EXHIBIT B

(12) **United States Patent**
Aldana et al.

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(45) **Date of Patent:** Apr. 9, 2013

(54) **EFFICIENT FEEDBACK OF CHANNEL INFORMATION IN A CLOSED LOOP BEAMFORMING WIRELESS COMMUNICATION SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 2247 days.

(21) Appl. No.: **11/237,341**

(22) Filed: **Sep. 28, 2005**

(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation-in-part of application No. 11/168,793, filed on Jun. 28, 2005.

(60) Provisional application No. 60/673,451, filed on Apr. 21, 2005, provisional application No. 60/698,686, filed on Jul. 13, 2005.

(51) **Int. Cl.**
    H04K 1/10   (2006.01)
(52) **U.S. Cl.** **375/260**; 375/267; 375/350
(58) **Field of Classification Search** 375/267
    See application file for complete search history.

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(57)   **ABSTRACT**

A method for feeding back transmitter beamforming information from a receiving wireless communication device to a transmitting wireless communication device includes a receiving wireless communication device receiving a preamble sequence from the transmitting wireless device. The receiving wireless device estimates a channel response based upon the preamble sequence and then determines an estimated transmitter beamforming unitary matrix based upon the channel response and a receiver beamforming unitary matrix. The receiving wireless device then decomposes the estimated transmitter beamforming unitary matrix to produce the transmitter beamforming information and then wirelessly sends the transmitter beamforming information to the transmitting wireless device. The receiving wireless device may transform the estimated transmitter beamforming unitary matrix using a QR decomposition operation such as a Givens Rotation operation to produce the transformer beamforming information.

20 Claims, 8 Drawing Sheets
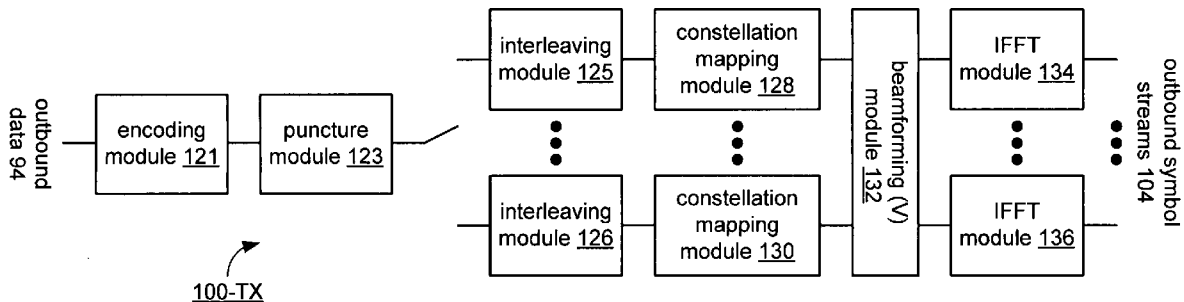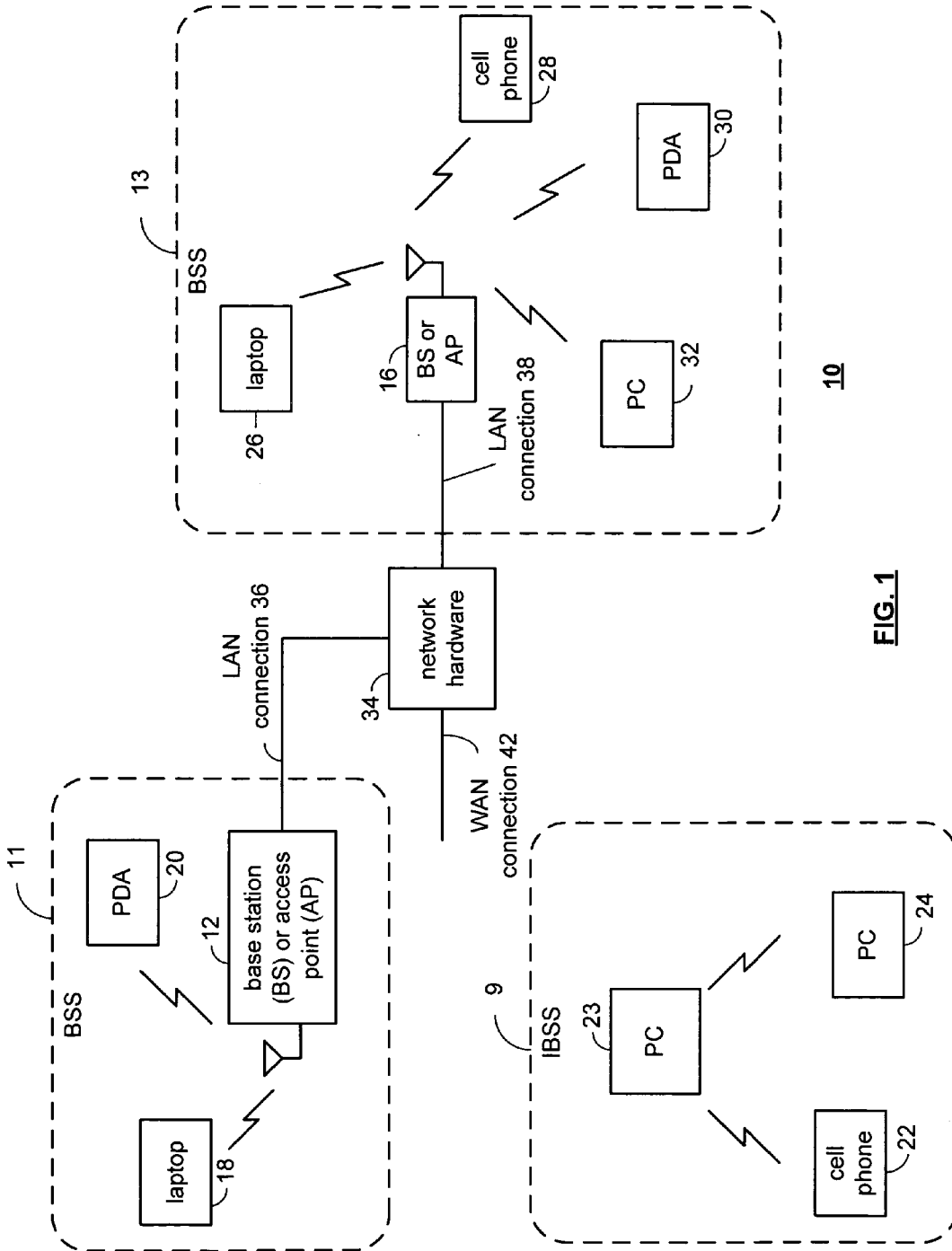
FIG. 1

FIG. 2

FIG. 3

DOCKET ALARM
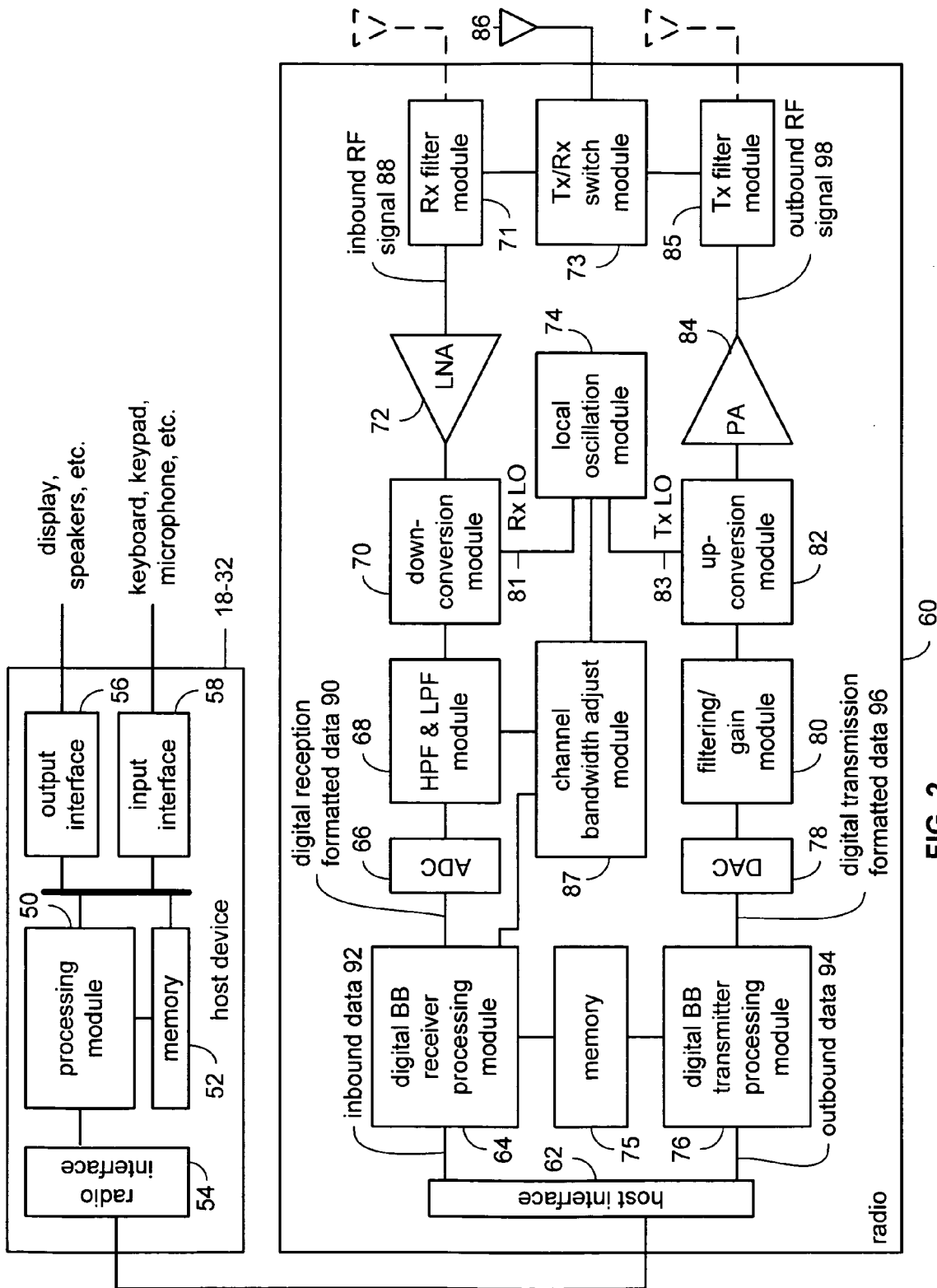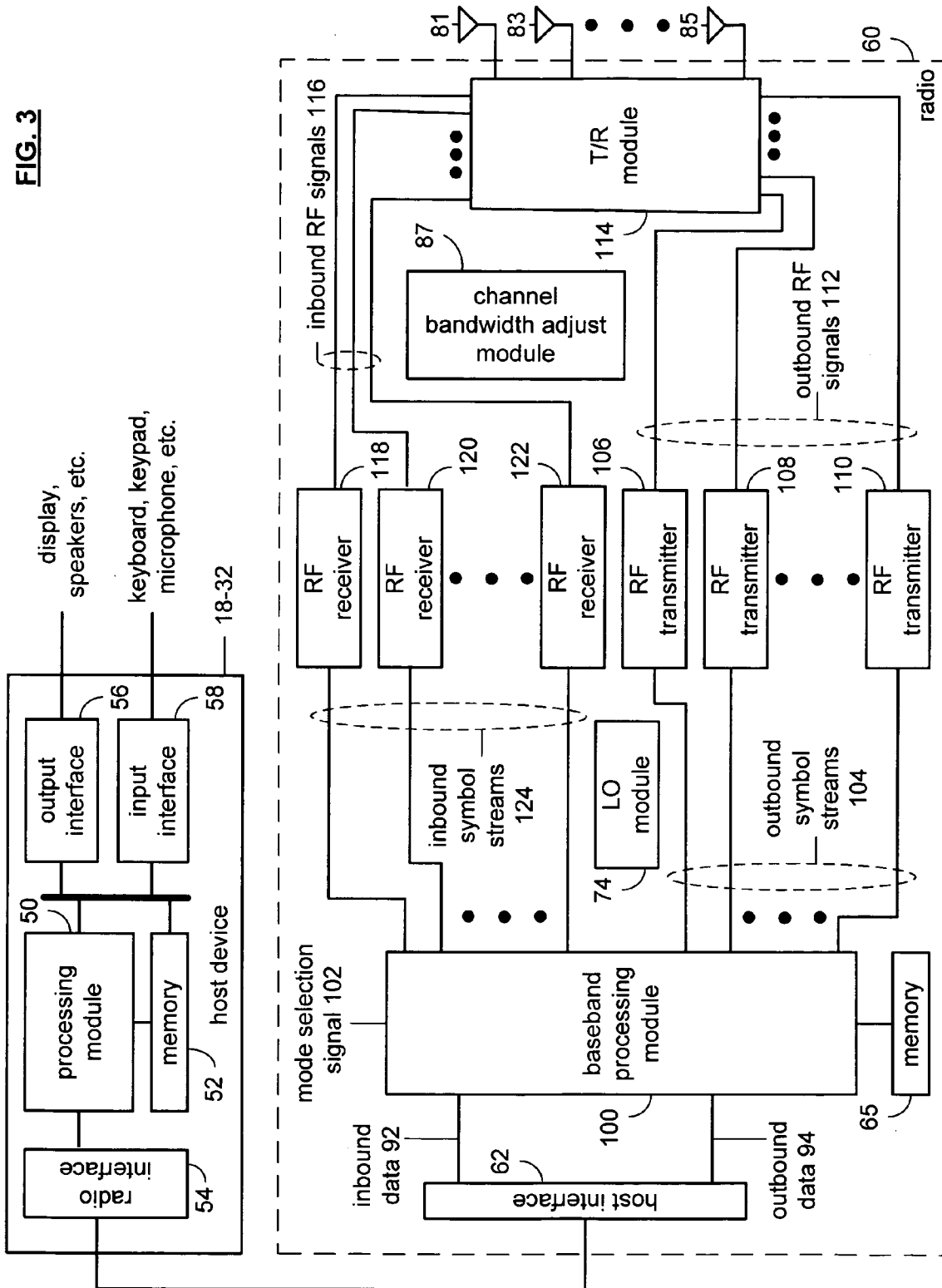
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