US 20220311760A1

(19) United States

(12) Patent Application Publication

Ohashi

(10) Pub. No.: US 2022/0311760 A1

(43) Pub. Date: Sep. 29, 2022

(54) **MONITORING APPARATUS, CONTROL METHOD THEREOF, STORAGE MEDIUM, AND IMAGE PROCESSING APPARATUS**

(71) Applicant: **CANON KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventor: **Toshio Ohashi**, Tokyo (JP)

(21) Appl. No.: **17/697,395**

(22) Filed: **Mar. 17, 2022**

(30) **Foreign Application Priority Data**

Mar. 23, 2021 (JP) 2021-049150

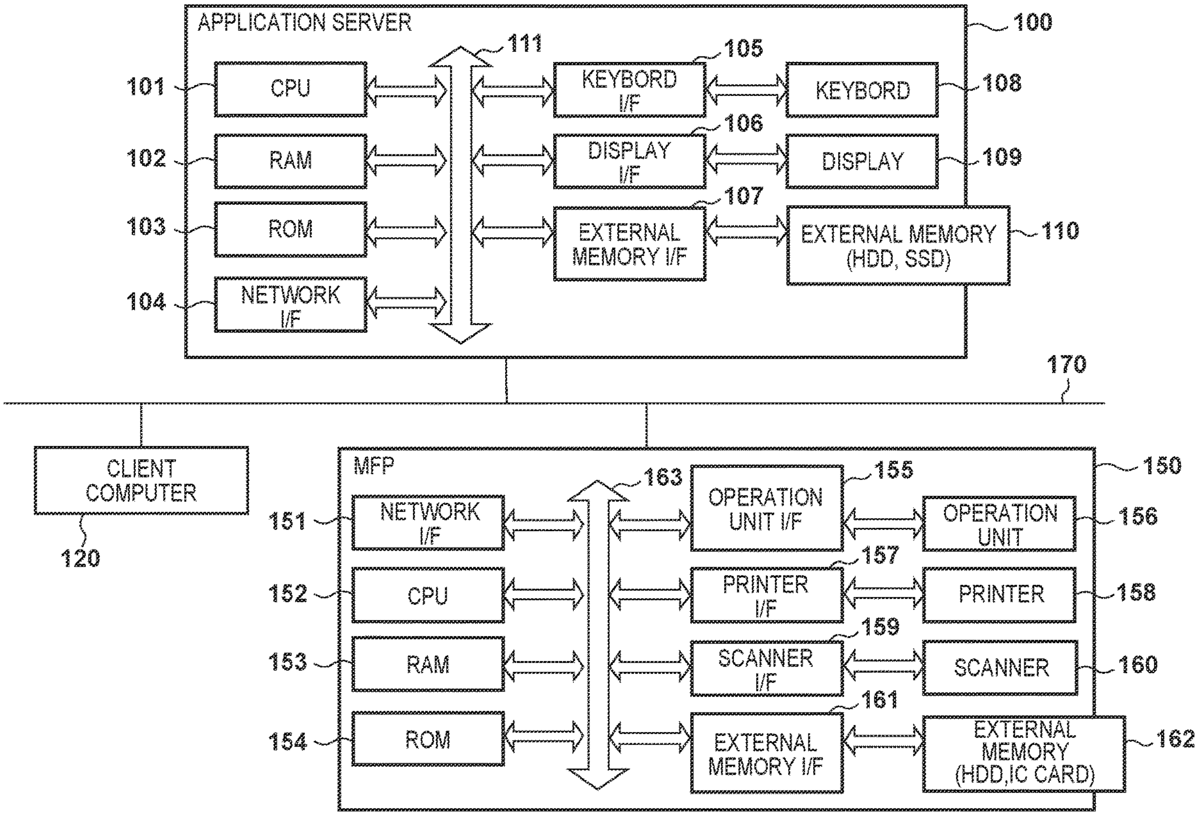
Publication Classification

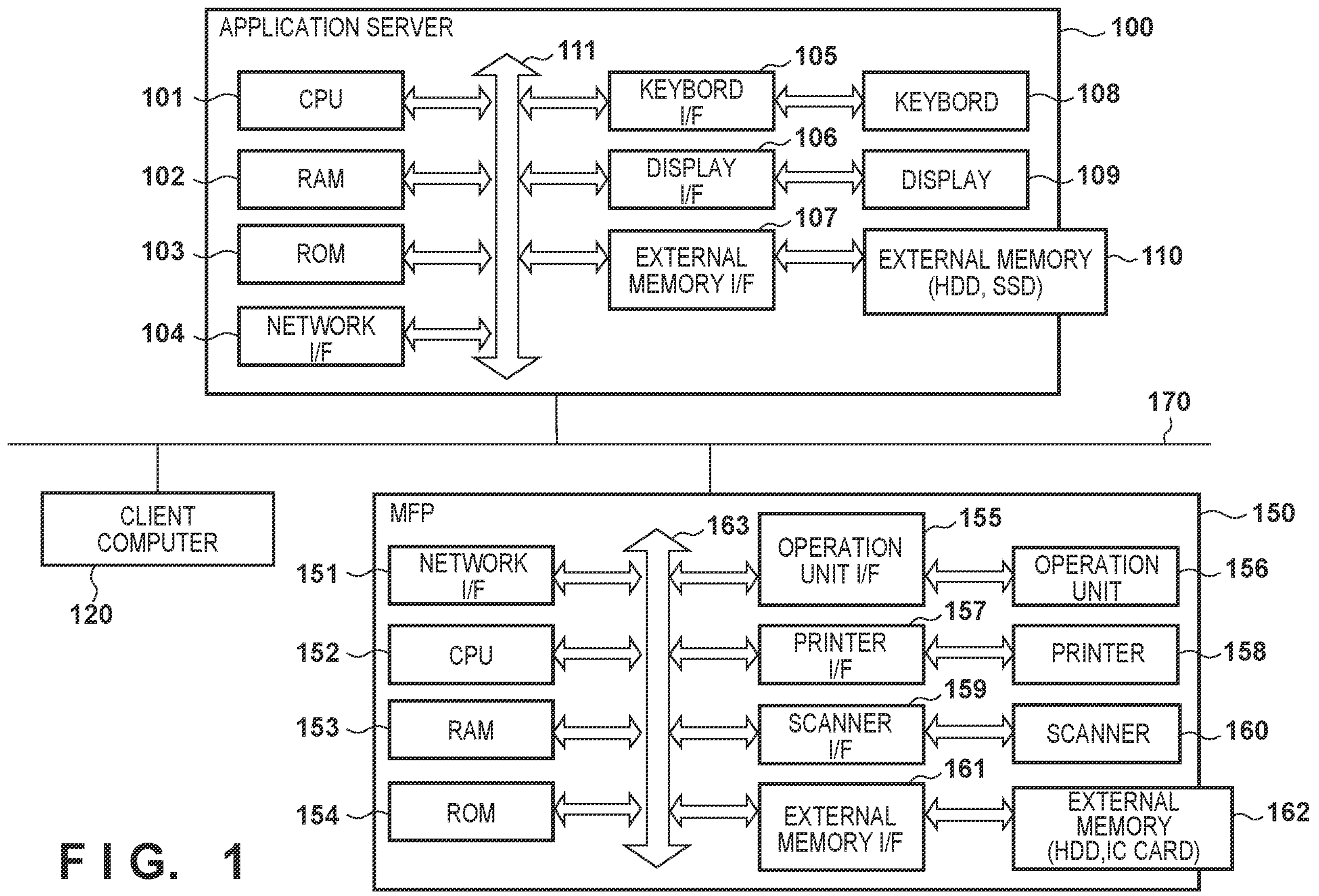
(51) **Int. Cl.**
H04L 9/40 (2006.01)

(52) **U.S. Cl.**
CPC *H04L 63/0823* (2013.01); *H04L 63/0876* (2013.01); *H04L 63/20* (2013.01)

(57) **ABSTRACT**

The present monitoring apparatus is capable of communicating with one or more network devices via a network and verifies content information of a certificate related to security set in a network device to be monitored. The present monitoring apparatus also verifies update setting information related to a certificate update and provides a report based on two verification results.




APPLICATION SERVER
100
101
CPU
102
RAM
103
ROM
104
NETWORK I/F
111
105
KEYBORD I/F
106
DISPLAY I/F
107
EXTERNAL MEMORY I/F
KEYBORD
108
DISPLAY
109
EXTERNAL MEMORY (HDD, SSD)
110
170
CLIENT COMPUTER
120
MFP
150
151
NETWORK I/F
152
CPU
153
RAM
154
ROM
163
OPERATION UNIT I/F
155
PRINTER I/F
157
SCANNER I/F
159
EXTERNAL MEMORY I/F
161
OPERATION UNIT
156
PRINTER
158
SCANNER
160
EXTERNAL MEMORY (HDD,IC CARD)
162

F I G. 1

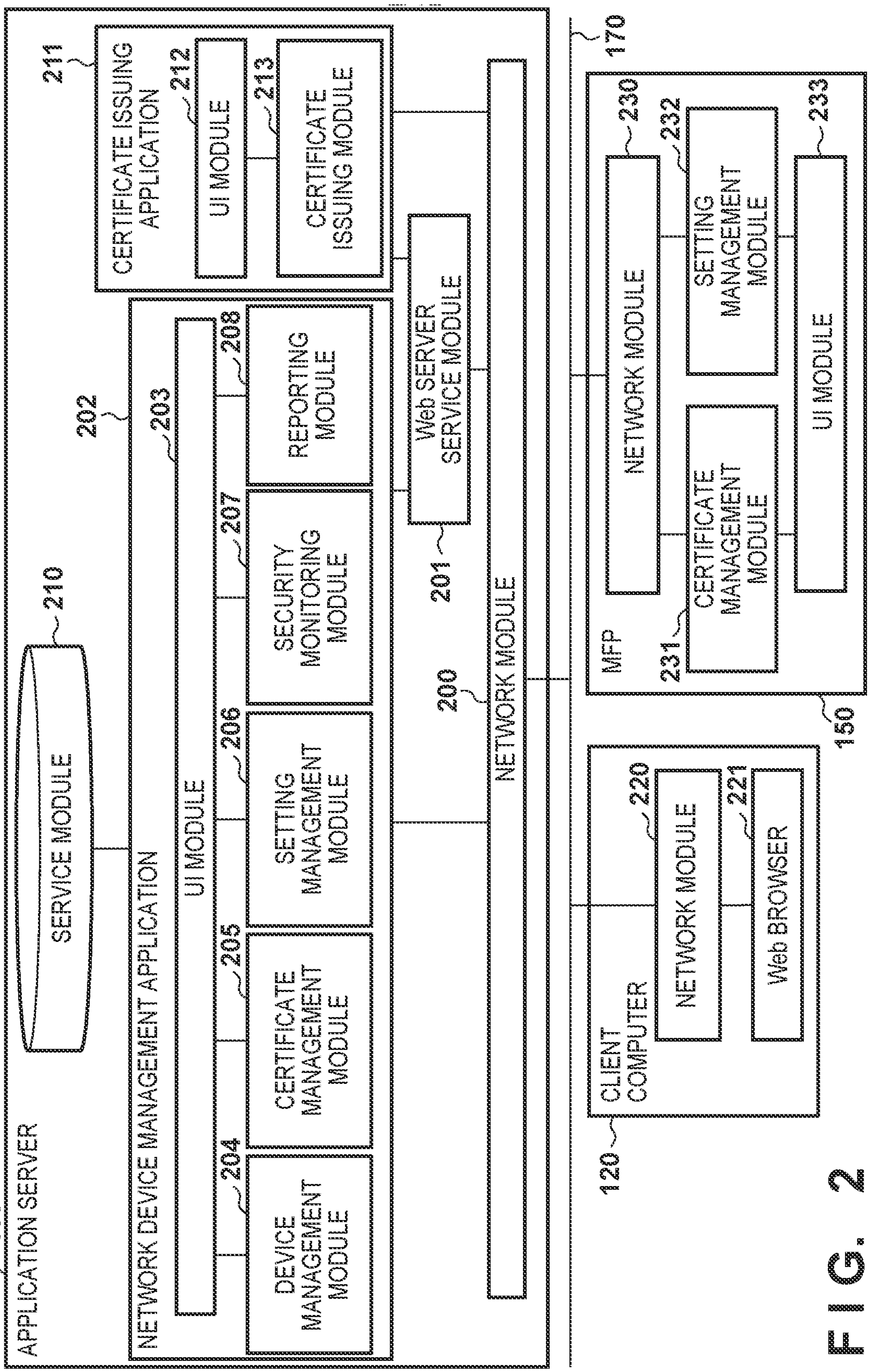
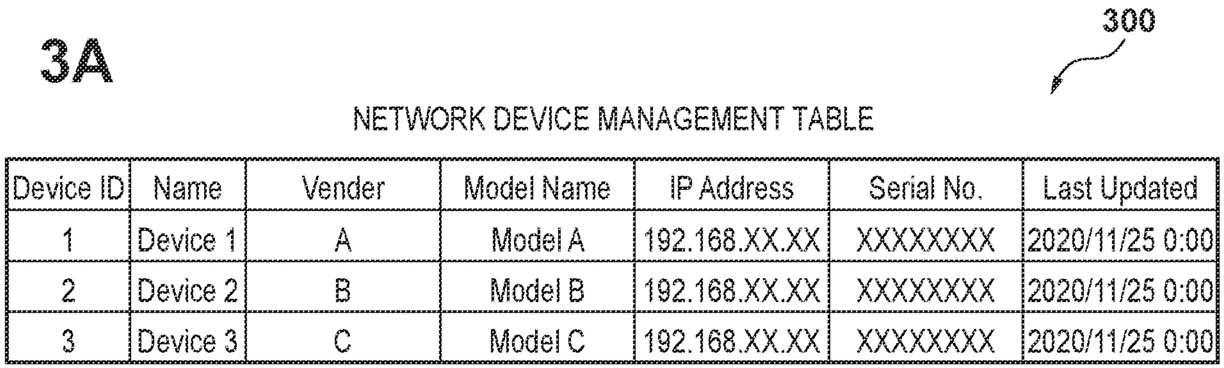

100
APPLICATION SERVER
210
SERVICE MODULE
202
NETWORK DEVICE MANAGEMENT APPLICATION
203
UI MODULE
204
DEVICE MANAGEMENT MODULE
205
CERTIFICATE MANAGEMENT MODULE
206
SETTING MANAGEMENT MODULE
207
SECURITY MONITORING MODULE
208
REPORTING MODULE
211
CERTIFICATE ISSUING APPLICATION
212
UI MODULE
213
CERTIFICATE ISSUING MODULE
201
Web SERVER SERVICE MODULE
200
NETWORK MODULE
170
120
CLIENT COMPUTER
220
NETWORK MODULE
221
Web BROWSER
150
MFP
230
NETWORK MODULE
231
CERTIFICATE MANAGEMENT MODULE
232
SETTING MANAGEMENT MODULE
233
UI MODULE

FIG. 2

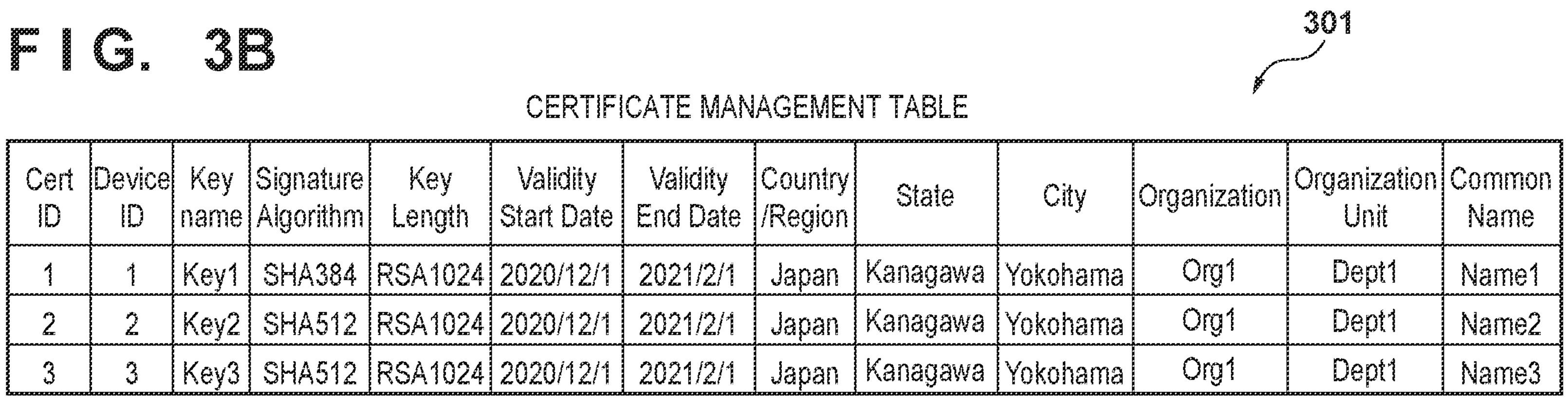
FIG. 3A



NETWORK DEVICE MANAGEMENT TABLE

Device ID	Name	Vender	Model Name	IP Address	Serial No.	Last Updated
1	Device 1	A	Model A	192.168.XX.XX	XXXXXXXX	2020/11/25 0:00
2	Device 2	B	Model B	192.168.XX.XX	XXXXXXXX	2020/11/25 0:00
3	Device 3	C	Model C	192.168.XX.XX	XXXXXXXX	2020/11/25 0:00

FIG. 3B



CERTIFICATE MANAGEMENT TABLE

Cert ID	Device ID	Key name	Signature Algorithm	Key Length	Validity Start Date	Validity End Date	Country /Region	State	City	Organization	Organization Unit	Common Name
1	1	Key1	SHA384	RSA1024	2020/12/1	2021/2/1	Japan	Kanagawa	Yokohama	Org1	Dept1	Name1
2	2	Key2	SHA512	RSA1024	2020/12/1	2021/2/1	Japan	Kanagawa	Yokohama	Org1	Dept1	Name2
3	3	Key3	SHA512	RSA1024	2020/12/1	2021/2/1	Japan	Kanagawa	Yokohama	Org1	Dept1	Name3

F I G. 3C

302

SETTING MANAGEMENT TABLE

Setting ID	Device ID	SCEP Server URL	Port number	Key name	Signature Algorithm	Key Length	Country /Region	State	City	Organi-zation	Organization Unit	Common Name	Challenge password	Execution date time	Usage
1	1	http://192.168.xxx.xxx/scep/	80	Key1	SHA384	RSA1024	Japan	Kanagawa	Yokohama	Org1	Dept1	Name1	XXXXX	2020/1/25 0:00	TLS
1	2	http://192.168.xxx.xxx/scep/	80	Key2	SHA512	RSA1024	Japan	Kanagawa	Yokohama	Org1	Dept1	Name2	XXXXX	2020/1/25 0:00	IPSec
1	3	http://192.168.xxx.xxx/scep/	80	Key3	SHA512	RSA1024	Japan	Kanagawa	Yokohama	Org1	Dept1	Name3	XXXXX	2020/1/25 0:00	IEEE802.1x

303

SECURITY MONITORING POLICY SETTING MANAGEMENT TABLE

Policy ID	Devic ID	Interval (days)	Next execution date time	TargetCertUsages	Cert PolicyID	CertAutoEnrollment PolicyID
1	1	3	2021/1/25 0:00	None,TLS,IEEE802.1x,IPSec	1	1
1	2	3	2021/1/25 0:00	None,TLS,IEEE802.1x,IPSec	1	1
1	3	3	2021/1/25 0:00	None,TLS,IEEE802.1x,IPSec	1	1

FIG. 3D

304

CERTIFICATE MONITORING POLICY SETTING MANAGEMENT TABLE

CertPolicy ID	Remaining Days - Passed	Remaining Days - Low risk	Remaining Days - Medium risk	Remaining Days - High risk
1	90	60	30	0
2	120	90	60	10
3	150	120	100	30

FIG. 3E

305

CERTIFICATE UPDATE SETTING MONITORING POLICY SETTING MANAGEMENT TABLE

CertAutoEnrollment Policy ID	Validity Check	SubjectField Check
1	TRUE	TRUE
2	TRUE	TRUE
3	TRUE	TRUE

FIG. 3F

FIG. 4

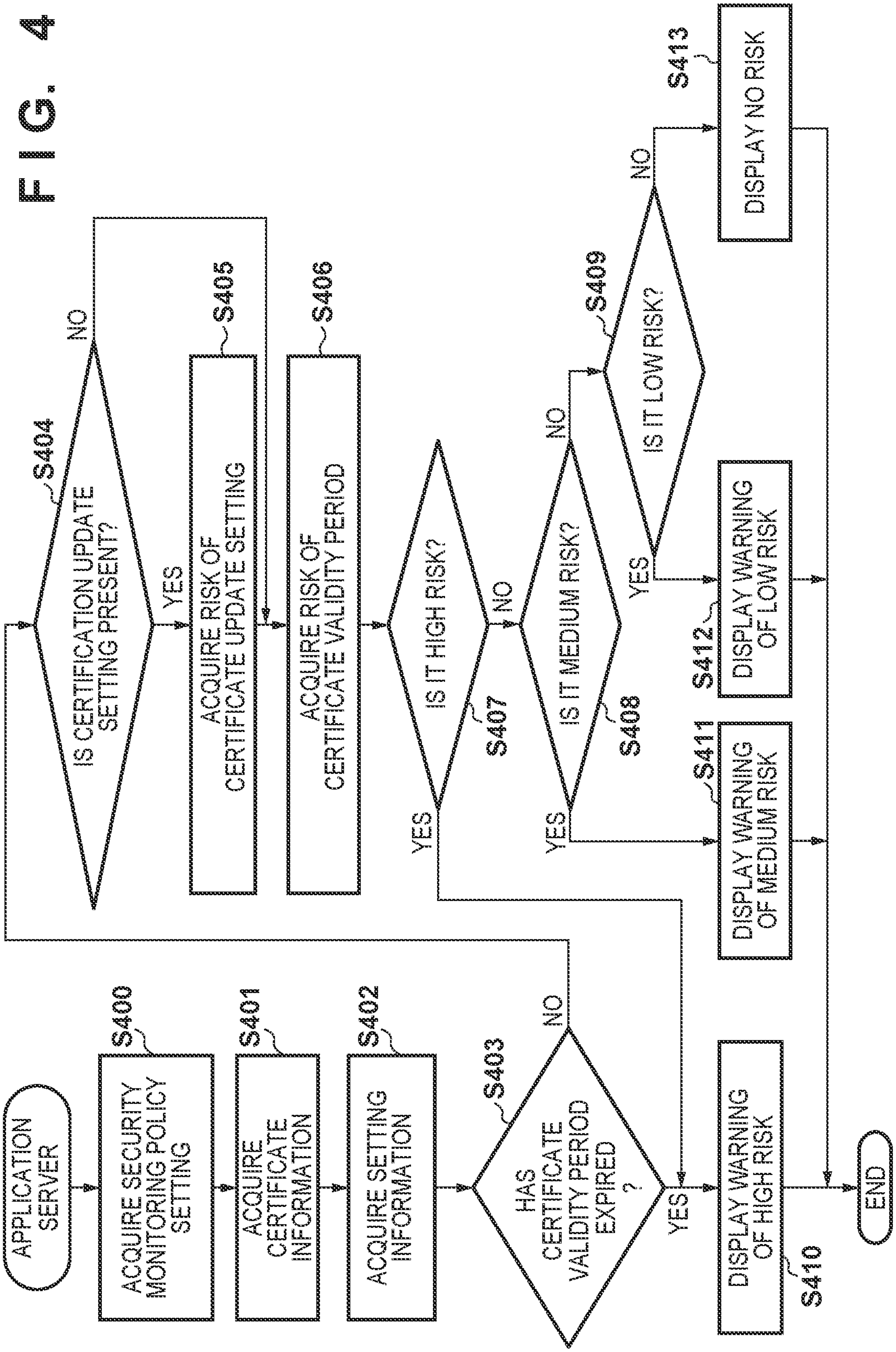
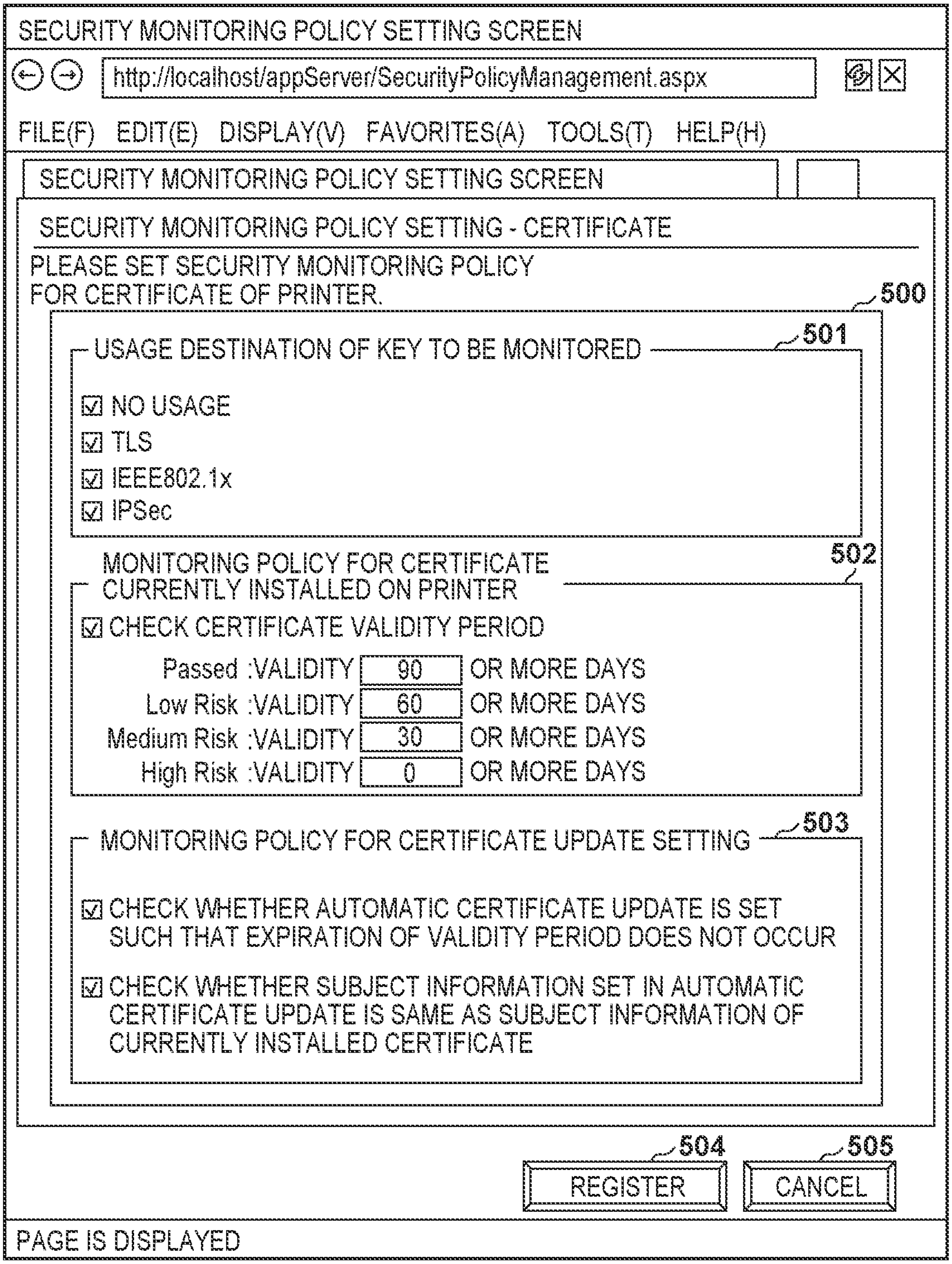

APPLICATION SERVER
S400
ACQUIRE SECURITY MONITORING POLICY SETTING
S401
ACQUIRE CERTIFICATE INFORMATION
S402
ACQUIRE SETTING INFORMATION
S403
HAS CERTIFICATE VALIDITY PERIOD EXPIRED ?
YES
NO
S404
IS CERTIFICATION UPDATE SETTING PRESENT?
YES
NO
S405
ACQUIRE RISK OF CERTIFICATE UPDATE SETTING
S406
ACQUIRE RISK OF CERTIFICATE VALIDITY PERIOD
S407
IS IT HIGH RISK?
YES
NO
S408
IS IT MEDIUM RISK?
YES
NO
S409
IS IT LOW RISK?
YES
NO
S410
DISPLAY WARNING OF HIGH RISK
S411
DISPLAY WARNING OF MEDIUM RISK
S412
DISPLAY WARNING OF LOW RISK
S413
DISPLAY NO RISK
END

FIG. 5


SECURITY MONITORING POLICY SETTING SCREEN
http://localhost/appServer/SecurityPolicyManagement.aspx
FILE(F) EDIT(E) DISPLAY(V) FAVORITES(A) TOOLS(T) HELP(H)
500
501
502
503
REGISTER
504
CANCEL
505

SECURITY MONITORING POLICY SETTING SCREEN

SECURITY MONITORING POLICY SETTING - CERTIFICATE

PLEASE SET SECURITY MONITORING POLICY
FOR CERTIFICATE OF PRINTER.

USAGE DESTINATION OF KEY TO BE MONITORED

☑ NO USAGE
☑ TLS
☑ IEEE802.1x
☑ IPSec

MONITORING POLICY FOR CERTIFICATE
CURRENTLY INSTALLED ON PRINTER

☑ CHECK CERTIFICATE VALIDITY PERIOD

Passed	:VALIDITY	90	OR MORE DAYS
Low Risk	:VALIDITY	60	OR MORE DAYS
Medium Risk	:VALIDITY	30	OR MORE DAYS
High Risk	:VALIDITY	0	OR MORE DAYS

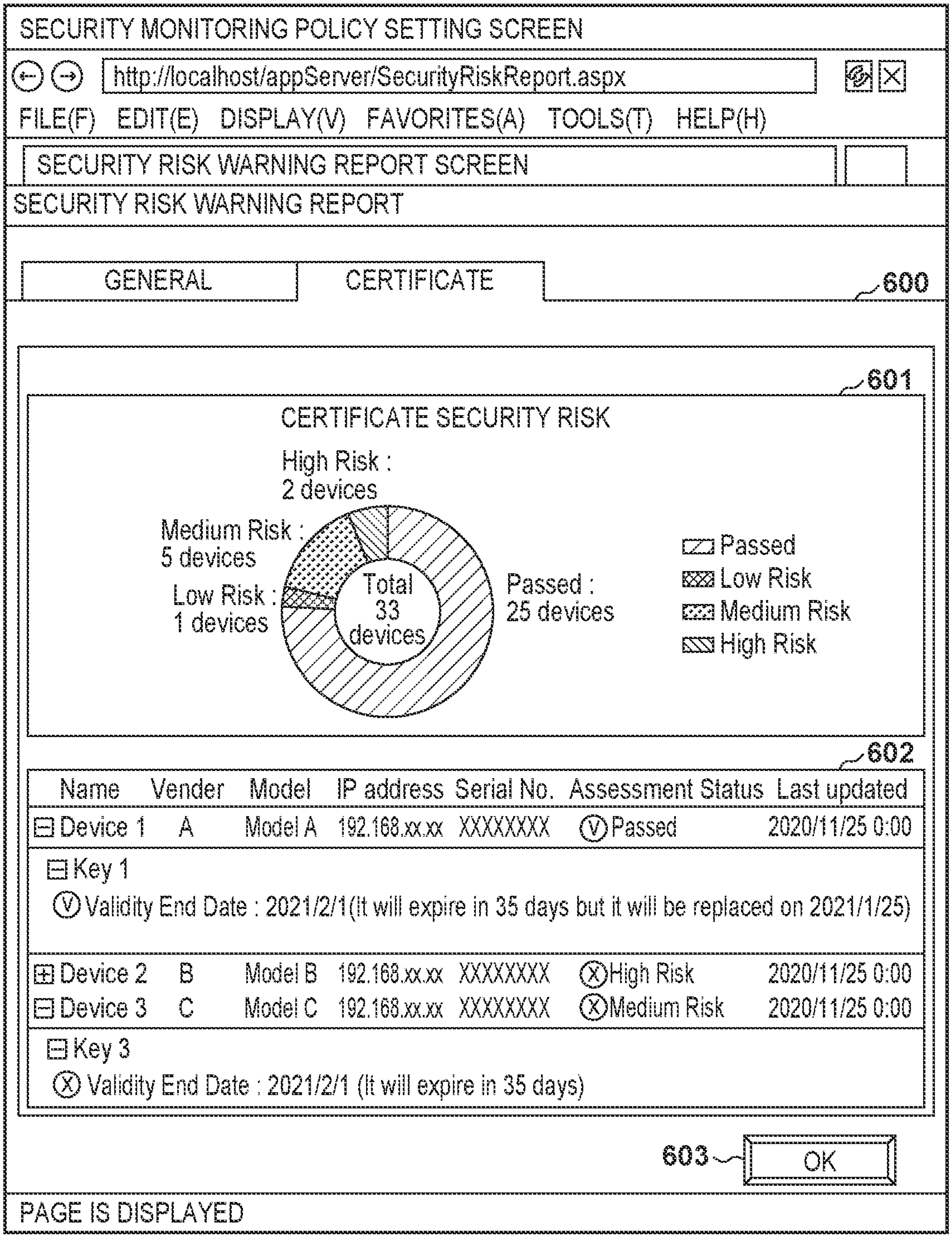
MONITORING POLICY FOR CERTIFICATE UPDATE SETTING

☑ CHECK WHETHER AUTOMATIC CERTIFICATE UPDATE IS SET SUCH THAT EXPIRATION OF VALIDITY PERIOD DOES NOT OCCUR

☑ CHECK WHETHER SUBJECT INFORMATION SET IN AUTOMATIC CERTIFICATE UPDATE IS SAME AS SUBJECT INFORMATION OF CURRENTLY INSTALLED CERTIFICATE

PAGE IS DISPLAYED

FIG. 6


SECURITY MONITORING POLICY SETTING SCREEN
http://localhost/appServer/SecurityRiskReport.aspx
FILE(F) EDIT(E) DISPLAY(V) FAVORITES(A) TOOLS(T) HELP(H)
SECURITY RISK WARNING REPORT SCREEN
SECURITY RISK WARNING REPORT
GENERAL
CERTIFICATE
600
601
CERTIFICATE SECURITY RISK
High Risk : 2 devices
Medium Risk : 5 devices
Low Risk : 1 devices
Total 33 devices
Passed : 25 devices
Passed
Low Risk
Medium Risk
High Risk
602
603
OK
PAGE IS DISPLAYED

Name	Vender	Model	IP address	Serial No.	Assessment Status	Last updated
⊟ Device 1	A	Model A	192.168.xx.xx	XXXXXXXX	Ⓥ Passed	2020/11/25 0:00
⊟ Key 1 Ⓥ Validity End Date : 2021/2/1(It will expire in 35 days but it will be replaced on 2021/1/25)						
⊞ Device 2	B	Model B	192.168.xx.xx	XXXXXXXX	ⓧ High Risk	2020/11/25 0:00
⊟ Device 3	C	Model C	192.168.xx.xx	XXXXXXXX	ⓧ Medium Risk	2020/11/25 0:00
⊟ Key 3 ⓧ Validity End Date : 2021/2/1 (It will expire in 35 days)						

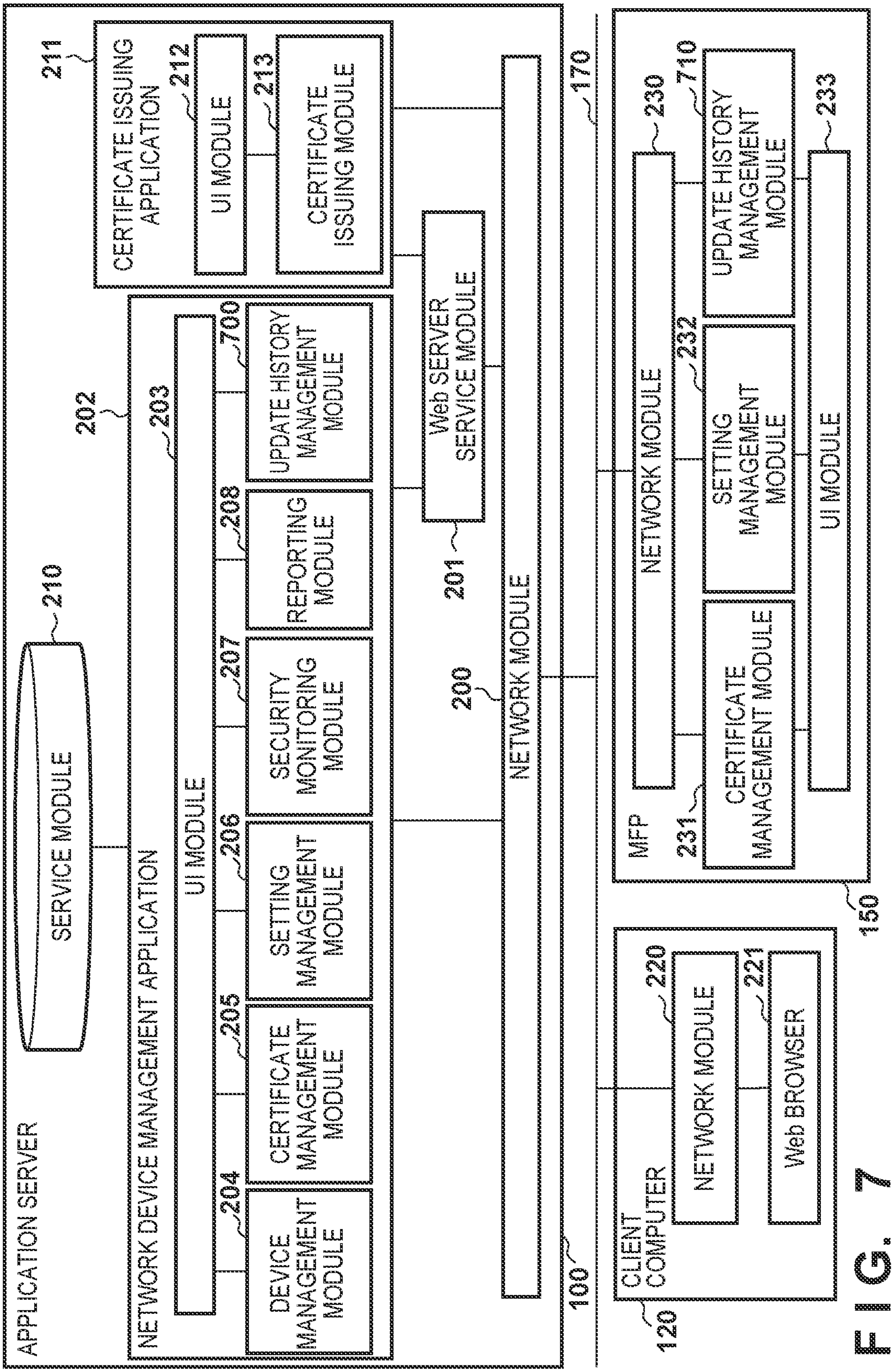
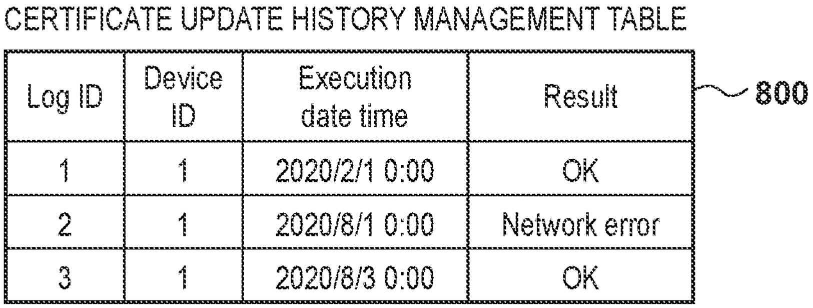

APPLICATION SERVER
100
SERVICE MODULE
210
NETWORK DEVICE MANAGEMENT APPLICATION
202
UI MODULE
203
DEVICE MANAGEMENT MODULE
204
CERTIFICATE MANAGEMENT MODULE
205
SETTING MANAGEMENT MODULE
206
SECURITY MONITORING MODULE
207
REPORTING MODULE
208
UPDATE HISTORY MANAGEMENT MODULE
700
CERTIFICATE ISSUING APPLICATION
211
UI MODULE
212
CERTIFICATE ISSUING MODULE
213
Web SERVER SERVICE MODULE
201
NETWORK MODULE
200
170
CLIENT COMPUTER
120
NETWORK MODULE
220
Web BROWSER
221
MFP
150
NETWORK MODULE
230
CERTIFICATE MANAGEMENT MODULE
231
SETTING MANAGEMENT MODULE
232
UPDATE HISTORY MANAGEMENT MODULE
710
UI MODULE
233

FIG. 7

FIG. 8



CERTIFICATE UPDATE HISTORY MANAGEMENT TABLE

Log ID	Device ID	Execution date time	Result
1	1	2020/2/1 0:00	OK
2	1	2020/8/1 0:00	Network error
3	1	2020/8/3 0:00	OK

FIG. 9A

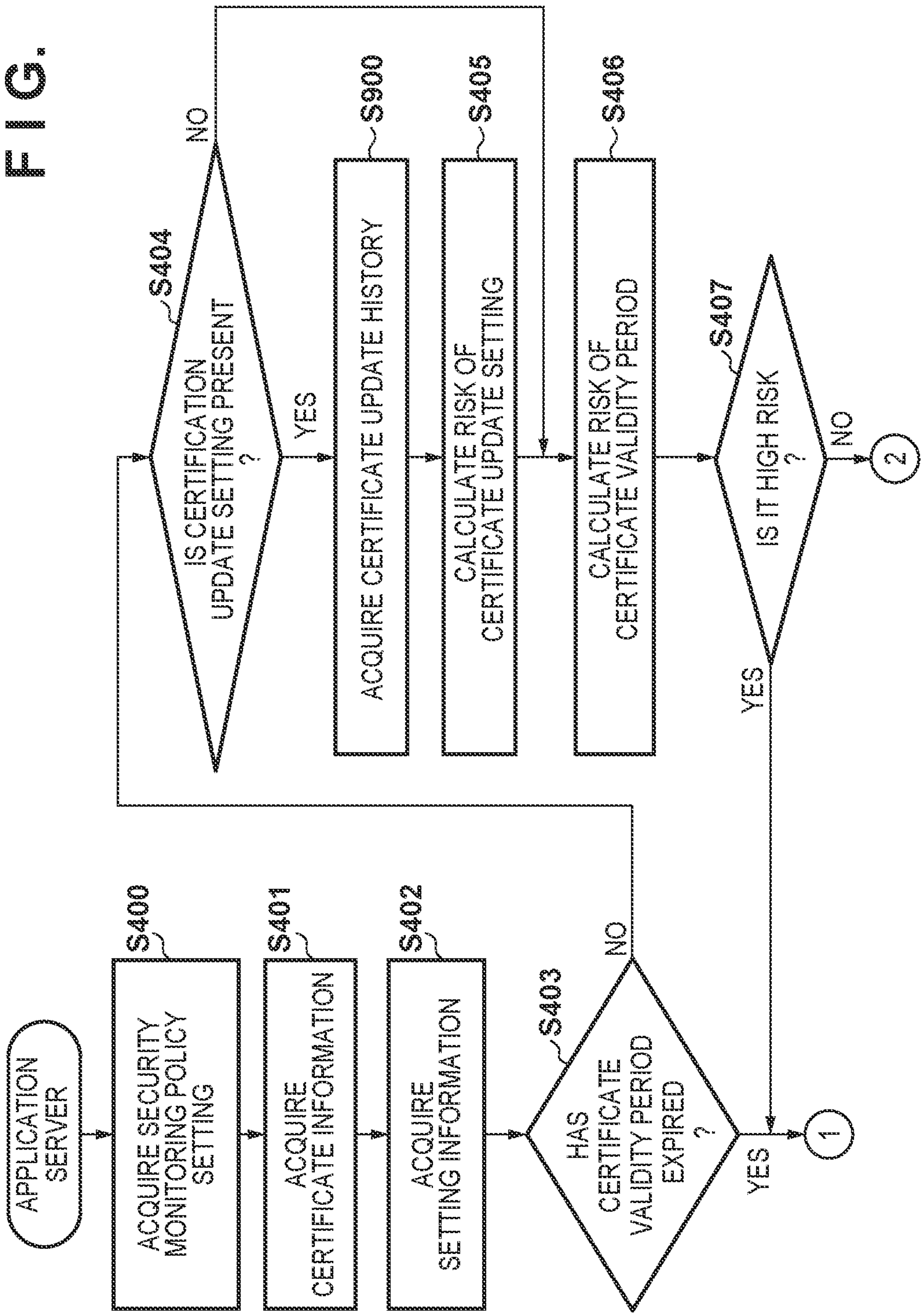
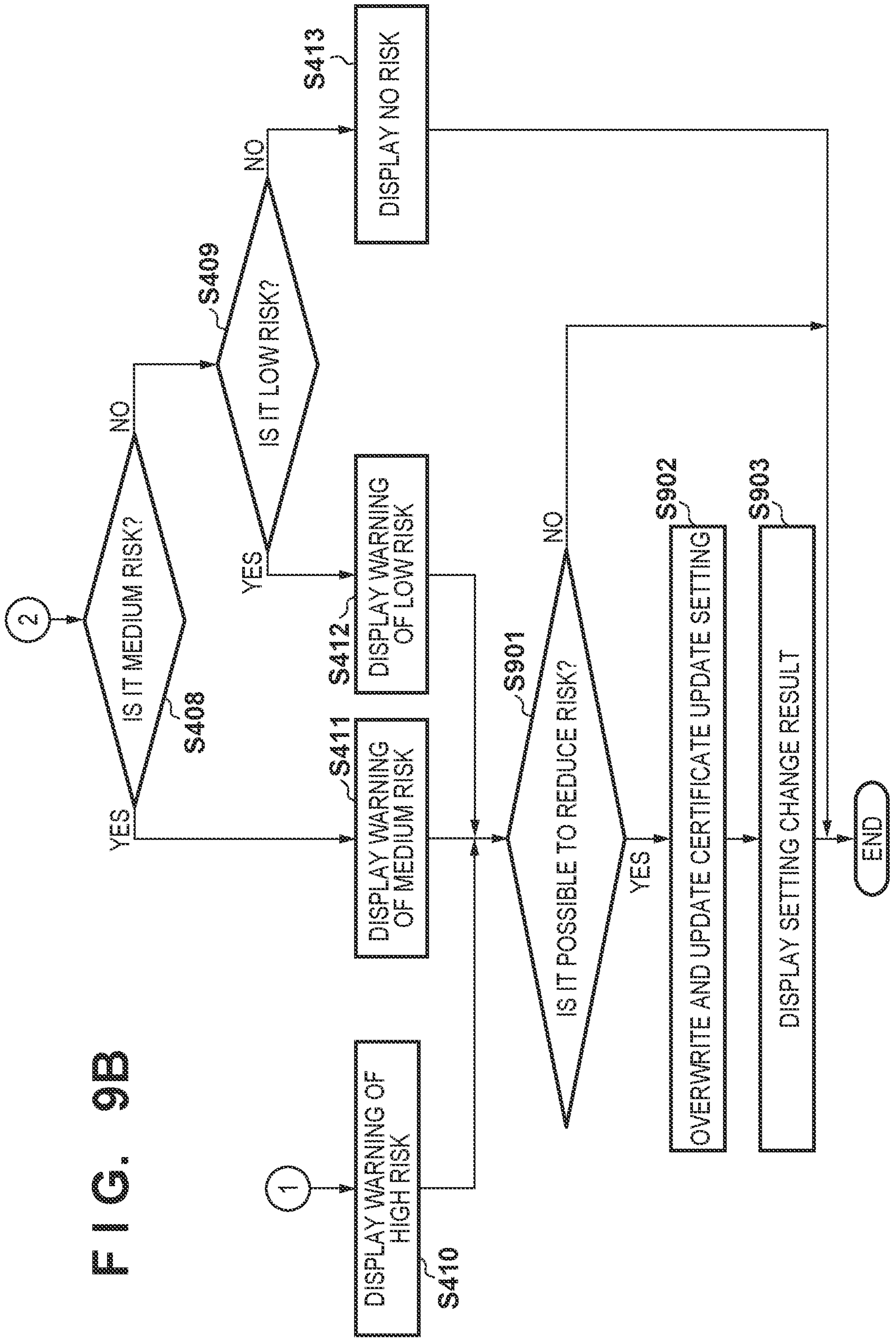

APPLICATION SERVER
S400
ACQUIRE SECURITY MONITORING POLICY SETTING
S401
ACQUIRE CERTIFICATE INFORMATION
S402
ACQUIRE SETTING INFORMATION
S403
HAS CERTIFICATE VALIDITY PERIOD EXPIRED ?
YES
NO
1
S404
IS CERTIFICATION UPDATE SETTING PRESENT ?
YES
NO
S900
ACQUIRE CERTIFICATE UPDATE HISTORY
S405
CALCULATE RISK OF CERTIFICATE UPDATE SETTING
S406
CALCULATE RISK OF CERTIFICATE VALIDITY PERIOD
S407
IS IT HIGH RISK ?
YES
NO
2

FIG. 9B


2
S408
IS IT MEDIUM RISK?
YES
NO
S409
IS IT LOW RISK?
YES
NO
S413
DISPLAY NO RISK
S411
DISPLAY WARNING OF MEDIUM RISK
S412
DISPLAY WARNING OF LOW RISK
1
S410
DISPLAY WARNING OF HIGH RISK
S901
IS IT POSSIBLE TO REDUCE RISK?
YES
NO
S902
OVERWRITE AND UPDATE CERTIFICATE UPDATE SETTING
S903
DISPLAY SETTING CHANGE RESULT
END

MONITORING APPARATUS, CONTROL METHOD THEREOF, STORAGE MEDIUM, AND IMAGE PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a monitoring apparatus, a control method thereof, a storage medium, and an image processing apparatus.

Description of the Related Art

[0002] In recent years, with increased demand for security, the number of network devices in which security functions, such as TLS/SSL communication and IPSec, can be used by registering certificates has increased. In order to use the security functions of network devices, it is important to correctly register and use appropriate certificates. Japanese Patent Laid-Open No. 2006-239930 proposes a technique verifying content—such as a common name and a validity period, for example—of a certificate registered in a network device and giving a warning when a problem occurs at the time of monitoring the security of the network device.

[0003] However, in the above prior art, there is the following problem. A certificate registered in a network device has a validity period. Therefore, in the above prior art, in order to guarantee the security of a network device, it is necessary to issue a new certificate before the validity period of a certificate expires and update the certificate registered in the network device. Therefore, in order to monitor the security of a network device, it is necessary to not only verify whether a certificate itself has no problem but also verify whether a schedule to appropriately update the certificate without security risk, such as expiration of the validity period, has been made.

SUMMARY OF THE INVENTION

[0004] The present invention enables realization of not only verifying the content of a certificate registered in a network device but also appropriately providing a result of monitoring security from many aspects in order to guarantee the security of the network device.

[0005] One aspect of the present invention provides a monitoring apparatus capable of communicating with one or more network devices via a network, the apparatus comprising: at least one memory device that stores a set of instructions; and at least one processor that executes the set of instructions to: verify content information of a certificate related to security set in a network device to be monitored; verify update setting information related to an update of the certificate; and provide a report based on each verification result.

[0006] Another aspect of the present invention provides a method of controlling a monitoring apparatus capable of communicating with one or more network devices via a network, the method comprising: verifying content information of a certificate related to security set in a network device to be monitored; verifying update setting information related to an update of the certificate; and providing a report based on each verification result.

[0007] Still another aspect of the present invention provides a non-transitory computer-readable storage medium storing a program that causes a computer to execute a method of controlling a monitoring apparatus capable of communicating with one or more network devices via a network, the method comprising: verifying content information of a certificate related to security set in a network device to be monitored via the network; verifying update setting information related to an update of the certificate; and providing a report based on each verification result.

[0008] Yet still another aspect of the present invention provides an image processing apparatus, comprising: the monitoring apparatus, a request unit that requests a certificate issuing server to issue a certificate and acquires the certificate; and an image processing unit.

[0009] Further features of the present invention will become apparent from the following description of exemplary embodiments (with reference to the attached drawings).

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. **1** is a diagram illustrating a system configuration and a hardware configuration according to an embodiment.

[0011] FIG. **2** is a diagram illustrating a software configuration according to the embodiment.

[0012] FIGS. **3**A-**3**F are a diagram illustrating a database configuration according to the embodiment.

[0013] FIG. **4** is a flowchart for when determining security risk and executing a warning display according to the embodiment.

[0014] FIG. **5** is a diagram illustrating an example of a screen for setting a monitoring policy related to security according to the embodiment.

[0015] FIG. **6** is a diagram illustrating an example of a security risk warning report screen according to the embodiment.

[0016] FIG. **7** is a diagram illustrating a software configuration according to an embodiment.

[0017] FIG. **8** is a diagram illustrating a database configuration according to the embodiment.

[0018] FIGS. **9**A-**9**B are a flowchart for when determining security risk and executing a warning display according to the embodiment.

DESCRIPTION OF THE EMBODIMENTS

[0019] Preferred embodiments of the present invention will now be described in detail with reference to the drawings. It should be noted that the relative arrangement of the components, the numerical expressions and numerical values set forth in these embodiments do not limit the scope of the present invention unless it is specifically stated otherwise.

[0020] Hereinafter, embodiments will be described in detail with reference to the attached drawings. Note, the following embodiments are not intended to limit the scope of the claimed invention. Multiple features are described in the embodiments, but limitation is not made to an invention that requires all such features, and multiple such features may be combined as appropriate.

[0021] Furthermore, in the attached drawings, the same reference numerals are given to the same or similar configurations, and redundant description thereof is omitted.

First Embodiment

<Overall Configuration of System>

[0022] Hereinafter, a first embodiment of the present invention will be described. First, examples of a system configuration and a hardware configuration of a network device management system according to the present embodiment will be described with reference to FIG. **1**. Here, description will be given using an application server as an example of a network device management apparatus according to the present embodiment. Further, in the present embodiment, description will be given using an MFP (Multifunction Peripheral, multifunction device), which is an image processing apparatus, as an example of the network device to be managed by the management apparatus. Note that the network device includes devices other than an MFP, such as a printer and a fax machine. Since a hardware configuration of a client computer **120** is the same as that of an application server **100** to be described below, description thereof will be omitted.

[0023] The network device management system is configured to include the application server **100**, the client computer **120**, and an MFP **150**, which are connected by a network **170**. The application server **100** and the client computer **120** have a configuration of a general-purpose computer. The configuration of a general-purpose computer for implementing the application server **100** may be implemented using hardware resources supplied on demand by virtualization technology.

[0024] The application server **100** includes a CPU **101**, a RAM **102**, a ROM **103**, a network I/F **104**, a keyboard I/F **105**, a display I/F **106**, and an external memory I/F **107**. The application server **100** further includes a keyboard **108**, a display **109**, and an external memory **110**. A reference numeral **111** is a system bus, which connects the devices.

[0025] The CPU **101** executes processing based on an application program and the like stored in the ROM **103** or the external memory **110**. In addition, the CPU **101** collectively controls the devices connected to the system bus **111**. The CPU **101** also opens various registered windows based on commands instructed by a mouse cursor (not illustrated) and the like on the display **109** and performs various data processing. The RAM **102** functions as a main memory, work area, and the like of the CPU **101**. The ROM **103** is a read-only memory that functions as a storage area of a basic I/O program and the like. The ROM **103** or the external memory **110** stores a program and the like of an operating system (hereinafter, referred to as OS), which is a control program of the CPU **101**. Further, the ROM **103** or the external memory **110** stores files and various other data to be used for when performing processing based on the above application program and the like.

[0026] The network I/F **104** connects to the network **170** and performs network communication. The keyboard I/F **105** controls input from the keyboard **108** and a pointing device (not illustrated). The display I/F **106** controls display of the display **109**. The external memory I/F **107** controls access to the external memory **110** such as a hard disk drive (HDD) and a solid state drive (SSD). The external memory **110** stores a boot program, various applications, user files, editing files, and the like.

[0027] The application server **100** operates in a state in which the CPU **101** is executing the basic I/O program and the OS written to the ROM **103** or the external memory **110**. The basic I/O program is written to the ROM **103**, and the OS is written to the ROM **103** or the external memory **110**. When the computer is powered on, the OS is written to the RAM **102** from the ROM **103** or the external memory **110** by an initial program loading function in the basic I/O program, and the operation of the OS is started. Hardware resources such as the CPU **101**, the ROM **103**, and the external memory **110** comprising the application server **100** may be supplied on demand by virtualization technology. By providing these hardware resources on demand by virtualization technology, the application server **100** is configured as a virtual server on a cloud computing environment.

[0028] The MFP **150** includes a network I/F **151**, a CPU **152**, a RAM **153**, a ROM **154**, an operation unit I/F **155**, a printer I/F **157**, a scanner I/F **159**, and an external memory I/F **161**. The MFP **150** further comprises an operation unit **156**, a printer **158**, a scanner **160**, and an external memory **162**. A reference numeral **163** is a system bus, which connects the devices.

[0029] The network I/F **151** connects to the network **170** and performs network communication. The CPU **152** outputs an image signal as output information to the printer **158** via the printer I/F **157** connected to the system bus **163** based on a control program and the like. The control program is stored in the ROM **154**, the external memory **162**, or the like. The CPU **152** is capable of processing communication with a computer via the network I/F **151** and is configured to be capable of notifying the application server **100** of information and the like in the MFP **150**. Further, the CPU **152** executes processing based on an application program and the like stored in the ROM **154** or the external memory **162**. The RAM **153** functions as a main memory, a work area, and the like of the CPU **152** and is configured to be capable of expanding memory capacity by an optional RAM to be connected to an expansion port (not illustrated). Note that the RAM **153** is used as an output information expansion area, an environment data storage area, an NVRAM, and the like. The ROM **154** or the external memory **162** such as a hard disk drive (HDD) stores the control program of the CPU **152**, application programs, font data used for when generating the above output information, information used on the MFP **150**, and the like.

[0030] The operation unit I/F **155** controls an interface to and from the operation unit **156** and outputs, to the operation unit **156**, image data to be displayed. The operation unit I/F **155** also receives information that a user has inputted via the operation unit **156**. The operation unit **156** corresponds to an operation panel and the like on which switches, an LED display device, and the like for operation are disposed. The printer I/F **157** outputs an image signal as output information to the printer **158** (printer engine). The scanner I/F **159** receives an image signal as input information from the scanner **160** (scanner engine). The external memory I/F (memory controller) **161** controls access to the external memory **162** such as a hard disk drive (HDD) and an IC card. In addition, the above external memory is not limited to one, and configuration may be such that one or more external memories are provided and a plurality of external memories can be connected. Further, configuration may be such that an NVRAM (not illustrated) is included and stores printer mode setting information from the operation unit **156**.

[0031] <Software Configuration>

[0032] Next, a software configuration of the network device management system which includes the application server **100** which is the management apparatus according to the present embodiment will be described with reference to FIG. **2**.

[0033] First, a software configuration of the application server **100** will be described. The application server **100** includes a network module **200**, a Web server service module **201**, a network device management application **202**, a database server service module **210**, and a certificate issuing application **211**. The network device management application **202**, the certificate issuing application **211**, and each module are present as files stored in the external memory **110**. These are program modules that, at the time of execution, are loaded and executed in the RAM **102** by the OS or a module that uses these modules. The network device management application **202** and the certificate issuing application **211** can be added to a CD-ROM (not illustrated) of the external memory **110** or, via the network **170**, to an HDD or an SSD of the external memory **110**. Here, the external memory **110** may be supplied on demand by virtualization technology on a cloud computing environment.

[0034] The network module **200** performs network communication with the client computer **120** and the MFP **150** using any communication protocol. The Web server service module **201** provides a service that returns an HTTP response upon receiving an HTTP request from a Web browser **221** of the client computer **120**. As an example of an HTTP response to be returned, Web page data stored in the external memory **110** may be returned. Alternatively, the Web server service module **201** may request that a UI module **203** of the network device management application **202** generate an HTTP response.

[0035] The network device management application **202** is an application that manages the MFP **150** connected to the application server **100** via the network **170**. The network device management application **202** is implemented as a program that executes processing in response to a request to a Web page provided by the Web server service module **201**, for example. As described above, the network device management application **202** implements a Web application that manages the MFP **150** together with the Web server service module **201**.

[0036] The network device management application **202** includes the UI module **203**, a device management module **204**, a certificate management module **205**, a setting management module **206**, a security monitoring module **207**, and a reporting module **208**. The UI module **203** generates an HTTP response in response to a request from the Web server service module **201**. Further, the UI module **203** receives user input information transmitted from the Web browser **221** of the client computer **120** and invokes each module as necessary. Here, examples of modules to be invoked from the UI module **203** include the device management module **204**, the certificate management module **205**, the setting management module **206**, the security monitoring module **207**, and the reporting module **208**. Of course, the UI module **203** may invoke other modules.

[0037] The device management module **204** acquires, via the network module **200**, device information from the MFP **150** connected to the application server **100** via the network **170**. Any communication protocol is used to acquire device information from the MFP **150**. Examples of a communication protocol used by the device management module **204** include an SNMP (Simple Network Management Protocol) and the like. The device management module **204** stores the device information acquired from the MFP **150** in a network device management table **300** of a service module **210** to be described later and also retrieves the stored device information.

[0038] The certificate management module **205** manages certificate information registered in the MFP **150**. The certificate management module **205** acquires, via the network module **200**, certificate information registered in the MFP **150** from the MFP **150** connected to the application server **100** via the network **170**. Any communication protocol is used to acquire certificate information from the MFP **150**. Examples of a communication protocol used by the certificate management module **205** include a Web service and the like. Certificate information acquired from the MFP **150** includes, for example, a key name, a signature algorithm, a key algorithm, a key length/type, a validity period, a country/region name, a state, a city, an organization, an organization unit, a common name, a key usage destination, and the like. The certificate management module **205** stores certificate information in a certificate management table **301** of the service module **210** to be described later and retrieves the stored certificate information.

[0039] The setting management module **206** acquires, via the network module **200**, setting information from the MFP **150** connected to the application server **100** via the network **170**. Any communication protocol is used to acquire setting information from the MFP **150**. Examples of a communication protocol used by the setting management module **206** include a Web service and the like. Examples of setting information acquired from the MFP **150** include certificate update setting information and the like. The setting management module **206** stores a setting in a setting management table **302** of the service module **210** to be described later and retrieves the stored setting. In the present embodiment, the setting management module **206** acquires setting information, which includes certificate update setting information, from the MFP **150** but may acquire setting information from outside the MFP **150**. For example, if the network device management application **202** itself has setting information for the MFP **150**, the setting management module **206** may acquire setting information from the network device management application **202** instead of the MFP **150**.

[0040] The security monitoring module **207** manages security monitoring setting information and determines the security risk of the MFP **150** in accordance with the security monitoring setting information. The security monitoring module **207** stores a setting in a table of the service module **210** to be described later and retrieves the stored setting. Examples of tables to and from which settings are stored and retrieved include a setting management table **303** for monitoring policies related to security, a setting management table **304** for monitoring policies related to certificates, and a setting management table **305** for monitoring policies related to certificate update settings. For example, the security monitoring module **207** invoked from the UI module **203** stores security monitoring setting information inputted by the user in a table of the service module **210**. The security monitoring module **207** also periodically acquires setting information of the monitoring policy related to security from a table of the service module **210** at arbitrary intervals. Together with that, the security monitoring module **207** acquires, via the certificate management module **205** and the setting management module **206**, certificate information and setting information registered in the MFP **150**. Then, the security monitoring module **207** determines the security risk of the MFP **150** in accordance with the acquired security monitoring setting information, certificate information, and setting information. In the present embodiment, an example in which the security monitoring module **207** determines security risk specific to security risk related to certificates will be described. However, there is no intent to limit the present invention, and risk may be determined using setting information unrelated to certificates when determining the security risk of the MFP **150**. For example, the security risk that the security monitoring module **207** has determined with respect to certificates and the security risk that the security monitoring module **207** has determined with respect to setting information other than that may be used to determine the overall security risk of the MFP **150**.

[0041] The reporting module **208** generates a report that visualizes, in a table, graph, or the like, the security risk that the security monitoring module **207** has determined and displays the report on a UI via the UI module **203**. In the present embodiment, an example in which the reporting module **208** creates a report that visualizes security risk specific to security risk related to certificates will be described. However, there is no intent to limit the invention, and security risk associated with setting information unrelated to certificates may also be displayed. For example, the reporting module **208** may create a report that visualizes the overall security risk of the MFP **150** and individually visualize the security risk with respect to certificates as part of the report. In addition, instead of generating a screen for displaying a report as described in the present embodiment, the reporting module **208** may output, to an external device, data indicating content of a screen for displaying a warning report to be described later.

[0042] The service module **210** manages data and stores and retrieves data in accordance with requests from other modules. The service module **210** may be on a device separate from the application server **100** so long as it is accessible from the network device management application **202**. The service module **210** may be a database service on a cloud computing environment. A detailed data structure of the database will be described later with reference to FIGS. 3A-3F.

[0043] The certificate issuing application **211** is an application that issues a certificate in response to a request from the MFP **150** connected by the network **170**. The certificate issuing application **211** is implemented as a program that executes processing in response to a request to a Web page provided by the Web server service module **201**, for example. As described above, the certificate issuing application **211** implements a Web application that issues a certificate to the MFP **150** together with the Web server service module **201**. The certificate issuing application **211** may be on a device separate from the network device management application **202** so long as it is accessible from the MFP **150**. The certificate issuing application **211** may be a certificate issuing service on a cloud computing environment. That is, the certificate issuing application **211** may be provided on a device external to the application server **100** such as a certificate issuing server.

[0044] The certificate issuing application **211** includes a UI module **212** and a certificate issuing module **213**. The UI module **212** generates an HTTP response in response to a request from the Web server service module **201**. Further, the UI module **212** receives user input information transmitted from the Web browser **221** of the client computer **120** and invokes each module as necessary. Here, an example of a module invoked from the UI module **212** includes the certificate issuing module **213**. Of course, the UI module **212** may invoke other modules. The certificate issuing module **213** receives, via the network module **200**, a certificate issuance request from the MFP **150** connected to the application server **100** via the network **170**, issues a certificate, and returns the certificate to the MFP **150**. In addition, the certificate issuing module **213** returns a certificate issuance status in response to a request from the UI module **212**.

[0045] Next, a software configuration of the client computer **120** will be described. The client computer **120** includes a network module **220** and the Web browser **221**. Each of the modules comprising the client computer **120** is a program module that is present as a file stored in the ROM **103** or the external memory **110**. At the time of execution, these modules are loaded and executed in the RAM **102** by the OS or a module that uses these modules. The network module **220** performs network communication with the application server **100** and the MFP **150** using any communication protocol. The reference numeral **221** is a Web browser, which transmits an HTTP request message via the network module **220** and receives and displays an HTTP response message. Access from the client computer **120** to the application server **100** is performed via the Web browser **221**.

[0046] Next, a software configuration of the MFP **150** will be described. The MFP **150** includes a network module **230**, a certificate management module **231**, a setting management module **232**, and a UI module **233**. The respective modules are present as files stored in the ROM **154** or the external memory **162** and, at the time of execution, are loaded and executed in the RAM **153**. The network module **230** performs network communication with the application server **100** and the client computer **120** using any communication protocol. The certificate management module **231** manages a certificate registered in the MFP **150**. The certificate management module **231** also returns the certificate information of a certificate registered in the MFP **150** via the network module **230** in response to a request from the application server **100**. The certificate information returned here includes a key name, a signature algorithm, a key length, a validity period start date, a validity period end date, a country/region name, a state, a city, an organization, an organization unit, a common name, and the like, for example. The certificate management module **231** transmits a certificate issuance request to the certificate issuing application **211** of the application server **100** in accordance with a certificate update setting that the setting management module **232** to be described later manages. The certificate management module **231** receives a certificate that the certificate issuing application **211** of the application server **100** has issued and registers the certificate with the MFP **150**. In addition, when registering a certificate with the MFP **150**, the certificate management module **231** may remove an older key and a certificate whose usage destination is the same therewith. The setting management module **232** manages all the setting values of the MFP **150**. The setting management module **232** also returns a setting value of the MFP **150** via the network module **230** in response to a request from the application server **100**. The UI module **233** renders a UI displayed on the operation unit **156** of the MFP **150** and receives a user input value inputted by an UI operation of the user on the operation unit **156**.

[0047] <Database>

[0048] Next, examples of table configurations in the service module **210** of the database will be described with reference to FIGS. **3A-3F**. Note that the table configurations of FIGS. **3A-3F** are merely examples, do not intend to limit the present invention, and, in the present invention, there may be different table configurations from the table configurations to be described below.

[0049] The reference numeral **300** is a network device management table and is a table for managing device information related to network devices that the network device management application **202** manages. Information managed in the network device management table **300** includes a device ID (network device identifier), a device name, a vendor name, a model name, an IP address, a serial number, a last update date/time, and the like, for example. A device ID is an identifier that uniquely identifies a network device such as the MFP **150**. A last update date/time indicates the date/time at which the record was last updated with information acquired from a network device such as the MFP **150**.

[0050] The reference numeral **301** is a certificate management table and is a table for managing information of certificates registered in network devices. Information managed in the certificate management table **301** includes a certificate ID, a device ID, a key name, a signature algorithm, a key length, a validity period start date, a validity period end date, a country/region name, a state, a city, an organization, an organization unit, a common name, and the like, for example. A certificate ID is an identifier that uniquely identifies a certificate. A key name and a key length indicate the name and the data length of an encryption key. A signature algorithm indicates an algorithm for when verifying a certificate. A validity period start date and a validity period end date are dates indicating the start and the end of the validity period of a certificate.

[0051] The reference numeral **302** is a setting management table and is a table for managing setting information acquired from network devices such as the MFP **150**. Information managed in the setting management table **302** includes a setting ID, a device ID, certificate update setting information, certificate update date/time information, a key usage destination, and the like, for example. A setting ID is an identifier that uniquely identifies a setting. Certificate update setting information includes a SCEP server URL, a port number, a key name, a signature algorithm, a key length, a country/region name, a state, a city, an organization, an organization unit, a common name, a challenge password, and the like, for example. SCEP is an abbreviation of Simple Certificate Enrollment Protocol and is a protocol for registering certificates.

[0052] The reference numeral **303** is a setting management table for monitoring policies related to security and is a table for managing the settings of policies for monitoring the security of network devices. Information managed in the setting management table **303** is an ID of a policy related to security monitoring, a device ID, monitoring intervals, a next monitoring execution date/time, target key usage destination information, a certificate policy ID, an ID of a policy related to monitoring certificate update settings, and the like, for example. An ID of a policy related to security monitoring is an identifier that uniquely identifies a setting of a monitoring policy related to security. A certificate monitoring policy ID is an identifier that uniquely identifies a certificate monitoring policy. An ID of a policy for monitoring certificate update settings is an identifier that uniquely identifies a policy related to monitoring certificate update settings.

[0053] The reference numeral **304** is a setting management table for monitoring policies related to certificates and is a table for managing the settings of policies for monitoring the security of certificates registered with network devices. Information managed in the setting management table **304** is, for example, a certificate monitoring policy ID and a warning threshold related to a certificate validity period. A certificate monitoring policy ID is an identifier that uniquely identifies a certificate monitoring policy. Here, as an example of a warning threshold related to a certificate validity period, threshold information (threshold number of days), which indicates that there is “no problem” when the number of days remaining until the certificate validity period expires is a predetermined number or more, is stored. Furthermore, threshold information, which indicates whether to determine “Low risk” and “Medium risk” when the number of days is a predetermined number or more, and “High risk” when the number of days is a predetermined number or less, is stored.

[0054] The reference numeral **305** is a setting management table for monitoring policies related to certificate update settings and is a table for managing policy settings for monitoring the security of certificate update settings of network devices. The information managed in the setting management table **305** is, for example, an ID of a policy related to monitoring certificate update settings, a verification flag, a check flag related to setting content, and the like. An ID of a policy related to monitoring certificate update settings is an identifier that uniquely identifies a monitoring policy related to certificate update settings. A verification flag is flag information indicating whether or not to verify whether an update setting has been made such that a certificate registered in a network device is updated before the validity period of the certificate expires. A certificate update setting content check flag is flag information indicating whether or not to check whether the content of a certificate registered in a network device and the content set in a certificate update setting are the same. The content of a certificate to be checked here includes a key name, a signature algorithm, a key length, a country/region name, a state, a city, an organization, an organization unit, a common name, and the like, for example.

[0055] <Monitoring Flow>

[0056] Next, a flow of processing of the application server **100** when the application server **100** monitors the security risk of the MFP **150** and gives a warning based on the monitoring result will be described with reference to FIG. **4**. The processing described below is realized by, for example, the CPU **101** of the application server **100** reading a control program stored in a memory such as the ROM **103** into the RAM **102** and executing the control program.

[0057] In step S**400**, the security monitoring module **207** of the application server **100** acquires a setting of a monitoring policy related to security from a table of the service module **210**. Here, as a table from which a setting of a monitoring policy related to security is to be acquired, there are the setting management table **303**, the setting management table **304**, and the setting management table **305** which are related to security, certificates, and update settings. A setting of a monitoring policy related to security to be acquired is a user input value previously inputted by the user via a setting input screen that the UI module **203** has stored in a table via the security monitoring module **207**. Here, as a table to which a setting of a monitoring policy related to security is to be stored, there are the setting management table **303**, the setting management table **304**, and the setting management table **305** which are related to security, certificates, and update settings. A screen for inputting a setting of a monitoring policy related to security will be described later with reference to FIG. **5**.

[0058] In step S**401**, the security monitoring module **207** acquires certificate information of the MFP **150** or the like via the certificate management module **205** of the application server **100**. The certificate information to be acquired includes, as content information of a certificate, a key name, a signature algorithm, a key length, a validity period start date, a validity period end date, a country/region name, a state, a city, an organization, an organization unit, a common name, and the like, for example. Furthermore, in step S**402**, the security monitoring module **207** acquires setting information of the MFP **150** via the setting management module **206** of the application server **100**. The setting information to be acquired includes, certificate update setting information, certificate update date/time information, a usage destination of a key, and the like, for example. Here, certificate update setting information includes an SCEP server URL, a port number, a key name, a signature algorithm, a key length, a country/region name, a state, a city, an organization, an organization unit, a common name, a challenge password, and the like, for example.

[0059] In step S**403**, the security monitoring module **207** serves as a first verification unit and determines whether or not the validity period of a certificate has expired based on the certificate information acquired from the MFP **150** in step S**401**. If it is determined that the validity period of the certificate has expired, the process proceeds to step S**410**; otherwise, the process proceeds to step S**404**. In step S**404**, the security monitoring module **207** determines whether a valid certificate update setting is present in the setting information based on the setting information acquired from the MFP **150** in step S**402**. If a valid certificate update setting is present, the process proceeds to step S**405**; otherwise the process proceeds to step S**406**.

[0060] In step S**405**, the security monitoring module **207** acquires the risk of the certificate update setting based on the certificate update setting included in the setting information acquired from the MFP **150** in step S**402** and the setting of the monitoring policy related to security acquired in step S**400**. The security monitoring module **207** is an example of a second verification unit and verifies whether a certificate is scheduled to be updated in a predetermined period based on the update setting information. As a method for acquiring the risk of a certificate update setting, the risk is determined, for example, by whether or not the certificate update setting has been made such that the certificate will be updated by the expiration of the validity period of the certificate. The risk determined here may be, for example, "certificate has been set to be updated before expiration of validity period", "certificate is not set to be updated before expiration of validity period", or the like. The security monitoring module **207** acquires risk by scoring security risk for each risk. Thus, the degree of risk (degree of danger) can be determined for each predetermined range value of a score, and a warning can be made.

[0061] In step S**406**, the security monitoring module **207** serves as the first verification unit and acquires the risk of the certificate validity period based on the certificate information acquired from the MFP **150** in step S**401** and the setting of the monitoring policy related to security acquired in step S**400**. As a method of acquiring the risk of a certificate validity period, a comparison is made between the number of days until the validity period of a certificate expires and a threshold for warning of the certificate validity period included in the setting of a monitoring policy related to the certificate, which is included in the setting of a monitoring policy for security, for example. Furthermore, the risk is determined as "no problem," "low risk," "medium risk," and "high risk," in accordance with the result of the comparison. The risk is acquired by scoring the security risk for each risk.

[0062] In step S**407**, the security monitoring module **207** determines whether or not the overall security risk is "high risk" based on the score of the certificate update setting risk acquired in step S**405** and the certificate validity period risk acquired in step S**406**. If the result of the determination is "high risk", the process proceeds to step S**410**; otherwise, the process proceeds to step S**408**. In step S**408**, the security monitoring module **207** determines whether or not the overall security risk of the certificate is "medium risk" based on the score of the certificate update setting risk acquired in step S**405** and the certificate validity period risk acquired in step S**406**. If the result of the determination is "medium risk", the process proceeds to step S**411**; otherwise, the process proceeds to step S**409**. In step S**409**, the security monitoring module **207** determines whether or not the overall security risk of the certificate is "low risk" based on the score of the certificate update setting risk acquired in step S**405** and the certificate validity period risk acquired in step S**406**. If the result of the determination is "low risk", the process proceeds to step S**412**; otherwise, the process proceeds to step S**413**. In each of steps S**410**, S**411**, S**412**, and S**413**, the reporting module **208** serves as a providing unit and creates a report visualizing the security risk of the certificate determined by the security monitoring module **207** and displays it in a UI.

[0063] <Setting Input Screen>

[0064] Next, an example of a screen for inputting settings for setting a monitoring policy related to security will be described with reference to FIG. **5**. In FIG. **5**, a reference numeral **500** is a portion for inputting settings of a monitoring policy related to certificate security, and items that can be set for monitoring the security of a certificate for any MFP **150** managed by the network device management application **202** are displayed.

[0065] A reference numeral **501** is a portion for inputting the usage destination of a key to be monitored, and it is possible to select a usage destination of which key to make a security monitoring target using a check box. For example, "no usage", "TLS", "IEEE802.1x", and "IPSec" can be selected. A reference numeral **502** is a portion for inputting a setting of a monitoring policy related to certificates and it can be selected whether to confirm the validity period of a certificate registered in a network device such as the MFP **150**. It allows the threshold number of days to be inputted in a text box for at least how many days of validity period is remaining for the security risk to be determined as OK, low risk, medium risk, or high risk when confirming the validity period of a certificate. Each threshold number of days must be inputted with a numerical relationship of "OK">"low risk">"medium risk">"high risk", and it is desirable to display a pop-up or the like prompting to re-input a valid number when user input for which such a relationship cannot be maintained is received.

[0066] A reference numeral **503** is a portion for inputting a setting of a monitoring policy related to certificate update settings, and at least one monitoring item is displayed to be selectable. For example, it is possible to select whether or not to confirm whether a certificate update has been set such that expiration of the validity period of a certificate registered in the MFP **150** or the like does not occur. It is also possible to select whether or not to confirm whether the content information (subject information) of the certificate set in the certificate update setting matches the content information of the certificate registered in the current network device to be monitored. Incidentally, the monitoring items described here are an example, and may include other monitoring items.

[0067] A reference numeral **504** is a registration button and, when selected, the UI module **203** acquires the settings of the monitoring policy related to security set on the UI. The security monitoring module **207** updates the setting management table **303** related to security, the setting management table **304** related to certificates, and the setting management table **305** related to certificate update settings with the information acquired from the UI. A reference numeral **505** is a cancel button and, when clicked, cancels user input by discarding the settings of the monitoring policy related to security set on the UI.

[0068] <Warming Report>

[0069] Next, an example of a screen for displaying a security risk warning report that the reporting module **208** displays on a UI in steps S**410**, S**411**, S**412**, and S**413** will be described with reference to FIG. **6**. Although an example in which the reporting module **208** outputs a warning report on a display screen will be described here, there is no intention to limit the present invention. For example, data of a report indicating the content of a screen for displaying the report described below may be outputted as email, fax, or the like.

[0070] A reference numeral **600** is portion for displaying a security risk warning; when the "general" tab is selected, the overall security risk of the network is displayed, and when the "certificate" tab is selected, a certificate security risk warning display portion **601** specific to certificates is displayed. Although description will be omitted in the present embodiment for the method of displaying the overall security risk of a network device, the overall security risk may be displayed in a list, for example, for all of the network devices managed by the network device management application **202**.

[0071] The reference numeral **601** is a portion for displaying a certificate security risk warning. The warning display portion **601** displays, in a graph, a ratio of the number of devices (statistical data) for each risk level of the security risk of the certificates determined by the security monitoring module **207** for all of the network devices managed by the network device management application **202**. Although an example of displaying in a pie chart is indicated here, there is no intention to limit the present invention, and other display forms capable of displaying statistical data may be taken, such as displaying in a bar graph. Further, in these graphs, it is desirable that each risk level is displayed by a different display method, such as a different color and shading. Configuration may be taken such that higher risk is displayed with more emphasis.

[0072] A reference numeral **602** is a portion for displaying a list of devices and displays a list of all of the network devices managed by the network device management application **202**. A certificate registered for each network device including the MFP **150** and the content of the certificate update setting are displayed, and the security risk determined by the security monitoring module **207** is displayed for each of the certificates. By selecting each device, various setting screens for the device, for example, the setting input screen **500**, may be displayed. This allows the user to change the setting of a risky device from a report display screen or to manually set a certificate update. A reference numeral **603** is an OK button and, when clicked, ends the display of the security risk warning report screen.

[0073] As described above, the monitoring apparatus according to the present embodiment is capable of communicating with one or more network devices via a network and verifies the content information of a certificate related to security set in a network device to be monitored. The monitoring apparatus also verifies update setting information related to a certificate update and provides a report based on two verification results. Thus, the monitoring apparatus according to the present embodiment can verify not only the content of a certificate itself registered in a network device to be monitored but also whether or not a certificate update has appropriately been scheduled. Consequently, it is possible to provide verification result that is necessary and appropriate for guaranteeing the security of the MFP **150**. As described above, by virtue of the present invention, it becomes possible to not only verify the content of a certificate registered in a network device but also appropriately provide a result of monitoring the security from many aspects in order to guarantee the security of the network device.

Second Embodiment

[0074] Hereinafter, a second embodiment of the present invention will be described. In the present embodiment, an example will be described in which when security risk is determined based on the content information of a certificate registered in a network device and the update setting information of the certificate, the security risk is determined in consideration of past certificate update results. Also described is an example of changing a registered certificate update setting to reduce risk in accordance with security risk when displaying different warnings in accordance with the security risk. Since the system configuration and hardware configuration of the network device management system including the network device of the present embodiment is the same the above first embodiment, description thereof will be omitted.

[0075] <Software Configuration>

[0076] A software configuration of a network device management system including a management apparatus of the present embodiment will be described with reference to FIG. **7**. Since the reference numerals **200** to **213** in the software configuration of the application server **100**, the software configuration of the client computer **120**, and the reference numerals **230** to **233** in the software configuration of the MFP **150** are the same as the above first embodiment, description thereof will be omitted.

[0077] In the software configuration of the application server **100**, a reference numeral **700** is a certificate update history management module. The update history management module **700** acquires, via the network module **200**, certificate update history information from a network device such as the MFP **150** connected to the application server **100** via the network **170**. The update history management module **700** stores, for example, certificate update history information acquired from the MFP **150** in a certificate update history management table **800** of the service module **210** to be described later.

[0078] Meanwhile, in the software configuration of the MFP **150**, a reference numeral **710** is a certificate update history management module and manages a certificate update history of the MFP **150**. The certificate update history management module **710** also returns a certificate update history of the MFP **150** via the network module **230** in response to a request from the application server **100**.

[0079] <Table Configuration>

[0080] Next, examples of table configurations in the service module **210** in the application server **100** will be described with reference to FIG. **8**. Incidentally, the table configurations of FIG. **8** are merely an example and may be different table configurations from the present example. Since the reference numerals **300** to **305** are the same as FIGS. **3**A-**3**F of the above first embodiment, description thereof will be omitted. A reference numeral **800** is a certificate update history management table and is a table for managing the certificate update history of the MFP **150**. The information managed in the certificate update history management table **800** includes a history identifier, a device ID, a certificate update execution date/time, a certificate update execution result, and the like, for example. A history identifier is an identifier that uniquely identifies an update history of a certificate.

[0081] <Processing Flow>

[0082] Next, a flow of processing of the application server **100** when the application server **100** according to the present embodiment monitors the security risk of the MFP **150** and gives a warning based on the monitoring result will be described with reference to FIGS. **9**A and **9**B. The processing described below is realized by, for example, the CPU **101** of the application server **100** reading a control program stored in a memory such as the ROM **103** into the RAM **102** and executing the control program. Incidentally, since steps S**400** to S**404** and S**406** to S**413** are the same as the processing in FIG. **4** of the above first embodiment, description thereof will be omitted.

[0083] In step S**404**, it is determined whether or not a valid certificate update setting is present in the setting information based on the setting information that the security monitoring module **207** has acquired from a network device (assumed to be the MFP **150** here) in step S**402**. If a valid certificate update setting is present, the process proceeds to step S**900**; otherwise the process proceeds to step S**406**. In step S**900**, the security monitoring module **207** acquires certificate update history information from the MFP **150** via the certificate update history management module **700**. Then, in step S**405**, the security monitoring module **207** acquires the risk of the certificate update setting based on the certificate update setting included in the setting information acquired in step S**402**, the setting of the security monitoring policy acquired in step S**400**, and the certificate update history information acquired in step S**900**. As a method for acquiring the risk of a certificate update setting, if an error had occurred during the previous update of the certificate, for example, it is determined that there is risk, and the risk is acquired by scoring the risk. For example, if the previous update of the certificate had failed, the risk may be determined to be higher as the time interval between the date on which an execution of update of the certificate is scheduled and expiration of the validity period of the certificate decreases, so that even if the update also fails this time, it can be retried with time to spare.

[0084] In steps S**410**, S**411** and S**412**, the reporting module **208** creates a report visualizing the security risk of the certificate determined by the security monitoring module **207** and then proceeds to step S**901**. In step S**901**, the security monitoring module **207** determines whether changing the certificate update setting can reduce security risk. As a method of determining whether or not security risk can be reduced, it may be determined whether or not the update date/time of the certificate update setting can be changed to be executed in advance by any number of days, for example. If it is determined that security risk can be reduced, the process proceed to step S**902**; otherwise, the process is ended as is. In step S**902**, the security monitoring module **207** overwrites and updates the certificate update setting of the MFP **150** via the setting management module **206**. As a method of overwriting and updating the certificate update setting, the update date/time of the certificate update setting is changed so that it is executed in advance by any number of days, for example. In step S**903**, the reporting module **208** displays in a UI that the certificate update setting has been overwritten and updated.

[0085] As described above, the monitoring apparatus according to the present embodiment determines security risk based on the past update history of the certificate in addition to the content information and the update setting information of the certificate. This makes it possible to determine security risk in consideration of the result of past certificate updates in addition to the content information and the certificate update setting information of the certificate registered in the network device. It is also possible to change the registered certificate update setting to reduce security risk if the security risk is high.

[0086] <Variation>

[0087] The present invention is capable of various variations not limited to the above embodiments. In the above embodiments, an example has been described in which the application server **100**, which is a monitoring apparatus, is provided outside the MFP **150**, but a configuration may be taken such that a predetermined MFP on the network includes a monitoring apparatus. Alternatively, the monitoring function may be provided in each network device, and the monitoring result may be transmitted to a server such that a report summarizing the monitoring results of a plurality of network devices is outputted in the server. That is, the monitoring apparatus according to the present invention may be provided in any device on the network, and the monitoring function and the report (warning) function may be implemented by a plurality of devices cooperating.

OTHER EMBODIMENTS

[0088] Embodiment(s) of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions (e.g., one or more programs) recorded on a storage medium (which may also be referred to more fully as a 'non-transitory computer-readable storage medium') to perform the functions of one or more of the above-described embodiment(s) and/or that includes one or more circuits (e.g., application specific integrated circuit (ASIC)) for performing the functions of one or more of the above-described embodiment(s), and by a method performed by the computer of the system or apparatus by, for example, reading out and executing the computer executable instructions from the storage medium to perform the functions of one or more of the above-described embodiment(s) and/or controlling the one or more circuits to perform the functions of one or more of the above-described embodiment(s). The computer may comprise one or more processors (e.g., central processing unit (CPU), micro processing unit (MPU)) and may include a network of separate computers or separate processors to read out and execute the computer executable instructions. The computer executable instructions may be provided to the computer, for example, from a network or the storage medium. The storage medium may include, for example, one or more of a hard disk, a random-access memory (RAM), a read only memory (ROM), a storage of distributed computing systems, an optical disk (such as a compact disc (CD), digital versatile disc (DVD), or Blu-ray Disc (BD)™), a flash memory device, a memory card, and the like.

[0089] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0090] This application claims the benefit of Japanese Patent Application No. 2021-049150, filed Mar. 23, 2021, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. A monitoring apparatus capable of communicating with one or more network devices via a network, the apparatus comprising:

at least one memory device that stores a set of instructions; and

at least one processor that executes the set of instructions to:

verify content information of a certificate related to security set in a network device to be monitored;

verify update setting information related to an update of the certificate; and

provide a report based on each verification result.

2. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to:

verify, based on the update setting information, whether the update of the certificate is scheduled to be performed in a predetermined period.

3. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to: acquire the content information of the certificate and the update setting information via the network from the network device to be monitored.

4. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to: monitor a plurality of network devices; and

manage update setting information for each network device.

5. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to: set, in accordance with a user input, a monitoring policy related to security in a network device to be monitored;

determine a security risk in the network device in accordance with the monitoring policy and the update setting information; and

provide the determined security risk as the report.

6. The monitoring apparatus according to claim **5**,

wherein the at least one processor executes instructions in the memory device to: monitor a plurality of network devices, and

the report includes statistical data that accords with a level of a security risk in those plurality of network devices.

7. The monitoring apparatus according to claim **6**,

wherein the monitoring policy includes at least one of a usage destination of a key to be monitored, a threshold number of days related to a validity period of a certificate registered in a target network device, and a monitoring item related to an update setting of a certificate.

8. The monitoring apparatus according to claim **5**,

wherein the report includes different displays in accordance with a determined security risk.

9. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to: verify, based on an update history of the certificate, the content information of the certificate.

10. The monitoring apparatus according to claim **1**,

wherein the at least one processor executes instructions in the memory device to: change an update setting of a certificate related to the network device in accordance with a user input inputted via a display screen for displaying the report.

11. A method of controlling a monitoring apparatus capable of communicating with one or more network devices via a network, the method comprising:

verifying content information of a certificate related to security set in a network device to be monitored;

verifying update setting information related to an update of the certificate; and

providing a report based on each verification result.

12. A non-transitory computer-readable storage medium storing a program that causes a computer to execute a method of controlling a monitoring apparatus capable of communicating with one or more network devices via a network, the method comprising:

verifying content information of a certificate related to security set in a network device to be monitored via the network;

verifying update setting information related to an update of the certificate; and

providing a report based on each verification result.

13. An image processing apparatus, comprising:
the monitoring apparatus according to claim L;
a request unit that requests a certificate issuing server to issue a certificate and acquires the certificate; and
an image processing unit.

* * * * *