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(54) **SYSTEM AND METHOD FOR RULE BASED DYNAMIC SERVER SIDE STREAMING MANIFEST FILES**

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(52) **U.S. Cl.**
USPC **725/91**; 725/36; 725/97

(58) **Field of Classification Search**
USPC 725/91, 97, 36
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,892,915 A * 4/1999 Duso et al. 709/219
6,978,306 B2 * 12/2005 Miller et al. 709/226
2005/0262245 A1 * 11/2005 Menon et al. 709/226
2007/0157231 A1 * 7/2007 Eldering et al. 725/35
2008/0244669 A1 * 10/2008 Miner 725/109
2009/0193473 A1 * 7/2009 Moon et al. 725/81
2009/0204901 A1 * 8/2009 Dharmaji et al. 715/745
2009/0254952 A1 * 10/2009 Sridhar et al. 725/92
2010/0050083 A1 * 2/2010 Axen et al. 715/726

* cited by examiner

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(57) **ABSTRACT**

There is provided a system and method for rule-based dynamic server-side streaming manifest files. There is provided a method comprising receiving a request to provide a first video content for playback, evaluating a plurality of rules for the first video content, generating a dynamic manifest file referencing the first video content, and providing the dynamic manifest file in response to the request, thereby enabling an application to playback the first video content for output on a display by interpreting the dynamic manifest file. The rules may implement various features such as dynamic advertisement insertion, load balancing, client customization, user and device targeting, enhanced security mechanisms, global announcements, and others. As streaming protocols are widely supported by default on many client platforms, the dynamic manifest files can be utilized in a user friendly and transparent manner compared to client-side solutions requiring cumbersome client software installations.

18 Claims, 4 Drawing Sheets

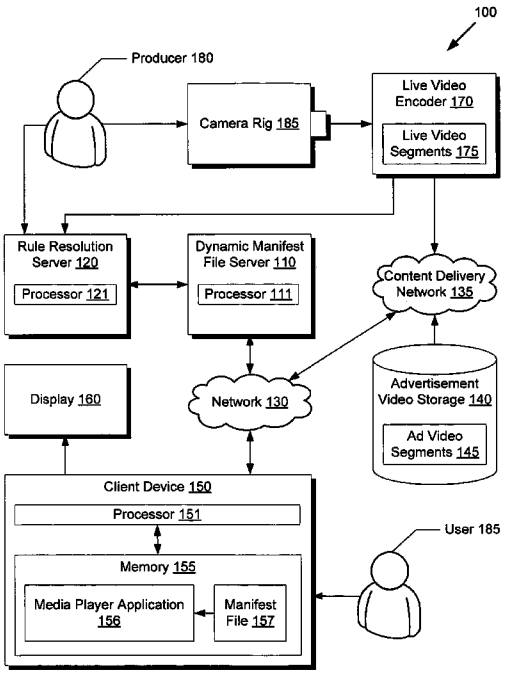


Fig. 1

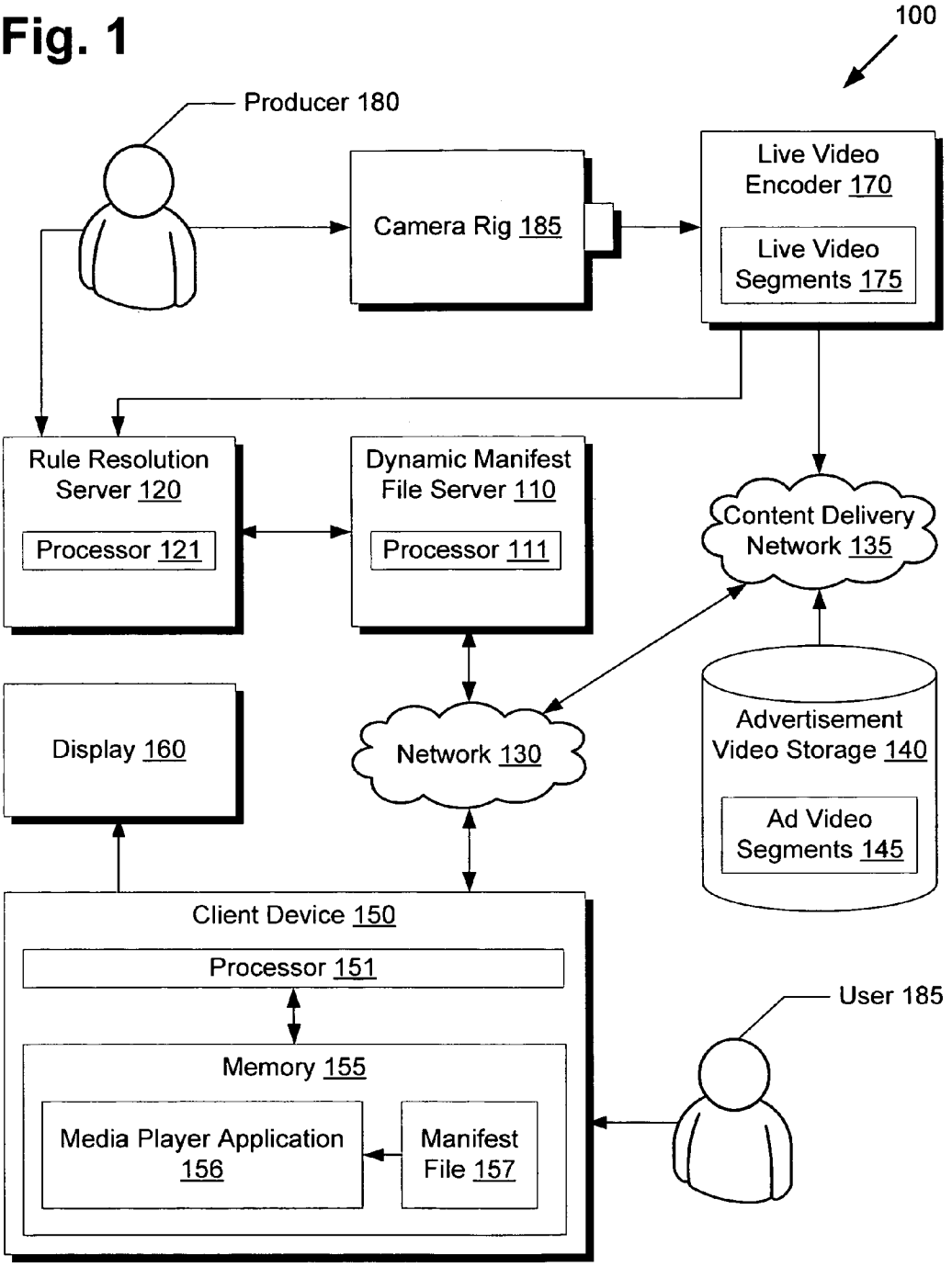

100
Producer 180
Camera Rig 185
Live Video Encoder 170
Live Video Segments 175
Rule Resolution Server 120
Processor 121
Dynamic Manifest File Server 110
Processor 111
Content Delivery Network 135
Display 160
Network 130
Advertisement Video Storage 140
Ad Video Segments 145
Client Device 150
Processor 151
Memory 155
Media Player Application 156
Manifest File 157
User 185

Fig. 2

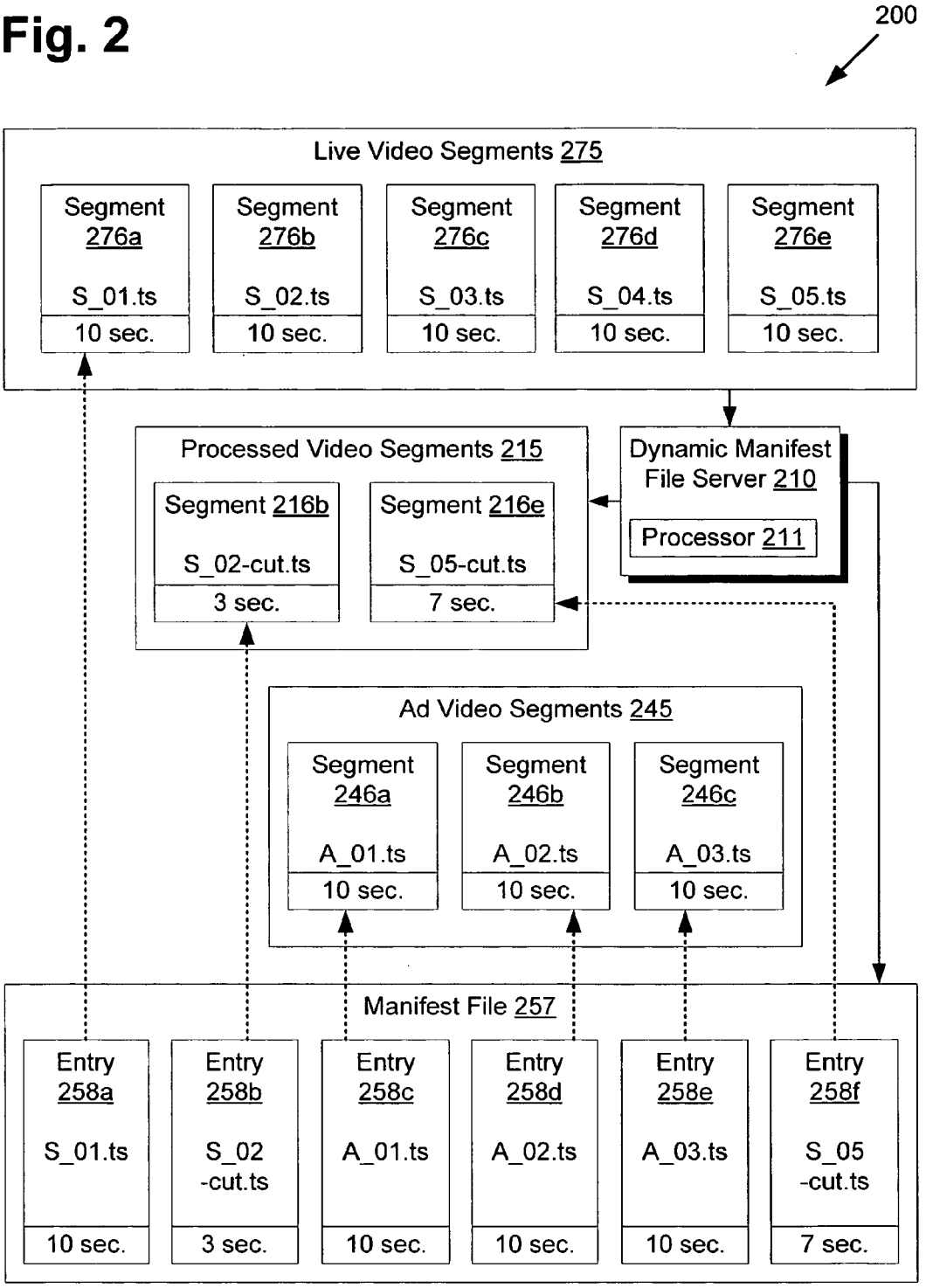

200
Live Video Segments 275
Segment 276a
S_01.ts
10 sec.
Segment 276b
S_02.ts
10 sec.
Segment 276c
S_03.ts
10 sec.
Segment 276d
S_04.ts
10 sec.
Segment 276e
S_05.ts
10 sec.
Processed Video Segments 215
Segment 216b
S_02-cut.ts
3 sec.
Segment 216e
S_05-cut.ts
7 sec.
Dynamic Manifest File Server 210
Processor 211
Ad Video Segments 245
Segment 246a
A_01.ts
10 sec.
Segment 246b
A_02.ts
10 sec.
Segment 246c
A_03.ts
10 sec.
Manifest File 257
Entry 258a
S_01.ts
10 sec.
Entry 258b
S_02 -cut.ts
3 sec.
Entry 258c
A_01.ts
10 sec.
Entry 258d
A_02.ts
10 sec.
Entry 258e
A_03.ts
10 sec.
Entry 258f
S_05 -cut.ts
7 sec.

Fig. 3

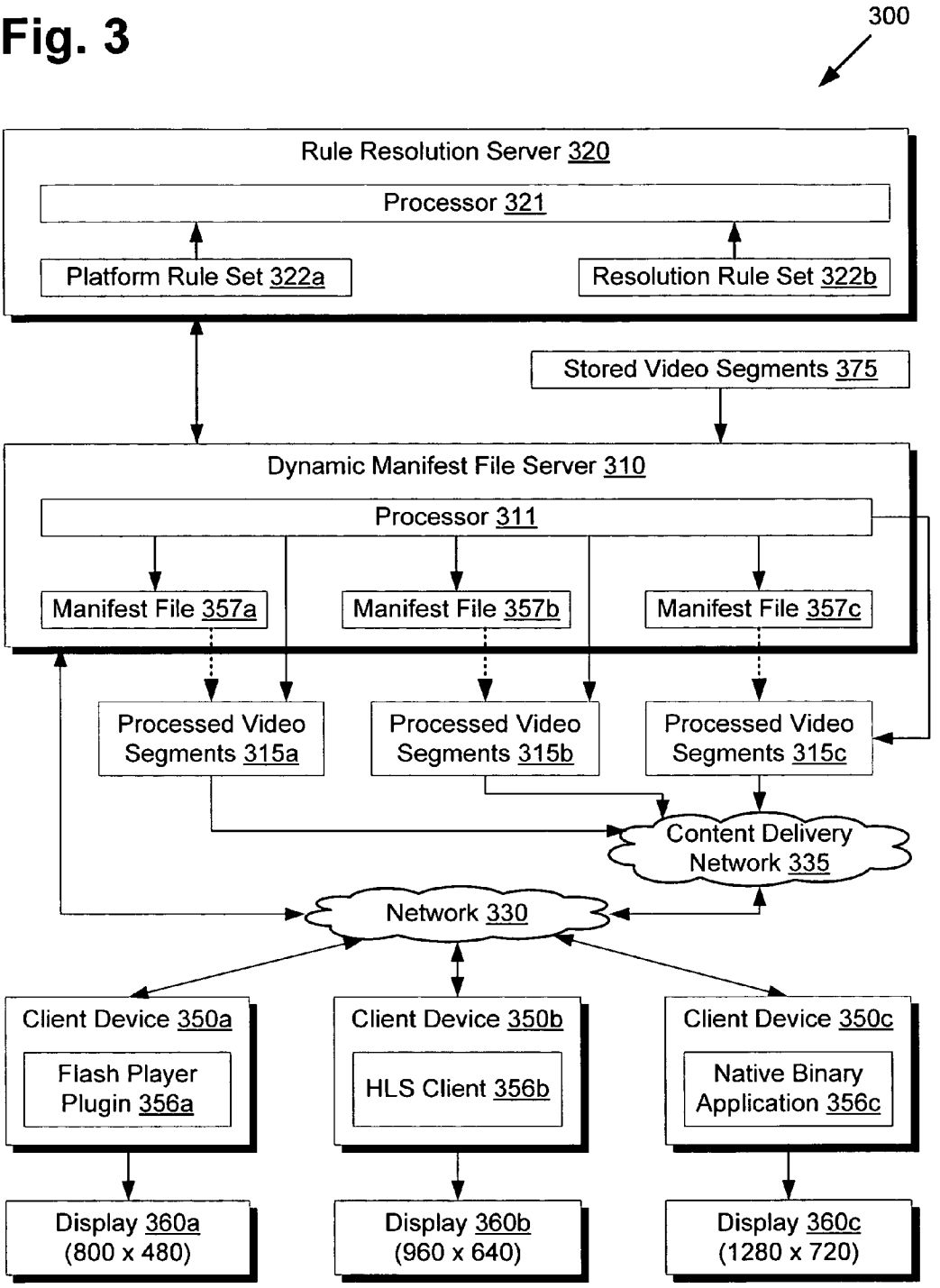
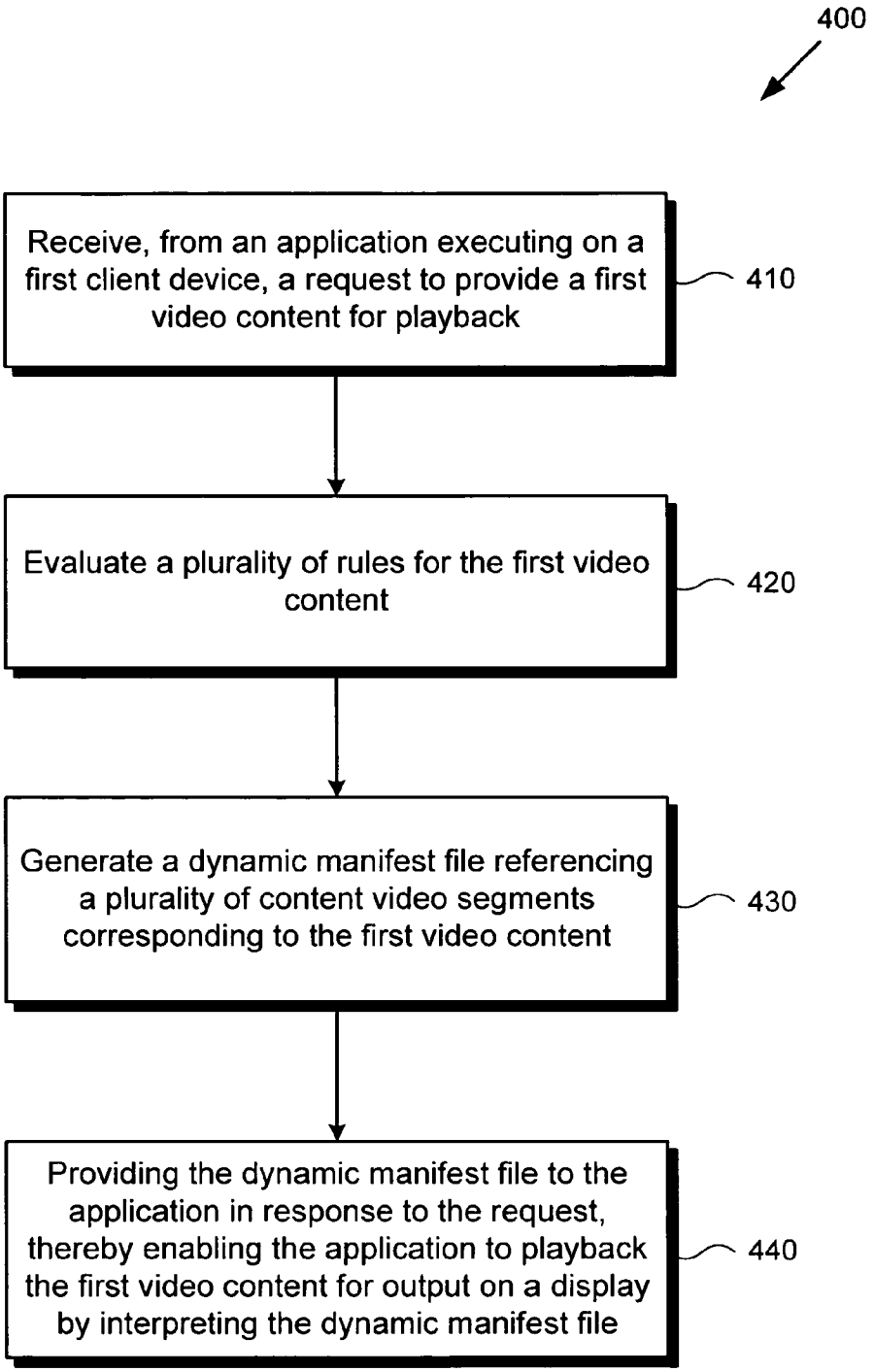

300
Rule Resolution Server 320
Processor 321
Platform Rule Set 322a
Resolution Rule Set 322b
Stored Video Segments 375
Dynamic Manifest File Server 310
Processor 311
Manifest File 357a
Manifest File 357b
Manifest File 357c
Processed Video Segments 315a
Processed Video Segments 315b
Processed Video Segments 315c
Content Delivery Network 335
Network 330
Client Device 350a
Flash Player Plugin 356a
Client Device 350b
HLS Client 356b
Client Device 350c
Native Binary Application 356c
Display 360a (800 x 480)
Display 360b (960 x 640)
Display 360c (1280 x 720)

Fig. 4


400
Receive, from an application executing on a first client device, a request to provide a first video content for playback
410
Evaluate a plurality of rules for the first video content
420
Generate a dynamic manifest file referencing a plurality of content video segments corresponding to the first video content
430
Providing the dynamic manifest file to the application in response to the request, thereby enabling the application to playback the first video content for output on a display by interpreting the dynamic manifest file
440

SYSTEM AND METHOD FOR RULE BASED DYNAMIC SERVER SIDE STREAMING MANIFEST FILES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to media playback. More particularly, the present invention relates to media playback using dynamic manifest files.

2. Background Art

Streaming platforms based on widely supported protocols such as Hypertext Transfer Protocol (HTTP), Internet Protocol (IP) multicast and peer to peer (P2P) streaming allow content producers to continue harnessing standard web delivery technologies for streamlined implementation using existing infrastructure, avoiding the need to develop and implement new data streaming protocols. As a result, such streaming platforms are seeing widespread adoption, with supporting player applications built for a wide range of operating systems and devices. By utilizing applications based on widely supported streaming protocols, users can enjoy live or recorded video content streamed conveniently to their favorite media consumption devices, whether it be a laptop or desktop computer, a mobile phone, a video game console, a digital video recorder, a set top box, or another network enabled media device.

Conventionally, many streaming platforms rely on a manifest file retrieved as a static playlist file from a web host. Thus, it is difficult to provide dynamic content where the contents of the manifest file may change. Moreover, the manifest file must be strictly sequential and provides no mechanisms for conditional logic or implementing business rules. This lack of flexibility makes it difficult to provide desirable features such as dynamic advertisement insertion, load balancing, client customization, user and device targeting, enhanced security mechanisms, and other features to more flexibly meet the needs of advertisers and content producers. For example, advertisers may want to use demographic information and user profile information to provide targeted advertising customized for each viewer, which is not possible if streaming media playback is only by a static and sequential manifest file.

Client side dynamic media streaming player applications may be provided to implement conditional logic and business rules. However, one of the most compelling features of streaming media is the capability for users to stream from many different media devices due to the widespread support of streaming protocols. As a result, a dynamic client side solution may necessitate significant development and maintenance costs to provide customized streaming applications for each major client platform, preventing cost effective implementation and deployment. Moreover, users may be required to search, download, and update dynamic media streaming applications for each individual device. This process may be inconvenient for many users, and the installation or updating of applications may be restricted in public or corporate environments.

Accordingly, there is a need to overcome the drawbacks and deficiencies in the art by providing flexible dynamic streaming media in a cost effective manner that is convenient and transparent for end users.

SUMMARY OF THE INVENTION

There are provided systems and methods for rule-based dynamic server-side streaming manifest files, substantially as shown in and/or described in connection with at least one of the figures, as set forth more completely in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present invention will become more readily apparent to those ordinarily skilled in the art after reviewing the following detailed description and accompanying drawings, wherein:

FIG. **1** presents a diagram of a system for providing rule-based dynamic server-side streaming manifest files, according to one embodiment of the present invention;

FIG. **2** presents a diagram of a system for using rule-based dynamic server-side streaming manifest files to implement dynamic in-stream advertisements, according to one embodiment of the present invention;

FIG. **3** presents a diagram of a system for using rule-based dynamic server-side streaming manifest files to implement stream targeting for client devices, according to one embodiment of the present invention; and

FIG. **4** shows a flowchart describing the steps, according to one embodiment of the present invention, by which rule-based dynamic server-side streaming manifest files may be provided.

DETAILED DESCRIPTION OF THE INVENTION

The present application is directed to a system and method for rule-based dynamic server-side streaming manifest files. The following description contains specific information pertaining to the implementation of the present invention. One skilled in the art will recognize that the present invention may be implemented in a manner different from that specifically discussed in the present application. Moreover, some of the specific details of the invention are not discussed in order not to obscure the invention. The specific details not described in the present application are within the knowledge of a person of ordinary skill in the art. The drawings in the present application and their accompanying detailed description are directed to merely exemplary embodiments of the invention. To maintain brevity, other embodiments of the invention, which use the principles of the present invention, are not specifically described in the present application and are not specifically illustrated by the present drawings.

FIG. **1** presents a diagram of a system for providing rule-based dynamic server-side streaming manifest files, according to one embodiment of the present invention. Diagram **100** of FIG. **1** includes producer **180**, camera rig **185**, live video encoder **170**, rule resolution server **120**, dynamic manifest file server **110**, content delivery network **135**, display **160**, network **130**, advertisement video storage **140**, client device **150**, and user **185**. Live video encoder **170** includes live video segments **175**. Rule resolution server **120** includes processor **121**. Dynamic manifest file server **110** includes processor **111**. Advertisement video storage **140** includes ad video segments **145**. Client device **150** includes processor **151** and memory **155**. Memory **155** includes media player application **156** and manifest file **157**.

As shown in diagram **100** of FIG. **1**, producer **180** may direct camera rig **185** to record live footage, such as a live event, to be streamed to users such as user **185**. Camera rig **185** may then record and send live video footage to live video encoder **170**, which may then encode the live video footage in real-time into live video segments **175**. For example, the live video footage may be encoded into MPEG transport stream (TS) fragment files of a fixed length, such as 10 seconds, for ease of distribution using streaming protocols such as HTTP

streaming, IP multicast, P2P streaming. As new live footage is captured and approved, new video segments may be encoded and stored within live video segments **175**, which may then be distributed over content delivery network **135**. Content delivery network **135** may, for example, comprise a network of servers for storage and distribution of media content. Live video encoder **170** may also provide rule resolution server **120** with an updated list of references for accessing live video segments **175** through content delivery network **135**, which may then be passed to dynamic manifest file server **110** for generating manifest file **157**. Producer **180** may provide specific rules to rule resolution server **120** to customize the generation of manifest file **157**, such a rule to insert advertising segments to overwrite a particular time block in the live stream.

As shown in diagram **100**, a client device **150** may send a request to dynamic manifest file server **110** for live video content. Client device **150** may comprise a laptop or desktop computer, a mobile phone, a video game console, a digital video recorder, a set top box, or another network enabled media device. User **185** may direct client device **150** to execute media player application **156**, for example by clicking on an application icon shown on display **160**. Media player application **156** may comprise, for example, a web browser. User **185** may navigate to a video streaming portal site accessible over network **130** to click on a link directed to dynamic manifest file server **110** for access to live video stream content. Media player application **156** may then send a request, such as a HTTP GET request over network **130** to dynamic manifest file server **110**. Dynamic manifest file server **110** may then forward various parameters received from the request originating from client device **150** to rule resolution server **120**. Client device **150** may also explicitly send parameter data to dynamic manifest file server **110** voluntarily or in response to a request for client parameters. Dynamic manifest file server **110** may then utilize rule resolution server **120** to evaluate various business rules and create a dynamically tailored manifest file accordingly, which may then be passed back to client device **150** over network **130** and placed into memory **155** as manifest file **157**, as shown in FIG. **1**.

Media player application **156** may then interpret manifest file **157** to playback video content on display **160**. For example, manifest file **157** may reference live video segments **175** and ad video segments **145** on servers hosted in content delivery network **135**, accessible over network **130**. Thus, manifest file **157** may comprise a playlist file such as a M3U8 playlist file. Media player application **156** may then request, stream, decode, and output the referenced video segments seamlessly to display **160** to playback the requested live video stream for user **185**. As camera rig **185** captures new live footage and live video encoder **170** adds new segments to live video segments **175**, media player application **156** can periodically request an updated manifest file **157** from dynamic manifest file server **110**. Producer **180** may dynamically add new rules to rule resolution server **120**, for example to schedule advertising blocks. Rule resolution server **120** may then direct dynamic manifest file server **110** to switch to advertising content at specific time blocks specified by the new rules added by producer **180**.

While the example system shown in diagram **100** of FIG. **1** is directed towards a live content streaming embodiment with advertisement insertion, the rule based dynamic server-side streaming manifest files provided by dynamic manifest file server **110** may also be utilized for alternative embodiments and use cases. For example, pre-recorded content may be provided rather than live content. If the pre-recorded content has existing advertising blocks, then rules may be provided at rule resolution server **120** to replace the existing advertising blocks, facilitating the reuse of existing video segments without re-encoding. Rules evaluated by rule resolution server **120** may also be directed towards other functions besides advertisement insertion, such as enhanced security, video content customization, client or user targeting, geographic or region targeting, content delivery network load balancing, priority broadcasts for concurrent playback, and other functions. Moreover, diagram **100** only depicts one simplified exemplary implementation for clarity. Alternative embodiments may, for example, combine, separate, or duplicate certain components and functions shown in diagram **100**. For example, dynamic manifest file server **110** and rule resolution server **120** may be combined into a single server, multiple servers may be utilized for load balancing to multiple client devices, multiple content delivery networks may be utilized for higher quality of service, and several different video streams may be offered for streaming.

Moving to FIG. **2**, FIG. **2** presents a diagram of a system for using rule-based dynamic server-side streaming manifest files to implement dynamic in-stream advertisements, according to one embodiment of the present invention. Diagram **200** of FIG. **2** includes live video segments **275**, processed video segments **215**, dynamic manifest file server **210**, ad video segments **245**, and manifest file **257**. Live video segments **275** include segments **275***a* through **275***e*. Processed video segments **215** include segments **216***b* and **216***e*. Dynamic manifest file server **210** includes processor **211**. Ad video segments **245** include segments **246***a* through **246***c*. Manifest file **257** includes entries **258***a* through **258***f*. With regards to FIG. **2**, it should be noted that live video segments **275** may correspond to live video segments **175** from FIG. **1**, that dynamic manifest file server **210** may correspond to dynamic manifest file server **110** from FIG. **1**, that ad video segments **245** may correspond to ad video segments **145** from FIG. **1**, and that manifest file **257** may correspond to manifest file **157** from FIG. **1**.

As previously discussed, media files may be encoded and segmented into fragment files of a fixed length to facilitate integration with streaming platforms. Thus, as shown in FIG. **2**, live video segments **275** may be prepared as successive ten second segments, shown as segments **276***a* through **276***e*. Similarly, ad video segments **245** are also prepared as three ten second segments, or segments **246***a* through **246***c*, which may comprise one complete thirty second commercial. As additional live footage is recorded and encoded into new segments, the new segments may be appended within live video segments **275**.

Dynamic manifest file server **210** may then dynamically create manifest file **257** referencing live video segments **275** and ad video segments **245**. For example, as previously described, producer **180** may provide a rule to rule resolution server **120** specifying a time block to switch to a commercial, such as thirteen (13) seconds into the live broadcast. However, since live video segments **275** are fragmented into ten second segments, an insertion of advertisement content may only be supported at ten second intervals since many standard manifest file formats do not support offset playback of segments. Thus, if commercial playback is desired at an offset of thirteen seconds, insertion must be delayed until the twenty second offset, resulting in dead time while waiting for the segment to finish.

To avoid such dead time, dynamic manifest file server **210** may be configured to generate processed video segments **215**, which may be preferably directly stream copied from the original sources and trimmed accordingly, or alternatively

trimmed and re-encoded if direct stream copies are not feasible. Assuming a rule specifying commercial insertion at thirteen seconds for ad video segments **245** running at thirty seconds, segments **216***b* and **216***e* may thus be created from segments **276***b* and **276***e*, respectively. More specifically, segment **216***b* may comprise the first three seconds of segment **276***b*, and segment **216***e* may comprise the last seven seconds of segment **276***e*. Processed video segments **215** may then be referenced accordingly instead of the original live video segments **275**, allowing advertisement or other content insertion at any desired playback offset or position without dead time. For pre-recorded content where it is desirable not to discard any of the original video content, dynamic manifest file server **210** may be configured to continue referencing the original video segments even after insertion of advertising.

Thus, dynamic manifest file server **210** may generate manifest file **257**, with entry **258***a* referencing original segment **276***a*, entry **258***b* referencing processed segment **216***b*, entries **258***c* through **258***e* referencing segments **246***a* through **246***c* respectively, and entry **258***f* referencing processed segment **216***e*. When entries **258***a* through **258***f* are played back successively without gaps by a media player application, the result is an advertisement smoothly integrated into a live stream with no interruptions or dead time. Since additional rules may be specified, for example to provide targeted advertising based on user tracking profiles, client device profiles, geographic regions, and other parameters, highly targeted advertising is possible even in live streaming embodiments.

Moving to FIG. **3**, FIG. **3** presents a diagram of a system for using rule-based dynamic server-side streaming manifest files to implement stream targeting for client devices, according to one embodiment of the present invention. Diagram **300** of FIG. **3** includes rule resolution server **320**, stored video segments **375**, dynamic manifest file server **310**, processed video segments **315***a* through **315***c*, content delivery network **335**, network **330**, client devices **350***a* through **350***c*, and displays **360***a* through **360***c*. Rule resolution server **320** includes processor **321**, platform rule set **322***a*, and resolution rule set **322***b*. Dynamic manifest file server **310** includes processor **311** and manifest files **357***a* through **357***c*. Client device **350***a* includes Flash player plugin **356***a*. Client device **350***b* includes HTTP Live Streaming or HLS client **356***b*. Client device **350***c* includes native binary application **356***c*. With respect to FIG. **3**, it should be noted that rule resolution server **320** may correspond to rule resolution server **120** of FIG. **1**, that dynamic manifest file server **310** may correspond to dynamic manifest file server **110** from FIG. **1**, that processed video segments **315***a* through **315***c* may each correspond to processed video segments **215** of FIG. **2**, that content delivery network **335** may correspond to content delivery network **135** of FIG. **1**, that network **330** may correspond to network **130** of FIG. **1**, that client devices **350***a* through **350***c* may each correspond to client device **150** of FIG. **1**, and that displays **360***a* through **360***c* may each correspond to display **160** of FIG. **1**.

While FIGS. **1** and **2** illustrate an advertisement insertion embodiment, FIG. **3** illustrates client or device targeting, wherein video content is processed and customized according to particular client device parameters. As shown in FIG. **3**, dynamic manifest file server **310** provides manifest files for a diverse range of client device platforms, including Flash Player plugin **356***a* at client device **350***a*, HTTP Live Streaming client **356***b* at client device **350***b*, and native binary application **356***c* at client device **356***c*. Platform rule set **322***a* may include various rules as how to customize video content based on the target device platform to be supported. Additionally, displays **360***a*, **360***b*, and **360***c* each utilize different screen resolutions to display video content, and resolution rule set **322***b* may include various rules as how to resize video content based on the target display resolution.

For example, for client device **350***a*, platform rule set **322***a* may dictate that if a request originates from a client device indicating Flash Player plug-in support, then dynamic manifest file server **310** should preferably generate a F4M Flash Zeri manifest file, or manifest file **357***a*, referencing F4F Flash video files, or processed video segments **315***a*. Processed video segments **315***a* may be encoded from stored video segments **375**, and may be resized and cropped according to resolution rule set **322***b* to optimally fit the 800 by 480 resolution provided by display **360***a*. Thus, when client device **350***a* requests video content represented by stored video segments **375**, dynamic manifest file server **310** may provide manifest file **357***a* in the Flash Zeri HTTP streaming format for facilitated playback by Flash Player plugin **356***a*. Flash Player plugin **356***a* may then access the referenced video content in processed video segments **315***a* over network **330** via content delivery network **335**.

Moving to client device **350***b*, platform rule set **322***a* may dictate that if a request originates from a client device indicating HLS or HTTP Live Streaming support, then dynamic manifest file server **310** should preferably generate a M3U8 manifest file, or manifest file **357***b*, referencing MPEG transport stream video files, or processed video segments **315***b*. Processed video segments **315***b* may be encoded from stored video segments **375**, and may be resized and cropped according to resolution rule set **322***b* to optimally fit the 960 by 640 resolution provided by display **360***b*. Thus, when client device **350***b* requests video content represented by stored video segments **375**, dynamic manifest file server **310** may provide manifest file **357***b* in the HTTP Live Streaming format for facilitated playback by HLS client **356***b*. HLS client **356***b* may then access the referenced video content in processed video segments **315***b* over network **330** via content delivery network **335**.

Moving to client device **350***c*, platform rule set **322***a* may dictate that if a request originates from a set top box running a native binary application, then dynamic manifest file server **310** should preferably generate a M3U8 manifest file, or manifest file **357***c*, referencing MPEG transport stream video files, or processed video segments **315***c*. Processed video segments **315***c* may be encoded from stored video segments **375**, and may be resized and cropped to optimally fit the 1280 by 720 resolution provided by display **360***c*. Thus, when client device **350***c* requests video content represented by stored video segments **375**, dynamic manifest file server **310** may provide manifest file **357***c* as a standard M3U8 playlist for facilitated playback by native binary application **356***c*. Native binary application **356***c* may then access the referenced video content in processed video segments **315***c* over network **330** via content delivery network **335**.

Thus, dynamic manifest file **310** and rule resolution server **320** may target specific client platforms to provide the optimal format for the manifest files and the processed video segments, and may also resize and process video for the best appearance on the specific display for each client device. While display resolution is shown as one example display parameter, other display parameters may also be considered such as color space or gamut, color bit-depth, refresh rate, and other parameters. Thus, as one example, rule resolution server **320** may include a color space conversion rule to adjust video colors to the color space of a targeted display. Another example rule may comprise a framerate conversion rule converting video framerates to adjust to specific refresh rates of a

targeted display, or downsampling three-dimensional stereoscopic video intended for three-dimensional displays into two-dimensional video for standard two-dimensional displays. To provide faster response time for client devices, video for the most common client configurations may be pre-processed and cached in advance. Additionally, multiple bit-rate streams may be encoded and referenced in the generated manifest files to allow graceful degradation to lower bit-rate video in response to adverse network conditions.

In addition to preparing video content for optimal presentation quality, substantive content such as advertising content may also be targeted and prepared based on various parameterized rules evaluated by rule resolution server **320**. Thus, for example, a user tracking profile associated with client device **350***a* may be analyzed to formulate a targeted advertising campaign for manifest file **357***a*, adding appropriate pre-roll, post-roll, and mid-roll advertising content estimated to be most relevant and interesting for the user of client device **350***a*. The geographic location or region of client device **350***a* may also be detected, for example through GPS tracking or geo-IP address look-up, and advertising may be adjusted accordingly for the detected region, for example by selecting from a regional advertising campaign. The detected region may also affect the requested substantive content, for example by configuring processed video segments **315***a* to include subtitles or a dubbed language track based on the detected region.

Besides advertisement insertion and user or client device targeting, rule resolution server **320** may also implement a wide variety of other rules to enhance, target, and customize the video streaming experience for the end user. For example, one rule may rewrite the URLs within a manifest file to point to the content delivery network in closest proximity to the client device, providing improved network performance and responsiveness. The proximity rule may be overridden or supplemented by another rule implementing client load balancing parameters, for example by steering users to content delivery networks with greater free user capacity. Another rule may implement enhanced security features, such as limiting or granting access or providing keys based on time windows or rental periods, HTTP cookie or login status, client device identification, or other criteria. For example, if the enhanced security checks fail, then the client may be redirected to a video showing how the user can remedy any failed security checks.

Other rules may provide features desirable for content creators and network administrators. For example, one rule may insert a high priority video segment into multiple manifest files for a specific group of clients or for all clients globally. Thus, for example, administrators can provide important news bulletins, alerts, or other high priority video to the displays of multiple clients concurrently. Content providers may also use such global notifications to advertise or promote specific content to all streaming clients regardless of the particular stream each client is watching. Since such global notifications may be configured to display concurrently on many different clients, viral effects, social interaction, and positive word of mouth may be encouraged.

Advantageously, since manifest files **357***a* through **357***c* are generated at the server side, no custom client-side applications are necessary. Thus, the system shown in diagram **300** of FIG. **3** operates transparently to provide dynamic manifest files without requiring any special intervention from the end user, such as searching, installing, and updating a custom client-side player application. Each client device **350***a* through **350***c* only needs to support at least one implementation of streaming using manifest files, whether the implementation is through a Flash Player plugin, through a HLS enabled web browser, or through another implementation such as a native binary application. Often, these implementations are already built into default platform installations or are otherwise easily accessible from application stores or original installation media, allowing users to immediately access and enjoy dynamic streaming video media enabled by dynamic manifest file server **310**. This may be a key advantage for users browsing from public locations or corporate environments, where application administration privileges for end users may be limited or restricted.

Moving to FIG. **4**, FIG. **4** shows a flowchart describing the steps, according to one embodiment of the present invention, by which rule-based dynamic server-side streaming manifest files may be provided. Certain details and features have been left out of flowchart **400** that are apparent to a person of ordinary skill in the art. For example, a step may comprise one or more substeps or may involve specialized equipment or materials, as known in the art. While steps **410** through **440** indicated in flowchart **400** are sufficient to describe one embodiment of the present invention, other embodiments of the invention may utilize steps different from those shown in flowchart **400**.

Referring to step **410** of flowchart **400** in FIG. **4** and diagram **100** of FIG. **1**, step **410** of flowchart **400** comprises processor **111** of dynamic manifest file server **110** receiving, from media player application **156** executing on processor **151** of client device **150**, a request to provide a first video content for playback. For example, media player application **156** may comprise a HLS enabled web browser. User **185** may then use media player application **156** to navigate to a website presenting a list of available live video streams. After user **185** selects a live stream corresponding to a live event being captured by camera rig **185**, a request for the live stream, such as a HTTP GET request, may be sent over network **130** to dynamic manifest file server **110**.

Referring to step **420** of flowchart **400** in FIG. **4** and diagram **100** of FIG. **1**, step **420** of flowchart **400** comprises processor **111** of dynamic manifest file server **110** passing parameters from the request received in step **410** to rule resolution server **120**, which may then evaluate a plurality of rules for the live event requested in step **410**. Thus, parameter data from the HTTP GET request and other platform parameters of client device **150** that may be retrieved automatically, such as by scripting, or voluntarily, such as from user form data, may all be passed to rule resolution server **120** for further evaluation. These parameters may include details such as the client IP address, browser or operating platform, device identifiers, browser cookies or login details, screen resolution of display **160**, and other device, display, or user parameters, which may then be evaluated against a plurality of rules as applied to live video segments **175**. For example, processor **121** of rule resolution server **120** may evaluate a dynamic advertisement insertion rule dictating specific advertisements and time blocks for substituting ad video segments **145** within live video segments **175** when generating manifest file **157**. Producer **180** may generate such insertion rules in real-time for rule resolution server **120**, allowing the dynamic insertion of advertisement time blocks or other content while a live event is in progress. Additional rules may further customize the final manifest file, as for example platform rule set **322***a* and resolution rule set **322***b* shown in FIG. **3**, which may be used to optimize video delivery for specific devices and display configurations.

Additionally, if any of the rules require the insertion of content at a time offset starting or ending within a video segment, then a cutting or cropping processing procedure

may be carried out with the affected video segments so that the generated manifest file can insert the content at any playback offset. For example, as shown in diagram **200** of FIG. **2**, processor **211** of dynamic manifest file server **210** may generate processed video segments **215** from live video segments **275** to allow the insertion of ad video segments **245** at 0:00:13 or the thirteen second playback offset within manifest file **257**. Thus, by adjusting the cutting procedure for generating processed video segments **215** accordingly, ad video segments **245** can be precisely referenced at any arbitrary playback offset within manifest file **257**. A direct stream copy and cutting procedure may be preferred to preserve the original video encoding quality, but alternative embodiments may re-encode to create processed video segments **215**. While re-encoding may result in some video quality degradation, such a process may be necessary due to, for example, specialized video codecs or compression methods, or to add certain processing effects such as cross-fading, subtitles, resolution resampling, or audio dubbing.

Referring to step **430** of flowchart **400** in FIG. **4** and diagram **100** of FIG. **1**, step **430** of flowchart **400** comprises processor **111** of dynamic manifest file server **110** generating manifest file **157** referencing live video segments **175** corresponding to the live event stream requested in step **410**. A specific host server or network of host servers may be referenced within manifest file **157**, such as content delivery network **135**. Additionally, the evaluation of the rules in step **420** may further affect the generation of manifest file **157**. For example, assuming the evaluation of an advertisement insertion rule in step **420**, step **430** may further reference ad video segments **145** and processor **111** may also perform video cutting processing to live video segments **175** to facilitate smooth insertion of ad content at a desired playback offset without dead time, as illustrated in the process shown in diagram **200** of FIG. **2**. To provide another example, the evaluation of rules such as platform rule set **322***a* and resolution rule set **322***b* shown in diagram **300** of FIG. **3** may further direct processor **111** to process live video segments **175** for optimal video quality depending on the requesting client device. Thus, for example, if the request received from step **410** identifies client device **150** as a HLS enabled web browser and display **160** as a screen with a 960 by 640 pixel resolution, then live video segments **175** and ad video segments **145** may be correspondingly resized to optimally fit within the target 960 by 640 pixel resolution, manifest file **157** may be provided as a M3U8 file, and each of the referenced video segments may comprise a MPEG-2 transport stream (.TS) file, in accordance with HLS platform requirements.

Referring to step **440** of flowchart **400** in FIG. **4** and diagram **100** of FIG. **1**, step **440** of flowchart **400** comprises processor **111** of dynamic manifest file server **110** providing, in response to the request received in step **410**, manifest file **157** to media player application **156** executing on processor **151** of client device **150**, thereby enabling media player application **156** to playback the live event captured by camera rig **185** for output on display **160** by interpreting manifest file **157**. For example, assuming manifest file **157** was generated in step **430** to reference both live video segments **175** and ad video segments **145**, media player application **156** can download the referenced segments over network **130** via content delivery network **135**, which may then be decoded and output to display **160** for viewing by user **185**. Moving to diagram **200** of FIG. **2**, the contents of manifest file **157** may appear similar to manifest file **257**, comprising a list of playlist entries referencing video segments to be played gapless and in sequence.

As in diagram **100** of FIG. **1**, if the requested stream is a live stream rather than pre-recorded content, additional content video segments may be continually added to live video segments **175**. Dynamic manifest file server **110** may then reference these additional segments when creating new dynamic manifest files. If the number of referenced segments becomes too large, then the number of entries within the playlist may be restricted, for example to the most recent **10** entries only. Media player application **156** may then periodically request and retrieve an updated manifest file **157** from dynamic manifest file server **110**. Media player application **156** may then reinterpret the newly received manifest file **157** to continue streaming new live video footage. Additionally, new rules may be provided at rule resolution server **120** to further customize manifest file **157** as the live event progresses. For example, producer **180** may continually generate new rules to queue advertising blocks at specific times during the live stream. In this manner, flexible advertisement insertion and other dynamic features can be provided even for live streaming events.

Moreover, as previously discussed, some rules may be provided that allow high priority video to be displayed globally or for a select group of clients. Thus, moving to diagram **300** of FIG. **3** for example, assuming that client devices **350***a* through **350***c* each specify a different video stream from stored video segments **375**, a rule stored in rule resolution server **320** may specify that globally all clients should playback a high priority video segment at a specified time, such as 8:00 PM PST. Accordingly, processor **311** of dynamic manifest file server **310** may modify any generated manifest files such as manifest files **357***a* through **357***c* to reference the high priority video segment instead of the requested video content if the current time matches 8:00 PM PST. Thus, even if client devices **350***a* through **350***c* are watching completely different content, displays **360***a* through **360***c* may all concurrently display the same high priority video segment at 8:00 PM PST. As previously described, this may be used for news, alerts, promotions, or for other purposes. Since all streaming clients may view the same high priority video segment on their respective displays, viral effects and social interaction may be encouraged through a shared audience experience. When used judiciously, this global announcement feature may generate strong positive impact for promotional campaigns.

Thus, it can be observed that server-side dynamic manifest files can provide flexible methods of customizing video streaming content without requiring users to install cumbersome client-side player application software. Since the dynamic manifest files can provide playback for widely available streaming platforms such as HLS enabled web browsers and the Flash Player plug-in, the solution can be deployed to the vast majority of existing clients in a user friendly and transparent manner. By utilizing existing video resources to the greatest extent possible and by automatically generating custom content according to specified business rules, much of the tedious labor and cost of manual editing is eliminated, providing significant cost savings to content providers while improving the user experience with highly targeted and optimized video streams.

From the above description of the invention it is manifest that various techniques can be used for implementing the concepts of the present invention without departing from its scope. Moreover, while the invention has been described with specific reference to certain embodiments, a person of ordinary skills in the art would recognize that changes can be made in form and detail without departing from the spirit and the scope of the invention. As such, the described embodiments are to be considered in all respects as illustrative and

not restrictive. It should also be understood that the invention is not limited to the particular embodiments described herein, but is capable of many rearrangements, modifications, and substitutions without departing from the scope of the invention.

What is claimed is:

1. A server for providing rule-based dynamic server-side streaming manifest files to enable flexible video playback, the server comprising:

a processor configured to:

receive, from an application executing on a first client device, a request to provide a first video content for playback;

request a client device parameter from the first client device;

evaluate a plurality of rules for the first video content;

generate, according to the plurality of rules, a dynamic manifest file referencing a plurality of content video segments for the application to stream, the plurality of content video segments corresponding to the first video content;

provide the dynamic manifest file to the application in response to the request for enabling the application to playback the first video content for output on a display by interpreting the dynamic manifest file;

wherein the plurality of rules include processing the plurality of content video segments according to the client device parameter.

2. The server of claim **1**, wherein the plurality of rules further include processing the plurality of content video segments according to a display parameter.

3. The server of claim **1**, wherein the plurality of rules further include specifying a content delivery network hosting the plurality of content video segments according to load balancing parameters applied to the first client device, and wherein the processor is further configured to generate the dynamic manifest file by referencing the specified content delivery network.

4. The server of claim **1**, wherein the plurality of rules further include selecting a plurality of advertisement video segments for the first client device, and wherein the processor is further configured to generate the dynamic manifest file by further referencing the plurality of advertisement video segments.

5. The server of claim **4**, wherein the selecting is by evaluating a user tracking profile associated with the first client device.

6. The server of claim **4**, wherein prior to generating the dynamic manifest file the processor is further configured to:

process the plurality of video segments by cutting one or more of the plurality of video segments such that the dynamic manifest file is enabled to reference each of the plurality of advertisement video segments at any playback offset.

7. The server of claim **1**, wherein the processor is further configured to:

update the dynamic manifest file to reference additional content video segments comprising live video content for enabling the application to live stream video content for output on the display by periodically retrieving and reinterpreting the dynamic manifest file.

8. The server of claim **1**, wherein the dynamic manifest file comprises a playlist in the M3U8 format, and wherein the plurality of content video segments comprise MPEG transport stream (TS) file fragments.

9. The server of claim **1**, wherein the processor is further configured to:

receive a request to provide a plurality of priority video segments for playback on a plurality of client devices;

modify a plurality of dynamic manifest files associated with the plurality of client devices to reference the plurality of priority video segments; and

provide the plurality of dynamic manifest files to the plurality of client devices for enabling concurrent playback of the plurality of priority video segments for output on a plurality of displays associated with the plurality of client devices.

10. A method for providing rule-based dynamic server-side streaming manifest files to enable flexible video playback, the method comprising:

receiving, from an application executing on a first client device, a request to provide a first video content for playback;

requesting a client device parameter from the first client device;

evaluating a plurality of rules for the first video content;

generating, according to the plurality of rules, a dynamic manifest file referencing a plurality of content video segments for the application to stream, the plurality of content video segments corresponding to the first video content; and

providing the dynamic manifest file to the application in response to the request for enabling the application to playback the first video content for output on a display by interpreting the dynamic manifest file;

wherein the plurality of rules include processing the plurality of content video segments according to the client device parameter.

11. The method of claim **10**, wherein the plurality of rules further include processing the plurality of content video segments according to a display parameter.

12. The method of claim **10**, wherein the plurality of rules further include specifying a content delivery network hosting the plurality of content video segments according to load balancing parameters applied to the first client device, and wherein the generating of the dynamic manifest file further comprises referencing the specified content delivery network.

13. The method of claim **10**, wherein the plurality of rules further include selecting a plurality of advertisement video segments for the first client device, and wherein the generating of the dynamic manifest file further comprises referencing the plurality of advertisement video segments.

14. The method of claim **13**, wherein the selecting is by evaluating a user tracking profile associated with the first client device.

15. The method of claim **13** further comprising prior to the generating of the dynamic manifest file:

processing the plurality of video segments by cutting one or more of the plurality of video segments such that the dynamic manifest file is enabled to reference each of the plurality of advertisement video segments at any playback offset.

16. The method of claim **10** further comprising:

updating the dynamic manifest file to reference additional content video segments comprising live video content for enabling the application to live stream video content for output on the display by periodically retrieving and reinterpreting the dynamic manifest file.

17. The method of claim **10**, wherein the dynamic manifest file comprises a playlist in the M3U8 format, and wherein the plurality of content video segments comprise MPEG transport stream (TS) file fragments.

18. The method of claim **10** further comprising:

receiving a request to provide a plurality of priority video segments for playback on a plurality of client devices;

modifying a plurality of dynamic manifest files associated with the plurality of clients to reference the plurality of priority video segments; and

providing the plurality of dynamic manifest files to the plurality of client devices for enabling concurrent playback of the plurality of priority video segments for output on a plurality of displays associated with the plurality of client devices.

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