

[0001] METHOD AND APPARATUS FOR IMPLEMENTING
 A DATA LIFESPAN TIMER FOR ENHANCED
 DEDICATED CHANNEL TRANSMISSIONS

[0002] FIELD OF INVENTION

[0003] The present invention is related to a wireless communication system including at least one wireless transmit/receive unit (WTRU), at least one Node-B and a radio network controller (RNC). More particularly, the present invention is related to a method and apparatus for implementing a data lifespan timer for supporting enhanced dedicated channel (E-DCH) transmissions.

[0004] BACKGROUND

[0005] Methods for improving uplink (UL) coverage, throughput, and transmission latency are currently being investigated in Release 6 of the Third Generation Partnership Project (3GPP). In order to achieve these goals, the Node-B will take over responsibility of scheduling and assigning UL resources to WTRUs. The Node-B can make more efficient decisions and manage UL radio resources on a short-term basis better than an RNC. The RNC still retains coarse overall control of the cell with enhanced uplink (EU) services so that the RNC can perform functions such as call admission control and congestion control.

[0006] Hybrid-automatic repeat request (H-ARQ) techniques provide a procedure for generating transmissions and retransmissions with low latency. A primary aspect of H-ARQ techniques is that data received in failed transmissions is soft combined with successive retransmissions to increase the probability of successful reception.

[0007] When an H-ARQ scheme and Node-B scheduling of transmissions is used, the time required to successfully transmit data will vary. Applications requiring very low latency transmission can be adversely effected by significantly delayed transmissions. For example, delayed data may be considered to be a failed transmission and end up being unnecessarily retransmitted by the application. Therefore, a mechanism that limits transmission latency is required.

[0008] SUMMARY

[0009] The present invention is implemented in a wireless communication system which supports E-DCH data transmissions. The wireless communication system includes a wireless transmit/receive unit (WTRU), at least one Node-B and a radio network controller (RNC). The WTRU includes a data buffer, a data lifespan timer, a data retransmission counter, a hybrid-automatic repeat request (H-ARQ) process and a controller. The lifespan timer establishes a lifespan for at least one data block stored in the buffer. The WTRU is configured to (i) periodically determine whether the lifespan timer has expired, (ii) determine whether the data block was previously transmitted, (iii) determine whether the lifespan timer is close to expiration, and (iv) determine whether physical resources have been allocated. If physical resources have not been allocated for a data block associated with a lifespan timer that is close to expiration, the WTRU sends an urgent channel allocation request to the Node-B. If physical resources have been allocated, the data block is prioritized for transmission with respect to other data blocks. The data block is discarded if the lifespan timer expires or if the WTRU receives feedback information indicating that the data block was successfully received by the Node-B.

[0010] BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A more detailed understanding of the invention may be had from the following description of a preferred embodiment, given by way of example and to be understood in conjunction with the accompanying drawing wherein:

[0012] Figure 1 is a block diagram of a wireless communication system operating in accordance with the present invention; and

[0013] Figure 2 is a flow diagram of a process for implementing a data lifespan timer in the WTRU of the system of Figure 1 in accordance with the present invention.

[0014] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] 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.

[0016] The features of the present invention may be incorporated into an integrated circuit (IC) or be configured in a circuit comprising a multitude of interconnecting components.

[0017] Figure 1 is a block diagram of a wireless communication system 100 in accordance with the present invention. The system 100 comprises at least one WTRU 102, at least one Node-B 104 and at least one RNC 106. The WTRU 102 includes a controller 122, a data lifespan timer 124, a buffer 126, a plurality of H-ARQ processes 128 and optionally a retransmission counter 130. The controller 122 controls overall data transmission procedures including initiation of the data lifespan timer 124 and allocation of an H-ARQ process 128.

[0018] The RNC 106 controls overall EU operation of the system 100 by configuring EU parameters for the Node-B 104 and the WTRU 102 such as the lifespan time for transport channel (TrCH) or logical channel data, initial transmit power level, maximum allowed EU transmit power or available channel resources per Node-B 104. E-DCH is established for supporting EU transmissions between the WTRU 102 and the Node-B 104.

[0019] For the E-DCH transmissions, the WTRU 102 sends a channel allocation request to the Node-B 104 via a UL EU signaling channel 110. The channel allocation request, (or other UL EU signaling), may be transmitted via the E-DCH 108 instead of the UL EU signaling channel 110. In response, the Node-B 104 sends channel allocation information to the WTRU 102 via a downlink (DL) EU signaling channel 112. After EU radio resources are allocated for the WTRU 102, the WTRU 102 transmits data via an E-DCH 108. In response to the E-DCH data transmission, the Node-B 104 sends an

acknowledgement (ACK) or non-acknowledgement (NACK) message for H-ARQ operation via the DL EU signaling channel 112.

[0020] Figure 2 is a flow diagram of a process 200 for implementing a data lifespan timer 124 in the WTRU 102 for supporting E-DCH transmissions in accordance with the present invention. The WTRU 102 may handle multiple E-DCH transmissions simultaneously using a plurality of data lifespan timers 124.

[0021] When a new data block is received for transmission via the E-DCH 108, the controller 122 activates a data lifespan timer 124 for the data block, associates an H-ARQ process 128 with the data block and the new data block waits in the buffer 126 (step 202). The RNC configures the data lifespan for each E-DCH TrCH or for each E-DCH logical channel. Upon reception in MAC or RLC for UL transmission the timer is initialized for each transmission.

[0022] The value of E-DCH data lifespan timer 124 may be determined by the controller 122 in the WTRU 102 considering several factors such as maximum allowed transmission latency, RLC configuration, and the TrCH block error ratio (BLER) requirement, or the like. For example, the maximum allowed latency determines how long the data can be buffered before delivery. Furthermore, the BLER determines the number of H-ARQ retransmissions which effect transmission latency. The value assigned to the data lifespan timer 124 may also take into account WTRU data processing external to a medium access control entity for EU (MAC-e) in the WTRU 102.

[0023] Application protocols, (e.g., TCP/IP), require minimal transmission latency and variance in transmission latency to achieve maximum throughput. When transmission delays occur, data is expected to be failed and discarded, not delayed and retransmitted. This results in an inefficient behavior of the application.

[0024] For each TTI at step 204, the controller 122 determines whether the data lifespan timer 124 for the data block in the buffer 126 of the WTRU 102 has expired (step 206). If the data lifespan timer 124 has expired, the controller 122 discards the data block and releases the associated H-ARQ process 128 (step

208). The WTRU 102 may report this event to either the RNC 106 or the Node-B 104 (step 210). The WTRU 102 may further report to the Node-B 104 that physical resources allocations are not sufficient by sending a channel allocation request with a unique indication.

[0025] Referring back to step 206, if the data lifespan timer 124 for the data block has not expired, the controller 122 determines whether the data block in the buffer 126 of the WTRU 102 was previously transmitted by the WTRU 102 (step 212). If the data block had been previously transmitted, it is further determined whether data feedback information associated with the data block was received from the Node-B 104 (step 214). If an acknowledgement (ACK) message indicating successful transmission of the data block is received, the data block is discarded from the buffer 126, the associated H-ARQ process 128 becomes available for supporting another data block and the data lifespan timer is reset (step 216). If no feedback message is received, the WTRU 102 waits for the feedback message until the next TTI (step 218).

[0026] If, at step 212, it is determined that the data block had not been previously transmitted by the WTRU 102, or that the data block has been transmitted but a non-acknowledgement (NACK) message indicating unsuccessful transmission of the data block is received, the data block is retransmitted. The controller 122 determines whether the data lifespan timer 124 for the data block is close to expiration (step 220). If the data lifespan timer 124 is not close to expiration, a normal H-ARQ operation is initiated for transmitting the data block (step 222).

[0027] In step 224, the controller 122 determines whether physical resources have been allocated when the data lifespan timer 124 is close to expiration (step 224). If physical resources have been allocated, the controller 122 may optionally prioritize transmission of the data block (step 226). If physical resources have not been allocated, the controller 122 may optionally send an urgent channel allocation request to the Node-B for supporting the transmission of the data block (step 228).

[0028] Referring back to step 214, if a NACK message has been received,

the data block is retransmitted, the controller 122 may determine whether the retransmission counter 130 has reached a maximum retransmission limit (step 230). The retransmission counter 130 is incremented each time the data block is retransmitted, and the maximum retransmission limit is configured by the RNC 106. If the retransmission counter 130 does not reach the maximum retransmission limit, the process 200 proceeds to step 220. If the retransmission counter 130 reaches the maximum retransmission limit, the controller 122 reinitializes the H-ARQ process 128 as long as the data lifespan timer 124 for the data block has not expired (step 232). The retransmission counter 130 is initialized and a new data indicator is incremented to indicate re-initiation of the H-ARQ process 128.

[0029] Although the features and elements of the present invention are described in the preferred embodiments in particular combinations, each feature or element can be used alone without the other features and elements of the preferred embodiments or in various combinations with or without other features and elements of the present invention.

* * *

CLAIMS

What is claimed is:

1. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, a method for utilizing at least one data lifespan timer in the WTRU for supporting enhanced dedicated channel (E-DCH) data transmissions, the method comprising:

- (a) storing a data block in a buffer in the WTRU;
- (b) activating a data lifespan timer for the data block; and
- (c) discarding the data block when the data lifespan timer expires.

2. The method of claim 1 further comprising:

- (d) assigning a hybrid-automatic repeat request (H-ARQ) process to support the transmission of the data block;
- (e) releasing the H-ARQ process when the data lifespan timer expires; and
- (f) sending a message to the Node-B indicating that the data block has been discarded and the H-ARQ process is available.

3. The method of claim 1 further comprising:

- (d) initiating a normal hybrid-automatic repeat request (H-ARQ) operation for transmission of the data block if the data block was previously transmitted and the data lifespan timer is not close to expiration.

4. The method of claim 1 wherein the wireless communication system further includes a radio network controller (RNC), the method further comprising:

- (d) the RNC configuring the data lifespan timer.

5. The method of claim 4 wherein the data lifespan timer is configured for each of a plurality of transport channels (TrCHs).

6. The method of claim 4 wherein the data lifespan timer is configured for each of a plurality of logical channels.

7. The method of claim 1 wherein the data lifespan timer is set based on at least one of a maximum allowed transmission latency, an established radio link control (RLC) configuration and a transport channel block error rate (BLER).

8. The method of claim 1 further comprising:

(d) periodically determining whether the data lifespan timer has expired.

9. The method of claim 1 wherein the wireless communication system further includes a radio network controller (RNC), the method further comprising:

(d) sending a message to the RNC indicating that the data lifespan timer has expired.

10. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, a method for utilizing at least one data lifespan timer in the WTRU for supporting enhanced dedicated channel (E-DCH) data transmissions, the method comprising:

(a) storing a data block in a buffer in the WTRU;

(b) activating a data lifespan timer for the data block; and

(c) discarding the data block before the data lifespan timer expires when the WTRU receives feedback information indicating that the data block was successfully received by the Node-B.

11. The method of claim 10 further comprising:

(d) resetting the data lifespan timer for the data block when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

12. The method of claim 10 further comprising:

(d) assigning a hybrid-automatic repeat request (H-ARQ) process to support the transmission of the data block; and

(e) releasing the H-ARQ process when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

13. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, a method for utilizing at least one data lifespan timer in the WTRU for supporting enhanced dedicated channel (E-DCH) data transmissions, the method comprising:

(a) storing a data block in a buffer in the WTRU;

(b) assigning a hybrid-automatic repeat request (H-ARQ) process to support the transmission of the data block;

(c) activating a data lifespan timer for the data block;

(d) if the data block was previously transmitted but was not successfully received by the Node-B, determining whether an established retransmission limit has been reached;

(e) if the retransmission limit has been reached and the lifespan timer did not expire, reinitiating the H-ARQ process; and

(f) initiating a normal H-ARQ operation for transmission of the data block if the retransmission limit was not reached and the data lifespan timer is not close to expiration.

14. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, a method for utilizing at least one data lifespan timer in the WTRU for supporting enhanced dedicated channel (E-DCH) data transmissions, the method comprising:

(a) storing a data block in a buffer in the WTRU;

(b) activating the data lifespan timer; and

(c) determining whether physical resources have been allocated for supporting the transmission of the data block when the lifespan timer is close to expiration.

15. The method of claim 14 further comprising:

(d) if the physical resources have not been allocated, sending an urgent channel allocation request to the Node-B for supporting the transmission of the data block.

16. The method of claim 14 further comprising:

(d) if the physical resources have been allocated, prioritizing the data block for transmission with respect to other data blocks.

17. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, the WTRU comprising:

(a) a buffer for storing a data block;

(b) a data lifespan timer for establishing a lifespan of the data block; and

(c) a controller in communication with the buffer and the data lifespan timer, wherein the controller discards the data block when the data lifespan timer expires.

18. The WTRU of claim 17 further comprising:

(d) a hybrid-automatic repeat request (H-ARQ) process assigned by the controller to support the transmission of the data block, wherein the controller releases the H-ARQ process when the data lifespan timer expires.

19. The WTRU of claim 18 wherein the WTRU sends a message to the Node-B indicating that the data block has been discarded and the H-ARQ process is available.

20. The WTRU of claim 17 wherein the WTRU sends a message to a radio network controller (RNC) indicating that the data lifespan timer has expired.

21. The WTRU of claim 17 wherein the controller initiates a normal hybrid-automatic repeat request (H-ARQ) operation for transmission of the data block if the data block was previously transmitted and the data lifespan timer is not close to expiration.

22. The WTRU of claim 17 wherein the wireless communication system further includes a radio network controller (RNC) which configures the data lifespan timer.

23. The WTRU of claim 22 wherein the data lifespan timer is configured for each of a plurality of transport channels (TrCHs).

24. The WTRU of claim 22 wherein the data lifespan timer is configured for each of a plurality of logical channels.

25. The WTRU of claim 17 wherein the controller sets the data lifespan timer based on at least one of a maximum allowed transmission latency, an established radio link control (RLC) configuration and a transport channel block error rate (BLER).

26. The WTRU of claim 17 wherein the controller periodically determines whether the data lifespan timer has expired.

27. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at

least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block; and
- (c) a controller in communication with the buffer and the data lifespan timer, wherein the controller discards the data block before the data lifespan timer expires when the WTRU receives feedback information indicating that the data block was successfully received by the Node-B.

28. The WTRU of claim 27 wherein the controller resets the data lifespan timer when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

29. The WTRU of claim 27 further comprising:

- (d) a hybrid-automatic repeat request (H-ARQ) process assigned by the controller to support the transmission of the data block, wherein the controller releases the H-ARQ process when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

30. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block;
- (c) a hybrid-automatic repeat request (H-ARQ) process for supporting the transmission of the data block; and
- (d) a controller in communication with the buffer and the data lifespan timer, wherein the controller activates the data lifespan timer and assigns the H-ARQ process to the data block, wherein (i) if the data block was previously transmitted but was not successfully received by the Node-B, the controller

determines whether an established retransmission limit has been reached, (ii) if the controller determines that the retransmission limit has been reached and the lifespan timer did not expire, the controller reinitiates the H-ARQ process, and (iii) the controller initiates a normal H-ARQ operation for transmission of the data block if the retransmission limit was not reached and the data lifespan timer is not close to expiration.

31. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block; and
- (c) a controller in communication with the buffer and the data lifespan timer, wherein the controller determines whether physical resources have been allocated for supporting the transmission of the data block when the lifespan timer is close to expiration.

32. The WTRU of claim 31 wherein if the controller determines that physical resources have not been allocated, the WTRU sends an urgent channel allocation request to the Node-B for supporting the transmission of the data block.

33. The WTRU of claim 31 wherein if the controller determines that physical resources have been allocated, the controller prioritizes the data block for transmission with respect to other data blocks.

34. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, an integrated circuit (IC) in the WTRU comprising:

(a) a buffer for storing a data block;
(b) a data lifespan timer for establishing a lifespan of the data block; and
(c) a controller in communication with the buffer and the data lifespan timer, wherein the controller discards the data block when the data lifespan timer expires.

35. The IC of claim 34 further comprising:

(d) a hybrid-automatic repeat request (H-ARQ) process assigned by the controller to support the transmission of the data block, wherein the controller releases the H-ARQ process when the data lifespan timer expires.

36. The IC of claim 35 wherein the WTRU sends a message to the Node-B indicating that the data block has been discarded and the H-ARQ process is available.

37. The IC of claim 34 wherein the WTRU sends a message to a radio network controller (RNC) indicating that the data lifespan timer has expired.

38. The IC of claim 34 wherein the controller initiates a normal hybrid-automatic repeat request (H-ARQ) operation for transmission of the data block if the data block was previously transmitted and the data lifespan timer is not close to expiration.

39. The IC of claim 34 wherein the wireless communication system further includes a radio network controller (RNC) which configures the data lifespan timer.

40. The IC of claim 39 wherein the data lifespan timer is configured for each of a plurality of transport channels (TrCHs).

41. The IC of claim 39 wherein the data lifespan timer is configured for each of a plurality of logical channels.

42. The IC of claim 34 wherein the controller sets the data lifespan timer based on at least one of a maximum allowed transmission latency, an established radio link control (RLC) configuration and a transport channel block error rate (BLER).

43. The IC of claim 34 wherein the controller periodically determines whether the data lifespan timer has expired.

44. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, an integrated circuit (IC) in the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block; and
- (c) a controller in communication with the buffer and the data lifespan timer, wherein the controller discards the data block before the data lifespan timer expires when the WTRU receives feedback information indicating that the data block was successfully received by the Node-B.

45. The IC of claim 44 wherein the controller resets the data lifespan timer when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

46. The IC of claim 44 further comprising:

- (d) a hybrid-automatic repeat request (H-ARQ) process assigned by the controller to support the transmission of the data block, wherein the controller releases the H-ARQ process when the WTRU receives the feedback information indicating that the data block was successfully received by the Node-B.

47. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, an integrated circuit (IC) in the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block;
- (c) a hybrid-automatic repeat request (H-ARQ) process for supporting the transmission of the data block; and
- (d) a controller in communication with the buffer and the data lifespan timer, wherein the controller activates the data lifespan timer and assigns the H-ARQ process to the data block, wherein (i) if the data block was previously transmitted but was not successfully received by the Node-B, the controller determines whether an established retransmission limit has been reached, (ii) if the controller determines that the retransmission limit has been reached and the lifespan timer did not expire, the controller reinitiates the H-ARQ process, and (iii) the controller initiates a normal H-ARQ operation for transmission of the data block if the retransmission limit was not reached and the data lifespan timer is not close to expiration.

48. In a wireless communication system including a wireless transmit/receive unit (WTRU) and at least one Node-B, the WTRU utilizing at least one data lifespan timer for supporting enhanced dedicated channel (E-DCH) data transmissions, an integrated circuit (IC) in the WTRU comprising:

- (a) a buffer for storing a data block;
- (b) a data lifespan timer for establishing a lifespan of the data block; and
- (c) a controller in communication with the buffer and the data lifespan timer, wherein the controller determines whether physical resources have been allocated for supporting the transmission of the data block when the lifespan timer is close to expiration.

49. The IC of claim 48 wherein if the controller determines that physical resources have not been allocated, the IC sends an urgent channel allocation request to the Node-B for supporting the transmission of the data block.

50. The IC of claim 48 wherein if the controller determines that physical resources have been allocated, the controller prioritizes the data block for transmission with respect to other data blocks.