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(54) **SECURE NETWORK RESOURCE ACCESS SYSTEM**

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(57) **ABSTRACT**

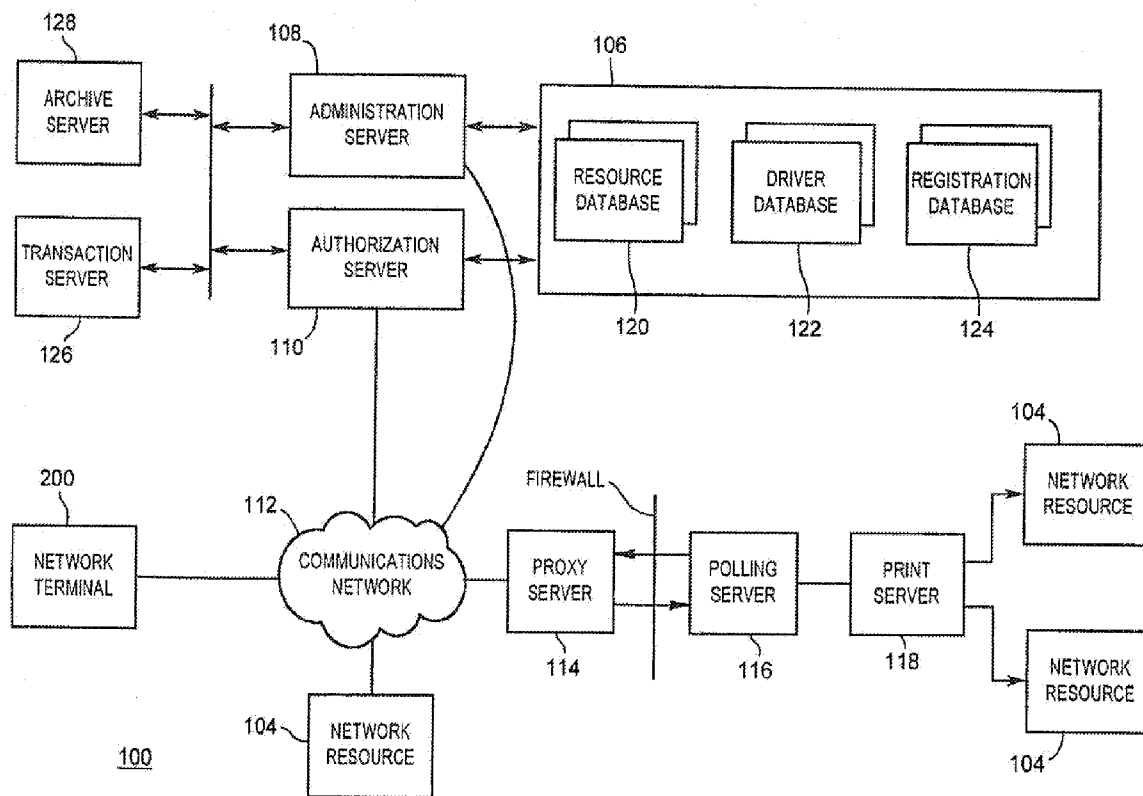
A secure network resource access system facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server, to receive application data and associated network resource data from the proxy server in response to the poll, and to direct the application data to one of the network resources in accordance with the associated network resource data.

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Related U.S. Application Data

(63) Continuation of application No. 09/926,436, filed on Jan. 18, 2002, now Pat. No. 7,827,293, filed as application No. PCT/CA01/00235 on Mar. 1, 2001.



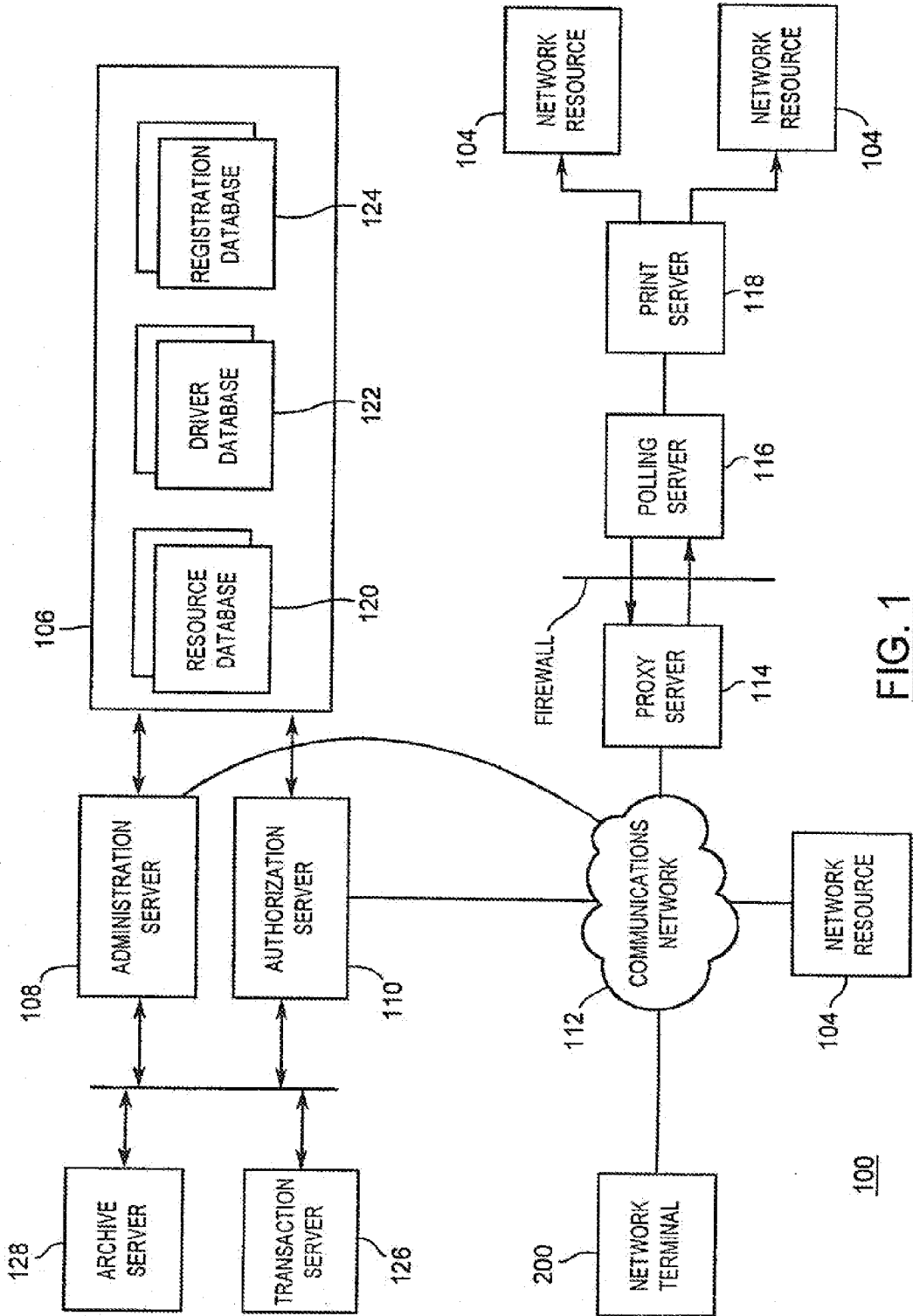


FIG. 1

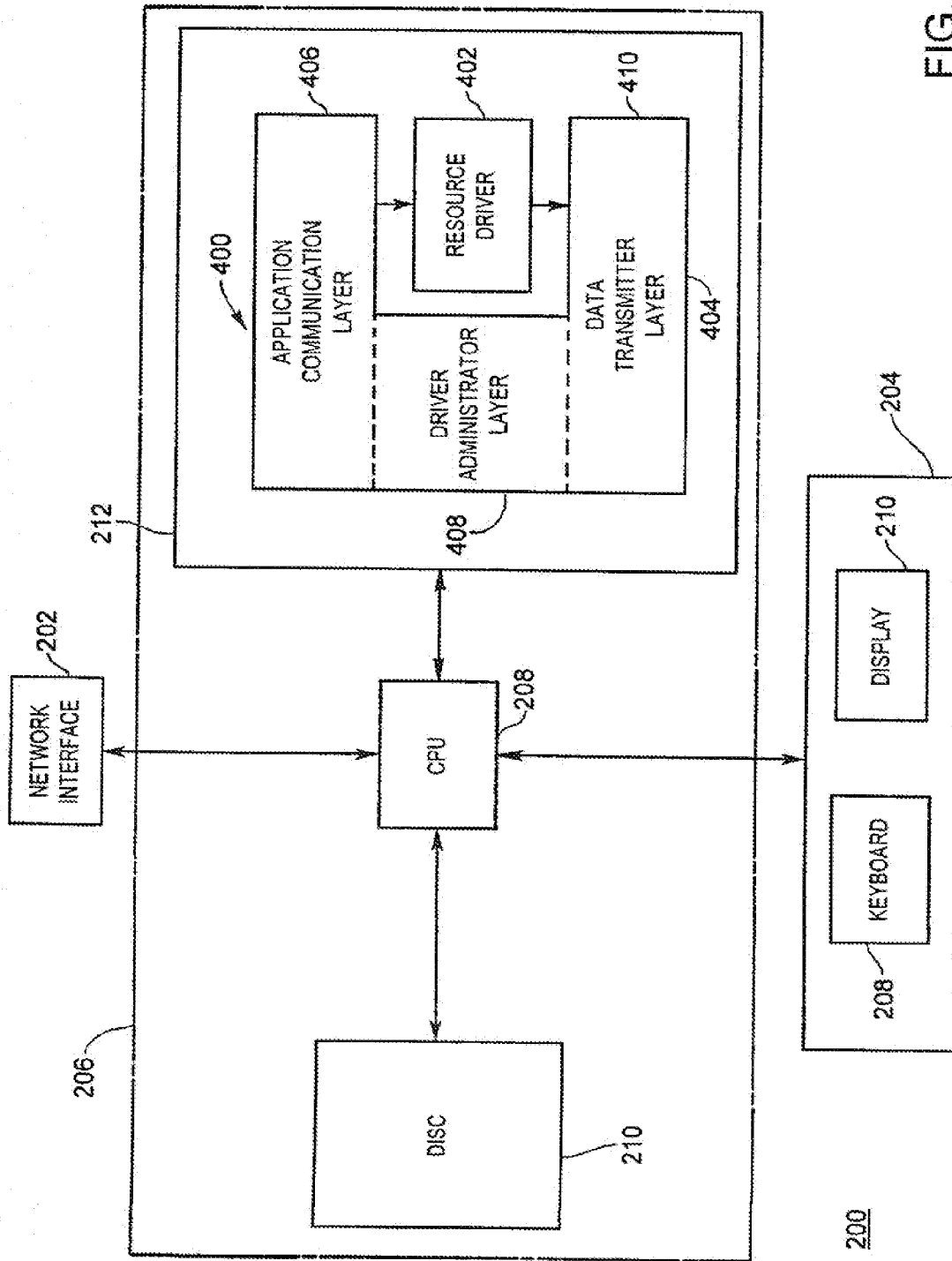


FIG. 2

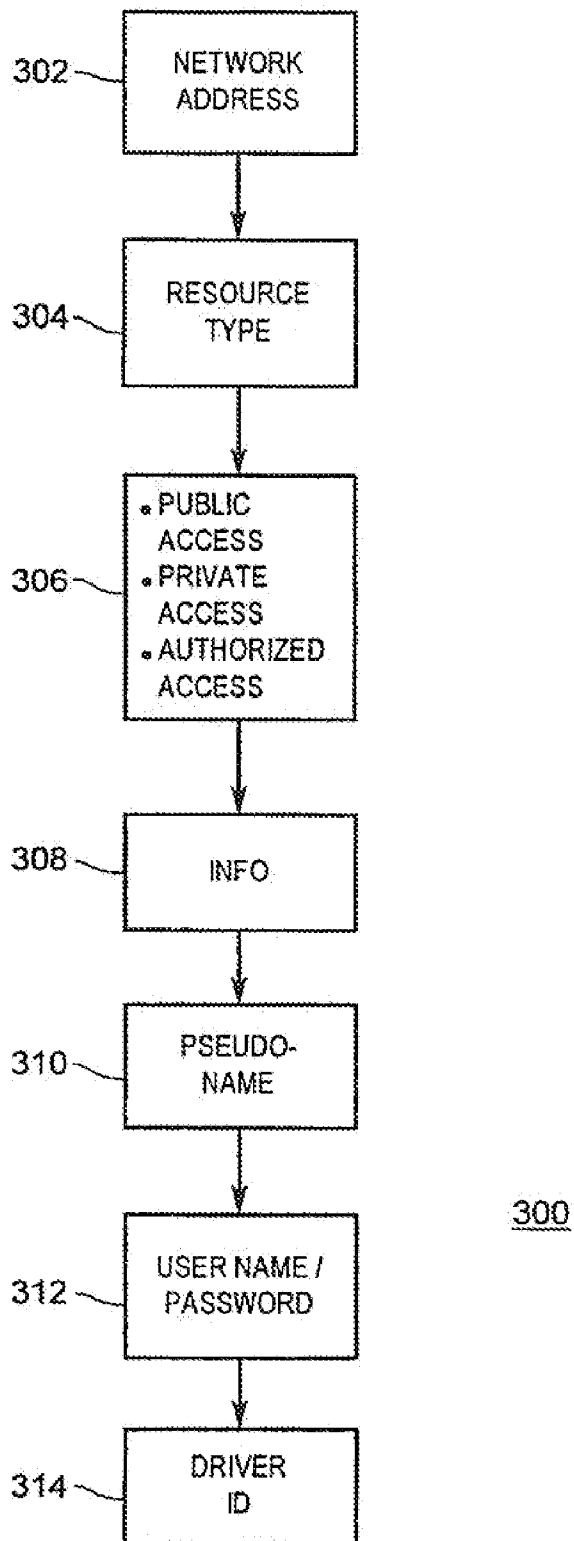


FIG. 3

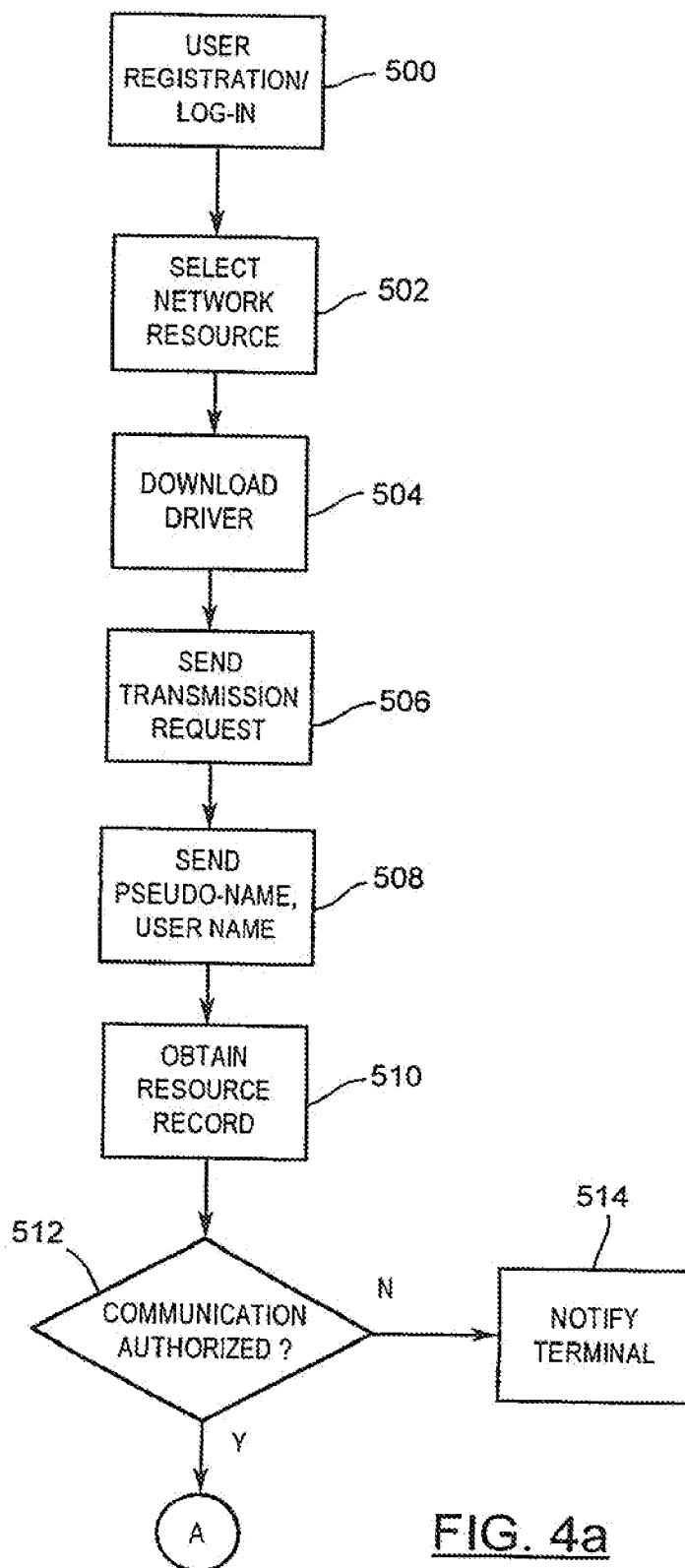


FIG. 4a

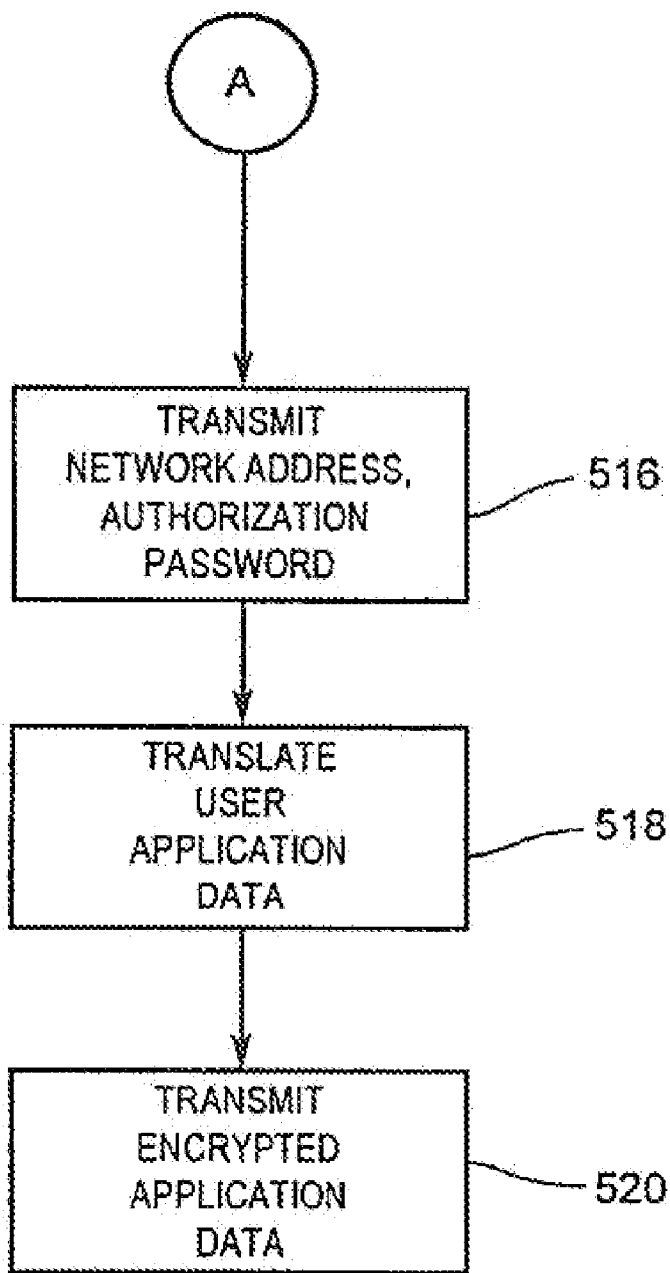


FIG. 4b

SECURE NETWORK RESOURCE ACCESS SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of earlier filed nonprovisional application having application Ser. No. 09/926,436 filed Jan. 18, 2002, now U.S. Pat. No. _____, issued _____, which in turn is a National Entry of International Application No. PCT/CA01/00235 filed Mar. 1, 2001, which claims priority to Canadian Application No. 2,299,824 filed Mar. 1, 2000. The disclosure of application Ser. No. 09/926,436 is hereby incorporated by reference in its entirety.

FIELD OF THE INVENTION

[0002] The present invention relates to a method and system for network management system. In particular, the present invention relates to a method and system for providing secure access to network resources.

BACKGROUND OF THE INVENTION

[0003] Local area networks are widely used as a mechanism for making available computer resources, such as file servers, scanners, and printers, to a multitude of computer users. It is often desirable with such networks to restrict user access to the computer resources in order to manage data traffic over the network and to prevent unauthorized use of the resources. Typically, resource access is restricted by defining access control lists for each network resource. However, as the control lists can only be defined by the network administrator, it is often difficult to manage data traffic at the resource level.

[0004] Wide area networks, such as the Internet, have evolved as a mechanism for providing distributed computer resources without regard to physical geography. Recently, the Internet Print Protocol ("IPP") has emerged as a mechanism to control access to printing resources over the Internet. However, IPP is replete with deficiencies.

[0005] First, as IPP-compliant printing devices are relatively rare, Internet printing is not readily available.

[0006] Second, although IPP allows user identification information to be transmitted to a target resource, access to IPP-compliant resources can only be changed on a per-resource basis. This limitation can be particularly troublesome if the administrator is required to change permissions for a large number of resources.

[0007] Third, users must have the correct resource driver and know the IPP address of the target resource before communicating with the resource. Therefore, if the device type or the IPP address of the target resource changes, users must update the resource driver and/or the IPP address of the resource. Also, if a user wishes to communicate with a number of different resources, the user must install and update the resource driver and IPP address for each resource as the properties of each resource changes.

[0008] Fourth, access to IPP printers cannot be obtained without the resource administrator locating the resource outside the enterprise firewall, or without opening an access port through the enterprise firewall. Whereas the latter solution provides the resource administrator with the limited ability to restrict resource access, the necessity of opening an access port in the enterprise firewall exposes the enterprise network to the possibility of security breaches.

[0009] Consequently, there remains a need for a network resource access solution which allows resource owners to easily and quickly control resource access, which is not hindered by changes in device type and resource network address, which facilitates simultaneous communication with a number of target resources, and which does not expose the enterprise network to a significant possibility of security breaches.

SUMMARY OF THE INVENTION

[0010] According to the invention, there is provided a secure network resource access system and a method of secure network resource access which addresses at least one deficiency of the prior art network resource access systems.

[0011] The secure network resource access system, according to the present invention facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises a proxy server and a polling server. The proxy server is located logically outside the enterprise firewall for receiving application data from the network terminals. The polling server is located logically behind the enterprise firewall, and is configured to poll the proxy server to initiate transmission of the received application data from the proxy server to the polling server.

[0012] The secure network resource access method, according to the present invention, facilitates network access by network terminals to network resources located behind an enterprise firewall, and comprises the steps of (1) polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources; (2) receiving application data and associated network resource data from the proxy server in response to the polling step; and (3) directing the application data to one of the network resources in accordance with the associated network resource data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The preferred embodiment of the invention will now be described, by way of example only, with reference to the drawings, in which:

[0014] FIG. 1 is a schematic view of the network resource access system, according to the present invention, showing the network terminals, the network resources, the resource registry, the authorization server, the administration server, the proxy server, and the polling server;

[0015] FIG. 2 is a schematic view one of the network terminals depicted in FIG. 1, showing the driver application for use with the present invention;

[0016] FIG. 3 is a schematic view of the format of the resource records comprising the resource database of the resource registry depicted in FIG. 1, showing the network address field, the resource type field, the user access level field, the resource information field, the pseudo-name field, the username/password field, and the driver identification field; and

[0017] FIG. 4 is a flow chart depicting the method of operation of the network resource access system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0018] Turning to FIG. 1, a network resource access system, denoted generally as 100, is shown comprising a network terminal 200, a network resource 104, a resource regis-

try 106, an administration server 108, and an authorization server 110. Typically, the network resource access system 100 comprises a plurality of network terminal 200, and a plurality of network resources 104, however for enhanced clarity of discussion, FIG. 1 only shows a single network terminal 200 and a single network resource 104.

[0019] The network resource access system 100 also includes a communications network 112 facilitating communication between the network terminals 200, the network resources 104, the administration server 108, and the authorization server 110. Preferably, the communications network 112 comprises a wide area network such as the Internet, however the network 112 may also comprise a local area network. Further, the network 112 need not be a land-based network, but instead may comprise a wireless network and/or a hybrid of a land-based network and a wireless network for enhanced communications flexibility.

[0020] Each network terminal 200 typically comprises a land-based network-enabled personal computer. However, the invention is not limited for use with personal computers. For instance, one or more of the network terminals 200 may comprise a wireless communications device, such as a wireless-enabled personal data assistant, or e-mail-enabled wireless telephone if the network 112 is configured to facilitate wireless data communication. In addition, the invention is not limited to only facilitating transmission of text data, but instead may be used to transmit image data, audio data or multimedia data, if desired.

[0021] As shown in FIG. 2, the network terminal 200 comprises a network interface 202, a user interface 204, and a data processing system 206 in communication with the network interface 202 and the user interface 204. Typically, the network interface 202 comprises an Ethernet network circuit card, however the network interface 202 may also comprise an RF antenna for wireless communication over the communications network 112. Preferably, the user interface 204 comprises a data entry device 208 (such as keyboard, microphone or writing tablet), and a display device 210 (such as a CRT or LCD display).

[0022] The data processing system 206 includes a central processing unit (CPU) 208, and a non-volatile memory storage device (DISC) 210 (such as a magnetic disc memory or electronic memory) and a read/write memory (RAM) 212 both in communication with the CPU 208. The DISC 210 includes data which, when loaded into the RAM 212, comprise processor instructions for the CPU 208 which define memory objects for allowing the network terminal 200 to communicate with the network resources 104 and the authorization server 110 over the communications network 112. The network terminal 200, and the processor instructions for the CPU 208 will be discussed in greater detail below.

[0023] Typically, each network resource 104 comprises a printing device, and in particular, an IPP-compliant printer. However, the invention is not limited for use with networked printers (IPP-compliant or otherwise), but instead can be used to provide access to any of a variety of data communication devices, including facsimile machines, image servers and file servers. Further, the invention is not limited for use with land-based data communications devices, but instead can be used to provide access to wireless communications devices. For instance, the network resource access system 100 can be configured to facilitate data communication with e-mail pagers or e-mail enabled wireless telephones.

[0024] It is expected that some of the network resources 104 may be located behind an enterprise firewall. Accordingly, to facilitate communication between network terminals 200 and firewall-protected network resources 104, the network resource access system 100 may also include a proxy server 114 located logically outside the enterprise firewall, and a polling server 116 located logically within the firewall, as shown in FIG. 1. Preferably, the proxy server 114 is located on-site at the enterprise responsible for administering the network resource 104, is provided with a network address corresponding to the enterprise, and includes a queue for receiving application data. However, the proxy server 114 may also be located off-site, and may be integrated with the authorization server 110 if desired. This latter option is advantageous since it allows system administrators to provide access to network resources 104, but without having to incur the expense of the domain name registration and server infrastructure.

[0025] In addition to the proxy server 114 and the polling server 116, preferably the enterprise includes an enterprise server 118 (e.g. a print server) to facilitate communication with the network resources 104 located behind the firewall. The polling server 116 is in communication with the enterprise server 118, and is configured to periodically poll the proxy server 114 through the firewall to determine whether application data from a network terminal 200 is waiting in the queue of the proxy server 114. The proxy server 114 is configured to transmit any queued application data to the polling server 116 in response to the poll signal from the polling server 116. Upon receipt of the queued application data from the proxy server 114, the polling server 116 transmits the application to the enterprise server 118 for distribution to the appropriate network resource 104. As will be apparent, this mechanism allows application data to be transmitted to network resources 104 located behind a firewall, but without exposing the enterprise to the significant possibility of security breaches associated with firewall access ports.

[0026] The resource registry 106 comprises a resource database 120, a driver database 122, and a user registration database 124. The resource database 120 includes resource records 300 identifying parameters associated with the network resources 104. As shown in FIG. 3, each resource record 300 comprises a network address field 302, a resource type field 304, and a user access level field 306 for the associated network resource 104. The network address field 302 identifies the network address of the network resource 104. As discussed above, typically each network resource 104 comprises an IPP-compliant printer, in which case the network address field 302 identifies comprises the network resource IPP address. However, in the case where the network resource 104 comprises a non-IPP-compliant device and the communications network 112 comprises the Internet, preferably the network resource 104 is linked to the communications network 112 via a suitable server, and the network address field 302 for the network resource 104 identifies the Internet Protocol ("IP") address of the server.

[0027] The resource type field 304 identifies the type of data communication device of the network resource 104. For instance, the resource type field 304 may specify that the network resource 104 is a printer, an image server, a file server, an e-mail pager, or an e-mail enabled wireless telephone. Further, the resource type field 304 may include a resource type sub-field specifying a sub-class of the network resource type. For example, the resource type sub-field may

specify that the network resource **104** is an IPP-capable printer, or a non-IPP-capable printer.

[0028] The user access level field **306** identifies the type of communications access which the network terminals **200** are allowed to have in regards to the associated network resource **104**. In the embodiment, as presently envisaged, the user access level field **306** establishes that the network resource **104** allows one of:

[0029] (a) “public access” in which any network terminal **200** of the network resource access system **100** can communicate with the network resource **104**;

[0030] (b) “private access” in which only members (e.g. employees) of the enterprise associated with the network resource **104** can communicate with the network resource **104**; and

[0031] (c) “authorized access” in which only particular network terminals **200** can communicate with the network resource **104**.

[0032] If the user access level field **306** specifies “authorized access” for a network resource **104**, preferably the user access level field **306** includes a sub-field which lists the names of the network terminals **200** authorized to access the network resource **104**, and a sub-field which includes an authorization password which the identified network terminals **200** must provide in order to access the network resource **104**. If the user access level field **306** specifies “private access” for a network resource **104**, preferably the user access level field **306** includes a sub-field which lists the network address of the network terminals **200** which are deemed to members of the enterprise.

[0033] It should be understood, however, that the user access level field **306** is not limited to identifying only the foregoing predefined user access levels, but may instead identify more than one of the predefined user access levels, or other user access levels altogether. For instance, the user access level field **306** may identify that the associated network resource **104** allows both private access to all employees of the enterprise running the network resource **104**, and authorized access to other pre-identified network terminals **200**. Further, the user access level field **306** may also include one or more sub-fields (not shown) which provide additional restrictions/permissions on the type of communications access which the network terminals **200** are allowed to have in regards to the associated network resource **104**. For instance, the user access level sub-fields may limit the hours of operation of the network resource **104**, or may place restrictions on the type of access limitations on a per-user basis, or per-group basis. Other variations on the type of access will be readily apparent, and are intended to be encompassed by the scope of the present invention.

[0034] Preferably, each resource record **300** includes an information field **308** which provides information on the network resource **104**, such as data handling capabilities, resource pricing and geographical co-ordinates. This latter parameter is particularly advantageous for use with mobile network terminals **200**, such as a wireless-enabled personal data assistant or an e-mail-enabled wireless telephone, since it allows the network terminal **200** to identify the nearest one of a plurality of available network resources **104**. This aspect of the invention will be explained in greater detail below.

[0035] Each resource record **300** also includes a pseudo-name field **310**, a username/password field **312** and a network driver identifier field **314**. The pseudo-name field **310** contains a resource pseudo-name which identifies the network

resource **104** to the network terminals **200**. Preferably, the pseudo-name is a network alias that identifies the physical location and properties of the network resource **104**, but does not identify the network address of the resource **104**. Further, preferably each pseudo-name uniquely identifies one of the network resources **104**, however a group of the network resources **104** may be defined with a common pseudo-name to allow communication with a group of network resources **104**. This latter feature is particularly advantageous since it allows the administrator of an enterprise associated with the group of network resources to dynamically allocate each network resource **104** of the group as the demands for the network resources **104** or maintenance schedules require.

[0036] In addition, preferably the resource record **300** includes a plurality of the pseudo-name fields **310** to allow the administrator of the associated network resource **104** to update the name assigned to the network resource **104**, while also retaining one or more previous pseudo-names assigned to the network resource **104**. As will be explained, this feature is advantageous since it allows the administrator to update a resource name without the risk that network terminals **200** using a prior pseudo-name will be unable to locate or communicate with the network resource **104**.

[0037] The username/password field **312** contains a unique username and password combination which allows the administrator of the associated network resource **104** to prevent authorized access and alteration to the data contained in the resource record **300**. Preferably, each resource record **300** also includes an e-mail address field (not shown) which the network resource access system **100** uses to provide the administrator of the associated network resource **104** with a notification e-mail message when a message is successfully transmitted to the network resource **104**.

[0038] The driver identifier field **314** contains a resource driver identifier which is used in conjunction with the driver database **122** to provide the network terminals **200** with the appropriate resource driver for communication with the network resource **104**. The driver database **122** includes resource drivers which allow software applications installed on the network terminals **200** to communicate with the network resources **104**. As will be explained below, in order for a network terminal **200** to communicate with a selected network resource **104**, the network terminal **200** first downloads a driver application data from the administration server **108** over the communications network **112**. The network terminal **200** may also download the appropriate resource driver from the driver database **122** (via the authorization server **110** over the communications network **112**), and then allow the authorization server **110** to configure the downloaded resource driver in accordance with the access level field **306** of the resource record **300** associated with the selected network resource **104**. Preferably, each resource driver includes a resource driver identifier which allows the authorization server **110** to identify the resource driver which the network terminal **200** has downloaded.

[0039] The driver application will now be discussed in association with FIG. 2. As discussed above, the DISC **210** of the network terminal **200** includes data which, when loaded into the RAM **212** of the network terminal **200**, comprise processor instructions for the CPU **208**. As shown, the downloaded driver application data defines in the RAM **212** a memory object comprising a driver application **400**. The driver application **400** includes a generic resource driver **402** and a wrap-around resource driver layer **404**. The generic

resource driver 402 allows the network terminal 200 to communicate with a variety of different network resources 104, however the generic resource driver 402 typically will not provide the network terminal 200 with access to all the features and capabilities of any particular network resource 104. If the network terminal 200 requires additional features not implemented with the generic resource driver 402, the appropriate resource driver may be downloaded from the driver database 116, as mentioned above.

[0040] The wrap-around driver layer 404 includes an application communication layer 406, a driver administrator layer 408, and a data transmitter layer 410. The application communication layer 406 is in communication with the resource driver 402 (generic or network resource specific) and the application software installed on the network terminal 200, and is configured to transmit user application data between the application software and the resource driver 402. The driver administrator layer 408 communicates with the resource registry 106 over the communications network 112 to ensure that the driver application 400 is properly configured for communication with the selected network resource 104. The data transmitter layer 410 is in communication with the resource driver 402 and is configured to transmit the data output from the resource driver 402 over the communications network 112 to the selected network resource 104, via the network interface 202. Although the driver application 400 and its constituent component layers are preferably implemented as memory objects or a memory module in the RAM 212, it will be apparent that the driver application 400 may instead be implemented in electronic hardware, if desired.

[0041] Returning to FIG. 1, the registration database 124 of the resource registry 106 includes user records each uniquely associated with a user of a respective network terminal 200 upon registration with the network resource access system 100. Each user record identifies the name of the registered user's name, post office address and e-mail address. In addition, each user record specifies a unique password which the registered user must specify in order to update the user's user record, and to obtain access to network resources 104 configured for "authorized access". The user record may also include additional information specifying default options for the network resource access system 100. For instance, the user may specify that the network resource access system 100 should provide the user with an acknowledgement e-mail message when a message is successfully transmitted to a selected network resource 104. The user may also specify an archive period for which the network resource access system 100 should archive the message transmitted to the selected network resource 104. This latter option is advantageous since it allows the user to easily transmit the same message to multiple network resources 104 at different times, and to periodically review transmission dates and times for each archive message.

[0042] The administration server 108 is in communication with the resource database 120 and the registration database 124. The administration server 108 provides administrators of the network resources 104 with access to the records of the resource database 120 to allow the administrators to update the network address field 302, the resource type field 304, the user access level field 306, the resource information field 308, the pseudo-name field 310, the username/password field 312 and/or the driver identifier field 314 of the resource record 300 for the associated network resource 104. As will become apparent, this mechanism allows network administrators to

change, for example, the network address and/or the restrictions/permissions of the network resources 104 under their control, or even the network resource 104 itself, without having to notify each network terminal 200 of the change. The administration server 108 also provides controlled access to the registration database 124 so that only the user of the network terminal 200 which established the user record can update the user record.

[0043] Where the username/password field 312 has been completed, the administration server 108 is configured to block access to the resource record 300 until the administrator provides the administration server 108 with the correct username/password key. This feature allows the resource administrator to make adjustments, for example, to pricing and page limit, in response to demand for the network resources 104, and to make adjustments to the restrictions/permissions set out in the user access level field 306 and the resource information field 308 and thereby thwart unauthorized access to the network resources 104.

[0044] The authorization server 110 is in communication with the resource database 120 and the driver database 122 for providing the network terminals 200 with the resource drivers 402 appropriate for the selected network resources 104. Preferably, the authorization server 110 is also configured to configure the driver application 400 for communication with the selected network resource 104, by transmitting the network address of the selected network resource 104 to the data transmitter layer 410 over a communications channel secure from the user of the network terminal 200 so that the network address of the network resource 104 is concealed from the user of the network terminal 200. In the case where the communications network 112 comprises the Internet, preferably the secure communications channel is established using the Secure Sockets Layer ("SSL") protocol.

[0045] In addition to the network terminal 200, the network resource 104, the resource registry 106, the administration server 108, the authorization server 110, and the communications network 112, preferably the network resource access system 100 also includes a transaction server 126 and an archive server 128. The transaction server 126 is in communication with the authorization server 110 for keeping track of each data transfer between a network terminal 200 and a network resource 104. For each transmission, preferably the transaction server 126 maintains a transmission record identifying the network terminal 200 which originated the transmission, the network resource 104 which received the transmission, and the date, time and byte size of the transmission.

[0046] The archive server 128 is configured to retain copies of the data transmitted, for a specified period. As discussed above, the user of a network terminal 200 specifies the requisite archive period (if any) for the data transmission, upon registration with the network resource access system 100. Preferably, the administration server 108 provides controlled access to the transaction server 126 and the archive server 128 so that only the user of the network terminal 200 which originated transmission of the data is allowed access to the transmission record associated with the transmission.

[0047] The process by which a user of a network terminal 200 can communicate with a network resource 104 will now be described with reference to FIG. 4. The following discussion presupposes that the user of the network terminal 200 has downloaded the driver application 400 from the administration server 108 over the communications network 112. At step 500, the user of a network terminal 200 decides whether to log

in to the network resource access system 100. As discussed above, if the user registers with the network resource access system 100 and subsequently logs in to the network resource access system 100 (by providing the authorization server 106 with the user's assigned password), the user will have access to any network resources 104 which have "authorized access" as the user access level and which have identified the registered user as a user authorized to access the network resource 104. If the user does not register or fails to log in to the network resource access system 100, the user will only have access to network resources 104 which have established "public access" as the user access level.

[0048] At step 502, the user selects a network resource 104 by querying the administration server 108 for a list of available network resources 104. Alternately, the user may postpone selection of a network resource 104 until initiation of the transmission command. The network user query may be based upon any desired criteria, including print turn-around time and page size (where the target network resource 104 is a printer), price, and geography. In addition, the user may provide the administration server 108 with the geographical coordinates of the user to determine the user's nearest network resources. The user may provide its geographical coordinates through any suitable mechanism known to those skilled in the art, including latitude/longitude co-ordinates, GPS, and wireless triangulation.

[0049] If the user requested a list of available network resources 104, the user is provided with a list of pseudo-names associated with each network resource 104 satisfying the designated search criteria. As discussed above, if the user logged in to the network resource access system 100, the pseudo-name list will include both "public access" network resources 104 and "authorized access" network resources 104 with which the user has been authorized to communicate. Also, if the user is member of an enterprise having network resources 104 registered with the network resource access system 100, the pseudo-name list will also identify network resources 104 which have been registered by the enterprise for "private access". Otherwise, the pseudo-name list will only identify network resources 104 registered for public access. Upon receipt of the resource list, the user selects a network resource 104 from the list.

[0050] At step 504, the administration server 108 queries the network user's network terminal 200 for the resource driver identifier of the resource driver 402 configured on the network terminal 200, and then compares the retrieved resource driver identifier against the resource driver identifier specified in the network driver identifier field 314 of the resource record 300 associated with the selected network resource 104 to determine whether the driver application 400 has been configured with the appropriate resource driver 402 for communication with the network resource 104. If the network terminal 200 has not been configured with the appropriate resource driver 402, the administration server 108 prompts the user's network terminal 200 to download the necessary resource driver 402. As will be apparent, the downloaded resource driver 402 becomes part of the driver application 400.

[0051] When the user of the network terminal 200 is ready to communicate with the selected network resource 104, the user of the network terminal 200 transmits a transmission request via its application software to the driver application 400, at step 506. If the user did not select a network resource 104 at step 502, the application communication layer 406 of

the driver application 400 contacts the administration server 108 over the communications network 112 and prompts the user to select a network resource 104, as described above. Once a network resource 104 is selected, and the appropriate resource driver 402 is installed, the application communication layer 406 notifies the driver administrator layer 408 of the transmission request.

[0052] At step 508, the driver administrator layer 408 provides the authorization server 110 with the transmission request and identifies the selected network resource 104, by transmitting to the authorization server 110 the pseudo-name assigned to the selected network resource 104. If the user of the network terminal 200 has registered and logged in to the network resource access system 100, the driver administrator layer 408 also provides the authorization server 110 with the registered user's name.

[0053] The authorization server 110 then queries the resource database 120 with the received pseudo-name for the resource record 300 associated with the pseudo-name, at step 510. The authorization server 110 then extracts the user access level from the user access level field 306 of the retrieved resource record 300, and determines whether the network terminal 200 is authorized to communicate with the selected network resource 104, at step 512. As will be apparent from the foregoing discussion, if the user access level field 306 specifies "public access" for the network resource 104, the network terminal 200 will be automatically authorized to communicate with the network resource 104.

[0054] However, if the user access level field 306 specifies "private access" for the network resource 104, the authorization server 110 determines the network address of the network terminal 200 from the transmission request transmitted by the network terminal 200, and then queries the user access level sub-field with the terminal's network address to determine whether the network terminal 200 is authorized to communicate with the network resource 104. In the case where the communications network 112 comprises the Internet, the authorization server 110 can determine the network terminal's network address from the IP packets received from the network terminal 200. On the other hand, if the user access level field 306 specifies "authorized access" for the network resource 104, the authorization server 110 queries the user access level sub-field with the user's name to determine whether the network terminal 200 is authorized to communicate with the network resource 104.

[0055] If the query at step 512 reveals that the network terminal 200 is not authorized to communicate with the network resource 104, at step 514 the authorization server 110 provides the network terminal 200 with a notification that the network terminal 200 is not authorized for communication with the selected resource 104. However, if the query at step 512 reveals that the network terminal 200 is authorized to communicate with the network resource 104, the authorization server 110 queries the network address field 302 of the resource record 300 associated with the network resource 104 for the network address of the network resource 104. The authorization server 110 then establishes a secure communications channel with the driver administrator layer 408, and then transmits the network address to the driver administrator layer 408 over the secure communications channel, at step 516.

[0056] Also, if the user access level field 306 specifies "authorized access" for the network resource 104, and the network terminal 200 is authorized to communicate with the

network resource **104**, the authorization server **110** queries the user access level sub-field for the authorization password assigned to the network resource **104**, and then transmits the authorization password to the driver administrator layer **408** over the secure communications channel, together with the network address. In the case where the communications network **112** comprises the Internet, preferably the authorization server **110** establishes the secure communications channel using a Secure Sockets Layer (“SSL”) protocol. Since the network address and the authorization password are transmitted over a secure communications channel, this information is concealed from the user of the network terminal **200**.

[0057] Preferably, the authorization server **110** also extracts the resource driver identifier from the resource identifier field **314** of the resource record **300**, and determines whether the network terminal **200** is still properly configured for communication with the network resource **14**. If the network terminal **200** no longer has the correct resource driver **402**, the authorization server **110** queries the driver database **122** for the correct resource driver **402**, and prompts the user of the network terminal **200** to download the correct resource driver **402**. This driver configuration verification step may be performed concurrently or consecutively with the network address providing step described in the preceding paragraph.

[0058] In addition, the administration server **108** queries the registration database **124** to determine whether the user of the network terminal **200** registered with the network resource access system **100**. If the user registered with the network resource access system **100** and specified that the archive server **128** should maintain archival copies of data transmissions, the administration server **108** transmits the network address of the archive server **128** to the driver administrator layer **408**. As a result, when the user of the network terminal **200** issues a data transmission command, the driver application **400** will transmit the user application data to the selected network resource **104** and to the archive server **128**.

[0059] At step **518**, the application communication layer **406** passes the application data received from the application software to the resource driver **402** for translation into a format suitable for processing by the selected network resource **104**. Meanwhile, the driver administrator layer **408** interrogates the network resource **104**, using the received network address, to determine whether the network resource **104** still resides at the specified network address, is operational and is on-line.

[0060] If the interrogated network resource **104** resides at the specified network address, is operational and is on-line, the resource driver **202** passes the translated application data to the data transmitter layer **410** of the driver application **400**. Preferably, the data transmitter layer **410** compresses and encrypts the translated application data upon receipt. The data transmitter layer **410** also receives the network address of the network resource **104** from the driver administrator layer **408**, adds the network address data to the compressed, encrypted data, and then transmits the resulting data over the communications network **112** to the network resource **104** at the specified network address, at step **520**.

[0061] Preferably, the data transmitter layer **410** also transmits details of the transmission to the transaction server **126**, such as the selected network resource **104** and the byte size of the transmission. Upon receipt of the transmission details, preferably the administration server **108** queries the resource database **120** and the user registration database **124** for the e-mail address of the resource administrator and the e-mail

address of the user of the network terminal **200**, if provided, and then transmits an e-mail message indicating completion of the transmission.

[0062] If the user access level field **306** specifies “authorized access” for the network resource **104**, the data transmitter layer **410** also receives the authorization password for the network resource **104** from the driver administrator layer **408**, and transmits the authorization password (as part of the compressed, encrypted data) to the network resource **104**.

[0063] If the user access level field **306** specifies “public access” for the network resource **104**, preferably the network resource **104** is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data, and then transmit the decompressed application data to the appropriate network resource **104**. Alternately, the network resource **104** itself may be configured for direct communication over the communications network **112**, such as an IPP-capable printer, so that the network resource **104** is able to process the application data directly.

[0064] If the user access level field **306** specifies “authorized access” for the network resource **104**, preferably the network resource **104** is accessible through a local server which serves to queue, decrypt and decompress the application data, and extract the network address data and authorization password, and then transmit the application data to the appropriate network resource **104** if the received authorization password is valid.

[0065] If the user access level field **306** specifies “private access” for the network resource **104**, typically the network resource **104** will be located behind a firewall. Accordingly, the proxy server **114** associated with the network resource **104** will receive the application data, and transfer the application data to the proxy server queue. The polling server **116** associated with the network resource **104** will poll the proxy server **114** to determine the status of the queue. Upon receipt of a polling signal from the polling server **116**, the proxy server **114** transmits any queued application data from the proxy server queue, through the firewall, to the polling server **116**. The polling server **116** then extracts the network address from the received application data, and transmits the application data to the appropriate server **118** or network resource **104** for processing.

[0066] As will be apparent from the foregoing discussion, regardless of the user class defined for a network resource **104**, if a resource administrator relocates a network resource **104** to another network address, and/or changes the device type and/or restrictions/permissions associated with the network resource **104**, the resource administrator need only update the resource record **300** associated with the network resource **104** to continue communication with the network resource **104**. Subsequently, when a user attempts communication with the network resource **104** using the original pseudo-name, the authorization server **110** will provide the administrator layer **408** with the updated network address of the network resource **104**, or prompt the user to download the appropriate resource driver **402**, assuming that the network terminal **200** is still authorized to communicate with the network resource **104**.

[0067] Further, if the user access level field **306** specifies “authorized access” for the network resource **104** and the resource administrator desires to change the pseudo-name and authorization password associated with the network resource **104**, the resource administrator need only update the

pseudo-name and authorization password provided on the resource record **300**. Subsequently, when a user of a network terminal **200** initiates communication with the network resource **104** using the original pseudo-name, the authorization server **110** scans the resource records **300** for occurrences of the original pseudo-name. After locating the appropriate resource record **300**, the authorization server **110** provides the driver administrator layer **408** with the updated pseudo-name and authorization password of the network resource **104**, provided that the network terminal **200** is still authorized to communicate with the network resource **104**. A network terminal **200** which is not authorized to communicate with the network resource **104** will not receive the updated pseudo-name and authorization password from the authorization server **110** and, consequently, will not be able to communicate with the network resource **104**, even if the user of the network terminal **200** knew the network address for the network resource **104**.

[0068] The foregoing description is intended to be illustrative of the preferred embodiment of the present invention. Those of ordinary skill may envisage certain additions, deletions and/or modifications to the described embodiment which, although not explicitly described herein, are encompassed by the spirit or scope of the invention, as defined by the claims appended hereto.

We claim:

1. A secure network resource access system for facilitating network access by network terminals to network resources located behind an enterprise firewall, the secure network resource access system comprising:

- a proxy server located logically outside the enterprise firewall for receiving application data from the network terminals; and
 - a polling server located logically behind the enterprise firewall, the polling server being configured for polling the proxy server to initiate transmission of the received application data from the proxy server to the polling server.
2. The secure network resource access system according to claim 1, wherein each said network resource includes an alias name, and the application data includes the alias name of one of the network resources, and the polling server is configured to direct the application data to the one network resource in accordance with alias name.
3. A method for facilitating secure network access by network terminals to network resources located behind an enterprise firewall, the method comprising the steps of:
- polling a proxy server located logically outside the enterprise firewall for requests for communication with the network resources;
 - receiving application data and associated network resource data from the proxy server in response to the polling step; and
 - directing the application data to one of the network resources in accordance with the associated network resource data.
4. The method according to claim 3, wherein each said network resource includes an alias name, and the network resource data includes the alias name of the one network resource.

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