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(54) **MALICIOUS MOBILE CODE RUNTIME MONITORING SYSTEM AND METHODS**

(56) **References Cited**

U.S. PATENT DOCUMENTS

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4,562,305 A 12/1985 Gaffney, Jr.  
5,077,677 A 12/1991 Murphy et al.

(Continued)

FOREIGN PATENT DOCUMENTS

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EP 0636977 7/1994  
EP 1021276 7/2000

(Continued)

OTHER PUBLICATIONS

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Zhong, et al., "Security in the Large: is Java's Sandbox Scalable?," *Seventh IEEE Symposium on Reliable Distributed Systems*, pp. 1-6, Oct. 1998.

(Continued)

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(57) **ABSTRACT**

Protection systems and methods provide for protecting one or more personal computers ("PCs") and/or other intermittently or persistently network accessible devices or processes from undesirable or otherwise malicious operations of Java TN applets, ActiveX™ controls, JavaScript™ scripts, Visual Basic scripts, add-ins, downloaded/uploaded programs or other "Downloadables" or "mobile code" in whole or part. A protection engine embodiment provides for monitoring information received, determining whether received information does or is likely to include executable code, and if so, causes mobile protection code (MPC) to be transferred to and rendered operable within a destination device of the received information. An MPC embodiment further provides, within a Downloadable-destination, for initiating the Downloadable, enabling malicious Downloadable operation attempts to be received by the MPC, and causing (predetermined) corresponding operations to be executed in response to the attempts.

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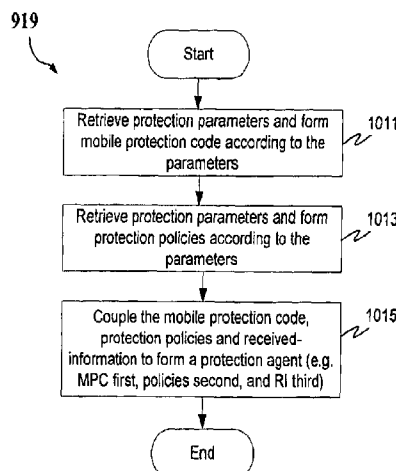
USPC ..... 726/24; 713/175

(58) **Field of Classification Search**

None

See application file for complete search history.

**18 Claims, 10 Drawing Sheets**



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continuation of application No. 11/370,114, filed on Mar. 7, 2006, now Pat. No. 7,613,926, which is a continuation of application No. 09/861,229, filed on May 17, 2001, now Pat. No. 7,058,822, which is a continuation-in-part of application No. 09/539,667, filed on Mar. 30, 2000, now Pat. No. 6,804,780, which is a continuation of application No. 08/964,388, filed on Nov. 6, 1997, now Pat. No. 6,092,194, said application No. 09/861,229 is a continuation-in-part of application No. 09/551,302, filed on Apr. 18, 2000, now Pat. No. 6,480,962, and a continuation of application No. 08/790,097, filed on Jan. 29, 1997, now Pat. No. 6,167,520.

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(56) **References Cited**

U.S. PATENT DOCUMENTS

5,263,147	A	11/1993	Francisco et al.
5,278,901	A	1/1994	Shieh et al.
5,311,591	A	5/1994	Fischer
5,319,776	A	6/1994	Hile et al.
5,359,659	A	10/1994	Rosenthal
5,361,359	A	11/1994	Tajalli et al.
5,398,196	A	3/1995	Chambers
5,412,717	A	5/1995	Fischer
5,414,833	A	5/1995	Hershey et al.
5,440,723	A	8/1995	Arnold et al.
5,452,442	A	9/1995	Kephart
5,483,649	A	1/1996	Kuznetsov et al.
5,485,409	A	1/1996	Gupta et al.
5,485,575	A	1/1996	Chess et al.
5,524,238	A	6/1996	Miller et al.
5,572,643	A	11/1996	Judson ..... 709/218
5,579,509	A	11/1996	Furtney et al.
5,606,668	A	2/1997	Shwed
5,621,889	A	4/1997	Lermuzeaux et al.
5,623,600	A	4/1997	Ji et al.
5,623,601	A	4/1997	Vu
5,638,446	A	6/1997	Rubin
5,675,711	A	10/1997	Kephart et al.
5,692,047	A	11/1997	McManis
5,692,124	A	11/1997	Holden et al.
5,696,822	A	12/1997	Nachenberg
5,720,033	A	2/1998	Deo
5,724,425	A	3/1998	Chang et al.
5,740,248	A	4/1998	Fieres et al.
5,740,441	A	4/1998	Yellin et al.
5,761,421	A	6/1998	Van Hoff et al.
5,765,030	A	6/1998	Nachenberg et al.
5,765,205	A	6/1998	Breslau et al.
5,784,459	A	7/1998	Devarakonda et al.
5,796,952	A	8/1998	Davis et al.
5,805,829	A	9/1998	Cohen et al.
5,809,230	A	9/1998	Pereira
5,825,877	A	10/1998	Dan et al.
5,832,208	A	11/1998	Chen et al.
5,832,274	A	11/1998	Cutler et al.
5,850,559	A	12/1998	Angelo et al.
5,854,916	A	12/1998	Nachenberg
5,859,966	A	1/1999	Hayman et al.
5,864,683	A	1/1999	Boebert et al.
5,867,651	A	2/1999	Dan et al.
5,878,258	A	3/1999	Pizi et al.
5,881,151	A	3/1999	Yamamoto
5,884,033	A	3/1999	Duvall et al.
5,889,943	A	3/1999	Ji et al.
5,892,904	A	4/1999	Atkinson et al.
5,951,698	A	9/1999	Chen et al.

5,960,170	A	9/1999	Chen et al.
5,963,742	A	10/1999	Williams
5,964,889	A	10/1999	Nachenberg
5,974,549	A	10/1999	Golan
5,978,484	A	11/1999	Apperson et al.
5,983,348	A	11/1999	Ji
5,987,611	A	11/1999	Freund
6,070,239	A	5/2000	McManis
6,088,801	A	7/2000	Grecsek
6,088,803	A	7/2000	Tso et al.
6,092,194	A	7/2000	Touboul
6,125,390	A	9/2000	Touboul
6,154,844	A	11/2000	Touboul et al.
6,167,520	A	12/2000	Touboul
6,263,442	B1	7/2001	Mueller et al.
6,339,829	B1	1/2002	Beadle et al.
6,351,816	B1	2/2002	Mueller et al.
6,425,058	B1	7/2002	Arimilli et al.
6,434,668	B1	8/2002	Arimilli et al.
6,434,669	B1	8/2002	Arimilli et al.
6,480,962	B1	11/2002	Touboul
6,487,666	B1	11/2002	Shanklin et al.
6,519,679	B2	2/2003	Devireddy et al.
6,571,338	B1	5/2003	Shaio et al.
6,598,033	B2	7/2003	Ross et al.
6,643,696	B2	11/2003	Davis et al.
6,732,179	B1	5/2004	Brown et al.
6,804,780	B1	10/2004	Touboul
6,917,953	B2	7/2005	Simon et al.
7,058,822	B2	6/2006	Edey et al.
7,143,444	B2	11/2006	Porras et al.
7,210,041	B1	4/2007	Gryaznov et al.
7,308,648	B1	12/2007	Buchthal et al.
7,343,604	B2	3/2008	Grabarnik et al.
7,418,731	B2	8/2008	Touboul
7,613,926	B2	11/2009	Edey et al.
7,647,633	B2	1/2010	Edey et al.
8,079,086	B1 *	12/2011	Edey et al. .... 726/24
2003/0014662	A1	1/2003	Gupta et al.
2003/0074190	A1	4/2003	Allison
2003/0101358	A1	5/2003	Porras et al.
2004/0073811	A1	4/2004	Sanin
2004/0088425	A1	5/2004	Rubinstein et al.
2005/0050338	A1	3/2005	Liang et al.
2005/0172338	A1	8/2005	Sandu et al.
2006/0031207	A1	2/2006	Bjarnestam et al.
2006/0048224	A1	3/2006	Duncan et al.
2008/0066160	A1	3/2008	Becker et al.
2010/0195909	A1	8/2010	Wasson et al.

FOREIGN PATENT DOCUMENTS

EP	1091276	4/2001	..... G06F 1/00
EP	1132796	9/2001	
JP	08-263447	10/1996	
WO	95/27249	10/1995	
WO	95/33237	12/1995	
WO	98/21683	5/1998	
WO	2004/063948	7/2004	
WO	WO 2004/063948	7/2004	..... G06F 17/30

OTHER PUBLICATIONS

Rubin, et al., "Mobile Code Security," *IEEE Internet*, pp. 30-34, Dec. 1998.

Schmid, et al. "Protecting Data From Malicious Software," *Proceeding of the 18<sup>th</sup> Annual Computer Security Applications Conference*, pp. 1-10, 2002.

Corradi, et al., "A Flexible Access Control Service for Java Mobile Code," *IEEE*, pp. 356-365, 2000.

International Search Report for Application No. PCT/IB97/01626, 3 pp., May 14, 1998 (mailing date).

International Search Report for Application No. PCT/IL05/00915, 4 pp., dated Mar. 3, 2006.

Written Opinion for Application No. PCT/IL05/00915, 5 pp., dated Mar. 3, 2006 (mailing date).

(56)

## References Cited

## OTHER PUBLICATIONS

International Preliminary Examination Report for Application No. PCT/IB01/01138, 2 pp., dated Dec. 19, 2002.

Sitaker, Kragen, "Rapid Genetic Evolution of Regular Expressions" [online], *The Mial Archive*, Apr. 24, 2004 (retrieved on Dec. 7, 2004), 5 pp., Retrieved from the Internet: <http://www.mail-archive.com/kragen-tol@canonical.org/msg00097.html>.

"Lexical Analysis: DFA Minimization & Wrap Up" [online], Fall, 2004 [retrieved on Mar. 2, 2005], 8 pp., Retrieved from the Internet: <http://www.owl.net.rice.edu/~comp412/Lectures/L06LexWrapup4.pdf>.

"Minimization of DFA" [online], [retrieved on Dec. 7, 2004], 7 pp., Retrieved from the Internet: <http://www.cs.odu.edu/~toidea/nerzic/390teched/regular/fa/min-fa.html>.

"Algorithm: NFS -> DFA" [online], Copyright 1999-2001 [retrieved on Dec. 7, 2004], 4 pp., Retrieved from the Internet: [http://rw4.cs.uni-sb.de/~ganimal/GANIFA/page16\\_e.htm](http://rw4.cs.uni-sb.de/~ganimal/GANIFA/page16_e.htm).

"CS 3813: Introduction to Formal Languages and Automata—State Minimization and Other Algorithms for Finite Automata," 3 pp., May 11, 2003, Retrieved from the Internet: <http://www.cs.msstate.edu/~hansen/classes/3813fall01/slides/06Minimize.pdf>.

Watson, Bruce W., "Constructing Minimal Acyclic Deterministic Finite Automata," [retrieved on Mar. 20, 2005], 38 pp., Retrieved from the Internet: [http://www.win.tue.nl/~watson/2R870/downloads/madfa\\_algs.pdf](http://www.win.tue.nl/~watson/2R870/downloads/madfa_algs.pdf).

Chang, Chia-Hsiang, "From Regular Expressions to DFA's Using Compressed NFA's," Oct. 1992, 112 pp., [http://www.cs.nyu.edu/web/Research/Theses/chang\\_chia-hsiang.pdf](http://www.cs.nyu.edu/web/Research/Theses/chang_chia-hsiang.pdf).

"Products," Articles published on the Internet, "Revolutionary Security for a New Computing Paradigm" regarding SurfingGate™, 7 pp. "Release Notes for the Microsoft ActiveX Development Kit," Aug. 13, 1996, <http://activex.adsp.or.jp/inetsdk/readme.txt>, pp. 1-10.

Doyle, et al., "Microsoft Press Computer Dictionary," Microsoft Press, 2d Edition, pp. 137-138, 1993.

Finjan Software Ltd., "Powerful PC Security for the New World of Java™ and Downloadables, SurfingShield™," Article published on the Internet by Finjan Software Ltd., 2 pp. 1996.

Finjan Software Ltd., "Finjan Announces a Personal Java™ Firewall for Web Browsers—the SurfingShield™ 1.6 (formerly known as SurfingBoard)," Press Release of Finjan Releases SurfingShield 1.6, 2 pp., Oct. 21, 1996.

Finjan Software Ltd., "Finjan Announces Major Power Boost and New Features for SurfingShield™ 2.0," Las Vegas Convention Center/Pavillion 5 P5551, 3 pp., Nov. 18, 1996.

Finjan Software Ltd., "Finjan Software Releases SurfingBoard, Industry's First JAVA Security Product for the World Wide Web," Article published on the Internet by Finjan Software Ltd., 1 p., Jul. 29, 1996.

Finjan Software Ltd., "Java Security: Issues & Solutions," Article published on the Internet by Finjan Software Ltd., 8 pp. 1996.

Finjan Software Ltd., Company Profile, "Finjan—Safe Surfing, The Java Security Solutions Provider," Article published on the Internet by Finjan Software Ltd., 3 pp., Oct. 31, 1996.

"IBM AntiVirus User's Guide, Version 2.4," International Business Machines Corporation, pp. 6-7, Nov. 15, 1995.

Khare, R., "Microsoft Authenticode Analyzed" [online], Jul. 22, 1996 [retrieved on Jun. 25, 2003], 2 pp., Retrieved from the Internet: <http://www.xent.com/FoRK-archiv/smmr96/0338.html>.

LaDue, M., Online Business Consultant: Java Security: Whose Business is It?, Article published on the Internet, Home Page Press, Inc., 4 pp., 1996.

Microsoft, "Microsoft ActiveX Software Development Kit" [online], Aug. 12, 1996 [retrieved on Jun. 25, 2003], pp. 1-6, Retrieved from the Internet: <http://activex.adsp.or.jp/inetsdk/help/overview.htm>.

Microsoft® Authenticode Technology, "Ensuring Accountability and Authenticity for Software Components on the Internet,"

Microsoft Corporation, Web Page Article "Frequently Asked Questions About Authenticode," last updated Feb. 17, 1997, printed Dec. 23, 1998, URL: <http://www.microsoft.com/workshop/security/authcode/signfaq.asp#9>, pp. 1-13.

Okamoto, E., et al., "ID-Based Authentication System for Computer Virus Detection," *IEEE/IEE Electronic Library online, Electronics Letters*, vol. 26, Issue 15, ISSN 0013-5194, Jul. 19, 1990, Abstract and pp. 1169-1170, URL: <http://iel.ihs.com:80/cgi-bin/iel.cgi?se...2ehts%26ViewTemplate%3ddocview%5fb%2ehts>.

Omura, J. K., "Novel Applications of Cryptography in Digital Communications," *IEEE Communications Magazine*, pp. 21-29, May 1990.

Zhang, X. N., "Secure Code Distribution," *IEEE/IEE Electronic Library online, Computer*, vol. 30, Issue 6, pp. 76-79, Jun. 1997.

D. Grune, et al., "Parsing Techniques: A Practical Guide," John Wiley & Sons, Inc., New York, New York, USA, pp. 1-326, 2000.

Scott, et al., "Abstracting Application-Level Web Security," *ACM*, pp. 396-407, 2002.

ThunderByte Antivirus for Windows.

InterScan VirusWall from Trend Micro.

VirusSafe from Elisham.

Intel LANProtect from Intel.

The Java Security Manager from Sun Microsystems.

McAfee Web Shield.

McAfee WebScan.

McAfee VirusScan.

McAfee NetShield.

Dr. Solomon's Antivirus Toolkit for Windows 95.

Dr. Solomon's Antivirus Toolkit for Windows NT.

Dr. Solomon's WinGuard.

Dr. Solomon's Virus Guard.

Dr. Solomon's Virus Shield.

Dr. Solomon's Virex.

Dr. Solomon's "Merlin" Anti-Virus Engine.

Dr. Solomon's iMcAfee "Olympus" Anti-Virus Engine.

ActiveX Web Tutorial.

Java FAQ (1995-1998).

Norton AntiVirus TU for Windows@95 User's Guide. Published by Symantec in 1995. (179 pages).

Jaeger, et al., "Building Systems that Flexibly Control Downloadable Executable Content," Proceedings of the Sixth USENIX UNIX Security Symposium, Jul. 1996. (19 pages).

Rasmuson, Andreas and Jansson, Sverker, "Personal Security Assistance for Secure Internet Commerce," Sep. 16, 1996. (12 pages).

Bharat et al. Migratory Applications\* Nov. 15, 1995. (10 pages).

Dean, Drew, et al., "Java Security: From HotJava to Netscape and Beyond," 1996 IEEE Symposium on Security and Privacy, May 6, 1996. (11 pages).

Sterbenz, Andreas, An Evaluation of the Java Security Model, • IEEE, Dec. 1996. (13 pages).

Fritzinger, J. Steven, et al., Java Security, • Sun Microsystems, Dec. 1996 (7 pages).

Bank Joseph A. "Java Security," Dec. 8, 1995. (14 pages).

Claunch, "Java Blocking," <http://groups.google.com/group/muc.lists.firewalls/msg/2a5ec02e00a37071>. Sep. 25, 1996. Accessed date: May 10, 2011. (2 pages).

Chappell, •Understanding ActiveX and OLE: A Guide for Developers and Managers (Strategic Technology), Sep. 1, 1996, Microsoft Press. (91 pages).

Crosbie, et al., "Active Defense of a Computer System Using Autonomous Agents". Feb. 15, 1995. (14 pages).

"Trend Micro's Virus Protection Added to Sun Microsystems Netra Internet Servers," Business Wire, Oct. 1, 1996, available at <http://www.cs.indiana.edu/~kinzler/pubs/viruswall.html>.

"Symantec Announces Norton Antivirus 2.0 for Windows NT," Symantec Corporation press release, Sep. 16, 1996, available at [http://www.symantec.com/about/news/release/article.jsp?prid=19960916\\_01](http://www.symantec.com/about/news/release/article.jsp?prid=19960916_01).

"Dark Avenger Mutation Engine No Threat to Protected PCs," McAfee, Inc. press release, May 11, 1992, available at <http://>

(56)

## References Cited

## OTHER PUBLICATIONS

"Dark Avenger Mutation Engine No Threat to Protected PCs," McAfee, Inc. press release, May 11, 1992, available at <http://securitydigest.org/virus/mirror/www.phreak.org/virus1/1992/vin105.191>.

Gryaznov, D.O., "Scanners of the Year 2000: Heuristics," Proceedings of the Fifth International Virus Bulletin Conference, pp. 225-234 (1995), available at <http://vxheavens.com/lib/adgOO.html>.

"Symantec Announces Norton Internet Email Gateway at Internet World—Booth # 369 on Dec. 11, 12, and 13," Symantec Corporation press release, Dec. 11, 1996, available at [http://www.symantec.com/about/news/release/article.jsp?prid=19961211\\_03](http://www.symantec.com/about/news/release/article.jsp?prid=19961211_03).

"Presenting Java," by John Dec. (1995).

"The Java Language Specification" by Gosling, et al. (1996).

"The Java Programming Language," by Ken Arnold and James Gosling (1996).

"The Java Virtual Machine Specification," by Tim Lindholm and Frank Yellin (1997).

"Computer Viruses and Artificial Intelligence," by David Stang (Sep. 1995).

"Java Security and a Firewall Extension for Authenticity Control of Java Applets," by Magnus Johansson (Jan. 29, 1997).

"Static Analysis of Programs With Application to Malicious Code Detection," by Raymond Lo (1992).

File History for U.S. Patent No. 6,804,780.

"Virus Detection Alternatives," by Patrick Min (Jul. 1992).

"Dynamic Detection and Classification of Computer Viruses Using General Behaviour Patterns," by LeCharlier, et al. (Sep. 1995).

The Giant Black Book of Computer Viruses by Mark Ludwig (1995).

HotJava: The Security Story.

The Java Filter.

"A Java Filter," by Balfanz, et al.

"Improved JavaScript and Java Screening Function," by Claunch (May 4, 1996).

"New Version of Java, JavaScript, ActiveX Screening," by Claunch (Jul. 3, 1996).

"A Toolkit and Methods for Internet Firewalls," by Ranum, et al.

"Identifying and Controlling Undesirable Program Behaviors," by Maria King.

"PACL1's: An Access Control List Approach to Anti-Viral Security," by Wichers, et al.

Endrijonas, Janet, Rx PC The Anti-Virus Handbook. Published in the U.S. in 1993 by TAB Books, a division of McGraw-Hill, Inc. (201 paQes).

"Secure Code Distribution," by X. Nick Zhang (Jun. 1997).

IBM AntiVirus User's Guide (Nov. 15, 1995).

"Breadth of Runtime Environments and Security Make Java a Good Choice for the Internet" (1996).

Omura, Jim K., "Novel Applications of Cryptography in Digital Communications," IEEE Communications Magazine, pp. 21-29, May 1990.

Okamoto, E., et al., "ID-Based Authentication System for Computer Virus Detection," IEEE/IEE Electronic Library online, Electronics Letters, vol. 26, Issue 15, ISSN 0013-5194, Jul. 19, 1990, Abstract and pp. 1169-1170, URL: <http://iel.ihs.com:80/cgibin/iel.cgi?se...2ehts%26ViewTemplate%3ddocview%5fb%2ehts>.

IBM AntiVirus User's Guide Version 2.4, International Business Machines Corporation, pp. 6-7, Nov. 15, 1995.

Leach, Norvin, et al., "IE 3.0 Applets Will Earn Certification," PC Week, vol. 13, No. 29,2 pp., Jul. 22, 1996.

"Finjan Software Releases SurfinBoard, Industry's First JAVA Security product for the World Wide Web," Article published on the Internet by Finjan Software Ltd., 1 p., Jul. 29, 1996.

"Powerful PC Security for the New World of JAVATM and Downloadables, Surfin Shield™," Article published on the Internet by Finjan Software Ltd., 2 pp. 1996.

Microsoft® Authenticode Technology, "Ensuring Accountability and Authenticity for Software Components on the Internet,"

Finjan Announces a Personal Java™ Firewall for Web Browsers—the SurfinShield™ 1.6 (formerly known as SurfinBoard), Press Release of Finjan Releases SurfinShield 1.6, 2 pp., Oct. 21, 1996.

Company Profile, "Finjan-Safe Surfing. The Java Security Solutions Provider," Article published on the Internet by Finjan Software Ltd., 3 pp., Oct. 31, 1996.

"Finjan Announces Major Power Boost and New Features for SurfinShield™ 2.0," Las Vegas Convention Center/Pavilion 5 P5551, 3 pp., Nov. 18, 1996.

"Java Security: Issues & Solutions," Article published on the Internet by Finjan Software Ltd., 8 pp., 1996.

"Products," Article published on the Internet, 7 pp.

Mark LaDue, "Online Business Consultant: Java Security: Whose Business Is It?," Article published on the Internet, Home Page Press, Inc., 4 pp., 1996.

Web Page Article, "Frequently Asked Questions About Authenticode," Microsoft Corporation, last updated Feb. 17, 1997, printed Dec. 23, 1998, URL: <http://www.microsoft.com/workshop/security/authcode/signfaq.asp#9>, pp. 1-13.

Zhang, X.N., "Secure Code Distribution," IEEE/IEE Electronic Library online, Computer vol. 30, Issue 6, pp. 76-79, Jun. 1997.

Binstock, Andrew, "Multithreading, Hyper-Threading, Multiprocessing: Now, What's the Difference?," <http://www.intel.com/ids/devdoQcr!asmo-na/enf/20456.htm>, Pacific Data Works, LLC, downloaded Jul. 7, 2008, 7 pp.

VirexPC Version 2.0 or later from Microcom.

AntiVirus Kit From 1 stAide Software.

FluShot+ Series of Products by Ross Greenberg.

Symantec Antivirus of the Mac version 3.0 or later.

"Synthesizing Fast Intrusion Prevention/Detection Systems From High-Level Specifications," by Sekar, et al. (1999).

Art of Computer Virus Research and Defense b Peter Szor (Feb. 2005).

"Process Execution Controls as a Mechanism to Ensure Consistency," by Eugen Bacic (1990).

"Process Execution Controls: Revisited," by Bacic (1990).

"A Flexible Access Control Service for Java Mobile Code," by Corradi, et al. (2000).

"Java Security: Issues & Solutions" (1996).

"Microsoft Authenticode analyzed," by Rohit Khare (Jul. 22, 1996).

"Java Security: Whose Business Is It?" by Mark LaDue (1996).

Microsoft Authenticode Technology (Oct. 1996).

"Mobile Code Security," by Rubin, et al.

"Protecting Data From Malicious Software," by Schmid, et al.

"Security in the Large: Is Java's Sandbox Scalable?" by Zhong, et al. (Apr. 1998).

"A Domain and type Enforcement UNIX Prototype," by Badger, et al. (Jun. 1995).

"Heuristic Anti-Virus Technology," by Frans Veldman.

"Standards for Security in Open Systems," by Warwick Ford (1989).

"Secure File Transfer Over TCP/IP," by Brown, et al. (Nov. 1992).

"Standards in Commercial Security," by Nick Pope.

"X.400 Security Features," by Tony Whyman.

"Using CASE Tools to Improve the Security of Applications Systems," by Hosmer, et al. (1988).

"Miro: Visual Specification of Security," by Heydon, et al. (Oct. 1990).

"An Evaluation of Object-Based Programming with Visual Basic," by Dukovic, et al. (1995).

"Visual Basic 5.0 Significantly Improved," by W. Dennis Swift (Jun. 1997).

"Development of an Object Oriented Framework for Design and Implementation of Database Powered Distributed Web Applications With the DEMETER Project as a Real-Life Example," by Goschka, et al. (1997).

Detecting Unusual Program Behavior Using the Statistical Component of the Nextgeneration Intrusion Detection Expert System (NIDES), by Anderson, et al. (May 1995).

"A Generic Virus Scanner in C++," by Kumar, et al. (Sep. 17, 1992).

"A Model for Detecting the Existence of Software Corruption in Real Time," by Voas, et al. (1993).



(56)

## References Cited

## OTHER PUBLICATIONS

"Information Agents for Automated Browsing," by Dharap, et al. (1996).

"Static Analysis Virus Detection Tools for Unix Systems," by Kerchen, et al. (1990).

"Managing Trust in an Information-Labeling System," by Blaze, et al. (Nov. 4, 1996).

List of Secure Internet Programming Publications from [www.cs.princeton.edu](http://www.cs.princeton.edu).

"A Guide to the Selection of Anti-Virus Tools and Techniques," by Polk, et al. (Dec. 2, 1992).

"An Integrated Toolkit for Operating System Security," by Rabin, et al. (Aug. 1988).

"A Web Navigator With Applets in Caml," by Francois Ronaix (May 1996).

"Intel Launches Virus Counterattack," by Charles Bruno (Aug. 1992).

Intel LANProtect Software User's Guide (1992).

"Parents Can Get PC Cruise Control," by George Mannes (Jul. 1996).

"A New Techniques for Detecting Polymorphic Computer Viruses," by Carey Nachenberg (1995).

"Heuristic Scanners: Artificial Intelligence," by Righard Zwienenberg (Sep. 1995).

Intel LANProtect, 30-Day Test Drive Version User's Manual.

Slade, Robert, "Guide to Computer Viruses: How to avoid Them, How to Get Rid of Them, and How to Get Help" (Apr. 1996).

A Pathology of Computer Viruses by David Ferbranche (Nov. 1994).

Earl Boebert's post to the greatcircle firewalls mailing list. Taken from <http://www.greatcircle.com/lists/firewalls/archive/firewalls.199410> (Oct. 16, 1994).

CSL Bulletin: Connecting to the Internet: Security Considerations. Taken from <http://csrc.nist.gov/publications/nistbul/cs193-07.txt> (Jul. 1993).

FAQ: Interscan Viruswall. Taken from <http://web.archive.org/web/19970605050331/www.antivirus.com/faq/finterscanfaq.html> (last updated Aug. 8, 1996).

Network Security and SunScreen SPF-100: Technical White Paper, Sun Microsystems, 1995.

"Why Do We Need Heuristics?" by Frans Veldman (Sep. 1995).

"Leading Content Security Vendors Announce Support for Check Point Firewall—1.3.0; New Partners for Anti-Virus Protection, URL Screening and Java Security," Business Wire, Oct. 7, 1996, available at [http://www.allbusiness.com/technolo\\_gyl/computer-networks-computer-networksecurity17274315-1.html#ixzz1gkbKf4g1](http://www.allbusiness.com/technolo_gyl/computer-networks-computer-networksecurity17274315-1.html#ixzz1gkbKf4g1).

"McAfee Introduces Web shield; Industry's First Secure Anti-Virus Solution for Network Firewalls: Border Network Technologies and Secure Computing to Enter into Web Shield OEM Agreements," Business Wire, May 14, 1996, available at [http://findarticles.compl/articles/mi\\_mOEINlis\\_1996\\_May\\_14/ai\\_182834561](http://findarticles.compl/articles/mi_mOEINlis_1996_May_14/ai_182834561).

"Trend Micro Announces Virus and Security Protection for Microsoft Proxy Server; Also Blocks Java Applets, ActiveX," Business Wire, Oct. 29, 1996, available at <http://www.thefreelibrary.com/Trend+Micro+announces+virus+and+security+protection+for+MicrosoftL.-aOI8810512>.

Finjan's Opposition to Websense's Renewed Motion for Judgment as a Matter of Law, dated Dec. 21, 2012, filed in *Finjan, Inc. v. Symantec Corp., Sophos, Inc., and Websense, Inc.*, C.A. No. 10-cv-593 (OMS). Declaration of Paul Batcher Re Websense, Inc.s. Proffer of Evidence Re Laches, dated Dec. 19, 2012, filed in *Finjan, Inc. v. Symantec Corp., Sophos, Inc., and Websense, Inc.*, C.A. No. 10-cv-593 (OMS) (Redacted Dec. 26, 2012).

Opposition to Symantec's Motion for JMOL, dated Dec. 17, 2012, filed in *Finjan, Inc. v. Symantec Corp., Sophos, Inc., and Websense, Inc.*, C.A. No. 10-cv-593 (OMS) (Redacted Dec. 27, 2012).

Omura, Jim K., "Novel Applications of Cryptography in Digital Communications," IEEE Communications Magazine, pp. 21-29, May 1990.

Okamoto, E., et al., "ID-Based Authentication System for Computer

and pp. 1169-1170, URL: <http://iel.ihs.com:80/cgi-bin/iel.cgi?se...2ehs%26ViewTemplate%3ddocview%5fb%ehts>.

IBM AntiVirus User's Ouide Version 2.4, International Business Machines Corporation, pp. 6-7, Nov. 15, 1995.

Leach, Norvin, et al., "IE 3.0 Applets Will Earn Certification," PC Week, vol. 13, No. 29, 2 pp., Jul. 22, 1996.

Finjan Announces a Personal Java198 Firewall for Web Browsers—the SurfInShield™ 1.6 (fonnerly known as SurfInBoard), Press Release of Finjan Releases SurfInShield 1.6,2 pp., Oct. 21, 1996.

Web Page Article, "Frequently Asked Questions About Authenticode," Microsoft Corporation, last updated Feb. 17, 1997, printed Dec. 23, 1998, URL: <http://www.microsoft.com/workshop/security/authcode/signfaq.asp#9>, pp. 1-13.

Binstock, Andrew, "Multithreading, Hyper-Threading, Multiprocessing: Now, What's the Difference?," <http://www.intel.com/cd/ids/developer/asmo-na/eng/20456.htm>, Pacific Data Works, LLC, downloaded Jul. 7, 2008,7 pp.

"Frequently Asked Questions About Authenticode," Microsoft Corporation, updated Feb. 17, 1997.

"WWWProxyto Cut Off Java," by Carl Claunch (Apr. 12, 1996).

"Combating Viruses Heuristically," by Frans Veldman (Sep. 1993).

"MCF: A Malicious Code Filter," by Lo, et al. (May 4, 1994).

Anti-Virus Tools and Techniques for Computer Systems by Polk, et al. (1995).

"Dynamic Detection and Classification of Computer Viruses Using General Behaviour Patterns," by LeCharlier, et al. (Jul. 2, 1995).

"Towards a Testbed for Malicious Code Detection," by Lo, et al. (1991).

"Blocking Java Applets at the Firewall," by Martin, et al.

Virus Detection and Elimination by Rune Skardhamar (1996).

Computer Viruses and Anti-Virus Warfare by Jan Hruska (1992).

"Active Content Security," by Brady, et al. (Dec. 13, 1999).

"Low Level Security in Java," by Frank Yellin.

"Email With a Mind ofIts Own: The Safe-Tcl Language for Enabled Mail," by Nathaniel Borenstein.

"Mobile Agents: Are They a Good Idea?" by Chess, et al. (Dec. 21, 1994).

"Remote Evaluation," by Stamos, et al. (Oct. 1990).

"Active Message Processing: Messages as Messengers," by John Vittal (1981).

"Programming Languages for Distributed Computing Systems," by Bal, et al. (Sep. 1989).

"Scripts and Agents: The New Software High Ground," by John Ousterhout (Oct. 20, 1995).

"The HotJava Browser: A White Paper".

The Java Virtual Machine Specification, Sun Microsystems (Aug. 21, 1995).

"Security of Web Browser Scripting Languages: Vulnerabilities, Attacks and Remedies," by Anupam, et al. (Jan. 1998).

"ActiveX and Java: The Next Virus Carriers?"

"Gateway Level Corporate Security for the New World of Java and Downloadables" (1996).

"Practical Domain and Type Enforcement for UNIX," by Badger, et al. (1995).

"A Sense of Self for Unix Processes," by Forrest, et al. (1996).

"Antivirus Scanner Analysis 1995," by Marko Helenius (1995).

"State Transition Analysis: A Rule-Based Intrusion Detection Approach," by Ilgun, et al. (Mar. 1995).

"Automated Detection of Vulnerabilities in Privileged Programs by Execution Monitoring," by Ko, et al. (1994).

"Execution Monitoring of Security-Critical Programs in Distributed Systems: A Specification-Based Approach," by Ko, et al. (1997).

"Classification and Detection of Computer Intrusions," by Sandeep Kumar (Aug. 1995).

ThunderBYTE Anti-Virus Utilities User Manual (1995).

Doyle, et al., "Microsoft Press Computer Dictionary," Microsoft Press, 2nd Edition, pp. 137-138,1993.

Schmitt, D.A., ".EXE files, OS-2 style," PC Tech Journal, vol. 6, No. 11, p. 76(13), Nov. 1988.

International Search Report for Application No. PCT/IB97/01626, dated May 14, 1999,2 pp.

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