



US006144695A

United States Patent [19]

[11] **Patent Number:** **6,144,695**

Helms et al.

[45] **Date of Patent:** **Nov. 7, 2000**

[54] **METHOD AND APPARATUS FOR REDUCING NEAR-END CROSSTALK (NEXT) IN DISCRETE MULTI-TONE MODULATOR/ DEMODULATORS**

| | | | |
|-----------|---------|-----------------|---------|
| 5,887,032 | 3/1999 | Cioffi | 375/257 |
| 5,970,088 | 10/1999 | Chen | 375/222 |
| 6,009,122 | 12/1999 | Chow | 375/260 |
| 6,014,412 | 1/2000 | Wiese et al. | 375/346 |
| 6,044,107 | 3/2000 | Gatherer et al. | 375/222 |

[75] Inventors: **Howard David Helms**, Brookside; **Robert Raymond Miller, II**, Township of Morris, Morris County; **Richard Robert Shively**, Convent Station, all of N.J.

OTHER PUBLICATIONS

American National Standards Institute, Standards Document—T1.413—1995; “Network and Customer Installation Interfaces—Asymmetric Digital Subscriber Line (ADSL) Metallic Interface”; Approved Aug. 18, 1995, pp.: cover page; two inside sheets; i–vi; 1–115.

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

Primary Examiner—Stephen Chin
Assistant Examiner—Michael W. Maddox

[21] Appl. No.: **08/997,176**

[57] ABSTRACT

[22] Filed: **Dec. 23, 1997**

[51] **Int. Cl.**⁷ **H04B 1/38**; H04B 15/00; H04L 5/16

This invention reduces near-end crosstalk between identical discrete multi-tone (DMT-type) modems by introducing the following modifications to modems at a central office or a subscriber premises. The modifications include: a mechanism for aligning the frames of all modems at the central office (CO), a mechanism for aligning the frames transmitted by the subscribers' modems with the frames received by those modems, and lengthening the DMT frame to include a cyclic prefix. The cyclic prefix to a frame has been made longer than twice the maximum round-trip delay, that is, the delay between the central office and the most distant subscriber to be served. By making adjacent DMT carrier frequencies be orthogonal to each other, the aforementioned modifications will reduce both Near End Cross-Talk (NEXT) and Leakage-Excited Cross-Talk (LEXT). These benefits apply to modems at both the central office (CO) and subscriber ends of the communication path (for example, a high capacity twisted-pair wire).

[52] **U.S. Cl.** **375/222**; 375/285; 375/346; 370/201; 370/480; 370/503; 379/93.01; 379/93.08; 379/406; 379/410; 379/417; 455/295; 455/501

[58] **Field of Search** 375/222, 285, 375/346, 356; 370/201, 286, 480, 503, 514, 515; 379/399, 406, 410, 416, 417, 90.01, 93.01, 93.08; 455/3.1, 5.1, 501, 502, 295

[56] References Cited

U.S. PATENT DOCUMENTS

| | | | |
|-----------|---------|-----------------|---------|
| 5,479,447 | 12/1995 | Chow et al. | 375/260 |
| 5,519,731 | 5/1996 | Cioffi | 375/260 |
| 5,521,949 | 5/1996 | Huang et al. | 375/377 |
| 5,668,802 | 9/1997 | Chalmers et al. | 370/276 |
| 5,673,290 | 9/1997 | Cioffi | 375/260 |
| 5,680,394 | 10/1997 | Bingham et al. | 370/294 |

26 Claims, 7 Drawing Sheets

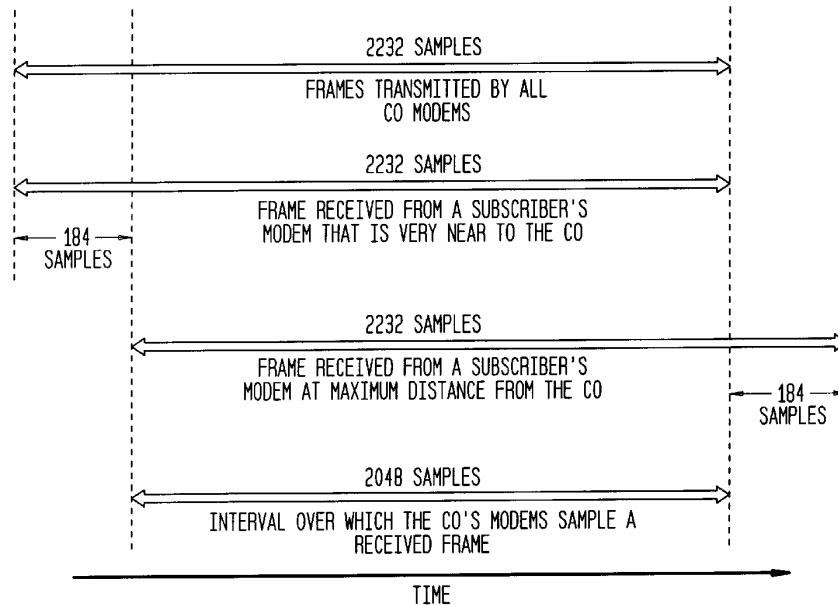


FIG. 1
(PRIOR ART)

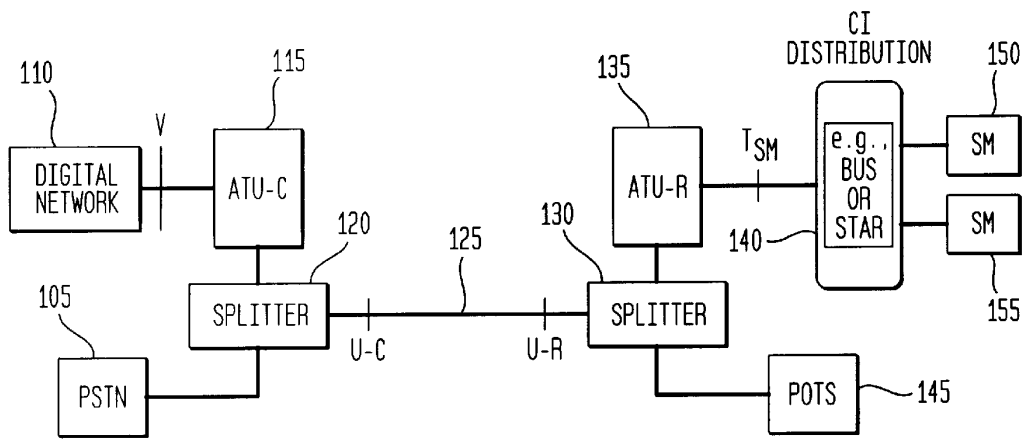


FIG. 2A
(PRIOR ART)

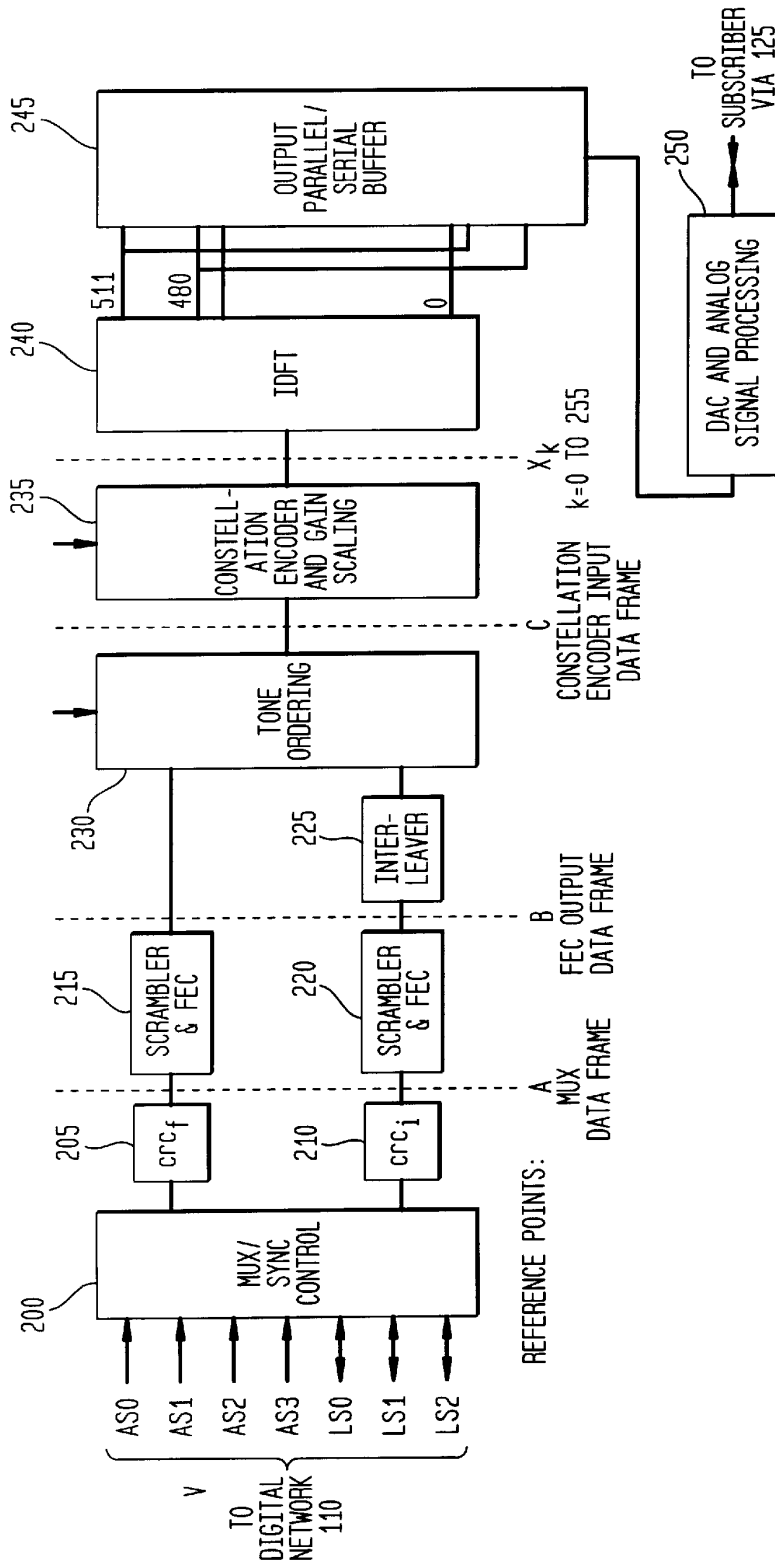


FIG. 2B
(PRIOR ART)

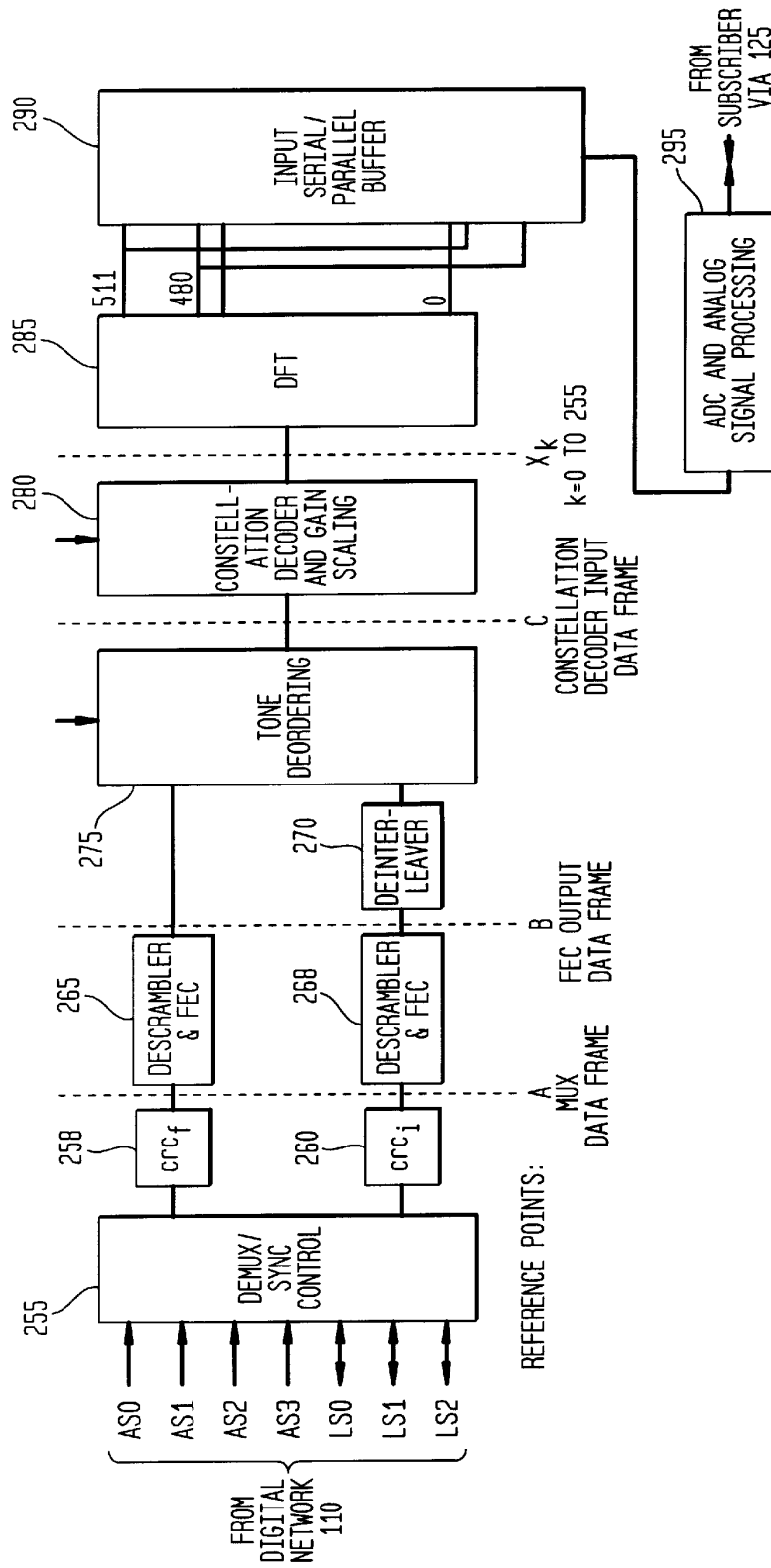


FIG. 3
(PRIOR ART)

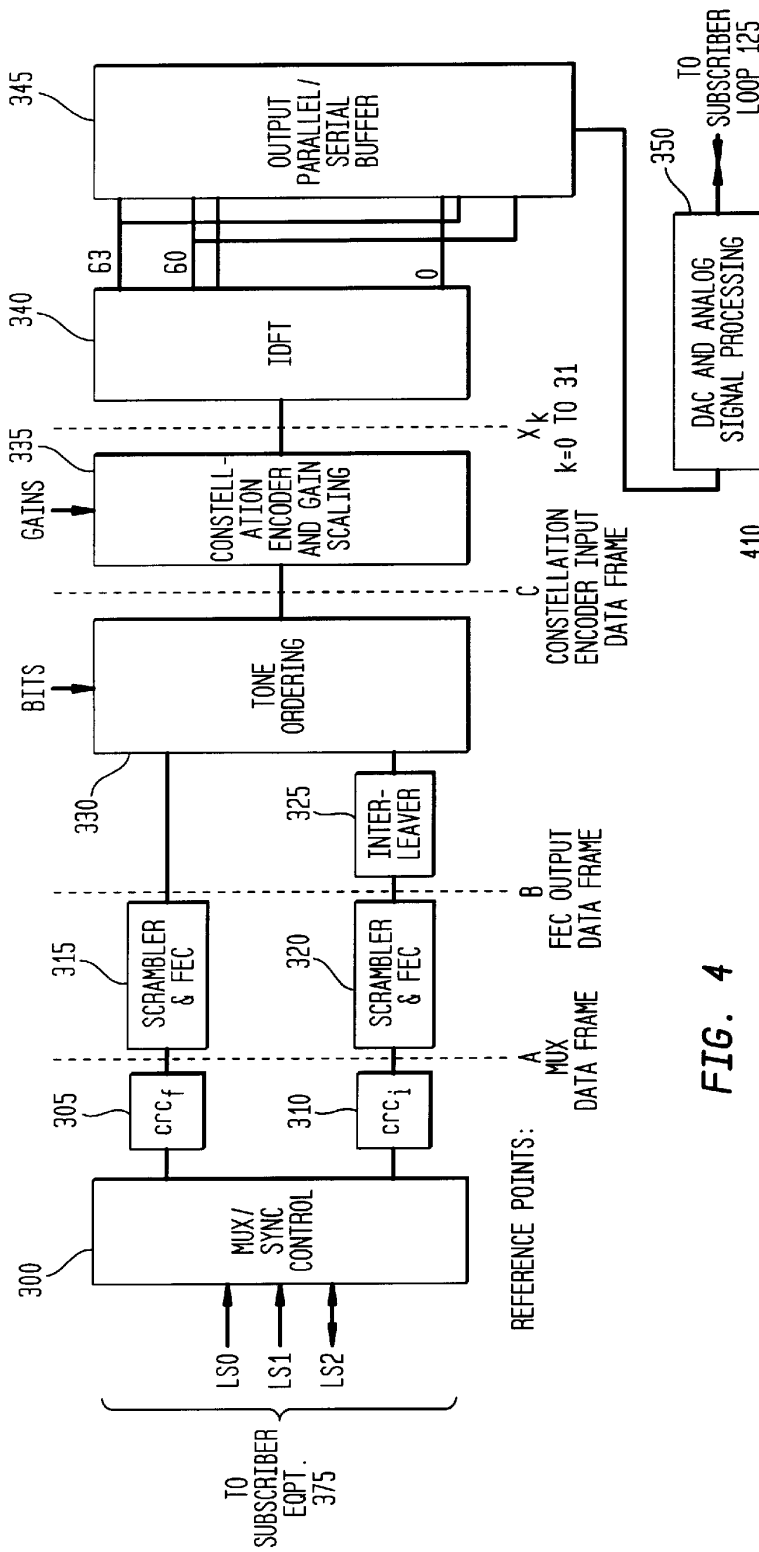
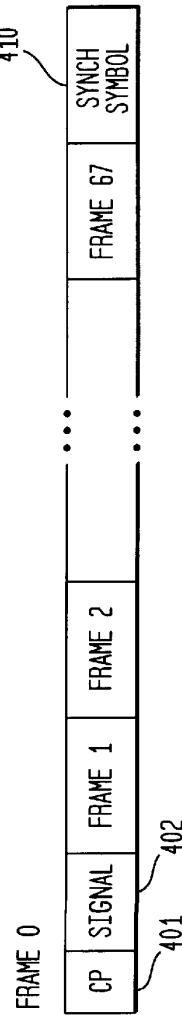


FIG. 4



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.