



US006144696A

United States Patent [19]  
Shively et al.

[11] Patent Number: 6,144,696  
[45] Date of Patent: Nov. 7, 2000

[54] SPREAD SPECTRUM BIT ALLOCATION ALGORITHM

5,598,435 1/1997 Williams ..... 375/261  
5,832,387 11/1998 Bae et al. .... 455/522  
5,960,003 9/1999 Fischer et al. .... 370/468

[75] Inventors: Richard Robert Shively, Convent Station; Ranjan V. Sonalkar, North Caldwell, both of N.J.

Primary Examiner—Stephen Chin  
Assistant Examiner—Mohammad Ghayour

[73] Assignee: AT&T Corp., New York, N.Y.

[57] ABSTRACT

[21] Appl. No.: 09/000,842

[22] Filed: Dec. 31, 1997

[51] Int. Cl.<sup>7</sup> ..... H04B 1/38

[52] U.S. Cl. .... 375/222; 375/225; 370/391; 370/358

[58] Field of Search ..... 375/222, 219, 375/225; 455/127, 509; 370/391, 358

[56] References Cited

U.S. PATENT DOCUMENTS

4,456,925	6/1984	Skerlos et al. ....	358/85
4,620,289	10/1986	Chauvel .....	364/521
4,725,694	2/1988	Auer et al. ....	178/18
4,916,441	4/1990	Gombrich .....	340/712
5,014,267	5/1991	Tompkins et al. ....	370/62
5,157,717	10/1992	Hitchcock .....	379/96
5,335,276	8/1994	Thompson et al. ....	380/21
5,393,964	2/1995	Hamilton et al. ....	235/381
5,406,615	4/1995	Miller, II et al. ....	379/59
5,488,412	1/1996	Majeti et al. ....	348/10
5,512,935	4/1996	Majeti et al. ....	348/9
5,528,593	6/1996	English et al. ....	370/84
5,534,913	7/1996	Majeti et al. ....	348/7

High transmission capacity in a twisted pair signal line, where power is limited by a power spectral-density mask and an aggregate signal power constraint, is obtained by: (1) allocating data to multitone sub-bands according to a lowest marginal power-cost per bit scheme and (2) in an environment where an aggregate power budget remains after all bits have been allocated to all sub-bands with sufficient margins to carry a bit, assigning additional bits to sub-bands with otherwise insufficient power margins to carry a single bit, by frequency-domain-spreading a single bit across several sub-bands at correspondingly reduced power levels, to permit the otherwise unacceptable noise levels to be reduced on average by despreading at the receiving end. Another feature of the invention, applicable in an environment in which multiple interfering channels are employed, provides increased signal throughput by (3) transmitting coherently in a number of multitone sub-bands, identical blocks of data, with the number of multitone sub-bands being equal to a number of interfering channels and multiplying the signal carried by corresponding sub-bands in the separate interfering channels by a different respective vector from an orthonormal basis set so that near-end cross-talk is eliminated upon despreading at the receiving end.

7 Claims, 5 Drawing Sheets

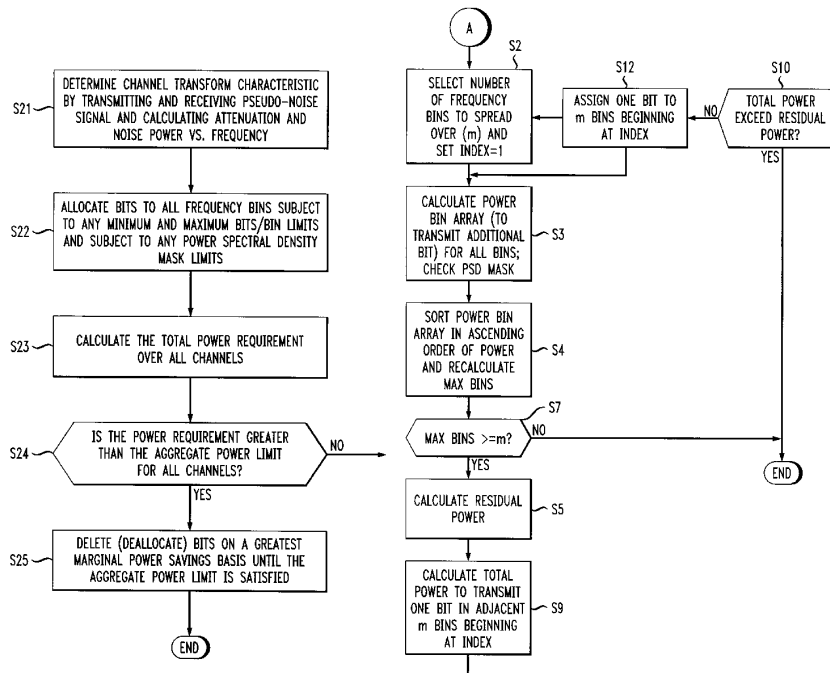


FIG. 1

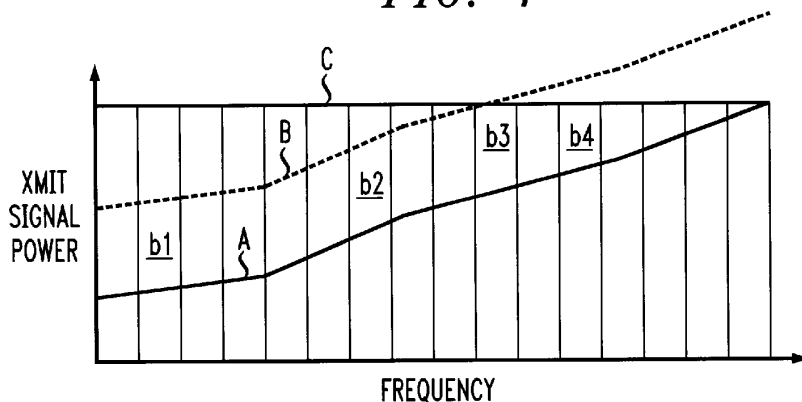


FIG. 2

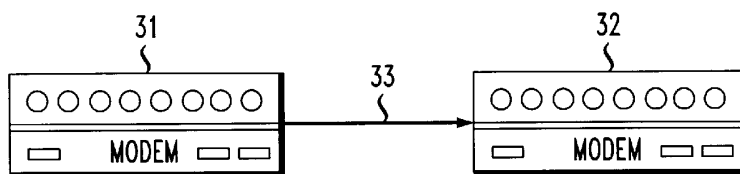


FIG. 3

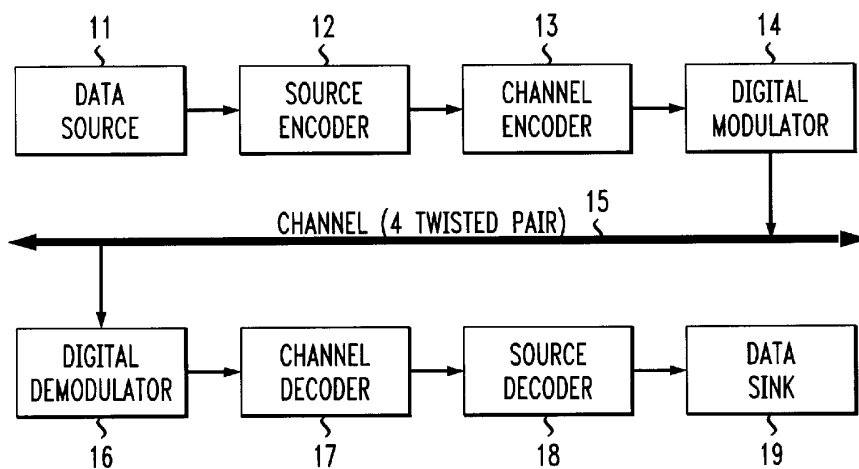


FIG. 4

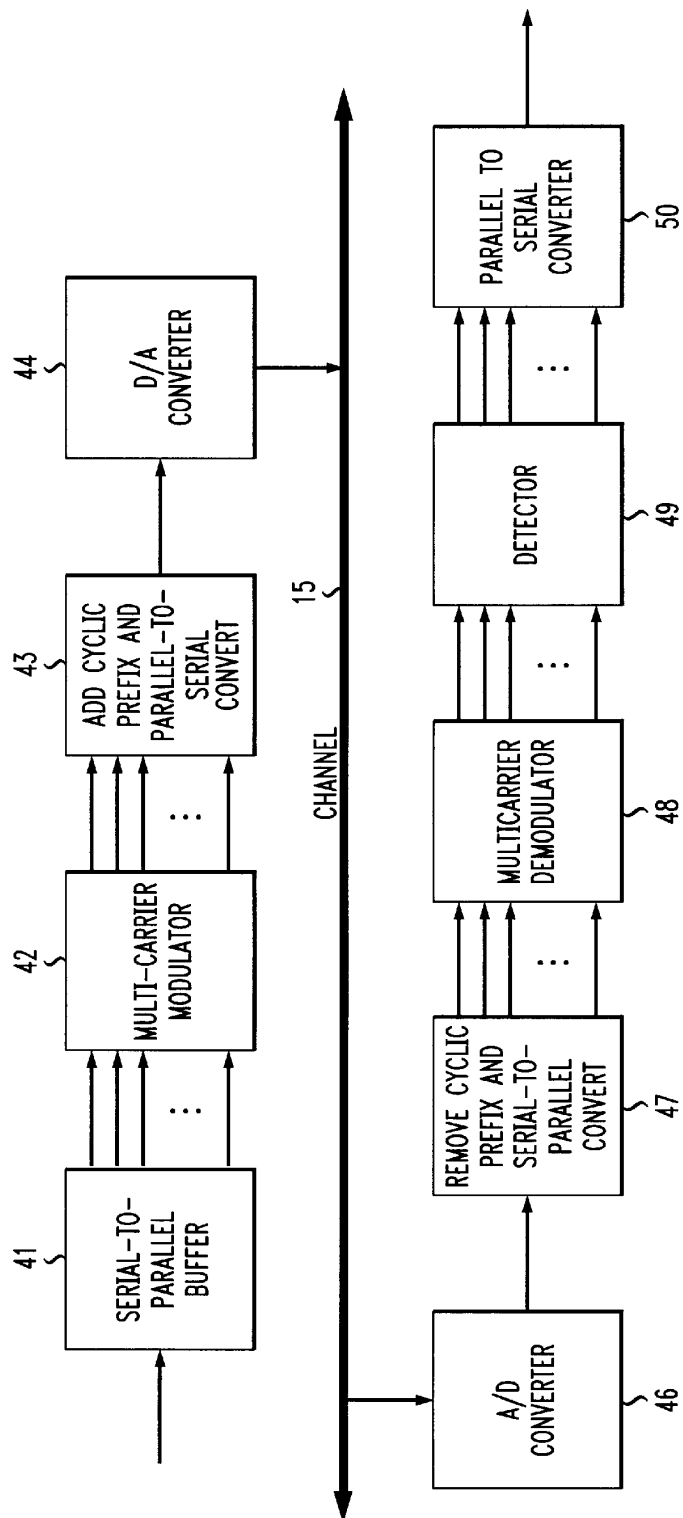


FIG. 5

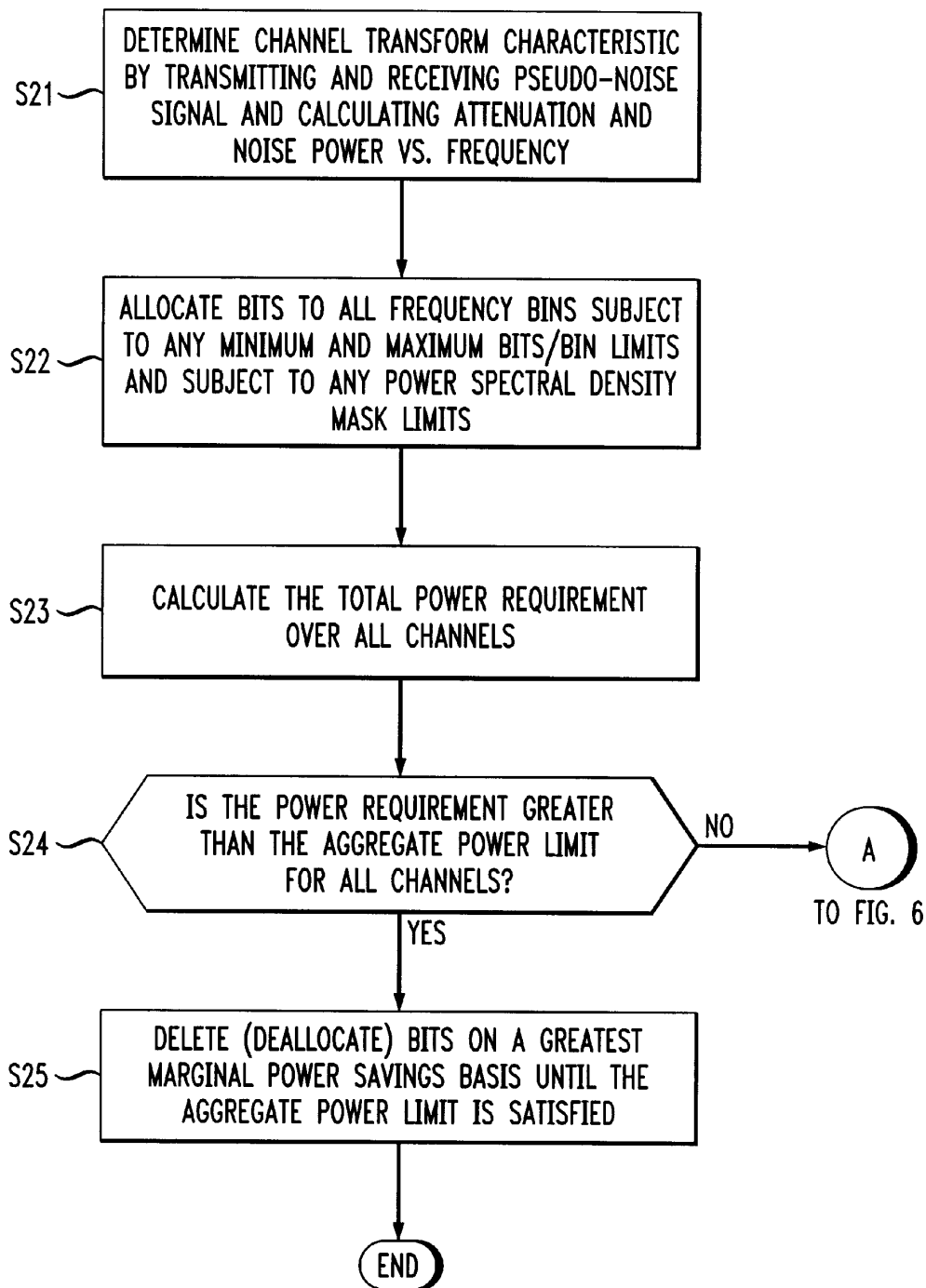
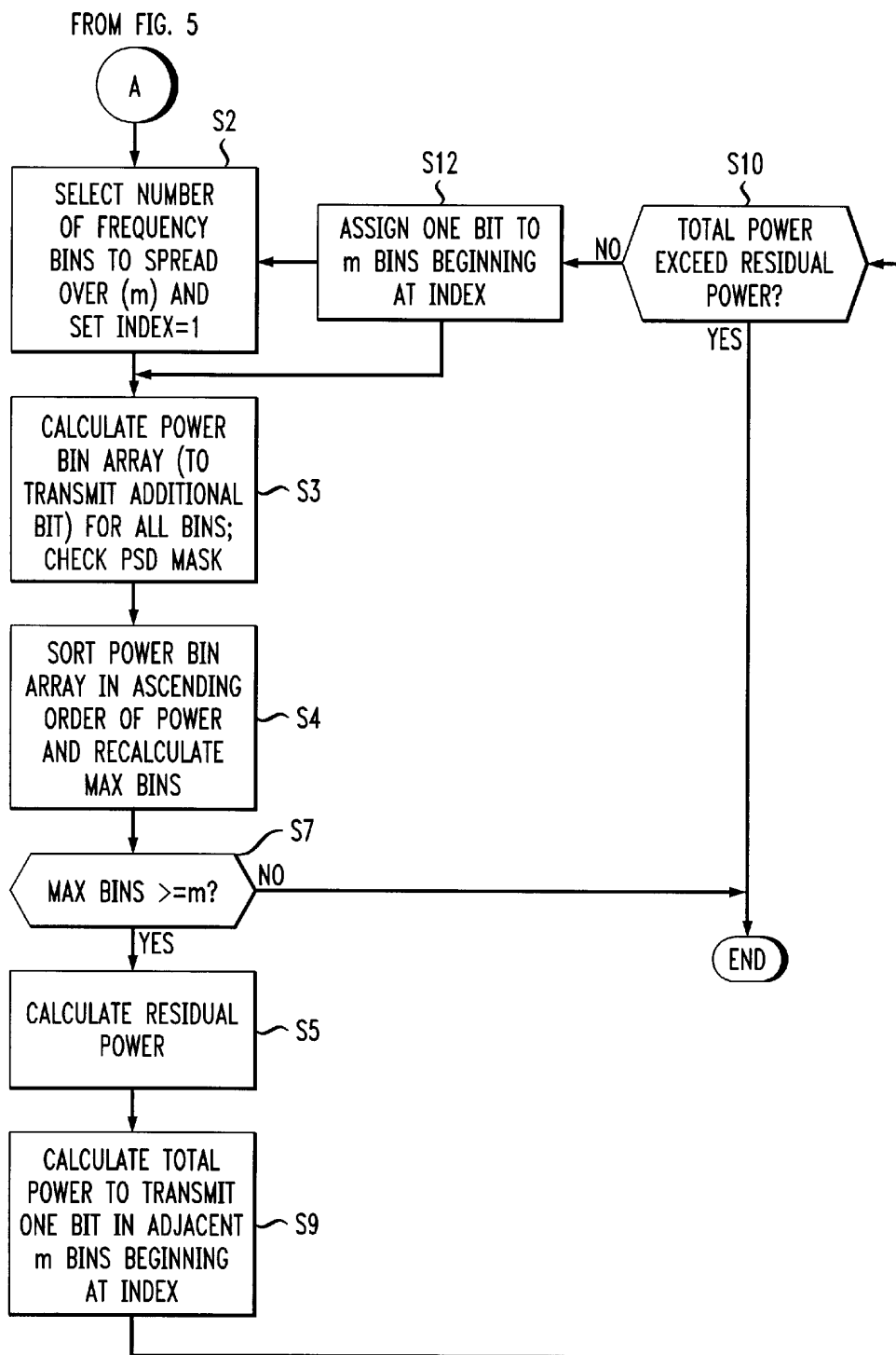


FIG. 6



# 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.