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Miller et al.

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(54) **METHOD AND APPARATUS FOR PROCESSING NETWORK PACKETS USING TIME STAMPS**

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(51) **Int. Cl.**[7] **G06F 15/16**; G06F 15/173; H04L 12/56

(52) **U.S. Cl.** **709/234**; 709/235; 709/240; 370/418; 370/429; 710/53; 710/54; 702/187

(58) **Field of Search** 709/234, 235, 709/240; 370/418, 429, 230; 710/53, 54; 702/187

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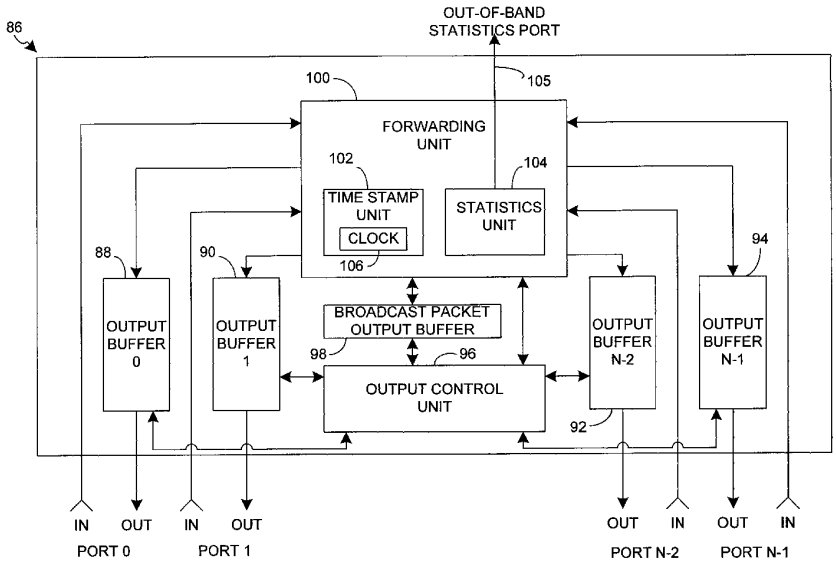
(57) **ABSTRACT**

A network device receives packets from a first network segment, time stamps the packets as they arrive, and transmits the packets to a second network segment. By time stamping packets as they arrive, stale packets can be identified and discarded. A stale packet is a packet that has been pending in the network device longer than an active timeout interval, which may be varied based on network traffic levels to conserve network bandwidth. Packets may also be discarded to conserve packet buffer memory in the network device. For example, when an incoming packet arrives and an output buffer in which the packet must be stored is full, the output buffer is scanned to identify and discard packets that have exceeded a minimum timeout interval, thereby allowing the incoming packet to be stored in the output buffer. Many network protocols initiate the retransmission of packets after a timeout interval has expired and an acknowledge packet has not been received. The present invention conserves network bandwidth by not transmitting stale packets that either will be ignored or redundant when network traffic becomes heavy. The present invention also conserves buffer memory by allowing broadcast and multicast packets to be stored in and transmitted from a single broadcast packet output buffer. The proper packet transmission order at each port is maintained by comparing the time stamp assigned to the broadcast packet when it arrived at the network device with the time stamps of the other packets in the output buffer. Finally, the present invention provides many opportunities for collecting statistics, such as the average latency, mean latency and standard deviation of the latency of packets processed by network device.

15 Claims, 10 Drawing Sheets



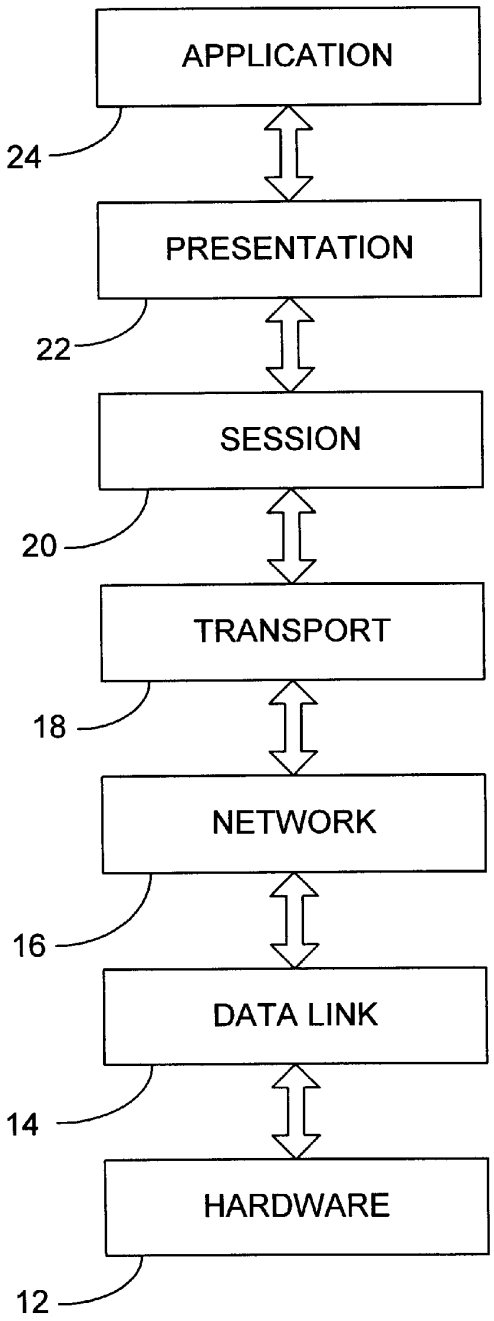


FIG. 1
(PRIOR ART)

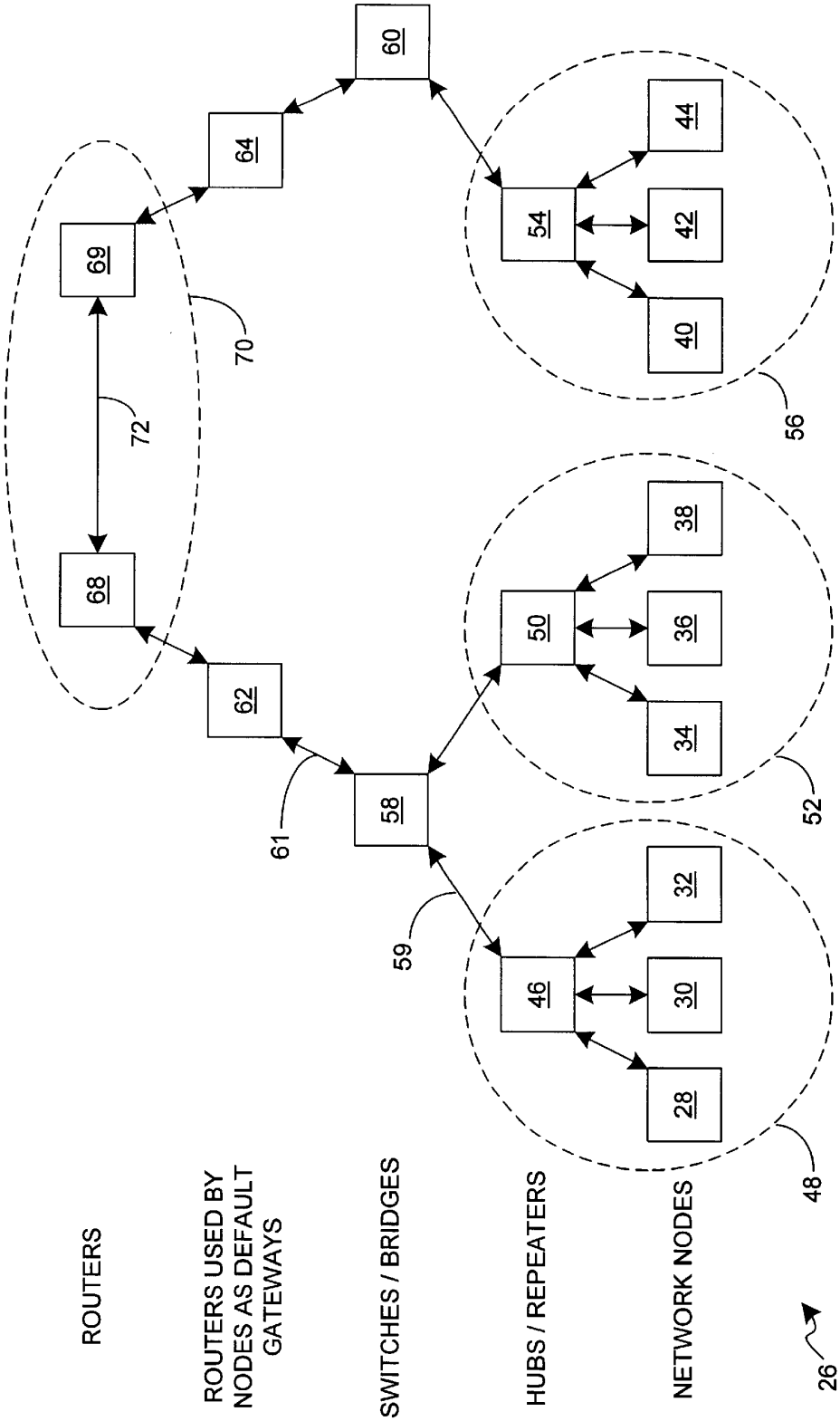


FIGURE 2
(PRIOR ART)

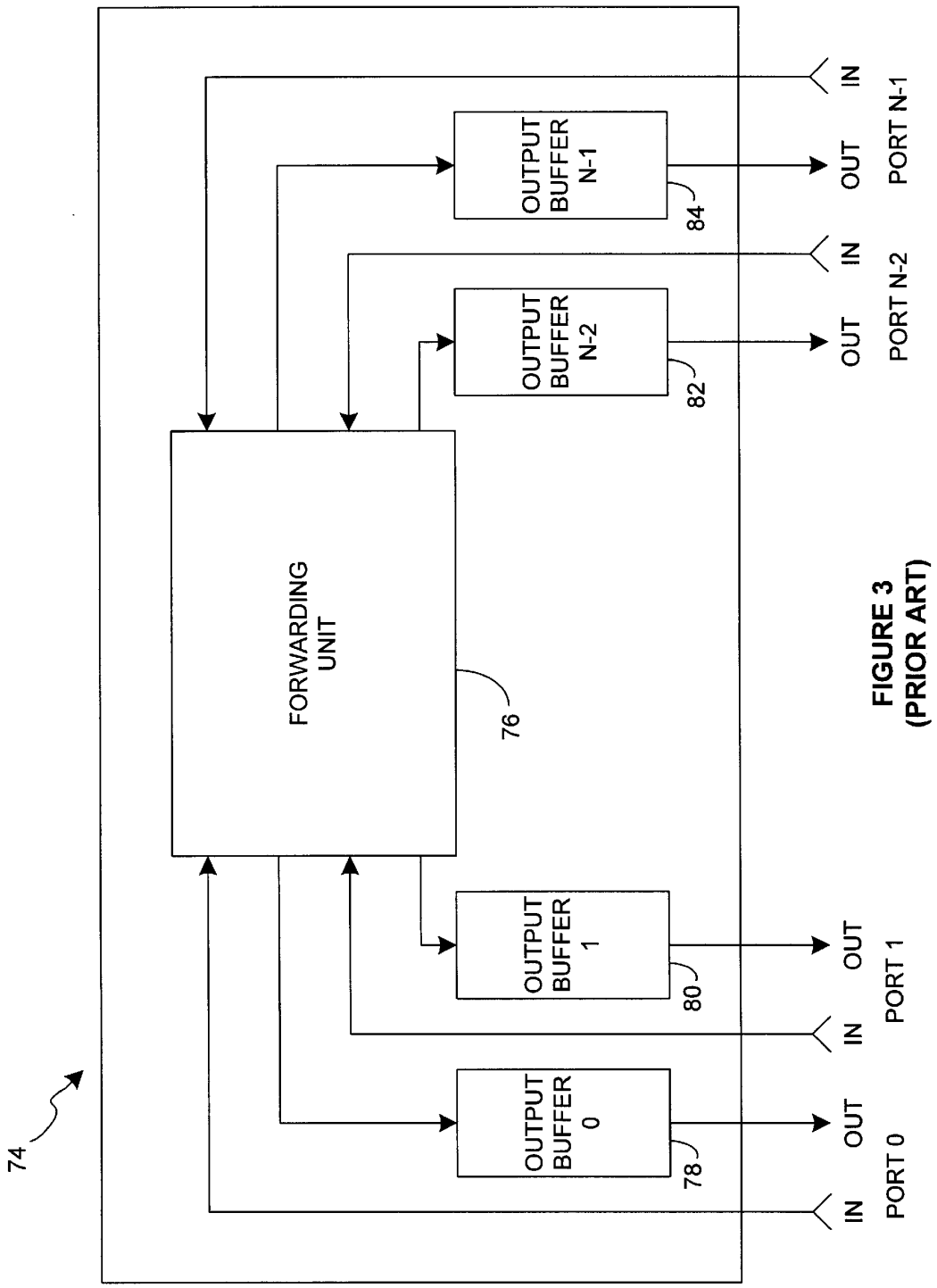


FIGURE 3
(PRIOR ART)

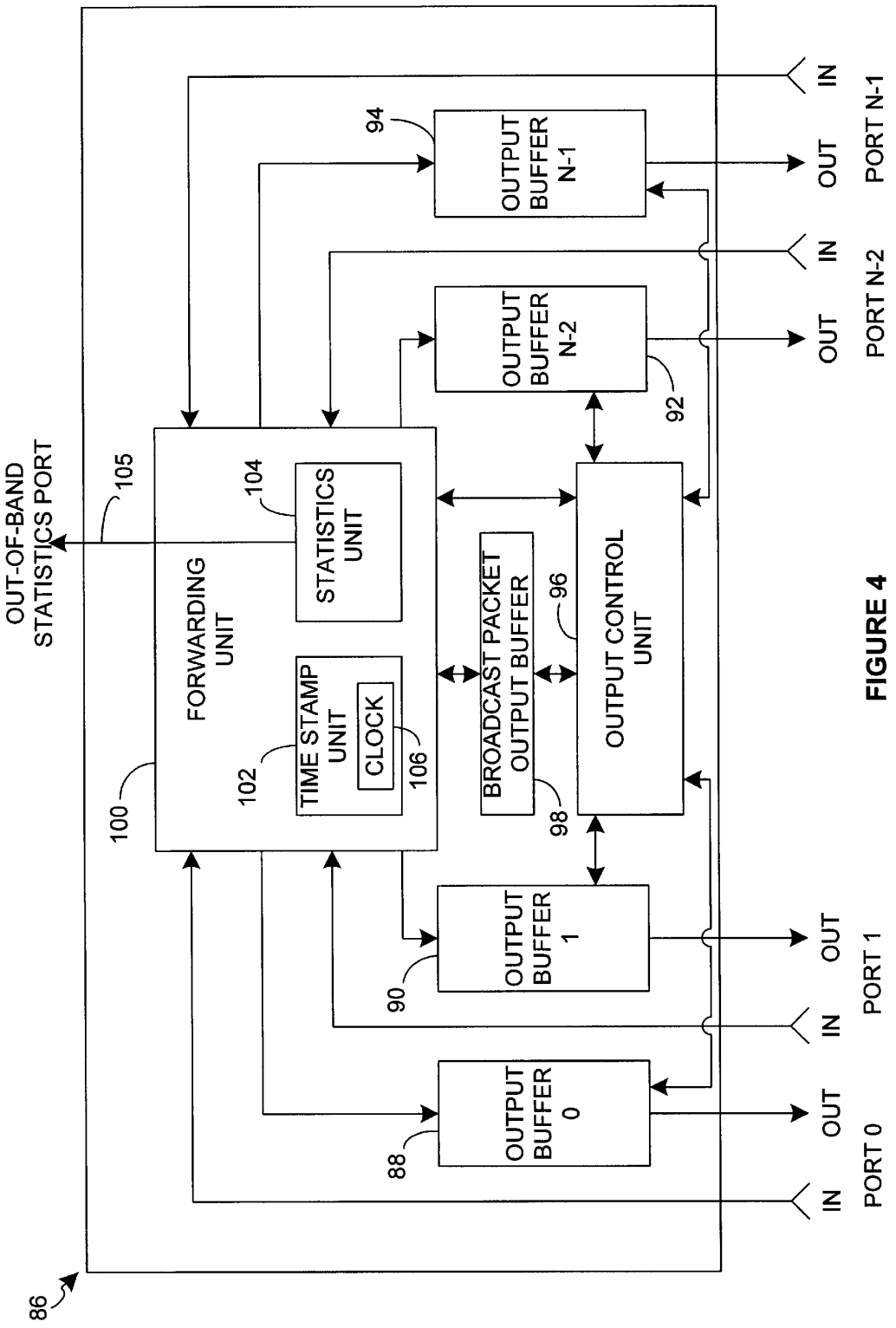


FIGURE 4

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