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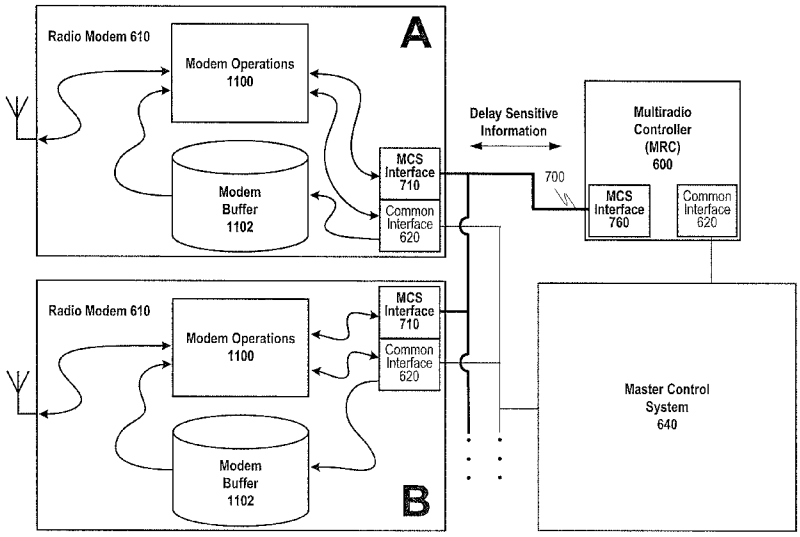
(54) Title: MULTIRADIO PRIORITY CONTROL BASED ON MODEM BUFFER LOAD



(57) Abstract: A system for controlling communications in a multiradio wireless communication device (WCD) by monitoring a backlog of messages waiting to be wirelessly transmitted through one or more radio modems as compared to a predetermined threshold. If the amount of pending messages meets and/or exceeds the predetermined threshold then a potentially problematic situation may exist, and actions may be taken to alleviate the large message backlog. Actions may include, for example, temporarily reallocating communication time for one or all of the radio modems. This time may be reallocated to radio modems experiencing potential message queue overflows in order to reduced the backlog of messages and avoid a potential communication failure.

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AMENDED CLAIMS

(received by the International Bureau on 11 July 2008 (11.07.2008))

1. A method, comprising:

defining an operational schedule for two or more radio modems integrated into a wireless communication device, the operational schedule being defined by a multiradio controller also in the device that is configured to convey the operational schedule to the two or more radio modems via a communication interface dedicated to the conveyance of delay-sensitive information;

receiving buffer level information into the multiradio controller from a threshold monitor corresponding to at least one of the two or more radio modems; and

adjusting the operational schedule for the two or more radio modems based on a threshold condition related to the buffer level, wherein adjusting the operational schedule for the two or more radio modules comprises defining a new operational schedule in the multiradio controller for at least one of the two or more radio modems and conveying the new operational schedule to the at least one of the two or more radio modules via the dedicated interface.

2. The method of claim 1, wherein defining an operational schedule for two or more radio modems includes allocating communication time to each of the radio modems for use in transmitting and receiving information via a wireless communication medium.

3. The method of claim 1, wherein at least one of each radio modem or each wireless medium is prioritized, and transmission time is allocated based on the priority.

4. The method of claim 1, wherein the buffer level information includes information about the amount of data in transmission buffer for each radio modem.

5. The method of claim 4, wherein the threshold condition related to the buffer level includes at least one of a percentage of buffer usage, a number of messages in the buffer, and a change of state of the buffer.

6. The method of claim 1, wherein the new operational schedule for the at least one of two or more radio modems temporarily alters the existing operational schedule.

7. The method of claim 6, wherein the new operational schedule reallocates communication time from at least one radio modem to at least one other radio modem.

8. The method of claim 6, wherein the operational schedule is restored when the threshold condition related to the buffer level is no longer met.

9. A device, comprising:

two or more radio modems, the two or more radio modems each including a threshold monitor configured to monitor a buffer level in each radio modem; and

a multiradio controller configured to receive buffer level information from the threshold monitors in the two or more radio modems and to adjust the operational schedule for the two or more radio modems based on a threshold condition related to the buffer level, wherein adjusting the operational schedule for the two or more radio modules comprises defining a new operational schedule in the multiradio controller for at least one of the two or more radio modems and conveying the new operational schedule to the at least one of the two or more radio modules via a communication interface dedicated to the conveyance of delay-sensitive information.

10. The device of claim 9, wherein the two or more radio modems and the multiradio controller are integrated within the device.

11. The device of claim 9, wherein each threshold monitor periodically sends buffer level information to the multiradio controller via a common interface.

12. The device of claim 9, wherein each threshold monitor periodically sends buffer level information to the multiradio controller via the dedicated interface.

13. The device of claim 9, wherein the threshold monitor sends a signal to the multiradio controller when the threshold condition related to the buffer level has been met.

14. The device of claim 13, wherein the signal is sent to the multiradio controller via the dedicated interface.

15. The device of claim 9, wherein the new operational schedule for the at least one of two or more radio modems temporarily alters the existing operational schedule.

16. The method of claim 15, wherein the new operational schedule reallocates communication time from at least one radio modem to at least one other radio modem.

17. The device of claim 15, wherein the operational schedule is restored when the threshold condition related to the buffer level is no longer met.

18. A computer program product comprising a computer readable medium having computer executable program code embodied in said medium, comprising:

a computer readable program code configured to define an operational schedule for two or more radio modems integrated into a wireless communication device, the operational schedule being defined by a multiradio controller also in the device that is configured to convey the operational schedule to the two or more radio modems via a communication interface dedicated to the conveyance of delay-sensitive information;

a computer readable program code configured to receive buffer level information into the multiradio controller from a threshold monitor corresponding to at least one of the two or more radio modems; and

a computer readable program code configured to adjust the operational schedule for the two or more radio modems based on a threshold condition related to the buffer level, wherein adjusting the operational schedule for the two or more radio modules comprises defining a new operational schedule in the multiradio controller for at least one of the two or more radio modems and conveying the new operational schedule to the at least one of the two or more radio modules via the dedicated interface.

19. The computer program product of claim 18, wherein defining an operational schedule for two or more radio modems includes allocating communication time to each of the radio modems for use in transmitting and receiving information via a wireless communication medium.

20. The computer program product of claim 18, wherein at least one of each radio modem or each wireless medium is prioritized, and transmission time is allocated based on the priority.

21. The computer program product of claim 18, wherein the buffer level information includes information about the amount of data in transmission buffer for each radio modem.

22. The computer program product of claim 21, wherein the threshold condition related to the buffer level includes at least one of a percentage of buffer usage, a number of messages in the buffer, and a change of state of the buffer.

23. The computer program product of claim 18, wherein the new operational schedule for the at least one of two or more radio modems temporarily alters the existing operational schedule.

24. The computer program product of claim 23, wherein the new operational schedule reallocates communication time from at least one radio modem to at least one other radio modem.

25. The computer program product of claim 23, wherein the operational schedule is restored when the threshold condition related to the buffer level is no longer met.

26. A controller, comprising:

at least one communication interface coupled to a common interface;

at least one communication interface coupled to a interface dedicated to conveying delay sensitive information; and

a control module configured to receive buffer level information from threshold monitors in two or more radio modems and to adjust an operational schedule for the two or more radio modems based on a threshold condition related to the buffer level, wherein adjusting the operational schedule for the two or more radio modules comprises defining a new operational schedule in the controller for at least one of the two or more radio modems and conveying the new operational schedule to the at least one of the two or more radio modules via the dedicated interface.

27. The controller of claim 26, wherein the new operational schedule for the at least one of two or more radio modems temporarily alters the existing operational schedule.

28. The controller of claim 27, wherein the new operational schedule reallocates communication time from at least one radio modem to at least one other radio modem.

29. The controller of claim 27, wherein the operational schedule is restored when the threshold condition related to the buffer level is no longer met.

30. A radio modem, comprising:

a transmitter configured to send message packets via wireless communication;

an interface dedicated to the conveyance of delay-sensitive information to and from the radio modem;

a buffer configured to temporarily store information packets awaiting transmission via wireless communication;

a control module configured to receive operational schedule information from a multiradio controller via the dedicated interface and to control the flow of information packets from the buffer to the transmitter in accordance with the operational schedule; and

a threshold monitor configured to monitor the level of information packets in the buffer based on a threshold condition related to the buffer level, and to send threshold-related information to the multiradio controller for defining the operational schedule.

31. A device, comprising:

means for defining an operational schedule for two or more radio modems integrated into a wireless communication device, the operational schedule being defined by a multiradio controller also in the device that is configured to convey the operational schedule to the two or more radio modems via a communication interface dedicated to the conveyance of delay-sensitive information;

means for receiving buffer level information into the multiradio controller from a threshold monitor corresponding to at least one of the two or more radio modems; and

means for adjusting the operational schedule for the two or more radio modems based on a threshold condition related to the buffer level, wherein adjusting the operational schedule for the two or more radio modules comprises defining a new operational schedule in the multiradio controller for at least one of the two or more radio modems and conveying the new operational schedule to the at least one of the two or more radio modules via the dedicated interface.

STATEMENT UNDER ARTICLE 19(1)

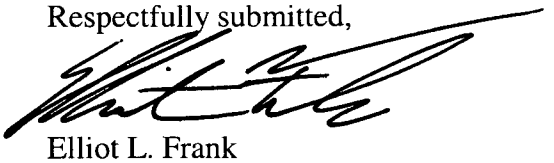
The Applicant respectfully states, in accordance with PCT Rule 46.4, that the claim amendments now presented herein for consideration by the Examiner have been submitted in order to further clarify the claimed embodiment of the present invention. The Applicant respectfully believes that the claimed embodiment of the present invention, as amended, is distinguishable from the cited references, taken alone or in combination.

In particular, the claimed embodiment of the invention, as amended herein, is asserted to be distinguishable from each of the D1 (EP 1703675 A1 to Sony), D2 (U.S. 5,448,701 A to Metz, Jr. et al.), D3 (U.S. 6,067,408 A to Runaldue et al.), D4 (U.S. 2004/0027990 A1 to Lee et al.) and D5 (U.S. 2005/0170776 A1 to Siorpaes) references identified in the International Search Report (ISO), or any combination thereof. The D1 reference is directed to a system for controlling multiple radio modems incorporated in the same device. The control methodology in D1 relies upon a strategy of preventing a second wireless radio modem from becoming active when a first wireless radio modem is scheduled to operate. The D2-D4 references are generally directed to buffer management, wherein access to a common communication bus may be regulated by a central controller (e.g., arbiter). The D5 reference has been cited merely to demonstrate the state of the art.

None of the D1-D5 references recite or imply the elements of multiradio control architecture, disclosed in the specification as originally filed, that have now been clarified in the amended claims. The buffer control configuration discussed in the D2, wherein separate control lines (e.g., PO(1) and PO(2) as shown in FIG. 5B) are utilized primarily for sending buffer status information to buffer arbiter 89, may be deemed generally relevant to the claimed invention, as amended. The buffer status information in D2 may be utilized in determining which buffer should be granted priority for accessing the bus. However, the D2 system is limited only to simple buffer status messages (e.g., 3-bit preprogrammed status indicators as described in column 7, lines 34-42). This simple signaling configuration does not teach or suggest the claimed invention, as amended.

In view of the above, the Applicant respectfully submits that the amended claims are distinguishable from the D1-D5 references, taken alone or in combination.

Respectfully submitted,



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