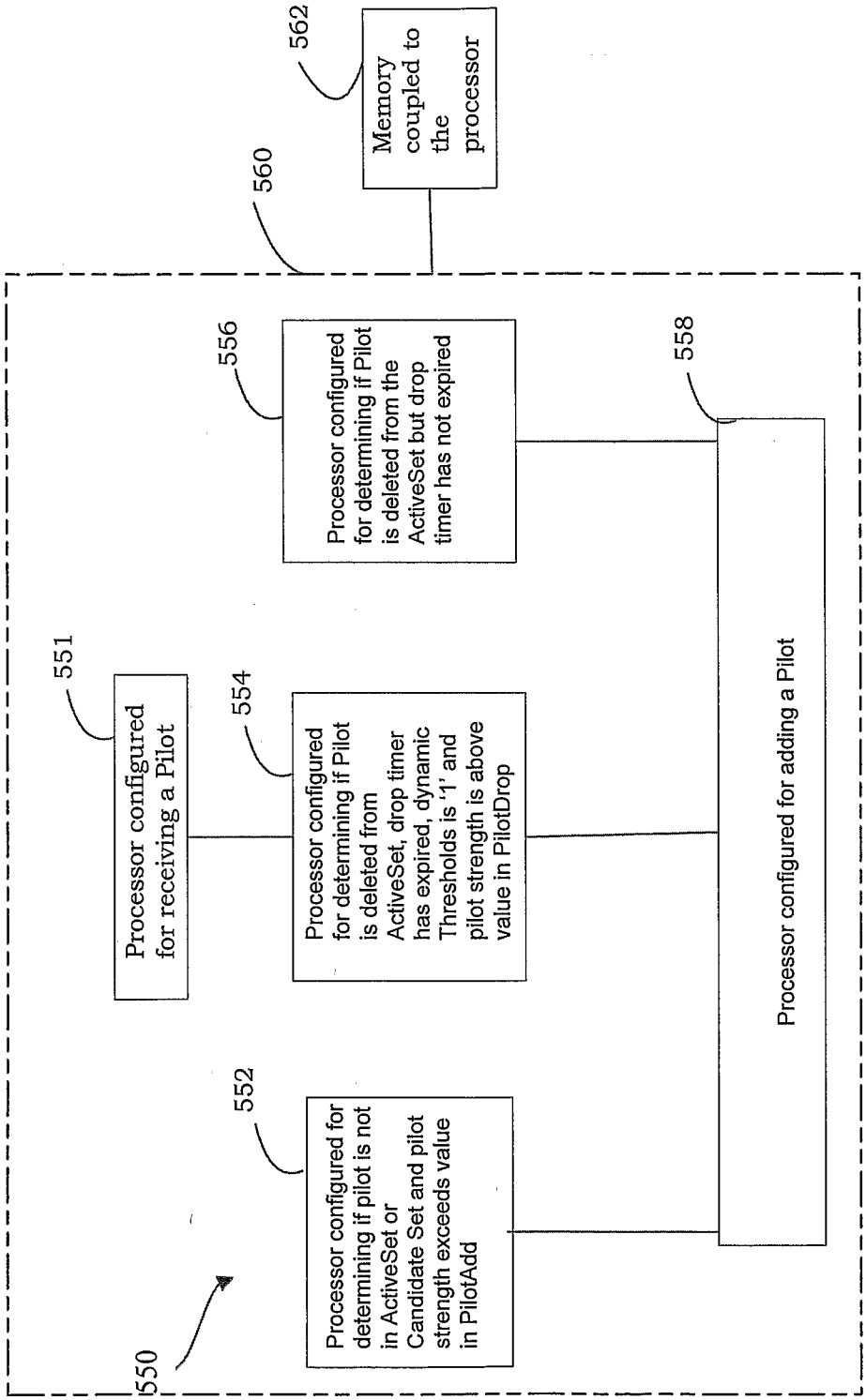
562
Memory coupled to the processor
560
556
Processor configured for determining if Pilot is deleted from the ActiveSet but drop timer has not expired
558
551
Processor configured for receiving a Pilot
554
Processor configured for determining if Pilot is deleted from ActiveSet, drop timer has expired, dynamic Thresholds is '1' and pilot strength is above value in PilotDrop
Processor configured for adding a Pilot
552
Processor configured for determining if pilot is not in ActiveSet or Candidate Set and pilot strength exceeds value in PilotAdd
550

Fig. 5B

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/041732

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04B H04L H04Q

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	3GPP2: "3GPP2 C.S0024-A v2.0: cdma2000 High Rate Packet Data Air Interface Specification" 3RD GENERATION PARTNERSHIP PROJECT 2 3GPP2, XX, XX, 27 July 2005 (2005-07-27), pages 482-532,1179, XP002423741 paragraph 8.7.6.1.2; paragraph 8.7.6.1.2.6 -----	1-15
P,X	TOMCIK J ET AL: "QFDD and QTDD: Proposed Draft Air Interface Specification, chapter 6, Lower MAC Control Sublayer" IEEE C802.20-05/69, XX, XX, 28 October 2005 (2005-10-28), pages I-XXXI,1, XP002423447 6.6.5.3.5 ----- -/--	1-15

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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

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

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

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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 March 2007	23/03/2007

Name and mailing address of the ISA/	Authorized officer
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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2006/041732

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 160 799 A1 (KRAUSE DAVID J [US] ET AL) 12 December 2000 (2000-12-12) column 1, line 47 - column 4, line 62	1-15
A	US 2005/176385 A1 (STERN-BERKOWITZ JANET [US] ET AL) 11 August 2005 (2005-08-11) paragraphs 0061-0076 figure 10	1-15
A	US 6 038 448 A1 (CHHEDA ASHVIN H [US] ET AL) 14 March 2000 (2000-03-14) column 7, line 6 - column 10, line 31 figures 3,4	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2006/041732

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6160799 A1		NONE	
US 2005176385 A1	11-08-2005	EP 1719353 A2	08-11-2006
		KR 20060108774 A	18-10-2006
		WO 2005076970 A2	25-08-2005
US 6038448 A1		NONE	