



(12) **United States Patent**  
**Poon**

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(54) **SPATIAL PUNCTURING APPARATUS, METHOD, AND 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 1297 days.

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(21) Appl. No.: **10/875,111**

*International Search Report and Written Opinion: Dated Aug. 31, 2005; PCT/US2005/017653; 17 pages.*

(22) Filed: **Jun. 23, 2004**

Gore, D. A., et al., "Selecting an Optimal Set of Transmit Antennas for a Low Rank Matrix Channel", *Acoustics, Speech, and Signal Processing, Ieee International Conference, vol. 05*, (Jun. 5, 2000), 2785-2788.

(65) **Prior Publication Data**

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Sandhu, S., et al., "Near-Optimal Selection of Transmit Antennas for a MIMO Channel based on Shannon Capacity", *Signals, Systems and Computers*, (Oct. 29, 2000), 567-571.

(51) **Int. Cl.**  
**H04Q 7/00** (2006.01)

PCT/US2005/017653, "International Preliminary Report on Patentability received for PCT Patent Application No. PCT/US2005/017653, mailed on Jan. 11, 2007", 2 pages.

(52) **U.S. Cl.** ..... **370/334; 375/267; 455/562.1**

(Continued)

(58) **Field of Classification Search** ..... 370/477, 370/478, 480, 498, 343, 345, 203, 208, 252-254, 370/310, 328, 334, 447; 375/299, 347, 260, 375/267; 455/562.1, 561

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See application file for complete search history.

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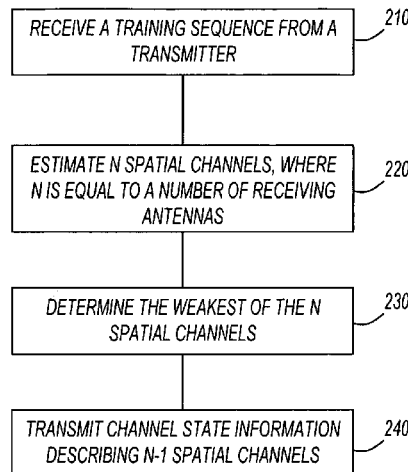
(57) **ABSTRACT**

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Stations in an N×N multiple-input-multiple-output (MIMO) wireless network always puncture the weakest spatial channel. A receiving station determines channel state information for N spatial channels and feeds back to the transmitting station channel state information for only N-1 spatial channels. The channel state information may include a beamforming matrix to cause the transmitting station to utilize N-1 spatial channels.

**13 Claims, 6 Drawing Sheets**



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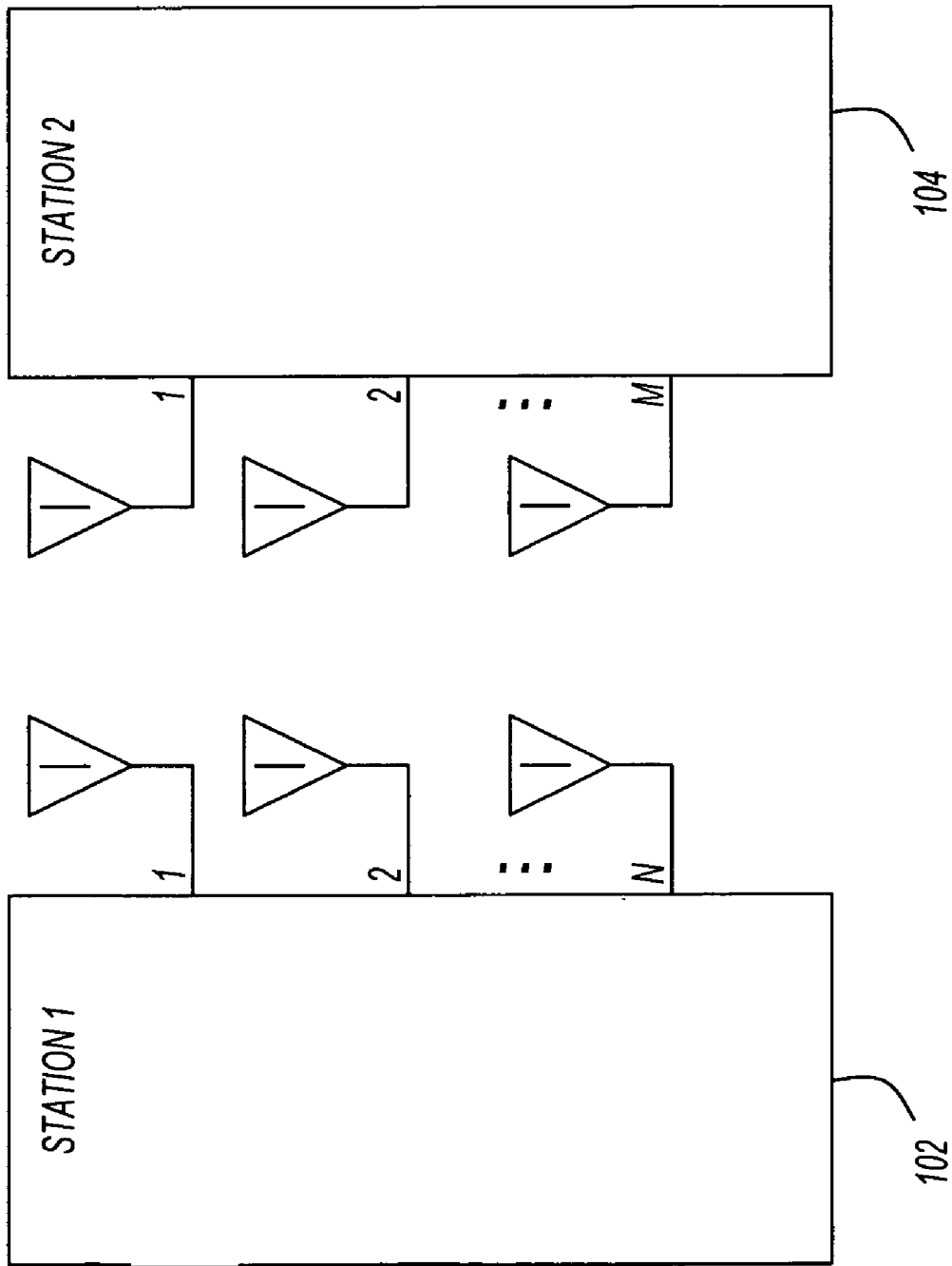


FIG. 1

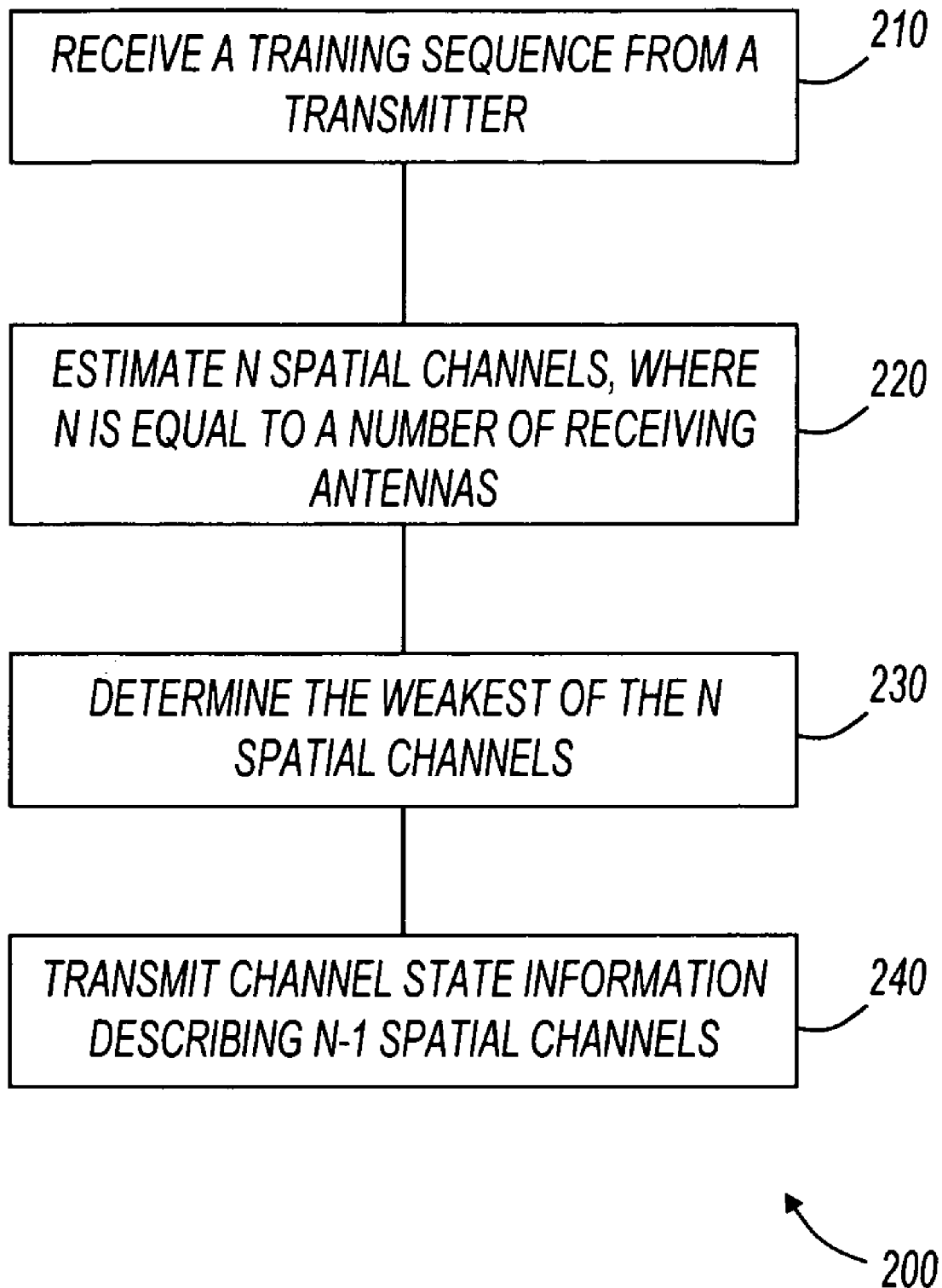


FIG. 2

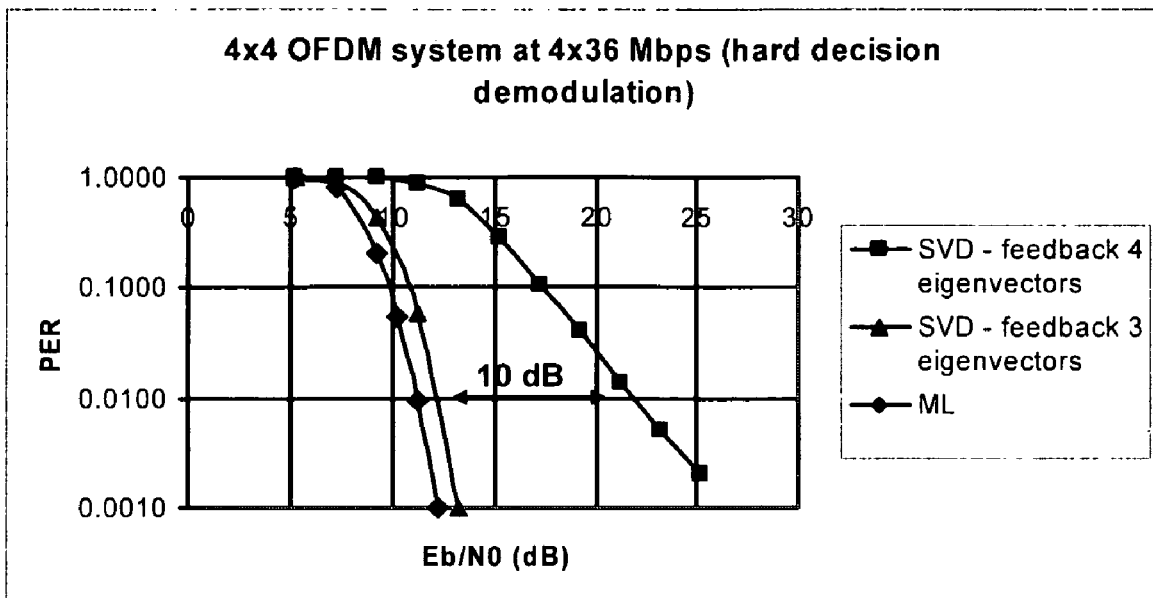


FIG. 3

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