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Dietz et al.

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(54) **METHOD AND APPARATUS FOR MONITORING TRAFFIC IN A NETWORK**

FOREIGN PATENT DOCUMENTS

JP 2003-44510 A 2/2003

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OTHER PUBLICATIONS

Advanced Methods for Storage and Retrieval in Image;
<http://www.cs.tulane.edu/ww/Prototype/proposal.html>;
1998.

(Continued)

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(57) **ABSTRACT**

(21) Appl. No.: **10/684,776**

A monitor for and a method of examining packets passing through a connection point on a computer network. Each packets conforms to one or more protocols. The method includes receiving a packet from a packet acquisition device and performing one or more parsing/extraction operations on the packet to create a parser record comprising a function of selected portions of the packet. The parsing/extraction operations depend on one or more of the protocols to which the packet conforms. The method further includes looking up a flow-entry database containing flow-entries for previously encountered conversational flows. The lookup uses the selected packet portions and determining if the packet is of an existing flow. If the packet is of an existing flow, the method classifies the packet as belonging to the found existing flow, and if the packet is of a new flow, the method stores a new flow-entry for the new flow in the flow-entry database, including identifying information for future packets to be identified with the new flow-entry. For the packet of an existing flow, the method updates the flow-entry of the existing flow. Such updating may include storing one or more statistical measures. Any stage of a flow, state is maintained, and the method performs any state processing for an identified state to further the process of identifying the flow. The method thus examines each and every packet passing through the connection point in real time until the application program associated with the conversational flow is determined.

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(65) **Prior Publication Data**

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Related U.S. Application Data

(63) Continuation of application No. 09/608,237, filed on Jun. 30, 2000, now Pat. No. 6,651,099.

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(51) **Int. Cl.**⁷ **G06F 15/173**

(52) **U.S. Cl.** **709/224; 370/392**

(58) **Field of Search** 709/200, 201,
709/220, 223, 224, 231, 232, 236, 238-240,
246; 370/389, 392

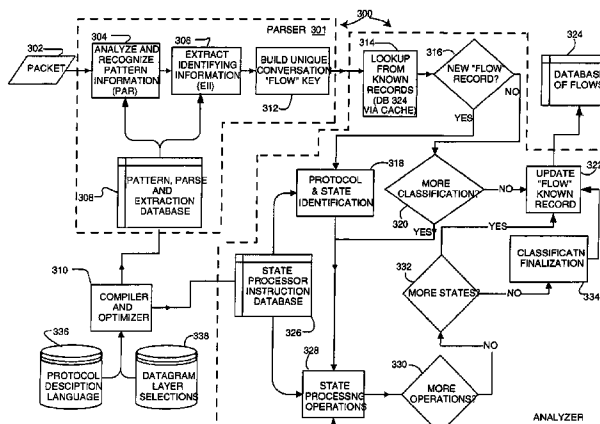
(56) **References Cited**

U.S. PATENT DOCUMENTS

3,949,369 A 4/1976 Churchill, Jr. 711/128
4,458,310 A 7/1984 Chang 711/119
4,559,618 A 12/1985 Houseman et al. 365/49

(Continued)

49 Claims, 18 Drawing Sheets



U.S. PATENT DOCUMENTS

4,736,320 A	4/1988	Bristol	364/300	5,835,726 A	11/1998	Shwed et al.	395/200.59
4,891,639 A	1/1990	Nakamura	340/825.5	5,838,919 A	11/1998	Schwaller et al.	395/200.54
4,910,668 A	3/1990	Okamoto et al.	711/207	5,841,895 A	11/1998	Huffman	382/155
4,972,453 A	11/1990	Daniel, III et al.	379/10	5,850,386 A	12/1998	Anderson et al.	370/241
5,101,402 A	3/1992	Chiu et al.	370/17	5,850,388 A	12/1998	Anderson et al.	370/252
5,247,517 A	9/1993	Ross et al.	370/85.5	5,862,335 A	1/1999	Welch, Jr. et al.	395/200.54
5,247,693 A	9/1993	Bristol	395/800	5,878,420 A	3/1999	de la Salle	707/10
5,249,292 A	9/1993	Chiappa	395/650	5,893,155 A	4/1999	Cheriton	711/144
5,315,580 A	5/1994	Phaal	370/13	5,903,754 A	5/1999	Pearson	395/680
5,339,268 A	8/1994	Machida	365/49	5,917,821 A	6/1999	Gobuyan et al.	370/392
5,351,243 A	9/1994	Kalkunte et al.	370/92	6,003,123 A	12/1999	Carter et al.	711/207
5,365,514 A	11/1994	Hershey et al.	370/17	6,014,380 A	1/2000	Hendel et al.	370/392
5,375,070 A	12/1994	Hershey et al.	364/550	6,097,699 A	8/2000	Chen et al.	370/231
5,394,394 A	2/1995	Crowther et al.	370/60	6,115,393 A	9/2000	Engel et al.	370/469
5,414,650 A	5/1995	Hekhuis	364/715.02	6,118,760 A	9/2000	Zaumen et al.	370/229
5,414,704 A	5/1995	Spinney	370/60	6,213,667 B1	6/2001	Kerr et al.	703/27
5,430,709 A	7/1995	Galloway	370/13	6,269,330 B1	7/2001	Cidon et al.	704/43
5,432,776 A	7/1995	Harper	370/17	6,272,151 B1	8/2001	Gupta et al.	370/489
5,493,689 A	2/1996	Waclawsky et al.	395/821	6,279,113 B1	8/2001	Vaidya	713/201
5,500,855 A	3/1996	Hershey et al.	370/17	6,282,570 B1	8/2001	Leung et al.	709/224
5,511,213 A	4/1996	Correa	395/800	6,330,226 B1	12/2001	Chapman et al.	370/232
5,511,215 A	4/1996	Terasaka et al.	395/800	6,363,056 B1	3/2002	Beigi et al.	370/252
5,530,834 A	6/1996	Colloff et al.	711/136	6,381,306 B1	4/2002	Lawson et al.	379/32
5,530,958 A	6/1996	Agarwal et al.	711/3	6,424,624 B1	7/2002	Galand et al.	703/231
5,535,338 A	7/1996	Krause et al.	395/200.2	6,430,409 B1	8/2002	Rossmann	455/422.1
5,568,471 A	10/1996	Hershey et al.	370/17	6,452,915 B1	9/2002	Jorgensen	370/238
5,574,875 A	11/1996	Stansfield et al.	395/403	6,453,345 B2	9/2002	Trcka et al.	709/224
5,586,266 A	12/1996	Hershey et al.	395/200.11	6,453,360 B1	9/2002	Muller et al.	709/250
5,606,668 A	2/1997	Shwed	395/200.11	6,466,985 B1	10/2002	Goyal et al.	709/238
5,608,662 A	3/1997	Large et al.	364/724.01	6,483,804 B1	11/2002	Muller et al.	370/230
5,634,009 A	5/1997	Iddon et al.	395/200.11	6,510,509 B1	1/2003	Chopra et al.	712/13
5,651,002 A	7/1997	Van Seters et al.	370/392	6,516,337 B1	2/2003	Tripp et al.	709/202
5,680,585 A	10/1997	Bruell	703/26	6,519,568 B1	2/2003	Harvey et al.	705/1
5,684,954 A	11/1997	Kaiserswerth et al.	395/200.2	6,570,875 B1	5/2003	Hegde	370/389
5,703,877 A	12/1997	Nuber et al.	370/395	6,625,657 B1	9/2003	Bullard	709/237
5,720,032 A	2/1998	Picazo, Jr. et al.	395/200.2	6,651,099 B1	11/2003	Dietz et al.	709/224
5,721,827 A	2/1998	Logan et al.	709/217	6,791,947 B2	9/2004	Oskouy et al.	370/238
5,732,213 A	3/1998	Gessel et al.	395/200.11				
5,740,355 A	4/1998	Watanabe et al.	395/183.21				
5,749,087 A	5/1998	Hoover et al.	711/108				
5,761,424 A	6/1998	Adams et al.	395/200.47				
5,761,429 A	6/1998	Thompson	709/224				
5,764,638 A	6/1998	Ketchum	370/401				
5,781,735 A	7/1998	Southard	395/200.54				
5,784,298 A	7/1998	Hershey et al.	364/557				
5,787,253 A	7/1998	McCreery et al.	395/200.61				
5,799,154 A	8/1998	Kuriyan	709/223				
5,802,054 A	9/1998	Bellenger	370/401				
5,805,808 A	9/1998	Hasani et al.	395/200.2				
5,812,529 A	9/1998	Czarnik et al.	370/245				
5,819,028 A	10/1998	Manghirmalani et al.	395/185.1				
5,825,774 A	10/1998	Ready et al.	370/401				

OTHER PUBLICATIONS

Measurement and Analysis of the Digital DECT propagation Channel; IEEE; 1998.

R, Periakaruppan and E. Nemeth. "GTrace—A Graphical Traceroute Tool." 1999 Usenix LISA. Available on www.caida.org, URL: <http://www.caida.org/outreach/papers/1999/GTrace/GTrace.pdf>.

W. Stallings. "Packet Filtering in the SNMP Remote Monitor." Nov. 1994. Available on www.ddj.com, URL: <http://www.ddj.com/documents/s=1013/ddj9411h/9411h.htm>.

"Technical Note: the Narus System," Downloaded Apr. 29, 1999 from www.narus.com, Narus Corporation, Redwood City California.

* cited by examiner

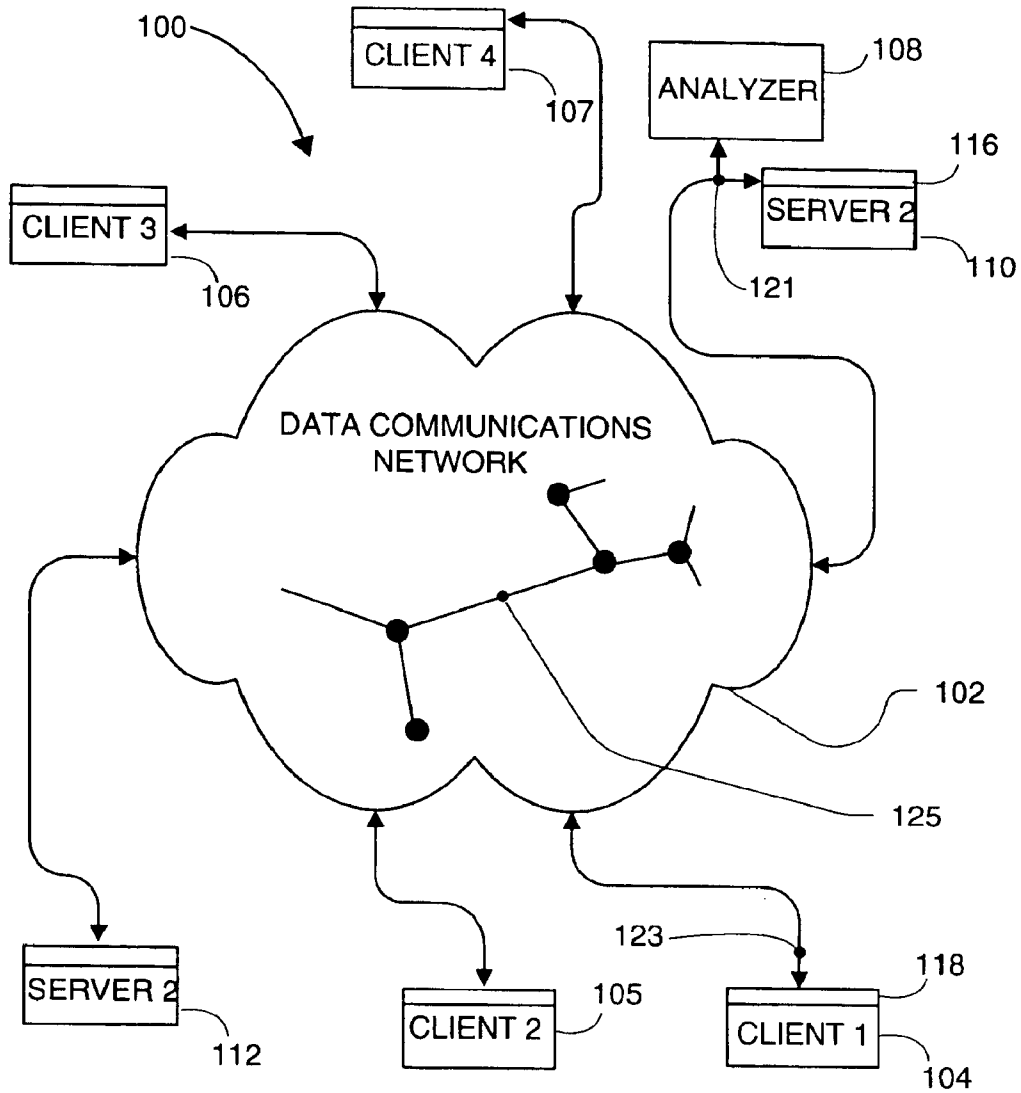


FIG. 1

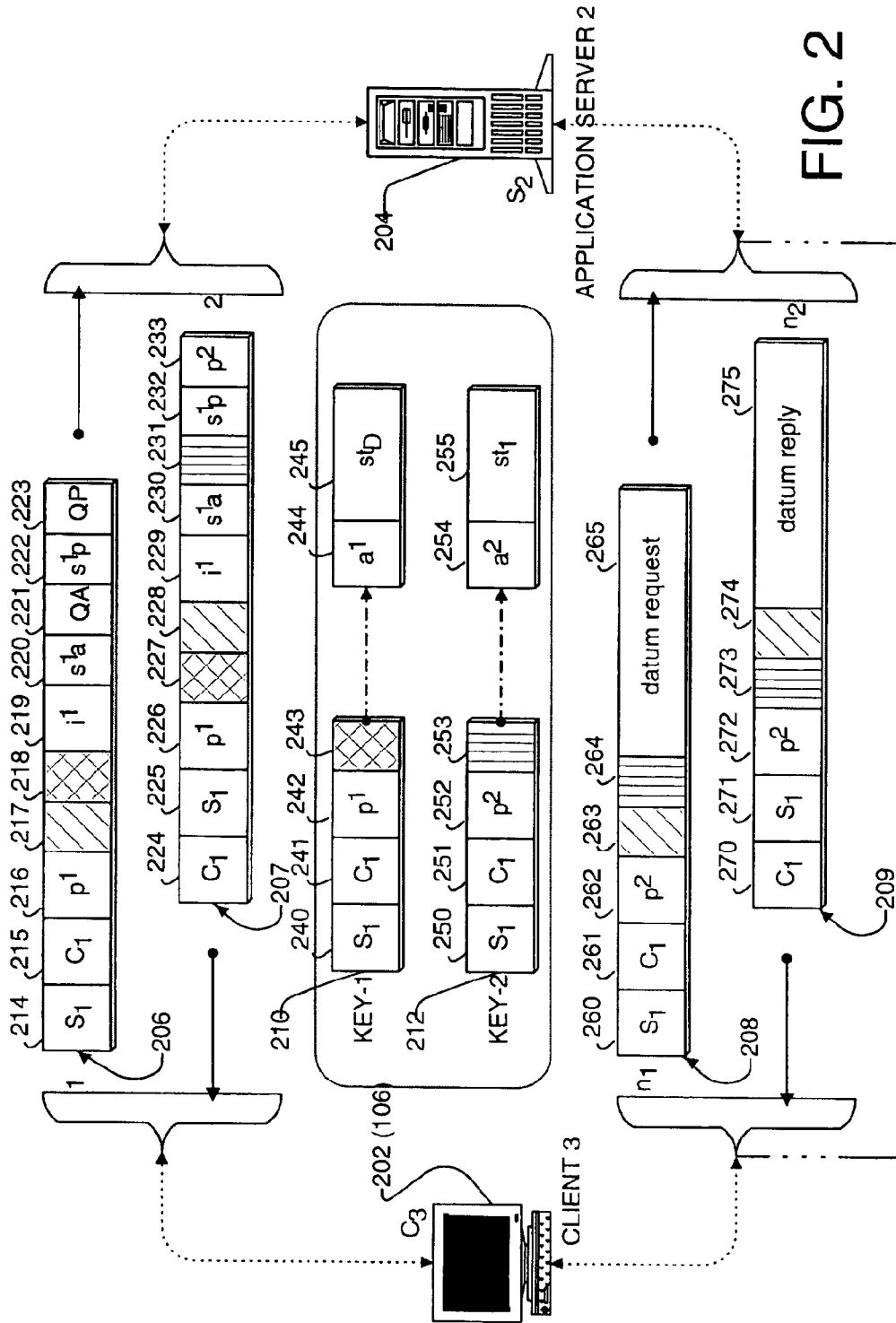


FIG. 2

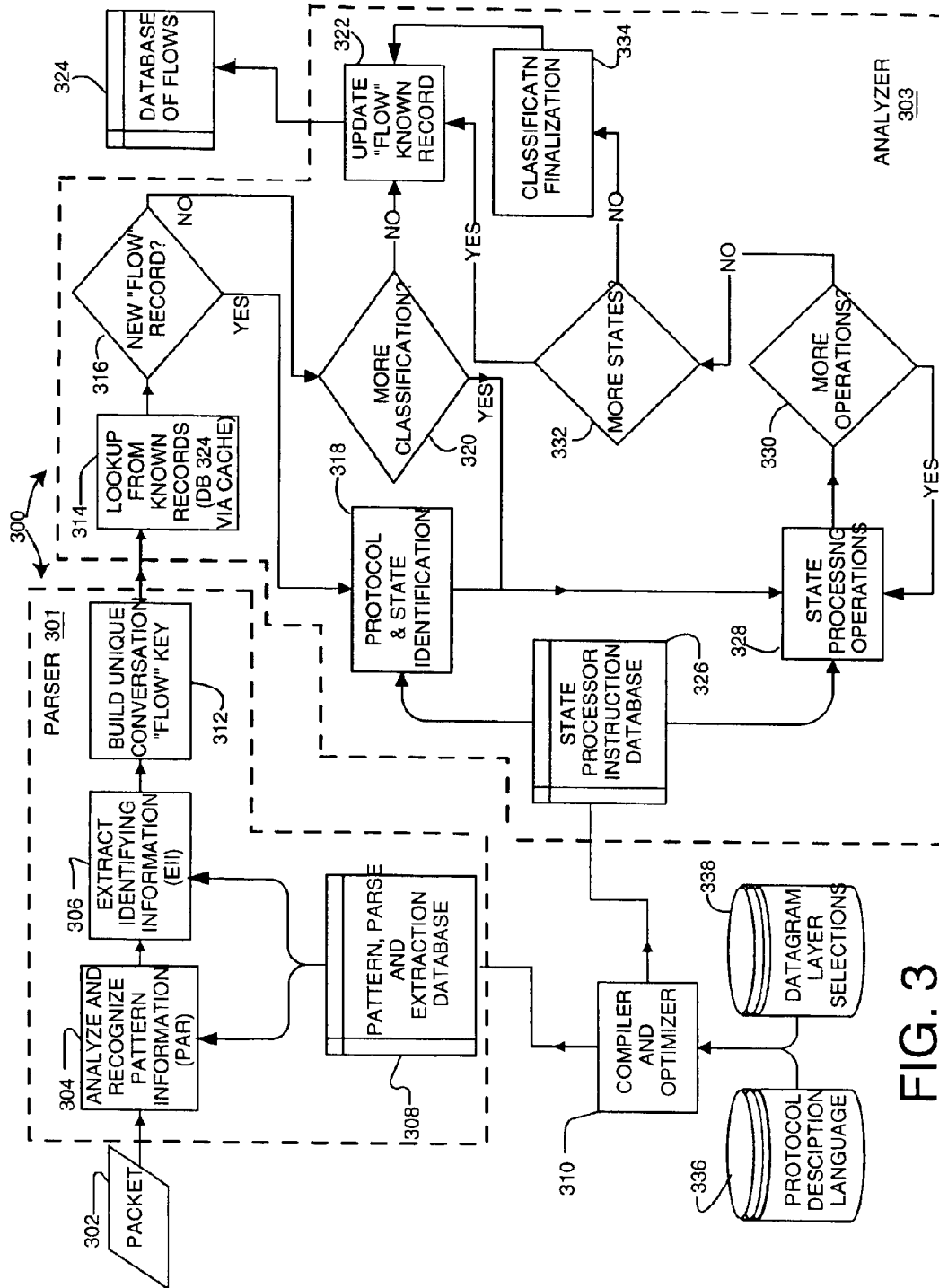


FIG. 3

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