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Matsugashita

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(54) AUTHORITY DELEGATE SYSTEM, AUTHORIZATION SERVER SYSTEM, CONTROL METHOD, AND PROGRAM

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(51) **Int. Cl.**
H04L 29/06 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 63/0884*** (2013.01); ***H04L 63/0823*** (2013.01)

(58) **Field of Classification Search**
CPC .. H04L 63/0884; H04L 63/08; H04L 63/0823; H04L 63/0807; H04L 63/102; G06F 21/30
See application file for complete search history.

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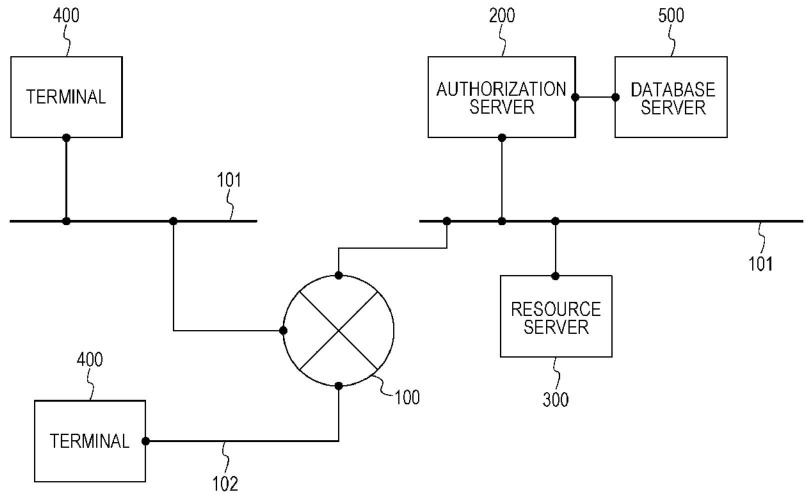
(57) **ABSTRACT**

An authority delegate system, including a server system which provides a service to a device having an application, and an authorization server system which performs authorization processing to delegate user authority in the service to a usage source of the service, includes a management unit, and a providing unit. The management unit identifies authority of the application, in accordance with having received a request to register the application as the usage source, and manages the identified authority, and an identifier of the application, in an associated manner. The providing unit provides the service, in a case where an authorization operation has been performed to permit delegating of the user authority to the application transmitting a request to use the service, and an authority which the application uses is included in authorities associated with the identifier of the application.

13 Claims, 15 Drawing Sheets



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D. Hardt, Ed., The OAuth 2.0 Authorization Framework, Internet Engineering Task Force (IETF), Oct. 2012, pp. 1-18.

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FIG. 1

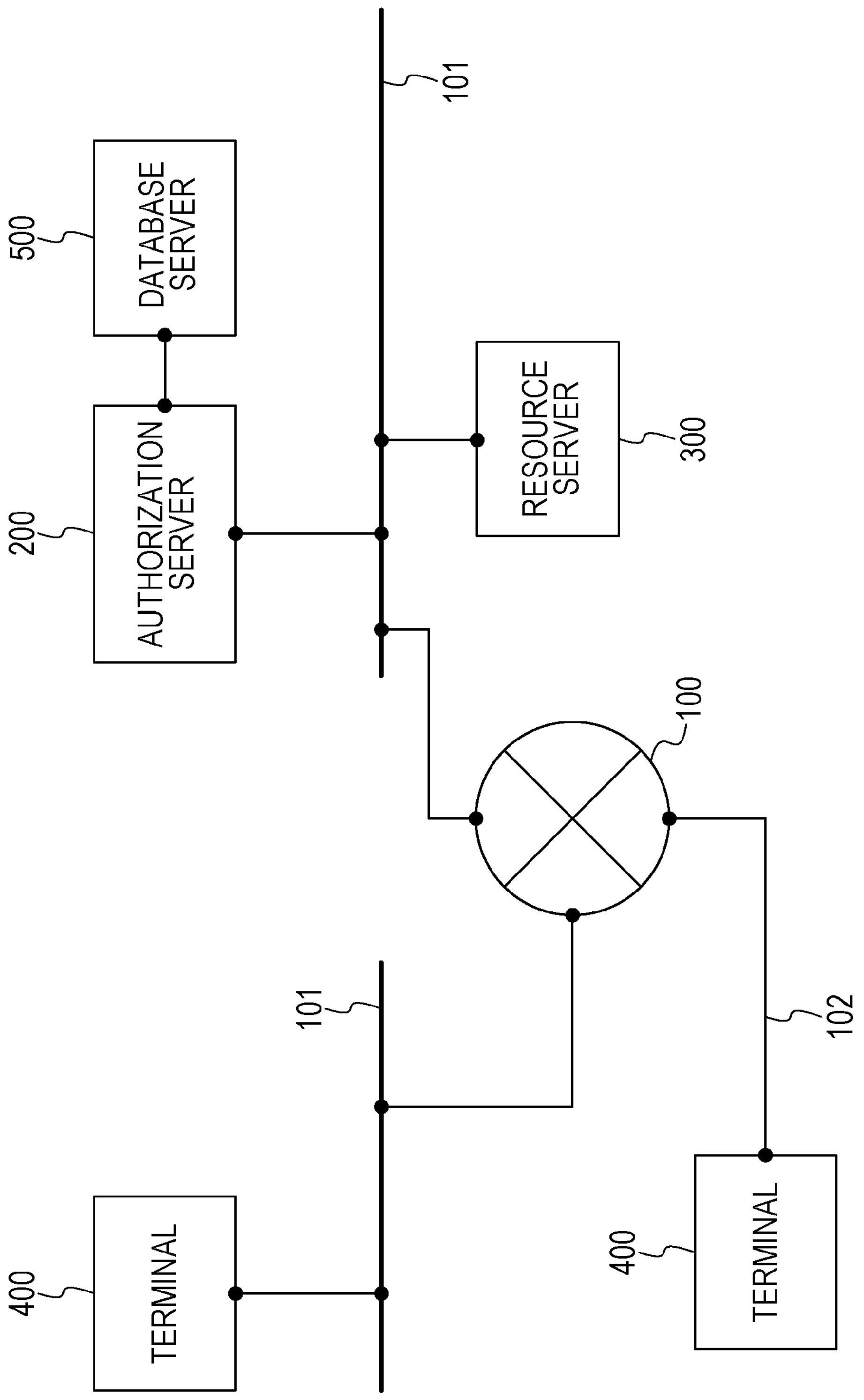

500
DATABASE SERVER
200
AUTHORIZATION SERVER
101
RESOURCE SERVER
300
100
101
102
400
TERMINAL
400
TERMINAL

FIG. 2

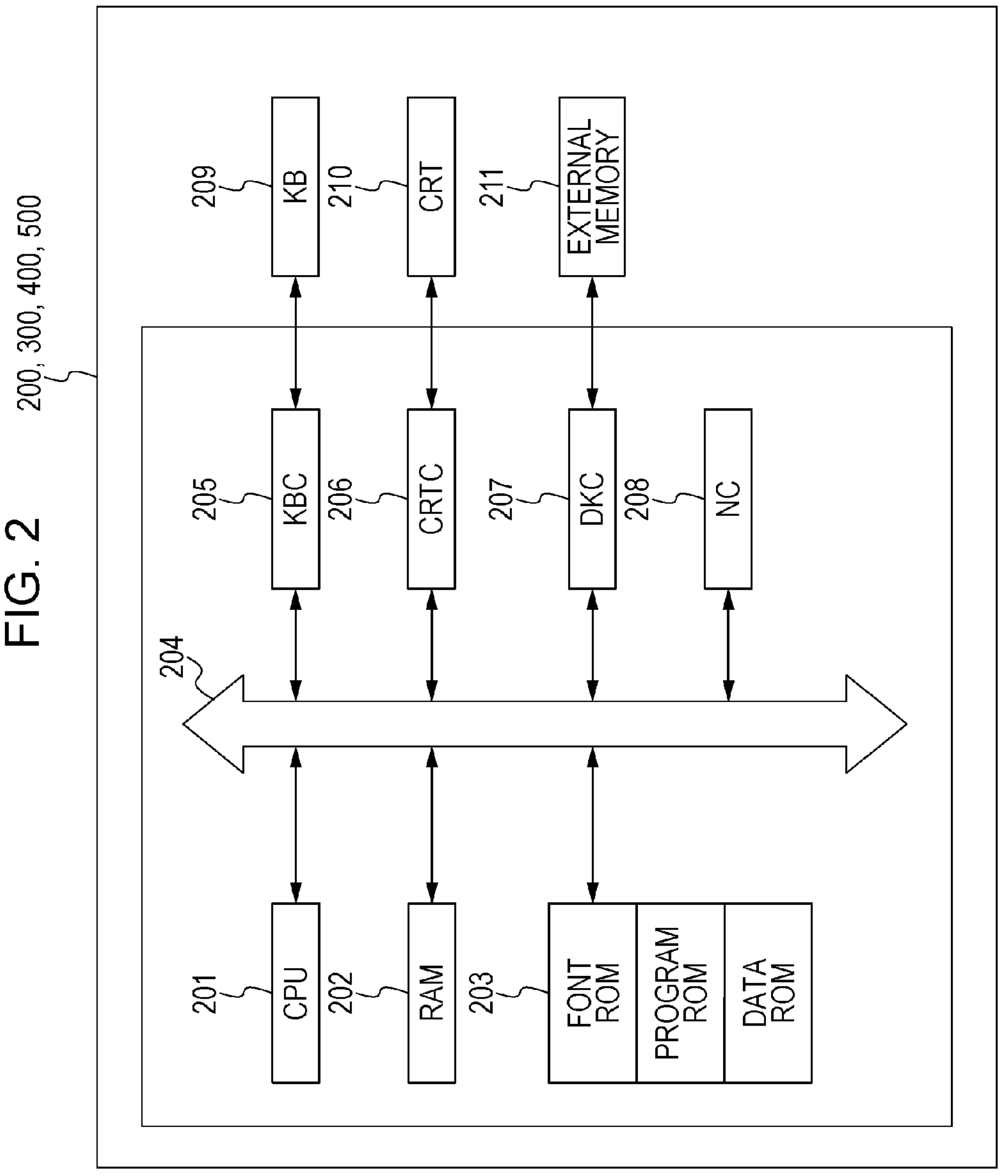

200, 300, 400, 500
209
KB
210
CRT
211
EXTERNAL MEMORY
205
KBC
206
CRTC
207
DKC
208
NC
204
201
CPU
202
RAM
203
FONT ROM
PROGRAM ROM
DATA ROM

FIG. 3

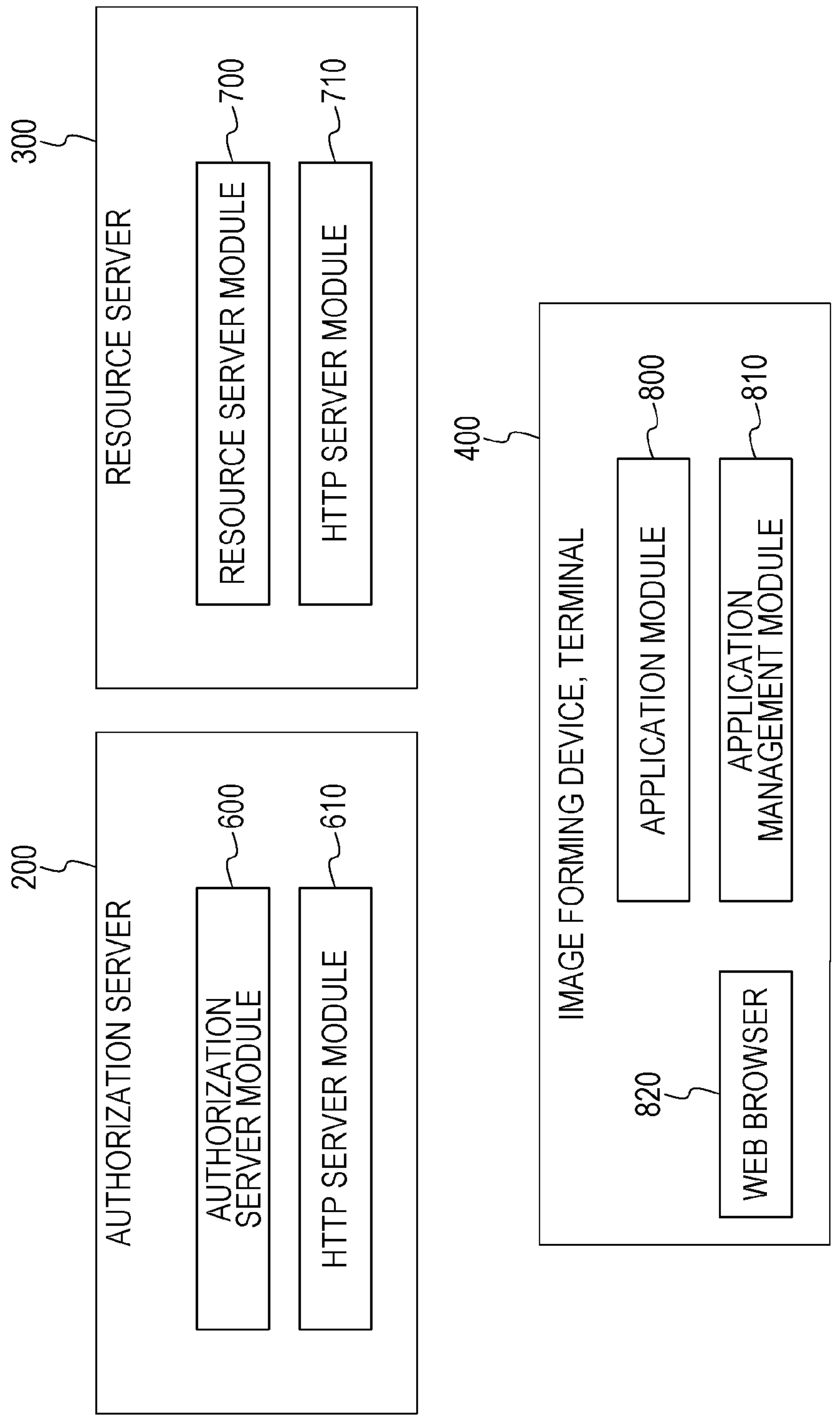

300
RESOURCE SERVER
RESOURCE SERVER MODULE
700
HTTP SERVER MODULE
710
200
AUTHORIZATION SERVER
AUTHORIZATION SERVER MODULE
600
HTTP SERVER MODULE
610
400
IMAGE FORMING DEVICE, TERMINAL
APPLICATION MODULE
800
APPLICATION MANAGEMENT MODULE
810
820
WEB BROWSER

FIG. 4A

1200

CERTIFICATE MANAGEMENT TABLE

1201	1202	1203	1204	1205	1206
SERIAL NO.	ISSUER	SUBJECT	START AT	END AT	TENANT MASTER DN
00abcdef0000000000001	AA Root CA 01	Client 00001 Master	05/30/2013	05/30/2015	CN=master00001,OU=10001AA
00abcdef0000000000002	AA Root CA 01	Client 00002 Master	05/30/2013	05/30/2015	CN=master00003,OU=10002AA
00abcdef0000000000003	AA Root CA 01	Client 00003 Master	05/30/2013	05/30/2036	CN=master00003,OU=10003AA

FIG. 4B

1300

CLIENT MANAGEMENT TABLE

1301	1302	1303	1304	1305	1306	1307
CLIENT ID	SECRET	TENANT ID	TYPE	DN	CLIENT NAME	REDIAL URL
master00001@10001AA	***************	10001AA	MASTER	CN=master00001,OU=10001AA		
master00003@10002AA	***************	10002AA	MASTER	CN=master00002,OU=10002AA		
master00003@10003AA	***************	10003AA	MASTER	CN=master00003,OU=10003AA		
01d7e3139d4e4e628203e179e1401de2@10001AA	***************	10001AA	GENERAL	CN=01d7e3139d4e4e628203e179e1401de2,OU=10001AA	IN-COMPANY APPLICATION	https://intranet/redirect
053753a39d3e4e648213f17eb1331a31@10002AA	***************	10002AA	GENERAL	CN=053753a39d3e4e648213f17eb1331a31,OU=10002AA	PRINTING APPLICATION	https://paidapplication/redirect
543ae4f3998be4eb7ed92ea99e43f2ae@10003AA	***************	10003AA	GENERAL	CN=543ae4f3998be4eb7ed92ea99e43f2ae,OU=10003AA	PRINTING APPLICATION	https://freeapplication/redirect

FIG. 4C

1400

DEFAULT AUTHORITY MANAGEMENT TABLE

1401 1402

TENANT ID	DEFAULT AUTHORITY ID
10001AA	USER PROVISIONING
10002AA	PAY DATA CONVERSION

FIG. 4D

1500

CLIENT AUTHORITY TABLE

1501 1502

CLIENT ID	AUTHORITY ID
01d7e3139d4e4e628203e179e1401de2@10001AA	USER PROVISIONING
053753a39d3e4e648213f17eb1331a31@10002AA	PAY DATA CONVERSION

FIG. 5A

1600

SCOPE TABLE

SCOPE ID (1601)	TYPE (1602)	DESCRIPTION (1603)	AUTHORITY ID (1604)
owner.UserAdmin	OWNER SCOPE	USER INFORMATION	TENANT MANAGER
client.UserProvisioning	CLIENT SCOPE	–	USER PROVISIONING
client.PaidService	CLIENT SCOPE	–	PAY DATA CONVERSION
client.FreeService	CLIENT SCOPE	–	–

FIG. 5B

1700

USER MANAGEMENT TABLE

USER ID (1701)	PASSWORD (1702)	TENANT ID (1703)
user001@user.com	**********	1001AA

FIG. 5C

1800

USER AUTHORITY TABLE

USER ID (1801)	AUTHORITY ID (1802)
user001@user.com	TENANT MANAGER

FIG. 5D

1900

AUTHORIZATION TOKEN MANAGEMENT TABLE

1901	1902	1903	1904	1905	1906
AUTHORIZATION TOKEN ID	TOKEN TYPE	EXPIRATION DATE	SCOPE ID	CLIENT TOKEN ID	OWNER ID
AC_0000001	AUTHORIZATION CODE	05/30 11:00.00/2013	owner.UserAdmin client.UserProvisioning	01d7e3139d4e4e628203e179e1401de2@10001AA	user001@user.com
AT_0000002	AUTHORIZATION TOKEN	05/30 24:00.00/2013	owner.UserAdmin client.UserProvisioning	01d7e3139d4e4e628203e179e1401de2@10001AA	user001@user.com
AT_0000003	AUTHORIZATION TOKEN	05/30 24:00.00/2013	client.PaidService	053753a39d3e4e648213f17eb1331a31@10002AA	053753a39d3e4e648213f17eb1331a31@10002AA
AT_0000004	AUTHORIZATION TOKEN	05/30 24:00.00/2013	client.FreeService	543ae4f3998be4eb7ed92ea99e43f2ae@10003AA	543ae4f3998be4eb7ed92ea99e43f2ae@10003AA

FIG. 6

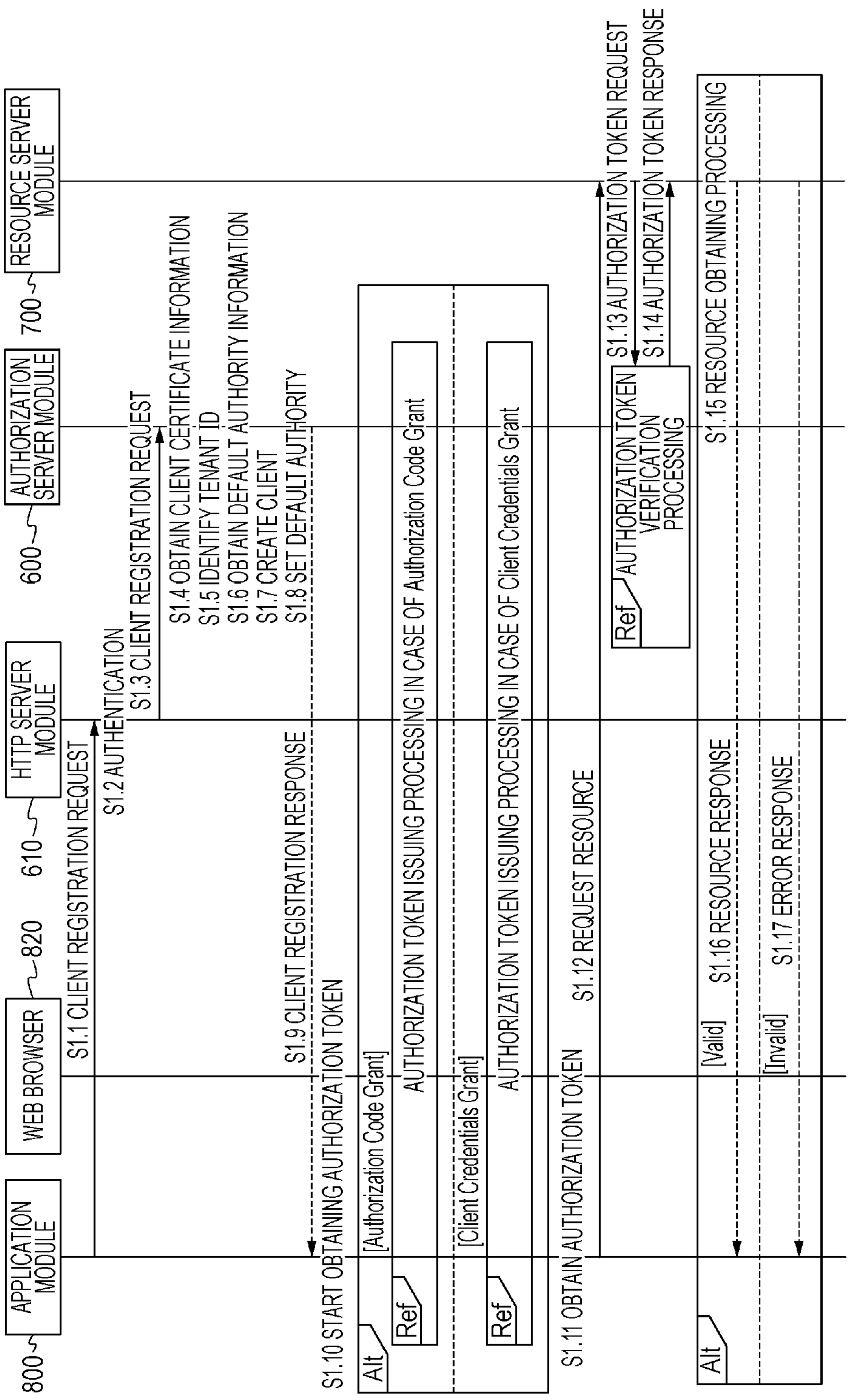

800
APPLICATION MODULE
WEB BROWSER
820
610
HTTP SERVER MODULE
600
AUTHORIZATION SERVER MODULE
700
RESOURCE SERVER MODULE
S1.1 CLIENT REGISTRATION REQUEST
S1.2 AUTHENTICATION
S1.3 CLIENT REGISTRATION REQUEST
S1.4 OBTAIN CLIENT CERTIFICATE INFORMATION
S1.5 IDENTIFY TENANT ID
S1.6 OBTAIN DEFAULT AUTHORITY INFORMATION
S1.7 CREATE CLIENT
S1.8 SET DEFAULT AUTHORITY
S1.9 CLIENT REGISTRATION RESPONSE
S1.10 START OBTAINING AUTHORIZATION TOKEN
Alt
[Authorization Code Grant]
Ref
AUTHORIZATION TOKEN ISSUING PROCESSING IN CASE OF Authorization Code Grant
[Client Credentials Grant]
Ref
AUTHORIZATION TOKEN ISSUING PROCESSING IN CASE OF Client Credentials Grant
S1.11 OBTAIN AUTHORIZATION TOKEN
S1.12 REQUEST RESOURCE
S1.13 AUTHORIZATION TOKEN REQUEST
S1.14 AUTHORIZATION TOKEN RESPONSE
Ref
AUTHORIZATION TOKEN VERIFICATION PROCESSING
S1.15 RESOURCE OBTAINING PROCESSING
Alt
[Valid]
S1.16 RESOURCE RESPONSE
[Invalid]
S1.17 ERROR RESPONSE

FIG. 7

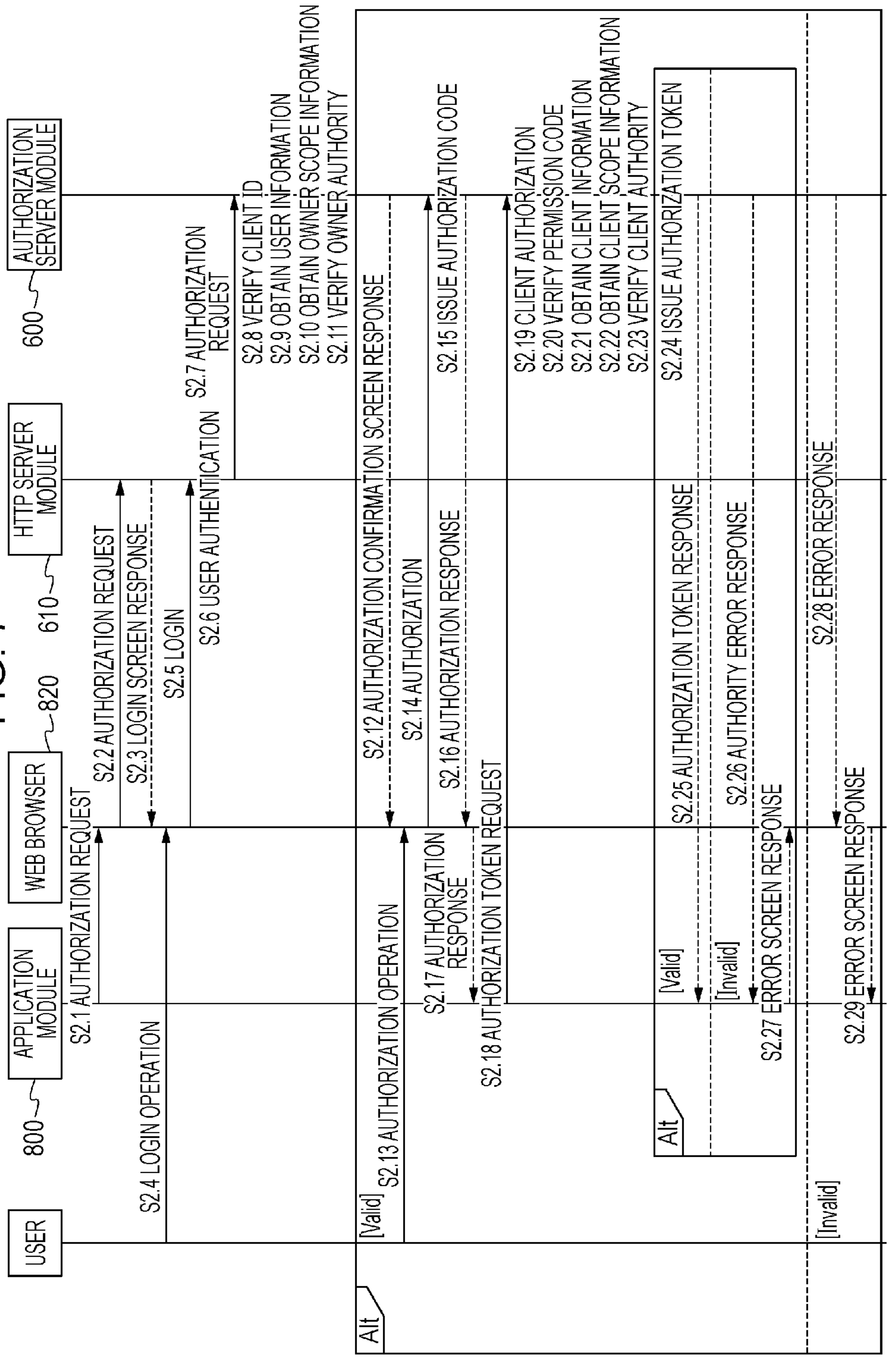

USER
800
APPLICATION MODULE
WEB BROWSER
820
610
HTTP SERVER MODULE
600
AUTHORIZATION SERVER MODULE
S2.1 AUTHORIZATION REQUEST
S2.2 AUTHORIZATION REQUEST
S2.3 LOGIN SCREEN RESPONSE
S2.4 LOGIN OPERATION
S2.5 LOGIN
S2.6 USER AUTHENTICATION
S2.7 AUTHORIZATION REQUEST
S2.8 VERIFY CLIENT ID
S2.9 OBTAIN USER INFORMATION
S2.10 OBTAIN OWNER SCOPE INFORMATION
S2.11 VERIFY OWNER AUTHORITY
Alt
[Valid]
S2.12 AUTHORIZATION CONFIRMATION SCREEN RESPONSE
S2.13 AUTHORIZATION OPERATION
S2.14 AUTHORIZATION
S2.15 ISSUE AUTHORIZATION CODE
S2.16 AUTHORIZATION RESPONSE
S2.17 AUTHORIZATION RESPONSE
S2.18 AUTHORIZATION TOKEN REQUEST
S2.19 CLIENT AUTHORIZATION
S2.20 VERIFY PERMISSION CODE
S2.21 OBTAIN CLIENT INFORMATION
S2.22 OBTAIN CLIENT SCOPE INFORMATION
S2.23 VERIFY CLIENT AUTHORITY
S2.24 ISSUE AUTHORIZATION TOKEN
Alt
[Valid]
S2.25 AUTHORIZATION TOKEN RESPONSE
[Invalid]
S2.26 AUTHORITY ERROR RESPONSE
S2.27 ERROR SCREEN RESPONSE
[Invalid]
S2.28 ERROR RESPONSE
S2.29 ERROR SCREEN RESPONSE

FIG. 8A

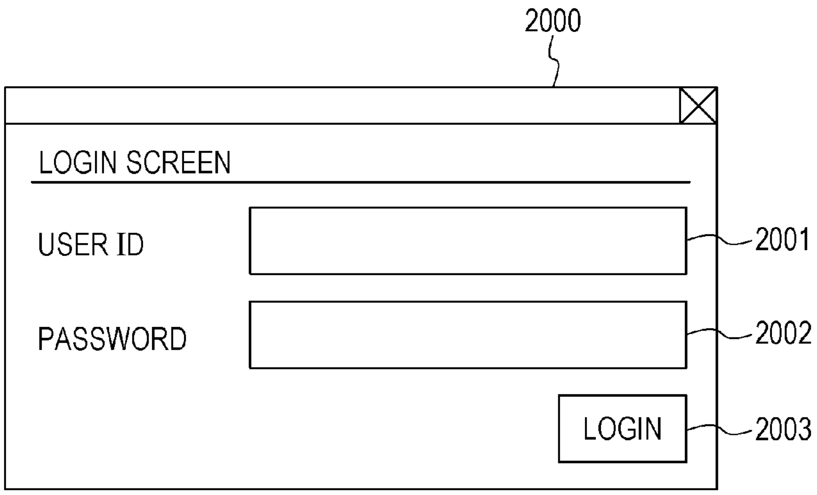
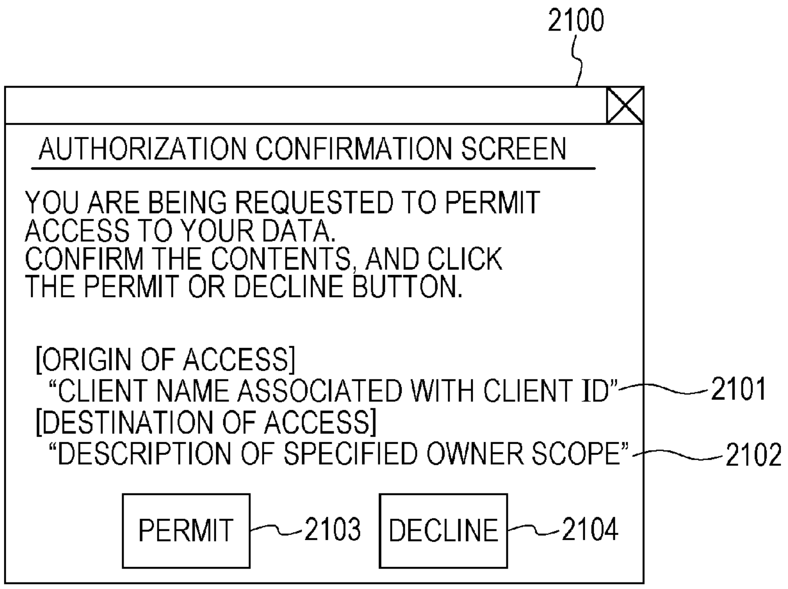


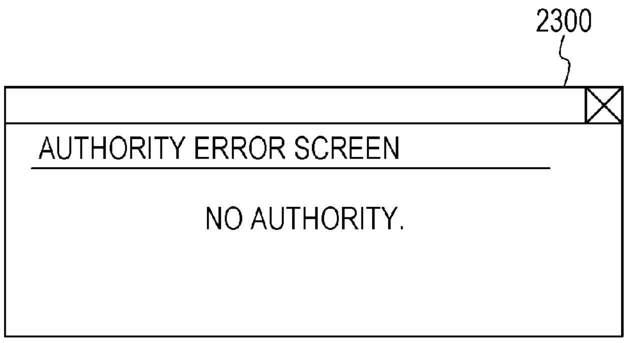
FIG. 8B


AUTHORIZATION CONFIRMATION SCREEN

YOU ARE BEING REQUESTED TO PERMIT ACCESS TO YOUR DATA.
CONFIRM THE CONTENTS, AND CLICK THE PERMIT OR DECLINE BUTTON.

[ORIGIN OF ACCESS]
"CLIENT NAME ASSOCIATED WITH CLIENT ID"
[DESTINATION OF ACCESS]
"DESCRIPTION OF SPECIFIED OWNER SCOPE"

FIG. 8C


AUTHORITY ERROR SCREEN

NO AUTHORITY.

FIG. 9

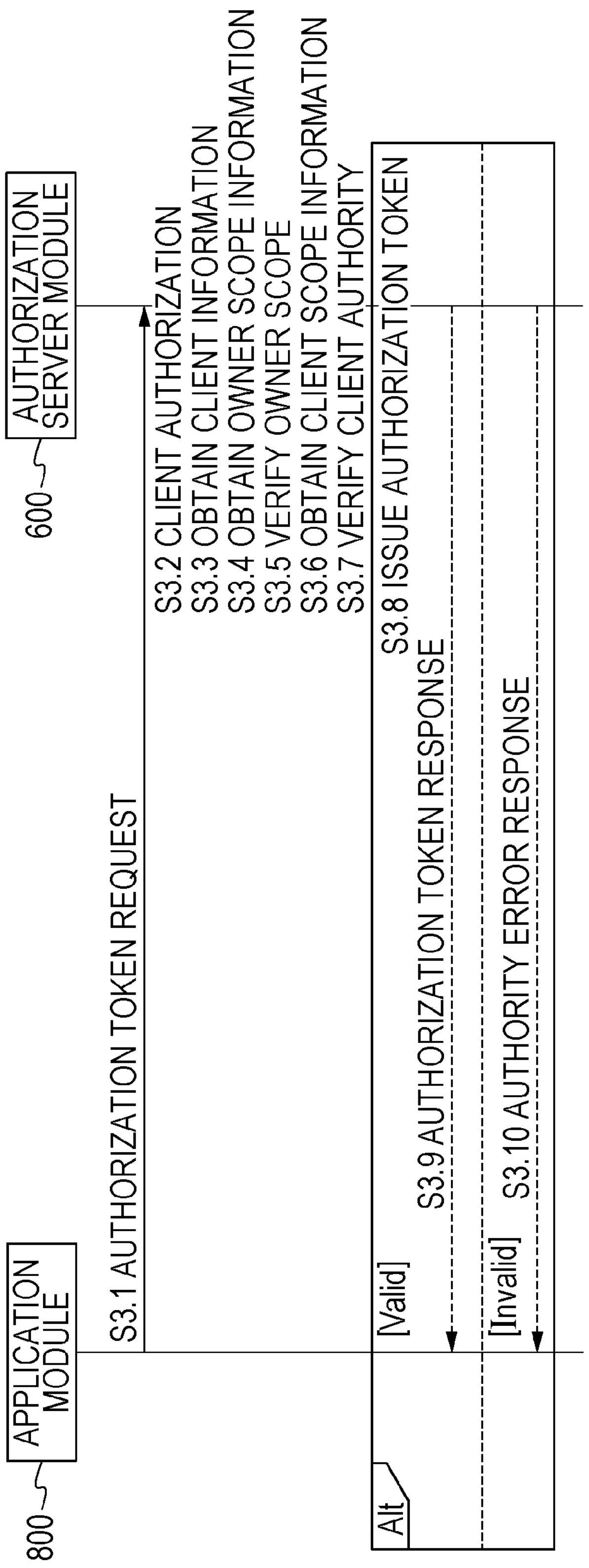

800
APPLICATION MODULE
600
AUTHORIZATION SERVER MODULE
S3.1 AUTHORIZATION TOKEN REQUEST
S3.2 CLIENT AUTHORIZATION
S3.3 OBTAIN CLIENT INFORMATION
S3.4 OBTAIN OWNER SCOPE INFORMATION
S3.5 VERIFY OWNER SCOPE
S3.6 OBTAIN CLIENT SCOPE INFORMATION
S3.7 VERIFY CLIENT AUTHORITY
Alt
[Valid]
S3.8 ISSUE AUTHORIZATION TOKEN
S3.9 AUTHORIZATION TOKEN RESPONSE
[Invalid]
S3.10 AUTHORITY ERROR RESPONSE

FIG. 10

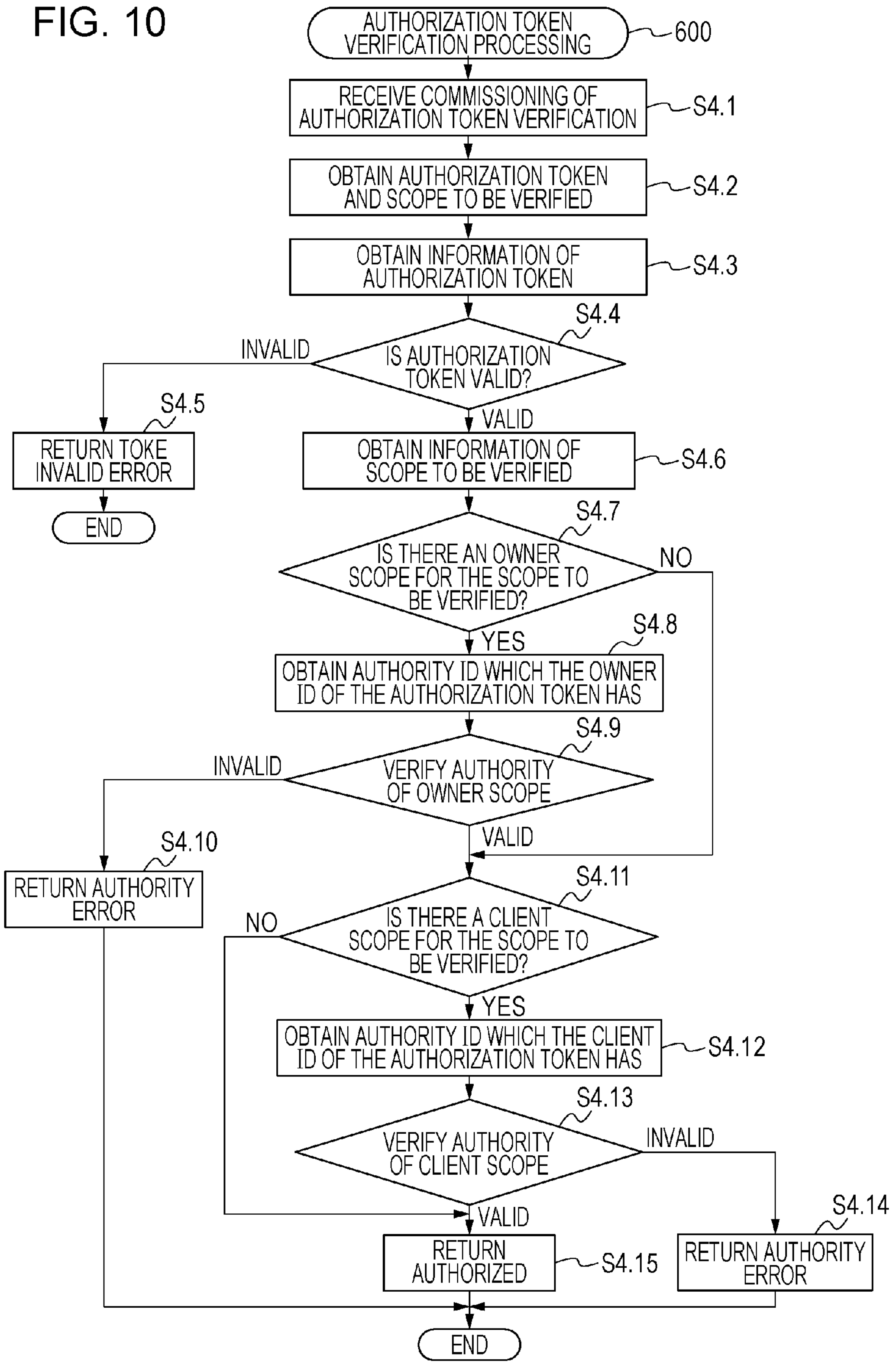

AUTHORIZATION TOKEN VERIFICATION PROCESSING
600
RECEIVE COMMISSIONING OF AUTHORIZATION TOKEN VERIFICATION
S4.1
OBTAIN AUTHORIZATION TOKEN AND SCOPE TO BE VERIFIED
S4.2
OBTAIN INFORMATION OF AUTHORIZATION TOKEN
S4.3
S4.4
IS AUTHORIZATION TOKEN VALID?
INVALID
VALID
S4.5
RETURN TOKE INVALID ERROR
END
OBTAIN INFORMATION OF SCOPE TO BE VERIFIED
S4.6
S4.7
IS THERE AN OWNER SCOPE FOR THE SCOPE TO BE VERIFIED?
NO
YES
S4.8
OBTAIN AUTHORITY ID WHICH THE OWNER ID OF THE AUTHORIZATION TOKEN HAS
S4.9
VERIFY AUTHORITY OF OWNER SCOPE
INVALID
VALID
S4.10
RETURN AUTHORITY ERROR
S4.11
IS THERE A CLIENT SCOPE FOR THE SCOPE TO BE VERIFIED?
NO
YES
OBTAIN AUTHORITY ID WHICH THE CLIENT ID OF THE AUTHORIZATION TOKEN HAS
S4.12
S4.13
VERIFY AUTHORITY OF CLIENT SCOPE
INVALID
VALID
S4.14
RETURN AUTHORIZED
S4.15
RETURN AUTHORITY ERROR
END

FIG. 11

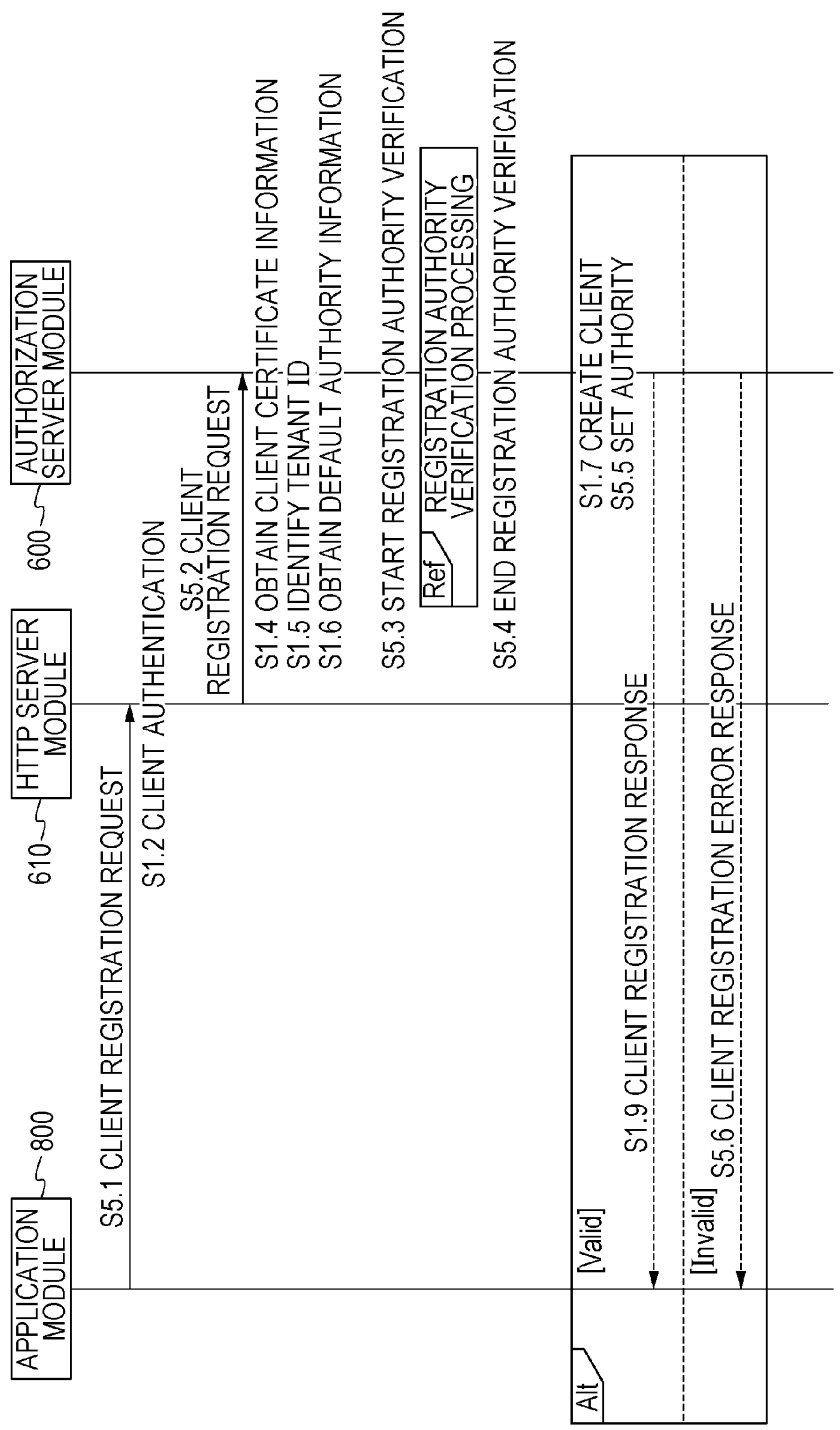
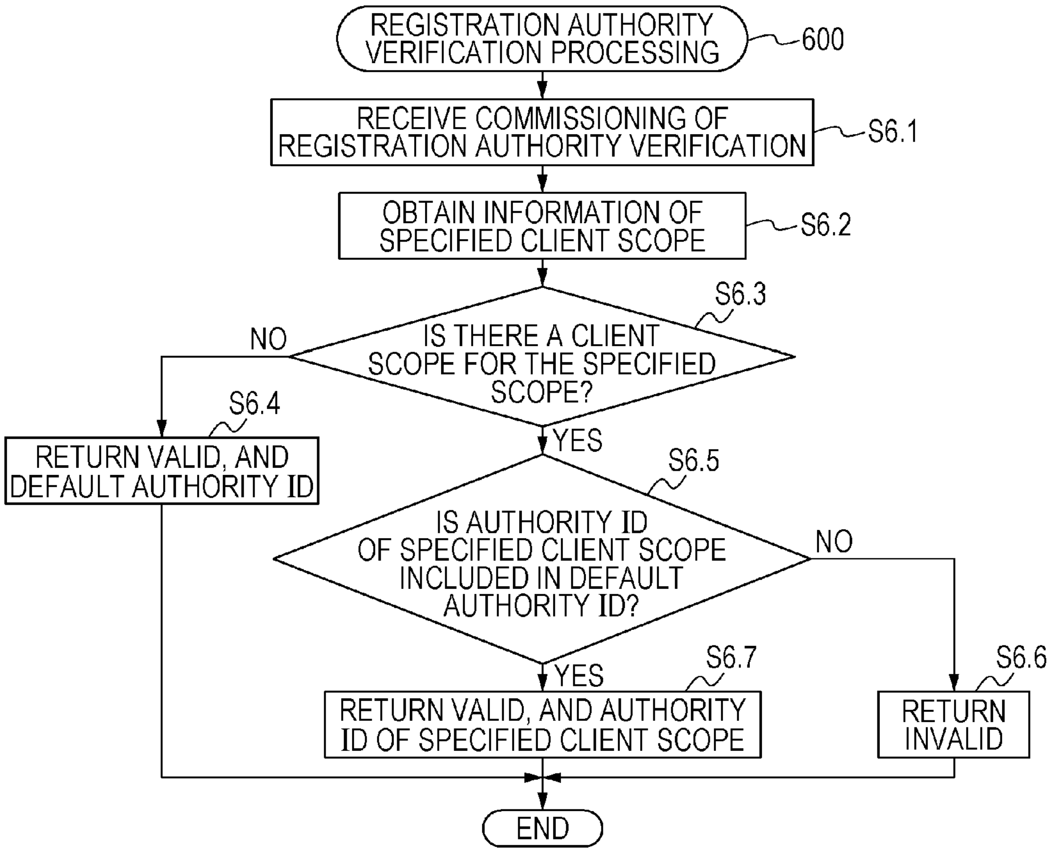

APPLICATION MODULE
800
HTTP SERVER MODULE
610
AUTHORIZATION SERVER MODULE
600
S5.1 CLIENT REGISTRATION REQUEST
S1.2 CLIENT AUTHENTICATION
S5.2 CLIENT REGISTRATION REQUEST
S1.4 OBTAIN CLIENT CERTIFICATE INFORMATION
S1.5 IDENTIFY TENANT ID
S1.6 OBTAIN DEFAULT AUTHORITY INFORMATION
S5.3 START REGISTRATION AUTHORITY VERIFICATION
Ref
REGISTRATION AUTHORITY VERIFICATION PROCESSING
S5.4 END REGISTRATION AUTHORITY VERIFICATION
Alt
[Valid]
S1.7 CREATE CLIENT
S5.5 SET AUTHORITY
S1.9 CLIENT REGISTRATION RESPONSE
[Invalid]
S5.6 CLIENT REGISTRATION ERROR RESPONSE

FIG. 12


REGISTRATION AUTHORITY VERIFICATION PROCESSING
600
RECEIVE COMMISSIONING OF REGISTRATION AUTHORITY VERIFICATION
S6.1
OBTAIN INFORMATION OF SPECIFIED CLIENT SCOPE
S6.2
IS THERE A CLIENT SCOPE FOR THE SPECIFIED SCOPE?
S6.3
NO
S6.4
RETURN VALID, AND DEFAULT AUTHORITY ID
YES
S6.5
IS AUTHORITY ID OF SPECIFIED CLIENT SCOPE INCLUDED IN DEFAULT AUTHORITY ID?
NO
YES
S6.7
RETURN VALID, AND AUTHORITY ID OF SPECIFIED CLIENT SCOPE
S6.6
RETURN INVALID
END

AUTHORITY DELEGATE SYSTEM, AUTHORIZATION SERVER SYSTEM, CONTROL METHOD, AND PROGRAM

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to an authority delegate system which performs client registration, an authorization server system, a control method, and a program.

Description of the Related Art

There is a standard protocol to realize coordination of authorization, called OAuth 2.0 ("The OAuth 2.0 Authorization Framework", [online] D. Hardt, May 2013 <URL http://tools.ietf.org/html/rfc6749>). OAuth 2.0 enables an application B which has been authorized by a user and which is installed in a terminal operated by the user, to access data of the user which a service A on the Internet manages, for example. OAuth 2.0 refers to a subject to which authority is delegated, like the application B, as an "OAuth client", or simply "client". The service A is supposed to obtain explicit user authorization regarding access by the application B, upon having clarified the range of access by the application B. The action of the user giving explicit authorization is called "authorization operation".

Once the user has performed an authorization operation, the application B receives a token certifying that access has been permitted by service A (hereinafter referred to as "authorization token"). Access thereafter can be realized using this authorization token. The application B which uses the authorization token can access the service A under the authority of the user which has performed the authorization operation, without prompting the user for input of authorization information. Accordingly, the application B which has been authorized by the user and acquired the authorization token is bound responsible to manage the authorization token in a secure and proper manner.

OAuth 2.0 has to authenticate the application B and grant predefined authority before the authorization operation is performed, in order to prevent spoofing of the application B. In order to authenticate the application B, the service A has to issue and manage authentication information of the application B beforehand. This authentication information is a client ID and secret. Further, this authentication information has to be set in the application B. An online application registration protocol is being studied as a specification pertaining to OAuth 2.0, called Dynamic Client Registration Protocol. According to this Dynamic Client Registration Protocol, a requestor for each client registration is dynamically subjected to client registration by transmitting metadata to an endpoint for client registration, and thus authentication information can be obtained. The endpoint is an authorization service provided to a server side implementing OAuth 2.0. This mechanism enables the trouble of performing individual settings to be avoided, since each application subjectively obtains authentication information, rather than authentication information being set to each of a great number of applications which have been distributed. When confirming an authorization token, not only is the authority delegated from the user confirmed, but also the authority of the application B itself is confirmed, and whether to permit or deny usage of the user is thus decided.

SUMMARY OF THE INVENTION

Registration protocols of application involving authority delegate processing, such as OAuth 2.0, grant uniformly

identical authority to all applications being registered. For example, in the event that an unnecessary authority is granted to a certain application, and user authority is grated to that application, there is the concern that the certain application may use a service which was not expected to be used.

It has been found a benefit to provide an authorization server which grants suitable authority in accordance with applications being registered by an application registration protocol in authority delegate processing.

According to an aspect of the present invention, an authority delegate system, including a server system which provides a service to a device having an application, and an authorization server system which performs authorization processing to delegate user authority in the service to a usage source of the service, includes a management unit configured to identify authority of the application, in accordance with having received a request to register the application as the usage source, and manage the identified authority, and an identifier of the application, in an associated manner, and a providing unit configured to provide the service, in a case where an authorization operation has been performed to permit delegating of the user authority to the application transmitting a request to use the service, and an authority which the application uses is included in authorities associated with the identifier of the application.

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

According to the present invention, suitable authority can be granted in accordance with applications being registered by an application registration protocol in authority delegate processing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a system according to a first embodiment.

FIG. **2** is a block diagram of hardware of components.

FIG. **3** is a block diagram of software modules of components.

FIGS. **4**A through **4**D illustrate client-related table structures managed at an authorization server.

FIGS. **5**A through **5**D illustrate token-related table structures managed at an authorization server.

FIG. **6** illustrates a sequence from client registration to resource access.

FIG. **7** illustrating an authorization token issuing sequence in a case of Authorization Code Grant.

FIGS. **8**A through **8**C are examples of screens.

FIG. **9** illustrates an authorization token issuing sequence in a case of Client Credentials Grant.

FIG. **10** is an authorization token verification process flow.

FIG. **11** illustrates a registration sequence according to a second embodiment.

FIG. **12** illustrates a registration authority verification process flow.

DESCRIPTION OF THE EMBODIMENTS

Terminology used in the present invention, an outline of service which the system in the embodiments of the present invention have, and applications cooperating with the service, will be described. The service is a function provided to a server connected via a network, and can supplement functions not provided to accessing terminals. The phrase "provide service" means to allow an accessing source and/or a user to use functions provided to the server. In an example, service is provided in a case where an authority used by an application is within authority associated with an identifier of the application.

Services include pay services for which the user is billed for using, and free services with no billing. A pay service basically can be used by a user entering into contract therewith, and the service is bound responsible to provide the service in accordance with the contents of the contract in a stable manner. For example, there is a system to ensure the quality of service, called Service Level Agreement (SLA). SLA defines the minimum speed, upper limit of down time, and so forth, of the service being provided. The user pays usage fees as the price of the service quality defined in the SLA. The SLA also defines actions to be taken in a caser where the defined quality is not delivered, including penalties for the service provider, and guaranteeing the user such as discounting usage fees, for example. Accordingly, it is very important for pay services to deliver the quality defined in the SLA. Free services have interface specifications disclosed for receiving services, and third parties have opportunities to develop applications. No terms like those of the SLA exist for free services.

There are at least three services which the system in the embodiments of the present invention provides. One is a pay service, in which a user provisioning service for provisioning user data registered on the Internet is installed in a server on the Internet. A second is a pay service, in which a pay data conversion service to convert document data which a terminal holds into printable data, is installed in a server on the Internet. The third is a free service, and in the same way as with the second service, in that a free data conversion service to convert document data which a terminal holds into printable data, is installed in a server on the Internet. Each of these servers will be referred to as a "resource server". These are servers configuring the system which the present invention assumes. While description will be made regarding an arrangement where one service is provided to each resource server, two or more different services may be provided to one resource server.

Further, there are both pay applications and free applications for applications which are provided to terminals such as smartphones and tablets and which are coordinated with the service. A pay application has to guarantee quality to the user, in the same way as with the pay service. Moreover, there is the need to create the application coordinating with the service to a high level of quality in order to deliver on the SLA for the pay service, which is costly. In other words, the service providers pay a great deal of money create applications to achieve the SLA for the pay service. The pay applications are provided to user to have paid, while the free applications are distributed free of cost.

In the case of such a system, there are the following specific problems. In a case where a conventional application registration protocol is provided to the user in the authority delegate processing, to avoid the trouble of distributing applications, it becomes difficult to prevent a free application created by a third party from using the pay service. If the user authority for a pay service is delegated to a free application, the free application has the authority to use the service, no different from the pay application, which is unpreventable. As a result, the pay service provider finds it difficult to achieve the SLA, and consequently the pay service business may collapse. Moreover, the application which the provider has paid a great amount of money to

develop in order to achieve the SLA is not used, and recovering this investment becomes difficult.

First Embodiment

A first embodiment is directed to detailed description of a system to solve the above-described problem. The authority delegate system according to the present embodiment is realized on a network configuration such as illustrated in FIG. **1**. Reference numeral **100** denotes a wide area network (hereinafter "WAN **100**"). A World Wide Web (WWW) system is configured in the present invention. Reference numeral **101** denotes a local area network (LAN **101**) connecting the components, and **102** denotes a public network connecting the components.

Reference numeral **200** denotes an authorization server to realize OAuth 2.0, and includes an authorization server module which performs authorization processing to issue tokens. Reference numeral **300** denotes a resource server, and includes resource server modules such as a user provisioning service, pay data conversion service, free data conversion service, and so forth. Note that the number of resource server modules installed in one resource server may be one, or may be multiple. Reference numeral **400** denotes a device such as a smartphone, portable terminal, image formation apparatus, or the like. One or more application modules are installed therein. The user uses the application modules to communicate with the resource server. Reference numeral **500** denotes a database server, which is connected to the authorization server **200** via the LAN **101**, and stores data which the authentication server module uses.

The authorization server **200**, resource server **300**, and terminal **400** are each connected via the WAN **100** and LAN **101**. The authorization server **200**, resource server **300**, and terminal **400** may each be configured on separate LANs, or may be configured on the same LAN. The authorization server **200**, resource server **300**, and database server **500** may be configured on the same server. Each server may be configured of multiple servers, and there is no restriction on the number of servers. A server configured including one or multiple servers is called a "server system", and the term "authorization server system" means one or multiple authorization servers.

The authority delegate system according to the present embodiment is realized on a system including servers configured such as illustrated in FIG. **2**, and terminals. FIG. **2** illustrates the hardware configuration of the authorization server **200**, resource server **300**, terminal **400**, and database server **500**. The hardware block diagram illustrated in FIG. **2** is equivalent to a hardware block diagram of a common information processing apparatus, so common information processing apparatus hardware configurations can be applied to the servers and terminals of the present embodiment.

In FIG. **2**, a CPU **201** executes programs, such as an operating system (OS) and applications and the like, stored in program read only memory (ROM) of ROM **203**, or external memory **211** such as a hard disk (HD) and loaded to random access memory (RAM) **202**, thereby controlling the blocks connected to a system bus **204**. The later-described sequences can be realized by executing these programs. The RAM **202** functions as main memory, work area, and so forth for the CPU **201**. A keyboard controller (KBC) **205** controls key input from a keyboard **209** or a pointing device which is omitted from illustration. A cathode ray tube (CRT) controller (CRTC) **206** controls display on a CRT display **210**. A disk controller (DKC) **207** controls data access of external memory **211** such as the HD storing various types of data. A network controller (NC) performs communication control processing with other devices connected over the WAN **100**, LAN **101**, or public circuit **102**. Note that in the following description, unless specifically stated otherwise, the hardware subject is the CPU **201**, and the software subject is application programs installed in the external memory **211**.

FIG. **3** is a diagram illustrating the modular configuration of the authorization server **200**, resource server **300**, and terminal **400** according to the present embodiment. Note that the authorization server **200**, resource server **300**, and terminal **400** are the same as illustrated in FIG. **2**. The authorization server **200** includes an authorization server module **600** and an HTTP server module **610**. The HTTP server module **610** is a module for performing HTTP communication with terminals **400** connecting thereto via the WAN **100**. The HTTP server module **610** is configured so as to be capable of communication by secure socket layer (SSL)/transport layer security (TLS), and has a function of saving certificates (not illustrated). The present embodiment is configured such that endpoints, which accept later-described client registration requests, request authentication by X.509 format certificate of the requestor. Next, the authorization server module **600** receives a request from a terminal **400** via the HTTP server module **610**, processes the request and responds. In the present embodiment, in the event that the HTTP server module **610** accepts a client registration request and succeeds in authenticating the requestor, the HTTP server module **610** notifies the authorization server module **600** of the certificate received from the client.

The resource server **300** illustrated in FIG. **3** includes a resource server module **700** and an HTTP server module **710**. The HTTP server module **710** has the same functions as the HTTP server module **610**. The resource server module **700** receives requests from terminals **400** via the HTTP server module **710**, processes the requests, and responds.

The terminal **400** in FIG. **3** includes an application managing module **810**, a Web browser **820**, and one or more application modules **800**. The application managing module **810** manages the life cycle of application modules **800** to be managed which are running on the terminal **400**. "Life cycle" means the state of the application, including installation, startup, quitting, and uninstalling. An example of the application managing module **810** is Open Services Gateway initiative (OSGi, a registered trademark) stipulated by the OSGi alliance.

The application managing module **810** is an application which runs in an application execution environment which the terminal **400** provides. The life cycle of applications is managed by the application managing module **810**. The application module **800** may be initially provided to the terminal **400**, or may be installed through the application managing module **810** later. The Web browser **820** is a user agent which is provided to the terminal **400** using the WWW. The application module **800** also has an X.509 certificate and the secret key thereof to certify itself. Thus, the HTTP server module **610** can certify that a request from the application module **800** in communication therewith is a request from an application module, by using the X.509 certificate and the secret key at the time of establishing communication.

FIGS. **4**A through **4**D are data tables stored in external memory of the database server **500**. The data tables are configured so as to be communicated by the authorization

server **200** over the LAN **101**. These data tables may be configured in external memory of the authorization server **200** instead.

FIG. **4**A illustrates a certificate management table **1200**. X.509 format certificates are used in the present embodiment. The certificate management table **1200** includes a certificate serial No. **1201**, certificate issuer **1202**, a subject **1203**, a start date **1204**, an end data **1205**, and a distinguished name (DN) of a later-described tenant master user that is correlated. FIG. **4**B illustrates a client management table **1300**. The client management table **1300** includes a client ID **1301**, client secret **1302**, tenant ID **1303**, type **1304**, DN **1305**, client name **1306**, and redirect URL **1307**. The authorization server **200** has a function of verifying the set of the information in the client ID **1301** and client secret **1302**, and generating authentication information if correct, thereby authenticating clients. The client name **1306** and redirect URL **1307** are values used in a later-described sequence. The type **1304** stores data to identify whether or not the client of this record is the master user of a tenant.

FIG. **4**C illustrates a default authority management table **1400**. The default authority management table **1400** includes a tenant ID **1401** and default authority ID **1402**. The tenant ID **1401** and tenant ID **1303** of the client management table **1300** are configured so as to be mutually referenced. FIG. **4**D illustrates a client authority table **1500**. The client authority table **1500** includes a client ID **1501** and authority ID **1502**. The client ID **1501** and the client ID **1301** of the client management table **1300** are configured so as to be mutually referenced. The authority ID **1502** stores the authority ID set in the default authority ID **1402** of the default authority management table **1400**. Registration of the authority ID to the authority ID **1502** will be described later. The information illustrated in FIG. **4**D is set by authority associated with certificates being identified using FIGS. **4**A through **4**C, based on the certificate received from the client. That is to say, the authority differs depending on the certificate which the client transmits. Note that the IDs in the present embodiment are one form of identifiers, and that other forms may be used. The term "client ID", for example, means information by which a client can be uniquely identified.

FIGS. **5**A through **5**D are data tables stored in external memory of the database server **500** configured so as to be communicable with the authorization server **200** via the LAN **101**. These data tables may be configured in the external memory of the authorization server **200** instead. FIG. **5**A illustrates a scope table **1600**. The term "scope" here refers to an accessible range of resources which can be referenced by an issued authorization token, which constitutes authorization information in the OAuth 2.0 authority delegate protocol. The format of expressing the authorization information does not have to be an authorization token (string of alphanumeric characters). The scope table **1600** includes a scope ID **1601**, scope type **1602**, description **1603** of the scope to be used in a later-described screen example, and authority ID **1604**. Two types of scopes are defined here as the scope type **1602**, owner scope and client scope. An owner scope indicates a resource access range of the authority delegate source (resource owner) in the later-described OAuth 2.0 authority delegate flow. A client scope indicates a resource access range of the authority delegate destination (client) in the later-described OAuth 2.0 authority delegate flow. While the increments of resource access range will be described as being in increments of services in the first embodiment, functions within the service may be further broken down, or conversely, several services may be grouped together as a service group. The resource access range which can be referenced by an authorization token will be referred to as "authority". Applications or services can use functions such as authority delegate source services or service groups by holding a certain authority.

The term "resource owner" as used here differs depending on the OAuth 2.0 flow. More specifically, in a case of an authorization token acquisition flow by Authorization Code Grant, the resource owner is the user. In a case of an authorization token acquisition flow by Client Credentials Grant, the resource owner is the client itself. The authority ID **1604** in the scope table **1600** indicates the authority necessary to access the scope which that scope ID indicates, with which 0 or more authority IDs can be associated. In a case where multiple authority IDs are associated therewith, the resource indicated by the scope can be accessed by having at least one authority of the multiple authority IDs. If zero authority IDs are associated, i.e., if not even one authority ID is associated therewith, this means that anyone can access the resource as long as a subject authenticated regarding this scope.

FIG. **5**B illustrates a user management table **1700**. The user management table **1700** includes a user ID **1701**, password **1702**, and tenant ID **1703**. The authorization server **200** has a function of verifying the set of the information in the user ID **1701** and password **1702**, and generating authentication information if correct, thereby authenticating users. FIG. **5**C is a user authority table **1800**. The user authority table **1800** includes a user ID **1801** and authority ID **1802**. The user ID **1801** and the user ID **1701** of the user management table **1700** are configured so as to be mutually referenced. While the user authority table **1800** and client authority table **1500** are described as separate tables in the present embodiment, these may be managed as a single table in the table column configuration. FIG. **5**D illustrates an authorization token management table **1900**. The authorization token management table **1900** includes an authorization token ID **1901**, token type **1902**, expiration date **1903**, scope ID **1904**, client ID **1905**, and owner ID **1906**. Details of processing regarding the authorization token management table **1900** will be described later.

A sequence according to the present embodiment, relating to client registration through resource acquisition at the application module **800**, will be described with reference to FIG. **6**. This sequence illustrates a flow of a user of a terminal **400** using an application module **800** which is not registered at the authorization server module **600**. An arrangement may be made wherein, for example, client registration at the application module **800** of the terminal **400** only needs to be performed once, and thereafter can be performed from an authorization token acquisition sequence.

First, description will be made regarding the client registration sequence at the application module **800**, with reference to FIG. **6**. In S**1.1**, the application module **800** of the terminal **400** makes a client registration request to the HTTP server module **610** of the authorization server **200**, to register the application module **800** of the usage source of a resource server module **330**. The resource server module **330** is not restricted to one and may be multiple, as described above. Description will be made in the present embodiment in which the trigger for the client registration request of the application module **800** is the timing at which the user first installs the application module **800** in the terminal **400** and starts it up. Other conceivable triggers might include the timing of the user selecting a function of the application module **800**, causing a resource request to the resource

server **300**. Another is where the application module **800** has an explicit start operation, and the user has performed this operation at the terminal **400**. Note that a client registration request includes the client name, and a redirect URL to use Authorization Code Grant. Other information which may be included are a text string to describe the client, a URL of a site which is described, and other like attached information.

The HTTP server module **610** which has received the client registration request from the application module **800** starts SSL/TSL communication negotiation. At this time, the application module **800** is requested to present a certificate, since settings are configured such that client authentication is to be requested for a client registration request. In S**1.2**, the HTTP server module **610** uses a certificate set in a certificate store omitted from illustration, to verify the acquired certificate, and authenticate the application module **800** as the requestor for client registration. While authentication of the requestor for the client registration request is described here as being performed by certificate through SSL/TLS in the present embodiment, other methods using IDs and passwords may be used, such as Basic authentication and Digest authentication. An arrangement may be made where a mechanism to issue an authorization token to an authenticated subject for client registration, and accept client registration by verifying the authorization token, having passed through a mechanism to authenticate these subjects. In a case where authentication fails, the HTTP server module **610** returns an error response to the application module **800**.

In S**1.3**, after having authenticated the application module **800**, the HTTP server module **610** notifies the authorization server module **600** of the client registration request received from the application module **800**. The HTTP server module **610** also notifies the authorization server module **600** of information to identify the authenticated application module **800** at this time. More specifically, the HTTP server module **610** notifies the authorization server module **600** of the information of the acquired certificate. In S**1.4**, the authorization server module **600** obtains the information of the certificate notified thereto by the HTTP server module **610**. In the following S**1.5**, the authorization server module **600** identifies the information in the certificate management table **1200** using the serial No., issuer, and subject in the acquired certificate as a key, and acquires information of the tenant master DN **1206**. The start date **1204** and end date **1205** may also be used as a valid period for verification. In a case where there is no record in the certificate management table **1200**, or verification of the valid period fails, the authorization server module **600** returns an error response to the application module **800** via the HTTP server module **610**.

Next, in S**1.6** the authorization server module **600** acquires the tenant ID **1303** from the client management table **1300** using the acquired tenant master DN **1206** as a key. The authorization server module **600** then acquires the default authority ID **1402** from the default authority management table **1400**, using the acquired tenant ID **1303** as a key. There may be cases where multiple default authority IDs **1402** are acquired. In a case where there is none registered in the default authority management table **1400**, later-described registration to the client authority table **1500** is not performed. Accordingly, authority associated with the authentication information which the application module **800** that is the client transmits, is granted to the application module **800**.

In S**1.7**, the authorization server module **600** newly registers the client in the client management table **1300**, based on the acquired information. More specifically, the authorization server module **600** issues a client ID and secret, creates a DN, and stores these in the client ID **1301**, client secret **1302**, and DN **1305**. The authorization server module **600** also stores the acquired client name, redirect URL, and tenant ID identified from the tenant master DN **1206**, in the client name **1306**, redirect URL **1307**, and tenant ID **1303**. The type **1304** is set to general at this time. In S**1**.**8** the authorization server module **600** stores the issued and registered client ID and the default authority ID acquired form the default authority management table **1400** in the client authority table **1500**. If multiple default authority IDs have been acquired, multiple records will be stored.

After this registration has been completed, in S**1**.**9** the authorization server module **600** returns the issued client ID and secret to the application module **800** via the HTTP server module **610**, thus ending the flow of client registration. This sequence enables online registration of clients to be performed such that the application module **800** is identified, and appropriate authority is granted.

Next, authorization token acquisition through usage of the authorization token to acquire a resource at the application module **800** will be described with reference to FIG. **6**. Note that in FIG. **6**, "Ref" indicates a reference, meaning that this will be described with reference to another drawing. "Alt" indicates a branch, meaning that this is a branch according to results upstream in the sequence.

In S**1**.**10**, the application module **800** starts authorization token acquisition. The trigger for starting the authorization token acquisition may be the timing at which the user starts the application module **800** at the terminal **400**. Another conceivable trigger is where the application module **800** has an explicit start operation, and the user has performed this operation at the terminal **400**. The authorization token issuing processing is carried out following the flow defined in OAuth 2.0. Cases of Authorization Code Grant and Client Credentials Grant will be described in the present embodiment. A case of authorization token issuing processing according to Authorization Code Grant will be described later with reference to FIGS. **7** through **8**C. A case of authorization token issuing processing according to Client Credentials Grant will be described later with reference to FIG. **9**. In S**1**.**11**, the application module **800** acquires an authorization token by way of authorization token acquisition flow. In S**1**.**12**, the application module **800** makes a resource request to the resource server module **700** using the acquired authorization token. The resource server module **700** then receives the request and transmits a response via the HTTP server module **710** which is omitted from illustration in FIG. **6**.

In S**1**.**13**, the resource server module **700** makes an authorization token verification request to the authorization server module **600**. While description will be made here regarding the communication between the resource server module **700** and the authorization server module **600** being carried out over the LAN **101** in the present embodiment, a configuration may be made where this is carried out over the WAN **100**. In this case, communication is carried out through the HTTP server modules **610** and **710**. The authorization token verification processing performed when the authorization token verification request is accepted at the authorization server module **600** will be described later with reference to FIG. **10**.

In S**1**.**14**, the resource server module **700** receives an authorization token verification response from the authorization server module **600**. In the event that the verification result is valid, in S**1**.**15** resource acquisition processing is performed. The acquired resource is then returned to the application module **800** in S**1**.**16**, and the processing ends. On the other hand, in a case where the authorization token verification response result is invalid, an error response is returned to the application module **800** n S**1**.**17**, and the processing ends, thus ending the flow of authorization token acquisition through resource acquisition using the authorization token at the application module **800**.

Next, authorization token issuing processing in a case of Authorization Code Grant in OAuth 2.0 will be described with reference to FIGS. **7** through **8**C. In S**2**.**1**, the application module **800** makes an authorization request to the HTTP server module **610** via the Web browser **820**. Note that settings are made at the HTTP server module **610** so that the endpoint accepting the authorization request is to request user authorization, not client authorization. An authorization request includes one or more scope IDs, including at least client ID acquired as the result of client registration, registered redirect URL, and at least one owner scope indicating the intended resource range. The resource intended for acquisition i.e., the authority which the application module **800** requests, differs depending on which function of the application module **800** the user has selected. For example, if the user has selected secure printing, this requires the security function and the printing function which the resource server provides, so the two authorities need to be requested accordingly.

In S**2**.**2**, the HTTP server module **610** accepts the authorization request. In S**2**.**3**, the HTTP server module **610** returns a login screen, which is an authentication screen, to the Web browser **820** so as to authenticate the user. FIG. **8**A is an example of a login screen **2000** which the HTTP server module **610** returns. In the present embodiment, the user inputs the user ID and password, and authentication is made in a case where this set matches a set of information registered in the user management table **1700**. Note that user authentication is not restricted to this arrangement, and other ways of user authentication may be used, such as an X.509 certificate, multi-step authentication where passwords are input multiple times, or the like. The login screen **2000** illustrated in FIG. **8**A includes a user ID entry field **2001** to input a user ID, a password entry field **2002** to input a password, and a login button **2003** to execute the login operation.

In S**2**.**4**, the user inputs necessary information in the login screen **2000** illustrated in FIG. **8**A which is displayed on the Web browser **820**, and presses the login button **2003**. In S**2**.**5**, the Web browser **820** transmits the input information to the HTTP server module **610**. In S**2**.**6**, the HTTP server module **610** acquires the user ID and password, and verifies these by comparing with the information set of user ID **1701** and password **1702** in the user management table **1700**, thus authenticating the user. In a case where the user authentication fails, i.e., in a case where the acquired information is not registered in the user management table **1700**, the HTTP server module **610** returns an authentication error screen, omitted from illustration, to the Web browser **820**. In a case where user authentication is successful, the HTTP server module **610** generates an authentication token. This authentication token is saved in nonvolatile memory of the HTTP server module **610**, correlated with the user ID. In S**2**.**7**, the HTTP server module **610** notifies the authorization server module **600** of the authorization request received from the application module **800**. This notification is made with the generated authentication token attached.

In S**2**.**8** the authorization server module **600** verifies whether the set of client ID and redirect URL in the authorization request which it has received is correct. Specifically, the authorization server module **600** verifies whether the set of the client ID **1301** and the redirect URL **1307** registered in the client management table **1300** is correct. In the case of a non-match, the authorization server module **600** returns an error screen, omitted from illustration, to the Web browser **820** via the HTTP server module **610**. If matching, the authorization server module **600** acquires user information in S**2**.**9**. More specifically, the authorization server module **600** acquires an associated user ID from the HTTP server module **610**, using the authentication token notified thereto from the HTTP server module **610**. The authority ID **1802** is then obtained from the user authority table **1800** based on this user ID. The number of authority IDs **1802** acquired here may be none, one, or multiple. While an example has been described in the present embodiment where user information acquisition is performed by the authorization server module **600** acquiring the user ID based on the authentication token and then obtaining user information, but user information acquisition is not restricted thusly. For example, an arrangement may be made where necessary user information is notified from the HTTP server module **610**, or where necessary user information is acquired by handing the authentication token to the HTTP server module **610**.

In S**2**.**10**, the authorization server module **600** acquires, of the scopes included in the authorization request, the authority ID **1604** for each owner scope from the scope table **1600** with the owner scope ID as a key. In S**2**.**11** the authorization server module **600** verifies whether the authority ID **1604** for each owner scope that has been acquired is included in the authority ID **1802** acquired from the user authority table **1800**. If there are multiple authority IDs **1604** associated to the owner scope ID in the scope table **1600**, the verification is deemed to be valid if at least one of the multiple authority IDs **1604** is set to the user. Of course, an arrangement may be made where verification is deemed to be valid if all of the multiple authority IDs **1604** are set to the user. What is pertinent is that the requested authority is included in the authority defined beforehand. In a case where authority ID associated with the owner scope ID has not been set, a valid result is given regardless of user authority. In a case where an invalid result is given for one or more authority IDs of owner scopes included in the authorization request, in S**2**.**28** the authorization server module **600** returns an authority error to the Web browser **820**. In S**2**.**29**, the Web browser **820** returns the authority error to the application module **800**. More specifically, the authorization server module **600** makes a redirect response to the Web browser **820** so as to redirect the Web browser **820** to the redirect URL acquired in the authorization request. In S**2**.**30**, the application module **800** returns an authority error screen **2300** exemplarily illustrated in FIG. **8**C to the Web browser **820**, and the flow ends.

In a case where a valid result is given for all owner scopes included in the authorization request, the authorization server module **600** returns an authorization confirmation screen **2100** to the Web browser **820** in S**2**.**12**. The authorization confirmation screen **2100** includes an access source display area **2101** which is an area to display the client name **1306** acquired from the client management table **1300**, using the client ID included in the authorization request as a key. The authorization confirmation screen **2100** also includes a scope display area **2102** which is an area to display description **1603** of the scope obtained from the scope table **1600** with the owner scope ID included in the authorization request as a key. The authorization confirmation screen **2100** further includes a permit button **213** for the user to execute

authorization operation of contents of the information listed above, and a decline button **2104** to decline execution. In a case where the user presses the decline button **2104**, the authorization server module **600** returns an authority error to the application module **800** in S**2**.**28**, in the same way as a case where the result of owner authority verification is invalid. Note that such authority error response may be of a configuration of a screen to display on the application module **800** receiving the response, or of a configuration where the contents of the error response can be selected, to change the expression.

In a case where the user has pressed the permit button **2103** on the authorization confirmation screen **2100** in S**2**.**13**, i.e., has performed an authorization operation, the authorization server module **600** is notified in S**2**.**14** via the Web browser **820** that permission has been granted. In S**2**.**15** the authorization server module **600** issues an authorization code. More specifically, the authorization server module **600** issues an authorization token ID, and registers the scope ID and client ID included in the authorization request, and the user ID of the user which has been authenticated and which has granted permit, as the owner ID, in the authorization token management table **1900**. The token type **1902** at this time is authorization code, and the date and time when this authorization code will cease to be valid is registered in the expiration date **1903**. In S**2**.**16** and S**2**.**17** the authorization server module **600** returns an authorization to the application module **800** via the Web browser **820**, with the authorization token ID of the issued authorization code attached thereto. More specifically, the authorization server module **600** makes a redirect response to the Web browser **820** so as to redirect the Web browser **820** to the redirect URL acquired in the authorization request.

In S**2**.**18**, the application module **800** requests the authorization server module **600** for an authorization token. This authorization token request includes at least the acquired authorization code, client ID, secret, and redirect URL transmitted at the time of transmitting the authorization request.

In S**2**.**19** the authorization server module **600** authenticates the client by the set of client ID and secret that has been obtained. More specifically, the authorization server module **600** authenticates the client by verifying whether or not the obtained set of client ID and secret match the set of client ID **1301** and secret **1302** in the client management table **1300**. In a case where the client authentication fails, the authorization server module **600** returns an authentication error response to the application module **800**. If the client authentication is successful, in S**2**.**20** the authorization server module **600** verifies the obtained authorization code.

The authorization code verification involves whether the authorization token ID of the acquired authorization code is registered in the authorization token management table **1900**, and if registered, whether within the range of the expiration date. Further, the authorization server module **600** verifies whether the redirect URL acquired in the authorization token request matches the redirect URL **1307** registered in the client management table **1300** with the client ID **1905** associated with the authorization token ID as a key. In a case where the result of authorization code verification is invalid, the authorization server module **600** returns a token invalid error reply to the application module **800**. In a case where the result of authorization code verification is valid, in S**2**.**21** the authorization server module **600** acquires client information. More specifically, the authorization server module **600** acquires the authority ID **1502** from the client authority table **1500** with the authenticated client ID as a key. At this time, the number of acquired authority IDs **1502** may be none, one or multiple.

In S**2.22**, the authorization server module **600** acquires the scope ID **1904** from the authorization token management table **1900**, with the acquired authorization token ID of the authorization code as a key. Next, the authorization server module **600** acquires the authority ID **1604** of each client scope from the scope table **1600**, with the client scope ID of the acquired scopes as a key. At this time, if no client scope is included in the scope ID acquired from the authorization token management table **1900**, the client authority verification result is valid.

In S**2.23**, the authorization server module **600** verifies whether the authority ID **1604** for each acquired client scope is included in the authority ID **1502** acquired from the client authority table **1500**. In a case where there are multiple authority ID, **1604** associated with the client scope ID in the scope table **1600**, if at least one authority ID of the multiple authority IDs **1604** is set to the client, the result is deemed to be valid. In a case where authority ID associated with the client scope ID has not been set, a valid result is given regardless of client authority. In a case where an invalid result is given for one or more authority IDs of client scopes associated with the authorization code, in S**2.26** the authorization server module **600** returns an authority error to the application module **800**. In S**2.27**, the application module **800** returns the authority error screen **2300** illustrated in FIG. **8**C to the Web browser **820**, and the processing ends.

In a case where a valid result is given for all client scopes associated to the authorization code, in S**2.24** the authorization server module **600** issues an authorization token. More specifically, the authorization server module **600** issues an authorization token ID, and registers the scope ID associated to the authorization code, owner ID, and authenticated client ID, in the authorization token management table **1900**. At this time, the token type **1902** is set to authorization token, and the date and time at which the authorization token expires is registered in the expiration date **1903**. In S**2.24** the authorization server module **600** returns the authorization token ID of the authorization token that has been issued to the application module **800**, and the processing ends. An arrangement may be made where the expiration date of the authorization token is returned as well. An example of not issuing a refresh token to update the authorization token has been described in the present embodiment, but an arrangement may be made where the ID and expiration date of refresh tokens are managed at the authorization token management table **1900**. At this time, a configuration may be made where a refresh token is issue at the same time as issuing the authorization token, and returning the ID of the issued refresh token when returning the authorization token.

Description will now be made regarding authorization token issuing processing in the case of Client Credentials Grant in OAuth 2.0, with reference to FIG. **9**. In S**3.1** the application module **800** requests the authorization server module **600** for an authorization token. This authorization token request includes at least client ID, secret, and at least one owner scope indicating resource range intended for acquisition or range of service to be used.

In S**3.2**, the authorization server module **600** authenticates the client using the set of client ID and secret that has been acquired. More specifically, the authorization server module **600** performs this authentication by verifying whether the set of client ID and secret match the set of client ID **1301** and secret **1302** in the client management table **1300**. In a case of failing client authentication here, the authorization server module **600** returns an authentication error to the application module **800**. If client authentication is successful, in S**3.3** the authorization server module **600** acquires client information. More specifically, the authorization server module **600** acquires the authority ID **1502** from the client authority table **1500** with the authenticated client ID as a key. The number of authority IDs **1502** may be none, one, or multiple.

In S**3.4**, the authorization server module **600** acquires, of the scopes included in the authorization token request, the authority ID **1604** for each owner scope from the scope table **1600** with the owner scope ID as a key. In S**3.5** the authorization server module **600** verifies whether the authority ID **1604** for each owner scope that has been acquired is included in the authority ID **1502** acquired from the client authority table **1500**. At this time, if there are multiple authority IDs **1604** associated with the owner scope ID in the scope table **1600**, the result is deemed to be valid if at least one authority ID of the multiple authority IDs **1604** is set to the client. If no authority ID associated to the owner scope ID is set, the result is deemed to be valid regardless of client authority.

In a case where the result is valid for all owner scopes included in the authorization token request, the flow advances to S**3.6**. In S**3.6**, the authorization server module **600** acquires the authority ID **1604** of each client scope from the scope table **1600**, with the client scope ID of the scopes included in the authorization token request as a key. At this time, if no client scope is included in the scope IDs in the authorization token request, the result of client authority verification is valid. The authorization server module **600** then verifies in S**3.7** whether the acquired authority ID **1604** for each client scope is included in the authority ID **1502** acquired from the client authority table **1500**. At this time, if there are multiple authority IDs **1604** associated with the client scope ID in the scope table **1600**, the result is deemed to be valid if at least one authority ID of the multiple authority IDs **1604** is set to the client. If no authority ID associated to the client scope ID is set, the result is deemed to be valid regardless of client authority.

In a case where, the result of this verification is invalid for one or more authority IDs of the owner scopes and client scopes included in the authorization token request, the flow advances to S**3.10**. In S**3.10**, the authorization server module **600** returns an authority error reply to the application module **800** and the processing ends. In a case where the result is valid for all owner scopes and client scopes included in the authorization token request, in S**3.8** the authorization server module **600** issues an authorization token. More specifically, the authorization server module **600** issues an authorization token ID, and registers the scope ID included in the authorization request, the client ID of the client which has been authenticated, and the client ID as the owner ID, in the authorization token management table **1900**. The token type **1902** at this time is authorization token, and the date and time when this authorization code will cease to be valid is registered in the expiration date **1903**. In S**3.9** the authorization server module **600** returns the authorization token ID of the issued authorization token to the application module **800**, and ends the processing. A configuration may also be made where the expiration date of the authorization token is returned at this time as well.

Next, authorization token verification processing will be described with reference to FIG. **10**. FIG. **10** is a flowchart illustrating the authorization token verification processing executed at the authorization server module **600**. In S**4.1**, the authorization server module **600** is commissioned by the resource server module **700** to verify an authorization token.

This authorization token verification commissioning includes the authorization token ID of the authorization token to be verified, and one or more scope IDs. In S4.**2**, the authorization server module **600** acquires the authorization token ID and scope ID. Next, in S4.**3** the authorization server module **600** acquires information of the authorization token based on the acquired authorization token ID. More specifically, the authorization server module **600** acquires the expiration date **1903** from the authorization token management table **1900** with the authorization token ID and "token type: authorization token" as a key. In S4.**4**, the authorization server module **600** verifies whether or not the authorization token exists in the authorization token management table **1900**, and whether or not the authorization token is yet unexpired. If the verification result is that the authorization token does not exist, or does exist but has expired, the authorization token is determined to be invalid, so in S4.**5** the authorization server module **600** returns a token invalid error, and ends the processing. If the verification finds that the authorization token exists and is still valid, the processing continues.

In S4.**6** the authorization server module **600** obtains scope information included in the verification commission. More specifically, the authorization server module **600** acquires the type **1602** and authority ID **1604** of each scope in the scope table **1600** with the scope ID as the key. In S4.**7**, whether one or more owner scope is included in the type **1602** of the one or multiple scopes acquired, is confirmed. If none, the flow advances to S4.**11**. If there is one or more included, in S4.**8** the authorization server module **600** acquires owner information. More specifically, the authorization server module **600** acquires owner ID **1908** from the authorization token management table **1900** with the authorization token ID as a key. The authorization server module **600** then acquires the authority ID **1502** and authority ID **1802** from the client authority table **1500** and user authority table **1800** respectively, with the acquired owner ID as a key. The number of authority IDs **1502** acquired here may be none, one, or multiple.

Next, in S4.**9** the authorization server module **600** performs authority verification of the owner scope acquired in S4.**6**. More specifically, the authorization server module **600** acquires the authority ID **1604** of each owner scope from the scope table **1600** with the owner scope ID acquired in S4.**6** as a key. The authorization server module **600** then verifies each authority ID **1604** of each owner scope that has been acquired regarding whether included in the authority ID **1502** acquired in S4.**8**, or the authority ID **1802**. At this time, if there are multiple authority IDs **1604** associated with the owner scope ID in the scope table **1600**, the result is deemed to be valid if at least one authority ID of the multiple authority IDs **1604** is set to the owner. If no authority ID associated to the owner scope ID is set, the result is deemed to be valid regardless of client authority. In a case where the result of verification is invalid for one or more authority ID, in S4.**10** the authorization server module **600** returns an authority error response to the resource server module **700** and ends the processing. In a case where the verification result is that all owner scopes acquired in S4.**6** are valid, the flow advances to S4.**11**.

In S4.**11**, the authorization server module **600** confirms whether the one or multiple scope types **1602** acquired in S4.**6** include at least one client scope. If none, the flow advances to S4.**15**. If there is one or more included, in S4.**12** the authorization server module **600** acquires client information. More specifically, the authorization server module **600** acquires client ID **1907** from the authorization token management table **1900** with the authorization token ID as a key, and acquires the authority ID **1502** from the client authority table **1500** with the acquired client ID as a key. The number of authority IDs **1502** acquired here may be none, one, or multiple.

Next, in S4.**13**, the authorization server module **600** authority verification of the client scope acquired in S4.**6**. More specifically, the authorization server module **600** acquires the authority ID **1604** of each client scope from the scope table **1600** with the client scope ID acquired in S4.**6** as a key. The authorization server module **600** then verifies each authority ID **1604** of each client scope that has been acquired regarding whether included in the authority ID **1502** acquired in S4.**12**. At this time, if there are multiple authority IDs **1604** associated with the client scope ID in the scope table **1600**, the result is deemed to be valid if at least one authority ID of the multiple authority IDs **1604** is set to the client. If no authority ID associated to the owner scope ID is set, the result is deemed to be valid regardless of client authority. In a case where the result of verification is invalid for one or more authority ID, in S4.**14** the authorization server module **600** returns an authority error response to the resource server module **700** and ends the processing.

In a case where the result of verification is valid for all client scopes obtained in S4.**6**, the flow advances to S4.**15**. In S4.**15** the authorization server module **600** returns to the resource server module **700** that the authority is valid as a result of the authorization token validation processing, and ends the processing. This sequence enables the resource server module **700** to validate only accesses with proper authority from the application module **800** to be validated, and prevent accesses from unintended application modules **800** to be handled as authority errors.

According to the present embodiment, authority granted to an application module **800** registered online can be granted while identifying the application module **800**. Thus, usage of the resource server module **700** from an unintended application module **800** can be prevented. For example, with regard to a pay service of a resource server module **700**, a certificate enabling the pay services is assembled in the application module **800** (pay application) which can use the pay service beforehand, so only such application modules **800** can use the resource server module **700**.

Second Embodiment

The client registration sequence described in FIG. **6** involved the authorization server module **600** side deciding the authority ID set to the client. However, this processing flow may result in a situation where client registration is successful, but thereafter authority errors occur at the time of making an authorization token issue request. In this case, the client registration process is useless. On the other hand, the client knows the client scope ID specified for an authorization request or authorization token issue request. Accordingly, an arrangement may be made where the client scope to be used is requested at the time of client registration, and if authority is insufficient, a registration error is returned at that point. Thus, useless client registration can be avoided.

A second embodiment which deals with this will be described with reference to FIGS. **11** and **12**. Note that the second embodiment is no different from the first embodiment except for the client registration sequence in FIG. **6**, so description of the same portions will be omitted. Steps which are the same as those in FIG. **6** will also be denoted by the same numerals and description will be omitted.

FIG. **11** illustrates the client registration sequence according to the second embodiment. In S**5**.**1**, the application module **800** of the terminal **400** makes a client registration request to the HTTP server module **610** of the authorization server **200**. Note that the trigger for the client registration request of the application module **800** is the timing at which the user first installs the application module **800** in the terminal **400** and starts it up. Other conceivable triggers include the timing of the user selecting a function of the application module **800**, causing a resource request to the resource server **300**. Another is where the application module **800** has an explicit start operation, and the user has performed this operation at the terminal **400**. Note that a client registration request includes the client name, a redirect URL to use Authorization Code Grant, and client scope ID to specify at the time of an authorization request or authorization token request. Other information which may be included are a text string to describe the client, a URL of a site which is described, and other like attached information.

Next, description of the client authentication processing S**1**.**2** at the HTTP server module **610** upon having accepted the client registration request from the application module **800** will be omitted. In S**5**.**2**, after having authenticated the application module **800**, the HTTP server module **610** notifies the authorization server module **600** of the client registration request received from the application module **800**. At this time, the HTTP server module **610** also notifies the authorization server module **600** of information to identify the authenticated application module **800**. More specifically, the HTTP server module **610** notifies the authorization server module **600** of information of the acquired certificate. After S**1**.**4**, S**1**.**5**, and S**1**.**6**, the authorization server module **600** acquires the default authority ID **1402**. Details are as described earlier.

Next, in S**5**.**3** the authorization server module **600** starts registration authority verification. This registration authority verification will be described with reference to FIG. **12**. FIG. **12** is a flow of the registration authority verification processing at the authorization server module **600**. In S**6**.**1**, the authorization server module **600** accepts a registration authority verification commission. Next, in S**6**.**2**, the authorization server module **600** acquires client scope information regarding which the client registration request has been received. More specifically, the authorization server module **600** acquires the authority ID **1604** from the scope table **1600** with the specified scope ID and "scope type: client scope" as a key. In a case where no client scope is included in the specified scope ID in S**6**.**3**, the flow advances to S**6**.**4**, the default authority ID acquired in S**1**.**6** due to the verification result being valid is returned, and the process ends. In a case where a client scope is included in the specified scope ID, the flow advances to S**6**.**5**.

In S**6**.**5** the authorization server module **600** verifies whether the authority ID **1604** of the acquired client scope is included in the default authority ID acquired in S**1**.**6**. If one or more authority IDs **1604** is not included in the default authority ID, an authority error is returned in S**6**.**6** and the processing ends. In a case where all authority IDs **1604** acquired in S**6**.**2** are included in the default authority ID, in S**6**.**7** the authorization server module **600** returns all authority IDs **1604** acquired in S**6**.**2** since the verification result is valid, and the processing ends.

Returning to FIG. **11**, in S**5**.**4** the authorization server module **600** acquires the results of the registration authority verification processing having ended. If the result is invalid, in S**5**.**6** a client registration error response is returned to the application module **800**. In a case where the registration authority verification result is valid, in S**1**.**7** the authorization server module **600** newly registers the client. Details of the processing are as described earlier. Next, in S**5**.**5** the authorization server module **600** issues a client ID and secret, and stores the registered client ID and authority ID obtained as the result of the registration authority verification in the client authority table **1500**. In a case where multiple authority IDs have been acquired, multiple records will be stored. After this registration has been completed, in S**1**.**9** the authorization server module **600** returns the issued client ID and secret to the application module **800** via the HTTP server module **610**. This ends description of the client registration according to the second embodiment.

According to the above-described processing, the authorization server module **600** accepts a request for a scope to be used at the time of client registration, and if the authority thereof is insufficient, and perform processing to return a registration error at that point. Thus, useless client registration can be avoided.

Other Embodiments

The embodiments of the present invention have been described by way of examples of pay services, free services, pay applications, and free applications. However, services and applications are not necessarily restricted to these. Any sort of services and applications may be used, as long an application registration protocol can be restricted in authority delegate processing so that a particular application does not unnecessarily access a particular service.

Also, the embodiments of the present invention have been described with regard to a method of authority delegate in processing between an application in a terminal and a service on the Internet. However, this is not restricted to applications in terminals, and may also be applied to server-type services connected over the Internet. Accordingly, in the present embodiment, subject of the source of coordination is called "service".

The present invention is realized by executing the following processing. Software (program) realizing the functions of the above-described embodiments is supplied to a system or device via network or various types of storage media, and a computer (or CPU or MPU) of the system or device reads and executes the program.

Other Embodiments

Embodiments of the present invention can also be realized by a computer of a system or apparatus that reads out and executes computer executable instructions recorded on a storage medium (e.g., non-transitory computer-readable storage medium) to perform the functions of one or more of the above-described embodiment(s) of the present invention, 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). The computer may comprise one or more of a central processing unit (CPU), micro processing unit (MPU), or other circuitry, and may include a network of separate computers or separate computer processors. 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.

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.

This application claims the benefit of Japanese Patent Application No. 2013-130857, filed Jun. 21, 2013, which is hereby incorporated by reference herein in its entirety.

What is claimed is:

1. An authority delegate system, including a provider server system which provides a service to a device having an application, and an authorization server system which performs authorization processing to delegate user authority in the service to a usage source of the service, the authority delegate system comprising:

at least one processor coupled to a memory;

a management unit of the authorization server system configured to receive a request from the device to register the application as the usage source of the service, to identify authority of the application in accordance with the received request, and to manage, in an associated manner, an identifier of the application and the identified authority; and

a providing unit of the provider server system configured to provide the service in a case where

(i) an authorization operation has been performed to permit delegating the user authority to the application that will be transmitting a request to use the service, and

(ii) the management unit issues an authorization code to the application in response to permitting delegating the user authority to the application, and

(iii) the issued authorization code is received by the providing unit from the application, wherein a scope identification (ID) is acquired based on the authorization code, and

(iv) a range authorization ID, identified by the acquired scope ID, is included in range authorization IDs set in the application,

wherein the management unit and the providing unit are implemented by the at least one processor.

2. The authority delegate system according to claim **1**, wherein the management unit receives authentication information of the application along with the request to register the application as the usage source, and identifies the authority of the application based on the received authentication information.

3. The authority delegate system according to claim **1**,

wherein an authentication screen is provided to input authentication information of the user, and the authority of the user is identified based on the authentication information input by way of the authentication screen, and

wherein the providing unit provides the service in a further case where the authority which the application uses is included within the identified authority of the user.

4. The authority delegate system according to claim **3**,

wherein, in a case where the authorization operation to permit delegating the user authority to the application transmitting a request to use the service has not been performed, an error response is transmitted,

wherein, in a case where an authority which the application uses is not included in authorities associated with the identifier of the application, an error response is transmitted, or

wherein, in a case where the authority which the application uses is not included within the identified authority of the user, an error response is transmitted.

5. The authority delegate system according to claim **1**,

wherein the management unit receives information of the authority which the application uses and authentication information of the application along with the request to register the application as the usage source,

wherein, in a case where the authority that the application uses is included within the authority of the application identified based on the authentication information of the application, the management unit manages the identified authority and the identifier of the application in an associated manner, and

wherein, in a case where the authority that the application uses is not included within the authority of the application identified based on the authentication information of the application, the management unit does not register the application but instead transmits an error response.

6. The authority delegate system according to claim **1**, wherein the identified authority of the application differs depending on a certificate that the application transmits.

7. The authority delegate system according to claim **1**, wherein, in response to a user installing and then starting the application in the device, the management unit receives the request from the device to register the application as the usage source of the service.

8. The authority delegate system according to claim **1**, wherein, authority associated with the authentication information which the application transmits, is granted by the management unit of the authorization server system to the application module.

9. The authority delegate system according to claim **8**, wherein the management unit obtains a tenant master distinguished name (DN) based on the authentication information and uses the tenant master DN to obtain a tenant identification (ID), wherein the management unit uses the tenant ID to obtain the authority associated with the authentication information.

10. The authority delegate system according to claim **1**, wherein the device is at least one of a smartphone, a portable terminal, and an image formation apparatus.

11. The authority delegate system according to claim **1**, wherein the authorization server system is configured to be in communication with a database server and the authorization server, the provider server system, and database server are configured on the same server.

12. A control method to control an authority delegate system, including a provider server system which provides a service to a device having an application, and an authorization server system which performs authorization processing to delegate user authority in the service to a usage source of the service, the control method comprising:

in a management unit of the authorization server system, receiving a request from the device to register the application as the usage source of the service, identifying authority of the application in accordance with the received request, and managing, in an associated manner, an identifier of the application and the identified authority; and

providing, via a providing unit of the provider server system, the service in a case where

(i) an authorization operation has been performed to permit delegating the user authority to the application that will be transmitting a request to use the service, and

(ii) the management unit issues an authorization code to the application in response to permitting delegating the user authority to the application, and

(iii) the issued authorization code is received by the providing unit from the application, wherein a scope identification (ID) is acquired based on the authorization code, and

(iv) a range authorization ID, identified by the acquired scope ID, is included in range authorization IDs set in the application.

13. A non-transitory computer-readable storage medium storing a program to cause an authority delegate system to perform a control method, wherein the authority delegate system includes a provider server system which provides a service to a device having an application, and an authorization server system which performs authorization processing to delegate user authority in the service to a usage source of the service, the control method comprising:

in a management unit of the authorization server system, receiving a request from the device to register the application as the usage source of the service, identifying authority of the application in accordance with the received request, and managing, in an associated manner, an identifier of the application and the identified authority; and

providing, via a providing unit of the provider server system, the service in a case where

(i) an authorization operation has been performed to permit delegating the user authority to the application that will be transmitting a request to use the service, and

(ii) the management unit issues an authorization code to the application in response to permitting delegating the user authority to the application, and

(iii) the issued authorization code is received by the providing unit from the application, wherein a scope identification (ID) is acquired based on the authorization code, and

(iv) a range authorization ID, identified by the acquired scope ID, is included in range authorization IDs set in the application.

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