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Sarkissian et al.

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(54) **ASSOCIATIVE CACHE STRUCTURE FOR LOOKUPS AND UPDATES OF FLOW RECORDS IN A NETWORK MONITOR**

(75) Inventors: **Haig A. Sarkissian**, San Antonio, TX (US); **Russell S. Dietz**, San Jose, CA (US)

(73) Assignee: **Hi/fn, Inc.**, Los Gatos, CA (US)

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Related U.S. Application Data

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(51) **Int. Cl.**⁷ **G01R 31/08**

(52) **U.S. Cl.** **370/392; 370/412; 370/252; 370/352; 709/223; 711/119**

(58) **Field of Search** **370/241.1, 252, 370/253, 352, 353, 355, 389, 392, 401, 395.1; 709/223, 224**

(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
- 4,736,320 A 4/1988 Bristol 364/300
- 4,891,639 A 1/1990 Nakamura 340/825.5
- 4,910,668 A * 3/1990 Okamoto et al. 711/207
- 4,972,453 A 11/1990 Daniel, III et al. 379/10
- 5,101,402 A 3/1992 Chiu et al.
- 5,247,517 A 9/1993 Ross et al. 370/85.5
- 5,247,693 A 9/1993 Bristol 395/800
- 5,315,580 A 5/1994 Phaal
- 5,339,268 A 8/1994 Machida 365/49
- 5,351,243 A 9/1994 Kalkunte et al.

- 5,365,514 A 11/1994 Hershey et al.
- 5,375,070 A 12/1994 Hershey et al. 364/550
- 5,394,394 A 2/1995 Crowther et al.
- 5,414,650 A 5/1995 Hekhuis 364/715.02
- 5,414,704 A 5/1995 Spinney
- 5,430,709 A 7/1995 Galloway

(List continued on next page.)

FOREIGN PATENT DOCUMENTS

JP 02003044510 A * 2/2003 G06F/17/30

OTHER PUBLICATIONS

R. Periakarupam 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.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.

Primary Examiner—Ricky Ngo

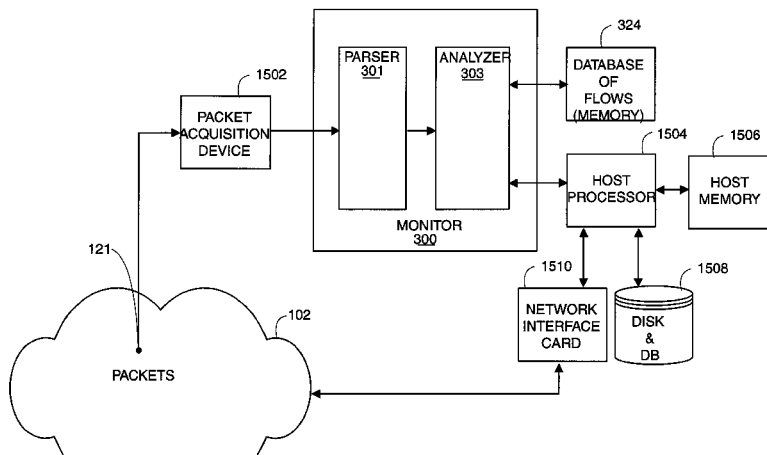
Assistant Examiner—Alan V. Nguyen

(74) *Attorney, Agent, or Firm*—Dov Rosenfeld; Inventek

(57) **ABSTRACT**

A cache system for looking up one or more elements of an external memory includes a set of cache memory elements coupled to the external memory, a set of content addressable memory cells (CAMs) containing an address and a pointer to one of the cache memory elements, and a matching circuit having an input such that the CAM asserts a match output when the input is the same as the address in the CAM cell. The cache memory element which a particular CAM points to changes over time. In the preferred implementation, the CAMs are connected in an order from top to bottom, and the bottom CAM points to the least recently used cache memory element.

20 Claims, 21 Drawing Sheets



U.S. PATENT DOCUMENTS

5,432,776 A	7/1995	Harper		5,805,808 A	9/1998	Hasani et al.	395/200.2
5,493,689 A	2/1996	Waclawsky et al.	395/821	5,812,529 A	9/1998	Czarnik et al.	370/245
5,500,855 A	3/1996	Hershey et al.		5,819,028 A	10/1998	Manghirmalani et al.	395/185.1
5,511,215 A	4/1996	Terasaka et al.	395/800	5,825,774 A	10/1998	Ready et al.	370/401
5,530,834 A	* 6/1996	Colloff et al.	711/136	5,835,726 A	11/1998	Shwed et al.	395/200.59
5,530,958 A	* 6/1996	Agarwal et al.	711/3	5,835,963 A	11/1998	Yoshioka et al.	711/207
5,535,338 A	7/1996	Krause et al.	395/200.2	5,838,919 A	11/1998	Schwaller et al.	395/200.54
5,568,471 A	10/1996	Hershey et al.		5,841,895 A	11/1998	Huffman	382/155
5,574,875 A	11/1996	Stansfield et al.	395/403	5,850,386 A	12/1998	Anderson et al.	370/241
5,586,266 A	12/1996	Hershey et al.	395/200.11	5,850,388 A	12/1998	Anderson et al.	370/252
5,606,668 A	2/1997	Shwed	395/200.11	5,860,114 A	1/1999	Sell	711/146
5,608,662 A	3/1997	Large et al.	364/724.01	5,862,335 A	1/1999	Welch, Jr. et al.	395/200.54
5,634,009 A	5/1997	Iddon et al.	395/200.11	5,878,420 A	3/1999	de la Salle	707/10
5,651,002 A	7/1997	Van Seters et al.	370/392	5,893,155 A	4/1999	Cheriton	711/144
5,684,954 A	11/1997	Kaiserswerth et al. ...	395/200.2	5,903,754 A	5/1999	Pearson	395/680
5,703,877 A	12/1997	Nuber et al.	370/395	5,917,821 A	6/1999	Gobuyan et al.	370/392
5,720,032 A	2/1998	Picazo, Jr. et al.	395/200.2	6,003,123 A	* 12/1999	Carter et al.	711/207
5,732,213 A	3/1998	Gessel et al.	395/200.11	6,014,380 A	1/2000	Hendel et al.	370/392
5,740,355 A	4/1998	Watanabe et al.	395/183.21	6,115,393 A	9/2000	Engel et al.	370/469
5,749,087 A	* 5/1998	Hoover et al.	711/108	6,279,113 B1	8/2001	Vaidya	713/201
5,761,424 A	6/1998	Adams et al.	395/200.47	6,330,226 B1	12/2001	Chapman et al.	370/232
5,764,638 A	6/1998	Ketchum	370/401	6,363,056 B1	3/2002	Beigi et al.	370/252
5,781,735 A	7/1998	Southard	395/200.54	6,424,624 B1	7/2002	Galand et al.	370/231
5,784,298 A	7/1998	Hershey et al.	364/557	6,625,657 B1	9/2003	Bullard	709/237
5,787,253 A	7/1998	McCreery et al.	395/200.61	6,651,099 B1	11/2003	Dietz et al.	709/224
5,802,054 A	9/1998	Bellenger	370/401				

* cited by examiner

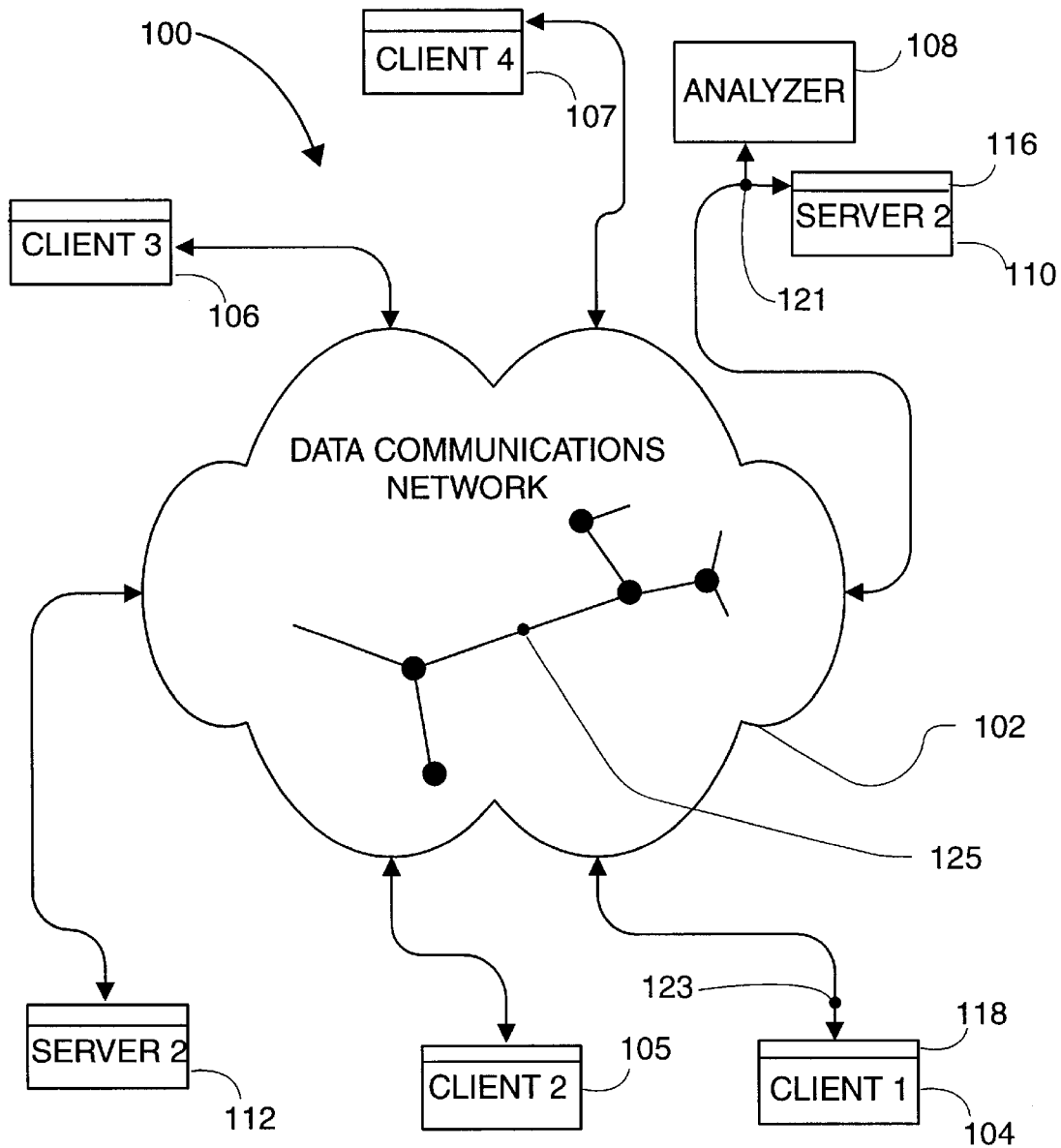


FIG. 1

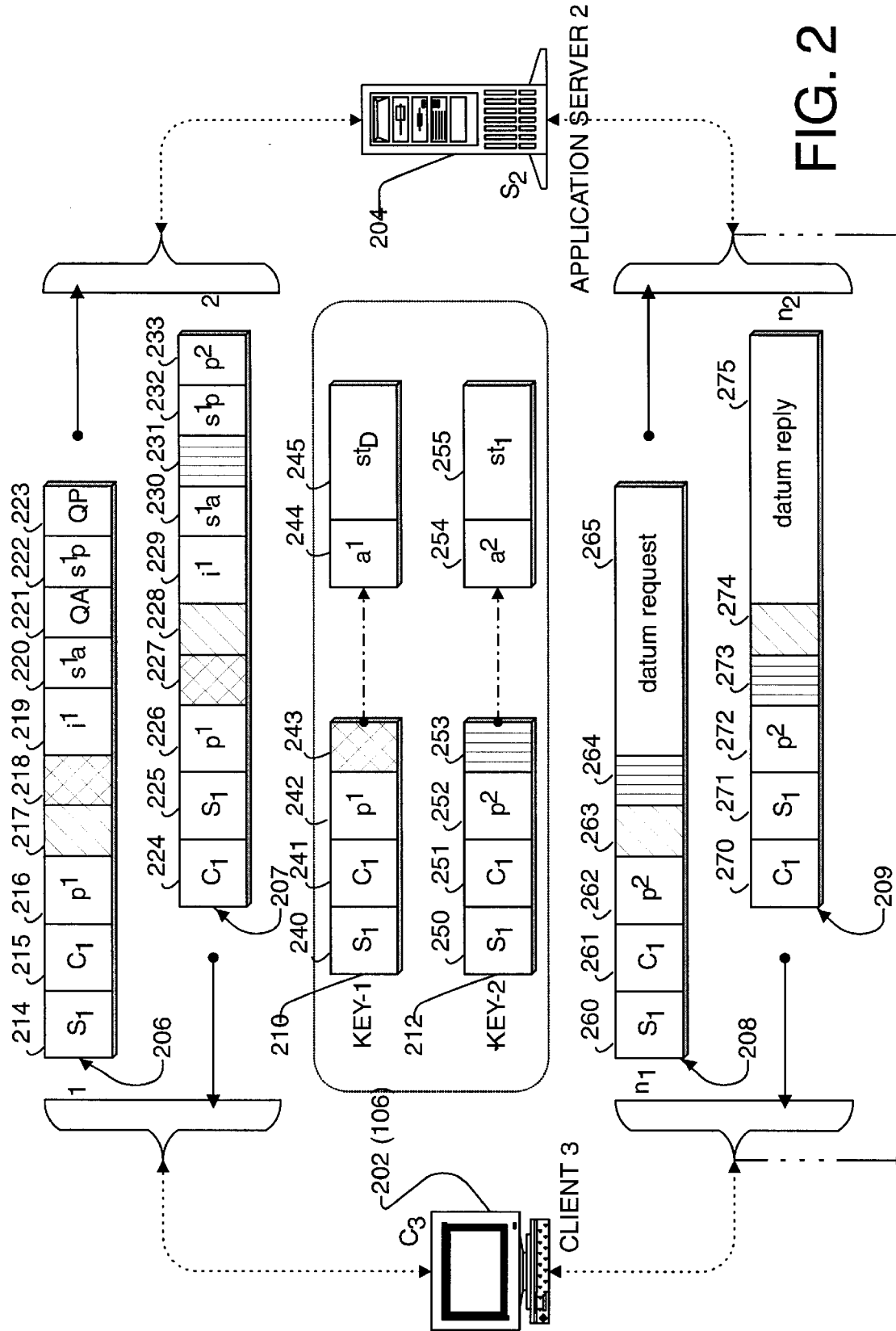


FIG. 2

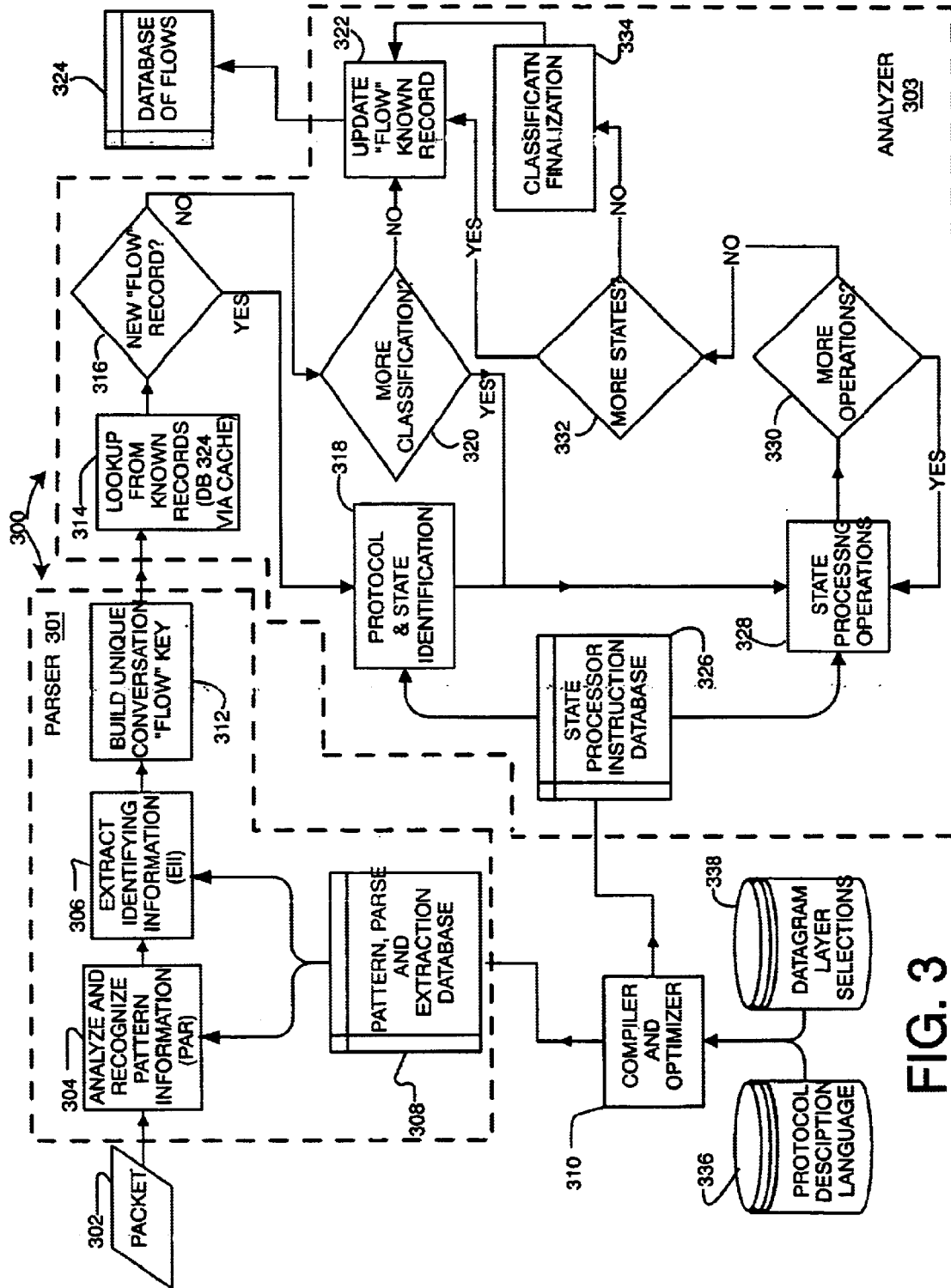


FIG. 3

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