



US006308228B1

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

(10) **Patent No.:** US 6,308,228 B1  
(45) **Date of Patent:** Oct. 23, 2001

(54) **SYSTEM AND METHOD OF ADAPTIVE MESSAGE PIPELINING**

(75) Inventors: **Kenneth G. Yocum; Jeffrey S. Chase**, both of Durham, NC (US)

(73) Assignee: **Duke University**, Durham, NC (US)

(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/197,598**

(22) Filed: **Nov. 23, 1998**

(51) **Int. Cl.**<sup>7</sup> ..... **G06F 13/00**

(52) **U.S. Cl.** ..... **710/52; 710/30; 710/131; 709/250**

(58) **Field of Search** ..... **709/250; 710/52-57, 710/29-35, 129-131**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

4,258,418	*	3/1981	Heath	710/53
4,860,193	*	8/1989	Bentley et al.	710/55
5,121,479	*	6/1992	O'Brien	710/34
5,664,116	*	9/1997	Gaytan et al.	709/234
5,671,445	*	9/1997	Gluyas et al.	710/53
5,732,094	*	3/1998	Petersen et al.	714/805
5,864,713	*	1/1999	Terry	395/872
5,944,802	*	8/1999	Bello et al.	710/52
5,991,835	*	11/1999	Mashimo et al.	710/58
6,014,722	*	1/2000	Rudin et al.	710/240
6,015,086	*	1/2000	Ritchie et al.	231/2.5
6,094,695	*	7/2000	Kornher	710/56

**FOREIGN PATENT DOCUMENTS**

9400935 \* 1/1994 (WO).

**OTHER PUBLICATIONS**

Wang et al., "Modeling Communication Pipeline Latency", *Proc. of ACM International Conference on Measurement and Modeling of Computer Systems, Sigmetrics*, Jun. 1998.

Yocum et al., "Cut-Through Delivery in Trapeze: An Exercise in Low-Latency Messaging", *Proc. Of Sixth IEEE International Symposium on High Performance Distributed Computing*, Aug. 1997.

Dittia et al., "The APIC Approach to High Performance Network Interface Design: Protected DMA and Other Techniques", *Proceedings of INFOCOM '97*, Apr. 7-11, 1997.

Lauria et al., "Efficient Layering for High Speed Communication: Fast Messages 2.x\*", *IEEE*, Jul. 1998.

Tezuka et al., "PM: An Operating System Coordinated High Performance Communication Library", *Real World Computing Partnership*, 1997.

Prylli et al., "Modeling of a High Speed Network to Maximize Throughput Performance: the Experience of BIP over Myrinet", Sep. 26, 1997.

\* cited by examiner

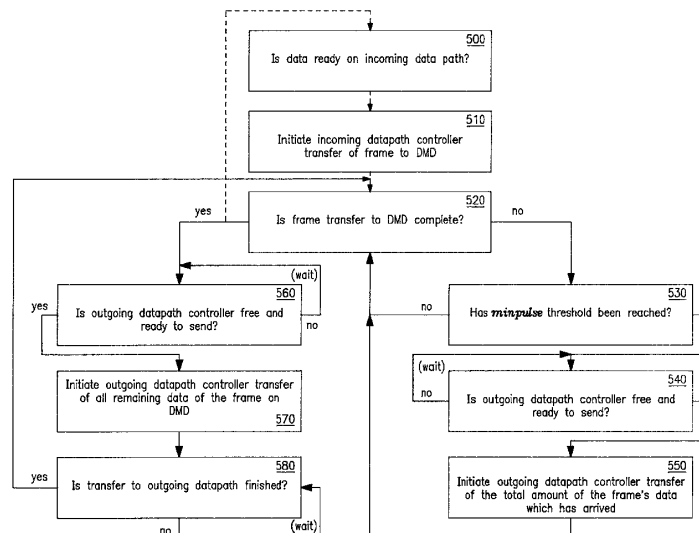
*Primary Examiner*—Christopher B. Shin

(74) *Attorney, Agent, or Firm*—Jenkins & Wilson, P.A.

(57) **ABSTRACT**

A system and method termed adaptive message pipelining in which two or more data paths are joined by a data movement device. The data movement device has a data path controller for each incoming and outgoing data path. Adaptive message pipelining is a dynamic policy which adjusts between a store and forward data delivery method and a cut through delivery of data based upon network and I/O bus contention in order to decrease latency and maximize system throughput.

**15 Claims, 8 Drawing Sheets**



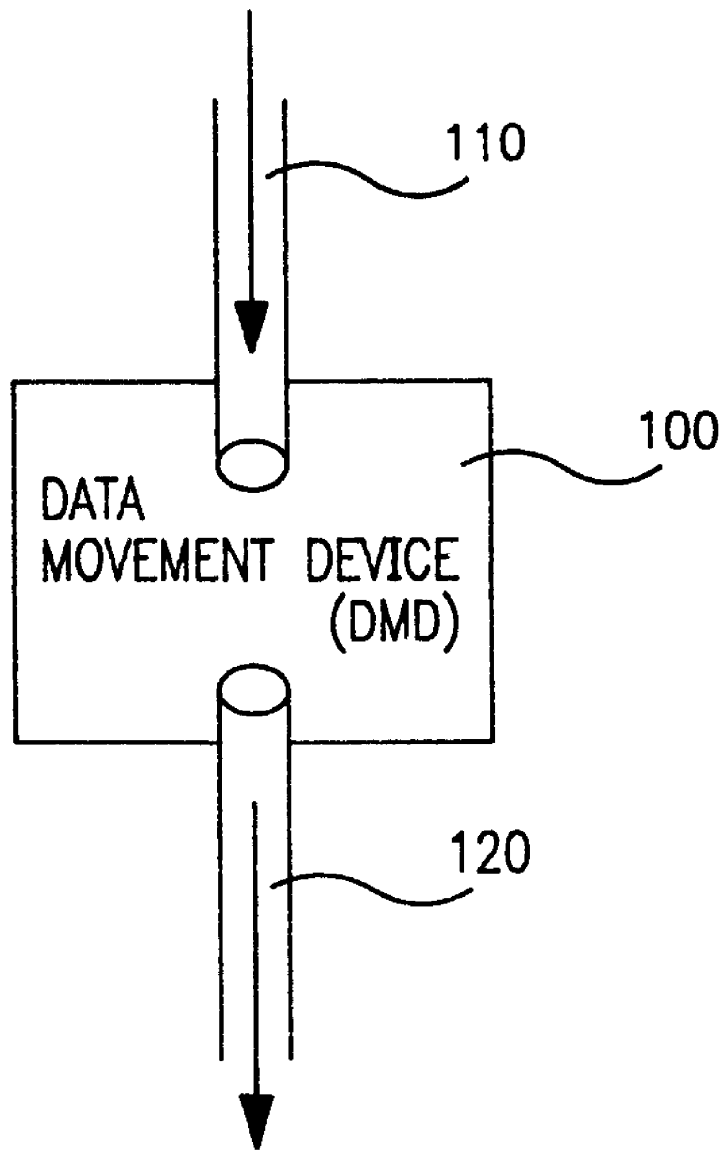


FIG. 1

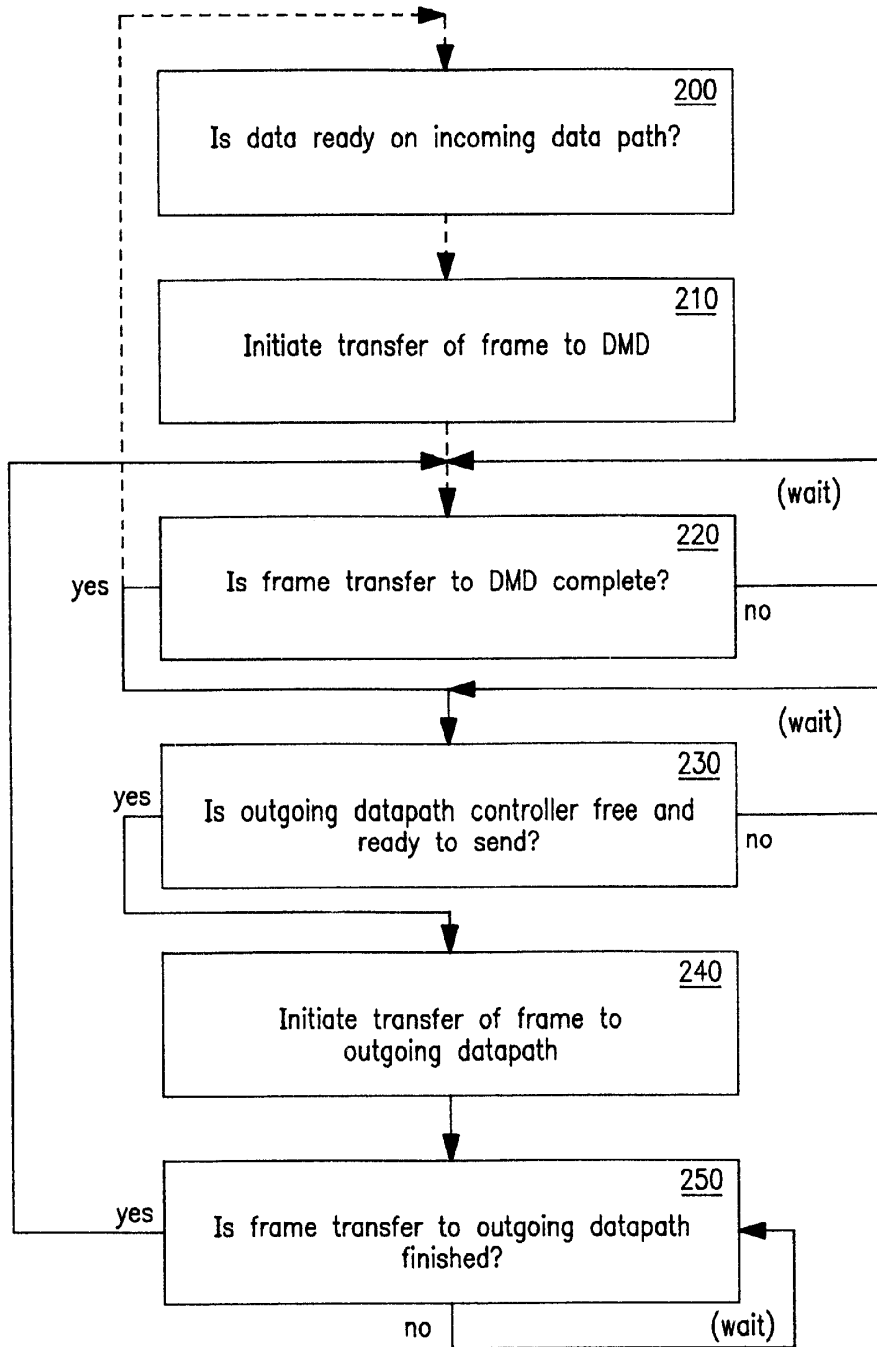


FIG. 2  
PRIOR ART

FIG. 3  
PRIOR ART

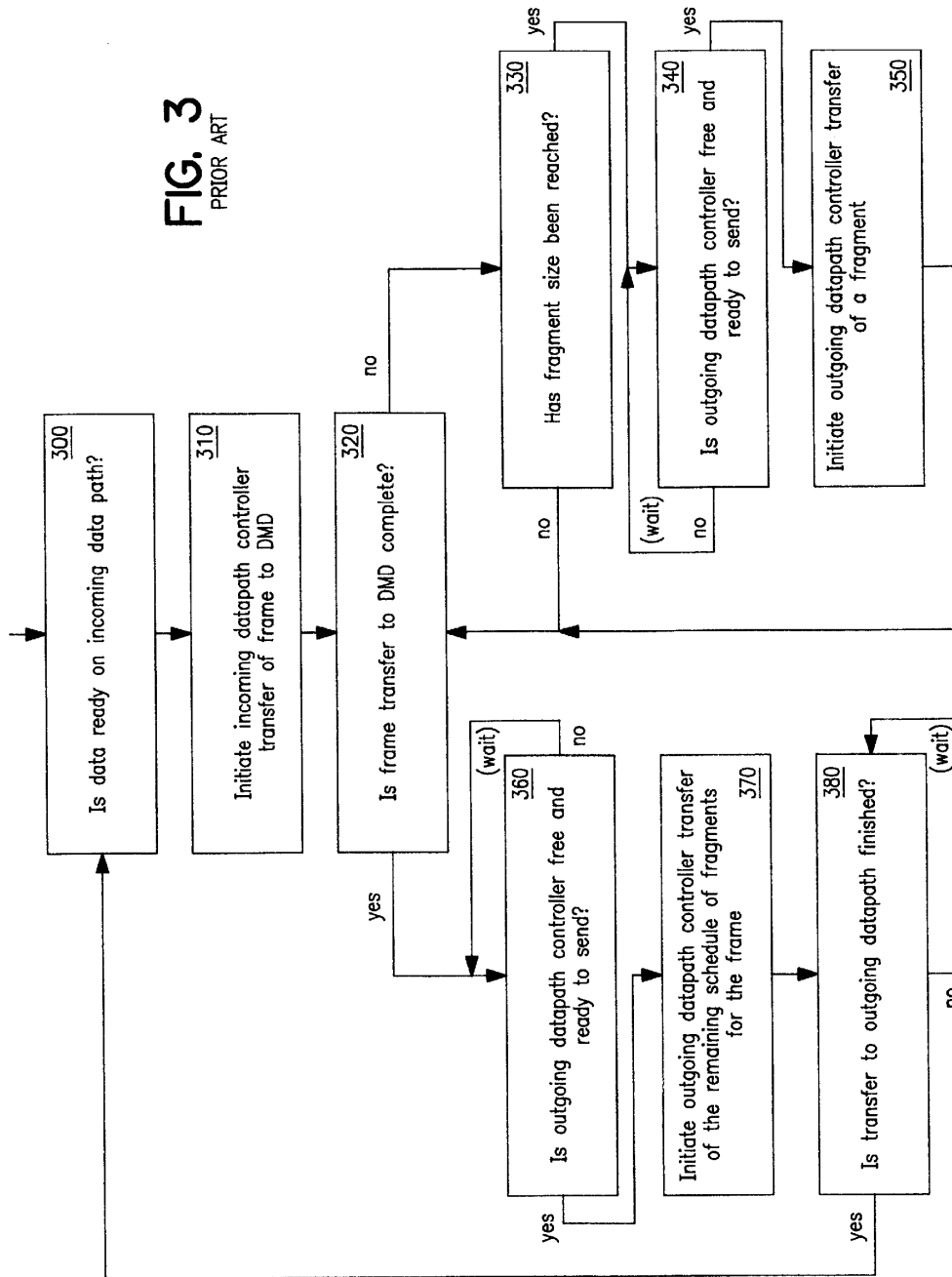
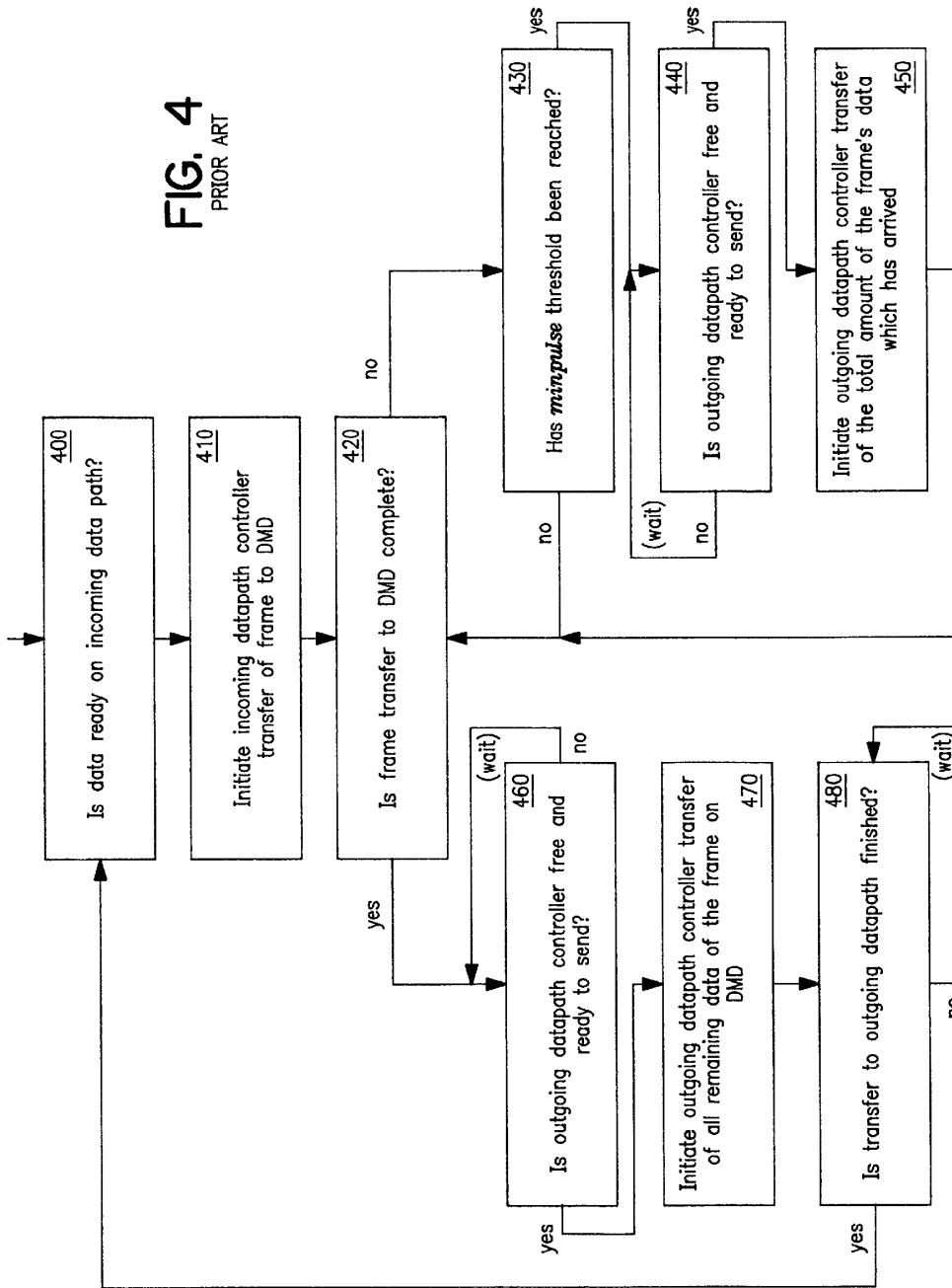


FIG. 4  
PRIOR ART



# 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.