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(54) **SYSTEM AND METHOD FOR REMOTE MANAGEMENT OF COMMUNICATIONS NETWORKS**

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(22) Filed: **Nov. 26, 2003**

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(51) **Int. Cl.**

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H04L 29/00	(2006.01)
H04L 9/08	(2006.01)
G06F 9/00	(2006.01)
G06F 21/02	(2006.01)

(52) **U.S. Cl.** **726/11**; 380/259; 380/277; 713/171; 726/17; 726/21; 726/26

(58) **Field of Classification Search** 713/150–154, 713/170, 171, 162, 168; 726/11, 2–4, 12, 726/16, 17, 21, 26, 27; 380/59, 255, 259, 380/277–279, 282, 283, 285
See application file for complete search history.

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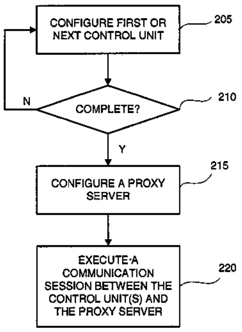
Primary Examiner—Nasser Moazzami
Assistant Examiner—Fatoumata Traore
(74) *Attorney, Agent, or Firm*—Schwegman, Lundberg & Woessner, P.A.

(57) **ABSTRACT**

The invention provides a system and method for that facilitating the remote management of one or more networks. In enabling the remote management of a network, embodiments of the invention provide limited access to service providers through a firewall, without the need to modify the configuration of the firewall. Advantageously, the cost of providing such access may be reduced compared to conventional approaches. In addition, such access may be limited to data inquiries or other commands, which can reduce the risk that the security of the network is compromised.

13 Claims, 6 Drawing Sheets


CONFIGURE FIRST OR NEXT CONTROL UNIT
205
N
COMPLETE?
210
Y
215
CONFIGURE A PROXY SERVER
EXECUTE A COMMUNICATION SESSION BETWEEN THE CONTROL UNIT(S) AND THE PROXY SERVER
220

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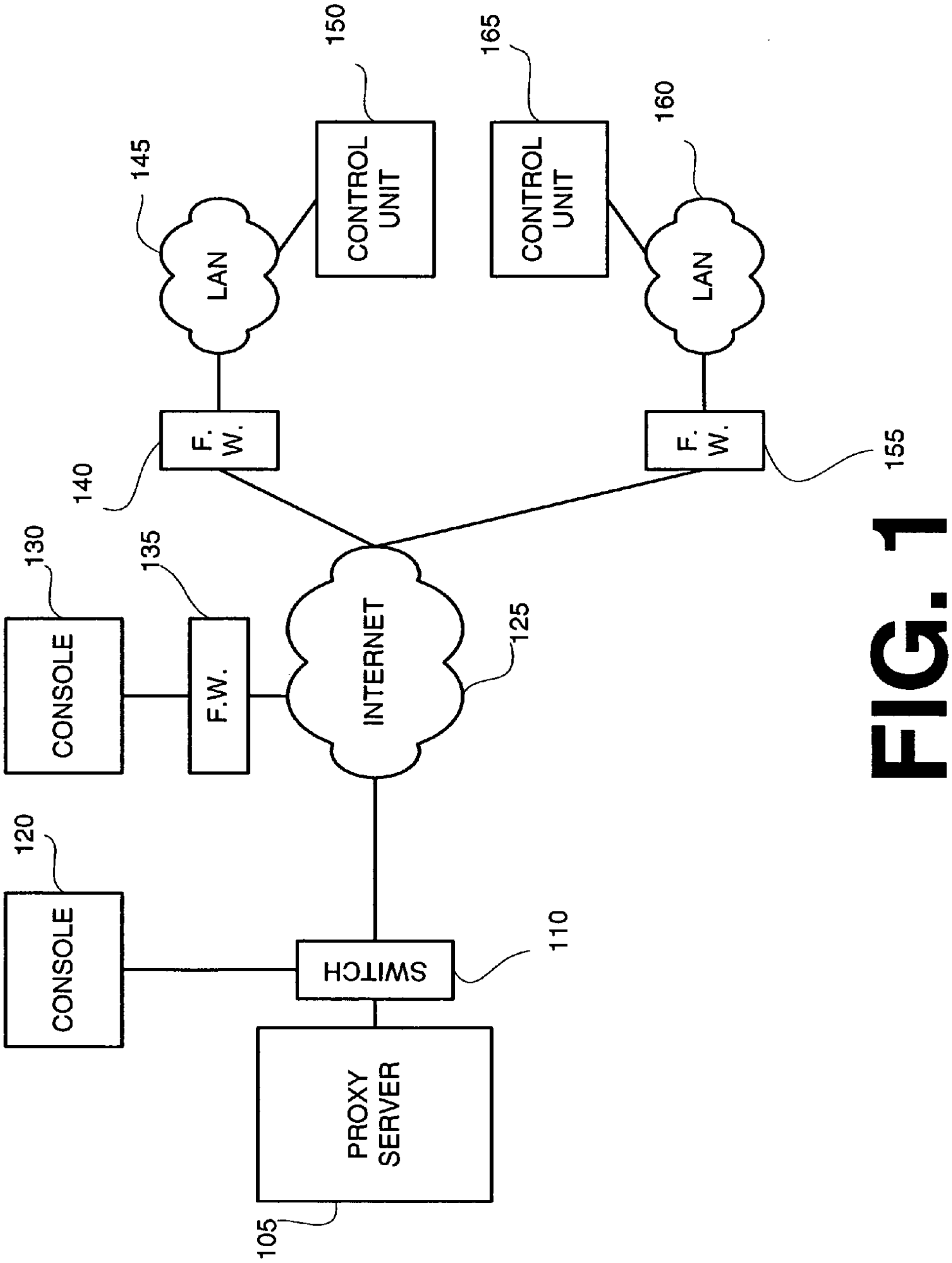
PROXY SERVER
105
SWITCH
110
CONSOLE
120
CONSOLE
130
F.W.
135
INTERNET
125
F. W.
140
LAN
145
CONTROL UNIT
150
F. W.
155
LAN
160
CONTROL UNIT
165

FIG. 1

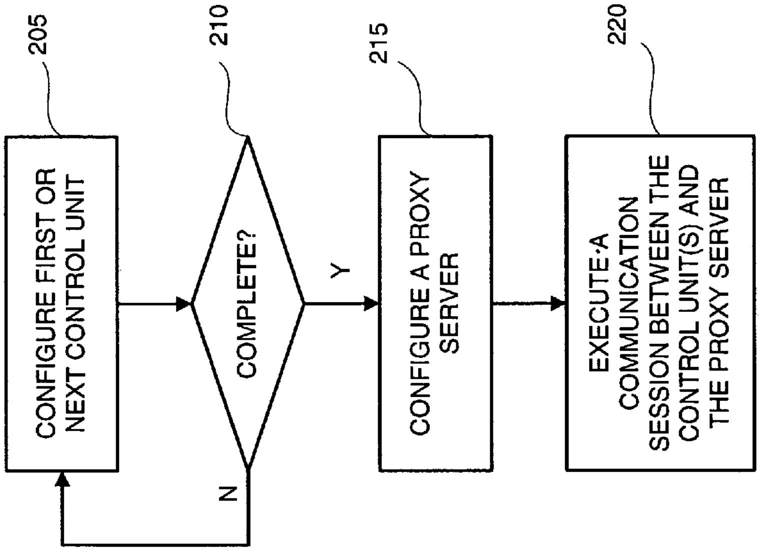
205
CONFIGURE FIRST OR NEXT CONTROL UNIT
210
COMPLETE?
Y
N
215
CONFIGURE A PROXY SERVER
220
EXECUTE·A COMMUNICATION SESSION BETWEEN THE CONTROL UNIT(S) AND THE PROXY SERVER

FIG. 2

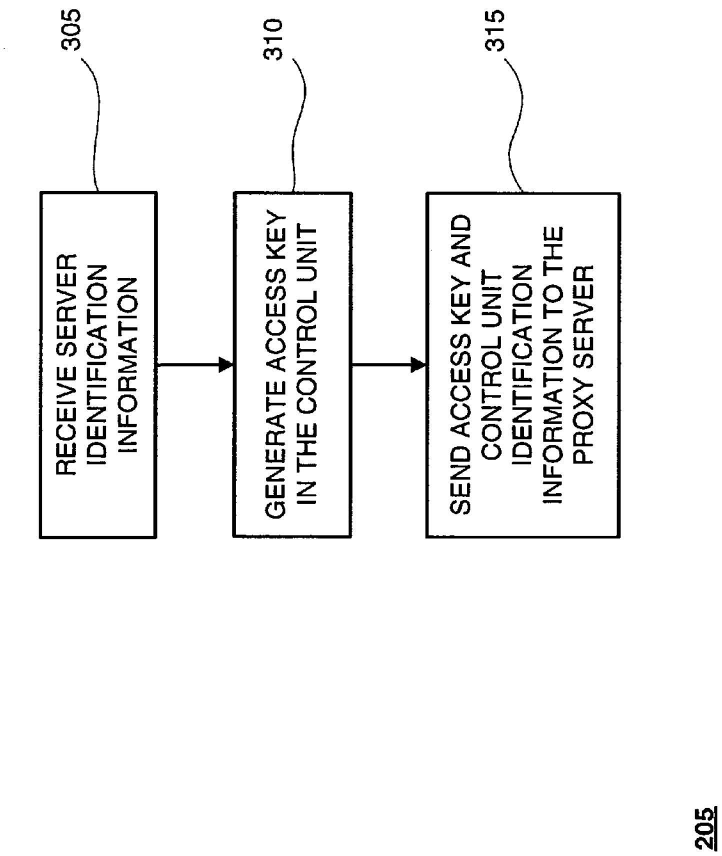
305
RECEIVE SERVER IDENTIFICATION INFORMATION
310
GENERATE ACCESS KEY IN THE CONTROL UNIT
315
SEND ACCESS KEY AND CONTROL UNIT IDENTIFICATION INFORMATION TO THE PROXY SERVER
205

FIG. 3

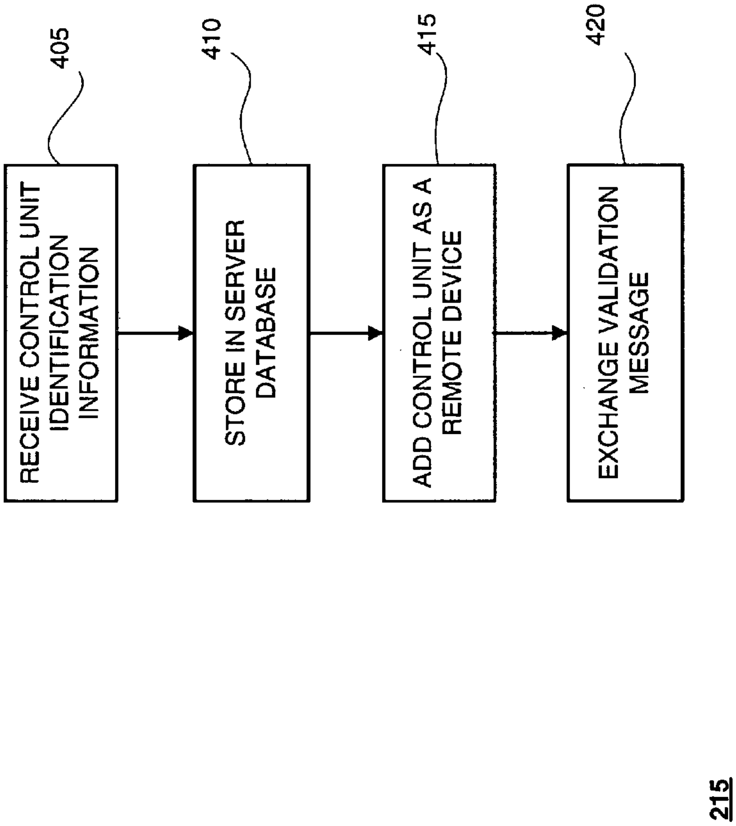
RECEIVE CONTROL UNIT IDENTIFICATION INFORMATION
405
STORE IN SERVER DATABASE
410
ADD CONTROL UNIT AS A REMOTE DEVICE
415
EXCHANGE VALIDATION MESSAGE
420
215

FIG. 4

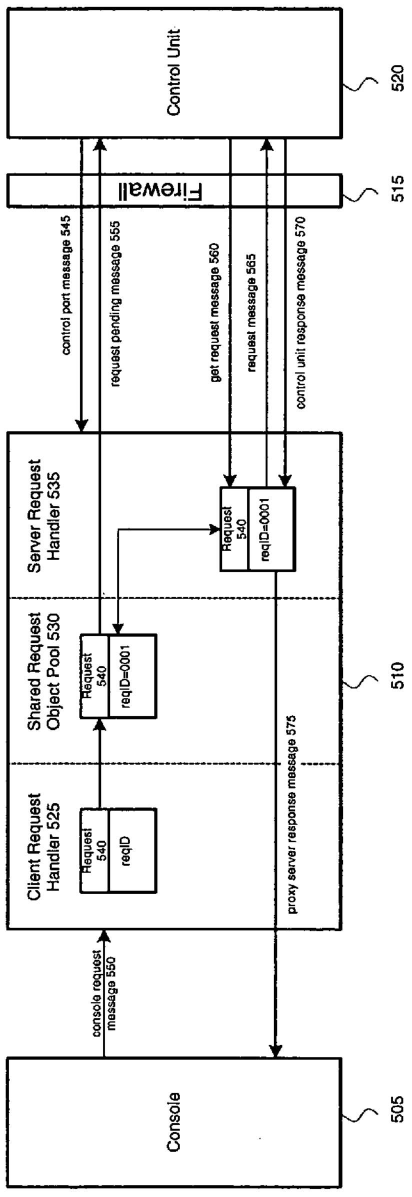
Console
505
console request message 550
Client Request Handler 525
Request 540
reqID
Shared Request Object Pool 530
Request 540
reqID=0001
Server Request Handler 535
Request 540
reqID=0001
510
proxy server response message 575
control port message 545
request pending message 555
get request message 560
request message 565
control unit response message 570
Firewall
515
Control Unit
520

FIG. 5

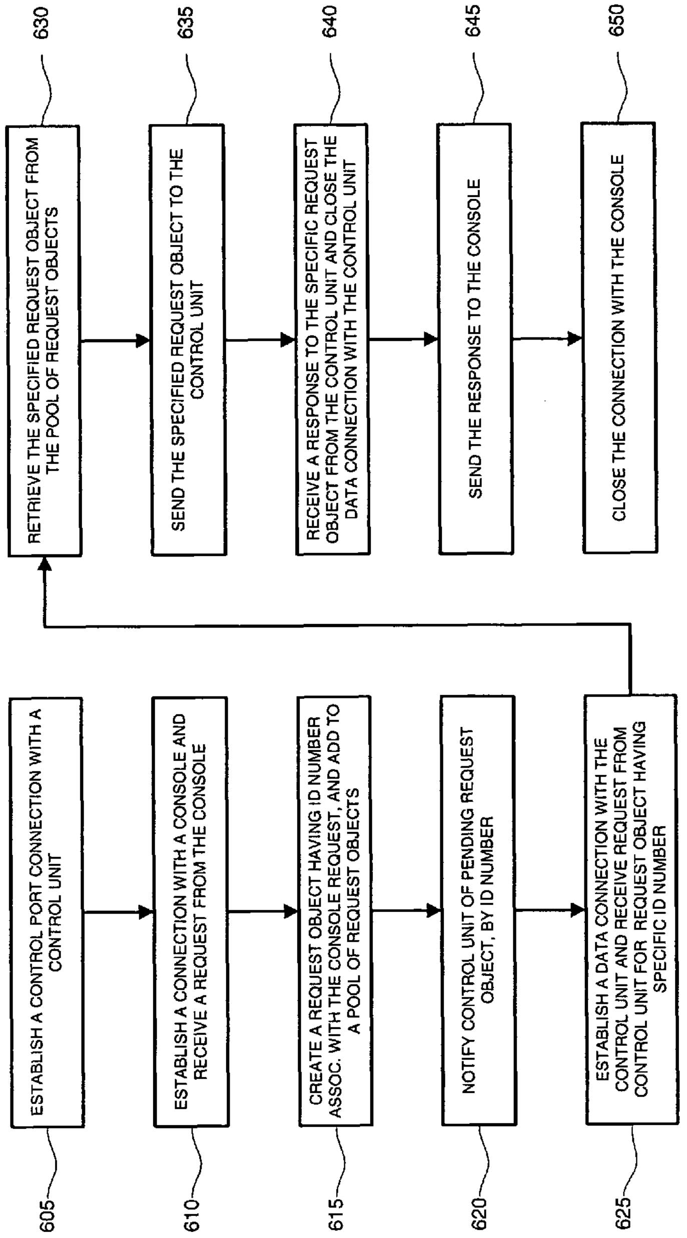
605
ESTABLISH A CONTROL PORT CONNECTION WITH A CONTROL UNIT
610
ESTABLISH A CONNECTION WITH A CONSOLE AND RECEIVE A REQUEST FROM THE CONSOLE
615
CREATE A REQUEST OBJECT HAVING ID NUMBER ASSOC. WITH THE CONSOLE REQUEST, AND ADD TO A POOL OF REQUEST OBJECTS
620
NOTIFY CONTROL UNIT OF PENDING REQUEST OBJECT, BY ID NUMBER
625
ESTABLISH A DATA CONNECTION WITH THE CONTROL UNIT AND RECEIVE REQUEST FROM CONTROL UNIT FOR REQUEST OBJECT HAVING SPECIFIC ID NUMBER
630
RETRIEVE THE SPECIFIED REQUEST OBJECT FROM THE POOL OF REQUEST OBJECTS
635
SEND THE SPECIFIED REQUEST OBJECT TO THE CONTROL UNIT
640
RECEIVE A RESPONSE TO THE SPECIFIC REQUEST OBJECT FROM THE CONTROL UNIT AND CLOSE THE DATA CONNECTION WITH THE CONTROL UNIT
645
SEND THE RESPONSE TO THE CONSOLE
650
CLOSE THE CONNECTION WITH THE CONSOLE

FIG. 6

SYSTEM AND METHOD FOR REMOTE MANAGEMENT OF COMMUNICATIONS NETWORKS

FIELD OF INVENTION

The invention relates generally to the field of telecommunications. More specifically, but not by way of limitation, the invention relates to a system and method for remotely managing one or more communications networks.

BACKGROUND

Systems and methods are generally known for managing networks with the application of administrative consoles. One problem is how to enable network management by external service providers. A known solutions for management by an external service provider is to grant general administrative privileges to the service provider on a Local Area Network (LAN) or other network to be managed. Another known solution is to configure a firewall to permit access to the network from remote management consoles.

These known systems and methods for management by external service providers have several disadvantages. For example, direct connection to a LAN may not be feasible for a remote service provider. In addition, systems and method for modifying the configuration of a firewall may be costly to implement. Furthermore, approaches that result in broad administrative privileges to external service providers may present a security risk to stakeholders of data in the managed network.

What is needed is a system and method that facilitates remote management of one or more networks, while mitigating the risk associated with providing access through network firewalls.

SUMMARY OF THE INVENTION

The invention provides a system and method for that facilitating the remote management of one or more networks. In enabling the remote management of a network, embodiments of the invention provide limited access to service providers through a firewall, without the need to modify the configuration of the firewall. Advantageously, the cost of providing such access may be reduced compared to conventional approaches. In addition, such access may be limited to data inquiries or other commands, which can reduce the risk that the security of the network is compromised.

Embodiments of the invention provide a functional architecture having a control unit inside the firewall, and a proxy server outside the firewall. In one respect, embodiments of the invention provide a method to configure the control unit. In another respect, embodiments of the invention provide a method to configure the server. In yet another: respect, embodiments of the invention provide a system and method for communicating between the control unit and the proxy server.

The features and advantages of the invention will become apparent from the following drawings and detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention are described with reference to the following drawings, wherein:

FIG. **1** is a block diagram of a functional architecture for a communications system, according to an embodiment of the invention;

FIG. **2** is a flow diagram of a process for remotely managing a network, according to an embodiment of the invention;

FIG. **3** is a flow diagram of a process for configuring a control unit, according to an embodiment of the invention;

FIG. **4** is a flow diagram of a process for configuring a proxy server, according to an embodiment of the invention;

FIG. **5** is a block diagram of a detailed functional architecture for a communications system according to an embodiment of the invention; and

FIG. **6** is a flow diagram of a process for performing a communication session through a firewall, according to an embodiment of the invention.

DETAILED DESCRIPTION

Sub-headings are used below for organizational convenience. The disclosure of any particular feature is not necessarily limited to any particular section, however. The detailed description begins with an overview of a system architecture.

System Architecture

FIG. **1** is a block diagram of a functional architecture for a communications system, according to an embodiment of the invention. As shown therein, a proxy server **105** is coupled to console **120** and Internet **125** via a switch **110**. Internet **125** is further coupled to firewall **135**, which is coupled to console **130**. In addition, Internet **125** is coupled to firewall **140**, which is coupled to control unit **150** via LAN **145**. Likewise, Internet **125** is also coupled to firewall **155**, which is coupled to control unit **165** via LAN **160**. Control units **150** and **165** may also be coupled to other networks (not shown) or devices (not shown).

As used herein, Internet **125** represents a public network. Internet **125** can be replaced with a Wide Area Network (WAN), Local Area Network (LAN), or other publicly-accessible wired or wireless network, according to design choice.

As used herein, LAN **145** and LAN **160** represent enterprise networks that are inside (i.e., on the protected side) of firewalls **140** and **155**, respectively. LANs **145** and **160** could be or include WANs or other network configurations, according to application requirements.

Consoles **120** and **130** each may be or include a personal computer, a desktop computer, a laptop computer, a Personal Digital Assistant (PDA), or other terminal or device suitable for handling necessary user interface functions. Moreover, consoles **120** and **130** each may include client software to facilitate operation in a networked environment.

The control units **150** and **165** may each include a central processing unit (CPU) (not shown), such as an Intel x86, Intel x86 compatible device, Intel Pentium™, or other processor. The control units **150** and **165** may each further include a hard disk or other storage device (not shown) for storing programs and/or data. In addition, control units **150** and **165** may each have Random Access Memory (RAM), or other temporary memory (not shown) to execute Linux or other resident OS, and to execute application programs. Control units **150** and **165** may include application code (not shown) for managing LANs **145** and **160**, respectively or for managing other networks (not shown) and/or devices (not shown). In addition, the control units **150** and **165** may each be or include a network server. In the illustrated embodiment, Control Units **150** and **165** are inside (i.e., on the protected side) of firewalls **140** and **155**, respectively.

Proxy server **105** is a network-based server, and may include an Operating System (OS) (not shown), application code (not shown), and/or a database (not shown). In one respect, proxy server **105** provides access between each of consoles **120** and **130** and each of the control units **150** and **165**. Control unit **150** may contain management data related to LAN **145** or other network (not shown) or network device (not shown), and control unit **165** may contain management data related to LAN **160** or other network (not shown) or network device (not shown). Proxy server **105** may aggregate and store performance data provided by control units **150** and **165**, respectively. In operation, a user at either console **120** or **130** may provide commands to either or both of control units **150** and **165** via the proxy server **105**.

In the illustrated embodiment, proxy server **105** is coupled to a public network. In an alternative embodiment, proxy server **105** may be protected inside a firewall (not shown). In yet another embodiment, proxy server **105** may be implemented within a De-Militarized Zone (DMZ) between a protected network (not shown) and the unprotected Internet **125** or other public network.

The quantity of any component illustrated in FIG. **1** may vary, according to application requirements.

Process Flows

FIGS. **2**-**4** illustrate enabling processes that can be performed using the functional architecture described above.

FIG. **2** is a flow diagram of a process for remotely managing a network, according to an embodiment of the invention. As shown therein, an overall process begins in step **205** by configuring a first or next control unit. Step **205** is described in more detail below, with reference to FIG. **3**. Then, in conditional step **210**, it is determined whether all control units have been configured. Where the result of conditional step **210** is in the negative, the process returns to step **205**. If however, the result of conditional step **210** is in the affirmative, the process advances to step **215** to configure a proxy server. Step **215** is described in more detail below, with reference to FIG. **4**. Finally, after both the control unit(s) and the proxy server have been configured, the process advances to step **220** to execute a communication session between the control unit(s) and the proxy server. Step **220** is described in more detail below, with reference to FIGS. **5** and **6**.

In an alternative embodiment of the process illustrated in FIG. **2**, conditional step **210** is omitted. Thus, a communication session can be executed in step **220** after a single control unit is configured in step **205** and after the proxy server is configured in step **215**.

FIG. **3** is a flow diagram of a process for configuring a control unit, according to an embodiment of the invention. The diagram is from the perspective of a control unit. As shown therein, the process begins in step **305** by receiving proxy server identification information. Such proxy server identification information may include, for example, server host name, IP address and logical port number.

Where a user, at console **120** or **130**, for example, does not provide the server IP address, control unit **150** or **165** may obtain the server IP address using an inquiry command directed to the proxy server **105**.

Next, the process advances to step **310** where the control unit **150** or **165** generates an access key. Finally, in step **315**, the control unit **150** or **165** sends the access key and control unit identification information to the proxy server **105**. Control unit identification information may include, for example, one or more of an external IP address and an internal IP address.

Accordingly, one or both of control units **150** and **165** are configured for remote communications with proxy server **105**.

FIG. **4** is a flow diagram of a process for configuring a proxy server, according to an embodiment of the invention. The diagram is from the perspective of the proxy server **105**. As; shown therein, the process begins in step **405** by receiving control unit identification information from each of control units **150** and **165**. Next, in step **410**, the proxy server **105** stores the control unit information in a server database. Then, in step **415**, the proxy server **105** adds each of control units **150** and **165** as remote devices. Finally, in step **420**, a validation message may be exchanged between the proxy server **105** and each of the control units **150** and **165** to confirm the configuration of the control units and the server.

Communicating Through a Firewall

FIG. **5** is a block diagram of a detailed functional architecture for a communications system, according to an embodiment of the invention. As shown therein, a console **505** is coupled to a proxy server **510**. The Proxy server **510** is coupled to a control unit **520** through a firewall **515**. Proxy server **510** includes client request handler **525**, shared request object pool **530** and server request handler **535**. A request object **540** may be instantiated in any one or more of handler **525**, pool **530**, and handler **535**.

In other embodiments, multiple consoles may be coupled to the proxy server **510**. For example, consoles **120** and **130** could be substituted for console **505**. In addition, in other embodiments, the proxy server **510** may be coupled to multiple control units through corresponding multiple firewalls. For instance, control units **150** and **165** could be substituted for control unit **520**, and firewalls **140** and **155** could be substituted for firewall **515**. Moreover, a proxy server **510** may have the features described above with reference to proxy server **105**.

The operation of the functional components illustrated in FIG. **5**, including messages **545**, **550**, **560**, **565**, **570** and **575** is described with reference to FIG. **6** below.

FIG. **6** is a flow diagram of a process for performing a communication session through a firewall, according to an embodiment of the invention.. FIG. **6** is illustrated from the perspective of a proxy server. As shown therein, the process beings in step **605** by establishing a control port connection with a control unit. For example, proxy server **510** may establish a control port connection by receiving control port message **515** from the control unit **520** via firewall **515**. The port connection may be used, for example, to open and close data connections, and/or to provide security functions.

Next, in step **610**, the proxy server **510** establishes a connection with a console, and receives a request from the console. For instance, after establishing a server/client link with the console, which may be or include a Secure Socket Layer (SSL) link, proxy server **510** may receive console request message **550** from console **505**.

Console request message **550** may be a request for network management data from control unit **520** related to LAN **145**, LAN **160**, other networks (not shown) coupled to control unit **150** and/or **165**, or network devices (not shown) coupled to control units **150** and/or **165**. For instance, console request message **550** may be a request for IP-PBX status information, where an IP-PBX is coupled to control unit **150** and/or **165**. Console request message **550** may be a request for status information related to an Uninterruptible Power Supply (UPS) or other network device coupled to control unit **150** and/or **165**. Further, console request message **550** may be a back-up, shut-down, re-start, or other control command directed to the control unit **150** and/or **165**, or to an IP-PBX coupled to one of control unit **150** and/or **165**, for example.

Then, in step **615**, the proxy server **510** creates a request object having an identification (ID) number, where the request object is related to the console request. In addition, in step **615**, the proxy server **510** adds the request object to a pool of one or more request objects. With reference to FIG. **5**, step **615** may include creating request object **540** in client request handler **525**. Step **615** may also include the assignment of ID number **0001** to request object **540**, and the addition of request object **540** to object pool **530**.

The process is then promoted to step **620**, where the proxy server **510** notifies the control unit of a pending request object, by ID number. For example, proxy server **510** could send request pending message **555** to control unit **520** with notice of pending request object **540** having ID number **0001**.

Next, in step **625**, the proxy driver creates a data connection with the control unit, and receives a request from the control unit for a request object having a specific ID number. The data connection may be, for example, a TCP/IP socket, opened according to commands issued via the control port connection. As an illustration of the data flow over the data connection, proxy driver **510** could receive a get request message **560** from the control unit **520**. For instance, the get request message could specifically request the request object **540** having ID number **0001**.

Then, in step **630**, the proxy driver retrieves the specified request object from the pool of one or more request objects. For example, with reference to FIG. **5**, the server request handler **535** could retrieve request **540** having specified ID number **0001** from the shared request object pool **530**.

The process then advances to step **635**, where the proxy driver sends the specified request object to the control unit. Thus, in FIG. **5**, the request handler **535** sends request **540** having the specified ID number **0001** to the control unit **520** as part of request message **565**.

In step **640**, the proxy server **510** receives a response to the specific request object from the control unit and closes the data connection with the control unit. For instance, in this step, the request handler **535** receives management data from the control unit **520** as part of control unit response message **570**.

In step **645**, the proxy server **510** sends the response to the console. As an example, request handler **535** could send the management data to the console **505** as part of proxy server response message **575**. In this case, proxy server response message **575** contains management data from control unit **520** that satisfies console request message **550** from the console **505**.

Finally, the proxy server **510** closes the connection with the console in step **650**, for example by ending the SSL link between the console **505** and the proxy server **510**.

The description above illustrates how the process in FIG. **6** can be executed by the functional architecture in FIG. **5**. In addition, the process described with reference to FIG. **6** can be adapted to architectures having multiple consoles and/or multiple control units. To the extent that proxy server **510** includes at least one processor, the process illustrated in FIG. **6** may be embodied in processor-executable code, the processor-executable code being executed by the at least one processor.

CONCLUSION

The invention described above thus overcomes the disadvantages of known systems and methods by facilitating the remote management of one or more networks without requiring modification to a firewall protecting the network to be managed, and without granting broad administrative privileges to external service providers. While this invention has been described in various explanatory embodiments, other embodiments and variations can be effected by a person of ordinary skill in the art without departing from the scope of the invention.

The invention claimed is:

1. A method for controlling a network remotely, the method comprising:

configuring a first control unit, inside a first firewall, the first control unit separate from the first firewall and used to control the network, configuring of the first control unit including:

querying a proxy server outside the first firewall from the first control unit to obtain a proxy server IP address,

receiving proxy server identification information with respect to the proxy server outside the first firewall, the proxy server identification information including the proxy server IP address,

generating an access key in the first control unit, and

sending the access key and first control unit identification information to the proxy server;

configuring the proxy server outside the first firewall, the proxy server being implemented within a De-Militarized Zone (DMZ) between the network and an unprotected public network, configuring of the proxy server including:

receiving the first control unit identification information,

storing the first control unit identification information in the proxy server,

adding the first control unit as a first remote device, and

exchanging a validation message between the first control unit and the proxy server,

establishing a session between the first control unit and the proxy server, by use of the access key; and

establishing a connection between the proxy server and a console which resides within the unprotected public network, to permit remote user management of the network by communication between the first control unit and the console via the proxy server.

2. The method of claim **1**, further comprising configuring a second control unit inside a second firewall, the proxy server being outside the second firewall.

3. The method of claim **1**, wherein receiving the proxy server identification information includes receiving a proxy server host name, a proxy server IP address, and a proxy server port number.

4. The method of claim **1**, wherein establishing a session between the first control unit and the proxy server includes coupling through a second firewall, the proxy server being inside the second firewall.

5. The method of claim **4**, further comprising connecting between the proxy server and a console, the console being inside the second firewall, the connecting using an IP address facing inside the second firewall.

6. A communications system, comprising:

a first enterprise network;

a first firewall;

a first control unit communicatively coupled to the first enterprise network to manage the first enterprise network, the first control unit being separate from the first firewall:

a public network; and

a proxy server located outside the first fire wall and implemented within a De-Militarized Zone (DMZ) between the first enterprise network and the public network, the first control unit being configured to:

querying the proxy server to obtain a proxy server IP address;

receive proxy server identification information with respect to the proxy server, the proxy server identification information including the proxy server IP address;

generate an access key; and

send the access key and first control unit identification information to the proxy server,

the proxy server being configured to:

receive the first control unit identification information;

store the first control unit identification information;

add the first control unit as a first remote device; and

exchange a validation message between the first control unit and the proxy server, the first control unit and the proxy server configured to establish a communication session based on the first access key, the proxy server to aggregate and store performance data provided by the first control unit.

7. The communications system of claim **6**, wherein receiving the proxy server information includes a proxy server host name and a proxy server port number.

8. The communication system of claim **6**, further comprising:

a second firewall communicatively coupled to the public network;

a second control unit communicatively coupled to the second firewall; and

a second enterprise network communicatively coupled to the second control unit, the second control unit being configured with proxy server information, the proxy server being configured with second control unit information, the second control unit being further configured to send a second access key to the proxy server, the second control unit and the proxy server configured to establish a communication session based on the second access key.

9. A communications system, comprising:

a first console residing within an unprotected public network and configured to generate at least one console request message, the console request message including at least one of a request for network management data, a request for Internet Protocol (IP)-Private Branch Exchange (PBX), or a request for status information;

a first firewall communicatively coupled to the proxy server;

a first control unit to control a protected network, the first control unit residing within the protected network and being communicatively coupled to the first firewall; and

a proxy server communicatively coupled to the first console, the proxy server configured to establish a connection with the first control unit by sending proxy server identification information including a proxy server IP address to the first control unit, receive from the first control unit control unit identification information and an access key generated by the first control unit, adding the first control unit as a first remote device, and

exchange a validation message with the first control unit, the proxy server further being configured to pool the at least one console request message, to provide access from the first console to the first control unit and to aggregate and store performance data provided by the first control unit, the proxy server being implemented within a De-Militarized Zone (DMZ) between a protected network and the unprotected public network

the first control unit configured to receive the at least one request from the proxy server, and to output at least one response corresponding to the at least one request to the proxy server, the proxy server configured to output the at least one response to the first console.

10. The system of claim **9**, further comprising a second console communicatively coupled to the proxy server, the second console configured to generate at least one other request, the proxy server configured to pool the at least one other request.

11. The system of claim **9**, further comprising:

a second firewall communicatively coupled to the proxy server; and

a second control unit, the second control unit communicatively coupled to the second firewall, the second control unit configured to receive the at least one request from the proxy server, the second control unit further configured to output at least one response corresponding to the at least one request to the proxy server, the proxy server configured to output the at least one response to the first console.

12. The system of claim **9**, wherein the proxy server includes:

a client request handler for receiving a client request from the first console;

a shared request object pool communicatively coupled to the client request handler, the shared request object pool configured to store the at least one request; and

a server request handler communicatively coupled to the shared request object pool, the server request handler configured to read the at least one request from the shared request object pool, the server request handler configured to send the at least one request to the first control unit, the server request handler configured to receive the at least one response, the server request handler configured to output the at least one response to the first console.

13. The system of claim **9**, wherein the proxy server includes processor-executable code, the code performing the steps of:

receiving a client request from the first console;

writing the at least one request;

reading the at least one request;

sending the at least one request to the first control unit;

receiving the at least one response; and

outputting the at least one response to the first console.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO.	: 7,890,995 B2	Page 1 of 1
APPLICATION NO.	: 10/721753	
DATED	: February 15, 2011	
INVENTOR(S)	: Choon B. Shim et al.	

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On the face page, in field (57), under “Abstract”, in column 2, line 1, after “for” delete “that”.

In column 7, line 54, in Claim 9, after “control unit” delete “control unit”.

Signed and Sealed this
Third Day of May, 2011

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office