[0001] WIRELESS COMMUNICATION METHOD AND APPARATUS COORDINATING NODE-B'S AND SUPPORTING ENHANCED UPLINK TRANSMISSIONS DURING HANDOVER

[0002] FIELD OF INVENTION

[0003] 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.

[0004] BACKGROUND

[0005] 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.

[0006] 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.

[0007] Figure 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 120A, 120B. Each of the cells 120A, 120B, 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 120A and 120B, a handover process is initiated.

[0008] 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 Figure 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.

[0009] 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.

[0010] 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.

[0011] 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.

[0012] SUMMARY

[0013] The present invention is related to a wireless communication method and apparatus for coordinating Node-Bs during handover for enhanced uplink transmission. The apparatus may be a wireless communication system, an RNC, a Node-B and/or an integrated circuit (IC).

[0014] In one embodiment, a wireless multi-cell communication system includes an RNC, a plurality of Node-Bs, and a plurality of WTRUs. Each Node-B serves at least one cell and schedules EU transmissions from the WTRUs. Once an RNC recognizes a need for soft handover, a WTRU establishes connections to Node-Bs in an active set. One of the Node-Bs in the active set is designated as a primary Node-B and all other Node-Bs are designated as a non-primary Node-B. An RNC or a WTRU selects a primary Node-B and informs the other Node-Bs about the primary Node-B. During soft handover, the primary Node-B schedules EU transmission and performs ACK/NACK.

[0015] In a separate embodiment, an RNC initiates a hard handover for a WTRU connected to the source Node-B. The RNC informs the source Node-B when the WTRU will stop transmission and reception while being connected to the source Node-B. The RNC sends an activation timer to the source Node-B to set the time for handover. The handover is completed when the activation timer expires.

[0016] The source Node-B may determine whether there are any previously transmitted data packets that were negatively acknowledged (NACKed) by the source Node-B. In order to receive as many previously NACKed data packets as possible before the activation timer expires, the source Node-B may adjust the priority and/or adjust a modulation and coding scheme (MCS) used for data packet retransmissions sent by the WTRU.

[0017] BRIEF DESCRIPTION OF THE DRAWINGS

[0018] 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:

[0019] Figure 1 shows a conventional wireless communication system;

[0020] Figure 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;

[0021] Figure 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;

[0022] Figure 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

[0023] Figure 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.

[0024] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0025] The present invention will be described with reference to the drawing figures wherein like numerals represent like elements throughout.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] The features of the present invention may be incorporated into an IC or be configured in a circuit comprising a multitude of interconnecting components.

[0030] Figure 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., 210A, 210B), an RNC 215 and a plurality of cells 260 (i.e., 260A, 260B, 260C). Cells 260A and 260C are served by the Node-B 210A. Cells 260B are served by the Node-Bs 210B. All of the Node-Bs 210 are controlled by the RNC 215.

[0031] 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 210A, and the other Node-Bs are designated as non-primary Node-Bs 210B.

[0032] As shown in Figure 2, the primary Node-B 210A includes a MAC entity 250A including a UL scheduler 255. Each of the non-primary Node-Bs 210B also includes a MAC entity 250B. Each of the MAC entities 250A, 250B, handles EU transmissions. The UL scheduler 255 in the MAC entity 250A is responsible for scheduling the EU transmissions.

[0033] In accordance with one embodiment of the present invention, the UL scheduler 255 is implemented only at the primary Node-B 210A during soft handover. The WTRU 205 receives a UL transmission schedule only from the primary Node-B 210A in a primary cell 260A. However, the primary Node-B 210A cannot send the scheduling information to the non-primary Node-Bs 210B in every transmission time interval (TTI). In order to allow the primary Node-B 210A to allocate resources for the WTRU 205 to transmit in cells controlled by the non-primary Node-Bs 210B, those resources scheduled by the primary Node-B 250A in a plurality of cells 260B controlled by the non-primary Node-Bs 210B cannot be assigned by the non-primary Node-Bs 210B. 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 210A.

[0034] The UL scheduler 255 located in the primary Node-B 210A considers the interference level caused by the EU transmission at any cell 260A, 260B,

260C, in the EU active subset to be below a predetermined maximum allowed interference level. Thus, the primary Node-B 250A 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 260B, 260C. To achieve this, the RNC 215 needs to relay necessary information, such as transmission power level and interference level, of the cells 260B controlled by the non-primary Node-Bs 210B to the primary Node-B 210A, which then uses the information to schedule the UL transmissions.

[0035] The EU scheduling information is transmitted to the WTRU 205 only by the primary Node-B 210A through the primary cell 260A. During soft handover, the WTRU 205 receives EU scheduling information only in the primary cell 260A, although the EU scheduling information is valid in all other cells 260B, 260C.

[0036] In one embodiment, the primary Node-B 250A 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.

[0037] 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 210A. The RNC 215 then notifies the WTRU 205 and all other Node-Bs about the primary Node-B 210A via radio resource control (RRC) and Iub signaling, respectively.

[0038] 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 210A. 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 210A. The WTRU 205 then notifies all other Node-Bs about the primary Node-B 210A via fast physical layer signaling.

[0039] 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 210a 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 260is 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 210A via RRC and Iub signaling, respectively.

[0040] The present invention is advantageous over prior art systems. Using the present invention, a WTRU does not receive conflicting scheduling of EU transmission 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 210A to the WTRU 205 is much lower as compared to signaling delay from the RNC 215 to the WTRU 205.

[0041] In a separate embodiment, Figure 3 shows a wireless multi-cell communication system 300, similar to the system 200 shown in Figure 2. As shown in Figure 3, the primary Node-B 210A includes a MAC entity 250A including an ACK/NACK generator 305. Only the primary Node-B 210A has the ACK/NACK generator 305. The primary Node-B 210A may perform H-ARQ with incremental redundancy, or only ARQ without implementing incremental redundancy.

[0042] Still referring to Figure 3, the primary Node-B 210A receives at least one data packet from the WTRU 205 through the primary cell 260A 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 210A correctly decodes the data packet, such as passing the CRC, the primary Node-B 210A transmits an ACK to the WTRU 205 and also transmits the correctly decoded data packet to the RNC 215. If the primary Node-B 210A fails to correctly decode the data packet, the primary Node-B 210A transmits a NACK to the WTRU 205.

[0043] The non-primary Node-Bs 210B also perform an error check on the data packet. However, the non-primary Node-Bs 210B 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 210A generates H-ARQ (or ARQ), ACKs and NACKs, and controls retransmissions.

[0044] The MAC layer WTRU identities received by the non-primary Node-Bs 210B may be used for routing of successfully received transmissions in a universal terrestrial radio access network (UTRAN). Since the non-primary Node-Bs 210B are not aware of which WTRUs have been scheduled for EU transmission by the primary Node-B 210A, the non-primary Node-Bs 210B 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 210A may be aware of which WTRU is scheduled, the same method may be implemented by the primary Node-B 210A.

[0045] Preferably, the primary Node-B 210A may use soft combining to process transmissions, while the non-primary Node-Bs 210B 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 210A, and the NACKed data packet is combined with a retransmitted data packet. In contrast, the non-primary Node-Bs 210B 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.

[0046] 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 210B may simply perform an ARQ, without using an incremental combining process. This eliminates the soft buffer corruption problem.

[0047] In the case where non-primary Node-Bs 210B 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 210B. 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.

[0048] 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 210B. If this method is used to allow soft combining in the non-primary Node-Bs 210B, the primary Node-B 210A may not have to rely on scheduling and H-ARQ ACK/NACK decisions to determine when combining should be performed.

[0049] 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.

[0050] In a separate embodiment, preferably implemented for the asynchronous ACK/NACK feedback case, the non-primary Node-Bs 210B may

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

[0051] In order to speed up H-ARQ processing, the first ACK message from any non-primary Node-B 210B received by the RNC is preferably immediately forwarded to the primary Node-B 210A. The primary Node-B 210A also immediately generates an ACK message if the transmission is received correctly in the primary Node-B 210A without waiting for feedback from the non-primary Node-Bs 210B. The primary Node-B 210A 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.

[0052] 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 210A.

[0053] 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 210A 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.

[0054] 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 210A.

[0055] 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 210A and/or the WTRU 205.

[0056] Figure 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 210A and the one or more Node-B(s) 210 remaining in the active set are designated as a non-primary Node-Bs 210B. In step 420, the primary Node-B 210A controls UL transmissions during soft handover by performing EU scheduling and H-ARQ operations.

[0057] Figure 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.

[0058] Still referring to Figure 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.

[0059] Still referring to Figure 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.

[0060] 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.

[0061] 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.

* * *

CLAIMS

What is claimed is:

1. In a wireless multi-cell communication system including a radio network controller (RNC), a plurality of Node-Bs, and at least one wireless transmit/receive unit (WTRU), a method of coordinating Node-Bs during handover, the method comprising:

(a) the RNC initiating an inter-Node-B soft handover;

(b) the WTRU establishing communication connections with at least two of the Node-Bs;

(c) designating a particular one of the Node-Bs as a primary Node-B;

(d) designating the other one(s) of the Node-Bs as a non-primary Node-B; and

(e) the RNC informing the Node-Bs that the particular Node-B is a primary Node-B.

2. The method of claim 1 further comprising:

(f) the primary Node-B controlling an uplink (UL) transmission originating from the WTRU during soft handover.

3. The method of claim 2 wherein the primary Node-B schedules the UL transmission.

4. The method of claim 3 wherein the primary Node-B receives physical measurement information regarding the non-primary Node-B(s), and considers the information when scheduling the UL transmission.

5. The method of claim 4 wherein the primary Node-B transmits scheduling information to the WTRU and the non-primary Node-B(s).

6. The method of claim 1 further comprising:

(f) the primary Node-B controlling transmissions during soft handover by performing enhanced uplink (EU) scheduling and hybrid automatic repeat request (H-ARQ) operations.

7. The method of claim 6 wherein a positive acknowledgement (ACK) or negative acknowledgement (NACK) is transmitted either synchronously or non-synchronously from the primary Node-B to the WTRU.

8. The method of claim 6 wherein the non-primary Node-B transmits correctly decoded data blocks to the RNC.

9. The method of claim 1 wherein the primary Node-B is selected by the WTRU based on a downlink quality received from the Node-Bs.

10. The method of claim 9 wherein the downlink quality is downlink pilot power.

11. The method of claim 1 wherein the primary Node-B is selected by the RNC based on uplink performance statistics at each Node-B.

12. The method of claim 11 wherein the RNC selects the primary Node-B further based on a report generated by the WTRU regarding a downlink quality from the Node-Bs.

13. The method of claim 11 wherein the RNC selects the primary Node-B further based on a report generated by the WTRU regarding a combination of uplink and downlink quality.

14. In a wireless multi-cell communication system including a radio network controller (RNC), a source Node-B, a target Node-B and at least one wireless transmit/receive unit (WTRU), a method of coordinating Node-Bs during handover, the method comprising:

(a) the RNC initiating a hard handover for a WTRU connected to the source Node-B;

(b) the RNC informing the source Node-B when the WTRU will stop transmission and reception while being connected to the source Node-B; and

(c) the RNC sending an activation timer to the source Node-B to set the time for handover, wherein the handover is completed when the activation timer expires.

15. The method of claim 14 further comprising:

(d) the source Node-B determining whether there are any previously transmitted data packets that were negatively acknowledged (NACKed) by the source Node-B; and

(e) the source Node-B adjusting the priority of data packet transmissions sent by the WTRU in order to receive as many previously NACKed data packets as possible before the activation timer expires.

16. The method of claim 14 further comprising:

(d) the source Node-B determining whether there are any previously transmitted data packets that were negatively acknowledged (NACKed) by the source Node-B; and

(e) the source Node-B adjusting a modulation and coding scheme (MCS) used for data packet retransmissions sent by the WTRU in order to receive as many previously NACKed data packets as possible before the activation timer expires.

17. A wireless communication system for coordinating Node-Bs during handover for enhanced uplink communication, the system comprising:

(a) a wireless transmit/receive unit (WTRU); and

(b) a plurality of Node-Bs, each Node-B comprising an entity for enhanced uplink (EU) functionalities and processing a transmission from the WTRU independently, wherein a particular one of the Node-Bs is designated as being a primary Node-B, the other Node-B(s) being designated as a non-primary Node-B,

and the primary Node-B controlling EU transmissions from the WTRU during handover.

18. The system of claim 17 wherein the primary Node-B controls an uplink (UL) transmission originating from the WTRU during soft handover.

19. The system of claim 18 wherein the primary Node-B schedules the UL transmission.

20. The system of claim 19 wherein the primary Node-B receives physical measurement information regarding the non-primary Node-B(s), and considers the physical measurement information when scheduling the UL transmission.

21. The system of claim 19 wherein the primary Node-B transmits scheduling information to the WTRU and the non-primary Node-B(s).

22. The system of claim 17 wherein a positive acknowledgement (ACK) or negative acknowledgement (NACK) is transmitted either synchronously or non-synchronously from the primary Node-B to the WTRU.

23. In a wireless multi-cell communication system including a radio network controller (RNC), a plurality of Node-Bs, and at least one wireless transmit/receive unit (WTRU), an integrated circuit (IC) used to coordinate Node-Bs during handover, the IC comprising:

(a) means for designating a particular one of the Node-Bs as a primary Node-B;

(b) means for designating one or more other ones of the Node-Bs as a non-primary Node-B; and

(c) means for informing the Node-Bs that the particular Node-B has been designated as a primary Node-B.

24. The IC of claim 23 wherein the IC is integrated with the RNC.

25. In a wireless multi-cell communication system including a radio network controller (RNC) and at least one wireless transmit/receive unit (WTRU), a Node-B comprising:

(a) means for communicating with the WTRU before and during inter-Node-B hard handover;

(b) means for determining whether there are any previously transmitted data packets that were negatively acknowledged (NACKed) by the source Node-B; and

(c) means for adjusting the priority of data packet retransmissions received from the WTRU in order to receive as many previously NACKed data packets as possible before the activation timer expires.

26. The Node-B of claim 25 further comprising:

(d) means for receiving an activation timer from the RNC, wherein the timer is used to set the time for handover; and

(e) means for adjusting a modulation and coding scheme (MCS) used for data packet retransmissions received from the WTRU in order to receive as many previously NACKed data packets as possible before the activation timer expires.

27. In a wireless multi-cell communication system including a plurality of Node-Bs, a radio network controller (RNC) comprising:

(a) means for controlling the plurality of Node-Bs;

(b) means for initiating an inter-node-B soft handover;

(c) means for designating a particular one of the Node-Bs as a primary Node-B;

(d) means for designating one or more other ones of the Node-Bs as a non-primary Node-B; and

(e) means for informing the Node-Bs that the particular Node-B has been designated as a primary Node-B.

28. In a wireless multi-cell communication system including a plurality of Node-Bs, an integrated circuit (IC) comprising:

(a) means for controlling the plurality of Node-Bs;

(b) means for initiating an inter-Node-B soft handover;

(c) means for designating a particular one of the Node-Bs as a primary Node-B;

(d) means for designating one or more other ones of the Node-Bs as a non-primary Node-B; and

(e) means for informing the Node-Bs that the particular Node-B has been designated as a primary Node-B.

29. The IC of claim 28 wherein the IC is integrated with a radio network controller (RNC) that controls the plurality of Node-Bs.