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(54) SYSTEM AND METHOD OF STREAMING DATA OVER A DISTRIBUTED INFRASTRUCTURE

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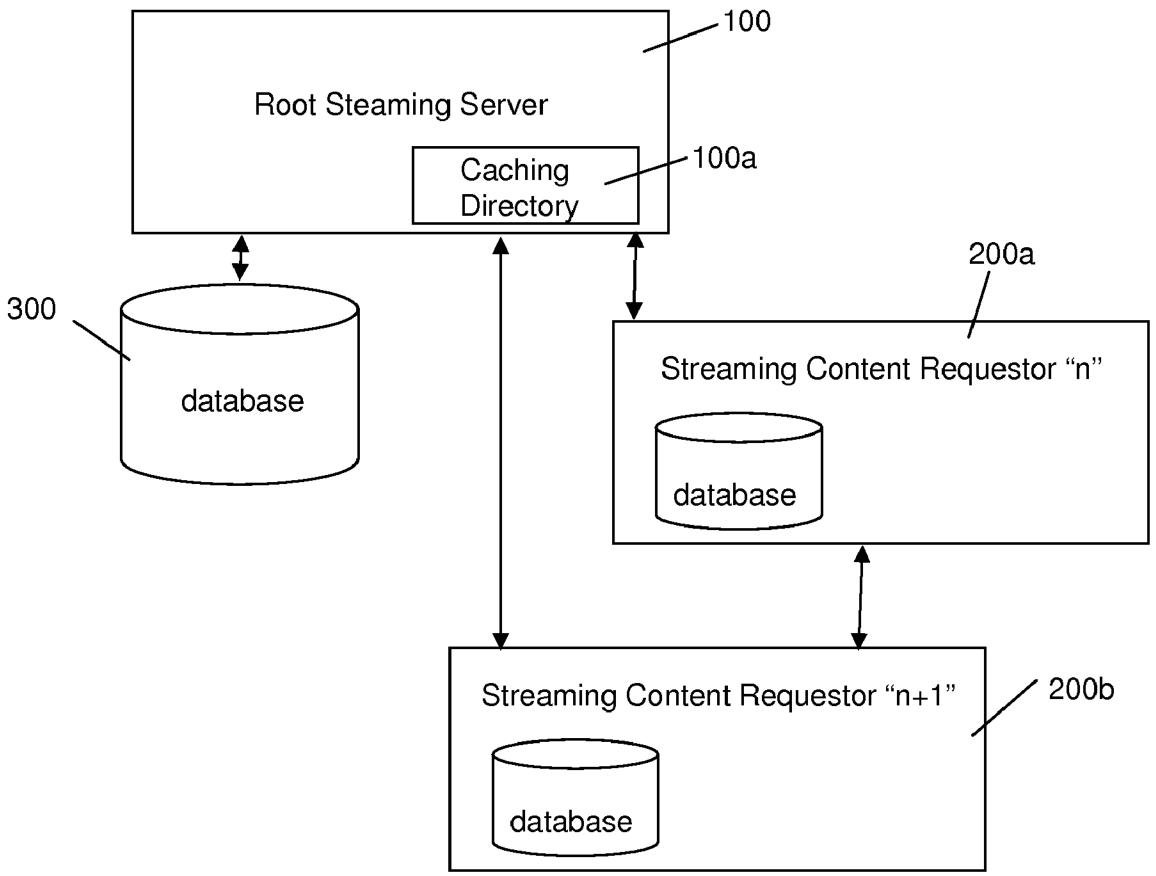
(57) ABSTRACT

A system and method of streaming data in real time and, more particularly, a system and method of real time streaming of data over a grid network or other distributed infrastructure. The method and system comprises updating a content directory of a root server with end resource information. The method and system further includes processing the end resource information to determine connection locations for streaming data to at least one requesting end resource in a network.



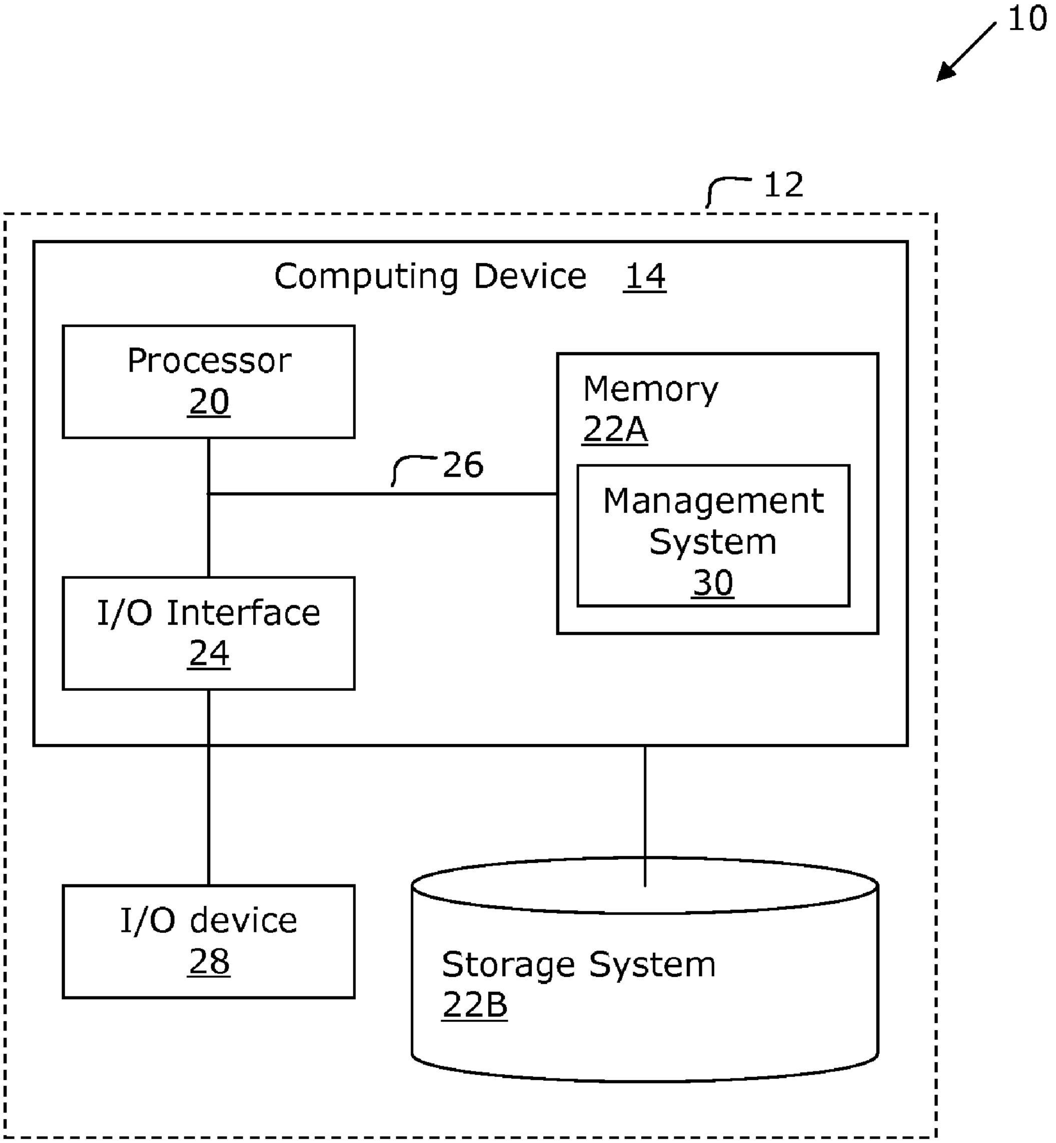

10
12
Computing Device 14
Processor 20
Memory 22A
26
Management System 30
I/O Interface 24
I/O device 28
Storage System 22B

FIG. 1

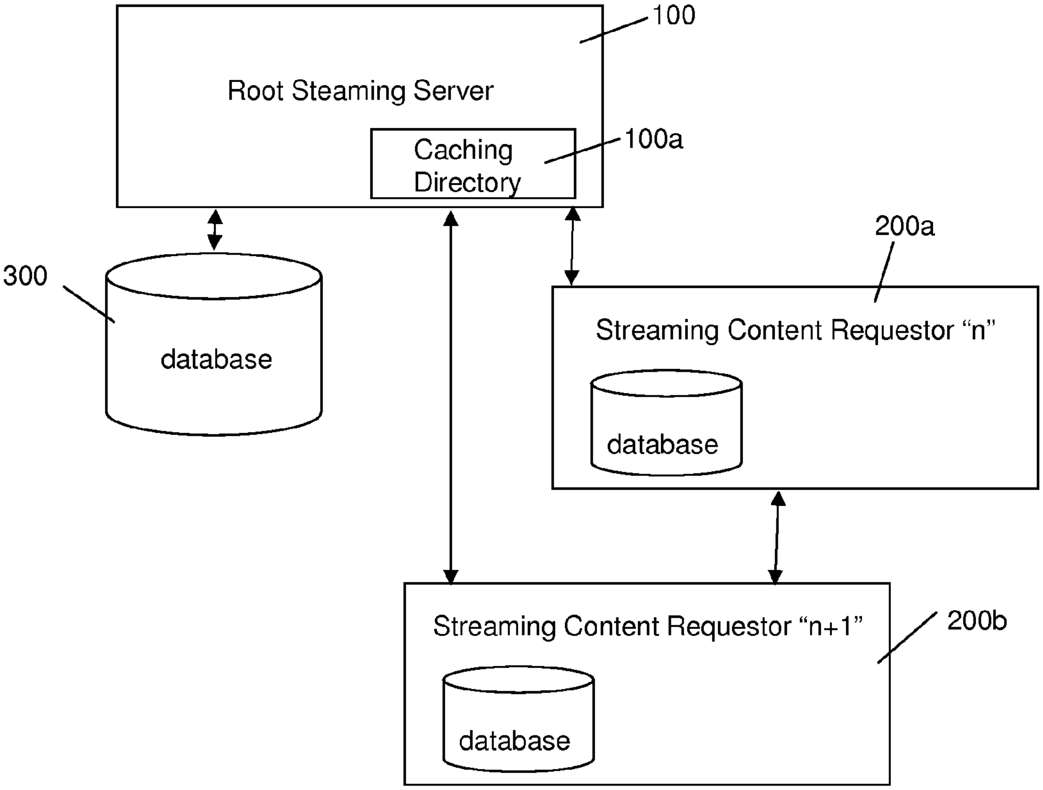

100
Root Steaming Server
Caching Directory
100a
300
database
200a
Streaming Content Requestor "n"
database
Streaming Content Requestor "n+1"
200b
database

FIG. 2

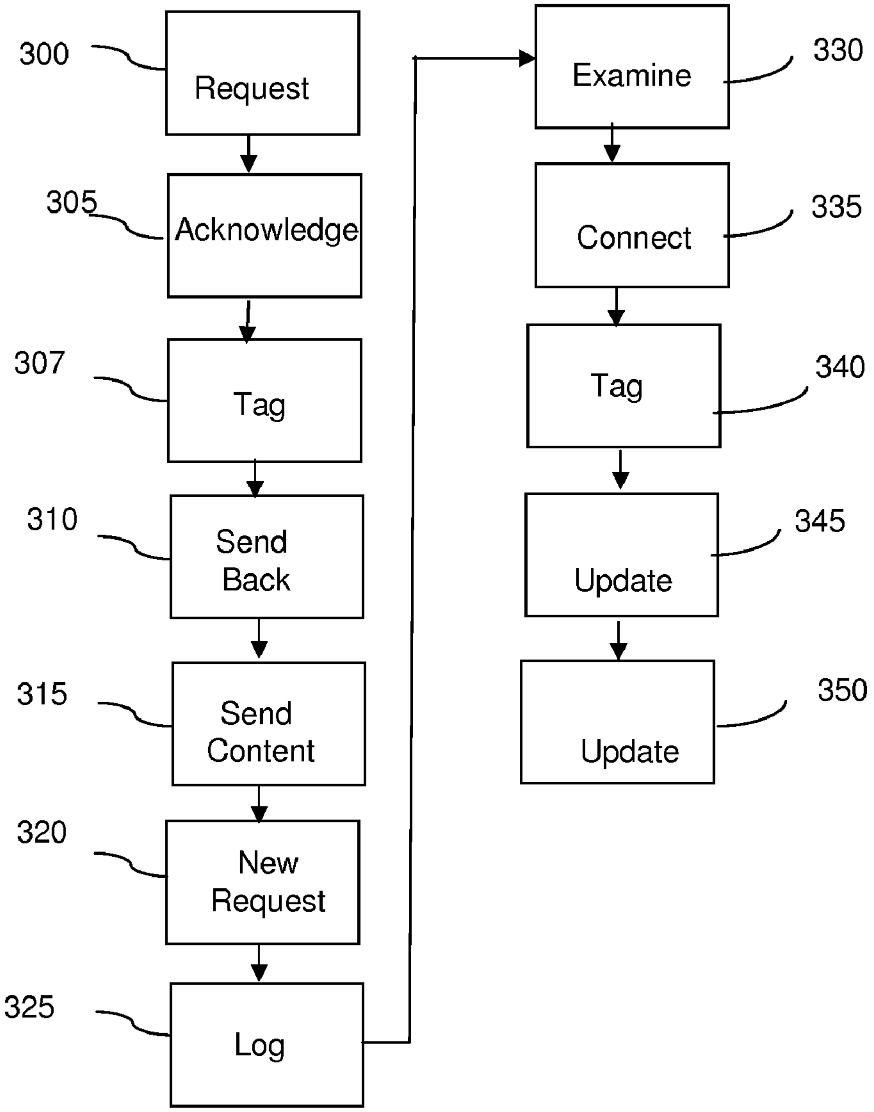

300
Request
305
Acknowledge
307
Tag
310
Send
Back
315
Send
Content
320
New
Request
325
Log
330
Examine
335
Connect
340
Tag
345
Update
350
Update

FIG. 3

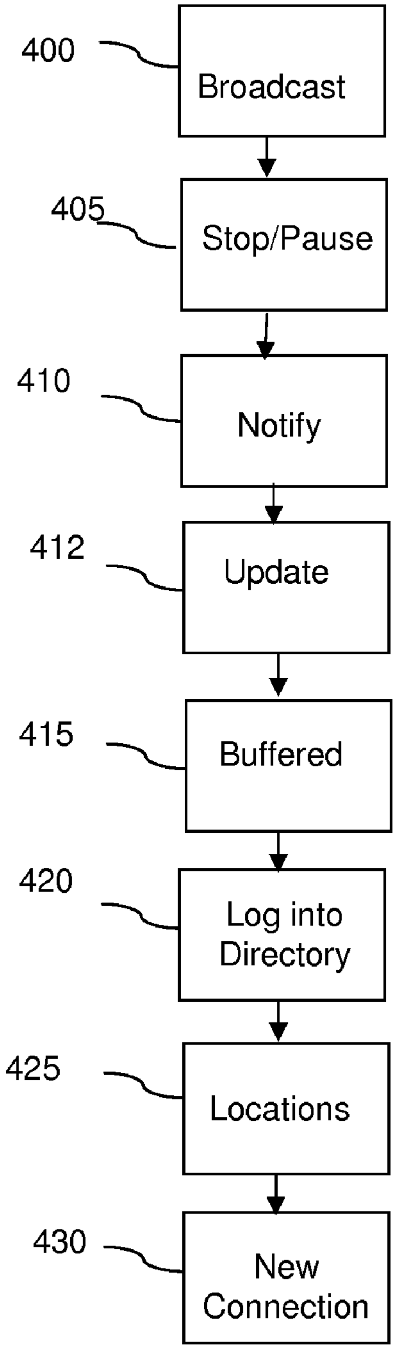

400
Broadcast
405
Stop/Pause
410
Notify
412
Update
415
Buffered
420
Log into Directory
425
Locations
430
New Connection

FIG. 4

SYSTEM AND METHOD OF STREAMING DATA OVER A DISTRIBUTED INFRASTRUCTURE

FIELD OF THE INVENTION

[0001] The invention generally relates to a system and method of streaming data in real time across a wide area network and, more particularly, to a system and method of real time streaming of data over a grid network or other distributed infrastructure.

BACKGROUND OF THE INVENTION

[0002] Managing multiple separate point-to-point connections from a storage source to an end user or application is very inefficient, as the same piece of information will be sent multiple times simultaneously. Consider the example of a group of people in one office listening to an audio stream from a server somewhere on the Internet, where everyone in the room is listening to the same streaming content, such as a conference call.

[0003] In known systems, data is streamed by unicast or point-to-point algorithms such as a TCPIP/IP connection from a centralized location (for example a Real Audio server) or by the use of a multicast. The use of IP multicasting is a method to reduce a huge amount of bandwidth and waste by only sending the data out to a preset collection of multicast nodes. The drawbacks to using multicasting is that the preset number of multicast nodes must be known beforehand and many routers over the public Internet do not understand the multicast protocol. Thus, multicasting is limited to synchronized streams, and foreknowledge of the multicast servers is required.

[0004] P2P protocols, through the use of complex hashing algorithms, can pull multiple file segments from separate sources and re-assemble those segments into a file. P2P protocols, however, require that the source file must be intact first, before the audio or video can be viewed. Also, regular TCP/IP can be wasteful of bandwidth, as it requires high utilization from the streaming data server. Also, systems require that the file be re-assembled before playback, and therefore, cannot be streamed. Thus, while the file transfer protocols are much more efficient, they do not allow for multiple streams to be re-assembled real-time and operated upon real-time.

[0005] Accordingly, there exists a need in the art to overcome the deficiencies and limitations described hereinabove.

SUMMARY OF THE INVENTION

[0006] In a first aspect of the invention a method comprises updating a content directory of a root server with end resource information. The method further includes processing the end resource information to determine connection locations for streaming data to at least one requesting end resource in a network.

[0007] In another aspect of the invention, the method comprises updating a content directory of the root directory with information related to a connected end user resource and creating a hierarchy of end user resources as the end user resource is connected with the root server. The method further comprises determining a connection location within the hierarchy of end user resources including the root server for receiving streamed data, the determining being based on information in the content directory.

[0008] In yet another aspect of the invention, a system comprising a server having a database contains data associated with one or more end user resources and connection information. At least one of a hardware and software component dynamically creates a data source hierarchy of the end user resources based on the data. The at least one of a hardware and software component provides connection locations to each of the end user resources that request access to the data stream. Each of the end user resources that request access to the data stream becomes part of the data source hierarchy.

[0009] In still another aspect of the invention, a computer program product comprises a computer usable medium having readable program code embodied in the medium. The computer program product includes at least one component to: update a content directory of a root server with end resource information; and process the end resource information to determine connection locations for streaming data to at least one requesting end resource in a network.

[0010] In a still further aspect of the invention, a method for deploying an application for streaming data over a network, comprises providing a computer infrastructure operable to: dynamically create a data source hierarchy of end user resources based on information associated with the end user resources which are connected to a root server, and provide connection locations to each of the end user resources that request access to a data stream streaming from one or more of the end user resources of the data source hierarchy and/or the root server.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] FIG. **1** shows an illustrative environment for implementing the steps in accordance with the invention;

[0012] FIG. **2** shows a block diagram of an embodiment in accordance with the invention;

[0013] FIG. **3** is a flow chart of steps for implementing aspects of the invention; and

[0014] FIG. **4** is a flow chart of steps for implementing aspects of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0015] The invention generally relates to a system and method of streaming data in real time and, more particularly, to a system and method of real time streaming of data over a grid network or other distributed infrastructure. In embodiments, the system and method dynamically creates and maintains a hierarchy of data storage resources within a grid infrastructure to allow for efficient streaming of data to multiple end users and applications simultaneously. The storage resources are dynamically created based on, for example, the type and location of the end users and the applications that are accessing the streamed data, amongst other variables and combinations contemplated by the invention. In embodiments, to dynamically create the data source hierarchy, each end resource that requests access to the data stream becomes part of the stream tree. The system and method of the invention can be implemented using standard unicast protocols such as TCP/IP.

[0016] By using the invention, it is possible to reduce the amount of data that needs to flow over a distributed Information Technology (IT) infrastructure without the restrictions of IP multicasting. The system and method of the invention also solves the problem of one-to-many distribution of streaming data using standard unicast algorithms such as simple TCP/IP. In addition, the system and method is configured to allow data streaming from different sources simultaneously which is not "file block" dependent, e.g., streaming audio from one server and video from another. The different data streams can be combined on a local resource, i.e., at the requesting end user. Moreover, the invention is configured to operate upon multiple streams of data in real-time thus effectively managing streaming nodes dynamically across the distributed IT enterprise.

[0017] Thus, as further discussed below, the system and method of the invention is configured to, amongst other things:

[0018] (i) cache streaming data over disparate data storage devices to reduce overall bandwidth requirements, server utilization, and to increase data transfer rates;

[0019] (ii) separate a data stream into multiple parts such that an end resource can retrieve these separate streams from separate sources;

[0020] (iii) allow end resources the ability to start, stop, and/or pause data streams without affecting other end users; and

[0021] (iv) create and manage streaming nodes dynamically across the distributed IT enterprise.

[0022] FIG. **1** shows an illustrative environment **10** for managing the processes in accordance with the invention. To this extent, the environment **1 0** includes a computer infrastructure **12** that can perform the processes described herein. In particular, the computer infrastructure **12** includes a computing device **14** that comprises a management system **30**, which makes computing device **14** operable to dynamically manage real time streaming of data over a grid network or other distributed infrastructure in accordance with the invention, e.g., process described herein. The computing device **14** includes a processor **20**, a memory **22**A, an input/output (I/O) interface **24**, and a bus **26**. Further, the computing device **14** is in communication with an external I/O device/resource **28** and a storage system **22**B.

[0023] In general, the processor **20** executes computer program code, which is stored in memory **22**A and/or storage system **22**B. While executing computer program code, the processor **20** can read and/or write data to/from memory **22**A, storage system **22**B, and/or I/O interface **24**. The bus **26** provides a communications link between each of the components in the computing device **14**. The I/O device **28** can comprise any device that enables an individual to interact with the computing device **14** or any device that enables the computing device **14** to communicate with one or more other computing devices using any type of communications link.

[0024] The computing device **14** can comprise any general purpose computing article of manufacture capable of executing computer program code installed thereon (e.g., a personal computer, server, handheld device, etc.). However, it is understood that the computing device **14** is only representative of various possible equivalent-computing devices that may perform the processes described herein. To this extent, in embodiments, the functionality provided by computing device **14** can be implemented by a computing article of manufacture that includes any combination of general and/or specific purpose hardware and/or computer program code. In each embodiment, the program code and hardware can be created using standard programming and engineering techniques, respectively.

[0025] Similarly, the computer infrastructure **12** is only illustrative of various types of computer infrastructures for implementing the invention. For example, in embodiments, the computer infrastructure **12** comprises two or more computing devices (e.g., a server cluster) that communicate over any type of communications link, such as a network, a shared memory, or the like, to perform the process described herein. Further, while performing the process described herein, one or more computing devices in the computer infrastructure **12** can communicate with one or more other computing devices external to computer infrastructure **12** using any type of communications link. The communications link can comprise any combination of wired and/or wireless links; any combination of one or more types of networks (e.g., the Internet, a wide area network, a local area network, a virtual private network, etc.); and/or utilize any combination of transmission techniques and protocols. As discussed herein, the management system **30** enables the computer infrastructure **12** to dynamically manage real time streaming of data over a grid network or other distributed infrastructure.

[0026] FIG. **2** shows a block diagram of a system in accordance with the present invention. As seen in FIG. **2**, the system includes a root server **100** and "n" number of requesting servers **200***a,* **200***b* (e.g., end resources). The system is configured to allow the components to transmit and send data to one another via a network. Although only two requesting servers are shown in FIG. **2**, it is understood that three or more (e.g., hundreds) requesting servers are also contemplated by the invention.

[0027] The root server **100** is designated as the master stream server for broadcasting a stream of content, e.g., a data stream, in real-time. As should be understood, the root server **100** may be implemented in the computer infrastructure of FIG. **1**. For example, the root server **100** may be the computing device **14** of FIG. **1**.

[0028] The root server **100** includes a cache table (content directory) **100***a* configured to store information associated with the requesting servers **200***a,* **200***b.* In this manner, the cache table **100***a* acts as a content directory, listing the locations of other servers or end resources in the enterprise amongst other information. The caching table (content directory) **100***a* is dynamically built, in real-time.

[0029] As each requesting server is connected to the network, the cache table **100***a* is updated with information related to the requesting servers **200***a,* **200***b* such as, for example, information and/or characteristics of and associated with the requesting servers **200***a,* **200***b.* The cache table **100***a* can be continuously and dynamically updated, in real-time, as each new requesting server is connected to the network or a triggering event occurs. The updated information may include:

[0030] (i) listings of the locations of the connected servers and other resources in the enterprise,

[0031] (ii) the data requested from the requesting server (s), e.g., audio, video, etc.,

[0032] (iii) the bandwidth capabilities of the requesting server(s),

[0033] (iv) the quality of data which is requested to be received from the root server, and/or

[0034] (v) the applications that are accessing the streamed data, in addition to a host of other system dependent information.

The triggering event, on the other hand, may be a new connection, a different connection, a stop or pause event of the streaming data, or other event which affects the streaming of the data. The information and triggering event may be transmitted to and used by any of the requesting servers to make a connection determination to either the root server **100** or another end resource.

[0035] The root server **100** may stream/broadcast content and other types of data to the requesting servers **200***a*, **200***b* via the network. The data transmitted by the root server **100** may be streamed content or the information associated with other requesting servers such as, for example, bandwidth capabilities of the requesting server(s), quality of data which is requested to be received from the root server, in addition to other dependent system information.

[0036] The root server **100** is configured to obtain content from a database **300**, which is streamed to the end resources such as, for example, the requesting servers **200***a*, **200***b*. The database **300** may be external or internal to the root server **100**, depending on the configuration of the system. The database **300** is configured to store a specific set of data or content (e.g. audio, video, or any continuous stream, etc.).

[0037] The requesting servers **200***a*, **200***b*, in embodiments, may be dedicated data storage resources on the grid infrastructure (network) or multiple end user machines running over a network, to name just two different embodiments contemplated by the invention. As further embodiments contemplated by the invention, the requesting servers may be any types of end user machine including, but not limited to, a server, in a client server relationship, a user workstation or a personal computer. In embodiments, the requesting servers **200***a*, **200***b* may locally store information associated with other servers, content, etc., as discussed with reference to the cache table **100***a*. The stored information on the requesting servers **200***a*, **200***b* may be used in the same or similar manner as the information stored in the cache table **100***a*.

[0038] The requesting servers **200***a*, **200***b* each include a database which stores the requested data, i.e., content stream, and possibly the locations and characteristics of other servers in the enterprise. The databases also buffer a predetermined amount of the content stream, which may be used to (i) provide content to other requesting servers or (ii) ensure that the content stream is not interrupted when a streaming server stops or pauses the streaming data.

[0039] In embodiments, each of the requesting servers **200***a*, **200***b* may stream content, in real-time, to other requesting servers, upon authentication and authorization. More specifically, in embodiments, the requesting servers **200***a*, **200***b* may be dynamically created into a hierarchical set of streaming data resources as the real-time data stream is being broadcast. For example, the server **200***a*, upon request and authentication of requesting server **200***b*, may stream data (content) to the requesting server **200***b*. The streamed data, though, is originated from the root server **200***a*.

[0040] By way of non-limiting illustration, upon the correct authentication and authorization, end resources can request data from the root server **100**. As each end resource communicates with the root server **100**, the root server **100** will add the address information, amongst other data such as the requested data, broadcast requests (bandwidth, quality), etc. into its cache table **100***a*. With such information available, the root server **100** will send the information stored in the cache table **100***a* to the requesting server **200***b*. Upon receipt of such information, the requesting server **200***b* can process this information and, upon making a location determination, request that the streaming data be broadcast from the root server **100**, another requesting server **200***a* or a combination thereof. This determination may be based on many different criteria (i.e., information stored in the cache table **100***a*) including, but not limited to:

[0041] (i) The location to the requesting server **200***b* to the root server **100** and other requesting server **200***a*;

[0042] (ii) The type of content requested, e.g., high quality content vs. low quality content, video, audio, etc.; and/or

[0043] (iii) The amount of bandwidth that the resource is willing to use up to receive the data stream, etc.

In this way, the content can be requested from any source dynamically and in real-time during the actual streaming of the data.

[0044] Thus, in embodiments, initially there is only one stream server, i.e., the root server **100**. However, as multiple new end resources request the same stream of data, the server **100** provides information, from its cache table **100***a*, to the end resources for making a connection determination to any number of machines. In this manner, the system and method can stream data from different sources simultaneously, resulting in the dynamic creation of a data source hierarchy, where each end resource that requests access to the data stream can become part of the stream tree, e.g., a proxy stream server.

[0045] When the end resource receives the data stream, it updates the root cache table **100***a* with its information, including the delay of the stream it is receiving, which pieces of the stream that it is receiving from which server (e.g., just audio, audio and video, quality, etc. from which server), etc. This allows the cache table **100***a* to be constantly updated, thus ensuring that the end resources obtain the most updated information when making connection decisions.

[0046] In embodiments, the system and method is configured to permit any of the end resource(s) (e.g., requesting servers, **200***a*, **200***b*) to obtain different content pieces from multiple sources. By way of non-limiting example, the end resource, e.g., server **200***b*, may request high quality video data from the root server **100** and audio data from another requesting server, e.g., server **200***a*. In this process, the end resource, e.g., server **200***b*, makes a determination, based on an analysis of the information received from the root server **100**, as to which type of data it will receive from which particular stream server(s). The stream server may be the root server or other end resource(s) or a combination thereof, for example. In embodiments, the receiving (requesting) end resource can use a plurality of methods including but not limited to ping, bandwidth, hop count, etc. to find the best matching resources.

[0047] Once the end resource receives the different pieces of content from different sources, the end resource can locally recombine the data streams into a complete data stream of content, as can be implemented by those of ordinary skill in the art using well-known algorithms. Accordingly, the end resources are capable of reassembling and operating upon multiple streams of data in real-time, whereby the system is thus capable of effectively managing streaming nodes dynamically across the distributed IT enterprise. In this way, the system and method is configured to dynamically create and maintain a hierarchy of disparate data storage resources within the distributed infrastructure to allow data streaming from different sources simultaneously. The streaming data is not “file block” dependent, e.g., streaming audio from one server and video from another.

[0048] In further implementations, each requesting server **200***a*, **200***b* may act independently of one another. That is, each requesting server **200***a*, **200***b* may pause, stop or start the streaming data without affecting other end users. This is further described with reference to FIGS. **3** and **4**.

[0049] FIG. **3** is a flow diagram implementing steps of the invention which may be implemented in the environment of FIG. **1**. FIG. **3** (and all other flow diagrams) equally represents a high-level block diagram of the invention. The steps of FIG. **3** (and all other flow diagrams) may be implemented and executed from either a server, in a client server relationship, or they may run on a user workstation with operative information conveyed to the user workstation to dynamically manage real time streaming of data over a grid network or other distributed infrastructure. Additionally, the invention can take the form of an entirely hardware embodiment, an entirely software embodiment or an embodiment containing both hardware and software elements.

[0050] In an embodiment, the invention is implemented in software, which includes but is not limited to firmware, resident software, microcode, etc. Furthermore, the invention can take the form of a computer program product accessible from a computer-usable or computer-readable medium providing program code for use by or in connection with a computer or any instruction execution system. The software and/or computer program product can be implemented in the environment of FIG. **1**. For the purposes of this description, a computer-usable or computer readable medium can be any apparatus that can contain, store, communicate, propagate, or transport the program for use by or in connection with the instruction execution system, apparatus, or device. The medium can be an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system (or apparatus or device) or a propagation medium. Examples of a computer-readable medium include a semiconductor or solid state memory, magnetic tape, a removable computer diskette, a random access memory (RAM), a read-only memory (ROM), a rigid magnetic disk and an optical disk. Current examples of optical disks include compact disk—read only memory (CD-ROM), compact disc—read/write (CD-R/W) and DVD.

[0051] FIG. **3** shows an implementation of the processes using, for example, unicasting methodologies. The example of FIG. **3** starts with one streaming server, e.g., root server. This streaming server originally contains the source data to be streamed. In step **300**, an end resource, e.g., server **1**, requests access to the streaming data source. To accomplish this process, in embodiments, the end resource sends a connection request command (authentication and authorization process) to the root server to request a particular data stream. Included with the connection request may be, for example, information on the level of quality that the end resource wishes to receive and the amount of bandwidth that the resource is willing to use up to receive the data stream.

[0052] In step **305**, upon acknowledgement of the request, the root server updates the content directory (cache table) for requests to include server **1**. In step **307**, the root server tags server **1** as a "tier 1" node, i.e., it is one hop away from the root node.

[0053] In step **310**, the request is sent back to the root server process. In step **315**, the root server sends the content to the requester at the quality level requested by server **1**. The root server uses a unicast streaming protocol such as regular TCP/IP. This is synonymous with a regular point to point protocol such as a Real Audio Server streaming to a Real Audio Client.

[0054] In step **320**, a new end resource request for the same content arrives from a second end user, e.g., server **2**. In embodiments, server **2** provides the requirements as to quality and bandwidth restrictions to receive the data stream, similar to that described with reference to server **1**. In step **325**, the new requester (server **2**) is logged into the content directory (cache table) to determine the possible connection locations for requesting and receiving the requested data stream. In one example, server **2** will receive two locations, e.g., the root server at high quality or server **1** at lower quality and delayed by a number of seconds (since server **1** is one hop away from the root server).

[0055] At step **330**, server **2** examines the information and makes a connection determination. In this example, server **2** is collocated with server **1** and the available data stream from server **1** meets its requirements. In step **335**, server **2** connects to server **1** at which time it can start to receive the data stream. The content directory (cache table) is updated with the connection information.

[0056] Although not necessarily in this order, in step **340**, server **2** is tagged as a "tier 2" server because it is two hops away from the root server. In step **345**, the content directory on the root node is updated to include server **2** as a "tier 2" stream server. Server **2** may also be tagged as tier **1** if it receives information directly from the root server.

[0057] In embodiments, the servers can be tagged with various tiers, depending on which piece of the data streamed from a particular source. An example of this embodiment includes the example of the server obtaining high quality data from the root source and low quality data from another requesting server. In this scenario, a tier **1** tag is associated with high quality data and a tier **2** tag is associated with the low quality data. Basically, server **2** is tagged as a "tier 1" server for high quality data because it is one hop away from the root server; whereas, server **2** is tagged as a "tier 2" server for low quality data because it is two hops away from the root server.

[0058] As should be understood this same process may continue with more than two end resources, using the steps as described above. By way of example, another end resource (e.g., server **3**), may request data from server **1**, server **2**, the root server or any combination thereof. In this example, server **3** accesses the root server, which will update the content directory (cache table) to include server **3** information. Directory information will be sent to server **3** for processing in order to determine one or more location connections based on the criteria of server **3**. By illustration, server **2** requests high quality video data and lower quality audio data.

[0059] Based on information received from the root server, server **3** is provided with three possible location connections, e.g., high quality video data from the root server and low quality audio data from either of server **1** or server **2**. Making the determination that the high quality video data will be streamed from the root server and the low quality audio data will be streamed from server **2**, the root server will tag server **2** as a tier **1** and/or tier **2**. In this scenario, as to the audio stream, server **2** will be tagged tier **1** if the audio stream is originating from only the root server. Otherwise, server **2** will be tagged a tier **2** when the audio stream is diverted through server **1**. In any scenario, the content directory (cache table) is updated with the connection information.

[0060] In step **350**, in the event that server **1** becomes unavailable (e.g., stops or pauses), server **2** can connect back to the root server and re-request access to the data stream. In this example, because there is no other servers to stream from, server **2** can upgrade to a tier **1** node and start to receive the data stream directly from the root server. This latter step is further explored in FIG. **4**.

[0061] FIG. **4** is a flow diagram illustrating a non-limiting example of an aspect of the invention. This example shows that a streaming server can stop or pause the streamed data without affecting other end users. In step **400**, the requesting server, e.g., server **1**, broadcasts information to the another server, server **2**. In step **405**, server **1** either stops or pauses the streamed data. In step **410**, server **2** is notified or becomes aware that server **1** has stopped or paused the streamed data. The awareness may simply be that sever **2** is no longer receiving streaming data from server **1**. In step **412**, the cache table is updated with the stop or pause time of server **1**.

[0062] In step **41 5**, server **2** uses its buffered content to ensure that there is no discernable interruption in the streamed data to the end user. In step **420**, server **2**, logged into the cache table of the root server, determines other connection locations, noting that the cache table is updated with the stop or pause time information of server **1**. In step **425**, in one example, server **2** receives additional connection locations which it can receive the streamed data, e.g., the root server or from server **3**. In step **430**, server **2** will make a connection to a server which provides the streamed data at the particular location of the stop or pause time of server **1** or at any point within the buffered content. This information will be updated into the content directory in step **435**.

[0063] In embodiments, the invention provides a business method that performs the process steps of the invention on a subscription, advertising, and/or fee basis. That is, a service provider, such as a Solution Integrator, could offer to perform the processes described herein. In this case, the service provider can create, maintain, and support, etc., a computer infrastructure that performs the process steps of the invention for one or more customers. In return, the service provider can receive payment from the customer(s) under a subscription and/or fee agreement and/or the service provider can receive payment from the sale of advertising content to one or more third parties.

[0064] While the invention has been described in terms of embodiments, those skilled in the art will recognize that the invention can be practiced with modifications and in the spirit and scope of the appended claims.

What is claimed is:

1. A method, comprising:

updating a content directory of a root server with end resource information; and

processing the end resource information to determine connection locations for streaming data to at least one requesting end resource in a network.

2. The method of claim **1**, wherein the processing is performed by the at least one requesting end resource.

3. The method of claim **1**, wherein the at least one requesting end resource is two or more requesting end resources communicating with the root server over the network.

4. The method of claim **3**, further comprising updating the content directory each time a new connection is made to the root server or a triggering event occurs.

5. The method of claim **1**, further comprising tagging each of the at least one requesting end resources with a hierarchy level designation.

6. The method of claim **5**, wherein the tagging is based on a position away from the root server.

7. The method of claim **3**, wherein one of the two or more requesting end resources is a streaming server, responsive to a request by another of the requesting end resources.

8. The method of claim **7**, wherein the streaming server streams the streaming data to the another of the requesting end resources over the network.

9. The method of claim **7**, wherein the streaming server is tagged as a first tier streaming resource and the another of the requesting end resources is tagged as a second tier streaming resource.

10. The method of claim **7**, further comprising updating the content directory with new information concerning the streaming server including at least one of a tag type and a type of data which is streaming to the another of the requesting end resources.

11. The method of claim **1**, wherein each of the requesting end resources is configured to act independently of one another.

12. The method of claim **1**, wherein the root server is designated as a master stream server for broadcasting the data stream in real-time to the at least one requesting end resource.

13. The method of claim **1**, wherein the content directory is dynamically built, in real-time, as each of the at least one requesting end resources connects to the root server.

14. The method of claim **1**, wherein the end resource information includes information and/or characteristics of and associated with the at least one requesting end resource.

15. The method of claim **14**, wherein the end resource information includes at least one of:

listings of locations of connected requesting end resources;

data requested from the at least one requesting end resource;

bandwidth requests and/or bandwidth capabilities of the at least one requesting end resource; and

quality of data which is requested to be received from the root server.

16. The method of claim **15**, wherein the resource connection information is used by the at least one requesting end resource to make a connection determination to the root server and/or another end resource.

17. The method of claim **1**, wherein the at least one requesting end resource is at least one of: data storage resources on a grid infrastructure, multiple end user machines running over the network, a server, in a client server relationship, a user workstation and a personal computer.

18. The method of claim **1**, further comprising buffering a predetermined amount of content stream on the at least one requesting end resource to provide content to other requesting end users or to ensure that the content is not interrupted when a streaming server stops or pauses the streaming data.

19. The method of claim **1**, wherein the at least one requesting end resource are two or more requesting end resources which are dynamically created into a hierarchical set of streaming data resources as the data stream is broadcast in real-time.

20. The method of claim **1**, wherein the root server receives a request from the at least one requesting end resource and the root server will add address information and broadcast requests into the content directory.

21. The method of claim **20**, wherein the streaming data is streamed from the root server, another requesting end resource or a combination thereof.

22. The method of claim **21**, wherein initially there is only one streaming server, and as multiple new end resources request a same stream of data, the root server provides information to the requesting end resources for making a connection determination to any number of machines.

23. The method of claim 1, wherein the at least one requesting end resource obtains pieces of the streamed data from the root server, one or more of the at least one requesting end resource or a combination thereof.

24. The method of claim 23, wherein the at least one requesting end resource locally recombines the data streams into a complete data stream of content.

25. The method of claim 1, further comprising at least one of creating, maintaining and supporting a computer infrastructure that performs the steps of claim 1.

26. The method of claim 1, wherein a service provider, on a subscription, advertising, and/or fee basis, provides the verification information.

27. A method, comprising:

updating a content directory of a root directory with information related to a connected end user resource;

creating a hierarchy of end user resources as the end user resource is connected with the root server; and

determining a connection location within the hierarchy of end user resources including the root server for receiving streamed data, the determining being based on information in the content directory.

28. The method of claim 27, wherein the hierarchy is dynamically configured as the streamed data is broadcasting in real-time.

29. The method of claim 27, further comprising authentication the connected end resource.

30. The method of claim 27, wherein the end resource sends a connection request command to the root server to request a particular data stream.

31. The method of claim 30, wherein the connection request includes at least one of information on a level of quality that the end resource wishes to receive and amount of bandwidth that the end resource is willing to use up to receive the streamed data.

32. The method of claim 31, wherein the content directory is updated after authentication of the connected end resource.

33. The method of claim 27, further comprising tagging each connected end user resource in the hierarchy with a hierarchy level designation.

34. The method of claim 33, wherein the tagging is based on a position away from the root server.

35. The method of claim 33, wherein the tagging is based on pieces of content received from the root directory or other end resource.

36. The method of claim 33, wherein the end user resource receiving the streamed data directly from the root server is tagged as a first tier streaming resource and another of the end user resources receiving the streamed data from the first tier streaming resource is tagged as a second tier streaming resource.

37. The method of claim 27, wherein each of the end user resources is configured to act independently of one another.

38. The method of claim 27, wherein the content directory is dynamically built, in real-time, as each of the end user resource connects to the root server.

39. The method of claim 27, wherein the information includes information and/or characteristics of and associated with the end user resources, including at least one of:

listings of locations of connected end user resources;

data requested from the end user resources;

bandwidth requests and/or bandwidth capabilities of the end user resources; and

quality of data which is requested to be received from the root server.

40. The method of claim 27, further comprising buffering a predetermined amount of content stream on the end user resources to provide content to other end user resources or to ensure that the content is not interrupted when a streaming server stops or pauses the streamed data.

41. The method of claim 27, wherein the end user resources are two or more end user resources which are dynamically created into a hierarchical set of streaming data resources as the streamed data is broadcast in real-time.

42. The method of claim 41, wherein the streamed data is streamed from the root server, one or more of the end user resources or a combination thereof.

43. The method of claim 27, wherein the end user resources locally recombine the streamed data into a complete data stream of content.

44. The method of claim 27, further comprising at least one of creating, maintaining and supporting a computer infrastructure that performs the steps of claim 27.

45. The method of claim 27, wherein a service provider, on a subscription, advertising, and/or fee basis, provides the verification information.

46. A system comprising a server having a database containing data associated with one or more end user resources and connection information, and at least one of a hardware and software component for dynamically creating a data source hierarchy of the end user resources based on the data, the at least one of a hardware and software component providing connection locations to each of the end user resources that request access to a data stream, wherein each of the end user resources that request access to the data stream becomes part of the data source hierarchy.

47. The system of claim 46, wherein the at least one of a hardware and software component resides on a server provided by a service provider.

48. The system of claim 46, wherein the at least one of a hardware and software component tags each connected end user resource in the data source hierarchy with a hierarchy level designation.

49. The system of claim 48, wherein the tagging is based on a position away from a root server and on pieces of content received from a root directory of the root server or other end resource.

50. The system of claim 49, wherein the end user resource receiving the data stream directly from the root server is tagged as a first tier streaming resource and another of the end user resources receiving the data stream from the first tier streaming resource is tagged as a second tier streaming resource.

51. A computer program product comprising a computer usable medium having readable program code embodied in the medium, the computer program product includes at least one component to:

update a content directory of a root server with end resource information; and

process the end resource information to determine connection locations for streaming data to at least one requesting end resource in a network.

52. A method for deploying an application for streaming data over a network, comprising providing a computer infrastructure being operable to: dynamically create a data source

hierarchy of end user resources based on information associated with the end user resources which are connected to a root server, and provide connection locations to each of the end user resources that request access to a data stream that is streaming from one or more of the end user resources of the data source hierarchy and/or the root server.

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