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(54) **ESTABLISHMENT OF A SECURE COMMUNICATION LINK BASED ON A DOMAIN NAME SERVICE (DNS) REQUEST**

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G06F 15/173 (2006.01)

(52) **U.S. Cl.** **709/225**; 709/229

(58) **Field of Classification Search** 709/217–225, 709/229; 713/201

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,933,846 A 6/1990 Humphrey et al.

(Continued)

FOREIGN PATENT DOCUMENTS

DE 199 24 575 12/1999

(Continued)

OTHER PUBLICATIONS

Search Report (dated Aug. 23, 2002), International Application No. PCT/US01/13260.

(Continued)

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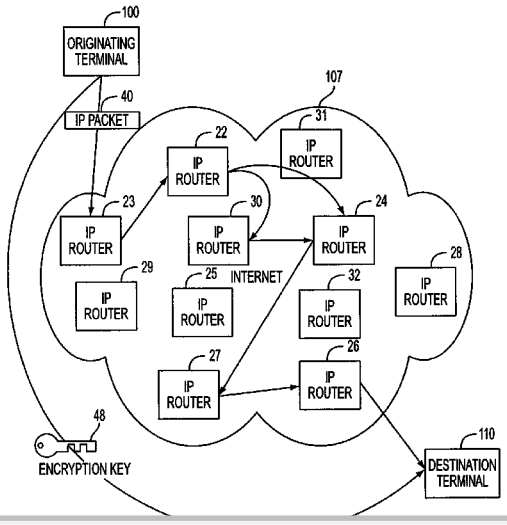
(57) **ABSTRACT**

A plurality of computer nodes communicate using seemingly random Internet Protocol source and destination addresses. Data packets matching criteria defined by a moving window of valid addresses are accepted for further processing, while those that do not meet the criteria are quickly rejected. Improvements to the basic design include (1) a load balancer that distributes packets across different transmission paths according to transmission path quality; (2) a DNS proxy server that transparently creates a virtual private network in response to a domain name inquiry; (3) a large-to-small link bandwidth management feature that prevents denial-of-service attacks at system chokepoints; (4) a traffic limiter that regulates incoming packets by limiting the rate at which a transmitter can be synchronized with a receiver; and (5) a signaling synchronizer that allows a large number of nodes to communicate with a central node by partitioning the communication function between two separate entities.

16 Claims, 35 Drawing Sheets



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U.S. PATENT DOCUMENTS

4,988,990	A		1/1991	Warrior
5,164,986	A	*	11/1992	Bright 380/273
5,276,735	A		1/1994	Boebert et al.
5,311,593	A		5/1994	Carmi
5,329,521	A		7/1994	Walsh et al.
5,341,426	A		8/1994	Barney et al.
5,367,643	A		11/1994	Chang et al.
5,559,883	A		9/1996	Williams
5,561,669	A		10/1996	Lenney et al.
5,588,060	A		12/1996	Aziz
5,625,626	A		4/1997	Umekita
5,654,695	A		8/1997	Olnowich et al.
5,682,480	A		10/1997	Nakagawa
5,689,566	A		11/1997	Nguyen
5,740,375	A		4/1998	Dunne et al.
5,774,660	A		6/1998	Brendel et al.
5,787,172	A		7/1998	Arnold
5,790,548	A	*	8/1998	Sistanizadeh et al. 370/401
5,796,942	A		8/1998	Esbensen
5,805,801	A		9/1998	Holloway et al.
5,842,040	A		11/1998	Hughes et al.
5,845,091	A		12/1998	Dunne et al.
5,867,650	A		2/1999	Osterman
5,870,610	A		2/1999	Beyda et al.
5,878,231	A		3/1999	Baehr et al.
5,892,903	A		4/1999	Klaus
5,898,830	A	*	4/1999	Wesinger et al. 726/15
5,905,859	A		5/1999	Holloway et al.
5,918,019	A		6/1999	Valencia
5,996,016	A		11/1999	Thalheimer et al.
6,006,259	A		12/1999	Adelman et al.
6,006,272	A		12/1999	Aravamudan et al.
6,016,318	A		1/2000	Tomoike
6,016,512	A		1/2000	Huitema
6,041,342	A		3/2000	Yamaguchi
6,052,788	A		4/2000	Wesinger, Jr. et al.
6,055,574	A		4/2000	Smorodinsky et al.
6,061,736	A		5/2000	Rochberger et al.
6,079,020	A	*	6/2000	Liu 713/201
6,092,200	A		7/2000	Muniyappa et al.
6,101,182	A	*	8/2000	Sistanizadeh et al. 370/352
6,119,171	A		9/2000	Alkhatib
6,119,234	A	*	9/2000	Aziz et al. 713/201
6,147,976	A		11/2000	Shand et al.
6,157,957	A		12/2000	Berthaud
6,158,011	A		12/2000	Chen et al.
6,168,409	B1		1/2001	Fare
6,175,867	B1		1/2001	Taghadoss
6,178,409	B1		1/2001	Weber et al.
6,178,505	B1		1/2001	Schneider et al.
6,179,102	B1		1/2001	Weber et al.
6,222,842	B1		4/2001	Sasyan et al.
6,226,751	B1		5/2001	Arrow et al.
6,233,618	B1		5/2001	Shannon
6,243,360	B1		6/2001	Basilico
6,243,749	B1		6/2001	Sitaraman et al.
6,243,754	B1		6/2001	Guerin et al.
6,256,671	B1	*	7/2001	Strentzsch et al. 709/227
6,263,445	B1		7/2001	Blumenau
6,286,047	B1		9/2001	Ramanathan et al.
6,301,223	B1		10/2001	Hrastar et al.
6,308,274	B1		10/2001	Swift
6,311,207	B1		10/2001	Mighdoll et al.
6,324,161	B1		11/2001	Kirch
6,330,562	B1		12/2001	Boden et al.
6,332,158	B1	*	12/2001	Risley et al. 709/219
6,353,614	B1		3/2002	Borella et al.
6,425,003	B1	*	7/2002	Herzog et al. 709/223
6,430,155	B1		8/2002	Davie et al.
6,502,135	B1	*	12/2002	Munger et al. 709/225
6,505,232	B1		1/2003	Mighdoll et al.
6,510,154	B1		1/2003	Mayes et al.
6,549,516	B1		4/2003	Albert et al.
6,557,037	B1		4/2003	Provino
6,571,296	B1		5/2003	Dillon
6,571,338	B1		5/2003	Shaio et al.
6,581,166	B1		6/2003	Hirst et al.
6,606,708	B1	*	8/2003	Devine et al. 713/201
6,618,761	B2		9/2003	Munger et al.
6,671,702	B2		12/2003	Kruglikov et al.
6,687,551	B2		2/2004	Steindl
6,714,970	B1		3/2004	Fiveash et al.
6,717,949	B1		4/2004	Boden et al.
6,751,738	B2	*	6/2004	Wesinger et al. 713/201
6,760,766	B1		7/2004	Sahlqvist
6,826,616	B2		11/2004	Larson et al.
6,839,759	B2		1/2005	Larson et al.
7,010,604	B1		3/2006	Munger et al.
7,133,930	B2		11/2006	Munger et al.
7,188,180	B2		3/2007	Larson et al.
7,197,563	B2		3/2007	Sheymov et al.
2002/0004898	A1		1/2002	Droge
2003/0196122	A1	*	10/2003	Wesinger et al. 713/201
2005/0055306	A1		3/2005	Miller et al.
2006/0059337	A1	*	3/2006	Poyhonen et al. 713/165

FOREIGN PATENT DOCUMENTS

EP	0 814 589		12/1997
EP	0 814 589	A	12/1997
EP	0 838 930		4/1998
EP	0 838 930	A	4/1998
EP	836306	A1	4/1998
EP	0 858 189		8/1998
GB	2 317 792		4/1998
GB	2 317 792	A	4/1998
GB	2 334 181	A	8/1999
GB	2334181	A	8/1999
WO	9827783	A	6/1998
WO	WO 98/27783		6/1998
WO	WO 9827783	A	6/1998
WO	WO 98 55930		12/1998
WO	WO 98 59470		12/1998
WO	WO 99 38081		7/1999
WO	WO 99 48303		9/1999
WO	WO 00/17775		3/2000
WO	WO 00/70458		11/2000
WO	WO 01 50688		7/2001

OTHER PUBLICATIONS

Donald E. Eastlake, 3rd, "Domain Name System Security Extensions", Internet Draft, Apr. 1998, pp. 1-51.

D. B. Chapman et al., "Building Internet Firewalls", Nov. 1995, pp. 278-375.

P. Srisuresh et al., "DNA extensions to Network address Translators (DNS_ALG)", Internet Draft, Jul. 1998, pp. 1-27.

James E. Bellaire, "New Statement of Rules—Naming Internet Domains", Internet Newsgroup, Jul. 30, 1995, 1 page.

D. Clark, "US Calls for Private Domain-Name System", Computer Society, Aug. 1, 1998, pp. 22-25.

August Bequai, "Balancing Legal Concerns Over Crime and Security in Cyberspace", Computer & Security, vol. 17, No. 4, 1998, pp. 293-298.

Rich Winkel, "CAQ: Networking With Spooks: The NET & The Control Of Information", Internet Newsgroup, Jun. 21, 1997, 4 pages.

Search Report (dated Jun. 18, 2002), International Application No. PCT/US01/13260.

Search Report (dated Jun. 28, 2002), International Application No. PCT/US01/13261.

DOCKET ALARM
Find authenticated court documents without watermarks at docketalarm.com.

D. B. Chapman et al., "Building Internet Firewalls", Nov. 1995, pp. 278-297 and pp. 351-375.
P. Srisuresh et al., "DNS extensions to Network Address Translators", Jul. 1998, 27 pages.
Laurie Wells, "Security Icon", Oct. 19, 1998, 1 page.
W. Stallings, "Cryptography And Network Security", 2nd Edition, Chapter 13, IP Security, Jun. 8, 1998, pp. 399-440.
W. Stallings, "New Cryptography and Network Security Book", Jun. 8, 1998, 3 pages.
Search Report (dated Aug. 20, 2002), International Application No. PCT/US01/04340.
Shree Murthy et al., "Congestion-Oriented Shortest Multipath Routing", Proceedings of IEEE Infocom, 1996, pp. 1028-1036.
Jim Jones et al., "Distributed Denial of Service Attacks: Defenses", Global Integrity Corporation, 2000, pp. 1-14.
Fasbender, Kesdogan, and Kubitz: "Variable and Scalable Security: Protection of Location Information in Mobile IP", IEEE publication, 1996, pp. 963-967.
Laurie Wells (Lancasterbibelmail MSN COM); "Subject: Security Icon" Usenet Newsgroup, Oct. 19, 1998, XP002200606.
Davila J et al, "Implementation of Virtual Private Networks at the Transport Layer", Information Security, Second International Workshop, ISW '99. Proceedings (Lecture Springer-Verlag Berlin, Germany, [Online] 1999, pp. 85-102, XP002399276, ISBN 3-540-66695-B, retrieved from the Internet: URL: http://www.springerlink.com/content/4uac0tb0heccma89/fulltext.pdf> (Abstract).
Alan 0. Frier et al., "The SSL Protocol Version 3.0", Nov. 18, 1996, printed from http://www.netscape.com/eng/ssl13/ draft302.txt on Feb. 4, 2002, 56 pages.
Davila J et al, "Implementation of Virtual Private Networks at the Transport Layer", Information Security, Second International Workshop, ISW'99. Proceedings (Lecture Springer-Verlag Berlin, Germany, [Online] 1999, pp. 85-102, XP002399276, ISBN 3-540-66695-B, retrieved from the Internet: URL: http://www. springerlink.com/content/4uac0tb0hecoma89/fulltext.pdf>.
Dolev, Shlomi and Ostrovsky, Rafil, Efficient Anonymous Multicast and Reception (Extended Abstract), 16 pages.
F. Halsall, "Data Communications, Computer Networks and Open Systems", Chapter 4, Protocol Basics, 1996, pp. 198-203.
Glossary for the Linux FreeS/WAN project, printed from http://liberty.freeswan.org/freeswan_trees/freeswan-1.3/ doc/glossary.html on Feb. 21, 2002, 25 pages.
J. Gilmore, "Swan: Securing the Internet against Wiretapping", printed from http://liberty.freeswan.org/freeswan_trees/freeswan-1.3.doc/rationale.html on Feb. 21, 2002, 4 pages.
Linux FreeS/WAN Index File, printed from http://liberty.freewan.org/freeswan trees/freeswan-1.3/doc/ on Feb. 21, 2002, 3 pages.
Reiter, Michael K. and Rubin, Aviel D. (AT&T Labs—Research), Crowds: Anonymity for Web Transactions, pp. 1-23.
RFC 2401-Security Architecture for the Internet Protocol (RTP).
RFC 2543-SIP: Session Initiation Protocol (SIP or SIPS).
Rubin, Aviel D., Geer, Daniel, and Ranum, Marcus J. (Wiley Computer Publishing), "Web Security Sourcebook", pp. 82-94.
Search Report, IPER (dataed Nov. 13, 2002), International Application No. PCT/US01/04340.
Search Report, IPER (dated Feb. 6, 2002), International Application No. PCT/US01/13261.
Search Report, IPER (dated Jan. 14, 2003), International Application No. PCT/US01/13260.
Shankar, A.U. "A verified sliding window protocol with variable flow control". Proceedings of ACM SIGCOMM conference on Communications architectures & protocols. pp. 84-91, ACM Press, NY,NY 1986.

* cited by examiner

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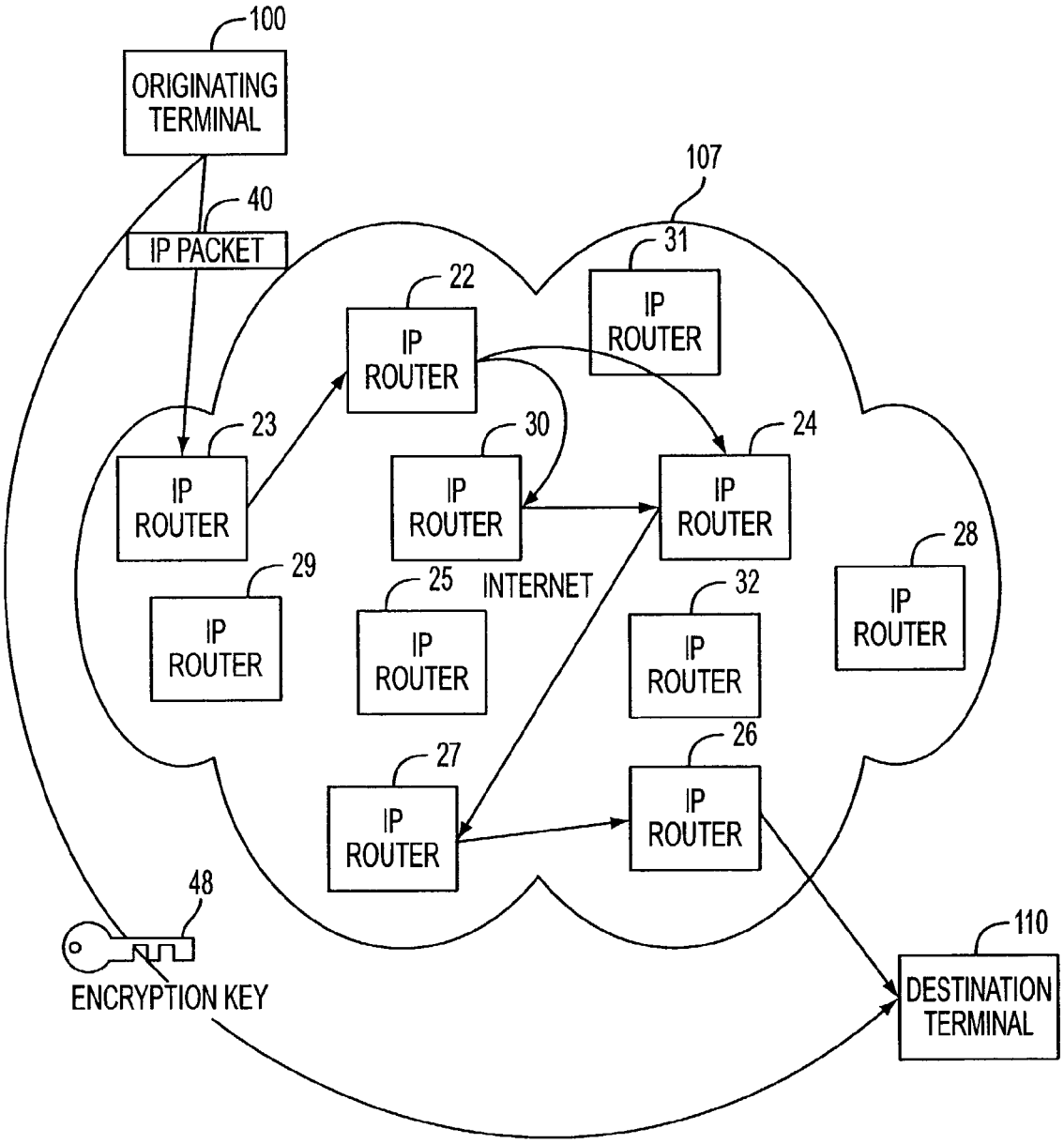

FIG. 1

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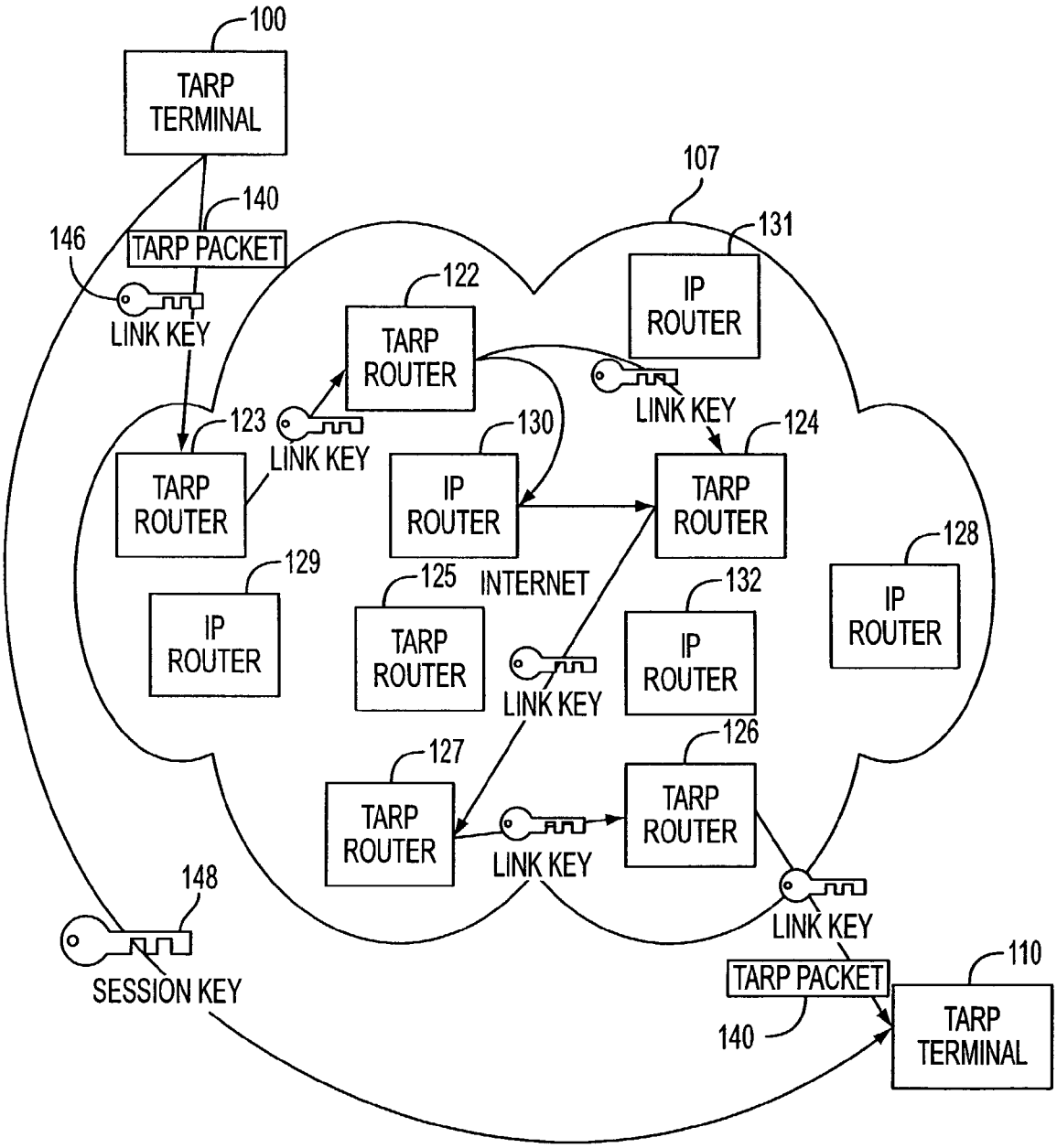

FIG. 2

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