



US006934256B1

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

(10) **Patent No.:** **US 6,934,256 B1**  
(45) **Date of Patent:** **Aug. 23, 2005**

(54) **METHOD OF DETECTING  
NON-RESPONSIVE NETWORK FLOWS**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 916 days.

(21) Appl. No.: **09/769,544**

(22) Filed: **Jan. 25, 2001**

(51) Int. Cl.<sup>7</sup> ..... **H04L 12/26**

(52) U.S. Cl. .... **370/235; 370/235.1**

(58) Field of Search ..... **370/235, 235.1, 370/236, 401, 412**

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

- 6,646,988 B1 \* 11/2003 Nandy et al. .... 370/235
- 6,690,645 B1 \* 2/2004 Aweya et al. .... 370/230
- 2002/0089930 A1 \* 7/2002 Aceves et al. .... 370/230

**OTHER PUBLICATIONS**

Sally Floyd and Van Jacobson Random Early Detection Gateways for Congestion Avoidance Aug., 1993 pp. 1-22.  
V. Jacobson, K. Nichols, K. Poduri Cisco Systems RED in a Different Light Sep. 30, 1999 pp. 1-38.  
Van Jacobson Notes on using RED for Queue Management and Congestion Avoidance Jun. 8, 1998.

\* cited by examiner

*Primary Examiner*—Kenneth Vanderpuye

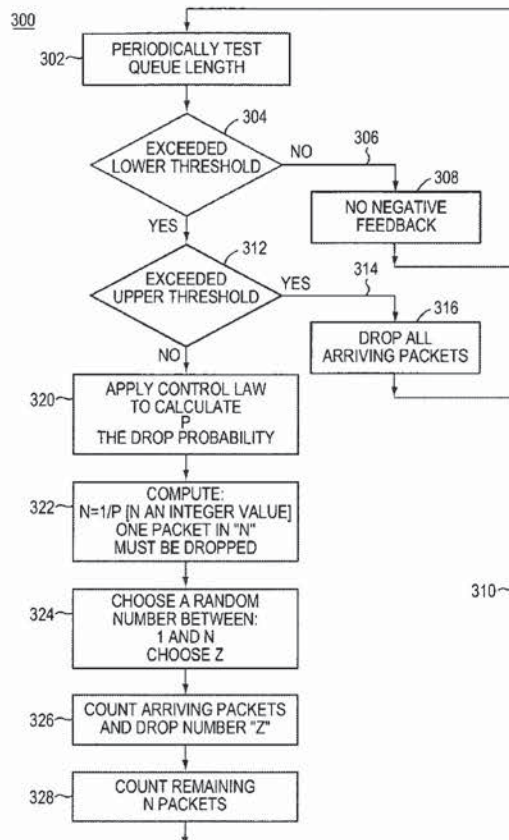
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(57) **ABSTRACT**

A network device identifies a non-adaptive flow as follows. The network device drops packets on a random basis using a Random Early Detection (RED) algorithm. A classifier reads indicia of a selected flow from at least one field of a header of a packet received by the network device. The network device calculates a drop interval for packets of the selected flow dropped by the RED algorithm, in response to a time at which the packets were dropped. The network device then applies a statistical test to drop intervals of a plurality of flows in order to identify the non-adaptive flow.

**20 Claims, 15 Drawing Sheets**



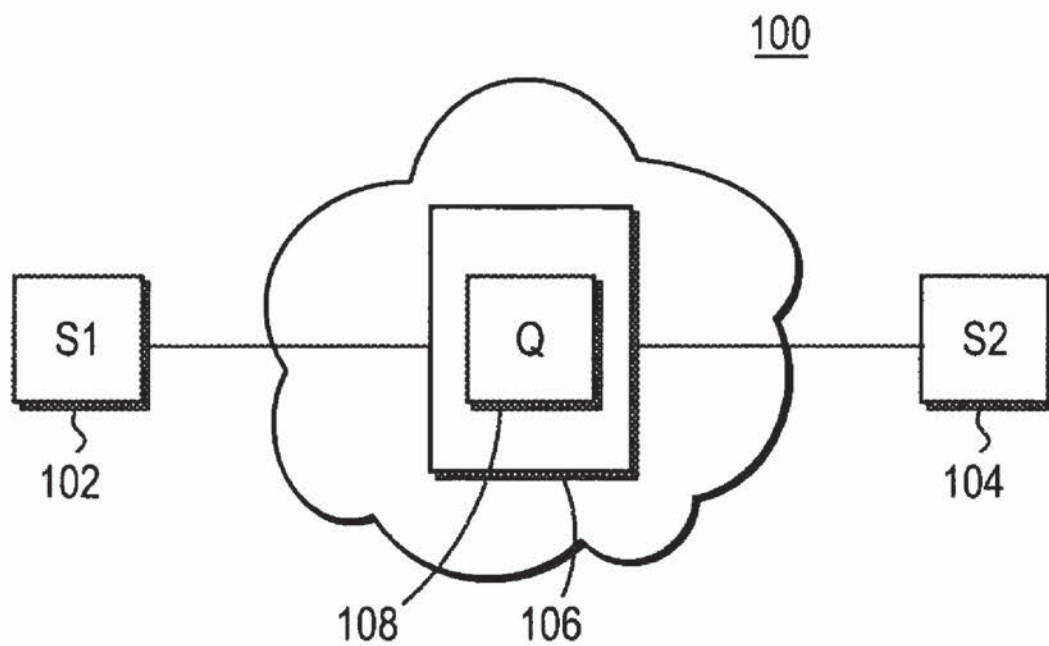


FIG. 1

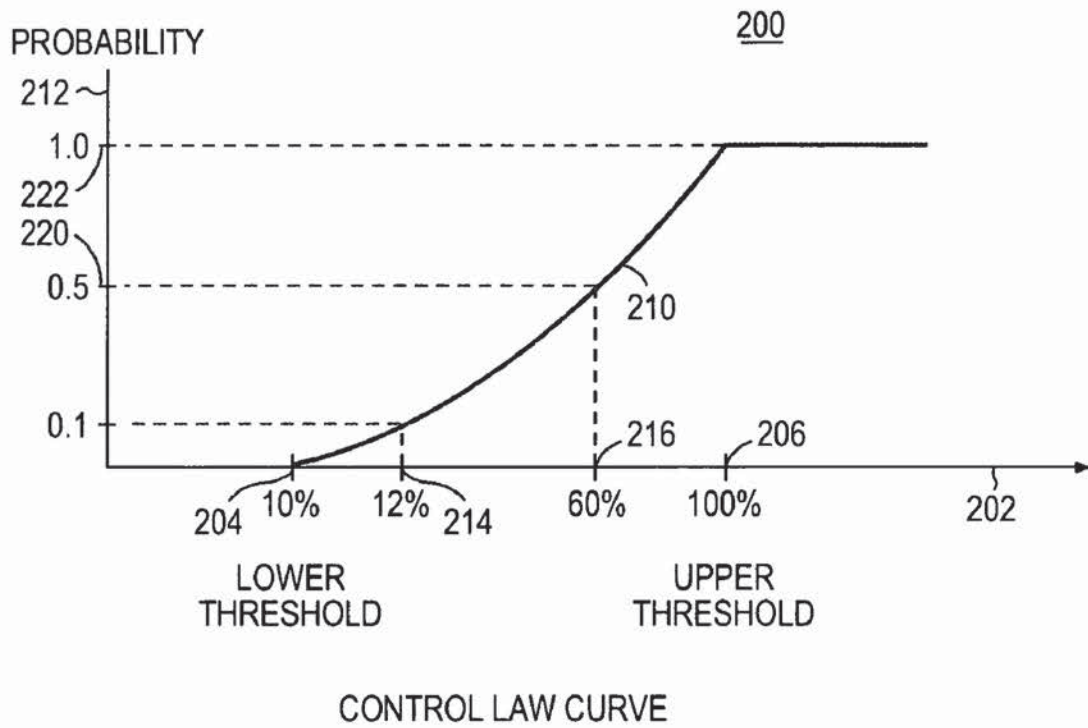


FIG. 2

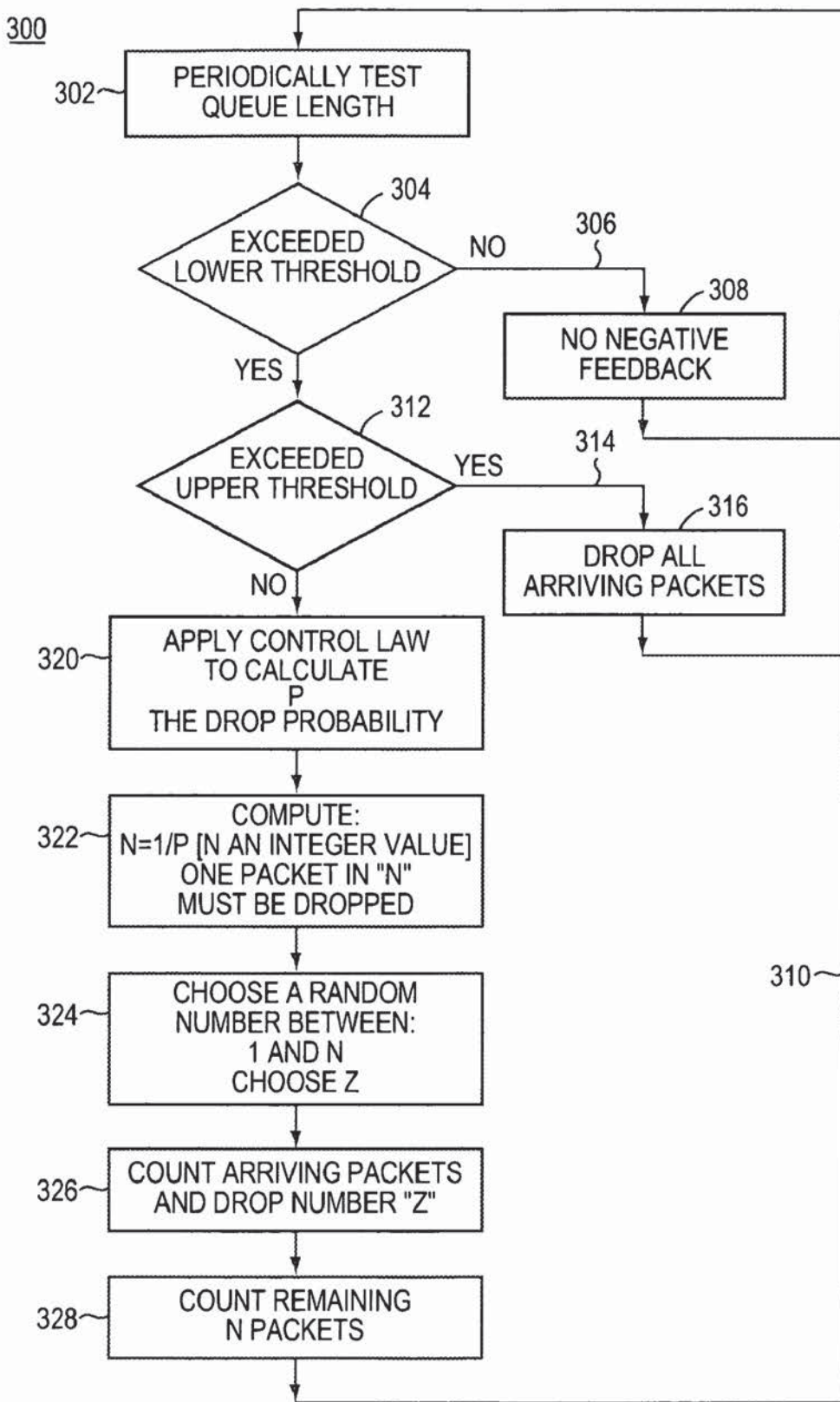


FIG. 3



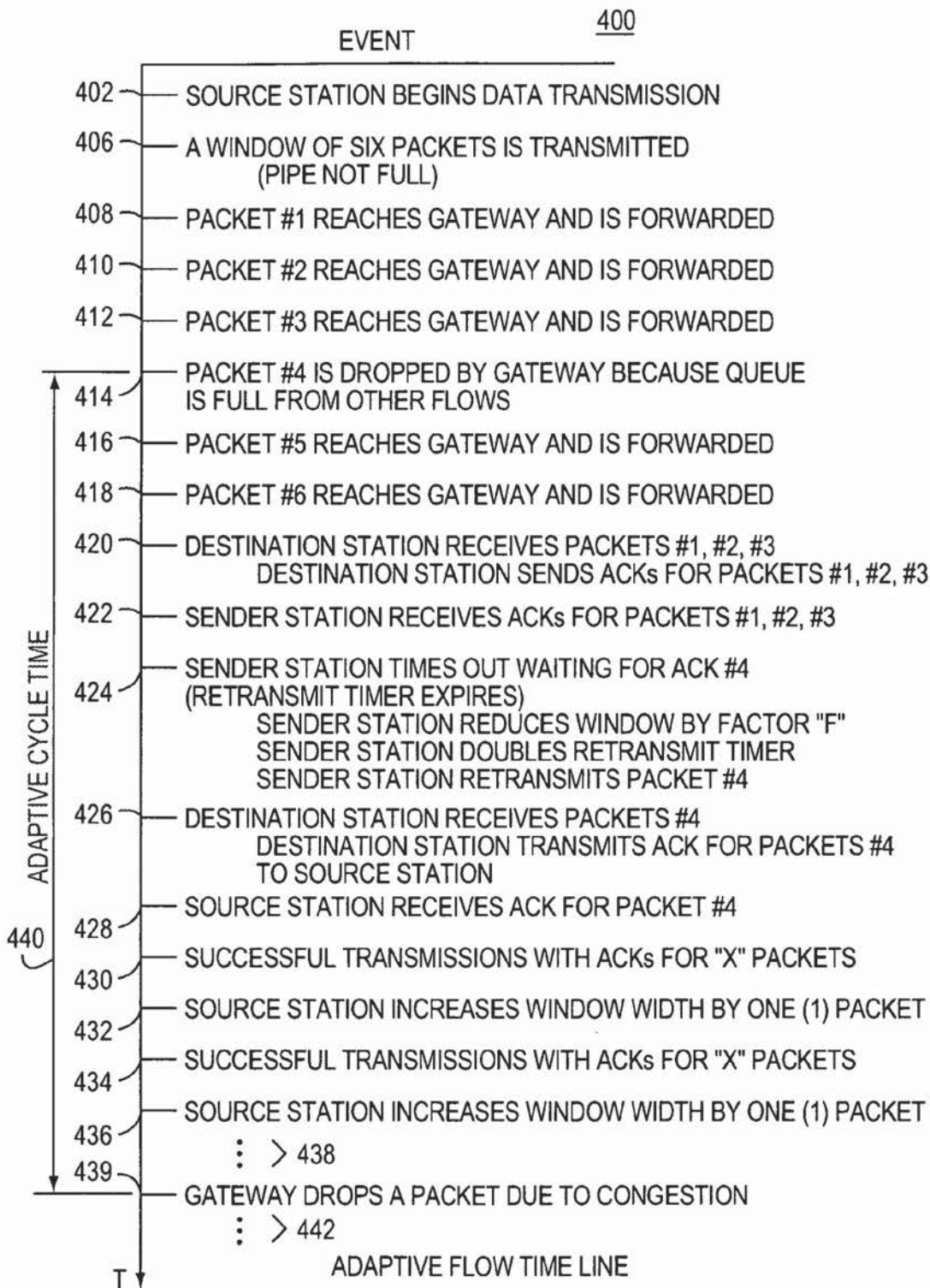


FIG. 4

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