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Twitchell, Jr.

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(54) **VIRTUAL DISPERSIVE NETWORKING SYSTEMS AND METHODS**
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See application file for complete search history.

(56) **References Cited**
U.S. PATENT DOCUMENTS

5,274,762 A 12/1993 Peterson et al.
5,537,417 A 7/1996 Sharma et al.
(Continued)

FOREIGN PATENT DOCUMENTS

EP 1089506 A2 4/2001
EP 1791300 A1 5/2007
(Continued)

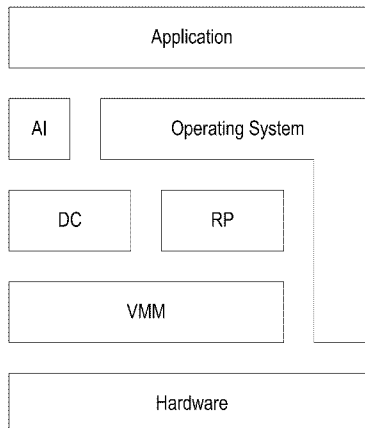
OTHER PUBLICATIONS

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(57) **ABSTRACT**
A method for network communications from a first device to a second device includes communicating data from the first device to the second device by spawning a first virtual machine for a first network connection that virtualizes network capabilities of the electronic device, and using the virtualized network capabilities of the first virtual machine, transmitting a plurality of packets for communication to a first network address and port combination associated with the second device. The method further includes repeatedly changing to a respective another network address and port combination by repeatedly spawning a respective another virtual machine for a respective another network connection that virtualizes network capabilities of the electronic device, and using the virtualized network capabilities of the spawned respective another virtual machine, transmitting a plurality of packets for communication to the respective another network address and port combination associated with the second device.

20 Claims, 38 Drawing Sheets



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continuation-in-part of application No. 12/499,075, filed on Jul. 7, 2009, now Pat. No. 8,539,098, which is a continuation-in-part of application No. 12/253,926, filed on Oct. 17, 2008, now Pat. No. 7,895,348.

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(56) **References Cited**

U.S. PATENT DOCUMENTS

5,598,532 A 1/1997 Liron
 5,761,195 A 6/1998 Lu
 5,910,179 A 6/1999 Mohseni
 6,011,792 A 1/2000 Miloslavsky
 6,061,349 A 5/2000 Coile et al.
 6,104,801 A 8/2000 Miloslavsky
 6,683,885 B1 1/2004 Sugai et al.
 6,704,803 B2 3/2004 Wilson et al.
 6,742,023 B1 5/2004 Fanning et al.
 6,922,774 B2 7/2005 Meushaw et al.
 7,213,246 B1 5/2007 van Rietschote et al.
 7,254,114 B1 8/2007 Turner et al.
 7,270,193 B2 9/2007 Hashimoto et al.
 7,281,247 B2 10/2007 Lodwick et al.
 7,319,700 B1 1/2008 Kompella
 7,350,071 B1 3/2008 Reisman
 7,383,327 B1 6/2008 Tormasov et al.
 7,441,113 B2 10/2008 Chong et al.
 7,441,270 B1 10/2008 Edwards et al.
 7,472,182 B1 12/2008 Young et al.
 7,483,978 B2 1/2009 Esfahany et al.
 7,584,285 B2 9/2009 Hudson et al.
 7,620,955 B1 11/2009 Nelson
 7,630,368 B2 12/2009 Tripathi et al.
 7,693,064 B2 4/2010 Thubert et al.
 7,720,672 B1 5/2010 Buswell et al.
 7,756,027 B1 7/2010 Reddy et al.
 7,757,293 B2* 7/2010 Caceres et al. 726/25
 7,765,307 B1 7/2010 Kritov et al.
 7,788,713 B2 8/2010 Grobman et al.
 7,860,725 B2 12/2010 Gopinathan et al.
 7,895,348 B2 2/2011 Twitchell
 7,941,510 B1 5/2011 Tormasov et al.
 8,051,180 B2 11/2011 Mazzaferri et al.
 8,166,475 B1 4/2012 Scales et al.
 8,341,291 B2 12/2012 Twitchell, Jr.
 8,341,292 B2 12/2012 Twitchell, Jr.
 8,352,636 B2 1/2013 Twitchell, Jr.
 8,423,664 B2 4/2013 Twitchell
 8,429,226 B2 4/2013 Twitchell
 8,429,293 B2 4/2013 Twitchell
 8,433,818 B2 4/2013 Twitchell
 8,433,819 B2 4/2013 Twitchell, Jr.
 8,443,440 B2 5/2013 McGee
 8,447,882 B2 5/2013 Twitchell, Jr.
 8,539,098 B2 9/2013 Twitchell, Jr.
 8,560,634 B2 10/2013 Twitchell, Jr.
 2002/0019831 A1 2/2002 Wade
 2002/0052763 A1 5/2002 Jung Richardson
 2002/0055855 A1 5/2002 Cule et al.

2002/0119821 A1 8/2002 Sen et al.
 2002/0132209 A1 9/2002 Grant et al.
 2002/0136209 A1 9/2002 Shtivelman
 2003/0008712 A1 1/2003 Poulin
 2003/0050538 A1 3/2003 Naghavi et al.
 2003/0069957 A1 4/2003 Malmskog et al.
 2003/0088610 A1 5/2003 Kohn et al.
 2003/0110288 A1 6/2003 Ramanujan et al.
 2003/0123419 A1 7/2003 Rangnekar et al.
 2003/0137974 A1 7/2003 Kwan et al.
 2003/0149763 A1 8/2003 Heitman et al.
 2003/0202008 A1 10/2003 McDonald et al.
 2004/0054650 A1 3/2004 Chun
 2004/0076277 A1 4/2004 Kuusinen et al.
 2004/0083216 A1 4/2004 Kozam et al.
 2004/0128670 A1 7/2004 Robinson et al.
 2004/0205777 A1 10/2004 Zalenski et al.
 2004/0230660 A1 11/2004 Abjanic et al.
 2004/0240440 A1 12/2004 Wild, III et al.
 2004/0252661 A1 12/2004 Lintulampi et al.
 2004/0252674 A1 12/2004 Soininen et al.
 2004/0255161 A1 12/2004 Cavanaugh
 2005/0004968 A1 1/2005 Mononen et al.
 2005/0010687 A1 1/2005 Dai
 2005/0015511 A1 1/2005 Izmailov et al.
 2005/0086523 A1 4/2005 Zimmer et al.
 2005/0100002 A1 5/2005 Oouchi et al.
 2005/0132362 A1 6/2005 Knauerhase et al.
 2005/0222858 A1 10/2005 Okada
 2005/0232151 A1 10/2005 Chapweske et al.
 2006/0028545 A1 2/2006 Stapleton
 2006/0029064 A1 2/2006 Rao et al.
 2006/0031094 A1 2/2006 Cohen et al.
 2006/0050719 A1 3/2006 Barr et al.
 2006/0085855 A1 4/2006 Shin et al.
 2006/0182108 A1 8/2006 Krumel
 2006/0224920 A1 10/2006 Rooholamini et al.
 2006/0253532 A1 11/2006 Kukoleca
 2007/0055481 A1 3/2007 Baird et al.
 2007/0060363 A1 3/2007 Nguyen et al.
 2007/0078988 A1 4/2007 Miloushev et al.
 2007/0079082 A1 4/2007 Gladwin et al.
 2007/0088580 A1 4/2007 Richards, Jr.
 2007/0110048 A1 5/2007 Voit et al.
 2007/0130287 A1 6/2007 Kumar et al.
 2007/0179955 A1 8/2007 Croft et al.
 2007/0192862 A1 8/2007 Vermeulen et al.
 2007/0198656 A1 8/2007 Mazzaferri et al.
 2008/0002663 A1 1/2008 Tripathi et al.
 2008/0008202 A1 1/2008 Terrell et al.
 2008/0043756 A1 2/2008 Droux et al.
 2008/0049753 A1 2/2008 Heinze et al.
 2008/0075084 A1 3/2008 Choi et al.
 2008/0090628 A1 4/2008 Mueller et al.
 2008/0167068 A1 7/2008 Mosleh et al.
 2008/0270564 A1 10/2008 Rangegowda et al.
 2008/0271015 A1* 10/2008 Ibrahim 718/1
 2009/0005649 A1 1/2009 Baird et al.
 2009/0077254 A1 3/2009 Darcie et al.
 2009/0094251 A1 4/2009 Gladwin et al.
 2009/0100128 A1 4/2009 Czechowski et al.
 2009/0106439 A1 4/2009 Twitchell
 2009/0199132 A1 8/2009 Chong et al.
 2009/0204964 A1 8/2009 Foley et al.
 2009/0248445 A1 10/2009 Harnick
 2009/0320137 A1 12/2009 White et al.
 2009/0327392 A1 12/2009 Tripathi et al.
 2010/0009758 A1 1/2010 Twitchell
 2011/0071848 A1 3/2011 Sweeney
 2011/0179136 A1 7/2011 Twitchell
 2011/0295616 A1 12/2011 Vesto
 2012/0014389 A1 1/2012 Twitchell
 2012/0016955 A1 1/2012 Twitchell, Jr.
 2012/0016956 A1 1/2012 Twitchell
 2012/0016984 A1 1/2012 Twitchell, Jr.
 2012/0017005 A1 1/2012 Twitchell, Jr.
 2012/0017006 A1 1/2012 Twitchell

(56)

References Cited

U.S. PATENT DOCUMENTS

2012/0017265	A1	1/2012	Twitchell, Jr.
2012/0020352	A1	1/2012	Twitchell
2012/0020353	A1	1/2012	Twitchell
2012/0023202	A1	1/2012	Twitchell, Jr.
2012/0023244	A1	1/2012	Twitchell, Jr.
2012/0023258	A1	1/2012	Twitchell
2012/0026889	A1	2/2012	Twitchell, Jr.
2012/0030362	A1	2/2012	Twitchell, Jr.
2012/0166653	A1	6/2012	Twitchell
2012/0272315	A1	10/2012	Twitchell
2013/0117823	A1	5/2013	Dang et al.
2014/0019604	A1	1/2014	Twitchell, Jr.
2014/0173058	A1	6/2014	Twitchell, Jr.

FOREIGN PATENT DOCUMENTS

WO	2006058544	A1	6/2006
WO	2009052452		4/2009

OTHER PUBLICATIONS

Petrone, M.; Zarrelli, R., "Enabling PVM to build parallel multidomain virtual machines," Parallel, Distributed, and Network-Based Processing, 2006. 14th Euromicro International Conference on, vol., No., pp. 8 pp., Feb 15-17, 2006 doi: 10.1109/PDP.2006.33.

Maier, S.; Grau, A.; Weinschrott, H.; Rothermel, K.; "Scalable Network Emulation: A Comparison of Virtual Routing and Virtual Machines," Computers and Communications, 2007. ISCC 2007. 12th IEEE Symposium on, vol., No., pp. 395-402, Jul. 1-4, 2007.

Agrawal, A.; Ganguly, A.; Boykin, P.O.; Figueiredo, R.J.; "Towards P2P-routed IF overlay networks for grid virtual machines," High Performance Distributed Computing, 2005. HPDC-14. Proceedings. 14th IEEE International Symposium on, vol., No., pp. 293-294, Jul. 24-27, 2005.

"Virtual Routing: Bringing TCP/IP to a New Level." Interpeak AB. 2005. pp. 1-8. <http://www.interpeak.com/files/vr_white.pdf>.

Dacey, Andrew. "How ARP Works". Archived by the Internet Archive on Apr. 3, 2005: <<http://web.archive.org/web/20050403205914/http://tildegrugal.net/tech/arp.php>>. pp. 1-4.

Ford, Bryan, Srisuresh, Pyda, and Kegel, Dan, "Peer-To-Peer Communication Across Network Address Translators", Feb. 17, 2005, 13 pages. <http://www.brynosaurus.com/pub/net/p2pnat/> Accessed Jan. 13, 2012.

"International Search Report" and "Written Opinion of the International Search Authority" (Korean Intellectual Property Office) in Dispersive Networks Inc. et al, International Patent Application Serial No. PCT/US2008/080397, dated May 21, 2009, 12 pages.

Franco Travostino, Paul Daspit, Leon Gommans, Chetan Jog, Cees de Laat, Joe Mambretti, Inder Monga, Bas van Oudenaarde, Satish Raghunath, Phil Wang. "Seamless Live Migration of Virtual

Machines over the MAN/WAN", Journal. Future Generation Computer Systems—IGrid 2005: The global lambda integrated facility, vol. 22 Issue 8, pp. 901-907. Oct. 2006.

Christopher Clark, Keir Fraser, Steven Hand, Jacob Gorm Hansen, Eric Jul, Christian Limpach, Ian Pratt, Andrew Warfield, titled "Live Migration of Virtual Machines" presented at NSDI 2005: 2nd Symposium on Networked Systems Design & Implementation, vol. 2, in the Proceedings, sponsored by USENIX Association in May 2005 pp. 273-286.

Anjit Ganguly, Abhishek Agrawal, P. Oscar Boykin, Renato Figueiredo, titled WOW: Self-Organizing Wide Area Overlay Networks of Virtual Workstations, High Performance Distributed Computing, 2006 15th IEEE International Symposium on, vol., No., pp. 30,42, 0-0 0 doi: 10.1109/HPDC.2006.1652133.

Transparent Network Services via Virtual Traffic Layer for Virtual Machines; John R. Lange and Peter A Dinda; Published in: Proceeding HPDC '07 Proceedings of the 16th international symposium on High performance distributed computing pp. 23-32, ACM New York, NY, USA, 2007; table of contents ISBN: 978-1-59593-673-8; doi:10.1145/1272366.1272370.

Ganguly, A.; Agrawal, A.; Boykin, P.O.; Figueiredo, R., "IP over P2P: enabling self-configuring virtual IP networks for grid computing," Parallel and Distributed Processing Symposium, 2005. IPDPS 2006. 20th International, vol., No., pp., Apr. 25-29, 2006, doi: 10.1109/IPDPS.2006.1639287.

Lee, P.P.C.; Misra, V.; Rubenstein, D., "Distributed algorithms for secure multipath routing," INFOCOM 2005, 24th Annual Joint Conference of the IEEE Computer and Communications Societies, Proceedings IEEE, vol. 3, No., pp. 1952, 1963 vol. 3 Mar. 13-17, 2005, doi: 10.1109/INFCOM.2005.1498473.

Wenjing Lou; Yuguang Fang, "A multipath routing approach for secure data delivery," Military Communications Conference, 2001, MILCOM 2001. Communications for Network-Centric Operations: Creating the Information Force, IEEE, vol. 2, No., pp. 1467, 1473 vol. 2, doi: 10.1109/MILCOM.2001.986098.

Zlatokrilov, H.; Levy, H., "Session Privacy Enhancement by Traffic Dispersion," INFOCOM 2006 25th IEEE International Conference on Computer Communications. Proceedings, vol., No., pp. 1, Apr. 12, 2006, doi: 10.1109/INFCOM.2006.155.

Wei Huang, Jiuxing Liu, Bulent Abali, Dhableswar K. Panda, (Huang et al.), titled "A case for high performance computing with virtual machines" (Huang hereinafter), presented in Proceedings of the 20th annual international conference, ICS '06 International Conference on Supercomputing 2006, Jun. 28-Jul. 1, 2006, doi:10.1145/1183401.1183421.

Melvin Ming-Che Tsai, Doctor of Philosophy in Engineering—Electrical Engineering and Computer Sciences in the Graduate Division of the University of California, Berkeley, titled "RouterVM: A Practical, High-Level Configuration Interface for Next-Generation Routers and Appliances", Fall 2005.

* cited by examiner

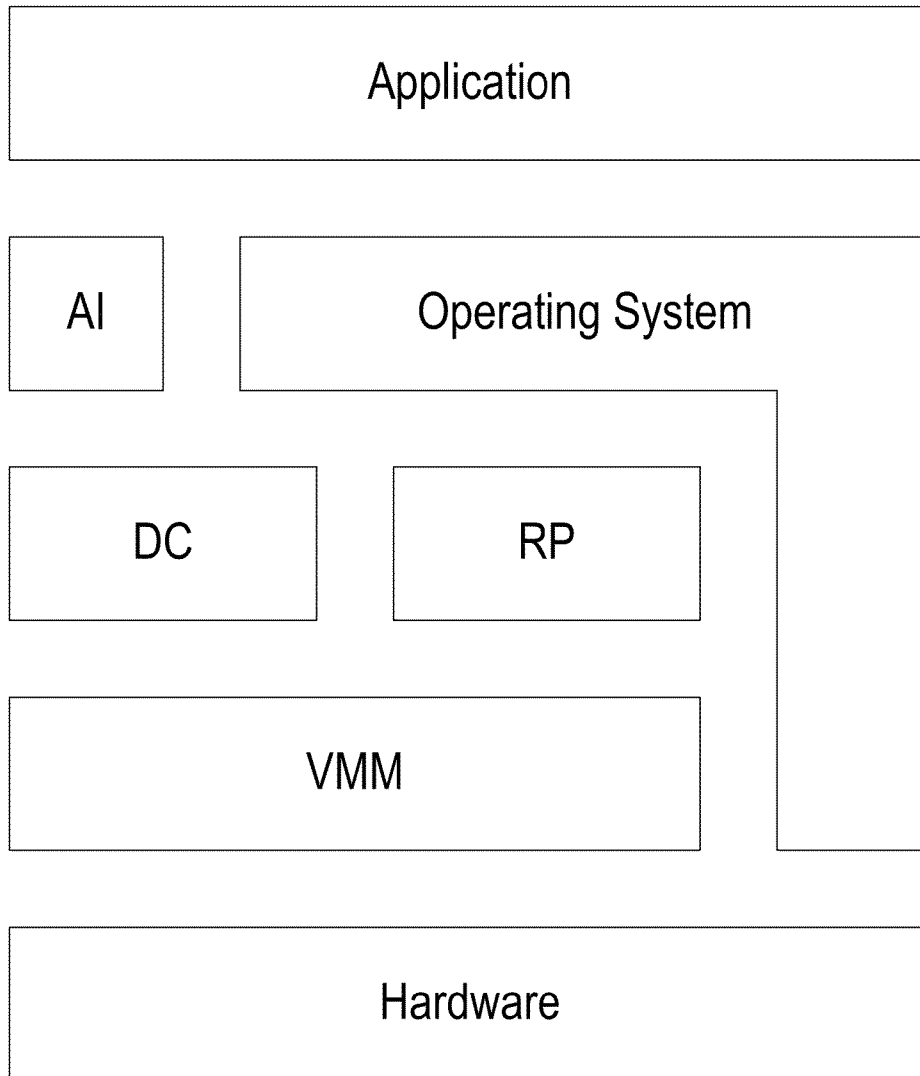


FIG. 1

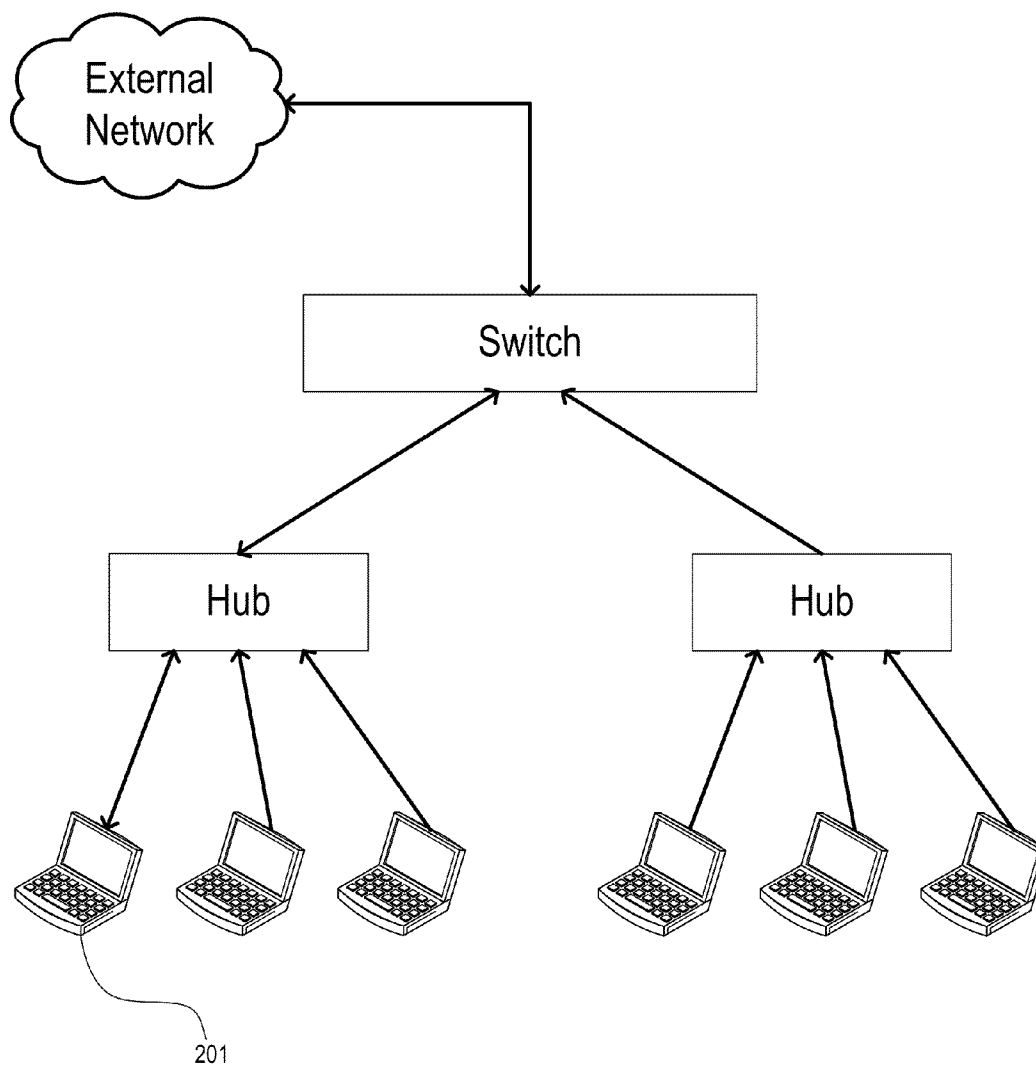


FIG. 2

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