US009767280B2

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

(10) **Patent No.: US 9,767,280 B2**
(45) **Date of Patent: Sep. 19, 2017**

(54) **INFORMATION PROCESSING APPARATUS, METHOD OF CONTROLLING THE SAME, INFORMATION PROCESSING SYSTEM, AND INFORMATION PROCESSING METHOD**

(71) Applicant: **Canon Denshi Kabushiki Kaisha**, Chichibu-shi, Saitama-ken (JP)

(72) Inventors: **Kazuki Takano**, Saitama-ken (JP); **Satoshi Yonekawa**, Saitama (JP); **Azusa Sekiguchi**, Funabashi (JP); **Tomonori Sato**, Fujisawa (JP)

(73) Assignee: **Canon Denshi Kabushiki Kaisha**, Chichibu-shi (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 243 days.

(21) Appl. No.: **14/664,410**

(22) Filed: **Mar. 20, 2015**

(65) **Prior Publication Data**

US 2015/0193618 A1 Jul. 9, 2015

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2013/006022, filed on Oct. 9, 2013.

(30) **Foreign Application Priority Data**

Oct. 9, 2012	(JP)	2012-224574
Oct. 9, 2012	(JP)	2012-224575

(Continued)

(51) **Int. Cl.**

G06F 21/00	(2013.01)
G06F 21/55	(2013.01)

(Continued)

(52) **U.S. Cl.**
CPC ***G06F 21/554*** (2013.01); ***G06F 8/61*** (2013.01); ***G06F 8/65*** (2013.01); ***G06F 9/445*** (2013.01);

(Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,799,277	B2 *	9/2004	Colvin	G06F 21/121 705/51
6,836,712	B2	12/2004	Nishina	701/35

(Continued)

FOREIGN PATENT DOCUMENTS

JP	S61-131136 A	6/1986
JP	H04-157599	5/1992

(Continued)

OTHER PUBLICATIONS

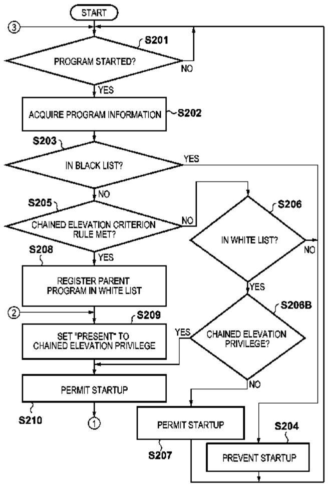
Yukio Sakajo, "Antivirus and Internet Security Software, White Shield", Meiden-Jihou, Meidensha Corporation, Oct. 26, 2009, No. 4, pp. 10-13, with partial translation.

Primary Examiner — Maung Lwin
(74) *Attorney, Agent, or Firm* — Fitzpatrick, Cella, Harper & Scinto

(57) **ABSTRACT**

Startup of a program and generation or change of a program is detected, or a program is searched for. It is determined, based on program information of a program whose startup is detected or a program which is found, whether or not the program meets a predetermined criterion. The program determined to meet the predetermined criterion is registered in a white list or black list.

32 Claims, 20 Drawing Sheets



START
3
S201
PROGRAM STARTED?
NO
YES
ACQUIRE PROGRAM INFORMATION
S202
S203
IN BLACK LIST?
YES
NO
S205
CHAINED ELEVATION CRITERION RULE MET?
NO
S206
IN WHITE LIST?
NO
S208
YES
REGISTER PARENT PROGRAM IN WHITE LIST
YES
2
S209
S206B
SET "PRESENT" TO CHAINED ELEVATION PRIVILEGE
YES
CHAINED ELEVATION PRIVILEGE?
NO
PERMIT STARTUP
S210
1
PERMIT STARTUP
S204
S207
PREVENT STARTUP

(30) **Foreign Application Priority Data**

Mar. 1, 2013	(JP)	2013-041248
Oct. 8, 2013	(JP)	2013-211423
Oct. 8, 2013	(JP)	2013-211424

(51) **Int. Cl.**

G06F 9/445	(2006.01)
G06F 21/51	(2013.01)
H04L 29/06	(2006.01)

(52) **U.S. Cl.**
CPC ***G06F 21/51*** (2013.01); ***H04L 63/0227*** (2013.01); *G06F 2221/2145* (2013.01); *H04L 63/101* (2013.01); *H04L 63/1441* (2013.01)

(56) **References Cited**

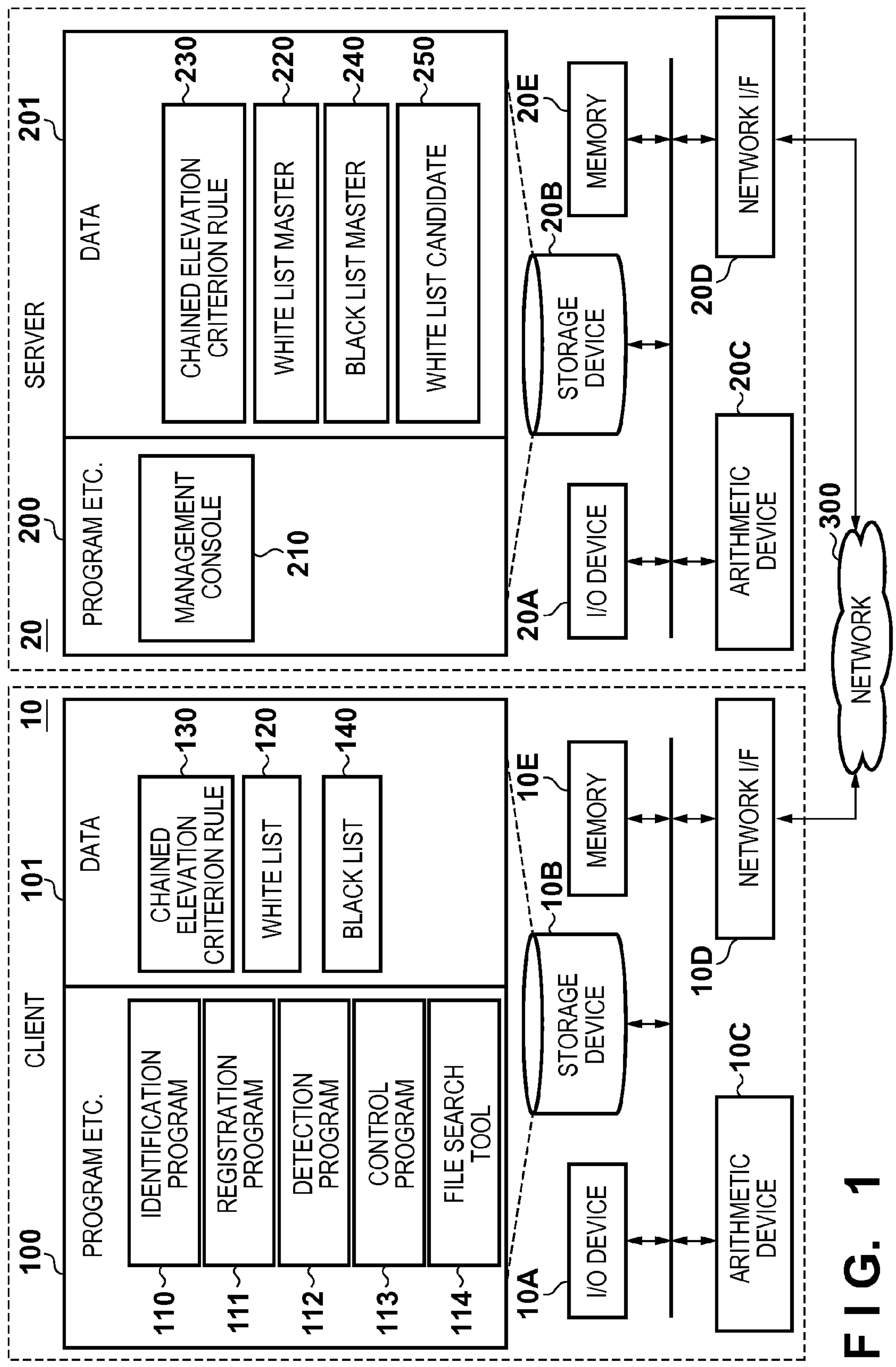
U.S. PATENT DOCUMENTS

8,161,552	B1 *	4/2012	Sun	G06F 21/566 726/22
8,321,949	B1 *	11/2012	Green	G06F 21/51 707/687
8,701,192	B1 *	4/2014	Glick	G06F 21/566 726/24
2001/0034712	A1 *	10/2001	Colvin	G06F 21/121 705/52
2006/0272011	A1 *	11/2006	Ide	G06F 21/31 726/5
2007/0250547	A1	10/2007	Kai et al.	707/202
2008/0086776	A1 *	4/2008	Tuvell	G06F 21/564 726/24
2009/0083852	A1	3/2009	Kuo et al.	726/22
2009/0125902	A1 *	5/2009	Ghosh	G06F 9/45533 718/1
2009/0286512	A1 *	11/2009	Huber	G06Q 20/1235 455/411
2009/0293125	A1 *	11/2009	Szor	G06F 21/56 726/24
2010/0082530	A1	4/2010	Miyamoto	707/609
2010/0100939	A1 *	4/2010	Mahaffey	G06F 21/30 726/4
2013/0097708	A1 *	4/2013	Jayanthi	G06F 21/554 726/25
2015/0172150	A1 *	6/2015	Ding	H04L 67/42 709/203

FOREIGN PATENT DOCUMENTS

JP	H09-114708		5/1997
JP	H10-124261	A	5/1998
JP	2000-293219		10/2000
JP	2002-157122		5/2002
JP	2003-057076		2/2003
JP	2007-280096		10/2007
JP	2009-259160	A	11/2009
JP	2010-009186		1/2010
JP	2010-072984		4/2010
JP	2010-182196	A	8/2010
JP	2011-123675	A	6/2011
JP	2011-141806		7/2011
JP	2011-252339	A	12/2011
JP	2012-185745	A	9/2012
WO	WO 2012/027588	A1	3/2012

* cited by examiner



20
SERVER
200
PROGRAM ETC.
MANAGEMENT CONSOLE
210
201
DATA
CHAINED ELEVATION CRITERION RULE
230
WHITE LIST MASTER
220
BLACK LIST MASTER
240
WHITE LIST CANDIDATE
250
20A
I/O DEVICE
20B
STORAGE DEVICE
20E
MEMORY
20C
ARITHMETIC DEVICE
20D
NETWORK I/F
300
NETWORK
10
CLIENT
100
PROGRAM ETC.
IDENTIFICATION PROGRAM
110
REGISTRATION PROGRAM
111
DETECTION PROGRAM
112
CONTROL PROGRAM
113
FILE SEARCH TOOL
114
101
DATA
CHAINED ELEVATION CRITERION RULE
130
WHITE LIST
120
BLACK LIST
140
10A
I/O DEVICE
10B
STORAGE DEVICE
10E
MEMORY
10C
ARITHMETIC DEVICE
10D
NETWORK I/F

F I G. 1

FIG. 2

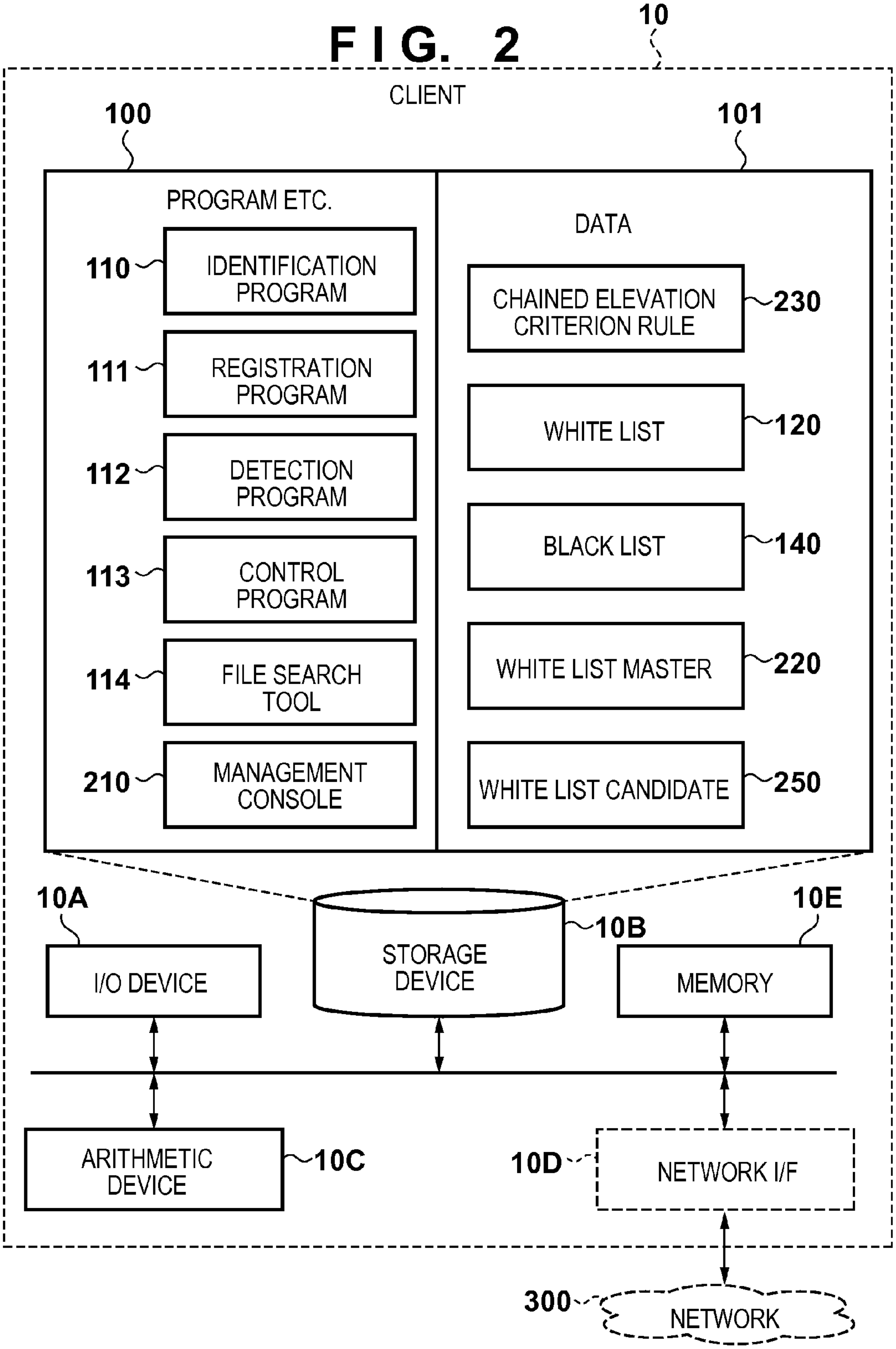
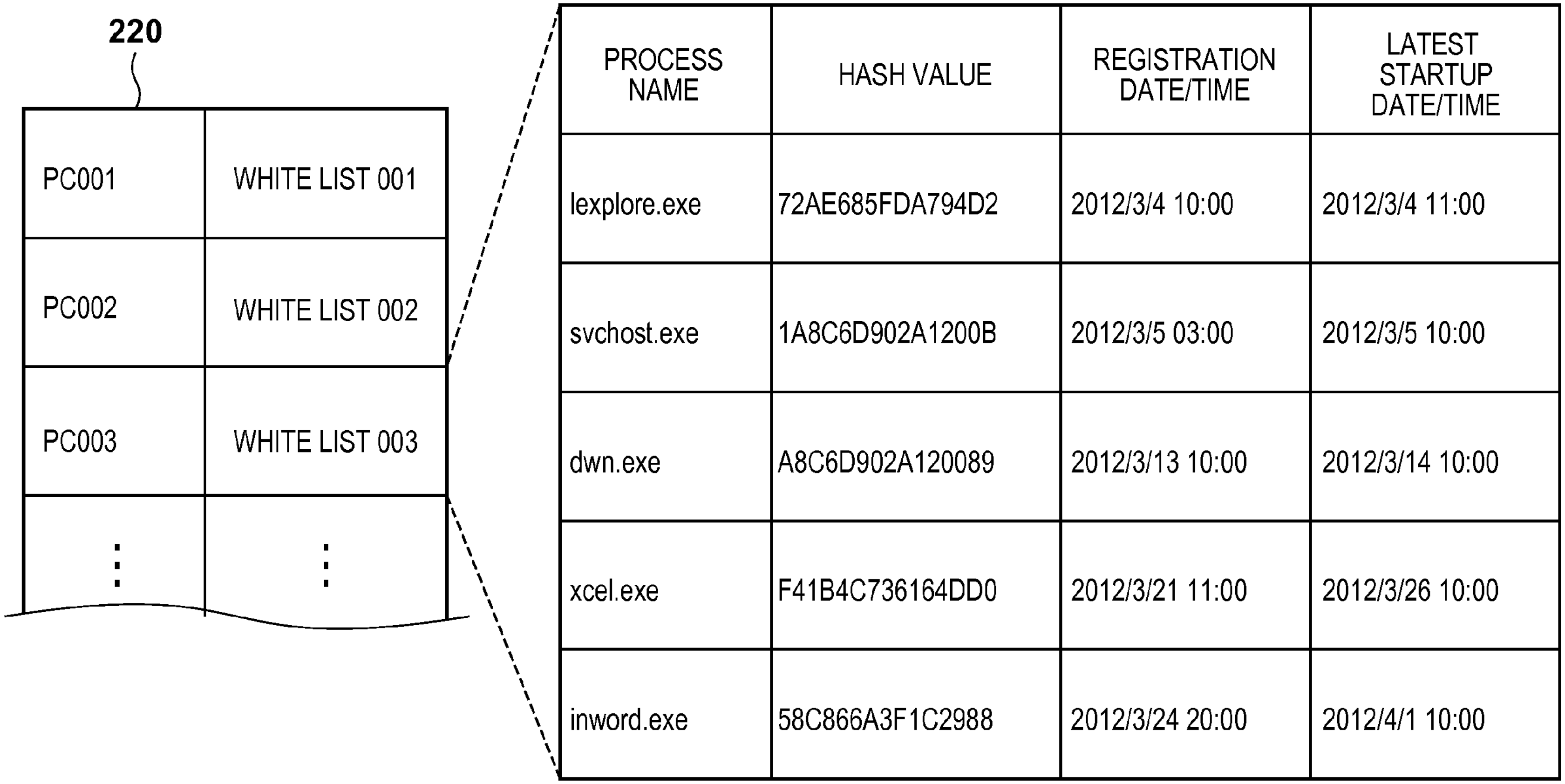

10
CLIENT
100
101
PROGRAM ETC.
110
IDENTIFICATION PROGRAM
111
REGISTRATION PROGRAM
112
DETECTION PROGRAM
113
CONTROL PROGRAM
114
FILE SEARCH TOOL
210
MANAGEMENT CONSOLE
DATA
CHAINED ELEVATION CRITERION RULE
230
WHITE LIST
120
BLACK LIST
140
WHITE LIST MASTER
220
WHITE LIST CANDIDATE
250
10A
I/O DEVICE
STORAGE DEVICE
10B
10E
MEMORY
ARITHMETIC DEVICE
10C
10D
NETWORK I/F
300
NETWORK

FIG. 3

120

PROGRAM NAME	HASH VALUE	VERSION	FILE SIZE	CHAINED ELEVATION PRIVILEGE
lexplore.exe	72AE6B5FDA794D2	1.0.0.1	56.3KB	ABSENT
svchost.exe	1A8C6D902A1200B	2.1	1.43MB	ABSENT
dwn.exe	A8C6D902A120089	10.7.1	321.8KB	PRESENT
xcel.exe	F41B4C736164DD0	4.0	214KB	ABSENT
inword.exe	5BC866A3F1C29B8	1.10.2	2.1MB	ABSENT
⋮	⋮	⋮	⋮	⋮

FIG. 4



PC001	WHITE LIST 001
PC002	WHITE LIST 002
PC003	WHITE LIST 003
⋮	⋮

PROCESS NAME	HASH VALUE	REGISTRATION DATE/TIME	LATEST STARTUP DATE/TIME
lexplore.exe	72AE685FDA794D2	2012/3/4 10:00	2012/3/4 11:00
svchost.exe	1A8C6D902A1200B	2012/3/5 03:00	2012/3/5 10:00
dwn.exe	A8C6D902A120089	2012/3/13 10:00	2012/3/14 10:00
xcel.exe	F41B4C736164DD0	2012/3/21 11:00	2012/3/26 10:00
inword.exe	58C866A3F1C2988	2012/3/24 20:00	2012/4/1 10:00

FIG. 5A

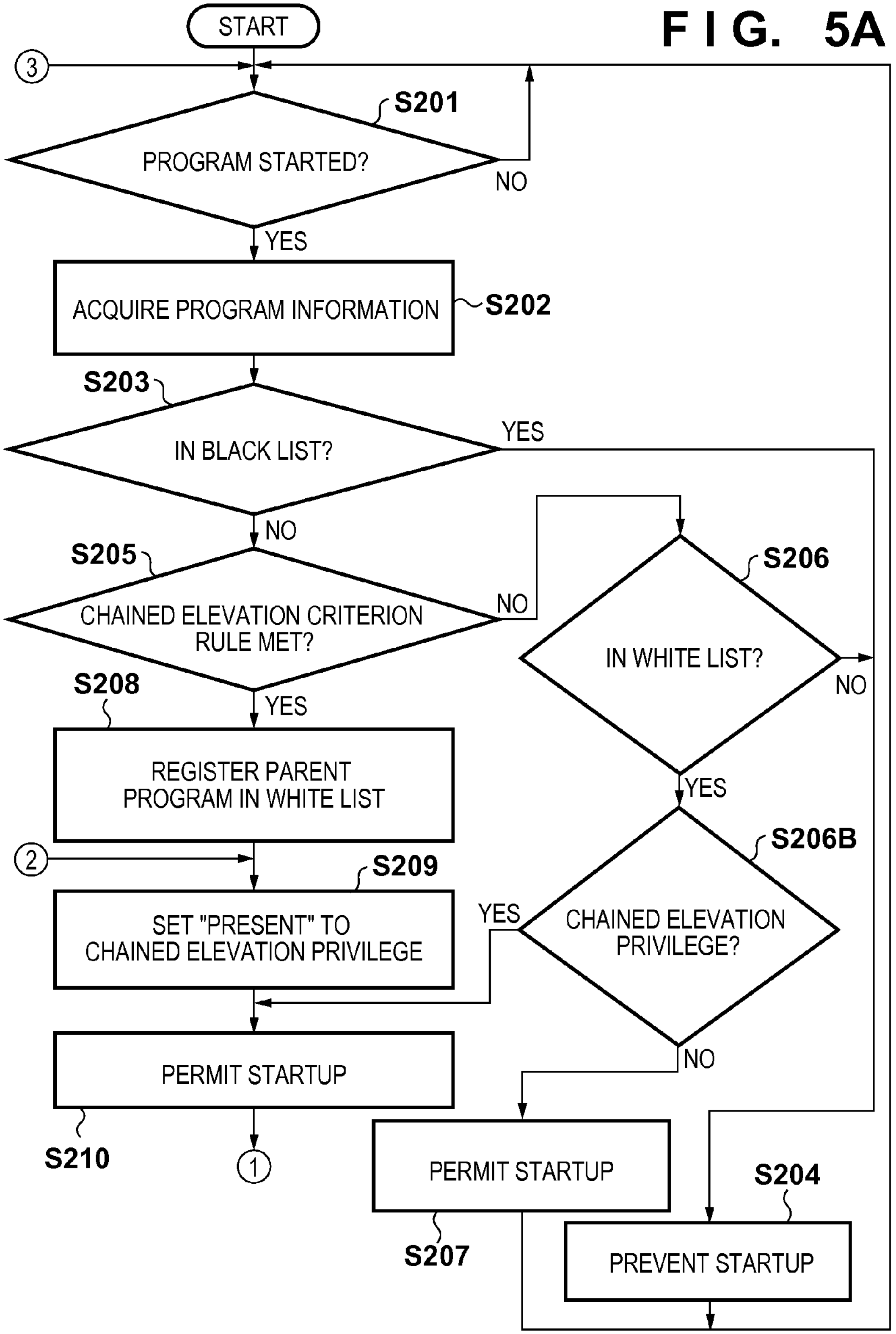
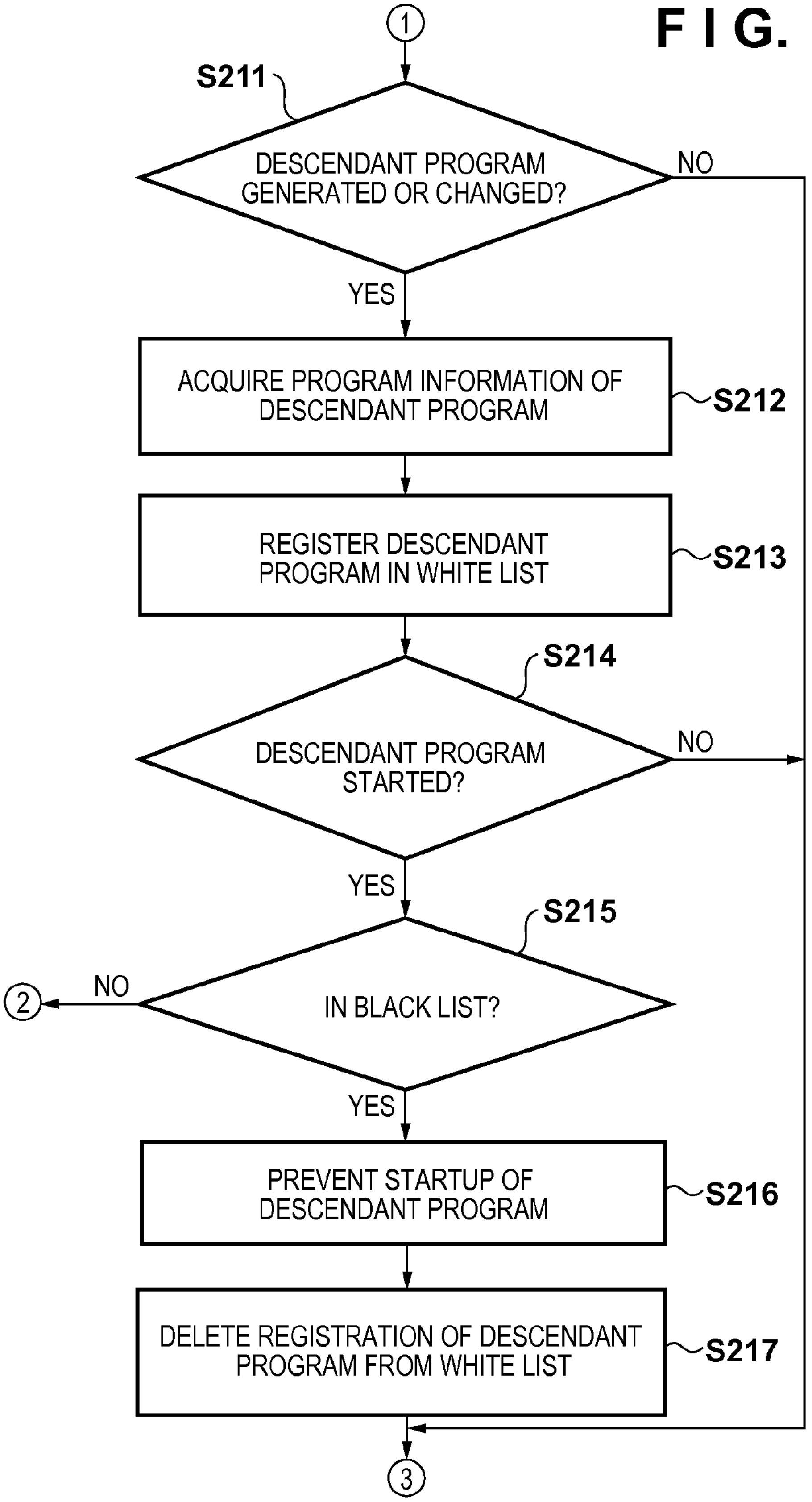
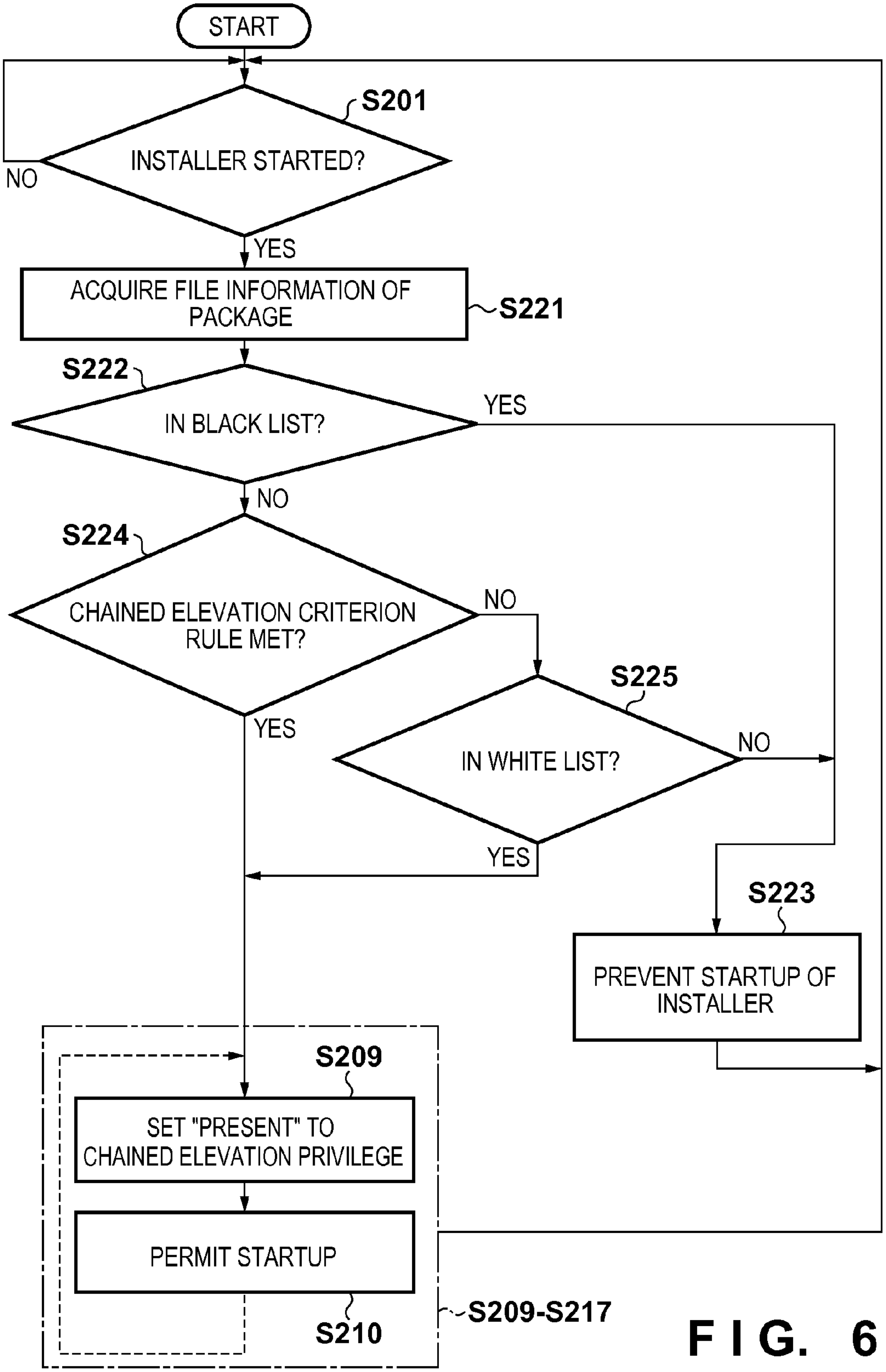

START
3
S201
PROGRAM STARTED?
NO
YES
ACQUIRE PROGRAM INFORMATION
S202
S203
IN BLACK LIST?
YES
NO
S205
CHAINED ELEVATION CRITERION RULE MET?
NO
S206
IN WHITE LIST?
NO
S208
YES
REGISTER PARENT PROGRAM IN WHITE LIST
YES
S206B
2
S209
SET "PRESENT" TO CHAINED ELEVATION PRIVILEGE
YES
CHAINED ELEVATION PRIVILEGE?
PERMIT STARTUP
NO
S210
1
PERMIT STARTUP
S204
S207
PREVENT STARTUP

FIG. 5B


1
S211
DESCENDANT PROGRAM GENERATED OR CHANGED?
NO
YES
ACQUIRE PROGRAM INFORMATION OF DESCENDANT PROGRAM
S212
REGISTER DESCENDANT PROGRAM IN WHITE LIST
S213
S214
DESCENDANT PROGRAM STARTED?
NO
YES
S215
IN BLACK LIST?
NO
2
YES
PREVENT STARTUP OF DESCENDANT PROGRAM
S216
DELETE REGISTRATION OF DESCENDANT PROGRAM FROM WHITE LIST
S217
3


START
S201
INSTALLER STARTED?
NO
YES
ACQUIRE FILE INFORMATION OF PACKAGE
S221
S222
IN BLACK LIST?
YES
NO
S224
CHAINED ELEVATION CRITERION RULE MET?
NO
YES
S225
IN WHITE LIST?
NO
YES
S223
PREVENT STARTUP OF INSTALLER
S209
SET "PRESENT" TO CHAINED ELEVATION PRIVILEGE
PERMIT STARTUP
S210
S209-S217

F I G. 6

FIG. 7

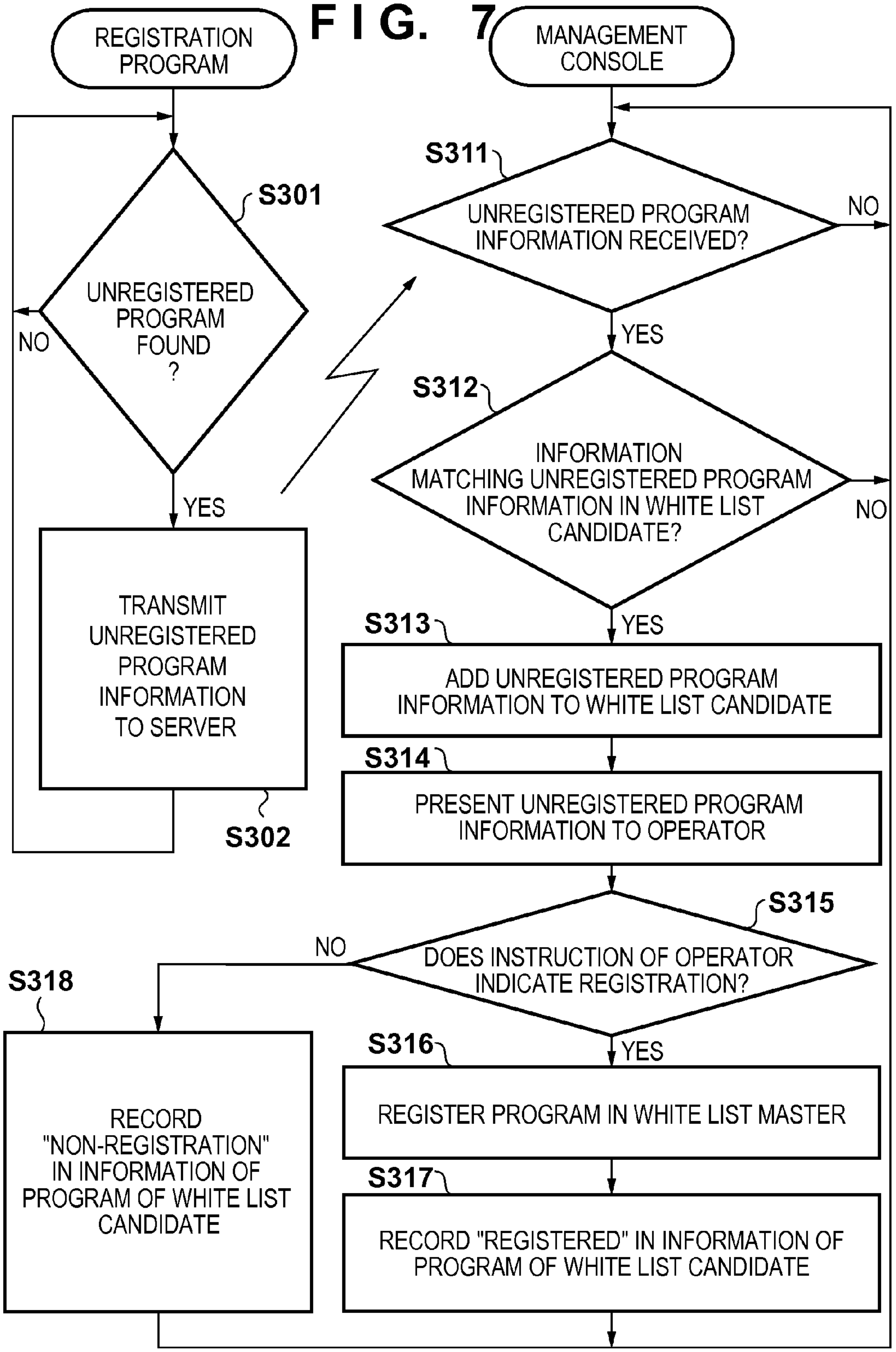

REGISTRATION PROGRAM
UNREGISTERED PROGRAM FOUND ?
S301
NO
YES
TRANSMIT UNREGISTERED PROGRAM INFORMATION TO SERVER
S302
MANAGEMENT CONSOLE
S311
UNREGISTERED PROGRAM INFORMATION RECEIVED?
NO
YES
S312
INFORMATION MATCHING UNREGISTERED PROGRAM INFORMATION IN WHITE LIST CANDIDATE?
NO
YES
S313
ADD UNREGISTERED PROGRAM INFORMATION TO WHITE LIST CANDIDATE
S314
PRESENT UNREGISTERED PROGRAM INFORMATION TO OPERATOR
S315
DOES INSTRUCTION OF OPERATOR INDICATE REGISTRATION?
NO
YES
S318
RECORD "NON-REGISTRATION" IN INFORMATION OF PROGRAM OF WHITE LIST CANDIDATE
S316
REGISTER PROGRAM IN WHITE LIST MASTER
S317
RECORD "REGISTERED" IN INFORMATION OF PROGRAM OF WHITE LIST CANDIDATE

FIG. 8

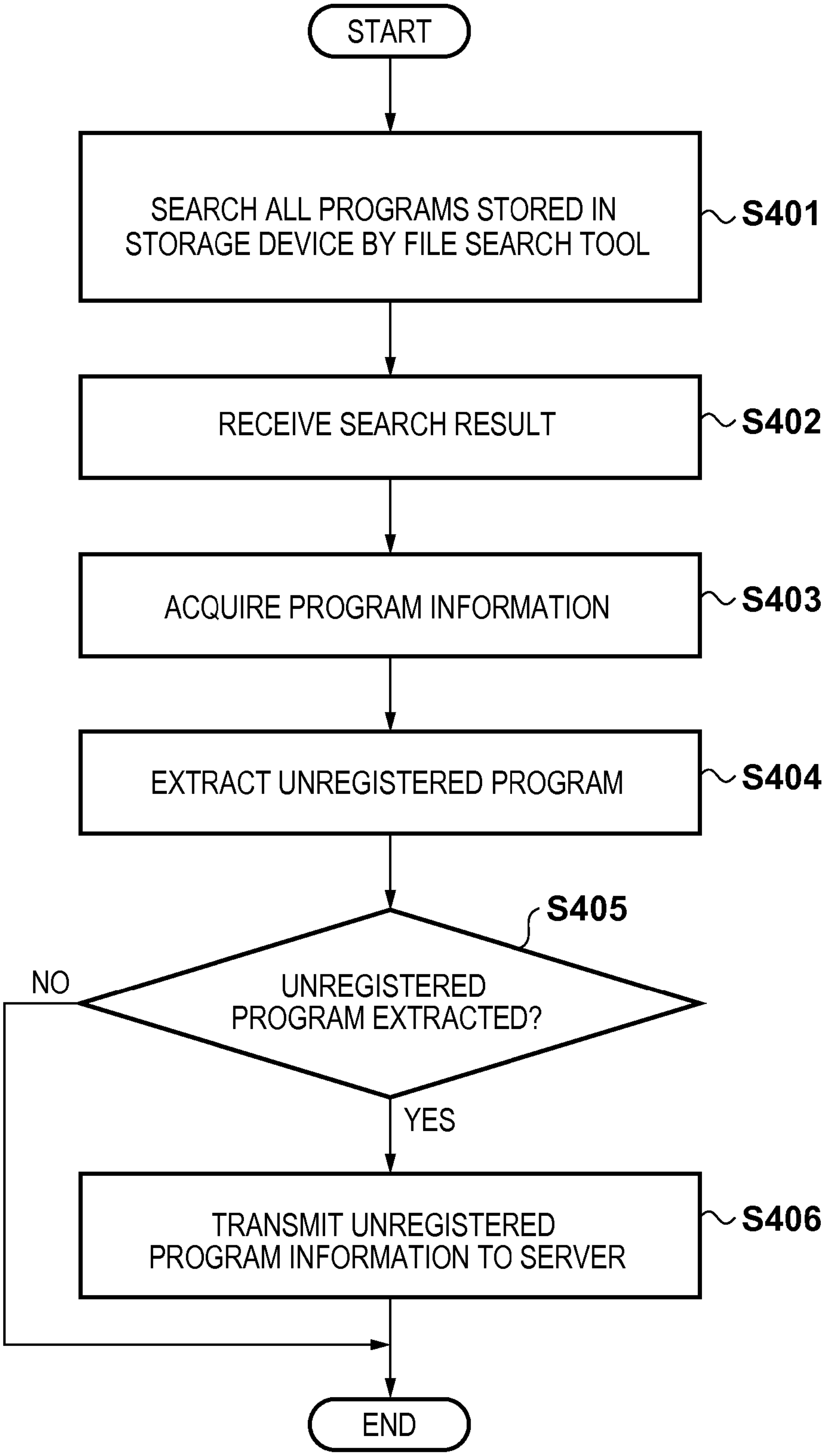
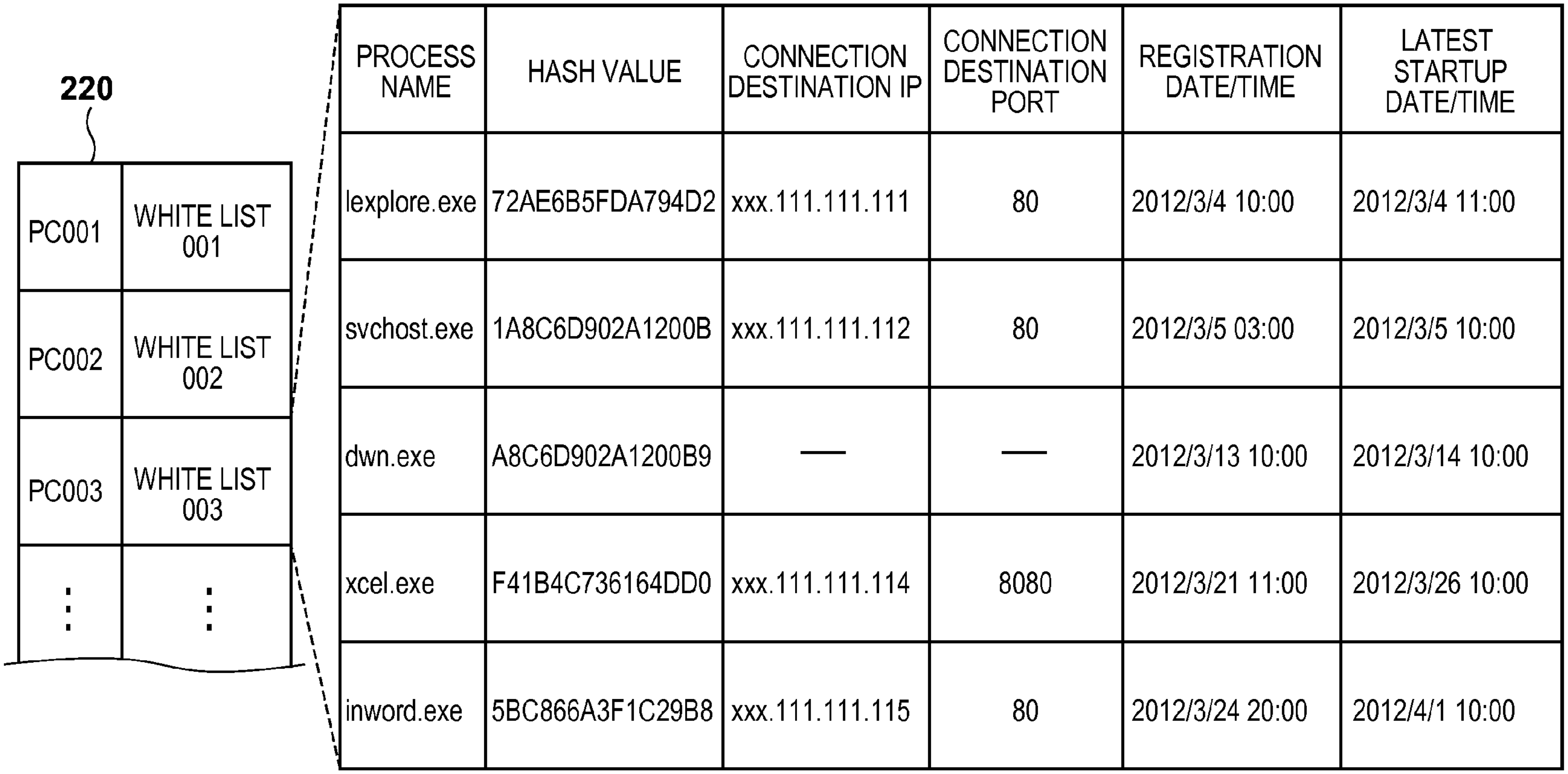

START
SEARCH ALL PROGRAMS STORED IN STORAGE DEVICE BY FILE SEARCH TOOL
S401
RECEIVE SEARCH RESULT
S402
ACQUIRE PROGRAM INFORMATION
S403
EXTRACT UNREGISTERED PROGRAM
S404
S405
UNREGISTERED PROGRAM EXTRACTED?
NO
YES
TRANSMIT UNREGISTERED PROGRAM INFORMATION TO SERVER
S406
END

FIG. 9

120

PROGRAM NAME	HASH VALUE	VERSION	FILE SIZE	CHAINED ELEVATION PRIVILEGE	CONNECTION DESTINATION IP	CONNECTION DESTINATION PORT
lexplore.exe	72AE6B5FDA794D2	1.0.0.1	56.3KB	ABSENT	xxx.111.111.111	80
svchost.exe	1A8C6D902A120OB	2.1	1.43MB	ABSENT	xxx.111.111.112	80
dwn.exe	A8C6D902A1200B9	10.7.1	321.8KB	PRESENT	—	—
xcel.exe	F41B4C736164DD0	4.0	214KB	ABSENT	xxx.111.111.114	8080
inword.exe	5BC866A3F1C29B8	1.10.2	2.1MB	ABSENT	xxx.111.111.115	80
⋮	⋮	⋮	⋮	⋮	⋮	⋮

F I G. 10



PC001	WHITE LIST 001
PC002	WHITE LIST 002
PC003	WHITE LIST 003
⋮	⋮

PROCESS NAME	HASH VALUE	CONNECTION DESTINATION IP	CONNECTION DESTINATION PORT	REGISTRATION DATE/TIME	LATEST STARTUP DATE/TIME
lexplore.exe	72AE6B5FDA794D2	xxx.111.111.111	80	2012/3/4 10:00	2012/3/4 11:00
svchost.exe	1A8C6D902A1200B	xxx.111.111.112	80	2012/3/5 03:00	2012/3/5 10:00
dwn.exe	A8C6D902A1200B9	—	—	2012/3/13 10:00	2012/3/14 10:00
xcel.exe	F41B4C736164DD0	xxx.111.111.114	8080	2012/3/21 11:00	2012/3/26 10:00
inword.exe	5BC866A3F1C29B8	xxx.111.111.115	80	2012/3/24 20:00	2012/4/1 10:00

FIG. 11A

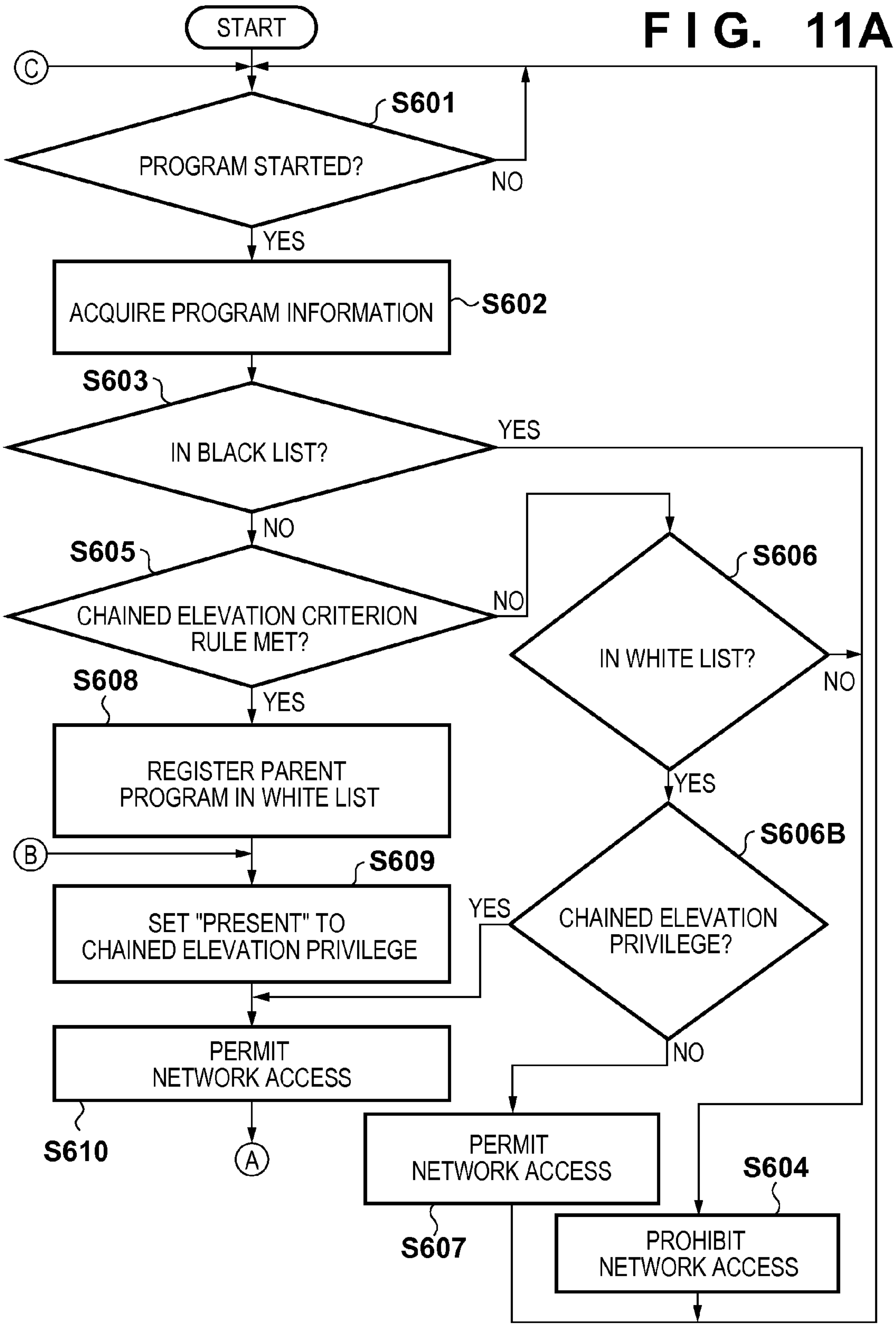
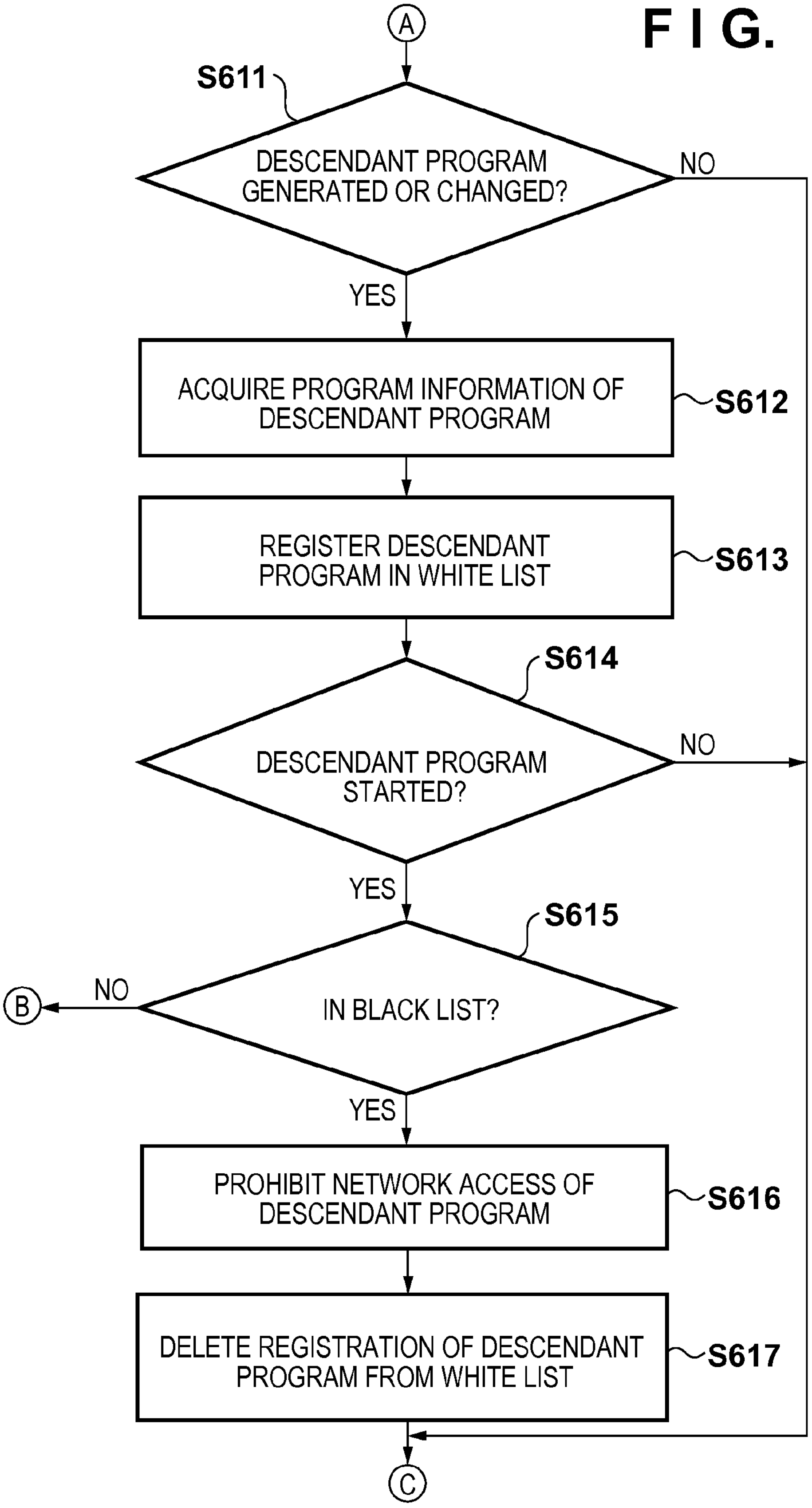

START
C
S601
PROGRAM STARTED?
NO
YES
ACQUIRE PROGRAM INFORMATION
S602
S603
IN BLACK LIST?
YES
NO
S605
CHAINED ELEVATION CRITERION RULE MET?
NO
S606
IN WHITE LIST?
NO
YES
S608
YES
REGISTER PARENT PROGRAM IN WHITE LIST
B
S609
SET "PRESENT" TO CHAINED ELEVATION PRIVILEGE
S606B
YES
CHAINED ELEVATION PRIVILEGE?
NO
PERMIT NETWORK ACCESS
S610
A
PERMIT NETWORK ACCESS
S607
S604
PROHIBIT NETWORK ACCESS

FIG. 11B


A
S611
DESCENDANT PROGRAM GENERATED OR CHANGED?
NO
YES
ACQUIRE PROGRAM INFORMATION OF DESCENDANT PROGRAM
S612
REGISTER DESCENDANT PROGRAM IN WHITE LIST
S613
S614
DESCENDANT PROGRAM STARTED?
NO
YES
S615
IN BLACK LIST?
NO
B
YES
PROHIBIT NETWORK ACCESS OF DESCENDANT PROGRAM
S616
DELETE REGISTRATION OF DESCENDANT PROGRAM FROM WHITE LIST
S617
C

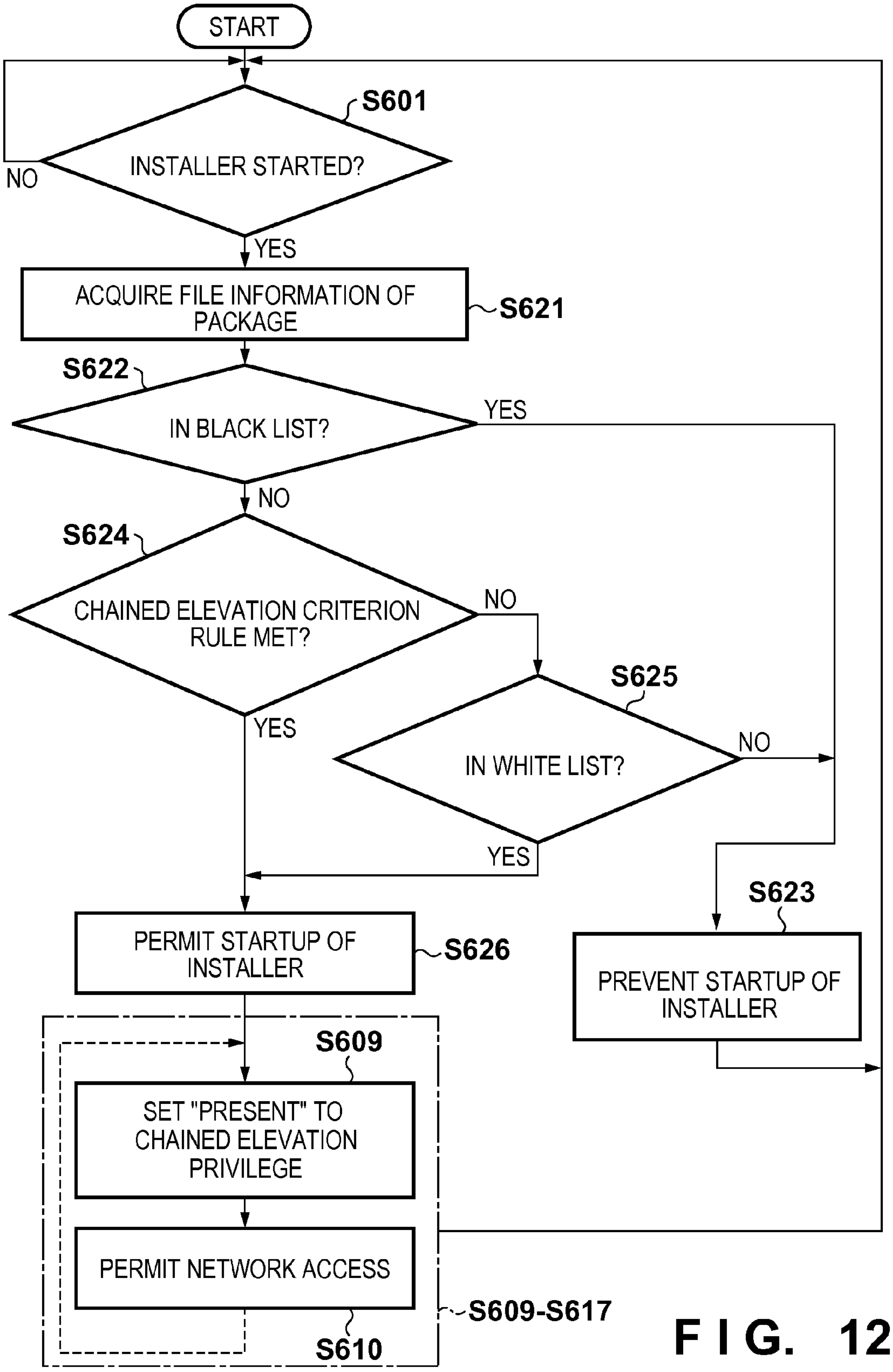

START
S601
INSTALLER STARTED?
NO
YES
ACQUIRE FILE INFORMATION OF PACKAGE
S621
S622
IN BLACK LIST?
YES
NO
S624
CHAINED ELEVATION CRITERION RULE MET?
NO
YES
S625
IN WHITE LIST?
NO
YES
S623
PERMIT STARTUP OF INSTALLER
S626
PREVENT STARTUP OF INSTALLER
S609
SET "PRESENT" TO CHAINED ELEVATION PRIVILEGE
PERMIT NETWORK ACCESS
S609-S617
S610

FIG. 12

FIG. 13

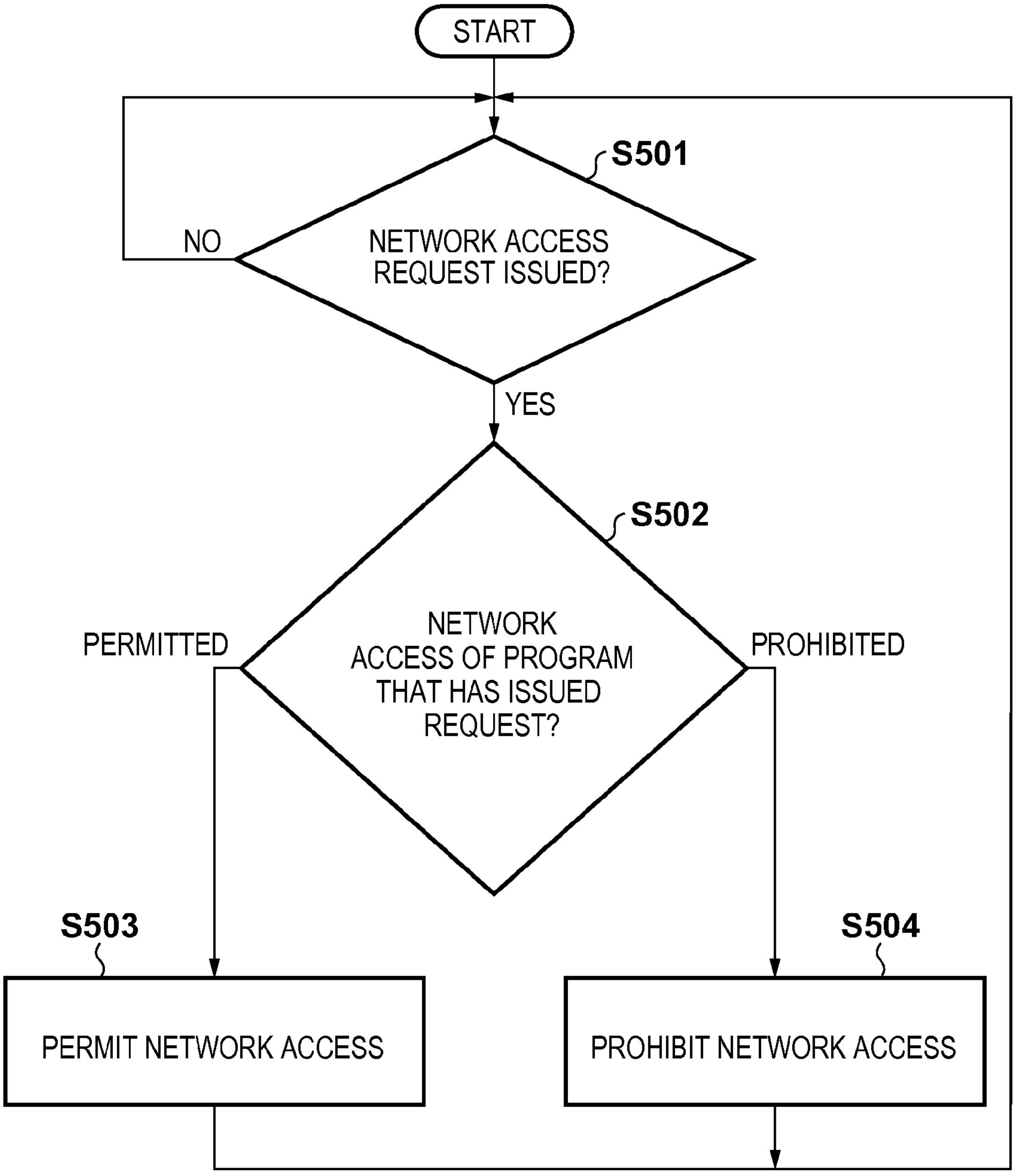

START
S501
NETWORK ACCESS REQUEST ISSUED?
NO
YES
S502
NETWORK ACCESS OF PROGRAM THAT HAS ISSUED REQUEST?
PERMITTED
PROHIBITED
S503
PERMIT NETWORK ACCESS
S504
PROHIBIT NETWORK ACCESS

FIG. 14

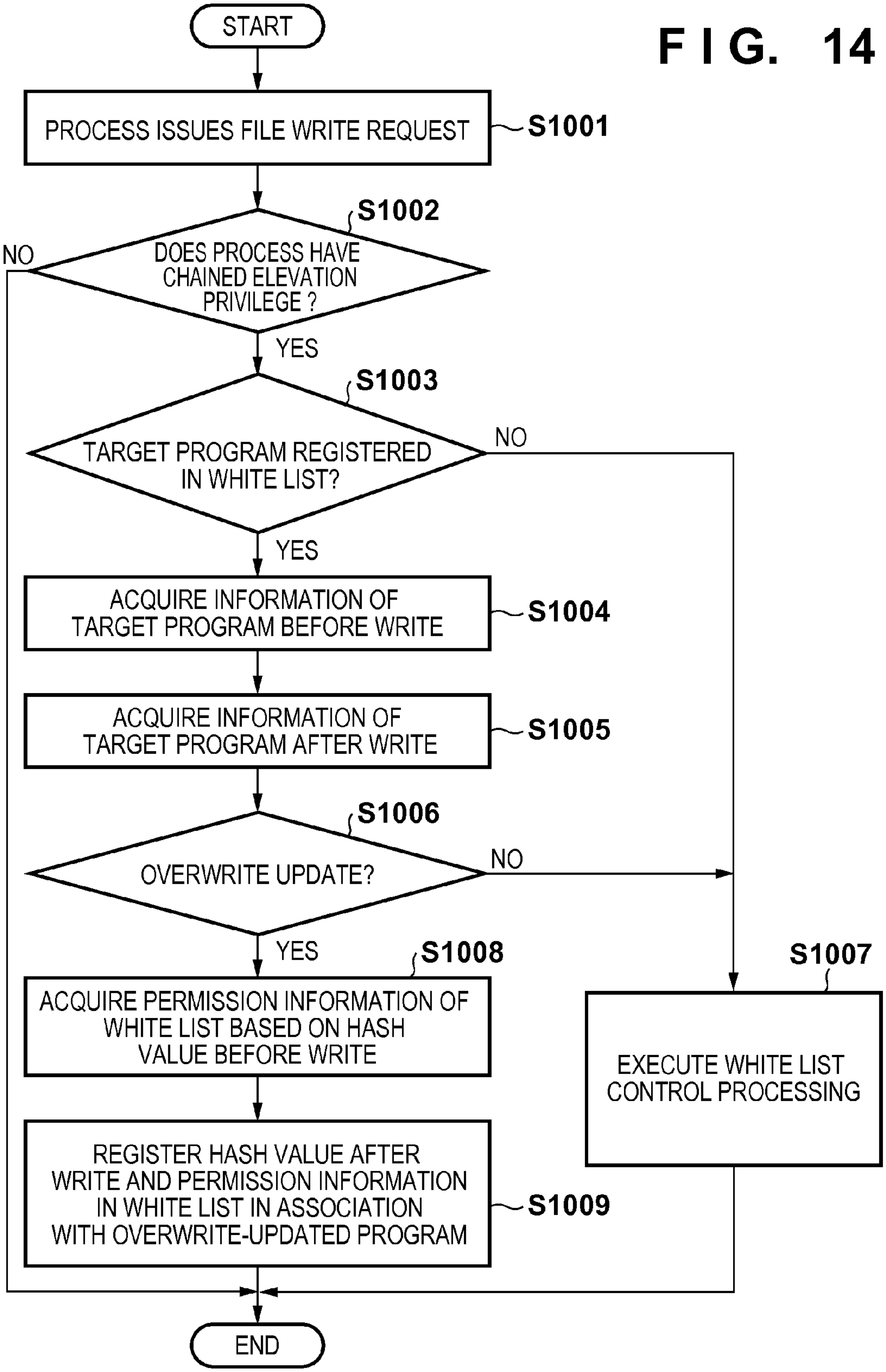

START
PROCESS ISSUES FILE WRITE REQUEST
S1001
S1002
DOES PROCESS HAVE CHAINED ELEVATION PRIVILEGE ?
NO
YES
S1003
TARGET PROGRAM REGISTERED IN WHITE LIST?
NO
YES
ACQUIRE INFORMATION OF TARGET PROGRAM BEFORE WRITE
S1004
ACQUIRE INFORMATION OF TARGET PROGRAM AFTER WRITE
S1005
S1006
OVERWRITE UPDATE?
NO
YES
S1008
ACQUIRE PERMISSION INFORMATION OF WHITE LIST BASED ON HASH VALUE BEFORE WRITE
S1007
EXECUTE WHITE LIST CONTROL PROCESSING
REGISTER HASH VALUE AFTER WRITE AND PERMISSION INFORMATION IN WHITE LIST IN ASSOCIATION WITH OVERWRITE-UPDATED PROGRAM
S1009
END

FIG. 15

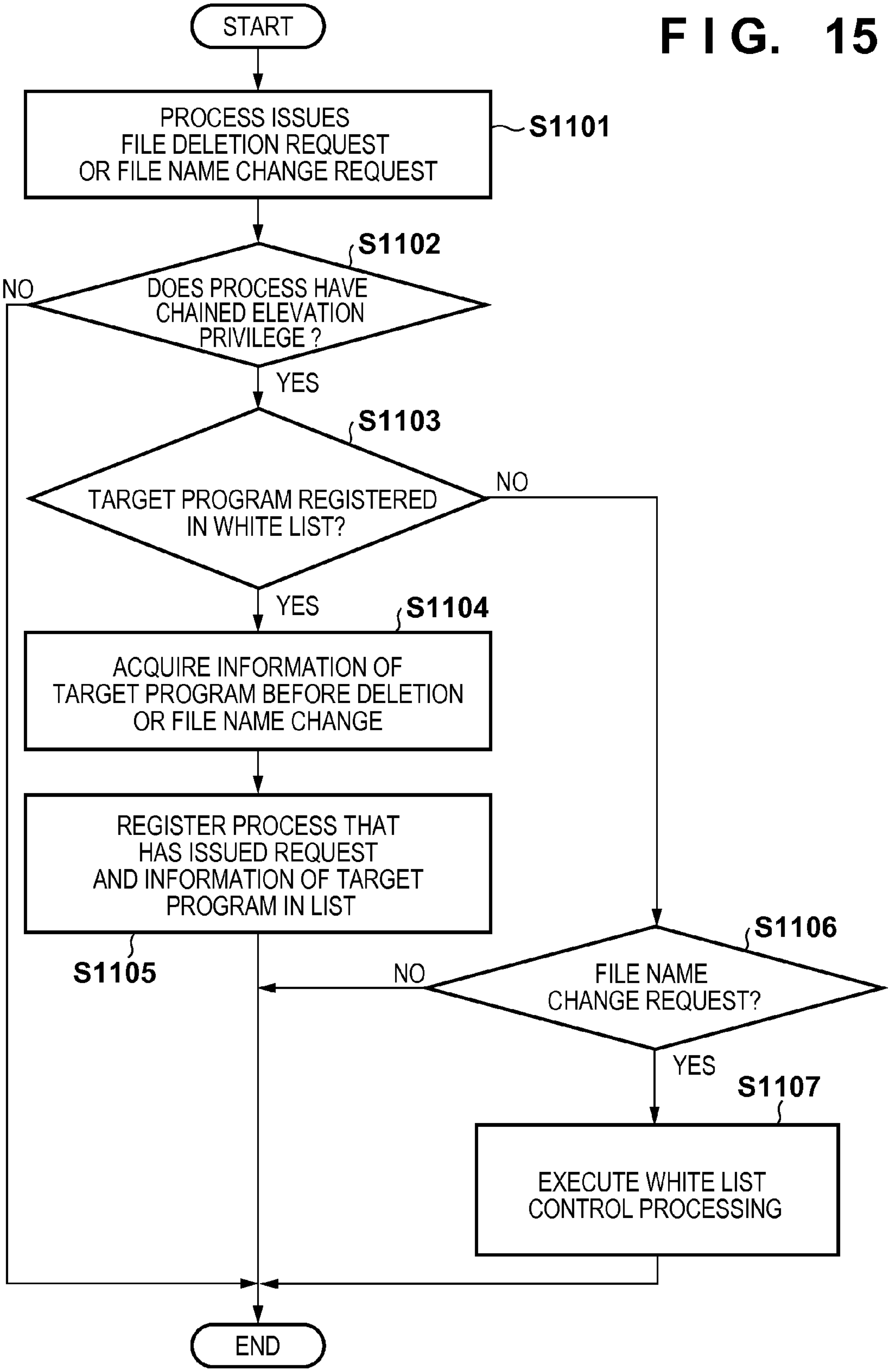

START
PROCESS ISSUES FILE DELETION REQUEST OR FILE NAME CHANGE REQUEST
S1101
DOES PROCESS HAVE CHAINED ELEVATION PRIVILEGE ?
S1102
NO
YES
TARGET PROGRAM REGISTERED IN WHITE LIST?
S1103
NO
YES
ACQUIRE INFORMATION OF TARGET PROGRAM BEFORE DELETION OR FILE NAME CHANGE
S1104
REGISTER PROCESS THAT HAS ISSUED REQUEST AND INFORMATION OF TARGET PROGRAM IN LIST
S1105
FILE NAME CHANGE REQUEST?
S1106
NO
YES
EXECUTE WHITE LIST CONTROL PROCESSING
S1107
END

FIG. 16

PROCESS NAME	PROCESS ID	FILE NAME	HASH VALUE	FILE PATH	SIGNATORY NAME	CREATOR NAME	CREATION COMPANY NAME
TestA.exe	100	A.exe	72ABC758...	C:\test\A.exe	A Sign	ABC	ABC Inc.
TestB.exe	200	B.exe	1AFC412...	C:\test\B.exe	Sign B	BCD	BCD Inc.
TestC.exe	300	C.exe	EFD1C32...	C:\test\C.exe	A Sign	CDE	ABC Inc.
⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮

FIG. 17

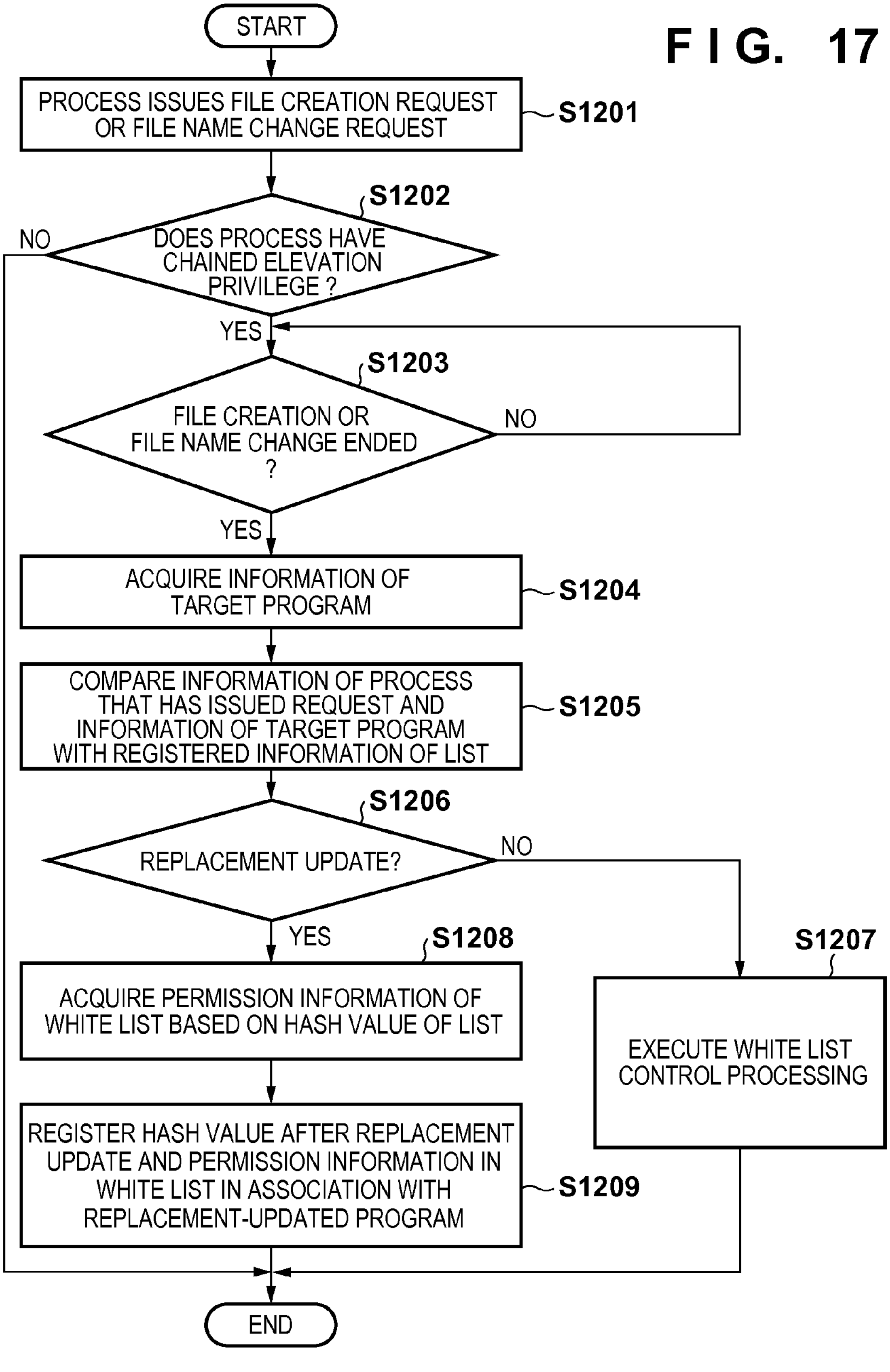
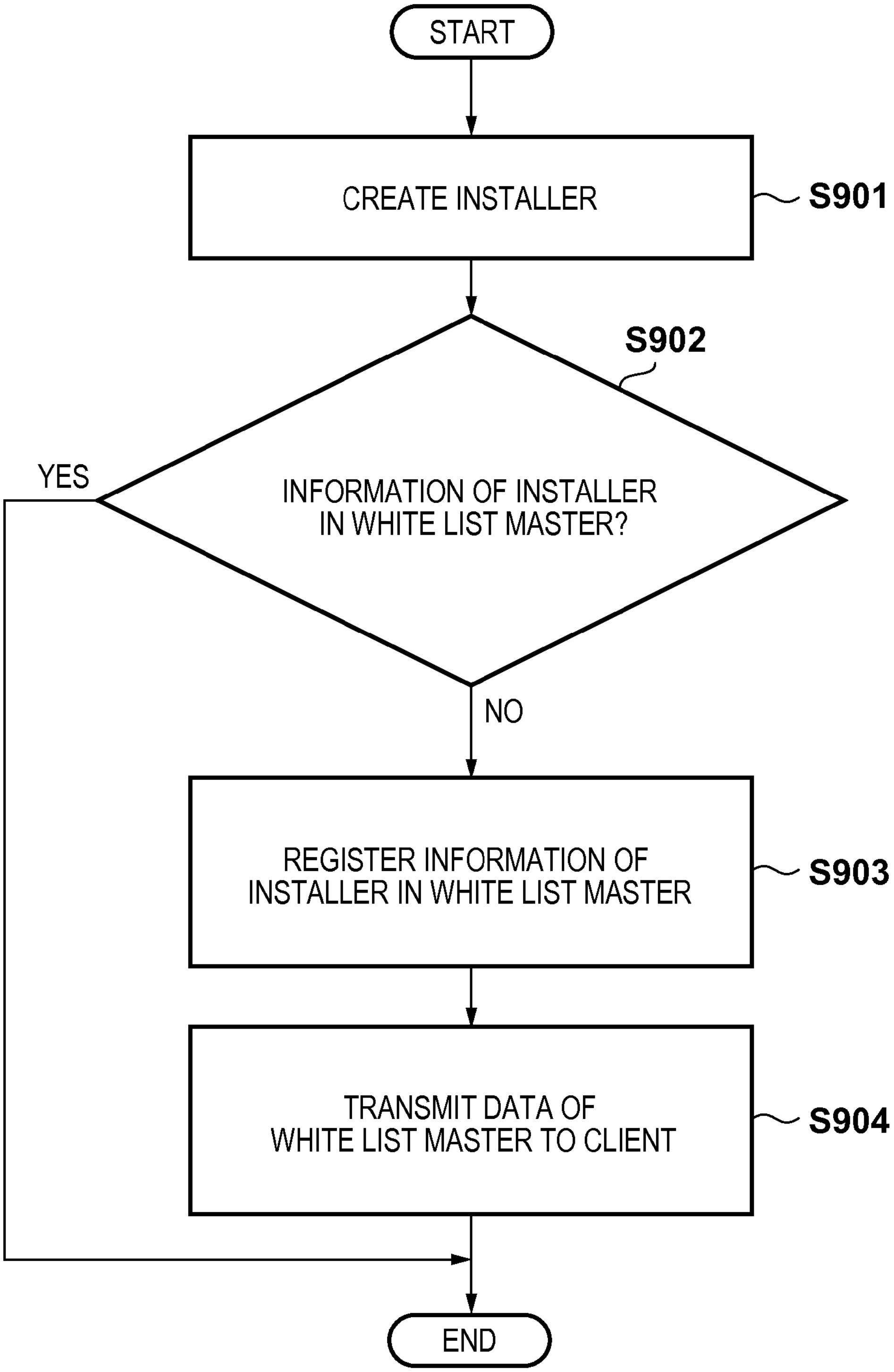

START
PROCESS ISSUES FILE CREATION REQUEST OR FILE NAME CHANGE REQUEST
S1201
S1202
DOES PROCESS HAVE CHAINED ELEVATION PRIVILEGE ?
NO
YES
S1203
FILE CREATION OR FILE NAME CHANGE ENDED ?
NO
YES
ACQUIRE INFORMATION OF TARGET PROGRAM
S1204
COMPARE INFORMATION OF PROCESS THAT HAS ISSUED REQUEST AND INFORMATION OF TARGET PROGRAM WITH REGISTERED INFORMATION OF LIST
S1205
S1206
REPLACEMENT UPDATE?
NO
YES
S1208
ACQUIRE PERMISSION INFORMATION OF WHITE LIST BASED ON HASH VALUE OF LIST
S1207
EXECUTE WHITE LIST CONTROL PROCESSING
REGISTER HASH VALUE AFTER REPLACEMENT UPDATE AND PERMISSION INFORMATION IN WHITE LIST IN ASSOCIATION WITH REPLACEMENT-UPDATED PROGRAM
S1209
END

FIG. 18


START
CREATE INSTALLER
S901
S902
INFORMATION OF INSTALLER IN WHITE LIST MASTER?
YES
NO
REGISTER INFORMATION OF INSTALLER IN WHITE LIST MASTER
S903
TRANSMIT DATA OF WHITE LIST MASTER TO CLIENT
S904
END

INFORMATION PROCESSING APPARATUS, METHOD OF CONTROLLING THE SAME, INFORMATION PROCESSING SYSTEM, AND INFORMATION PROCESSING METHOD

This application is a continuation of International Patent Application No. PCT/JP2013/006022 filed on Oct. 9, 2013, and claims priority to Japanese Patent Application Nos. 2012-224574 and 2012-224575 filed Oct. 9, 2012, Japanese Patent Application No. 2013-041248 filed Mar. 1, 2013, and Japanese Patent Application Nos. 2013-211423 and 2013-211424 filed Oct. 8, 2013, the entire content of which are incorporated herein by reference.

TECHNICAL FIELD

The present invention relates to an information processing apparatus, an information processing system, and an information processing method for controlling permission/prohibition of startup of a program and controlling network access.

BACKGROUND ART

A recently increasing new form of cyber attack affecting companies is a targeted attack that infects a target computer used or owned by a specific employee of a company with malware and steals information from the company.

Conventional antivirus software uses a virus definition file using a black list method. However, the number of types of malware containing computer viruses is increasing by the ten thousands a day. It is therefore impossible to keep up with the abrupt increase in the number of malware types by updating the virus definition software. Hence, it is difficult to cope with a targeted attack by conventional antivirus software.

On the other hand, there exists a measure against a targeted attack using a so-called white list type control method that allows execution of known programs and restricts execution of the remaining programs. When updating a program in a computer using the white list type control method, an updater program used for updating is registered in the white list.

However, the updater normally generates a plurality of other execution files in many cases. Hence, even when the updater is registered in the white list, the execution files generated by the updater are not registered in the white list. As a result, if the execution files generated by the updater are installed in the computer, and the update completed, it may be impossible to start the execution files and normally operate the updated program.

There also exists a measure against a targeted attack using a so-called white list type network access control that allows network access by known programs and restricts network access by a program included in the remaining programs.

When starting white list type network access control, a program to be permitted is registered in the white list. However, if an update is performed by, for example, applying a security patch, the previously registered white list permitted program is updated and no longer matches the registration, and the updated program needs to be re-registered in the white list. In addition, if a program is newly generated by an updater, it is necessary to register the newly generated program as well.

A system administrator or the like conventionally performs an operation of extracting an execution file generated by an updater and registering it in a white list or an operation of registering an updated program or a program generated by an updater in a white list every time an update is performed. According to these methods, it is necessary to do burdensome operations, for example, not only an operation of determining whether an updater is reliable but also an operation of registering an updated program or generated program in a white list and an operation of extracting an execution file and updating the white list.

SUMMARY OF INVENTION

According to an aspect, an information processing apparatus comprising: a detection unit configured to detect startup of a program and generation or change of a program, or search for a program; an identification unit configured to identify a program; and a registration unit configured to register a program in a white list or black list, wherein the identification unit determines, based on program information of a program whose startup is detected by the detection unit or a program which is found in the search by the detection unit, whether or not the program meets a predetermined criterion regarding program information, and the registration unit registers, in the white list or black list, the program determined to meet the predetermined criterion.

Other features and advantages of the present invention will be apparent from the following descriptions taken in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the figures thereof.

BRIEF DESCRIPTION OF DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate embodiments of the invention and, together with the description, serve to explain the principles of the invention.

FIG. **1** is a block diagram showing the arrangement of a white list control system according to the first embodiment.

FIG. **2** is a block diagram showing the arrangement of the white list control system according to the first embodiment in which no server exists.

FIG. **3** is a view showing an example of a white list.

FIG. **4** is a view showing an example of a white list master existing in a server.

FIGS. **5**A and **5**B are flowcharts for explaining white list control processing.

FIG. **6** is a flowchart for explaining white list control processing when an installer is started.

FIG. **7** is a flowchart for explaining white list update processing triggered by program startup.

FIG. **8** is a flowchart for explaining white list update processing triggered by a program search.

FIG. **9** is a view showing an example of a white list according to the second embodiment.

FIG. **10** is a view showing an example of a white list master according to the second embodiment existing in a server.

FIGS. **11**A and **11**B are flowcharts for explaining white list control processing according to the second embodiment.

FIG. **12** is a flowchart for explaining white list control processing according to the second embodiment when an installer is started.

FIG. **13** is a flowchart for explaining network access control.

FIG. **14** is a flowchart for explaining white list update processing for program update via overwrite.

FIG. **15** is a flowchart for explaining white list update processing for program update via replacement.

FIG. **16** is a view showing an example of a list in which a registration program registers information.

FIG. **17** is a flowchart for explaining white list update processing by replacement update.

FIG. **18** is a flowchart for explaining processing of creating the installer of a control program from a management console.

DESCRIPTION OF EMBODIMENTS

An information processing apparatus and a method of controlling the same, an information processing system, and an information processing method according to the embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

First Embodiment

[System Arrangement]

FIG. **1** is a block diagram showing the arrangement of a white list control system. The white list control system includes an information processing apparatus and a server apparatus that manages the information processing apparatus.

Referring to FIG. **1**, a client computer (to be referred to as a "client" hereinafter) **10** is an information processing apparatus in the white list control system. The client **10** is, for example, a personal computer (PC) set up in a company, school, administrative organ, or home or a computer device such as a tablet terminal or smartphone used or owned by an individual.

A server computer (to be referred to as a "server" hereinafter) **20** is a server apparatus that manages the information processing apparatus in the white list control system. The server **20** acquires information of a white list **120** from a plurality of clients **10** and forms a database, or periodically transmits white list data to the client **10** and updates the white list **120**.

A network **300** is a computer network such as the Internet or an intranet. The client **10** is connected to the server **20** or a web server or FTP (File Transfer Protocol) server (not shown) through the network **300**.

Note that FIG. **1** illustrates one client **10** and one server **20** for the sake of simplicity. In fact, a plurality of clients and a plurality of servers can exist in the white list control system.

Client

In the client **10**, an arithmetic device **10**C is a microprocessor (CPU). The arithmetic device **10**C starts an OS (Operating System) stored in a storage device **10**B in accordance with a boot program such as a BIOS (Basic Input/Output System) stored in a ROM (Read Only Memory) of a memory **10**E, and also starts various kinds of resident programs (for example, a control program **113** and the like) in accordance with the OS. At this time, the arithmetic device **10**C uses the RAM (Random Access Memory) of the memory **10**E as a work area. The OS is, for example, Windows®, Mac OS®, Linux®, iOS™, or Android™.

The storage device **10**B is a hard disk drive (HDD) or solid-state drive (SSD), and stores not only the OS but also data **101** and various kinds of programs **100** that operate on the client **10**. The various kinds of programs **100** stored in the storage device **10**B include an identification program **110**, a registration program **111**, a detection program **112**, a control program **113**, and a file search tool **114**, and details will be described later.

Note that the program **100** can include a plurality of programs of various functions such as the identification program **110** or only a single program having various functions. The various kinds of data **101** stored in the storage device **10**B include the white list **120**, a chained elevation criterion rule **130**, and a black list **140**, and details will be described later.

An I/O device **10**A is an input/output interface (I/F) used to connect a pointing device (for example, mouse) and a keyboard, or a display incorporating a touch panel. Note that the keyboard may be a software keyboard. The I/O device **10**A may be a speech input unit including a microphone or the like, which recognizes an input speech of an operator by a speech recognition function and transmits the recognized speech to the arithmetic device **10**C. The I/O device **10**A also functions as a user interface (UI) for displaying information.

A network I/F **10**D is an interface to the network **300** and serves as a communication circuit to communicate with another computer. The arithmetic device **10**C receives information, for example, partial data of the white list **120** from the server **20** and also transmits various kinds of information to the server **20** through the network I/F **10**D.

Server

In the server **20**, an arithmetic device **20**C is a microprocessor (CPU). The arithmetic device **20**C starts an OS stored in a storage device **20**B in accordance with a boot program such as a BIOS stored in a ROM of a memory **20**E. The arithmetic device **20**C also loads a management console **210** from the storage device **20**B to the RAM of the memory **20**E. The arithmetic device **20**C acquires information (for example, information of the white list **120**) from a plurality of clients **10** and forms a database, or reversely transmits information to the client **10** and updates the white list **120**.

The storage device **20**B is an HDD or SSD, and stores not only the OS but also data **201** and various kinds of programs **200** that include the management console **210** and operate on the server **20**. The various kinds of data **201** stored in the storage device **10**B include a white list master **220**, a chained elevation criterion rule **230**, a black list master **240**, and a white list candidate **250**, and details will be described later.

An I/O device **20**A is an interface (I/F) used to connect a pointing device (for example, mouse), a keyboard, and a monitor, and the monitor functions as a UI to display information. A network I/F **20**D is an interface to the network **300** and serves as a communication circuit to communicate with another computer such as the client **10**.

The arithmetic device **20**C receives information about the white list **120** or the black list **140** from a plurality of clients **10** through the network I/F **20**D, and manages the white list master **220** or the black list master **240** based on the received information.

In the white list control system, the server **20** is not an indispensable component. FIG. **2** is a block diagram showing the arrangement of the white list control system in which no server **20** exists. In the arrangement shown in FIG. **2**, since communication between the client **10** and the server **20** is unnecessary, the network **300** and the network I/F **10**D are options.

The white list control system may use a thin client (for example, terminal service). The thin client is a system that allows the client to be remote-connected to the server and execute an application program on the server using a virtual desktop environment generated on the server.

[Programs and Data]

The identification program **110** is executed by the arithmetic device **10**C and acquires information (to be referred to as program information hereinafter) such as a file name (program name), hash value, version information, file size, file path, and digital signature from a separately started program. The identification program **110** has an identification function of identifying the program based on the acquired program information. The identification program **110** collates the acquired program information with the chained elevation criterion rule **130** to be described later, and determines whether the program meets the chained elevation criterion.

The white list **120** is a list of information about programs that can be executed. As the information that constitutes the white list **120**, program information acquired by the identification program **110** is used.

FIG. **3** shows an example of the white list **120**. The white list **120** holds five types of information, that is, a program name, hash value, version information, file size, and chained elevation privilege flag (to be described later) for each program. Note that FIG. **3** shows merely an example, and the types and number of information held as the white list **120** are not limited to those in FIG. **3**.

The white list master **220** is a list of a plurality of white lists **120**. FIG. **4** shows an example of the white list master **220** existing in the server **20**. The white list master **220** holds information associated with the white lists **120** of a plurality of clients in association with the names or codes of the clients. In the example of FIG. **4**, the process names, hash values, registration dates/times, and latest startup dates/times of a plurality of programs are held as white list **003** corresponding to client PC **003**. Note that FIG. **4** shows merely an example, and the types and number of information held as the white list master **220** are not limited to those in FIG. **4**.

The detection program **112** is executed by the arithmetic device **10**C, and has a monitoring function of monitoring startup of a program and generation of another program by the started program and a detection function of detecting these.

The registration program **111** is executed by the arithmetic device **10**C, and has a registration function of registering, in a white list **120**, a program whose startup or generation is detected by the detection program **112**, based on the program information of the program acquired by the identification program **110**.

The control program **113** is executed by the arithmetic device **10**C, and has an startup permission/prohibition control functions for permitting or prohibiting (preventing) startup of a program that is about to be started on the client **10**.

The chained elevation criterion rule **130** is a rule to determine whether a program or file was issued by a reliable issuer. The chained elevation criterion rule **130** includes rules defined by the administrator or user based on program information. The rules include, for example, a digital signature added to a program or file, verifying whether a digital certificate is authentic, determining whether the signatory name of a file is a name stored in advance, and determining whether a file name meets a designated condition.

The types and number of rules applied as the chained elevation criterion rule **130** are not limited to the above-described detailed examples. A combination of a plurality of rules, for example, "the digital signature or digital certificate is authentic, and the file name includes a character string "Setup" or "Update"" may be applied. In this case, when "malware that generates malware by exploiting vulnerability of an image viewer (Viewer.exe)" starts, the file name does not include the above-described character strings even if the digital signature of the image viewer is authentic. As a result, an effect of preventing an attack exploiting the vulnerability of the image viewer can be obtained.

The black list **140** is a list of programs prohibited from startup/execution. The data structure of the black list **140** is almost the same as the white list **120** shown in FIG. **3**. The black list **140** is not required and may be absent on the client **10**. If the black list **140** is not used, the black list master **240** in the server **20** is not required, either.

[White List Control Processing]

Outline of Processing

The detection program **112** detects startup of a program in the client **10** using a global hook (API (Application Programming Interface) hook or filter driver) or the like, and upon detecting startup of a program, calls the identification program **110**. The identification program **110** acquires the program information of the program to be started and verifies whether the program meets the chained elevation criterion rule **130**.

Upon determining via verification that the program meets the chained elevation criterion rule **130**, the control program **113** permits startup of the program and calls the registration program **111**. The registration program **111** receives the program information of the program from the identification program **110** and registers the program in the white list **120**.

Note that if the program to be started meets the chained elevation criterion rule **130** but is registered in the black list **140**, the control program **113** does not cause the registration program **111** to execute registration of the program. That is, prohibition of startup/execution of the program is maintained.

Next, the registration program **111** gives "chained elevation privilege" to the program registered in the white list **120**. The presence/absence of chained elevation privilege is set to, for example, the chained elevation privilege flag in the white list **120**. Alternatively, a table corresponding to the white list **120** may be stored in the storage device **10**B, and the presence/absence of chained elevation privilege may be registered in each record of the table. The chained elevation privilege is defined as follows.

When a program (parent program) having chained elevation privilege generates some program (child program), the child program is unconditionally registered in the white list **120**. When the parent program starts the child program, the child program is also given chained elevation privilege. When the arrangement shown in FIG. **1** performs registration processing concerning chained elevation privilege, the following processing is performed.

The detection program **112** monitors the behavior of the parent program using a global hook or the like. Upon detecting generation of a child program by the parent program, the detection program **112** causes the identification program **110** to acquire the program information of the child program. The identification program **110** transfers the acquired program information to the registration program **111**. The registration program **111** creates data of a record to be added to the white list **120** based on the received program information, and adds the created data to the white list **120**.

At this time, the following method is also available. That is, upon detecting generation of a child program, the detection program **112** analyzes the generated file and determines whether it is necessary to register information about the generated file in the white list. Upon determining that the information need not be registered, the processing ends without program information acquisition by the identification program **110**. The registration is determined to be unnecessary in a case where, for example, the binary header of the generated file is analyzed, and the file can be determined not to be an execution file because the configuration is not a PE (Portable Executable) format.

Next, the detection program **112** monitors startup of the child program by the parent program. Upon detecting startup of the child program by the parent program, the detection program **112** calls the registration program **111**. The called registration program **111** sets "present" to the chained elevation privilege flag of the child program. The control program **113** permits startup of the child program.

Using the chained elevation privilege, a program generated by a program having a behavior of generating a child program, for example, a security patch of software can automatically be added to the white list **120**. In other words, an operation concerning white list update, that is, an operation concerning registering a generated child program in the white list **120** can be reduced.

Note that the processing concerning chained elevation privilege can be performed not only when the parent program generates a child program but also when the parent program is changed (for example, renamed) or the child program is changed.

"Determining whether a program has an authentic digital signature" is applied to the chained elevation criterion rule **130**. This makes it possible to determine, without making the operator's awareness intervene, that the program was issued by a reliable issuer and is not a malicious program such as malware. Note that whether an authentic digital signature is present can be determined by, for example, a method using a Windows® API (Application Programming Interface).

Upon determining that the program does not meet the chained elevation criterion rule **130**, the control program **113** performs general white list control. That is, upon determining that the program does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the program is registered in the white list **120**. Upon determining that the program is registered in the white list **120**, the control program **113** determines whether the program has chained elevation privilege, and permits startup of the program. Upon determining that the program is not registered in the white list **120**, the control program **113** prevents startup of the program using a global hook or the like.

In addition, the identification program **110** determines whether the program to be started is registered in the black list **140**. If the program is registered in the black list **140**, startup of the program is prevented. If the program is not registered in the black list **140**, startup of the program is permitted. Such a method is also employable.

Note that in the following explanation, a state in which a program or the like is registered in the white list **120** or black list **140** will sometimes be expressed as "exists in the list", and a state in which a program or the like is not registered as "does not exist in the list".

Details of Processing

White list control processing will be described with reference to the flowcharts of FIGS. **5**A and **5**B.

The detection program **112** monitors startup of a program (step S**201**), and upon detecting startup of the program, advances the process to step S**202**.

Upon detecting startup of the program, the identification program **110** acquires the program information of the program (step S**202**) and determines whether the program exists in the black list **140** (step S**203**). Upon determining that the program exists in the black list **140**, the control program **113** prevents startup of the program (step S**204**) and returns the process to step S**201**.

If the program does not exist in the black list **140**, the identification program **110** determines whether the program meets the chained elevation criterion rule **130** (step S**205**). If the program does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the program exists in the white list **120** (step S**206**).

Upon determining that the program exists in the white list **120**, the identification program **110** determines whether the program has chained elevation privilege (step S**206**B). Upon determining that the program has chained elevation privilege, the control program **113** permits startup of the program (step S**210**).

Upon determining that the program does not have chained elevation privilege, the control program **113** permits startup of the program (step S**207**), and returns the process to step S**201**. Upon determining that the program does not exist in the white list **120**, the control program **113** prevents startup of the program (step S**204**), and returns the process to step S**201**.

Upon determining that the program meets the chained elevation criterion rule **130**, the control program **113** transfers the program information of the program to the registration program **111**. The registration program **111** thus registers the program (parent program) in the white list **120** (step S**208**), and sets "present" to the chained elevation privilege flag (step S**209**). Next, the control program **113** permits startup of the parent program (step S**210**).

The detection program **112** monitors generation of a child program by the parent program given chained elevation privilege (step S**211**). If the parent program generates a child program, the detection program **112** advances the process to step S**212**. If the parent program does not generate a child program, the process returns to step S**201**.

Note that in step S**211**, the detection program **112** may monitor not only generation of a child program but also a change (for example, rename) of a child program or parent program. Upon detecting a change of the parent program, the same processing as that for the child program is performed for the program (parent program).

Upon detecting generation of a child program, the identification program **110** acquires the program information of the child program (step S**212**), and transfers the acquired program information to the registration program **111**. The registration program **111** thus registers the child program in the white list **120** (step S**213**).

The detection program **112** monitors whether the parent program given chained elevation privilege starts the child program (step S**214**). If the parent program starts the child program, the detection program **112** advances the process to step S**215**. If the parent program does not start the child program, the detection program **112** returns the process to step S**201**.

Upon detecting startup of the child program by the parent program, the identification program **110** determines whether the child program exists in the black list **140** (step S**215**). Upon determining that the child program exists in the black list **140**, the control program **113** prevents startup of the child program (step S**216**). The registration program **111** deletes registration of the child program from the white list **120** (step S**217**), and returns the process to step S**201**.

Upon determining that the child program does not exist in the black list **140**, the process returns to step S**209**. Hence, "present" is set to the chained elevation privilege flag of the child program (step S**209**), startup of the child program is permitted (step S**210**), and generation of a grandchild program by the child program given chained elevation privilege is monitored (step S**211**). If the child program generates a grandchild program, the grandchild program is registered in the white list **120**. If the child program given chained elevation privilege starts the grandchild program, chained elevation privilege is given to the grandchild program. These processes (steps S**209** to S**215**) are recursively repeated.

Note that if the black list **140** is absent, the identification program **110** passes the determination of step S**215**. In this case, "present" is set to the chained elevation privilege flag of the child program started by the parent program or the grandchild program started by the child program (step S**209**), and startup of the child program is permitted (step S**210**).

Note that when registering the parent program/descendant program in the white list **120**, it may be determined whether the program is registered in the white list **120**, and upon determining that the program is not registered, the program may be registered in the white list **120**. If the program is already registered in the white list **120**, the process advances to the next process without performing registration. Repetitive registration action can be prevented by determining whether a program is already registered in the white list **120**.

Programs from the second generation such as a child program and a grandchild program generated based on the parent program of the first generation will be referred to as "descendant programs" hereinafter.

Coping with Installers

In step S**201**, the detection program **112** determines, by comparison with the list, whether the program to be started is an installer program (for example, msiexec.exe in Windows®) stored in the storage device **10**B in advance. Upon determining that an installer program (to be referred to as an "installer" hereinafter) is to be started, processing from step S**202** is switched because the operation of the installer is different from the operation of other programs.

When the operator instructs execution of an installer package file (for example, msi file, msp file, or msu file), the installer is started and decompresses files stored in the installer package file (to be referred to as a "package" hereinafter). Hence, determination based on the chained elevation criterion rule **130** needs to be performed for not the installer but the package, and the processes shown in FIGS. **5**A and **5**B cannot directly be applied.

White list control processing when an installer is started will be described with reference to the flowchart of FIG. **6**.

The identification program **110** acquires the file information of the package (step S**221**) and determines whether the package exists in the black list **140** (step S**222**). Upon determining that the package exists in the black list **140**, the control program **113** prevents startup of the installer (step S**223**) and returns the process to step S**201**. Note that if the black list **140** is absent, the identification program **110** passes the determination of step S**222**.

If the package does not exist in the black list **140**, the identification program **110** determines whether the package meets the chained elevation criterion rule **130** (step S**224**). If the package does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the package exists in the white list **120** (step S**225**). Upon determining that the package exists in the white list **120**, the control program **113** sets the chained elevation privilege flag of the installer to "present" (step S**209**) and permits startup of the installer (step S**210**). Upon determining that the package does not exist in the white list **120**, the control program **113** prevents startup of the installer (step S**223**), and returns the process to step S**201**.

On the other hand, processes performed when the package meets the chained elevation criterion rule **130** are the same as in steps S**209** to S**217** of FIGS. **5**A and **5**B. "Present" is set to the chained elevation privilege flag of the installer (step S**209**), and startup of the installer is permitted (step S**210**). A program extracted from the package by the installer is handled like a child program generated by a parent program (in this case, installer). That is, the program extracted from the package is registered in the white list **120** as a descendant program. When the descendant program starts a program of the next generation, chained elevation privilege is given to the program to be started. These processes (steps S**209** to S**215**) are recursively repeated.

Note that a child program is not generated by a parent program, but instead an installer package by the program (parent program) is generated in step S**211**, the processing shown in FIG. **6** is applicable to the package file.

[Cases where Chained Elevation Privilege is Inherited by/Given to Program Other than Child Program Generated by Parent Program]

If a child program generated from a parent program having chained elevation privilege is started by the parent program, the child program inherits the chained elevation privilege. In the following cases as well, chained elevation privilege may also be inherited or given.

Pattern **1**

Assume a case where a plurality of descendant programs are generated from a single parent program in FIGS. **5**A and **5**B. At this time, if one of the descendant programs inherits the chained elevation privilege from the parent program, and the descendant program that has inherited the chained elevation privilege starts another descendant program, the started descendant program can inherit the chained elevation privilege.

For example, the update operation of Windows® includes the above-described operation. When the method of pattern **1** is executed, update of Windows® can be performed without being blocked.

When pattern **1** is executed, it is determined in step S**214** of FIG. **5**B "whether the descendant program is started by the parent program or a program generated from the same parent program and having inherited chained elevation privilege from the parent program".

Pattern **2**

Assume a case where an installer is started from another program in FIG. **6**. At this time, if a program having chained elevation privilege starts the installer, the installer can inherit the chained elevation privilege.

Some pieces of commercially available software start an installer at the time of installation. When the method of pattern **2** is executed, such software can be installed without being blocked.

Pattern **3**

Assume a case where a child program generated from a program having chained elevation privilege is started by a program that does not have chained elevation privilege in FIGS. **5**A and **5**B. At this time, two program groups, that is, a "generated program group" and a "startup program group" are defined in advance. Processing of giving chained elevation privilege can be performed for a program generated from a program belonging to the generated program group and started by a program belonging to the startup program group.

Some pieces of commercially available software perform the above-described operation at the time of installation.

When the method of pattern **3** is executed, such software can be installed without being blocked.

[Creation of White List]

To operate the white list control system, the white list **120** suitable for the operation environment needs to be created.

Processing Triggered by Program Startup

In FIGS. **5**A, **5**B, and **6**, if a program or package neither meets the chained elevation criterion rule **130** nor exists in the white list **120** (NO in step S**206** or S**225**), the control program **113** prevents startup of the program (step S**204** or S**223**), as described above. However, if such a program or package (to be referred to as "unregistered program" hereinafter) is found, it is possible to attempt to update the white list **120**.

Update processing of the white list **120** triggered by program startup will be described with reference to the flowchart of FIG. **7**.

If an unregistered program is found (step S**301**), the registration program **111** transmits, to the server **20**, the program information (to be referred to as "unregistered information" hereinafter) of the unregistered program transferred from the identification program **110** (step S**302**). The process then returns to step S**301**.

Note that the unregistered information may be transmitted to the server **20** not immediately after finding of the unregistered program but on a predetermined cycle. For example, the registration program **111** temporarily stores unregistered information in a predetermined area of, for example, the storage device **10**B or the memory **10**E. It is determined on a predetermined cycle (for example, every five min or every hour) whether stored unregistered information exists. If unregistered information is stored, the information is transmitted to the server **20**.

Upon receiving the unregistered information from the client **10** (step S**311**), the management console **210** of the server **20** determines whether information that matches the received unregistered information exists in the white list candidate **250** (step S**312**). If information that matches the received unregistered information exists in the white list candidate **250**, the process returns to step S**311**.

If information that matches the received unregistered information does not exist in the white list candidate **250**, the management console **210** adds the received unregistered information to the white list candidate **250** (step S**313**). The unregistered information added to the white list candidate **250** is presented to the operator of the server **20** by, for example, email or an alert window (step S**314**).

The operator determines, by referring to the presented information, whether to register the unregistered program in the white list, and inputs an instruction according to the determination result to the management console **210**. The management console **210** determines whether the instruction of the operator indicates registration of the program (step S**315**). If the instruction of the operator indicates registration, the program is registered in the white list master **220** (step S**316**), and "registered" is recorded in the record of the program in the white list candidate **250** (step S**317**). If the instruction of the operator indicates non-registration, "non-registration" is recorded in the record of the program in the white list candidate **250** without registering the program in the white list master **220** (step S**318**). Then, the process returns to step S**311**.

The management console **210** transmits the data of the white list master **220** to the client **10** periodically (for example, every other hour or every other day). The white list **120** of the client **10** is thus updated.

Processing Triggered by Program Search

Processing of adding a program to the white list candidate **250** which is triggered by program startup has been described above. However, it is also possible to search for a program using, for example, a file search tool of OS standard and register the found program in the white list candidate **250**. With this processing, all programs stored in the storage device **10**B of the client **10** can be added to the white list candidate **250**.

White list update processing triggered by a program search will be described with reference to the flowchart of FIG. **8**.

The file search tool **114** is started by an instruction of the operator of the client **10** (or server **20**), and a file search is executed based on an instructed search condition (step S**401**). When adding a program to the white list candidate **250**, all programs stored in the storage device **10**B are searched, and the identification program **110** receives the search result (step S**402**).

Upon receiving the search result, the identification program **110** acquires the program information of the found programs (step S**403**). An unregistered program that neither meets the chained elevation criterion rule **130** nor exists in the white list **120** is extracted from the found programs (step S**404**). When an unregistered program is extracted (step S**405**), the registration program **111** transmits the program information of the unregistered program to the server **20** (step S**406**).

Processing of the management console **210** is the same as the processing (steps S**311** to S**318** of FIG. **7**) triggered by program startup, and a detailed description thereof will be omitted.

An example has been described above in which a program that is not registered in the white list **120** is registered in the white list **120**. The same processing as described above is performed when a package that is not registered in the white list **120** is registered in the white list **120**.

In the arrangement shown in FIG. **2** without the server **20**, the processing (steps S**311** to S**318**) of the management console **210** shown in FIG. **7** is also executed on the client **10**, as a matter of course.

As described above, it is possible to reduce update operations of the white list when using the white list type control method. This reduces the burden on the system administrator or the like in extracting an execution file and updating the white list. In addition, the determination using the chained elevation criterion rule **130** reduces an operation of determining whether an updater is reliable.

Automatic Registration of Installer

An example has been described above in which a program already registered in the white list master **220** (white list **120**) meets the chained elevation criterion rule **230**. However, in a system that adds setting information and the like to a program to dynamically create an installer (by, for example, combining another file to an execution file), it may be difficult to meet the above conditions (for example, determination by a digital signature). Such a dynamically created installer (or updater) needs to be automatically registered in the white list master **220**.

Processing of creating the installer of the control program **113** from the management console **210** will be described with reference to the flowchart of FIG. **18**. Note that the same processing is performed to create an updater.

In accordance with an instruction of an operator of the server **20**, the management console **210** is started, and the installer of the control program **113** is created (step S**901**). The management console **210** creates the installer and determines whether the information of the installer exists in the white list master **220** (step S**902**). If the information of the installer already exists, the installer creation processing ends.

If the information of the installer does not exist in the white list master **220**, the management console **210** registers the information of the installer in the white list master **220** (step S**903**). The management console **210** transmits the data of the white list master **220** to the client **10** periodically (for example, every other hour or every other day) (step S**904**). The white list **120** of the client **10** is thus updated, and startup of the installer in the client **10** is permitted.

From step S902, a specific startup option may be given to startup of the management console **210**, thereby registering a designated program (file) in the white list master **220**. An example of the specific startup option is "-register c:\sample\sample.exe".

An example has been described above in which a program (installer or updater) that is not registered in the white list master **220** is registered in the white list master **220**. The same processing as described above is performed when a package that is not registered in the white list master **220** is registered in the white list master **220**. In the arrangement shown in FIG. **2** without the server **20**, the processing of the management console **210** is also executed on the client **10**, as a matter of course.

Process startup has been described above as an example of white list control. The white list control can also be performed for a predetermined operation such as network access. In this case, the white list **120** includes a connection destination IP address, a connection destination port number, and the like.

With the above processing, a program generated in accordance with a specific procedure or a program generated from a specific program can automatically be registered in the white list master **220**/white list **120** in spite of the chained elevation criterion rule **230**.

Second Embodiment

A white list control system according to the second embodiment of the present invention will be described below. Note that the same reference numerals as in the first embodiment denote the same parts in the second embodiment, and a detailed description thereof will be omitted.

[System Arrangement]

A white list control system according to the second embodiment has the same arrangement as in FIG. **1** or **2**, and a detailed description thereof will be omitted. Only parts different from the first embodiment will be explained.

An identification program **110** according to the second embodiment acquires program information, as in the first embodiment. However, the program information acquired by the identification program **110** according to the second embodiment includes the name of a PC that stores the program. The identification program **110** according to the second embodiment has an identification function of identifying the program based on the acquired program information, and a function of collating the acquired program information with a chained elevation criterion rule **130** and determining whether the program meets the chained elevation criterion, as in the first embodiment.

A white list **120** according to the second embodiment is a list of information about programs permitted to do network access. As the information that constitutes the white list **120**, program information acquired by the identification program **110** is used.

FIG. **9** shows an example of the white list **120** according to the second embodiment. The white list **120** holds seven types of information, that is, a program name (execution file name), hash value, version information, file size, connection destination IP address, connection destination port number, and chained elevation privilege flag to be described later for each program. Note that FIG. **9** shows merely an example, and the types and number of information held as the white list **120** are not limited to those in FIG. **9**.

FIG. **10** shows an example of a white list master **220** according to the second embodiment which exists in a server **20**. The white list master **220** holds information associated with the white lists **120** of a plurality of clients in association with the names or codes of the clients. In the example of FIG. **10**, the process names, hash values, connection destination IP addresses, connection destination port numbers, registration dates/times, and latest startup dates/times of a plurality of programs are held as white list **003** corresponding to PC **003**. Note that FIG. **10** shows merely an example, and the types and number of information held as the white list master **220** are not limited to those in FIG. **10**.

A detection program **112** and a registration program **111** according to the second embodiment have the same functions as in the first embodiment.

A control program **113** according to the second embodiment has a control function of permitting or prohibiting, based on the white list **120**, network access of a program started on a client **10**. The control program **113** according to the second embodiment also has a control function of controlling network access using the IP address or port number of a connection destination to be accessed by a program as a determination criterion.

The chained elevation criterion rule **130** is the same as in the first embodiment.

A black list **140** according to the second embodiment is a list of programs prohibited from network access. The data structure of the black list **140** is almost the same as the white list **120** shown in FIG. **9**. As in the first embodiment, the black list **140** is not required and may be absent on the client **10**. If the black list **140** is not used, a black list master **240** in the server **20** is not required, either.

[White List Control Processing]

Outline of Processing

As in the first embodiment, the detection program **112** detects startup of a program in the client **10** using a global hook or the like, and upon detecting startup of a program, calls the identification program **110**. The identification program **110** acquires the program information of the program to be started and verifies whether the program meets the chained elevation criterion rule **130**.

Upon determining by the verification that the program meets the chained elevation criterion rule **130**, the control program **113** determines that the program is an updater and calls the registration program **111**. The registration program **111** receives the program information of the program from the identification program **110** and registers the program in the white list **120**. This registration enables network access of the program.

Note that if the program to be started meets the chained elevation criterion rule **130** but is registered in the black list **140**, the control program **113** does not cause the registration program **111** to execute registration of the program. That is, prohibition of network access of the program is maintained. Note that if prohibition of network access is maintained, execution of the program to be started may be prevented or permitted.

At this point of time, it is impossible to know the IP address or port number of the connection destination to be accessed by the program. For this reason, the registration program **111** registers, in the white list **120**, a record (for example, third row in FIG. **9**) that is set not to restrict the IP address or port number of the connection destination. Hence, the program determined to be an updater can normally operate without a restriction on network access.

Next, the registration program **111** gives "chained elevation privilege" to the program registered in the white list **120**. This processing is the same as in the first embodiment.

When the detection program **112** detects startup of a child program by a parent program, and the registration program **111** sets "present" to the chained elevation privilege flag of the child program, the control program **113** permits network access of the child program.

Upon determining that the program does not meet the chained elevation criterion rule **130**, the control program **113** performs general white list control. That is, upon determining that the program does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the program is registered in the white list **120**. Upon determining that the program is registered in the white list **120**, the control program **113** determines whether the program has chained elevation privilege, and permits network access of the program. Upon determining that the program is not registered in the white list **120**, network access of the program is prohibited by a global hook, packet filtering, or the like.

In addition, the identification program **110** determines whether the program to be started is registered in the black list **140**. If the program is registered in the black list **140**, network access of the program is prohibited. If the program is not registered in the black list **140**, network access of the program is permitted. Such a method is also employable.

Details of Processing

White list control processing according to the second embodiment will be described with reference to the flowcharts of FIGS. **11**A and **11**B.

The detection program **112** monitors startup of a program (step S**601**), and upon detecting startup of the program, advances the process to step S**602**.

Upon detecting startup of the program, the identification program **110** acquires the program information of the program (step S**602**) and determines whether the program exists in the black list **140** (step S**603**). Upon determining that the program exists in the black list **140**, the control program **113** prohibits network access of the program (step S**604**) and returns the process to step S**601**. Note that if the black list **140** is absent, the identification program **110** passes the determination of step S**603**.

If the program does not exist in the black list **140**, the identification program **110** determines whether the program meets the chained elevation criterion rule **130** (step S**605**). If the program does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the program exists in the white list **120** (step S**606**).

Upon determining that the program exists in the white list **120**, the identification program **110** determines whether the program has chained elevation privilege (step S**606**B). Upon determining that the program has chained elevation privilege, the control program **113** permits network access of the program (step S**610**).

Upon determining that the program does not have chained elevation privilege, the control program **113** permits network access of the program (step S**607**), and returns the process to step S**601**. Upon determining that the program does not exist in the white list **120**, the control program **113** prohibits network access of the program (step S**604**), and returns the process to step S**601**.

Upon determining that the program meets the chained elevation criterion rule **130**, the control program **113** transfers the program information of the program to the registration program **111**. The registration program **111** thus registers the program (parent program) in the white list **120** (step S**608**), and sets "present" to the chained elevation privilege flag (step S**609**). Next, the control program **113** permits network access of the parent program (step S**610**).

The detection program **112** monitors generation of a child program by the parent program given chained elevation privilege (step S**611**). If the parent program generates a child program, the detection program **112** advances the process to step S**612**. If the parent program does not generate a child program, the process returns to step S**601**.

Note that in step S**611**, the detection program **112** may monitor not only generation of a child program but also a change (for example, rename) of a child program or parent program. Upon detecting a change of the parent program, the same processing as that for the child program is performed for the program (parent program).

Upon detecting generation of a child program, the identification program **110** acquires the program information of the child program (step S**612**), and transfers the acquired program information to the registration program **111**. The registration program **111** thus registers the child program in the white list **120** (step S**613**).

The detection program **112** monitors whether the parent program given chained elevation privilege starts the child program (step S**614**). If the parent program starts the child program, the detection program **112** advances the process to step S**615**. If the parent program does not start the child program, the detection program **112** returns the process to step S**601**.

Upon detecting startup of the child program by the parent program, the identification program **110** determines whether the child program exists in the black list **140** (step S**615**). Upon determining that the child program exists in the black list **140**, the control program **113** prohibits network access of the child program (step S**616**). The registration program **111** deletes registration of the child program from the white list **120** (step S**617**), and returns the process to step S**601**.

Upon determining that the child program does not exist in the black list **140**, the process returns to step S**609**. Hence, "present" is set to the chained elevation privilege flag of the child program (step S**609**), network access of the child program is permitted (step S**610**), and generation of a grandchild program by the child program given chained elevation privilege is monitored (step S**611**). If the child program generates a grandchild program, the grandchild program is registered in the white list **120**. If the child program given chained elevation privilege starts the grandchild program, chained elevation privilege is given to the grandchild program. These processes (steps S**609** to S**615**) are recursively repeated.

Note that if the black list **140** is absent, the identification program **110** passes the determination of step S**615**. In this case, "present" is set to the chained elevation privilege flag of the child program started by the parent program or the grandchild program started by the child program (step S**609**), and network access of the child program is permitted (step S**610**).

Note that when registering the parent program/descendant program in the white list **120**, it may be determined whether the program is registered in the white list **120**, and upon determining that the program is not registered, the program may be registered in the white list **120**. If the program is already registered in the white list **120**, the process advances to the next process without performing registration. Repetitive registration actions can be prevented by determining whether the program is already registered in the white list **120**.

Coping with Installer

As in the first embodiment, in step S**601**, the detection program **112** determines, by comparison with the list, whether the program to be started is an installer stored in a storage device **10**B in advance. Upon determining that an installer is to be started, processing from step S**602** is switched because the operation of the installer is different from the operation of other programs. That is, determination based on the chained elevation criterion rule **130** needs to be performed for not the installer but the package, and the processes shown in FIGS. **11**A and **11**B cannot directly be applied.

White list control processing according to the second embodiment when an installer is started will be described with reference to the flowchart of FIG. **12**.

The identification program **110** acquires the file information of the package (step S**621**) and determines whether the package exists in the black list **140** (step S**622**). Upon determining that the package exists in the black list **140**, the control program **113** prohibits startup of the installer (step S**623**) and returns the process to step S**601**. Note that if the black list **140** is absent, the identification program **110** passes the determination of step S**622**.

If the package does not exist in the black list **140**, the identification program **110** determines whether the package meets the chained elevation criterion rule **130** (step S**624**). If the package does not meet the chained elevation criterion rule **130**, the control program **113** prohibits startup of the installer (step S**623**) and returns the process to step S**601**. That is, installation of a package registered in the black list **140** or a package that does not meet the chained elevation criterion rule **130** is stopped.

If the package does not exist in the black list **140**, the identification program **110** determines whether the package meets the chained elevation criterion rule **130** (step S**624**). If the package does not meet the chained elevation criterion rule **130**, the identification program **110** determines whether the package exists in the white list **120** (step S**625**). Upon determining that the package does not exist in the white list **120**, the control program **113** prevents startup of the installer (step S**623**), and returns the process to step S**601**.

On the other hand, if the package meets the chained elevation criterion rule **130** or exists in the white list **120**, the control program **113** permits startup of the installer (step S**626**). Subsequent processes are the same as in steps S**609** to S**617** of FIGS. **11**A and **11**B. "Present" is set to the chained elevation privilege flag of the installer (step S**609**), and network access of the installer is permitted (step S**610**). A program extracted from the package by the installer is handled like a child program generated by a parent program (in this case, installer). That is, the program extracted from the package is registered in the white list **120** as a descendant program. When the descendant program starts a program of the next generation, chained elevation privilege is given to the program to be started. These processes (steps S**609** to S**615**) are recursively repeated.

Note that if not generation of a child program by a parent program but generation of an installer package by the program (parent program) is done in step S**611**, the processing shown in FIG. **12** is applicable to the package file.

If a child program generated from a parent program having chained elevation privilege is started by the parent program, the chained elevation privilege is inherited. The chained elevation privilege may be inherited or given, as in patterns **1** to **3** described in the first embodiment.

[Network Access Control]

Network access control will be described with reference to the flowchart of FIG. **13**. Network access control is executed by an arithmetic device **10**C that executes the OS. Information (for example, ACL (Access Control List)) representing permission or prohibition of network access of each program is stored in the RAM of a memory **10**E or a predetermined area of the storage device **10**B as a table by the control program **113**.

The arithmetic device **10**C monitors network access by a program (step S**501**). When a program issues a network access request, the arithmetic device **10**C refers to the ACL and determines permission or prohibition of network access of the program (step S**502**). Network access of the program is controlled in accordance with the determination result.

If network access of the program is permitted, the arithmetic device **10**C permits network access (step S**503**). That is, a command or data issued by the program is transferred to a network I/F **10**D, and data addressed to the program and received by the network I/F **10**D is transferred to the program. Note that a restriction on the IP address or port number of the connection destination may be set in the ACL for each program. In this case, the arithmetic device **10**C performs filtering in accordance with the restriction.

If network access of the program is prohibited, the arithmetic device **10**C does not permit network access (step S**504**). That is, data transfer between the program and the network I/F **10**D is not executed, an error message is returned to the network access request of the program.

[Creation of White List]

To operate the white list control system, the white list **120** suitable for the operation environment needs to be created.

In FIGS. **11**A and **11**B, if a program neither meets the chained elevation criterion rule **130** nor exists in the white list **120** (NO in step S**606**), the control program **113** prohibits network access of the program (step S**604**), as described above. In FIG. **12**, if a package neither meets the chained elevation criterion rule **130** nor exists in the white list **120** (NO in step S**625**), the control program **113** prohibits startup of the installer (step S**623**), as described above. However, if such a program or package (unregistered program) is found, it is possible to attempt to update the white list **120**, as in the first embodiment. White list update processing according to the second embodiment is the same as white list update processing according to the first embodiment shown in FIGS. **7** and **8**, and a detailed description thereof will be omitted.

[Modification]

An example has been described above in which no restriction is set on the IP address or port number of the connection destination in a record registered in the white list **120** by the registration program **111** (for example, third row in FIG. **9**). However, for example, even if the program name does not change before and after update, if the program to be updated can be specified, the IP address or port number can be restricted to that of the same connection destination as the program before update. Note that the restriction can be imposed not by the IP address or port number but using terminal information such as a MAC address.

For example, processing of overwriting a program before update with a program after update or replacing a program before update with a program after update is detected, and the programs before and after update are associated with each other. Then, the white list **120** is updated based on this association. This makes it possible to register a record of the same setting as the program before update in the white list **120** and attain a securer white list update function. Details will be described below.

Updating White List Upon Detecting Overwrite

An example will be described in which when a process having chained elevation privilege overwrite-updates a program registered in the white list **120**, the write processing of the process is monitored, thereby appropriately setting the white list **120**. Note that the overwrite update corresponds to processing of, for example, overwriting data (file) before update with data (file) after update.

Update processing of the white list **120** by overwrite update will be described with reference to the flowchart of FIG. **14**.

When a file write request is issued by an arbitrary process, the detection program **112** detects the write request (step S**1001**) and determines whether the process that has issued the write request has chained elevation privilege (step S**1002**). If the process does not have chained elevation privilege, the detection program **112** ends the processing for the write request and monitors a write request from the process again.

If the process that has issued the write request has chained elevation privilege, the identification program **110** specifies the write target program (to be referred to as a "target program" hereinafter) from the write request. The target program is specified from, for example, the file path and the file name. The hash value of the target program is acquired, and it is determined based on the hash value whether the target program is registered in the white list **120** (step S**1003**).

If the target program is not registered in the white list **120**, the process advances to white list control processing shown in FIGS. **11**A and **11**B or FIG. **12** to add the target program to the white list **120** (step S**1007**), and the processing for the write request ends.

If the target program is registered in the white list **120**, the identification program **110** acquires the information of the target program before write (step S**1004**). The acquired information includes, for example, a hash value, file path, signatory name, creator name, creation company name, and the like.

When the write by the process has ended, the identification program **110** acquires the information of the target program after write (step S**1005**). The acquired information includes, for example, a hash value, file path, signatory name, creator name, creation company name, and the like. The pieces of information of the target programs before and after write are compared, thereby determining whether overwrite update has been done (step S**1006**). This determination is done based on a condition, for example, whether the file paths are identical, whether the file names are identical, or whether the signatory names are identical. Either one or a plurality of determination conditions can be used.

Upon determining that overwrite update has not been done, the process advances to step S**1007** described above. Upon determining that overwrite update has been done, the identification program **110** acquires permission information of the white list **120** based on the hash value before write (before overwrite update) (step S**1008**). The permission information includes, for example, chained elevation privilege, a connection destination port permitted to communicate, a connection destination IP address permitted to communicate, and the like (see FIG. **9**).

The registration program **111** receives the hash value after write (after overwrite update) acquired in step S**1005** and the permission information acquired in step S**1008** from the identification program **110**. The registration program **111** registers the hash value after overwrite update and the permission information in the white list **120** in association with the overwrite-updated target program (step S**1009**), and the processing for the write request ends.

The above-described processing enables update that continues the setting of the white list **120** before overwrite update. Note that in step S**1009**, the hash value and permission information before overwrite update may be deleted from the white list **120** or left in the white list **120**. When the hash value and permission information before overwrite update remain in the white list **120**, it is possible to restore the program before update in case of an error in the updated program or cope with a situation where another user has not executed the update.

Updating White List Upon Detecting Replacement

An example of overwrite update has been described above. Replacement update will be described below. The replacement update corresponds to processing of, for example, deleting or moving a file or changing a file name, and after that, creating or moving a file after update or changing a file name, thereby updating a program.

Update processing of the white list **120** by replacement update will be described with reference to the flowchart of FIG. **15**. FIG. **15** illustrates processing for an original file deletion request or file name change request.

When a file deletion request or file name change request is issued by an arbitrary process, the detection program **112** detects the deletion request or change request (to be referred to as a "request" hereinafter) (step S**1101**) and determines whether the process that has issued the request has chained elevation privilege (step S**1102**). If the process does not have chained elevation privilege, the detection program **112** ends the processing for the request and monitors a deletion request or change request from the process again.

If the process that has issued the request has chained elevation privilege, the identification program **110** specifies, from the request, the program (to be referred to as a "target program" hereinafter) to be deleted or change the file name. The target program is specified from, for example, the file path and the file name. The hash value of the target program is acquired, and it is determined based on the hash value whether the target program is registered in the white list **120** (step S**1103**).

If the target program is not registered in the white list **120**, the identification program **110** determines whether the request is a file name change request (step S**1106**). If the request is not a file name change request (that is, deletion request), the identification program **110** ends the processing for the request, and the detection program **112** monitors a file deletion request or file name change request from the process again. If the request is a file name change request, the process advances to white list control processing shown in FIGS. **11**A and **11**B or FIG. **12** to add the target program to the white list **120** (step S**1107**), and the processing for the request ends.

If the target program is registered in the white list **120**, the identification program **110** acquires the information of the target program before deletion or file name change (step S**1104**). The acquired information includes, for example, a hash value, file path, signatory name, creator name, creation company name, and the like.

The registration program **111** receives the process name and process ID of the process that has issued the request, the file name of the target program, and the information acquired in step S1104 from the identification program **110**. The registration program **111** registers the received information in a list (step S**1105**), and the processing for the request ends. FIG. **16** shows an example of the list in which the registration program **111** registers the information.

Update processing of the white list **120** by replacement update will be described with reference to the flowchart of FIG. **17**. FIG. **17** illustrates processing for a file creation request or file name change request.

When a file creation request or file name change request is issued by an arbitrary process, the detection program **112** detects the creation request or change request ("request") (step S**1201**) and determines whether the process that has issued the request has chained elevation privilege (step S1202). If the process does not have chained elevation privilege, the detection program **112** ends the processing for the request and monitors a creation request or change request from the process again.

If the process that has issued the request has chained elevation privilege, the identification program **110** determines whether file creation or file name change has ended (step S1203). If file creation or file name change has ended, information of the created file or the file whose file name has been changed ("target program") is acquired (step S**1204**). The acquired information includes, for example, file name, hash value, file path, signatory name, creator name, creation company name, and the like of the target program.

The identification program **110** compares the process name and process ID of the process that has issued the request and the information acquired in step S**1204** with the registered information of the list shown in FIG. **16** (step S1205). It is determined whether replacement update has been done (step S**1206**). This determination is done based on a condition, for example, whether the process IDs are identical, whether the file paths are identical, whether the file names are identical, or whether the signatory names are identical. Either one or a plurality of determination conditions can be used.

Upon determining that replacement update has not been done, the process advances to white list control processing shown in FIGS. **11**A and **11**B or FIG. **12** to add the target program to the white list **120** (step S1207), and the processing for the request ends.

Upon determining that replacement update has been done, the identification program **110** acquires permission information of the white list **120** based on the hash value of a record corresponding to the target program in the list (step S**1208**). The permission information includes, for example, chained elevation privilege, a connection destination port permitted to communicate, a connection destination IP address permitted to communicate, and the like (see FIG. **9**).

The registration program **111** receives the hash value of the target program after replacement update and the permission information acquired in step S**1208** from the identification program **110**. The registration program **111** registers the hash value after replacement update and the permission information in the white list **120** in association with the replacement-updated target program (step S**1209**), and the processing for the request ends.

The above-described processing enables update that continues the setting of the white list **120** before replacement update. Note that in step S**1208**, the hash value and permission information before replacement update may be deleted from the white list **120** or left in the white list **120**. When the hash value and permission information before replacement update remain in the white list **120**, it is possible to restore the program before update in case of an error in the updated program or cope with a situation where another user has not executed the update.

In the first and second embodiments, a PC, tablet terminal, and smartphone have been described as the examples of the client **10**. However, the above-described processing can be applied using a terminal including no pointing device (for example, network scanner) or a terminal including no display (for example, embedded terminal) as a client.

In the first and second embodiments, the white list control system using a white list has been described. However, the present invention is not limited to the white list, and the above-described processing can also be applied to a black list control system using a black list.

The client **10** according to the first or second embodiment may have an operation history (not shown). Program information acquired by the identification program **110** and the like are recorded in the operation history as the operation history of the user. For example, concerning startup of a program, an execution file name (program name), hash value, version information, file size, file path, digital signature, permission/prohibition (success/failure) of program startup, and the like are recorded in the operation history. Concerning a network access request, an execution file name (program name), hash value, version information, file size, connection destination IP address, connection destination port number, permission/prohibition (success/failure) of network access, and the like are recorded in the operation history. A date/time when an action of a process was detected, and the like are also recorded in the operation history.

The server **20** according to the first or second embodiment may have an operation history (not shown). The control program **113** may transmit the operation history (data file) that the client **10** has to the server **20** periodically (for example, every other hour or every other day). The operation history transmitted from the client **10** may be recorded and managed in the operation history of the server **20** in association with the name or code of the client **10**. Note that the control program **113** may transmit the operation history to the server **20** in real time.

If a program recorded in the operation history has not been started for a predetermined period (for example, one month), and the information of the program is included in the white list **120** or the white list master **220**, the information may automatically be deleted.

OTHER EMBODIMENTS

The present invention is also implemented by executing the following processing. That is, software (program) that implements the functions of the above-described embodiments is supplied to the system or apparatus through a network or various kinds of storage media, and the computer (or CPU or MPU) of the system or apparatus reads out and executes the program.

The program may be executed by one computer or by a plurality of computers cooperatively.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are made.

The invention claimed is:

1. An information processing apparatus comprising:

a detection unit configured to detect startup of a program and generation or change of the program, or search for the program;

an identification unit configured to identify the program; and

a registration unit configured to register the program in a white list or black list,

wherein the identification unit determines, based on program information of the program whose startup is detected by the detection unit or the program which is found in the search by the detection unit, whether or not the program meets a predetermined criterion regarding program information,

wherein the registration unit registers, in the white list or black list, the program determined to meet the predetermined criterion,

wherein at least one of the detection unit, the identification unit, or the registration unit is implemented using a processor,

wherein the registration unit registers a correspondence between the program determined to meet the predetermined criterion and chained elevation privilege in the white list in order to give the chained elevation privilege to the program, and

wherein when the detection unit detects generation or change of a child program by the program given the chained elevation privilege, the registration unit registers the child program in the white list.

2. The information processing apparatus according to claim **1**, wherein the white list comprises a list of programs whose execution is permitted.

3. The information processing apparatus according to claim **2**, wherein the black list comprises a list of programs whose execution is prohibited,

the identification unit determines whether or not the detected or found program is registered in the black list, and

the registration unit gives the chained elevation privilege to the detected or found program determined to be unregistered in the black list.

4. The information processing apparatus according to claim **3**, wherein when the detection unit detects generation or change of a program of a next generation by the program given the chained elevation privilege, the identification unit determines, based on the program information of the program of the next generation, whether or not the program of the next generation is registered in the black list, and

the registration unit gives the chained elevation privilege to the program of the next generation determined to be unregistered in the black list.

5. The information processing apparatus according to claim **4**, wherein the registration unit deletes, from the white list, registration of the program of the next generation determined to be registered in the black list.

6. The information processing apparatus according to claim **3**, wherein when the detection unit detects startup of a program of a next generation by the program given the chained elevation privilege, the identification unit determines, based on the program information of the program whose startup is detected, whether or not the program is registered in the black list or whether or not the program is registered in the white list, and

the registration unit executes processing for registering, in the white list, the program determined to be unregistered in the black list or the program determined to be unregistered in the white list.

7. The information processing apparatus according to claim **3**, further comprising a control unit configured to permit or prevent startup of the program based on the white list or black list.

8. The information processing apparatus according to claim **2**, wherein when the detection unit detects generation or change of a program of a next generation by the program given the chained elevation privilege, the registration unit recursively repeats processing of registering the program of the next generation in the white list.

9. The information processing apparatus according to claim **8**, wherein when the detection unit detects startup of the program of the next generation by the program given the chained elevation privilege, the registration unit gives the chained elevation privilege to the program of the next generation.

10. The information processing apparatus according to claim **9**, wherein when the detection unit detects startup of a program of another next generation by the program of the next generation given the chained elevation privilege, the registration unit gives the chained elevation privilege to the program of the other next generation.

11. The information processing apparatus according to claim **2**, wherein when the detection unit detects startup of an installer by the program given the chained elevation privilege, the registration unit gives the chained elevation privilege to the installer.

12. The information processing apparatus according to claim **2**, wherein the registration unit gives the chained elevation privilege to a program generated from a program belonging to a generated program group stored in advance and started by a program belonging to a startup program group stored in advance.

13. The information processing apparatus according to claim **1**, wherein the program information comprises a digital signature.

14. The information processing apparatus according to claim **1**, wherein the white list comprises a list of programs whose network access is permitted.

15. The information processing apparatus according to claim **14**, wherein the black list comprises a list of programs whose network access is prohibited,

the identification unit determines whether or not the detected or found program is registered in the black list, and

the registration unit gives the chained elevation privilege to the detected or found program determined to be unregistered in the black list.

16. The information processing apparatus according to claim **15**, wherein when the detection unit detects generation or change of a program of a next generation by the program given the chained elevation privilege, the identification unit determines, based on the program information of the program of the next generation, whether or not the program of the next generation is registered in the black list, and

the registration unit gives the chained elevation privilege to the program of the next generation determined to be unregistered in the black list.

17. The information processing apparatus according to claim **16**, wherein the registration unit deletes, from the white list, registration of the program of the next generation determined to be registered in the black list.

18. The information processing apparatus according to claim **15**, wherein when the detection unit detects startup of a program of a next generation by the program given the chained elevation privilege, the identification unit determines, based on the program information of the program whose startup is detected, whether or not the program is registered in the black list or whether or not the program is registered in the white list, and

the registration unit executes processing for registering, in the white list, the program determined to be unregistered in the black list or the program determined to be unregistered in the white list.

19. The information processing apparatus according to claim **15**, further comprising a control unit configured to permit network access of the program based on the white list, and prohibit network access of the list.

20. The information processing apparatus according to claim **14**, wherein when the detection unit detects generation or change of a program of a next generation by the program given the chained elevation privilege, the registration unit recursively repeats processing of registering the program of the next generation in the white list.

21. The information processing apparatus according to claim **20**, wherein when the detection unit detects startup of the program of the next generation by the program given the chained elevation privilege, the registration unit gives the chained elevation privilege to the program of the next generation.

22. The information processing apparatus according to claim **21**, wherein when the detection unit detects startup of a program of another next generation by the program of the next generation given the chained elevation privilege, the registration unit gives the chained elevation privilege to the program of the other next generation.

23. The information processing apparatus according to claim **14**, wherein when the detection unit detects startup of an installer by the program given the chained elevation privilege, the registration unit gives the chained elevation privilege to the installer.

24. The information processing apparatus according to claim **14**, wherein the registration unit gives the chained elevation privilege to a program generated from a program belonging to a generated program group stored in advance and started by a program belonging to a startup program group stored in advance.

25. The information processing apparatus according to claim **14**, wherein the identification unit acquires setting information of a program associated with the program determined to meet the predetermined criterion, and

the registration unit registers the program determined to meet the predetermined criterion and the setting information acquired by the identification unit in association with each other.

26. The information processing apparatus according to claim **1**, wherein the registration unit registers, in the white list or black list, a program generated in accordance with a specific procedure or a program generated from a specific program.

27. An information processing system comprising:

the information processing apparatus according to claim **1**; and

a server apparatus configured to transmit information regarding a white list or black list of programs to the information processing apparatus through a network.

28. The information processing system according to claim **27**, wherein the server apparatus receives information regarding the program to be registered in the white list or black list from the information processing apparatus through the network.

29. The information processing system according to claim **28**, wherein the white list comprises a list of programs whose execution is permitted, and the black list comprises a list of programs whose execution is prohibited.

30. The information processing system according to claim **28**, wherein the white list comprises a list of programs whose network access is permitted, and the black list comprises a list of programs whose network access is prohibited.

31. An information processing method comprising:

using a processor to perform steps of:

detecting startup of a program and generation or change of the program, or searching for the program;

identifying the program; and

registering the program in a white list or black list,

wherein in the identifying step, it is determined, based on program information of the program whose startup is detected in the detecting step or the program which is found in the search in the detecting step, whether or not the program meets a predetermined criterion,

wherein in the registering step, the program determined to meet the predetermined criterion is registered in the white list or black list,

wherein the registering step registers a correspondence between the program determined to meet the predetermined criterion and chained elevation privilege in the white list in order to give the chained elevation privilege to the program, and

wherein when the detecting step detects generation or change of a child program by the program given the chained elevation privilege, the registering step registers the child program in the white list.

32. A non-transitory computer readable medium storing a computer-executable program for causing a computer to execute an information processing method comprising the steps of:

detecting startup of a program and generation or change of the program, or searching for the program;

identifying the program; and

registering the program in a white list or black list,

wherein in the identifying step, it is determined, based on program information of the program whose startup is detected in the detecting step or the program which is found in the search in the detecting step, whether or not the program meets a predetermined criterion,

wherein in the registering step, the program determined to meet the predetermined criterion is registered in the white list or black list,

wherein the registering step registers a correspondence between the program determined to meet the predetermined criterion and chained elevation privilege in the white list in order to give the chained elevation privilege to the program, and

wherein when the detecting step detects generation or change of a child program by the program given the chained elevation privilege, the registering step registers the child program in the white list.

* * * * *