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Lei et al.

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(54) **ADAPTIVE TIMER FOR LLC TYPE 2 RELIABLE TRANSPORT IN A COMPUTER NETWORK**

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(51) **Int. Cl.**[7] **G06F 13/00**
(52) **U.S. Cl.** **709/235**; 709/232
(58) **Field of Search** 709/200–253

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,331,637	A	7/1994	Francis et al.	370/54
5,353,283	A	10/1994	Tsuchiya	370/60
5,442,633	A	8/1995	Perkins et al.	370/94.1
5,583,996	A	12/1996	Tsuchiya	395/200.15
5,600,644	A	2/1997	Chang et al.	370/404
5,633,866	A	5/1997	Callon	370/397
5,818,842	A	10/1998	Burwell et al.	370/397
5,828,844	A	10/1998	Civanlar et al.	395/200.58
5,898,686	A	4/1999	Virgile	370/381
5,909,441	A	6/1999	Alexander, Jr. et al.	370/395
5,909,550	A	6/1999	Shankar et al.	395/200.57
6,076,114	A *	6/2000	Wesley	709/235

OTHER PUBLICATIONS

Pearlman, Radia, *Interconnections, Bridges and Routers*, Addison Wesley, 1992, pp. 34–35.

Tanenbaum, Andrew, *Computer Networks, Second Edition*, 1988, PGS. 253–257.

Comer, Douglas, E., *Internetworking With TCP/IP, 3rd Edition, vol. 1*, Prentice Hall, 1995, pp. 208–216.

Tanenbaum, Andrew S., "*Computer Networks, 3rd edition*", Prentice Hall, PTR, 1996, pp. 28–54.

RFC 1795 "IETF", Request For Comments, Informational RFC, RFC 1795, dated Apr., 1995, (www.ietf.org)., Section 2.

(List continued on next page.)

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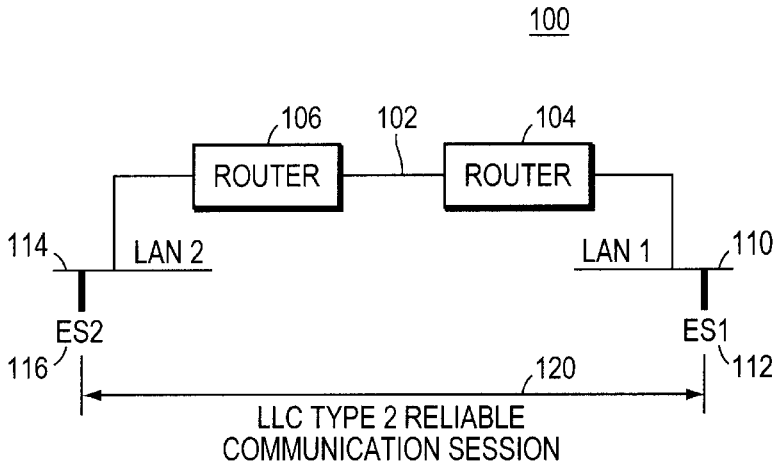
(57) **ABSTRACT**

A method for computing an ACK timing interval for an ACK timer in a protocol layer LLC type 2 session first measures a time interval between transmission of a frame by a source computer joined to a to a destination computer by an intermediate link, and receipt of a corresponding acknowledgment frame by the source computer from the destination computer. The two events at the source computer, starting a timer upon commencement of transmission of a frame or sequence of frames and the later reception of an acknowledge message indicating receipt of those frames, permits calculation of a measured time interval. The measured time interval is used to compute the bandwidth of the intermediate link. The required ACK timing interval for the ACK timer is then computed in response to the bandwidth, the number of bytes transmitted after starting the ACK timer, and the return time for an acknowledgment message. The ACK timing interval may be recomputed after every transmission of frames and receipt of a corresponding ACK message. The ACK timing interval is thereby dynamically adjusted to conditions on the intermediate link, including natural bandwidth for either a slow or fast link, congestion due to other traffic on the link, etc. The dynamic adjustment of the ACK timing interval prevents inadvertent timeouts of the ACK timer, and so prevents inadvertent breaking of the LLC type 2 reliable transport connection.

15 Claims, 9 Drawing Sheets



OTHER PUBLICATIONS

Tanenbaum, Andrew, *Computer Networks, 3rd edition*, Prentice Hall, 1996, pp. 28–35, 35–39.
Tanenbaum, Andrew S., *Computer Networks, Second Edition*, Prentice Hall, 1998, pp. 253–268.
Comer, Douglas E., *Computer Networks and Internets*, Prentice Hall, 1997, pp. 239–249.
Comer, Douglas E., *Internetworking with TCP/IP, vol. 1, Third Edition*, Prentice Hall, 1995, pp. 89–107.

* cited by examiner

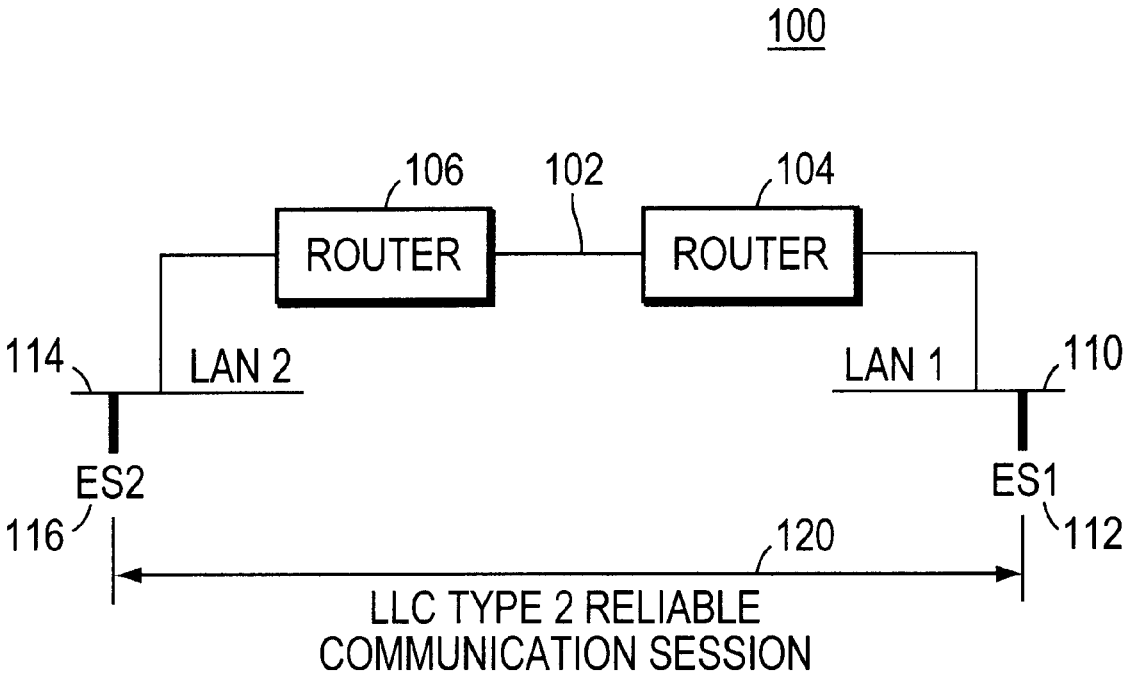


FIG. 1

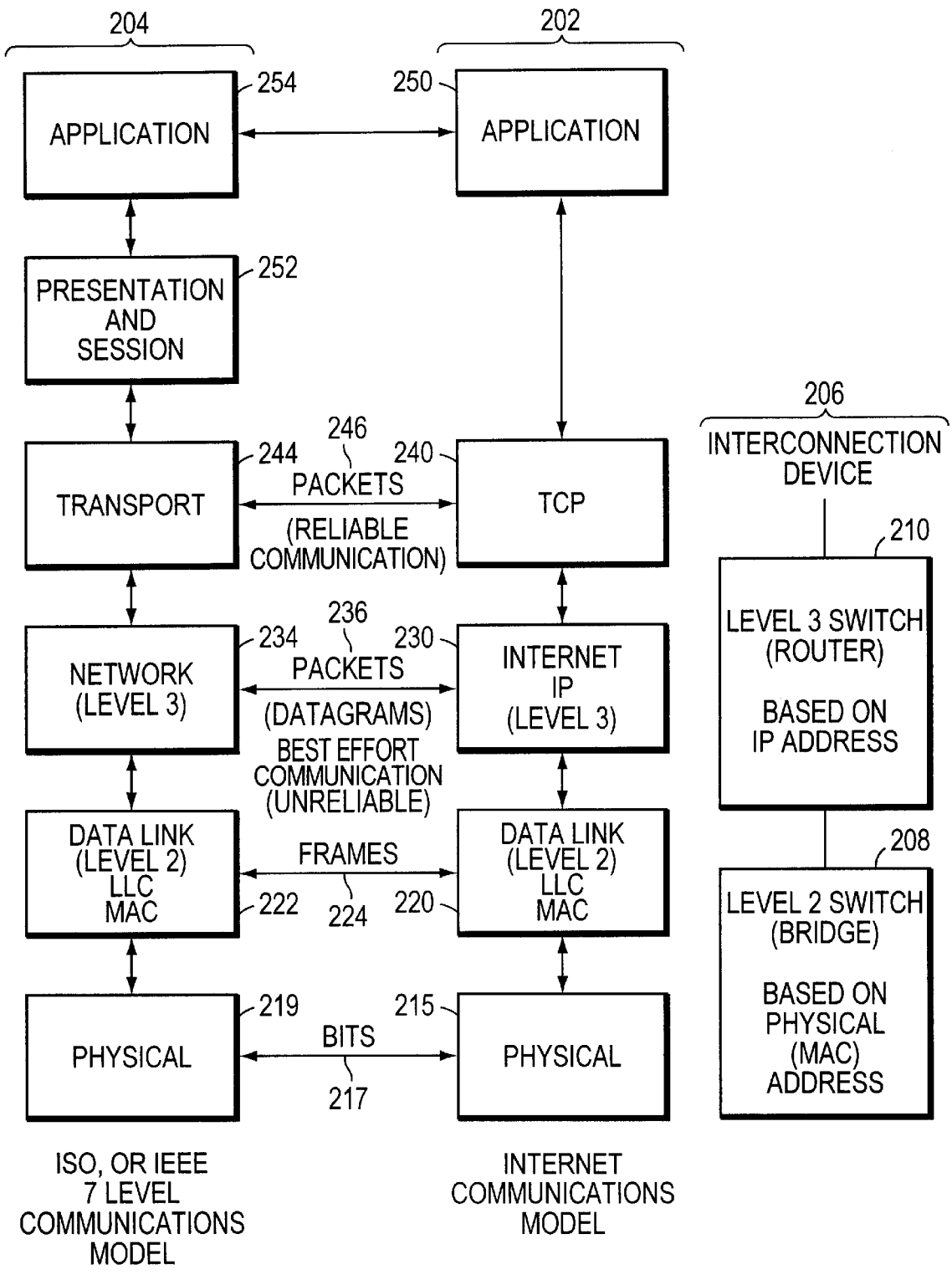
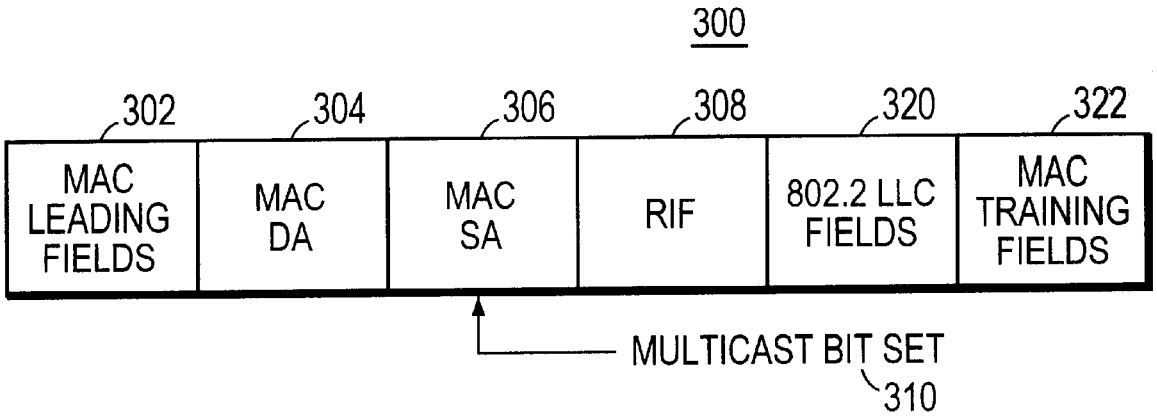
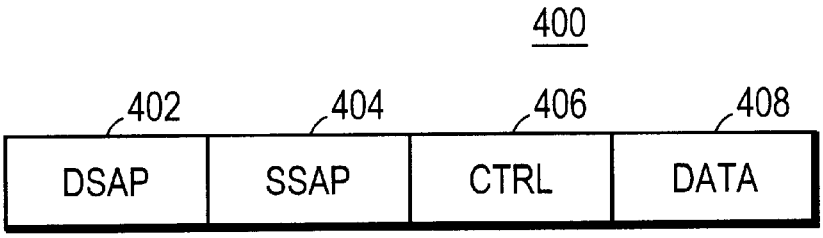


FIG. 2



IEEE 802.5: LEVEL 2 MAC FRAME FIELDS

FIG. 3



IEEE 802.2 LLC FIELDS

FIG. 4

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