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(54) **ON-DEMAND OVERLAY ROUTING FOR COMPUTER-BASED COMMUNICATION NETWORKS**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

4,112,488 A 9/1978 Smith, III 364/200
4,345,116 A 8/1982 Ash et al. 179/18 EA

4,495,570 A 1/1985 Kitajima et al.
4,591,983 A 5/1986 Bennett et al.
4,594,704 A 6/1986 Ollivier
4,669,113 A 5/1987 Ash et al. 379/221
4,679,189 A * 7/1987 Olson et al. 370/396
4,726,017 A 2/1988 Krum et al.
4,788,721 A 11/1988 Krishnan et al. 379/221
4,803,641 A 2/1989 Hardy et al.
4,839,798 A 6/1989 Eguchi et al.
4,839,892 A 6/1989 Sasaki 370/95
4,847,784 A 7/1989 Clancey

(Continued)

FOREIGN PATENT DOCUMENTS

AU 763380 11/2003

(Continued)

OTHER PUBLICATIONS

A. Chankhunthod et al., "A Hierarchical Internet Object Cache", Journal, 1993.

(Continued)

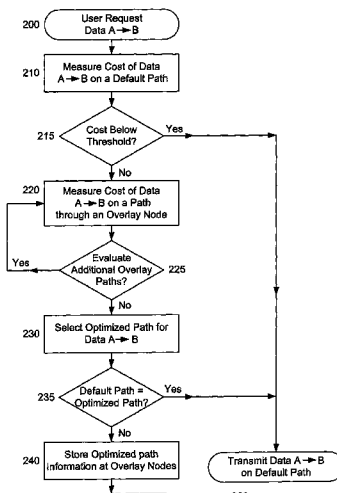
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(57) **ABSTRACT**

Methods and apparatus are disclosed for dynamically discovering and utilizing an optimized network path through overlay routing for the transmission of data. A determination whether to use a default network path or to instead use an alternate data forwarding path through one or more overlay nodes is based on real-time measurement of costs associated with the alternative paths, in response to a user request for transmission of message data to a destination on the network. Cost metrics include delay, throughput, jitter, loss, and security. The system chooses the best path among the default forwarding path and the multiple alternate forwarding paths, and implements appropriate control actions to force data transmission along the chosen path. No modification of established network communication protocols is required.

20 Claims, 5 Drawing Sheets



U.S. PATENT DOCUMENTS					
4,905,233	A	2/1990	Cain et al.	370/94.1	5,659,729 A 8/1997 Nielsen
4,920,432	A	4/1990	Eggers		5,666,362 A 9/1997 Chen
4,922,417	A	5/1990	Churm et al.		5,671,279 A 9/1997 Elgamai
4,943,932	A	7/1990	Lark et al.		5,675,734 A 10/1997 Hair
4,949,187	A	8/1990	Cohen		5,682,512 A 10/1997 Tetrick
4,949,248	A	8/1990	Caro		5,699,347 A 12/1997 Callon
4,985,830	A	1/1991	Atac et al.	364/200	5,699,513 A 12/1997 Feigen et al.
4,987,536	A	1/1991	Humblet	364/200	5,712,979 A 1/1998 Graber et al.
5,029,232	A	7/1991	Nall		5,715,453 A 2/1998 Stewart
5,048,011	A	9/1991	Melen		5,721,914 A 2/1998 DeVries
5,058,105	A	10/1991	Mansour et al.	370/16	5,721,916 A 2/1998 Pardikar
5,088,032	A	2/1992	Bosack	395/200	5,734,831 A 3/1998 Sanders
5,115,495	A	5/1992	Tsuchiya et al.	395/200	5,740,423 A 4/1998 Logan et al.
5,128,926	A	7/1992	Perlman et al.	370/54	5,742,762 A 4/1998 Scholl
5,130,792	A	7/1992	Tindell et al.		5,751,961 A 5/1998 Smyk
5,132,992	A	7/1992	Yurt et al.		5,754,790 A 5/1998 France et al.
5,136,716	A	8/1992	Harvey		5,761,507 A 6/1998 Govett
5,172,413	A	12/1992	Bradley		5,761,663 A 6/1998 Lagarde et al.
5,191,573	A	3/1993	Hair		5,764,906 A 6/1998 Edelman et al.
5,218,676	A	6/1993	Ben-Ayed et al.	395/200	5,774,526 A 6/1998 Propp et al.
5,233,604	A *	8/1993	Ahmadi et al.	370/238	5,774,660 A 6/1998 Brendel et al.
5,253,248	A	10/1993	Dravida et al.	370/16	5,774,668 A 6/1998 Choquier et al.
5,253,275	A	10/1993	Yurt et al.		5,777,989 A 7/1998 McGarvey
5,253,341	A	10/1993	Rozmanith		5,784,058 A 7/1998 LaStrange et al.
5,287,499	A	2/1994	Nemes		5,787,271 A 7/1998 Box et al.
5,287,537	A	2/1994	Newmark et al.		5,787,470 A 7/1998 DeSimone et al.
5,291,554	A	3/1994	Morales		5,790,541 A 8/1998 Patrick et al.
5,321,815	A	6/1994	Bartolanzo, Jr. et al.	395/200	5,796,952 A 8/1998 Davis
5,341,477	A	8/1994	Pitkin et al.		5,799,141 A 8/1998 Galipeau et al.
5,371,532	A	12/1994	Gelman		5,802,106 A 9/1998 Packer
5,377,262	A	12/1994	Bales et al.	379/220	5,802,291 A 9/1998 Balick et al.
5,410,343	A	4/1995	Coddington		5,802,503 A 9/1998 Sansone
5,414,455	A	5/1995	Hooper		5,812,769 A 9/1998 Graber et al.
5,430,729	A	7/1995	Rahnema	270/94.1	5,815,664 A 9/1998 Asano
5,442,389	A	8/1995	Blahut		5,819,092 A 10/1998 Ferguson
5,442,390	A	8/1995	Hooper		5,826,031 A 10/1998 Nielsen
5,442,749	A	8/1995	Northcutt		5,828,847 A 10/1998 Gehr
5,452,294	A	9/1995	Natarajan	370/54	5,832,506 A 11/1998 Kuzma
5,457,680	A *	10/1995	Kamm et al.	370/332	5,832,514 A 11/1998 Norin et al.
5,471,467	A	11/1995	Johann	370/60	5,835,718 A 11/1998 Blewett
5,471,622	A	11/1995	Eadline		5,838,906 A 11/1998 Doyle et al.
5,475,615	A	12/1995	Lin		5,845,303 A 12/1998 Templeman
5,491,690	A	2/1996	Alfonsi et al.	370/60	5,854,899 A * 12/1998 Callon et al.
5,508,732	A	4/1996	Bottomley		5,856,974 A 1/1999 Gervais et al.
5,515,511	A	5/1996	Nguyen		5,862,339 A 1/1999 Bonnaure
5,519,435	A	5/1996	Anderson		5,867,706 A 2/1999 Martin et al.
5,519,836	A	5/1996	Gawlick et al.	395/200	5,867,799 A 2/1999 Lang et al.
5,526,414	A	6/1996	Bédard et al.	379/221	5,870,546 A 2/1999 Kirsch
5,528,281	A	6/1996	Grady		5,870,559 A 2/1999 Leshem et al.
5,532,939	A	7/1996	Psinakis et al.	364/514	5,878,212 A 3/1999 Civanlar et al.
5,539,621	A	7/1996	Kikinis		5,884,038 A 3/1999 Kapoor
5,542,087	A	7/1996	Neimat et al.		5,890,171 A 3/1999 Blumer et al.
5,544,313	A	8/1996	Shachnai		5,893,116 A 4/1999 Simmonds et al.
5,544,327	A	8/1996	Dan		5,894,554 A 4/1999 Lowery et al.
5,550,577	A	8/1996	Verbiest		5,896,533 A 4/1999 Ramos et al.
5,550,863	A	8/1996	Yurt		5,898,668 A 4/1999 Shaffer
5,550,982	A	8/1996	Long		5,903,723 A 5/1999 Beck et al.
5,557,317	A	9/1996	Nishio		5,907,704 A 5/1999 Gudmundson et al.
5,559,877	A	9/1996	Ash et al.	379/221	5,913,028 A 6/1999 Wang et al.
5,572,643	A	11/1996	Judson		5,913,033 A 6/1999 Grout
5,590,288	A	12/1996	Castor		5,918,010 A 6/1999 Appleman et al.
5,592,611	A	1/1997	Midgely		5,918,021 A 6/1999 Aditya
5,594,910	A	1/1997	Filepp et al.		5,919,247 A 7/1999 Van Hoff et al.
5,596,722	A	1/1997	Rahnema	395/200.15	5,920,701 A 7/1999 Miller et al.
5,603,026	A	2/1997	Demers et al.		5,922,049 A 7/1999 Radia et al.
5,608,721	A	3/1997	Natarajan et al.	370/238	5,931,904 A 8/1999 Banga
5,619,648	A	4/1997	Canale		5,933,832 A 8/1999 Suzuoka et al.
5,623,656	A	4/1997	Lyons		5,935,207 A 8/1999 Logue et al.
5,625,781	A	4/1997	Cline		5,944,780 A 8/1999 Chase
5,627,829	A	5/1997	Gleeson et al.		5,945,989 A 8/1999 Freishtat et al.
5,630,067	A	5/1997	Kindell		5,956,489 A 9/1999 San Andres et al.
5,633,999	A	5/1997	Clowes		5,956,716 A 9/1999 Kenner
5,634,006	A	5/1997	Baugher et al.		5,958,008 A 9/1999 Pogrebisky et al.
5,638,443	A	6/1997	Stefik et al.		5,961,596 A 10/1999 Takubo et al.
5,644,714	A	7/1997	Kikinis		5,966,440 A 10/1999 Hair
5,646,676	A	7/1997	Dewkett et al.		5,968,121 A 10/1999 Logan et al.
					5,978,791 A 11/1999 Farber et al.

5,987,606	A	11/1999	Cirasole et al.	6,256,675	B1	7/2001	Rabinovich	
5,991,809	A	11/1999	Kriegsman	6,263,313	B1	7/2001	Milsted	
5,996,025	A	11/1999	Day	6,266,699	B1	7/2001	Sevcik	
6,002,720	A	12/1999	Yurt et al.	6,269,394	B1	7/2001	Kenner et al.	
6,003,030	A	12/1999	Kenner et al.	6,272,566	B1	8/2001	Craft	
6,006,264	A	12/1999	Colby et al.	6,275,470	B1	8/2001	Ricciulli	
6,012,090	A	1/2000	Chung et al.	6,282,569	B1	8/2001	Wallis et al.	
6,014,686	A	1/2000	Elnozahy et al.	6,282,574	B1	8/2001	Voit	
6,014,698	A	1/2000	Griffiths	6,286,045	B1	9/2001	Griffiths et al.	
6,016,307	A	1/2000	Kaplan et al.	6,298,041	B1	10/2001	Packer	370/238
6,018,516	A	1/2000	Packer	6,310,858	B1*	10/2001	Kano et al.	370/235
6,021,426	A	2/2000	Douglis	6,311,214	B1	10/2001	Rhoads	
6,026,440	A	2/2000	Sharder et al.	6,314,565	B1	11/2001	Kenner et al.	
6,029,175	A	2/2000	Chow et al.	6,330,602	B1	12/2001	Law et al.	
6,029,176	A	2/2000	Cannon	6,332,195	B1	12/2001	Green et al.	
6,035,332	A	3/2000	Ingrassia, Jr. et al.	6,338,044	B1	1/2002	Cook et al.	
6,038,216	A	3/2000	Packer	6,347,085	B2	2/2002	Kelly	
6,038,310	A	3/2000	Hollywood et al.	6,360,256	B1	3/2002	Lim	
6,038,610	A	3/2000	Belfiore et al.	6,363,053	B1	3/2002	Schuster et al.	
6,041,324	A	3/2000	Earl et al.	6,370,571	B1	4/2002	Medin, Jr.	
6,044,405	A	3/2000	Driscoll, III et al.	6,370,580	B2	4/2002	Kriegsman	
6,046,980	A	4/2000	Packer	6,398,245	B1	6/2002	Gruse	
6,049,831	A	4/2000	Gardell et al.	6,400,681	B1	6/2002	Bertin et al.	
6,052,718	A	4/2000	Gifford	6,405,252	B1	6/2002	Gupta et al.	
6,052,730	A	4/2000	Feliciano et al.	6,405,257	B1	6/2002	Gersht et al.	
6,065,051	A	5/2000	Steele et al.	6,412,000	B1	6/2002	Riddle et al.	
6,065,062	A	5/2000	Periasamy et al.	6,415,280	B1	7/2002	Farber et al.	
6,070,191	A	5/2000	Narendran et al.	6,418,421	B1	7/2002	Hurtado	
6,078,943	A	6/2000	Yu	6,421,726	B1	7/2002	Kenner et al.	
6,081,829	A	6/2000	Sidana	6,430,618	B1	8/2002	Karger et al.	
6,081,835	A	6/2000	Antcliff	6,442,549	B1	8/2002	Schneider	
6,084,858	A*	7/2000	Matthews et al.	6,449,259	B1	9/2002	Allain et al.	370/238
6,092,112	A	7/2000	Fukushige	6,452,922	B1	9/2002	Ho	
6,092,204	A	7/2000	Baker	6,456,630	B1	9/2002	Packer et al.	
6,098,078	A	8/2000	Gehani	6,460,082	B1	10/2002	Lumelsky	
6,105,028	A	8/2000	Sullivan et al.	6,460,085	B1	10/2002	Toporek et al.	
6,108,673	A	8/2000	Brandt et al.	6,463,454	B1	10/2002	Lumelsky	
6,108,703	A	8/2000	Leighton et al.	6,463,508	B1	10/2002	Wolf	
6,112,231	A	8/2000	DeSimone et al.	6,470,389	B1	10/2002	Chung et al.	
6,112,239	A	8/2000	Kenner et al.	6,473,405	B2	10/2002	Ricciulli	
6,112,240	A	8/2000	Pogue et al.	6,480,893	B2	11/2002	Kriegsman	
6,115,357	A	9/2000	Packer et al.	6,484,143	B1	11/2002	Swildens et al.	
6,115,752	A	9/2000	Chauhan	6,484,204	B1	11/2002	Rabinovich	
6,119,143	A	9/2000	Dias et al.	6,490,580	B1	12/2002	Dey et al.	
6,125,388	A	9/2000	Reisman	6,493,707	B1	12/2002	Dey et al.	
6,125,394	A	9/2000	Rabinovich	6,496,477	B1	12/2002	Perkins et al.	
6,128,279	A	10/2000	O'Neil et al.	6,496,856	B1	12/2002	Kenner et al.	
6,128,601	A	10/2000	Van Horne et al.	6,502,125	B1	12/2002	Kenner et al.	
6,128,660	A	10/2000	Grimm et al.	6,502,135	B1	12/2002	Munger et al.	
6,130,890	A	10/2000	Leinwand et al.	6,502,215	B2	12/2002	Raad et al.	
6,134,583	A	10/2000	Herriot	6,505,248	B1	1/2003	Casper et al.	
6,137,792	A*	10/2000	Jonas et al.	6,507,577	B1	1/2003	Mauger et al.	370/354
6,144,375	A	11/2000	Jain et al.	6,512,761	B1	1/2003	Schuster et al.	
6,144,702	A	11/2000	Yurt et al.	6,529,477	B1	3/2003	Toporek et al.	
6,144,996	A	11/2000	Starnes et al.	6,529,499	B1	3/2003	Doshi et al.	
6,151,624	A	11/2000	Teare et al.	6,542,469	B1*	4/2003	Kelley et al.	370/238
6,154,738	A	11/2000	Call	6,553,413	B1	4/2003	Leighton et al.	
6,154,744	A	11/2000	Kenner et al.	6,553,420	B1	4/2003	Karger et al.	
6,154,753	A	11/2000	McFarland	6,557,054	B2	4/2003	Reisman	
6,154,777	A	11/2000	Ebrahim	6,564,251	B2	5/2003	Katariya et al.	
6,163,779	A	12/2000	Mantha et al.	6,577,595	B1	6/2003	Counterman	
6,167,427	A	12/2000	Rabinovich et al.	6,577,600	B1	6/2003	Bare	370/238
6,173,311	B1	1/2001	Hassett et al.	6,581,090	B1	6/2003	Lindbo et al.	
6,173,322	B1	1/2001	Hu	6,584,083	B1	6/2003	Toporek et al.	
6,178,160	B1	1/2001	Bolton et al.	6,587,837	B1	7/2003	Spagna	
6,181,867	B1	1/2001	Kenner et al.	6,591,299	B2	7/2003	Riddle et al.	
6,185,598	B1	2/2001	Farber et al.	6,611,812	B2	8/2003	Hurtado et al.	709/200
6,185,619	B1	2/2001	Joffe et al.	6,611,862	B2	8/2003	Reisman	
6,189,030	B1	2/2001	Kirsch et al.	6,611,872	B1*	8/2003	McCanne	709/238
6,189,039	B1	2/2001	Harvey	6,614,781	B1	9/2003	Elliott et al.	
6,195,680	B1	2/2001	Goldszmidt	6,625,643	B1	9/2003	Colby et al.	
6,205,120	B1	3/2001	Packer et al.	6,654,344	B1	11/2003	Toporek et al.	
6,226,618	B1	5/2001	Downs	6,654,807	B2	11/2003	Farber et al.	
6,226,642	B1	5/2001	Beranek et al.	6,658,464	B2	12/2003	Reisman	
6,230,196	B1	5/2001	Guenthner et al.	6,658,479	B1*	12/2003	Zaumen et al.	709/238
6,236,642	B1*	5/2001	Shaffer et al.	6,665,706	B2	12/2003	Kenner et al.	370/237
6,243,752	B1	6/2001	Butt	6,665,726	B1	12/2003	Leighton et al.	

6,694,358	B1	2/2004	Swildens et al.	2002/0083124	A1	6/2002	Knox et al.
6,697,333	B1 *	2/2004	Bawa et al. 370/238	2002/0099850	A1	7/2002	Farber et al.
6,699,418	B2	3/2004	Okada et al.	2002/0124080	A1	9/2002	Leighton et al.
6,708,137	B2	3/2004	Carley	2002/0129134	A1	9/2002	Leighton et al.
6,718,328	B1	4/2004	Norris	2002/0131645	A1	9/2002	Hamilton
6,741,563	B2	5/2004	Packer	2002/0143798	A1	10/2002	Lisiecki et al.
6,744,767	B1	6/2004	Chiu et al.	2002/0143888	A1	10/2002	Lisiecki et al.
6,751,673	B2	6/2004	Shaw	2002/0147774	A1	10/2002	Lisiecki et al.
6,754,219	B1 *	6/2004	Cain et al. 370/401	2002/0147842	A1 *	10/2002	Breitbart et al. 709/241
6,754,699	B2	6/2004	Swildens et al.	2002/0163882	A1	11/2002	Bornstein et al.
6,754,706	B1	6/2004	Swildens et al.	2002/0163889	A1 *	11/2002	Yemini et al. 370/238
6,763,377	B1	7/2004	Belknap et al.	2002/0199016	A1	12/2002	Freedman
6,763,388	B1	7/2004	Tsimelzon	2003/0009444	A1	1/2003	Eidler et al.
6,778,494	B1	8/2004	Mauger	2003/0018966	A1	1/2003	Cook et al.
6,778,502	B2	8/2004	Ricciulli	2003/0028623	A1	2/2003	Hennessey et al.
6,799,221	B1	9/2004	Kenner et al.	2003/0028626	A1	2/2003	Hennessey et al.
6,801,576	B1	10/2004	Haldeman et al.	2003/0028777	A1	2/2003	Hennessey et al.
6,831,895	B1	12/2004	Ji et al.	2003/0055972	A1	3/2003	Fuller et al.
6,834,306	B1	12/2004	Tsimelzon	2003/0061263	A1	3/2003	Riddle
6,842,604	B1	1/2005	Cook et al.	2003/0061280	A1	3/2003	Bulson et al.
6,859,791	B1	2/2005	Spagna	2003/0078888	A1	4/2003	Lee et al.
6,870,851	B1	3/2005	Leinwand et al.	2003/0078889	A1	4/2003	Lee et al.
6,874,032	B2	3/2005	Gersht et al.	2003/0105604	A1	6/2003	Ash et al.
6,888,797	B1	5/2005	Cao et al.	2004/0022194	A1	2/2004	Ricciulli
6,901,604	B1	5/2005	Kiraly	2004/0139097	A1	7/2004	Farber et al.
6,904,017	B1	6/2005	Meempat et al.	2004/0177148	A1	9/2004	Tsimelzon
6,915,329	B2	7/2005	Kriegsman	2005/0033858	A1	2/2005	Swildens et al.
6,928,442	B2	8/2005	Farber et al.	2005/0038851	A1	2/2005	Kriegsman
6,934,255	B1	8/2005	Toporek et al.	2005/0100027	A1	5/2005	Leinwand et al.
6,950,623	B2	9/2005	Brown et al.	2005/0114296	A1	5/2005	Farber et al.
6,954,784	B2	10/2005	Aiken, Jr. et al.	2005/0262104	A1	11/2005	Robertson et al.
6,963,910	B1	11/2005	Belknap	2006/0143293	A1	6/2006	Freedman
6,963,980	B1	11/2005	Mattsson				
6,963,981	B1	11/2005	Bailey et al.				
6,965,890	B1	11/2005	Dey et al.				
6,970,432	B1	11/2005	Hankins et al.				
6,973,485	B2	12/2005	Ebata et al.				
6,973,490	B1	12/2005	Robertson et al.				
6,981,050	B1	12/2005	Tobias et al.				
6,981,180	B1	12/2005	Bailey et al.				
6,996,616	B1	2/2006	Leighton et al.				
7,003,572	B1	2/2006	Lownsbrough et al.				
7,007,089	B2	2/2006	Freedman				
7,010,578	B1	3/2006	Lewin et al.				
7,012,900	B1	3/2006	Riddle				
7,039,633	B1	5/2006	Dey et al.				
7,047,300	B1	5/2006	Oehrke et al.				
7,054,935	B2	5/2006	Farber et al.				
7,058,706	B1	6/2006	Iyer et al.				
7,069,177	B2	6/2006	Carley				
7,096,266	B2	8/2006	Lewin et al.				
7,103,564	B1	9/2006	Ehnebuske				
7,103,645	B2	9/2006	Leighton et al.				
7,110,984	B1	9/2006	Spagna				
7,117,259	B1	10/2006	Rohwer				
7,127,513	B2	10/2006	Karger et al.				
7,159,035	B2	1/2007	Garcia-Luna-Aceves et al.				
7,187,658	B2 *	3/2007	Koyanagi et al. 370/254				
7,188,085	B2	3/2007	Pelletier				
7,206,748	B1	4/2007	Gruse				
7,240,100	B1	7/2007	Wein et al.				
7,260,060	B1	8/2007	Abaye et al.				
7,457,233	B1	11/2008	Gan et al.				
2001/0029525	A1	10/2001	Lahr				
2001/0056500	A1	12/2001	Farber et al.				
2002/0018449	A1	2/2002	Ricciulli				
2002/0023164	A1	2/2002	Lahr				
2002/0023165	A1	2/2002	Lahr				
2002/0032029	A1 *	3/2002	Angin 455/428				
2002/0040404	A1	4/2002	Lahr				
2002/0042817	A1	4/2002	Lahr				
2002/0046273	A1	4/2002	Lahr et al.				
2002/0046405	A1	4/2002	Lahr				
2002/0049857	A1	4/2002	Farber et al.				
2002/0059592	A1	5/2002	Kiraly				
2002/0062388	A1 *	5/2002	Ogier et al. 709/238				
2002/0066038	A1	5/2002	Mattsson				

FOREIGN PATENT DOCUMENTS

CA	2202572	10/1998
CA	2335661	9/2001
CA	2335662	9/2001
CA	2467998	4/2006
CN	ZL99810853.7	8/2004
EP	0637153	7/1993
EP	0637153 A1	7/1993
EP	0660569	12/1993
EP	0343611 B1	8/1994
EP	0865180 A2	9/1998
EP	0660569 A1	12/1998
EP	1104555	6/2001
GB	2353877	3/2004
IL	140935	3/2006
JP	5-130144	5/1993
JP	10-70571	3/1998
JP	2002522995	7/2002
JP	3566626	6/2004
JP	2005124165	5/2005
JP	3762649	1/2006
NI	176482	8/2003
WO	WO 98/57465	12/1998
WO	WO 00/33511	8/2000

OTHER PUBLICATIONS

Collins, "The Detour Framework for Packet Rerouting", Journal Oct. 29, 1998.

D. Estrin et al., "Source Demand Routing: Packet Format and Forwarding Specification (Version 1)", May 1996, Memo; Internet RFC/STD/FYI/BCP Archives, RFC1940; Network Working Group.

Deborah Estrin et al., "Source Demand Routing Protocol Specification (Version 1)", Oct. 10, 1992, Memo; Internet Draft; Network Working Group.

C. Hedrick., "Routing Information Protocol", Jun. 1998, Memo, Internet Working Group, Request for Comments: 1058; <http://www.cis.ohio-state.edu/cgi-bin/rfc/rfc1058.html>.

Savage et al., "Detour: Informed Internet Routing and Transport", Jan.-Feb. 1999, IEEE, pp. 50-59.

Segall et al., "QoS Routing Using Alternate Paths".

Touch, "The X-Bone", USC/Information Sciences Institute, NGI Workshop White Paper—Mar. 1997.

- D. Wessels, "Configuring Hierarchical Squid Caches", Aug. 19, 1997.
- D. Wessels et al., "Internet Cache Protocol (ICP), Version 2", Sep. 1997, Memo; Internet RFC/STD/FYI/BCP Archives, RFC2186; Network Working Group.
- D. Wessels et al., "Application of Internet Cache Protocol (ICP), Version 2", Sep. 1997, Memo; Internet RFC/STD/FYI/BCP Archives, RFC2187; Network Working Group.
- R. Woodburn et al., "A scheme for an Internet Encapsulation Protocol: Version 1", Jul. 1991, Internet, <http://www.cis.ohio-state.edu/cgi-bin/rfc/rfc1241.html>, pp. 1-17.
- Web Site, "Scaling the Internet," Inktomi Corp., www.inktomi.com, pp. 1-5 (likely prior to Jun. 18, 1999).
- Web Site, "Are you Akamaiized?," Akamai, www.akamai.com, pp. 1-2 (likely prior to Jun. 18, 1999).
- Office Action from corresponding European Application No. 00941508.4-2416 mailed Aug. 9, 2006.
- Roch A. Guerin et al., "QoS Routing Mechanisms and OSPF Extensions", Global Telecommunications Conference, US, New York, IEEE, Nov. 3, 1997, pp. 1903-1908, XP000737848 ISBN: 0-7803-4199-6.
- Office Action from corresponding Canadian Application No. 2,374,621 mailed Jun. 23, 2006.
- Joint Claim Construction and Prehearing Statement from Civil Action No. CV 02-3708 CRB.
- Memorandum and Order from Civil Action No. C 02-03708 CRB.
- Exhibit A Regarding U.S. Patent No. 6,275,470 from Civil Action Case 3:02-cv-03708-CRB.
- Akamai Technologies, Inc.'s Amended Answer to Complaint, Affirmative Defenses and Counterclaims; Demand for Jury Trial from Civil Action No. CV 02-3708 CRB.
- Cable & Wireless' Reply to Akamai Technologies, Inc.'s Amended Answer and Counterclaims from from Civil Action No. CV 02-3708 CRB.
- Exhibit C Regarding U.S. Patent No. 5,774,660 from Civil Action Case 3:02-CV-03708-CRB.
- "Akamai's Preliminary Claim Construction for Disputed Term, Phrases, or Clauses for the '470 Patent", Exh. B, to Joint Claim Construction and Prehearing Statement, filed in civil case No. CV-02-3708 (CRB), Mar. 31, 2003.
- "U.S. Patent No. 6,275,470—CWIS Disputed Claim Constructions", Exh. A, to Joint Claim Construction and Prehearing Statement, filed in civil case No. CV-02-3708 (CRB), Mar. 31, 2003.
- American Heritage College Dictionary, 3d. Ed., 1997, pp. 79, 283, 709, 842, 1413.
- American Heritage Dictionary, 2nd College Ed., "meaningful" to "mechanism" (p. 776), "merry-bells" to "metamorphosis", (pp. 788-789) "respectability" to "restharrow" (p. 1053), filed as an exhibit in civil case No. CV-02-3708 (CRB), Dec. 2002.
- Chankunthod, A. et al., "A Hierarchical Internet Object Cache", Proc. of the 1996 USENIX Technical Conf., Jan. 1996, pp. 153-163. Chart titled "Collins The Detour Framework for Packet Rerouting anticipates the 470 Patent." [1 pg.], Exh. I to Decl. of Leighton in Support of Defendant Akamai's Opposition to Plaintiffs Motion for PI, in case No. CV-02-3708 (CRB), Dec. 2002.
- Chart titled "RFC 2186, RFC 2187 and Chankunthod et al. 'A Hierarchical Internet Object Cache' render the '470 Patent Obvious" [3 pgs.], Exh. M to Decl. of Leighton in Support of Defendant Akamai's Opposition to Plaintiffs Motion for PI, in case No. CV-02-3708 (CRB) Dec. 2002.
- Chart titled Segall et al. 'QoS Routing Using Alternate Paths' anticipates the '470 Patent [2 pgs.], Exh. G to Decl. Of Leighton in Support of Defendant Akamai's Opposition to Plaintiffs Motion for PI, in case No. CV-02-3708 (CRB), Dec. 2002.
- Chart titled U.S. Patent No. 5,774,660 Is material to the Patentability of the 470 Patent, Exh. C to Decl. Of Bestavros in Support of Defendant Akamai's Opposition to Plaintiffs Motion for Preliminary Injunction, filed Dec. 2, 2002 in Civil Action 3:02-cv-03708-CRB.
- Chart titled: "The Combination of RFC 1241 and U.S. Patent No. 6,016,307 to Kaplan et al. anticipates the '470 Patent" [2 pgs.], Exh. D to Decl. of Leighton in Support of Defendant Akamai's Opposition
- Collins, A. The Detour Framework for Packet Rerouting. Master's thesis, University of Washington, Oct. 1998.
- Declaration of Frank Thomson Leighton in Support of Defendant Akamai Technologies, Inc.'s Answering Brief on Claim Construction, filed May 19, 2003 in No. CV-02-3708 (CRB).
- Declaration of Frank Thomson Leighton in Support of Defendant Akamai Technologies, Inc.'s Opposition to Plaintiff's Motion for Preliminary Injunction, filed in civil case No. CV-02-3708 (CRB), Dec. 2, 2002 [23 pages], and Exhibits A-M.
- Declaration of Tony Clark in Support of Plaintiff's Proposed Claim Construction, filed May 1, 2003 in No. CV-02-3708 (CRB).
- Defendant Akamai Technologies, Inc.'s Answering Brief on Claim Construction filed May 19, 2003 in civil case No. CV-02-3708 (CRB).
- Defendant Akamai Technologies, Inc.'s Opposition to Plaintiff's Motion for Preliminary Injunction, filed Dec. 20, 2002 in civil case No. CV-02-3708 (CRB).
- Dyson, P., The Network Press Dictionary of Networking, 2d ed., p. 343, 1995.
- Estrin, D., et al., "Source Demand Routing Protocol Specification (Version 1)", Oct. 10, 1992, Memo; Internet Draft; Network Working Group.
- Estrin, D., et al., RFC 1940, "Source Demand Routing: Packet Format and Forwarding Specification (Version 1)", May 1996, Memo; Internet RFC/STD/FYI/BCP Archives, Network Working Group.
- Freedman, A., "The Computer Glossary. The complete Illustrated Dictionary", 8th Ed., 1998 (ISBN 0-8144-7978-2), p. 72.
- Hedrick, C., RFC 1058 "Routing Information Protocol", Jun. 1998, Memo, Internet Working Group.
- Joint Claim Construction and Prehearing Statement, filed Mar. 31, 2003 in civil Case 3:02-cv-03708-CRB [7 pages], with exhibit A [9 pages] and exhibit B [12 pgs].
- Mills, D. & Woodburn, R., A Scheme for an Internet Encapsulation Protocol: Version 1. RFC 1241, DDN Network Information Center, Jul. 1991.
- Nader, J.C., Prentice Hall's Illustrated Dictionary of Computing, 2d. ed., 1995, p. 110.
- Newton, H., 'Newton's Telecom Dictionary', Flatiron Publishing, Inc., pp. 610-611, Sep. 1995.
- Newton, H., 'Newton's Telecom Dictionary', p. 198, Feb. 2001.
- Plaintiff's Opening Claim Construction Brief Construing the Terms At Issue in U.S. Patent No. 6,275,470, filed May 1, 2003 in civil case No. CV-02-3708 (CRB). [28 pgs.].
- Plaintiff's Reply Claim Construction Brief Construing the Terms At Issue in U.S. Patent No. 6,275,470, filed May 27, 2003 in civil case No. CV-02-3708 (CRB).
- Reply Declaration of Tony Clark in Support of CWIS' Proposed Claim Construction, filed May 27, 2003 in civil case No. CV-02-3708 (CRB).
- Savage, S. et al., "Detour: A Case for Informed Internet Routing and Transport", IEEE Micro, vol. 19, No. 1, Jan./Feb. 1999.
- Segall, A., et al. "QoS Routing Using Alternate Paths." Journal of High Speed Networks, 7(2):141-158, 1998.
- Thyagarajan, A., et al., "Making the Mbone Real", May 10, 1995, Internet, <http://www.isoc.org/HMP/Paper/227/html/paper.html>.
- Touch, J. "The X-Bone", USC/Information Sciences Institute, Workshop on Research Directions for the Next-Generation Internet, Vienna, VA, May 13-14, 1997.
- Touch, J. et al., "The X-Bone," Third Global Internet Mini-Conference at Globecom '98. Sydney, Australia, Nov. 1998, pp. 59-68 (pp. 44-52 of the mini-conference).
- Wessels, D. "Configuring Hierarchical Squid Caches", Aug. 19, 1997.
- Wessels, D. et al., RFC2186, "Internet Cache Protocol (ICP), Version 2", Sep. 1997, Memo; Internet RFC/STD/FYI/BCP Archives, Network Working Group.
- Wessels, D. et al., RFC2187, "Application of Internet Cache Protocol (ICP), Version 2", Sep. 1997, Memo; Internet RFC/STD/FYI/BCP Archives; Network Working Group.
- Bahk, S. et al., "Dynamic multi-path routing and how it compares

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