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(54) **SUPPORTING UPLINK TRANSMISSIONS**

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CPC ***H04W 36/18*** (2013.01); ***H04L 1/1812*** (2013.01); ***H04L 1/1887*** (2013.01);
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(58) **Field of Classification Search**
None
See application file for complete search history.

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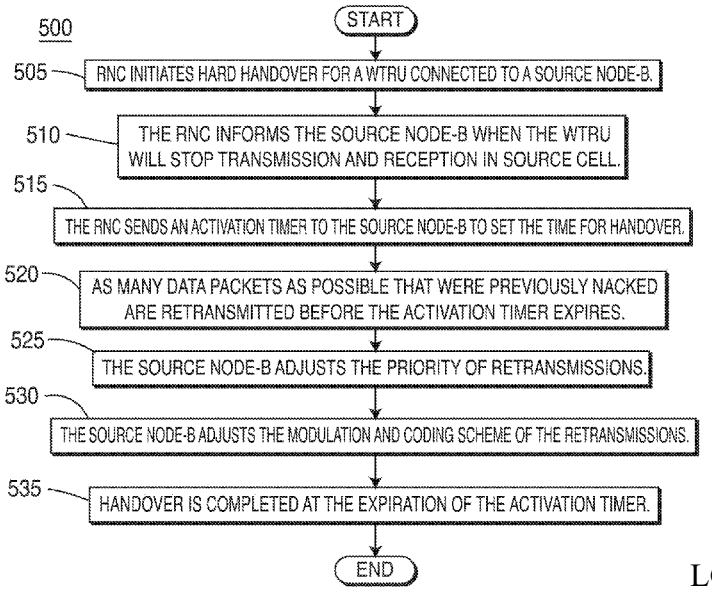
(57) **ABSTRACT**

A method and a wireless transmit/receive unit (WTRU) supporting uplink transmissions. The method being used in a WTRU and comprising transmitting a data block to a base station using a hybrid automatic repeat request (H-ARQ) process, receiving uplink scheduling information from the base station, wherein the uplink scheduling information includes a H-ARQ process identification for the H-ARQ process, and determining whether to retransmit the data block based on the received uplink scheduling information and not based on whether the WTRU has received a negative acknowledgement (NACK) from the base station. The uplink scheduling information includes physical channel resources. The uplink scheduling information is received from a primary cell and the WTRU transmits to the primary cell and at least one secondary cell. The scheduling information indicates a modulation and coding scheme.

20 Claims, 4 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/283,407, filed on Feb. 22, 2019, now Pat. No. 10,791,490, which is a continuation of application No. 15/699,418, filed on Sep. 8, 2017, now Pat. No. 10,219,196, which is a continuation of application No. 14/869,313, filed on Sep. 29, 2015, now Pat. No. 9,763,156, which is a continuation of application No. 13/908,242, filed on Jun. 3, 2013, now Pat. No. 9,215,636, which is a continuation of application No. 13/308,950, filed on Dec. 1, 2011, now Pat. No. 8,457,072, which is a continuation of application No. 11/434,330, filed on May 15, 2006, now Pat. No. 8,130,720, which is a continuation of application No. 10/962,720, filed on Oct. 12, 2004, now Pat. No. 7,046,648.

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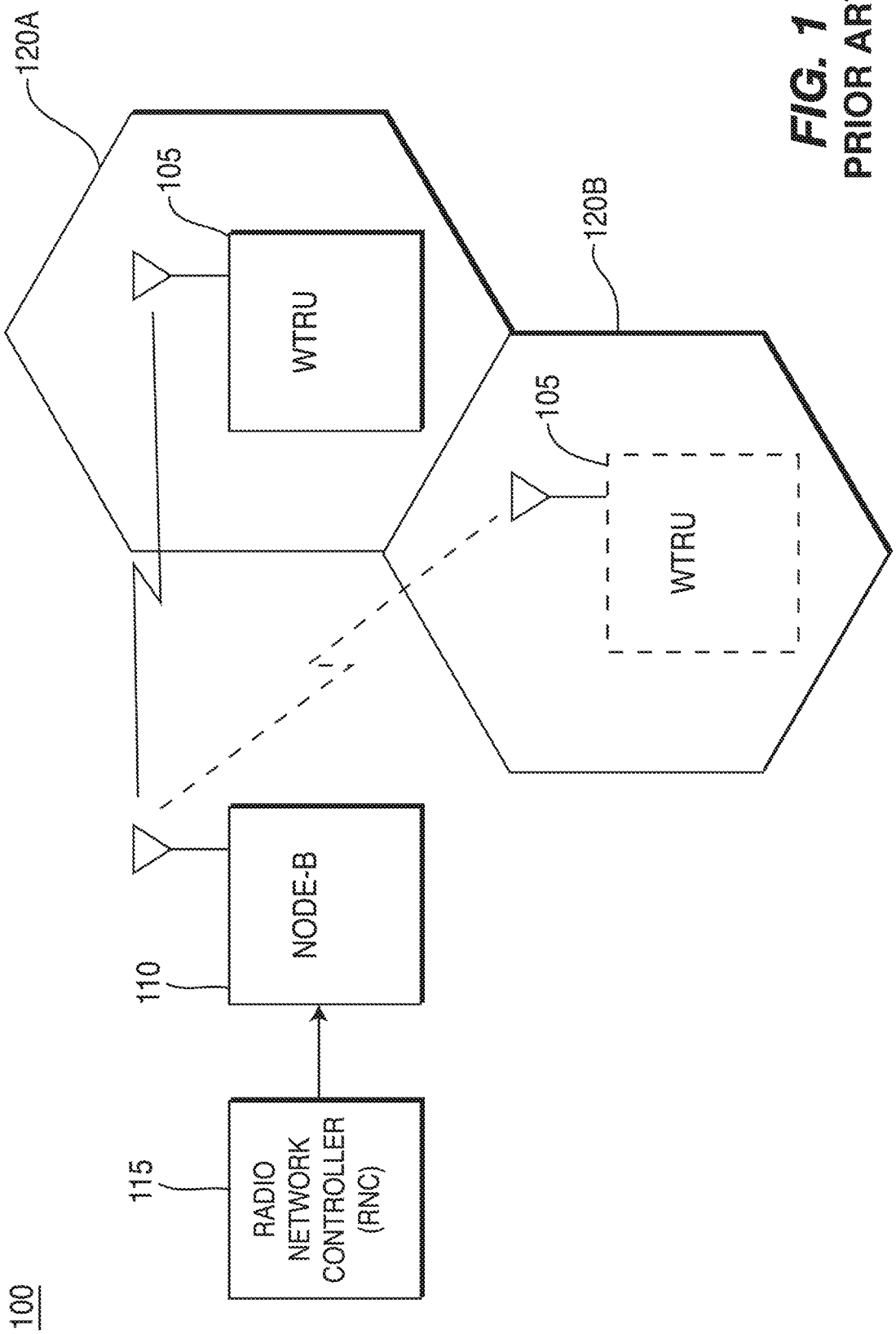

FIG. 1
PRIOR ART

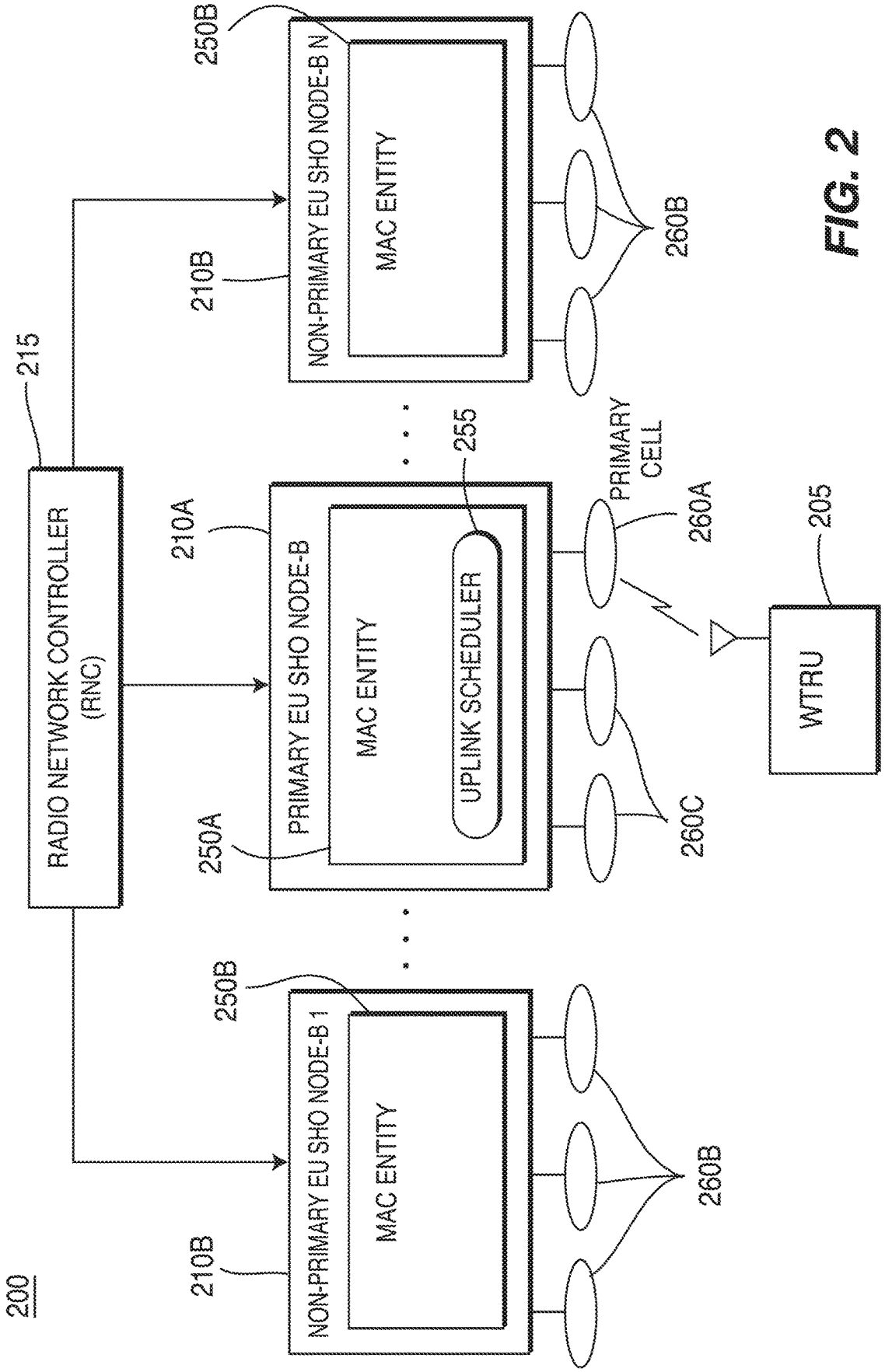
200
RADIO NETWORK CONTROLLER (RNC)
215
NON-PRIMARY EU SHO NODE-B 1
MAC ENTITY
210B
250B
PRIMARY EU SHO NODE-B
MAC ENTITY
UPLINK SCHEDULER
210A
250A
255
NON-PRIMARY EU SHO NODE-B N
MAC ENTITY
210B
250B
260B
260C
PRIMARY CELL
260A
WTRU
205

FIG. 2

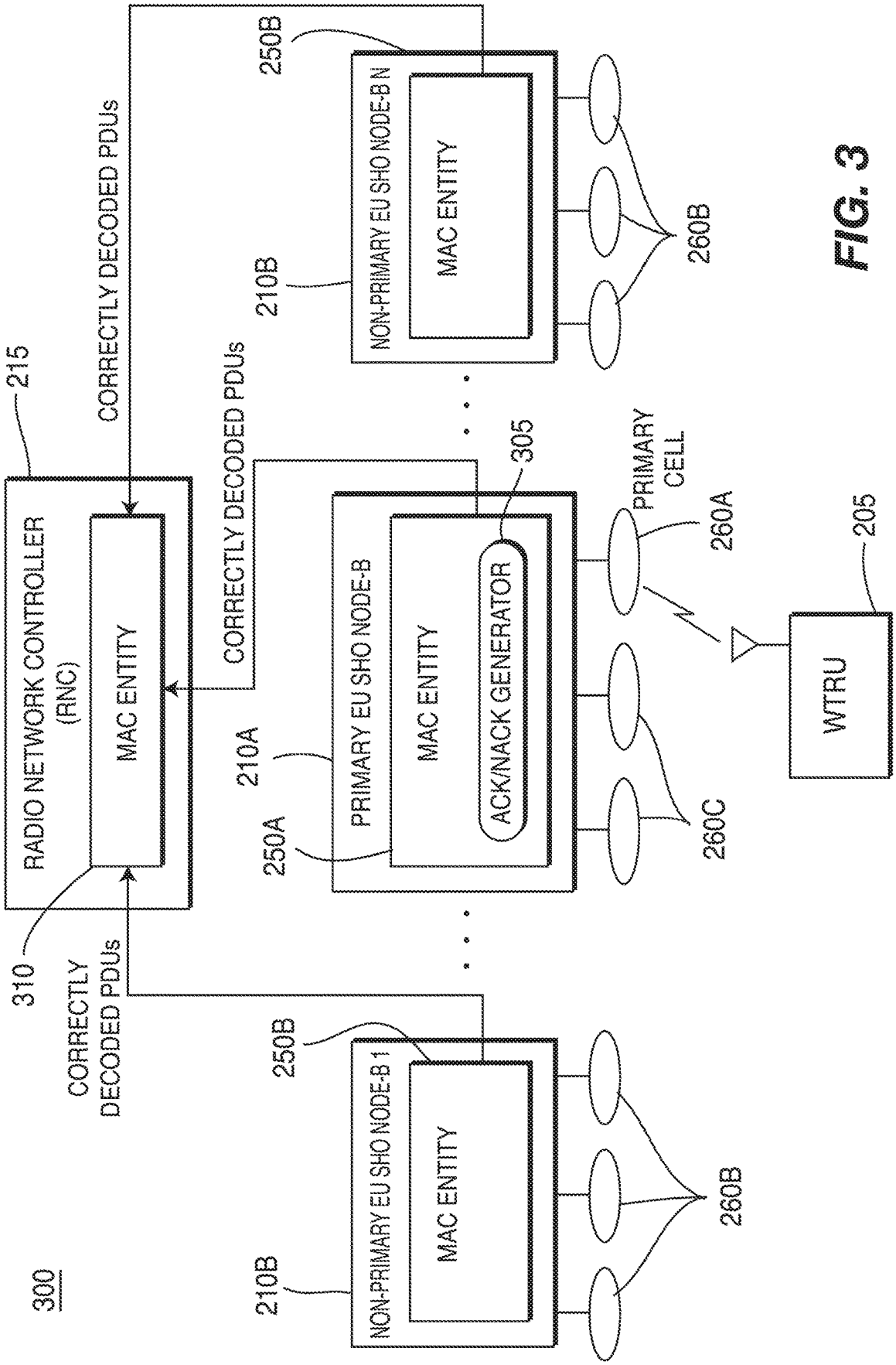
300
RADIO NETWORK CONTROLLER (RNC)
MAC ENTITY
215
310
CORRECTLY DECODED PDUs
CORRECTLY DECODED PDUs
CORRECTLY DECODED PDUs
NON-PRIMARY EU SHO NODE-B 1
MAC ENTITY
210B
250B
NON-PRIMARY EU SHO NODE-B N
MAC ENTITY
210B
250B
PRIMARY EU SHO NODE-B
MAC ENTITY
ACK/NACK GENERATOR
210A
250A
305
PRIMARY CELL
260A
260B
260C
260B
WTRU
205

FIG. 3

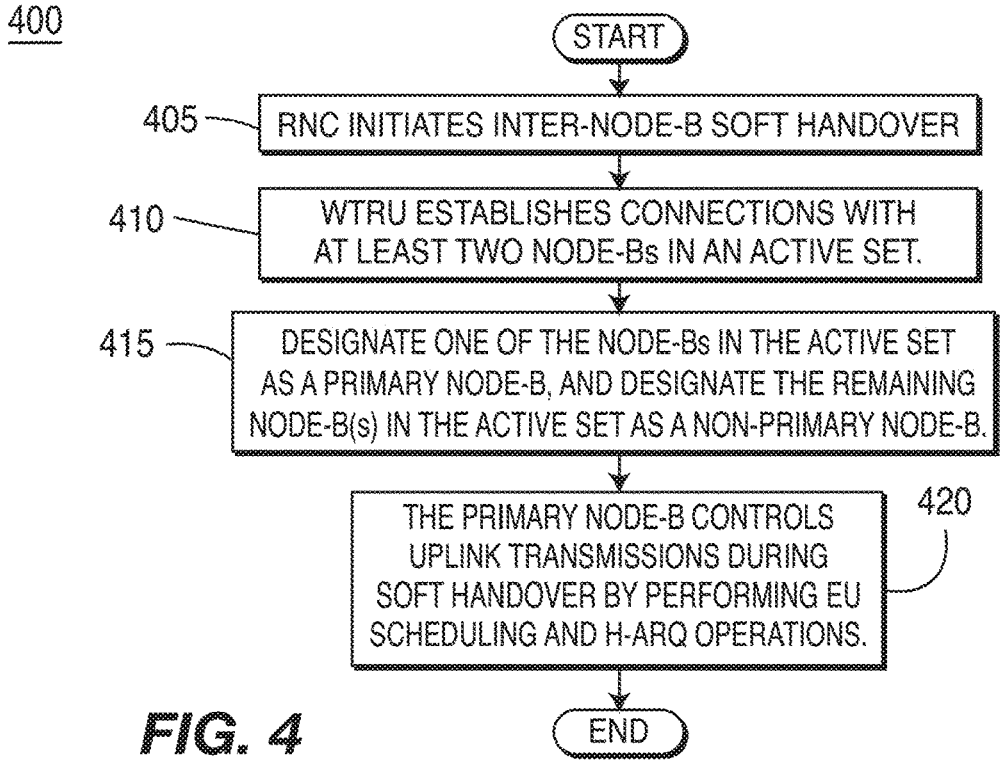
400
START
405
RNC INITIATES INTER-NODE-B SOFT HANDOVER
410
WTRU ESTABLISHES CONNECTIONS WITH AT LEAST TWO NODE-Bs IN AN ACTIVE SET.
415
DESIGNATE ONE OF THE NODE-Bs IN THE ACTIVE SET AS A PRIMARY NODE-B, AND DESIGNATE THE REMAINING NODE-B(s) IN THE ACTIVE SET AS A NON-PRIMARY NODE-B.
420
THE PRIMARY NODE-B CONTROLS UPLINK TRANSMISSIONS DURING SOFT HANDOVER BY PERFORMING EU SCHEDULING AND H-ARQ OPERATIONS.
END

FIG. 4

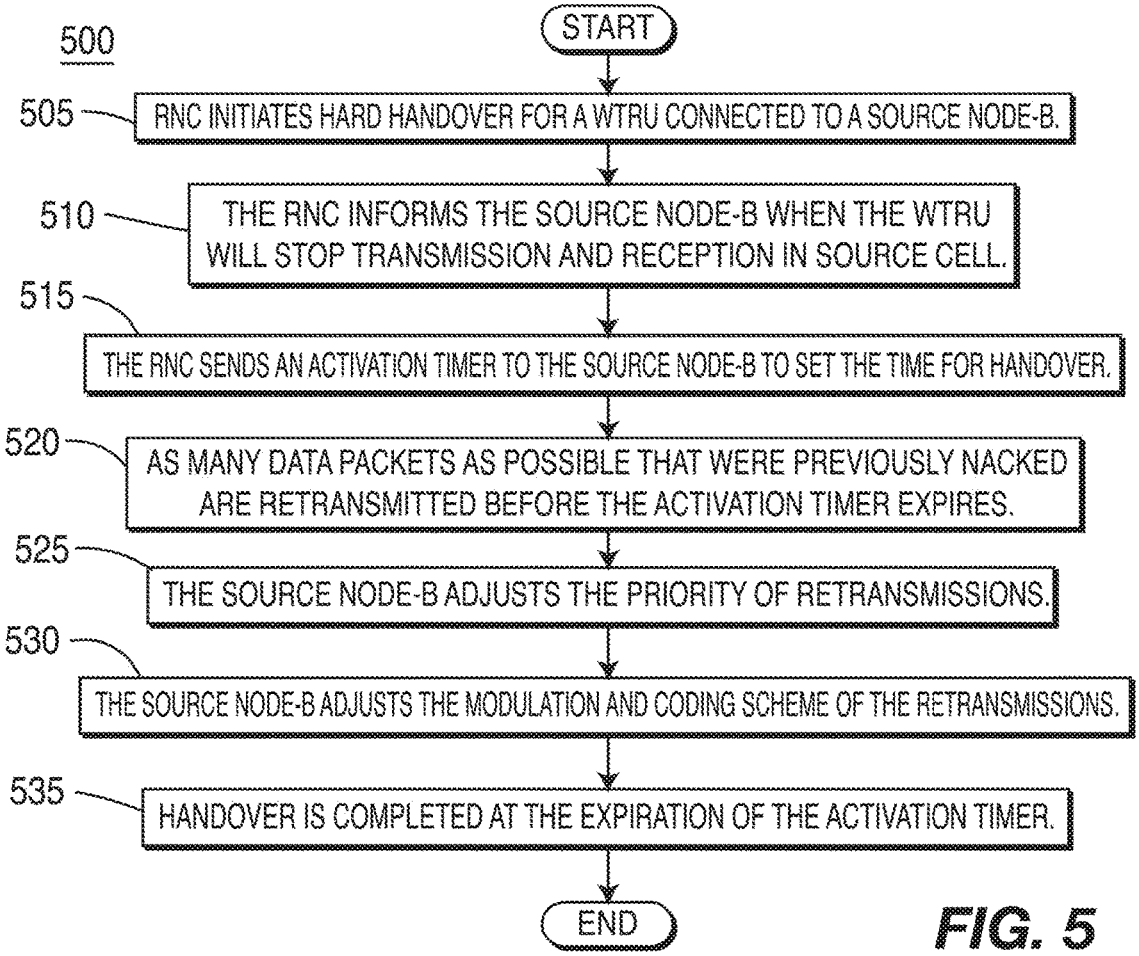
500
START
505
RNC INITIATES HARD HANDOVER FOR A WTRU CONNECTED TO A SOURCE NODE-B.
510
THE RNC INFORMS THE SOURCE NODE-B WHEN THE WTRU WILL STOP TRANSMISSION AND RECEPTION IN SOURCE CELL.
515
THE RNC SENDS AN ACTIVATION TIMER TO THE SOURCE NODE-B TO SET THE TIME FOR HANDOVER.
520
AS MANY DATA PACKETS AS POSSIBLE THAT WERE PREVIOUSLY NACKED ARE RETRANSMITTED BEFORE THE ACTIVATION TIMER EXPIRES.
525
THE SOURCE NODE-B ADJUSTS THE PRIORITY OF RETRANSMISSIONS.
530
THE SOURCE NODE-B ADJUSTS THE MODULATION AND CODING SCHEME OF THE RETRANSMISSIONS.
535
HANDOVER IS COMPLETED AT THE EXPIRATION OF THE ACTIVATION TIMER.
END

FIG. 5

SUPPORTING UPLINK TRANSMISSIONS

CROSS REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/545,398, filed Aug. 20, 2019, which is a continuation of U.S. patent application Ser. No. 16/283,407, filed Feb. 22, 2019, which is a continuation of U.S. patent application Ser. No. 15/699,418 filed on Sep. 8, 2017, now U.S. Pat. No. 10,219,196 issued on Feb. 26, 2019, which is a continuation of U.S. patent application Ser. No. 14/869,313, filed on Sep. 29, 2015, now U.S. Pat. No. 9,763,156 issued on Sep. 12, 2017, which is a continuation of U.S. patent application Ser. No. 13/908,242 filed on Jun. 3, 2013, now U.S. Pat. No. 9,215,636 issued on Dec. 15, 2015, which is a continuation of U.S. patent application Ser. No. 13/308,950 filed on Dec. 1, 2011, now U.S. Pat. No. 8,457,072 issued on Jun. 4, 2013, which is a continuation of U.S. patent application Ser. No. 11/434,330 filed on May 15, 2006, now U.S. Pat. No. 8,130,720 issued on Mar. 6, 2012, which is a continuation of U.S. patent application Ser. No. 10/962,720 filed Oct. 12, 2004, now U.S. Pat. No. 7,046,648 issued on May 16, 2006, which claims the benefit of U.S. Provisional Application Ser. No. 60/578,674 filed Jun. 10, 2004; 60/520,692 filed Nov. 17, 2003; 60/519,990 filed Nov. 14, 2003; and 60/517,656 filed Nov. 5, 2003, all of which are incorporated by reference as if fully set forth. This application is also related to a co-pending patent application, entitled "Supporting Uplink Transmissions", Ser. No. 17/008,468, filed on Aug. 31, 2020.

FIELD OF INVENTION

The present invention is related to a wireless communication system. More particularly, the present invention is related to a method and apparatus for coordinating Node-Bs and supporting enhanced uplink (EU) transmissions during handover.

BACKGROUND

Many schemes have been proposed to improve coverage, throughput, and transmission latency for EU transmissions in third generation partnership project (3GPP). One of the developments is to move the functions for scheduling and assigning uplink (UL) physical channel resources from a radio network controller (RNC) to a Node-B. A Node-B can make more efficient decisions and manage UL radio resources on a short-term basis better than the RNC, even if the RNC retains overall control over Node-Bs. A similar approach has already been adopted in downlink for high speed data packet access (HSDPA) in both universal mobile telecommunication system (UMTS) frequency division duplex (FDD) and time division duplex (TDD) modes.

It has also been recognized that performance is greatly enhanced with the use of medium access control (MAC) level automatic repeat request (ARQ) and hybrid ARQ (H-ARQ). Application of these techniques during soft handover provides additional significant benefits.

FIG. **1** shows a conventional wireless multi-cell communication system **100** including a wireless transmit/receive unit (WTRU) **105**, a Node-B **110**, an RNC **115**, and at least two cells **120**A, **120**B. Each of the cells **120**A, **120**B, is served by the Node-B **110**. Node-B **110** is controlled by the

RNC **115**. When a change in the cell offering the best radio conditions is determined between cells **120**A and **120**B, a handover process is initiated.

An "intra-Node-B handover" occurs when a WTRU changes from one cell to another cell controlled by the same Node-B, as shown in FIG. **1**. An "inter-Node-B handover" occurs when a WTRU changes from one cell to another cell controlled by a different Node-B. In the latter case, the Node-B that controls the cell before the handover is called a source Node-B, and the Node-B that controls the cell after the handover is called a target Node-B.

During soft handover, a WTRU establishes a plurality of connections with a plurality of Node-Bs in an active set. In this situation, a problem may arise for scheduling and H-ARQ operation. A WTRU may receive conflicting EU transmission scheduling from more than one Node-B. It is also difficult for the WTRU to receive, decode and process H-ARQ positive and negative acknowledgements (ACKs/NACKs) generated by a plurality of Node-Bs. The soft buffer of an H-ARQ process in Node-Bs may be corrupted during soft handover.

One method to support H-ARQ across multiple Node-Bs, when the WTRU is in soft handover, is to place the ACK/NACK generation function in the RNC, which derives a single ACK/NACK based on the results from the multiple Node-Bs. However, this approach presents a significant delay to the ACK/NACK process, which is highly undesirable for performance reasons.

When a WTRU undergoes an inter-Node-B hard handover, there is a possibility that a source Node-B, which is a Node-B before hard handover is completed, may not successfully receive EU transmissions for data packets that have been NACKed prior to hard handover activation time. Other WTRUs competing for UL resources may not be provided with enough physical resources in the source cell. If data blocks that have been NACKed prior to the handover are retransmitted to the source Node-B before the handover activation timer expires, those data blocks can be combined with the previous data blocks for H-ARQ decoding. In this way, the decoding takes the advantage of previous, although failed, transmissions of those data blocks in the source cell. If data blocks that have been NACKed prior to the handover are not retransmitted to the source Node-B before the handover activation timer is expired, they have to be transmitted again in the target cell as new data blocks. In this case, the previous transmissions of those data blocks in the source cell are not utilized.

SUMMARY

An enhanced uplink user equipment is in soft handover. A radio network controller selects a primary Node-B out of a plurality of Node-Bs supporting the soft handover. The radio network controller receiving successfully received enhanced uplink data packets from the plurality of Node-Bs. The radio network controller reordered the successfully received enhanced uplink data packets for in-sequence deliver. The primary Node-B sends specified scheduling information to the user equipment that the other Node-Bs does not transmit. At least the primary Node-B transmits acknowledgements and negative acknowledgements to the user equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

A more detailed understanding of the invention may be had from the following description, given by way of

example and to be understood in conjunction with the accompanying drawings wherein:

FIG. **1** shows a conventional wireless communication system;

FIG. **2** shows a system which uses a UL scheduler located in a primary Node-B during soft handover for EU in accordance with the present invention;

FIG. **3** shows a system which uses an ACK/NACK generation function located in a primary Node-B during soft handover for EU in accordance with the present invention;

FIG. **4** is a flowchart of a process including method steps for coordinating Node-Bs during soft handover in accordance with one embodiment of the present invention; and

FIG. **5** is a flowchart of a process including method steps for prioritizing the transmission of NACKed data in a source Node-B before hard handover is completed in accordance with a separate embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention will be described with reference to the drawing figures wherein like numerals represent like elements throughout.

Hereafter, the terminology "WTRU" includes but is not limited to a user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, or any other type of device capable of operating in a wireless environment.

When referred to hereafter, the terminology "Node-B" includes but is not limited to a base station, a site controller, an access point or any other type of interfacing device in a wireless environment.

The present invention may be implemented in any type of wireless communication systems, such as UMTS-FDD, TDD, time division synchronous code division multiple access (TDSCDMA), code division multiple access **2000** (CDMA2000) (EV-DO and EV-DV) or any other type of wireless communication system.

The features of the present invention may be incorporated into an IC or be configured in a circuit comprising a multitude of interconnecting components.

FIG. **2** shows a wireless multi-cell communication system **200** which uses a UL scheduler located in a primary Node-B in accordance with the present invention. The wireless multi-cell communication system **200** includes a WTRU **205**, a plurality of Node-Bs **210** (i.e., **210**A, **210**B), an RNC **215** and a plurality of cells **260** (i.e., **260**A, **260**B, **260**C). Cells **260**A and **260**C are served by the Node-B **210**A. Cells **260**B are served by the Node-Bs **210**B. All of the Node-Bs **210** are controlled by the RNC **215**.

During soft handover, the WTRU **205** establishes multiple connections with the Node-Bs **210** included in an active set. Each transmission from the WTRU **205** is processed independently at each of the Node-Bs **210**. One of the Node-Bs **210** in the active set is designated as a primary Node-B **210**A, and the other Node-Bs are designated as non-primary Node-Bs **210**B.

As shown in FIG. **2**, the primary Node-B **210**A includes a MAC entity **250**A including a UL scheduler **255**. Each of the non-primary Node-Bs **210**B also includes a MAC entity **250**B. Each of the MAC entities **250**A, **250**B, handles EU transmissions. The UL scheduler **255** in the MAC entity **250**A is responsible for scheduling the EU transmissions.

In accordance with one embodiment of the present invention, the UL scheduler **255** is implemented only at the primary Node-B **210**A during soft handover. The WTRU **205** receives a UL transmission schedule only from the primary Node-B **210**A in a primary cell **260**A. However, the primary Node-B **210**A cannot send the scheduling information to the non-primary Node-Bs **210**B in every transmission time interval (TTI). In order to allow the primary Node-B **210**A to allocate resources for the WTRU **205** to transmit in cells controlled by the non-primary Node-Bs **210**B, those resources scheduled by the primary Node-B **250**A in a plurality of cells **260**B controlled by the non-primary Node-Bs **210**B cannot be assigned by the non-primary Node-Bs **210**B. Therefore, some physical resources common to all of the cells in the active EU subset should be assigned and reserved by a particular Node-B for the WTRU **205** during the soft handover, so that those resources can be used only by the primary Node-B **210**A.

The UL scheduler **255** located in the primary Node-B **210**A considers the interference level caused by the EU transmission at any cell **260**A, **260**B, **260**C, in the EU active subset to be below a predetermined maximum allowed interference level. Thus, the primary Node-B **250**A limits the transmit power level of the WTRU **205** such that the interference levels are also within the maximum allowed interference levels at other cells **260**B, **260**C. To achieve this, the RNC **215** needs to relay necessary information, such as transmission power level and interference level, of the cells **260**B controlled by the non-primary Node-Bs **210**B to the primary Node-B **210**A, which then uses the information to schedule the UL transmissions.

The EU scheduling information is transmitted to the WTRU **205** only by the primary Node-B **210**A through the primary cell **260**A. During soft handover, the WTRU **205** receives EU scheduling information only in the primary cell **260**A, although the EU scheduling information is valid in all other cells **260**B, **260**C.

In one embodiment, the primary Node-B **250**A is selected by either the RNC **215** or the WTRU **205**. The RNC **215** may choose a Node-B that has the highest percentage of correctly received data blocks during a predefined time window as a primary Node-B.

In another embodiment, the RNC **215** generates statistics for each Node-B, such as a bit error rate (BER) or a frame error rate (FER), or the like, over a predetermined time period. Then, the RNC **215** may select a Node-B having the best performance to be the primary Node-B **210**A. The RNC **215** then notifies the WTRU **205** and all other Node-Bs about the primary Node-B **210**A via radio resource control (RRC) and Iub signaling, respectively.

In another embodiment, the WTRU **102** may choose a Node-B **210** that has the best downlink pilot power, (i.e., best downlink path loss or highest code power), as a primary Node-B **210**A. The WTRU **205** measures the power of pilot signals received from all Node-Bs **210** and selects the Node-B **210** having the highest pilot power to be the primary Node-B **210**A. The WTRU **205** then notifies all other Node-Bs about the primary Node-B **210**A via fast physical layer signaling.

The WTRU **205** may report the downlink pilot power of all cells **260** to the RNC **215**. The RNC **215** then chooses one Node-B **210** to be the primary Node-B **210***a* based on the combined uplink and downlink quality. The uplink quality of a cell **260** based on the percentage of correctly received data blocks, (or BER, FER, or the like), during a predefined time window, and the downlink quality of a cell **260** is based on the WTRU received downlink pilot power. Then, the RNC **215** notifies the WTRU **205** and all of the Node-Bs **210** about the primary Node-B **210**A via RRC and Iub signaling, respectively.

The present invention is advantageous over prior art systems. Using the present invention, a WTRU does not receive conflicting scheduling of EU transmissions from Node-Bs during soft handover. In addition, EU transmission is scheduled in consideration of an interference level and radio resources in cells controlled by non-primary Node-Bs. Signaling delay from the primary Node-B **210**A to the WTRU **205** is much lower as compared to signaling delay from the RNC **215** to the WTRU **205**.

In a separate embodiment, FIG. **3** shows a wireless multi-cell communication system **300**, similar to the system **200** shown in FIG. **2**. As shown in FIG. **3**, the primary Node-B **210**A includes a MAC entity **250**A including an ACK/NACK generator **305**. Only the primary Node-B **210**A has the ACK/NACK generator **305**. The primary Node-B **210**A may perform H-ARQ with incremental redundancy, or only ARQ without implementing incremental redundancy.

Still referring to FIG. **3**, the primary Node-B **210**A receives at least one data packet from the WTRU **205** through the primary cell **260**A and performs an error check on the data packet. Any error checking method, such as a cyclic redundancy check (CRC), may be utilized. If the primary Node-B **210**A correctly decodes the data packet, such as passing the CRC, the primary Node-B **210**A transmits an ACK to the WTRU **205** and also transmits the correctly decoded data packet to the RNC **215**. If the primary Node-B **210**A fails to correctly decode the data packet, the primary Node-B **210**A transmits a NACK to the WTRU **205**.

The non-primary Node-Bs **210**B also perform an error check on the data packet. However, the non-primary Node-Bs **210**B do not send ACKs or NACKs to the WTRU **205**. Instead, the non-primary Node-Bs send successfully decoded data packets to the RNC **215**. During soft handover, only the primary Node-B **210**A generates H-ARQ (or ARQ), ACKs and NACKs, and controls retransmissions.

The MAC layer WTRU identities received by the non-primary Node-Bs **210**B may be used for routing of successfully received transmissions in a universal terrestrial radio access network (UTRAN). Since the non-primary Node-Bs **210**B are not aware of which WTRUs have been scheduled for EU transmission by the primary Node-B **210**A, the non-primary Node-Bs **210**B may rely on in-band MAC layer signaling of the WTRU ID to route correctly received transmissions to the correct RNC radio link. Even though the primary Node-B **210**A may be aware of which WTRU is scheduled, the same method may be implemented by the primary Node-B **210**A.

Preferably, the primary Node-B **210**A may use soft combining to process transmissions, while the non-primary Node-Bs **210**B may process each transmission without soft combining. If the primary Node-B sends a NACK to the WTRU **205**, the NACKed data packet is stored in a buffer of the primary Node-B **210**A, and the NACKed data packet is combined with a retransmitted data packet. In contrast, the non-primary Node-Bs **210**B do not store the NACKed data packets. This eliminates the problem of soft buffer corruption between the Node-Bs **210**, and the complexities of multiple independent ACKs and/or NACKs.

When an incremental combining process is implemented, measures should be taken to avoid soft buffer corruption. Sequence information or a new data indicator is required to enable a Node-B **210** to detect that the WTRU **205** is no longer repeating data for a particular WTRU H-ARQ process, but instead is sending new data. This is specifically required because the Node-B **210** has no other way to learn that a new transmission has started. Alternatively, the non-primary Node-Bs **210**B may simply perform an ARQ, without using an incremental combining process. This eliminates the soft buffer corruption problem.

In the case where non-primary Node-Bs **210**B perform simple ARQ without incremental combining, the WTRU **205** must transmit self-decodable data packets to ensure that all of the Node-Bs **210** may decode transmissions, regardless of the result of earlier transmissions. Preferably, the H-ARQ functionality is terminated at the Node-Bs **210**. Each of the Node-Bs **210** sends to the RNC **215** successfully decoded data packets with explicit identification of transmission, such as a transmission sequence number (TSN). The RNC **215** may optionally use data packets delivered from the non-primary Node-Bs **210**B. A MAC entity **310**, located in the RNC **215**, is used to implement an in-sequence delivery process for delivering data to higher layers over all of the packets received from the Node-Bs **210**. After the RNC MAC entity **310** has completed its re-ordering process, it sends the data to a radio link control (RLC) (not shown). Missed packets are identified at the RNC **215** and the WTRU **205** is informed through RLC messaging.

Alternatively, EU transmissions may identify WTRU ID, H-ARQ process, transmission sequence and/or new data indication (NDI) to allow for soft combining in the non-primary Node-B's **210**B. If this method is used to allow soft combining in the non-primary Node-Bs **210**B, the primary Node-B **210**A may not have to rely on scheduling and H-ARQ ACK/NACK decisions to determine when combining should be performed.

There are two options for the transmission of ACK/NACK messages. The first option is a synchronous transmission. The ACK/NACK messages are transmitted after a unique time delay with respect to the corresponding uplink transmission or the EU channel allocation message. The second option is an asynchronous transmission. There is no unique delay between the transmission of ACK/NACK messages and the corresponding uplink transmission or the EU channel allocation message. Explicit information in the ACK/NACK message identifies the corresponding uplink transmission to enable the WTRU **205** to make the correct association between the ACK/NACK message and the transmission. This association is made by either identifying the H-ARQ process number and/or a unique sequence number, such as a TSN with each ACK/NACK feedback message to the WTRU **205**.

In a separate embodiment, preferably implemented for the asynchronous ACK/NACK feedback case, the non-primary Node-Bs **210**B may provide H-ARQ ACK/NACK results to the primary Node-B **210**A in order to avoid unnecessary retransmissions for transmissions that are not correctly received by the primary Node-B **210**A, but are correctly received by the non-primary Node-Bs **210**B. A non-primary Node-B **210**B does not directly send an ACK or NACK message to the WTRU **205**. The non-primary Node-Bs **210**B sends ACK/NACK or CRC results to the RNC **215**. Then, the RNC **215** sends ACK or CRC results to the primary Node-B **210**A.

In order to speed up H-ARQ processing, the first ACK message from any non-primary Node-B **210**B received by the RNC is preferably immediately forwarded to the primary Node-B **210**A. The primary Node-B **210**A also immediately generates an ACK message if the transmission is received correctly in the primary Node-B **210**A without waiting for feedback from the non-primary Node-Bs **210**B. The primary Node-B **210**A also generates an ACK message immediately upon reception of a forwarded ACK message from the RNC, even if other ACK messages may be forwarded. Since an

ACK is generated if any of the paths are successful, an ACK can be generated as soon as the first successful transmission is found.

Alternatively, in order to simplify the design of the ACK/NACK generator **205**, only a subset of the generating nodes may be used. For example, ACKs may be generated only at the RNC, or at the RNC and the primary Node-B **210**A.

When the WTRU **205** sends an uplink transmission, for each H-ARQ process the WTRU **205** waits at least the time required for the primary Node-B **210**A to send ACK/NACK feedback. For each H-ARQ process, if an ACK is received by the WTRU **205**, the WTRU **205** may send new data in the next available or assigned opportunity.

A NACK message can only originate in the RNC **215** since it is the only node that has all of the information necessary in the soft handover to determine that there have been no successful receptions at any Node-B **210**. The RNC **215** generates a NACK command if the RNC **215** receives no ACK from the Node-Bs **210** within a predetermined time interval. The RNC **215** forwards the NACK message to the WTRU **205** via the primary Node-B **210**A.

It is also possible that this procedure can be implemented without an explicit NACK command. In this case, the lack of ACK reception within a particular period of time is considered the same as an explicit NACK command at either the primary Node-B **210**A and/or the WTRU **205**.

FIG. **4** is a flowchart of a process **400** including method steps for coordinating Node-Bs during soft handover in accordance with one embodiment of the present invention. In step **405**, the RNC **215** makes a decision to initiate an inter-Node-B soft handover. In step **410**, the WTRU **205** establishes connections with at least two Node-Bs **210** in an active set. In step **415**, one of the Node-Bs **210** in the active set is designated as a primary Node-B **210**A and the one or more Node-B(s) **210** remaining in the active set are designated as a non-primary Node-Bs **210**B. In step **420**, the primary Node-B **210**A controls UL transmissions during soft handover by performing EU scheduling and H-ARQ operations.

FIG. **5** is a flowchart of a process **500** including method steps for prioritizing the transmission of NACKed data in a source Node-B before hard handover is completed in accordance with a separate embodiment of the present invention. In step **505**, the RNC **215** makes a decision to initiate a hard handover for a WTRU **205** connected to a source Node-B **210**. In step **510**, the RNC **215** informs the source Node-B **210** when the WTRU **205** will stop transmission and reception in the source cell **260**. In step **515**, the RNC **215** sends an activation timer to the source Node-B **210** to set the time for handover.

Still referring to FIG. **5**, if the source Node-B **210** determines that there are data packets that were previously NACKed, as many previously NACKed data packets as possible should be retransmitted before the handover activation timer expires. Otherwise, the system may lose the benefit of incrementally combining the previous transmission with the retransmission. Therefore, the source Node-B scheduler **255** takes the handover activation time into account when it schedules the data packets that have been NACKed. If there is not enough radio resource for the source Node-B **210** to schedule transmission of all the NACKed data packets in time, the source Node-B **210** should manage to schedule transmission of as many NACKed data packets as possible.

Still referring to FIG. **5**, in order to transmit as many NACKed data packets as possible before the activation timer expires, the source Node-B **210** adjusts the priority of transmissions (step **525**) and, in step **530**, the source node-B **210** adjusts the MCS of the transmissions (step **530**). Higher priority of scheduling is given to the data packets that have been NACKed. If the radio resources are sufficient, a more robust MCS may be used to increase the probability of successful transmissions from the WTRU **205** to the source Node-B **210**. In step **535**, the handover is completed at the expiration of the activation timer.

In order for the WTRU **205** to understand that the scheduled uplink transmission is intended for data blocks with previous transmission failures, the source Node-B **210** uplink scheduler **255** may specify that the scheduled UL transmission is intended for the data blocks that were previously NACKed. This may be implemented by including H-ARQ process identification in the UL scheduling information that is sent from the source Node-B **210** to the WTRU **205**. By receiving the scheduling information from the source Node-B **210**, the WTRU **205** knows that the scheduled transmission is for specific data associated with HARQ process identification sent together with the scheduling information.

While this invention has been particularly shown and described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes in forms and details may be made therein without departing from the scope of the invention as described above.

What is claimed is:

1. A wireless transmit/receive unit (WTRU) comprising:
at least one transceiver; and
a processor;
wherein the at least one transceiver and the processor are configured to cause the WTRU to:
transmit, using a hybrid automatic repeat request (H-ARQ) process, a data block to a base station;
receive uplink scheduling information from the base station, wherein the uplink scheduling information includes a H-ARQ process identification for the H-ARQ process; and
determine whether to retransmit the data block based on the received uplink scheduling information and not based on whether the WTRU has received a negative acknowledgement (NACK) from the base station.

2. The WTRU of claim **1**, wherein the at least one transceiver and the processor are further configured to cause the WTRU to, in response to a determination to retransmit the data block, retransmit the data block.

3. The WTRU of claim **2**, wherein the data block is retransmitted using physical channel resources included in the uplink scheduling information.

4. The WTRU of claim **1**, wherein the reception of the uplink scheduling information initiates retransmission of a negatively acknowledged (NACK'ed) data block.

5. The WTRU of claim **1**, wherein the uplink scheduling information includes physical channel resources.

6. The WTRU of claim **1**, wherein the uplink scheduling information is received from a primary cell and the WTRU transmits to the primary cell and at least one secondary cell.

7. The WTRU of claim **1**, wherein the at least one transceiver and the processor are further configured to cause the WTRU to receive an ACK/NACK signal from the base station.

8. The WTRU of claim **1**, wherein the scheduling information indicates a modulation and coding scheme.

9. The WTRU of claim **1**, wherein the transmitted data block has a first modulation and coding scheme (MCS) and

the scheduling information indicates a second MCS, wherein the first MCS and the second MCS are different.

10. The WTRU of claim **9**, wherein the at least one transceiver and the processor are further configured to cause the WTRU to, in response to a determination to retransmit the data block, retransmit the data block using the second MCS.

11. A method comprising:

transmitting, by a wireless transmit/receive unit (WTRU), a data block to a base station using a hybrid automatic repeat request (H-ARQ) process;

receiving, by the WTRU, uplink scheduling information from the base station, wherein the uplink scheduling information includes a H-ARQ process identification for the H-ARQ process; and

determining, by the WTRU, whether to retransmit the data block based on the received uplink scheduling information and not based on whether the WTRU has received a negative acknowledgement (NACK) from the base station.

12. The method of claim **11** further comprising, in response to a determination to retransmit the data block, retransmitting, by the WTRU, the data block.

13. The method of claim **12**, wherein the data block is retransmitted using physical channel resources included in the uplink scheduling information.

14. The method of claim **11**, wherein the reception of the uplink scheduling information initiates retransmission of a negatively acknowledged (NACK'ed) data block.

15. The method of claim **11**, wherein the uplink scheduling information includes physical channel resources.

16. The method of claim **11**, wherein the uplink scheduling information is received from a primary cell and the WTRU transmits to the primary cell and at least one secondary cell.

17. The method of claim **11** further comprising receiving, by the WTRU, an ACK/NACK signal from the base station.

18. The method of claim **11**, wherein the scheduling information indicates a modulation and coding scheme.

19. The method of claim **11**, wherein the transmitted data block has a first modulation and coding scheme (MCS) and the scheduling information indicates a second MCS, wherein the first MCS and the second MCS are different.

20. The method of claim **19** further comprising, in response to a determination to retransmit the data block, retransmitting the data block using the second MCS.

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