

## SUMMARY

[0012] A method and system for unified caching of media content are described. According to one aspect, the system includes a streaming media protocol engine to receive a request for a data stream in a first format from a client system; a streaming media mass storage subsystem to locate the data stream stored by a cache server in a second format; and a network protocol engine to serve the located data stream to the client system in the first format.

[0013] Other features of the present invention will be apparent from the accompanying drawings and from the detailed description, which follows.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention is illustrated by way of example and not limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

[0015] **FIG. 1** is a schematic block diagram of a network where a streaming media cache receives a multimedia stream from a server and broadcasts the stream to one or more clients, according to one embodiment of the present invention;

[0016] **FIG. 2** is a schematic block diagram of a computer system that may embody the streaming media cache in **FIG. 1**, according to one embodiment of the present invention;

[0017] **FIG. 3** is a schematic block diagram of a storage operating system for use with the streaming media cache in **FIG. 1**, according to one embodiment of the present invention; and

[0018] **FIG. 4** is a flowchart illustrating a method for unified caching of media content, according to one embodiment of the present invention.

[0019] **FIG. 5A** illustrates an MMS/MMS-HTTP data header, according to one embodiment of the present invention.

[0020] **FIG. 5B** illustrates an RTP data header, according to one embodiment of the present invention.

[0021] **FIG. 6** illustrates replacing the MMS-HTTP header with the RTP header, according to one embodiment of the present invention.

[0022] **FIG. 7** illustrates replacing the RTP header with the MMS-HTTP header, according to one embodiment of the present invention.

## DETAILED DESCRIPTION

[0023] In order to process requests for streaming data more efficiently and to optimize the disk space of a network cache and bandwidth utilization, in one embodiment of the present invention, a network cache converts the encapsulation of data packets (data packets' headers) received by one protocol into a unified format packet. A single copy of the cached content is stored by the network cache, and the content can be served to a requesting client off the cache regardless of the streaming media protocol associated with the request.

[0024] In one embodiment of the present invention, unified caching is accomplished by storing data on disk in a

predetermined format (a unified format) and, if a client requests the cached data in a different format, converting the cached data into the requested format. For example, the MMS format may be designated as the unified format. During processing of a file access request from a client, if a client requests a cached file via a first protocol (e.g., RTSP), the on-disk headers associated with the requested data (e.g., in the MMS format) are converted into headers in the requested format (e.g., RTP headers), while the client is waiting for the request to be serviced, and the requested data is served to the client off the cache, thereby serving data with a header that complies with the requested protocol.

[0025] **FIG. 1** illustrates a streaming media cache (server) **200** coupled to an origin server **110** and a plurality of clients **120** over a network **100**. The streaming media cache typically communicates with the origin server and the clients by exchanging discrete data packets **130** over the network. As used herein, a data packet is broadly understood to be a unit of data transmitted over the network. As such, a data packet according to the invention may comprise one or more conventional data packets. Typically, the packets are formatted in accordance with predetermined communication protocols, such as the Transmission Control Protocol (TCP), User Datagram Protocol (UDP) and the Internet Protocol (IP). In this context, a protocol consists of a set of rules defining how packets are communicated. Each data packet generally comprises "payload" data appended to one or more network headers that define the packet's routing through the network.

[0026] The network **100** includes a plurality of interconnected "nodes," e.g., computers, including the streaming media cache **200**, the origin server **110**, and the plurality of clients **120**. The network may be organized to include wide area networks (WAN), shared local area networks (LAN), point-to-point links, virtual private networks (VPN) implemented over a public network such as the Internet, and so forth. Intermediate network devices (not shown), such as conventional routers and switches, in the network **100** typically provide network services that facilitate the transmission of data packets between nodes. For example, a Web Cache Coordination Protocol (WCCP) router in the network may be configured to forward data packets communicated between the clients **120** and the streaming media cache **200**.

[0027] In operation, a client **120** sends a request for a data stream, or a portion of a data stream, over the network **100** to the streaming media cache **200**. The requested data stream may comprise digitized representations of audio data, video data, static images, executable files, and the like, or any combination thereof. The client's request may take the form of a Uniform Resource Locator (URL), a Hypertext Transport Protocol (HTTP) message, etc.

[0028] If the streaming media cache **200** determines that it has a previously stored copy of the requested data stream, it returns a copy of the requested data stream to the client **120**. The streaming media cache **200** may retrieve the client-requested data stream from its "permanent," e.g., non-volatile, storage media and/or from its "in-core" memory, such as random access memory (RAM). For instance, in a video-on-demand (VOD) configuration, the streaming media cache may retrieve a client-requested video data stream from one or more of its storage disks. Alternatively, a client-requested "live" video data stream, e.g., received