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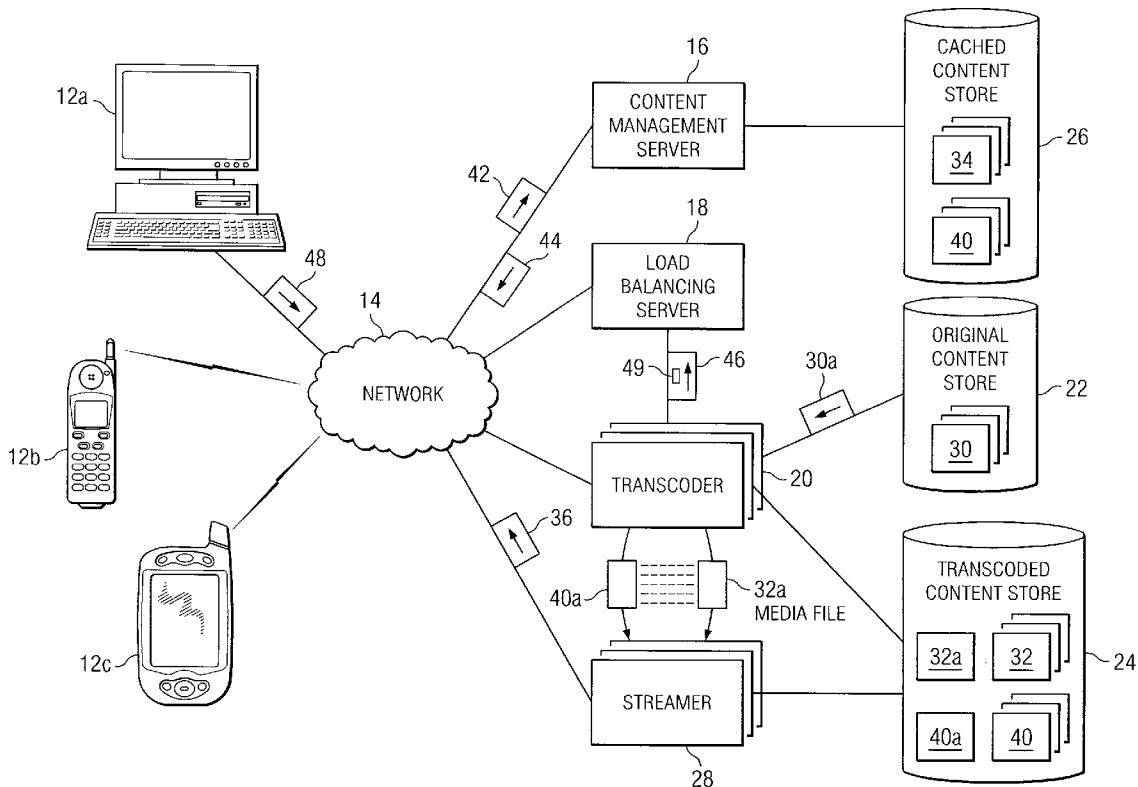
(19) **United States**(12) **Patent Application Publication**
Hosur(10) **Pub. No.: US 2010/0070608 A1**(43) **Pub. Date: Mar. 18, 2010**(54) **SYSTEM AND METHOD FOR DELIVERING CONTENT**(52) **U.S. Cl. 709/218; 707/E17.032**(75) **Inventor: Prabhudev I. Hosur, Austin, TX (US)**(57) **ABSTRACT**

Correspondence Address:
BAKER BOTTS L.L.P.
2001 ROSS AVENUE, SUITE 600
DALLAS, TX 75201-2980 (US)

(73) **Assignee: Ripcode, Inc., Richardson, TX (US)**(21) **Appl. No.: 12/208,122**(22) **Filed: Sep. 10, 2008****Publication Classification**

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G06F 15/16 (2006.01)

A method for delivering media content includes receiving a request identifying a requested media file. The method also includes, in response to receiving the request, accessing the requested media file. The requested media file includes media content in a first format. The method further includes generating a modified media file based on the requested media file. The modified media file includes media content in a second format. Additionally, the method includes generating an auxiliary file associated with the modified media file. The auxiliary file includes a plurality of content records associated with different portions of the media content in the modified media file and indicating a location of the associated portion. Each content record includes information to facilitate transmission of the associated portion of the media content to a remote client prior to the modified media file being completely generated.



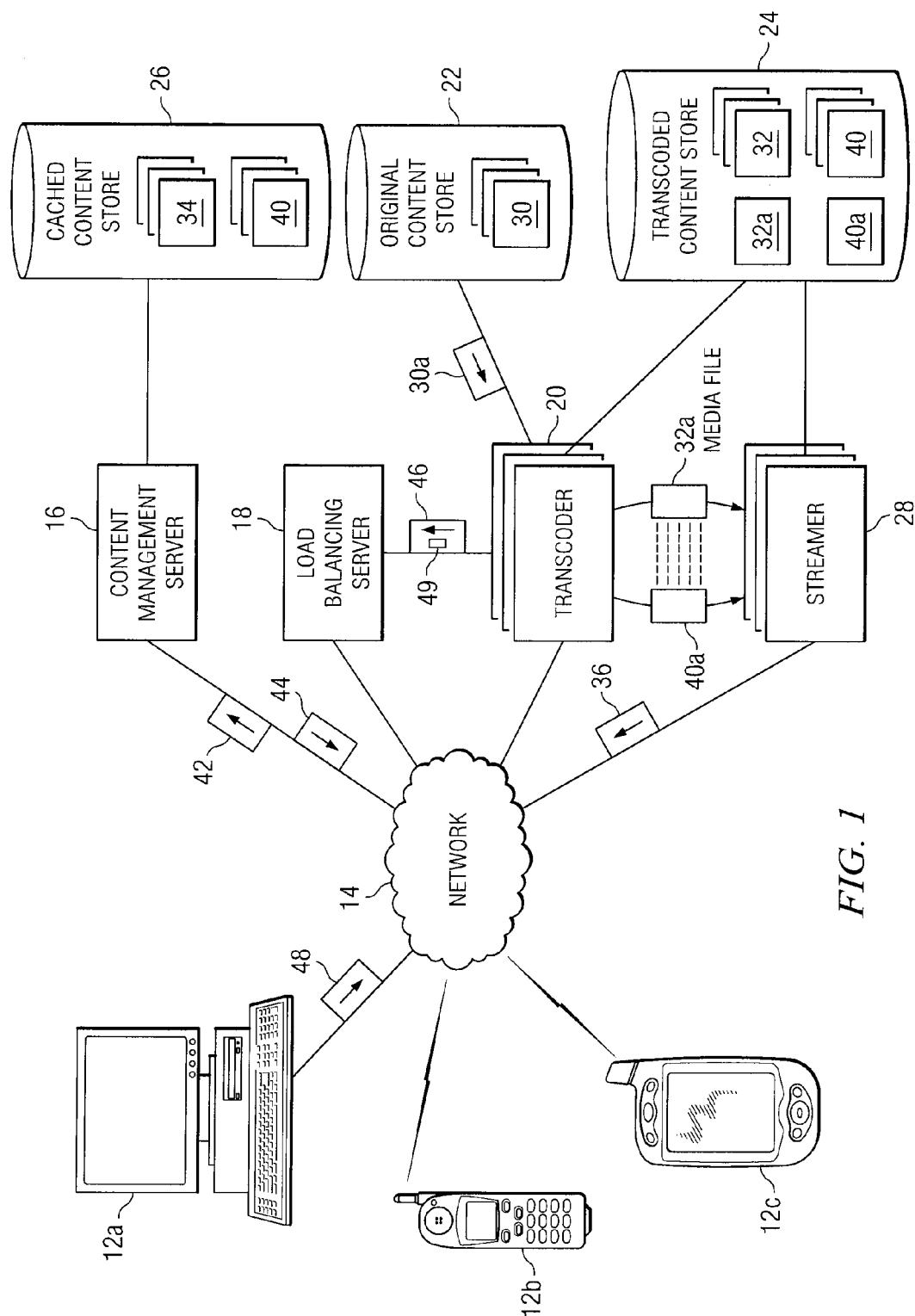
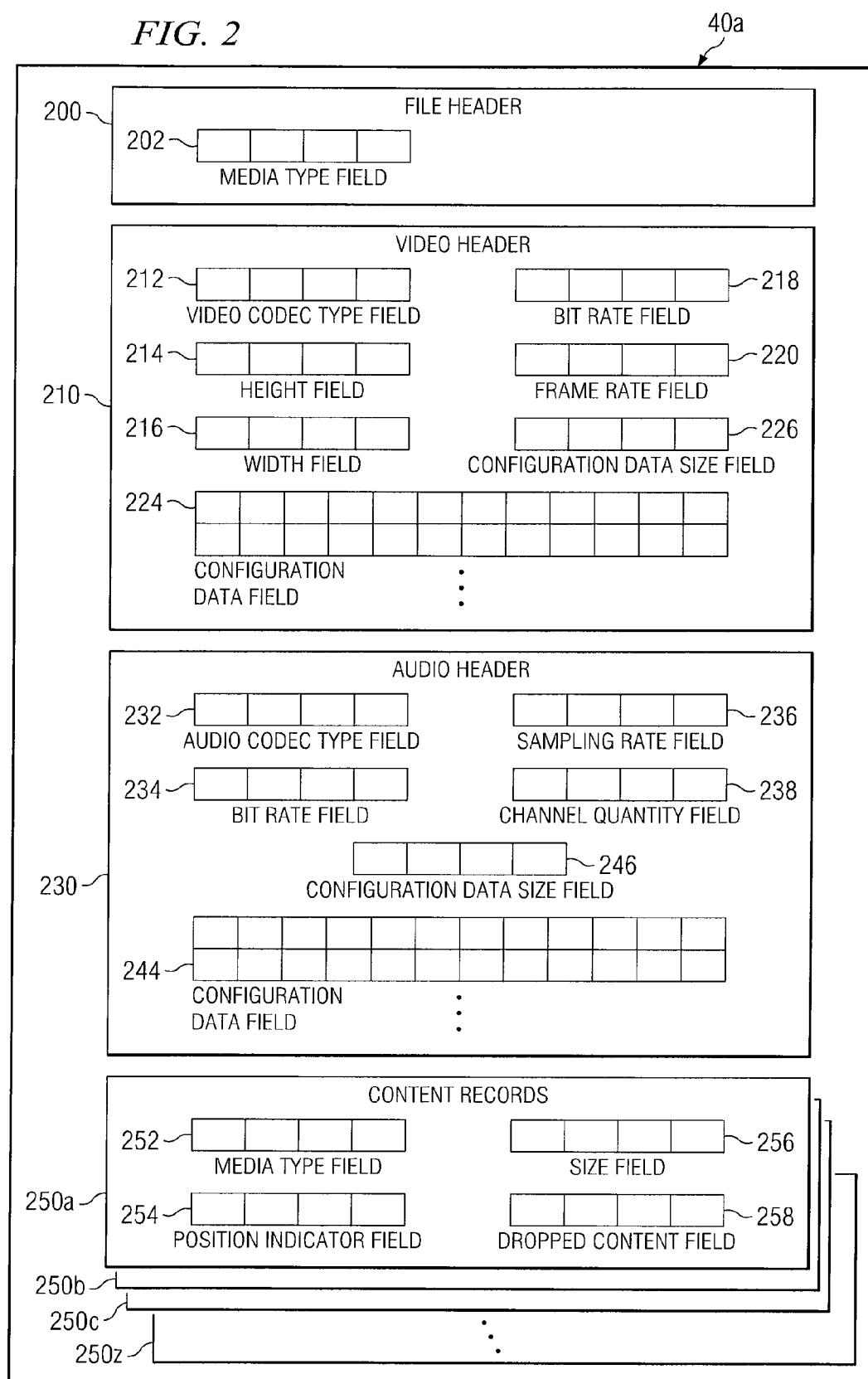


FIG. 2



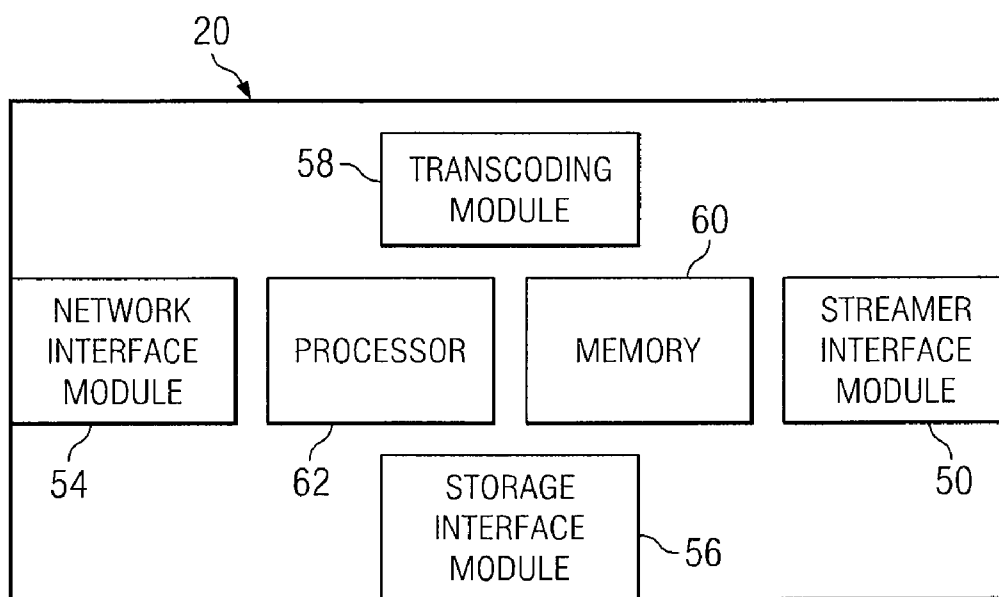


FIG. 3

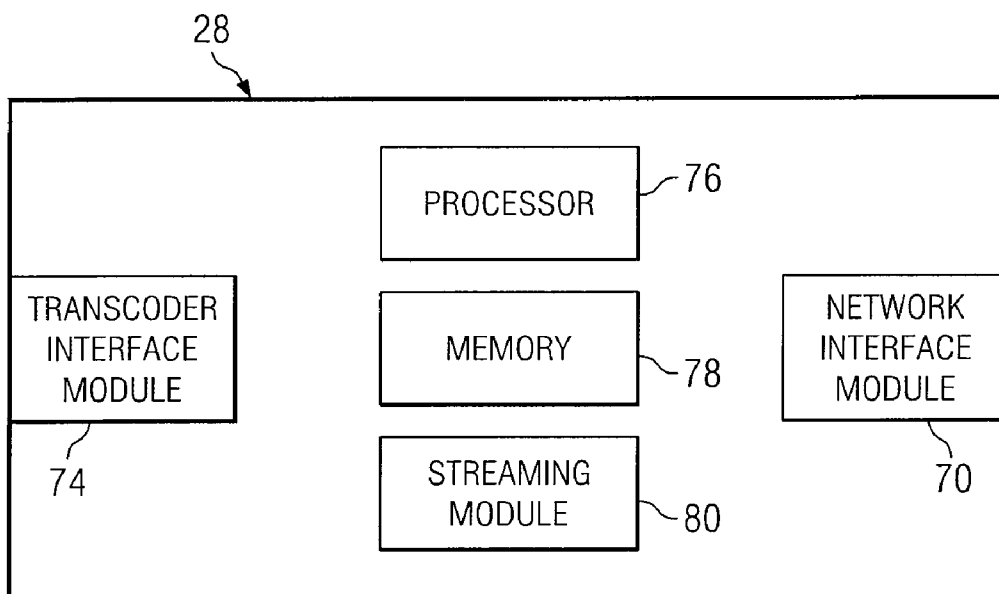
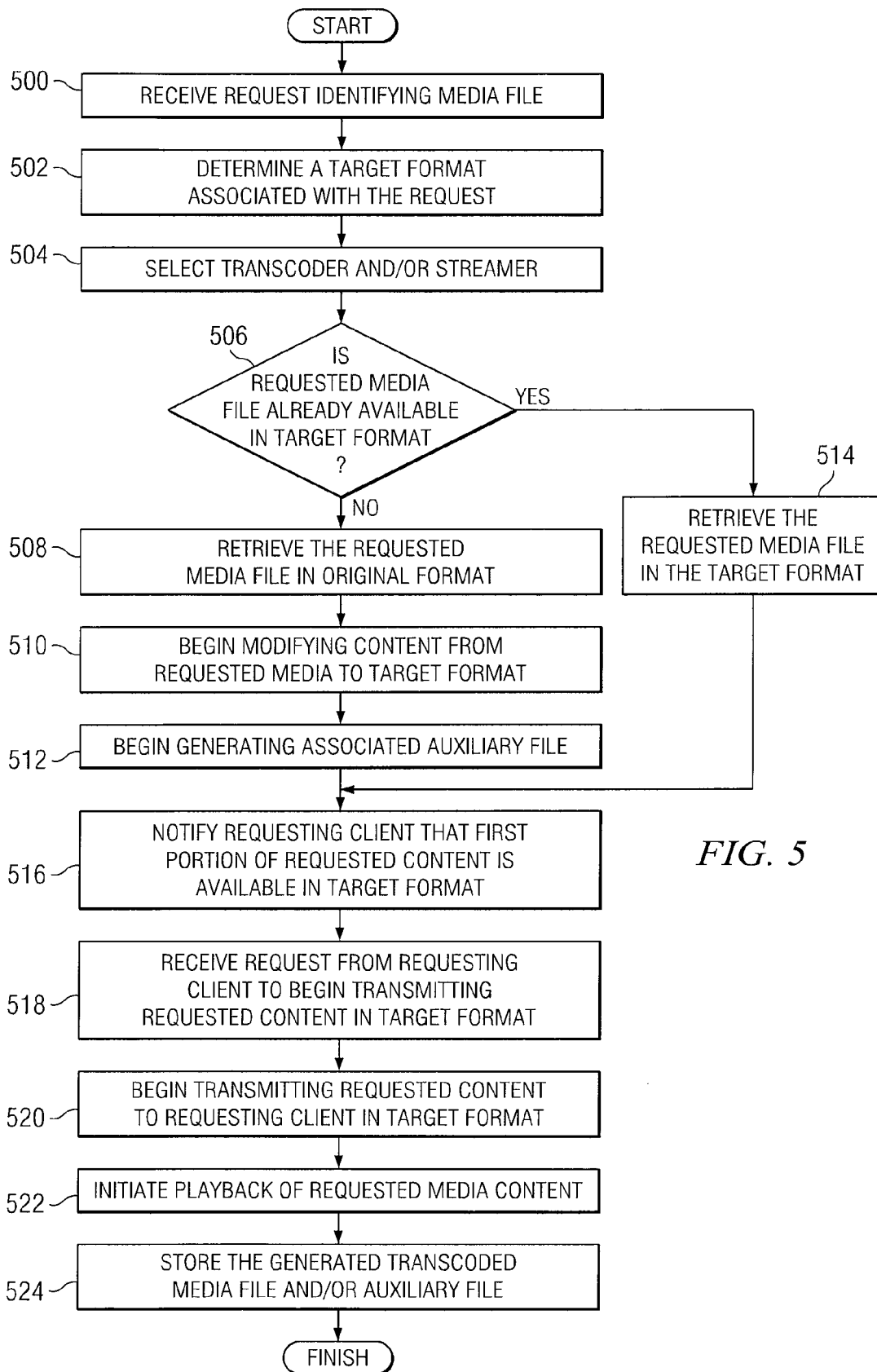


FIG. 4



SYSTEM AND METHOD FOR DELIVERING CONTENT

TECHNICAL FIELD

[0001] This invention relates, in general, to media-content delivery systems and, more particularly, to a system and method for delivering media content.

BACKGROUND OF THE INVENTION

[0002] The variety and availability of audio, video, and multimedia content has increased significantly in the recent past. Internet, mobile Internet, cell phones, personal data assistants, and other mobile media devices fuel constant development and increased demand for media content delivery in a variety of formats. Furthermore, the rapid growth in user-generated content has created a large supply of media content available to users in a large number of disparate formats.

[0003] Converting content from a source format provided by a content source to a different target format supported by a particular media player can be time-consuming and computationally-intensive. Moreover, the wide variety of source and target formats available can result in slow content-delivery, create congestion in content-processing components, and require ever increasing storage capabilities. Additionally, delays in content processing may degrade the user experience.

SUMMARY OF EXAMPLE EMBODIMENTS

[0004] In accordance with the present invention, disadvantages and problems associated with managing media content have been substantially reduced or eliminated.

[0005] In accordance with one embodiment of the present invention, a method for delivering media content includes receiving a request identifying a requested media file. The method also includes, in response to receiving the request, accessing the requested media file. The requested media file includes media content in a first format. The method further includes generating a modified media file based on the requested media file. The modified media file includes media content in a second format. Additionally, the method includes generating an auxiliary file associated with the modified media file. The auxiliary file includes a plurality of content records associated with different portions of the media content in the modified media file and indicating a location of the associated portion.

[0006] In accordance with another embodiment of the present invention, a method for delivering media content includes receiving a media file that includes media content and accessing an auxiliary file associated with the received media file. The auxiliary file includes a plurality of content records, and each content record is associated with a particular portion of the media content. The method further includes determining the location of a first portion of the media content within the modified media file based on the content record associated with the first portion of the media content and transmitting the first portion of the media content to a remote client.

[0007] Technical advantages of certain embodiments include the ability to provide media content to devices in various formats. Certain embodiments teach a content-transmission system and method that provides low-latency delivery of content to remote clients. Additionally, particular

embodiments may significantly increase content available to media players while decreasing the time necessary to deliver the content. Certain embodiments overcome problems associated with rapid delivery of media files in particular formats, and may increase efficient use of transcoding and streaming resources, as well as provide low-latency transcoding, transrating, streaming, delivery, and/or other modifications of media content in various formats. Additionally, particular embodiments may reduce system complexity. Other technical advantages will be readily apparent to one skilled in the art from the following figures, descriptions, and claims. Moreover, while specific advantages have been enumerated above, various embodiments may include all, some, or none of the enumerated advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] For a more complete understanding of the present invention and for further features and advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings, in which:

[0009] FIG. 1 illustrates a system for managing media content according to particular embodiments;

[0010] FIG. 2 illustrates an auxiliary file that may be utilized in particular embodiments of the system shown in FIG. 1;

[0011] FIG. 3 is a functional diagram of a transcoder that may be utilized in particular embodiments of the system shown in FIG. 1;

[0012] FIG. 4 is a functional diagram of a streamer that may be utilized in particular embodiments of the system shown in FIG. 1; and

[0013] FIG. 5 is a flowchart detailing an example operation of a system for managing media in accordance with certain embodiments.

DETAILED DESCRIPTION

[0014] FIG. 1 illustrates a particular embodiment of a system 10 for transmitting content from media files stored in original content store 22 to clients 12. System 10 includes clients 12a-c, network 14, content management server (CMS) 16, load balancing server (LBS) 18, one or more transcoders 20, original content store 22, transcoded content store 24, cached content store 26, and one or more streamers 28. To provide content to clients 12 having a variety of different reception and display requirements, system 10 may modify content in original content store 22 to make the content suitable for transmission to and/or display by a particular client 12. By initiating the transmission or delivery of modified content from a particular media file to a requesting client 12 before the entire media file has been modified, system 10 may reduce the latency associated with processing content for delivery to a diverse range of clients 12.

[0015] In general, within particular embodiments of system 10, clients 12 communicate with CMS 16 through network 14 for purposes of requesting content. CMS 16 connects to cached content store 26 and manages access to cached content store 26. Additionally, CMS 16 is coupled to load balancing server (LBS) 18, which receives and fulfills transcoding requests 44 sent by CMS 16. LBS 18 is coupled to one or more transcoders 20 and streamers 28 and manages the operation of the associated transcoders 20 and streamers 28. Transcoders 20 are capable of retrieving source media files 30 from original content store 22 and modifying the retrieved

source media files **30** so that content from source media files **30** can be transmitted to and displayed by a particular client **12**. Transcoders **20** are additionally coupled to one or more streamers **28**, which operate to stream or transmit content to clients **12**. Thus, as a result of the operation of these components, system **10** may, in particular embodiments, be capable of supporting on-demand content provision in a variety of formats for a wide range of different clients.

[0016] Content in system **10** is stored in various media files, including source media files **30**, transcoded media files **32**, and cached media files **34**. These media files may comprise any suitable form of voice, non-voice audio, animation, and/or video information or data that may be played, displayed or otherwise communicated by clients **12** to users of clients **12**. As discussed further below, the content available on system **10** may, in particular embodiments, have a variety of different characteristics that may determine the types of clients **12** that can utilize the content of the various media files. For example, media files may be associated with different codecs, bit-rates, resolutions, and/or other characteristics that may effect which clients **12** can utilize the various media files.

[0017] Clients **12** display, play, or otherwise communicate content retrieved from original content store **22**, transcoded content store **24**, and/or from cached content store **26** to users. Clients **12** may represent any type of device appropriate to play one or more type of media content utilized in system **10**. Examples of clients **12** may include, but are not limited to, computers, video-enabled telephones, media players (such as, for example, audio- and/or video-capable iPods), televisions, PDAs, cell phones, portable communication devices, and other electronic devices. In general, however, clients **12** may include any appropriate combination of hardware, software, and/or encoded logic suitable to provide the described functionality. Clients **12** may couple to network **14** through a dedicated connection (wired or wireless) or may connect to network **14** only as needed to access media content. For example, clients **12**, such as portable media players, may connect temporarily to network **14** to download content from source media files **30** but then disconnect before displaying content from the source media files **30**. Although FIG. **1** illustrates, for purposes of example, a particular number and type of clients **12**, alternative embodiments of system **10** may include any appropriate number and type of clients **12**.

[0018] In particular embodiments, various clients **12** may be capable of receiving and/or playing media associated with particular file formats, file types, codecs, bit-rates, and/or resolutions, and/or having other appropriate characteristics. For example, in the illustrated embodiment, client **12a** may comprise a computer which utilizes a different media file format than a video-enabled cellphone, represented as client **12b**, or a portable communication device, represented as client **12c**. Consequently, as described further below, system **10** may modify requested content to match the capabilities of the specific requesting client **12**.

[0019] Network **14** represents any form of communication network supporting circuit-switched, packet-based, and/or any other suitable type of communication. Although shown in FIG. **1** as a single element, communication network may represent one or more separate networks, including all or parts of various different networks that are separated and serve different groups of clients **12**. Network **14** may include routers, hubs, switches, gateways, call controllers, and/or any other suitable components in any suitable form or arrangement. In general, network **14** may comprise any combination

of public or private communication equipment such as elements of the public-switched telephone network (PSTN), a global computer network such as the Internet, a local area network (LAN), a wide-area network (WAN), or other appropriate communication equipment.

[0020] Additionally, although FIG. **1** illustrates a particular configuration of elements directly connected to network **14**, network **14** may, in particular embodiments, connect directly or indirectly to and/or interact with any appropriate elements of system **10**. For example, although FIG. **1** shows transcoders **20** directly connected to original content store **22** and streamers **28**, transcoders **20** may, alternatively connect to either or both of original content store **22** and streamers **28** over network **14**. Likewise, although in FIG. **1** CMS **16** communicates with LBS **18** over network **14**, in particular embodiments, CMS **16** may be directly connected to LBS **18**. Accordingly, the components of system **10** may be arranged and configured in any appropriate manner to communicate over network **14** and/or over direct connections between the relevant components.

[0021] CMS **16** processes requests from clients **12** to download, retrieve, stream, view, or otherwise receive content from source media files **30**. In particular embodiments, CMS **16** may also be responsible for initiating transcoding and streaming, or otherwise managing the operation of transcoders **20** and streamers **28** in delivering content to clients **12**. CMS **16** may additionally authenticate users, execute content search requests, or otherwise facilitate interaction between users and the content-provision services offered by system **10**.

[0022] Additionally, in particular embodiments, CMS **16** may allow clients **12** to browse or search for source media files **30** and/or preview content from source media files **30** available from system **10**. For example, in particular embodiments, CMS **16** may host a web page that displays content available on system **10** and allows a user of a particular client **12** to specify or describe a source media file **30** requested by the user. Thus, in such embodiments, clients **12** may access the web page and request a download of content from selected source media files **30**. CMS **16** may then initiate appropriate operations to deliver content from the source media file **30** to client **12**.

[0023] Although shown in FIG. **1** as a single component, in particular embodiments, CMS **16** may represent functionality provided by several separate physical components. More generally, CMS **16** may represent any appropriate combination of software and/or hardware suitable to provide the described functionality. As one specific example, in particular embodiments, CMS **16** may represent a web server configured to receive and respond to Hypertext Transfer Protocol (HTTP) requests from clients **12**.

[0024] LBS **18** receives transcoding requests **44** from CMS **16** and selects an appropriate transcoder **20** to modify or format requested content. LBS **18** may also, in certain embodiments, select an appropriate streamer **28** to stream, send, or otherwise forward requested content to client **12**. LBS **18** may additionally notify CMS **16** and/or clients **12** that the modification of requested content has begun and identify the transcoder **20** and/or streamer **28** responsible for satisfying the request to the relevant components of system **10**. LBS **18** may include any appropriate combination of software and/or hardware suitable to provide the described functionality.

[0025] Transcoders **20** retrieve, receive, or otherwise access requested content from original content store **22** and

modify requested content in a manner suitable for transmission to and display by the requesting client 12. Depending on the capabilities of the requesting client 12 and the characteristics of the requested source media file 30, transcoders 20 may transcode, transrate, adjust the resolution of, and/or modify content from the requested source media file 30 and/or appropriate characteristics of the source media file 30 in any appropriate manner to make the content suitable for transmission to and/or playback by the requesting client 12. Transcoders 20 may also be capable of sending, forwarding, sharing, or otherwise transmitting modified content to one or more streamers 28. In particular embodiments, transcoders 20 may be capable of transcoding content at realtime.

[0026] Transcoders 20 may be capable of modifying content in source media files 30 to facilitate transmission to and/or playback by clients 12. As part of modifying content, transcoders 20 may modify the content of a requested source media file 30 from a first format, such as an original format in which the relevant source media file 30 is stored, to a second format, such as a target format appropriate for transmission to and display by a requesting client 12. For purposes of this description and the claims that follow, the “format” of content refers to an encoding, bit-rate, resolution, frame rate, configuration, and/or any other aspect, characteristic, or property of the relevant content that is associated with transmitting the content to or displaying the content with a particular type of client.

[0027] Additionally, as described further below, transcoders 20 may also generate auxiliary files 40 that include certain information to allow streamers 28 to stream transcoded content from source media files 30 to clients 12 before the relevant transcoder 28 has completed transcoding the entire source media file 30. As described further below, auxiliary files 40 may include any suitable form of data, code, or information that may be used by one or more streamers 28 to deliver transcoded content from a requested source media file 30 while transcoding is ongoing.

[0028] Streamers 28 retrieve, receive, or otherwise access modified content from transcoders 20 to deliver, stream, or otherwise transmit transcoded content to clients 12. Depending on the relevant configuration of system 10, streamers 28 and transcoders 20 may comprise a single component, or may alternatively comprise separate components. In certain embodiments, streamers 28 receive auxiliary files 40 from transcoders 20 to facilitate proper transmission of content from transcoded media files 32 to client 12. Streamers 28 may, in particular embodiments, utilize auxiliary file 40 to transmit transcoded or modified content from a requested source media file 30 to one or more requesting clients 12 before transcoder 20 completes transcoding of the entire file, thereby reducing the delay between the client's request for the source media file 30 and delivery of appropriately formatted content to the requesting client 12. Streamers 28 and transcoders 20 may include any appropriate combination of software and/or hardware suitable to provide the described functionality. The contents of particular embodiments of transcoder 20 and streamer 28 are described in greater detail below with respect to FIGS. 3 and 4.

[0029] Although FIG. 1 and the description below describe a particular embodiment of system 10 in which the functionality of system 10 is divided among the various components in a particular manner, in alternative embodiments, the described functionality of system 10 may be divided between CMS 16, LBS 18, transcoders 20, streamers 28, and/or other

appropriate components of system 10 in any suitable manner. Additionally, CMS 16, LBS 18, transcoders 20, and/or streamers 28 may each comprise separate components of system 10, or may alternatively be combined in any manner as appropriate for performing the described functions. For example, in certain embodiments, CMS 16 and LBS 18 may comprise a single component of system 10.

[0030] Furthermore, CMS 16, LBS 18, transcoders 20, streamers 28, and/or other appropriate portions of system 10 may all be operated by the same entity or by any number of different entities. As one example, in particular embodiments, CMS 16 may be operated by a wireless telecommunications provider that outsources transcoding responsibilities to the operator of transcoders 20. As another example, in particular embodiments, CMS 16 may be operated by the operator of a peer-to-peer content-sharing website, such as YouTube, or a social networking website, such as MySpace. More generally, however, the components of system 10 may be controlled or operated by any appropriate combination of entities.

[0031] Original content store 22, transcoded content store 24, and cached content store 26 may each represent or include any appropriate type of memory devices. These content stores may comprise, for example, any collection and arrangement of volatile or non-volatile, local or remote devices suitable for storing data, such as random access memory (RAM) devices, read only memory (ROM) devices, magnetic storage devices, optical storage devices, or any other suitable data storage devices. Additionally, although each are shown as a single element in system 10, these content stores may each represent a plurality of devices and may be distributed across multiple locations within system 10. For example, in particular embodiments, one or more of these content stores may represent a network-attached storage (NAS) or portion thereof.

[0032] Original content store 22 stores source media files 30 for delivery to clients 12. As noted above, source media files 30 may comprise any appropriate type of content files. Specific examples of source media files 30 include video/multimedia content files such as Moving Picture Experts Group (MPEG), Windows Media Video (WMV), Audio Video Interleave (AVI), and QuickTime files; audio content files such as Waveform audio (WAV), MPEG-1 Audio Layer 3 (MP3), and/or Windows Media Audio (WMA) files; and/or content files of any other appropriate type or format. In particular embodiments, the source media files 30 in original content store 22 may all be stored in a single storage format supported by system 10. Alternatively, original content store 22 may store source media files 30 having a variety of different formats. Original content store 22 may store source media files 30 appropriate for transmission or display by a variety of different clients 12. Although shown in FIG. 1 as part of system 10, original content store 22 may represent components external to system 10, such as memory components distributed throughout the Internet. As a result, in particular embodiments, transcoders 20 may be able to retrieve, receive, otherwise access and/or process source media files 30 provided by a vast number of content sources available throughout the Internet for delivery to clients 12.

[0033] Transcoded content store 24 stores transcoded media files 32 representing content from source media files 30 that has been generated, transcoded, or otherwise modified by transcoders 20. In certain embodiments, transcoders 20 may store transcoded media files 32 that contain modified content from a particular source media file 30 in transcoded content store 24 while transcoders 20 continue modifying the

relevant source media file **30**. Transcoded media files **32** may comprise media content of any appropriate type or format including, but not limited to, those listed above for source media files **30**. In particular embodiments, transcoded media files **32** may be of types or formats (such as 3GP files) that are not conducive to streaming, using traditional streaming techniques, until transcoders **20** have finished writing to the relevant transcoded media files **32**. Additionally, although referred to here as “files,” in certain embodiments, a transcoded media file **32** stored in transcoded content store **24** may, at a given point in time, represent a partial file that is not complete according to a type or format associated with the relevant transcoded media file **32** or the content it contains.

[0034] Transcoded content store **24** may also store auxiliary files **40** generated by transcoders **20** during the process of transcoding media files **30** in transcoded content store **24**. As discussed further below, auxiliary files **40** may be used to facilitate streaming of transcoded media files **32** or cached media files **34** under certain circumstances. In particular embodiments, transcoded content store **24** represents storage local or internal to transcoders **20**, such as the internal memory of a web server functioning as one of transcoders **20**.

[0035] Cached content store **26** stores cached media files **34** for delivery to clients **12**. As discussed above, cached media files **34** may comprise media content of any appropriate type or format including, but not limited to, those listed above for source media files **30**. Cached media files **34** may, in certain embodiments, represent transcoded media files **32** that are stored in cached content store **26** after being created by transcoders **20**. Depending on the configuration of system **10**, cached content store **26** may also store auxiliary files **40** associated with the relevant transcoded media files **32**.

[0036] Additionally, in particular embodiments, cached content store **26** stores cached media files **34** in a commonly-requested format to minimize the frequency with which transcoding of source media files **30** is performed. As a result, CMS **16** may determine whether the content of a particular source media file **30** requested by client **12** is stored in cached content store **26** in an appropriate format before requesting the relevant source media file **30** from LBS **18**, transcoders **20**, and/or streamers **28**. Moreover, in certain embodiments, CMS **16** may instruct or otherwise communicate with a streamer **28** to deliver cached media files **34** directly from cached content store **26** to clients **12** capable of receiving and displaying content in the storage content format. As a result, in such embodiments, system **10** may deliver content, when appropriate, from cached content store **26** to clients **12** without any transcoding, transrating, or other modification. For example, if a particular video file is frequently requested by clients **12** in 3GP format, but rarely requested in QuickTime video format, system **10** may store the video file in cached content store **26** in 3GP format but not QuickTime format for efficient use of storage and transcoding resources.

[0037] In operation, CMS **16** initiates the retrieval of media content requested by clients **12**. As part of this process, source media files **30** may be transcoded or otherwise modified by transcoders **20** to provide content suitable for transmission to and/or display by the requesting client **12**. Transcoders **20** additionally generate an auxiliary file **40** associated with the transcoded media file **32**. Streamers **28** may reduce the latency associated with transmission by utilizing auxiliary file **40** to transmit transcoded content from a transcoded media file **32** to client **12** before the entirety of the requested source media file **30** is transcoded.

[0038] FIG. 1 illustrates an example of this process implemented by system **10**. As shown by FIG. 1, a client **12** (here, client **12a**) may initiate the delivery process by transmitting a content request **42** to CMS **16**. Content request **42** may identify a specific source media file **30** or may describe characteristics (using, for example, keywords) of the requested media content. Content request **42** may represent any appropriate message, request, or appropriately structured collection of information requesting delivery of content by the transmitting client **12**. For example, in particular embodiments, content request **42** represents a Hypertext Transfer Protocol (HTTP) request that identifies a particular source media file **30** stored by original content store **22**.

[0039] In response to receiving content request **42**, CMS **16** may, in particular embodiments, determine an appropriate format (referred to here as the “target format”) for the requested content to allow, facilitate, and/or optimize transmission to and playback by the requesting client **12**. CMS **16** may determine the target format based on any appropriate information, considerations, or and/or circumstances. As one example, content request **42** may indicate the appropriate format that the requested content should have for transmission to and/or playback by the requesting client **12**. Thus, in particular embodiments, CMS **16** may receive an HTTP request specifying the codec, bit-rate, and/or other parameters for the requested content. As a result, CMS **16** may be able to determine, based on information contained in the HTTP request, the output format and characteristics appropriate for the requested content. As another example, CMS **16** may identify the requesting client **12** and/or relevant characteristics of the requesting client **12** and determine a target format for the requested content based on this information. For example, CMS **16** may identify whether the client is a computer **12a**, cellular phone **12b**, or personal data assistant **12c**, and/or other type of client device. In response, CMS **16** may determine the format characteristics appropriate for the particular client **12a-c** based on its type. As yet another example, CMS **16** may detect characteristics of the particular network or portion of network **14** that the requesting client **12** is communicating over to determine an appropriate target format in which to provide the requested content to the requesting client **12**. Thus, in particular embodiments, CMS **16** may determine, based on the fact that content request **42** was received over a certain type of network, an appropriate codec or bit-rate at which to transmit the requested content to the requesting client **12**. In general, however, CMS **16** may determine, in any suitable manner and based on input from any appropriate components, the proper format and characteristics for the content requested by the requesting client **12**.

[0040] In particular embodiments, system **10** may include cached content store **26** in which cached media files **34** may be stored in certain formats (e.g., after being transcoded by transcoders **20** in response to a previous content request **42**). As a result, in such embodiments, CMS **16** may determine whether content from the requested source media file **30** is already stored in cached content store **26** in the target format. If cached content store **26** contains a cached media file **34** containing the requested content in the target format, CMS **16** may instruct a streamer **28** to retrieve the relevant cached media file **34** and transmit the relevant cached media file **34** to the requesting client **12**.

[0041] If, however, cached content store **26** does not contain a cached media file **34** containing the requested content in the target format (or if system **10** does not include any cached

content store 26), CMS 16 may initiate transcoding of a source media file 30 containing the requested content. To initiate transcoding and/or transmission of the requested content, CMS 16 may transmit a transcoding request 44 to a transcoder 20 and/or streamer 28 or, in embodiments that include LBS 18, to LBS 18. Transcoding request 44 may represent any appropriate message, request, or suitably-structured collection of information requesting modification and/or streaming of particular content. For example, in particular embodiments, transcoding request 44 represents an HTTP request that identifies a particular source media file 30 containing content to be transcoded and/or transmitted to a client 12, and an appropriate output format for the requested content.

[0042] In embodiments of system 10 that include LBS 18, LBS 18 receives a transcoding request 44 and, in response, selects a transcoder 20 to modify the requested content based on the target format. LBS 18 may additionally select a streamer 28 to transmit or stream the requested content to the requesting client 12 in the target format. In various embodiments, LBS 18 may select a transcoder 20 and/or streamer 28 based on process loads, queues, and other availability indicators associated with transcoders 20 and/or streamers 28. LBS 18 may then forward transcoding request 44 to the selected transcoder 20 and/or streamer 28 requesting modification and/or transmission of requested content according to the target format.

[0043] A particular transcoder 20 and/or streamer 28 then receives transcoding request 44 from CMS 16 or LBS 18. In response to receiving transcoding request 44, the transcoder 20 locates and retrieves the requested source media file 30 (referred to here as “requested source media file 30a”) from original content store 22. Transcoder 20 may retrieve, receive, or otherwise access requested source media file 30a in any appropriate manner. In particular embodiments, original content store 22 includes one or more web servers (and associated memory elements) accessible through the Internet and the relevant transcoder 20 may communicate with original content store 22 using the HTTP protocol.

[0044] Transcoder 20 then modifies requested source media file 30a according to a target format. As noted above, transcoder 20 may modify requested source media file 30a by transcoding, transrating, changing the resolution of, and/or otherwise modifying any aspect, characteristic, or property of the content in requested source media file 30a. While modifying requested source media file 30a, transcoder 20 stores portions of the modified content from requested source media file 30a (referred to, in this example, as “transcoded media file 32a”) in transcoded content store 24.

[0045] Problems may arise in low-latency transmission, however, where a target format is not conducive to transmission or streaming until a requested source media file 30 is completely transcoded. For example, certain file formats may require data blocks, headers, or other file information which is not written until file transcoding is complete, but is needed to properly transmit, display, view, and/or otherwise use the requested content at client 12. As one example, 3GP files include a structure called a “moov” box that contains information about the content stored in the 3GP file, such as the starting point of the content in the 3GP file, the type of content stored in the file, and the sequence in which the content should be played. The information contained in the “moov” box of a 3GP file is written progressively and is, thus, incomplete while a media file is being written to the 3GP format.

Accordingly, for 3GP files, this “moov” information is not complete until the entire 3GP file is written and all 3GP audio and video data is available. As a result, the use of 3GP files may hinder or prevent certain conventional systems from streaming content from a 3GP file that a transcoder is still transcoding. Similar or comparable problems may arise with respect to other media file formats as well.

[0046] Thus, to facilitate streaming of portions of transcoded media file 32a while transcoder 20 is still writing to transcoded media file 32a, transcoder 20 may additionally generate an auxiliary file 40 (referred to in this example as “auxiliary file 40a”). Auxiliary file 40a may include any suitable form of data, code, or information that may be used by one or more streamers 28 to deliver portions of the content in a requested source media file 30 while transcoding is ongoing. For example, in certain embodiments, auxiliary file 40a may include a plurality of records associated with particular portions of the media content in a transcoded media file 32a. Such content records may indicate a location of the associated portion of media content within the transcoded media file 32a. Some embodiments may contain information regarding where within transcoded media file 32a a streamer 28 may locate particular audio and video data. In such embodiments, streamer 28 may use this information to identify a particular location within a portion of transcoded media file 32a, read a specified amount of information (e.g., a particular number of bytes) as directed by auxiliary file 40a, and accordingly send a portion of modified content from transcoded media file 32a to client 12 before transcoder 20 completes the modification of requested source media file 30a. Additionally or alternatively, auxiliary file 40a may include file header information for transcoded media file 32a, location data for frames or other portions of transcoded media file 32a, audio and/or video data such as timestamp data, framerate data, resolution data, bitrate data, and any other appropriate information. The structure and content of an example auxiliary file 40 is discussed more fully below with reference to FIG. 2.

[0047] In certain embodiments, while a transcoder 20 is transcoding requested source media file 30a, the same or another transcoder 20 may simultaneously generate auxiliary file 40a containing information regarding modified content in transcoded media file 32a. Auxiliary file 40a may be accessed by a selected streamer 28 and used by that streamer 28 to transmit all or portions of transcoded media file 32a to client 12 while transcoding is ongoing. Accordingly, streamer 28 may utilize information in auxiliary file 40a to transmit content from requested source media file 30a to a client 12 even though requested source media file 30a and/or the content it contains has a format that is not conducive to being streamed, using traditional streaming techniques, until the entire content of requested source media file 30a is transcoded.

[0048] Transcoder 20 may generate auxiliary file 40a and make the information in auxiliary file 40a accessible to the relevant streamer or streamers 28 in any appropriate manner. In certain embodiments, transcoder 20 may generate a partial auxiliary file 40a in transcoded content store 24 containing information about a first portion of transcoded media file 32a and continue writing information to this partial auxiliary file 40a as transcoding continues. The relevant streamer or streamers 28 may then access the partial auxiliary file 40a incrementally to allow streaming of content from transcoded media file 32a while transcoded media file 32a and auxiliary file 40a are still being written. In certain embodiments, the salient information in auxiliary file 40a may be generated

during the course of transcoding. Accordingly, auxiliary file data may be a by-product of the transcoding process and thus transcoder 20 may be able to generate auxiliary file 40a without generating any additional information beyond that otherwise generated in the transcoding process.

[0049] Before or during modification of the content in requested source media file 30a, transcoder 20 may notify a selected streamer 28 that transcoding has begun. Additionally, transcoder 20 or, if notified by transcoder 20, streamer 28 may transmit information to the requesting client 12 indicating that the requested content may be retrieved in the target format. For example, in particular embodiments transcoder 20 notifies a selected streamer 28 that transcoding of requested source media file 30a has begun, and streamer 28 sends a content response 46 to CMS 16 indicating a first portion of requested source media file 30a has been (or will be) modified according to the target format and is available (or will soon be available) for delivery to client 12. Content response 46 may be sent from transcoder 20 and/or streamer 28 to CMS 16 directly over network 14, or by first passing through LBS 18. CMS 16 may then communicate content response 46 to the requesting client 12, e.g., as an HTTP response.

[0050] In particular embodiments, content response 46 may include a streamer identifier 49 that represents an address, location, or other identifier for the relevant streamer 28 that the requesting client 12 may use to retrieve the modified content. For example, in particular embodiments, streamer identifier may represent a Real Time Streaming Protocol (RTSP) uniform resource locator (URL) address. As a result, in particular embodiments, streamer 28 may transmit an HTTP response to CMS 16 that includes a URL address that the requesting client 12 can use to communicate with streamer 28.

[0051] Client 12 may then request the transcoded content from streamer 28. For example, the requesting client 12 may transmit a transmit request 48 to the relevant streamer 28 requesting transmission of content from transcoded media file 32a to the requesting client 12. In particular embodiments, clients 12 communicate with streamer over network 14 using streamer identifier 49 communicated as part of content response 46 to initiate transmission of requested content in the target format. The transmitted portions are shown in FIG. 1 as streamed media content 36. Alternatively, in particular embodiments, the selected streamers 28 may be provided an address, identifier, or other information identifying the requesting client 12, and the selected streamer 28 may itself initiate transmission of the transcoded content to the requesting client 12 without receiving any request from the relevant client 12.

[0052] After transcoder 20 has begun transcoding requested source media file 30a and the selected streamer 28 has received any appropriate requests, the selected streamer 28 may begin transmitting streamed media content 36 to the requesting client 12 in the appropriate target format. Although referred, for purposes of illustration, as "streamed" media content, streamer 28 may transmit streamed media content 36 to client 12 as a media stream, progressive download, or in any other appropriate manner. Additionally, in particular embodiments, streamer 28 may begin transmitting streamed media content 36 to client 12 while the selected transcoder 20 is still modifying the content of requested source media file 30a. Thus, the content flow through

transcoder 20 and streamer 28 represented in FIG. 1 by 30a, 32a, and 36 may be concurrently ongoing.

[0053] To facilitate transmission of streamed media content 36 from transcoded media file 32a while transcoder 20 is still writing content to transcoded media file 32a, streamer 28 may utilize information in auxiliary file 40a to access and/or transmit streamed media content 36 to the requesting client 12. As one example, in certain embodiments, auxiliary file 40a may include one or more records storing location and/or size information associated with separate portions (e.g., individual video frames) of the modified media content in transcoded media file 32a. Streamer 28 receives or otherwise accesses a first record in auxiliary file 40a while transcoding is ongoing and, using information in this first record, determines a location for a corresponding first portion of media content stored in transcoded media file 32a. Streamer 28 may then use this location information to access the corresponding first media portion and transmit this first media portion to client 12.

[0054] Furthermore, streamer 28 may repeat this process for additional records in auxiliary file 40a and, thus, may access and transmit portions of transcoded media file 32a associated with each record of auxiliary file 40a. For example, in an embodiment of system 10 delivering video content, streamer 28 may increment a pointer associated with transcoded media file 32a based on a frame size associated with transcoded media file 32a, retrieve a particular video frame from a location determined based on the pointer by reading a number of bits equal to the size of the video frame, and then transmit the retrieved video frame to the requesting client 12.

[0055] As another example, auxiliary file 40a may also include information to allow streamers 28 to synchronize portions of the modified content in transcoded media file 32a before streaming the relevant portions to client 12 and/or to allow clients 12 to synchronize portions of the modified content after streamers 28 have transmitted the relevant portions. For example, in particular embodiments, auxiliary file 40a may include information specifying an amount of content missing from transcoded media file 32a or from between consecutive portions of transcoded media file 32a (e.g., a number of frames dropped during transcoding from between two video frames of transcoded media file 32a), and streamers 28 may utilize this information in generating time stamps for content portions and/or packets used to transmit content, numbering frames or other portions of content, or for otherwise indicating to clients 12 a timing, spacing, or sequence for playback of the modified content so as to maintain synchronization during playback.

[0056] In general, however, auxiliary files 40 may include any appropriate information to permit, enable, or otherwise facilitate streamers 28 transmitting streamed media content 36 from transcoded media file 32 while modification of content from requested source media file 30 is ongoing. In particular embodiments, auxiliary files 40 may include information specifying a media type for content in associated portions of a transcoded media file 32, information indicating a resolution or screen-size for content in associated portions of a transcoded media file 32, and/or any other appropriate information associated with the relevant portions of a transcoded media file 32. Furthermore, streamers 28 may access and utilize the information stored in auxiliary files 40 in any suitable manner based on the configuration and capabilities of streamers 28 and the specific information stored in auxiliary files 40.

[0057] After client 12 begins to receive streamed media content 36 from the selected streamer 28, client 12 may initiate playback of streamed media content 36. In particular embodiments, client 12 initiates playback of the streamed media content 36 immediately or shortly after receiving it. Thus, in such embodiments, the fact that streamer 28 is able to begin transmitting transcoded content to the requesting client 12 while the selected transcoder 20 is still transcoding requested source media file 30a means that appropriately-transcoded content may be provided to the requesting client 12 with only a minimal delay between a user's request for content and playback of the content regardless of the capabilities or format requirements of the particular client 12 being utilized.

[0058] Additionally, in certain embodiments, system 10 may be configured so that if a second client 12 sends a second content request 42 to CMS 16 requesting the same requested source media file 30a in the same target format as the original content request 42 while the relevant transcoder 20 is still modifying the requested content, rather than repeating the process described above, CMS 16 may send a transcoding request 44 to LBS 18 identifying the requested source media file 30a and target format. LBS 18 may then send CMS 16 an identifier 49 associated with the transcoder 20 and/or streamer 28 that is currently modifying the requested content, or any other transcoder 20 and/or streamer 28. CMS 16 then directs the second client 12 to the transcoder 20 and/or streamer 28 performing the modification. Once the second client is in communication with the transcoder 20 and/or streamer 28, the second client may retrieve modified content at the same time as the original client 12.

[0059] When transcoder 20 completes modification of the requested content, transcoder 20 may indicate to LBS 18 and/or CMS 16 that modification is complete. In particular embodiments, transcoder 20 may send a message to the CMS 16 in response to which CMS 16 may direct transcoder 20 to continue storing the modified content in transcoded content store 24, send the modified content to cached content store 26, and/or delete the modified content from the transcoded content store 24. For example, in particular embodiments, transcoder 20 may transmit a message to CMS 16 specifying a URL address from which CMS 16 may retrieve the transcoded media file 32a. Alternatively, in particular embodiments, transcoder 20 may automatically store the completed transcoded media file 32a in cached content store 26 after modifying transcoded media file 32a. Likewise transcoder 20 may store, save, send, or delete auxiliary file 40a in any appropriate manner. For example, in particular embodiments, transcoder 20 may store both the completed transcoded media file 32a and the completed auxiliary file 40a in cached content store 26 once transcoding of requested source media file 30a is completed.

[0060] Thus, by allowing clients 12 to retrieve content from source media files 30 in a modified form before transcoders 20 have fully completed modifying the relevant source media files 30, system 10 may provide low-latency content delivery. Additionally, as a result of the ability of transcoder 20 to provide simultaneous, real-time modification, and of streamers 28 to provide delivery of modified content to multiple users, CMS 16 and cached content store 26 can store content in one or a select few frequently-requested output formats, but deliver requested content in a variety of formats with little to no increase in delivery times and quality. This may result in reduced storage requirements for cached content store 26 and

may allow CMS 16 and cached content store 26 to service a greater number and variety of users and eliminate the time and expense of pre-transcoding all content to be stored on cached content store 26. Consequently, particular embodiments of system 10 may provide numerous operational benefits. Specific embodiments, however, may provide none, some, or all of these benefits.

[0061] FIG. 2 is a diagram illustrating in greater detail the contents and structure of auxiliary file 40a that may be generated by particular embodiments of transcoder 20 when completing the content delivery process described with respect to FIG. 1. As discussed above, a transcoder 20 generates auxiliary file 40a while transcoding content from requested source media file 30a to create the corresponding transcoded media file 32a. One or more streamers 28 may then access auxiliary file 40a while transcoding is still ongoing and utilize the information in the accessed auxiliary file 40a to facilitate transmission of media content from transcoded media file 32a before the relevant transcoder 20 has completed modification of transcoded media file 32a.

[0062] In the illustrated embodiment, auxiliary file 40a includes a file header 200, one or more media headers (including a video header 210 and an audio header 230), and one or more content records 250. While FIG. 2 and the description below describe a particular embodiment of auxiliary file 40a that includes certain information structured in a particular manner, auxiliary files 40 may include other appropriate information and/or be structured in a different manner than that described. In general, auxiliary files 40 may include any data appropriate to facilitate transmission of media content from transcoded media file 32a while the transcoder 20 responsible for generating transcoded media file 32a is still storing modified content in the relevant file. As a result, alternative embodiments of system 10 may generate auxiliary files 40 having some, none, or all of the elements described below and/or having elements in addition to those described below.

[0063] In the example auxiliary file 40a shown in FIG. 2, file header 200 holds general information relating to the media included in transcoded media file 32a described by auxiliary file 40a. As one example, in particular embodiments, this general information may include a media types field 202 identifying one or more media types for the modified media being written to transcoded media file 32a. For example, the illustrated auxiliary file 40a includes a media types field 202 that stores a four-byte value indicating the various media types included in transcoded media file 32a. If transcoded media file 32a includes only audio content, the transcoder 20 responsible for generating this auxiliary file 40a may store a value of "1" in the media types field 202. If, instead, transcoded media file 32a includes only video content or includes both audio and video content then the relevant transcoder 20 may store a value of "2" or a value of "3," respectively, in media types field 202 of the illustrated auxiliary file 40a.

[0064] Data in the media headers, such as video header 210 and audio header 230, is used by the selected streamer 28 to determine various properties of the different types of media included in transcoded media file 32a. Each media header may include information specific to the content of that type in transcoded media file 32a. For example, in the illustrated auxiliary file 40a, video header 210 holds information regarding video content in transcoded media file 32a such as, for example, a video codec type, a content size, a bit rate, and a frame rate. In the illustrated auxiliary file 40a, this data is

stored in a video codec type field 212, multiple size fields (including a height field 214 and a width field 216), a bit rate field 218, and a frame rate field 220, respectively. In particular embodiments, video codec type field 212, height field 214, width field 216, bit rate field 218, and frame rate field 220 each store a four-byte value holding the relevant data.

[0065] Audio header 230 may include information similar to video header 210 but relating to audio information in transcoded media file 32a. For example, audio header 230 may include information such as an audio codec type, a bit rate, a sampling rate, and a number of audio channels encoded in the audio content of transcoded media file 32a. In the illustrated auxiliary file 40a, this data is stored in audio codec type field 232, bit rate field 234, sampling rate field 236, and channel quantity field 238, respectively. In particular embodiments, audio codec type field 232, bit rate field 234, sampling rate field 236, and channel quantity field 238 each store a four-byte value indicating the relevant data.

[0066] Additionally, certain target formats may utilize configuration information that is provided to the selected streamer 28 to allow the selected streamer 28 to transmit content from transcoded media file 32a and/or to the requesting client 12 to allow the requesting client 12 to receive or play content from transcoded media file 32a. For example, in particular embodiments, when transcoded media file 32a represents a 3GP file, streamer 28 may utilize a session description protocol (SDP) file to properly stream media content from the 3GP file to the requesting client 12. This SDP file may contain a specific type of configuration information, such as a configuration ("config") string, defining features of the encoded video and/or audio stream contained in transcoded media file 32a. This configuration string may be used by one or both of the selected streamer 28 and the requesting client 12 to properly configure themselves and/or the communication session over which content from transcoded media file 32a will be transmitted.

[0067] As a result, in certain embodiments, delays in transmitting modified content from transcoded media file 32a may be avoided by including configuration data in a configuration data field 224 of video header 210 and/or a configuration data field 244 of audio header 230. In particular embodiments, the amount of information stored in these fields may vary, and as a result, the value stored in the field may be padded to bring the amount of data up to a particular size. For example, in particular embodiments, configuration information stored in configuration data field 224 or 244 is padded so that 108 bytes of data are stored in these fields. The size of the actual configuration data stored in configuration data fields 224 and 244 may then be stored in a configuration data size field 226 and 246, respectively.

[0068] Configuration data field 224 of video header 210 and configuration data field 244 of audio header 230 may store any appropriate information to be utilized to configure the selected streamer 28, the requesting client 12, and/or the transmission session used to transmit content from transcoded media file 32a to the requesting client 12. For example, in certain embodiments, the responsible transcoder 20 may generate a config string from video or audio media in transcoded media file 32a during transcoding of the relevant media and store the generated config string within the appropriate configuration data field 224 or 244 of auxiliary file 40a. Utilizing this config string, the selected streamer 28 may then initiate an RTSP session with the requesting client 12 to transmit content from transcoded media file 32a.

[0069] Content records 250 include information regarding the structure and contents of transcoded media file 32a. Auxiliary file 40a may include multiple content records 250 each associated with a different portion of the content in transcoded media file 32a. As noted above, these different content portions of transcoded media file 32a may each represent a discrete portion of content (e.g., an individual frame or a predetermined number of frames) or arbitrarily-sized portions (e.g., a five-second portion of video data or a kilobyte-sized portion of audio data). In particular embodiments, each audio frame and each video frame in the associated transcoded media file 32a has a corresponding content record 250 in auxiliary file 40a.

[0070] Content records 250 may each include any appropriate information structured in any appropriate manner to allow the selected streamer 28 to access the associated portion of transcoded media file 32a associated with that content record 250 and transmit the associated portion to the requesting client 12. For purposes of illustration, the example content records 250 shown in FIG. 2 each include a media type field 252 indicating a type of content associated with the relevant content record 250 (e.g., Audio-1, Video-2), a position indicator field 254 indicating the location of the associated content portion in transcoded media file 32a, a size field 256 indicating the size of the associated content portion, and a dropped content field 258 indicating an amount of content (e.g., a number of frames) dropped during transcoding of the associated portion of media (or dropped in between the transcoding of the associated portion and the immediately preceding or succeeding portion).

[0071] Thus, in particular embodiments, when retrieving content from transcoded media file 32a for transmission to the requesting client 12, the selected streamer 28 may access a first content record 250 of auxiliary file 40a to determine a location of the modified content in transcoded media file 32a associated with the first content record 250. In particular, the selected streamer 28 may access the associated content portion by reading from a location within transcoded media file 32a (e.g., as measured by a number of bytes from the beginning of transcoded media file 32a) based on the position indicator field 254 of the first content record 250. The selected streamer 28 may then retrieve the associated portion of content by reading a quantity of data determined based on the size field 256 of the associated content record 250 and transmit the associated portion to the requesting client 12. The selected streamer 28 may then read another content record 250 and repeat the process. The selected streamer 28 may continue this process until reaching an appropriate stopping point, such as when the responsible transcoder 20 has completed modifying content for transcoded media file 32a and the selected streamer 28 has transmitted all the modified content to the requesting client 12. At the stopping point, the transcoder 20 may generate a content record 250 designated as an end-of-file record (shown in FIG. 2 as "content record 250z"), in which media type field 252 is set as "end-of-file" and other fields are set to zero.

[0072] Additionally, content records 250 may also include dropped content field 258 storing information regarding an amount of content dropped during transcoding. This information may allow the selected streamer 28 to transmit portions of a media file 30 with proper timing and synchronization. For example, in particular embodiments, each content record 250 is associated with a particular video frame in transcoded media file 32a, and the dropped content field 258 for a par-

particular video frame indicates a number of video frames dropped between transcoding of that particular video frame and the transcoding of the immediately preceding video frame. In such embodiments, the selected streamer 28 may then utilize information in the dropped content field 258 of each content record 250 to increment timestamps for the associated video frames when transmitting to the requesting client 12. This may allow the selected streamer 28 and/or the requesting client to maintain audio-video synchronization during streaming of the requested content.

[0073] FIG. 3 is a block diagram illustrating in greater detail the contents and operation of a particular embodiment of the transcoders 20 shown in FIG. 1. In general, as discussed above with respect to FIG. 1, transcoder 20 retrieves or otherwise receives content for delivery to clients 12, modifies the retrieved content in an appropriate manner, and generates a corresponding auxiliary file 40 to facilitate transmission of the modified content by streamer 28 and/or display of the modified content by the requesting client 12. As shown in FIG. 3, transcoder 20 may include a streamer interface module 50, a network interface module 54, a storage interface module 56, a transcoding module 58, a memory 60, and a processor 62.

[0074] Processor 62 may represent or include any form of processing component, including general purpose computers, dedicated microprocessors, or other processing devices capable of processing electronic information. Examples of processor 62 include digital signal processors (DSPs), application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and any other suitable specific or general purpose processors. Although FIG. 3 illustrates a particular embodiment of transcoder 20 that includes a single processor 62, transcoder 20 may, in general, include any suitable number of processors 62.

[0075] Memory 60 stores processor instructions, codecs, and/or values and parameters utilized by transcoder 20 during operation. Memory 60 may comprise any collection and arrangement of volatile or non-volatile, components suitable for storing data, such as for example random access memory (RAM) devices, read only memory (ROM) devices, magnetic storage devices, optical storage devices, or any other suitable data storage devices. In particular embodiments, memory 60 may represent, in part, computer-readable media on which computer instructions are encoded. In such embodiments, some or all the described functionality of transcoder 20 may be provided by processor 62 executing the instructions encoded on the described media. Although shown in FIG. 3 as a single component, memory 60 may represent any number of memory elements within, local to, or accessible by transcoder 20.

[0076] Streamer interface module 50 couples transcoder 20 to one or more streamers 28 to facilitate communication and data flow between transcoder 20 and streamers 28. For example, transcoder 20 may transmit portions of a transcoded media file 32 and auxiliary file 40 to a selected streamer 28 through streamer interface module 50. In certain embodiments, communications and data flow between transcoder 20 and streamer 28 may alternatively occur via network interface module 54.

[0077] Network interface module 54 couples transcoder 20 to appropriate components of system 10 to facilitate communication over network 14 between transcoder 20 and streamers 28, LBS 18, CMS 16, clients 12, and/or other appropriate components of system 10 regarding content-delivery opera-

tions performed by transcoder 20. For example, transcoder 20 may receive transcoding requests 44 from LBS 18 and transmit content responses 46 to LBS 18 over network 14 through network interface module 54. In particular embodiments, network interface module 54 includes or represents one or more network interface cards (NICs) suitable for packet-based communication over network 14.

[0078] Transcoding module(s) 58 modifies content received by transcoder 20. In particular embodiments, transcoder 20 may include multiple transcoding modules 58 capable of translating, transcoding, transrating, and/or otherwise modifying various different types of received content based on a target format for a received request. In certain of the embodiments that include multiple transcoding modules 58, transcoding modules 58 may be capable of operating concurrently so that multiple sets of content can be modified simultaneously. As a result, transcoder 20 may provide a robust platform for use in high-traffic content-delivery systems.

[0079] Storage interface module 56 facilitates communication of content between transcoder 20 and various components of system 10. Specifically, transcoder 20 receives content from original content store 22 and communicates content to and from transcoded content store 24 through storage interface module 56. To support multiple simultaneous transcoding processes, storage interface module 56 may include multiple ports through which storage interface module 56 can receive/transmit multiple flows simultaneously from/to transcoded content store 24 and/or original content store 22.

[0080] In particular embodiments, original content store 22 and transcoded content store 24 are both remote from transcoder 20. As a result, in such embodiments, storage interface module 56 may represent, in part or in whole, elements of network interface module 54. In alternative embodiments, one or both of original content store 22 or transcoded content store 24 may represent memory components internal to transcoder 20, such as memory 60. In such embodiments, storage interface module 56 may represent, in whole or in part, a memory bus and/or other suitable components configured to communicate information between internal memory components and other components of transcoder 20.

[0081] In general, each of network interface module 54, transcoding module 58, and storage interface module 56 may represent any appropriate combination of hardware and/or software suitable to provide the described functionality. Additionally, any two or more of network interface module 54, transcoding module 58, and storage interface module 56 may represent or include common elements. In particular embodiments, network interface module 54, transcoding module 58, and storage interface module 56 represent, in part, software applications being executed by processor 62.

[0082] As one specific example, particular embodiments of transcoder 20 may contain a plurality of transcoding modules 58 with each transcoding module 58 representing or including a digital signal processor (DSP). Each DSP may have a portion of memory 60 local to that DSP in which appropriate information for encoding/decoding multiple different codecs is stored. As a result, transcoder 20 may provide a power-efficient, compact platform for realtime transcoding in a high-traffic system.

[0083] FIG. 4 is a block diagram illustrating in greater detail the contents and operation of a particular embodiment of streamer 28 shown in FIG. 1. In general, as discussed above with respect to FIGS. 1 and 2, streamer 28 receives, retrieves,

or otherwise accesses transcoded media files **32** and auxiliary files **40** from transcoder **20** for transmission or delivery to clients **12**. As shown in FIG. **4**, streamer **28** may include a network interface module **70**, a transcoder interface module **74**, a processor **76**, a memory **78**, and a streaming module **80**.

[0084] Processor **76** may represent or include any form of processing component, including general purpose computers, dedicated microprocessors, or other processing devices capable of processing electronic information. Examples of processor **76** include digital signal processors (DSPs), application-specific integrated circuits (ASICs), field-programmable gate arrays (FPGAs), and any other suitable specific or general purpose processors. Although FIG. **4** illustrates a particular embodiment of streamer **28** that includes a single processor **76**, streamer **28** may, in general, include any suitable number of processors **76**, and certain embodiments of streamer **28** may not include any processor **76**.

[0085] Memory **78** stores processor instructions, codecs, and/or values and parameters utilized by streamer **28** during operation. Memory **78** may comprise any collection and arrangement of volatile or non-volatile, components suitable for storing data, such as for example random access memory (RAM) devices, read only memory (ROM) devices, magnetic storage devices, optical storage devices, or any other suitable data storage devices. In particular embodiments, memory **78** may represent, in part, computer-readable media on which computer instructions are encoded. In such embodiments, some or all of the described functionality of streamer **28** may be provided by processor **76** executing the instructions encoded on the described media. Although shown in FIG. **4** as a single component, memory **78** may represent any number of memory elements within, local to, or accessible by streamer **28**.

[0086] Transcoder interface module **74** couples streamer **28** to transcoder **20** to facilitate communication and data flow between streamer **28** and transcoder **20**. For example, streamer **28** may receive portions of a transcoded media file **32** and auxiliary file **40** from transcoder **20** through streamer interface module **74**. In certain embodiments, communications and data flow between streamer **28** and transcoder **20** may alternatively occur over network **14** via network interface module **70**.

[0087] Network interface module **70** couples streamer **28** to appropriate components of system **10** to facilitate communication between streamer **28**, transcoder **20**, LBS **18**, CMS **16**, clients **12**, and/or other appropriate components of system **10** regarding content-delivery operations performed by streamer **28**. For example, streamer **28** may receive transcoding requests **44** from LBS **18** and transmit content responses **46** to LBS **18** through network interface module **54**. In particular embodiments, network interface module **54** includes or represents one or more network interface cards (NICs) suitable for packet-based communication over network **14**.

[0088] Streaming module(s) **80** transmit, stream, deliver, or otherwise send content received by streamer **28**. In particular embodiments, streamer **28** may include multiple streaming modules **80** capable of transmitting requested content in a target format to clients **12** over network **14**. In certain of the embodiments that include multiple streaming modules **80**, streaming modules **80** may be capable of operating concurrently so that multiple sets of content can be transmitted simultaneously. As a result, streamer **28** may provide a robust platform capable of delivering multiple content streams in parallel.

[0089] In general, each of transcoder interface module **74**, streaming module **80**, processor **76**, memory **78**, and network interface module **70** may represent any appropriate combination of hardware and/or software suitable to provide the described functionality. Additionally, any two or more of transcoder interface module **74**, streaming module **80**, and network interface module **70** may represent or include common elements. In particular embodiments, transcoder interface module **74**, streaming module **80**, and network interface module **70** represent, in part, software applications being executed by processor **76**.

[0090] Furthermore, in certain embodiments, transcoder **20** and streamer **28** may represent or include common elements. For example, in certain embodiments, transcoder **20** and streamer **28** may share common memory and processing components, and/or software modules. In some embodiments, CMS **16** and/or LBS **18** may additionally represent or include common elements with transcoder **20** and/or streamer **28**.

[0091] FIG. **5** is a flowchart illustrating operation of a particular embodiment of system **10** in delivering content to a requesting client **12**. The steps illustrated in FIG. **5** may be combined, modified, or deleted where appropriate, and additional steps may also be added to the flowchart. Additionally, the steps may be performed in any suitable order without departing from the scope of the invention.

[0092] Operation, in the illustrated example, begins at step **500** with appropriate components of system **10** receiving a request identifying a media file **30**. For example, CMS **16** may receive a content request **42** for a requested source media file **30a** from a client **12**. In particular embodiments, the requesting client **12** requests a particular media file from CMS **16** by transmitting an HTTP request to CMS **16** that identifies requested source media file **30a**. The HTTP request may also specify information about the requesting client **12** and/or a requested display format so that the content can be modified in a manner appropriate for transmission to and display by the relevant client **12**.

[0093] At step **502**, transcoder **20** determines a target format associated with the request. Transcoder **20** may determine the target format for the requested media content based on the particular characteristics of client **12** or other appropriate considerations. The target format may represent a format that is appropriate for transmission to, receipt at, and/or playback by the requesting client **12**, such as a computer **12a**, cell phone **12b**, or personal data assistant **12c**.

[0094] At step **504**, a transcoder **20** and/or streamer **28** is selected. In particular embodiments, CMS **16** and/or LBS **18** may be responsible for selecting a transcoder **20** and/or streamer **28** to modify and/or deliver the requested media file **30** according to the target format. CMS **16** and/or LBS **18** may select a particular transcoder **20** and streamer **28** to perform the modification based on availability, capacity, functionality, and/or any other appropriate factors or considerations.

[0095] At step **506**, LBS **18** or transcoder **20** determines whether requested source media file **30a** is already stored or otherwise available in the target format. For example, in particular embodiments, CMS **16** may determine whether cached content store **26** is storing a cached media file **34** that contains the content of the requested source media file **30a** in the target format. If requested source media file **30a** is already stored or available in the target format, operation proceeds to step **514** where the selected streamer **28** then retrieves

requested source media file **30a** from an appropriate content store in the target format and operation moves to step **516**.

[0096] If requested source media file **30a** is not available in the target format, at step **508**, the selected transcoder **20** may retrieve requested source media file **30a** for subsequent modification and transmission. At step **510**, a selected transcoder **20** begins modifying content in the requested media file and generating transcoded media file **32a** in the target format. Additionally, the selected transcoder **20** also begins generating an auxiliary file **40a** associated with transcoded media file **32a** at step **512**. In particular embodiments, the selected transcoder **20** may generate transcoded media file **32a** and auxiliary file **40a** contemporaneously.

[0097] The requesting client **12** is notified that a first portion of transcoded media file **32a** is available in the target format at step **516**, and at step **518**, streamer **28** and/or transcoder **20** receive a request from the requesting client **12** to begin transmission of the streaming file. At step **520**, streamer **28** begins transmitting streamed media content **36** to the requesting client **12**. If streamer **28** is transmitting streamed media content from a transcoded media file **32** (e.g., transcoded media file **32a**) while content is still being written to the relevant transcoded media file **32**, then streamer **28** may utilize a corresponding auxiliary file **40** (e.g., auxiliary file **40a**) to facilitate access to and transmission of the content in the relevant transcoded media file **32**. Additionally, in particular embodiments, streamer **28** may utilize auxiliary files **40** even if streaming from a completed transcoded media file **32** or from a cached media file **34**. In alternative embodiments, however, streamer **28** may be configured to use auxiliary files **40** only if streaming transcoded media files **32** that are still being transcoded and may not utilize auxiliary files **40** when streaming from completed transcoded media files **32** or cached media files **34**. After streamer **28** begins transmitting streamed media content **36** to the requesting client **12**, the requesting client **12** initiates playback of streamed media content **36** at step **522**.

[0098] The selected transcoder **20** may also store the generated transcoded media file **32a** and/or auxiliary file **40a** at step **524**. The selected transcoder **20** may store transcoded media file **32a** and/or auxiliary file **40a** in an ongoing process during generation or may store these files once transcoder **20** completely finishes generating transcoded media file **32a**. Operation of system **10** with respect to delivering requested source media file **30a** may then end as shown in FIG. 5.

[0099] Although the present invention has been described with several embodiments, a myriad of changes, variations, alterations, transformations, and modifications may be suggested to one skilled in the art, and it is intended that the present invention encompass such changes, variations, alterations, transformations, and modifications as fall within the scope of the appended claims.

What is claimed is:

1. A method for processing media content, comprising:
 - receiving a request identifying a requested media file;
 - in response to receiving the request, accessing the requested media file, wherein the requested media file comprises media content in a first format;
 - generating a modified media file based on the requested media file, wherein the modified media file comprises media content in a second format; and
 - while generating the modified media file, generating an auxiliary file associated with the modified media file, the auxiliary file comprising a plurality of content records,

each content record associated with a portion of the media content in the modified media file and indicating a location of the associated portion of the media content in the modified media file.

2. The method of claim 1, wherein each content record includes information to facilitate transmission of an associated portion of the media content to a remote client prior to the modified media file being completely generated.

3. The method of claim 1, wherein each content record further comprises dropped content information for an associated portion of the media content, wherein the dropped content information indicates an amount of content dropped during transcoding.

4. The method of claim 1, wherein the auxiliary file indicates a frame rate associated with the modified media file.

5. The method of claim 1, wherein the auxiliary file indicates a bit rate associated with the modified media file.

6. The method of claim 1, wherein the auxiliary file indicates a codec associated with the modified media file.

7. The method of claim 1, further comprising transmitting a first portion of the modified media file to a remote client while generating the modified media file.

8. The method of claim 7, further comprising:

- storing the modified media file in a content store;

- receiving a second request identifying the requested media file;

- in response to the second request, retrieving the modified media file from the content store; and

- transmitting the modified media file to a second remote client.

9. The method of claim 1, wherein receiving the request identifying the requested media file comprises:

- receiving the request transmitted from a remote client; and

- in response to receiving the request, selecting one of a plurality of a transcoding elements to access the requested media file.

10. The method of claim 1, wherein accessing the requested media file comprises:

- determining whether the requested media file is stored in a first content store in the second format; and

- in response to determining that the requested media file is not stored in the content store in the second format, transmitting a request to the first content store, the request identifying the requested media file; and

- receiving the media file from the first content store in the first format.

11. The method of claim 10, wherein transmitting a request to the first content store comprises:

- transmitting a Hypertext Transfer Protocol (HTTP) request identifying the media file to the first content store.

12. The method of claim 1, wherein the modified media file comprises a 3GP file.

13. An apparatus for processing media content, comprising:

- a memory operable to store processor instructions;

- a processor operable to execute the processor instructions and, while executing the processor instructions, operable to:

- receive a request identifying a requested media file;

- in response to receiving the request, accessing the requested media file, wherein the requested media file comprises media content in a first format;

generate a modified media file based on the requested media file, wherein the modified media file comprises media content in a second format; and

while generating the modified media file, generate an auxiliary file associated with the modified media file, the auxiliary file comprising a plurality of content records, each content record associated with a portion of the media content in the modified media file and indicating a location of the associated portion of the media content in the modified media file.

14. The apparatus of claim **13**, wherein the processor is further operable to generate the auxiliary file by generating an auxiliary file wherein each content record includes information to facilitate transmission of an associated portion of the media content to a remote client prior to the modified media file being completely generated.

15. The apparatus of claim **13**, wherein the processor is further operable to generate the auxiliary file by generating an auxiliary file wherein each content record further comprises dropped content information for an associated portion of the media content, wherein the dropped content information indicates an amount of content dropped during transcoding.

16. The apparatus of claim **13**, wherein the processor is further operable to generate the auxiliary file by generating an auxiliary file wherein the auxiliary file indicates a frame rate associated with the modified media file.

17. The apparatus of claim **13**, wherein the processor is further operable to generate the auxiliary file by generating an auxiliary file wherein the auxiliary file indicates a bit rate associated with the modified media file.

18. The apparatus of claim **13**, wherein the processor is further operable to generate the auxiliary file by generating an auxiliary file wherein the auxiliary file indicates a codec associated with the modified media file.

19. The apparatus of claim **13**, wherein the processor is further operable to transmit a first portion of the modified media file to a remote client while generating the modified media file.

20. The apparatus of claim **19**, wherein the processor is further operable to:

- store the modified media file in a content store;
- receive a second request identifying the requested media file;
- in response to the second request, retrieve the modified media file from the content store; and
- transmit the modified media file to a second remote client.

21. The apparatus of claim **13**, wherein the processor is further operable to receive the request identifying a media file by:

- receiving the request transmitted from a remote client; and
- in response to receiving the request, selecting one of a plurality of a transcoding elements to access the requested media file.

22. The apparatus of claim **13**, wherein the processor is further operable to access the requested media file by:

- determining whether the requested media file is stored in a first content store in the second format; and
- in response to determining that the requested media file is not stored in the content store in the second format, transmitting a request to the first content store, the request identifying the requested media file; and
- receiving the media file from the first content store in the first format.

23. The apparatus of claim **22**, wherein the processor is operable to transmit a request to the first content store by: transmitting a Hypertext Transfer Protocol (HTTP) request identifying the media file to the first content store.

24. The apparatus of claim **13**, wherein the modified media file comprises a 3GP file.

25. A method for delivering media content, comprising: receiving a media file comprising media content; accessing an auxiliary file associated with the modified media file, the auxiliary file comprising a plurality of content records, each content record associated with a particular portion of the media content; determining a location of a first portion of the media content within the modified media file, based on the content record associated with the first portion of the media content; and transmitting the first portion of the media content to a remote client.

26. The method of claim **25**, wherein transmitting the first portion of the media content comprises transmitting the first portion of the media content to the remote client while additional media content is being written to the media file.

27. The method of claim **25**, further comprising: determining locations of additional portions of the media content within the media file, based on additional content records associated with each of the additional portions of the media content; and transmitting the additional portions of the media content to the remote client.

28. The method of claim **25**, wherein transmitting the first portion of the media content to the remote client comprises: transmitting a notification to the remote client indicating that at least the first portion of the media content is available for transmission, wherein the notification includes a streamer identifier;

- receiving, at a streamer associated with the streaming identifier, a request from the remote client to begin transmitting media content from the media file to the remote client; and

- in response to the request from the remote client, transmitting at least the first portion of the media content to the remote client, while determining the location of additional portions of the media content within the media file.

29. The method of claim **28**, wherein: the streamer identifier comprises a uniform resource locator (URL) address associated with the streamer; and receiving the request from the remote client to begin transmitting media content comprises receiving the request at the URL address.

30. The method of claim **25**, wherein the remote client comprises a first remote client, and further comprising:

- receiving a request from a second remote client to begin transmitting the modified media file to the second remote client; and

- while transmitting media content from the media file to the first remote client, transmitting media content from the media file to the second remote client.

31. An apparatus for delivering media content, comprising: a memory operable to store processor instructions; and a processor operable to execute the processor instructions and, while executing the processor instructions, operable to:

receive a media file comprising media content;
 access an auxiliary file associated with the modified media file, the auxiliary file comprising a plurality of content records, each content record associated with a particular portion of the media content;
 determine the location of a first portion of the media content within the modified media file, based on the content record associated with the first portion of the media content; and
 transmit the first portion of the media content to a remote client.

32. The apparatus of claim **31**, wherein the processor is further operable to transmit the first portion of the media content by transmitting the first portion of the media content to the remote client while additional media content is being written to the media file.

33. The apparatus of claim **31**, wherein the processor is further operable to determine the location of additional portions of the media content within the media file, based on additional content records associated with each of the additional portions of the media content; and

transmit the additional portions of the media content to the remote client.

34. The apparatus of claim **31**, wherein the processor is operable to transmit the first portion of the media content to the remote client by:

transmitting a notification to the remote client indicating that at least the first portion of the media content is available for transmission, wherein the notification includes a streamer identifier;

receiving, at a streamer associated with the streaming identifier, a request from the remote client to begin transmitting media content from the media file to the remote client; and

in response to the request from the remote client, transmitting at least the first portion of the media content from the streamer to the remote client.

35. The apparatus of claim **34**, wherein:

the streamer identifier comprises a uniform resource locator (URL) address associated with the streamer; and
 the processor is operable to receive the request from the remote client to begin transmitting media content comprises receiving the request at the URL address.

36. The apparatus of claim **31**, wherein the remote client comprises a first remote client, and the processor is further operable to:

receive a request from a second remote client to begin transmitting the modified media file to the second remote client; and

while transmitting media content from the media file to the first remote client, transmit media content from the media file to the second remote client.

37. A system for managing media content, comprising:

a transcoder comprising:

a memory operable to store processor instructions for the transcoder; and

a processor operable, when executing the processor instructions for the transcoder, to:

receive a request identifying a requested media file;
 in response to receiving the request, accessing the requested media file, wherein the requested media file comprises media content in a first format;

generate a modified media file based on the requested media file, wherein the modified media file comprises media content in a second format; and

while generating the modified media file, generate an auxiliary file associated with the modified media file, the auxiliary file comprising a plurality of content records, each content record associated with a portion of the media content in the modified media file and indicating a location of the associated portion of the media content in the modified media file; and

a streamer comprising:

a memory operable to store processor instructions for the streamer; and

a processor operable, when executing the processor instructions for the streamer, to:

receive the modified media file and the auxiliary file;
 based on a first content record in the auxiliary file, determine a location of a first portion of the media content in the modified media file associated with the first content record;

transmit the first portion of the media content in the modified media file to a remote client, while the transcoder is generating the modified media file.

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