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Weizman

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(54) **APPARATUS AND METHOD FOR ESTABLISHING A PEER-TO-PEER COMMUNICATION SESSION WITH A HOST DEVICE**

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This patent is subject to a terminal disclaimer.

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G06F 12/14 (2006.01)

(52) **U.S. Cl.** **726/4**; 726/27; 726/2; 713/169; 713/170

(58) **Field of Classification Search** 726/4
See application file for complete search history.

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(57) **ABSTRACT**

An apparatus and method of establishing a peer-to-peer communication session between a host device and a client device. Routing information of the host device is received from a server via a wide area network, routing information of the client device is provided to the server, and authentication information is provided to the host device via the wide area network. Peer-to-peer communication is transmitted to the client device via the wide area network if the client device is authenticated for peer-to-peer communication by the host device.

25 Claims, 12 Drawing Sheets

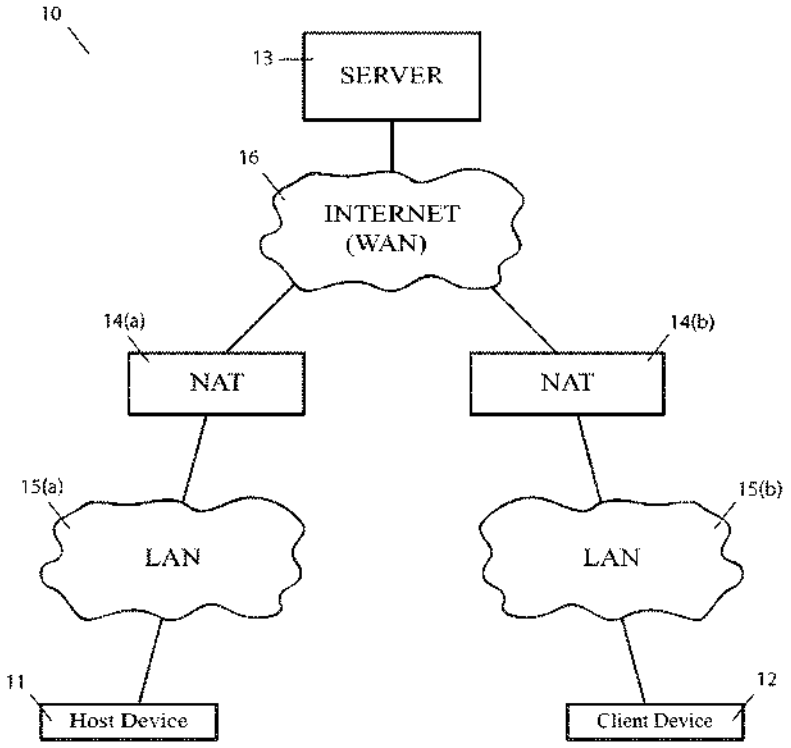


FIG. 1(a)

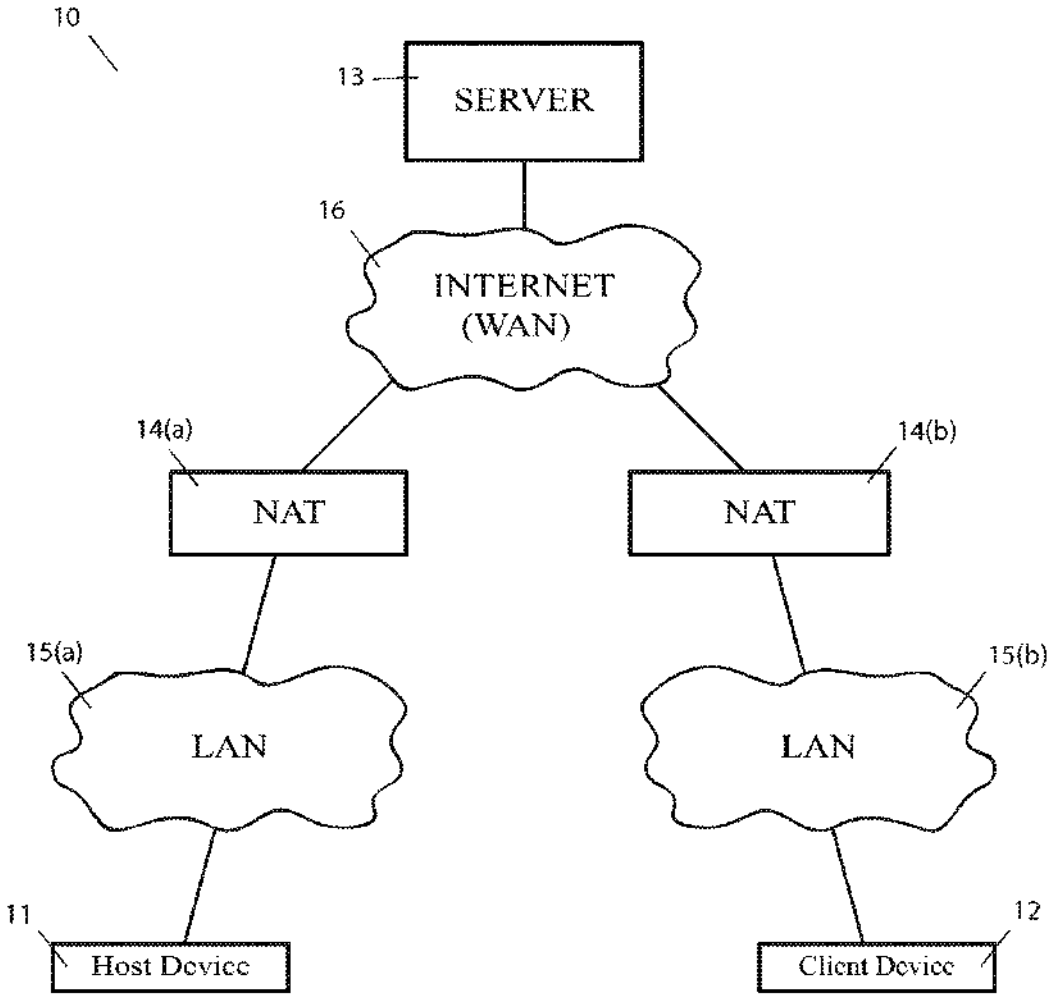

10
13
SERVER
16
INTERNET
(WAN)
14(a)
14(b)
NAT
NAT
15(a)
15(b)
LAN
LAN
11
12
Host Device
Client Device

FIG. 1(b)

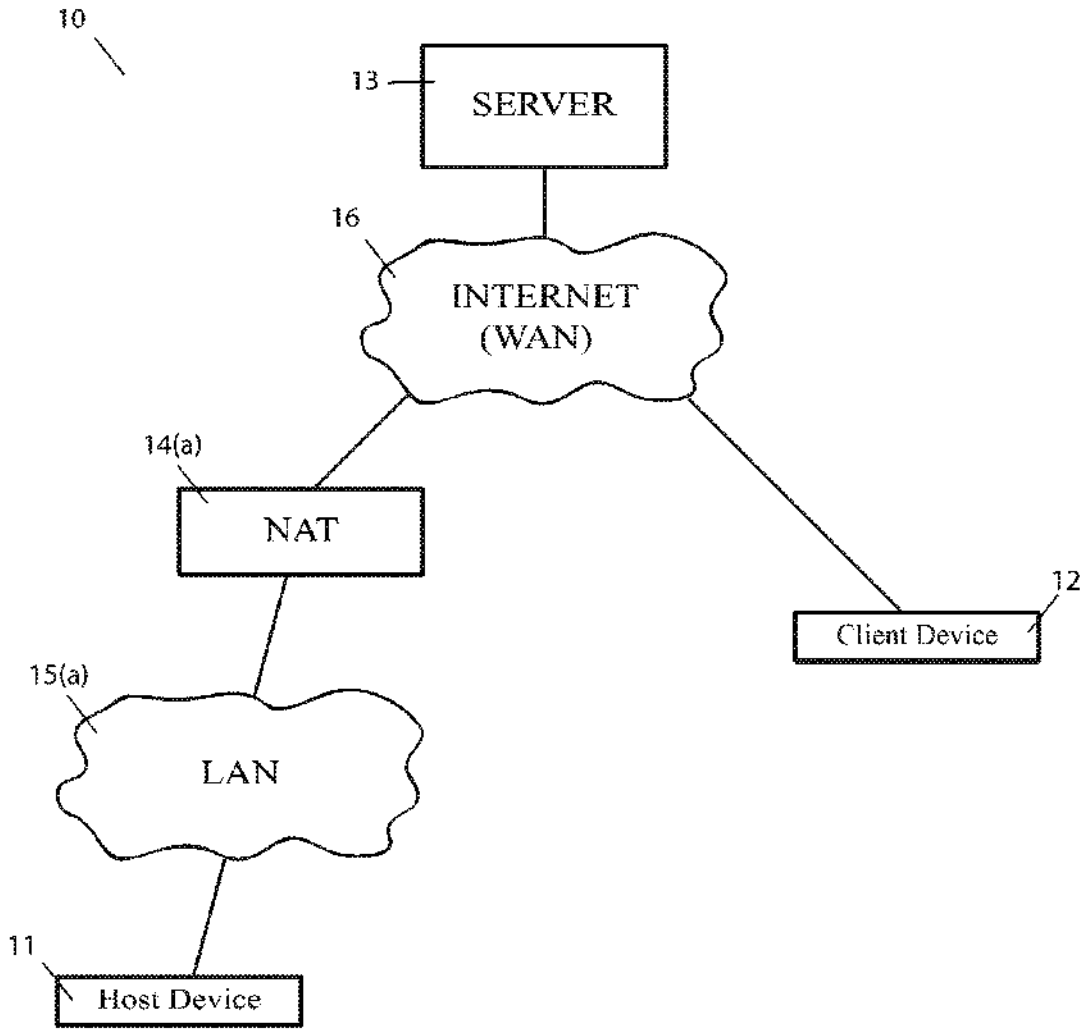

10
13
SERVER
16
INTERNET
(WAN)
14(a)
NAT
12
Client Device
15(a)
LAN
11
Host Device

FIG. 2(a)

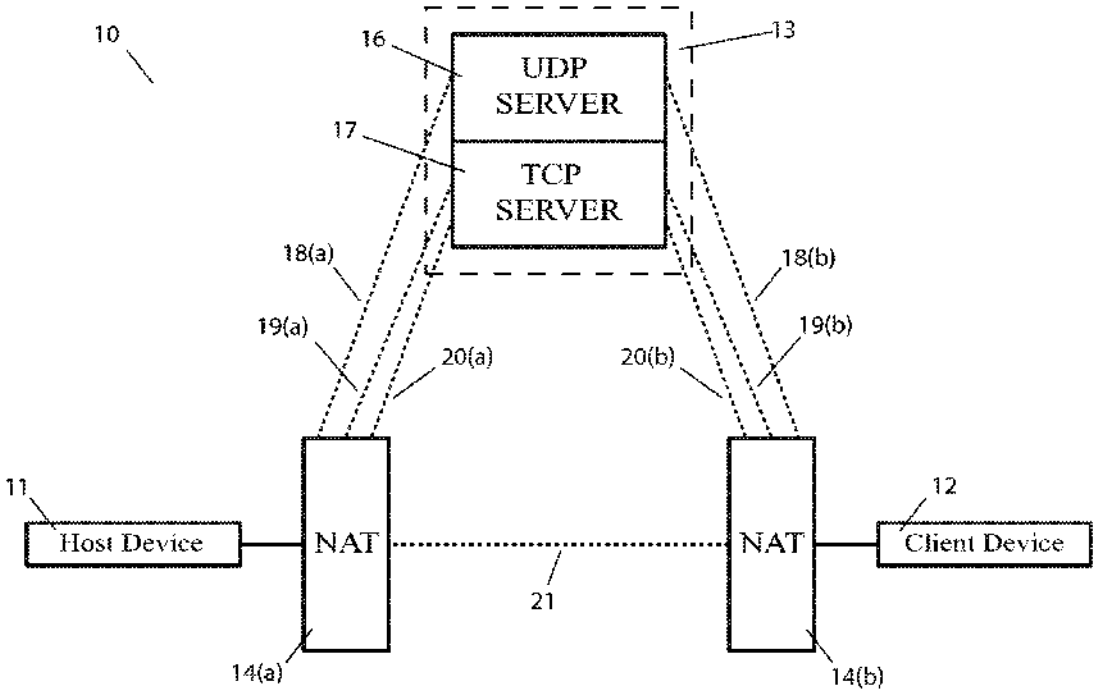

10
16
UDP SERVER
13
17
TCP SERVER
18(a)
18(b)
19(a)
19(b)
20(a)
20(b)
11
Host Device
NAT
NAT
12
Client Device
21
14(a)
14(b)

FIG. 2(b)

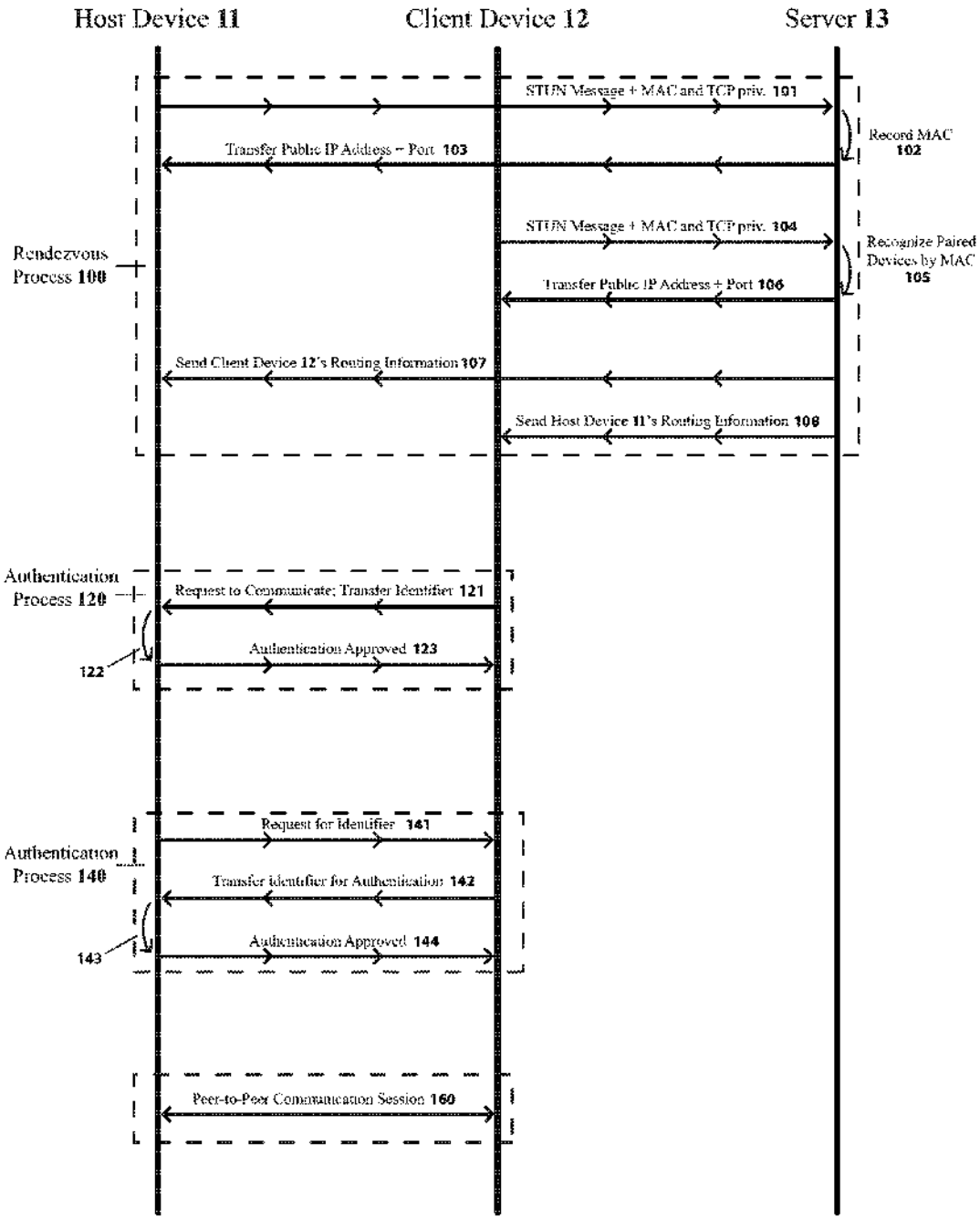

Host Device 11
Client Device 12
Server 13
STUN Message + MAC and TCP priv. 101
Record MAC 102
Transfer Public IP Address + Port 103
STUN Message + MAC and TCP priv. 104
Recognize Paired Devices by MAC 105
Rendezvous Process 100
Transfer Public IP Address + Port 106
Send Client Device 12's Routing Information 107
Send Host Device 11's Routing Information 108
Authentication Process 120
Request to Communicate; Transfer Identifier 121
122
Authentication Approved 123
Request for Identifier 141
Authentication Process 140
Transfer Identifier for Authentication 142
143
Authentication Approved 144
Peer-to-Peer Communication Session 160

FIG. 2(c)

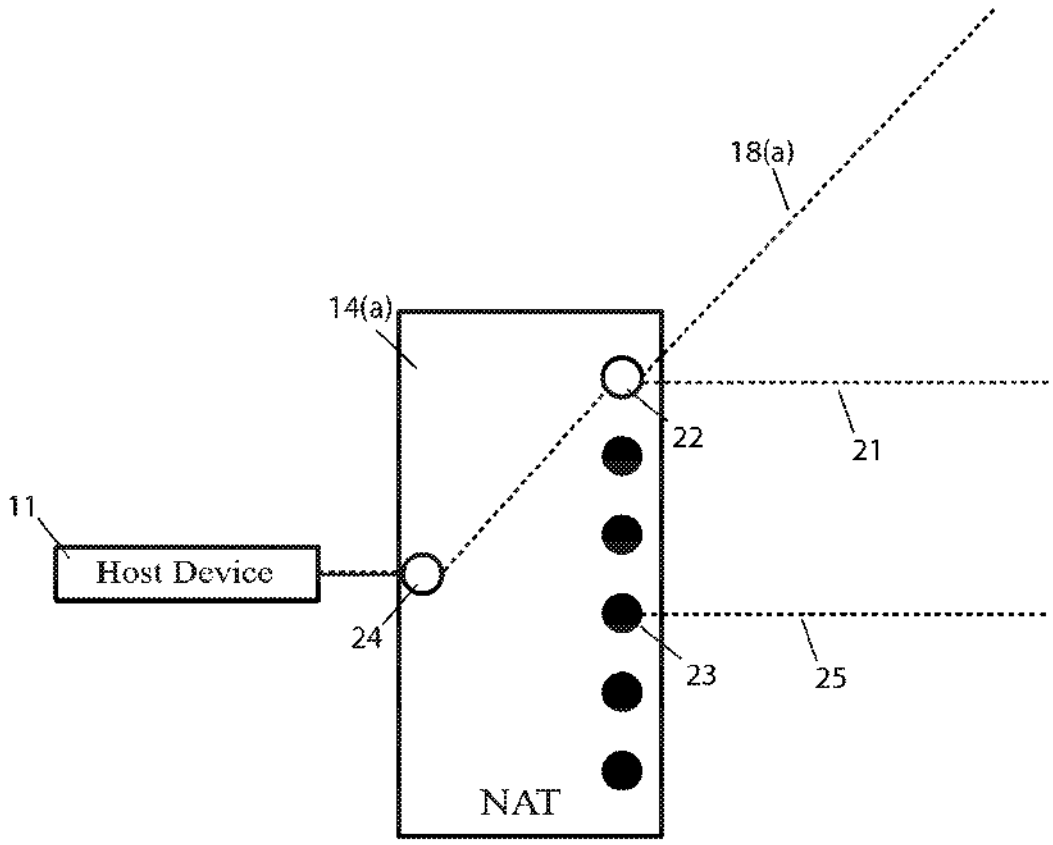


FIG. 3(a)

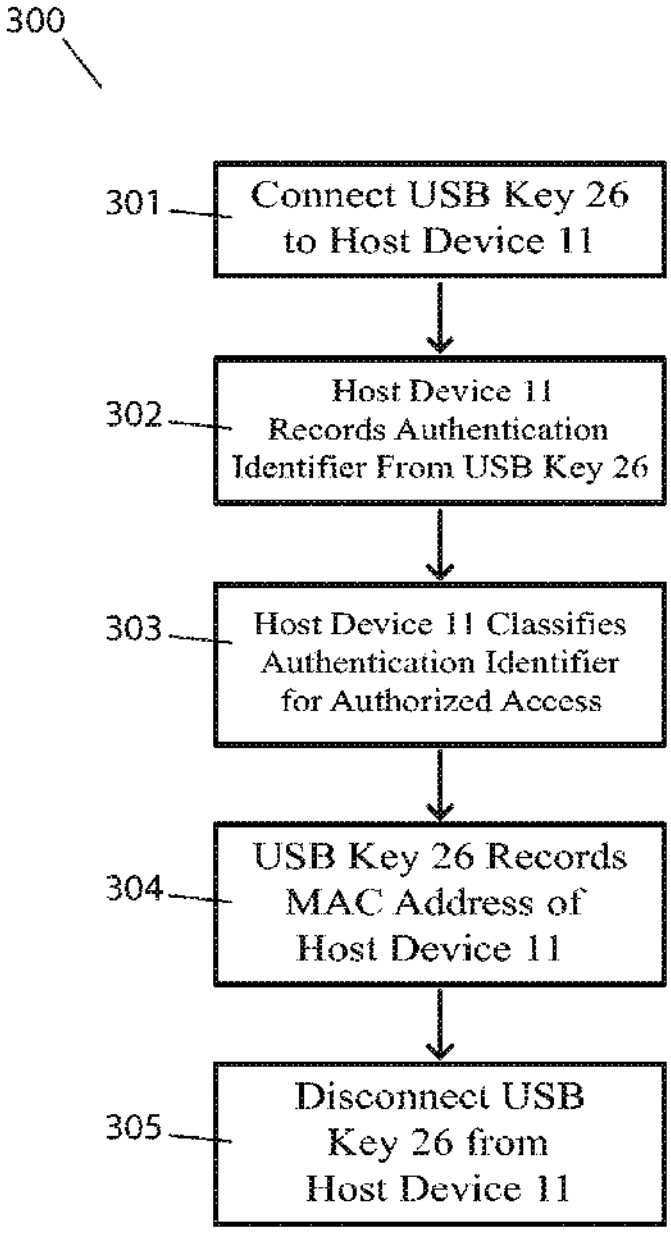

300
301
Connect USB Key 26 to Host Device 11
302
Host Device 11 Records Authentication Identifier From USB Key 26
303
Host Device 11 Classifies Authentication Identifier for Authorized Access
304
USB Key 26 Records MAC Address of Host Device 11
305
Disconnect USB Key 26 from Host Device 11

FIG. 3(b)

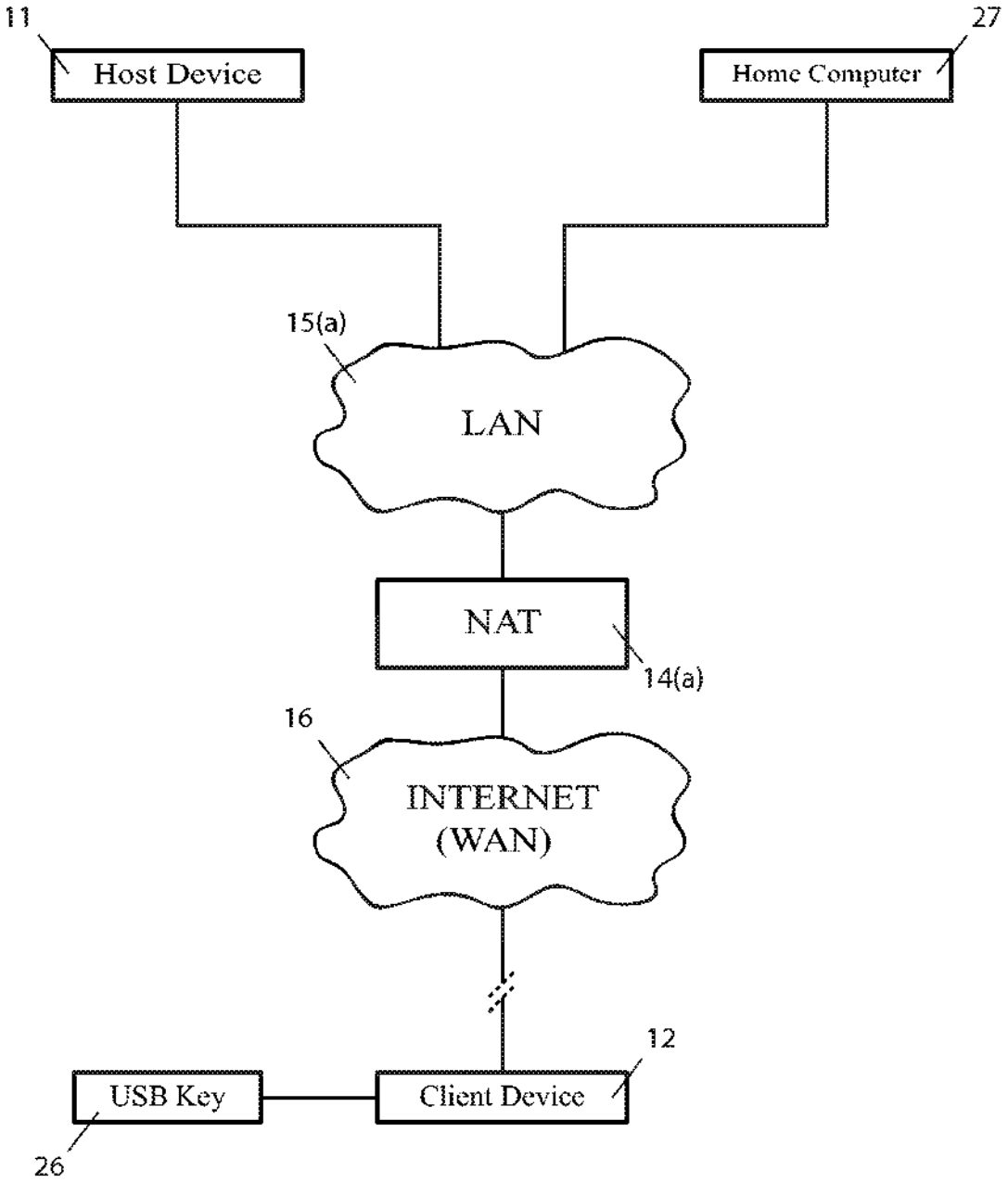

11
Host Device
27
Home Computer
15(a)
LAN
NAT
14(a)
16
INTERNET
(WAN)
12
USB Key
Client Device
26

FIG. 4(a)

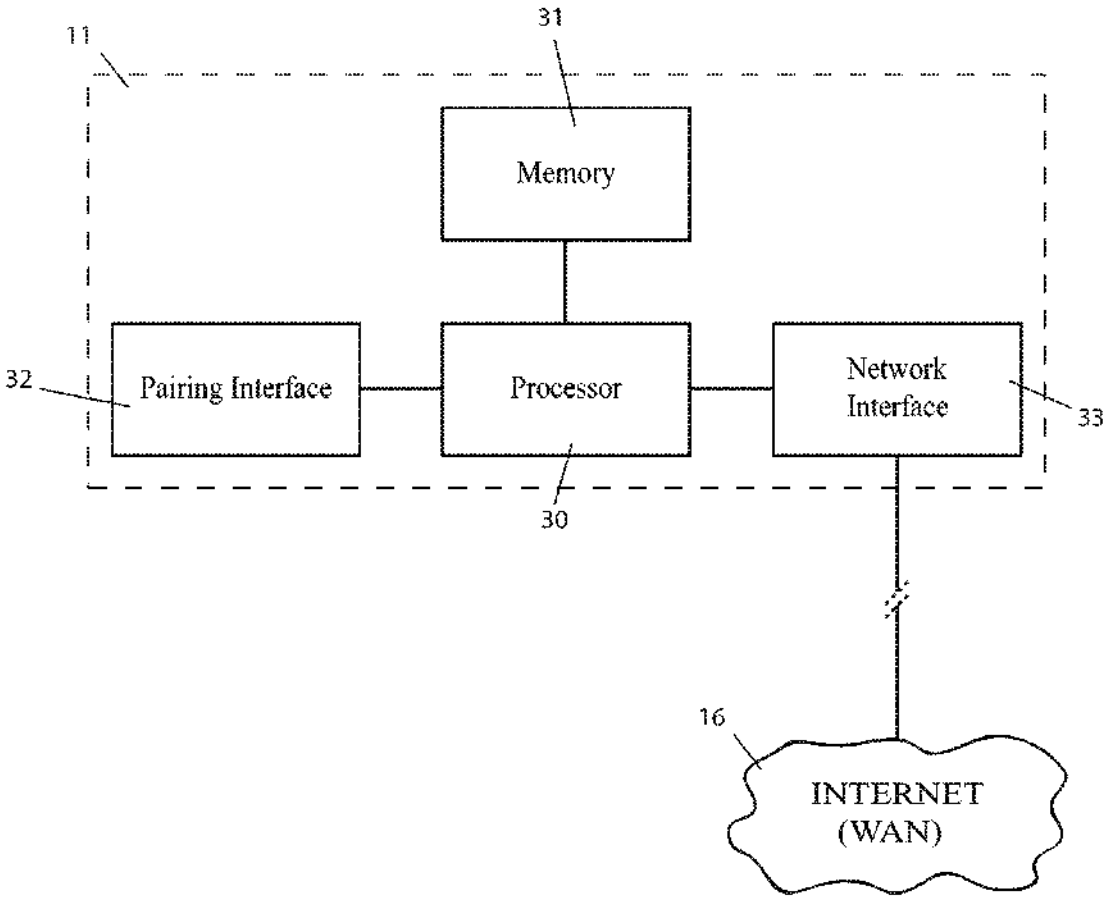

11
31
Memory
32
Pairing Interface
Processor
Network Interface
33
30
16
INTERNET (WAN)

FIG. 4(b)

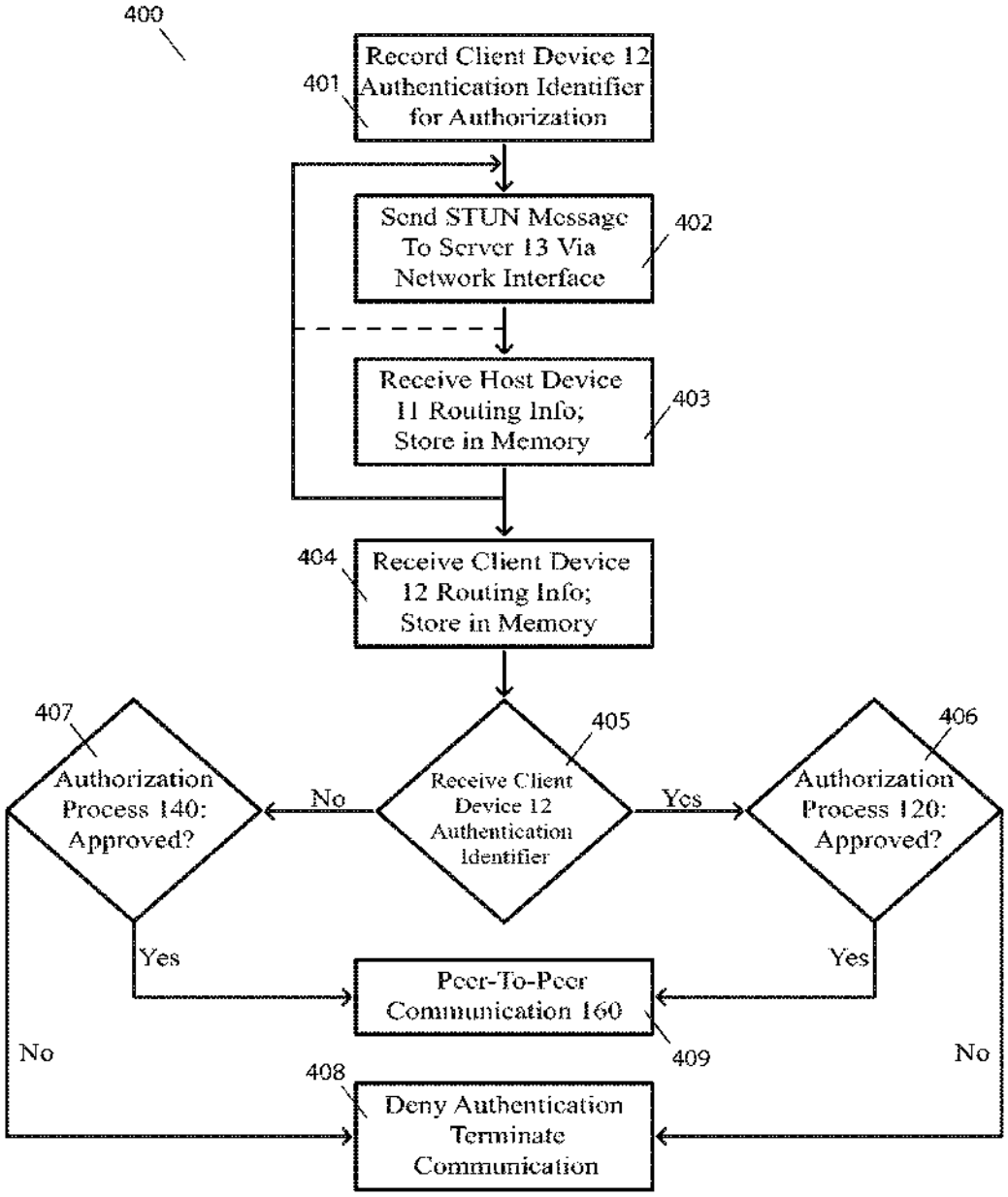

400
Record Client Device 12 Authentication Identifier for Authorization
401
Send STUN Message To Server 13 Via Network Interface
402
Receive Host Device 11 Routing Info; Store in Memory
403
Receive Client Device 12 Routing Info; Store in Memory
404
Receive Client Device 12 Authentication Identifier
405
Authorization Process 140: Approved?
407
Authorization Process 120: Approved?
406
No
Yes
Yes
Yes
Peer-To-Peer Communication 160
409
No
No
Deny Authentication Terminate Communication
408

FIG. 5(a)

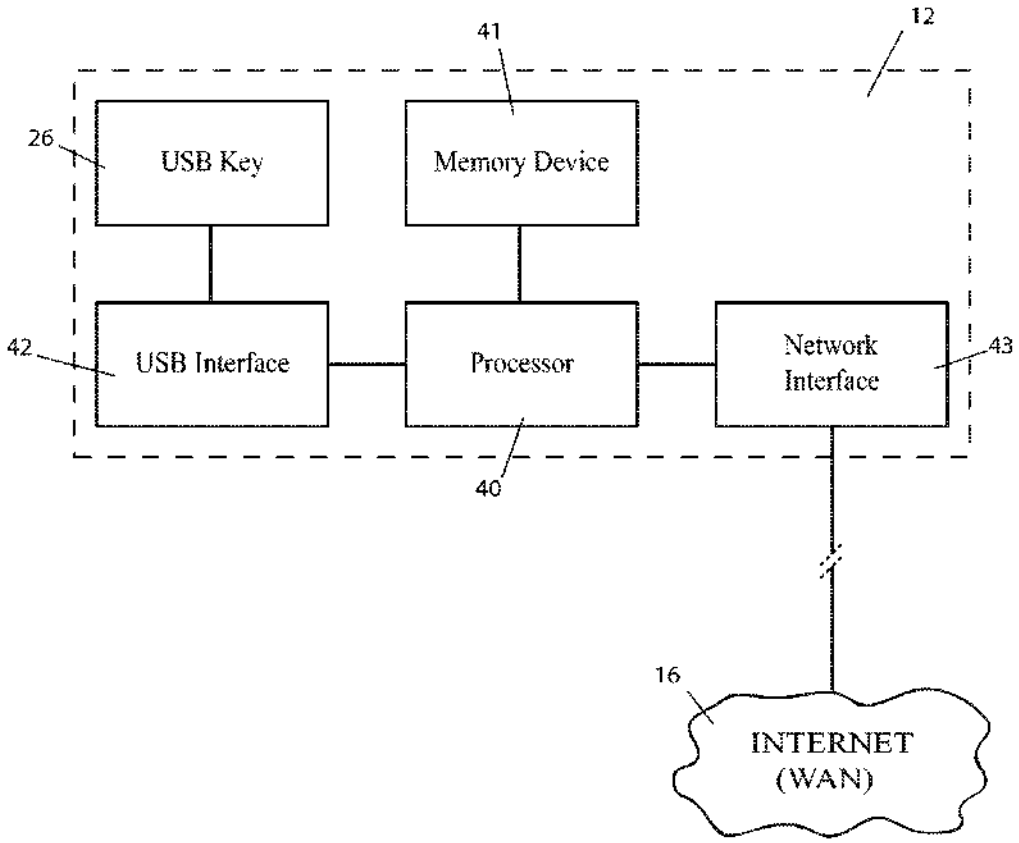

12
41
26
USB Key
Memory Device
42
USB Interface
Processor
Network Interface
43
40
16
INTERNET (WAN)

FIG. 5(b)

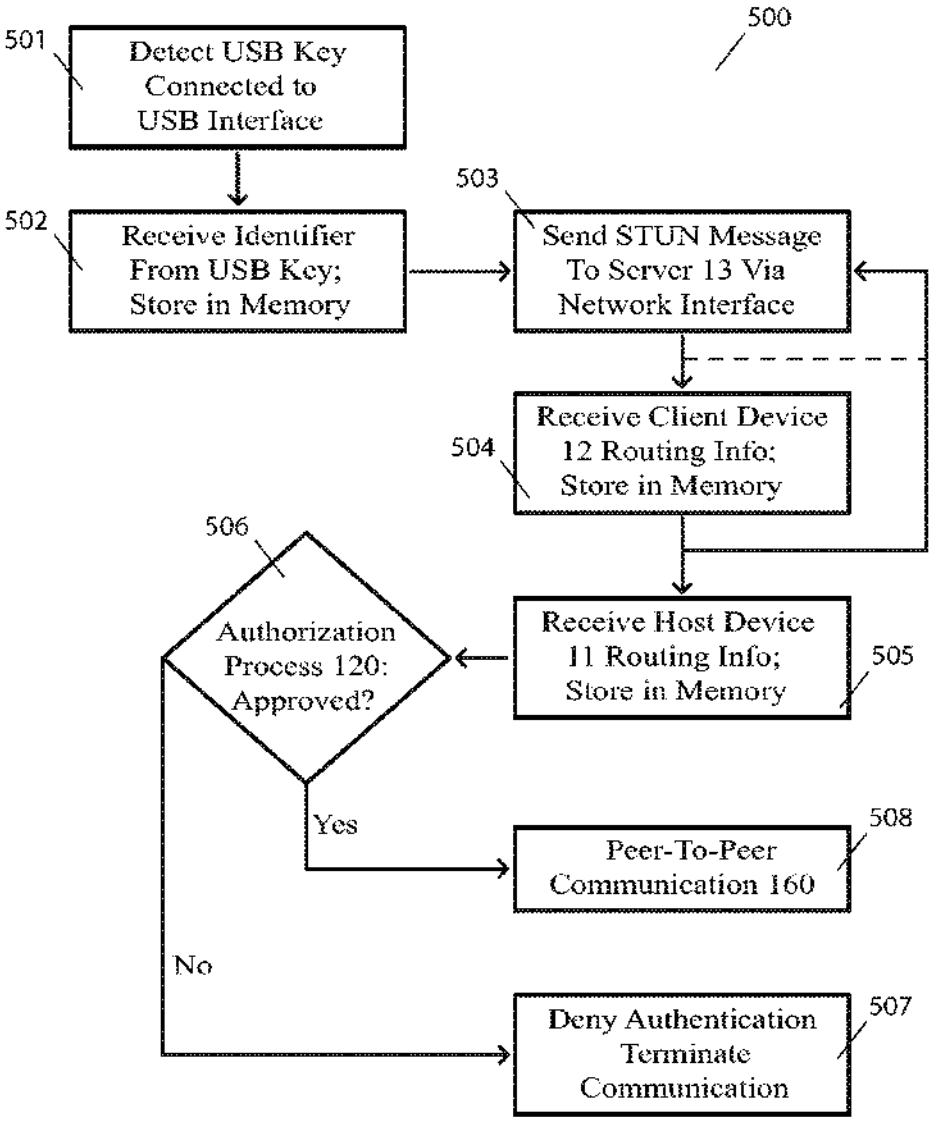
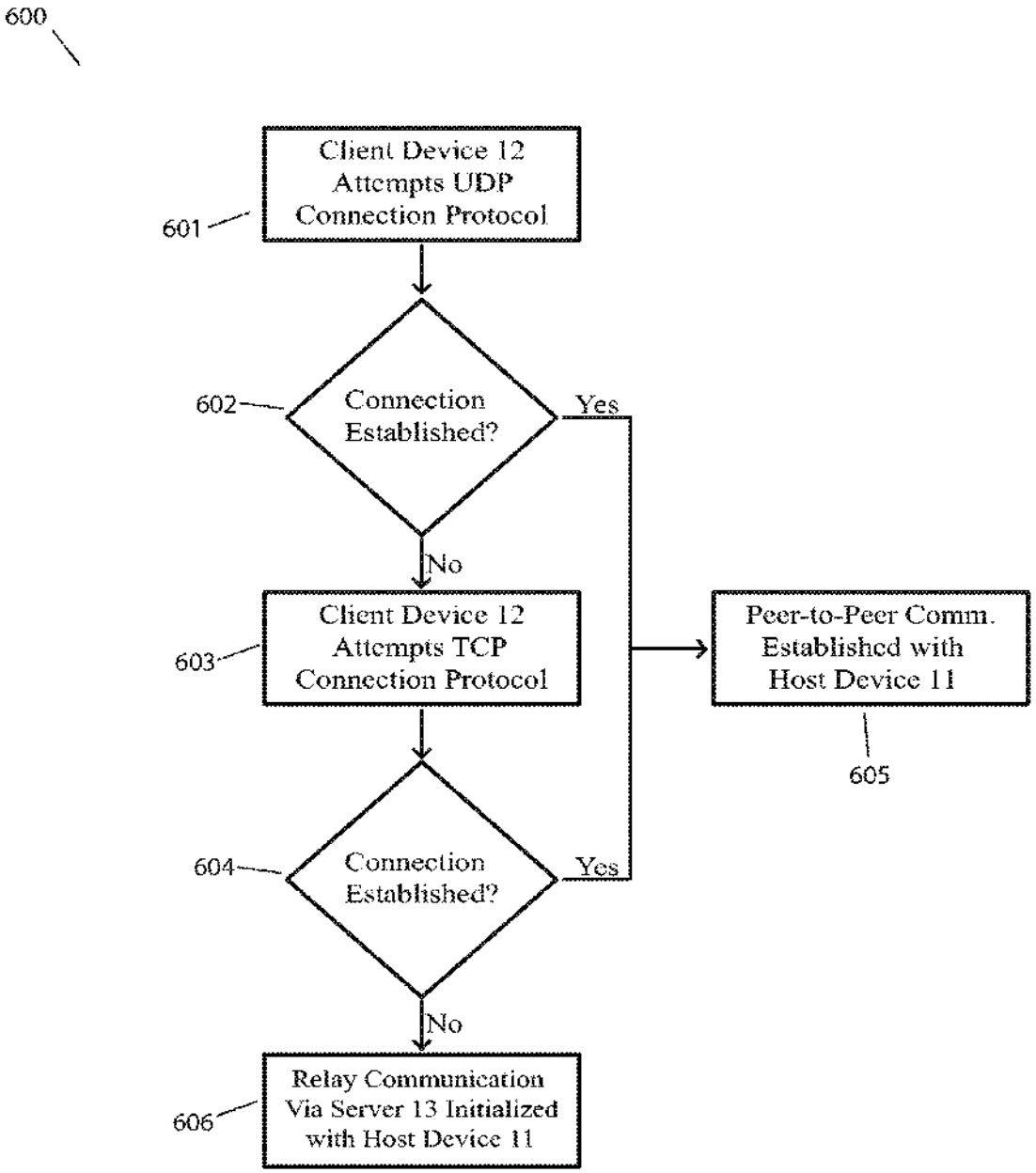

500
501
Detect USB Key Connected to USB Interface
502
Receive Identifier From USB Key; Store in Memory
503
Send STUN Message To Server 13 Via Network Interface
504
Receive Client Device 12 Routing Info; Store in Memory
505
Receive Host Device 11 Routing Info; Store in Memory
506
Authorization Process 120: Approved?
Yes
508
Peer-To-Peer Communication 160
No
507
Deny Authentication Terminate Communication

FIG. 6


600
Client Device 12 Attempts UDP Connection Protocol
601
Connection Established?
602
Yes
No
Client Device 12 Attempts TCP Connection Protocol
603
Peer-to-Peer Comm. Established with Host Device 11
605
Connection Established?
604
Yes
No
Relay Communication Via Server 13 Initialized with Host Device 11
606

APPARATUS AND METHOD FOR ESTABLISHING A PEER-TO-PEER COMMUNICATION SESSION WITH A HOST DEVICE

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to electronic communication and data transfer, and more specifically, to an apparatus and method for establishing a peer-to-peer communication session between a host device and a client device separated by a wide area network.

BACKGROUND OF THE INVENTION

Currently there are few options available should one want to access electronic files from a remote location. While one may store their electronic documents on a public or private server at a remote location, this method has significant drawbacks. Should the server ever crash, files may become corrupted, deleted, or in the best case scenario, temporarily unavailable. Further, remote data storage on a third-party server is costly, potentially subjecting one to fees or unwanted advertisements. Most worrisome, however, is that the storage of files on a remote server may pose security risks.

An alternative method to remote data storage on a third-party server is the utilization of a peer-to-peer communication session to access documents from a remote location. However, current methods for the initialization of a peer-to-peer communication session between electronic devices on local area networks separated by a wide area network are limited. If one were on a local area network separated from the internet by a network address translator, commonly referred to as a NAT, their device would not be detectible to devices on the wide area network. As such, in order to initiate a peer-to-peer communication session between a first and a second communication device on local area networks separated by a wide area network, one must either leave a port in their network address translator permanently open for incoming communication transmissions, place their files in an unsecured location, or utilize a relay server to route the data to its intended destination, thereby not initializing a peer-to-peer communication session at all.

These alternatives, however, have significant drawbacks. The best current option for the initialization of a peer-to-peer communication session between electronic devices, leaving a port permanently open in a network address translator, creates high security risks for devices on the local area network. Permanently opened ports create high risks of a security breach in the local area network, allowing unwanted or unauthorized communication through the network address translator, increasing the risk that data or system performance may be compromised by third party devices or programs, such as viruses, worms, or spy ware.

Furthermore, the utilization of a relay server to transfer data from a first communication device to a second communication device also creates high risks of data exposure to harmful third parties and other breaches of confidentiality. Should the relay server store or copy data, or should the relay server allow a third party to listen in on the relayed data, the data may be compromised. Moreover, utilization of a relay server imposes additional bandwidth costs. As such, there is a need for a method and system for establishing a peer-to-peer communication session between a first and a second communication device on local area networks separated by the wide area network that does not create the risks of the current methods.

Current methods of file sharing between devices on local area networks separated by a wide area network, such as the internet, are limited. There is a need in the art for an apparatus and method for establishing a peer-to-peer communication session between electronic devices over a wide area network. Specifically, there is a need for a device that facilitates a direct peer-to-peer communication session between a first and a second communication device on different local area networks separated by the wide area network. It is to these ends that the present invention has been developed.

SUMMARY OF THE INVENTION

To minimize the limitations in the prior art, and to minimize other limitations that will be apparent upon reading and understanding the present specification, the present invention describes a method of establishing a peer-to-peer communication session with a host device by a client device, comprising receiving routing information of the host device from a server coupled to a wide area network, sending routing information of the client device to the server, providing authentication information to the host device via the wide area network, and sending peer-to-peer communication to the host device via the wide area network if authenticated to communicate with the host device.

The present invention also describes a client device for establishing a peer-to-peer communication session with a host device, adapted to receive routing information of the host device from a server coupled to a wide area network, send routing information of the client device to the server, provide authentication information to the host device via the wide area network, and send peer-to-peer communications to the host device via the wide area network if authenticated to communicate with the host device.

The present invention further describes a computer-readable medium including codes executable by a processor, for receiving routing information of the host device from a server coupled to a wide area network, sending routing information of the client device to the server, providing authentication information to the host device via the wide area network, and sending peer-to-peer communication to the host device via the wide area network if authenticated to communicate with the host device.

It is an objective of the present invention to provide an effective method for the initiation of a peer-to-peer communication session between electronic devices on separate local area networks.

It is another objective of the present invention to provide a system for establishing a peer-to-peer communication session between a host device and a client device.

It is yet another objective of the present invention to provide a computer-readable medium adapted to provide the receiving of routing information of a host device, from a server, provide routing information to the host device by transmitting the routing information to the server, and providing authentication information to the host device via a wide area network in order to establish a peer-to-peer communication session with the host device.

Finally, it is yet another objective of the present invention to reduce the risk of a private network security breach, or some other data security compromise, from a third-party as a result of attempts to initiate a peer-to-peer communication session between a first and a second communication device.

These and other advantages and features of the present invention are described herein with specificity so as to make the present invention understandable to one of ordinary skill in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

Elements in the figures have not necessarily been drawn to scale in order to enhance their clarity and improve understanding of these various elements and embodiments of the invention. Furthermore, elements that are known to be common and well understood to those in the industry are not depicted in order to provide a clear view of the various embodiments of the invention.

FIG. **1**(*a*) illustrates a block diagram of an exemplary embodiment of a system for establishing a peer-to-peer communication session.

FIG. **1**(*b*) illustrates a block diagram of another exemplary embodiment of a system for establishing a peer-to-peer communication session.

FIG. **2**(*a*) illustrates a block diagram of an exemplary embodiment of communication between components of a system for establishing a peer-to-peer communication session.

FIG. **2**(*b*) illustrates a flow diagram of methods utilized by a system for establishing a peer-to-peer communication session.

FIG. **2**(*c*) illustrates a block diagram of a network address translator communicating with third party devices.

FIG. **3**(*a*) illustrates a flow chart of a method utilized for the initial authorization pairing necessary for establishing a peer-to-peer communication session.

FIG. **3**(*b*) illustrates as block diagram of an exemplary network setup utilized by a host device and a client device for the establishment of a peer-to-peer communication session.

FIG. **4**(*a*) illustrates a block diagram of an exemplary embodiment of a host communication device.

FIG. **4**(*b*) illustrates a flow chart of a method utilized by a host communication device for establishing a peer-to-peer communication session with a client communication device.

FIG. **5**(*a*) illustrates a block diagram of an exemplary embodiment of a client communication device.

FIG. **5**(*b*) illustrates a flow chart of a method utilized by a client communication device for establishing a peer-to-peer communication session with a host communication device.

FIG. **6** illustrates a flow chart of a method utilized by client communication device for establishing a communication session with host communication device.

DETAILED DESCRIPTION OF THE DRAWINGS

In the following discussion that addresses a number of embodiments and applications of the present invention, reference is made to the accompanying drawings that form a part hereof, where depictions are made, by way of illustration, of specific embodiments in which the invention may be practiced. It is to be understood that other embodiments may be utilized and changes may be made without departing from the scope of the present invention.

In the present disclosure, peer-to-peer communication may comprise communication or data transmission between two devices in direct connection over a network, without data transmission relayed through a server or another third party device.

A local area network ("LAN") may comprise a network of computers or other electronic devices within a home, office, or other location, wherein the network is separated or kept private from a wide area network ("WAN"), by a router, network hub, or network address translator ("NAT"). A WAN may comprise a broad computer network, such as the internet, that may connect multiple devices or LANs together.

An internet protocol ("IP") address may comprise a numeric label used to identify specific devices or locations on a network. A public IP address is an identifier that may be used to identify a device or location on a WAN, most typically assigned to public servers or NATs used to separate private networks from the WAN. A private IP address is an IP address assigned to a device for identification within a LAN, separated from the WAN by a NAT.

A NAT may comprise a device used for the modification of a network address header in data packets transmitted between a device on LAN and the WAN. NATs allow a single public IP address to be used by many devices on a LAN, redirecting and re-labeling incoming and outgoing communications to hide private IP address information from the WAN. Additionally, NAT devices may forward application or process specific ports from one network node to another.

In the context of the present application, an open port may comprise a port allowing for the data packet to be accepted or to pass through to its intended destination. In contrast, a closed port may comprise a port wherein data packets will be denied, and will not be received at the intended destination.

Now referring to the drawings, FIG. **1**(*a*) illustrates a block diagram of an exemplary embodiment of a system for establishing a peer-to-peer communication session. FIG. **1**(*b*) illustrates a block diagram of an alternative embodiment of a system for establishing a peer-to-peer communication session. Both FIGS. **1**(*a*) and **1**(*b*) depict system **10**, which comprises host device **11**, client device **12**, and server **13**. System **10** is designed to facilitate the establishment of a peer-to-peer communication session between host device **11** and client device **12**.

Host device **11** is a component of system **10** designed to send and receive peer-to-peer communications with client device **12** over WAN **16**. In an exemplary embodiment, of the present invention, host device **11** is hidden from devices on WAN **16** behind NAT **14**(*a*). To devices on WAN **16**, any communication from host device **11** is seen as being sent from the public IP address of NAT **14**(*a*). In embodiments utilizing NAT **14**(*a*), all communications transmitted from and sent to host device **11** may pass through NAT **14**(*a*).

As illustrated in FIGS. **1**(*a*) and **1**(*b*), host device **11** is connected to LAN **15**(*a*). LAN **15**(*a*), and all devices that may be located within it, is separated from WAN **16** by NAT **14**(*a*). Devices on LAN **15**(*a*) are typically identified by a private IP address utilized by NAT **14**(*a*) to differentiate devices located behind NAT **14**(*a*). In an exemplary embodiment, host device **11** may be assigned a unique private IP address by NAT **14**(*a*). In order for host device **11** to communicate with a device not within LAN **15**(*a*), the communication may traverse LAN **15**(*a*), NAT **14**(*a*), and WAN **16** in order to reach the intended recipient. To receive a communication from outside LAN **15**(*a*), the communication must pass through NAT **14**(*a*), and host device **11** must be anticipating the incoming data communication. Should host device **11** not be waiting for a data transmission, the communication will be blocked by NAT **14**(*a*).

Client device **12** is a component of system **10** designed to initiate a peer-to-peer communication session with host device **11** for data transfer over WAN **16**. In the exemplary embodiment depicted in FIG. **1**(*a*), client device **12** may be a component on LAN **15**(*b*), hidden from devices on WAN **16** behind NAT **14**(*b*). In such an embodiment, for client device **12** to communicate with a device not within LAN **15**(*b*), the communication may traverse LAN **15**(*b*), NAT **14**(*b*), and WAN **16** in order to reach its intended recipient. In an alternative embodiment of the present invention, as depicted in FIG. **1**(*b*), client device **12** may directly connect to WAN **16**.

To initiate a peer-to-peer communication session between host device **11** and client device **12**, both host device **11** and client device **12** must learn their own routing information and the routing information of the other respective device in order to initiate peer-to-peer communication. As such, both host device **11** and client device **12** are designed to communicate with server **13**. Server **13** is a component of system **10** designed to facilitate a peer-to-peer communication session between host device **11** and client device **12**. Server **13** may have a static IP address, such that host device **11** and client device **12** may know its location in order to initiate communication with server **13**.

In exemplary usage of the present invention, host device **11** and client device **12** may communicate with server **13** over WAN **16**. To facilitate a peer-to-peer communication session, server **13** exchanges the routing information of both host device **11** and client device **12** to host device **11** and client device **12**, respectively. Routing information of host device **11** and client device **12** may comprise the media access control ("MAC") address of the host device, Transmission Control Protocol ("TCP") private IP address, TCP public IP address, and User Datagram Protocol ("UDP") public address. The UDP public address comprises the public IP address and port number. With such routing information, host device **11** and client device **12** may initiate direct peer-to-peer communication.

FIG. **2**(*a*) illustrates a block diagram of an exemplary embodiment of communication between components of a system for establishing a peer-to-peer communication session. FIG. **2**(*a*) shows system **10**, comprising host device **11**, client device **12**, and server **13**, which may comprise UDP server **16** and TCP server **17**. FIG. **2**(*a*) further emphasizes Session Traversal Utilities for NAT ("STUN") message **18**(*a*), STUN message **18**(*b*), TCP registration **19**(*a*), TCP registration **19**(*b*), routing information message **20**(*a*), routing information message **20**(*b*), and request **21**. The components of system **10** are designed to communicate to facilitate the establishment of a peer-to-peer communication session between host device **11** and client device **12**.

To conduct peer-to-peer communication, both host device **11** and client device **12** are provided with their own respective UDP public address. In an exemplary embodiment, to discover their UDP public address, both host device **11** and client device **12** send STUN message queries to UDP server **16**, which is located on the opposing side of the NAT of each respective device.

For the purposes of the present invention, a STUN message is a query sent by a device on a LAN to UDP server **16** on the opposing side of the NAT separating the device from the WAN, requesting its UDP public address. UDP server **16** is a component of server **13** that, in response to a STUN message query, sends a data packet to the querying device containing the UDP public address of the device.

As such, to discover its UDP public address, host device **11** sends STUN message **18**(*a*) to UDP server **16**. In response to STUN message **18**(*a*), UDP server **16** sends host device **11** a data packet containing the UDP public address of host device **11**. In an exemplary embodiment, host device **11** may continuously send STUN message **18**(*a*) to UDP server **16** in frequent intervals, so that host device **11** may learn its new public IP address, should the address change. Likewise, client device **12** sends STUN message **18**(*b*) to UDP server **16**. In response to STUN message **18**(*b*), server **13** sends client device **12** a data packet containing the UDP public address of client device **12**. Client device **12** may continuously send STUN message **18**(*b*) to UDP server **16** in order to discover its UDP public address, should the address change.

Host device **11** completes TCP registration **19**(*a*) by transmitting its MAC address and TCP private IP address to TCP server **17**. Client device **12** completes TCP registration **19**(*b*) by transmitting its TCP private IP address and the MAC address of host device **11** to TCP server **17**. TCP server **17** is a component of server **13** which receives and records the routing information from host device **11** and client device **12**. As such, TCP registration **19**(*a*) and TCP registration **19**(*b*) both comprise of the MAC address of host device **11**, however, TCP registration **19**(*a*) includes the TCP private IP address of host device **11**, and TCP registration **19**(*b*) includes the TCP private IP address of client device **12**.

When server **13** recognizes a matching pair of devices based upon registration of the MAC address of host device **11**, server **13** forwards the routing information of client device **12** to host device **11** by way of TCP server **17**. Server **13** also forwards the routing information of host device **11** to client device **12** by way of TCP server **17**. Server **13** provides routing information to host device **11** through routing information message **20**(*a*). Server **13** provides routing information to client device **12** through routing information message **20**(*b*).

When client device **12** is provided the routing information of host device **11**, it sends request **21** to host device **11**, requesting to initiate a peer-to-peer communication session. Should host device **11** authorize client device **12** for peer-to-peer communication, peer-to-peer communication may commence.

In another exemplary embodiment of the present invention, host device **11**, after it has received the routing information of client device **12**, may attempt to initiate a peer-to-peer communication session with client device **12**. Host device **11** may send request **21** to client device **12**, requesting an authentication identifier from client device **12**, which is necessary in order to initiate peer-to-peer communication. An authentication identifier may comprise a unique identifier, such as a MAC address, serial number, username or password. Should host device **11** authorize client device **12** for peer-to-peer communication, peer-to-peer communication between host device **11** and client device **12** may commence.

FIG. **2**(*b*) illustrates flow diagrams of processes utilized by system **10** for establishing a peer-to-peer communication session between host device **11** and client device **12**, in accordance with one embodiment of the present invention. FIG. **2**(*b*) shows rendezvous process **100**, authentication process **120**, authentication process **140**, and peer-to-peer communication session **160**. Rendezvous process **100**, authentication process **120**, and authentication process **140** are explained in the orders described below; however, the following steps may be taken in any other conceivable sequence without deviating from the scope of the present invention.

Rendezvous process **100** is utilized by system **10** to transfer the routing information of client device **12** to host device **11** and the routing information of host device **11** to client device **12**. In an exemplary embodiment of the present invention, rendezvous process **100** may repeat continuously, as long as host device **11** and client device **12** are able to communicate with server **13**, even after peer-to-peer communication has been established. In the embodiment illustrated in FIG. **2**(*b*), rendezvous process **100** comprises steps **101**-**108**.

In step **101**, host device **11** sends STUN message **18**(*a*) and TCP registration **19**(*a*) to server **13**, as previously described for FIG. **2**(*a*). In step **102**, server **13** checks the memory of TCP server **17** to see if client device **12** has already registered with the MAC address of host device **11**. If there is no other device on record with such a MAC address, server **13** records the MAC address of host device **11** in the memory of TCP

server **17** and proceeds to step **103**. If client device **12** has already registered the MAC address of host device **11**, then server **13** recognizes the paired devices and proceeds to steps **107** and **108**.

In step **103**, server **13**, in response to STUN message **18**(*a*) sent by host device **11**, transfers the public IP address and port number of host device **11** to host device **11**. As long as host device **11** is online and able to communicate with server **13**, host device **11** and server device **13** will repeat steps **101-103**.

In step **104**, client device **12** may send STUN message **18**(*b*) and TCP registration **19**(*b*) to server **13**, as previously described above for FIG. **2**(*a*). In step **105**, server **13** checks the memory of TCP server **17** to see if host device **11** has already registered. If host device **11** has already registered its MAC address with TCP server **17**, then server **13** will recognize the paired devices and proceeds to steps **107** and **108**. If, however, host device **11** has not registered with server **13** prior to client device **12**, server **13** records the MAC address of host device **11** in the memory of TCP server **17**, as transmitted by client device **12**. Until both host device **11** and client device **12** are simultaneously in communication with server **13**, sending STUN messages to server **13**, system **10** cannot yet proceed to steps **107** and **108**.

In step **106**, server **13**, in response to STUN message **18**(*b*) sent by client device **12**, transfers the public IP address and port number of client device **12** to client device **12**. As long as client device **12** is online and able to communicate with server **13**, client device **12** and server device **13** will repeat steps **104-106**. Further, in other embodiments of the present invention, steps **104-105** may occur before or simultaneously with steps **101-103**.

In step **107**, server **13** transmits routing information **20**(*a*) to host device **11**. In step **108**, server **13** transmits routing information **20**(*b*) to client device **12**. Note, however, in other embodiments of the present invention, server **12** may perform step **108** before or simultaneously with step **107**. Once steps **107** and **108** have been completed, with routing information **20**(*a*) and **20**(*b*) transferred to host device **11** and client device **12**, system **10** proceeds to authentication process **120**, or in other embodiments of the present invention, authentication process **140**.

Authentication process **120** is utilized by system **10** to authorize and initiate a peer-to-peer communication session between host device **11** and client device **12**. In the embodiment illustrated in FIG. **2**(*b*), authentication process **120** comprises steps **121-123**.

In step **121**, client device **12** directly communicates with host device **11**, sending request **21** to initiate a peer-to-peer communication session and its authentication identifier. Should host device **11** receive request **21**, sent by client device **12**, system **10** proceeds to step **122**. However, should host device **11** not receive request **21** from client device **12**, system **10** cannot proceed to step **122**, but instead may initiate authentication process **140**. Client device **12** may repeat step **121** until it receives a response from host device **11**.

In step **122**, host device **11** compares the authentication identifier of client device **12** with identifiers of authorized devices stored in the memory of host device **11**. Should the authentication identifier of client device **12** match that of an authorized device stored in the memory of host device **11**, then client device **12** is authorized for peer-to-peer communication. If, however, the authentication identifier of client device **12** is not found in the memory of host device **11**, then client device **12** is not authorized for peer-to-peer communication.

In step **123**, host device **11** replies to client device **12**, either approving or denying a request to initiate a peer-to-peer communication session. If authentication of client device **12** is approved by host device **11**, then system **10** proceeds to peer-to-peer communication session **160**. Should authentication be denied by host device **11**, then peer-to-peer communication with client device **12** is terminated.

Authentication process **140** is an alternative authentication process utilized by system **10** to authorize and initiate a peer-to-peer communication session between host device **11** and client device **12**. In the embodiment illustrated in FIG. **2**(*b*), authentication process **140** comprises steps **141-144**.

In step **141**, host device **11** sends request **21** to initiate a peer-to-peer communication session, requesting an authentication identifier from client device **12**. Should the request sent by host device **11** be received by client device **12**, system **10** will proceed to step **142**. Until host device **11** receives a response from client device **12**, host device **11** may repeat step **141**.

In step **142**, client device **12** responds to host device **11** by transferring its authentication identifier. Should host device **11** receive the authentication identifier sent by client device **12**, system **10** will proceed to step **143**. Until client device **12** receives a response from host device **11**, client device **12** may repeat step **141**. Additionally, should client device **12** not receive a response from host device **11**, client device **12** may initiate authentication process **120**.

In step **143**, host device **11** compares the authentication identifier of client device **12** with identifiers of authorized devices stored in the memory of host device **11**. Should the authentication identifier of client device **12** match that of an authorized device stored in the memory of host device **11**, then client device **12** is authorized for peer-to-peer communication. If, however, the authentication identifier of client device **12** is not found in the memory of host device **11**, then client device **12** is not authorized for peer-to-peer communication.

In step **144**, host device **11** replies to client device **12**, either approving or denying a request to initiate a peer-to-peer communication session. If authentication of client device **12** is approved by host device **11**, then system **10** proceeds to peer-to-peer communication session **160**.

Peer-to-peer communication **160** is a form of communication between host device **11** and client device **12** wherein data is transferred directly between the devices, without the need for a relay server. At anytime during peer-to-peer communication **160**, should communication be interrupted or routing information for either host device **11** or client device **12** is altered, authentication process **120** or authentication process **140** may be reinitialized to reestablish peer-to-peer communication **160**.

FIG. **2**(*c*) illustrates a block diagram of NAT **14**(*a*) communicating with third party devices. FIG. **2**(*c*) shows NAT **14**(*a*), comprising open port **22**, closed port **23** and translated port **24**. NAT **14**(*a*) translates STUN message **18**(*a*) from host device **11** to UDP server **16** and allows request **21** through open port **22** to reach host device **11**, but denies communication **25** from reaching host device **11**.

Open port **22** is a component of NAT **14**(*a*) which allows expected communications from WAN **16** to reach devices on LAN **15**(*a*), such as host device **11**. In exemplary performance of NAT **14**(*a*), ports are left closed, such as closed port **23**. Only when a communication is expected is a port left open. In an exemplary performance the present invention, when STUN message **18**(*a*) is sent to UDP server **16**, both host device **11** and NAT **14**(*a*) expect a response communication from UDP server **16**. As a result, NAT **14**(*a*) allows access to open port **22** in order to receive communication from UDP server **16**.

Translated port **24** is the private port address that NAT **14**(*a*) routes communications that were not blocked by closed port **23**. Should a communication pass through open port **22**, NAT **14**(*a*) translates the destination information within the communication such that the communication may lead to translated port **24**.

Communications from devices on WAN **16** that are not expected by will not be allowed to reach LAN **15**(*a*). As illustrated, communication **25** may be blocked by closed port **23** because it is not directed to open port **22**. Should communication **25** be directed at open port **22**, however, it may be permitted to pass through to LAN **15**(*a*) only if it contained routing information **20**(*b*), which is necessary to pass through open port **22**.

In exemplary usage of the present invention, request **21** may pass through open port **22** because request **21** contains routing information **20**(*b*) in its destination information. NAT **14**(*a*) allows request **21** to pass through to host device **11**, even though request **21** was not sent from UDP server **16** in response to STUN message **18**(*a*) because client device **12** tailored request **21** to include routing information **20**(*b*). Because client device **12** was provided with the TCP private address of host device **11** in routing information **20**(*b*), request **21** is approved by NAT **14**(*a*) to be transmitted to host device **11**.

FIG. **3**(*a*) explains an initial pairing procedure in order for host device **11** to recognize and authorize client device **12** for peer-to-peer communication. In order for host device **11** to authorize client device **12**, host device **11** must possess the authentication identifier of client device **12**. In an exemplary embodiment of the present invention, client device **12** may comprise a Universal Serial Bus ("USB") compatible device, or USB key **26**, illustrated in FIG. **3**(*b*), containing an authentication identifier, such as a serial number. In such embodiments, as explained below, USB key **26** of client device **12** may be connected to host device **11** for initial pairing. In other embodiments of the present invention, however, client device **12** may comprise some other electronic device, such as a PDA or smart device, thereby requiring a different method of initial pairing, such as inputting the authentication identifier via keyboard interface.

FIG. **3**(*a*) illustrates a flow chart of method **300** utilized by host device **11** and a USB key for the initial authorization pairing necessary for establishing a peer-to-peer communication session between host device **11** and client device **12**. Method **300** is explained in the order shown below; however, the following steps may be taken in any other conceivable sequence without deviating from the scope of the present invention.

In step **301**, USB key **26** of client device **12** is connected to host device **11**. In exemplary usage of the present invention, USB key **26** may be plugged into a USB port of host device **11**. In other embodiments of the present invention, client device **12** may connect to host device **11** via direct peer-to-peer communication, such as BLUETOOTH®, or over LAN **15**(*a*). In step **302**, the authentication identifier of USB key **26** is recorded in the memory of host device **11**.

In an exemplary embodiment of the present invention, recorded authentication identifiers within the memory of host device **11** are classified for unauthorized access to host device **11**. In step **303**, host device **11** reclassifies the authentication identifier of USB key **26** stored in the memory of host device **11** for authorized communication with host device **11**. In another embodiment of the present invention, recorded authentication identifiers stored within the memory of host device **11** may be reclassified from authorized to unauthorized, or vice versa.

In step **304**, USB key **26** records the MAC address of host device **11** into its memory. As previously described, in an exemplary embodiment of the present invention, client device **12** submits the MAC address of host device **11** to server **13** in order to receive the routing information of host device **11** necessary for initialization of a peer-to-peer communication session.

Finally, in step **305**, USB key **26** is disconnected from host device **11**. Should a user of the present invention intend to establish a peer-to-peer communication session with host device **11**, the user must first connect USB key **26** to their electronic device in order to authorize it for peer-to-peer communication access. In the event that USB key **26** is not plugged into the user's electronic device, or in another embodiment of the present invention should authorized software not be installed and running, then the electronic device will not be authorized for peer-to-peer communication with host device **11**.

FIG. **3**(*b*) illustrates a block diagram of an exemplary network setup utilized by host device **11** and client device **12** for the establishment of a peer-to-peer communication session through NAT **14**(*a*) and WAN **16**. FIG. **3**(*b*) shows client device **12**, utilizing USB key **26**, and host device **11**, communicating through NAT **14**(*a*) and WAN **16**. Additionally, host device **11** may communicate with home computer **27** over LAN **15**(*a*).

In an exemplary embodiment of the present invention, host device **11** may comprise a network connected data storage device, located on LAN **15**(*a*), such as a network hard drive or data storage server. As previously described for FIG. **3**(*a*), host device **11** is initially paired with USB key **26** for peer-to-peer communication authorization. When host device **11** is connected to LAN **15**(*a*), it may be accessible for peer-to-peer communication with client device **12**.

In the embodiment of the present invention illustrated in FIG. **3**(*b*), client device **12** may comprise any network accessible electronic device, such as a personal computer, notebook computer, smart phone or personal digital assistant, and USB key **26**, provided that the electronic device may access USB key **26**. Client device **12** may communicate with host device **11** over WAN **16** and through NAT **14**(*a*). As previously described, client device **12** need be authorized for peer-to-peer communication with host device **11** in order initiate a peer-to-peer communication session through NAT **14**(*a*), and need to communicate with server **13** in order to learn the routing information of host device **11** in order to initiate a peer-to-peer communication session.

Communication between host device **11** and devices on LAN **15**(*a*) behind NAT **14**(*a*), and separate from WAN **16**, however, may not require the provision of routing information or an authorization identifier. In an exemplary embodiment, home computer **27** may initiate a peer-to-peer communication session with host device **11** on LAN **15**(*a*) without the need to provide routing information or an authorization identifier. Because host device **11** is not hidden from personal computer **27** by NAT **14**(*a*), host device **11** may be accessible and visible on LAN **15**(*a*) and may be communicated with by home computer **27** without the need for a complex peer-to-peer communication session initiation procedure. In the present example, home computer **27** may comprise a network accessible electronic device. In exemplary embodiments, home computer **27** may comprise a personal computer, notebook computer, smart phone or personal digital assistant, or other electronic device capable of network.

FIG. **4**(*a*) illustrates a block diagram of an exemplary embodiment of the internal components of host device **12**. FIG. **4**(*a*) shows host device **11**, comprising processor **30**,

memory **31**, pairing interface **32**, and network interface **33**, connected to an external network, such as WAN **16**. Host device **11**, however, may comprise other internal or external components and not depart from the scope of the present invention. Host device **11** is designed to initiate a peer-to-peer communication session with client device **12** over WAN **16**.

Processor **30** is a component of host device **11** that governs the functionality of host device **11**. All data inputs and command instructions from external devices through network interface **33** may ultimately be relayed through processor **30**. In an exemplary embodiment of the present invention, processor **30** instructs network interface **33** to communicate with external devices.

Memory **31** is a component of host device **11** wherein data is stored and accessed for peer-to-peer communication with client device **12**. Processor **30** may access data stored in memory **31** for transmission through peer-to-peer communication, or for authorization of client device **12**. Additionally, processor **30** may access memory **31** to record, modify, or delete data stored within in memory **31**. Data stored in memory **31** may be transferred through network interface **33** via processor **30**.

Pairing interface **32** is a component of host device **11** wherein external devices may be connected with host device **11** for initial pairing and authorization, as previously discussed for FIG. **3**(*a*). In an exemplary embodiment of the present invention, pairing interface **32** may comprise a USB receiver port, wherein a USB key such as USB key **26** may be plugged into pairing interface **32** such that processor **30** may store the authentication identifier of the USB key within memory **31**. Additionally, processor **30** may instruct pairing interface **32** to record the MAC address of network interface **33** within the memory of the USB key for later rendezvous between client device **12** and server **13**. In another embodiment of the present invention, pairing interface **32** may comprise a keyboard interface, wherein a user of host device **11** may key in the authentication identifier of client device **12** for initial pairing between host device **11** and client device **12**.

Network Interface **33** is a component of host device **11** that communicates with external devices, such as client device **12** and server **13**, through an external network connection. Network interface **33** may comprise a wired connection to NAT **14**(*a*), or may utilize a wireless LAN, BLUETOOTH® protocol, or some other compatible connection interface with NAT **14**(*a*). In an exemplary embodiment of the present invention, network interface **33** may communicate with server **13** for rendezvous process **100**, and client device **12** for direct peer-to-peer communication. In such an embodiment, processor **30** may direct network interface **33** to accept or reject incoming communications from external electronic devices, direct network interface **33** to send an appropriate communication to server **13** or client device **12**.

FIG. **4**(*b*) illustrates a flow chart of method **400** utilized by host device **11** for establishing a peer-to-peer communication session with client device **12**. Method **400** is explained in the order shown below; however, the following steps may be taken in any other conceivable sequence without deviating from the scope of the present invention.

In step **401**, host device **11** completes the initial pairing method with client device **12**, as described in FIGS. **3**(*a*) and **4**(*a*). Once initial pairing has been completed, and the authentication identifier for client device **12** has been recorded, host device **11** proceeds to step **402**.

In step **402**, host device **11** sends STUN message **18**(*a*) to UDP server **16** and TCP registration **19**(*a*) to TCP server **17** via network interface **33**. In an exemplary embodiment of the present invention, step **402** may be continuously repeated. In step **402**, host device **11** continually updates server **13** with the routing information of host device **11**, should it change.

In step **403**, host device **11** receives the UDP public IP address of host device **11** from server **13** via network interface **33**, in response to the STUN message **18**(*a*) sent in step **402**. Processor **30** stores the UDP public IP address of host device **11** within memory **31**. In an exemplary embodiment of the present invention, step **403** updates host device **11** of its own UDP public IP address, should the address change. Step **403** may repeat continuously, as server **13** may repeatedly send responses to STUN messages sent in step **402**. In step **404**, host device **11** receives routing information **20**(*a*), the routing information of client device **12** from server **13** via network interface **33**. Processor **30** stores routing information **20**(*a*) client device **12** within memory **31**.

In step **405**, host device **11** waits for the initial peer-to-peer communication from client device **12** via network interface **33**. Should host device **11** receive request **21** from client device **12**, host device **11** proceeds to step **406**. Should host device **11** not receive request **21** to communicate and an authentication identifier from client device **12** within a set period of time, host device **11** proceeds to step **407**. In an alternative embodiment of the present invention, host device **11** may proceed directly to step **407** without waiting for communication from client device **12**.

In step **406**, host device **11** performs authorization process **120**, as previously described for FIG. **2**(*b*). Host device **11** receives request **21** from client device **12** via network interface **33** along with an authentication identifier from client device **12**. Should the authentication identifier transferred from client device **12** be stored in memory **31**, processor **30** will approve client device **12** for peer-to-peer communication, instruct network interface **33** to send an approval message to client device **12**, and host device **11** will proceed to step **409**. However, should the authentication identifier not be stored in memory **31**, or the identifier transferred was not authorized, processor **30** may deny client device **12** for peer-to-peer communication, and host device **11** will proceed to step **408**.

In step **407**, host device **11** performs authorization process **140** as previously described for FIG. **2**(*b*). Host device **11** sends request **21** to client device **12** for its authentication identifier, to initiate a peer-to-peer communication session. Should client device **12** transfer its authentication identifier to host device **11**, host device **11** may check memory **31** if the authentication identifier is approved. Should the authentication identifier transferred by client device **12** be stored in memory **31**, processor **30** will approve client device **12** for peer-to-peer communication, instruct network interface **33** to send an approval message to client device **12**, and host device **11** will proceed to step **409**. However, should the authentication identifier not be stored in memory **31**, or the identifier transferred was not authorized, processor **30** may deny client device **12** for peer-to-peer communication, and host device **11** will proceed to step **408**.

In step **408**, host device **11** denies client device **12** access because it is not authorized for peer-to-peer communication. Host device **11** may send a denial communication to client device **12** and terminate peer-to-peer communication. Finally, in step **409**, host device **11** may send an approval message to client device **12**, and begin peer-to-peer communication session for data transfer. In an exemplary embodiment of the present invention, should a peer-to-peer communication session conclude or end prematurely because of a disconnection or other network problems, host device **11** may reestablish a peer-to-peer communication session with client

device **12** by performing steps **404-407** again to reauthorize client device **12** for peer-to-peer communication.

FIG. **5**(*a*) illustrates a block diagram of an exemplary embodiment of the internal components of client device **12**. FIG. **5**(*a*) shows client device **12**, comprising processor **40**, memory **41**, USB interface **42**, USB key **26**, and network interface **43**, connected to an external network, such as WAN **16**. Client device **12**, however, may comprise other internal or external components and not depart from the scope of the present invention. Client device **12** is designed to initiate a peer-to-peer communication session with host device **11** over WAN **16**.

Processor **40** is a component of client device **12** that governs the functionality of client device **12**. All data inputs and command instructions from external devices through network interface **43** may ultimately be relayed through processor **40**. In an exemplary embodiment of the present invention, processor **40** instructs network interface **43** to communicate with external devices.

Memory **41** is a component of client device **12** in which data is stored for peer-to-peer communication with host device **11**. Processor **40** may access data stored in memory **41** for transmission through peer-to-peer communication, or for authorization of client device **12** with host device **11**. Additionally, processor **40** may access memory **41** to record, modify, or delete data stored in memory **41**. Data stored in memory **41** may be transferred through network interface **43** via processor **40**.

USB Interface **42** is a component of client device **12** wherein external devices may be connected to client device **12** for access to an authentication identifier for the initialization of peer-to-peer communication with host device **11**. In an exemplary embodiment of the present invention, USB interface **42** may comprise a USB receiver port, wherein USB key **26** may be plugged into USB interface **42** such that processor **40** may access the authentication identifier for authentication process **120** or authentication process **140**, as previously described for FIG. **2**(*b*). Additionally, processor **40** may instruct USB interface **42** to record the MAC address of host device **11** stored within the memory of USB key **26** for rendezvous between client device **12** and server **13**.

USB key **26** is a component of client device **12** that may be initially paired for authorization with host device **11**, as previously described for FIG. **3**(*a*). USB key **26** may include the MAC address of host device **11**, such that when connected to USB interface **42**, processor **40** may request the routing information of host device **11** from server **13** to initiate a peer-to-peer communication session. Additionally, USB key **26** may store an authentication identifier, which may be initially transferred to host device **11** such that client device **12** may be authorized for peer-to-peer communication with host device **11**. In an exemplary embodiment of the present invention, USB key **26** may connect with USB interface **42** such that processor **40** may access the authentication identifier and transfer it to host device **11** through network interface **43** for authorization to initiate peer-to-peer communication.

In an alternative embodiment of the present invention, client device **12** may not include USB key **26**. In such an embodiment, when USB key **26** is connected to USB interface **42**, processor **40** may copy the authentication identifier stored in USB key **26** to memory **41**. As such, client device **12** may utilize the authentication identifier stored in memory **41** to be authorized for peer-to-peer communication with host device **11**, should USB key **26** not be connected to client device **12**. In another embodiment of the present invention, however, the authentication identifier stored in USB key **26** may be read-only, prohibiting processor **40** from storing the authentication identifier in memory **41**.

Network Interface **43** is a component of client device **12** that communicates with external devices, such as host device **11** and server **13**, through an external network connection. Network interface **43** may comprise a wired connection to NAT **14**(*b*), or may utilize a wireless LAN, BLUETOOTH® protocol, or some other compatible connection interface with NAT **14**(*b*). In an exemplary embodiment of the present invention, network interface **43** may communicate with server **13** for rendezvous process **100**, and host device **11** for direct peer-to-peer communication. In such an embodiment, processor **40** may direct network interface **43** to accept or reject incoming communications from external electronic devices, direct network interface **43** to send an appropriate communication to server **13** or host device **11**.

FIG. **5**(*b*) illustrates a flow chart of method **500** utilized by client device **12** for establishing a peer-to-peer communication session with host device **11**. Method **500** is explained in the order shown below; however, the following steps may be taken in any other conceivable sequence without deviating from the scope of the present invention.

In step **501**, USB key **26** is detected by processor **40** through USB interface **42**. In an exemplary embodiment of the present invention, USB key **26** may be connected to client device **12** through USB interface **42**. In alternative embodiments of the present invention wherein client device **12** does not comprise USB key **26** or USB interface **42**, step **501** may be skipped. In step **502**, processor **40** accesses USB key **26** through USB interface **42** and receives the authentication identifier and MAC address from USB key **26** necessary for peer-to-peer communication with host device **11**. In one embodiment of the present invention, processor **40** may copy the authentication identifier and MAC address stored on USB key **26** to memory **41**. In other embodiments of the present invention, USB key **26** may include software for peer-to-peer communication with host device **11**, which may be run by processor **40**.

In step **503**, client device **12** sends STUN message **18**(*b*) to UDP server **16** and TCP registration **19**(*b*) to TCP server **17** via network interface **43**. In an exemplary embodiment of the present invention, step **503** may be continuously repeated. In step **503**, client device **12** continually updates server **13** with the routing information of client device **12**, should it change.

In step **504**, client device **12** receives the UDP public IP address of client device **12** from server **13** via network interface **43**, in response to the STUN message **19**(*b*) sent in step **503**. Processor **40** stores the UDP public IP address of client device **12** within memory **41**. In an exemplary embodiment of the present invention, step **504** updates client device **12** of its own UDP public IP address, should the address change. Step **504** may repeat continuously, as server **13** may repeatedly send responses to STUN messages sent in step **503**. In step **505**, client device **12** receives routing information **20**(*b*) of host device **11** from server **13** via network interface **43**. Processor **40** stores the routing information of host device **11** within memory **41**.

In step **506**, client device **12** performs authentication process **120**, as previously described for FIG. **2**(*b*). Client device **12** sends request **21** and its authentication identifier to host device **11** via network interface **43**. Processor **40** then instructs network interface **43** to wait for a response from host device **11**. Should client device **12** receive an authentication approval message from host device **11** via network interface **43**, client device **12** may proceed to step **508**. Should client device **12** receive an authentication denied message from host device **11** via network interface **43**, client device **12** may

proceed to step **507**. Should client device **12** receive no response from host device **11** or should client device **12** receive a request for its authentication identifier from host device **11**, client device **12** may repeat step **506**.

In step **507**, client device **12** received an authentication denied message from host device **11** via network interface **43**, terminating peer-to-peer communication between host device **11** and client device **12**. In one embodiment of the present invention, client device **12** may return to step **506** to request peer-to-peer communication.

Finally, in step **508**, client device **12** may begin peer-to-peer communication and data transfer with host device **11**, as client device **12** has been authorized for peer-to-peer communication. In an exemplary embodiment of the present invention, should a peer-to-peer communication session conclude or end prematurely because of a disconnection or other network problems, client device **12** may reestablish a peer-to-peer communication session with host device **11** by performing steps **505-508** again to reauthorize client device **12** for peer-to-peer communication.

FIG. **6** illustrates a flow chart of method **600** utilized by client device **12** for establishing a communication session with host device **11**. Method **600** is explained in the order shown below; however, the following steps may be taken in any other conceivable sequence without deviating from the scope of the present invention.

In step **601**, client device **12** attempts to establish a peer-to-peer communication session with host device **11** via UDP connection protocol. In an exemplary embodiment, client device **12** attempts to initialize communication with host device **11** via the UDP public IP address and port of host device **11**. Client device **12** may attempt this UDP connection because client device **12** was previously relayed the UDP public IP address and port of host device **11** by server **13** in routing information message **20**(*b*). In such an embodiment, client device **12** may attempt to initialize UDP connection with host device **11** for 2 seconds.

In alternative embodiments of the present invention, client device **12** may attempt to receive communication from host device **11** via UDP connection protocol. In such embodiments, client device **12** may listen for communication via its UDP public IP address and port number for communication from host device **11**.

Likewise, host device **11** may attempt to receive or send communication to client device **12** via UDP protocol. In an exemplary embodiment of the present invention, host device **11** may attempt to accept communication from client device **12** via its UDP public IP address and port for two seconds. In other embodiments, host device **11** may attempt to connect with client device **12** via UDP protocol for two seconds.

In step **602**, client device **12** determines if peer-to-peer communication via UDP protocol has been established with host device **11**. If client device **12** were to receive a connection acknowledgement from host device **11** that peer-to-peer communication has been established, then peer-to-peer communication via UDP protocol succeeded and client device **12** may proceed to step **605**. If, however, client device **12** were not to receive a connection acknowledgement from host device **11**, then peer-to-peer communication via protocol cannot be verified, and client device **12** proceeds to step **603**.

In step **603**, client device **12** attempts to establish a peer-to-peer communication session with host device **11** via TCP connection protocol. In an exemplary embodiment, client device **12** attempts to initialize a three-part handshake procedure with host device **11** via the TCP private IP address of host device **11**. Client device **12** may attempt this TCP connection because client device **12** was previously relayed the TCP private IP address of host device **11** by server **13** in routing information message **20**(*b*). In such an embodiment, client device **12** may attempt to initialize TCP connection with host device **11** for 2 seconds.

In alternative embodiments of the present invention, client device **12** may attempt to receive communication from host device **11** via TCP connection protocol. In such an embodiment, client device **12** may listen for communication via its TCP private IP address for communication from host device **11**.

Likewise, host device **11** may attempt to receive or send communication to client device **12** via TCP protocol. In an exemplary embodiment of the present invention, host device **11** may attempt to accept communication from client device **12** via its TCP private IP address for two seconds. In other embodiments, host device **11** may attempt to connect with client device **12** via TCP protocol for two seconds.

In step **604**, client device **12** determines if peer-to-peer communication via TCP protocol has been established with host device **11**. If client device **12** were to receive a connection acknowledgement from host device **11** that peer-to-peer communication has been established, then peer-to-peer communication via TCP protocol succeeded and client device **12** may proceed to step **605**. If, however, client device **12** were not to receive a connection acknowledgement from host device **11**, then peer-to-peer communication via protocol cannot be verified, and client device **12** may proceed to step **606**.

In some embodiments of the present invention, should client device **12** be unable to establish peer-to-peer communication with host device **11** via TCP protocol utilizing the TCP private IP address of host device **11**, client device **12** may then attempt to initialize peer-to-peer communication with host device **11** via TCP protocol utilizing the TCP public IP address of host device **11**. In such embodiments, client device **12** and host device **11** may repeat steps **603** and **604** utilizing the TCP private IP addresses of host device **11** and client device **12**, respectively.

In step **605**, a peer-to-peer communication session has been established between host device **11** and client device **12**. In exemplary embodiments of the present invention, the connection protocol used to initialize the peer-to-peer communication session may be utilized during the peer-to-peer communication session between host device **11** and client device **12**. For example, should client device **12** successfully establish connection with host device **11** utilizing the UDP connection protocol, client device **12** and host device **11** may then utilize the UDP connection protocol for communication and data transfer during their peer-to-peer communication session. Should the peer-to-peer communication session be terminated, client device **12** may attempt to reinitialize the communication session by returning to step **601**.

In step **606**, client device **12** utilizes server **13** to relay data and communication to and from host device **11** because peer-to-peer communication could not be established between host device **11** and client device **12** utilizing either the TCP or UDP connection protocols. In an exemplary embodiment, data may be transferred between host device **11** and client device **12** via relay over server **13**. In alternative embodiments, should a peer-to-peer connection later be established, the relay connection with server **13** may be terminated.

In alternative embodiments of the present invention, client device **12** may attempt to establish peer-to-peer communication with host device **11** via TCP protocol before later attempting to establish peer-to-peer communication with host device **11** via UDP protocol. In such an embodiment, client device **12** may attempt communication via UDP protocol should communication via TCP protocol be unsuccessful.

In yet other embodiments of the present invention, client device **12** and host device **11** may initialize relay communication via server **13** prior to any attempt to establish a peer-to-peer communication session. In such embodiments, data transfer may be accomplished via relay server until a peer-to-peer communication session is established. Should a peer-to-peer communication session be established between client device **12** and host device **11**, data transfer via relay through server **13** may be discontinued.

An apparatus and method for establishing a peer-to-peer communication session between electronic devices over a wide area network has been described. The foregoing description of the various exemplary embodiments of the invention has been presented for the purposes of illustration and disclosure. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention not be limited by this detailed description, but by the claims and the equivalents to the claims.

What is claimed is:

1. A method of establishing a peer-to-peer communication session with a host device by a client device, comprising:

detecting an attached USB compatible device;

receiving a first authentication information from the attached USB compatible device;

receiving routing information of the host device from a server coupled to a wide area network;

wherein the host device is located behind a Network Address Translator ("NAT") device;

sending routing information of the client device to the server;

providing a second authentication information to the host device via the wide area network;

comparing the first authentication information with the second authentication information to authenticate the client device;

establishing a peer-to-peer communication session with the host device via the wide area network if authenticated to communicate with the host device; and

transmitting data to the host device via the peer-to-peer communication session;

wherein routing information of the client device comprises any one or more of a TCP public IP address and port number, a UDP public IP address and port number, and a private IP address and port number of the client device; and a MAC address of the host device.

2. The method of claim **1**, further comprising communication with the server to maintain availability of a port.

3. The method of claim **1**, wherein routing information of the host device comprises any one or more of a Transmission Control Protocol (TCP) public Internet Protocol (IP) address and port number, a User Datagram Protocol (UDP) public IP address and port number, a private IP address and port number, and a Media Access Control (MAC) address of the host device.

4. The method of claim **2**, further comprising transmitting a STUN (Simple Traversal of UDP through Network Address Translators (NATs)) message query to the server for the UDP public IP address and port information of the client device.

5. The method of claim **4**, wherein the client device receives the UDP public IP address and port information of the client device from the server in response to the STUN message query.

6. The method of claim **1**, wherein the second authentication information of the client device is sent to the private IP address of the host device.

7. The method of claim **1**, wherein the second authentication information of the client device is sent to the TCP public IP address of the host device.

8. The method of claim **1**, wherein the second authentication information of the client device is sent to the UDP public IP address of the host device.

9. The method of claim **1**, wherein second authentication information comprises an identification code, serial number, username and password, or other unique identification information stored by the host device to identify an authorization of the client device for peer-to-peer communication.

10. The method of claim **1**, further comprising receiving a request for the second authentication information from the host device via an open private port.

11. The method of claim **1**, further comprising receiving a request for the second authentication information from the host device via an open public port.

12. The method of claim **1**, wherein the client device records the MAC address of the host device.

13. A client device for establishing a peer-to-peer communication session with a host device, adapted to:

detect an attached USB compatible device;

receive a first authentication information from the attached USB compatible device;

receive routing information of the host device from a server coupled to a wide area network;

wherein the host device is located behind a Network Address Translator ("NAT") device;

send routing information of the client device to the server;

provide a second authentication information to the host device via the wide area network;

compare the first authentication information with the second authentication information to authenticate the client device;

establish a peer-to-peer communication session with the host device via the wide area network if authenticated to communicate with the host device; and

transmit data to the host device via the peer-to-peer communication session;

wherein routing information of the client device comprises any one or more of a TCP public IP address and port number, a UDP public IP address and port number, and a private IP address and port number of the client device, and a MAC address of the host device.

14. The device of claim **13**, wherein the client device is further adapted to communicate with the server to maintain availability of a port.

15. The device of claim **13**, wherein routing information of the host device comprises any one or more of a Transmission Control Protocol (TCP) public Internet Protocol (IP) address and port number, a User Datagram Protocol (UDP) public IP address and port number, a private IP address and port number, and a Media Access Control (MAC) address of the host device.

16. The device of claim **14**, wherein the client device is adapted to send a STUN (Simple Traversal of UDP through Network Address Translators (NATs)) message query to the server for the UDP public IP address and port information of the client device.

17. The device of claim **16**, wherein the client device is adapted to receive the UDP public IP address and port information of the client device from the server in response to the STUN message query.

18. The device of claim **13**, wherein the second authentication information comprises an identification code, serial number, MAC address, username and password, or some other unique identification information that may be stored by

the host device to identify an authorization of the client device for peer-to-peer communication.

19. The device of claim **13**, wherein the client device is adapted to send the second authentication information of the client device to the private IP address of the host device.

20. The device of claim **13**, wherein the client device is adapted to send the second authentication information of the client device to the TCP public IP address of the host device.

21. The device of claim **13**, wherein the client device is adapted to send the second authentication information of the client device to the UDP public IP address of the host device.

22. The device of claim **13**, wherein the client device is further adapted to receive a request for the second authentication information from the host device via an open private port.

23. The device of claim **13**, wherein the client device is further adapted to receive a request for the second authentication information from the host device via an open public port.

24. The device of claim **21**, wherein the client device records the MAC address of the host device.

25. A non-transitory computer-readable medium including codes executable by a processor, for:

detecting an attached USB compatible device;

receiving a first authentication information from the attached USB compatible device;

receiving routing information of the host device from a server coupled to a wide area network;

wherein the host device is located behind a Network Address Translator ("NAT") device;

sending routing information of the client device to the server;

providing a second authentication information to the host device via the wide area network;

comparing the first authentication information with the second authentication information to authenticate the client device;

establishing a peer-to-peer communication session with the host device via the wide area network if authenticated to communicate with the host device; and

transmitting data to the host device via the peer-to-peer communication session;

wherein routing information of the client device comprises any one or more of a TCP public IP address and port number, a UDP public IP address and port number, and a private IP address and port number of the client device, and a MAC address of the host device.

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