

[0001] WIRELESS COMMUNICATION METHOD AND APPARATUS FOR
TRANSFERRING BUFFERED ENHANCED UPLINK
DATA FROM A MOBILE STATION TO A NODE-B

[0002] FIELD OF INVENTION

[0003] The present invention is related to a wireless communication system including a wireless transmit/receive unit (WTRU) and a Node-B. More particularly, the present invention is related to providing WTRU uplink (UL) traffic information to the Node-B for scheduling enhanced uplink (EU) transmissions.

[0006] BACKGROUND

[0007] Methods for enhancing UL coverage, throughput and transmission latency in a wireless communication system, such as a frequency division duplex (FDD) system, are currently being investigated in release 6 (R6) of the third generation partnership project (3GPP). Instead of scheduling and assigning UL physical channels in a radio network controller (RNC), a Node-B (i.e., a base station controller) is used to communicate with a plurality of WTRUs such that more efficient decisions can be made and UL radio resources can be managed on a short-term basis better than the RNC, even if the RNC retains overall control of the system. A similar approach has already been adopted in the downlink for release 5 (R5) of high speed data packet access (HSDPA) in a universal mobile telecommunications system (UMTS) for both an FDD mode and a time division duplex (TDD) mode.

[0008] In order for the Node-B to make efficient allocation decisions and prioritize between different data flows, the Node-B requires knowledge of UL data buffered in the WTRU for individual data channels along with their associated priority. However, conventional UL signaling methods have limited capacity, and thus may not be able to accommodate the reporting of detailed traffic volume measurement (TVM) information from the WTRU.

[0009]

SUMMARY

[0010] Embodiments of the present invention relate to a wireless communication method and apparatus for transferring buffered EU data from a WTRU, (i.e., a mobile station), to a Node-B. The apparatus may be a wireless communication system, a WTRU and/or an integrated circuit (IC). The EU data is generated and stored in a buffer of the WTRU. The WTRU transmits an initial EU data transmission request message to the Node-B indicating that the WTRU has EU data to transfer to the Node-B. The initial EU data transmission request message includes a request for a desired transport format combination (TFC) or data traffic indicator. In response to receiving the initial EU data transmission request message, the Node-B schedules one or more allowed EU data transmissions between the WTRU and the Node-B by transmitting an EU data scheduling message to the WTRU. The WTRU transfers all of the EU data stored in the buffer to the Node-B if the allowed EU data transmissions are sufficient to support transmission of all of the EU data stored in the buffer. Otherwise, the WTRU transmits a portion of the EU data along with the desired TFC or detailed TVM information to the Node-B.

[0011] The procedure used to transfer EU data stored in the buffer of the WTRU may be dependent upon whether or not the quantity of the EU data exceeds an established threshold. The initial EU data transmission request message may be transmitted to the Node-B only after the quantity of the stored EU data exceeds the established threshold. When the established threshold is not exceeded, the WTRU may transfer all of the EU data from the buffer of the WTRU to the Node-B without requiring scheduling information from the Node-B. If the established threshold is set to zero, the WTRU may transfer the stored EU data from the buffer of the WTRU to the Node-B only after receiving scheduling information from the Node-B.

[0012] The EU data transmission request message may be identified in at least one layer 1 physical control field or layer 2 medium access control (MAC) header.

[0013] The desired TFC or data traffic indicator may be signaled in at least

one physical control field on an EU dedicated physical control channel (EU-DPCCH). Another field on the EU-DPCCH may include other EU related messages. If there is no EU data for the WTRU to transfer to the Node-B that requires further scheduling, the physical control field is empty or not included.

[0014] In an alternate embodiment, the EU data transmission message may include a MAC header with a field including the desired TFC or detailed TVM information. The MAC header may further include one or more other EU MAC fields. When the MAC header is empty or not included, there is no EU data for the WTRU to transfer to the Node-B.

[0014a] According to a first aspect of the invention, there is provided a method for scheduling an enhanced uplink (EU) dedicated channel data transmission, implemented in a wireless transmit/receive unit (WTRU), comprising: transmitting a data traffic indicator to a Node-B; when an amount of data in an EU data buffer is greater than zero, transmitting an EU scheduling information message in an EU dedicated channel medium access control (MAC) header to the Node-B, the EU scheduling information message indicating a total amount of data in the EU data buffer and an amount of EU data buffered for a priority logical channel; and scheduling EU dedicated channel data transmissions based on the scheduling information and the data traffic indicator.

[0014b] According to a second aspect of the invention, there is provided a frequency division duplex wideband code division multiple access wireless transmit/receive unit (WTRU) comprising: a buffer having buffered data for enhanced uplink (EU) transmission, the EU data including data for a priority logical channel; and a transmitter configured to transmit EU scheduling information in an EU dedicated channel medium access control (MAC) header when an amount of the EU buffered data is greater than zero, the EU scheduling information indicating a total amount of the buffered EU data and an amount of EU data buffered for a priority logical channel, and further configured to transmit a data traffic indicator, the scheduling information and data traffic indicator for scheduling EU dedicated channel data transmissions.

[0014c] According to a third aspect of the invention, there is provided a frequency division duplex wideband Node-B for scheduling EU data transmissions comprising: a receiver configured to receive a dedicated channel medium access control (MAC) header from a wireless transmit/receive unit (WTRU), the MAC header having scheduling information when an amount EU buffered data of the WTRU is greater than zero, the scheduling information indicating a total amount of buffered EU data and an amount of EU data buffered for a priority logical channel, further configured to receive a data traffic indicator; and circuitry configured to schedule EU data transmission based on the scheduling information and the data traffic indicator.

[0015] **BRIEF DESCRIPTION OF THE DRAWING(S)**

[0016] A more detailed understanding of the invention may be had from the following description of a preferred example, given by way of example and to be understood in conjunction with the accompanying drawing wherein:

[0017] Figure 1 shows a wireless communication system operating in accordance with the present invention;

[0018] Figure 2 is a signal flow diagram for the system of Figure 1 when the EU data transmissions allowed by an EU data scheduling message are not sufficient to transmit all of the EU data buffered in the WTRU;

[0019] Figure 3 is a signal flow diagram for the system of Figure 1 when the EU data transmissions allowed by an EU data scheduling message are sufficient to transmit all of the EU data buffered in the WTRU;

[0020] Figure 4 shows a frame structure used for requesting EU data scheduling information via an EU channel in accordance with one embodiment of the present invention;

[0021] Figure 5 show a MAC PDU format used to indicate a desired TFC or detailed TVM information in accordance with an alternate embodiment of the present invention; and

[0022] Figure 6 is a flowchart of a process including method steps for transferring buffered EU data in accordance with the present invention.

[0023] DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0024] Hereafter, the terminology "WTRU" includes but is not limited to a user equipment (UE), mobile station, fixed or mobile subscriber unit, pager, or any other type of device capable of operating in a wireless environment.

[0025] When referred to hereafter, the terminology "Node-B" includes but is not limited to a base station, site controller, access point or any other type of interfacing device in a wireless environment.

[0026] The present invention may be further applicable to TDD, FDD, and time division synchronous code division multiple access (TD-SCDMA), as applied to Universal Mobile Telecommunications System (UMTS), CDMA 2000 and CDMA in general, but is envisaged to be applicable to other wireless systems as well.

[0027] The features of the present invention may be incorporated into an IC or be configured in a circuit comprising a multitude of interconnecting components.

[0028] Figure 1 shows a wireless communication system 100 operating in accordance with the present invention. The system 100 includes a WTRU 105 and a Node-B 110 which communicate with each other via wireless signals 115. The WTRU 105 includes at least one buffer 120.

[0029] Figure 2 is a signal flow diagram for the wireless communication system 100 when one or more EU data transmissions allowed by a first EU data scheduling message are not sufficient to transmit all of the EU data stored in the buffer 120 of the WTRU 105. EU data 205 is generated at the WTRU 105 and is stored in the buffer 120 of the WTRU 105. When the quantity of the EU data in the buffer 120 exceeds an established EU data buffer threshold, the WTRU 105 sends an initial request message 210 to the Node-B 110 via an EU signaling channel. EU data transmissions sent by the WTRU 105 are not required to be scheduled by the Node-B 110 when the established threshold is not exceeded.

[0030] The initial request message 210 may include a desired TFC or a data traffic indicator. If the limited payload capacity of the EU control channel cannot accommodate the signaling of a desired TFC, the WTRU 105 may send a

message to the Node-B 110 indicating that the WTRU 105 has EU data to transmit to the Node-B 110 via an EU control channel. The desired TFC may be an index to a preconfigured list of possible uplink transport formats (or TFCs).

[0031] Referring still to Figure 2, upon receiving the initial request message 210, the Node-B 110 schedules one or more EU data transmissions between the WTRU 105 and the Node-B 110 via a first EU data scheduling message 215. In response to receiving the first EU data scheduling message 215, the WTRU 105 sends one or more EU data transmissions 220 to the Node-B 110 allowed by the first EU data scheduling message 215. If the EU data transmissions allowed by the first EU data scheduling message 215 are not sufficient to transmit all of the EU data buffered in the WTRU 105, the WTRU 105 sends EU data transmissions 220 including desired TFC information to the Node-B 110. The desired TFC information included in messages 210 and 220 may either be signaled in at least one physical control field or MAC header along with the EU data transmissions 220. The desired TFC may be reflected by an index into a list of predetermined TFCs. The desired TFC is used by the Node-B 110 to determine and generate subsequent scheduling messages 225a - 225n.

[0032] Alternatively, in lieu of the desired TFC information, detailed TVM information may be provided with the EU data transmissions 220. The detailed TVM information may indicate the amount of buffered data associated with individual traffic flows (channels) that can be associated with priority classes mapped to the EU dedicated channel (EU-DCH). Node-B 110 can utilize the comprehensive knowledge of the desired TFC or detailed TVM information and potentially associated priorities reported via the EU transmissions 220 to determine subsequent uplink scheduling. When the WTRU 105 obtains additional EU data later on, the WTRU 105 may choose to report updated desired TFC or detailed TVM information to the Node-B 110. The Node-B 110 then schedules subsequent EU data transmissions from the WTRU 105 to the Node-B 110 via subsequent EU data scheduling messages 225a - 225n.

[0033] Figure 3 is a signal flow diagram for the wireless communication system 100 when one or more EU data transmissions allowed by an EU data

scheduling message are sufficient to transmit all of the EU data stored in the buffer 120 of the WTRU 105. EU data 305 is generated at the WTRU 105 and is stored in the buffer 120 of the WTRU 105. When the quantity of the EU data in the buffer 120 exceeds an established EU data buffer threshold, the WTRU 105 sends an initial request message 310 to the Node-B 110 via an EU signaling channel. The initial request message 310 may include a desired TFC or a data traffic indicator. If the limited payload capacity of the EU control channel cannot accommodate the signaling of a desired TFC, the WTRU 105 may send a message to the Node-B 110 indicating that the WTRU 105 has EU data to transmit to the Node-B 110 via an EU control channel. The desired TFC may be an index to a preconfigured list of possible uplink transmission formats (or TFCs).

[0034] EU data transmissions sent by the WTRU 105 are not required to be scheduled by the Node-B 110 when the established EU data buffer threshold is not exceeded.

[0035] Still referring to Figure 3, upon receiving the initial request message 310, the Node-B 110 schedules one or more EU data transmissions between the WTRU 105 and the Node-B 110 via an EU data scheduling message 315. In response to receiving the EU data scheduling message 315, the WTRU 105 sends one or more EU data transmissions 320 allowed by the EU data scheduling message 315. If the EU data transmissions allowed by the EU data scheduling message 315 are sufficient to transmit all of the EU data 305 buffered in the WTRU 105, all of the EU data stored in the buffer 120 of the WTRU 105 is sent to the Node-B 110. In this case, UL signaling information indicating the desired TFC or detailed TVM information is either not included or an associated message field is left empty, indicating that the WTRU 105 does not require further scheduling allocations.

[0036] Figure 4 shows a frame structure 400 used for requesting EU data scheduling information via an EU channel in accordance with one embodiment of the present invention. The frame structure 400 may be incorporated into the initial request message 210 and, potentially, the EU data transmissions 220 previously described in conjunction with Figure 2.

[0037] The frame structure 400 includes a "requested TFC information / EU data indication" field 405 and an "other EU related messages" field 410. The requested TFC information / EU data indication field 405 is signaled in at least one physical control field on the EU-DPCCH. An empty requested TFC information / EU data indication field 405 indicates that there is no more buffered EU data for the WTRU 105 to send to the Node-B 110, and thus, no further scheduling allocations from the Node-B 110 are required. The EU-DPCCH may be code or time-multiplexed with an EU-DCH and/or a high speed dedicated physical control channel (HS-DPCCH).

[0038] Figure 5 shows a MAC protocol data unit (PDU) format 500 used to indicate a desired TFC or detailed TVM information in accordance with an alternate embodiment of the present invention. The MAC PDU format 500 may be incorporated into the EU data transmissions 220 and, potentially, the initial request message 210 previously described in conjunction with Figure 2.

[0039] The MAC PDU format 500 includes a "requested TFC/TVM information field" 505, one or more "other EU MAC header fields" 510, and a MAC SDU field 515. The requested TFC/TVM information field 505 is signaled within the MAC header of EU data transmissions. An empty requested TFC/TVM information field 505 indicates that there is no more buffered EU data for the WTRU 105 to send to the Node-B 110, and thus, no further scheduling allocations from the Node-B 110 are required.

[0040] Figure 6 is a flowchart of a process 600 including method steps for transferring user data from the WTRU 105 to the Node-B 110 in accordance with the present invention. In step 605, EU data is generated and stored in the buffer 120 of the WTRU 105. In optional step 610, a determination is made as to whether or not the quantity of EU data stored in the buffer 120 of the WTRU 105 exceeds an established threshold. When the quantity of the stored EU data in the buffer 120 of the WTRU 105 does not exceed the established threshold, EU transmissions are allowed without Node-B scheduling, and all of the stored EU data is transmitted to the Node-B 110 (step 630). If the quantity of the stored EU data exceeds the established threshold, the WTRU 105 sends an initial EU

data transmission request message including desired TFC information or just a traffic indicator (i.e., an EU data indication) to the Node-B 110 indicating that the WTRU 105 has EU data to send to the Node-B 110 (step 615).

[0041] It should be noted that the established EU data buffer threshold may be set to zero. In this case, the storage of any amount of EU data in the buffer 120 of the WTRU 105 will always trigger the transmission of an initial request message 210.

[0042] Still referring to Figure 6, in step 620, the Node-B 110 sends an EU data scheduling message, including information on one or more allowed EU data transmissions, to the WTRU 105 to schedule transmission of the EU data buffered in the WTRU 105 to the Node-B 110. In step 625, the WTRU 105 determines if the allowed EU data transmissions are sufficient to transmit all of the buffered EU data. If the EU data transmissions allowed by the current scheduling information are sufficient to support transmission of all of the EU data stored in the buffer 120, all of the EU data buffered in the WTRU 105 is transmitted to the Node-B 110 in the allowed EU data transmissions (step 630).

[0043] If the EU data transmissions allowed by the current scheduling information are not sufficient to transmit all of the EU data buffered in the WTRU 105, the WTRU 105 transmits one or more EU data transmissions including the desired TFC or detailed TVM information to the Node-B 110 (step 635). In step 640, the Node-B 110 determines priorities associated with the EU data. Node-B 110 utilizes the knowledge of the requested TFC or detailed TVM information, and associated priorities for determining the EU physical channel, and scheduling and transmitting one or more additional EU data transmissions until there is no more EU data buffered in the WTRU 105.

[0044] 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 form and details may be made therein without departing from the scope of the invention described hereinabove.

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CLAIMS

What is claimed is:

1. A method for scheduling an enhanced uplink (EU) dedicated channel data transmission, implemented in a wireless transmit/receive unit (WTRU), comprising:
 - transmitting a data traffic indicator to a Node-B;
 - when an amount of data in an EU data buffer is greater than zero, transmitting an EU scheduling information message in an EU dedicated channel medium access control (MAC) header to the Node-B, the EU scheduling information message indicating a total amount of data in the EU data buffer and an amount of EU data buffered for a priority logical channel; and
 - scheduling EU dedicated channel data transmissions based on the scheduling information and the data traffic indicator.
2. The method of claim 1 wherein the EU scheduling information message is updated and retransmitted.
3. The method of claim 1 further comprising:
 - when an amount of transmitted EU data is below an established threshold, transmitting EU dedicated channel data without being scheduled.
4. The method according to claim 1 wherein the EU scheduling information message identifies the highest priority logical channel with data in the EU data buffer.
5. The method according to claim 1 wherein the EU scheduling information message indicates the maximum transmission power and the corresponding code power of the dedicated channel.
6. The method according to claim 1 wherein the EU scheduling information message includes a requested transport format combination (TFC) information / EU data indication field.

7. The method according to claim 1 wherein the EU scheduling information message includes a field containing a plurality of EU related messages during all uplink transmissions in the dedicated channel.
8. A frequency division duplex wideband code division multiple access wireless transmit/receive unit (WTRU) comprising:
 - a buffer having buffered data for enhanced uplink (EU) transmission, the EU data including data for a priority logical channel; and
 - a transmitter configured to transmit EU scheduling information in an EU dedicated channel medium access control (MAC) header when an amount of the EU buffered data is greater than zero, the EU scheduling information indicating a total amount of the buffered EU data and an amount of EU data buffered for a priority logical channel, and further configured to transmit a data traffic indicator, the scheduling information and data traffic indicator for scheduling EU dedicated channel data transmissions.
9. The WTRU of claim 8 further comprising
 - a circuit configured to update and retransmit the EU scheduling information.
10. The WTRU of claim 8 wherein the transmitter is configured to transmit EU dedicated channel data without being scheduled when an amount of transmitted EU data is below an established threshold.
11. The WTRU of claim 8 wherein the EU scheduling information identifies the highest priority logical channel with data in the EU data buffer.
12. The WTRU of claim 8 wherein the EU scheduling information indicates the maximum transmission power and the corresponding code power of the dedicated channel.
13. The WTRU of claim 8 wherein the EU scheduling information includes a requested transport format combination (TFC) information / EU data indication field.

14. The WTRU of claim 8 wherein the EU scheduling information includes a field containing a plurality of EU related messages during all uplink transmissions in the dedicated channel.
15. A frequency division duplex wideband Node-B for scheduling EU data transmissions comprising:
 - a receiver configured to receive a dedicated channel medium access control (MAC) header from a wireless transmit/receive unit (WTRU), the MAC header having scheduling information when an amount EU buffered data of the WTRU is greater than zero, the scheduling information indicating a total amount of buffered EU data and an amount of EU data buffered for a priority logical channel, further configured to receive a data traffic indicator; and
 - circuitry configured to schedule EU data transmission based on the scheduling information and the data traffic indicator.
16. The Node-B of claim 15 wherein the scheduling information is updated.
17. The Node-B of claim 15 wherein the receiver is further configured to receive unscheduled EU transmitted data when an amount of transmitted EU data is below an established threshold for the WTRU.
18. The Node-B of claim 15 wherein the EU scheduling information identifies the highest priority logical channel with data in the EU data buffer.
19. The Node-B of claim 15 wherein the EU scheduling information indicates the maximum transmission power of the WTRU and the corresponding code power of the dedicated channel.
20. The Node-B of claim 15 wherein the EU scheduling information includes a requested transport format combination (TFC) information / EU data indication field.

21. The Node-B of claim 15 wherein the EU scheduling information includes a field containing a plurality of EU related messages during all uplink transmissions in the dedicated channel.