



US007392279B1

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

(10) **Patent No.:** **US 7,392,279 B1**  
(45) **Date of Patent:** **Jun. 24, 2008**

(54) **NETWORK TRAFFIC SHAPING USING TIME-BASED QUEUES**

6,404,737 B1 \* 6/2002 Novick et al. .... 370/235.1  
6,438,134 B1 \* 8/2002 Chow et al. .... 370/412  
6,526,062 B1 \* 2/2003 Milliken et al. .... 370/395.42  
6,621,792 B1 \* 9/2003 Petty ..... 370/230.1  
6,724,767 B1 \* 4/2004 Chong et al. .... 370/412

(75) Inventors: **Kartik S. Chandran**, Sunnyvale, CA (US); **Guenter Roeck**, San Jose, CA (US); **Sunil Khaunte**, Santa Clara, CA (US)

**OTHER PUBLICATIONS**

R. Ladner, "CSE 326: Data Structures", Spring 1998, Lecture Overheads: Lecture 19, Calendarqueues.  
Randy Brown, "Calendar Queues: A Fast O(1) Priority Queue Implementation For the Simulation Even Set Problem", Oct. 1988. vol. 31, Communications of the ACM.  
LSI Logic Corporation, "LSI Logic's L64364 ATMizer II+ ATM-SAR Chip Technical Manual" Chapter 7, Nov. 16, 1998.  
R. Ladner, "CSE 326: Data Structures", Spring 1998, Lecture Overheads: Lecture 19, Calendarqueues, month unknown.

\* cited by examiner

*Primary Examiner*—Dustin Nguyen

(74) *Attorney, Agent, or Firm*—Weaver Austin Villeneuve & Sampson LLP

(73) Assignee: **Cisco Technology, Inc.**, San Jose, CA (US)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 152 days.

(21) Appl. No.: **09/276,917**

(22) Filed: **Mar. 26, 1999**

(51) **Int. Cl.**  
**G06F 15/16** (2006.01)

(52) **U.S. Cl.** ..... **709/200**; 370/230.1; 370/235; 370/395.4; 370/412; 719/314; 718/102

(58) **Field of Classification Search** ..... 717/153; 370/412, 60, 229, 230, 395, 235, 429, 236.1, 370/395.42; 709/240

See application file for complete search history.

(57) **ABSTRACT**

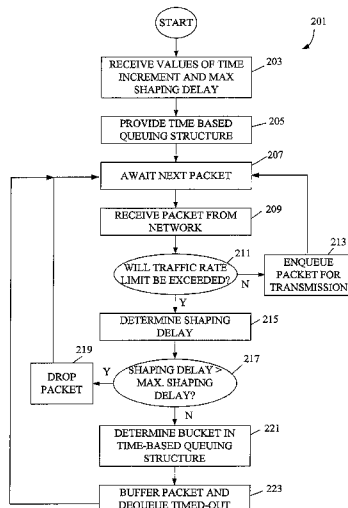
A time-based buffering system buffers data based upon how long the data should be held in order to comply with a traffic shaping policy. The data's source or destination need not be considered in determining where to buffer the data. The time-based buffering system includes a collection of time-based queues, each of which has a different time to dequeue. The system controlling traffic shaping determines how long a particular piece of data should be buffered (a "traffic shaping delay") until it can be put on the network. Then, based upon that length of time, the system chooses one of the time-based queues in which to buffer the data. That chosen queue has a dequeuing time that matches the traffic shaping delay. After the chosen queue dequeues its contents (at the specified time), it assumes a new dequeuing time and is free to buffer new data that must be delayed by a time matching the new dequeuing time.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,435,753 A \* 3/1984 Rizzi ..... 364/200  
5,231,633 A \* 7/1993 Hluchyj et al. .... 370/429  
5,317,562 A \* 5/1994 Nardin et al.  
5,463,620 A \* 10/1995 Sriram ..... 370/60  
5,754,530 A \* 5/1998 Awdeh et al. .... 370/236.1  
5,838,915 A 11/1998 Klausmeier et al. .... 395/200.45  
6,052,375 A \* 4/2000 Bass et al. .... 370/412  
6,104,700 A \* 8/2000 Haddock et al. .... 370/235  
6,195,333 B1 \* 2/2001 Wise ..... 370/235  
6,247,061 B1 \* 6/2001 Douceur et al.  
6,259,699 B1 \* 7/2001 Opalka et al.  
6,389,019 B1 \* 5/2002 Fan et al. .... 370/395.42

**29 Claims, 11 Drawing Sheets**



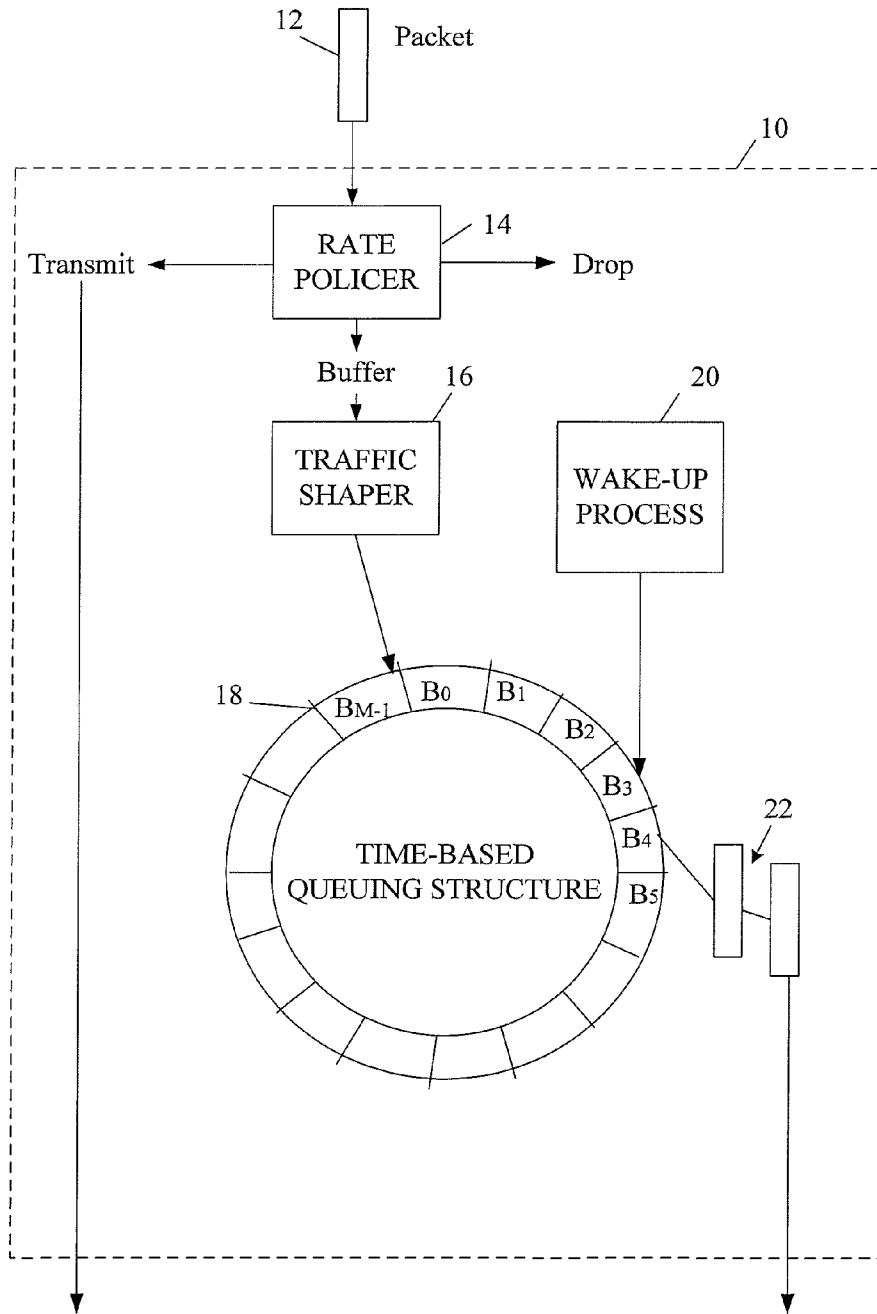


Figure 1

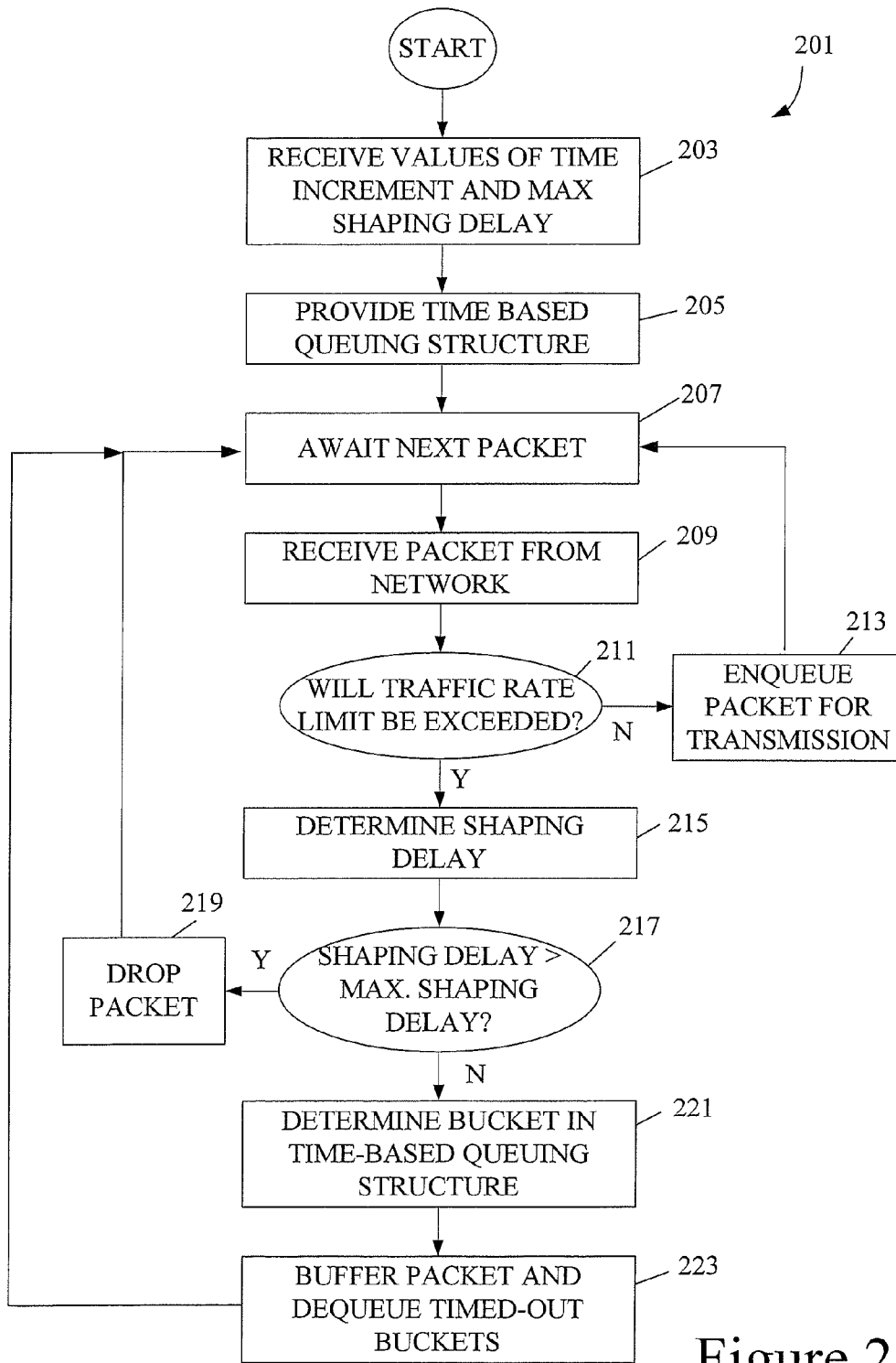


Figure 2

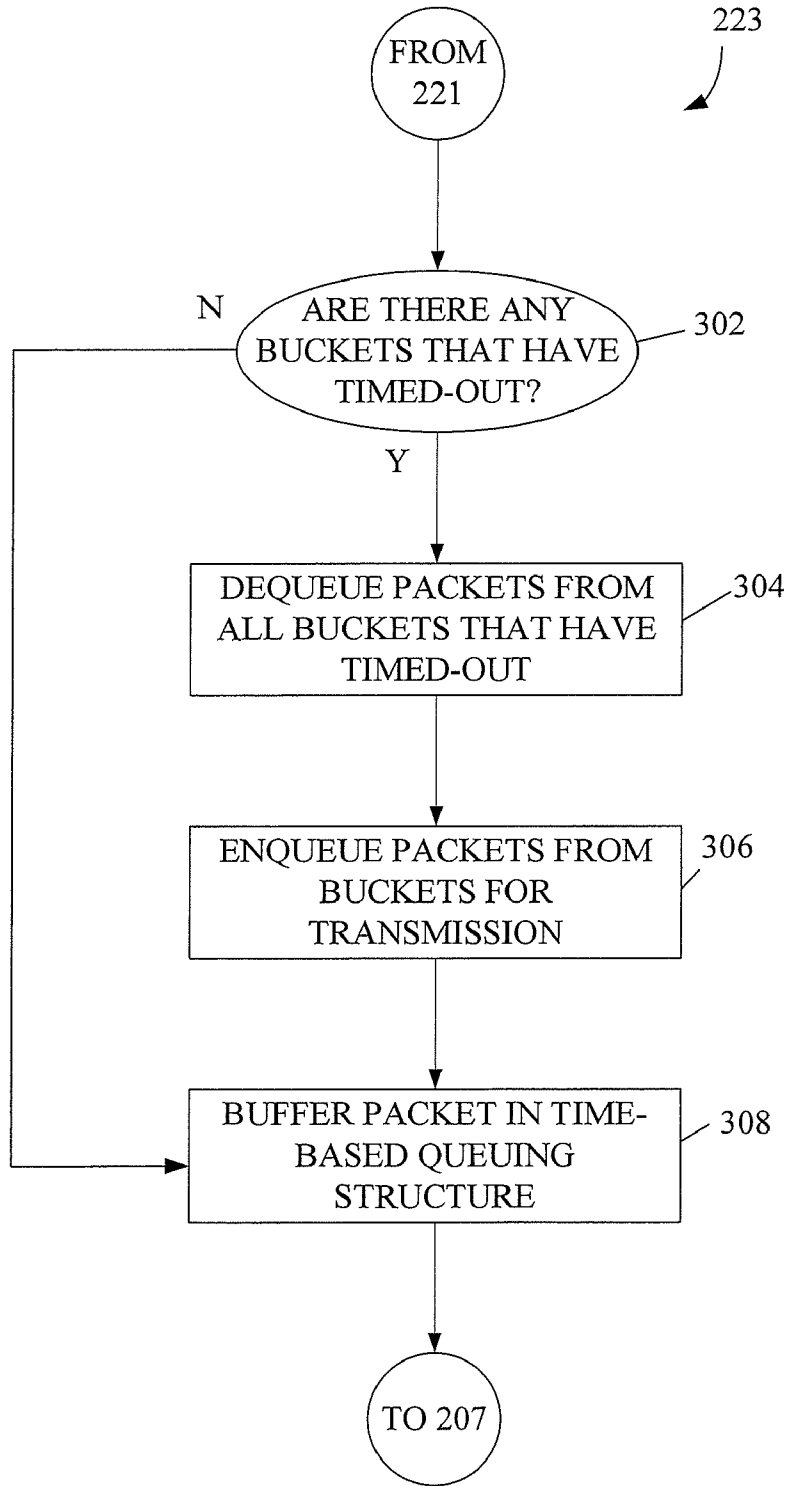


Figure 3

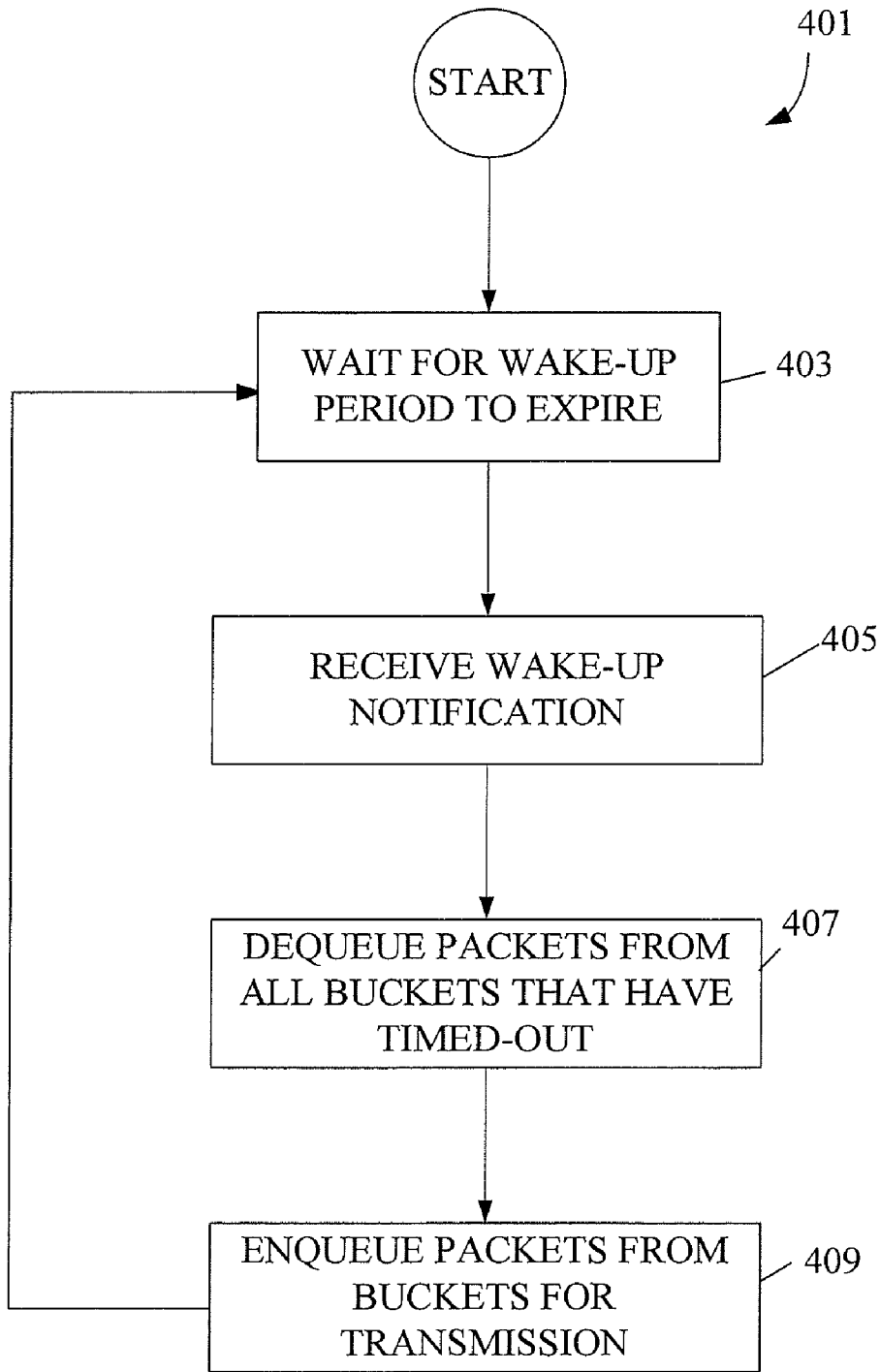


Figure 4

# 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.