



US 20040141566A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0141566 A1**

Kim et al.

(43) **Pub. Date: Jul. 22, 2004**

(54) **APPARATUS AND METHOD FOR ADAPTIVELY MODULATING SIGNAL BY USING LAYERED TIME-SPACE DETECTOR USED IN MIMO SYSTEM**

Publication Classification

(51) **Int. Cl.⁷ H04L 1/02**

(52) **U.S. Cl. 375/267**

(76) **Inventors: Young-Doo Kim, Seoul (KR); Inhyoung Kim, Daejon (KR); Heejuung Yu, Daejon (KR); Jihoon Choi, Gyeongsangnam-Do (KR); Taehyun Jeon, Seoul (KR); Jae-Young Ahn, Daejon (KR); Yong-Hoon Lee, Daejon (KR)**

(57) **ABSTRACT**

An apparatus for adaptively modulating/demodulating signals in a multi-input multi-output (MIMO) system having a layered time-space architecture detector and a method thereof is disclosed. The apparatus includes: a bit and power allocation information calculator for deciding an equivalent channel gain in a reverse order of Vertical-Bell laboratories Space Time (V-BLAST) based on MIMO channel information feedbacked from a receiver and determining the number of bits and transmission power to be transmitted to each transmitting antenna by using the equivalent channel gain; and adaptive modulation means for modulating signal of each layer with corresponding modulation method based on the determined number of bits and transmitting power, controlling the transmitting power and transmitting the adaptively modulated signal through each transmitting antenna. The present invention can improve performance without increase of implementation complexity and easily expand to MIMO-OFDM system by adaptively modulating and demodulating signals in reverse order of conventional V-BLAST detection method.

Correspondence Address:

**BLAKELY SOKOLOFF TAYLOR & ZAFMAN
12400 WILSHIRE BOULEVARD, SEVENTH FLOOR
LOS ANGELES, CA 90025 (US)**

(21) **Appl. No.: 10/737,398**

(22) **Filed: Dec. 16, 2003**

(30) **Foreign Application Priority Data**

Dec. 26, 2002 (KR) 2002-84478

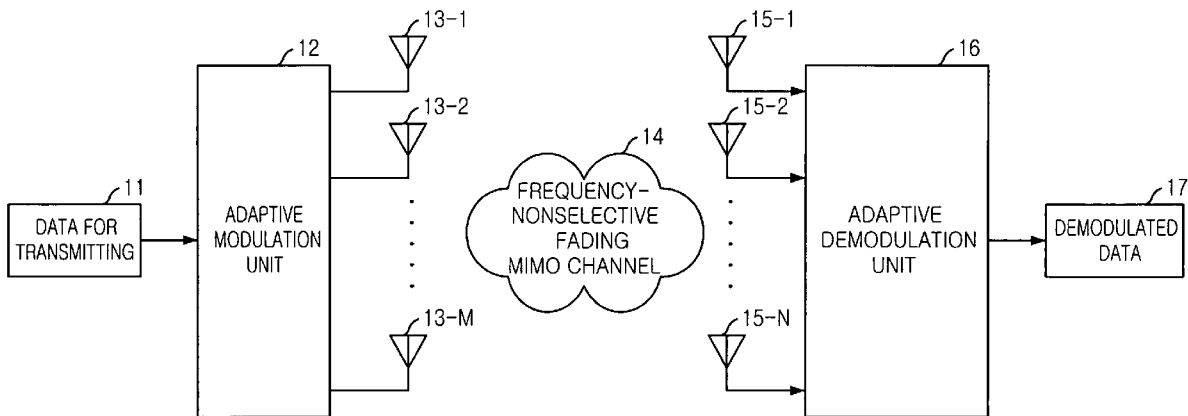


FIG. 1

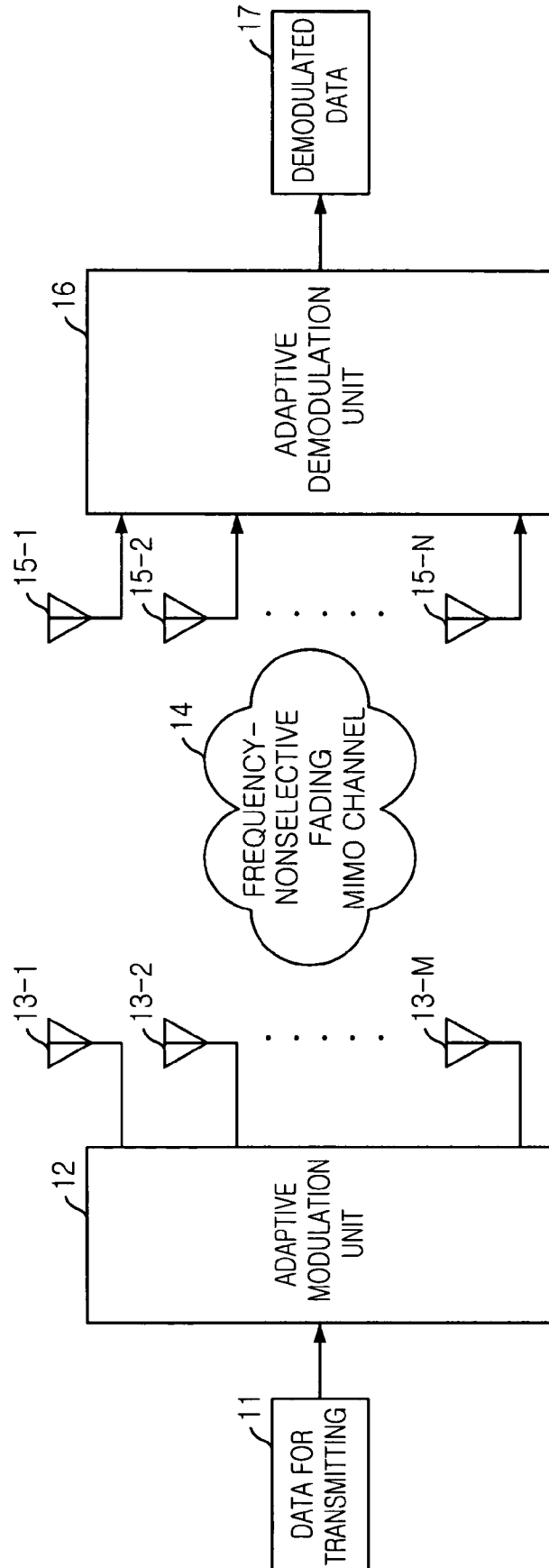


FIG. 2

$$H = \begin{bmatrix} 1.2 & 0.5 & 1.5 \\ 1.5 & 1.0 & 0.4 \\ 1.3 & 0.2 & 1.2 \end{bmatrix}$$

ORDER FOR V-BLAST

	FIRST LAYER	SECOND LAYER	THIRD LAYER
$\ w_k\ ^2$	4.789	7.941	2.163
THIRD LAYER NULLING			
$\ w_k\ ^2$	0.941	3.925	X
SECOND LAYER NULLING			
$\ w_k\ ^2$	X	0.775	X
FINAL EQUIVALENT CHANNEL GAIN			
$1/\ w_k\ ^2$	1.063	1.290	0.462

RANDOM ORDER

	FIRST LAYER	SECOND LAYER	THIRD LAYER
$\ w_k\ ^2$	4.789	7.941	2.163
FIRST LAYER NULLING			
$\ w_k\ ^2$	X	1.269	0.425
SECOND LAYER NULLING			
$\ w_k\ ^2$	X	X	0.260
FINAL EQUIVALENT CHANNEL GAIN			
$1/\ w_k\ ^2$	0.209	0.788	3.846

REVERSE ORDER FOR V-BLAST

	FIRST LAYER	SECOND LAYER	THIRD LAYER
$\ w_k\ ^2$	4.789	7.941	2.163
SECOND LAYER NULLING			
$\ w_k\ ^2$	0.765	X	1.069
THIRD LAYER NULLING			
$\ w_k\ ^2$	0.185	X	X
FINAL EQUIVALENT CHANNEL GAIN			
$1/\ w_k\ ^2$	5.405	0.126	0.935

FIG. 3

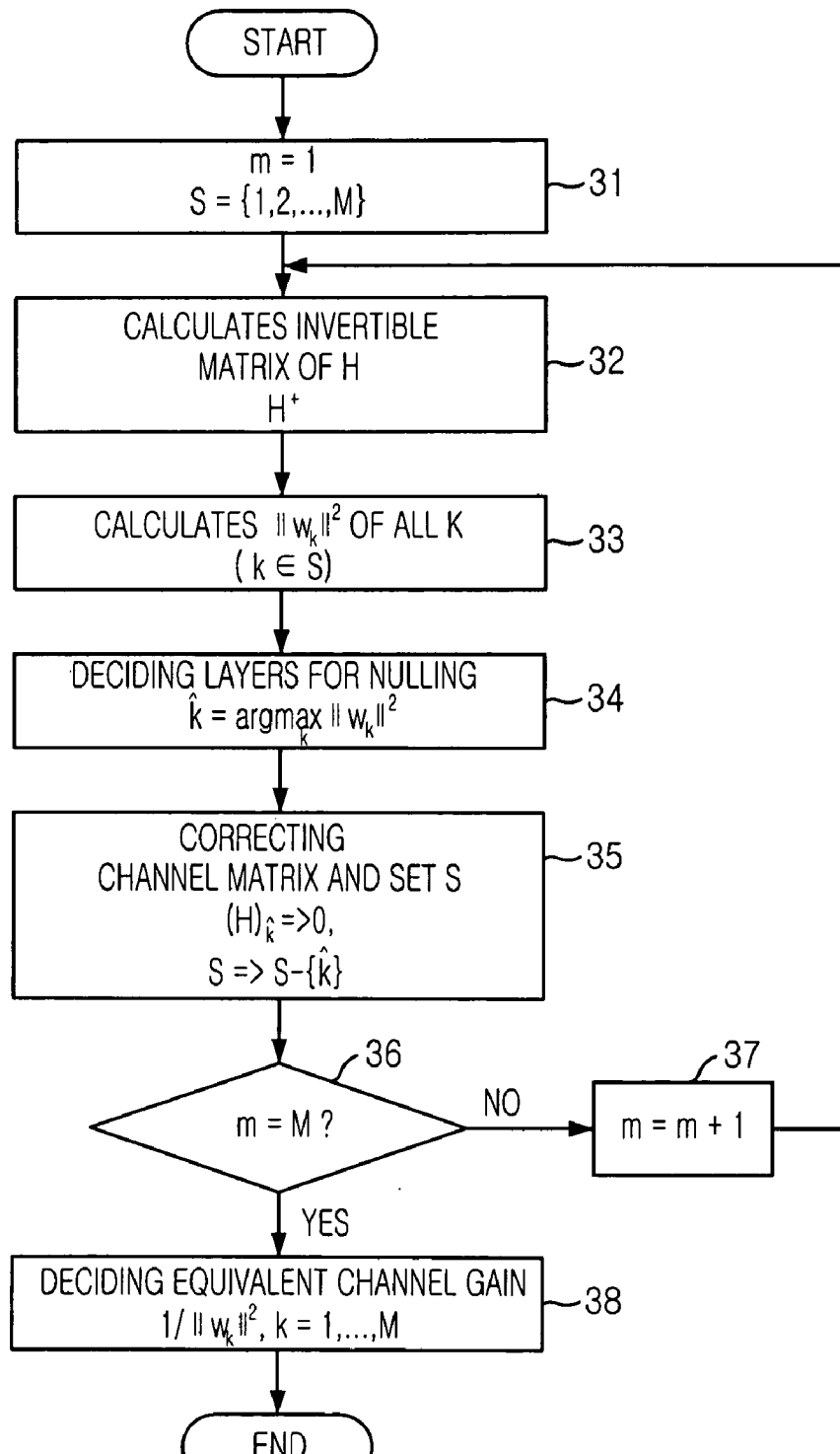
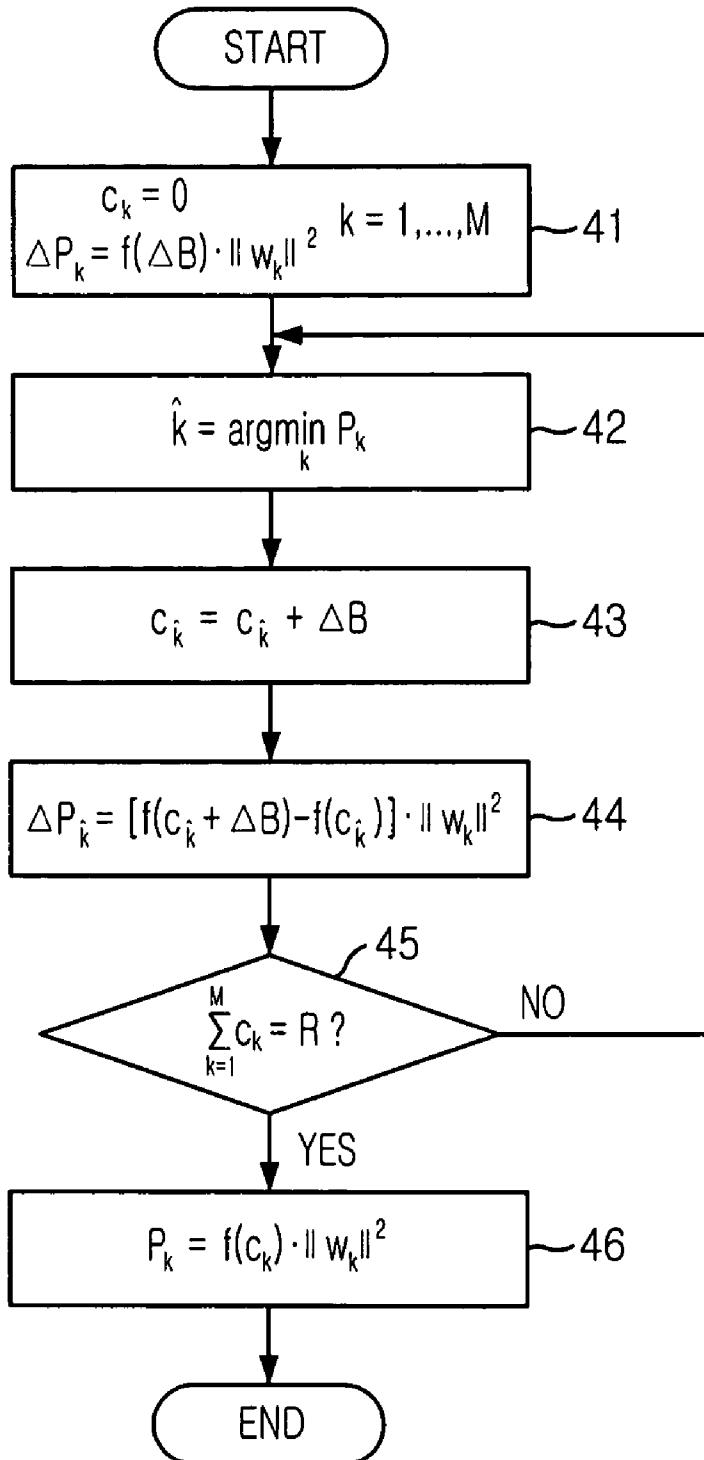


FIG. 4



Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.