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(54) **ADAPTIVE ON-SCREEN GUIDE BASED ON CHANNEL OR CONTENT TRANSITION COMMANDS**

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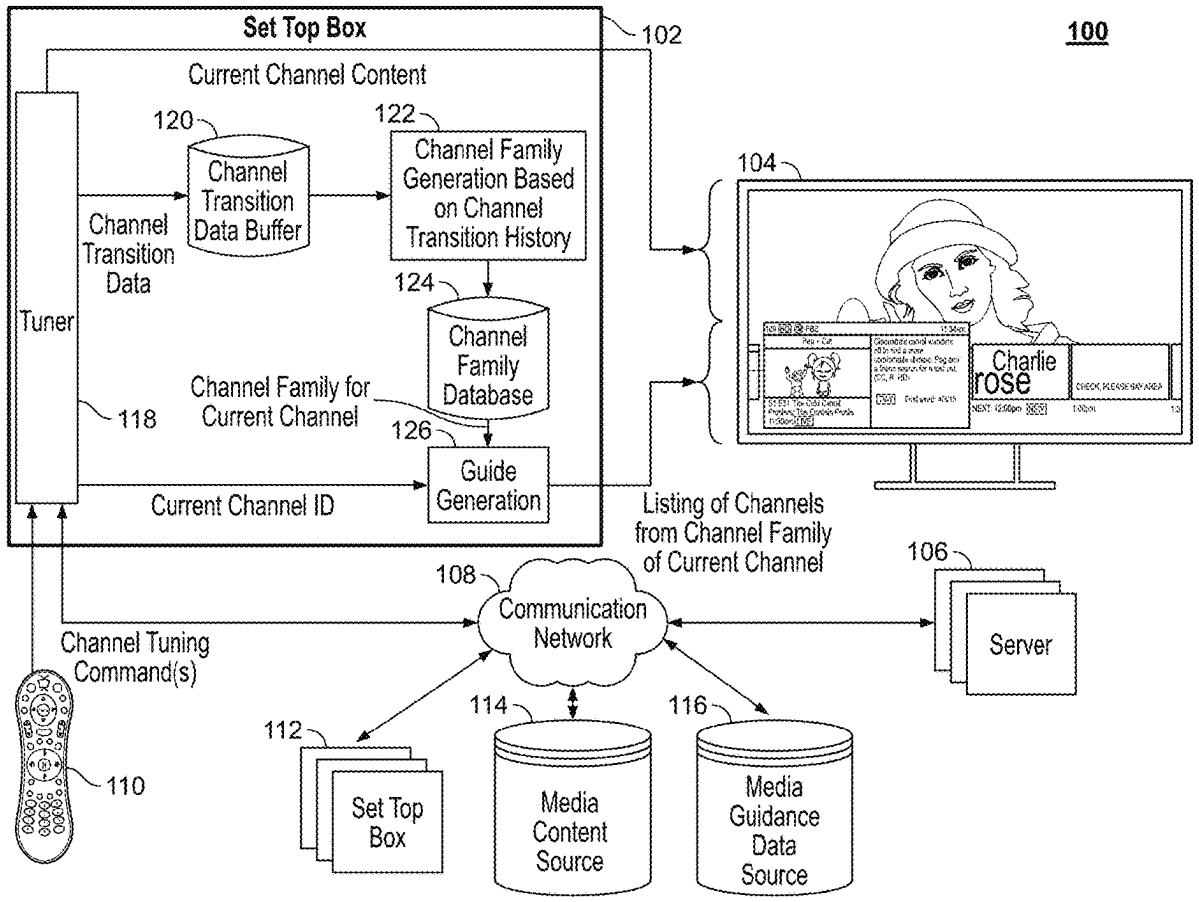
(57) **ABSTRACT**

Systems and methods for generating a channel sequence for display via an abbreviated on-screen guide are disclosed herein. Channel tuning commands are entered via a user interface of a computing device. Channel tuning data, which describes channel transitions caused by the channel tuning commands, is stored in a buffer. Based on the channel tuning data, a channel family comprising a plurality of channels is generated. A determination is made as to whether a currently tuned channel is included in the channel family. In response to determining that the currently tuned channel is included in the channel family, an on-screen guide, which comprises an abbreviated channel listing of the plurality of channels of the channel family, is generated for display.



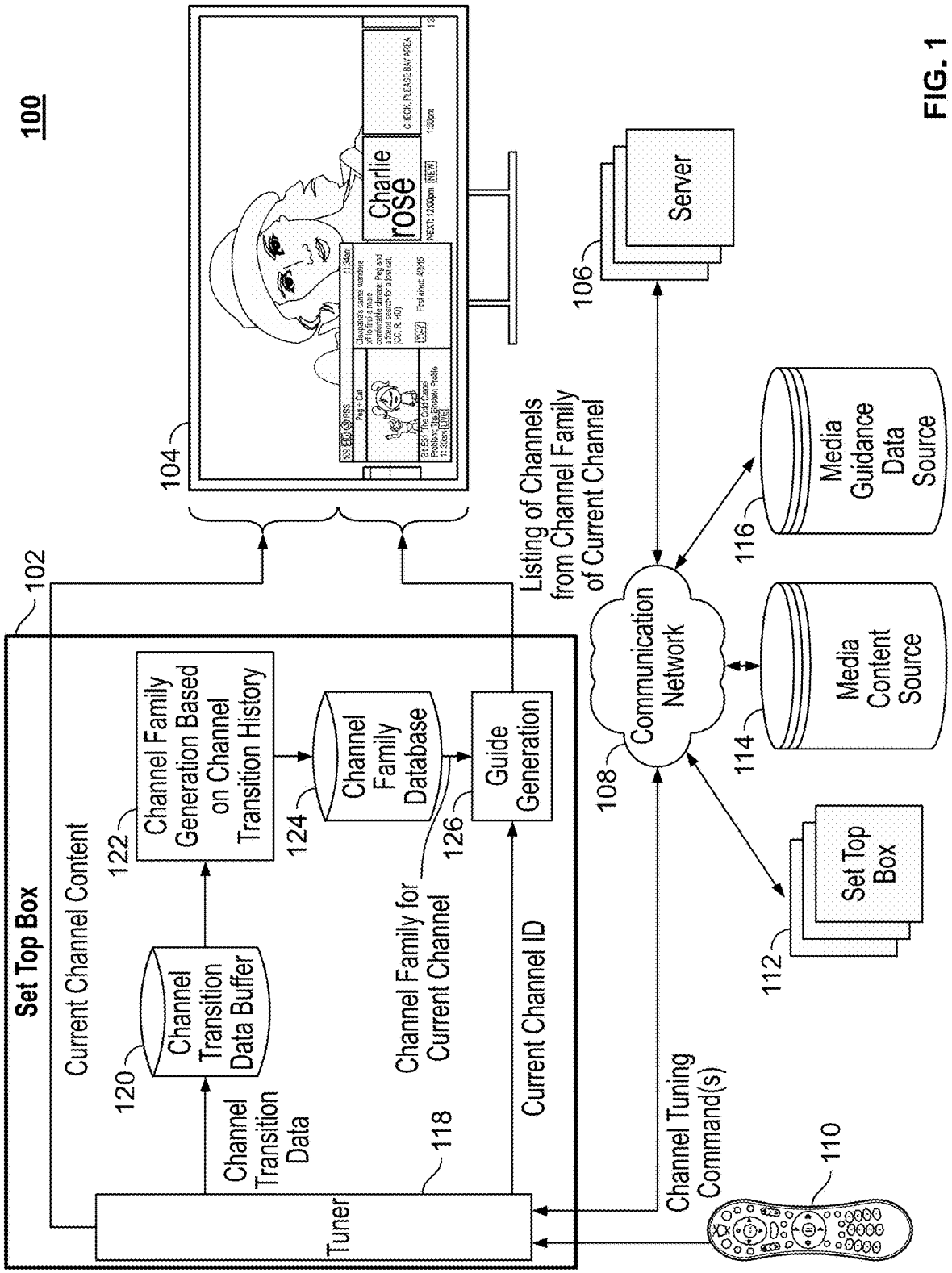

100
Set Top Box
102
Current Channel Content
Channel Transition Data
Channel Transition Data Buffer
120
Channel Family Generation Based on Channel Transition History
122
Channel Family Database
124
Guide Generation
126
Channel Family for Current Channel
Current Channel ID
Tuner
118
104
Listing of Channels from Channel Family of Current Channel
Channel Tuning Command(s)
110
Communication Network
108
Server
106
Media Guidance Data Source
116
Media Content Source
114
Set Top Box
112

FIG. 1

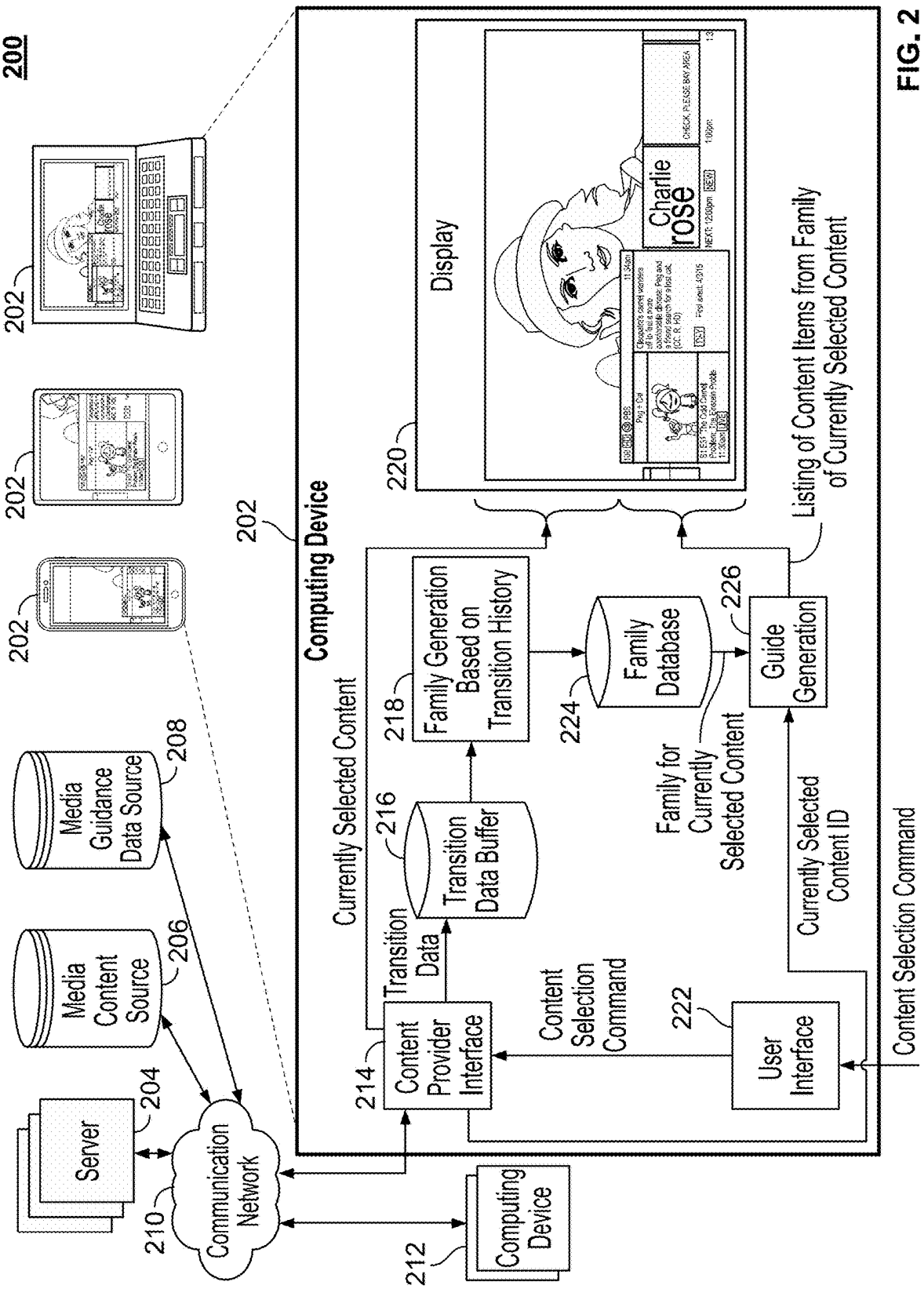

200
202
202
202
202
Computing Device
Display
220
Charlie rose
Media Guidance Data Source
208
Media Content Source
206
Server
204
Communication Network
210
Computing Device
212
Content Provider Interface
214
Transition Data
Transition Data Buffer
216
Currently Selected Content
Family Generation Based on Transition History
218
Family Database
224
Guide Generation
226
Family for Currently Selected Content
Content Selection Command
User Interface
222
Currently Selected Content ID
Content Selection Command
Listing of Content Items from Family of Currently Selected Content

FIG. 2

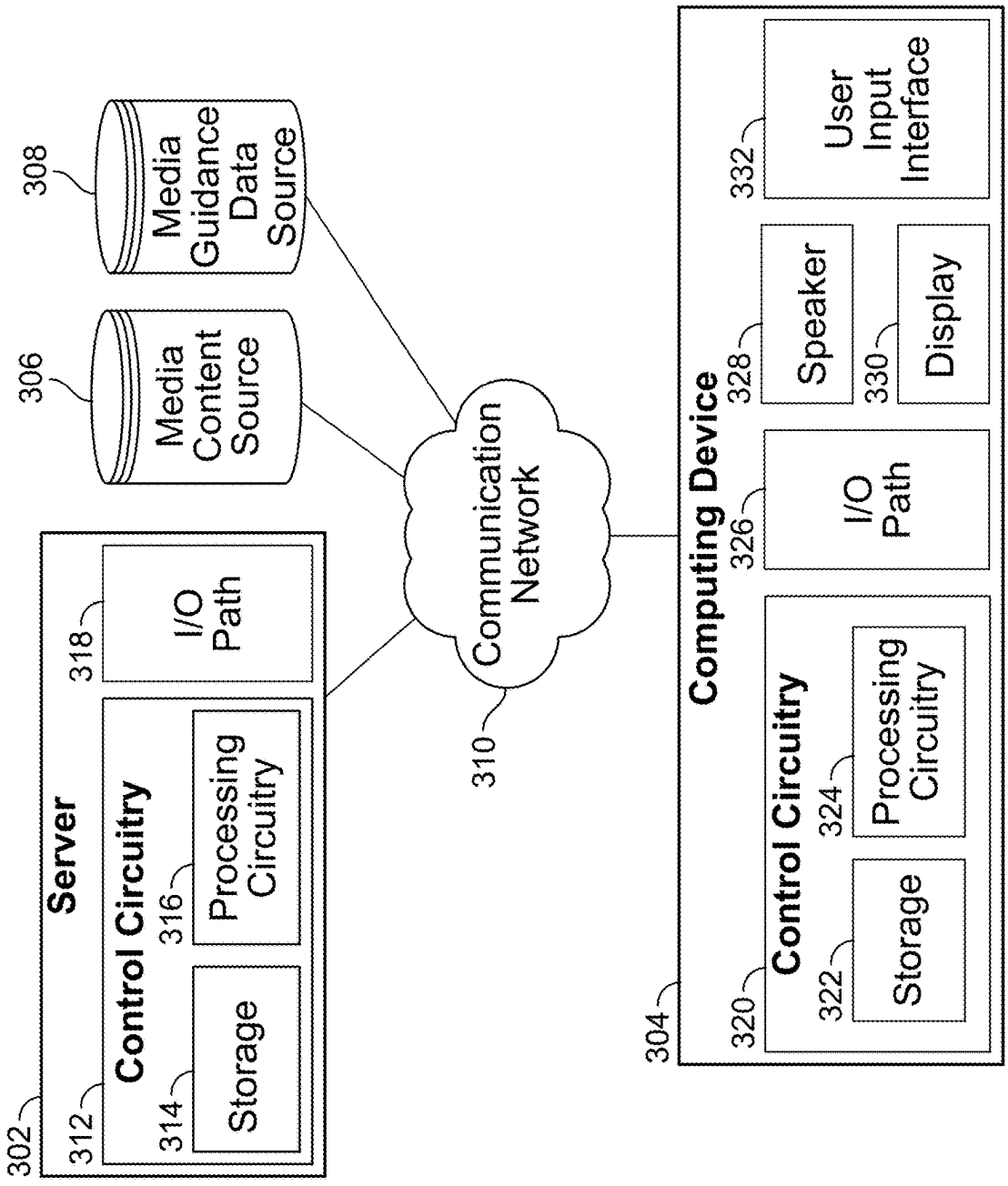

300
Server
302
Control Circuitry
312
Storage
314
Processing Circuitry
316
I/O Path
318
Media Content Source
306
Media Guidance Data Source
308
Communication Network
310
Computing Device
304
Control Circuitry
320
Storage
322
Processing Circuitry
324
I/O Path
326
Speaker
328
Display
330
User Input Interface
332

FIG. 3

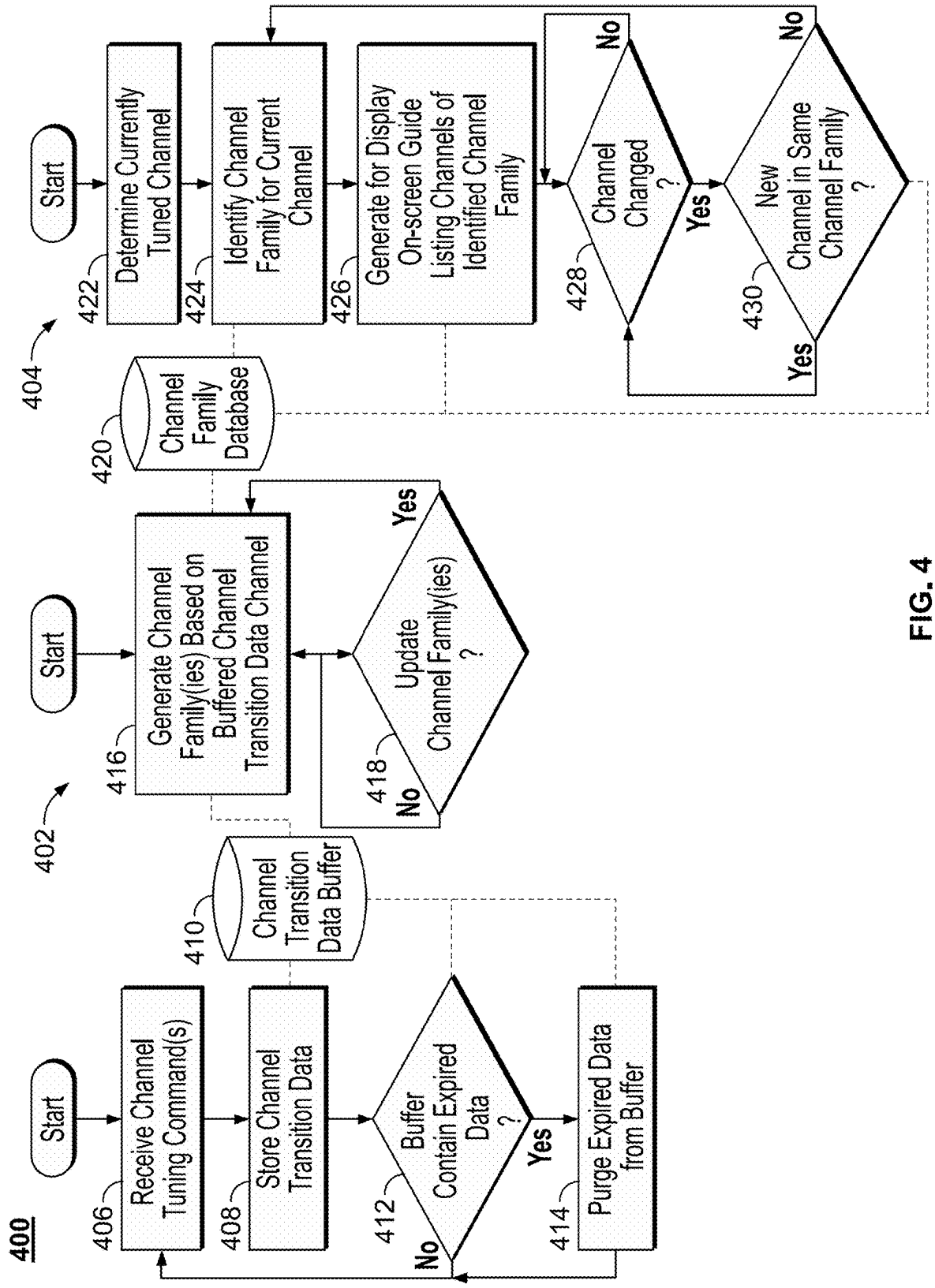

400
402
404
Start
Receive Channel Tuning Command(s)
406
Store Channel Transition Data
408
Buffer Contain Expired Data ?
412
Yes
No
Purge Expired Data from Buffer
414
Channel Transition Data Buffer
410
Start
Generate Channel Family(ies) Based on Buffered Channel Transition Data Channel
416
Update Channel Family(ies) ?
418
Yes
No
Start
Determine Currently Tuned Channel
422
Identify Channel Family for Current Channel
424
Generate for Display On-screen Guide Listing Channels of Identified Channel Family
426
Channel Family Database
420
Channel Changed ?
428
No
Yes
New Channel in Same Channel Family ?
430
No
Yes

FIG. 4

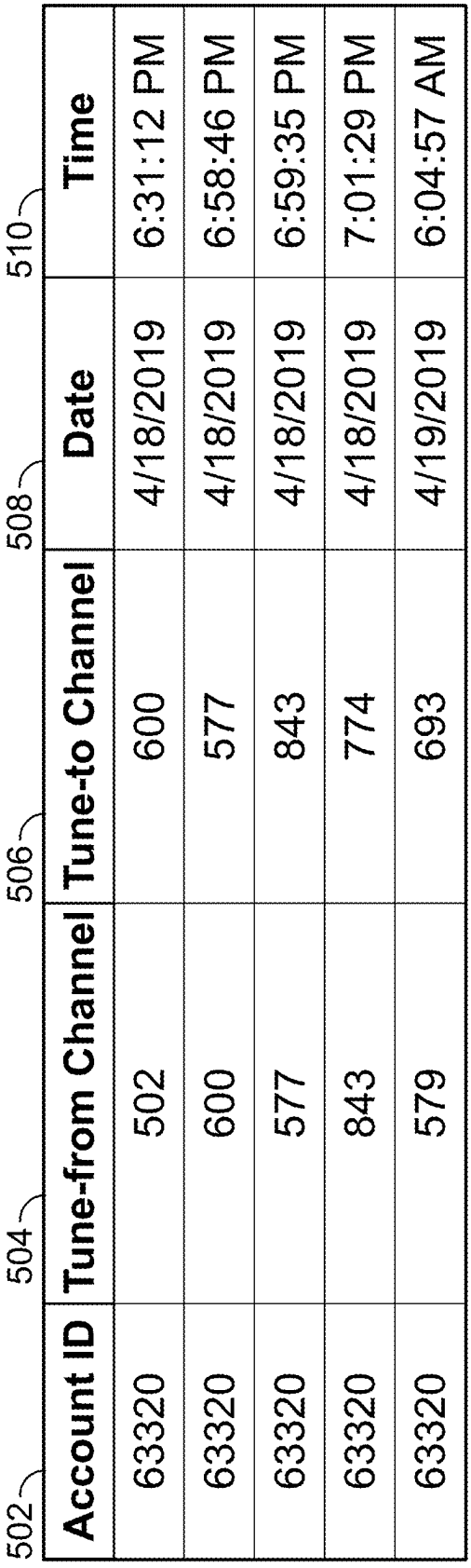

500
502
504
506
508
510
Account ID
Tune-from Channel
Tune-to Channel
Date
Time
63320 502 600 4/18/2019 6:31:12 PM
63320 600 577 4/18/2019 6:58:46 PM
63320 577 843 4/18/2019 6:59:35 PM
63320 843 774 4/18/2019 7:01:29 PM
63320 579 693 4/19/2019 6:04:57 AM

FIG. 5

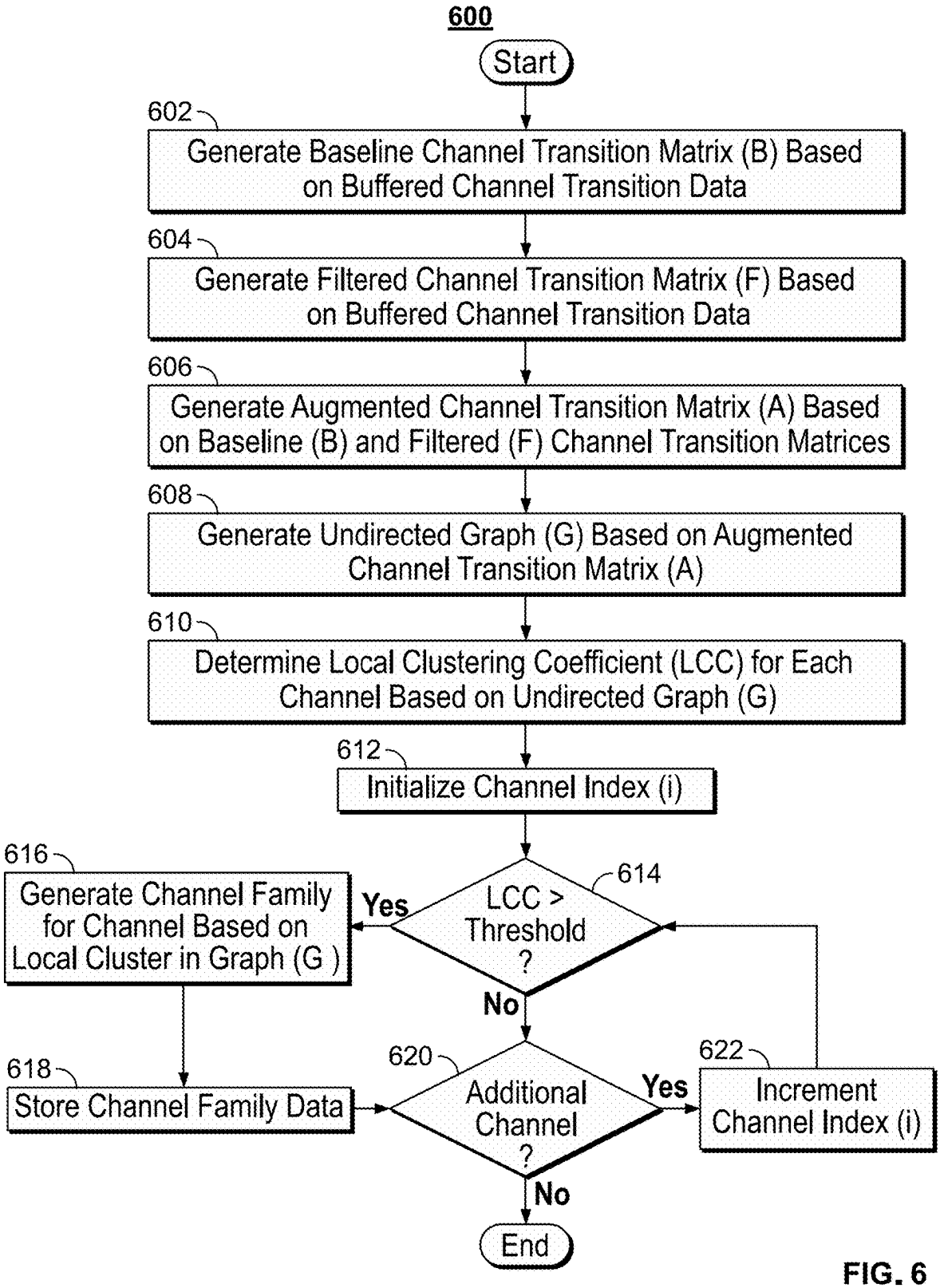

600
Start
602
Generate Baseline Channel Transition Matrix (B) Based on Buffered Channel Transition Data
604
Generate Filtered Channel Transition Matrix (F) Based on Buffered Channel Transition Data
606
Generate Augmented Channel Transition Matrix (A) Based on Baseline (B) and Filtered (F) Channel Transition Matrices
608
Generate Undirected Graph (G) Based on Augmented Channel Transition Matrix (A)
610
Determine Local Clustering Coefficient (LCC) for Each Channel Based on Undirected Graph (G)
612
Initialize Channel Index (i)
614
LCC > Threshold ?
Yes
616
Generate Channel Family for Channel Based on Local Cluster in Graph (G)
No
618
Store Channel Family Data
620
Additional Channel ?
Yes
622
Increment Channel Index (i)
No
End

FIG. 6

700

Tune-from Channel \ Tune-to Channel	1	2	3	4	5
1	-	B_{12}	B_{13}	B_{14}	B_{15}
2	B_{21}	-	B_{23}	B_{24}	B_{25}
3	B_{31}	B_{32}	-	B_{34}	B_{35}
4	B_{41}	B_{42}	B_{43}	-	B_{44}
5	B_{51}	B_{52}	B_{53}	B_{54}	-

702 704 706 706 706

FIG. 7

800

Tune-from Channel (Within Day/Time Frame) \ Tune-to Channel (Within Day/Time Frame)	1	2	3	4	5
1	-	F_{12}	F_{13}	F_{14}	F_{15}
2	F_{21}	-	F_{23}	F_{24}	F_{25}
3	F_{31}	F_{32}	-	F_{34}	F_{35}
4	F_{41}	F_{42}	F_{43}	-	F_{44}
5	F_{51}	F_{52}	F_{53}	F_{54}	-

802 804 806 806 806

FIG. 8

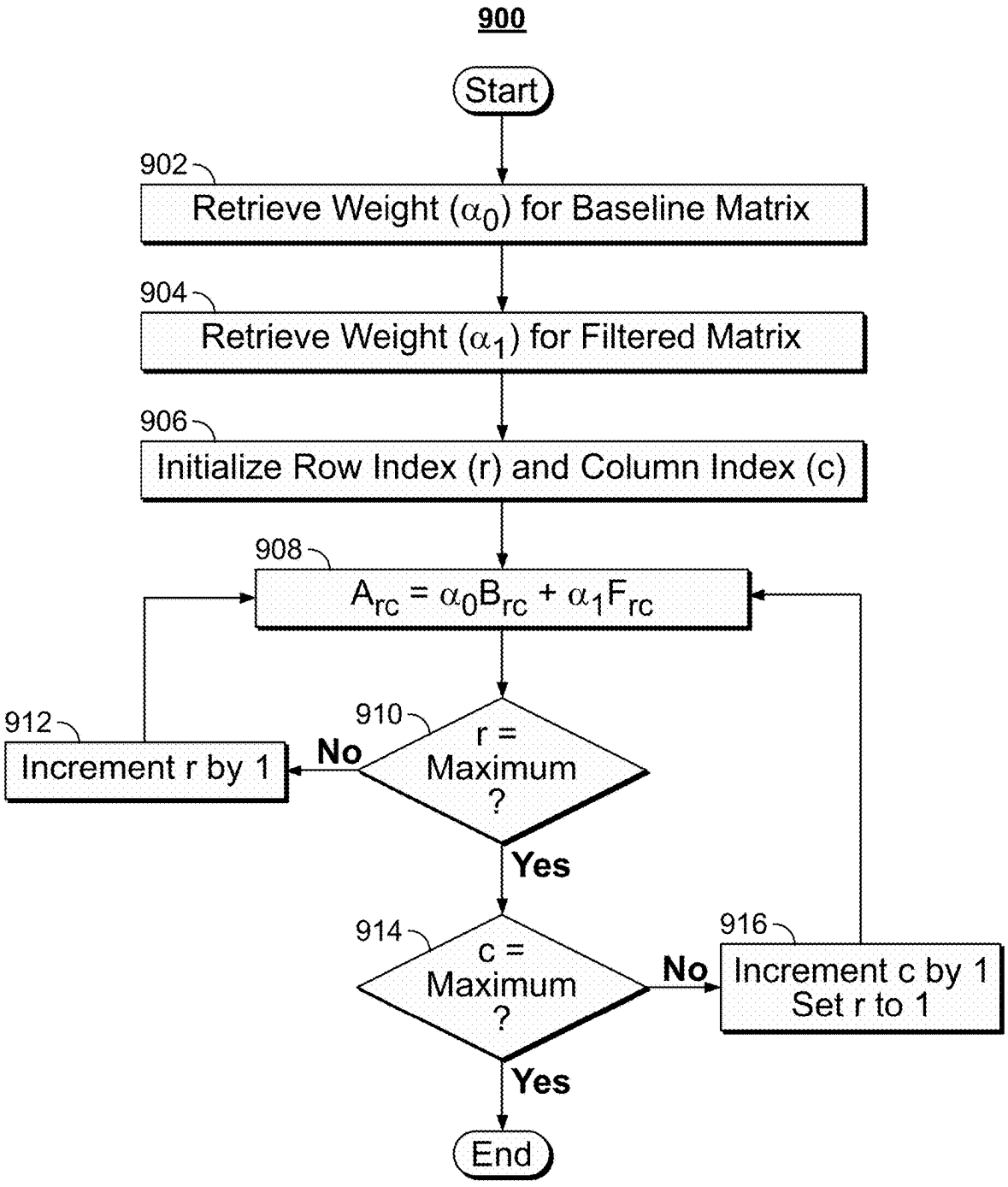

900
Start
902
Retrieve Weight (α_0) for Baseline Matrix
904
Retrieve Weight (α_1) for Filtered Matrix
906
Initialize Row Index (r) and Column Index (c)
908
$A_{rc} = \alpha_0 B_{rc} + \alpha_1 F_{rc}$
910
r = Maximum ?
No
912
Increment r by 1
Yes
914
c = Maximum ?
No
916
Increment c by 1
Set r to 1
Yes
End

FIG. 9

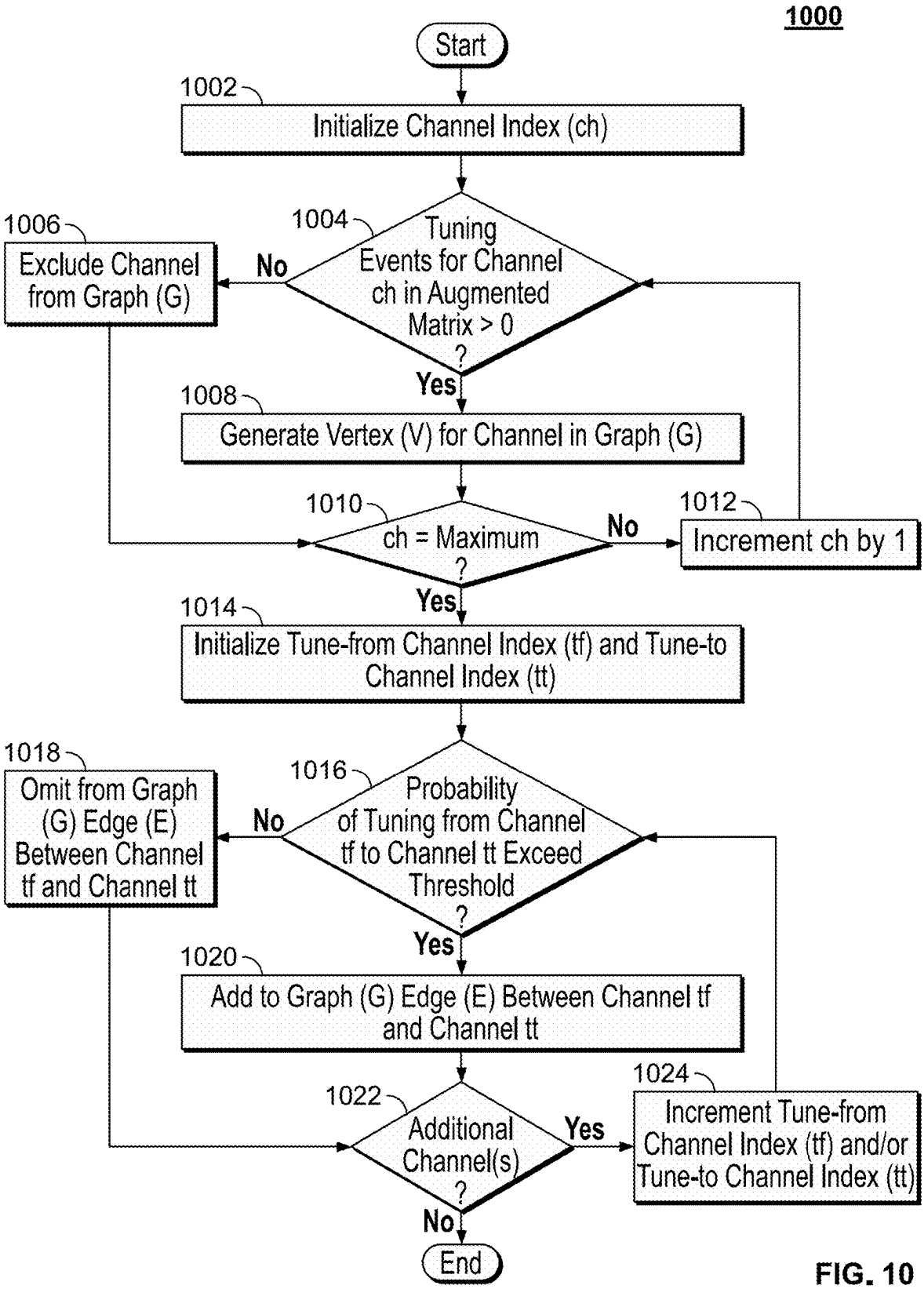

1000
Start
1002
Initialize Channel Index (ch)
1004
Tuning Events for Channel ch in Augmented Matrix > 0 ?
No
1006
Exclude Channel from Graph (G)
Yes
1008
Generate Vertex (V) for Channel in Graph (G)
1010
ch = Maximum ?
No
1012
Increment ch by 1
Yes
1014
Initialize Tune-from Channel Index (tf) and Tune-to Channel Index (tt)
1016
Probability of Tuning from Channel tf to Channel tt Exceed Threshold ?
No
1018
Omit from Graph (G) Edge (E) Between Channel tf and Channel tt
Yes
1020
Add to Graph (G) Edge (E) Between Channel tf and Channel tt
1022
Additional Channel(s) ?
Yes
1024
Increment Tune-from Channel Index (tf) and/or Tune-to Channel Index (tt)
No
End

FIG. 10

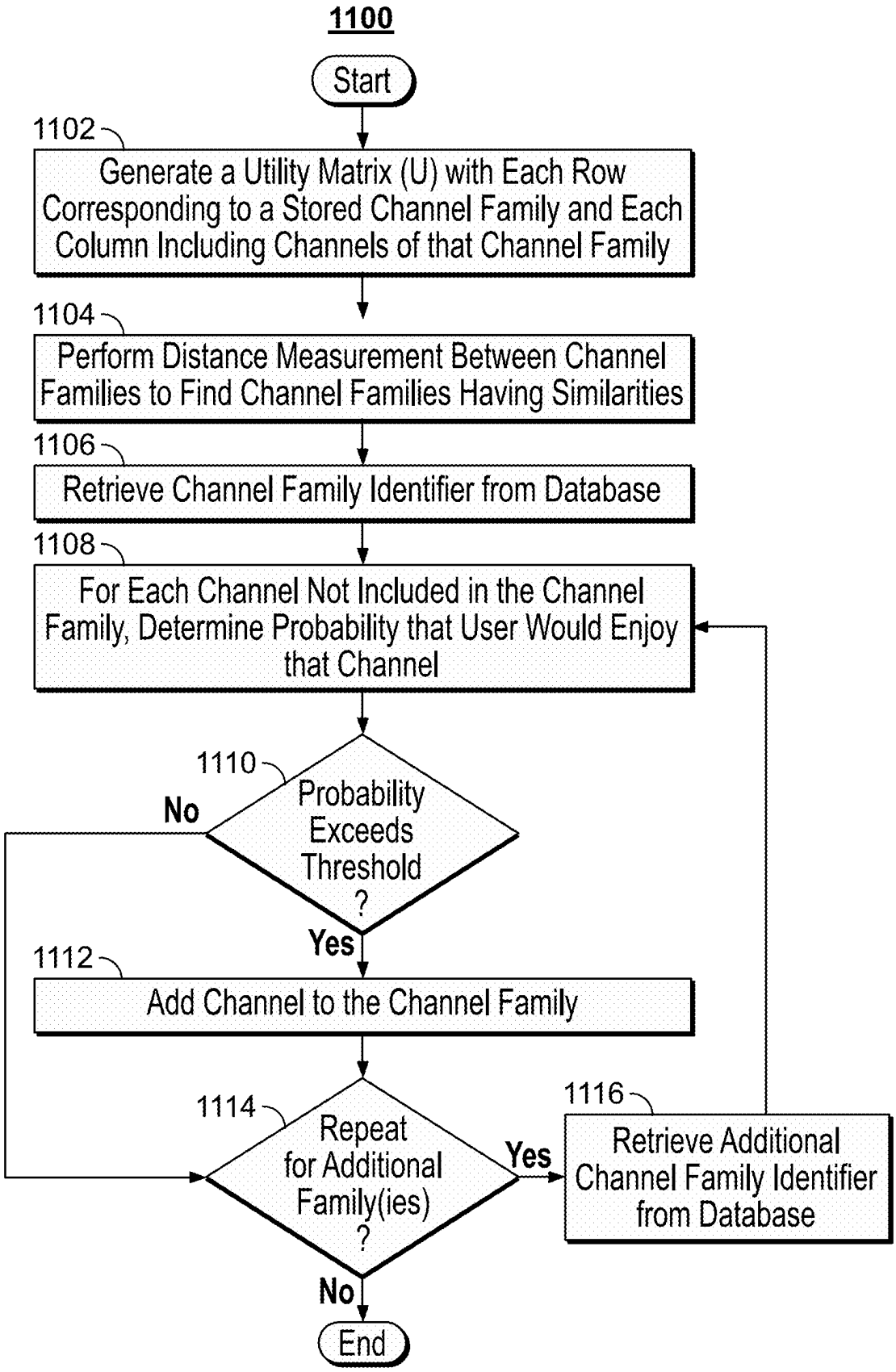

1100
Start
1102
Generate a Utility Matrix (U) with Each Row Corresponding to a Stored Channel Family and Each Column Including Channels of that Channel Family
1104
Perform Distance Measurement Between Channel Families to Find Channel Families Having Similarities
1106
Retrieve Channel Family Identifier from Database
1108
For Each Channel Not Included in the Channel Family, Determine Probability that User Would Enjoy that Channel
1110
Probability Exceeds Threshold ?
No
Yes
1112
Add Channel to the Channel Family
1114
Repeat for Additional Family(ies) ?
Yes
1116
Retrieve Additional Channel Family Identifier from Database
No
End

FIG. 11

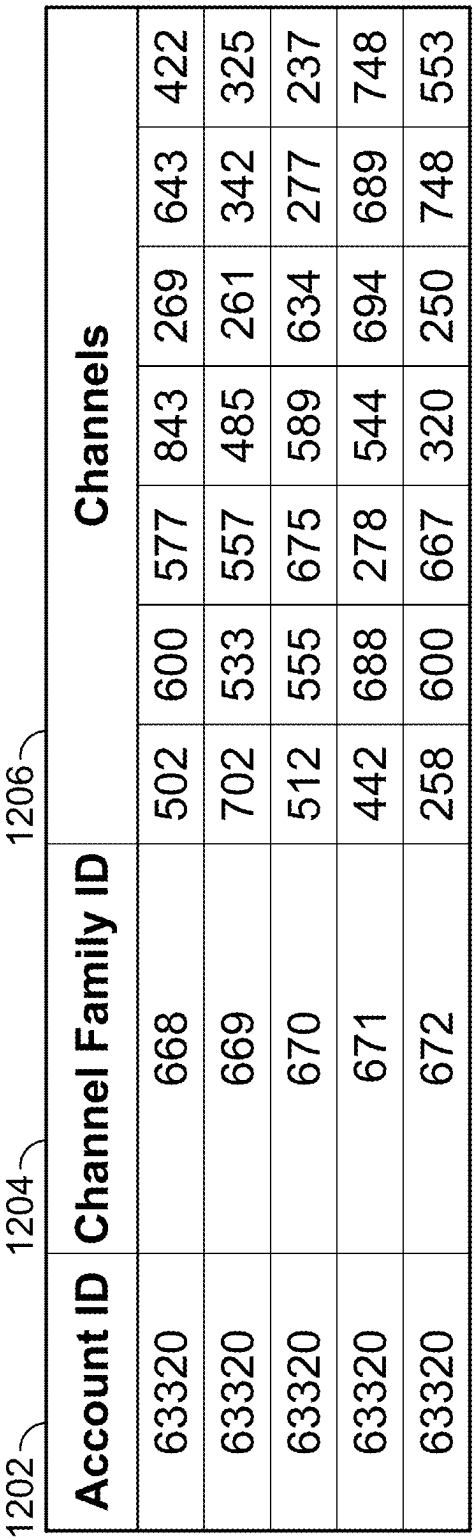

1200
1202
1204
1206
Account ID
Channel Family ID
Channels
63320 668 502 600 577 843 269 643 422
63320 669 702 533 557 485 261 342 325
63320 670 512 555 675 589 634 277 237
63320 671 442 688 278 544 694 689 748
63320 672 258 600 667 320 250 748 553

FIG. 12

ADAPTIVE ON-SCREEN GUIDE BASED ON CHANNEL OR CONTENT TRANSITION COMMANDS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This patent application a continuation of U.S. patent application Ser. No. 18/425,125, filed Jan. 29, 2024, which is a continuation of U.S. patent application Ser. No. 17/731,552, filed Apr. 28, 2022, now U.S. Pat. No. 11,924,517, which is a continuation of U.S. patent application Ser. No. 16/427,674, filed May 31, 2019, now U.S. Pat. No. 11,350,176, which are hereby incorporated by reference herein in their entireties.

BACKGROUND

[0002] The present disclosure relates to on-screen content guides and, more particularly, to systems and related processes for generating sequences of channels and/or content items for display via an abbreviated on-screen guide based on previously entered content and/or channel transition commands.

SUMMARY

[0003] A full-screen content guide typically provides detailed information about a linear content schedule, such as details about currently airing and upcoming shows, and provides for user-friendly navigation throughout a channel lineup. A full-screen content guide is thus suitable for browsing through the channel lineup for something new to watch when a user is uninterested in the currently displayed content. A full-screen content guide, however, often dominates the available area of a display. Accordingly, the user may desire an alternative to a full-screen content guide when the user wishes to browse guide content without significantly interrupting the viewing experience.

[0004] One alternative to a full-screen content guide is an abbreviated on-screen content guide. An abbreviated on-screen content guide, sometimes referred to as a one-line guide, enables a user to view a relatively small sampling of linear guide data (such as what's on next) while minimizing interruption of the viewing experience. Abbreviated guides provide a non-intrusive "what's on/what's next" discovery mechanism for linear content. Conventional abbreviated guides, however, merely provide a limited view of the full-screen guide with a more constrained navigation experience. That is, a typical abbreviated guide merely displays the same data used by a full-screen guide, only in a different viewing format. For example, an abbreviated guide may display guide data for a current channel and enable the user to navigate one channel at a time in either direction in a channel lineup. An abbreviated guide can therefore create a cumbersome user experience when navigating across many channels, particularly since a user's favorite channels are often spaced a considerable distance apart in a channel lineup. The suitability of abbreviated guides is thus limited to merely indicating "what's on/what's next" for the current channel and other channels immediately before or after it in the channel lineup. For example, if a user is watching ESPN, the abbreviated guide may be helpful to browse upcoming programs on ESPN, ESPN2, ESPNEWS, and ESPN Classic, but unhelpful for scrolling through to movie channels or local channels, which are typically much farther away in the channel lineup.

[0005] One approach to overcoming the navigational challenges of a conventional abbreviated guide is to enable each user to create a list of their favorite channels. Such a favorite channels list is typically applied as a filter to an abbreviated guide to restrict the list of available channels to only those the user has pre-selected as favorites. For instance, a user may enter a menu screen to create a new favorite channels list and then scroll through the channel lineup to select the individual channels as favorites. Since there are often multiple users per household, a content provider account for the household may include several favorites lists. In such cases, each user repeats this exercise to create their favorite channels list and/or to update their favorite channels list when the channel lineup changes or when new programming causes a change in user preference toward particular channels. To make use of their favorite channels list, each user selects an option in the abbreviated guide to enable their favorite channels list. Favorite channels lists thus can be tedious to create and manage, and also tend not to account for variances in user mood or combinations of users. Further, once favorite channels are set, barring manual updates of a favorite channels list by a user, the list may not promote discovery of new channels or programs that may be of interest.

[0006] In addition, manually created favorite channels lists tend to be relatively large, since they tend to encompass all of the various moods and habits of the user. For example, a user who enjoys watching college football, sitcom re-runs from a particular decade, and new movies might include in their favorite channels list numerous sports channels, channels that host syndicated shows, and premium movie channels. In such an instance, for example, if the user wants to utilize an abbreviated guide to navigate through channels to browse college football games available on a Saturday afternoon, the user may be required to scroll through a large number of channels not of interest to the user at that time, even with the user's favorite channels list employed. One alternative involves creating even more favorites lists or sub-lists for the user to fine-tune channel lineups, but that becomes even more tedious for the user to create, manage, select, and utilize.

[0007] In view of the foregoing, the present disclosure provides systems and related methods that can predict which channels will be likely targets for a channel tune given past user behavior, current channel viewing activities and popularity, thus providing a way to adapt a channel lineup in a one-line guide to include only the most relevant linear content for the current user. The systems and methods described herein avoid the need to manually add channels to a favorites list and then manually select and enable the favorites list via an on-screen guide. In some aspects, the systems and methods described herein can also infer a user's mood and/or a particular combination of users viewing content together, learn channel groupings based on user mood and/or user combination, and adaptively enable a channel list appropriate based on user mood and/or user combination. In yet another aspect, the systems and methods described herein also constrain processing, memory, and storage requirements to allow for distributed implementation on client devices themselves.

[0008] In one example, the present disclosure provides a system for generating a channel sequence for display via an abbreviated on-screen guide. The system comprises a communication port, a memory, and control circuitry. The communication port is configured to receive channel tuning commands entered via a user interface. The memory is configured to store, in a buffer, channel tuning data describing channel transitions caused by the channel tuning commands. In some examples, the channel tuning data comprises, for each of the received channel tuning commands, a tune-from channel identifier, a tune-to channel identifier, and at least one of a transition date identifier or a transition time identifier. Based on the channel tuning data, the control circuitry is configured to generate a channel family comprising a plurality of channels. A determination is then made as to whether a currently tuned channel is included in the channel family. The control circuitry, for instance, may determine whether the currently tuned channel is included in the channel family by obtaining an identifier of the currently tuned channel, retrieving identifiers of the plurality of channels from the memory, and determining whether the identifiers of the plurality of channels of the channel family include the currently tuned channel identifier. In response to determining that the currently tuned channel is included in the channel family, an on-screen guide, which comprises an abbreviated channel listing of the plurality of channels of the channel family, is generated for display.

[0009] In various aspects, based on the channel tuning data, the control circuitry is configured to generate a channel transition matrix that is used as a basis for generating the channel family. Each entry of the channel transition matrix indicates a respective number of channel transitions from a first channel to a second channel caused by the channel tuning commands.

[0010] In another example, the control circuitry is configured to generate a filtered channel transition matrix that is used as a basis for generating the channel family. For instance, the control circuitry may determine a current day of the week and/or a current time and then filter the stored channel tuning data to include only channel tuning data for channel tuning commands received on a day or at a time within a degree of proximity to the current day of the week and/or the current time. The control circuitry can then generate a filtered channel transition matrix based on the filtered channel tuning data, with each entry of the filtered channel transition matrix indicating a respective number of channel transitions from a first channel to a second channel caused by the channel tuning commands for the filtered channel tuning data. In this manner, a channel family can be adaptively tailored to a user's viewing habits during similar days and/or times, thus improving the relevance or quality of channel family groupings.

[0011] In a further aspect, the control circuitry is configured to generate a baseline channel transition matrix based on the channel tuning data, with each entry of the baseline channel transition matrix indicating a respective number of channel transitions from a first channel to a second channel caused by the channel tuning commands. The control circuitry then determines a current day (e.g., day of the week) and/or a current time and filters the channel tuning data to include only channel tuning data for channel tuning commands received at a day or time within a degree of proximity to the current day of the week and/or current time. The control circuitry then generates a filtered channel transition matrix based on the filtered channel tuning data. Each entry of the filtered channel transition matrix indicates a respective number of channel transitions from the first channel to the second channel caused by the channel tuning commands for the filtered channel tuning data. The control circuitry then generates an augmented channel transition matrix based on a weighted combination of the baseline channel transition matrix and the filtered channel transition matrix. The channel family is then generated based on the augmented channel transition matrix.

[0012] In some examples, the control circuitry is further configured to generate, based on the augmented channel transition matrix, an undirected graph comprising channel vertices and channel transition edges, and to compute local clustering coefficients for each of the channel vertices. A respective channel family is then generated for each of the channel vertices based on the local clustering coefficients. The channel vertices correspond to channels in a channel lineup and the channel transition edges correspond to the channel transitions caused by the channel tuning commands. The control circuitry, in some instances, is configured to compare the local clustering coefficient to a threshold to determine whether the local clustering coefficient exceeds the threshold and generate the channel family in response to a determination that the local clustering coefficient exceeds the threshold.

[0013] In yet another example, the control circuitry is further configured to add a channel to the channel family based on collaborative filtering of additional channel families generated based on channel tuning data from other devices. In this manner, channel families may be augmented using a backend server, for instance, to promote discovery of additional channels and/or content that may be of interest to the user, based on channels and/or content of interest to other users having exhibited interest in similar channels and/or content.

[0014] In accordance with another aspect, the present disclosure provides systems and related methods for generating a sequence of content items, content categories, content genres, and/or any other type of content identifier for display via an abbreviated on-screen guide. One such system, for example, includes a communication port, a memory, and control circuitry. The communication port is configured to receive content selection commands entered via a user interface. The memory is configured to store, in a buffer, transition data describing content item playback transitions caused by the content selection commands. In some examples, the transition data comprises, for each of the content selection commands, a transition-from content identifier, a transition-to content identifier, and at least one of a transition date identifier or a transition time identifier. Based on the transition data, the control circuitry is configured to generate a content family comprising a plurality of content items. A determination is then made as to whether a content item currently being played back is included in the content family. The control circuitry may determine whether the currently played-back content item is included in the content family, for example, by obtaining an identifier of the currently played-back content item; retrieving, from a memory, identifiers of the plurality of content items; and determining whether the identifiers of the plurality of content items of the content family include the currently played-back content item identifier. In response to determining that the currently played-back content item is included in the content family,

an on-screen guide, which comprises an abbreviated content item listing of the plurality of content items of the content family, is generated for display.

[0015] In various aspects, the control circuitry is further configured to generate a transition matrix based on the transition data, with each entry of the transition matrix indicating a respective number of transitions from a first content item to a second content item caused by the content selection commands. In such aspects, the content family may be generated based on the transition matrix.

[0016] In another example, the control circuitry is further configured to generate a filtered transition matrix to be used as a basis for generating the content family. For instance, the control circuitry may determine a current day of the week and/or a current time of day and then filter the transition data to include only transition data for content selection commands received at a day or time within a degree of proximity to the current day of the week and/or current time. The control circuitry then generates a filtered transition matrix based on the filtered transition data, with each entry of the filtered transition matrix indicating a respective number of transitions from a first content item to a second content item caused by the content selection commands for the filtered transition data. The content family is generated based on the filtered transition matrix.

[0017] In a further aspect, the control circuitry is configured to generate a baseline transition matrix based on the transition data, with each entry of the baseline transition matrix indicating a respective number of transitions from a first content item to a second content item caused by the content selection commands. The control circuitry determines a current day of the week and/or a current time of day and filters the transition data to include only transition data for content selection commands received at a day or time within a degree of proximity to the current day or current time. The control circuitry then generates a filtered transition matrix based on the filtered transition data, with each entry of the filtered transition matrix indicating a respective number of transitions from the first content to the second content caused by the content selection commands for the filtered transition data. The control circuitry then generates an augmented transition matrix based on a weighted combination of the baseline transition matrix and the filtered transition matrix. The content family is generated based on the augmented transition matrix.

[0018] In some examples, based on the augmented transition matrix, the control circuitry is configured to generate an undirected graph comprising content vertices and content transition edges. The channel vertices correspond to channels in a channel lineup and the channel transition edges correspond to the channel transitions caused by the channel tuning commands. A local clustering coefficient, in some aspects, is computed for a content vertex from among the content vertices and the content family is generated for the content vertex based on the local clustering coefficient. For instance, the control circuitry may compare the local clustering coefficient to a threshold to determine whether the local clustering coefficient exceeds the threshold. In response to a determination that the local clustering coefficient exceeds the threshold, the content family is generated for that channel.

[0019] In yet a further aspect, the control circuitry is further configured to add a content item to the content family based on collaborative filtering of a plurality of additional content families generated based on content selection data from other devices. In this manner, families may be augmented to promote discovery of additional channels and/or content that may be of interest to the user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The above and other objects and advantages of the disclosure will be apparent upon consideration of the following detailed description, taken in conjunction with the accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

[0021] FIG. **1** shows an illustrative block diagram of a system for generating a sequence of channels for display via an abbreviated on-screen guide, in accordance with some embodiments of the disclosure;

[0022] FIG. **2** shows an illustrative block diagram of a system for generating a sequence of content items for display via an abbreviated on-screen guide, in accordance with some embodiments of the disclosure;

[0023] FIG. **3** is an illustrative block diagram showing additional details of the systems of FIG. **1** and/or FIG. **2**, in accordance with some embodiments of the disclosure;

[0024] FIG. **4** depicts illustrative flowcharts of processes for generating channel tuning data and/or content selection data, generating a sequence of channels and/or content items, and displaying such a sequence via an abbreviated on-screen guide, in accordance with some embodiments of the disclosure;

[0025] FIG. **5** depicts an example data structure for channel tuning data, in accordance with some embodiments of the disclosure;

[0026] FIG. **6** depicts an illustrative flowchart of a process for generating a channel family based on channel tuning data, in accordance with some embodiments of the disclosure;

[0027] FIG. **7** depicts an example baseline channel transition matrix, in accordance with some embodiments of the disclosure;

[0028] FIG. **8** depicts an example filtered channel transition matrix, in accordance with some embodiments of the disclosure;

[0029] FIG. **9** depicts an illustrative flowchart of a process for generating an augmented channel matrix based on baseline and filtered channel transition matrices, in accordance with some embodiments of the disclosure;

[0030] FIG. **10** depicts an illustrative flowchart of a process for generating an undirected graph based on an augmented channel transition matrix, in accordance with some embodiments of the disclosure;

[0031] FIG. **11** depicts an illustrative flowchart of a process for augmenting a channel family based on collaborative filtering, in accordance with some embodiments of the disclosure; and

[0032] FIG. **12** depicts an example data structure for channel family data, in accordance with some embodiments of the disclosure.

DETAILED DESCRIPTION

[0033] FIG. **1** shows an illustrative block diagram of system **100** for generating a sequence of channels for display via an abbreviated on-screen guide, in accordance with some embodiments of the disclosure. Although FIG. **1** shows system **100** as including a number and configuration of

individual components, in some embodiments, any number of the components of system **100** may be combined and/or integrated as one device. System **100** includes set-top box **102**, display **104**, server **106**, communication network **108**, remote control **110**, one or more additional set-top boxes **112**, media content source **114**, and media guidance data source **116**. Set-top box **102** is communicatively coupled to display **104** by way of communication paths, such as video signal paths. Communication network **108** communicatively couples various components of system **100** to one another. For instance, set-top box **102** is also communicatively coupled to server **106**, communication network **108**, remote control **110**, one or more additional set-top boxes **112**, media content source **114**, and/or media guidance data source **116**, by way of communication network **108**. Communication network **108** may be any type of communication network, such as the Internet, a mobile phone network, mobile voice or data network (e.g., a 4G or LTE network), cable network, public switched telephone network, or any combination of two or more of such communication networks. Communication network **108** includes one or more communication paths, such as a satellite path, a fiber-optic path, a cable path, a path that supports Internet communications (e.g., IPTV), free-space connections (e.g., for broadcast or other wireless signals), or any other suitable wired or wireless communication path or combination of such paths.

[0034] Set-top box **102** includes tuner **118**, channel transition data buffer **120**, channel family generator **122**, channel family database **124**, and guide generator **126**. Tuner **118** is configured to receive channel tuning commands entered via remote control **110** and, in response to receiving the channel tuning commands, cause a channel transition from one channel (e.g., a tuned-from channel) to another channel (e.g., a tuned-to channel) of content provided to tuner **118** by server **106** and/or media content source **114** over communication network **108**. Tuner **118** provides content of a currently tuned channel to display **104** for presentation. Tuner **118** is also configured to store channel transition data (sometimes referred to as channel tuning data), which describes such channel tuning events, in channel transition data buffer **120**. In some aspects, channel transition data buffer **120** may be a first-in-first-out (FIFO) type of buffer that purges or overwrites channel transition data that is older than a fixed or configurable threshold, such as a date threshold and/or a time threshold. In this manner, channel transition data buffer **120** may avoid storing and relying upon data that is out-of-date or otherwise stale. An example data structure **500** for channel transition data is described below in connection with FIG. **5**. In some examples, the channel tuning data comprises, for each of the channel tuning commands, an account identifier **502** that identifies a user account for which the channel tuning command was received, a tune-from channel identifier **504**, a tune-to channel identifier **506**, a transition date identifier **508**, and/or a transition time identifier **510**.

[0035] Based on channel transition data stored in channel transition data buffer **120**, channel family generator **122** is configured to generate one or more channel families, with each channel family including specific channels of a channel lineup that, based on the channel transition data, is deemed likely to be of interest to a particular user (e.g., a user associated with the user account under which the channel transition commands were entered via remote control **110**). Channel family generator **122** generates channel family data that describes each generated channel family, for instance, listing the particular channels that are included in each channel family. An example channel family data structure **1200** is described in further detail below in connection with FIG. **12**. Channel family generator **122** stores the generated channel family data in channel family database **124**. Guide generator **126** is configured to receive an identifier of a currently tuned channel from tuner **118** and, based on the currently tuned channel and based on a channel family stored in channel family database **124** for that channel, generate, for display via an abbreviated on-screen guide on display **104**, a navigable listing or sequence of channels and corresponding channel guide data obtained from media guidance data source **116**. Channel families generated in the above-noted manner thus become the basis for populating the abbreviated on-screen guide. When a user is tuned to a member of a given channel family, the abbreviated on-screen guide provides discovery for other channels in that family to which the user is likely to tune. When a new user comes into play, the user's mood changes, or the combination of users who are viewing content changes, and the user changes to a channel in a different channel family, the abbreviated on-screen guide adapts and provides discovery for the channels in the new family. Additional details regarding the features and functionality of system **100** are provided below.

[0036] FIG. **2** shows an illustrative block diagram of system **200** for generating a sequence of content items for display via an abbreviated on-screen guide, in accordance with some embodiments of the disclosure. Although FIG. **2** shows system **200** as including a number and configuration of individual components, in some embodiments, any number of the components of system **200** may be combined and/or integrated as one device. In various aspects, system **200** includes some components similar to those described above in connection with system **100**, and so a description of such components and/or their functionality is not repeated here. In particular, system **200** includes server **204**, media content source **206**, media guidance data source **208**, and communication network **210**, which may correspond to, and have similar features or functionality as, server **106**, media content source **114**, media guidance data source **116**, and communication network **108**, respectively, of system **100**. Instead of set-top box **102**, remote control **110**, and additional set-top boxes **112**, however, system **200** includes computing device **202** and additional computing devices **212**. Computing device **202** may be a smartphone, a tablet, a laptop computer, a desktop computer, a smart TV, or any type of computing device that has a user interface and a display and is configured to receive and visibly and/or audibly present items of content.

[0037] In some aspects, computing device **202** operates in a manner similar to that described above for set-top box **102**, except instead of receiving channel selections entered via a remote control, and using a tuner to tune channels of content provided to computing device **202** by server **204** and/or media content source **206** via communication network **210**, computing device **202** receives content item (or channel) selections entered via a user interface (e.g., a touchscreen, a microphone, or the like), and requests the selected content item for downloading and/or streaming from server **204** and/or media content source **206** over communication network **210**. More specifically, computing device **202** includes content provider interface **214**, transition data buffer **216**,

family generator **218**, display **220**, user interface **222**, family database **224**, and guide generator **226**. User interface **222** may be a touchscreen, a computer mouse, a microphone, and/or any other type of user interface that enables a user to input content selections or other types of selections. Content provider interface **214** is configured to receive content selection commands (and/or category selection commands, genre selection commands, or any other type of selection commands) entered via user interface **222** and, in response to receiving the content selection commands, cause a transition from one content item (e.g., a tuned-from content item) to another content item (e.g., a tuned-to content item) provided to content provider interface **214** by server **204** and/or media content source **206** over communication network **210**. Content provider interface **214** also provides currently selected content to display **220** for presentation. Content provider interface **214** is also configured to forward transition data, which describes such content selection events, for storage in transition data buffer **216**. In some aspects, transition data buffer **216** may be a FIFO type of buffer that purges or overwrites transition data that is older than a fixed or configurable threshold, such as a date threshold and/or a time threshold. In this manner, transition data buffer **216** may avoid storing and relying upon data that is out-of-date or otherwise stale.

[0038] Based on transition data stored in transition data buffer **216**, family generator **218** is configured to generate one or more families of content, content categories, and/or the like, with each family including specific items of content, items of content of specific categories, and/or the like, that, based on the transition data, are deemed likely to be of interest to a particular user (e.g., a user associated with the user account under which the transition commands were entered via user interface **222**). Family generator **218** generates family data that describes each generated family, for instance, listing the particular content items, content item categories, and/or the like that are included in each family. Family generator **218** stores the generated channel data in family database **224**. Guide generator **226** is configured to receive an identifier of a currently selected content item from content provider interface **214** and, based on the currently selected content item and based on a family stored in family database **224** for that content item, generate, for display via an abbreviated on-screen guide on display **220**, a navigable listing or sequence of content and corresponding guide data obtained from media guidance data source **208**. Additional details regarding the features and functionality of system **200** are provided below.

[0039] FIG. **3** is an illustrative block diagram showing additional details of systems **100** and/or **200**, of FIG. **1** and/or FIG. **2**, respectively, in accordance with some embodiments of the disclosure. In various embodiments, system **300** includes some components described above in connection with system **100** and/or system **200**. For instance, in some aspects, server **302**, media content source **306**, media guidance data source **308**, communication network **310**, and/or computing device **304** of system **300** further represent server **106**, media content source **114**, media guidance data source **116**, communication network **108**, and/or set-top box **102**, respectively, of system **100**. Likewise, in other aspects, server **302**, media content source **306**, media guidance data source **308**, communication network **310**, and/or computing device **304** of system **300** further represent server **204**, media content source **206**, media guidance data source **208**, communication network **210**, and/or computing device **202** of system **200**. Additionally, in various embodiments, components of set-top box **102** (e.g., tuner **118**, channel transition data buffer **120**, channel family generator **122**, channel family database **124**, guide generator **126**) are implemented by one or more components of computing device **304**, such as processing circuitry **324** and/or storage **322** of control circuitry **320**. Likewise, components of computing device **202**, in some examples, are implemented by one or more components of computing device **304**, such as processing circuitry **324** and/or storage **322** of control circuitry **320**. Although FIG. **3** shows certain numbers of components, in various examples, system **300** may include fewer than the illustrated components and/or multiples of one or more illustrated components.

[0040] Server **302** includes control circuitry **312** and I/O path **318**, and control circuitry **312** includes storage **314** and processing circuitry **316**. Computing device **304** includes control circuitry **320**, **1**/O path **326**, speaker **328**, display **330**, and user input interface **332**. Control circuitry **320** includes storage **322** and processing circuitry **324**. Control circuitry **312** and/or **320** may be based on any suitable processing circuitry such as processing circuitry **316** and/or **324**. As referred to herein, processing circuitry should be understood to mean circuitry based on one or more microprocessors, microcontrollers, digital signal processors, programmable logic devices, field-programmable gate arrays (FPGAs), application-specific integrated circuits (ASICs), etc., and may include a multi-core processor (e.g., dual-core, quad-core, hexa-core, or any suitable number of cores). In some embodiments, processing circuitry may be distributed across multiple separate processors, for example, multiple of the same type of processors (e.g., two Intel Core i9 processors) or multiple different processors (e.g., an Intel Core i7 processor and an Intel Core i9 processor).

[0041] Each of storage **314**, storage **322**, and/or storages of other components of system **300** (e.g., storages of media content source **306**, media guidance data source **308**, and/or the like) may be an electronic storage device. As referred to herein, the phrase "electronic storage device" or "storage device" should be understood to mean any device for storing electronic data, computer software, or firmware, such as random-access memory, read-only memory, hard drives, optical drives, digital video disc (DVD) recorders, compact disc (CD) recorders, BLU-RAY disc (BD) recorders, BLU-RAY 3D disc recorders, digital video recorders (DVRs, sometimes called personal video recorders, or PVRs), solid state devices, quantum storage devices, gaming consoles, gaming media, or any other suitable fixed or removable storage devices, and/or any combination of the same. Each of storage **314**, storage **322**, and/or storages of other components of system **300** may be used to store various types of content, metadata, media guidance data, and or other types of data. Non-volatile memory may also be used (e.g., to launch a boot-up routine and other instructions). Cloud-based storage may be used to supplement storages **314**, **322** or instead of storages **314**, **322**. In some embodiments, control circuitry **312** and/or **320** executes instructions for an application stored in memory (e.g., storage **314** and/or **322**). Specifically, control circuitry **312** and/or **320** may be instructed by the application to perform the functions discussed herein. In some implementations, any action performed by control circuitry **312** and/or **320** may be based on

instructions received from the application. For example, the application may be implemented as software or a set of executable instructions that may be stored in storage **314** and/or **322** and executed by control circuitry **312** and/or **320**. In some embodiments, the application may be a client/server application where only a client application resides on computing device **304**, and a server application resides on server **302**.

[0042] The application may be implemented using any suitable architecture. For example, it may be a stand-alone application wholly implemented on computing device **304**. In such an approach, instructions for the application are stored locally (e.g., in storage **322**), and data for use by the application is downloaded on a periodic basis (e.g., from an out-of-band feed, from an Internet resource, or using another suitable approach). Control circuitry **320** may retrieve instructions for the application from storage **322** and process the instructions to perform the functionality described herein. Based on the processed instructions, control circuitry **320** may determine what action to perform when input is received from user input interface **332**.

[0043] In client/server-based embodiments, control circuitry **320** may include communication circuitry suitable for communicating with an application server (e.g., server **302**) or other networks or servers. The instructions for carrying out the functionality described herein may be stored on the application server. Communication circuitry may include a cable modem, an integrated services digital network (ISDN) modem, a digital subscriber line (DSL) modem, a telephone modem, an Ethernet card, or a wireless modem for communication with other equipment, or any other suitable communication circuitry. Such communication may involve the Internet or any other suitable communication networks or paths (e.g., communication network **310**). In another example of a client/server-based application, control circuitry **320** runs a web browser that interprets web pages provided by a remote server (e.g., server **302**). For example, the remote server may store the instructions for the application in a storage device. The remote server may process the stored instructions using circuitry (e.g., control circuitry **312**) and generate the displays discussed herein. Computing device **304** may receive the displays generated by the remote server and may display the content of the displays locally via display **330**. This way, the processing of the instructions is performed remotely (e.g., by server **302**) while the resulting displays, such as the display windows described elsewhere herein, are provided locally on computing device **304**. Computing device **304** may receive inputs from the user via input interface **332** and transmit those inputs to the remote server for processing and generating the corresponding displays.

[0044] A user may send instructions to control circuitry **312** and/or **320** using user input interface **332**. User input interface **332** may be any suitable user interface, such as a remote control, trackball, keypad, keyboard, touchscreen, touchpad, stylus input, joystick, voice recognition interface, a gaming controller, or other user input interfaces. User input interface **332** may be integrated with or combined with display **330**, which may be a monitor, a television, a liquid crystal display (LCD), electronic ink display, or any other equipment suitable for displaying visual images.

[0045] Server **302** and computing device **304** may receive content and data via input/output (hereinafter "I/O") path **318** and **326**, respectively. For instance, I/O path **318** may include a communication port configured to receive a live content stream from server **302** and/or media content source **306** via a communication network **310**. Storage **322** may be configured to buffer the received live content stream for playback, and display **330** may be configured to present the buffered content, navigation options, alerts, and/or the like via a primary display window and/or a secondary display window. I/O paths **318**, **326** may provide content (e.g., a live stream of content, broadcast programming, on-demand programming, Internet content, content available over a local area network (LAN) or wide area network (WAN), and/or other content) and data to control circuitry **312**, **320**. Control circuitry **312**, **320** may be used to send and receive commands, requests, and other suitable data using I/O paths **318**, **326**. I/O paths **318**, **326** may connect control circuitry **312**, **320** (and specifically processing circuitry **316**, **324**) to one or more communication paths (described below). I/O functions may be provided by one or more of these communication paths but are shown as single paths in FIG. **3** to avoid overcomplicating the drawing.

[0046] Media content source **306** may include one or more types of content distribution equipment, including a television distribution facility, cable system headend, satellite distribution facility, programming sources (e.g., television broadcasters, such as NBC, ABC, HBO, etc.), intermediate distribution facilities and/or servers, Internet providers, on-demand media servers, and other content providers. NBC is a trademark owned by the National Broadcasting Company, Inc.; ABC is a trademark owned by the American Broadcasting Company, Inc.; and HBO is a trademark owned by the Home Box Office, Inc. Media content source **306** may be the originator of content (e.g., a television broadcaster, a Webcast provider, etc.) or may not be the originator of content (e.g., an on-demand content provider, an Internet provider of content of broadcast programs for downloading, etc.). Media content source **306** may include cable sources, satellite providers, on-demand providers, Internet providers, over-the-top content providers, or other providers of content. Media content source **306** may also include a remote media server used to store different types of content (e.g., including video content selected by a user) in a location remote from computing device **304**. Systems and methods for remote storage of content and providing remotely stored content to user equipment are discussed in greater detail in connection with Ellis et al., U.S. Pat. No. 7,761,892, issued Jul. 20, 2010, which is hereby incorporated by reference herein in its entirety.

[0047] Content and/or data delivered to computing device **304** (e.g., by media content source **306** and/or media guidance data source **308**) may be over-the-top (OTT) content or data. OTT content delivery allows Internet-enabled user devices, such as computing device **304**, to receive content and data that is transferred over the Internet, including any content or data described herein, in addition to content and data received over cable or satellite connections. OTT content is delivered via an Internet connection provided by an Internet service provider (ISP), but a third party distributes the content. The ISP may not be responsible for the viewing abilities, copyrights, or redistribution of the content, and may transfer only IP packets provided by the OTT content provider. Examples of OTT content providers include YOUTUBE, NETFLIX, and HULU, which provide audio and video via IP packets. YouTube is a trademark owned by Google LLC; Netflix is a trademark owned by

Netflix, Inc.; and Hulu is a trademark owned by Hulu, LLC. OTT content providers may additionally or alternatively provide media guidance data described above. In addition to content and/or media guidance data, providers of OTT content can distribute applications (e.g., web-based applications or cloud-based applications), or the content can be displayed by applications stored on computing device **304**.

[0048] Having described system **100**, reference is now made to FIG. **4**, which depicts illustrative flowcharts of process **400** for generating channel tuning data, process **402** for generating a sequence of channels based on channel tuning data, and process **404** for displaying such a sequence via an abbreviated on-screen guide, each process of which may be implemented by using system **300** (which, as described above may further represent system **100** and/or system **200**), in accordance with some embodiments of the disclosure. To avoid repetition, much of the description of processes **400**, **402**, **404**, **600**, **900**, **1000**, and **1100** is provided in the context of generating a channel sequence based on channel tuning commands, for instance, implemented by system **100** and/or system **300**. The description of processes **400**, **402**, **404**, **600**, **900**, **1000**, and **1100** herein, however, is similarly applicable, mutatis mutandis, to embodiments in which a sequence of content items, categories, or the like, is generated based on content selection commands, category selection commands, or the like, for instance, as implemented by system **200** and/or system **300**. In various embodiments, individual steps of process **400**, or any process described herein, may be implemented by one or more components of system **300**. Although the present disclosure may describe certain steps of process **400** (and of other processes described herein) as being implemented by certain components of system **300**, this is for purposes of illustration only, and it should be understood that other components of system **300** may implement those steps instead.

[0049] Before describing in detail processes **400**, **402**, and **404**, which, in various embodiments, are executed in parallel with one another, an overview of those processes is provided. Processes **400**, **402**, and **404** are based on a model for channel tuning events. To this end, each channel may be deemed a state for the model. A user changes states by tuning to a new channel, with the new channel becoming the new state of the model. Each tuning event is a discrete-time event that relies only upon the current state of the model. Thus, the channel tuning events themselves can be modeled as a discrete-time Markov chain. The probability of a user changing from one state (or channel) to another is captured in a transition matrix for the discrete-time Markov chain. Each row of the transition matrix may thus, in some aspects, describe the most likely channels a user will tune to when viewing a particular channel. The transition matrix is generated from a collection of channel tuning events stored on a device, with the events themselves partitioned, in some examples, into buckets based on their collection date and/or time. In some aspects, channel tuning events older than a particular threshold are purged from storage and a running total for each entry of the transition matrix is stored in memory, with purged event totals being decremented from these running totals as they become out-of-date and new events being added to the running totals as they are received. Probabilities, in some examples, may be computed by dividing channel tune events by the total number of channel tuning events for a particular channel, with running counts of total channel tuning events being maintained in storage.

[0050] In some aspects, a transition matrix generated in the above-noted manner is used as the basis for populating an abbreviated on-screen guide with channels. In other examples, as described elsewhere herein, the transition matrix is used to identify or infer one or more users presently viewing content and/or moods of such users, to assist in channel family identification and/or selection. For instance, channel families may be generated or regenerated at set times throughout the day to rebuild channel families as appropriate, allowing for weighing of data points that occur at particularly relevant points in time. For example, when executing on a Saturday afternoon, data points collected on previous Saturday afternoons may be weighted more highly than data points collected, say, on Tuesday evenings. To that end, the transition matrix may be filtered, weighted, and/or augmented.

[0051] With reference to FIG. **4**, process **400** begins at **406**, at which control circuitry **320** receives channel tuning commands entered via user input interface **332**, such as remote control **110**. At **408**, control circuitry **320** stores the received channel tuning data in channel transition data buffer **410** (which may correspond to channel transition data buffer **120** and/or transition data buffer **216**). An example data structure **500** for channel tuning data is shown in FIG. **5**, as described above.

[0052] At **412**, control circuitry **320** determines whether channel transition data buffer **410** includes any expired channel tuning data, such as data that was received and/or stored on a day and/or at a time earlier than the present day and/or time by at least a threshold amount. If channel transition data buffer **410** includes expired channel tuning data ("Yes" at **412**), then at **414** control circuitry **320** purges or overwrites the expired channel transition data in channel transition data buffer **410**. As mentioned above, purging and/or overwriting channel transition data in this manner avoids reliance upon out-of-date or stale channel transition data that may no longer be relevant for a user. If channel transition data buffer **410** includes no expired channel tuning data ("NO" at **412**), then control passes back to **406** to receive additional channel tuning commands, if any.

[0053] Process **402** begins with **416**, at which control circuitry **320** generates, and stores in channel family database **420** (which may correspond to channel family database **124** and/or family database **224**), one or more channel families (and/or content families, category families, or other types of families) based on the channel tuning data stored in channel transition data buffer **410**. Additional details on how control circuitry **320** may generate one or more channel families at **416** are provided below in connection with FIG. **6** through FIG. **12**. At **418**, control circuitry **320** determines whether to update any channel families stored in channel family database **420**. In various aspects, updating of channel families stored in channel family database **420** is triggered in a variety of ways. As one example, channel families are automatically updated periodically, such as after a predetermined or configurable update period has elapsed. In another example, channel families are updated in response to control circuitry **320** having received at least a threshold amount of channel tuning commands since a most recent update of the channel families. If control circuitry **320** determines that one or more channel families stored in channel family database **420** are to be updated ("Yes" at **418**), then control passes

back to **416** to update the one or more channel families in the manner described above. If, on the other hand, control circuitry **320** determines that no channel family stored in channel family database **420** is to be updated yet ("No" at **418**), then control circuitry **320** waits, for instance for a predetermined wait period, to repeat the determination at **418** as to whether a channel update is warranted.

[0054] Process **404** begins with **422**, at which control circuitry **320** determines a currently tuned channel. For instance, with reference to FIG. **1**, tuner **118** communicates a current channel identifier to guide generator **126**. At **424**, based on the currently tuned channel identifier determined at **422**, control circuitry **320** identifies a channel family for the currently tuned channel. For example, control circuitry **320** performs a lookup in channel family database **420** to identify a channel family identifier that is associated with the currently tuned channel, as described in further detail below in connection with FIG. **12**. In some embodiments, if the currently tuned channel is not associated with any channel families in channel family database **420**, then a default channel family, for instance, a channel family including an entire channel lineup, is used as the channel family for the currently tuned channel. At **426**, control circuitry **320** generates for display, for instance, via display **104**, an on-screen guide listing channels of the channel family identified at **424**.

[0055] At **428**, control circuitry **320** determines whether, subsequent to the channel family being identified at **424**, a channel tuning command has been received which may warrant identification of a different channel family. If no channel tuning command has been received ("No" at **428**), then control circuitry **320** waits, for instance for a predetermined wait period, to repeat the determination at **428** as to whether a channel has been changed. If, on the other hand, a channel tuning command has been received ("Yes" at **428**), then at **430** control circuitry **320** determines whether the new tuned-to channel is included in the same channel family that was identified at **424**. If control circuitry **320** determines that the new tuned-to channel is included in the same channel family that was identified at **424** ("Yes" at **430**), then no change is made to the channel family being used to generate the on-screen guide at **426**, and control passes back to **428** to repeat the determination as to whether the channel has been changed yet again. If, on the other hand, control circuitry **320** determines that the new tuned-to channel is not included in the same channel family that was identified at **424** ("No" at **430**), then control passes to **424** to identify a channel family to which the new tuned-to channel belongs, in the manner described above. In this manner, for instance, viewing a channel that overlaps with multiple families will not cause a chaotic change to the abbreviated lineup in the abbreviated on-screen guide.

[0056] FIG. **6** depicts an illustrative flowchart of a process **600** for generating a channel family based on channel tuning data, in accordance with some embodiments of the disclosure. In some aspects, process **600** further represents process **416** of process **402** described above in connection with FIG. **4**. At **602**, based on buffered channel transition data stored in channel family database **420**, control circuitry **320** generates a baseline channel transition matrix (B), which generally accounts for channel tuning events received for the computing device **304**. FIG. **7** depicts an example baseline channel transition matrix **700**, in accordance with some embodiments of the disclosure. The baseline channel transition matrix (B) **700** includes multiple rows **702** and multiple columns **704**. Each entry **706** of baseline channel transition matrix (B) **700** is indexed by a row and a column that indicate a tune-from channel and a tune-to channel, respectively. Each value **706** indicates a cumulative number of tuning transitions received and stored for that particular combination of a tune-from channel **702** and a tune-to channel **704** (e.g., excluding any channel transition events that may have been purged to implement a sliding window accumulator functionality).

[0057] At **604**, control circuitry **320** generates a filtered channel transition matrix (F) based on the buffered channel transition data stored in channel family database **420**. Filtered channel transition matrix (F) includes a filtered set of day and/or time segments from the available channel tuning event data, such as only channel tuning events received on Saturdays between noon and 6:00 PM. FIG. **8** depicts an example filtered channel transition matrix (F) **800**, in accordance with some embodiments of the disclosure. The filtered channel transition matrix (F) **800** includes multiple rows **802** and multiple columns **804**. Each entry **806** of filtered channel transition matrix (F) **800** is indexed by a row and a column that indicate a tune-from channel and a tune-to channel, respectively. Each value **806** indicates a cumulative number of tuning transitions received and stored for that particular combination of a tune-from channel **702** and a tune-to channel **704** within specified day and/or time filter criteria, which may be based on a current day and/or time.

[0058] At **606**, control circuitry **320** generates an augmented channel transition matrix (A) based on the baseline channel transition matrix (B) and the filtered channel transition matrix (F) generated at **602** and **604**, respectively. In general, as described in further detail below in the context of FIG. **9**, the augmented channel transition matrix (A) is generated as a weighted combination of the baseline channel transition matrix (B) and the filtered channel transition matrix (F), such as to more heavily weight the filtered data that may be more relevant than the unfiltered data. At **608**, control circuitry **320** generates an undirected graph (G) based on the augmented channel transition matrix (A) generated at **606**. The undirected graph is used to identify channel families. At **610**, control circuitry **320** determines a local clustering coefficient (LCC) for each channel, or each channel vertex, based on the graph (G) generated at **608**. For instance, control circuitry **320** may compute the local clustering coefficient as a ratio of actual edges in a neighborhood in the graph (e.g., edges that are connected to a particular vertex in the graph) to the total possible number of edges in that neighborhood. In this manner, when a neighborhood in the graph has a local clustering coefficient that exceeds a particular threshold, for example, that neighborhood may be captured as a channel family and assigned a channel family identifier.

[0059] At **612**, control circuitry **320** initializes a channel index (i), for instance, by setting the channel index (i) equal to a first channel among the multiple channels of a channel lineup. At **614**, control circuitry **320** determines whether the local clustering coefficient, for the channel that corresponds to the current value of the channel index (i), exceeds a threshold. If control circuitry **320** determines that the local clustering coefficient for the channel exceeds the threshold ("Yes" at **614**), then at **616** control circuitry **320** generates a channel family for the channel based on its local cluster indicated in the graph (G) generated at **608**. At **618**, control

circuitry **320** stores in channel family database **420** channel family data based on the channel family generated at **616**. If, on the other hand, control circuitry **320** determines that the local clustering coefficient for the channel does not exceed the threshold ("No" at **614**), then at **620** control circuitry **320** determines whether an additional channel remains to be processed in the channel lineup to determine whether any channel family is to be created for the additional channel. If an additional channel remains to be processed to determine whether any channel family is to be created for the additional channel ("Yes" at **620**), then at **622** control circuitry **320** increments the channel index to correspond to the additional channel, and control passes back to **614** to repeat the determination for that channel as described above. If no additional channel remains to be processed in the channel lineup ("No" at **620**), then process **600** terminates.

[0060] FIG. **9** depicts an illustrative flowchart of process **900** for generating an augmented channel matrix based on baseline and filtered channel transition matrices, in accordance with some embodiments of the disclosure. In some aspects, process **900** further represents process **606** of process **600** described above in connection with FIG. **6**. At **902**, control circuitry **320** retrieves from storage **322** a weight value (α_0) for the baseline matrix (B) that was generated at **602**. At **904**, control circuitry **320** retrieves from storage **322** a weight value (α_1) for the filtered matrix (F) that was generated at **604**. At **906**, control circuitry **320** initializes a row index (r) and a column index (c). At **908**, control circuitry **320** computes the element of the augmented channel matrix (A) at the r^{th} row and c^{th} column (A_{rc}) according to equation (1) below.

$$A_{rc}=\alpha_0 B_{rc}+\alpha_1 F_{rc} \quad (1)$$

At **910**, control circuitry **320** determines whether the row index r has reached the maximum number, namely, the total number of rows to be included in augmented channel matrix A. If the row index r has not reached the total number of rows to be included in augmented channel matrix A ("No" at **910**), then at **912** control circuitry **320** increments the row index r by 1 and passes control back to **908** to compute the element of the augmented channel matrix (A) for the new row and the c^{th} column (A_{rc}) according to equation (1) in the manner described above. If the row index r has reached the total number of rows to be included in augmented channel matrix A ("Yes" at **910**), then at **914** control circuitry **320** determines whether the column index c has reached the maximum number, namely, the total number of columns to be included in augmented channel matrix A. If the column index c has not reached the total number of columns to be included in augmented channel matrix A ("No" at **914**), then at **916** control circuitry **320** increments the column index c by 1, resets the row index r to 1, and passes control back to **908** to compute the element of the augmented channel matrix (A) for the new row r and the c column (A_{rc}) according to equation (1) in the manner described above. If the column index c has reached the total number of columns to be included in augmented channel matrix A ("Yes" at **914**), then process **900** terminates.

[0061] FIG. **10** depicts an illustrative flowchart of process **1000** for generating an undirected graph based on an augmented channel transition matrix, in accordance with some embodiments of the disclosure. In some aspects, process **1000** further represents process **608** of process **600** described above in connection with FIG. **6**. At **1002**, control circuitry **320** initializes a channel index (ch), for instance, by setting the channel index to correspond to a first channel among the multiple channels of a channel lineup. At **1004**, control circuitry **320** determines whether the augmented matrix (A) generated at **606** and/or **900** includes any channel tuning events (or channel transition events) for the channel designated by channel index (ch). If the augmented matrix (A) does not include any channel tuning events for the channel designated by channel index (ch) ("No" at **1004**), then at **1006** control circuitry **320** excludes that channel from the graph (G). If, on the other hand, the augmented matrix (A) includes one or more channel tuning events for the channel designated by channel index (ch) ("Yes" at **1004**), then at **1008** control circuitry **320** generates a vertex (V) for that channel to be included in the graph (G). At **1010**, control circuitry **320** determines whether the channel index (ch) has reached its maximum, such as by reaching the final channel included in the channel lineup. If the channel index (ch) has not reached its maximum ("No" at **1010**), then at **1012** control circuitry **320** increments the channel index (ch) by **1** channel and passes control back to **1004** to repeat the determination at **1004** for the newly indexed channel in the manner described above.

[0062] If, on the other hand, the channel index (ch) has reached its maximum ("Yes" at **1010**), then at **1014** control circuitry **320** initializes a tune-from channel index (tf) and a tune-to channel index (tt), for instance, by setting the tune-from channel index (tf) and the tune-to channel index (tt) to a first and a second channel, respectively among the channels of the channel lineup. At **1016**, control circuitry **320** determines whether a probability of tuning from the channel indexed by the tuned-from channel index (tf) to the channel indexed by the tuned-to channel index (tt) exceeds a threshold. Such a probability, for instance, may be computed by dividing channel tune events by the total number of channel tuning events for a particular channel. If the probability of tuning from the channel indexed by the tuned-from channel index (tf) to the channel indexed by the tuned-to channel index (tt) does not exceed the threshold ("No" at **1016**), then at **1018** control circuitry **320** omits from graph (G) an edge (E) that would otherwise connect the tune-from channel (tf) to the tune-to channel (tt). Control then passes to **1022**, which is described below. If, on the other hand, the probability of tuning from the channel indexed by the tuned-from channel index (tf) to the channel indexed by the tuned-to channel index (tt) exceeds the threshold ("Yes" at **1016**), then at **1020** control circuitry **320** adds to graph (G) an edge (E) that connects the tune-from channel (tf) to the tune-to channel (tt). At **1022**, control circuitry **320** determines whether any additional channels of the channel lineup remain to be processed to complete generation of graph (G). If one or more additional channels of the channel lineup remain to be processed ("Yes" at **1022**), then at **1024** control circuitry **320** increments the tune-from channel index (tf) and/or the tune-to channel index (tt) and passes control back to **1016** to repeat the determination for the newly indexed tune-from and/or tune-to channels in the manner described above. If, on the other hand, no additional channel of the channel lineup remains to be processed ("No" at **1022**), then generation of graph (G) is complete and process **1000** terminates.

[0063] FIG. **11** depicts an illustrative flowchart of process **1100** for augmenting a channel family based on collaborative filtering, in accordance with some embodiments of the

disclosure. Before describing process **1100** in detail, an overview is provided. In some aspects, in addition to capturing per-user behavior, channel families (or content families, category families, or other types of families) generated in the manner described herein capture user moods (such as a user being in the mood to watch college football on Saturday afternoons) and/or combinations of users (such as a user repeatedly having a movie night with another user on Saturday evenings). Such scenarios may involve a user scanning a small subset of channels for content to watch, creating node clusters in graph (G) described herein. In some aspects, channel families derived by a computing device **304** for a particular user account are posted to a backend service (e.g., hosted by server **302**), which also receives such channel families from a large population of devices across communication network **310**. Server **302** then applies a collaborative filtering step, introducing a recommendation engine that adds one or more additional channels (or content items, categories, or the like) to a family, based on collaborative filtering involving data from other users having similar tastes.

[0064] As one example, since each channel family may correspond to a unique combination of users and their moods, the channel family can be viewed as a unique user row to a collaborative filtering utility matrix. Each channel family is added as a row to a utility matrix of the most recent set of received channel families (allowing old or stale channel families to expire), and a distance measurement is applied to find similar channel families (e.g., channel families of users having similar tastes). Using the collection of these similar channel families, the collaborative filtering process walks through each blank entry in an input channel family row of the utility matrix and estimates how likely the original user would enjoy that given channel. Since this backend service has access to program metadata and channel information, channel similarity can also be made available to this collaborative filtering step. For example, channels can be categorized into genres, where channels of the same genres as those in the input channel family would be weighted more highly for a recommendation.

[0065] Referring now to FIG. **11**, in some aspects, process **1100** is implemented as part of process **416** of process **400** described above in connection with FIG. **4** and/or is implemented by control circuitry **312** of server **302** for computing device **304**. At **1102**, control circuitry **312** generates a utility matrix (U) with each row corresponding to a channel family stored in channel family database **420**, or a version of channel family database **420** that is provided to server **302** over communication network **310**, and each column including channels of that channel family. At **1104**, control circuitry **312** performs a distance measurement between channel families to find channel families having similarities. At **1106**, control circuitry **312** retrieves a channel family identifier from the channel family database **420**. At **1108**, control circuitry **312** determines, for each channel that is included in the channel lineup but is not included in the channel family, a probability that a user associated with the user account for that channel family would enjoy that channel. At **1110**, control circuitry **312** determines whether the probability computed at **1108** exceeds a threshold. If the probability computed at **1108** exceeds the threshold ("Yes" at **1110**), then at **1112** control circuitry **312** adds that channel to the channel family. If, on the other hand, the probability computed at **1108** does not exceed the threshold ("No" at **1110**), then control passes to **1114**. At **1114**, control circuitry **312** determines whether any additional channel families stored in channel family database **420** remain to be processed for augmentation based on collaborative filtering. If one or more additional channel families stored in channel family database **420** remain to be processed for augmentation based on collaborative filtering ("Yes" at **1114**), then at **1116** control circuitry **312** retrieves from channel family database **420** an identifier for such an additional channel family and passes control back to **1108** to repeat the determination for that additional channel family in the manner described above. If, on the other hand, no additional channel family stored in channel family database **420** remains to be processed for augmentation based on collaborative filtering ("No" at **1114**), then process **1100** terminates.

[0066] FIG. **12** shows an example data structure **1200** for channel family data, such as channel family data that may be generated at **416**, stored in channel family database **420**, and/or augmented by way of process **1100** in the manner described above. Each item of channel family data includes an account identifier **1202** that identifies a user account for which the channel family was created, a channel family identifier **1204** that uniquely identifies the channel family among multiple channel families generated for that user account, and a listing of channels **1206** that belong to that channel family.

[0067] The systems and processes discussed above are intended to be illustrative and not limiting. One skilled in the art would appreciate that the actions of the processes discussed herein may be omitted, modified, combined, and/or rearranged, and any additional actions may be performed without departing from the scope of the invention. More generally, the above disclosure is meant to be exemplary and not limiting. Only the claims that follow are meant to set bounds as to what the present disclosure includes. Furthermore, it should be noted that the features and limitations described in any one embodiment may be applied to any other embodiment herein, and flowcharts or examples relating to one embodiment may be combined with any other embodiment in a suitable manner, done in different orders, or done in parallel. In addition, the systems and methods described herein may be performed in real time. It should also be noted that the systems and/or methods described above may be applied to, or used in accordance with, other systems and/or methods.

What is claimed is:

1. A method comprising:

identifying transition data, wherein the transition data comprises, for each respective transition, of a plurality of transitions indicated in the transition data, caused by a corresponding command, an indication that content associated with a first content identifier was switched to content associated with a second content identifier based on receiving the command, and wherein the transition data further comprises an indication of at least one of a day of the week or a time of day that the command was received;

for each respective transition of the plurality of transitions, inferring whether one or more particular users are likely to have been present when a command for the respective transition was received based at least in part on (a) the at least one of a day of the week or a time of day that the respective command was received and (b)

user behavior data associated with a first one or more particular users or a second one or more particular users

upon a determination that: (a) that a current day of week or time of day matches at least one of the day of the week or the time of day corresponding to the transition data and (b) the transition data corresponds to user behavior associated with the first one or more particular users:

inferring that the first one or more particular users are likely to have been present when the command for the respective transition was received;

generating, based at least in part on the transition data, a content family associated with the inferred first one or more particular users, the content family comprising a plurality of content items; and

generating, for display, respective content identifiers corresponding to at least a portion of the content items of the content family.

2. The method of claim **1**, wherein the generating, for display, the respective content identifiers corresponding to at least the portion of the content items of the content family is further based on receiving a user selection of a content identifier corresponding to one of the plurality of content items of the content family.

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

upon a determination that: (a) that a current day of week or time of day matches at least one of the day of the week or the time of day corresponding to the transition data and (b) the transition data corresponds to user behavior associated with the second one or more particular users:

inferring that the second one or more particular users are likely to have been present when the command for the respective transition was received;

generating, based at least in part on the transition data, a second content family associated with the inferred second one or more particular users, the second content family comprising a second plurality of content items; and

generating, for display, respective content identifiers corresponding to at least a portion of the second content items of the second content family.

4. The method of claim **3**, wherein at least one user of the first one or more particular users is the same as at least one user of the second one or more particular users.

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

receiving a subsequent command to transition to a subsequent content identifier;

based on determining that (a) a day of the week or a time of day corresponding to the subsequent command matches at least one of the day of the week or the time of day corresponding to the transition data and (b) that the subsequent content identifier corresponds to a content item that is included in the content family:

inferring that the first one or more particular users is likely to remain present when the subsequent command to transition to the subsequent content identifier was received.

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

receiving a subsequent command to transition to a subsequent content identifier;

based on determining that (a) a day of the week or a time of day corresponding to the subsequent command does not match at least one of the day of the week or the time of day corresponding to the transition data or (b) that the subsequent content identifier does not correspond to a content item that is included in the content family:

inferring that the first one or more particular users are likely to have changed when the subsequent command to transition to the subsequent content identifier was received.

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

generating a baseline content transition matrix based on the transition data, each entry of the baseline content transition matrix indicating a respective number of transitions from content associated with the first content identifier to content associated with the second content identifier caused by a corresponding command; and

wherein the generating the content family is further based on the baseline content transition matrix.

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

filtering the transition data to include only transition data for commands received at a day or time within a degree of proximity to a current day of the week or a current time;

generating a filtered content transition matrix based on the filtered transition data, each entry of the filtered content transition matrix indicating a respective number of transitions between content caused by the commands for the filtered transition data; and

wherein the generating the content family is further based on the filtered content transition matrix.

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

inferring a mood of one or more particular users based on the transition data; and

wherein the generating the content family is further based on the inferred mood.

10. A system comprising:

control circuitry configured to:

identify transition data, wherein the transition data comprises, for each respective transition, of a plurality of transitions indicated in the transition data, caused by a corresponding command, an indication that content associated with a first content identifier was switched to content associated with a second content identifier based on receiving the command, and wherein the transition data further comprises an indication of at least one of a day of the week or a time of day that the command was received;

for each respective transition of the plurality of transitions, infer whether one or more particular users are likely to have been present when a command for the respective transition was received based at least in part on (a) the at least one of a day of the week or a time of day that the respective command was received and (b) user behavior data associated with a first one or more particular users or a second one or more particular users

upon a determination that: (a) that a current day of week or time of day matches at least one of the day of the week or the time of day corresponding to the transition data and (b) the transition data corresponds to user behavior associated with the first one or more particular users:

infer that the first one or more particular users are likely to have been present when the command for the respective transition was received; and

generate, based at least in part on the transition data, a content family associated with the inferred first one or more particular users, the content family comprising a plurality of content items; and

input/output circuitry configured to:

generate, for display, respective content identifiers corresponding to at least a portion of the content items of the content family.

11. The system of claim **10**, wherein the generating, for display, the respective content identifiers corresponding to at least the portion of the content items of the content family is further based on receiving a user selection of a content identifier corresponding to one of the plurality of content items of the content family.

12. The system of claim **10**, wherein the control circuitry is further configured to:

upon a determination that: (a) that a current day of week or time of day matches at least one of the day of the week or the time of day corresponding to the transition data and (b) the transition data corresponds to user behavior associated with the second one or more particular users:

infer that the second one or more particular users are likely to have been present when the command for the respective transition was received;

generate, based at least in part on the transition data, a second content family associated with the inferred second one or more particular users, the second content family comprising a second plurality of content items; and

generate, for display, respective content identifiers corresponding to at least a portion of the second content items of the second content family.

13. The system of claim **12**, wherein at least one user of the first one or more particular users is the same as at least one user of the second one or more particular users.

14. The system of claim **10**:

wherein the input/output circuitry is further configured to:

receive a subsequent command to transition to a subsequent content identifier;

wherein the control circuitry is further configured to:

based on determining that (a) a day of the week or a time of day corresponding to the subsequent command matches at least one of the day of the week or the time of day corresponding to the transition data and (b) that the subsequent content identifier corresponds to a content item that is included in the content family:

infer that the first one or more particular users is likely to remain present when the subsequent command to transition to the subsequent content identifier was received.

15. The system of claim **10**:

wherein the input/output circuitry is further configured to:

receive a subsequent command to transition to a subsequent content identifier;

wherein the control circuitry is further configured to:

based on determining that (a) a day of the week or a time of day corresponding to the subsequent command does not match at least one of the day of the week or the time of day corresponding to the transition data or (b) that the subsequent content identifier does not correspond to a content item that is included in the content family:

infer that the first one or more particular users are likely to have changed when the subsequent command to transition to the subsequent content identifier was received.

16. The system of claim **10**, wherein the control circuitry is further configured to:

generate a baseline content transition matrix based on the transition data, each entry of the baseline content transition matrix indicating a respective number of transitions from content associated with the first content identifier to content associated with the second content identifier caused by a corresponding command; and

wherein the generating the content family is further based on the baseline content transition matrix.

17. The system of claim **16**, wherein the control circuitry is further configured to:

filter the transition data to include only transition data for commands received at a day or time within a degree of proximity to a current day of the week or a current time;

generate a filtered content transition matrix based on the filtered transition data, each entry of the filtered content transition matrix indicating a respective number of transitions between content caused by the commands for the filtered transition data; and

wherein the generating the content family is further based on the filtered content transition matrix.

18. The system of claim **10**, wherein the control circuitry is further configured to:

infer a mood of one or more particular users based on the transition data; and

wherein the generating the content family is further based on the inferred mood.

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