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(54) **DELIVERY OF STREAMING MEDIA CONTENT**

(75) Inventors: **Venkata S. Adimatyam**, Irving, TX (US); **Sameer Vasant Gavade**, Irving, TX (US); **Laxmi Ashish Arte**, Austin, TX (US)

(73) Assignee: **VERIZON PATENT AND LICENSING INC.**, Basking Ridge, NJ (US)

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(51) **Int. Cl.**

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H04N 21/262	(2011.01)
H04L 29/06	(2006.01)
H04N 21/2343	(2011.01)
H04N 21/643	(2011.01)
H04N 21/845	(2011.01)

(52) **U.S. Cl.**
CPC ***H04N 21/26258*** (2013.01); ***H04L 65/4084*** (2013.01); ***H04N 21/23439*** (2013.01); ***H04N 21/64322*** (2013.01); ***H04N 21/8456*** (2013.01)

(58) **Field of Classification Search**
None
See application file for complete search history.

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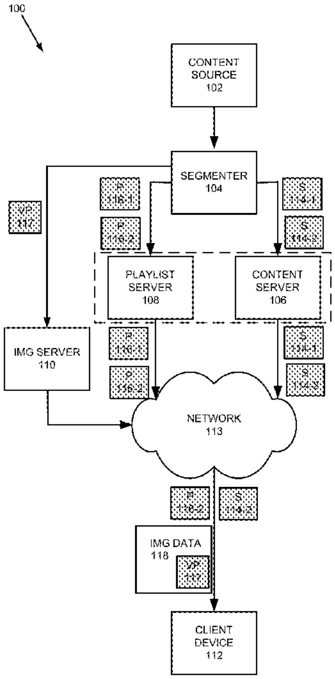
Primary Examiner — Wing F Chan
Assistant Examiner — Padma Mundur

(57) **ABSTRACT**

A device includes a communication interface and one or more processors. The communication interface may receive media guide data, from a media guide server via a network, including information relating to a number of available media items and playlist information relating to at least one available playlist file associated with a particular media item. The one or more processors may receive a user selection of the particular media item and may request the playlist file from a playlist server via the network based on the playlist information via the interface. The interface may receive the playlist file from the playlist server, the playlist file including locations of stream segments corresponding to the selected playlist. The one or more processors may request the stream segments from a content server via the network based on the received playlist file.

19 Claims, 7 Drawing Sheets



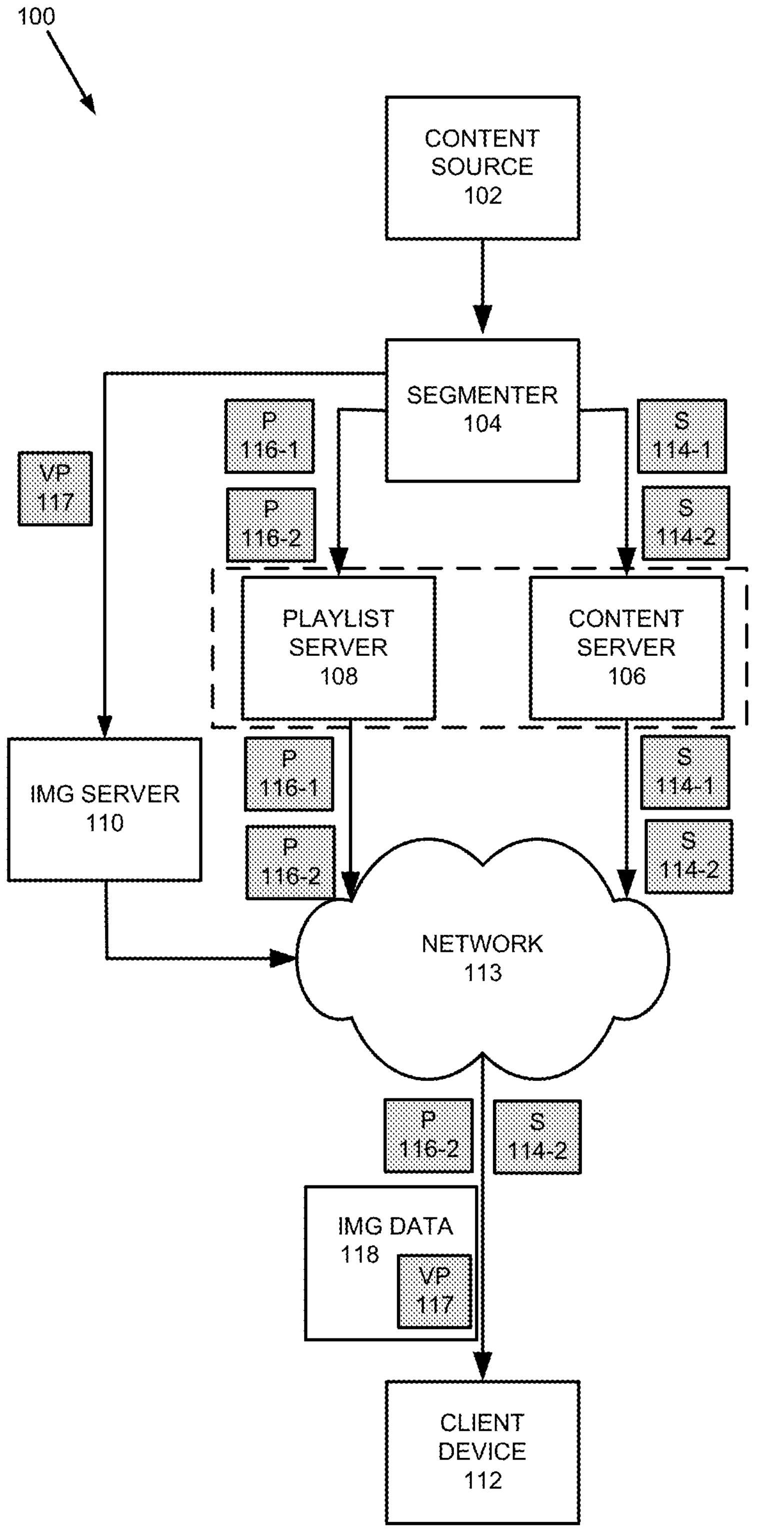

100
CONTENT SOURCE 102
SEGMENTER 104
VP 117
P 116-1
P 116-2
S 114-1
S 114-2
PLAYLIST SERVER 108
CONTENT SERVER 106
IMG SERVER 110
P 116-1
P 116-2
S 114-1
S 114-2
NETWORK 113
P 116-2
S 114-2
IMG DATA 118
VP 117
CLIENT DEVICE 112

FIG. 1

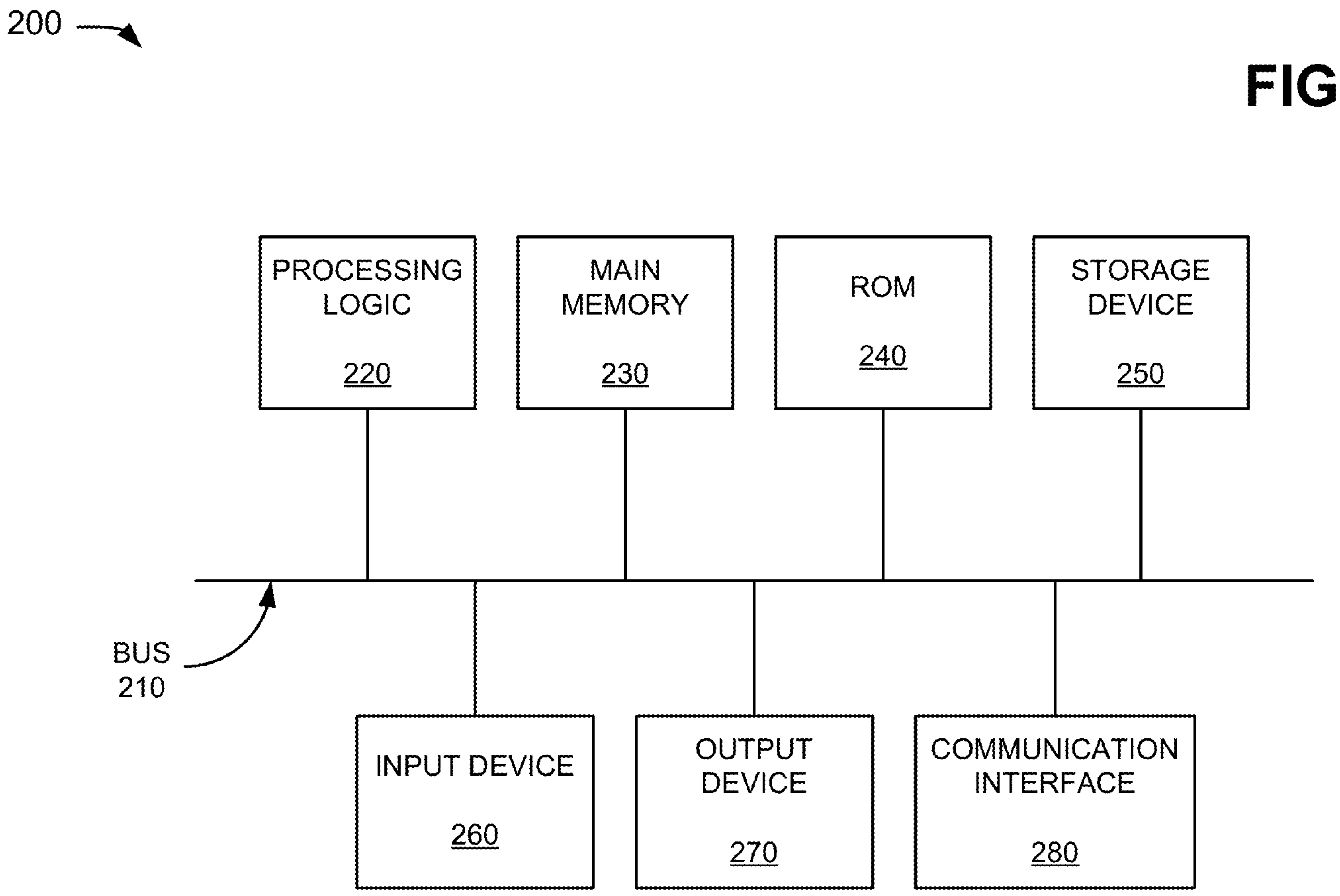

200
PROCESSING LOGIC 220
MAIN MEMORY 230
ROM 240
STORAGE DEVICE 250
BUS 210
INPUT DEVICE 260
OUTPUT DEVICE 270
COMMUNICATION INTERFACE 280

FIG. 2

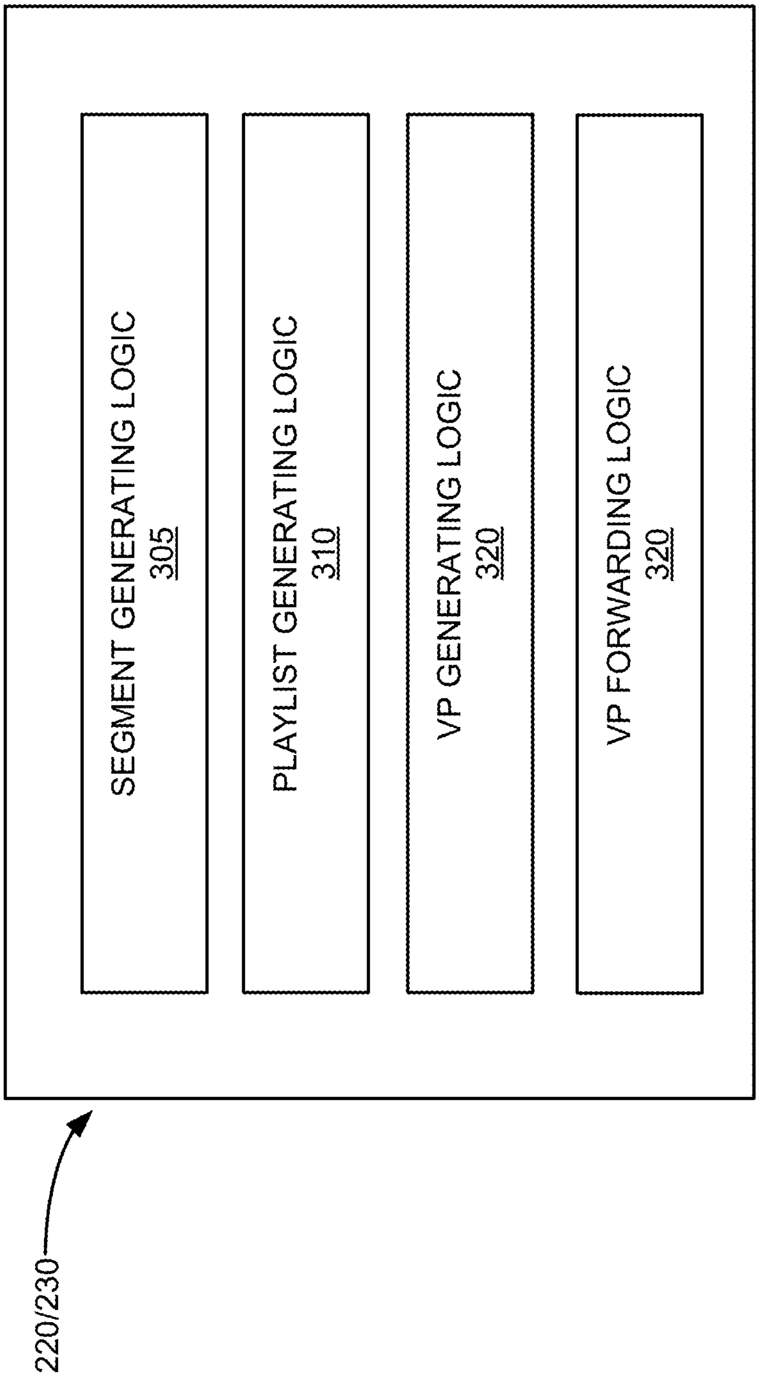
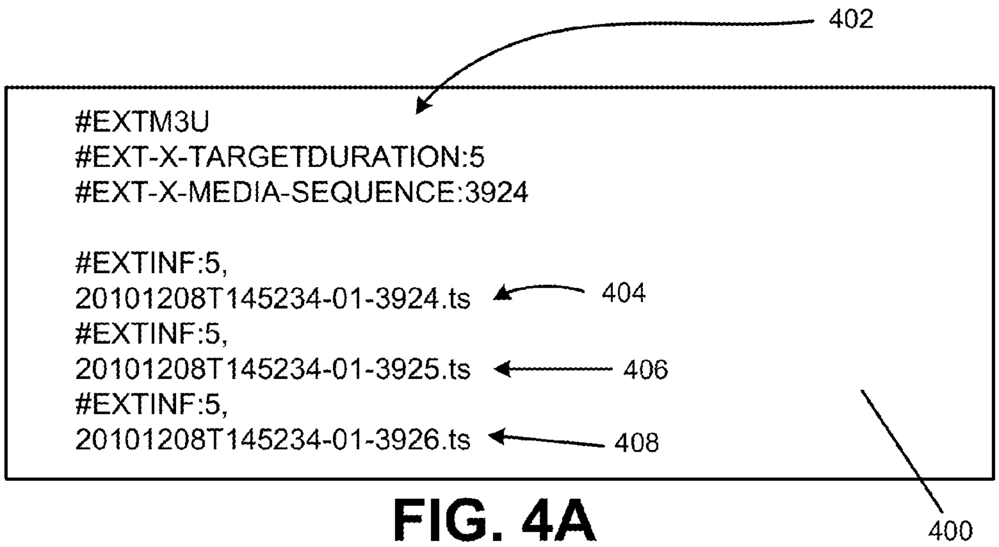

SEGMENT GENERATING LOGIC
305
PLAYLIST GENERATING LOGIC
310
VP GENERATING LOGIC
320
VP FORWARDING LOGIC
320
220/230

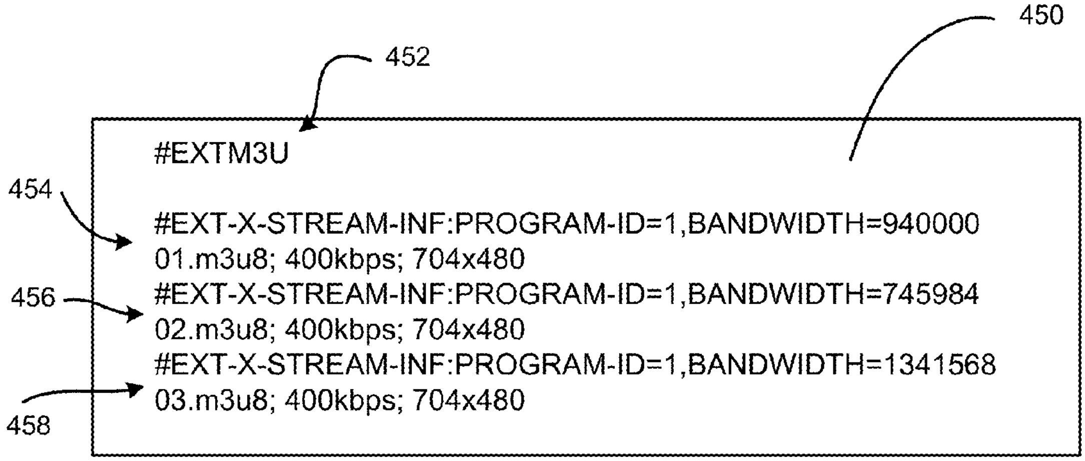
FIG. 3



```
#EXTM3U
#EXT-X-TARGETDURATION:5
#EXT-X-MEDIA-SEQUENCE:3924

#EXTINF:5,
20101208T145234-01-3924.ts
#EXTINF:5,
20101208T145234-01-3925.ts
#EXTINF:5,
20101208T145234-01-3926.ts
```

FIG. 4A



```
#EXTM3U

#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=940000
01.m3u8; 400kbps; 704x480
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=745984
02.m3u8; 400kbps; 704x480
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=1341568
03.m3u8; 400kbps; 704x480
```

FIG. 4B

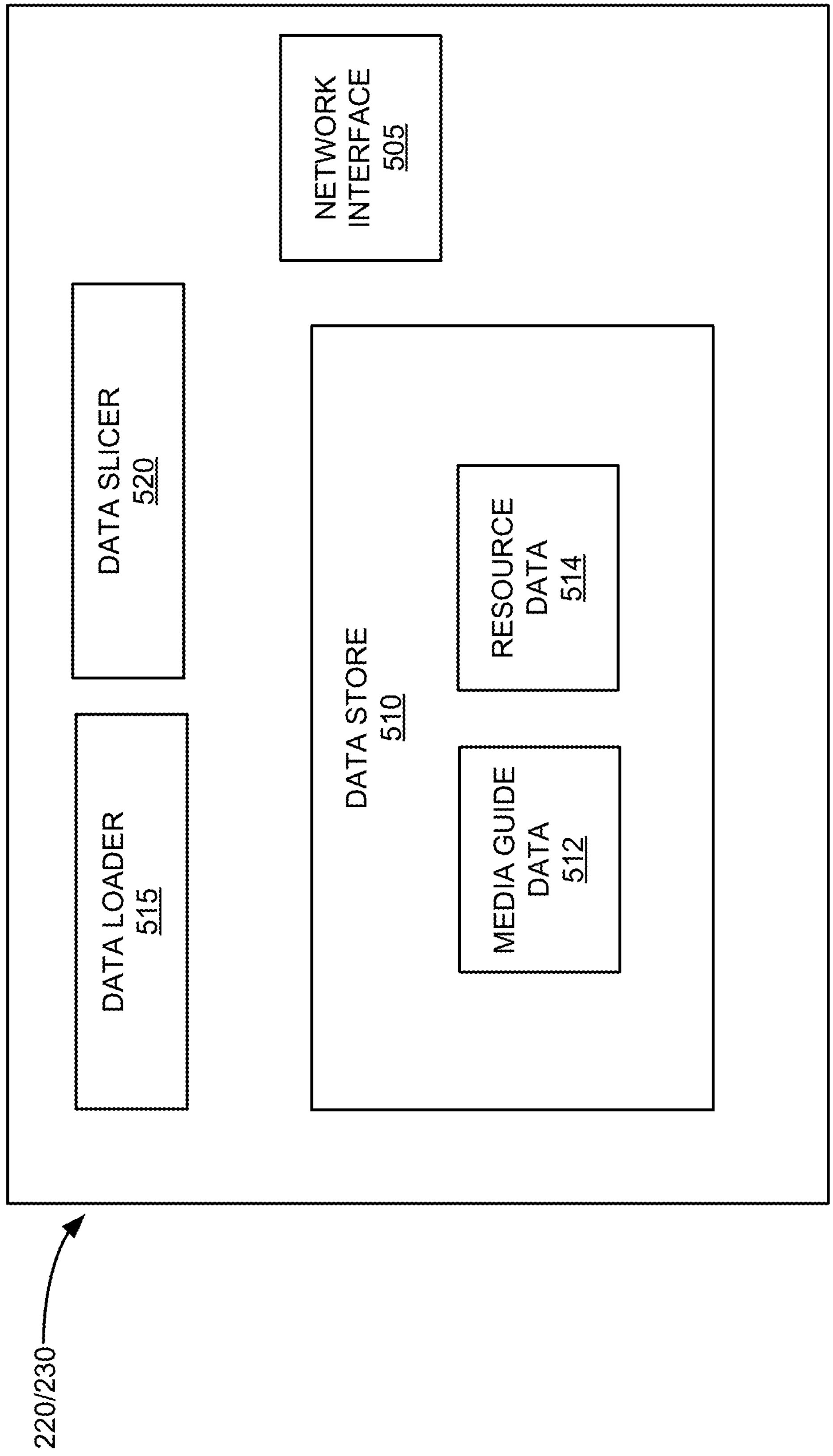

NETWORK INTERFACE 505
DATA SLICER 520
DATA LOADER 515
DATA STORE 510
RESOURCE DATA 514
MEDIA GUIDE DATA 512
220/230

FIG. 5

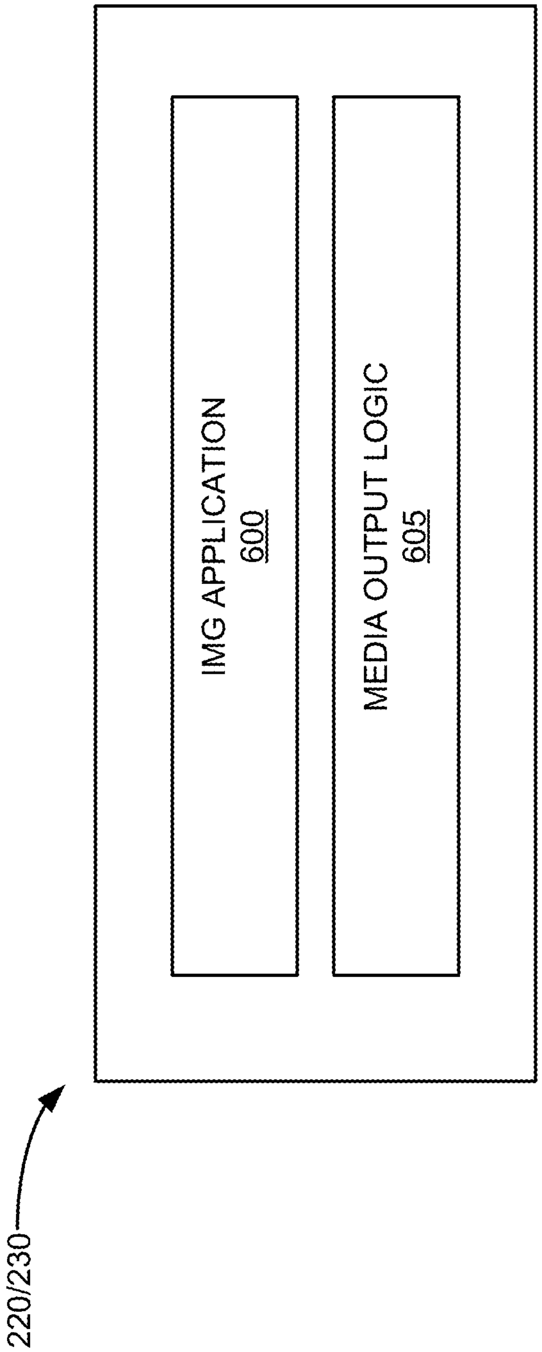


FIG. 6

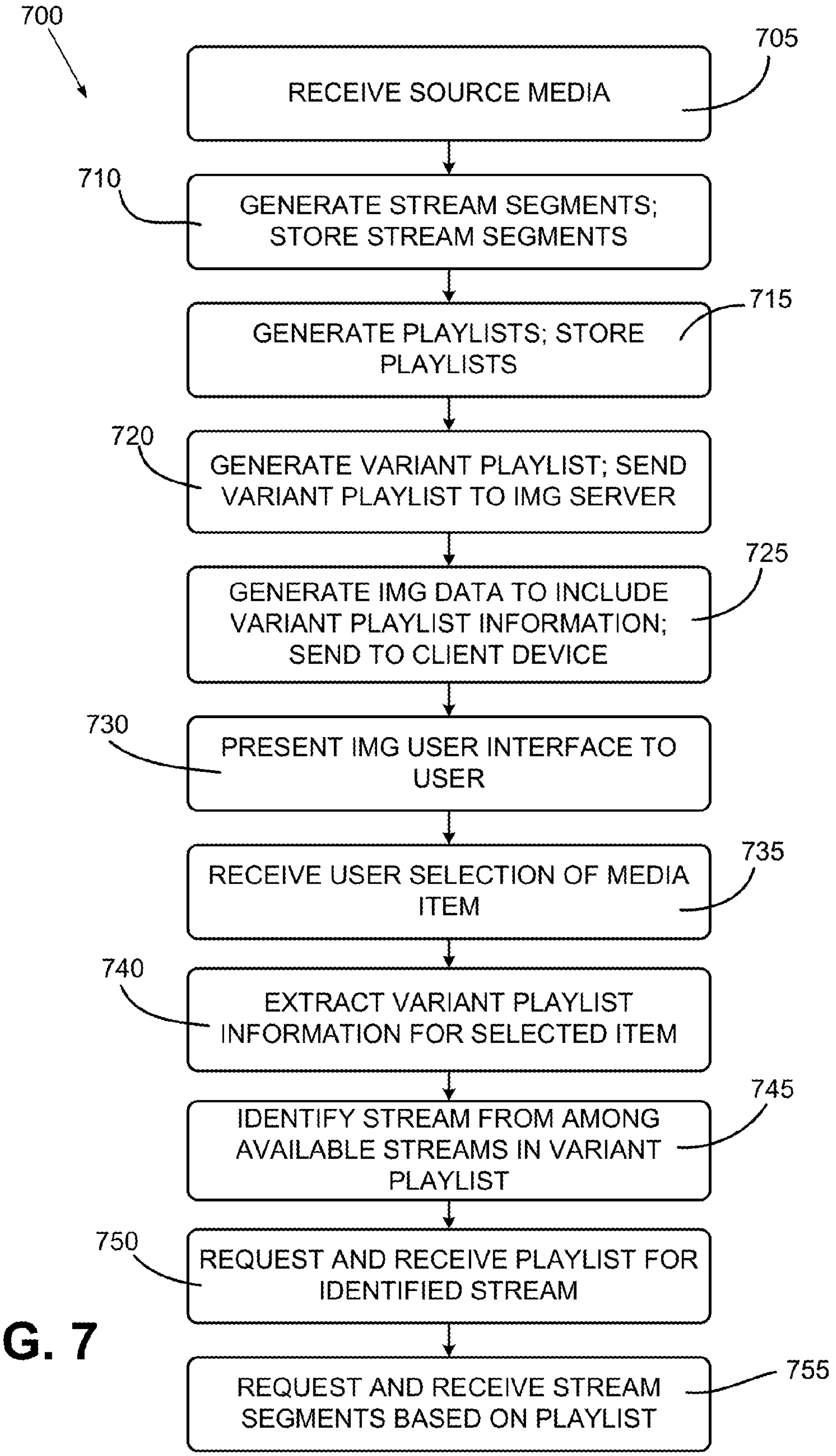

700
RECEIVE SOURCE MEDIA
705
710
GENERATE STREAM SEGMENTS; STORE STREAM SEGMENTS
GENERATE PLAYLISTS; STORE PLAYLISTS
715
720
GENERATE VARIANT PLAYLIST; SEND VARIANT PLAYLIST TO IMG SERVER
GENERATE IMG DATA TO INCLUDE VARIANT PLAYLIST INFORMATION; SEND TO CLIENT DEVICE
725
730
PRESENT IMG USER INTERFACE TO USER
RECEIVE USER SELECTION OF MEDIA ITEM
735
740
EXTRACT VARIANT PLAYLIST INFORMATION FOR SELECTED ITEM
IDENTIFY STREAM FROM AMONG AVAILABLE STREAMS IN VARIANT PLAYLIST
745
750
REQUEST AND RECEIVE PLAYLIST FOR IDENTIFIED STREAM
REQUEST AND RECEIVE STREAM SEGMENTS BASED ON PLAYLIST
755

FIG. 7

DELIVERY OF STREAMING MEDIA CONTENT

BACKGROUND

Many of today's entertainment or communication-related electronic devices rely on receiving, transmitting, and/or using streaming digital data or content. For example, a set-top box may receive broadcast television programs and/or video-on-demand (VOD) that is streamed from a content provider. A personal computer may receive a stream of a video clip over the Internet. A soft phone may receive streaming audio data over a suitable link/channel that is established over an Internet Protocol (IP) or other packet-based network. As a number of available media streams increases, loads placed on serving content files and associating data files also increases, requiring corresponding increases in network capacity and robustness.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** illustrates an exemplary system for streaming content;

FIG. **2** illustrates exemplary components of one or more devices depicted in FIG. **1**;

FIG. **3** is an exemplary functional block diagram of components implemented in the inserter of FIG. **1**;

FIG. **4**A illustrates an exemplary playlist of FIG. **1**;

FIG. **4**B illustrates an exemplary variant playlist of FIG. **1**;

FIG. **5** is an exemplary functional block diagram of components implemented in the IMG server of FIG. **1**;

FIG. **6** is an exemplary functional block diagram of components implemented in the client device of FIG. **1**; and

FIG. **7** is a flow diagram of exemplary processes according to implementations described herein.

DETAILED DESCRIPTION

The following detailed description refers to the accompanying drawings. The same reference numbers in different drawings may identify the same or similar elements. As used herein, the term "content" may refer to audio and/or video content (e.g., a movie, a three-dimensional (3D) movie, show, television program, video stream, audio stream, Internet radio, broadcast of a live event (e.g., sporting event, concert, etc.)).

As described herein, content streaming systems may provide a number of different streams of an identical piece of content, such as content streams corresponding to a number of different criteria, such as bandwidth, bit rate, resolution, etc. The system may receive (or retrieve) a content item (e.g., a movie or television show) and partition the stream into a plurality of segments corresponding to the each of the different streams. The system may also generate a file that identifies that different streams available for download. This files is sometimes referred to as a manifest file or variant playlist. The system also generates a number of playlist files corresponding to the number of variant streams indicated in the manifest file. The playlist files indicate the order in which the segments are to be played and identify the individual media files for download by client devices.

Consistent with embodiments described herein, the information contained in the manifest or variant playlist file (referred to herein as variant playlist or manifest information) may be transmitted to client devices along with media guide or program guide information. For example, client devices may periodically request guide information from a program guide server or other device. In some instances, the media guide information and variant playlist file may be pushed or otherwise automatically delivered to client devices, such as on a periodic basis, e.g., daily, hourly, etc. Then, depending on available bandwidth, resolution, memory, etc., a client/media player may identify a corresponding playlist file for retrieval based on the received manifest information. Corresponding media segments identified in the playlist files may then be downloaded and played back in a sequential manner.

FIG. **1** is a block diagram of an exemplary network **100** in which systems and methods described herein may be implemented. As shown, system **100** may include a content source **102**, segmenter **104**, content server **106**, playlist server **108**, an interactive media guide (IMG) server **110**, client device **112**, and network **113**. These components/devices are described below in greater detail with references to FIGS. **2-5**.

Briefly, content source **102** may include a live or prerecorded audio or video source. An encoder (not shown) associated with content source **102** may receive a signal from source **102** and encode the media to include a format such as, for example, H.264, MPEG-4 Advanced Video coding (AVC), high efficiency advanced audio coding (HE-AAC), etc. Source **102** may send the encoded media in a transport stream (e.g., MPEG-2) to segmenter **104** for downstream processing.

Segmenter **104** may be configured to split a source content from content source **102** into a number of stream segments, shown as content segments **114-1**, and **114-2** (collectively referred to as "segments **114**") in FIG. **1**. As described above, in some instances, segmenter **104** may be configured to generate segments corresponding to more than one stream, such as a number of streams for differing quality, bitrates, output resolution, etc. This concept is schematically illustrated in FIG. **1** as segment group **114-1** associated with a first stream and segment group **114-2** associated with a second stream.

In addition, segmenter **104** may generate one or more playlists **116** (e.g., playlists **116-1** and **116-2**) that indicate the order in which segments **114** are to be played for each respective stream and that additionally point to the locations of segments **114**. As above in relation to the various segment groups **114**, when segmenter **104** has generated information for multiple streams, segmenter **104** generates a corresponding number of playlists **116**, referred to as playlist **116-1** and playlist **116-2** in FIG. **1**.

When multiple media streams are provided for a single content item, segmenter **104** may also generate a file **117** that identifies the various available streams and their corresponding playlist files **116**. Depending on the streaming protocol implemented, file **117** may be referred to by different names. For HTTP Live Streaming from Apple Inc., the file is referred to as a variant playlist (VP). For Smooth Streaming from Microsoft® the file is referred to as a manifest file or client manifest file (e.g., an .ismc file). For Adobe® Flash the file is referred to as a "smil" file. Although named and formatted differently, each of these file types includes similar types of information relating to identifying a number of different available streams for a particular content item. For ease of description, file **117** is referred to herein as variant playlist (VP) **117**.

Stream segments **114** and playlists **116** may be distributed or served to client device **112** via content server **106** and playlist server **108**, respectively, over network **113**. It should be noted that, although content server **106** and playlist server **108** are shown as distributed or separate devices in FIG. **1**, in other implementations these servers may be located/executed from the same physical server or group of servers. Consistent with implementations described herein, VP **117** may be transmitted or otherwise relayed to IMG server **110**. As described herein, IMG server **110** may refer to any device or combination of devices configured to provide media guide information to client device **112** via network **113**. As described below, IMG server **110** may provide program guide data (IMG Data) **118** associated with television or other multi-media programming to client devices **112**.

Program guide data **118** may include any data that may be useful for generating and/or included in a program guide user interface, and/or metadata associated with such information. For example, program guide data **118** may include data related to (e.g., descriptive of) media content (e.g., from content source **102**), program data, data descriptive of media content ordering information, data related to stations providing media content (i.e., station data), data related to channels used for transmission of media content (i.e., channel data), data related to scheduling of media content such as broadcast times and channels (i.e., schedule data), media ratings information, credits, casts, reviews, episode information, series information, show information, pay-per-view information, and any other information associated with media content.

Consistent with embodiments described herein, IMG server **110** may be configured to insert or otherwise include VP **117** within program guide data **118**. For example, VP **117** may be associated with (e.g., as metadata) a guide listing associated with the particular content item from content source **102**. In this manner, selection of the content item via the IMG provided at client device **112** results in corresponding retrieval/identification of VP **117**.

Client device **112** may, based on various factors, such as available bandwidth and output resolution, select a particular stream identified in VP **117**. Client devices **112** may access a particular playlist **116** (e.g., playlist **116-1**) identified in VP **117** and may receive and play content segments **114** (e.g., segments **114-1**) in accordance with the information provided in the particular playlist **116-1**.

Depending on the implementation, system **100** may include additional, fewer, or different components than those illustrated in FIG. **1**. For example, in one implementation, system **100** may include additional content sources **102**, inserters **104**, client devices **112**, etc. Furthermore, although not illustrated in FIG. **1**, in an actual implementation, system **100** may include different network components, such as switches, bridges, routers, gateways, firewalls, different types of client/server devices, etc.

FIG. **2** is an exemplary diagram of a device **200** that may correspond to any of segmenter **104**, content server **106**, playlist server **108**, IMG server **110**, and/or client device **112**. As illustrated, device **200** may include a bus **210**, processing logic **220**, a main memory **230**, a read-only memory (ROM) **240**, a storage device **250**, an input device **260**, an output device **270**, and a communication interface **280**. Bus **210** may include a path that permits communication among the components of device **200**.

Processing logic **220** may include a processor, microprocessor, or other type of processing logic that may interpret and execute instructions. Main memory **230** may include a random access memory (RAM) or another type of dynamic storage device that may store information and instructions for execution by processing logic **220**. ROM **240** may include a ROM device or another type of static storage device that may store static information and/or instructions for use by processing logic **220**. Storage device **250** may include a magnetic and/or optical recording medium and its corresponding drive.

Input device **260** may include a mechanism that permits an operator to input information to device **200**, such as a keyboard, a mouse, a pen, a microphone, voice recognition and/or biometric mechanisms, remote control **130**, etc. Output device **270** may include a mechanism that outputs information to the operator, including a display, a printer, a speaker, etc. Communication interface **280** may include a transceiver that enables device **200** to communicate with other devices and/or systems. For example, communication interface **280** may include mechanisms for communicating with another device or system via a network, such as network **160**.

As described herein, device **200** may perform certain operations in response to processing logic **220** executing software instructions contained in a computer-readable medium, such as main memory **230**. A computer-readable medium may be defined as a physical or logical memory device. The software instructions may be read into main memory **230** from another computer-readable medium, such as storage device **250**, or from another device via communication interface **280**. The software instructions contained in main memory **230** may cause processing logic **220** to perform processes described herein. Alternatively, hardwired circuitry may be used in place of or in combination with software instructions to implement processes described herein. Thus, implementations described herein are not limited to any specific combination of hardware devices, circuitry, and/or software.

Although FIG. **2** shows exemplary components of device **200**, in other implementations, device **200** may contain fewer, different, or additional components than depicted in FIG. **2**. In still other implementations, one or more components of device **200** may perform one or more other tasks described as being performed by one or more other components of device **200**.

FIG. **3** is an exemplary functional block diagram of components implemented in segmenter **104**. In an exemplary implementation, all or some of the components illustrated in FIG. **3** may be stored in memory **230**. For example, referring to FIG. **3**, memory **230** may include segment generating logic **305**, playlist generating logic **310**, variant playlist (VP) generating logic **315**, and VP forwarding logic **320**. In addition, various logic components illustrated in FIG. **3** may be implemented by processing logic **220** executing one or more programs stored in memory **230**.

As described briefly above, segment generating logic **305** may include logic for generating segments for one or more video audio/streams. For example, as briefly described above, segment generating logic **305** may receive/retrieve an encoded source content item from content source **102** and generate even length stream segments corresponding to the source. The stream segments may be formatted based on the implemented streaming protocol (e.g., HTML Live Streaming, Smooth Streaming, Flash, etc.). In addition, as described above, segment generating logic **305** may generate segment files for multiple streams, such as streams having different bitrates, resolutions, etc. In some implementations, the stream segments may be stored as sequential transport stream (.ts) files. Segment generating logic **305** may store the generated stream segments on content server **106** for retrieval by client device **112**.

Playlist generating logic **310** may include logic for generating a playlist file **116** corresponding to each stream. More specifically, playlist generating logic **310** may be configured to generate playlist files **116** identifying the location, duration, and sequence numbering of the segment files **114** corresponding to a particular stream. Playlist generating logic **310** may store the generated playlist files on playlist server **108** for retrieval by client device **112**.

FIG. **4**A shows an exemplary index file or a playlist file **400** that lists storage locations (e.g., universal resource locator (URL) or uniform resource identifier (URI), network addresses, etc.) of content file segments in an order that the segments are to be reassembled and/or output by client device **112**. Examples of index/playlist files may include M3U8 files, M3U files, PLS files, Advanced Stream Redirector (ASX) files, etc.

As shown, playlist **400** may include header **402** and segment identifiers **404**, **406**, and **408**. Playlist **400** is depicted for simplicity and does not include many components that may be present in other playlist files (e.g., M3U8 files). As shown, header **402** includes a #EXTM3U statement, #EXT-X-TARGETDURATION statement, and #EXT-X-MEDIA-SEQUENCE statement. #EXTM3U indicates the type of playlist/index file (e.g., extension to M3U).

Playlist file **400** is depicted as being in an extended M3U file format, including the comment character "#" preceding the tag "EXTM3U" in the first line **402**, and an ordered list of content file segment identifiers indicated by the tags "EXT-X-STREAM-INF" in content segment identifiers **404**-**426**. Other text files/protocols may be used. Playlist file **400** is depicted for simplicity and may include additional tags that may be defined by extended playlist file (e.g., M3U8) protocol.

#EXT-X-TARGETDURATION indicates the maximum duration of segments in playlist **116**. In FIG. **4**A, the maximum duration is shown as 5 seconds. #EXT-X-MEDIA-SEQUENCE indicates a minimum sequence number of any file (i.e., segment) in playlist **400**. For example, in FIG. **4**A, the minimum number is specified as 3924. In segment identifiers **404**-**408**, the actual sequence numbers are 3924, 3925, and 3926, respectively, in strings 20101208T145234-01-3924.ts, 20101208T145234-01-3925.ts, and 20101208T145234-01-3926.ts.

Each of segment identifiers **404**-**408** includes a #EXTINF statement and a string (e.g., URL or URI). #EXTINF indicates the duration of the content segment. The string identifies a location of the segment. In some implementations, the URL or URI of the location string may be provided in non-relative format (e.g., https://www.server.com/ . . .).

Returning to FIG. **3**, variant playlist generating logic **315** may include logic for generating variant playlist (VP) **117** identifying the various available media streams **116** corresponding to the particular content item from content source **102**. More specifically, VP generating logic **315** may be configured to generate may VP **117** that includes the identities, attributes, and locations of playlist files **116** corresponding to the available media streams.

FIG. **4**B illustrates an exemplary VP **450**. As shown, VP **450** may include header **452** and stream identifiers **454**, **456**, and **458**. VP **450** is depicted for simplicity and does not include many components that may be present in other playlist files (e.g., M3U8 files). As shown, header **452** includes a #EXTM3U statement indicating the type of playlist/index file (e.g., extension to M3U). VP **452** is depicted as being in an extended M3U file format, including the comment character "#" preceding the tag "EXTM3U" in the first line **402**

VP **452** further includes a listing of the available streams, attributes, and corresponding playlist locations/file names indicated by the tag "EXT-X-STREAM-INF" in stream identifiers **454**-**458**. Other text files/protocols may be used. In addition, each of stream identifiers **454**-**458** includes a PROGRAM-ID attribute identifying the content item associate with the stream, and a BANDWIDTH attribute identifying the client bandwidth required to view the stream. For each of stream identifiers **454**-**458**, the PROGRAM attribute includes a value of "1," indicating that all streams correspond to a same content item. Stream identifier **454** includes a BANDWIDTH attribute value of "940000," indicating the client bandwidth required to view/retrieve the associated stream. Stream identifier **456** includes a BANDWIDTH attribute value of "745984." Stream identifier **458** includes a BANDWIDTH attribute value of "1341568." The client device/media player may be configured to dynamically switch among the variant bandwidths based on an amount of bandwidth that the client device/media player can support at any given time.

Each of stream identifiers **454**-**458** may include a URL/URI to another playlist (e.g., playlist **400**) that may be retrieved and used by client device **112** when the condition specified in a particular segment identifier is satisfied. For example, stream identifier **454** specifies that the available bandwidth for receiving the content stream is 940000 (e.g., 940 kbps) and a corresponding URI of 01.m3u8, which is playlist **400**. In addition, as shown in FIG. **4**B, each provided URI may include one or more attributes relating to, for example, the bitrate and resolution of the associated stream. For example, stream identifier **454** may indicate a bitrate of 400 kbps and a resolution of 704×480. This information may be used by client device **112** in selecting the appropriate stream for viewing. Client device **112** may be configured to dynamically switch among the variant streams based on an amount of bandwidth that the client device/media player can support at any given time. When a client device processes VP **450** and maintains the required bandwidth (e.g., to content server **106**), client device **112** may obtain content segments **114** that are listed in playlist **400**. Other observed bandwidths, may result in retrieval of content segments identified in other playlists **116** (e.g., 02.m3u8 or 03.m3u8).

Returning to FIG. **3**, VP forwarding logic **320** may include logic configured to forward VP **117** generated by VP generating logic **315** to IMG server **110**. In other implementations, VP forwarding logic **320** may include logic configured to store VP **117** in a location accessible to IMG server **110**.

FIG. **5** is an exemplary functional block diagram of components implemented in IMG server **110**. In an exemplary implementation, all or some of the components illustrated in FIG. **5** may be stored in memory **230**. For example, referring to FIG. **5**, memory **230** may include network interface **505**, data store **510**, data loader **515**, and data slicer **520**.

Network interface **505** may include one or more devices capable of communicating with the client device **112** via network **113**, such as one or more servers, routers, etc. In particular, network interface unit **505** may be configured to provide content (e.g., data streams carrying content) to client device **112** over network **113**. In some implementations, IMG server **110** may be implemented at a head-end unit (e.g., a super and/or local head-end unit), base station, central office, video hub office ("VHO"), video serving offices ("VSDs"), network node, other suitable locations, or at any combination of one or more of these locations. In some implementations, IMG server **110** may be logically separated from client device **112** by several entities, such as a super head-end, VHO, and/or VSO.

Consistent with embodiments described herein, network interface **505** may be configured to retrieve content from data store **510** and/or data slicer **520** for transmission to client device **112** via network **113**. Accordingly, content stored in data store **510** may be made available over the network **113** by the network interface unit **505**. The content may be provided at any suitable time, including in response to a request from the client device **112**, at a predefined time or event, and periodically. The content may be provided in any suitable manner, including using in-band, out-of-band, or a combination of in-band and out-of-band communications. Examples of the IMG server **110** delivering IMG-related content to the client device **112** are described further below.

Data store **510** may include one or more data storage mediums, devices, or configurations and may employ any type, form, and combination of storage media, including hard disk drives, read-only memory, caches, databases, optical media, and random access memory. Data store **510** may include any known technologies useful for storing, updating, modifying, accessing, retrieving, and deleting content (e.g., media guide data, IMG data, etc.). For example, data store **510** may include media guide data **512**, and resource data **514**. In other implementations, data store **510** may store other content or types of content.

As used herein, the term "media guide data" may include any data that may be useful for generating and/or that may be included in an IMG user interface. Media guide data **512** may include data related to (e.g., descriptive of) media content (e.g., media content metadata), program data, data descriptive of media content ordering information, data related to stations providing media content (i.e., station data), data related to channels used for transmission of media content (i.e., channel data), data related to scheduling of media content such as broadcast times and channels (i.e., schedule data), media ratings information, credits, casts, reviews, episode information, series information, show information, pay-per-view information, and any other information associated with media content.

Resource data **514** may include any data that can be accessed and utilized by applications running on client device **112**, including, but not limited to, configuration files, images (e.g., bitmaps), graphics, templates, and library files. By way of an example, resource data **514** may include images (e.g., channel and/or station logos) that can be used by an IMG application running on user device **112** to generate an IMG user interface.

User device **112** may receive the content stored in data store **510** from any suitable source, including one or more internal and/or external sources. In certain implementations, for example, media guide data **512** may be received in a raw form from a third-party data provider, processed, and stored in data store **510** as media guide data **512**. Such a third-party data provider may include any suitable external source of data, including a provider of program guide information such as FYI Television, Inc. of Grand Prairie, Tex. or Tribune Media Services of Chicago, Ill.

As shown in FIG. **5**, IMG server **110** may include a data loader **515** configured to receive variant playlist data (e.g., VP **117**) from segmenter **104**. In addition, data loader **515** may be configured to receive media data (e.g., programming data) from a third-party data provider, as described above.

Consistent with embodiments described herein, data loader **515** may be configured to associate received VPs **117** with corresponding media items/program items identified in received media data. The media data may be received from a third party provider or may be retrieved internally from data store **510**. The media data and corresponding VP data may be stored in data store **510** for delivery to client device **112**. For example, the VP associated with a particular media item (e.g., a movie) may be stored as metadata associated with an IMG entry corresponding the media item. In one implementation, selected information from the VP may be associated with the IMG entry. For example, VP information associated with the IMG entry may include the URIs of the playlist files, the bandwidth limits, and the output resolution information. In some implementations, only VP information for a single playlist may be provided in IMG data **118**. For example, information relating to the lowest bandwidth version of the stream may be provided in IMG data **118**. This may facilitate rapid channel or media changes.

As described below, upon selection of the media item via the IMG at client device **112**, the corresponding VP (e.g., VP **117**) may be simultaneously retrieved and processed. This eliminates a call to playlist server **108** and significantly increasing system responsiveness, while simultaneously reducing load on playlist server **108**. When it is determined that the user has watched or consumed the media stream for more than a minimum period of time (e.g., 30 seconds), or that more than a minimum number of stream segments have been output, client device **112** may be configured to retrieve VP **117** from playlist server **108** in the typical manner. This allows higher bandwidth stream to be identified and selected.

In some implementations, IMG data **118** may be transmitted to client device **112** as "slices." Consistent with such an implementation, IMG server **110** may include data slicer **520** configured to communicate with data loader **515**, data store **510**, and network interface unit **505**.

Data slicer **520** may process media guide data **512** stored in data store **510**, including generating one or more optimized configuration of media guide data **512** that can help conserve both memory and processing resources of client device **112**. The optimized configuration (e.g., IMG data **118**) may be forwarded to client device **112** via network interface unit **505** and network **113**. Client device **112** may be configured to utilize the received IMG data **118** for generating an IMG user interface having VPs corresponding to particular media items identified in the guide.

An exemplary configuration of program guide data **240** that may be generated by data slicer **520** will now be described in detail. As used herein, the term "group" may be used to refer to any discrete grouping of data. A data group may be an electronic file (or simply "file") or other discrete data instance. A data group may include one or more discrete data structures. One or more of the data structures may be organized into an array of data structures in a data group.

Data slicer **520** may be configured to organize media guide data **512** based on categories of the data. Accordingly, different categories of media guide data **512** may be stored in separate data structures and/or groups. Examples of categories that may be used include, but are not limited to, channel, lookup, schedule, series, episode, show, PPV, VOD, and cast/credit data.

Based on these categories, data slicer **520** may be configured to store the categories of media guide data into separate groups of data. For example, data slicer **520** may create a channel data group, a lookup data group, and at least one schedule data group and organize the data structures into these groups in accordance with predefined heuristics.

Once data slicer **520** has generated an optimized configuration of media guide data **512**, IMG server **110** is ready and configured to provide at least a subset of the media guide data configuration to client device **112** as IMG data **118**. For example, IMG server **110** may provide a number of data corresponding to discrete units of time (e.g., days) to client device **112** via network **113**.

FIG. **6** is an exemplary functional block diagram of components implemented in client device **112** of FIG. **1**. In an exemplary implementation, all or some of the components illustrated in FIG. **6** may be stored in memory **230**. For example, referring to FIG. **6**, memory **230** may include IMG application **600** and media output logic **605**. In one embodiment, IMG application **600** and/or media output logic **605** may be implemented by processing logic **220** executing one or more programs stored in memory **230**.

As described above, IMG application **600** may be configured to receive IMG data **118** from IMG server **110**. Consistent with embodiments described herein, IMG data **118** may include data used to generate an IMG user interface and may include VPs **117** corresponding to one or more media items presented in the IMG user interface.

IMG application **600** may be further configured to, upon receipt of a user selection of a media item corresponding to a particular VP **117**, extract the VP from the IMG data **118**. As described above in relation to FIG. **4**B, VP **117** includes identifiers, attributes, and locations corresponding with available variant media streams associated with the selected media item. IMG application **600** may, based on usage characteristics, such as available bandwidth, stream bitrate, output resolution, etc., identify a particular media stream for output by media output logic **605**. In addition, IMG application **600** may pass (or otherwise make available) VP **117** to media output logic **605**, for dynamic stream selection during playback of the selected media item.

Media output logic **605** may include logic to communicate with playlist server **108** and content server **106** to retrieve playlists **116** corresponding to dynamically selected variant media streams and their associated content. Media output logic **605** may further include logic and/or processing to output received stream segments **114** via an output device, such as output device **270** (e.g., a television, monitor, speakers, etc.).

FIG. **7** is a flow diagram illustrating exemplary processing **700** associated with the above-described features of FIGS. **1-6**. Processing **700** may begin with content segmenter **104** receiving/retrieving a source media item from content source **102** (block **705**). As described above, in one implementation, the content may have been sent as an MPEG-2 Transport Stream. Upon receiving the source content, segmenter **104** may partition the content stream into one or more sets of stream segments **114**, and send segments **114** to content server **106** (block **710**).

In addition, segmenter **104** may generate playlists **116** that describe segments **114**, and send playlists **116** to playlist server **108** (block **715**). As described above, a playlist **116** is generated for each different variant stream generated by segmenter **104**. Segmenter **104** further generates VP **117** identifying the available playlists **116** associated with the source content and any attributes corresponding to their selection and send VP **117** to IMG server **110** (block **720**).

IMG server **110** may generate IMG data **118** to include information relating to various media items, schedules, etc. and send IMG data **118** to client device **112** (block **725**). As described above, IMG data **118** may be configured to include VP **117**.

Client device **112** may receive IMG data **118** and present an IMG user interface to a user (block **730**). For example, IMG application **600** may receive IMG data **118** periodically via network **113**. IMG application **600** may receive a user selection of an available media item (block **735**). In response, IMG application **600** may extract VP **117** associated with the selected media item (block **740**). IMG application **600** may, based on usage and/or network characteristics associated with client device **112** (e.g., network bandwidth, output resolution, etc.), identify a particular stream from among a number of available media streams identified in VP **117** (block **745**). IMG application **600** and/or output logic **605** may, based on the identified stream, request/retrieve a corresponding playlist **116** based on information in VP **117** (block **750**). Output logic **605** may retrieve content segments based on the retrieved playlist **116** (block **755**).

By providing a variant playlist and related information in IMG or program guide data, the above-described systems and methods significantly reduce server loads by eliminating the need for client devices to dynamically request and receive variant playlists from network server resources. In addition, providing a variant playlist in IMG or program guide data for use by the client device upon selection of a particular media item significantly decreases the time required to begin outputting the selected media stream.

The foregoing description of implementations provides illustration, but is not intended to be exhaustive or to limit the implementations to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the teachings.

In addition, while series of blocks have been described with regard to an exemplary process illustrated in FIG. **7**, the order of the blocks may be modified in other implementations. In addition, non-dependent blocks may represent acts that can be performed in parallel to other blocks.

It will be apparent that aspects described herein may be implemented in many different forms of software, firmware, and hardware in the implementations illustrated in the figures. The actual software code or specialized control hardware used to implement aspects does not limit the invention. Thus, the operation and behavior of the aspects were described without reference to the specific software code—it being understood that software and control hardware can be designed to implement the aspects based on the description herein.

Further, certain portions of the implementations have been described as "logic" that performs one or more functions. This logic may include hardware, such as a processor, a microprocessor, an application specific integrated circuit, or a field programmable gate array, software, or a combination of hardware and software.

No element, act, or instruction used in the present application should be construed as critical or essential to the implementations described herein unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items. Further, the phrase "based on" is intended to mean "based, at least in part, on" unless explicitly stated otherwise.

What is claimed is:

1. A computing-device implemented method, comprising:

generating two or more media streams based on a source media item, wherein the two or more media streams each include a number of stream segments;

storing the stream segments for each of the two or more media streams on a content server;

generating playlist files for each of the two or more media streams, wherein the playlist files identify network locations of the associated stream segments on the content server;

storing the playlist files, for each of the two or more media streams, on a playlist server;

generating a variant playlist file that identifies network locations and at least a bandwidth attribute associated with each of the playlist files;

inserting playlist information based on the variant playlist file into media guide data,

wherein the media guide data is to be used by a client device to generate an interactive media guide user interface, the media guide data including a plurality of entries corresponding to a plurality of media content items, wherein each entry includes media content metadata, media content scheduling data, and media content channel data, wherein the media guide data includes an entry corresponding to the source media item,

wherein, following inserting of the playlist information, the entry corresponding to the source media item includes the playlist information,

wherein the playlist information identifies the network location of at least one of the playlist files; and

transmitting the media guide data to the client device via a network.

2. The method of claim **1**, wherein the information based on the variant playlist file comprises playlist location and bandwidth information for at least one of the two or more media streams.

3. The method of claim **2**, wherein the playlist information that is inserted into the entry in the media guide data corresponding to the source media item comprises playlist location and bandwidth information for only a single media stream, from the at least two media streams, having a lowest bandwidth attribute.

4. The method of claim **1**, wherein the media guide data comprises information relating to available media items for a particular period of time.

5. The method of claim **1**, wherein transmitting the media guide data is performed periodically.

6. The method of claim **1**, further comprising:

receiving a request from the client device for a particular playlist file identified in the media guide data;

transmitting the particular playlist file to the client device;

receiving a request from the client device for stream segments identified in the particular playlist from the content server; and

transmitting the requested stream segments to the client device for output to a user.

7. A computing-device implemented method, comprising:

receiving media guide data from a media guide server via a network,

wherein the media guide data includes information relating to a number of available media items to be used by a client device to generate an interactive media guide user interface, the media guide data including a plurality of entries corresponding to the number of available media items, wherein each entry includes media content metadata, media content scheduling data, and media content channel data,

wherein the media guide data includes an entry corresponding to a streaming media item,

and wherein the entry corresponding to the streaming media item includes playlist information relating to at least one available playlist file associated with the streaming media item, wherein the playlist information includes at least a network location of the playlist file;

generating the interactive media guide user interface based on the received media guide data;

receiving a user selection of the streaming media item from the interactive media guide user interface;

automatically requesting the playlist file from a playlist server via the network based on the network location in the playlist information;

receiving the playlist file from the playlist server, wherein the playlist file includes network locations of stream segments corresponding to the selected media item; and

requesting the stream segments from a content server via the network based on the received playlist file.

8. The method of claim **7**, wherein the entry corresponding to the streaming media item further includes variant playlist information,

wherein the variant playlist information includes playlist information relating to more than one available playlist file associated with the streaming media item.

9. The method of claim **8**, further comprising:

determining at least one network characteristic associated with the network, wherein requesting the playlist file comprises requesting one of the more than one playlist files from the playlist server via the network based on the at least one network characteristic.

10. The method of claim **9**, wherein the at least one network characteristic comprises available bandwidth.

11. The method of claim **7**, further comprising:

receiving and outputting at least one of the stream segments;

subsequent to outputting the at least one of the stream segments, requesting and receiving a variant playlist file from the playlist server, wherein the variant playlist file includes playlist information relating to more than one available playlist file associated with the streaming media item;

determining at least one network characteristic associated with the network;

requesting a selected one of the more than one playlist file from the playlist server via the network based on the at least one network characteristic;

receiving the selected one of the more than one playlist files from the playlist server; and

requesting the stream segments from the content server via the network based on the received selected one of the more than one playlist file.

12. The method of claim **11**, further comprising:

requesting the variant playlist file from the playlist server based on a determination that more than a predetermined number of stream segments have been output.

13. A network device comprising:

one or more processors configured to:

generate two or more media streams based on a source media item, wherein the two or more media streams each include a number of stream segments;

store the stream segments for each of the two or more media streams on a content server;

generate playlist files for each of the two or more media streams, wherein the playlist files identify locations of the associated stream segments on the content server;

store the playlist files for each of the two or more media streams on a playlist server;

generate a variant playlist file that identifies the network locations of each of the playlist files on the playlist server and at least a bandwidth attribute associated with each of the playlist files; and

insert playlist information based on the variant playlist file into media guide data,

wherein the media guide data is to be used by a user device to generate an interactive media guide user interface, the media guide data including a plurality of entries corresponding to a plurality of media content items, wherein each entry includes media content metadata, media content scheduling data, and media content channel data,

wherein the media guide data includes an entry corresponding to the source media item,

wherein, following insertion of the playlist information, the entry corresponding to the source media item includes the playlist information,

wherein the playlist information identifies the network location of at least one of the playlist files; and

an interface configured to:

send, via a network, the media guide data to a user device.

14. The network device of claim **13**, wherein the information based on the variant playlist file comprises playlist location and bandwidth information for at least one of the two or more media streams.

15. The network device of claim **13**, wherein the interface is further configured to send the media guide data on a periodic basis.

16. The network device of claim **13**, wherein the interface is further configured to:

receive a request from the user device for a particular playlist file identified in the media guide data;

transmit the particular playlist file to the user device;

receive a request from the user device for stream segments identified in the particular playlist file from the content server; and

transmit the stream segments to the user device for presentation to a user.

17. A network device, comprising:

an interface configured to:

receive media guide data from a media guide server via a network,

wherein the media guide data includes information relating to a number of available media items to be used by a client device to generate an interactive media guide user interface, the media guide data including a plurality of entries corresponding to the number of available media items, wherein each entry includes media content metadata, media content scheduling data, and media content channel data,

wherein the media guide data includes an entry corresponding to a streaming media item,

and wherein the entry corresponding to the streaming media item includes playlist information relating to at least one available playlist file associated with a streaming media item, wherein the playlist information includes at least a network location of the playlist file;

at least one processor configured to:

generate the interactive media guide user interface based on the received media guide data;

receive a user selection of the streaming media item from the interactive media guide user interface;

automatically request the playlist file from a playlist server via the interface based on the playlist information;

receive the playlist file from the playlist server via the interface, wherein the playlist file identifies locations, on a content server, of stream segments corresponding to the selected playlist file; and

request the stream segments from the content server via the interface based on the received playlist file.

18. The network device of claim **17**, wherein the entry corresponding to the streaming media item further includes variant playlist information,

wherein the variant playlist information includes playlist information relating to more than one available playlist file associated with the streaming media item.

19. The network device of claim **17**, wherein the processor is further configured to:

receive at least one of the stream segments from the content server via the interface;

output the at least one of the stream segments via an output device;

subsequent to outputting the at least one of the stream segments, request a variant playlist file from the playlist server via the interface, wherein variant playlist information includes playlist information relating to more than one available playlist file associated with the streaming media item;

determine at least one network characteristic associated with the network;

request a selected one of the more than one playlist file from the playlist server via the interface based on the at least one network characteristic;

receive the selected one of the more than one playlist file from the playlist server; and

request the stream segments from the content server via the network based on the received selected one of the more than one playlist file.

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