US008739302B2

(12) **United States Patent**
Vainstein et al.

(10) **Patent No.: US 8,739,302 B2**
(45) **Date of Patent: *May 27, 2014**

(54) **METHOD AND APPARATUS FOR TRANSITIONING BETWEEN STATES OF SECURITY POLICIES USED TO SECURE ELECTRONIC DOCUMENTS**

(75) Inventors: **Klimenty Vainstein**, Cupertino, CA (US); **Satyajit Nath**, Cupertino, CA (US); **Michael Michio Ouye**, Mountain View, CA (US)

(73) Assignee: **Intellectual Ventures I LLC**, Wilmington, DE (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **13/404,578**

(22) Filed: **Feb. 24, 2012**

(65) **Prior Publication Data**

US 2012/0159191 A1 Jun. 21, 2012

Related U.S. Application Data

(63) Continuation of application No. 10/676,474, filed on Sep. 30, 2003, now Pat. No. 8,127,366.

(51) **Int. Cl.**
G06F 17/30 (2006.01)

(52) **U.S. Cl.**
USPC **726/27**; 726/1

(58) **Field of Classification Search**
USPC 380/277, 280, 281, 284
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,203,166	A	5/1980	Ehrsam et al.
4,238,854	A	12/1980	Ehrsam et al.
4,423,387	A	12/1983	Sempel
4,734,568	A	3/1988	Watanabe
4,757,533	A	7/1988	Allen et al.
4,796,220	A	1/1989	Wolfe
4,799,258	A	1/1989	Davies

(Continued)

FOREIGN PATENT DOCUMENTS

EP	0 672 991	A2	9/1995
EP	0 674 253	A1	9/1995

(Continued)

OTHER PUBLICATIONS

"Encrypting File System," from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

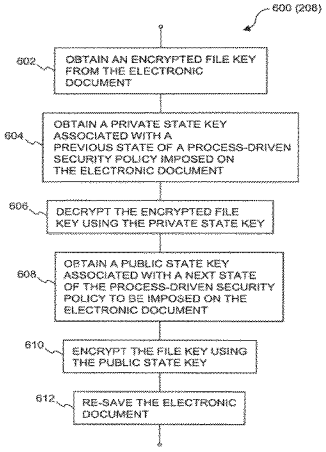
(Continued)

Primary Examiner — Edward Zee
(74) *Attorney, Agent, or Firm* — Sterne, Kessler, Goldstein & Fox P.L.L.C.

(57) **ABSTRACT**

Techniques for dynamically altering security criteria used in a file security system are disclosed. The security criteria pertains to keys (or ciphers) used by the file security system to encrypt electronic files to be secured or to decrypt electronic files already secured. The security criteria can, among other things, include keys that are required to gain access to electronic files. Here, the keys can be changed automatically as electronic files transition between different states of a process-driven security policy. The dynamic alteration of security criteria enhances the flexibility and robustness of the security system. In other words, access restrictions on electronic files can be dependent on the state of the process-driven security policy and enforced in conjunction with one or more cryptographic methods.

18 Claims, 13 Drawing Sheets



600 (208)
602
OBTAIN AN ENCRYPTED FILE KEY FROM THE ELECTRONIC DOCUMENT
604
OBTAIN A PRIVATE STATE KEY ASSOCIATED WITH A PREVIOUS STATE OF A PROCESS-DRIVEN SECURITY POLICY IMPOSED ON THE ELECTRONIC DOCUMENT
606
DECRYPT THE ENCRYPTED FILE KEY USING THE PRIVATE STATE KEY
608
OBTAIN A PUBLIC STATE KEY ASSOCIATED WITH A NEXT STATE OF THE PROCESS-DRIVEN SECURITY POLICY TO BE IMPOSED ON THE ELECTRONIC DOCUMENT
610
ENCRYPT THE FILE KEY USING THE PUBLIC STATE KEY
612
RE-SAVE THE ELECTRONIC DOCUMENT

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,827,508	A	5/1989	Shear
4,887,204	A	12/1989	Johnson et al.
4,888,800	A	12/1989	Marshall et al.
4,912,552	A	3/1990	Allison et al.
4,972,472	A	11/1990	Brown et al.
5,032,979	A	7/1991	Hecht et al.
5,052,040	A	9/1991	Preston et al.
5,058,164	A	10/1991	Elmer et al.
5,144,660	A	9/1992	Rose
5,204,897	A	4/1993	Wyman
5,212,788	A	5/1993	Lomet et al.
5,220,657	A	6/1993	Bly et al.
5,235,641	A	8/1993	Nozawa et al.
5,247,575	A	9/1993	Sprague et al.
5,267,313	A	11/1993	Hirata
5,276,735	A	1/1994	Boebert et al.
5,301,247	A	4/1994	Rasmussen et al.
5,319,705	A	6/1994	Halter et al.
5,369,702	A	11/1994	Shanton
5,375,169	A	12/1994	Seheidt et al.
5,404,404	A	4/1995	Novorita
5,406,628	A	4/1995	Beller et al.
5,414,852	A	5/1995	Kramer et al.
5,434,918	A	7/1995	Kung et al.
5,461,710	A	10/1995	Bloomfield et al.
5,467,342	A	11/1995	Logston et al.
5,495,533	A	2/1996	Linehan et al.
5,497,422	A	3/1996	Tysen et al.
5,499,297	A	3/1996	Boebert
5,502,766	A	3/1996	Boebert et al.
5,535,375	A	7/1996	Eshel et al.
5,557,765	A	9/1996	Lipner et al.
5,570,108	A	10/1996	McLaughlin et al.
5,584,023	A	12/1996	Hsu
5,600,722	A	2/1997	Yamaguchi et al.
5,606,663	A	2/1997	Kadooka
5,619,576	A	4/1997	Shaw
5,638,501	A	6/1997	Gough et al.
5,640,388	A	6/1997	Woodhead et al.
5,655,119	A	8/1997	Davy
5,661,668	A	8/1997	Yemini et al.
5,661,806	A	8/1997	Nevoux et al.
5,671,412	A	9/1997	Christiano
5,673,316	A	9/1997	Auerbach et al.
5,677,953	A	10/1997	Dolphin
5,680,452	A	10/1997	Shanton
5,682,537	A	10/1997	Davies et al.
5,684,987	A	11/1997	Mamiya et al.
5,689,688	A	11/1997	Strong et al.
5,689,718	A	11/1997	Sakurai et al.
5,699,428	A	12/1997	McDonnal et al.
5,708,709	A	1/1998	Rose
5,715,403	A	2/1998	Stefik
5,717,755	A	2/1998	Shanton
5,719,941	A	2/1998	Swift et al.
5,720,033	A	2/1998	Deo
5,729,734	A	3/1998	Parker et al.
5,732,265	A	3/1998	Dewitt et al.
5,745,573	A	4/1998	Lipner et al.
5,745,750	A	4/1998	Porcaro
5,748,736	A	5/1998	Mittra
5,751,287	A	5/1998	Hahn et al.
5,757,920	A	5/1998	Misra et al.
5,765,152	A	6/1998	Erickson
5,768,381	A	6/1998	Hawthorne
5,778,065	A	7/1998	Hauser et al.
5,778,350	A	7/1998	Adams et al.
5,781,711	A	7/1998	Austin et al.
5,787,169	A	7/1998	Eldridge et al.
5,787,173	A	7/1998	Seheidt et al.
5,787,175	A	7/1998	Carter
5,790,789	A	8/1998	Suarez
5,790,790	A	8/1998	Smith et al.
5,813,009	A	9/1998	Johnson et al.
5,821,933	A	10/1998	Keller et al.
5,825,876	A	10/1998	Peterson
5,835,592	A	11/1998	Chang et al.
5,835,601	A	11/1998	Shimbo et al.
5,850,443	A	12/1998	Van Oorschot et al.
5,857,189	A	1/1999	Riddle
5,862,325	A	1/1999	Reed et al.
5,870,468	A	2/1999	Harrison
5,870,477	A	2/1999	Sasaki et al.
5,881,287	A	3/1999	Mast
5,892,900	A	4/1999	Ginter et al.
5,893,084	A	4/1999	Morgan et al.
5,898,781	A	4/1999	Shanton
5,922,073	A	7/1999	Shimada
5,923,754	A	7/1999	Angelo et al.
5,933,498	A	8/1999	Schnek et al.
5,944,794	A	8/1999	Okamoto et al.
5,953,419	A	9/1999	Lohstroh et al.
5,968,177	A	10/1999	Batten-Carew et al.
5,970,502	A	10/1999	Salkewicz et al.
5,978,802	A	11/1999	Hurvig
5,987,440	A	11/1999	O'Neil et al.
5,991,879	A	11/1999	Still
5,999,907	A	12/1999	Donner
6,011,847	A	1/2000	Follendore, III
6,014,730	A	1/2000	Ohtsu
6,023,506	A	2/2000	Ote et al.
6,031,584	A	2/2000	Gray
6,032,216	A	2/2000	Schmuck et al.
6,035,404	A	3/2000	Zhao
6,038,322	A	3/2000	Harkins
6,044,155	A	3/2000	Thomlinson et al.
6,055,314	A	4/2000	Spies et al.
6,058,424	A	5/2000	Dixon et al.
6,061,790	A	5/2000	Bodnar
6,069,957	A	5/2000	Richards
6,070,244	A	5/2000	Orchier et al.
6,085,323	A	7/2000	Shimizu et al.
6,088,717	A	7/2000	Reed et al.
6,088,805	A	7/2000	Davis et al.
6,098,056	A	8/2000	Rusnak et al.
6,101,507	A	8/2000	Cane et al.
6,105,131	A	8/2000	Carroll
6,122,630	A	9/2000	Strickler et al.
6,134,327	A	10/2000	Van Oorschot
6,134,658	A	10/2000	Multerer et al.
6,134,660	A	10/2000	Boneh et al.
6,134,664	A	10/2000	Walker
6,141,754	A	10/2000	Choy
6,145,084	A	11/2000	Zuili
6,148,338	A	11/2000	Lachelt et al.
6,158,010	A	12/2000	Moriconi et al.
6,161,139	A	12/2000	Win et al.
6,182,142	B1	1/2001	Win et al.
6,185,684	B1	2/2001	Pravetz et al.
6,192,408	B1	2/2001	Vahalia et al.
6,199,070	B1	3/2001	Polo-Wood et al.
6,205,549	B1	3/2001	Pravetz
6,212,561	B1	4/2001	Sitaraman et al.
6,223,285	B1	4/2001	Komuro et al.
6,226,618	B1	5/2001	Downs et al.
6,226,745	B1	5/2001	Wiederhold et al.
6,240,188	B1	5/2001	Dondeti et al.
6,249,755	B1	6/2001	Yemini et al.
6,249,873	B1	6/2001	Richard et al.
6,253,193	B1	6/2001	Ginter et al.
6,260,040	B1	7/2001	Kauffman et al.
6,260,141	B1	7/2001	Park
6,263,348	B1	7/2001	Kathrow et al.
6,266,420	B1	7/2001	Langford et al.
6,272,631	B1	8/2001	Thomlinson et al.
6,272,632	B1	8/2001	Carmen et al.
6,282,649	B1	8/2001	Lambert et al.
6,289,450	B1	9/2001	Pensak et al.
6,289,458	B1	9/2001	Garg et al.
6,292,895	B1	9/2001	Baltzley
6,292,899	B1	9/2001	McBride
6,295,361	B1	9/2001	Kadansky et al.
6,299,069	B1	10/2001	Shona
6,301,614	B1	10/2001	Najork et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,308,256	B1	10/2001	Folmsbee	
6,308,273	B1	10/2001	Goertzel et al.	
6,314,408	B1	11/2001	Salas et al.	
6,314,409	B2	11/2001	Schnek et al.	
6,317,777	B1	11/2001	Skarbo et al.	
6,332,025	B2	12/2001	Takahashi et al.	
6,336,114	B1	1/2002	Garrison	
6,339,423	B1	1/2002	Sampson et al.	
6,339,825	B2	1/2002	Pensak et al.	
6,341,164	B1 *	1/2002	Dilkie et al.	380/278
6,343,316	B1	1/2002	Sakata	
6,347,374	B1	2/2002	Drake et al.	
6,349,337	B1	2/2002	Parsons et al.	
6,351,813	B1	2/2002	Mooney et al.	
6,356,903	B1	3/2002	Baxter et al.	
6,356,941	B1	3/2002	Cohen	
6,357,010	B1	3/2002	Viets et al.	
6,363,480	B1	3/2002	Perlman	
6,366,298	B1	4/2002	Haitsuka et al.	
6,370,249	B1	4/2002	Van Oorschot	
6,381,698	B1	4/2002	Devanbu et al.	
6,385,644	B1	5/2002	Devine et al.	
6,389,433	B1	5/2002	Bolosky et al.	
6,389,538	B1	5/2002	Gruse et al.	
6,393,420	B1	5/2002	Peters	
6,405,315	B1	6/2002	Burns et al.	
6,405,318	B1	6/2002	Rowland	
6,408,404	B1	6/2002	Ladwig	
6,421,714	B1	7/2002	Rai et al.	
6,442,688	B1	8/2002	Moses et al.	
6,442,695	B1	8/2002	Dutcher et al.	
6,446,090	B1	9/2002	Hart	
6,449,721	B1	9/2002	Pensak et al.	
6,453,353	B1	9/2002	Win et al.	
6,453,419	B1	9/2002	Flint et al.	
6,466,476	B1	10/2002	Wong et al.	
6,466,932	B1	10/2002	Dennis et al.	
6,477,544	B1	11/2002	Bolosky et al.	
6,487,662	B1	11/2002	Kharon et al.	
6,490,680	B1	12/2002	Scheidt et al.	
6,505,300	B2	1/2003	Chan et al.	
6,510,349	B1	1/2003	Schneck et al.	
6,519,700	B1	2/2003	Ram et al.	
6,529,956	B1	3/2003	Smith et al.	
6,530,020	B1	3/2003	Aoki	
6,530,024	B1	3/2003	Proctor	
6,542,608	B2	4/2003	Scheidt et al.	
6,549,623	B1	4/2003	Scheidt et al.	
6,550,011	B1	4/2003	Sims	
6,557,039	B1	4/2003	Leong et al.	
6,567,914	B1	5/2003	Just et al.	
6,571,291	B1	5/2003	Chow	
6,574,733	B1	6/2003	Langford	
6,584,466	B1	6/2003	Serbinis et al.	
6,587,878	B1	7/2003	Merriam	
6,587,946	B1	7/2003	Jakobsson	
6,588,673	B1	7/2003	Chan et al.	
6,591,295	B1	7/2003	Diamond et al.	
6,594,662	B1	7/2003	Sieffert et al.	
6,598,161	B1	7/2003	Kluttz et al.	
6,601,170	B1	7/2003	Wallace, Jr.	
6,603,857	B1	8/2003	Batten-Carew et al.	
6,608,636	B1	8/2003	Roseman	
6,611,599	B2	8/2003	Natarajan	
6,611,846	B1	8/2003	Stoodley	
6,615,349	B1	9/2003	Hair	
6,615,350	B1	9/2003	Schell et al.	
6,625,650	B2	9/2003	Stelliga	
6,625,734	B1	9/2003	Marvit et al.	
6,629,140	B1	9/2003	Fertell et al.	
6,629,243	B1	9/2003	Kleinman et al.	
6,633,311	B1	10/2003	Douvikas et al.	
6,640,307	B2	10/2003	Viets et al.	
6,646,515	B2	11/2003	Jun et al.	
6,647,388	B2	11/2003	Numao et al.	
6,678,835	B1	1/2004	Shah et al.	
6,683,954	B1	1/2004	Searle et al.	
6,687,822	B1	2/2004	Jakobsson	
6,693,652	B1	2/2004	Barrus et al.	
6,698,022	B1	2/2004	Wu	
6,711,683	B1	3/2004	Laczko et al.	
6,718,361	B1	4/2004	Basani et al.	
6,735,701	B1	5/2004	Jacobson	
6,738,908	B1	5/2004	Bonn et al.	
6,751,573	B1	6/2004	Burch	
6,754,657	B2	6/2004	Lomet	
6,754,665	B1	6/2004	Futagami et al.	
6,775,779	B1	8/2004	England et al.	
6,779,031	B1	8/2004	Picher-Dempsey	
6,782,403	B1	8/2004	Kino et al.	
6,801,999	B1	10/2004	Venkatesan et al.	
6,807,534	B1	10/2004	Erickson	
6,807,636	B2	10/2004	Hartman et al.	
6,810,389	B1	10/2004	Meyer	
6,810,479	B1	10/2004	Barlow et al.	
6,816,871	B2	11/2004	Lee	
6,816,969	B2	11/2004	Miyazaki et al.	
6,826,698	B1	11/2004	Minkin et al.	
6,834,333	B2	12/2004	Yoshino et al.	
6,834,341	B1	12/2004	Bahl et al.	
6,842,825	B2	1/2005	Geiner et al.	
6,845,452	B1	1/2005	Roddy et al.	
6,851,050	B2	2/2005	Singhal et al.	
6,862,103	B1	3/2005	Miura et al.	
6,865,555	B2	3/2005	Novak	
6,870,920	B2	3/2005	Henits	
6,874,139	B2	3/2005	Krueger et al.	
6,877,010	B2	4/2005	Smith-Semedo et al.	
6,877,136	B2	4/2005	Bess et al.	
6,882,994	B2	4/2005	Yoshimura et al.	
6,889,210	B1	5/2005	Vainstein	
6,891,953	B1	5/2005	DeMello et al.	
6,892,201	B2	5/2005	Brown et al.	
6,892,306	B1	5/2005	En-Seung et al.	
6,898,627	B1	5/2005	Sekiguchi	
6,907,034	B1	6/2005	Begis	
6,909,708	B1	6/2005	Krishnaswamy et al.	
6,915,425	B2	7/2005	Xu et al.	
6,915,434	B1	7/2005	Kuroda et al.	
6,915,435	B1	7/2005	Merriam	
6,920,558	B2	7/2005	Sames et al.	
6,922,785	B1	7/2005	Brewer et al.	
6,924,425	B2	8/2005	Naples et al.	
6,931,450	B2	8/2005	Howard et al.	
6,931,530	B2	8/2005	Pham et al.	
6,931,597	B1	8/2005	Prakash	
6,938,042	B2	8/2005	Aboulhosn et al.	
6,938,156	B2	8/2005	Wheeler et al.	
6,941,355	B1	9/2005	Donaghey et al.	
6,941,456	B2	9/2005	Wilson	
6,941,472	B2	9/2005	Moriconi et al.	
6,944,183	B1	9/2005	Iyer et al.	
6,947,556	B1	9/2005	Matyas, Jr. et al.	
6,950,818	B2	9/2005	Dennis et al.	
6,950,936	B2	9/2005	Subramaniam et al.	
6,950,941	B1	9/2005	Lee et al.	
6,950,943	B1	9/2005	Bacha et al.	
6,952,780	B2	10/2005	Olsen et al.	
6,957,261	B2	10/2005	Lortz	
6,959,308	B2	10/2005	Gramsamer et al.	
6,961,849	B1	11/2005	Davis et al.	
6,961,855	B1	11/2005	Rich et al.	
6,968,060	B1	11/2005	Pinkas	
6,968,456	B1	11/2005	Tripathi et al.	
6,971,018	B1	11/2005	Witt et al.	
6,976,259	B1	12/2005	Dutta et al.	
6,978,366	B1	12/2005	Ignatchenko et al.	
6,978,376	B2	12/2005	Giroux et al.	
6,978,377	B1	12/2005	Asano et al.	
6,987,752	B1	1/2006	Falco et al.	
6,988,133	B1	1/2006	Zavalkovsky et al.	
6,988,199	B2	1/2006	Toh et al.	
6,990,441	B1	1/2006	Bolme et al.	
6,993,135	B2	1/2006	Ishibashi	

(56) References Cited

U.S. PATENT DOCUMENTS

6,996,718	B1	2/2006	Henry et al.	
7,000,150	B1	2/2006	Zunino et al.	
7,003,116	B2	2/2006	Riedel et al.	
7,003,117	B2	2/2006	Kacker et al.	
7,003,560	B1	2/2006	Mullen et al.	
7,003,661	B2	2/2006	Beattie et al.	
7,010,689	B1	3/2006	Matyas et al.	
7,010,809	B2	3/2006	Hori et al.	
7,013,332	B2	3/2006	Friedel et al.	
7,013,485	B2	3/2006	Brown et al.	
7,020,645	B2	3/2006	Bisbee et al.	
7,024,427	B2	4/2006	Bobbitt et al.	
7,035,854	B2	4/2006	Hsiao et al.	
7,035,910	B1	4/2006	Dutta et al.	
7,043,637	B2	5/2006	Bolosky et al.	
7,046,807	B2	5/2006	Hirano et al.	
7,047,404	B1	5/2006	Doonan et al.	
7,051,213	B1	5/2006	Kobayashi et al.	
7,058,696	B1	6/2006	Phillips et al.	
7,058,978	B2	6/2006	Feuerstein et al.	
7,073,063	B2	7/2006	Peinado	
7,073,073	B1	7/2006	Nonaka et al.	
7,076,067	B2	7/2006	Raike et al.	
7,076,312	B2	7/2006	Law et al.	
7,076,469	B2	7/2006	Schreiber et al.	
7,076,633	B2	7/2006	Tormasov et al.	
7,080,077	B2	7/2006	Ramamurthy et al.	
7,095,853	B2	8/2006	Morishita	
7,096,266	B2	8/2006	Lewin et al.	
7,099,926	B1	8/2006	Ims et al.	
7,103,911	B2	9/2006	Spies et al.	
7,107,185	B1	9/2006	Yemini et al.	
7,107,269	B2	9/2006	Arlein et al.	
7,107,416	B2	9/2006	Stuart et al.	
7,113,594	B2	9/2006	Boneh et al.	
7,116,785	B2	10/2006	Okaue	
7,117,322	B2	10/2006	Hochberg et al.	
7,120,635	B2	10/2006	Bhide et al.	
7,120,757	B2	10/2006	Tsuge	
7,124,164	B1	10/2006	Chemtob	
7,126,957	B1	10/2006	Isukapalli et al.	
7,130,964	B2	10/2006	Ims et al.	
7,131,071	B2	10/2006	Gune et al.	
7,134,041	B2	11/2006	Murray et al.	
7,136,903	B1	11/2006	Phillips et al.	
7,139,399	B1	11/2006	Zimmermann	
7,140,044	B2	11/2006	Redlich et al.	
7,145,898	B1	12/2006	Elliott	
7,146,388	B2	12/2006	Stakutis et al.	
7,146,498	B1	12/2006	Takechi et al.	
7,159,036	B2	1/2007	Hinchliffe et al.	
7,168,094	B1	1/2007	Fredell	
7,171,557	B2	1/2007	Kallahalla et al.	
7,174,563	B1	2/2007	Brownlie et al.	
7,177,427	B1	2/2007	Komuro et al.	
7,177,839	B1	2/2007	Claxton et al.	
7,178,033	B1	2/2007	Garcia	
7,181,017	B1	2/2007	Nagel et al.	
7,185,364	B2	2/2007	Knouse et al.	
7,187,033	B2	3/2007	Pendharkar	
7,188,181	B1	3/2007	Squier et al.	
7,194,764	B2	3/2007	Martherus et al.	
7,197,638	B1	3/2007	Grawrock et al.	
7,200,747	B2	4/2007	Kallahalla et al.	
7,203,317	B2	4/2007	Kallahalla et al.	
7,203,968	B2	4/2007	Asano et al.	
7,219,230	B2	5/2007	Riedel et al.	
7,224,795	B2	5/2007	Takada et al.	
7,225,256	B2	5/2007	Villavicencio	
7,227,953	B2	6/2007	Shida	
7,233,948	B1	6/2007	Shamoon et al.	
7,237,002	B1	6/2007	Estrada et al.	
7,249,044	B2	7/2007	Kumar et al.	
7,249,251	B2	7/2007	Todd et al.	
7,260,555	B2	8/2007	Rossmann et al.	
7,265,764	B2	9/2007	Alben et al.	
7,266,684	B2	9/2007	Jancula	
7,280,658	B2	10/2007	Amini et al.	
7,281,272	B1	10/2007	Rubin et al.	
7,287,055	B2	10/2007	Smith et al.	
7,287,058	B2	10/2007	Loveland et al.	
7,290,148	B2	10/2007	Tozawa et al.	
7,308,702	B1	12/2007	Thomsen et al.	
7,313,824	B1	12/2007	Bala et al.	
7,319,752	B2	1/2008	Asano et al.	
7,340,600	B1	3/2008	Corella	
7,343,488	B2	3/2008	Yadav	
7,359,517	B1	4/2008	Rowe	
7,362,868	B2	4/2008	Madoukh et al.	
7,380,120	B1	5/2008	Garcia	
7,383,586	B2	6/2008	Cross et al.	
7,386,529	B2	6/2008	Kiessig et al.	
7,386,599	B1	6/2008	Piersol et al.	
7,401,220	B2	7/2008	Bolosky et al.	
7,406,596	B2	7/2008	Tararukhina et al.	
7,415,608	B2	8/2008	Bolosky et al.	
7,434,048	B1	10/2008	Shapiro et al.	
7,454,612	B2	11/2008	Bolosky et al.	
7,461,157	B2	12/2008	Ahlard et al.	
7,461,405	B2	12/2008	Boudreault et al.	
7,478,243	B2	1/2009	Bolosky et al.	
7,478,418	B2	1/2009	Supramaniam et al.	
7,484,245	B1	1/2009	Friedman et al.	
7,496,959	B2	2/2009	Adelstein et al.	
7,509,492	B2	3/2009	Boyen et al.	
7,512,810	B1	3/2009	Ryan	
7,539,867	B2	5/2009	Bolosky et al.	
7,555,558	B1	6/2009	Kenrich et al.	
7,562,232	B2	7/2009	Zuili et al.	
7,565,683	B1	7/2009	Huang et al.	
7,631,184	B2	12/2009	Ryan	
7,681,034	B1	3/2010	Lee et al.	
7,698,230	B1	4/2010	Brown et al.	
7,702,909	B2	4/2010	Vainstein	
7,703,140	B2	4/2010	Nath et al.	
7,707,427	B1	4/2010	Kenrich et al.	
7,729,995	B1	6/2010	Rossmann et al.	
7,730,543	B1	6/2010	Nath et al.	
7,748,045	B2	6/2010	Kenrich et al.	
8,127,366	B2 *	2/2012	Vainstein et al.	726/27
2001/0000265	A1	4/2001	Schreiber et al.	
2001/0011254	A1	8/2001	Clark	
2001/0014882	A1	8/2001	Stefik et al.	
2001/0018743	A1	8/2001	Takuya	
2001/0021255	A1	9/2001	Ishibashi	
2001/0021926	A1	9/2001	Schneck et al.	
2001/0023421	A1	9/2001	Numao et al.	
2001/0032181	A1	10/2001	Jakstadt et al.	
2001/0033611	A1	10/2001	Grimwood et al.	
2001/0034839	A1	10/2001	Karjoth et al.	
2001/0042110	A1	11/2001	Furusawa et al.	
2001/0044903	A1	11/2001	Yamamoto et al.	
2001/0056541	A1	12/2001	Matsuzaki et al.	
2001/0056550	A1	12/2001	Lee	
2002/0003886	A1	1/2002	Hillegass et al.	
2002/0007335	A1	1/2002	Millard et al.	
2002/0010679	A1	1/2002	Felsher	
2002/0013772	A1	1/2002	Peinado	
2002/0016921	A1	2/2002	Olsen et al.	
2002/0016922	A1	2/2002	Richards et al.	
2002/0019935	A1 *	2/2002	Andrew et al.	713/165
2002/0023208	A1	2/2002	Jancula	
2002/0026321	A1	2/2002	Faris et al.	
2002/0027886	A1	3/2002	Fischer et al.	
2002/0029340	A1	3/2002	Pensak et al.	
2002/0031230	A1	3/2002	Sweet et al.	
2002/0035624	A1	3/2002	Kim	
2002/0036984	A1	3/2002	Chiussi et al.	
2002/0041391	A1	4/2002	Bannai	
2002/0042756	A1	4/2002	Kumar et al.	
2002/0046350	A1	4/2002	Lordemann et al.	
2002/0050098	A1	5/2002	Chan	
2002/0052981	A1	5/2002	Yasuda	
2002/0056042	A1	5/2002	Van Der Kaay et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2002/0062240	A1	5/2002	Morinville
2002/0062245	A1	5/2002	Niu et al.
2002/0062451	A1	5/2002	Scheidt et al.
2002/0069077	A1	6/2002	Brophy et al.
2002/0069272	A1	6/2002	Kim et al.
2002/0069363	A1	6/2002	Winburn
2002/0073320	A1	6/2002	Rinkevich et al.
2002/0077986	A1	6/2002	Kobata et al.
2002/0077988	A1	6/2002	Sasaki et al.
2002/0078239	A1	6/2002	Howard et al.
2002/0078361	A1	6/2002	Giroux et al.
2002/0087479	A1	7/2002	Malcolm
2002/0089602	A1	7/2002	Sullivan
2002/0091532	A1	7/2002	Viets et al.
2002/0091745	A1	7/2002	Ramamurthy et al.
2002/0091928	A1	7/2002	Bouchard et al.
2002/0093527	A1	7/2002	Sherlock et al.
2002/0099947	A1	7/2002	Evans
2002/0112035	A1	8/2002	Carey et al.
2002/0112048	A1	8/2002	Gruyer et al.
2002/0120851	A1	8/2002	Clarke
2002/0124180	A1	9/2002	Hagman
2002/0129158	A1	9/2002	Zhang et al.
2002/0129235	A1	9/2002	Okamoto et al.
2002/0133500	A1	9/2002	Arlein et al.
2002/0133699	A1	9/2002	Pueschel
2002/0138571	A1	9/2002	Trinon et al.
2002/0138726	A1	9/2002	Sames et al.
2002/0138762	A1	9/2002	Horne
2002/0143710	A1	10/2002	Liu
2002/0143906	A1	10/2002	Tormasov et al.
2002/0150239	A1	10/2002	Carny et al.
2002/0152302	A1	10/2002	Motoyama et al.
2002/0156726	A1	10/2002	Kleckner et al.
2002/0157016	A1	10/2002	Russell et al.
2002/0162104	A1	10/2002	Raike et al.
2002/0165870	A1	11/2002	Chakraborty et al.
2002/0166053	A1	11/2002	Wilson
2002/0169963	A1	11/2002	Seder et al.
2002/0169965	A1	11/2002	Hale et al.
2002/0172367	A1	11/2002	Mulder et al.
2002/0174030	A1	11/2002	Praisner et al.
2002/0174109	A1	11/2002	Chandy et al.
2002/0174415	A1	11/2002	Hines
2002/0176572	A1	11/2002	Ananth
2002/0178271	A1	11/2002	Graham et al.
2002/0184217	A1	12/2002	Bisbee et al.
2002/0184488	A1	12/2002	Amini et al.
2002/0194484	A1	12/2002	Bolosky et al.
2002/0198798	A1	12/2002	Ludwig et al.
2003/0005168	A1	1/2003	Leerssen et al.
2003/0009685	A1	1/2003	Choo et al.
2003/0014391	A1	1/2003	Evans et al.
2003/0023559	A1	1/2003	Choi et al.
2003/0026431	A1	2/2003	Hammersmith
2003/0028610	A1	2/2003	Pearson
2003/0033528	A1	2/2003	Ozog et al.
2003/0037029	A1	2/2003	Holenstein et al.
2003/0037133	A1	2/2003	Owens
2003/0037237	A1	2/2003	Abgrall et al.
2003/0037253	A1	2/2003	Blank et al.
2003/0046176	A1	3/2003	Hynes
2003/0046238	A1	3/2003	Nonaka et al.
2003/0046270	A1	3/2003	Leung et al.
2003/0050919	A1	3/2003	Brown et al.
2003/0051039	A1	3/2003	Brown et al.
2003/0056139	A1	3/2003	Murray et al.
2003/0061482	A1	3/2003	Emmerichs
2003/0061506	A1	3/2003	Cooper
2003/0074580	A1	4/2003	Knouse et al.
2003/0078959	A1	4/2003	Yeung et al.
2003/0079175	A1	4/2003	Limantsev
2003/0081784	A1	5/2003	Kallahalla et al.
2003/0081785	A1	5/2003	Boneh et al.
2003/0081787	A1	5/2003	Kallahalla et al.
2003/0081790	A1	5/2003	Kallahalla et al.
2003/0088517	A1	5/2003	Medoff
2003/0088783	A1	5/2003	DiPierro
2003/0093457	A1	5/2003	Goldick
2003/0095552	A1	5/2003	Bernhard et al.
2003/0099248	A1	5/2003	Speciner
2003/0101072	A1	5/2003	Dick et al.
2003/0110169	A1	6/2003	Zuili
2003/0110266	A1	6/2003	Rollins et al.
2003/0110280	A1	6/2003	Hinchliffe et al.
2003/0110397	A1	6/2003	Supramaniam
2003/0115146	A1	6/2003	Lee et al.
2003/0115218	A1	6/2003	Bobbitt et al.
2003/0115570	A1	6/2003	Bisceglia
2003/0120601	A1	6/2003	Ouye
2003/0120684	A1	6/2003	Zuili et al.
2003/0126434	A1	7/2003	Lim et al.
2003/0132949	A1	7/2003	Fallon et al.
2003/0154296	A1	8/2003	Noguchi et al.
2003/0154381	A1	8/2003	Ouye
2003/0154396	A1	8/2003	Godwin et al.
2003/0154401	A1	8/2003	Hartman et al.
2003/0159048	A1	8/2003	Matsumoto et al.
2003/0159066	A1	8/2003	Staw et al.
2003/0163704	A1	8/2003	Dick et al.
2003/0165117	A1	9/2003	Garcia-Luna-Aceves et al.
2003/0172280	A1	9/2003	Scheidt et al.
2003/0177070	A1	9/2003	Viswanath et al.
2003/0177378	A1	9/2003	Wittkotter
2003/0182310	A1	9/2003	Charnock et al.
2003/0182579	A1	9/2003	Leporini et al.
2003/0182584	A1	9/2003	Banes et al.
2003/0191938	A1	10/2003	Woods et al.
2003/0196096	A1	10/2003	Sutton
2003/0197729	A1	10/2003	Denoue et al.
2003/0200202	A1	10/2003	Hsiao et al.
2003/0204692	A1	10/2003	Tamer et al.
2003/0208485	A1	11/2003	Castellanos
2003/0217264	A1	11/2003	Martin et al.
2003/0217281	A1	11/2003	Ryan
2003/0217282	A1	11/2003	Henry
2003/0217333	A1	11/2003	Smith et al.
2003/0220999	A1	11/2003	Emerson
2003/0222141	A1	12/2003	Vogler et al.
2003/0226013	A1	12/2003	Dutertre
2003/0233650	A1	12/2003	Zaner et al.
2004/0022390	A1	2/2004	McDonald et al.
2004/0025037	A1	2/2004	Hair
2004/0039781	A1	2/2004	LaVallee et al.
2004/0041845	A1	3/2004	Alben et al.
2004/0049702	A1	3/2004	Subramaniam et al.
2004/0064507	A1	4/2004	Sakata et al.
2004/0064710	A1	4/2004	Vainstein
2004/0068524	A1	4/2004	Aboulhosn et al.
2004/0068664	A1	4/2004	Nachenberg et al.
2004/0073660	A1	4/2004	Toomey
2004/0073718	A1	4/2004	Johannessen et al.
2004/0088548	A1	5/2004	Smetters et al.
2004/0098580	A1	5/2004	DeTreville
2004/0103202	A1	5/2004	Hildebrand et al.
2004/0103280	A1	5/2004	Balfanz et al.
2004/0117371	A1	6/2004	Bhide et al.
2004/0131191	A1	7/2004	Chen et al.
2004/0133544	A1	7/2004	Kiessig et al.
2004/0158586	A1	8/2004	Tsai
2004/0186845	A1	9/2004	Fukui
2004/0193602	A1	9/2004	Liu et al.
2004/0193905	A1	9/2004	Lirov et al.
2004/0193912	A1	9/2004	Li et al.
2004/0199514	A1	10/2004	Rosenblatt et al.
2004/0205576	A1	10/2004	Chikirivao et al.
2004/0215956	A1	10/2004	Venkatachary et al.
2004/0215962	A1	10/2004	Douceur et al.
2004/0243853	A1	12/2004	Swander et al.
2004/0254884	A1	12/2004	Haber et al.
2005/0021467	A1	1/2005	Franzdonk
2005/0021629	A1	1/2005	Cannata et al.
2005/0028006	A1	2/2005	Leser et al.
2005/0039034	A1	2/2005	Doyle et al.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2005/0050098	A1	3/2005	Barnett	
2005/0071275	A1	3/2005	Vainstein et al.	
2005/0071657	A1	3/2005	Ryan	
2005/0071658	A1	3/2005	Nath et al.	
2005/0081029	A1	4/2005	Thornton et al.	
2005/0086531	A1	4/2005	Kenrich	
2005/0091289	A1	4/2005	Shappell et al.	
2005/0091484	A1	4/2005	Thornton et al.	
2005/0097061	A1	5/2005	Shapiro et al.	
2005/0120199	A1	6/2005	Carter	
2005/0138371	A1	6/2005	Supramaniam	
2005/0138383	A1	6/2005	Vainstein	
2005/0168766	A1 *	8/2005	Troyansky et al.	358/1.14
2005/0177716	A1	8/2005	Ginter et al.	
2005/0177858	A1	8/2005	Ueda	
2005/0198326	A1	9/2005	Schlimmer et al.	
2005/0223242	A1	10/2005	Nath	
2005/0223414	A1	10/2005	Kenrich et al.	
2005/0235154	A1	10/2005	Serret-Avila	
2005/0256909	A1	11/2005	Aboulhosn et al.	
2005/0268033	A1	12/2005	Ogasawara et al.	
2005/0273600	A1	12/2005	Seeman	
2005/0283610	A1	12/2005	Serret-Avila et al.	
2005/0288961	A1	12/2005	Tabrizi	
2006/0005021	A1	1/2006	Torrubia-Saez	
2006/0075258	A1	4/2006	Adamson et al.	
2006/0075465	A1	4/2006	Ramanathan et al.	
2006/0093150	A1	5/2006	Reddy et al.	
2006/0101285	A1	5/2006	Chen et al.	
2006/0149407	A1	7/2006	Markham et al.	
2006/0168147	A1	7/2006	Inoue et al.	
2006/0184637	A1	8/2006	Hultgren et al.	
2006/0230437	A1	10/2006	Alexander Boyer et al.	
2006/0277316	A1	12/2006	Wang et al.	
2007/0006214	A1	1/2007	Dubal et al.	
2007/0067837	A1	3/2007	Schuster	
2007/0083575	A1	4/2007	Leung et al.	
2007/0192478	A1	8/2007	Louie et al.	
2007/0193397	A1	8/2007	Corenthin et al.	
2007/0294368	A1	12/2007	Bomgaars et al.	
2008/0075126	A1	3/2008	Yang	
2009/0254843	A1	10/2009	Van Wie et al.	
2010/0047757	A1	2/2010	McCurry et al.	
2010/0199088	A1	8/2010	Nath	

FOREIGN PATENT DOCUMENTS

EP	0 809 170	A1	11/1997
EP	0 913 966	A2	5/1999
EP	0 913 967	A2	5/1999
EP	0 950 941	A2	10/1999
EP	0 950 941	A3	10/1999
EP	1 107 504	A2	6/2001
EP	1 107 504	B1	6/2001
EP	1 130 492	A2	9/2001
EP	1 154 348	A2	11/2001
EP	1 324 565	A1	7/2003
GB	2 328 047	A	2/1999
JP	2001-036517		2/2001
JP	2006-244044	A	9/2006
JP	2009-020720	A	1/2009
WO	WO 96/41288	A	12/1996
WO	WO 00/56028	A2	9/2000
WO	WO 01/61438	A2	8/2001
WO	WO 01/63387	A2	8/2001
WO	WO 01/63387	A3	8/2001
WO	WO 01/77783	A2	10/2001
WO	WO 01/78285	A1	10/2001
WO	WO 01/84271	A2	11/2001

OTHER PUBLICATIONS

"Features of EFS" from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

"Windows 2000 EFS" in the Apr. 1999 issue of Windows NT magazine.

"How EFS work," from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

"Inside Encryping file system," from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

"Inside Encryping file system," Part 2, from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

"Security with Encryping File System," from MSDN Oct. 2001 version, exact publication date is unknown but believed prior to Dec. 12, 2001.

Crocker, Steven Toye, "Effectuating access policy changes to designated places for secured files," U.S. Appl. No. 10/259,075, filed Sep. 27, 2002.

Crocker, Steven Toye, "Multi-level cryptographic transformations for securing digital assets ," U.S. Appl. No. 10/404,566, filed Mar. 31, 2003.

Expiration Mechanism for Chipcards, IBM Technical Disclosure Bulletin, Oct. 1, 2001, UK.

Kenrich, Michael Frederick, "Multi-Level File Digest", U.S. Appl. No. 10/894,493, filed Jul. 19, 2004.

Kinghorn, Gary Mark, "Method and system for protecting electronic data in enterprise environment," U.S. Appl. No. 10/159,220, filed May 31, 2002.

McDaniel et al. "Antigone: A Flexible Framework for Secure Group Communication," Proceedings of the 8th USENIX Security Symposium, Aug. 23, 1999.

Nath, Satyajit, "Method and system for securing digital assets using content type designations," U.S. Appl. No. 10/405,587, filed Apr. 1, 2003.

Prakash, Nalini J., "Method and apparatus for securing/unsecuring files by file crawling," U.S. Appl. No. 10/325,102, filed Dec. 20, 2002.

Rossmann, Alain, "Hybrid systems for securing digital assets," U.S. Appl. No. 10/325,013, filed Dec. 20, 2002.

Stallings, William, "Cryptography and Network Security: Principles and Practice," 1999, pp. 333-337, Second Edition, Prentice Hall, Upper Saddle River, New Jersey.

"Affect," The American Heritage Dictionary of the English Langaage, Fourth Edition, Houghton Mifflin Company, 2002. Retrieved May 4, 2006 from http://dictionary.reference.com/search?q=affect.

Microsoft Windows 200 server. Windows 2000 Group Policy White Paper, 2000.

Symantec. Norton Antivirus Corporate Edition Implementation Guide, 1999.

A Real-Time Push-Pull Communications Model for Distributed Real-Time and Multimedia Systems, Jan. 1999, School of Computer Sciences Carnegie Mellon University, Kanaka Juvva, Raj Rajkumar.

U.S. Appl. No. 10/889,685, entitled "Method and Apparatus for Controlling the Speed Ranges of a Machine" inventor Thomas, Jul. 13, 2004, 18 pgs.

U.S. Appl. No. 10/028,397, entitled "Method and system for restricting use of a clipboard application," inventor Zuili, Dec. 21, 2001, 38 pgs.

U.S. Appl. No. 10/368,277, entitled "Method and apparatus for uniquely identifying files," inventor Ouye, Feb. 18, 2003, 25 pgs.

U.S. Appl. No. 10/327,320, entitled "Security system with staging capabilities" inventor Vainstein, Dec. 20, 2002, 39 pgs.

U.S. Appl. No. 10/286,524, entitled "Security system that uses indirect password-based encrypytion," inventor Gutnik, Nov. 1, 2002, 38 pgs.

U.S. Appl. No. 10/242,185, entitled "Method and system for protecting encrypyted files transmitted over a network" inventor Ryan, Sep. 11, 2002, 33 pgs.

U.S. Appl. No. 10/642,041, entitled "Method and system for fault-tolerant transfer of files across a network" inventor Kenrich, Aug. 15, 2003, 32 pgs.

U.S. Appl. No. 10/610,832, entitled "Method and system for enabling users of a group shared across multiple file security systems to access secured files" inventors Ryan, Jun. 30, 2003, 33 pgs.

(56) **References Cited**

OTHER PUBLICATIONS

U.S. Appl. No. 10/448,806, entitled "Method and System for Using Remote Headers to Secure Electronic Files" inventor Ryan, May 30, 2003, 35 pgs.

U.S. Appl. No. 10/074,194, entitled "Methods for identifying compounds that inhibit or reduce PTP1B expressions" inventor Rondinone, Feb. 12, 2002, 69 pgs.

U.S. Appl. No. 10/074,804, entitled "Secured Data Format for Access Control," inventor Garcia, Feb. 12, 2002, 108 pgs.

U.S. Appl. No. 10/075,194, entitled "System and Method for Providing Multi-location Access Management to Secured Items," inventor Vainstein et al., Feb. 12, 2002, 110 pgs.

U.S. Appl. No. 10/074,996, entitled "Method and Apparatus for Securing Electronic Data," inventor Lee et al., Feb. 12, 2002, 111 pgs.

U.S. Appl. No. 10/074,825, entitled "Method and Apparatus for Accessing Secured Electronic Data Off-line," inventor Lee et al., Feb. 12, 2002, 108 pgs.

U.S. Appl. No. 10/105,532, entitled "System and Method for Providing Different Levels of Key Security for Controlling Access to Secured Items," inventor Hildebrand et al., Mar. 20, 2002, 86 pgs.

U.S. Appl. No. 10/186,203, entitled "Method and System for Implementing Changes to Security Policies in a Distributed Security System," inventor Huang, Jun. 26, 2002, 65 pgs.

U.S. Appl. No. 10/201,756, entitled "Managing Secured Files in Designated Locations," inventor Alain, Jul. 22, 2002, 121 pgs.

U.S. Appl. No. 10/206,737, entitled "Method and System for Updating Keys in a Distributed Security System," inventor Hildebrand, Jul. 26, 2002, 60 pgs.

U.S. Appl. No. 10/246,079, entitled "Security System for Generating Keys from Access rules in a Decentralized Manner and Methods Therefore," inventor Hildebrand, Sep. 17, 2002, 78 pgs.

U.S. Appl. No. 10/259,075, entitled "Effectuating Access Policy Changes to Designated Places for Secured Files," inventor Crocker, Sep. 27, 2002, 60 pgs.

U.S. Appl. No. 10/286,575, entitled "Method and Architecture for Providing Access to Secured Data from Non-Secured Clients," inventor Vainstein, Nov. 1, 2002, 46 pgs.

U.S. Appl. No. 10/295,363, entitled "Security System Using Indirect Key Generation from Access Rules and Methods Therefore," inventor Vainstein, Nov. 15, 2002, 70 pgs.

U.S. Appl. No. 11/889,310, entitled "Methods and Systems for Providing Access Control to Electronic Data," inventor Rossmann, Aug. 10, 2007, 90 pgs.

U.S. Appl. No. 11/797,367, entitled "Method and System for Managing Security Tiers," inventor Vainstein, May 2, 2007, 11 pgs.

Adobe Acrobat 5.0 Classroom in a Book, Adobe Press, Jun. 26, 2001, pp. 1-4.

Adobe Acrobat Security Settings, Acrobat 7.0, Nov. 15, 2004, pp. 1-4.

"Security Options". Dec. 20, 2001. DC & Co. pp. 1-2.

Microsoft Press Computer Dictionary, 1997, Microsoft Press, Third Edition, p. 426.

Search Report, completion date May 8, 2003, for European Patent Application No. EP 02 25 8530, 2 pages.

Search Report, completion date Oct. 2, 2003, for European Patent Application No. EP 02 25 8531, 2 pages.

Search Report, completion date Apr. 14, 2005, for European Patent Application No. EP 02 25 8533, 2 pages.

Search Report, completion date Mar. 16, 2005, for European Patent Application No. EP 02 25 8534, 2 pages.

Search Report, completion date Mar. 2, 2005, for European Patent Application No. EP 02 25 8535, 2 pages.

Search Report, completion date Mar. 3, 2005, for European Patent Application No. EP 02 25 8537, 2 pages.

Search Report, completion date May 12, 2005, for European Patent Application No. EP 02 25 8539, 2 pages.

Search Report, completion date Jul. 6, 2005, for European Patent Application No. EP 02 25 8529, 4 pages.

Search Report, completion date Oct. 8, 2003, for European Patent Application No. EP 02 25 8536, 2 pages.

Search Report, completion date May 8, 2003, for European Patent Application No. EP 02 25 8540, 2 pages.

Examination Report, completion date Jun. 18, 2008, for European Patent Application No. EP 02 258 532.7-1244, 6 pgs.

Office Action, dated May 10, 2005, for European Patent Application No. 02258532.7, 5 pgs.

Office Action, dated Dec. 5, 2006, for European Patent Application No. 02258532.7, 5 pgs.

Boneh et al., "Hierarchical Identity Based Encryption with Constant Size Ciphertext," Advances in Cryptology—EUROCRYPT 2005, vol. 3493, Jun. 20, 2005, pp. 440-456.

Boneh et al., "IBE Secure E-mail," Stanford University, Apr. 8, 2002, http://crypto.stanford.edu/ibe/.

Curtis et al., "Securing the Global, Remote, Mobile User," 1999 John Wiley & Sons, Ltd., Int. J. Network Mgmt. 9, pp. 9-21.

"Columns Archives," Microsoft TechNet, Professor Windows, technet.microsoft.com/enus/library/bb878075.aspx, retrieved on Dec. 3, 2009.

"Columns," Microsoft TechNet http://web.archive.org/web/20021014225142/www.microsoft.com/techneUcolumns/default. asp Oct. 14, 2002, Retrieved from web.archive.org on Dec. 3, 2009.

"eXPeriencing Remote Assistance" Microsoft TechNet—Professor Windows Oct. 2002 Oct. 15, 2002 http://web.archive.org/web/20021015165237/www.microsoft.com/techneUcolumns/proofwin/, Retrieved from web.archive.org on Dec. 3, 2009.

"Migrating Accounts From Windows NT 4.0 Domains to Windows 2000," Microsoft TechNet—Professor Windows Apr. 2002, http://web.archive.org/web/20020415004611/www. m icrosoft.com/tech netlcolu mns/profwin/, Apr. 15, 2002.

"Scripting Your Windows 2000 Network, Part 1" Microsoft TechNet—Professor Windows Jun. 2002, http://web.archive.org/web/2002062205555532/www.microsoft.com/techneUcolumns/profwin/ Retrieved from web.archive.org on Dec. 3, 2009.

"Way-Back Machine" weh.archive.org, http://web.archive.org/web/*/http://www.microsoft.com/technetlcolumns/profwin/, Retrieved on Dec. 3, 2009.

English language translation (unverified, machine-generated) of Japanese Patent Publication No. JP 2006-244044, Japanese Patent Office, Patent & Utility Model Gazette DB, 2006.

English language translation (unverified, machine-generated) of Japanese Patent Publication No. 2009-020720, Japanese Patent Office, Patent & Utility Model Gazette DB, 2009.

English language abstract for Japanese Appl. No. 2001-036517, filed Feb. 9, 2001, 1 pg.

Botha et al., "Access Control in Document-Centric Workflow Systems—An Agent-Based Approach," Computers & Security, vol. 20:6, Sep. 2001, pp. 525-532.

Botha et al., "Separation of Duties for Access Control Enforcement in Workflow Environments," IBM, 2001.

Adobe Acrobat Security Settings, Acrobat 7.0, Nov. 15, 2004; pp. 1-4.

U.S. Appl. No. 60/475,109, Leser, et al., "Method for Enforcing and Managing Usage Rights of Digital Data Objects in Dynamic, Distributed and Collaborative Contexts", filed Jun. 2, 2003.

VeriSign, Inc., "Secure Sockets Layer (SSL): How it Works" (Jan. 8, 2008), http://www.verisign.com/ssl/ssl-information-center/how-ssl-security-works, pp. 1-2.

* cited by examiner

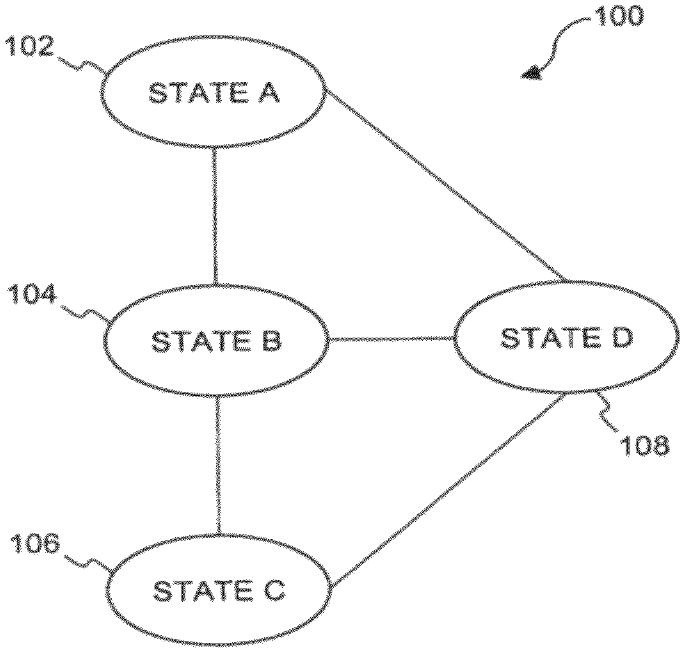


FIG. 1

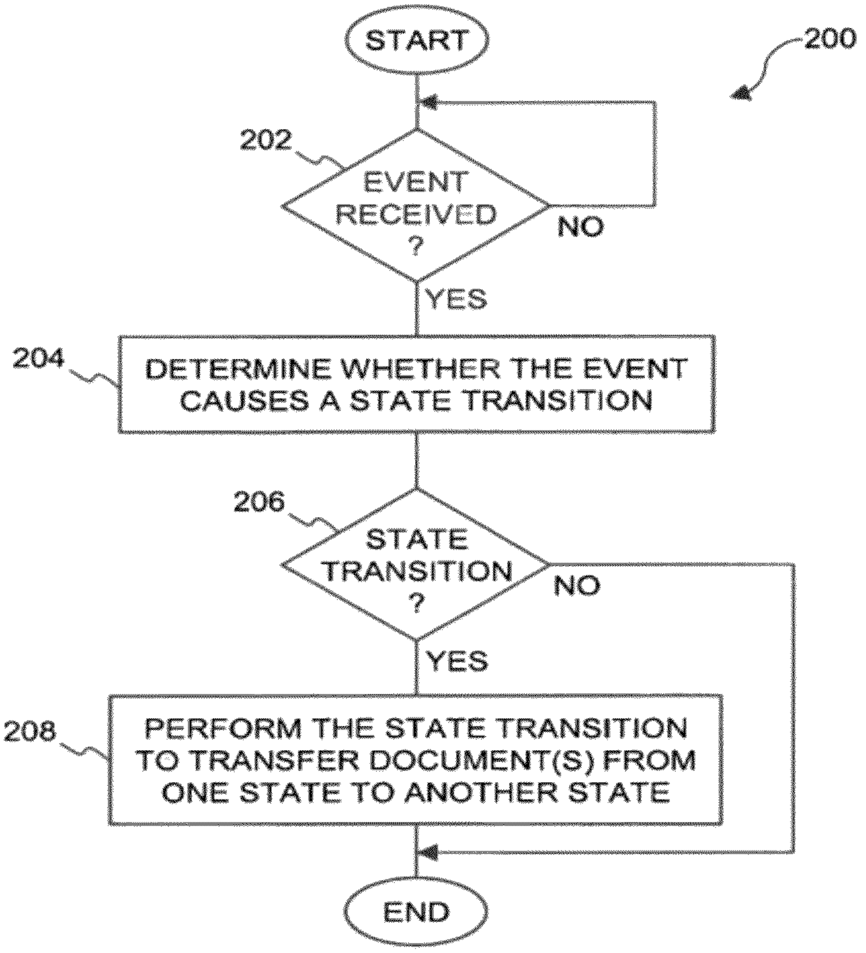

START
200
202
EVENT RECEIVED ?
NO
YES
204
DETERMINE WHETHER THE EVENT CAUSES A STATE TRANSITION
206
STATE TRANSITION ?
NO
YES
208
PERFORM THE STATE TRANSITION TO TRANSFER DOCUMENT(S) FROM ONE STATE TO ANOTHER STATE
END

FIG. 2

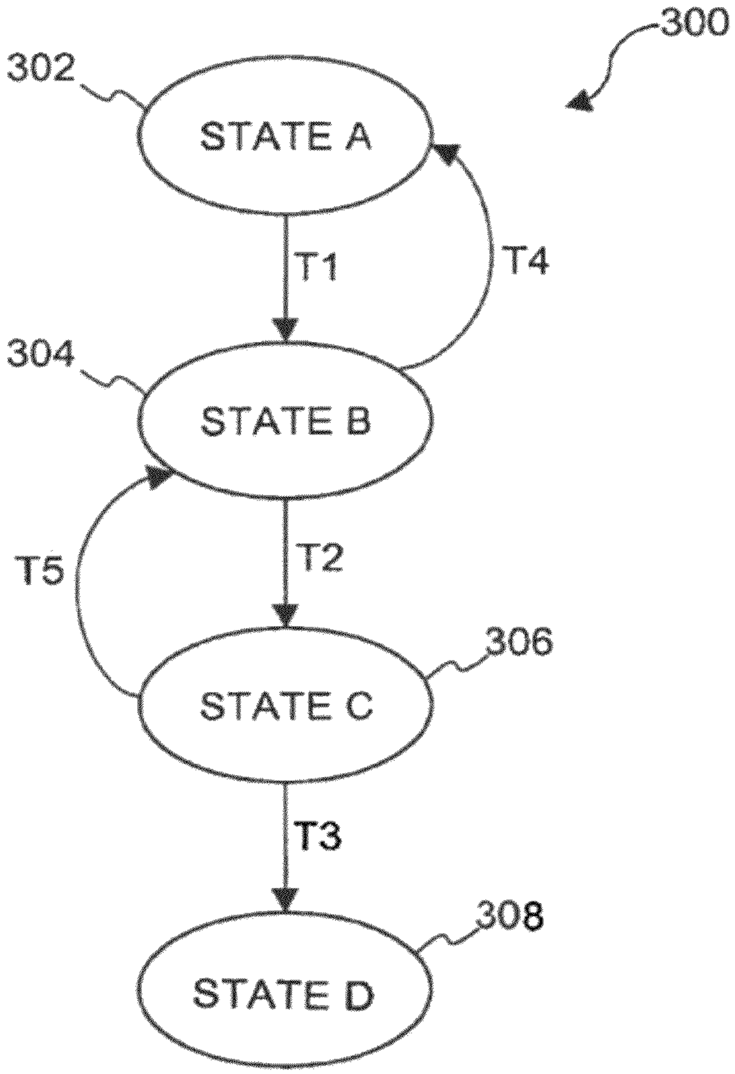


FIG. 3

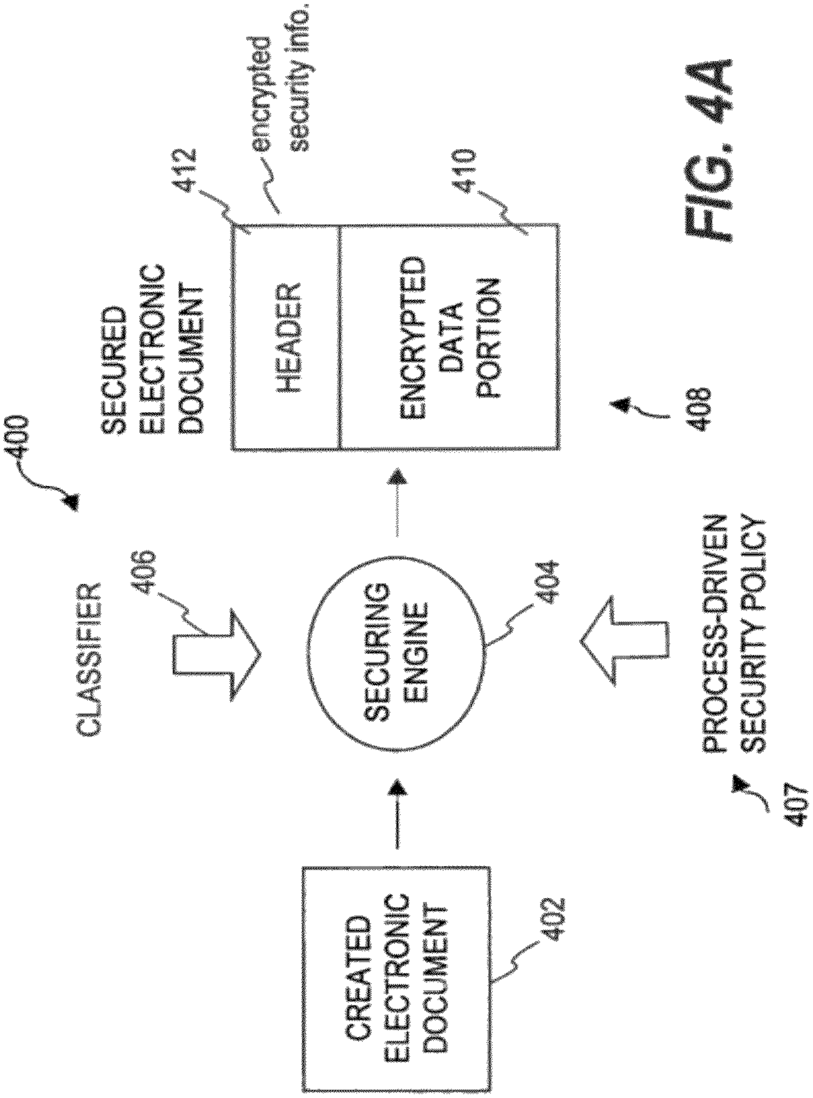

400
CLASSIFIER
406
SECURED ELECTRONIC DOCUMENT
412
encrypted security info.
HEADER
ENCRYPTED DATA PORTION
410
408
CREATED ELECTRONIC DOCUMENT
402
SECURING ENGINE
404
PROCESS-DRIVEN SECURITY POLICY
407

FIG. 4A

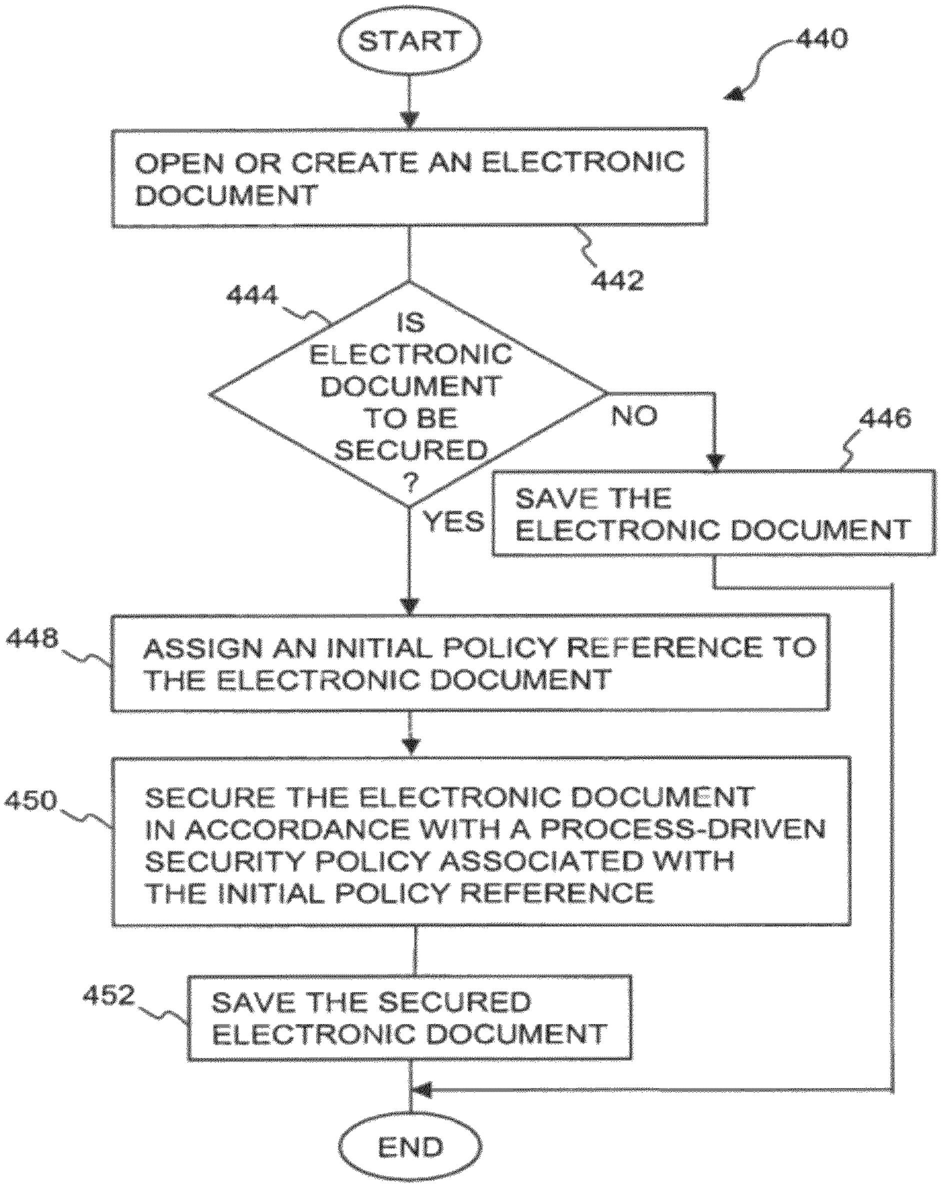

START
440
OPEN OR CREATE AN ELECTRONIC DOCUMENT
442
444
IS ELECTRONIC DOCUMENT TO BE SECURED ?
NO
446
SAVE THE ELECTRONIC DOCUMENT
YES
448
ASSIGN AN INITIAL POLICY REFERENCE TO THE ELECTRONIC DOCUMENT
450
SECURE THE ELECTRONIC DOCUMENT IN ACCORDANCE WITH A PROCESS-DRIVEN SECURITY POLICY ASSOCIATED WITH THE INITIAL POLICY REFERENCE
452
SAVE THE SECURED ELECTRONIC DOCUMENT
END

FIG. 4B

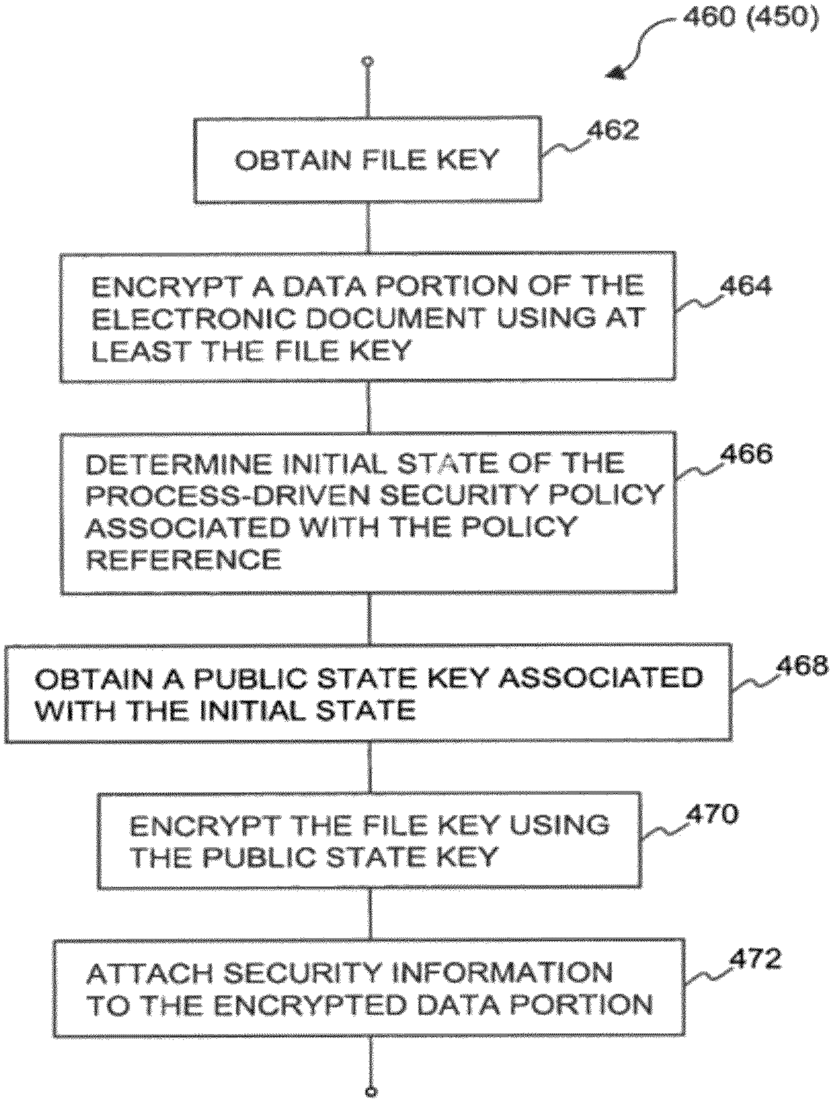

460 (450)
OBTAIN FILE KEY
462
ENCRYPT A DATA PORTION OF THE ELECTRONIC DOCUMENT USING AT LEAST THE FILE KEY
464
DETERMINE INITIAL STATE OF THE PROCESS-DRIVEN SECURITY POLICY ASSOCIATED WITH THE POLICY REFERENCE
466
OBTAIN A PUBLIC STATE KEY ASSOCIATED WITH THE INITIAL STATE
468
ENCRYPT THE FILE KEY USING THE PUBLIC STATE KEY
470
ATTACH SECURITY INFORMATION TO THE ENCRYPTED DATA PORTION
472

FIG. 4C

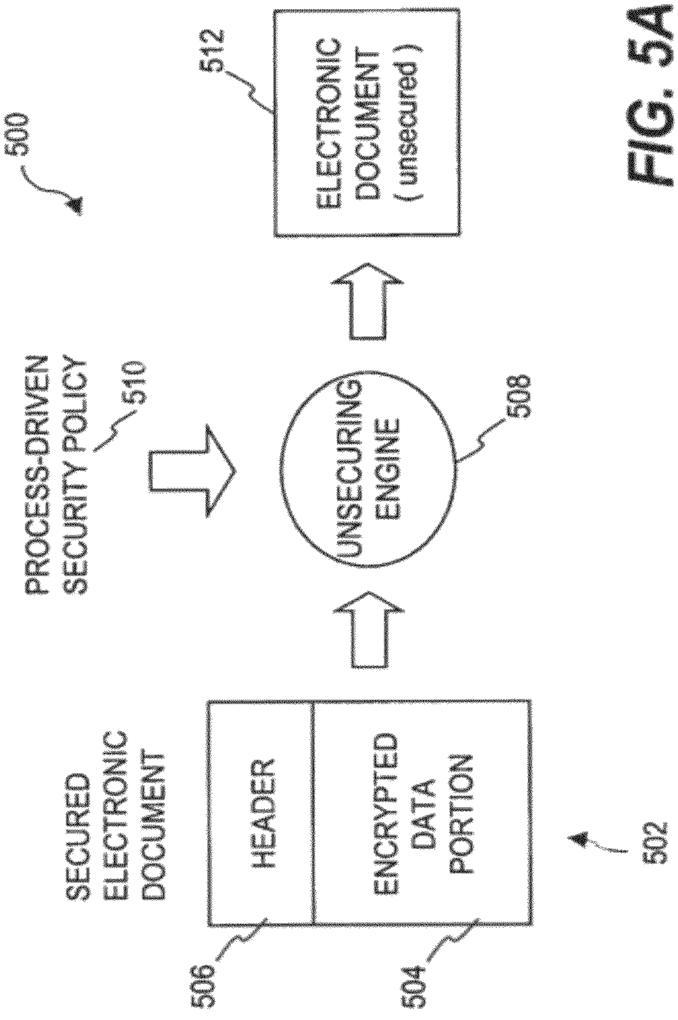

500
SECURED ELECTRONIC DOCUMENT
HEADER
ENCRYPTED DATA PORTION
506
504
502
PROCESS-DRIVEN SECURITY POLICY
510
UNSECURING ENGINE
508
ELECTRONIC DOCUMENT (unsecured)
512

FIG. 5A

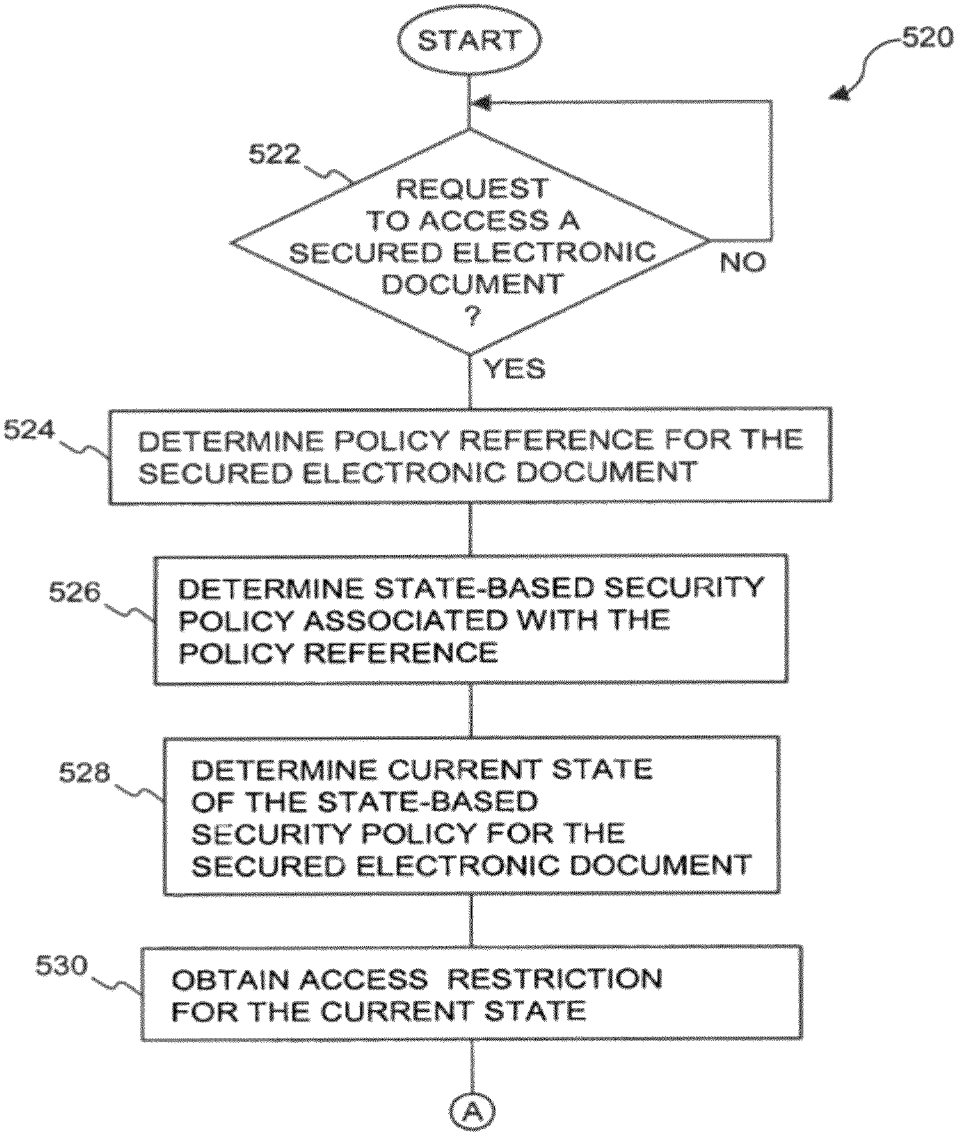

START
520
522
REQUEST TO ACCESS A SECURED ELECTRONIC DOCUMENT ?
NO
YES
524
DETERMINE POLICY REFERENCE FOR THE SECURED ELECTRONIC DOCUMENT
526
DETERMINE STATE-BASED SECURITY POLICY ASSOCIATED WITH THE POLICY REFERENCE
528
DETERMINE CURRENT STATE OF THE STATE-BASED SECURITY POLICY FOR THE SECURED ELECTRONIC DOCUMENT
530
OBTAIN ACCESS RESTRICTION FOR THE CURRENT STATE
A

FIG. 5B

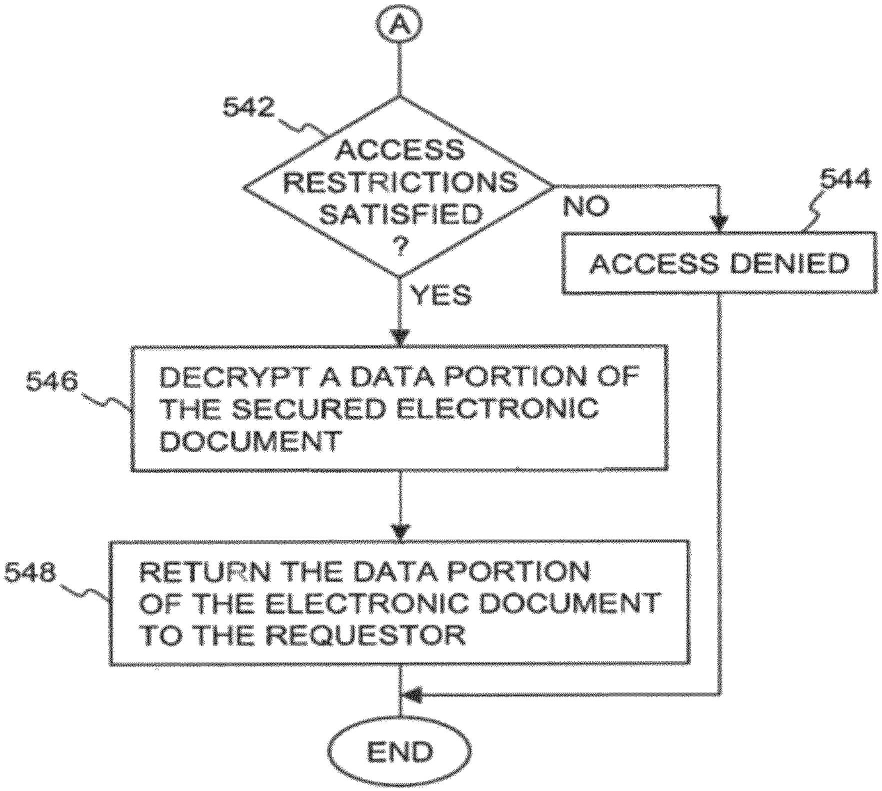

A
542
ACCESS RESTRICTIONS SATISFIED ?
NO
YES
544
ACCESS DENIED
546
DECRYPT A DATA PORTION OF THE SECURED ELECTRONIC DOCUMENT
548
RETURN THE DATA PORTION OF THE ELECTRONIC DOCUMENT TO THE REQUESTOR
END

FIG. 5C

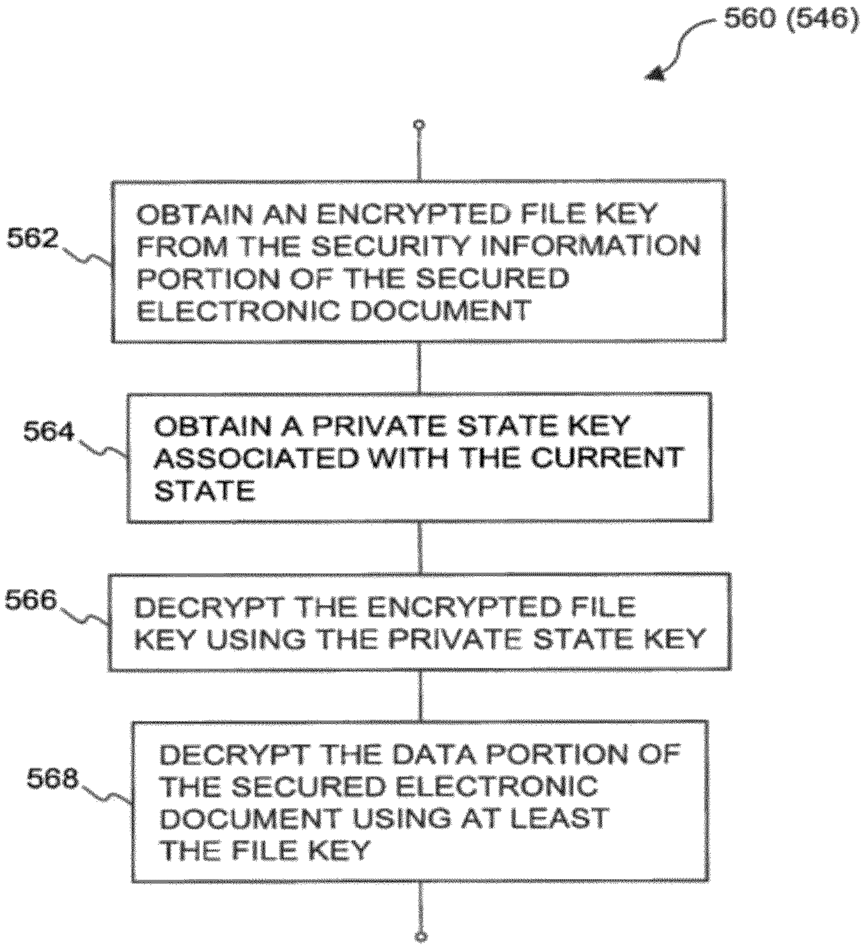

560 (546)
562
OBTAIN AN ENCRYPTED FILE KEY FROM THE SECURITY INFORMATION PORTION OF THE SECURED ELECTRONIC DOCUMENT
564
OBTAIN A PRIVATE STATE KEY ASSOCIATED WITH THE CURRENT STATE
566
DECRYPT THE ENCRYPTED FILE KEY USING THE PRIVATE STATE KEY
568
DECRYPT THE DATA PORTION OF THE SECURED ELECTRONIC DOCUMENT USING AT LEAST THE FILE KEY

FIG. 5D

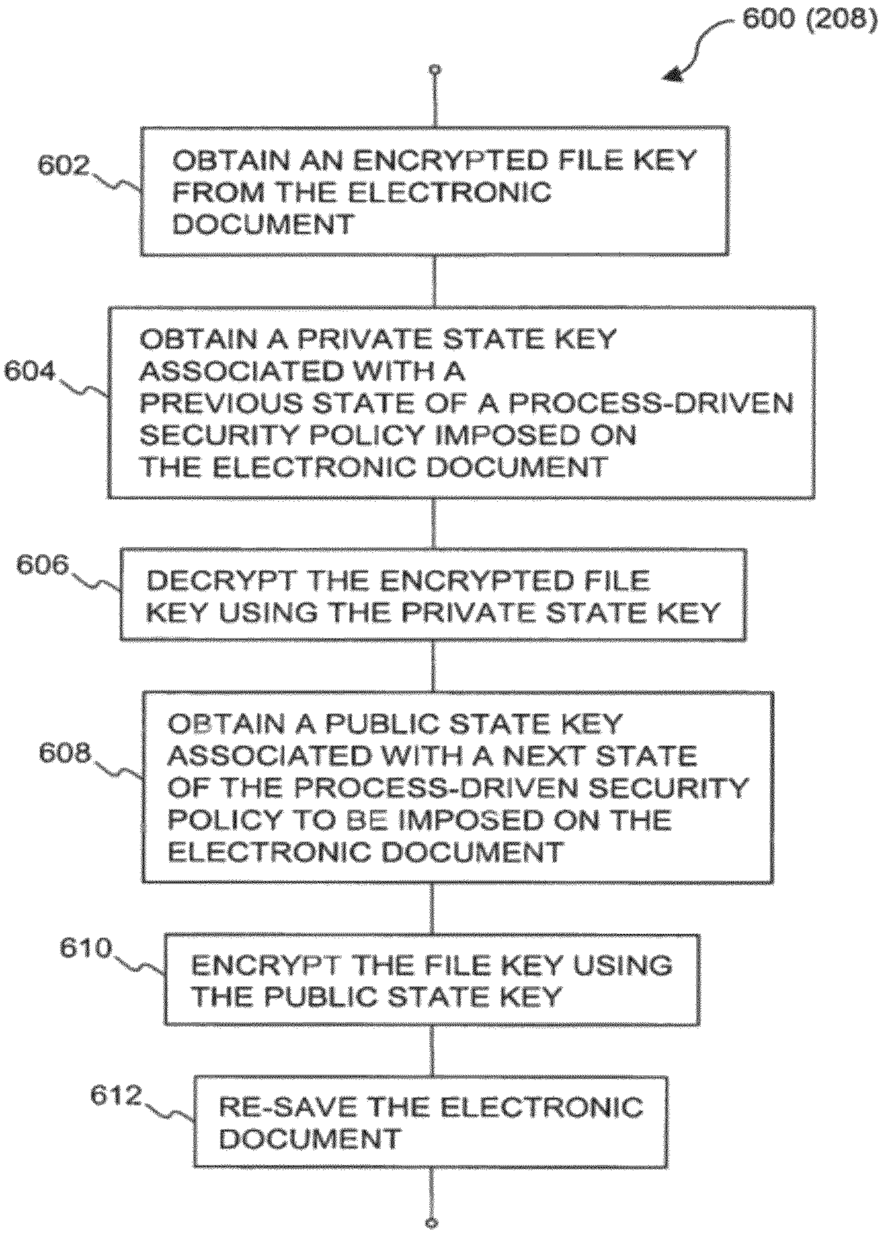

600 (208)
602
OBTAIN AN ENCRYPTED FILE KEY FROM THE ELECTRONIC DOCUMENT
604
OBTAIN A PRIVATE STATE KEY ASSOCIATED WITH A PREVIOUS STATE OF A PROCESS-DRIVEN SECURITY POLICY IMPOSED ON THE ELECTRONIC DOCUMENT
606
DECRYPT THE ENCRYPTED FILE KEY USING THE PRIVATE STATE KEY
608
OBTAIN A PUBLIC STATE KEY ASSOCIATED WITH A NEXT STATE OF THE PROCESS-DRIVEN SECURITY POLICY TO BE IMPOSED ON THE ELECTRONIC DOCUMENT
610
ENCRYPT THE FILE KEY USING THE PUBLIC STATE KEY
612
RE-SAVE THE ELECTRONIC DOCUMENT

FIG. 6

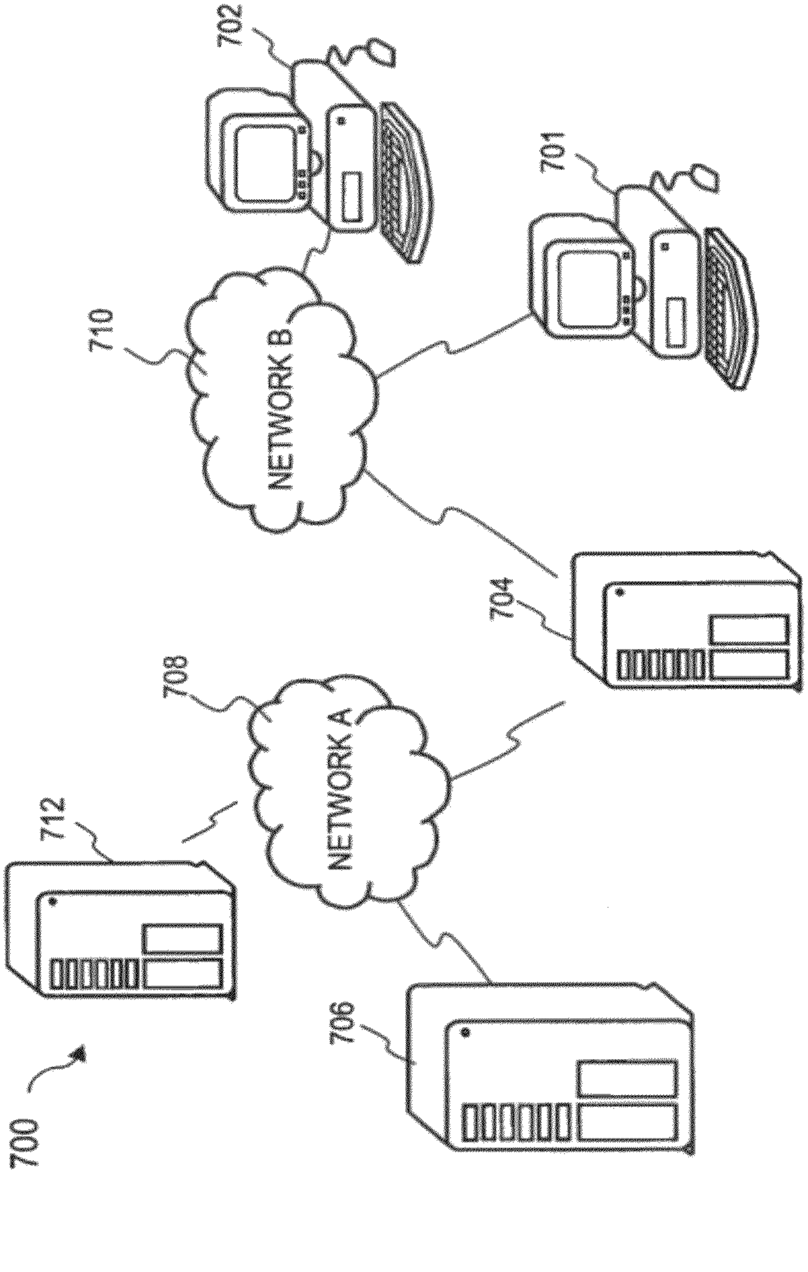


FIG. 7

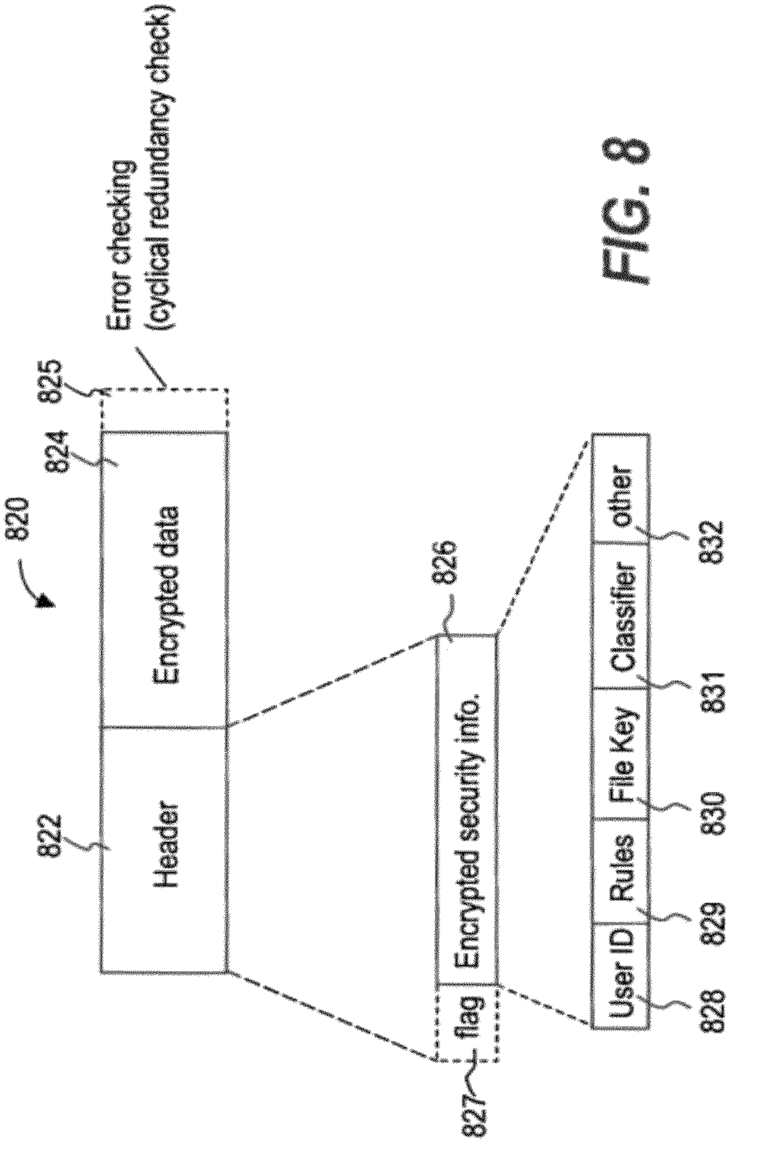

820
822
Header
824
Encrypted data
825
Error checking
(cyclical redundancy check)
826
Encrypted security info.
827
flag
828
User ID
829
Rules
830
File Key
831
Classifier
832
other

FIG. 8

METHOD AND APPARATUS FOR TRANSITIONING BETWEEN STATES OF SECURITY POLICIES USED TO SECURE ELECTRONIC DOCUMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 10/676,474, filed Sep. 30, 2003, now issued as U.S. Pat. No. 8,127,366 and incorporated by reference herein in its entirety, which is related to: (i) U.S. patent application Ser. No. 10/677,049, filed concurrently herewith, and entitled "METHOD AND SYSTEM FOR SECURING DIGITAL ASSETS USING PROCESS-DRNEN SECURITY POLICIES," which is hereby incorporated herein by reference; (ii) U.S. patent application Ser. No. 10/405,587, filed Apr. 1, 2003, and entitled "METHOD AND APPARATUS FOR SECURING DIGITAL ASSETS USING CONTENT TYPE DESIGNATIONS," which is hereby incorporated herein by reference; (iii) U.S. patent application Ser. No. 10/159,537, filed May 5, 2002, and entitled "METHOD AND APPARATUS FOR SECURING DIGITAL ASSETS," which is hereby incorporated herein by reference; and (iv) U.S. patent application Ser. No. 10/127,109, filed Apr. 22, 2002, and entitled "EVALUATION OF ACCESS RIGHTS TO SECURED DIGITAL ASSETS," which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to security systems for data and, more particularly, to security systems that protect data in an inter/intra enterprise environment.

2. Description of Related Art

The Internet is the fastest growing telecommunications medium in history. This growth and the easy access it affords have significantly enhanced the opportunity to use advanced information technology for both the public and private sectors. It provides unprecedented opportunities for interaction and data sharing among businesses and individuals. However, the advantages provided by the Internet come with a significantly greater element of risk to the confidentiality and integrity of information. The Internet is an open, public and international network of interconnected computers and electronic devices. Without proper security means, an unauthorized person or machine may intercept information traveling across the Internet and even gain access to proprietary information stored in computers that interconnect to the Internet.

There are many efforts in progress aimed at protecting proprietary information traveling across the Internet and controlling access to computers carrying the proprietary information. Cryptography allows people to carry over the confidence found in the physical world to the electronic world, thus allowing people to do business electronically without worries of deceit and deception. Every day millions of people interact electronically, whether it is through e-mail, e-commerce (business conducted over the Internet), ATM machines, or cellular phones. The perpetual increase of information transmitted electronically has led to an increased reliance on cryptography.

One of the ongoing efforts in protecting the proprietary information traveling across the Internet is to use one or more cryptographic techniques to secure a private communication session between two communicating computers on the Internet. The cryptographic techniques provide a way to transmit

information across an unsecure communication channel without disclosing the contents of the information to anyone eavesdropping on the communication channel. Using an encryption process in a cryptographic technique, one party can protect the contents of the data in transit from access by an unauthorized third party, yet the intended party can read the encrypted data after using a corresponding decryption process.

A firewall is another security measure that protects the resources of a private network from users of other networks. However, it has been reported that many unauthorized accesses to proprietary information occur from the inside, as opposed to from the outside. An example of someone gaining unauthorized access from the inside is when restricted or proprietary information is accessed by someone within an organization who is not supposed to do so. Due to the open nature of networks, contractual information, customer data, executive communications, product specifications, and a host of other confidential and proprietary intellectual property remain available and vulnerable to improper access and usage by unauthorized users within or outside a supposedly protected perimeter.

Many businesses and organizations have been looking for effective ways to protect their proprietary information. Typically, businesses and organizations have deployed firewalls, Virtual Private Networks (VPNs), and Intrusion Detection Systems (IDS) to provide protection. Unfortunately, these various security means have been proven insufficient to reliably protect proprietary information residing on private networks. For example, depending on passwords to access sensitive documents from within often causes security breaches when the password of a few characters long is leaked or detected. Consequently, various cryptographic means are deployed to provide restricted access to electronic data in security systems.

Various security criteria, such as encryption or decryption keys, are often used to facilitate restricted access to data in security systems. Conventional uses of security criteria provide static assignment of security criteria to electronic resources being secured. However, the assigning of security criteria in a static manner does not permit subsequent alteration of the security criteria under certain conditions. Although an administrator may be able to change the security criteria for an electronic resource that has already been secured, such alteration would be a manual process only available to the administrator. Further, given that an administrator is managing secure electronic resources (e.g., data) for many users, it is not feasible for the administrator to participate in the changing of security criteria for a large volume of electronic resources. Therefore, there is a need to provide more effective ways for security systems to permit security criteria imposed on electronic resources to be changed, thereby altering the security used to protect the electronic resources.

SUMMARY OF THE INVENTION

The invention relates to techniques for dynamically altering security criteria used in a system (e.g., a file security system for an enterprise). The security criteria pertains to keys (or ciphers) used by the file security system to encrypt electronic files to be secured, or to decrypt electronic files already secured. The security criteria can, among other things, include keys that are required to gain access to electronic files. Here, the keys can be changed automatically as electronic files transition between different states of a process-driven security policy. The dynamic alteration of security criteria enhances the flexibility and robustness of the security system. In other words, access restrictions on electronic files can be dependent on the state of the process-driven security policy and enforced in conjunction with one or more cryptographic methods.

According to one aspect of the invention, methods and systems for securing electronic files use process-driven security policies. As an electronic file transitions through a process, access restrictions can automatically change. The process can be defined by a number of states, with each state having different security policies associated therewith. The security policies control, for example, which users are permitted to access the electronic files, or how the electronic files can be accessed. In one embodiment, the access restrictions are imposed by one or more keys that are required to decrypt electronic files that were previously secured. The process can also be referred to as a workflow, where the workflow has a series of states through which files (documents) can move, where different security policies can be imposed at different states.

Another aspect of the invention is that process-driven security policies are enforced or controlled at a server of a file security system. A group of one or more electronic documents are bound together and progress together through states of a process specified by process-driven security policies. The server can automatically and remotely enforce the process-driven security policies on the group of electronic documents.

Still another aspect of the invention is that process-driven security policies are controlled at a client of a file security system. Here, each individual electronic document can be separately and independently bound to process-driven security policies. The process-driven security policies can thus operate at the client with little or no communication with a central server in most cases.

The process-driven security policies typically offer persistent states. Each state can specify a different set of users or groups of users that are permitted access to an electronic document. The states are also independent of the electronic documents themselves.

The invention can be implemented in numerous ways, including as a method, system, device, and computer readable medium. Several embodiments of the invention are discussed below.

As a document security system for restricting access to documents, one embodiment of the invention includes at least: a process-driven security policy that includes a plurality of states and transition rules, each of the states corresponding to one or more access restrictions, and the transition rules specify when the secured document is to transition from one state to another; and an access manager that determines whether access to a secured document is permitted by a requester based on the state and the corresponding one or more access restrictions thereof for the process-driven security policy.

As a method for transitioning at least one secured document through a security-policy state machine having a plurality of states, one embodiment of the invention includes at least the acts of: receiving an event; determining whether the event causes a state transition for the at least one secured document from a former state to a subsequent state of the security-policy state machine; and automatically transitioning from the former state to the subsequent state of the security-policy state machine when the determining determines that the event causes the state transition.

As a method for imposing access restrictions on electronic documents, one embodiment of the invention includes at least the acts of: providing at least one process-driven security policy at a server machine, the process-driven security policy having a plurality of states associated therewith, each of the states having distinct access restrictions; providing a reference to the process-driven security policy at a client machine, the reference referring to the process-driven security policy resident on the server machine; associating the reference to an electronic document; transitioning the process-driven security policy from one state to a current state; and subsequently determining at the server computer whether a requestor is permitted to access the electronic document, the access being based on a current state of the process-driven security policy, the current state being informed to the server computer by sending the reference to the server computer.

As a computer readable medium including at least computer program code for transitioning at least one secured document through a security-policy state machine having a plurality of states, one embodiment of the invention includes at least: computer program code for receiving an event; computer program code for determining whether the event causes a state transition for the at least one secured document from a former state to a subsequent state of the security-policy state machine; and computer program code for automatically transitioning from the former state to the subsequent state of the security-policy state machine when the computer program code for determining determines that the event causes the state transition.

As a computer readable medium including at least computer program code for imposing access restrictions on electronic documents, one embodiment of the invention includes at least: computer program code for providing at least one process-driven security policy at a server machine, the process-driven security policy having a plurality of states associated therewith, each of the states having distinct access restrictions; computer program code for providing a reference to the process-driven security policy at a client machine, the reference referring to the process-driven security policy resident on the server machine; computer program code for associating the reference to an electronic document; computer program code for transforming the process-driven security policy from one state to a current state; and computer program code for determining at the server computer whether a requestor is permitted to access the electronic document, the access being based on a current state of the process-driven security policy, the current state being informed to the server computer by sending the reference to the server computer.

Other objects, features, and advantages of the present invention will become apparent upon examining the following detailed description of an embodiment thereof, taken in conjunction with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the invention will become better understood with regard to the following description, appended claims and accompanying drawings, wherein:

FIG. **1** is a diagram of an exemplary process-driven security policy (PDSP) according to one embodiment of the invention.

FIG. **2** is a flow diagram of a transition process according to one embodiment of the invention.

FIG. **3** illustrates a security policy state machine according to one embodiment of the invention.

FIG. **4**A is a diagram of a document securing system according to one embodiment of the invention.

FIG. **4**B is a flow diagram of a document securing process according to one embodiment of the invention.

FIG. 4C is a detailed flow diagram of an encryption process according to one embodiment of the invention.

FIG. 5A is a diagram of a document unsecuring system according to one embodiment of the invention.

FIGS. 5B and 5C are flow diagrams of a document access process according to one embodiment of the invention.

FIG. 5D is a flow diagram of a decryption process according to one embodiment of the invention.

FIG. 6 is a flow diagram of a transition process according to one embodiment of the invention.

FIG. 7 shows a basic security system in which the invention may be practiced in accordance with one embodiment thereof.

FIG. 8 shows an exemplary data structure of a secured file that may be used in one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The invention relates to techniques for dynamically altering security criteria used in a system (e.g., a file security system for an enterprise). The security criteria pertains to keys (or ciphers) used by the file security system to encrypt electronic files to be secured, or to decrypt electronic files already secured. The security criteria can, among other things, include keys that are required to gain access to electronic files. Here, the keys can be changed automatically as electronic files transition between different states of a process-driven security policy. The dynamic alteration of security criteria enhances the flexibility and robustness of the security system. In other words, access restrictions on electronic files can be dependent on the state of the process-driven security policy.

As used herein, a file may include, but not be limited to, one or more various types of documents, multimedia files, data, executable code, images and texts, and in some cases, a collection of files. Accordingly, a secured file means that an electronic file typically stored or presented in a form that is nearly impossible to read without authorization and authentication. Its purpose is to ensure privacy by keeping the content in a file hidden from anyone for whom it is not intended, even those who may have a copy of the file.

According to one aspect of the invention, methods and systems for securing electronic files use process-driven security policies. As an electronic file transitions through a process, access restrictions can automatically change or remain intact depending on the process. The process can be defined by a number of states, with each state having its corresponding security policies associated therewith. The security policies control, for example, which users are permitted to access the electronic files or how the electronic files can be accessed. In one embodiment, the access restrictions are imposed by one or more keys that are required to decrypt electronic files that were previously secured. The process can also be referred to as a workflow, where the workflow has a series of states through which files (documents) can move, where different security policies can be imposed at different states.

Another aspect of the invention is that process-driven security policies are controlled at a server of a file security system. A group of one or more electronic documents are bound together and progress together through states of a process specified by process-driven security policies. The server can automatically and remotely enforce the process-driven security policies on the group of electronic documents.

Still another aspect of the invention is that process-driven security policies are controlled at a client of a file security system. Here, each individual electronic document can be separately and independently bound to process-driven security policies. The process-driven security policies can thus operate at the client with little or no communication with a central server.

The process-driven security policies typically offer persistent states. Each state can specify a different set of users that are permitted access to an electronic document. The states are also independent of the electronic documents themselves.

Secured files are files that require one or more keys, passwords, access privileges, etc. to gain access to their content. The security is often provided through encryption and access rules. The files, for example, can pertain to documents, multimedia files, data, executable code, images and text. In general, a secured file can only be accessed by authenticated users with appropriate access rights or privileges. In one embodiment, each secured file is provided with a header portion and a data portion, where the header portion contains, or points to, security information. The security information is used to determine whether access to associated data portions of secured files is permitted.

In one embodiment, security information provided with an electronic document controls restrictive access to a data portion which is encrypted. The security information can employ access rules together with cipher keys (e.g., a file key and various other keys) to ensure that only those users with proper access privileges or rights can access the encrypted data portion.

As used herein, a user may mean a human user, a software agent, a group of users, a member of the group, a device and/or application. Besides a human user who needs to access a secured document, a software application or agent sometimes needs to access secured files in order to proceed. Accordingly, unless specifically stated, the “user” as used herein does not necessarily pertain to a human being.

The invention is related to processes, systems, architectures and software products for providing pervasive security to digital assets (e.g., electronic documents). The invention is particularly suitable in an enterprise environment. In general, pervasive security means that digital assets are secured (i.e., secured data) and can only be accessed by authenticated users with appropriate access rights or privileges. Digital assets may include, but not be limited to, various types of documents, multimedia files, data, executable code, images and texts.

In the following description, numerous specific details are set forth in order to provide a thorough understanding of the invention. However, it will become obvious to those skilled in the art that the invention may be practiced without these specific details. The description and representation herein are the common meanings used by those experienced or skilled in the art to most effectively convey the substance of their work to others skilled in the art. In other instances, well-known methods, procedures, components, and circuitry have not been described in detail to avoid unnecessarily obscuring aspects of the invention.

Reference herein to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with the embodiment can be included in at least one embodiment of the invention. The appearances of the phrase “in one embodiment” in various places in the specification are not necessarily all referring to the same embodiment, nor are separate or alternative embodiments mutually exclusive of other embodiments. Further, the order of blocks in process flowcharts or diagrams representing one or more embodiments of the invention do not inherently indicate any particular order, nor imply any limitations in the invention.

Embodiments of the invention are discussed herein with reference to FIGS. **1-8**. However, those skilled in the art will readily appreciate that the detailed description given herein with respect to these figures is for explanatory purposes as the invention extends beyond these limited embodiments.

FIG. **1** is a diagram of an exemplary process-driven security policy (PDSP) **100** according to one embodiment of the invention. The process-driven security policy **100** includes a plurality of different states. As shown in FIG. **1**, the process-driven security policy **100** can include state A **102**, state B **104**, state C **106**, and state D **108**. Each of these different states can be associated with one or more access restrictions.

The process-driven security policy **100** is used by a file (document) security system to restrict access to files (documents). As files are placed in different ones of the states of the process-driven security policy **100**, the access restrictions being utilized to secure access to the files typically changes. More particularly, as the files move from state-to-state in accordance with a process, the access restrictions utilized by the files often changes. Indeed, the access restrictions can change automatically based upon the state the file is in, and thus does not necessarily require user or administrator interaction in order to change the access restrictions. Typically, access restrictions will designate which users (or groups of users) are able to access secure documents, whether certain clearance levels are needed, whether off-line access is permitted, and which of various other possible criteria or considerations are utilized. A set of access restrictions for the various states can be referred to as a security policy.

A file can transition between the various states of the process-driven security policy **100** in a controlled manner. Often, the process-driven security policy **100** defines the transitions that are permissible. In one embodiment, the state transitions are event-driven. The everts can be either internal to the file security system or external to the file security system. When event-driven, the transitions between states can be automatic and thus do not require user or administrator interaction. However, some events can be triggered or initiated by user or administrator interaction.

As shown in FIG. **1**, a file (document) can transition between the different states **102-108** offered by the process-driven security policy **100**. For example, a file currently in state A **102** can transition to state B **104** or state D **108**, depending upon process-related conditions (e.g., events). Similarly, a file in state D **108**, depending upon process considerations, can transition to state A **102**, state B **104** or state C **106**. Likewise, a file in state B **104** or state C **106** can transition to one or more other states. Additional details on states, security policies and transitions between states are discussed in additional detail below.

FIG. **2** is a flow diagram of a transition process **200** according to one embodiment of the invention. The transition process **200** can be used to transition a document (file) between different states of a process-driven security policy, such as the process-driven security policy shown in FIG. **1**. The transition process **200** is typically deemed process-driven because it is driven by a process. The process is, for example, defined by transition rules. The transition rules typically rely upon events to cause transitions between states. Often user or administrator interaction is not involved when activating transitions. However, the transition process **200** can permit a user or administrator to participate in activating transitions, such as by causing an event to occur which initiates a transition.

The transition process **200** begins with a decision **202** that determines whether an event relevant to the process-driven security policy imposed on a document has been received. Typically, the process-driven security policy is imposed on the document by a file security system. One implementation of a process-driven security policy is a security policy state machine. The process-driven security policy (or security policy state machine) has a plurality of states, and transition rules for transitioning between the various states. In any case, the transition process **200** monitors events that are relevant to the process-driven security policy (or the security policy state machine). When the decision **202** determines that an event has not yet been received, the transition process **200** awaits such an event.

On the other hand, when the decision **202** determines that an event has been received, then the transition process **200** determines **204** whether the event causes a state transition. Here, the rules by which transitions between states occur, i.e., transition rules, can be specified by the process-driven security policy. For example, an administrator for the document security system may have created the process-driven security policy and thus defined its states and its transition rules. Hence, when an event is received, it is evaluated to determine **204** whether the event causes a state transition. When the decision **206** determines that a state transition is to occur, the state transition is performed **208** to transfer one or more documents from one state to another state. Alternatively, when the decision **206** determines that a state transition is not to occur, the block **208** is bypassed so that no state transition is performed. Once the one or more documents transition to the new state, the access restrictions for the new state govern when access to the documents, which are secured, is permitted. Following the block **208** or its being bypassed, the transition process **200** is complete and ends.

FIG. **3** illustrates a security policy state machine **300** according to one embodiment of the invention. As previously noted, a security policy state machine is one implementation of a process-driven security policy. In this exemplary embodiment, the security policy state machine **300** includes four distinct states, namely, a state A ("Draft") **302**, state B ("Final Draft") **304**, state C ("Retain") **306**, and state D ("Delete") **308**. Each of these states has one or more associated access restriction for documents (files) which reside in that state. Further, the permitted transitions between the various states **302-308** are identified by transitions T**1**-T**5**. In particular, a document in the Draft state **302** can follow the transition T**1** to the Final Draft state **304**. A document in the Final Draft state **304** can follow the transition T**2** to the Retain state **306**. A document in the Retain state **306** can follow transition T**3** to the Delete state **308**. Further, a document in the Final Draft state **304** can follow transition T**4** to the Draft state **302**, and a document in the Retain state **306** can follow transition T**5** to the Final Draft state **304**.

A file security system can enforce the security policy state machine **300** on one or more electronic documents. In doing so, the security policy state machine **300** is typically described in a textual manner, such as in a markup language (e.g., XML), pseudo-code, and the like. One representative example of a textual description of the security policy state machine **300** is as follows.

State=DRAFT

Accessors=Finance, unrestricted

Deny off-line access

Grant audit access

State=FINAL DRAFT

Accessors=Finance, restricted; Finance Managers, unrestricted

Deny off-line access

Grant audit access

State=RETAIN

Accessors=All

Allow off-line access
Deny audit access
State=DELETE
Accessors=None

Note that in the Draft state, the users with permission to access the electronic document (referred to as "Accessors") include those users that are members of a Finance group. The access is also unrestricted in this Draft state. Also, in the Draft state, offline access to the electronic document is not permitted, but audit access is permitted. Note, however, in the Final Draft state, those users that are members of the Finance group now only have restricted access. In one embodiment, restricted access means that the data (content) of the document can be accessed but that such data cannot be further disseminated through operations such as cut, paste, print, etc.

Additionally, the security policy state machine **300** transitions between the various states in accordance with transition rules. Typically, the transition rules are triggered by the occurrence of events. The events can be internal or external. The external events can originate from users or from another system (e.g., a document management system). In a specific case of the security policy state machine **300**, a representative description of a transition rule is as follows.

On event ( ) transition from STATE1 to STATE2

Some exemplary transition rules using internal or external events are as follows.

On (time=Sep. 1, 2008), RETAIN to DELETE
On (ExtEvent==docCheckIn), FINAL DRAFT to RETAIN
On (ExtEvent==docFinalize), DRAFT to FINAL DRAFT
On (ExtEvent==docReject), FINAL DRAFT to DRAFT
On (period=event transition day (FINAL DRAFT)+90 days), FINAL DRAFT to RETAIN

Of these exemplary transition rules, the first and last transition rules are triggered by internal events and the others are triggered by external events. For example, the external events can be from a document management system that is separate from the file (document) security system.

FIG. **4**A is a diagram of a document securing system **400** according to one embodiment of the invention. The document securing system **400** is, for example, performed by a computing device, such as client computer **701** or **702** shown in FIG. **7** below.

The document securing system **400** creates or obtains an electronic document **402** that is to be secured. The electronic document **402** is then supplied to a securing engine **404**. The securing engine **404** receives a designation of a classifier **406** to be associated with the electronic document **402**. The classifier **406** refers to an accessor user list, and possibly other forms of access restriction. In one embodiment, the classifier **406** can be a label to a categorization of the electronic document with respect to a plurality of different types of content. Examples of classifiers include: External, Financial, Sales Forecast, Sales Quota, Press Release, Budget, Marketing Presentation, Marketing Planning, Engineering Planning, Engineering Project X, Engineering Specification, and Engineering Design. In addition, the securing engine **404** can receive a process-driven security policy **407** to be used to secure the electronic document **402**. In one embodiment, the process-driven security policy **407** is chosen from a plurality of process-driven security policies based on the classifier **406**. In another embodiment, the process-driven security policy **407** is made up of states, and each of the states correspond to one of the classifiers **406**.

The securing engine **404** operates to produce a secured electronic document **408**. The secured electronic document **408** includes an encrypted data portion **410** and a header portion **412**. The encrypted data portion **410** is the electronic document **402** after having been encrypted. The encryption can result from the use of one or more keys and encryption algorithms. For stronger security, a hierarchy of encryption may be used. The header portion **412** is also referred to as encrypted security information, because the header portion **412** includes the encrypted security information as at least a substantial component of the header portion **412**. The encrypted security information can include a classifier, access rules and at least one key (e.g., file key, private state key). The access rules and the keys utilized to encrypt the electronic document **402** depend on the state of the associated process-driven security policy **407** which is indicated by the classifier. Initially, the electronic document **402** is encrypted in accordance with an initial state of the process-driven security policy **407**. Typically, one of the states of the process-driven security policy **407** is designated as its initial state.

Hence, if the encrypted security information is able to be decrypted, the file key is able to be retrieved from the header portion **412** and used to decrypt the encrypted data portion **410** of the secured electronic document **408**, as will be discussed in more detail below with respect to FIG. **5**C. However, the encrypted security information in the header portion **412** is often secured through one or multiple layers of encryption, which can use various keys. These various keys are used to encrypt the security information. Typically, these various keys are managed by a server, but made available to client computers so that decryption can be performed locally. In one implementation, the encrypted security information within the header portion **412** can be decrypted if, and only if, the decrypting party has possession of both of the following: a group key (a private key for a group specified in the header), and a state key (a private key for the classifier specified in the header). As previously noted, the classifier is used to determine the state of the process-driven security policy **407**.

Additional details on securing files or documents is provided in U.S. patent application Ser. No. 10/159,537, filed May 5, 2002, and entitled "METHOD AND APPARATUS FOR SECURING DIGITAL ASSETS," which is hereby incorporated by reference.

FIG. **4**B is a flow diagram of a document securing process **440** according to one embodiment of the invention. The document securing process **440** represents processing performed by a document securing system, such as the document securing system **400** illustrated in FIG. **4**A.

The document securing process **440** initially opens or creates **442** an electronic document. Next, a decision **444** determines whether the electronic document is to be secured. When the decision **444** determines that the electronic document is not to be secured, then the electronic document is saved **446** in the normal course. Here, the electronic document is not secured but simply stored in a conventional fashion.

On the other hand, when the decision **444** determines that the electronic document is to be secured, then an initial policy reference for the electronic document is assigned **448**. In one implementation, the policy reference is a pointer to an accessor user list. A classifier for an electronic document can be assigned in a variety of different ways. In one implementation, a user or creator of the electronic document is able to assign the classifier. For example, the user or creator of the electronic document might interact with a graphical user interface to select a classifier from a list of available classifiers.

After the policy reference is assigned **448**, the electronic document is secured **450** in accordance with a process-driven security policy associated with the policy reference. Here, the electronic document is typically secured in accordance with the initial state of the process-driven security policy. Thereafter, the secured electronic document is saved **452**. Following the operations **452** and **446**, the document securing process **440** is complete and ends. The subsequent transitions to other states of the process-driven security policy is discussed below with reference to FIG. **6**.

FIG. **4**C is a detailed flow diagram of an encryption process **460** according to one embodiment of the invention. The encryption process **460** is, for example, processing suitable for being performed by the block **450** shown in FIG. **4**B in which an electronic document is secured in accordance with a process-driven security policy.

According to the encryption process **460**, a file key is obtained **462**. In one implementation, the file key is a symmetric key used to encrypt and decrypt a data portion of a secured document. After the file key is obtained **462**, the data portion of the electronic document is then encrypted **464** using at least the file key.

In one embodiment, each of the different states of the process-driven security policy would include a different public state key that would be used to encrypt documents being placed into such state. An initial state of the process-driven security policy associated with the policy reference is then determined **466**. Next, a public state key associated with the initial state is obtained **468**. Typically, the public state key is a public key of a public and private cryptography key pair that is to be utilized to encrypt documents associated with the initial state of the process-driven security policy. Once the public state key associated with the initial state has been obtained **468**, the file key is encrypted **470** using the public state key. Thereafter, security information is attached **472** to the encrypted data portion. The security information, for example, can include the policy reference and the encrypted file key. For example, the policy reference can be used as a state indicator to identify the applicable state of the process-driven security policy.

In one embodiment, the policy reference has a key pair associated therewith. The file (document) security system (e.g., server) maintains the current state of the process-driven security policy associated with the policy reference. The public key in this pair is used to encrypt the document and bind it with the process-driven security policy.

In this implementation, the electronic document has at least a data portion and a security information portion. The data portion is encrypted using at least the file key. In one embodiment, the electronic document can be encrypted many times over such that a plurality of different keys are needed to encrypt (and consequently to decrypt) the electronic document. In another embodiment, a key used to encrypt the electronic document can be encrypted many times over after being used to encrypt the electronic document. In other words, although the document securing process **440** refers to encryption of the data portion through use of the file key and then encryption of the file key through use of the public state key, it should be understood that additional keys can be used to directly encrypt the electronic document, or indirectly encrypt the electronic document by encrypting a key used to encrypt the electronic document. For example, the additional keys might include one or more of a classifier key, a user or group key, or a security clearance level key.

The security information is typically provided in a header (or header portion) of the electronic document. The header is thus typically attached to the encrypted data portion. The header together with the encrypted data portion represents a secured electronic document. Typically, the security information would include access rules, a policy reference (classifier), a private state key and at least one key (e.g., file key). The at least one key can be encrypted by a public state key that corresponds to the state, as well as possibly one or more other keys. The at least one key is often secured by encrypting either the at least one key itself, or the security information more generally, through use of one or more various other keys (e.g., group key, content type key, and/or clearance key).

FIG. **5**A is a diagram of a document unsecuring system **500** according to one embodiment of the invention. The document unsecuring system **500** represents a counterpart to the document securing system **400** illustrated in FIG. **4**A.

The document unsecuring system **500** cooperates to receive a secured electronic document **502**. The secured electronic document typically includes an encrypted data portion **504** and a header **506**. Often, but not necessarily, the header **506** is encrypted. The header **506** includes a policy reference and at least one key, e.g., a file key, that is needed to decrypt the encrypted data portion **504**. The secured electronic document **502** is supplied to an unsecuring engine **508**. The unsecuring engine **508** examines the header **506** of the secured electronic document **502** to determine the policy reference. The policy reference identifies a process-based security policy **510**, or a state thereof, that governs the security of the secured document **502**. The unsecuring engine **508** also receives at least that portion of the process-based security policy that pertains to the state of the secured electronic document **502**. In other words, the unsecuring engine **508** needs the access restrictions for the current state of the process-driven security policy **510** to unsecure the secured electronic document **502**, and thus gain access to its contents. The unsecuring engine **508** then evaluates whether the secured electronic document **502** is permitted to be accessed by the requestor, based on the access restrictions so retrieved. When the unsecuring engine **508** determines that the requestor is authorized to access the secured electronic document **502**, then the unsecuring engine **508** can decrypt the encrypted data portion **504** of the secured electronic document **502** (and also eliminate at least significant portions of the header **506**) to yield an electronic document **512** that is unsecured. In other words, the electronic document **512** is primarily (or exclusively) composed of the data portion of the encrypted data portion **504** after such has been decrypted. The decryption can involve the use of a number of keys (e.g., private keys) and decryption algorithms, one of such keys is the file key of the secured electronic document, and another of such keys is the private state key for the state of the secured electronic document.

FIGS. **5**B and **5**C are flow diagrams of a document access process **520** according to one embodiment of the invention. The document access process **520** operates to determine whether access to a particular document is permitted to a particular user (or group of users). The document access process **520** begins with a decision **522** that determines whether a request to access a secured electronic document has been received. When the decision **522** determines that such a request has not yet been received, the document access process **520** awaits such a request. Once the decision **522** determines that a request to access a secured electronic document has been received, the document access process **520** continues. In other words, the document access process **520** can be considered to be invoked once a request to access a secured electronic document has been received.

In any case, once a request to access a secured electronic document has been received, a policy reference for the secured electronic document to be accessed is determined **524**. In one embodiment, the security information portion of a secured electronic document contains the policy reference.

Next, a process-driven security policy associated with the policy reference is determined **526**. Then, the current state of the process-driven security policy for the secured electronic document is determined **528**. In one embodiment, the policy reference (or other indicator) can indicate the current state of the state-based security policy. Next, access restriction are obtained **530** for the current state. Each of the different states of the process-driven security policy often has a different access restriction. Here, the state policy restrictions are those restrictions associated with the current state of a process-driven security policy.

Thereafter, a decision **542** determines whether the state policy restrictions are satisfied. In other words, the secured electronic document to be accessed is presently in the current state of the process-driven security policy. This current state has the access restriction associated therewith, that must be satisfied in order to gain access to the secured electronic document. Hence, the decision **542** determines whether the access restriction is satisfied by the requestor (e.g., user or group of users) seeking access to the secured electronic document. When the decision **542** determines that the access restriction is not satisfied, access to the secured electronic document is denied **544**.

On the other hand, when the decision **542** determines that the access restriction has been satisfied, then a data portion of the secured electronic document is decrypted **546**. Then, the data portion of the electronic document is returned **548** to the requestor. Following the block **548**, as well as following the block **544**, the document access process **520** ends.

FIG. **5**D is a flow diagram of a decryption process **560** according to one embodiment of the invention. The decryption process **560** can, for example, pertain to detailed operations performed by the block **546** illustrated in FIG. **5**C. In any event, the decryption process **560** initially obtains **562** an encrypted file key from the security information portion of the secured electronic document. In addition, a private state key associated with the current state of the process-driven security policy for the secured electronic document is obtained **564**. Normally, only authorized users would be able to gain access to the private state key. The private state key is the private key of the same public and private cryptography key pair that provided the public state key that was used to encrypt the file key. Then, the encrypted file key is decrypted **566** using the private state key. Thereafter, the data portion of the secured electronic document is decrypted **568** using at least the file key. Consequently, the data portion of the secured electronic document is decrypted and is in the "clear" and thus usable by the requestor. Following the block **568**, the decryption process **560** is complete and ends.

FIG. **6** is a flow diagram of a transition process **600** according to one embodiment of the invention. The transition process **600** pertains to processing that can be utilized to transition between states of a process-driven security policy. More particularly, the transition process **600** is, for example, suitable for use as the processing performed by the block **208** illustrated in FIG. **2**.

The transition process **600** initially obtains **602** an encrypted file key from the electronic document. Typically, the encrypted file key would be retrieved from the security information portion of the electronic document. Then, a private state key is obtained **604**. Here, the private state key is associated with a previous state of a process-driven security policy that is imposed on the electronic document. After the private state key has been obtained **604**, the encrypted file key is decrypted **606** using the private state key. At this point, the file key has been decrypted and could be used to decrypt the data portion of the electronic document. However, the file key is instead re-encrypted in accordance with a next (current) state. More specifically, a public state key is then obtained **608**. The public state key is associated with the next state of the state-based security policy that is to be imposed on the electronic document. Then, using the public state key, the file key can be encrypted **610**. Thereafter, the electronic document is re-saved **612**. By re-saving **612** the electronic document, the security information portion of the electronic document is updated to include the new encrypted file key in accordance with the next state (or current state). Note that the data portion of the electronic document (which is secured by the file key) advantageously need not be decrypted in the transition process **600**; instead, the encryption of the file key is changed whenever a state transition occurs. Following the block **612**, the transition process **600** is complete.

In one embodiment, to effect a state transition, the user only needs permission to effect the state transition. Additionally, users authorized to effect state changes with respect to a document, might be quite different from users authorized to access the document.

FIG. **7** shows a basic security system **700** in which the invention may be practiced in accordance with one embodiment thereof. The security system **700** may be employed in an enterprise or inter-enterprise environment. It includes a first server **706** (also referred to as a central server) providing centralized access management for the enterprise. The first server **706** can control restrictive access to files secured by the security system **700**. To provide dependability, reliability and scalability of the system, one or more second servers **704** (also referred to as local servers, of which one is shown) may be employed to provide backup or distributed access management for users or client machines serviced locally. The server **704** is coupled to a network **708** and a network **710**. For illustration purposes, there are two client machines **701** and **702** being serviced by the local server **704**. Alternatively, one of the client machines **701** and **702** may be considered as a networked storage device.

Secured files may be stored in any one of the devices **701**, **702**, **704** and **706**. When a user of the client machine **701** attempts to exchange a secured file with a remote destination **712** being used by an external user, one or more of the processing **300**, **400**, **500** and **600** discussed above are activated to ensure that the requested secure file is delivered without compromising the security imposed on the secured file.

According to one embodiment, a created document is caused to go through an encryption process that is preferably transparent to a user. In other words, the created document is encrypted or decrypted under the authoring application so that the user is not aware of the process. One or more keys, such as a state key, a user key and/or a content type key, can be used to retrieve a file key to decrypt an encrypted document. Typically, the user key is associated with an access privilege for the user or a group of users, and the content type key is associated with the type of content of the created document. For a given secured document, only a user with proper access privileges can access the secured document.

In one setting, a secured document may be uploaded via the network **710** from the client computer **701** to a computing or storage device **702** that may serve as a central repository. Although not necessary, the network **710** can provide a private link between the computer **701** and the computing or storage device **702**. Such link may be provided by an internal network in an enterprise or a secured communication protocol (e.g., VPN and HTTPS) over a public network (e.g., the Internet). Alternatively, such link may simply be provided by a TCP/IP link. As such, secured documents on the computer **702** may be remotely accessed.

In another setting, the computer **701** and the computing or storage device **702** are inseparable, in which case the computing or storage device **702** may be a local store to retain secured documents or receive secured network resources (e.g., dynamic Web contents, results of a database query, or a live multimedia feed). Regardless of where the secured documents or secured resources are actually located, a user, with proper access privileges, can access the secured documents or resources from the client computer **701** or the computing or storage device **702** using an application (e.g., Microsoft Internet Explorer, Microsoft Word or Adobe Acrobat Reader).

Accordingly, respective local modules in local servers, in coordination with the central server, form a distributed mechanism to provide distributed access control enforcement. Such distributed access control enforcement ensures the dependability, reliability and scalability of centralized access control management undertaken by the central server for an entire enterprise or a business location.

FIG. **8** shows an exemplary data structure **820** of a secured file that may be used in one embodiment of the invention. The data structure **820** includes two portions: a header (or header portion) **822** and encrypted data (or an encrypted data portion) **824**. The header **822** can be generated in accordance with a security template associated with a data store and thus provides restrictive access to the data portion **824** which is an encrypted version of a plain file. Optionally, the data structure **820** may also include an error-checking portion **825** that stores one or more error-checking codes, for example, a separate error-checking code for each block of encrypted data **824**. These error-checking codes may also be associated with a Cyclical Redundancy Check (CRC) for the header **822** and/or the encrypted data **824**. The header **822** includes a flag bit or signature **827** and security information **826** that is in accordance with the security template for the store. According to one embodiment, the security information **826** is encrypted and can be decrypted with a user key associated with an authenticated user (or requestor).

The security information **826** can vary depending upon implementation. However, as shown in FIG. **8**, the security information **826** includes a user identifier (ID) **828**, access policy (access rules) **829**, a file key **830**, a classifier **831** and other information **832**. Although multiple user identifiers may be used, a user identifier **828** is used to identify a user or a group that is permitted to access the secured file. The access rules **829** provide restrictive access to the encrypted data portion **824**. The file key **830** is a cipher key that, once obtained, can be used to decrypt the encrypted data portion **824** and thus, in general, is protected. In one implementation of the data structure **820**, the file key **830** is encrypted in conjunction with the access rules **829**. In another implementation of the data structure **820**, the file key **830** is encrypted with a private state key and further protected by the access rules **829**. The other information **832** is an additional space for other information to be stored within the security information **826**. For example, the other information **832** may be used to include other information facilitating secure access to the secured file, such as version number or author identifier.

The invention is preferably implemented by software or a combination of hardware and software, but can also be implemented in hardware. The invention can also be embodied as computer readable code on a computer readable medium. The computer readable medium is any data storage device that can store data which can thereafter be read by a computer system. Examples of the computer readable medium include read-only memory, random-access memory, CD-ROMs, DVDs, magnetic tape, optical data storage devices, and carrier waves. The computer readable medium can also be distributed over network-coupled computer systems so that the computer readable code is stored and executed in a distributed fashion.

The various embodiments, implementations and features of the invention noted above can be combined in various ways or used separately. Those skilled in the art will understand from the description that the invention can be equally applied to or used in various other settings with respect to different combinations, embodiments, implementations or features as provided in the description herein.

The invention may be practiced in two broad approaches: one, where document move asynchronously through a persistent workflow (here, the state changes are typically triggered by the users); and two, where documents move synchronously through a single-use workflow, a plurality of which however can be initiated from a workflow template (here, the state changes are typically due to administrator central command). The two approaches may be combined for use in a single enterprise. State changes due to external events may occur with both approaches.

The advantages of the invention are numerous. Different embodiments or implementations may yield one or more of the following advantages. One advantage of the invention is that file security systems are able to automatically enforce process-driven security policies on files (e.g., documents). The automatic nature of the enforcement of the process-driven security policies alleviates otherwise excessive burdens on an administrator. Another advantage of the invention is that changing of the security policies for files (e.g., documents) in accordance with a process allows greater flexibility in utilizing security policies. Still another advantage of the invention is that the process-driven security policies can be enforced centrally or locally. Still another advantage is that a workflow ordered through a centralized document management system (DMS) may be extended to a plurality of documents stored in a distributed fashion, thereby allowing a system administrator to use the well-known DMS interface.

The foregoing description of embodiments is illustrative of various aspects/embodiments of the present invention. Various modifications to the invention can be made to the preferred embodiments by those skilled in the art without departing from the true spirit and scope of the invention as defined by the appended claims. Accordingly, the scope of the present invention is defined by the appended claims rather than the foregoing description of embodiments.

What is claimed is:

1. A method comprising:

transitioning from a previous state to a next state in accordance with a security policy;

retrieving, responsive to the transitioning, a file key from a security information portion of a secured document, wherein the file key is encrypted by a first encryption in accordance with the previous state;

producing a decrypted file key, wherein producing the decrypted file key comprises decrypting the file key encrypted by the first encryption, wherein the decrypted file key is usable to decrypt an encrypted data portion of the secured document; and

re-encrypting the decrypted file key with a second encryption in accordance with the next state, wherein the first encryption and the second encryption are different.

2. The method of claim **1**, further comprising:

receiving an event; and

determining whether the event causes the transitioning.

3. The method of claim **2**, wherein the event is an external event originating from outside of a file security system.

4. The method of claim **1**, wherein additional states each have different access restrictions when applied to the secured document.

5. The method of claim **1**, wherein producing the decrypted file key comprises:

obtaining a decryption key corresponding, to the previous state; and

decrypting the file key encrypted by the first encryption using the decryption key.

6. The method of claim **1**, wherein re-encrypting the decrypted file key comprises:

obtaining an encryption key corresponding to the next state; and

encrypting the decrypted file key with the second encryption using the encryption key.

7. A computer-readable storage device having instructions stored thereon, execution of which, by a computing device, causes the computing device to perform operations comprising:

transitioning from a previous state to a next state in accordance with a security policy;

retrieving, responsive to the transitioning, a file key from a security information portion of a secured document, wherein the file key is encrypted by a first encryption in accordance with the previous state;

producing a decrypted file key, wherein producing the decrypted file key comprises decrypting the file key encrypted by the first encryption, wherein the decrypted file key is usable to decrypt an encrypted data portion of the secured document; and

re-encrypting the decrypted file key with a second encryption in accordance with the next state, wherein the first encryption and the second encryption are different.

8. The computer-readable storage device of claim **7**, the operations further comprising:

receiving an event; and

determining whether the event causes the transitioning.

9. The computer-readable storage device of claim **8**, wherein the event is an external event originating from outside of a file security system.

10. The computer-readable storage device of claim **7**, wherein additional states each have different access restrictions when applied to the secured document.

11. The computer-readable storage device of claim **7**, wherein producing the decrypted file key comprises:

obtaining a decryption key corresponding to the previous state; and

decrypting the file key encrypted by the first encryption using the decryption key.

12. The computer-readable storage device of claim **7**, wherein re-encrypting the decrypted file key comprises:

obtaining an encryption key corresponding to the next state; and

encrypting the decrypted file key with the second encryption using the encryption key.

13. A system comprising:

a memory configured to store a state machine, wherein the state machine is configured to:

transition from a previous state to a next state in accordance with a security policy;

retrieve, responsive to the transition, a file key from a security information portion of a secured document, wherein the file key is encrypted by a first encryption in accordance with the previous state,

produce a decrypted file key, wherein producing the decrypted file key comprises decrypting the file key encrypted by the first encryption, wherein the decrypted file key is usable to decrypt an encrypted data portion of the secured document, and

re-encrypt the decrypted file key with a second encryption in accordance with the next state, wherein the first encryption and the second encryption are different; and

one or more processors configured to process the state machine.

14. The system of claim **13**, wherein the state machine is further configured to receive an event and determine whether the event causes the transition.

15. The system of claim **14**, wherein the event is an external event originating from outside of a file security system.

16. The system of claim **13**, wherein additional states each have different access restrictions when applied to the secured document.

17. The system of claim **13**, wherein the state machine is further configured to produce the decrypted file key by obtaining a decryption key corresponding to the previous state and decrypting the file key encrypted by the first encryption using the decryption key.

18. The system of claim **13**, wherein the state machine is further configured to re-encrypt the decrypted file key by obtaining an encryption key corresponding to the next state and encrypting the decrypted file key with the second encryption using the encryption key.

* * * * *