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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	18050055US	9039

196949 7590 02/18/2025

Kudelski Group & MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

EXAMINER	
GADOMSKI, STEFAN J	

ART UNIT	PAPER NUMBER
2485	

NOTIFICATION DATE	DELIVERY MODE
02/18/2025	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docket@maierandmaier.com
maierandmaier_PAIR@firsttofile.com

APPLICATION NO.	ISSUE DATE	PATENT NO.
18/480,918	18-Feb-2025	12231703

Kudelski Group & MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants

Pinterest Ex. 1004, Page 2 of 401

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	02/18/2025	12231703	18050055US	9039

196949 7590 01/29/2025

Kudelski Group & MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

Amarendra N. Gogoi, Fremont, CA;
Sanjay Kumar Gupta, Bangalore, INDIA;
Ravikant Swami, Bangalore, INDIA;

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

OpenTV, Inc., San Francisco, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**01/14/2025 03:32:11 PM Z ET**	**18050055US**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Mark Gambriel
PATENT CENTER #	68731650	FILING DATE	10/04/2023
CUSTOMER #	196949	FIRST NAMED INVENTOR	Amarendra N. Gogoi
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Casey

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
P-18-p354-US3_Issue Fee Transmittal.pdf	1	Issue Fee Payment (PTO-85B)	126 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
P-18-p354-US3_Issue Fee Transmittal.pdf	5F252A53A9F850051A1DD3AD4009FCB60B7B36A06D7461A35 9FA0E0A700AF14EC094DA4B5C056056C51DD1097A90E82F05 05DF0A4F0D42BD9FE479DC6010C74D

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

~~44367~~ **196949** 7590 10/15/2024

~~SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV~~
~~P.O. BOX 2938~~
~~MINNEAPOLIS, MN 55402-0938~~

Kudelski Group & MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	~~2050.354US3~~ **18050055US**	9039

TITLE OF INVENTION: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/15/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
GADOMSKI, STEFAN J	2485	375-240010

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Maier & Maier, PLLC
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: OpenTV, Inc.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): San Francisco, CALIFORNIA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via the USPTO patent electronic filing system ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge ~~the required fee(s)~~, any deficiency, or credit any overpayment to Deposit Account No. 50-5976

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Michael R. Casey/ Date January 14, 2025

Typed or printed name Michael R. Casey Registration No. 40294

Pinterest Ex. 1004, Page 7 of 401

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**01/14/2025 03:32:11 PM Z ET**	**18050055US**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Mark Gambriel
PATENT CENTER #	68731650	AUTHORIZED BY	Michael Casey
CUSTOMER #	196949	FILING DATE	10/04/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Amarendra N. Gogoi

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 8716	**E20251DF32399419**	**Mark Gambriel**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1501	UTILITY ISSUE FEE	1200.00	1	1200.00
			TOTAL AMOUNT:	**$1,200.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/480,918	10/04/2023	Amarendra N. Gogoi	18050055US

CONFIRMATION NO. 9039

196949
Kudelski Group & MAIER & MAIER, PLLC
345 SOUTH PATRICK STREET
ALEXANDRIA, VA 22314

POA ACCEPTANCE LETTER

OC000000080289951

Date Mailed: 11/06/2024

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/01/2024.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/

Pinterest Ex. 1004, Page 10 of 401

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3

CONFIRMATION NO. 9039

44367
SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

POWER OF ATTORNEY NOTICE

OC000000080289841

Date Mailed: 11/06/2024

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 11/01/2024.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/dtdinh/

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**11/01/2024 10:28:39 AM Z ET**	**2050.354US3**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Mark Gambriel
PATENT CENTER #	67804943	FILING DATE	10/04/2023
CUSTOMER #	44367	FIRST NAMED INVENTOR	Amarendra N. Gogoi
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Michael Casey

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
POA.pdf	2	Power of Attorney	401 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
POA.pdf	57D82CC8E311727D93C7543AAF5C99B4B3502E588BFCB53C 1C83B9A12553EC84A6417250968F0BEB7B269DC0ABFE1217D 526893D733F17E6B18678F56E0CE1EB

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New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 09/30/2025. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	18/480,918
Filing Date	October 4, 2023
First Named Inventor	Amarendra N. Gogoi
Title	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION
Art Unit	2485
Examiner Name	STEFAN J GADOMSKI
Attorney Docket Number	18050055US

SIGNATURE of Applicant or Patent Practitioner

Signature	/Michael R. Casey/	Date (Optional)	
Name	Michael R. Casey	Registration Number	40294
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ *Total of _____ forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 09/30/2025. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 196949

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

OpenTV, Inc.

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	October 25, 2024
Name	Cheryl Franke		
Title	Patent Attorney		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☐ Total of forms are submitted.

A Federal agency may not conduct or sponsor, and a person is not required to respond to, nor shall a person be subject to a penalty for failure to comply with an information collection subject to the requirements of the Paperwork Reduction Act of 1995, unless the information collection has a currently valid OMB Control Number. The OMB Control Number for this information collection is 0651-0035. Public burden for this form is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the information collection. Send comments regarding this burden estimate or any other aspect of this information collection, including suggestions for reducing this burden to the Chief Administrative Officer, United States Patent and Trademark Office, P.O. Box 1450, Alexandria, VA 22313-1450 or email InformationCollection@uspto.gov. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.** If filing this completed form by mail, send to: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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NOTICE OF ALLOWANCE AND FEE(S) DUE

44367 7590 10/15/2024

SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

EXAMINER	
GADOMSKI, STEFAN J	
ART UNIT	**PAPER NUMBER**
2485	

DATE MAILED: 10/15/2024

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3	9039

TITLE OF INVENTION: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/15/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

44367 7590 10/15/2024
SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3	9039

TITLE OF INVENTION: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/15/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
GADOMSKI, STEFAN J	2485	375-240010

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

Pinterest Ex. 1004, Page 17 of 401

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3	9039

44367 7590 10/15/2024

SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

EXAMINER	
GADOMSKI, STEFAN J	

ART UNIT	PAPER NUMBER
2485	

DATE MAILED: 10/15/2024

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/480,918	Applicant(s) Gogoi et al.	
	Examiner STEFAN GADOMSKI	Art Unit 2485	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the response filed 09/04/2024.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 16-35 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All b) ☐ Some* c) ☐ None of the:

   1. ☑ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/STEFAN GADOMSKI/
Primary Examiner, Art Unit 2485

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Arguments

2. Applicant's arguments, see page 7, filed 09/04/2024, with respect to the double patenting rejection have been fully considered and are persuasive. The double patenting rejection has been withdrawn.

3. Applicant's arguments, see pages 7-8, filed 09/04/2024, with respect to the 101 rejection have been fully considered and are persuasive. The 101 rejection has been withdrawn.

Terminal Disclaimer

4. The terminal disclaimer filed on 09/04/2024 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of 11,825,139 has been reviewed and is accepted. The terminal disclaimer has been recorded.

Allowable Subject Matter

5. **Claims 16-35** are allowed. The prior art fails to disclose replacing an audio or video decoder and preserving a source element and demultiplexer of a new piece of content that has been deemed the same content type as a first piece of content transitioned from.

Overall, the claim language distinguishes the Applicant's invention over the cited references. The various claimed limitations are not taught or suggested by the prior art taken either singly or in combination, with emphasis that it is each claim, taken as a whole, including the interrelationships and interconnection between various claimed elements that make them allowable over the prior art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to STEFAN GADOMSKI whose telephone number is (571)270-5701. The examiner can normally be reached Monday - Friday, 12-8PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on 571-272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available

to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

STEFAN GADOMSKI
Primary Examiner
Art Unit 2485

/STEFAN GADOMSKI/
Primary Examiner, Art Unit 2485

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	**Art Unit**
	STEFAN GADOMSKI	2485

CPC						
Symbol					**Type**	**Version**
H04N	/	21	/	23655	F	2013-01-01
H04N	/	21	/	2662	I	2013-01-01
H04L	/	65	/	70	I	2022-05-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

Use images from artifact folder? (•) Yes ( ) No

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/STEFAN GADOMSKI/ Primary Examiner, Art Unit 2485	29 September 2024	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	**Art Unit**
	STEFAN GADOMSKI	2485

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04N21/2365	/	21	/	2365
H04N21/2662	/	21	/	2662
H04L65/70	/	65	/	70

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
375	240

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

Use images from artifact folder? (•) Yes ( ) No

NONE (Assistant Examiner) (Date)		**Total Claims Allowed:** 20
/STEFAN GADOMSKI/ Primary Examiner, Art Unit 2485 (Primary Examiner) (Date)	29 September 2024	O.G. Print Claim(s): 1 O.G. Print Figure: 4

Pinterest Ex. 1004, Page 25 of 401

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	**Art Unit**
	STEFAN GADOMSKI	2485

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
-	1	-	10	4	19	13	28								
-	2	-	11	5	20	14	29								
-	3	-	12	6	21	15	30								
-	4	-	13	7	22	16	31								
-	5	-	14	8	23	17	32								
-	6	-	15	9	24	18	33								
-	7	1	16	10	25	19	34								
-	8	2	17	11	26	20	35								
-	9	3	18	12	27										

Use images from artifact folder? ◉ Yes ○ No

NONE		**Total Claims Allowed:**
(Assistant Examiner)	(Date)	20
/STEFAN GADOMSKI/ Primary Examiner, Art Unit 2485	29 September 2024	O.G. Print Claim(s): 1 / O.G. Print Figure: 4
(Primary Examiner)	(Date)	

Pinterest Ex. 1004, Page 26 of 401

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	Art Unit
	STEFAN GADOMSKI	2485

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/15/2024	09/29/2024							
	1	-	-							
	2	-	-							
	3	-	-							
	4	-	-							
	5	-	-							
	6	-	-							
	7	-	-							
	8	-	-							
	9	-	-							
	10	-	-							
	11	-	-							
	12	-	-							
	13	-	-							
	14	-	-							
	15	-	-							
	16	✓	=							
	17	✓	=							
	18	✓	=							
	19	✓	=							
	20	✓	=							
	21	✓	=							
	22	✓	=							
	23	✓	=							
	24	✓	=							
	25	✓	=							
	26	✓	=							
	27	✓	=							
	28	✓	=							
	29	✓	=							
	30	✓	=							
	31	✓	=							
	32	✓	=							
	33	✓	=							
	34	✓	=							
	35	✓	=							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	Art Unit
	STEFAN GADOMSKI	2485

CPC - Searched*		
Symbol	Date	Examiner
See print out for complete history	06/15/2024	SG

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E inventor search	06/15/2024	SG
PE2E assignee search	06/15/2024	SG
PE2E text search	06/15/2024	SG
Review of parent case 16/645,598 and 17/454,169	06/15/2024	SG
Review of previously cited prior art	09/29/2024	SG

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	USPG, UPAD, UPAT databases + claims	09/29/2024	SG

/STEFAN GADOMSKI/ Primary Examiner, Art Unit 2485	

Bibliographic Data

Application No: 18/480,918

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [ ] Met After Allowance

Verified and Acknowledged: /STEFAN GADOMSKI/ Examiner's Signature | Initials

Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/04/2023	375	2485	
RULE			

APPLICANTS

INVENTORS

Amarendra N. Gogoi,

Sanjay Kumar Gupta,

Ravikant Swami,

CONTINUING DATA

This application is a CON of 17454169 11/09/2021 PAT 11825139

17454169 is a CON of 16645598 03/09/2020 PAT 11184652

16645598 is a 371 of PCT/US2018/046723 08/14/2018

FOREIGN APPLICATIONS

INDIA IN201741031917 09/08/2017

IF REQUIRED, FOREIGN LICENSE GRANTED**

10/18/2023

STATE OR COUNTRY

ADDRESS

FILING FEE RECEIVED

$1,980

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L41	7	((US-20140359150-A1 OR US-20150019629-A1 OR US-20140040498-A1 OR US-20150023404-A1 OR US-20080189352-A1 OR US-20040111526-A1).did. AND PGPB.dbnm.) OR ((WO-2016099356-A1).did. AND FTDB.dbnm.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/09/29 09:44 AM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N1	6	(new AND content AND playback AND preserve AND pipeline).CLM.	(US-PGPUB; USPAT)	OR	ON	ON	2024/09/29 09:51 AM

PE2E SEARCH - Search History (Similarity Search)

No Similarity Results available

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-22)
Approved for use through 05/31/2024. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18480918
Filing Date	2023-10-04
First Named Inventor	Amarendra N. Gogoi
Art Unit	2485
Examiner Name	Stefan Gadomski
Attorney Docket Number	2050.354US3

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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	Attorney Docket Number	2050.354US3

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EXAMINER SIGNATURE

Examiner Signature	/STEFAN GADOMSKI/	Date Considered	09/29/2024

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

PC 6.1.24

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☐ See attached certification statement.

☒ A certification statement is not submitted herewith.

FEE

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98 (d) (1) is attached.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/ Susan Yee /	Date (YYYY-MM-DD)	2024-09-04
Name/Print	Susan Yee	Registration Number	41,388

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Application Number	Application/Control No.	Applicant(s)/Patent under Reexamination	
* 18/480,918 *	18/480,918	Gogoi et al.	
	Examiner	**Art Unit**	
	GADOMSKI, STEFAN J	2485	

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Date Filed: **04 September 2024**	**This patent is subject to a Terminal Disclaimer**	

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**09/04/2024 03:36:09 PM Z ET**	**2050.354US3**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Farah O'Sullivan
PATENT CENTER #	67042689	FILING DATE	10/04/2023
CUSTOMER #	44367	FIRST NAMED INVENTOR	Amarendra N. Gogoi
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Susan Yee

Documents

TOTAL DOCUMENTS: 54

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
for_0009_ep_3679738_b1.pdf	17	Foreign Reference	371 KB
for_0010_ep_3965466_b1.pdf	18	Foreign Reference	330 KB
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2050.354US3 OA Response as Filed-TRAN.LET.pdf	(1-1)	1	Transmittal Letter	107 KB
2050.354US3 OA Response as Filed-DIST.pdf	(2-2)	1	Terminal Disclaimer Filed	188 KB
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Digest

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**09/04/2024 03:36:09 PM Z ET**	**2050.354US3**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Farah O'Sullivan
PATENT CENTER #	67042689	AUTHORIZED BY	Susan Yee
CUSTOMER #	44367	FILING DATE	10/04/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Amarendra N. Gogoi

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 3003	**E202494F36516701**	**Farah O'Sullivan**

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
190743	**37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	260.00	1	260.00
1814	STATUTORY DISCLAIMER, INCLUDING TERMINAL DISCLAIMER	170.00	1	170.00
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(19) Europäisches Patentamt
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H04N 21/236 *(2011.01)* ***H04L 29/06*** *(2006.01)*
H04N 21/433 *(2011.01)* ***H04N 21/438*** *(2011.01)*
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WO 2015/044870 (02.04.2015 Gazette 2015/13)

(54) SYSTEM AND METHOD FOR MANAGING ADJACENT CHANNELS IN AN ADAPTIVE STREAMING ENVIRONMENT

SYSTEM UND VERFAHREN ZUR VERWALTUNG VON NACHBARKANÄLEN IN EINER ADAPTIVEN STREAMING-UMGEBUNG

SYSTÈME ET PROCÉDÉ DE GESTION DE CANAUX ADJACENTS DANS UN ENVIRONNEMENT DE DIFFUSION ADAPTATIVE EN CONTINU

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US-B1- 6 848 004

- **CHAE YOUNG LEE ET AL: "Reducing Channel Zapping Time in IPTV Based on User's Channel Selection Behaviors", IEEE TRANSACTIONS ON BROADCASTING, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 56, no. 3, 1 September 2010 (2010-09-01), pages 321-330, XP011312107, ISSN: 0018-9316**
- **RGB NETWORKS: 'Comparing Adaptive HTTP Streaming Technologies' November 2011, XP055316468 Retrieved from the Internet: <URL:http://www.rgbnetworks.com/pdfs/RGB_Ad aptive_HTTP_Streaming_Comparison_1211-01.pdf>**

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Description

FIELD OF THE DISCLOSURE

[0001] The present disclosure generally relates to communication networks. More particularly, and not by way of any limitation, the present disclosure is directed to a system and method for managing adjacent channels in an adaptive streaming environment.

BACKGROUND

[0002] Adaptive streaming is a popular means of non-traditional video delivery. Although there have been several advances, changing adaptively streamed content (e.g., from one stream or channel to another stream or channel) remains a cumbersome process in current implementations. As such, typical adaptive streaming techniques do not provide for a realistic or user-friendly "channel surfing" experience, thereby negatively impacting the quality of user enjoyment.

[0003] Lee et al., "Reducing Channel Zapping Time in IPTV Based on User's Channel Selection Behaviors", IEEE TRANSACTIONS ON BROADCASTING, describes a predictive tuning method, which reduces channel zapping time by prejoining channels that are likely to be selected next, in addition to the currently watched channel.

SUMMARY

[0004] The present patent disclosure is broadly directed to systems, methods, devices, apparatuses and associated computer-readable media for managing and effectuating fast channel changes (e.g., user-initiated "channel surfing" requests) in an adaptive streaming environment. One or more adjacent channels are adaptively defined relative to a current streaming channel that a client device is engaged on. The client device is configured to pre-fetch metadata and initialization information for the defined adjacent channels based on bandwidth conditions, buffer conditions, etc. When a channel is changed, the client device is operative to use the pre-fetched data to quickly obtain encoded media content for rendering.

[0005] In one aspect, an embodiment of a method operative in a streaming client device disposed in an adaptive streaming environment is disclosed. The claimed embodiment comprises, *inter alia*, monitoring at least a bandwidth condition relative to a network connection or a content distribution pipe between the streaming client device and a content delivery network and associated streaming server system. Based on the monitored conditions, one or more adjacent channels may be determined relative to a current streaming channel of the streaming client device. Responsive to the determination of the one or more adjacent channels, metadata information relative to the one or more adjacent channels is pre-fetched. Responsive to the pre-fetched metadata information, initialization information for the one or more adjacent channels is pre-fetched and stored locally on the streaming client device. If the current streaming channel is changed to a new streaming channel belonging to the one or more adjacent channels, the pre-fetched initialization information may be used to fetch encoded media content pertaining to the new streaming channel. In one variation, the claimed method further includes monitoring at least one of video buffer conditions and decoder processing conditions of the streaming client device, as well as determining the number of available decoders. In another variation, the pre-fetched metadata information of the adjacent channels comprises one or more manifest files generated in effectuating adaptive bit rate (ABR) streaming. The adjacent channels may be determined in a number of ways including, but not limited to, as a configurable number of consecutive channels above and/or below the current channel, based on users' favorite lists, and the like. In a still further variation, the claimed embodiment may comprise pre-fetching media content and immediately decoding the pre-fetched media content. If the current streaming channel is changed to a new streaming channel belong to one of the adjacent channels, the decoded media content of the adjacent channel is rendered promptly for display.

[0006] In another aspect, an embodiment of a client device is disclosed that comprises one or more processors, a bandwidth monitor and a streaming client module coupled to the one or more processors. The streaming client module may be configured to perform an embodiment of a method described hereinabove at least for purposes of managing adjacent channels in an adaptive streaming environment. In still further aspects, an embodiment of a non-transitory computer-readable medium containing instructions stored thereon is disclosed for performing one or more embodiments of the methods set forth above.

[0007] Advantages of the present invention include, but not limited to, facilitating a user-friendly channel surfing experience in an adaptive streaming environment that is similar to what is commonly encountered in existing TV broadcast environments. As one or more embodiments set forth herein allow rapid changing of adaptive streaming channels without bandwidth waste, unsatisactory viewing conditions that can result from changing streaming channels are mitigated. Further features of the various embodiments are as claimed in the dependent claims. Additional benefits and advantages of the embodiments will be apparent in view of the following description and accompanying Figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Embodiments of the present disclosure are illustrated by way of example, and not by way of limitation, in the Figures of the accompanying drawings in which like references indicate similar elements. It should be not-

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ed that different references to "an" or "one" embodiment in this disclosure are not necessarily to the same embodiment, and such references may mean at least one. Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to effect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0009] The accompanying drawings are incorporated into and form a part of the specification to illustrate one or more exemplary embodiments of the present disclosure. Various advantages and features of the disclosure will be understood from the following Detailed Description taken in connection with the appended claims and with reference to the attached drawing Figures in which:

FIG. 1 depicts an example streaming network environment including a content delivery network wherein one or more embodiments of the present patent application may be practiced:

FIG. 2 depicts a diagram of example stages involved in an illustrative acquisition and rendering process for streaming video content for purposes of the present patent disclosure;

FIGS. 3A-3C depict examples of various types of channel adjacencies according to one or more embodiments of the present patent disclosure;

FIG. 3D depicts a block diagram of an example streaming client device according to one embodiment;

FIGS. 4-6 depict flowcharts with blocks relative to various steps and acts that may take place at a client device according to one or more embodiments of the present patent application;

FIG. 7 depicts a flowchart with blocks relative to various steps and acts that may take place at an adaptive streaming server system according to one or more embodiments of the present patent application;

FIGS. 8-10 depicts flowcharts with blocks relative to various steps and acts that may take place at a client device according to one or more embodiments of the present patent application; and

FIG. 11 depicts another embodiment of an example streaming client device for purposes of the present patent application.

DETAILED DESCRIPTION OF THE DRAWINGS

[0010] In the following description, numerous specific details are set forth with respect to one or more embodiments of the present patent disclosure. However, it should be understood that one or more embodiments may be practiced without such specific details. In other instances, well-known circuits, subsystems, components, structures and techniques have not been shown in detail in order not to obscure the understanding of the example embodiments. Accordingly, it will be appreciated by one skilled in the art that the embodiments of the present disclosure may be practiced without such specific components-based details. It should be further recognized that those of ordinary skill in the art, with the aid of the Detailed Description set forth herein and taking reference to the accompanying drawings, will be able to make and use one or more embodiments without undue experimentation.

[0011] Additionally, terms such as "coupled" and "connected," along with their derivatives, may be used in the following description, claims, or both. It should be understood that these terms are not necessarily intended as synonyms for each other. "Coupled" may be used to indicate that two or more elements, which may or may not be in direct physical or electrical contact with each other, co-operate or interact with each other. "Connected" may be used to indicate the establishment of communication, i.e., a communicative relationship, between two or more elements that are coupled with each other. Further, in one or more example embodiments set forth herein, generally speaking, an element, component or module may be configured to perform a function if the element is capable of performing or otherwise structurally arranged to perform that function.

[0012] As used herein, a network element or node may be comprised of one or more pieces of service network equipment, including hardware and software that communicatively interconnects other equipment on a network (e.g., other network elements, end stations, etc.), and is adapted to host one or more applications or services with respect to a plurality of subscribers. Some network elements may comprise "multiple services network elements" that provide support for multiple network-based functions (e.g., A/V media management, session control, QoS policy enforcement, bandwidth scheduling management, subscriber/device policy and profile management, content provider priority policy management, streaming policy management, and the like), in addition to providing support for multiple application services (e.g., data and multimedia applications). Subscriber end stations or client devices may comprise any device configured to execute, *inter alia,* at least one streaming client application (e.g., an ABR streaming client application) for receiving content from a streaming server or content provider. Accordingly, such client devices may include set-top boxes, PVR/DVRs, workstations, laptops, netbooks, palm tops, mobile phones, smartphones, multimedia phones, Voice Over Internet Protocol (VOIP) phones, mobile/wireless user equipment, high definition TV terminals, portable media players, location-aware subscriber equipment gaming systems or consoles (such as the Wii®, Play Station 3®, Xbox 360®), etc., that may access or consume content/services provided over a content delivery network in accordance with one or more embodiments set forth herein. Further, the client devices may also access or consume content/services provided over broadcast networks (e.g., cable and satellite networks) as well as a packet-switched wide area public network such as the

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Internet via suitable service provider access networks. In a still further variation, the client devices or subscriber end stations may also access or consume content/services provided on virtual private networks (VPNs) overlaid on (e.g., tunneled through) the Internet.

[0013] One or more embodiments of the present patent disclosure may be implemented using different combinations of software, firmware, and/or hardware. Thus, one or more of the techniques shown in the Figures (e.g., flowcharts) may be implemented using code and data stored and executed on one or more electronic devices or nodes (e.g., a subscriber client device or end station, a network element, etc.). Such electronic devices may store and communicate (internally and/or with other electronic devices over a network) code and data using computer-readable media, such as non-transitory computer-readable storage media (e.g., magnetic disks, optical disks, random access memory, read-only memory, flash memory devices, phase-change memory, etc.), transitory computer-readable transmission media (e.g., electrical, optical, acoustical or other form of propagated signals - such as carrier waves, infrared signals, digital signals), etc. In addition, such network elements may typically include a set of one or more processors coupled to one or more other components, such as one or more storage devices (e.g., non-transitory machine-readable storage media) as well as storage database(s), user input/output devices (e.g., a keyboard, a touch screen, a pointing device, and/or a display), and network connections for effectuating signaling and/or bearer media transmission. The coupling of the set of processors and other components may be typically through one or more buses and bridges (also termed as bus controllers), arranged in any known (e.g., symmetric/shared multiprocessing) or heretofore unknown architectures. Thus, the storage device or component of a given electronic device or network element may be configured to store code and/or data for execution on one or more processors of that element, node or electronic device for purposes of implementing one or more techniques of the present disclosure.

[0014] Referring now to the drawings and more particularly to FIG. 1, depicted therein is an example streaming network environment 100 including a content delivery network or content distribution network (CDN) 122 coupled to an adaptive streaming server system 102 wherein one or more embodiments of the present patent application may be practiced. For purposes of the present patent application, CDN 122 may comprise an overlay network architected for high-performance streaming of a variety of digital assets or program assets as well as services (hereinafter referred to as "media content") to subscribers using one or more Internet-based infrastructures, private/dedicated infrastructures or a combination thereof. In general, the terms "media content" or "content file" (or, simply "content") as used in reference to at least some embodiments of the present patent disclosure may include digital assets and program assets such as any type of audio/video content or program segment, streaming or static (e.g., recorded over-the-air free network television (TV) shows or programs, pay TV broadcast programs via cable networks or satellite networks, free-to-air satellite TV shows, IPTV programs, etc.), Over-The-Top (OTT) and video-on-demand (VOD) or movie-on-demand (MOD) shows or programs, time-shifted TV (TSTV) content, as well as other content assets provided by content publishers, owners or providers, including but not limited to software files, executable computer code or programs, online electronic games, Internet radio shows/programs, entertainment programs, educational programs, movies, music video programs, and the like, that may be delivered using any known or heretofore unknown streaming technologies. Further, various programs or content files provided via streaming may be arranged as a collection or assembly of channels that are specific to different subscribers, wherein different channels may comprise media content from one or more content sources or originators.

[0015] By way of illustration, content may be delivered via CDN 122 using adaptive bit rate (ABR) streaming techniques and may be encoded to support Microsoft® Silverlight® Smooth Streaming, HTTP streaming (for instance, Dynamic Adaptive Streaming over HTTP or DASH, HTTP Live Streaming or HLS, HTTP Dynamic Streaming or HDS, etc.), Icecast, and so on. In general, the overlay architecture of CDN 122 may include a multi-level, hierarchically-organized interconnected assembly of network servers for providing media pathways or "pipes" from one or more central distribution nodes to one or more levels of regional distribution nodes that are connected to one or more local edge servers configured to serve a plurality of end users or subscribers in respective serving location areas. In addition to such "distribution servers" (sometimes also referred to as "surrogates"), CDN 122 may also include and/or interoperate with various network elements configured to effectuate request redirection or rerouting mechanisms as well as related back office systems such as subscriber management systems, bandwidth scheduling systems, account/billing systems and the like, that may be deployed as part of a streaming network back office (not specifically shown).

[0016] The streaming network environment 100 includes one or more subscriber end stations, as illustrated by an example client device or user equipment (UE) device 124 associated with a subscriber/customer for consuming content delivered via CDN 122 in any type or number of access technologies including broadband access via wired and/or wireless (radio) communications. For purposes of the present patent application, the terms "streaming client device" and "client device" may be used synonymously and may comprise any UE device or appliance that in one implementation not only receives program assets for live viewing, playback and/or decoding the content, but also operates as a command console or terminal that can accept user inputs, commands or re-

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quests to interact with a network element disposed in CDN 122 and/or the associated streaming server systems 102 for requesting content that may be selectively rendered at an internal display screen 126 and/or one or more external audio/visual (A/V) devices (not specifically shown). As such, the example client device 124 may include one or more streaming client modules 128 (e.g., an ABR streaming client) and associated decoding functionalities 134 depending on the streaming technologies implemented, each operating in association with a processor module 130 and video buffer memory 132 for effectuating acquisition, decoding and rendering of the streamed media content. Although not specifically shown, the client device 124 also includes appropriate user interfaces for viewing one or more electronic program guides that list, identify or otherwise show the various streaming channels the subscriber is able to receive. Such user interfaces may also be configured to allow the user to scroll through an electronic program guide (i.e., channel surfing), select or otherwise change a particular streaming channel, and the like. Further, as will be described in additional detail hereinbelow, the client device 124 includes appropriate structures and modules for facilitating such functionalities as channel surfing and channel selection within an adaptive streaming network environment.

[0017] Continuing to refer to FIG. 1, the example adaptive streaming server system 102 may be configured to accept media content from live sources 104A and/or static file sources 104B. In general operation, the example streaming server system 102 may be configured, under the control of one or more processors 108 executing appropriate program code stored in a persistent memory module 109, to effectuate adaptive streaming of content as follows. Initially, source media content is transcoded or otherwise encoded with different bit rates (e.g., multi-rate transcoding) using applicable encoder(s) 106. For example, a particular program content may be transcoded into five video files using variable bit rates, ranging from low to high bit rates (500 Kbps to 10 Mbps, by way of illustration). The particular content is therefore encoded as five different "versions" or "formats", wherein each bit rate is called a profile or representation. Reference numeral 110 refers to a collection of media streams encoded at different bit rates by the encoder 106. A segmentation server or segmenter 112 is operative to divide each version of the encoded media content into fixed duration segments or chunks, which are typically between two and ten seconds in duration, thereby generating a plurality of chunk streams 114. One skilled in the art will recognize that shorter segments may reduce coding efficiency whereas larger segments may impact the adaptability to changes in network throughput and/or fast changing client behavior. Regardless of the chunk size, the segments may be Group-of-Pictures (GOP)-aligned such that all encoding profiles have the same segments. One or more suitable Manifest Files are then created that describes the encoding rates and Universal Resource Locator (URL) pointers the various segments of encoded content. In one implementation, the Manifest File (MF), a Delivery Format (DF) and means for conversion from/to existing File Formats (FF) and Transport Streams (TS) may be provided by an origin server 116 as part of adaptive streams 120 to the client device 124 over CDN 122, which uses HTTP to fetch the encoded segments based on the URLs. Additionally, an error correction mechanism 118 may also be implemented, either as part of the streaming server system 102 or as a separate network element, in order to reduce transmission errors in the end-to-end streaming of the encoded media content. It should be apparent that the error correction mechanism 118 may be protocol-specific (e.g., Transmission Control Protocol or TCP), although other error correction schemes may also be used additionally or alternatively.

[0018] Still continuing to refer to FIG. 1, the media stream segments received by the client device 124 may be buffered, as needed, and decoded and played back (i.e., rendered) in sequence, either at the local display 126 or at an external A/V device associated with the client device 124. The ABR streaming client module 128 may be designed to select an optimum profile of each segment so as to maximize quality without risking buffer underflow and stalling (i.e., rebuffering) of the play-out. Each time the client device 124 fetches a segment, it may choose the profile based on the measured time to download the previous one or several segments.

[0019] It will be recognized that changing media content (i.e., from one streaming channel to another streaming channel) in an adaptive streaming environment such as the example network arrangement 100 shown in FIG. 1 can be a cumbersome process, especially in fast channel changing conditions. That is because adaptive streaming typically requires that appropriate video buffers be filled to certain levels before rendering, in addition to content segments encoded in high bit rates (i.e., "high bit rate content") being preferred to the same content segments encoded in low bit rates (i.e., "low bit rate content"), etc. Further, as several processing events or stages need to take place in a sequential order before the received media content can be properly rendered (i.e., played back), changing channels can yield an unacceptable viewing experience (e.g., stuttering, jitter, pixelation, etc.) because of the delays and/or interruptions introduced in the overall receive-decode-rendering process. Several embodiments will be set forth in detail hereinbelow, which relate to server-side processes and structures, client-side processes and structures, or both, that address the foregoing issues.

[0020] FIG. 2 depicts a diagram of example stages involved in an illustrative streaming media acquisition and rendering process 200 according to an embodiment of the present patent disclosure. As described above, a client device first obtains, receives or otherwise acquires certain metadata, e.g., manifest files, with respect to media transport streams (block 202). Based on the information contained in the manifest files, various pieces of in-

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itialization information are obtained or otherwise acquired (block 204). Such initialization information may comprise, *inter alia,* Sequence Parameters Set (SPS), Picture Parameters Set (PPS), one or more codec headers such as, e.g., MPEG-2 sequence headers, or High Efficiency Video Coding (HEVC) headers, or AC3 (audio) headers, and any data necessary to decode at least one or more frames, or depending on the granularity of prediction, one or more slices (which are spatially distinct regions of a frame that are encoded separately from other regions of that frame), and/or any combination thereof. Such encoded frames may comprise I-frames (Intra-coded pictures). B-frames (Bi-predictive pictures), or P-frames (Predictive pictures). Likewise, slices may comprise I-slices, B-slices or P-slices, Using the initialization information, encoded media content or data is then obtained or retrieved (block 206) and buffered (208). As appropriate levels of buffer data become available, such data is decoded (210) and then provided to a display screen for rendering (212), using suitable decoder/rendering engines.

[0021] In accordance with the teachings of the present patent disclosure, at least one or more stages of the process flow 200 set forth above may be performed in an anticipatory manner such that those process stages may be "pre-performed". Accordingly, certain basic information necessary to decode streaming media content is made readily available to an adaptive streaming client by virtue of pre-performing some of the early process stages. As a consequence, the adaptive streaming client can promptly utilize the already available information (i.e., "pre-fetched" information) to quickly adjust to a new channel when a user decides to scroll through the channels and/or select a particular channel thereafter. In further accordance with the teachings of the present patent disclosure, anticipatory pre-performance of certain process stages as set forth in the foregoing may be implemented for a select number of streaming channels that are determined to be "adjacent" with respect to a current streaming channel based on predictive channel surfing behavior, channel categorization, adaptive learning, pattern recognition, and other criteria.

[0022] FIGS. 3A-3C depict examples of various types of channel adjacencies according to one or more embodiments of the present patent disclosure. In example 300A shown in FIG. 3A, one or more adjacent channels may be determined as a configurable number of consecutive channels that are above the current streaming channel (i) (e.g., (i+2) channels), or as a configurable number of consecutive channels that are below the current streaming channel (i) (e.g., (i-3) channels), or both. In another embodiment, example 300B shown in FIG. 3B illustrates a scenario where channels may be grouped based on content categorization. Such categories may be defined as user-based "favorites lists", for example. Accordingly, all channels belonging to category "x" may be deemed to be adjacent with respect to one another. FIG. 3C illustrates a scenario where a user's surfing behavior pattern (e.g., over a period of time) may be used to identify whether the user is likely to surf in one direction or the other direction and then selecting adjacent channels in the direction.

[0023] Those skilled in the art should appreciate that the foregoing examples of channel adjacencies merely represent a non-exhaustive list, as there can be numerous variations, methodologies, determinations and schemes by which adjacency may be implemented. Channel adjacencies may also be dynamically changed from default settings and may be configured to vary from one scheme to another based on users' viewing habits, etc. It should also be recognized that certain channel adjacency implementations may depend on how electronic program guides are organized and presented to the users. Accordingly, for purposes of at least some embodiments of the present patent disclosure, an adjacent channel is a streaming channel for which certain process stages shown in FIG. 2 are preemptively performed. Moreover, the number of adjacent channels for which metadata is pre-fetched may be dependent on certain performance/resource constraints pertaining to the client device itself, e.g., current bandwidth conditions, the number of available decoders, buffer conditions, decode processing conditions, and the like.

[0024] Referring now to FIG. 3D, depicted therein is a block diagram of an example streaming client device 350 according to one embodiment wherein one or more aspects of the present patent disclosure may be practiced. It should be appreciated that the streaming client device 350 is a UE device that is generally representative of the subscriber/client device 124 illustrated in FIG. 1, and may include appropriate hardware/software components and subsystems that may augment or otherwise rearrange the blocks shown as part of the client device 124. Broadly, such hardware/software components and subsystems may be configured for performing any of the device-side processes (either individually or in any combination thereof) described hereinabove, which may be rearranged when taken in view of one or more processes described below. A processor module 302 including one or more microcontrollers/processors is provided for the overall control of the client UE device 350 and for the execution of various stored program instructions embodied in a persistent memory 315 that may be part of a memory subsystem 311 of the device 350. Also, one or more video buffers 319 may be included in the memory subsystem 311 for storing video streaming data. Controller/processor complex referred to by reference numeral 302 may also be representative of other specialty processing modules such as graphic processors, video processors, digital signal processors (DSPs), and the like, operating in association with suitable video and audio interfaces 314, 316 for receiving/transmitting content data, which interfaces may include or operate in conjunction with appropriate tuners, demodulators, descramblers, MPEG decoders/demuxes. For example, the client device 350 may be configured to operate with a number

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of known audio formats (e.g., MP3. AAC, AAC+, eAAC+, FLAC WMA, WAV, AMR, OGG, DTS, AC3, LPCM and MIDI) as well as video formats such as, e.g., MPEG4, H.263, H.264, DivX, XviD, WMV, AVI, 3GO, Flash Video, etc. A location-based and/or satellite communications interface 306 may be provided in certain embodiments for effectuating satellite-based communications. Other I/O or interfaces may include one or more user interfaces 320 generally illustrative of a graphic user interface (GUI), touch-sensitive screen, keyboard, microphone, etc., that may be used for inputting commands to effectuate, *inter alia,* channel surfing, channel selection, program guide manipulation, and the like. Additionally, one or more USB/HDMI/DVI/FireWire ports 318 may be provided for effectuating connections to one or more external A/V devices whereby the decoded media content may be rendered externally. Broadband network connectivity may be achieved via interfaces such as Ethernet I/F 308 as well as short-range and wide area wireless connectivity interfaces 312. In one implementation of the client device 350, a hard disk drive (HDD) system (not specifically shown) may be provided for mass storage of program assets such as A/V media, TV shows, movie titles, multimedia games, etc. Also included in the client/UE, device 350 is a suitable power supply 322, which may include AC/DC power conversion to provide power for the device 350. It should be appreciated that the actual power architecture for the client/US device 350 may vary by the hardware platform used, e.g., depending upon the core SoC (System on Chip), memory, analog front-end, analog signal chain components and interfaces used in the specific platform, and the like.

[0025] For purposes of the present patent application, the stored program instructions embodied in the persistent memory 315 (e.g., Flash memory) of the client device 350 may include computer-readable instructions configured to perform one or more device-side processes, selectively in conjunction with other subsystems or logic blocks such as one or more ABR streaming client and decode logic modules 310 and ether subsystems such as a channel change controller, bandwidth and other performance monitors, as well as view mode and channel adjacency determination mechanisms, all collectively referred to by reference numeral 304. Further, an optional local or included display 313 may also be provided as part the client device 350 for rendering received content locally (for example, in a number of resolutions such as Standard Definition, Enhanced Definition or High Definition) in addition to operating as a touch-sensitive screen.

[0026] In one aspect of the present patent disclosure, the various modules, blocks and subsystems set forth above may be configured to effectuate efficient display of adjacent channels through pre-fetched metadata in an adaptive streaming environment. In general, the client device 350 may be configured to operate in two functional modes: (i) a "viewing" mode in which certain data may be pre-fetched in addition to delivering high quality video; and (ii) a "channel changing" or "channel surfing" mode in which fetching low quality or "good enough" quality video to display rapidly changing channels is the main concern. The client device 350 may be in "viewing" mode if no channel is changed after or within a configurable period of time (e.g., 30 seconds). On the other hand, the client device 350 may be in "channel changing" mode if the channel has recently been changed (e.g., less than 30 seconds).

[0027] At least a portion of the modules, blocks and subsystems of the client device 350 are operable to effectuate one or more of the following processes and subprocesses under the control of processor 302 for purposes of facilitating efficient display of adjacent streaming channels according to one or more embodiments of the present patent application. Referring to an embodiment of process 400 shown in FIG. 4, the client device 350 may be configured to monitor current bandwidth conditions (e.g., relative to the network connection such as connection 136 shown in FIG. 1 as well as any other distributions pipes involved in the end-to-end distribution path through the CDN) and other performance conditions, as set forth at block 402. Responsive to the monitored conditions, a determination may be made as to how many adjacent channels for which certain metadata information is to be pre-fetched. In an illustrative example, if 2 Mb of bandwidth is currently available (after accounting for whatever bandwidth is being utilized for the current streaming session), assuming that each channel requires 400 Kb of bandwidth to fetch its metadata, a determination could be made that the client device is capable of fetching metadata for five adjacent channels. As described previously, various constructs of channel adjacencies may be implemented, including, e.g., user-specific or user-defined lists, operator-defined lists, based on program guide implementations, content categories, language-based definitions, static or fixed configurations, etc. In a predictive behavior modeling approach, if the user has pressed up three channels (i.e., scrolled up three times) within a specified period of time, a probabilistic determination can be made that the user is likely to scroll up again rather than down, for example. Accordingly, a certain number of channels above the current channel may be deemed to be the adjacent channels for which metadata will be pre-fetched. The foregoing operations are illustrative of the acts and functions set forth at block 404 of the process flow 400.

[0028] After determining one or more adjacent channels (e.g., relative to a current streaming channel), metadata information for the adjacent channels is obtained, requested, retrieved, or otherwise pre-fetched from the associated server system(s) (block 406). In one adaptive streaming implementation, such metadata may comprise appropriate manifest files relative to the encoded media content streaming on the adjacent channels. The streaming client logic executing on the client device 350 is operable to parse the pre-fetched metadata information, and responsive thereto, determine where to go to obtain initialization information for the adjacent channels (block

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408). As previously described, such initialization information may comprise at least one of SPS/PPS information, one or more codec headers, and the minimum amount of metadata necessary to decode slices/frames. Accordingly, based on the pre-fetched metadata information, the client device 350 is further operable to pre-fetch or pre-download the adjacent channels" initialization information, which may be locally stored in memory (block 408). If the current streaming channel is changed to a new streaming channel belonging to the group of adjacent channels (decision block 410), the initialization information for the new streaming channel (which is readily/locally available because it was pre-fetched) is used by the client device 350 to quickly fetch the required media content from appropriate locations (block 414). In one implementation, the streaming client logic executing on the client device 350 may be configured to request for only the media content that is encoded at a select bit rate, e.g., the lowest bit rate, by the streaming server's encoder. Additionally or alternatively, the client device 350 may also request for the encoded media content that is segmented into shorter segments.

[0029] If there is no channel changing, the client device 350 may continue to monitor the bandwidth conditions, buffer resources, and processing conditions so that new or modified channel adjacencies may continue to be (re)established or otherwise (re)determined (blocks 412, 402, 404). If the user settles into a particular channel (i.e., "viewing" mode) as set forth at decision block 416, the streaming client logic executing on the client device 350 may be configured to request for the media content that is encoded at higher bit rates, potentially going all way to the highest bit rate profiles possible (i.e., ramping up). Additionally or alternatively, the client device 350 may also request for the encoded media content that is segmented into larger segments. Accordingly, it should be appreciated that once the client device 350 is in "viewing" mode, media content with highest QoS may be presented to the user relatively quickly. These operations are illustratively set forth at block 418. Thereafter, the client device 350 may (re)establish or otherwise (re)determine newer channel adjacencies based on the monitored conditions as described previously.

[0030] One skilled in the art will recognize upon reference hereto that by executing the above-described pre-fetching operations, at least process stages 202 and 204 illustrated in FIG. 2 may be advantageously circumvented at the time of channel changing, thereby gaining a "head start" when the channel is changed. As the media content for the new channel is more readily available, albeit at low bit rate profiles and/or shorter segments (at least initially), the decoder/renderer engine of the client device can quickly process the media content so that at least some of the image rendering issues that can arise in a typical channel-changing streaming environment may be alleviated.

[0031] Referring now to FIG. 5, shown therein is another embodiment of a process flow 500 that may be implemented by a streaming client device (e.g., client device 350) having multiple streaming client applications and corresponding decoders for achieving additional efficiencies in a channel changing environment. Similar to the process flow 400 described above, the process flow 500 includes blocks 502-506 where the client device 350 may continue to monitor the bandwidth conditions, buffer resources, processing conditions, etc., so that appropriate channel adjacencies may be determined and metadata and initialization data may be pre-fetched. Using the pre-fetched initialization information, the client device 350 proceeds to fetch the adjacent channels' media content and begins to decode immediately (block 508). In other words, the client device 350 is operative to decode multiple streams from the adjacent channels in parallel (by virtue of separate streaming clients/decoders) (i.e., pre-decoding), thereby gaining an additional head start with respect to the process stage of 210 shown in FIG. 2. It should be realized that early parts of media segments may comprise a "moof" atom (e.g., in Fragmented MP4 coding) that informs where all the video samples in the segments are and an IDR (Instantaneous Decoding Refresh) slice of the frames. At this point, the rendering engine of the client device 350 has enough information to put some pixels on the display screen. Accordingly, if the current streaming channel is changed to one of the adjacent channels, the rendering engine of the client device 510 can begin rendering immediately (because the pre-decoded media content is already available in appropriate video buffers) as set forth at block 510. Thereafter, the client device 350 may (re)establish or otherwise (re)determine newer channel adjacencies based on the monitored conditions as described previously with respect to FIG. 4.

[0032] FIG. 6 depicts a flowchart of a high-level channel buildup process 600 that may be executed by the example client device 350 at least relative to certain aspects of the present patent disclosure. At block 602, one or more lists of adjacent channels may be built, which in some embodiments may be prioritized based on user preferences, content provider policies, etc. As discussed above, various pieces of data (up to and including encoded media segments, in certain implementations) may be pre-fetched for each adjacent channel. At decision block 604, a determination may be made as to whether adjacent channel buildup is complete, i.e., if all the necessary pre-fetching operations for the channels determined to be adjacent have been concluded. If so, the process flow stops (block 606). Otherwise, pre-fetching/downloading operations may continue to be performed relative to the remaining adjacent channels (block 608).

[0033] Turning now to FIG. 7, depicted therein is a flowchart with blocks relative to various steps and acts that may take place at an adaptive streaming server system (e.g., server system 102 shown in FIG. 1) according to one or more embodiments of the present patent applica-

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tion with respect to facilitating fast channel changes in an adaptive streaming environment. In particular, process flow 700 of FIG. 7 illustrates various functionalities that may be effectuated - independently or in some combination or sub-combination thereof - by the processor complex 108 upon executing appropriate service logic stored in the persistent memory 109 and operating in conjunction with other subsystems (e.g., encoder 106, segmenter 112, error correction 118, etc.) of the server system 102. When a new stream of media content is started at the server system 102 (e.g., because of a user's channel change request), the service logic embodied in the persistent memory 109 may be configured to always commence streaming of the requested media content at a specific point (block 702) such as a Stream Access Point (SAP), which is a GOP random access point in the content stream guaranteed that all frames in the GOP are decodable. Additionally or alternatively, the service logic of the server system 102 may be configured to disable error correction mechanisms 118 for the transmission of the new stream to the client device 350 for a select period of time (block 704). It will be recognized that disabling a protocol-specific error correction mechanism may yield a non-standard protocol transmission of streaming data, but one without the error correction overhead, thereby facilitating a faster transmission rate to the client device 350. It should further be apparent that the timing windows during which an error correction mechanism is relaxed may be configurable or otherwise customizable, e.g., responsive to requests, commands, signals, etc. from the network and/or client device 350. In an additional or alternative variation, the service logic of the server system 102 may be configured to facilitate, at least initially, only transmission of the media content encoded at a select bit rate (e.g., lowest bit rate possible) and/or segmented into shortest segments by the segmenter 112, as set forth at block 706. Again, the initial period during which the streaming server's functionalities are conditionally modulated (e.g., a ramping up period) may be configurable responsive to requests from the client device 350 and/or other control signals from network management nodes. For instance, in one implementation, the error correction relaxation period and initial ramp up period may be provided to be the same. In another implementation, the two time periods may be different. In a still further implementation, responsive to receiving one or more requests from the client device 350 (e.g., messages, alarms, status indicators, etc.), the error correction mechanism may be enabled or re-enabled regardless of the entity or event that initially disabled the error correction mechanism when the new media stream was started. Additionally or alternatively, one or more requests from the client device 350 (e.g., URLs, pointers, indicators, etc.) may selectively instruct the server system 102 to begin transmitting the media content encoded at higher bit rates and/or in larger segments. By way of illustration, the client device 350 may send one URL (operative as a first URL, for example) *http://www.purple-frog.com/vid/665/r1/0000311.m4s* for low bit rate media content and another URL (operative as a second URL, for example) *http://www.purple-frog.com/vid/665/r2/0000311.m4s* for high bit rate media content. It should be realized that such requests may be generated by the client device in response to various conditions, *inter alia,* bandwidth conditions, quality of the rendered video, buffer conditions, decode processing conditions, and the like. Accordingly, the streaming functionality effectuated by the server system 102 may be conditionally modulated responsive to the various requests as set forth at block 708.

[0034] To facilitate fast channel changes in concert with the foregoing functionalities of the streaming server system 102, the client device 350 may also be configured accordingly to effectuate a number of processes - independently or in some combination or sub-combination thereof. FIG. 8 depicts a process flow 800 with blocks relative to various steps and acts that may take place at the client device 350. When a media content stream is newly started (e.g., due to a channel change request), the client device 350 is operative to initiate a request for only media content that is encoded in the lowest bit rate possible and/or in shortest segments (block 802). As the encoded media content is being received, the client device 350 may be configured to commence immediate decoding and rendering of the received media content, regardless of the buffer state. As described previously with respect to the embodiment of FIG. 5, such immediate decoding/rendering is possible upon receiving at least a minimum amount of information. Additionally or alternatively, the video buffer memory 319 may be prevented from being flushed during a ramp up period. The foregoing functionalities, illustratively set forth at block 804, may be effectuated by the channel change controller and buffer monitor 304, preferably operating in concert with the appropriate streaming client 310 under the control of the processor complex 302. Depending on the bandwidth conditions, video quality, etc., the client device 350 may gradually ramp up the requested bit rates and/or segment sizes (potentially requesting media content encoded at the highest bit rates possible and segmented into largest segments) by generating appropriate signals to the streaming server system 102. The client device 350 is also operative to send a signal or request to enable or re-enable error correction at the streaming server system 102 if the error correction was disabled initially. After the client device 350 has achieved a bit rate suitable for acceptable quality video (e.g., high quality), the client device 350 behaves normally in "viewing" mode until a new media content stream is requested. The foregoing functionalities are illustratively set forth at block 806. It should be appreciated that the various requests/signals described above may be generated by the client device 350 at different times (i.e., asynchronous with respect to one another), and after expiration of select/customizable time periods from the time when the new stream is started.

[0035] FIG. 9 depicts an example user viewing expe-

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rience 900 that may be achieved by implementing an embodiment of the streaming server system 102 and client device 350 as set forth above. At block 902, the client device 350 (e.g., a streaming A/V player) is turned on and a select channel media content is requested. At block 904, the requested media content begins playing with video and audio in sync, although the rendered content may be at a low quality. At block 906, the user changes the channel, whereupon the new media content is played with video and audio in sync (block 908). Again, the overall quality of the new media content may be low, as there may be audio and/or visual glitches in the rendering. When the user settles on a channel, the media content of that channel gradually ramps up to the highest bit rate possible (potentially within in a few seconds), with the video buffer filling up accordingly (block 912).

[0036] FIG. 10 depicts a flowchart of a high-level channel changing process 1000 that may be executed by the example client device 350 at least relative to certain aspects of the present patent disclosure. At block 1002, a channel change is started, whereupon the client device 350 initially receives a lowest quality stream (1004). The received low quality stream is decoded and rendered as immediately as possible (block 1006). The bit rates, segment sizes and quality in general are ramped up until normal/acceptable quality is achieved, as set forth at blocks 1008, 1010. Thereafter, the client device 350 behaves normally in "viewing" mode until a new media content stream is requested, as described above.

[0037] FIG. 11 depicts anther embodiment of an example streaming client device 1100, which is representative of a portion of the client device 350, for purposes of the present patent application. A channel change controller 1106 is provided with communication paths 1105, 1107 to intercept, interrupt, or otherwise control the operations relative to a video buffer 1104 that is operative to store an incoming video stream and a decoder/renderer 1108, respectively. The decoder/renderer 1108 is coupled to the video buffer 1104 via a communication path 1109 and to a display screen 116 via a communication path 1114. In normal viewing operations, the decoder/renderer 1108 is operative to decode the buffered data when certain levels are achieved/maintained. Example decoded data is illustratively shown as header data 1110 and I/B/P frames or slices 1112 that may be provided to the display screen 1116 for forming images thereon. In channel changing conditions, on the other hand, the decoder/renderer 1108 is forced to process the video buffer data even if there is only a minimum amount of data.

[0038] Based upon the foregoing Detailed Description, it should be appreciated that the embodiments of the present disclosure can be advantageously implemented to facilitate channel changing in streaming environments. By pre-fetching certain initialization data in a predictive manner, a head start may be achieved in the overall media acquisition-decode-rendering process, thereby reducing the switching-induced delays that typically give rise to an unacceptable viewing experience. Accordingly, a channel surfing experience similar to one that is commonly expected in existing TV broadcast environments may be provided in an adaptive streaming network.

[0039] In the above-description of various embodiments of the present disclosure, it is to be understood that the terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the invention. Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. It will be further understood that terms, such as those defined in commonly used dictionaries, should be interpreted as having a meaning that is consistent with their meaning in the context of this specification and the relevant art and may not be interpreted in an idealized or overly formal sense expressly so defined herein.

[0040] At least some example embodiments are described herein with reference to block diagrams and/or flowchart illustrations of computer-implemented methods, apparatus (systems and/or devices) and/or computer program products. It is understood that a block of the block diagrams and/or flowchart illustrations, and combinations of blocks in the block diagrams and/or flowchart illustrations, can be implemented by computer program instructions that are performed by one or more computer circuits. Such computer program instructions may be provided to a processor circuit of a general purpose computer circuit, special purpose computer circuit, and/or other programmable data processing circuit to produce a machine, so that the instructions, which execute via the processor of the computer and/or other programmable data processing apparatus, transform and control transistors, values stored in memory locations, and other hardware components within such circuitry to implement the functions/acts specified in the block diagrams and/or flowchart block or blocks, and thereby create means (functionality) and/or structure for implementing the functions/acts specified in the block diagrams and/or flowchart block(s). Additionally, the computer program instructions may also be stored in a tangible computer-readable medium that can direct a computer or other programmable data processing apparatus to function in a particular manner, such that the instructions stored in the computer-readable medium produce an article of manufacture including instructions which implement the functions/acts specified in the block diagrams and/or flowchart block or blocks.

[0041] As alluded to previously, tangible, non-transitory computer-readable medium may include an electronic, magnetic, optical, electromagnetic, or semiconductor data storage system, apparatus, or device. More specific examples of the computer-readable medium would include the following: a portable computer diskette, a random access memory (RAM) circuit, a read-only memory (ROM) circuit, an erasable programmable read-only

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memory (EPROM or Flash memory) circuit, a portable compact disc read-only memory (CD-ROM), and a portable digital video disc read-only memory (DVD/Blu-ray). The computer program instructions may also be loaded onto or otherwise downloaded to a computer and/or other programmable data processing apparatus to cause a series of operational steps to be performed on the computer and/or other programmable apparatus to produce a computer-implemented process such that the instructions which execute on the computer or other programmable apparatus provide steps for implementing the functions/acts specified in the block diagrams and/or flowchart block or blocks. Accordingly, embodiments of the present invention may be embodied in hardware and/or in software (including firmware, resident software, microcode, etc.) that runs on a processor such as a digital signal processor, which may collectively be referred to as "circuitry," "a module" or variants thereof.

[0042] Further, in at least some additional or alternative implementations, the functions/acts described in the blocks may occur out of the order shown in the flowcharts. For example, two blocks shown in succession may in fact be executed substantially concurrently or the blocks may sometimes be executed in the reverse order, depending upon the functionality/acts involved. Moreover, the functionality of a given block of the flowcharts and/or block diagrams may be separated into multiple blocks and/or the functionality of two or more blocks of the flowcharts and/or block diagrams may be at least partially integrated. Finally, other blocks may be added/inserted between the blocks that are illustrated. Moreover, although some of the diagrams include arrows on communication paths to show a primary direction of communication, it is to be understood that communication may occur in the opposite direction relative to the depicted arrows.

[0043] Although various embodiments have been shown and described in detail, the claims are not limited to any particular embodiment or example. None of the above Detailed Description should be read as implying that any particular component, element, step, act, or function is essential such that it must be included in the scope of the claims. Reference to an element in the singular is not intended to mean "one and only one" unless explicitly so stated, but rather "one or more." Accordingly, those skilled in the art will recognize that the exemplary embodiments described herein can be practiced with various modifications and alterations within the scope of the claims appended below.

Claims

1. A method (400, 500) operative in a streaming client device (124, 350) disposed in an adaptive streaming environment (100), the method (400, 500) comprising:

   monitoring (402) at least a bandwidth condition relative to a network connection (136) between the streaming client device (124, 350) and a content delivery network (122);

   determining (404, 502) one or more adjacent channels relative to a current streaming channel of the streaming client device (124, 350);

   pre-fetching (406, 504) metadata information associated with the one or more adjacent channels;

   responsive to the pre-fetched metadata information, pre-fetching and storing (408, 506) initialization information for the one or more adjacent channels; and

   if the current streaming channel is changed (410) to a new streaming channel belonging to the one or more adjacent channels, using (414) the pre-fetched initialization information to fetch encoded media content pertaining to the new streaming channel.

2. The method (400, 500) as recited in claim 1, wherein the monitoring (402) further comprises monitoring at least one of video buffer conditions and decoder processing conditions of the streaming client device (124, 350).

3. The method (400, 500) as recited in claim 1, wherein the metadata information comprises manifest information associated with the respective one or more adjacent channels.

4. The method (400, 500) as recited in claim 1, wherein the initialization information corresponding to the one or more adjacent channels comprises at least one of a Sequence Parameters Set (SPS), a Picture Parameters Set (PPS), one or more codec headers, and data necessary to decode slices of frames.

5. The method (400, 500) as recited in claim 4, wherein the one or more codec headers comprise at least one of MPEG-2 sequence headers, High Efficiency Video Coding (HEVC) headers, and AC3 (audio) headers.

6. The method (400, 500) as recited in claim 1, wherein the one or more adjacent channels are determined as at least one of a first number of consecutive channels above the current streaming channel and a second number of consecutive channels below the current streaming channel, and further wherein the first number and the second number respectively range from 0 to a quantity based on the network bandwidth condition.

7. The method (400, 500) as recited in claim 1, wherein the one or more adjacent channels are determined as a group of streaming channels that belong to a content category to which the current streaming

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channel also belongs.

8. The method (400, 500) as recited in claim 1, wherein the one or more adjacent channels are determined based on predicting a user's behavioral patterns in a "channel surfing" mode when using the streaming client device (124, 350).

9. The method (400, 500) as recited in claim 8, wherein the "channel surfing" mode is ascertained responsive to detecting that the user has changed a plurality of channels within a select time period.

10. The method (400, 500) as recited in claim 1, further comprising:

using the pre-fetched initialization information, pre-fetching (508) encoded media content of the respective one or more adjacent channels ;
pre-decoding (508) the encoded media content; and
if the current streaming channel is changed to a new streaming channel belonging to the one or more adjacent channels, rendering (510) the pre-decoded media content to be displayed immediately.

11. The method (400, 500) as recited in claim 10, wherein the pre-fetched media content of the respective one or more adjacent channels comprises media content segments encoded at a low bit rate.

12. The method (400, 500) as recited in claim 11, further comprising:

after determining that a user has remained on the new streaming channel for a select time period, ascertaining (416) that the user is in a "viewing" mode;
sending (418) a request for streaming media content encoded at higher bit rates; and
continuing to monitor (402) at least one of the bandwidth conditions of the network connection (136), video buffer conditions and decoder processing conditions, to determine (404) one or more additional adjacent channels relative to the new streaming channel.

13. The method (400, 500) as recited in claim 12, further comprising sending (418) a request for streaming media content for the new streaming channel in larger segments.

14. A client device (124, 350) configured to perform the method of any of the preceding claims.

Patentansprüche

1. Verfahren (400, 500), das in einer Streaming-Client-Vorrichtung (124, 350) wirksam ist, die in einer adaptiven Streaming-Umgebung (100) angeordnet ist, wobei das Verfahren (400, 500) umfasst:

Überwachen (402) mindestens einer Bandbreitenbedingung in Bezug auf eine Netzwerkverbindung (136) zwischen der Streaming-Client-Vorrichtung (124, 350) und einem Content Delivery Network (122);
Bestimmen (404, 502) eines oder mehrerer benachbarter Kanäle relativ zu einem aktuellen Streaming-Kanal der Streaming-Client-Vorrichtung (124, 350);
Vorababrufen (406, 504) von Metadateninformationen, die einem oder mehreren Nachbarkanälen zugeordnet sind;
Vorababrufen und Speichern (408, 506) von Initialisierungsinformationen für einen oder mehrere Nachbarkanäle als Reaktion auf die vorab abgerufenen Metadateninformationen; und
Verwenden (414) der vorab abgerufenen Initialisierungsinformationen, um codierte Medieninhalte, die sich auf den neuen Streaming-Kanal beziehen, abzurufen, wenn der aktuelle Streaming-Kanal in einen neuen Streaming-Kanal geändert (410) wird, der zu einem oder mehreren Nachbarkanälen gehört.

2. Verfahren (400, 500) nach Anspruch 1, wobei das Überwachen (402) ferner ein Überwachen mindestens eines von den Videopufferbedingungen und den Decoder-Verarbeitungsbedingungen der Streaming-Client-Vorrichtung (124, 350) umfasst.

3. Verfahren (400, 500) nach Anspruch 1, wobei die Metadateninformationen Manifestinformationen umfassen, die dem entsprechenden einen oder den mehreren Nachbarkanälen zugeordnet sind.

4. Verfahren (400, 500) nach Anspruch 1, wobei die Initialisierungsinformationen, die dem einem oder den mehreren Nachbarkanälen entsprechen, mindestens eines von einem Sequenzparametersatz (Sequence Parameters Set, SPS), einem Bildparametersatz (Picture Parameters Set, PPS), einem oder mehreren Codec-Kopfsätzen und von Daten umfassen, die zum Decodieren von Rahmenscheiben erforderlich sind.

5. Verfahren (400, 500) nach Anspruch 4, wobei die einen oder mehreren Codec-Kopfsätze mindestens eines von MPEG-2-Sequenzkopfsätzen, High Efficiency Video Coding (HEVC)-Kopfsätzen und AC3 (Audio)-Kopfsätzen umfassen.

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6. Verfahren (400, 500) nach Anspruch 1, wobei der eine oder die mehreren Nachbarkanäle als mindestens eines von einer ersten Anzahl von aufeinanderfolgenden Kanälen oberhalb des aktuellen Streaming-Kanal und einer zweiten Anzahl von aufeinanderfolgenden Kanälen unterhalb des aktuellen Streaming-Kanals bestimmt werden, und wobei ferner die erste Anzahl und die zweite Anzahl jeweils im Bereich von 0 bis zu einer Menge liegt, die auf der Netzwerkbandbreitenbedingung begründet ist.

7. Verfahren (400, 500) nach Anspruch 1, wobei der eine oder die mehreren Nachbarkanäle als eine Gruppe von Streaming-Kanälen bestimmt werden, die zu einer Inhaltskategorie gehören, zu der auch der aktuelle Streaming-Kanal gehört.

8. Verfahren (400, 500) nach Anspruch 1, wobei der eine oder die mehreren Nachbarkanäle basierend auf einem Vorhersagen von Verhaltensmustern eines Benutzers in einem "Kanal-Surf"-Modus bei Verwendung der Streaming-Client-Vorrichtung (124, 350) bestimmt werden.

9. Verfahren (400, 500) nach Anspruch 8, wobei der "Kanal-Surf"-Modus als Reaktion auf ein Erfassen festgestellt wird, dass der Benutzer eine Vielzahl von Kanälen innerhalb eines ausgewählten Zeitraums geändert hat.

10. Verfahren (400, 500) nach Anspruch 1, ferner umfassend:

    Vorababrufen (508) eines codierten Medieninhalts des jeweiligen einen oder der mehreren Nachbarkanäle unter Verwendung der vorab abgerufenen Initialisierungsinformationen;
    Vordecodieren (508) des codierten Medieninhalts; und
    wenn der aktuelle Streaming-Kanal in einen neuen Streaming-Kanal geändert wird, der zu einem oder mehreren Nachbarkanälen gehört, Rendern (510) des vordecodierten Medieninhalts, der unmittelbar anzuzeigen ist.

11. Verfahren (400, 500) nach Anspruch 10, wobei der vorab abgerufene Medieninhalt des jeweiligen einen oder der mehreren Nachbarkanäle Medieninhaltssegmente umfasst, die mit einer niedrigen Bitrate codiert sind.

12. Verfahren (400, 500) nach Anspruch 11, ferner umfassend:

    nachdem bestimmt ist, dass ein Benutzer für einen ausgewählten Zeitraum auf dem neuen Streaming-Kanal verweilt ist, Feststellen (416), dass sich der Benutzer in einem "Betrachtungsmodus" befindet;
    Senden (418) einer Anforderung zum Streamen von Medieninhalten, die mit höheren Bitraten codiert sind; und
    Fortsetzen des Überwachens (402) mindestens einer von den Bandbreitenbedingungen der Netzwerkverbindung (136), den Videopufferbedingungen und den Decoder-Verarbeitungsbedingungen, um einen oder mehrere zusätzliche Nachbarkanäle in Bezug auf den neuen Streaming-Kanal zu bestimmen (404).

13. Verfahren (400, 500) nach Anspruch 12, ferner mit dem Schritt des Sendens (418) einer Anforderung zum Streamen von Medieninhalten für den neuen Streaming-Kanal in größeren Segmenten.

14. Client-Vorrichtung (124, 350), die konfiguriert ist, um das Verfahren eines der vorhergehenden Ansprüche auszuführen.

Revendications

1. Procédé (400, 500) opérationnel dans un dispositif client de transmission en continu (124, 350) disposé dans un environnement de transmission en continu adaptatif (100), le procédé (400, 500) comprenant :

    la surveillance (402) d'au moins une condition de bande passante relative à une connexion réseau (136) entre le dispositif client de transmission en continu (124, 350) et un réseau de diffusion de contenu (122) ;
    la détermination (404, 502) d'un ou de plusieurs canaux adjacents relatifs à un canal de transmission en continu actuel du dispositif client de transmission en continu (124, 350) ;
    la pré-extraction (406, 504) d'informations de métadonnées associées aux un ou plusieurs canaux adjacents ;
    en réponse aux informations de métadonnées pré-extraites, pré-extraction et stockage (408, 506) d'informations d'initialisation pour les un ou plusieurs canaux adjacents ; et
    si le canal de transmission en continu actuel est remplacé (410) par un nouveau canal de transmission en continu appartenant aux un ou plusieurs canaux adjacents, l'utilisation (414) des informations d'initialisation pré-extraites pour extraire du contenu multimédia codé relatif au nouveau canal de transmission en continu.

2. Procédé (400, 500) selon la revendication 1, dans lequel la surveillance (402) comprend en outre la surveillance de l'une au moins parmi des conditions de tampon vidéo et des conditions de traitement de décodeur du dispositif client de transmission en con-

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tinu (124, 350).

3. Procédé (400, 500) selon la revendication 1, dans lequel les informations de métadonnées comprennent des informations manifestes associées aux un ou plusieurs canaux adjacents respectifs.

4. Procédé (400, 500) selon la revendication 1, dans lequel les informations d'initialisation correspondant aux un ou plusieurs canaux adjacents comprennent au moins l'un parmi un ensemble de paramètres de séquence (SPS), un ensemble de paramètres d'image (PPS), un ou plusieurs en-têtes de codec, et des données nécessaires pour décodes des tranches de trames.

5. Procédé (400, 500) selon la revendication 4, dans lequel les un ou plusieurs en-têtes de codec comprennent au moins l'un parmi des en-têtes de séquence MPEG-2, des en-têtes de codage vidéo à haute efficacité (HEVC), et des en-têtes AC3 (audio).

6. Procédé (400, 500) selon la revendication 1, dans lequel les un ou plusieurs canaux adjacents sont déterminés comme l'un au moins parmi un premier nombre de canaux consécutifs au-dessus du canal de transmission en continu actuel et un deuxième nombre de canaux consécutifs en dessous du canal de transmission en continu actuel, et dans lequel le premier nombre et le deuxième nombre sont en outre respectivement compris entre 0 et une quantité basée sur la condition de bande passante de réseau.

7. Procédé (400, 500) selon la revendication 1, dans lequel les un ou plusieurs canaux adjacents sont déterminés comme un groupe de canaux de transmission en continu appartenant à une catégorie de contenu à laquelle appartient également le canal de transmission en continu actuel.

8. Procédé (400, 500) selon la revendication 1, dans lequel les un ou plusieurs canaux adjacents sont déterminés sur la base de modèles comportementaux d'utilisateur dans un mode de « navigation sur les canaux » lors de l'utilisation du dispositif client de transmission en continu (124, 350).

9. Procédé (400, 500) selon la revendication 8, dans lequel le mode de « navigation sur les canaux » est établi en réponse à la détection de la modification d'une pluralité de canaux par un utilisateur dans une période de temps sélectionnée.

10. Procédé (400, 500) selon la revendication 1, comprenant en outre :

l'utilisation des informations d'initialisation pré-extraites, la pré-extraction (508) de contenu multimédia codé des un ou plusieurs canaux adjacents respectifs ;
pré-décodage (508) du contenu multimédia codé; et
si le canal de transmission en continu actuel est remplacé par un nouveau canal de transmission en continu appartenant aux un ou plusieurs canaux adjacents, la restitution (510) du contenu multimédia pré-décodé pour un affichage immédiat.

11. Procédé (400, 500) selon la revendication 10, dans lequel le contenu multimédia pré-extrait des un ou plusieurs canaux adjacents respectifs comprend des segments de contenu multimédia codés à un débit binaire faible.

12. Procédé (400, 500) selon la revendication 11, comprenant en outre :

après avoir déterminé qu'un utilisateur est resté sur le nouveau canal de transmission en continu pour une période de temps sélectionnée, établissement (416) que l'utilisateur est dans un mode « visionnage » ;
l'envoi (418) d'une requête pour la transmission en continu de contenu multimédia codé à des taux binaires plus élevés ; et
la poursuite de la surveillance (402) de l'une au moins parmi les conditions de bande passante de la connexion réseau (136), les conditions de tampon vidéo et les conditions de traitement de décodeur, pour déterminer (404) un ou plusieurs canaux adjacents supplémentaires relatifs au nouveau canal de transmission en continu.

13. Procédé (400, 500) selon la revendication 12, comprenant en outre l'envoi (418) d'une requête pour la transmission en continu de contenu multimédia pour le nouveau canal de transmission en continu dans des segments plus grands.

14. Dispositif client (124, 350) configuré pour exécuter le procédé selon l'une quelconque des revendications précédentes.

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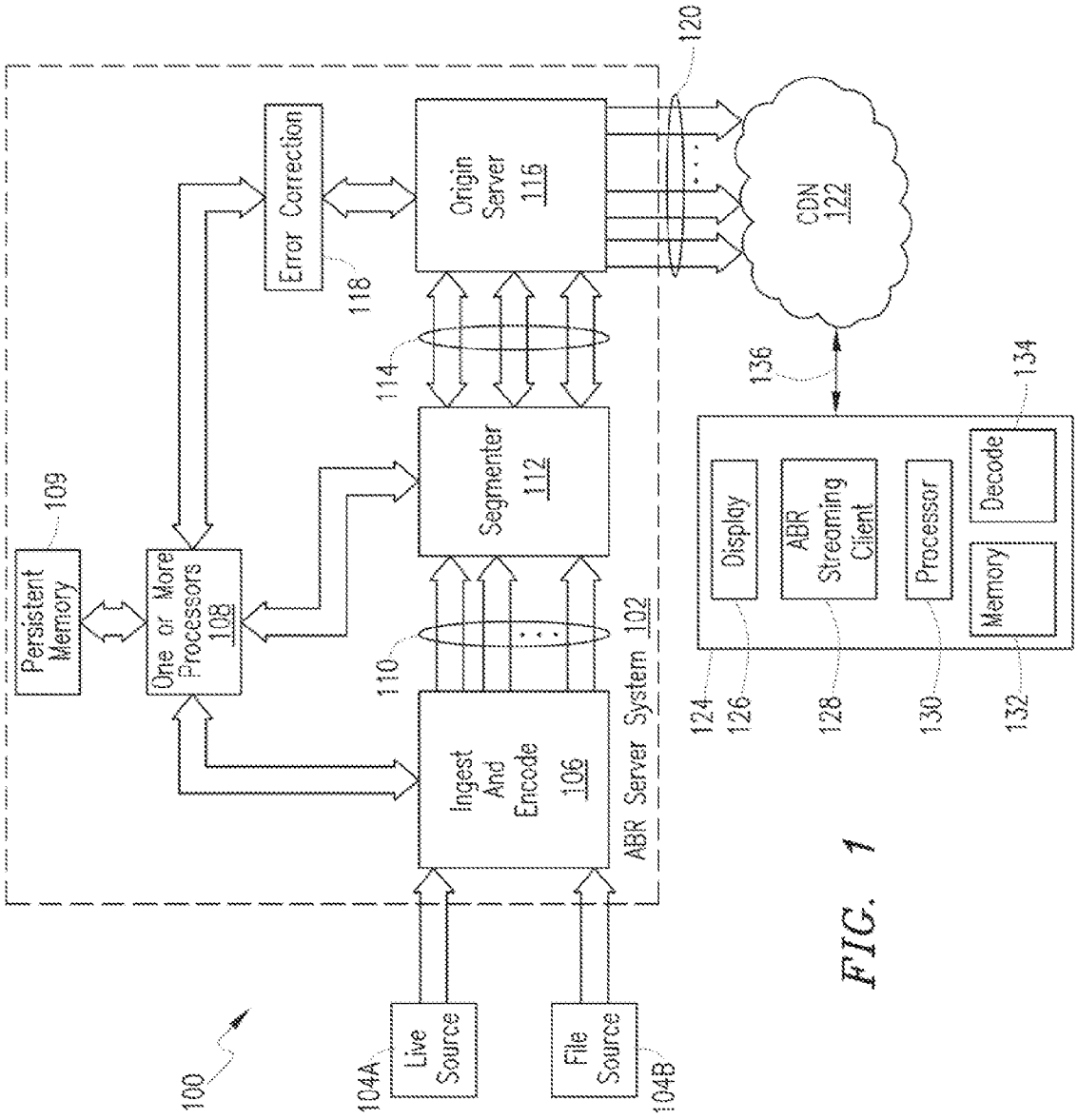


FIG. 1

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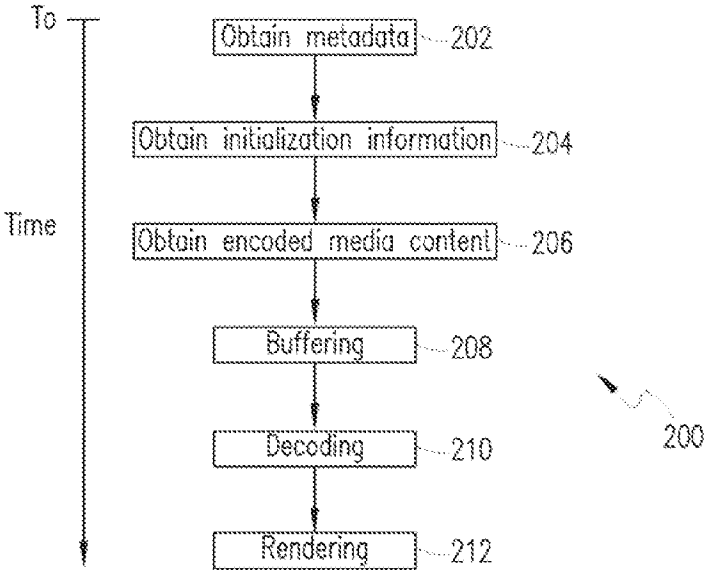


FIG. 2

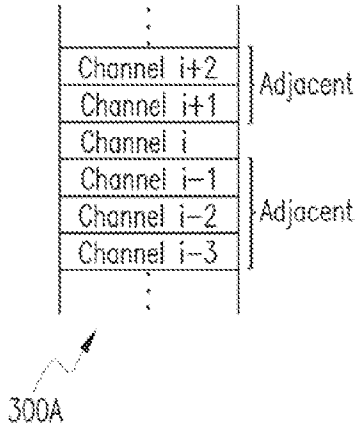


FIG. 3A

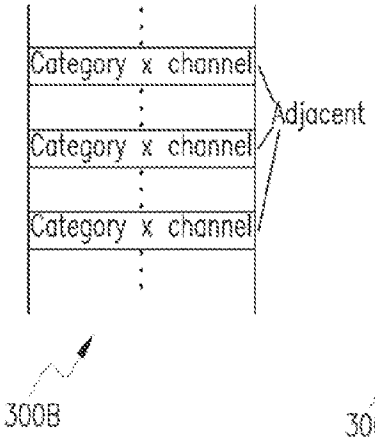


FIG. 3B

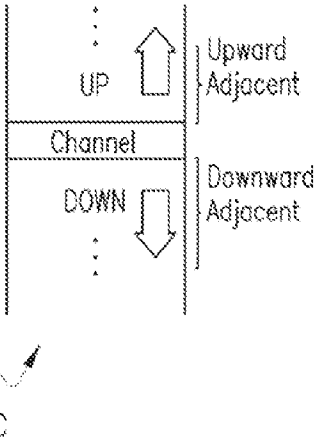


FIG. 3C

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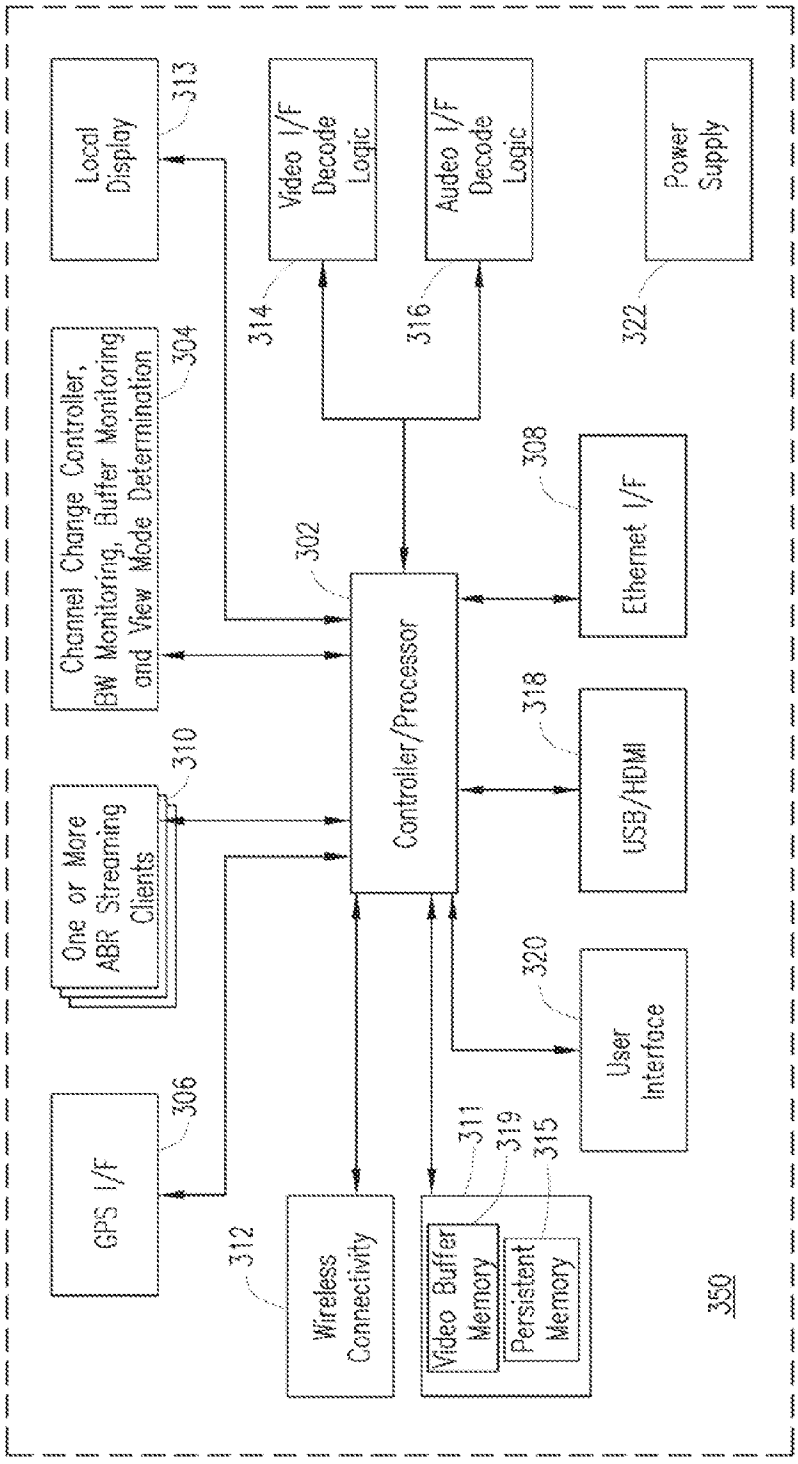


FIG. 3D

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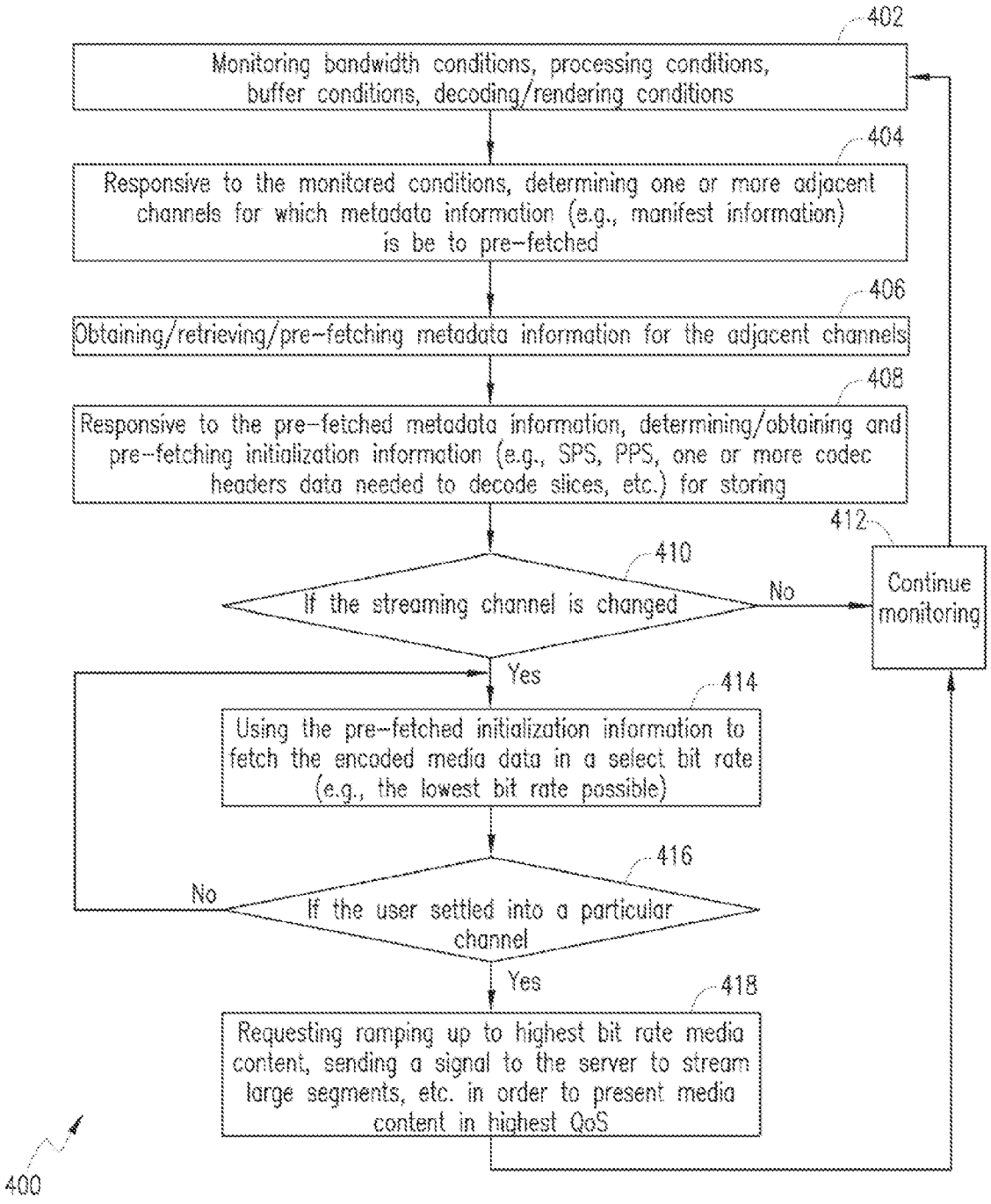


FIG. 4

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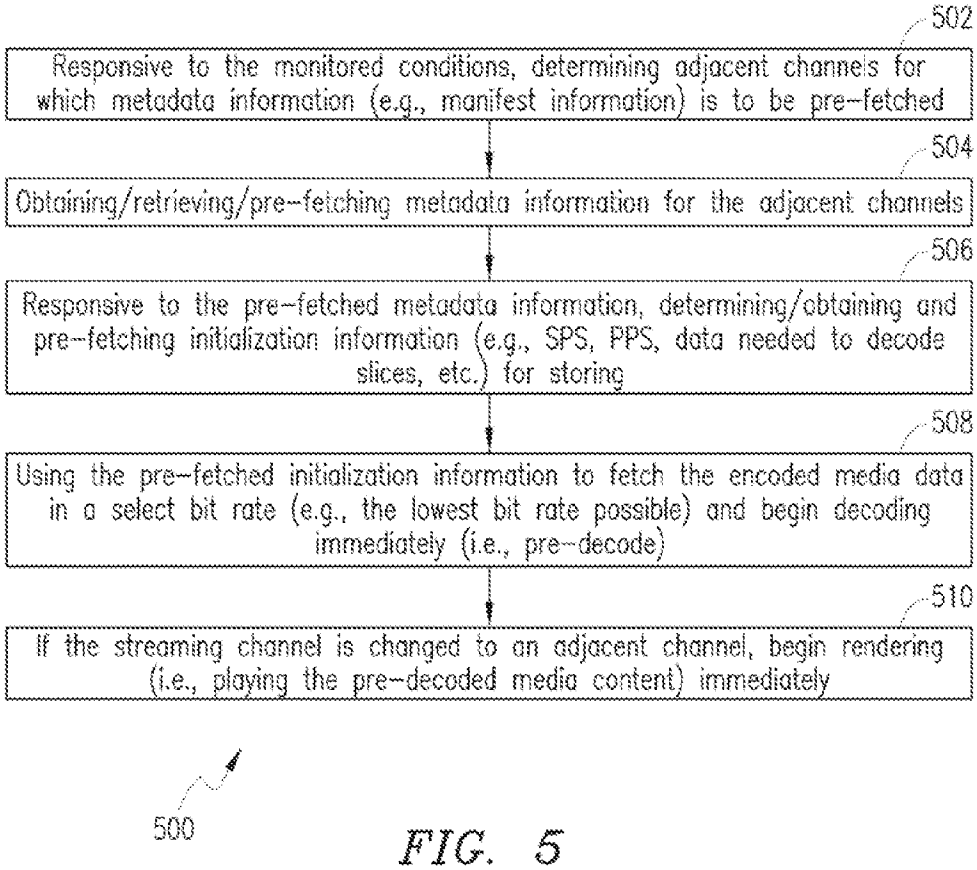


FIG. 5

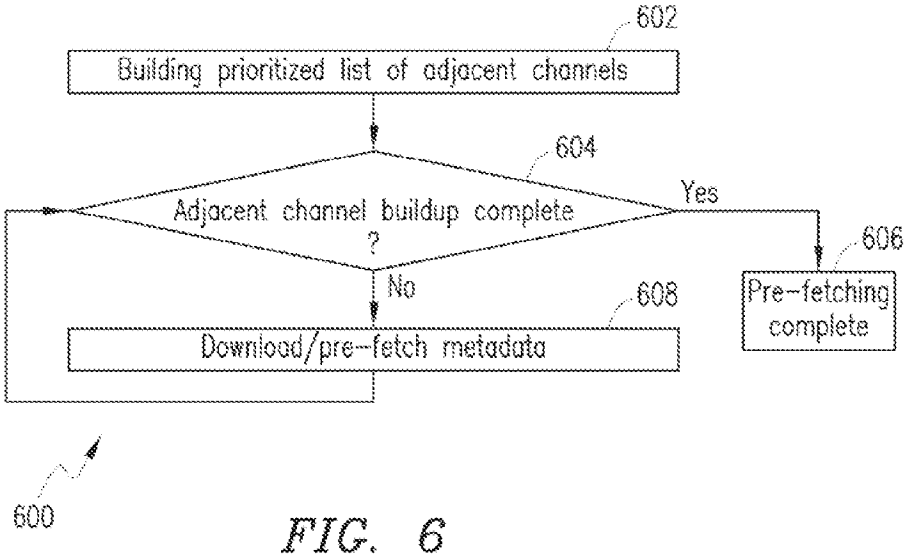


FIG. 6

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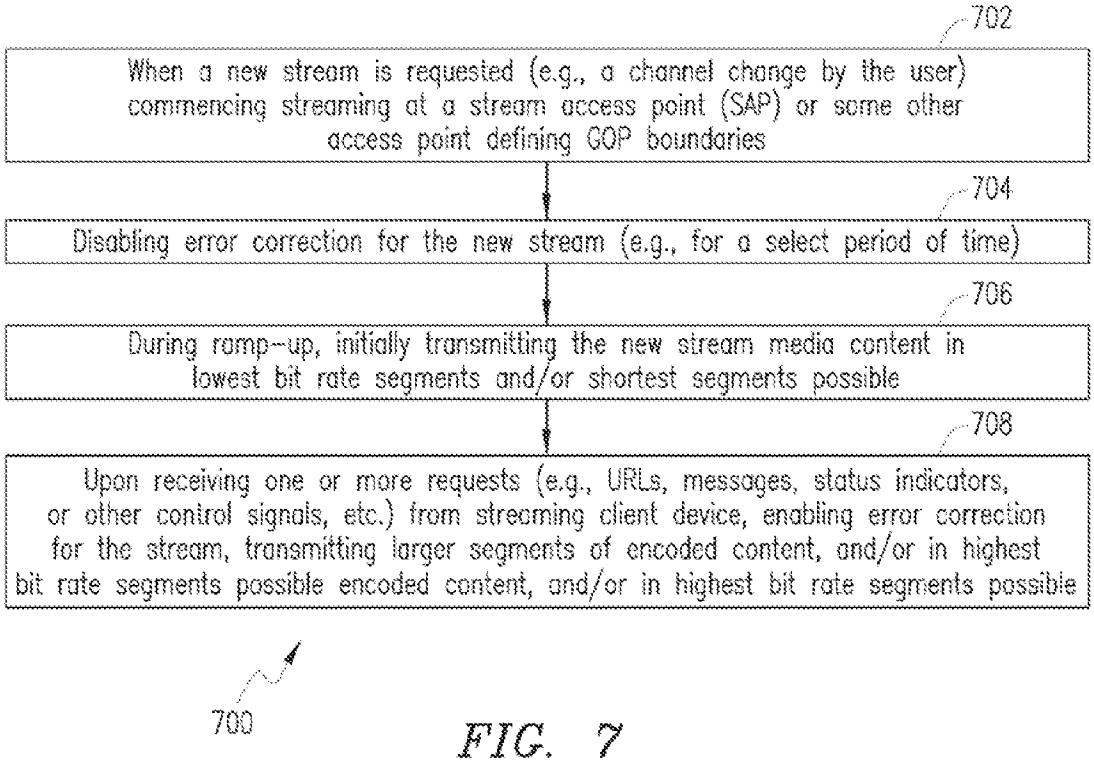


FIG. 7

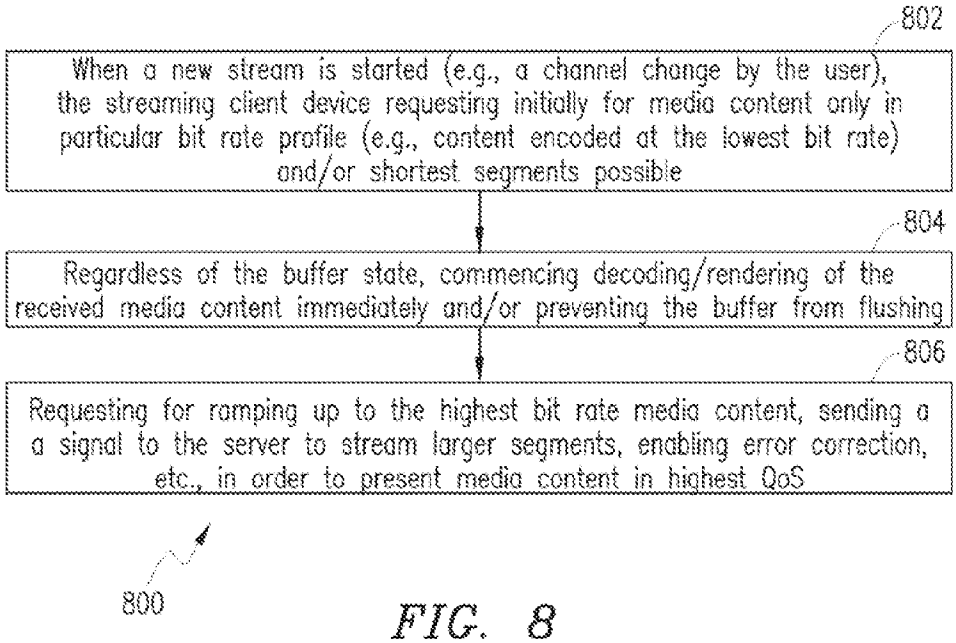


FIG. 8

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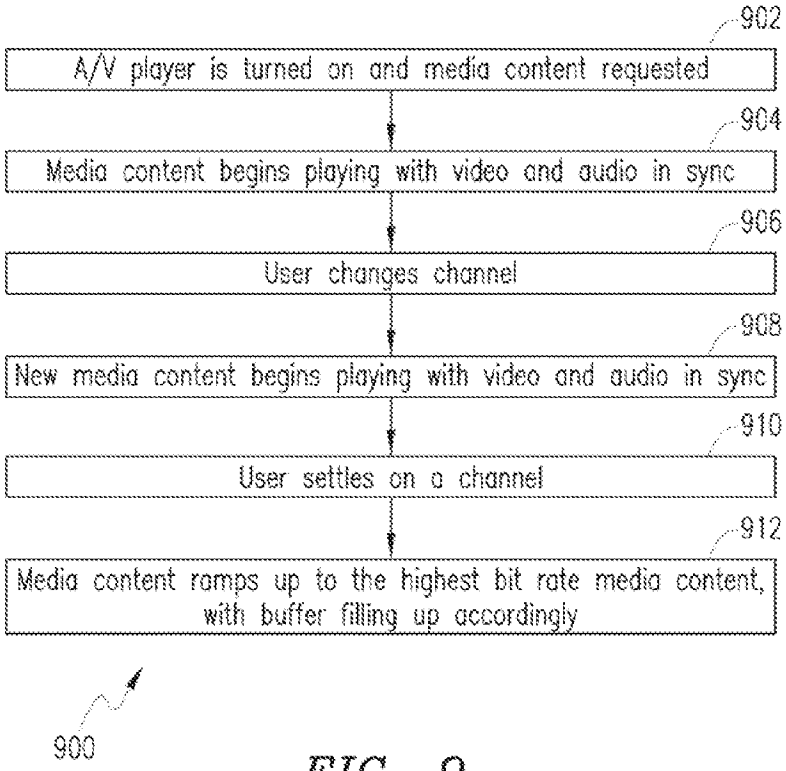


FIG. 9

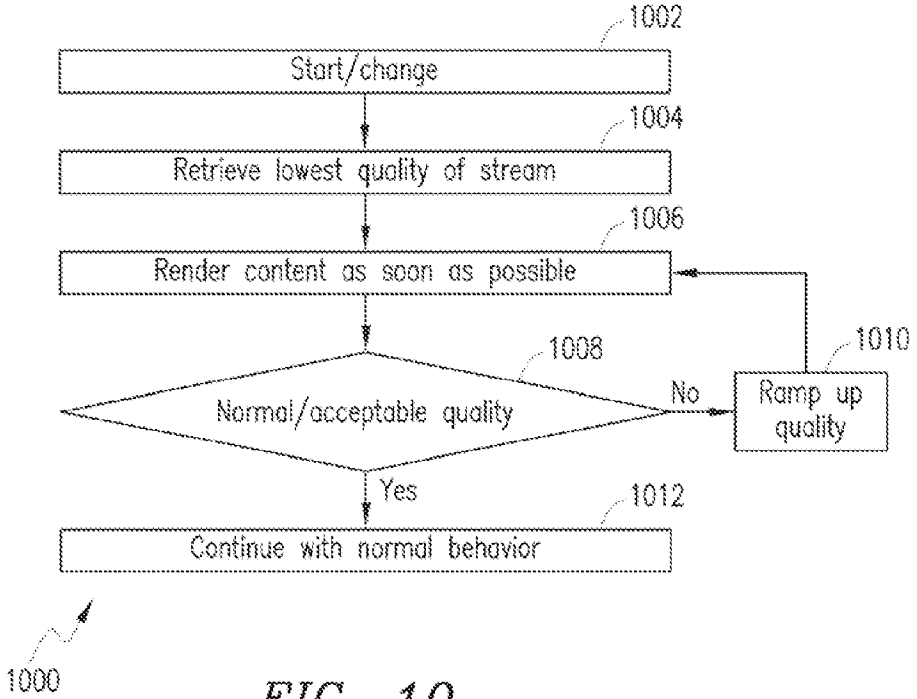


FIG. 10

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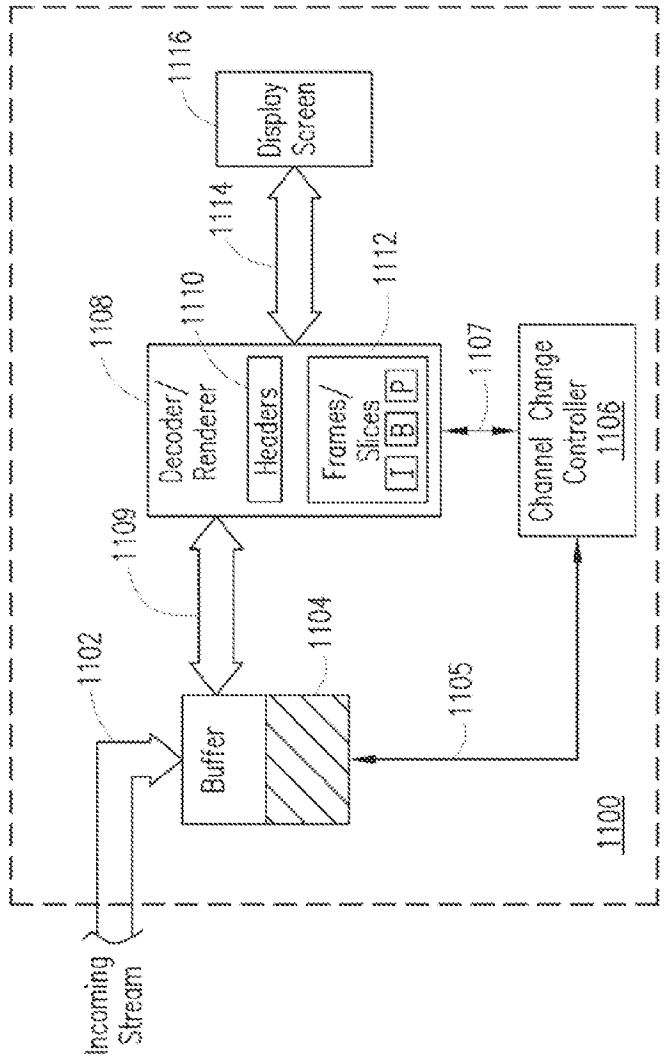


FIG. 11

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REFERENCES CITED IN THE DESCRIPTION

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Non-patent literature cited in the description

- **LEE et al.** Reducing Channel Zapping Time in IPTV Based on User's Channel Selection Behaviors. *IEEE TRANSACTIONS ON BROADCASTING* **[0003]**

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(54) Switching between digital video streams using buffering of second digital video stream

(57) A method (200, 300) for handling a plurality of digital video streams, each of the digital video streams being encoded in sequences of frames. Each of the sequences of frames comprising a key frame, at least one reference frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames. The method comprises displaying (204) at least a first digital video stream to be displayed and buffering (206) at least one of said key frame or said at least one reference frame for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered key frame or reference frame(s) when the second digital video stream is selected to be displayed. The invention also relates to a controller for controlling buffering of video information of a digital video stream not-displayed at that moment.

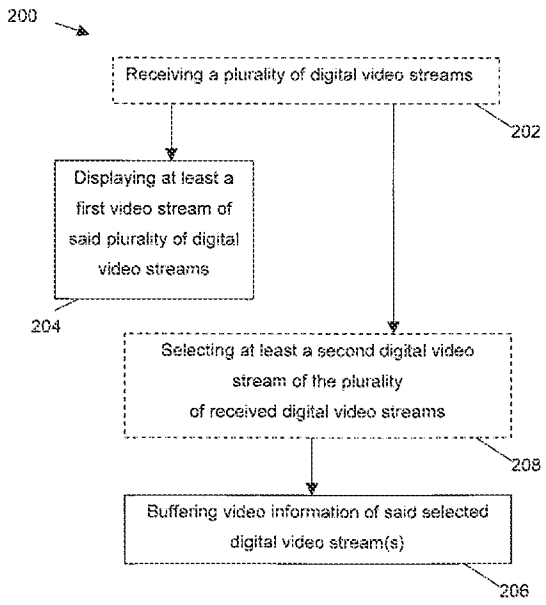


Fig. 3

EP 1 775 953 A1

Description

Technical field of the invention

[0001] The present invention relates to display of digital video streams such as e.g. digital television. More particularly, the present invention relates to methods and devices for display of digital video streams capable of switching between digital video streams.

Background of the invention

[0002] The use of digital video streams, such as e.g. in digital television, becomes a widely spread method for distributing information, especially as they allow the provision of high quality video and enable flexible use of the information provided. As digitisation of video content requires a large amount of data and as the bandwidth for transporting this data between a server and a client is limited, compression is needed. Such compression, also referred to as a type of encoding, is done at the server side, for instance at the video broadcaster-side. At the client side, a decompression process, also referred to as decoding, reconstructs the video pictures from the compressed video data. Typically, video specific compression and decompression processes profit from the digital video sequence structure to reduce the file size of the video. Two characteristics of video sequences are exploited to compress video data: as in still pictures, pixels correlate with their neighbouring pixels enabling so-called spatial compression and successive pictures also correlate with each other enabling temporal compression. Using this compression technique leads to the image content of different pictures or video frames being dependent upon each other. Hence, to decode a certain picture in a video stream, information from previous and/or next pictures may be needed. Because this dependency cannot be unlimited, every number of pictures a key frame is inserted in the digital video stream, this key frame being independent of every other frame. The other frames typically are dependent on this key frame. A digital video stream typically comprises sequences of frames comprising a key frame and other frames which may be directly or indirectly dependent on the key frame. In the different Motion Picture Experts Group (MPEG) standards, which are often used compression/decompression standards, such sequences of frames are also referred to as Groups Of Pictures (GOP).

[0003] The need for compression and decompression of digital video stream data typically results in a delay when an observer wants to switch between two video streams, as a newly selected video stream can only be displayed after a key frame is received and decoded. The moment the key frame is received, it is possible to decode all the further frames of the video stream. The time needed to receive a key frame and corresponding dependent frames may cause the largest delay. Transmission of digital video streams typically is done in spaced sequences. The time between receipt of two subsequent key frames may be up to a few seconds, depending on the length of the sequence of frames used in the compression/decompression (CODEC) system and on the moment switching between digital video streams is performed. The switching process between digital video streams thus may take significantly longer than the time needed for switching between analogue video streams. This may be disturbing and annoying for an observer who wants to switch quickly between real-time digital video streams, i.e. to "zap" between different real-time digital video streams.

[0004] The above described problem of delay in presented video stream during switching is known and a number of methods for solving this problem have already been described.

[0005] A number of methods is focused on influencing the data streams in the transport stream in order to obtain improved switching. E.g. in US 2003/0048808 A1 a method is described wherein, in order to obtain faster switching, the data stream for a newly selected content channel is temporarily sent at a higher rate, such that the data stream is received quicker and consequently, displaying of the data stream can be performed quicker. In order to obtain faster switching, the method requires communication about the switching between the client terminal and the server and adaptations for the transmission at the server side. In WO 2004/019530, a method is described for allowing seamless switching between data streams, whereby the data rate of the data streams may be adjusted to synchronise start and end points in the data streams. In this way a seamless transition between the data streams can be provided. Nevertheless, the latter results in a delay in switching from the old data stream to the new data stream, i.e. upon the act of initiating switching, the old data stream is still shown for a while, and requires changes in the creation of transport streams which may be CODEC dependent.

[0006] Alternatively, other methods operate on the client side, making e.g. use of additional components. In US 2004/0194134 A1 a method for fast switching between channels in a digital television transport stream is described, whereby a first tuner/decoder is used for displaying a first channel of a digital television transport stream and whereby a second tuner/decoder is used for storing a recent full-frame video still image from other channels of a digital television transport stream. When switching to a second channel, a stored video still image for the second channel is displayed using the second tuner/decoder, until sufficient data is received to generate real-time video for the second channel. The method requires at least two tuner/decoders and provides a still image during the switching time. Similar thereto, US 2004/0181813 A1 also describes a method for fast switching between channels in a digital television transport stream using a second tuner/decoder, e.g. a tuner/decoder present in the system to allow picture-in-picture imaging. In one embodiment, the document describes that additional video streams can be selected and de-

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coded using spare tuner/decoders. The system therefor requires a spare tuner/decoder system for each video stream to which fast switching is to be obtained. In another embodiment, the document describes a method comprising the storage of program identifying information to allow, upon zapping, extracting the necessary video stream as soon as it is available. Nevertheless, a delay still will occur, determined by the time needed to provide the necessary video stream data. In order to further fasten the display of a newly selected video stream, an I-frame may be cached. The latter allows providing a still image during the delay time.

[0007] None of the above prior art systems allows fast switching between digital video streams whereby a video stream is nearly immediately displayed, without the need for a large number of additional components or communication between the client and the server.

Summary of the invention

[0008] It is an object of the present invention to provide apparatus and methods allowing fast and qualitative switching between digital video streams. It is an advantage of embodiments of the present invention that fast switching between digital video streams can be performed without the need for communication between the receiver and the server side. It is furthermore an advantage of embodiments of the present invention that fast switching can be performed by introducing only minor changes to the equipment at the receiver side, i.e. for example without the need for a second set-top box. It is also an advantage of specific embodiments of the present invention that there is no need for additional decoders to obtain the fast and qualitative switching. It is an advantage of embodiments of the present invention that switching is substantially as fast and as good as can be obtained for switching between channels on an analogue television system.

[0009] The above objective is accomplished by a method and device according to the present invention.

[0010] The present invention relates to a method for handling a plurality of digital video streams, the method comprising displaying at least a first digital video stream to be displayed and buffering video information for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed. A moving window may be a window that comprises most recently received information about the digital video stream. The window may be frequently refreshed in order to comprise most recently received information. The updating may be done on a frame-by-frame basis or on a sequence of frames basis, e.g. a buffer is refreshed every time a reference frame is received. Allowing extraction of moving images from the buffered video information may be allowing extraction of moving images from the buffered video information for displaying the second digital video information substantially in a real-time manner. Substantially in a real-time manner may be with a small delay compared to receipt of the corresponding information in the second digital video stream. Substantially in a real-time manner may be with a delay of maximal the showing time for one sequence of frames. Said buffering may be buffering video information of a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information as to combine the moving images with further received video information of the second digital video stream when the second digital video stream is selected to be displayed.

[0011] Each of the digital video streams may be encoded in sequences of frames, each of the sequences of frames comprising a key frame, at least one reference frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames, wherein buffering video information may comprise buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream. It is an advantage of embodiments of the present invention that for at least a second digital video stream, but preferably for a plurality of further digital video streams, frame information is buffered that allows reducing the delay when switching from a first digital video stream to any of these further digital video streams. Digital video streams may refer to any type of framed information transferred in a sequence of sequences of frames. The latter may e.g. include 3D video images.

[0012] The method may comprise not buffering all of said further frames for a window of at least a second digital video stream. It is an advantage of embodiments of the present invention that not all frame information needs to be buffered. In this way a smart buffering is performed. The method may comprise not buffering any of said further frames for at least a second digital video stream

[0013] Said buffering video information may comprise buffering video information in an encoded format. It is an advantage of embodiments of the present invention that buffering of encoded frames is performed reducing the needed memory space and avoiding the need for first decoding the frames to be buffered. Consequently less decoding time may be needed which is advantageous as the major part of the buffered frames will not be used anyway.

[0014] Buffering said at least one of said key frame or said at least one reference frame may comprise buffering the key frame and all reference frames of a sequence of frames for said window of at least a second digital video stream. Buffering the key frame and all reference frames may allow extraction of moving images with a sufficient high quality.

[0015] With a moving window of at least a second digital video stream there may be a number of most recently received sequences of frames, e.g. a few most recently received sequences of frames, e.g. three most recently

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received sequences of frames or the most recently received sequence of frames or the most recently received sequence of frames and the last but one most recently received sequence of frames

[0016] Buffering said at least one of said key frame or said at least one reference frame furthermore may comprise buffering no further frames in a first half of a sequence of frames and buffering all further frames in a second half of a sequence of frames. The latter may allow synchronising the display and the receipt of sequences of frames of a second digital video stream once selecting of the second digital video stream is performed.

[0017] Said buffering may comprise buffering said frames of the most recently received sequence of frames for said at least a second digital video stream. The latter may allow, upon selection, to display digital video streams in "real time". The buffering also may comprise buffering at least one of a key frame or reference frame (s) from a last but one received sequence of frames for said at least a second digital video stream. The buffering also may consist of buffering said frames of the most recently received sequence of frames for said at least a second digital video stream.

[0018] The method may comprise refreshing said buffering when a new most recently received sequence of frames for said at least a second digital video stream is received. Refreshing said buffering may be reapplying the buffering step wherein buffering at least one of said key frame or said at least one reference frame of the most recently received sequence of frames for at least a second digital video stream is performed. Refreshing said buffering also may be applied after part of a new most recently received sequence of frames has already been buffered, the refreshing then referring to removal of the last but one received sequence of frames.

[0019] Buffering for at least a second digital video stream may comprise buffering for a plurality of further digital video streams. It is an advantage of embodiments of the present invention that a plurality of further digital video streams can be made available for fast switching without the need for decoding all of the plurality of further digital video streams.

[0020] The method furthermore may comprise decoding at least part of said buffered video information, e.g. key frame or reference frames, for at least one of said at least a second digital video stream. The decoding may be performed using spare time of the decoder used for displaying the at least one first digital video stream. The decoding may be performed using a spare decoder. The spare decoder may be a decoder typically used for picture-in-picture displaying. It may be an advantage of some embodiments of the present invention that part of the buffered video information, e.g. key frame or reference frames, are already decoded allowing a further decrease of the delay during switching between digital video streams. It may be an advantage that not all frames in a sequence of frames for a digital video stream need to be decoded but that only key frames and/or reference frames are decoded.

[0021] At least one of the digital video streams may comprise a number of video layers, e.g. encoded in sequences of frames, wherein buffering may be performed for at least one layer of said at least a second digital video stream. Either all layers can be buffered or a selection of the video layers may be buffered. The different video layers may comprise different levels of detail, whereby the buffering may be buffering of the video layer having the lowest image detail. Buffering also may be performed on a plurality of video layers comprising less image detail then the non-buffered video layers

[0022] The method furthermore may comprise, prior to said buffering, selecting said at least a second digital video stream based on a context of said plurality of digital video streams. Selecting based on context of said plurality of digital video streams may be based on statistical information of a client's viewing behaviour or may be based on another analysis of a client's viewing behaviour, such as e.g. by a neural network. Alternatively, said selecting at least a second digital video stream may be based on which at least one digital video stream is displayed. The plurality of digital video streams may be ranked and selecting at least a second digital video stream may be based on said ranking.

[0023] The method furthermore may comprise, providing to the viewer an indication of the digital video streams for which video information, e.g. at least one of said key frame or said at least one reference frame, are buffered. The latter provides a user friendly interface for clients that which to fastly switch between different digital video streams.

[0024] The buffering may comprise buffering said video information, e.g. said at least one of said key frame or said reference frame(s), with a resolution or size lower than a resolution or size of the received video information, e.g. key frame or reference frame(s).

[0025] The invention also relates to a method for switching between a plurality of digital video streams, the method comprising displaying at least a first digital video stream to be displayed and buffering video information for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed, and

upon selection of said digital second video stream for displaying,

extracting and displaying moving images from the buffered video information and after said extracting and displaying, displaying newly received sequences of frames for said second digital video stream.

[0026] Said displaying newly received sequences of frames may comprise receiving each frame of said sequence of frames in a buffer, decoding said frames and displaying said frames.

[0027] Each of the digital video streams may be encoded in sequences of frames, each of the sequences of frames comprising a key frame, at least one reference

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frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames, wherein buffering video information may comprise buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream.

[0028] The method furthermore may comprise, upon selection of said second digital video stream for displaying, adjusting the number of frames displayed in order to synchronise receiving sequences of frames for said second digital video stream and displaying newly received sequences of frames for said second digital video stream. The method for switching may comprise any of the features as described above for the method for handling a plurality of digital video streams.

[0029] The invention also relates to a controller for handling a plurality of digital video streams, the controller comprises means for controlling the display of at least a first digital video stream characterised in that the controller furthermore comprises means for controlling buffering video information for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed.

[0030] Each of said digital video streams may comprise sequences of frames, each of said sequences of frames comprising at least a key frame, at least one reference frame and further frames, said at least one key frame and said at least one reference frame suitable for deriving frame information for said further frames, wherein said means for controlling buffering video information may comprise a means for controlling buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream.

[0031] Said means for controlling buffering may be adapted so as to not buffer all of said further frames.

[0032] Said means for controlling buffering may be adapted so as to said buffer video information, e.g. at least one of said key frame or said at least one reference frame, in an encoded format.

[0033] The controller may be adapted for, upon selection of a second digital video stream to be displayed, controlling extraction and display of moving images from said buffered video information, e.g. buffered key frame or reference frames, for said second digital video stream and said controller may be adapted for, after said extraction and display, controlling display of newly received video information, e.g. newly received sequences of frames, for said second digital video stream. The controller may be adapted for, upon the display of moving images for said second digital video stream, synchronising the receipt of video information, e.g. sequences of frames, and the display thereof.

[0034] The invention also relates to a device for handling a plurality of digital video streams, the device comprising a buffer for buffering frames from a plurality of video images and a controller for controlling the display of at least a first digital video stream and for controlling buffering of video information for a moving window of at least a second video stream to said buffer, said buffering allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed.

[0035] Each of said digital video streams may comprise sequences of frames, each of said sequences of frames comprising at least a key frame, at least one reference frame and further frames, said at least one key frame and said at least one reference frame suitable for deriving frame information for said further frames. Said buffered video information may comprise at least one of a key frame or at least one reference frame of said at least second digital video stream.

[0036] The device furthermore may comprise a decoder for decoding of frames of said at least a first digital video stream and for decoding of said buffered video information, e.g. key frame or reference frame(s). The controller may be adapted for controlling said decoding of the buffered video information, e.g. key frame or reference frame(s), when the second digital video stream is selected to be displayed. The buffer for buffering frames from a plurality of video images may comprise a first sub-buffer for buffering frames of a first video stream and at least one second sub-buffer for buffering video information, e.g. at least one of said key frame or said at least one reference frame, for at least a second digital video stream. Such sub-buffers may be virtually separate buffers or such buffers may be physically separate buffers. The controller may have any of the above described features

[0037] The invention also relates to a display system for displaying at least one digital video stream from a plurality of video streams, the display system comprising a controller as described above or a device for handling a plurality of digital video frames as described above.

[0038] The invention furthermore relates to a computer program product for executing the method of handling a plurality of digital video streams and/or for executing part of the method for switching between digital video streams. The invention also relates to a machine readable data storage device for storing the computer program or to the transmission of such a computer program product over a local or wide area telecommunications network.

[0039] Particular and preferred aspects of the invention are set out in the accompanying independent and dependent claims. Features from the dependent claims may be combined with features of the independent claims and with features of other dependent claims as appropriate and not merely as explicitly set out in the claims.

[0040] The above and other characteristics, features and advantages of the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention. This description is given for the sake of example only, without limiting the scope of the invention. The ref-

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erence figures quoted below refer to the attached drawings.

Brief description of the drawings

[0041]

Fig. 1 is a schematic overview of an exemplary environment including devices according to the first and/or second embodiment of the present invention.
Fig. 2 is a schematic overview of a controller for handling a plurality of digital video streams according an embodiment of to the present invention.
Fig. 3 is a schematic overview of an exemplary method for handling a plurality of digital video streams according to the third embodiment of the present invention.
Fig. 4 is a schematic overview of an exemplary method for switching between digital video streams according to the third embodiment of the present invention.
Fig. 5 is a schematic overview of the frames that are buffered and the frames that are displayed for a first decoding and displaying scenario according to the third embodiment of the present invention.
Fig. 6 is a schematic overview of the frames that are buffered and the frames that are displayed for a second decoding and displaying scenario according to the third embodiment of the present invention.
Fig. 7 is a schematic overview of the frames that are buffered and the frames that are displayed for a third decoding and displaying scenario according to the third embodiment of the present invention.
Fig. 8 is a schematic overview of an exemplary trajectory for video streams in a method for handling a plurality of digital video streams according to the third embodiment of the present invention.
Fig. 9 is a schematic overview of an exemplary computing system suitable for running a method according to the third embodiment of the present invention.

[0042] In the different figures, the same reference signs refer to the same or analogous elements.

Definitions

[0043] The following terms are provided solely to aid in the understanding of the invention. These definitions should not be construed to have a scope less than understood by a person of ordinary skill in the art. In the present invention with digital video stream may be meant any type of framed information transferred in a sequence of sequences of frames. The latter also may e.g. include data streams, audio streams, video streams as such or a combination thereof. Furthermore 3D video images may be meant. It is possible that one video stream is split into different layers, e.g. in a layered, hierarchical structure. Each of these layers describes the video stream with a certain degree of details, e.g. starting with the basic layer which describes the pictures with a low quality. Each following layer depends on the previous layers and gives more details of the pictures, e.g. a better resolution. The present invention applies to both unlayered video streams, i.e. video stream with only one basic layer, and layered video streams. Therefore, in the following, with the terminology "video stream" the set of different layers of a stream of framed data such as a video stream are meant, or in case the set contains only one element, the only layer of framed data such as a single video stream is meant.

Description of illustrative embodiments

[0044] The present invention will be described with respect to particular embodiments and with reference to certain drawings but the invention is not limited thereto but only by the claims. The drawings described are only schematic and are non-limiting. In the drawings, the size of some of the elements may be exaggerated and not drawn on scale for illustrative purposes. The dimensions and the relative dimensions do not correspond to actual reductions to practice of the invention.

[0045] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0046] It is to be noticed that the term "comprising", used in the claims, should not be interpreted as being restricted to the means listed thereafter; it does not exclude other elements or steps. It is thus to be interpreted as specifying the presence of the stated features, integers, steps or components as referred to, but does not preclude the presence or addition of one or more other features, integers, steps or components, or groups thereof. Thus, the scope of the expression "a device comprising means A and B" should not be limited to devices consisting only of components A and B. It means that with respect to the present invention, the only relevant components of the device are A and B.

[0047] The invention will now be described by a detailed description of several embodiments of the invention. It is clear that other embodiments of the invention can be configured according to the knowledge of persons skilled in the art without departing from the true spirit or technical teaching of the invention, the invention being limited only by the terms of the appended claims. The present invention relates to a method and system for handling video streams, e.g. for switching between different video streams. Typically, for transfer reasons, such video streams are received by the client as a sequence of encoded slices. The video streams in the present invention

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may be encoded in any type of CODEC dividing the video stream in sequences, each sequence comprising a key-frame. Typical examples of such CODECs, the invention not being limited thereto, are the standards provided by the Motion Picture Experts Group (MPEG), such as e.g. MPEG-1 referring to ISO/IEC standard 11172, MPEG-2 referring to ISO/IEC standard 13818, MPEG-4 referring to ISO/IEC 14496 and the standards H.263 and H.264, being International Telecommunications Union standards. MPEG-4 Part 10 and H.264 are technically identical CODECs, written by the Joint Video Team. The technology used is known as Advanced Video Coding. It is possible that one video stream consists of multiple video layers. Each video layer describes the video stream in a certain degree of detail. The first layer, holding the less detailed information is called the basic layer and all the following layers will be dependent of the previous one(s). Typically the structure of the sequence of frames of different layers will be all the same. Depending on the CODEC used, the sequence of encoded slices may be a sequence of encoded frames, or, in more advanced CODECs, such as e.g. H.264/MPEG-4 Part 10, the sequence of encoded slices may be a sequence of encoded video objects, being an area of the video scene that may occupy an arbitrarily-shaped region and may exist for an arbitrary length of time and corresponding with a sequence of a part of frames. For the ease of explanation, the following description will be based on a CODEC using encoded frames, but it will be obvious for the person skilled in the art, that a sequence of encoded video objects can be used, whereby the different video objects are treated as a set of part of frames, each set of part of frames being independent of each other. In other words, each video object could be interpreted as a video stream, whereby putting all video objects together reults in the resulting video stream wanted. It is to be noted that video objects can have different structures for the sequences of frames, such that e.g. the key frames of the different video objects are not sent all at the same time. It is to be noted that the specific CODEC used is not limiting for the present invention. In other words, it is an advantage of embodiments of the present invention that the corresponding methods and systems can be used with any of the known CODECs.

[0048] Not all frames in a sequence of encoded frames, also referred to as pictures, are treated in the same way during encoding and decoding. In the present application, the following terminology will be used in general for each encoding/decoding system. By way of example, the corresponding terminology for the often used MPEG-2 standard will be indicated.

- α-frames, also referred to as a key frames, are those frames that are independent of other frames, i.e. those frames without any reference to other frames. In MPEG-2 standard, such frames may be referred to as Intra Coded frames or I-frames, in MPEG-4 Part 2, such frames may be referred to as I-VOP and in H.264/MPEG-4 part 10 such frames are referred to as instantaneous decoder refresh pictures (IDRP). Typically α-frames are used as a starting point for prediction after a video stream change and to recover from errors. All current CODECs and future CODECs have a key frame in the video sequence because a key frame is needed as a starting point when the television is switched on, for instance.
- β-frames are those frames that are only dependent on α-frames and β-frames and that can be used as a reference frame for all other frames except α-frames. In the MPEG-2 standard, predicted frames or P-frames are obtained by forward prediction from I-frames and P-frames. Such P-frames thus are examples of β-frames.

In the present patent application β-frames and optionally δ-frames will also be referred to as reference frames as they function as a reference frame for a plurality of other types of frames, i.e. β-frames, γ-frames, δ-frames and ε-frames.

- γ-frames are those frames that are dependent on other α- and β-frames but that cannot be used as a reference frame for other frames in the video stream. In the MPEG-2 standard Bi-directionally predicted frames or B-frames are obtained by forward prediction and/or backward prediction and/or interpolation from I-frames and P-frames. Such B-frames are not used as reference frames for other frames.
- δ-frames are those frames that are dependent on other α- and β-frames but, contrary to the γ-frames, they can be used as a reference frame but only for other δ-frames.
- ε-frames : frames that do no follow one of the mentioned classifications, e.g. such as D-frames in the MPEG-2 standard, being frames encoded like I-frames but whereto no reference may be made. These frames thus are not used for further decoding.

It is to be noted that during encoding and transferring of the digital video stream, some frames may be skipped and thus may not be sent at all. In the encoding, transferring and decoding process of video streams, each video stream is handled as a sequence of sequences of frames. Each sequence of frames comprises a key frame and additional basic reference frames and furthermore typically may allow a number of additional frames. Except for the key frame, the frames of a sequence of frames will depend on other frames of the sequence of frames. No references to frames outside the sequence of frames will be present, except maybe at the end of a sequence of frames where the last frames can be dependent on the first frame of the next sequence of frames. Typically such a sequence of frames corresponds with image data allowing generation of a few seconds of video stream. Therefor, when in the present application the term 'real-time' video stream is used, this might also refer to a video

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stream transferred in blocks corresponding with a few seconds of video. A sequence of frames is in the MPEG-1 and MPEG-2 standard referred to as a GOP. An example of such a sequence of frames in the MPEG-2 standard is the sequence IBBPBBPBBPBB. This format allows for a satisfactory video quality with an acceptable random access time (<0.5s) within a bit-rate of 1.15 Mbps, which is considered as low bit-rate. So: 1/12 I-pictures (no temporal compression); 3/12 P-pictures (+/- 75% temporal compression); 8/12 B-pictures (+/- 95% temporal compression) for a total compression ratio of +/- 82%, without taking into account spatial compression. It is to be noted that the methods and systems of the embodiments of the present patent application are not limited by the specific type of frames in the sequence of frames or by the number of frames present in the sequence of frames. The above example illustrated the use of temporal compression. In the present invention, furthermore also spatial compression may be used.

[0049] In a first embodiment, the present invention relates to a controller for controlling the handling of a plurality of digital video streams at a client side, also referred to as receiver side or user side or possibly in the network near the client side. Such a controller 100 typically may be used in a network between a server and a client, also referred to as user, an example thereof being shown in Fig. 1. Digital video typically is transferred between a server side 102, typically being a digital video broadcaster, and a client side 104 over a network 106. At the server side 102 encoding and streaming of the different video streams is done, while at the client side 104 decoding is done. The main purpose of encoding the video streams is the reduction of the needed bandwidth for streaming the video data, because bandwidth capacity typically is the main restriction of a network 106. The network 106 is responsible for the transportation of the video streams from the server 102 to the clients 104 and may be a network according to any suitable network technology such as, but not limited to digital describer line technologies xDSL, cable, satellite, digital video broadcasting - terrestrial (DVB-T) transmitting the digital signal through air, wireless WiFi technology or WiMAX technology or other wireless connections like 3G and 4G technologies (UMTS, etc.). Digital video typically is transferred over the network 106 using a transport stream 108. One such a transport stream 108 may comprise different digital video streams 110 corresponding with image content for different digital video streams. The transfer of different digital video streams 110 may be done, amongst other depending on the type of network 106 used and the number of video streams 110 to be sent, via different frequency bands, in broadband, and/or in a multiplexed way, such that typically a tuner and/or demultiplexer 112 may be used to extract different separate video streams 110. Such a tuner and/or demultiplexer may be incorporated or separate to a device 114 for handling a plurality of digital video streams (in Fig. 1 the tuner/demultiplexer is shown incorporated in device 114). Such a device 114 typically is referred to as a set-top box (STB). The device 114 furthermore comprises a buffer 116 for buffering image frames of the received digital video streams and also may comprise a decoder 118 for decoding the encoded digital video streams 110 received at the client side 104. Typically a client 104 selects at least one digital video stream to be displayed, the displaying done on any suitable type of display 120. It is to be noted that the controller and possibly the set-top box may be a network device, placed in the network rather than at the client side, such that the controller and possibly the set-top box may be used for different displays in one or multiple viewing places such as homes.

[0050] The controller 100 according to the first embodiment of the present invention is shown in more detail in Fig. 2. It comprises means for controlling the display 150 of at least a first digital video stream. The means for controlling the display 150 of at least a first digital video stream allows to display at least a first digital video stream that is selected for viewing by the client 104. Such controlling typically may comprise controlling the usual tasks performed for displaying a digital video stream 110. Such controlling may e.g. comprise selecting the at least first digital video stream from the plurality of encoded digital video streams 110 that are received, decoding the incoming frames of the at least a first digital video stream and displaying the decoded frames of the at least a first digital video stream. In order to take into account inertia of the decoder 118 or inertia of the display 120, both encoded frames, i.e. in advance of the decoding, and/or decoded frames may be buffered. This typically is limited to the most recent frames, e.g. the three most recent frames to be displayed and typically is completely independent of the sequence of frames structure of the received digital video stream 110. In systems where additional tuner/multiplexers and decoders are present, at least a first digital video stream may comprise more than one video stream, e.g. as obtained in picture-in-picture (PIP) systems. The means for controlling the display 150 of at least a first digital video stream then allows to display different digital video streams 110 simultaneously. The means for controlling the display 150 of at least a first digital video stream consequently directly or indirectly interacts with the tuner/multiplexer 112, the decoder 118 and the display 120. Besides these means 150 that allow to handle the selected video streams, the controller furthermore also comprises a means for controlling buffering 152 video information of a moving window of at least a second digital video stream that is not displayed at that time, but that might be selected in the near future. The buffered video information of a moving window of the at least a second video stream is such that it allows extraction of moving images from this buffered video information when the second digital video stream is selected. In other words, the buffered video information of a moving window of the at least a second video stream may be such that extraction of moving images can be done, based only on the buffered video information, i.e. without

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the need for other received frames. With a moving window of a digital video stream, typically there a window comprising most recently received information of the digital video stream. In other words, a moving window is refreshed such that it comprises most recently received information of the digital video stream. As described above, digital video streams 110 typically are built as a sequence of sequences of frames, whereby each sequence comprises a key frame, reference frames and further frames. Typically a few to a few hundreds frames may be present in a sequence of frames, such as e.g. between 6 and 300 frames. An often used number of frames at present is 15 frames per sequence. The reference frames are those frames that are, in combination with the key frame, used as reference frames to obtain full image information about other reference frames and further frames. In order to allow fast switching between digital video streams, typically information of the most recently received sequence of frames is buffered, as this will allow to display, upon selection of the corresponding digital video stream, at least part of the most recently received sequence of frames followed by further sequences received after switching. In other words, providing moving images nearly immediately after switching to a second digital video stream is obtained by buffering a moving window of the digital video stream, whereby the moving window typically comprises a number of most recently received sequences of frames, for example but not limited to the three most recently received sequences of frames, the most recently received sequence of frames and the last but one recently received sequence of frames, the most recently received sequence of frames and part of the last but one recently received sequence of frames or the most recently received sequence of frames. The buffering thus may be systematically refreshed, it is at regular moments, whereby the previously buffered frames or at least part thereof may be removed. Upon refreshment of the buffer 116, some frames of the next received sequence of frames might be buffered first before the frames of the previously received sequence of frames are removed. Thus, the means for controlling buffering 152 is adapted for, after or upon receipt of a new sequence of frames for the at least a second digital video stream, removing the frames buffered from previous sequences of frames. The means for controlling buffering 152 will be adapted for buffering at least one of a key frame or reference frames, whereby the buffered information allows to generate moving images based on the buffered frames. It may be adapted for controlling the buffering of the key frame and all reference frames of a sequence of frames for at least a second digital video stream. The latter guarantees a relatively high quality for displaying the digital video steam. If not all reference frames are buffered, a loss of quality will occur. The means for buffering also may allow the buffering of a number of further frames. Whereas in principle all frames of a sequence of frames could be buffered - e.g. in case buffer space is not an issue - the latter may be detrimental for the amount of buffer used and thus not preferable. It therefor may be advantageous to not buffer all further frames of the sequence of frames or even not to buffer any of the further frames. If a digital video stream 110 consists of different video layers, there is a choice of buffering all, some or none of the layers. If a video stream consists of different video layers, typically a basic layer, being the layer with the lowest detail, and enhancement layers will be present in the respective order. Each further enhancement layer, also referred to as higher enhancement layer, builds on the previous enhancement layers, also referred to as lower enhancement layer, providing enhanced information of the previous layers. If not all layers of a video stream are buffered, the means for buffering is adapted for controlling the buffering of at least the basic layer and possibly the lower enhancement layers are buffered. Furthermore, the controller may be adapted for controlling the buffering of layers on a frame by frame base. Once a layer of a frame has been dropped, all the higher enhancement layers above the dropped enhancement layer of that frame are useless, as they are building on the lower layers. Consequently, also on a frame by frame basis, only the basic layer and possibly the lowest enhancement layers may be buffered. Selection of layers to be buffered on a frame by frame basis may be for example such that only the basic layer and possibly the lowest enhancement layers of the further frames are buffered, while all layers are buffered of the key frame and the reference frame. In the present invention, the frames may be buffered in an encoded format, having the advantage of not needing to be decoded first. Only those encoded frames that really will be needed for display upon selection of that video stream then may be decoded, thus avoiding unnecessary use of decoder capacity. It thus is an advantage that no additional decoders are necessary for the buffering, while still providing fast switching between different video streams. Alternatively if spare decoders are present, the controller may be adapted for using spare time of these decoders to decode frames buffered from the at least a second digital video stream, this way further reducing the time needed for switching. Nevertheless, no substantial change is needed in order for the system to operate.

[0051] The at least a second digital video streams may be a plurality of video streams. Depending on the size of the buffer 116, either all digital video streams may be buffered, or a selection thereof may be buffered. Which video streams are buffered may change during operation. Such a selection may be based on heuristic results, based on the most popular video streams, based on the specific preferred video streams by the client or based on other video streams that are likely to be switched to, such as e.g. video streams having a position on the channel list being next to or close to currently displayed video streams, or a combination of any of these. The controller 100 may be adapted to perform any of the above analysis for which digital video streams are likely to be switched to.

[0052] The controller furthermore may comprise

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means for controlling extraction and display 154, upon selection of a second digital video stream, moving images based on the buffered frames for the second digital video stream. The means therefor may control the selecting of those buffered frames appropriate to be displayed, control the decoding of the frames necessary to generate the moving images and control the display thereof. Which buffered frames need to be extracted and displayed depends on the moment at which the selection of the second digital video stream is performed. If the latter is done at the start of a sequence of frames, the time to be bridged in order to receive a new sequence of frames for the second digital video stream will be longer than if this switching is performed at the end of a sequence of frames and preferably more buffered images will be used for providing moving images in that bridging time. Which buffered frames need to be extracted and displayed also depends on the type of decoding scenario that is used, which will be discussed further in this application. Control of the decoding of the frames and control of the display thereof also may be performed by the means for controlling the display 150 of at least a first digital video stream.

[0053] The controller 100 also may be adapted for displaying newly received sequences of frames, received after switching to the second digital video stream. Such sequences of frames will be displayed after the moving images are extracted and displayed based on the buffered frames. In principle, the further handling of the second digital video stream can be performed using the means for controlling 150 the display of at least a first digital video stream. The controller also may comprise a means for synchronising 156 the receipt of sequences of frames of the second digital video stream and the actual display of sequences of frames. The latter may e.g. be done by dropping frames in the moving images to be displayed, by allowing a standard delay between receipt and display or by changing the display rate of the frames.

[0054] The controller 100 may be made as software and installed on a host computer, which may be any suitable programmable computing device such as personal computer with a Pentium IV microprocessor supplied by Intel Corp. USA, for instance, with memory and a graphical interface such as Windows 2000 as supplied by Microsoft Corp. USA. Alternatively the controller may include a computing device, e.g. microprocessor, for instance it may a micro-controller. In particular, it may include a programmable controller, for instance a programmable digital logic device such as a Programmable Array Logic (PAL), a Programmable Logic Array, a Programmable Gate Array, especially a Field Programmable Gate Array (FPGA). The use of an FPGA allows subsequent programming of the controller, e.g. by downloading the required settings of the FPGA.

[0055] In a second embodiment, the present invention relates to a device for handling 114 a plurality of digital video streams 110 comprising the controller 100 as described in the first embodiment. Such a device for handling 114 a plurality of digital video streams 110 typically is referred to as a set-top box (STB) and is illustrated by way of example in Fig. 1. The device for handling 114 a plurality of digital video streams 110 typically comprises at least a buffer 116 for buffering frames from a plurality of video images and a controller 100 as described in detail in the first embodiment. The specific features and advantages of the controller 100 as described in the first embodiment apply to the controller 100 incorporated in the device for handling 114 a plurality of digital video streams 110 according to the second embodiment of the present invention. The amount of available storage space in the buffer 116 to buffer the different video streams 110 is restricted to the physical constraints of the device. Such physical constraints typically are the available amount of read/write memory, such as e.g. random access memory (RAM). The amount of memory of the buffer typically depends on the functionality of the device for handling 114 a plurality of digital video streams. If only decoding and displaying capability is present, typically a memory of 56MB, 128MB or 256MB is used, although the embodiments of the present invention are not limited thereto. Typically, these buffers may be fast memory modules based on RAM memory or flash memory. When recording capability is present in the device for handling 114 a plurality of digital video streams, a larger storage capacity typically is present such as e.g. 40GB, 80GB or 160GB, the embodiments of the present invention not being limited thereto. The buffer 116 fo the device for handling 114 a plurality of digital video streams preferably comprises RAM or flash memory to support the fast switching actions according to embodiments of the present invention. The buffer 116 may be considered as a first sub-buffer, wherein the buffering for the video stream displayed at the moment is performed, and a number of additional sub-buffers, each sub-buffer suitable for buffering video information for one of the at least one second digital video stream. The different sub-buffers may be virtual sub-buffers or also may be physically separated. Because the buffering of the different video streams 110 requires fast writing of big amounts of data to the memory of the device, a good memory management may be needed. Different possible memory structures may be used and some examples thereof are provided hereafter by way of illustration. If e.g. a linear memory structure is used, the buffer 116 may be regarded as one large single buffer, wherein all different frames of different video streams 110 are stored in a linear way. The different frames of one video stream are connected to each other by using a linked list. So every frame holds a pointer to the next frames of the video stream. Furthermore pointers are needed to the first frame of every video stream. This leads to a very flexible and efficient memory management, but the management of the pointers is quite complex. An alternative memory management may be based on circular buffers. In a system using circular buffers each video stream has a dedicated amount of memory. A key frame from the video stream is the first frame

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in the buffer. The following frames of the video stream are stored after this key frame. For this system, one or two pointers per video stream are needed, as there always needs to be a write pointer and in case the video stream is being displayed, also a read pointer is needed. Because, for this system, a dedicated amount of memory must be assigned to every video stream, this approach requires relatively much buffer capacity, but the management of the pointers are easier in comparison to the linear buffer approach. The system for handling 114 the plurality of digital video streams 110 is positioned at the client side 104. It may be incorporated in a display system, it may be part of a computing means or it may be a separate set-top box positioned between a central receiving point at the client side 104 and at least one display system.

[0056] In a third embodiment, the present invention relates to a method for handling a plurality of digital video streams. The method is suitable for handling a plurality of digital video streams received in an encoded format in sequences of frames. By way of illustration, basic and optional steps are shown in Fig. 3 for an exemplary method 200 according to the present embodiment. The method 200 is adapted for allowing fast switching between digital video streams 110. It typically may comprise receiving a plurality of digital video streams 110, transferred over a network 106, as described above and illustrated in step 202. The method according to the present embodiment comprises displaying at least a first digital video stream to be displayed, i.e. for example the video stream of a video channel that a user is watching, shown by step 204. E.g. for a picture-in-picture system or for a multi-view system having a number of displays, multiple video streams may be displayed at the same time. In order to allow fast switching, the method furthermore comprises buffering video information for a moving window of at least a second digital video stream, that is not displayed at that moment, as shown in step 206. The buffering allows extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed, i.e. when a user decides to switch from a first video stream to the second video stream, also referred to as zapping to the second video stream. For a sequence of frames comprising a key frame, at least one reference frame and further frames, whereby the reference frames are suitable for deriving frame information for the further frames, the buffered video information may comprise at least one of a key frame or a reference frame of a recently received sequence of frames of the second video stream, e.g. the last received sequence of frames. Typically, not all of the further frames are buffered, but a smart buffering system may be applied. In an alternative embodiment no further frames are buffered. Buffering at least one of a key frame or a reference frame may e.g. comprise buffering the key frame and may e.g. comprise buffering the key frame and all reference frames. The frames typically may be buffered in an encoded format, thus allowing to reduce the needed memory space and avoiding the need for first decoding the frames. Consequently less decoding time may be needed which is advantageous as the major part of the buffered frames will not be used anyway.

[0057] The at least a second video stream for which video information is buffered may be one video stream, but preferably is a number of video streams. The video streams for which video information is buffered could either be predetermined or could be variably selected, e.g. based on a context of the received video streams, e.g. based on statistical information of a client's viewing behaviour, e.g. based on user-inputted information or e.g. based on another analysis of a client's viewing behaviour, such as e.g. by using a neural network. Alternatively, or in combination therewith, the video streams for which video information is buffered could be based on the digital video stream that is displayed at that moment. The plurality of digital video streams may e.g. be ranked and selecting a video stream wherefore video information is buffered may be based on the ranking, e.g. it may be those video streams which have a number close to the number of the video stream that is displayed at that moment. In other words, the at least a second digital video stream of the plurality of received digital video streams may optionally be explicitly selected, as shown in optional step 208. The method also may comprise indicating to the client, e.g. by LED indications or by indications on the screen, which video streams are available for fast switching. Also an advanced remote controller can be used for indicating the video streams that are available for fast switching. The list of these video streams can be used as the dynamically adapted order of the available video streams. The latter could e.g. be commercially exploited, e.g. by making a digital video stream of an advertiser always available for fast switching upon payment of a fee. In the present invention, buffering video information typically may consist of buffering video information about a moving window of a video stream. With a moving window of a digital video stream, typically there a window comprising most recently received information of the digital video stream. In other words, a moving window is refreshed such that it comprises most recently received information of the digital video stream. Such a moving window may comprise frames of one sequence of frames or possibly of a few sequences of frames. This buffering typically is done to allow fast switching between digital video streams. An advantage of buffering only such a small window of a video stream is that in principle a plurality of digital video streams may be buffered, such that switching to any of this plurality of digital video streams can be done relatively fast. Typically frames of the most recently received sequence of frames or of a few of the most recently received sequences of frames for the at least a second digital video stream may be buffered. This allows to display digital video streams in "real time" or almost "real time", i.e. with a delay of less than a few sequences of frames, e.g. a delay of less than the showing time of one sequence of frames. The buffering also may comprise buffering at least one of a key

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frame or reference frame(s) from a last but one received sequence of frames for said at least a second digital video stream. In other words, such a moving window may comprise - although the invention is not limited thereto - a number of most recently received sequences of frames, such as e.g. the three most recently received sequences of frames, the two most recently received sequences of frames, the most recently received sequence of frames and part of the last but one most recently received sequence of frames or the most recently received sequence of frames. In order to reduce the necessary buffer capacity, frames may be buffered with a resolution or size lower than a resolution or size of the received frames, in general, frames may be buffered at a lower quality. It is also possible that the received frames already have a lower quality.

[0058] With buffering video information about a window of a video stream, there also may be meant that upon receipt of a new most recently received sequence of frames, the buffering may be refreshed. This refreshing may be reapplying the buffering step either immediately upon receipt of a new most recently received sequence of frames or after part of a new most recently received sequence of frames has already been buffered. The refreshing comprises removing the frames received during the last but one received sequence of frames or received earlier. In other words systematically buffering of video information about the most recently received part of the video stream may be performed. If sufficiently buffer memory is present, more information may be buffered and refreshing may be done less frequently.

[0059] In order to further save time, decoding of at least part of the buffered frames, e.g. part of the buffered key frame or reference frames, for at least one of the digital video streams for which video information is buffered, may be applied. Such decoding may for example be performed using spare time of a decoder used for displaying the digital video stream selected for display by the client or e.g. using a spare decoder, e.g. present for allowing picture-in-picture display.

[0060] When a client wishes to switch from a first digital video stream to a second digital video stream, typically a first digital video stream is displayed. According to the present method, video information of a moving window of the second digital video stream may also be buffered at that moment. Upon switching to a video stream that is part of the video streams for which video information is buffered, moving images may be extracted from the buffered video information and may be displayed nearly immediately. Switching may be performed by a method 300 as shown in Fig. 4, illustrating basic and optional steps for such a method 300. As mentioned, before switching, according to the present embodiment a first digital video stream is displayed, as shown in step 204 and video information for a window of at least a second digital video stream is buffered, as shown in step 206. When a client selects a new digital video stream to be displayed, i.e. when the client zaps between two digital video streams, shown in step 302, it is checked whether video information about a moving window of the newly selected digital video stream is buffered. The latter is performed in step 304. If this is not the case, switching to and displaying of the newly selected digital video stream occurs in a conventional way, as shown in step 306, typically requiring a large delay time. If video information about the newly selected digital video stream is buffered - which information might be available from actions in step 206 - the corresponding buffered video information may be selected or extracted from the buffer. The latter is performed in step 308, based on the buffering performed in step 206. The selected buffered video information then is decoded, if not already done using spare decoders, and displayed, which is performed in step 310. Meanwhile, further sequences of frames for the digital video streams will be received, shown in step 312, allowing to seamless or nearly seamless switch from the display of the moving images based on the buffered video information to display of newly received digital video stream, which is shown in step 314. In other words, during the display of the decoded frames, typically a new sequence of frames will be received for the newly selected digital video stream, which allows initiation of the standard display of the newly selected digital video stream providing a seamless transition between display of the buffered video information and the standard display. Typically for standard display, only the most recent frames to be displayed are buffered, decoded and displayed. Furthermore, buffering video information of a moving window of at least one other digital video stream typically will be performed, the at least one other digital video stream being selected e.g. based on content, client preferences or ranking of the different video streams, as shown in step 316. Additional buffers may be provided, e.g. before the decoder in order to solve for the inertia of the decoder, or after the decoder, e.g. to solve the inertia of the network, e.g. if packets sent over a network suffer from network delay, this still allows displaying video information during a period of time when no video data is received.

[0061] In order to provide a seamless transition between the frames derived from the buffered video information and the newly received sequences of frames, synchronisation might be necessary. The latter can be done by installing a fixed delay or by dropping some frames. The need for synchronisation and the type thereof typically is correlated with the way of decoding and displaying. Different scenarios are possible, three of them shown, by way of illustration in Fig. 5 to Fig. 7. In these examples, by way of illustration, the first video stream VS1 and the second video stream VS2 both consist of sequences of frames having a $\alpha/\gamma/\beta/\gamma/\beta$ structure.

[0062] In a first scenario, the buffered video information is used for generating moving images, i.e. the frames of the buffered video information may be decoded, as these typically are stored in an encoded format, whereby if zapping occurred during the Nth frame 402 of a sequence of frames for a first video stream VS1, the $N+1^{th}$

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frame 406 of a sequence of frames of the second video stream VS2 is shown. In this scenario, the sequences of frames for both video streams preferably may be equal in length. Fig. 5 illustrates this principle, whereby the frames displayed prior switching and the frames buffered after switching 404 are indicated for the first video stream VS1, the frames buffered before switching and the frames displayed after switching 408 are indicated for the second video stream VS2 and the frames displayed to the client are illustrated by frame set 410. A small zapping time may exist as decoding the first frame-to-be-displayed from the second video stream 408 typically requires decoding information from previous not-displayed frames, such as e.g. the key frame and other reference frames. It is to be noted that in this scenario it is not necessary to store all the video frames of a second video stream, as some frames are not needed for decoding other frames.

[0063] In a second scenario, shown in Fig. 6, the buffered video information is used for generating moving images, i.e. frames of the buffered video information may be decoded, as these typically are stored in an encoded format, whereby upon zapping, all frames that can be derived from the buffered video information from the second video stream are shown. The moment the user zaps to a second video stream VS2, the stored key frame 412 is shown immediately after the frame 402 of the first video stream VS1 wherein zapping occurred, while in the mean time further decoding of further frames of the second video stream VS2 can be done, leading to an almost nihil zapping time. A disadvantage may be that the user is not looking real-time to the second video stream VS2 but that a delay 414 occurs. The displayed frames have a fixed delay 414 with respect to their receipt. The amount of delay 414 depends on the time whereon zapping is performed, with respect to the sequence of frames. This delay will however be smaller than the showing time of one sequence of frames. In order to take this delay into account and to be sure that the frames are shown at the right moment in time, the timestamps of the frames need to be changed or the clock of the decoder needs to be adapted.

[0064] In a third exemplary scenario, the buffered video information is used for generating moving images, i.e. frames of the buffered video information may be decoded, as these typically are stored in an encoded format, whereby upon zapping, different frames of the sequence of frames of the second video stream, including frames at the start of the sequence 416, are displayed upon zapping. As frames at the start of the sequence, e.g. the key frame 412, are shown after zapping, the time needed for zapping is almost nihil. In the present example, resynchronisation between the display and the receipt of frames is obtained by dropping some frames 418, e.g. 1 picture per second or, if present, γ frames. The latter also requires adaptation of the timestamps of the frames or of the clock of the decoder, albeit temporarily. In order to resynchronise, it is also possible to show the frames for a shorter time, e.g. if normally each frame is displayed for 25 milliseconds this could be reduced to 20 milliseconds. The latter is shown, by way of illustration in Fig. 7.

[0065] In a fourth scenario, a guaranteed minimum zapping time is obtained by combining scenario 1 with scenarios 2 or 3. The first frames of the sequence of frames then are decoded as described in scenario 1, as long as not all buffered pictures are decoded or as long as the given minimum zapping time is not exceeded. If the given minimum zapping time is exceeded, the remaining buffered frames are decoded and displayed, resp. with a fixed delay or with a decreasing delay. The latter may be advantageously used in the buffer strategy applied, e.g. by buffering only the key-frame and reference frames in the first half of the sequence of frames, and by buffering all frames in the second half of the sequence of frames.

[0066] Alternatively, also reference frames could be dropped, although this will lead to loss of quality. After switching, the displayed frames will become better and better and at the moment the next key-frame is displayed, full quality will be achieved again.

[0067] By way of illustration, the video data flow for a method according to the present invention is illustrated for the case of video streams in MPEG video standard in Fig. 8. At the top, the encoded video files 502 are shown. Next, these video files are streamed 504 to the clients. Dependent on the network capacity, different video streams are buffered, resulting in buffered video information 506 of the displayed video stream 508 and buffered video information 510 of the video stream 512 not displayed at the moment, in the set-top box of the clients. The video stream 508 that is watched by the user will be decoded and sent to the display, as shown by the full line. When the user switches to another previously non-displayed video stream, as shown by the dashed line, buffered data of the new video stream 512, will be used to generate moving images thus reducing the zapping time. Depending on the buffered video data of the other video streams, multiple scenarios are possible for decoding and displaying leading to a seamless transition between moving images based on the buffered video information and moving images based on newly received sequences of frames and standard display thereof.

[0068] In a further embodiment, the invention relates to a processing system wherein the method embodiments according to the present invention are implemented, or in other words, wherein the method for handling a plurality of digital video streams according to the present invention, whereby buffering video information about a moving window of a non-displayed digital video stream is performed such that moving images can be derived from the buffered video information. An exemplary processing system 600 is shown in Fig. 9. Fig. 9 shows one configuration of processing system 600 that includes at least one programmable processor 603 coupled to a memory subsystem 605 that includes at least one form of memory, e.g., RAM, ROM, and so forth. A storage

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subsystem 607 may be included that has at least one disk drive and/or CD-ROM drive and/or DVD drive. In some implementations, a display system, a keyboard, and a pointing device may be included as part of a user interface subsystem 609 to provide for a user to manually input information. Ports for inputting and outputting data also may be included. More elements such as network connections, interfaces to various devices, and so forth, may be included, but are not illustrated in Fig. 9. The various elements of the processing system 600 may be coupled in various ways, including via a bus subsystem 613 shown in Fig. 9 for simplicity as a single bus, but will be understood to those in the art to include a system of at least one bus. The memory of the memory subsystem 605 may at some time hold part or all (in either case shown as 611) of a set of instructions that when executed on the processing system 600 implement the step(s) of the method embodiments described herein. Thus, while a processing system 600 such as shown in Fig. 9 is prior art, a system that includes the instructions to implement aspects of the present invention is not prior art, and therefore Fig. 4 is not labelled as

prior art.

[0069] It is to be noted that the processor 603 or processors may be a general purpose, or a special purpose processor, and may be for inclusion in a device, e.g., a chip that has other components that perform other functions. Thus, one or more aspects of the present invention can be implemented in digital electronic circuitry, or in computer hardware, firmware, software, or in combinations of them. Furthermore, aspects of the invention can be implemented in a computer program product tangibly embodied in a carrier medium carrying machine-readable code for execution by a programmable processor. Method steps of aspects of the invention may be performed by a programmable processor executing instructions to perform functions of those aspects of the invention, e.g., by operating on input data and generating output data. Accordingly, the present invention includes a computer program product which provides the functionality of any of the methods according to the present invention when executed on a computing device. Further, the present invention includes a data carrier such as for example a CD-ROM or a diskette which stores the computer product in a machine-readable form and which executes at least one of the methods of the invention when executed on a computing device. Nowadays, such software is often offered on the Internet or a company Intranet for download, hence the present invention includes transmitting the computer product according to the present invention over a local or wide area network.

[0070] It is an advantage that for the present invention only the buffer and more particularly the controlling thereof needs to be changed in a system for handling digital video streams, i.e. no changes are needed to e.g. the decoder.

[0071] It is to be noted that the system also works for dynamic sequences of frames, i.e. whereby the length of the sequences of frames used varies within a single video stream or between video streams. As information about the length of the sequence of frames may be provided together with the video information buffered for a second digital video stream, the latter could be handled using methods and systems according to the present invention, without substantial additional problems.

[0072] It is to be noted that the frame transmission order and the frame decoding order is not necessarily the same as the frame display order.

[0073] By applying a smart buffering strategy of the different video streams, this delay can be reduced to times similar to zapping on the analogue television. It is an advantage of embodiments of the present invention that the delay in displaying digital video stream in real-time or nearly real-time for embodiments of the present invention may be up to 10 times smaller than for existing digital systems.

[0074] It is an advantage of the present invention that no changes are needed at the server side of the network, nor in intermediate active nodes of the network, i.e. only changes at the client side of the network are needed.

[0075] It is to be understood that although preferred embodiments, specific constructions and configurations, as well as materials, have been discussed herein for devices according to the present invention, various changes or modifications in form and detail may be made without departing from the scope and spirit of this invention.

Claims

1. A method (200) for handling a plurality of digital video streams (110), the method comprising

   - displaying at least a first digital video stream to be displayed and
   - buffering video information for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed

2. A method (200) according to claim 1, each of the digital video streams (110) being encoded in sequences of frames, each of the sequences of frames comprising a key frame, at least one reference frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames,
   wherein buffering video information comprises buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream.

3. A method (200) according to claim 2, the method

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comprising not buffering all of said further frames for a moving window of at least a second digital video stream.

4. A method (200) according to any of claims 2 to 3, wherein buffering said at least one of said key frame or said at least one reference frame comprises buffering the key frame and all reference frames of a sequence of frames for said moving window of at least a second digital video stream.

5. A method (200) according to any of claims 2 to 4, wherein buffering said at least one of said key frame or said at least one reference frame furthermore comprises buffering no further frames in a first half of a sequence of frames and buffering all further frames in a second half of a sequence of frames.

6. A method (200) according to any of claims 2 to 5, wherein said buffering comprises buffering said frames of the most recently received sequence of frames for said at least a second digital video stream.

7. A method (200) according to any of claims 2 to 6, the method comprising refreshing said buffering when a new most recently received sequence of frames for said at least a second digital video stream is received.

8. A method (200) according to any of the previous claims, wherein said buffering video information for a moving window of at least a second digital video stream comprises buffering video information in an encoded format.

9. A method (200) according to any of the previous claims wherein buffering for at least a second digital video stream comprises buffering for a plurality of further digital video streams.

10. A method (200) according to any of the previous claims, the method furthermore comprising, decoding video information for at least one of said at least a second digital video stream.

11. A method (200) according to any of the previous claims, said digital video streams comprising a number of video layers, wherein said buffering is performed for at least one layer of said at least a second digital video stream.

12. A method (200) according to any of the previous claims, the method furthermore comprising, prior to said buffering, selecting said at least a second digital video stream based on a context of said plurality of digital video streams.

13. A method (200) according to any of the previous claims, the method furthermore comprising, providing to the viewer an indication of the digital video streams for which video information is buffered.

14. A method (200) according to any of the previous claims, wherein the buffering comprises buffering video information with a resolution or size lower than a resolution or size of the received video information.

15. A method (300) for switching between a plurality of digital video streams, the method comprising

- displaying at least a first digital video stream to be displayed and
- buffering video information for a moving window of at least a second video stream allowing extraction of moving images from the buffered video information when the second video stream is selected to be displayed, and upon selection of said digital second video stream for displaying,
- extracting and displaying moving images from the buffered video information and

after said extracting and displaying,
displaying newly received video information for said second digital video stream.

16. A method (300) according to the previous claim, each of the digital video streams being encoded in sequences of frames, each of the sequences of frames comprising a key frame, at least one reference frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames, wherein buffering video information comprises buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream.

17. A method (300) according to claim 16, the method furthermore comprising, upon selection of said second digital video stream for displaying, adjusting the number of frames displayed in order to synchronise receiving sequences of frames for said second digital video stream and displaying newly received sequences of frames for said second digital video stream.

18. A controller (100) for handling a plurality of digital video streams (110), wherein the controller (100) comprises means for controlling the display (150) of at least a first digital video stream
characterised in that
the controller (100) furthermore comprises means for controlling buffering (152) of video information for a moving window of at least a second digital video stream allowing extraction of moving images from the buffered video information when the second dig-

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ital video stream is selected to be displayed.

19. A controller (100) according to the previous claim, each of the digital video streams (110) being encoded in sequences of frames, each of the sequences of frames comprising a key frame, at least one reference frame and further frames, said key frame and at least one reference frame suitable for deriving frame information for said further frames, wherein said means for controlling buffering of video information comprises means for controlling buffering at least one of said key frame or said at least one reference frame of at least a second digital video stream.

20. A controller (100) according to claim 19, wherein said means for controlling buffering (152) is adapted so as to not buffer all of said further frames.

21. A controller (100) according to any of claims 18 to 20, wherein said means for controlling buffering (152) is adapted so as to buffer video information in an encoded format.

22. A controller (100) according to any of claims 18 to 21, the controller being adapted for, upon selection of a second digital video stream to be displayed, controlling extraction and display of moving images from said buffered video information and said controller being adapted for, after said extraction and display, controlling display of newly received video information for said second digital video stream.

23. A controller (100) according to claim 22, the controller being adapted for, upon the display of moving images for said second digital video stream, synchronising the receipt of newly received video information and the display thereof.

24. A device for handling (114) a plurality of digital video streams (110), the device comprising

- a buffer (116) for buffering frames from a plurality of video images and
- a controller (100) for controlling the display of at least a first digital video stream and for controlling buffering of video information for a moving window of at least a second video stream to said buffer, said buffering allowing extraction of moving images from the buffered video information when the second digital video stream is selected to be displayed.

25. A device (114) according to claim 24, each of said digital video streams (110) may comprise sequences of frames, each of said sequences of frames comprising at least a key frame, at least one reference frame and further frames, said at least one key frame and said at least one reference frame suitable for deriving frame information for said further frames, wherein said buffered video information comprises at least one of a key frame or at least one reference frame of at least a second digital video stream.

26. A device (114) according to any of claims 24 to 25, the device (114) furthermore comprising a decoder (118) for decoding of frames of said at least a first digital video stream and for decoding of said buffered video information.

27. A device (114) according to any of claims 24 to 26, the controller (100) being adapted for controlling said decoding of the buffered video information when the second digital video stream is selected to be displayed.

28. A device (114) according to any of claims 24 to 27, wherein said buffer (116) for buffering video information from a plurality of video images comprises a first sub-buffer for buffering said frames of a first video stream and at least one second sub-buffer for buffering video information for at least a second digital video stream.

29. A display system for displaying at least one digital video stream from a plurality of video streams, the display system comprising a controller according to any of claims 18 to 23 or a device for handling a plurality of digital video frames according to any of claims 24 to 28.

30. A computer program product for executing the method as claimed in any of claims 1 to 17.

31. A machine readable data storage device storing the computer program product of claim 30.

32. Transmission of the computer program product of claim 30 over a local or wide area telecommunications network.

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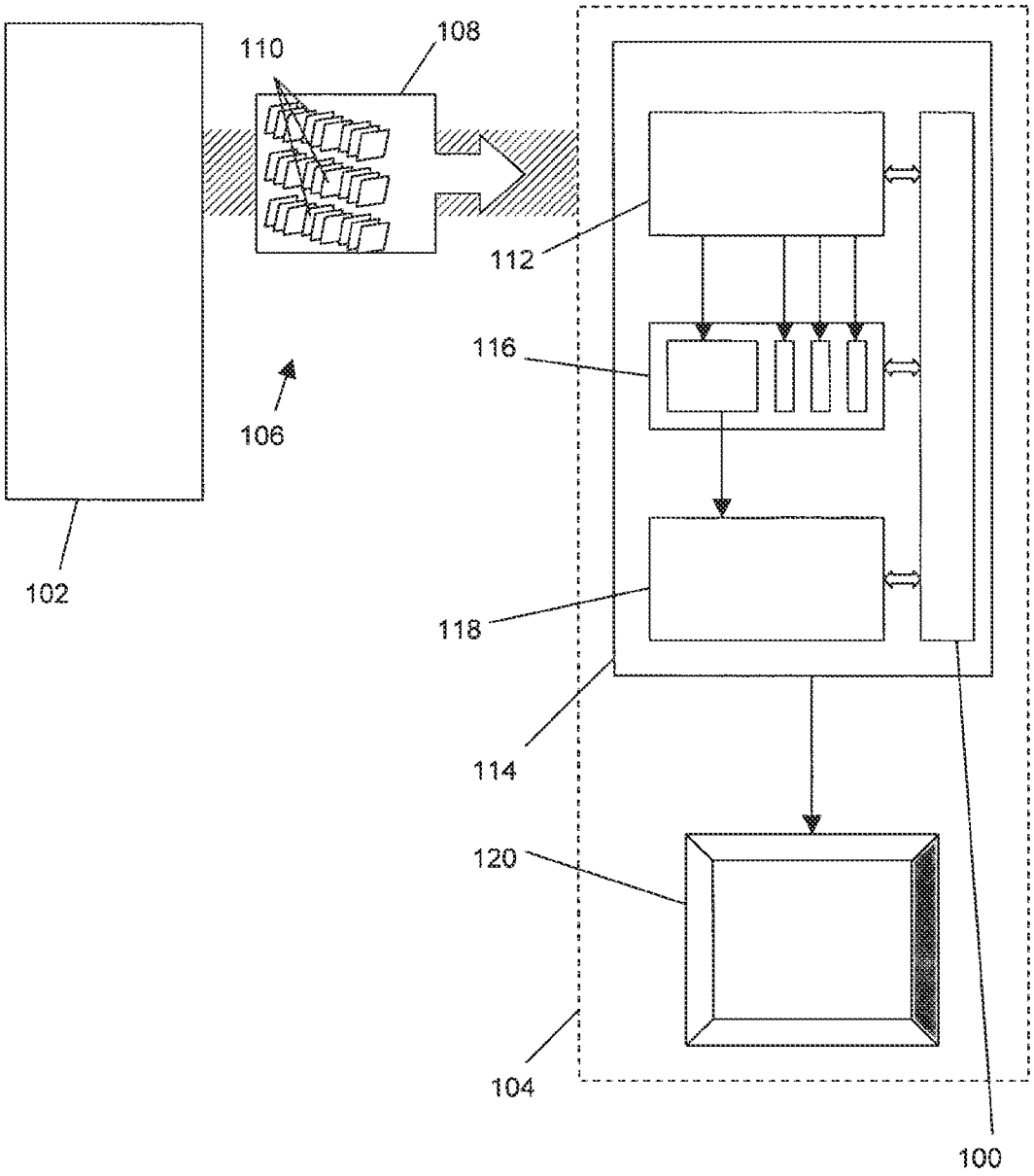


Fig. 1

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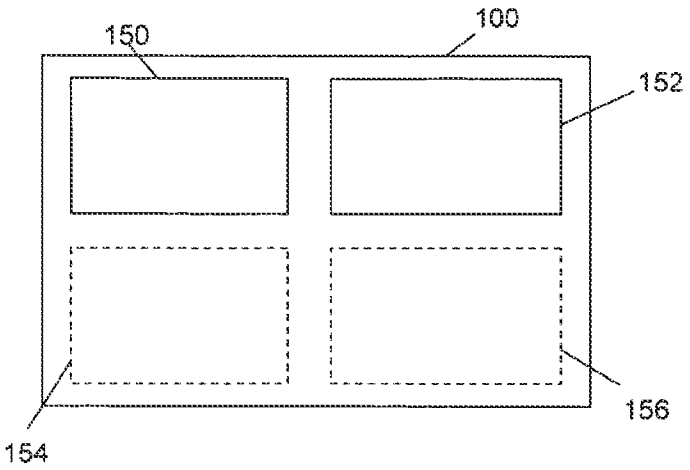


Fig. 2

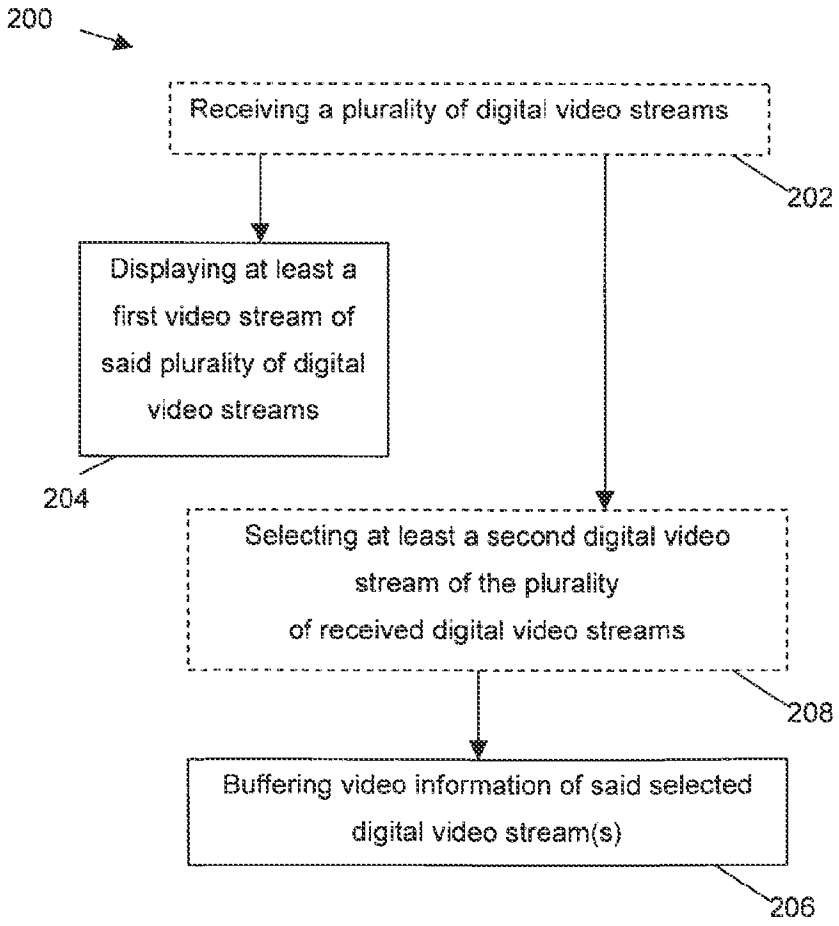


Fig. 3

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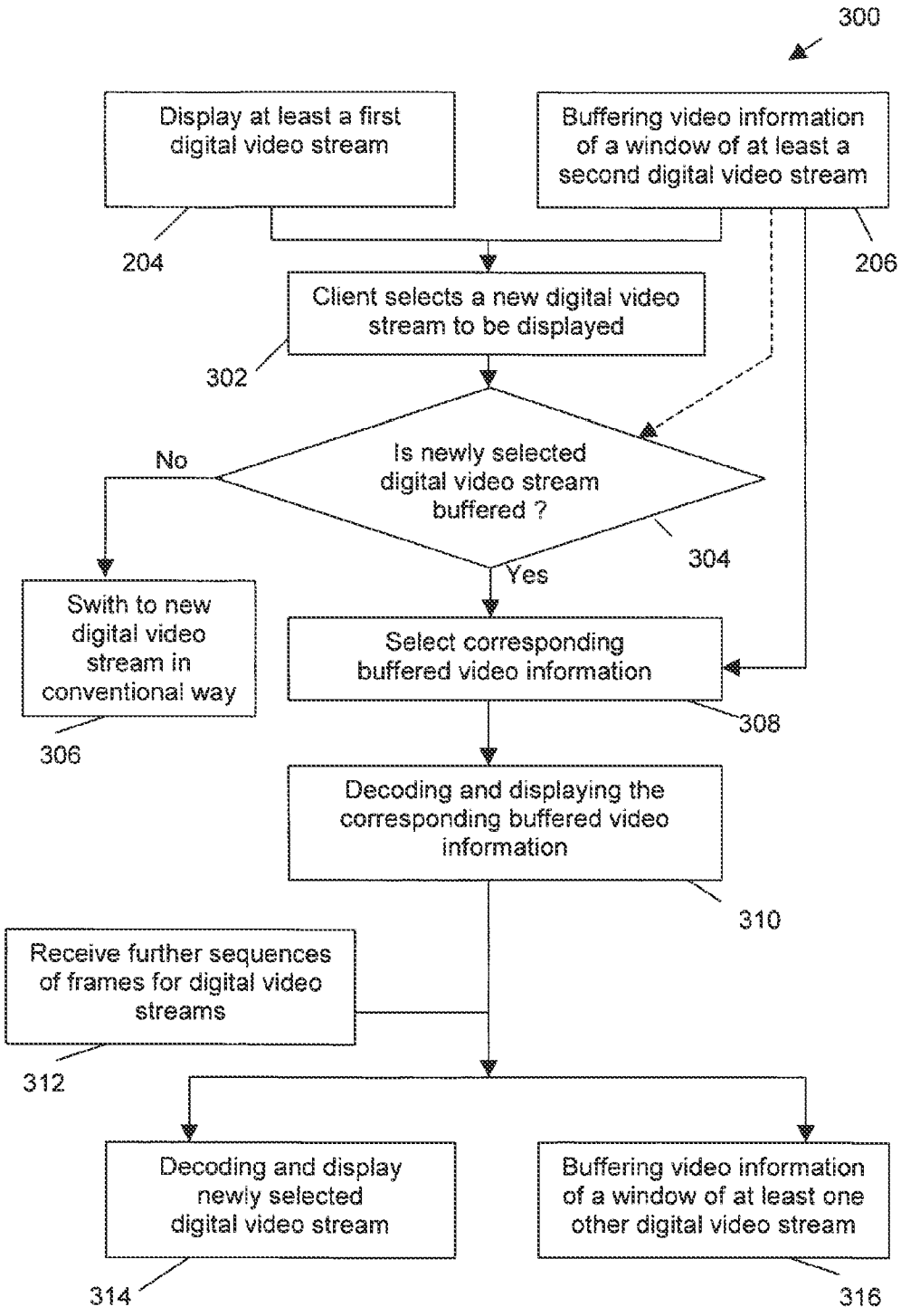


Fig. 4

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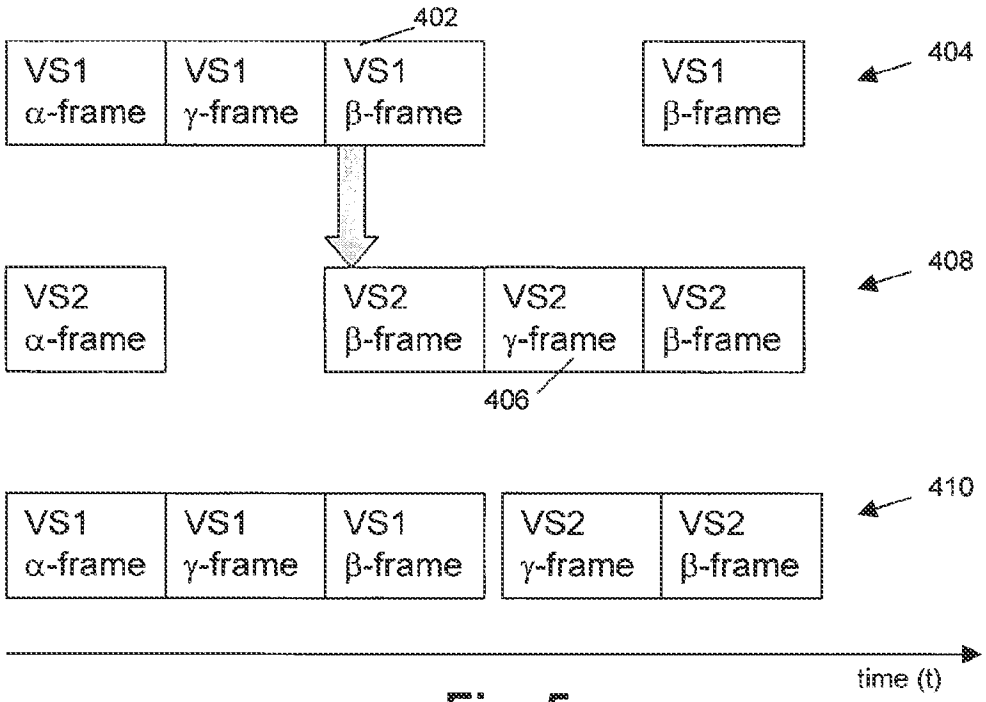


Fig. 5

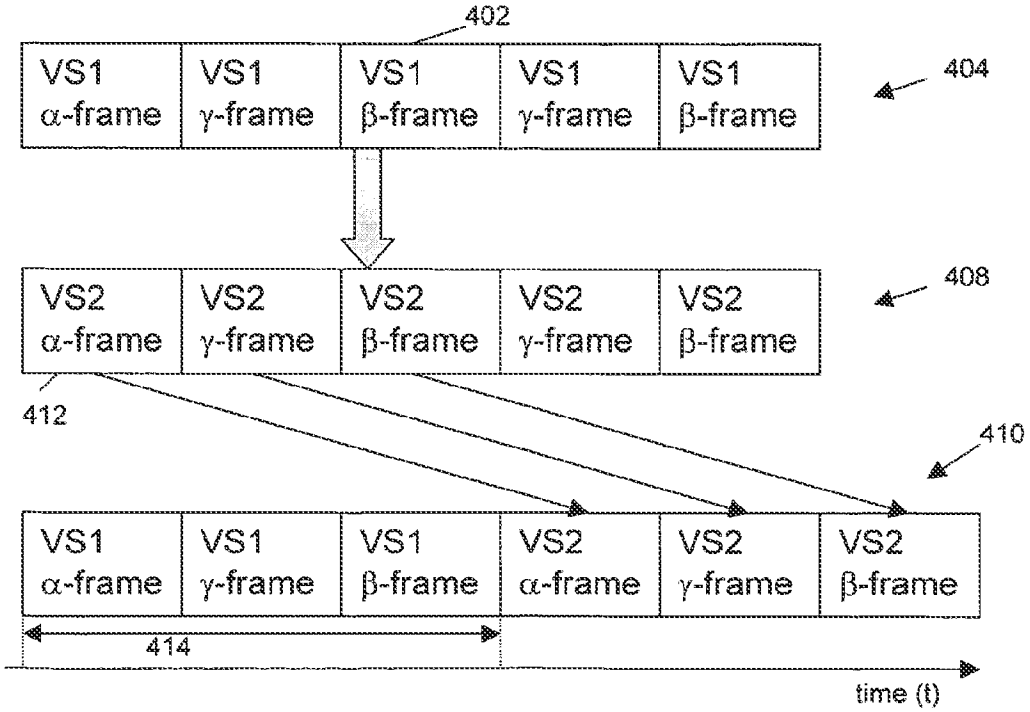


Fig. 6

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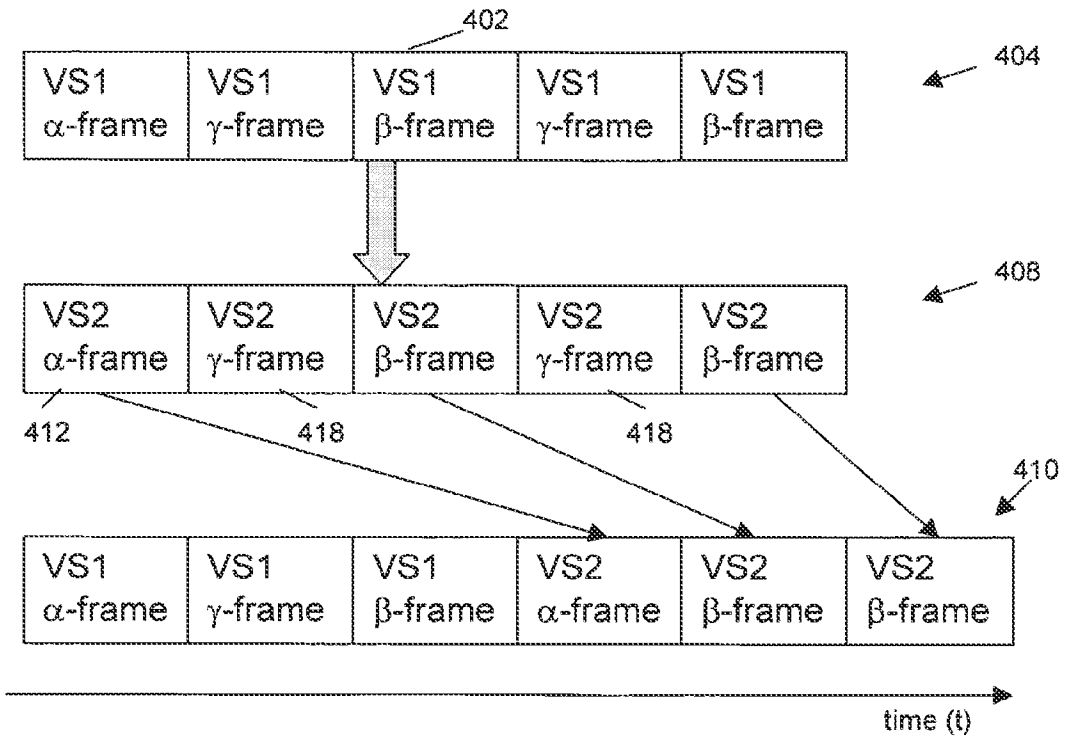


Fig. 7

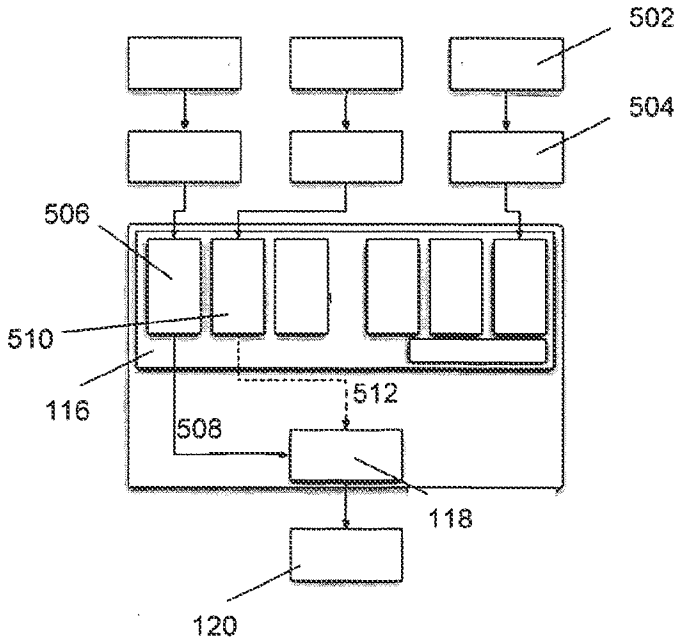


Fig. 8

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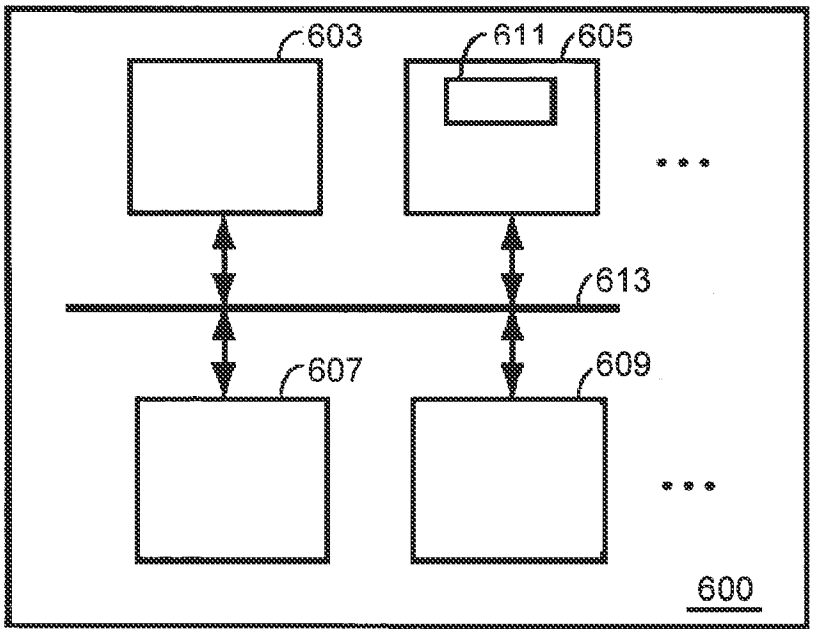


Fig. 9

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 2486

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	2 February 2006	McGrath, S

CATEGORY OF CITED DOCUMENTS

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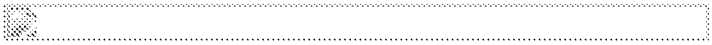
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ABSTRACT TWI826387B

[0001]

The present invention provides a system and method for optimizing a content change processing procedure. In an example embodiment, a digital receiver causes a first content segment to be played. The digital receiver receives a selection of a new content segment for playback during the playback of the first content segment. In response to receiving the selection, the digital receiver maintains a bit rate used to play the first content segment to initiate playback of the new content segment.



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【19】中華民國　　【12】專利公報　（B）

【11】證書號數：I826387
【45】公告日：中華民國 112 (2023) 年 12 月 21 日
【51】Int. Cl.：　*H04N21/23　(2011.01)*

發明　　全 8 頁

【54】名　稱：用於內容呈現之位元率及管線保留技術

【21】申請案號：107126926　　【22】申請日：中華民國 107 (2018) 年 08 月 02 日
【11】公開編號：201931861　　【43】公開日期：中華民國 108 (2019) 年 08 月 01 日
【30】優先權：2017/09/08　印度　201741031917

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美國
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【56】參考文獻：

US	2009/0254657A1	US	2011/0296047A1
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審查人員：陳逸

【57】申請專利範圍

1. 一種用於最佳化內容改變處理程序的方法，該方法包含：藉由一數位接收器，致使一第一內容片段以一第一位元率受到播放，該第一位元率係適於播放該第一內容片段的一位元率；藉由該數位接收器，在播放該第一內容片段之期間內接收要播放一新內容片段的一選擇；反應於接收到該選擇，使用被用來播放該第一內容片段的該第一位元率來起始對該新內容片段的播放，以從目前的該第一內容片段轉換成播放該新內容片段；在使用該第一位元率播放該新內容片段之期間內，偵測是否可維持使用該第一位元率來播放該新內容片段；以及反應於偵測出不可繼續以該第一位元率播放該新內容片段，調整該第一位元率。
2. 如請求項 1 之方法，其進一步包含：判定該新內容片段是否屬於與該第一內容片段相同之內容類型；以及由該新內容片段屬於與該第一內容片段相同之內容類型，而判定是否保留被用來播放該第一內容片段的一播放管線之至少一部分，其中，保留該播放管線之至少一部分之作業包含：保留一源元件、一解多工器、一音訊解碼器、或一視訊解碼器其中一或多者。
3. 如請求項 2 之方法，其中，判定是否保留之作業包含：偵測用於該新內容片段的編碼解碼器資訊，該編碼解碼器資訊指示該新內容片段所需的解碼器之類型；以及判定該播放管線中之該音訊解碼器和該視訊解碼器是否屬於該編碼解碼器資訊所指示之該等類型。
4. 如請求項 3 之方法，其進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器屬於由該編碼解碼器資訊所指示之該等類型，而保留整個播放管線。
5. 如請求項 3 之方法，其進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器與由該編碼解碼器資訊所指示之該等類型不同，而釋放該播放管線中之該音訊解碼器及該視訊解碼器；以及基於該編碼解碼器資訊而獲取新音訊解碼器和新視訊解碼器。

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6. 如請求項 1 之方法，其中：偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含：判定出下載該新內容片段所耗時間比預期少；並且調整該第一位元率之作業包含：增加該第一位元率。

7. 如請求項 1 之方法，其中：偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含：判定出下載該新內容片段所耗時間比預期長；並且調整該第一位元率之作業包含：減少該第一位元率。

8. 一種用於最佳化內容改變處理程序的系統，該系統包含：一或多個硬體處理器；以及一儲存裝置，其儲存有可組配該一或多個硬體處理器以進行數個操作的指令，該等操作包含：藉由一數位接收器，致使一第一內容片段以一第一位元率受到播放，該第一位元率係適於播放該第一內容片段的一位元率；藉由該數位接收器，在播放該第一內容片段之期間內接收要播放一新內容片段的一選擇；反應於接收到該選擇，使用被用來播放該第一內容片段的該第一位元率來起始對該新內容片段的播放，以從目前的該第一內容片段轉換成播放該新內容片段；在使用該第一位元率播放該新內容片段之期間內，偵測是否可維持使用該第一位元率來播放該新內容片段；以及反應於偵測出不可繼續以該第一位元率播放該新內容片段，調整該第一位元率。

9. 如請求項 8 之系統，其中，該等操作進一步包含：判定該新內容片段是否屬於與該第一內容片段相同之內容類型；以及由該新內容片段屬於與該第一內容片段相同之內容類型，而判定是否保留被用來播放該第一內容片段的一播放管線之至少一部分，其中，保留該播放管線之至少一部分之作業包含：保留一源元件、一解多工器、一音訊解碼器、或一視訊解碼器其中一或多者。

10. 如請求項 9 之系統，其中，判定是否保留之作業包含：偵測用於該新內容片段的編碼解碼器資訊，該編碼解碼器資訊指示該新內容片段所需的解碼器之類型；以及判定該播放管線中之該音訊解碼器和該視訊解碼器是否屬於該編碼解碼器資訊所指示之該等類型。

11. 如請求項 10 之系統，其中，該等操作進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器屬於由該編碼解碼器資訊所指示之該等類型，而保留整個播放管線。

12. 如請求項 10 之系統，其中，該等操作進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器與由該編碼解碼器資訊所指示之該等類型不同，而釋放該播放管線中之該音訊解碼器及該視訊解碼器；以及基於該編碼解碼器資訊而獲取新音訊解碼器和新視訊解碼器。

13. 如請求項 8 之系統，其中：偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含：判定出下載該新內容片段所耗時間比預期少；並且調整該第一位元率之作業包含：增加該第一位元率。

14. 如請求項 8 之系統，其中：偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含：判定出下載所耗時間比預期長；並且調整該第一位元率之作業包含：減少該第一位元率。

15. 一種機器儲存媒體，其儲存有當受一機器之一或多個硬體處理器執行時可致使該機器進行數個操作的指令，該等操作包含：藉由一數位接收器，致使一第一內容片段受到播放，第一位元率係適於播放該第一內容片段的一位元率；藉由該數位接收器，在播放該第一內容片段之期間內接收要播放一新內容片段的一選擇；反應於接收到該選擇，使用被用來播放該第一內容片段的該第一位元率來起始對該新內容片段的播放，以從目前的該第一內容片段轉換成播放該新內容片段；在使用該第一位元率播放該新內容片段之期間內，偵測是否可維持使用該第一位元率來播放該新內容片段；以及反應於偵測出不可繼續以該第一位元率播放該新內容片段，調整該第一位元率。

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16. 如請求項 15 之機器儲存媒體，其中，該等操作進一步包含：判定該新內容片段是否屬於與該第一內容片段相同之內容類型；以及由該新內容片段屬於與該第一內容片段相同之內容類型，而判定是否保留被用來播放該第一內容片段的一播放管線之至少一部分，其中，保留該播放管線之至少一部分之作業包含：保留一源元件、一解多工器、一音訊解碼器、或一視訊解碼器其中一或多者。

17. 如請求項 16 之機器儲存媒體，其中，判定是否保留之作業包含：偵測用於該新內容片段的編碼解碼器資訊，該編碼解碼器資訊指示該新內容片段所需之解碼器的類型；以及判定該播放管線中之該音訊解碼器和該視訊解碼器是否屬於由該編碼解碼器資訊所指示之該等類型。

18. 如請求項 17 之機器儲存媒體，其中，該等操作進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器屬於由該編碼解碼器資訊所指示之該等類型，而保留整個播放管線。

19. 如請求項 17 之機器儲存媒體，其中，該等操作進一步包含：反應於該播放管線中之該音訊解碼器及該視訊解碼器與由該編碼解碼器資訊所指示之該等類型不同，而釋放該播放管線中之該音訊解碼器及該視訊解碼器；以及基於該編碼解碼器資訊而獲取新音訊解碼器和新視訊解碼器。

20. 如請求項 15 之機器儲存媒體，其中：偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含判定出下載該新內容片段所耗時間比預期少，並且調整該第一位元率之作業包含增加該第一位元率；或者偵測是否可維持使用該第一位元率來播放該新內容片段之作業包含判定出下載所耗時間比預期長，並且調整該第一位元率之作業包含減少該第一位元率。

圖式簡單說明

隨附圖式之各種圖式僅僅說明本發明之實例實施例且不能被認為限制其範疇。

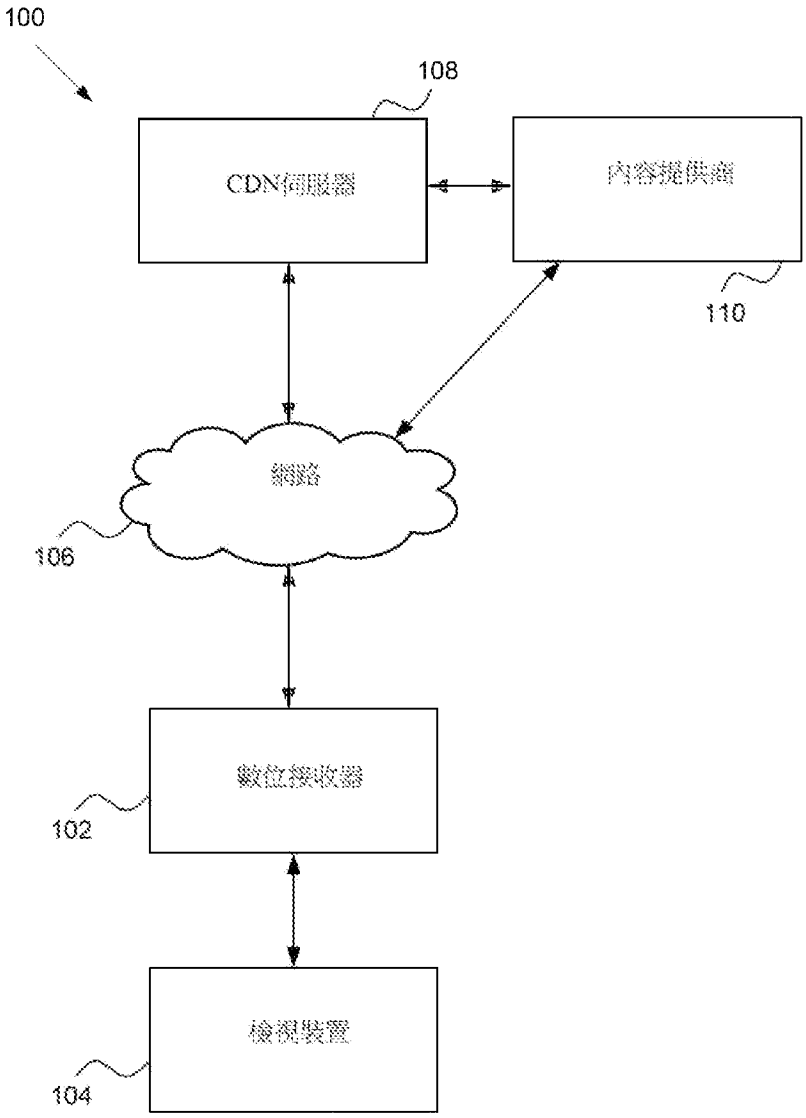
圖 1 為說明用於最佳化內容改變之實例環境的圖解；圖 2 為說明在根據實例實施例之數位接收器內之組件之實例實施例的方塊圖。

圖 3 為用於根據實例實施例之最佳化內容改變處理程序之方法的流程圖。

圖 4 為用於根據實例實施例之保留內容遞送管線之方法的流程圖。

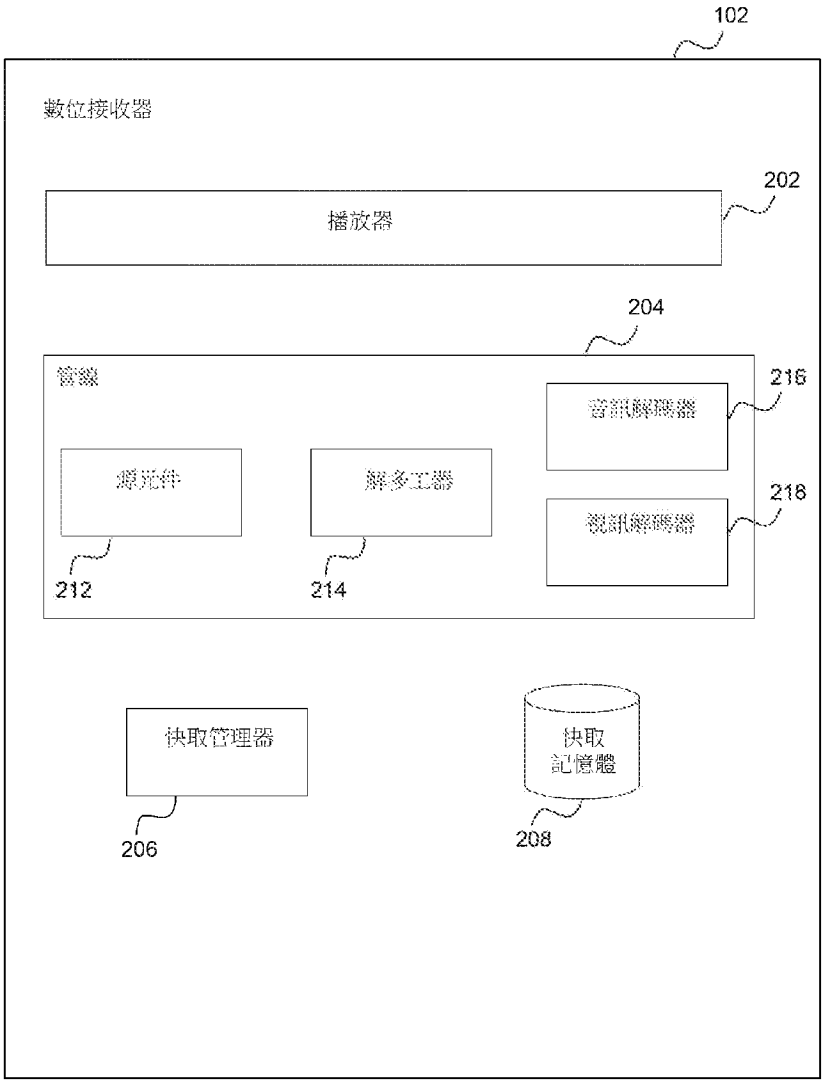
圖 5 為根據實例實施例的在一實例形式之計算系統中之機器的圖解表示，在該計算系統內可執行指令集以使機器執行本文中所論述之方法中之任一者或多者。

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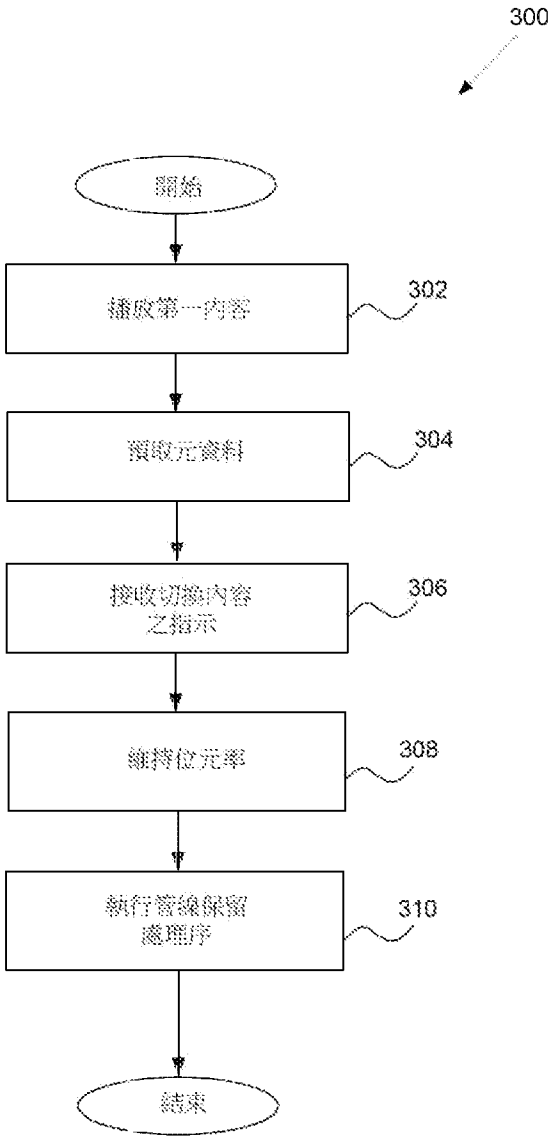
【圖1】

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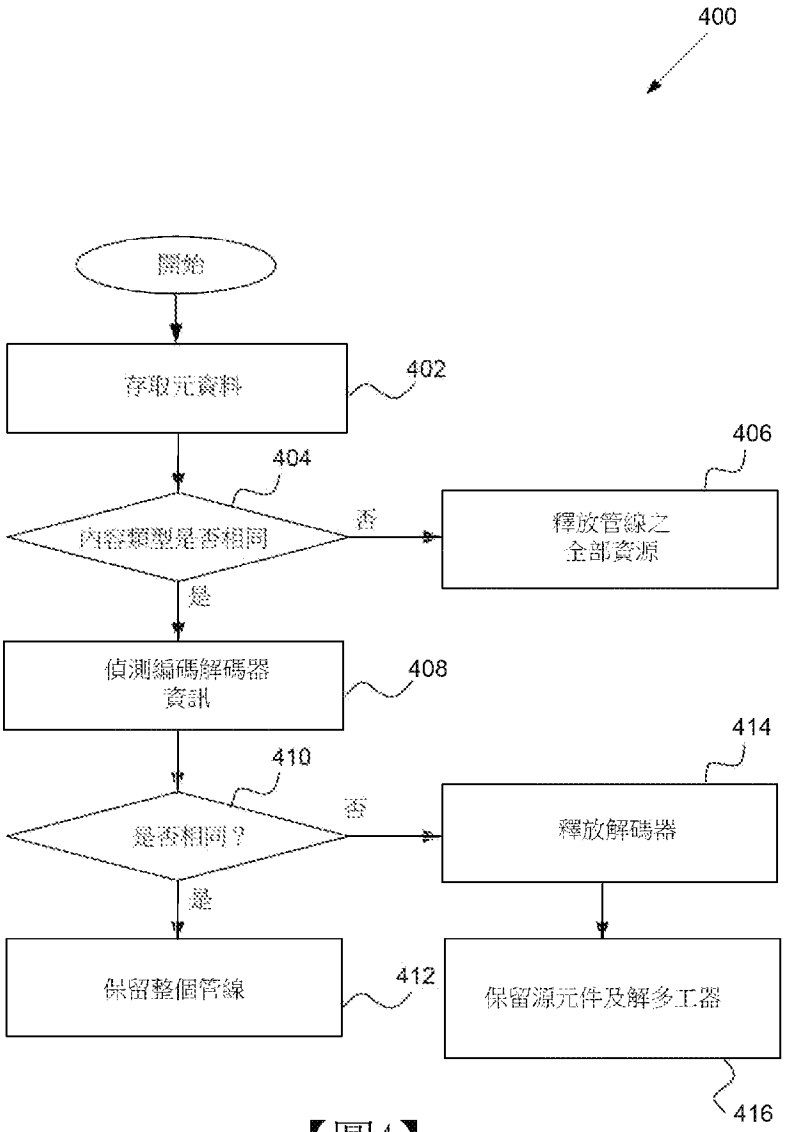
【圖2】

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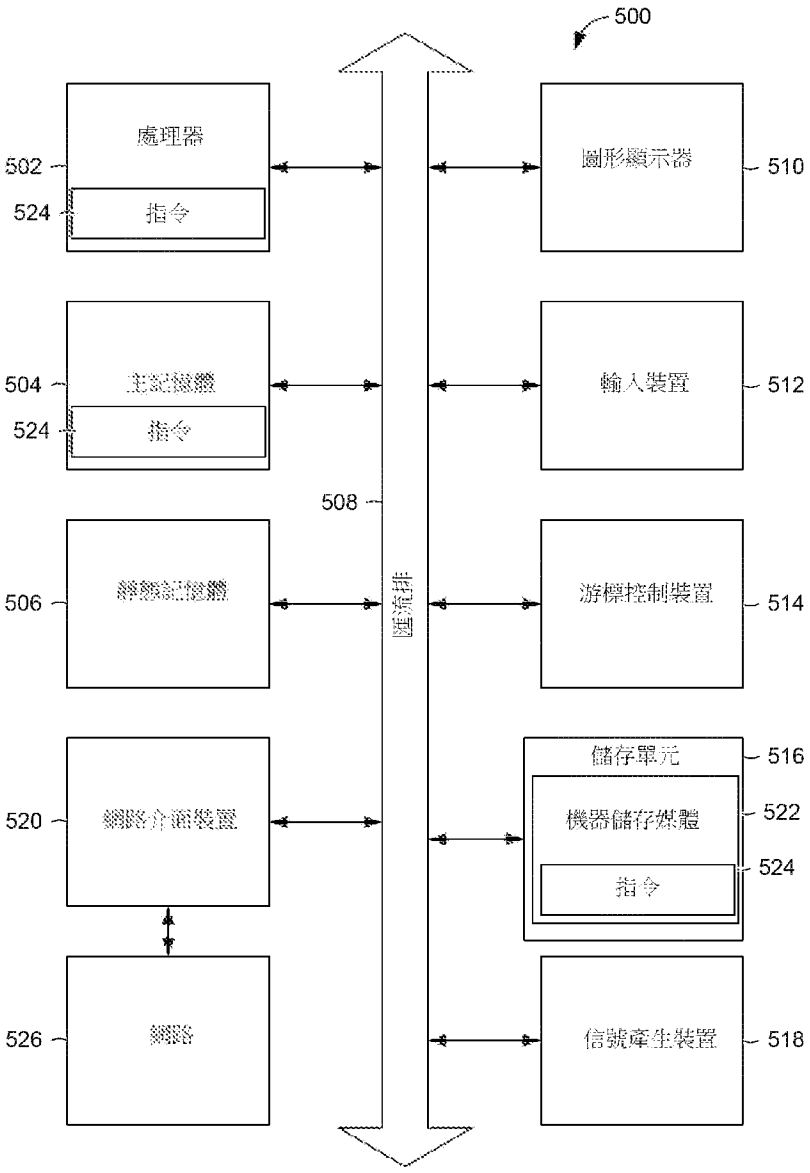
【圖3】

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【圖4】

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【圖5】

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference 2050-354WO1	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 18/46723	International filing date *(day/month/year)* 14 August 2018 (14.08.2018)	(Earliest) Priority Date *(day/month/year)* 08 September 2017 (08.09.2017)
Applicant OPENTV, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 8 sheets.

☐ It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

a. With regard to the **language**, the international search was carried out on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. ☐ This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2. ☐ **Certain claims were found unsearchable** (see Box No. II).

3. ☐ **Unity of invention is lacking** (see Box No. III).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. With regard to the **drawings**,

a. the figure of the **drawings** to be published with the abstract is Figure No. 3

☒ as suggested by the applicant.

☐ as selected by this Authority, because the applicant failed to suggest a figure.

☐ as selected by this Authority, because this figure better characterizes the invention.

b. ☐ none of the figures is to be published with the abstract.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 18/46723

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04W 28/02 (2018.01)
CPC - H04W 28/02; H04W 12/06; H04W 28/10; H04N 19/463; H04N 19/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History Document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History Document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History Document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2011/0296047 A1 (Orr) 01 December 2011 (01.12.2011), para [0024]-[0026], [0029], [0031]-[0033], [0035]-[0037], [0039].	1-2, 6-7, 11-12 --- 3-5, 8-10, 13-15
Y	US 2017/0244924 A1 (Sony Corporation) 24 August 2017 (24.08.2017), para [0040]-[0042].	3-5, 8-10, 13-15
A	US 2009/0254657 A1 (Melnyk et al.) 08 October 2009 (08.10.2009), entire document.	1-15
A	US 2010/0158101 A1 (Wu et al.) 24 June 2010 (24.06.2010), entire document.	1-15
A	US 8,532,171 B1 (Narayanan et al.) 10 September 2013 (10.09.2013), entire document.	1-15

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 September 2018	22 OCT 2018

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (January 2015)

Espacenet

Bibliographic data: CN105393516 (A) — 2016-03-09

Quality optimization with buffer and horizon constraints in adaptive streaming

Inventor(s): LI ZHI; BEGEN ALI C; GAHM JOSHUA B; OSLER BRUCE P; ORAN DAVID R ± (LI ZHI, ; BEGEN ALI C, ; GAHM JOSHUA B, ; OSLER BRUCE P, ; ORAN DAVID R, ; 李智, ; 艾丽·C·贝根, ; 乔舒亚·B·盖哈姆, ; 布鲁斯·P·奥斯勒, ; 大卫·R·奥兰)

Applicant(s): CISCO TECH INC ± (CISCO TECHNOLOGY, INC, ; 思科技术公司)

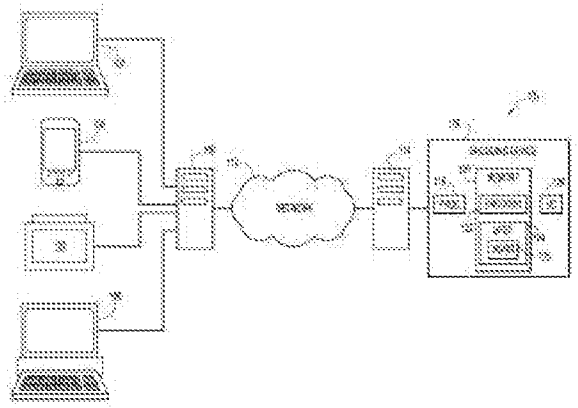
Classification: **- international:** ***H04L29/06***
- cooperative: H04L65/612 (EP, US); H04L65/752 (EP); H04L65/80 (EP, US); H04N19/152 (EP, US); H04N19/189 (EP, US)

Application number: CN20148040560 20140715 Global Dossier

Priority number(s): US201313943445 20130716 ; WO2014US46633 20140715

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Abstract of CN105393516 (A)



Techniques are provided for optimizing quality in adaptive streaming, where information is obtained relating to encoding bitrates and content quality scores for content segments of a content stream. The content segments of the content stream are provided by a content server and downloaded by a computing device. For each content segment, an encoding bitrate is determined for downloading the content segment from the content server, where determining the encoding bitrate for a current content segment is based upon an estimated current network bandwidth, constraints of a buffer into which downloaded content segments are stored, and also upon quality scores associated with content segments within a selected horizon extending from the current content segment to a future content segment in the content stream at an endpoint of the horizon. Each content segment with the determined bitrate for the content segment is downloaded from the content server.

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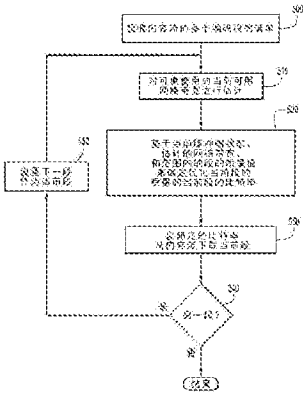
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在自适应流送中用缓冲器和范围约束来进行质量优化

(57)摘要

提供了用于在自适应流送中优化质量的技术，其中，关于内容流的内容段的编码比特率和内容质量评分的信息被获得。内容流的内容段由内容服务器提供并且由计算设备下载。针对每一内容段，编码比特率被确定以用于从内容服务器下载内容段，其中，确定当前内容段的编码比特率是基于估计的当前网络带宽、下载的内容段被存储到其中的缓冲器的约束、并且还基于与选定范围内的内容段相关联的质量评分，该选定范围从当前内容段延伸到在范围端点处的内容流中的将来内容段）。每一个内容段以针对该内容段确定的比特率被从内容服务器下载。



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1. 一种方法，包括：

获得关于内容流的内容段的编码比特率和内容质量评分的信息，其中，所述内容流的内容段由内容服务器提供并且由计算设备下载；

针对每一内容段，确定所述内容段将被从所述内容服务器下载的编码比特率，其中，确定当前内容段的编码比特率是基于以下各项的：估计的当前网络带宽、下载的内容段被存储到其中的缓冲器的约束、以及与选定范围内的内容段相关联的质量评分，所述选定范围从所述当前内容段延伸到在所述范围端点处的所述内容流中的将来内容段；以及

以针对每一内容段确定的比特率来从所述内容服务器下载所述内容段。

2. 如权利要求 1 所述的方法，其中，所述确定所述当前内容段的编码比特率还包括：

应用动态编程算法，所述动态编程算法使用与所述选定范围内的内容段相关联的质量评分和缓冲器约束信息来确定所述当前内容段的最优质量评分值；以及

应用在线算法，所述在线算法迭代地计算所述选定范围内的段的编码比特率，并且确定与所述当前内容段的最优质量评分值相关联的编码比特率。

3. 如权利要求 2 所述的方法，其中，所述应用动态编程算法包括将与所述选定范围内的内容段相关联的所述质量评分的平均评分最大化。

4. 如权利要求 2 所述的方法，其中，所述应用动态编程算法包括将与所述选定范围内的内容段相关联的所述质量评分的最差情况的质量评分最大化。

5. 如权利要求 2 所述的方法，其中，所述应用动态编程算法还包括基于所述当前内容段的最优质量评分值和先前内容段的最优质量评分值之间的差值来将所述当前内容段的最优质量评分值调整为经修改的质量评分值。

6. 如权利要求 2 所述的方法，其中，所述应用动态编程算法还包括通过幂函数调整所述当前内容段的最优质量评分值，其中，所述当前内容段的最优质量评分值由指数 b 修改，其中 $b \geq 1$。

7. 如权利要求 2 所述的方法，其中，与当前内容段相关联的所述缓冲器约束信息包括：缓冲器下限值、缓冲器上限值、与所述当前内容段之前的内容段相关联的缓冲器大小、和与所述计算设备相关联的网络带宽值。

8. 如权利要求 2 所述的方法，其中，关于内容质量评分的所述信息还包括多个编码比特率、多个段持续时间、和与每一内容段的编码比特率相对应的多个内容质量评分。

9. 如权利要求 1 所述的方法，其中，关于所述内容流的内容段的编码比特率和内容质量评分的所述信息从由所述内容服务器提供的清单获得的。

10. 一种装置，包括：

包括质量优化引擎的一个或多个存储器，所述质量优化引擎包括一个或多个应用以及缓冲器，其中所述一个或多个应用对从内容服务器下载的内容流的内容段的质量进行优化，所述缓冲器存储所下载的所述内容流的内容段；

通信接口设备，所述通信接口设备被配置为使能网络上的通信；和

处理器，所述处理器被配置为执行和控制所述质量优化引擎的操作，以执行以下操作：

获得关于所述内容流的内容段的比特率和内容质量评分的信息，其中所述内容流的内容段由内容服务器来提供以供计算设备使用；

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针对每一内容段，确定所述内容段将从所述内容服务器被下载的编码比特率，其中确定当前内容段的所述编码比特率是基于以下各项的：估计的当前网络带宽、下载的内容段被存储到其中的缓冲器的约束、以及与选定范围内的内容段相关联的质量评分，所述选定范围从所述当前内容段延伸到在所述范围端点处的所述内容流中的将来内容段；以及

以针对每一内容段确定的比特率来从所述内容服务器下载所述内容段。

11. 如权利要求 10 所述的装置，其中，所述处理器被配置为通过以下方式来确定所述当前内容段的编码比特率：

应用动态编程算法，所述动态编程算法使用与所述选定范围内的内容段相关联的质量评分和缓冲器约束信息来确定所述当前内容段的最优质量评分值；以及

应用在线算法，所述在线算法迭代地计算所述选定范围内的段的编码比特率，并且确定与所述当前内容段的最优质量评分值相关联的编码比特率。

12. 如权利要求 11 所述的装置，其中，所述处理器被配置为通过将与所述选定范围内的内容段相关联的所述质量评分的平均评分最大化来应用所述动态编程算法。

13. 如权利要求 11 所述的装置，其中，所述处理器被配置为通过将与所述选定范围内的内容段相关联的所述质量评分的最差情况的质量评分最大化来应用所述动态编程算法。

14. 如权利要求 11 所述的装置，其中，与当前内容段相关联的所述缓冲器约束信息包括：缓冲器下限值、缓冲器上限值、与所述当前内容段之前的内容段相关联的缓冲器大小、和与所述计算设备相关联的网络带宽值。

15. 如权利要求 11 所述的装置，其中，关于内容质量评分的所述信息还包括多个编码比特率、和于每一内容段的编码比特率相对应的多个内容质量评分。

16. 如权利要求 10 所述的装置，其中，所述处理器被配置为从由所述内容服务器提供的清单获得关于所述内容流的内容段的编码比特率和内容质量评分的信息。

17. 一种或多种计算机可读存储介质，所述计算机可读存储介质编码有包括计算机可执行指令的软件，并且当所述软件被执行时能操作来：

获得关于内容流的内容段的编码比特率和内容质量评分的信息，其中，所述内容流的内容段由内容服务器提供并且由计算设备下载；

针对每一内容段，确定所述内容段将被从所述内容服务器下载的编码比特率，其中，确定当前内容段的编码比特率是基于以下各项的：估计的当前网络带宽、下载的内容段被存储到其中的缓冲器的约束、以及与选定范围内的内容段相关联的质量评分，所述选定范围从所述当前内容段延伸到在所述范围端点处的所述内容流中的将来内容段；以及

以针对每一内容段确定的比特率来从所述内容服务器下载所述内容段。

18. 如权利要求 17 所述的计算机可读存储介质，其中，所述指令能操作来通过以下方式确定所述当前内容段的编码比特率：

应用动态编程算法，所述动态编程算法使用与所述选定范围内的内容段相关联的质量评分和缓冲器约束信息来确定所述当前内容段的最优质量评分值；以及

应用在线算法，所述在线算法迭代地计算所述选定范围内的段的编码比特率，并且确定与所述当前内容段的最优质量评分值相关联的编码比特率。

19. 如权利要求 18 所述的计算机可读存储介质，其中，所述指令能操作来应用所述动态编程算法，包括将与所述选定范围内的内容段相关联的所述质量评分的平均评分最大

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化。

20. 如权利要求 18 所述的计算机可读存储介质，其中，所述指令能操作来应用所述动态编程算法，包括将与所述选定范围内的内容段相关联的所述质量评分的最差情况的质量评分最大化。

21. 如权利要求 18 所述的计算机可读存储介质，其中，与当前内容段相关联的所述缓冲器约束信息包括：缓冲器下限值、缓冲器上限值、与所述当前内容段之前的内容段相关联的缓冲器大小、和与所述计算设备相关联的网络带宽值。

22. 如权利要求 18 所述的计算机可读存储介质，其中，关于内容质量评分的所述信息还包括多个编码比特率、和与每一内容段的编码比特率相对应的多个内容质量评分。

23. 如权利要求 17 所述的计算机可读存储介质，其中，所述指令能操作来从由所述内容服务器提供的清单获得所述内容流的内容段的编码比特率和内容质量评分。

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在自适应流送中用缓冲器和范围约束来进行质量优化

技术领域

[0001] 本公开涉及计算机网络中的自适应流送。

背景技术

[0002] 在传统的自适应流送中，视频流被分成各自为几秒的短段，其中，以若干不同的比特率从主要的高质量源来对这些段进行编码（或转码），并且输出被存储在客户端从其获取片段的服务器处。通常的做法是编码器/转码器使用恒定比特率(CBR)，来产生视频输出的层(tier)或"等级(level)"的集合。客户端应用使用HTTP GET请求来从服务器（经常顺序地）下载段、通过对下载性能进行测量来估计可用的带宽、以及在之前的段完成时选择要获取的下一段的视频等级。

[0003] 通常，几十秒所下载的视频段在客户端处被缓冲以适应带宽波动。可行的速率自适应算法实现了高的平均视频质量、低变化的视频质量和低概率的由缓冲器欠载运行(underrun)所引起的视频播出停止。

附图说明

[0004] 图1是示例系统的示意图，在该示例系统中自适应流送被用于通过网络向计算设备提供视频内容。

[0005] 图2是内容服务器的示例实施例的示意图，该内容服务器以不同比特率和质量等级来向图1的系统的计算设备提供内容流的段。

[0006] 图3是计算设备的示例实施例的示意框图，该计算设备接收视频流段以用于在图1的系统中的设备处显示并进行观看。

[0007] 图4是描述使用图1的系统以不同的比特率和相应的质量等级来对内容流的段进行编码的示例处理的流程图。

[0008] 图5是描述使用图1的系统基于缓冲器和范围约束来对内容流的段的质量进行优化的示例处理的流程图。

[0009] 图6是描述计算设备的示意图，该计算设备根据本文中所描述的技术以选定比特率来从内容服务器接收视频段。

具体实施方式

[0010] 概述

[0011] 本文中描述了用于优化自适应流送的质量的技术，其中，关于内容流的视频段的编码比特率和视频质量评分的信息被获得。内容流的视频段由内容服务器提供并且由计算设备下载。针对每一视频段，编码比特率被确定以用于从内容服务器下载视频段，其中，确定当前视频段的编码比特率是基于估计的当前可用网络带宽、下载的视频段被存储于其中的缓冲器的约束、并且还基于在所选择的范围（该所选择的范围从当前视频段延伸到在范围端点处的内容流中的将来视频段）内与视频段相关联的质量评分。每一内容段以针对该

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内容段的所确定的比特率被从内容服务器下载。

[0012] 示例实施例

[0013] 本文中描述了用于通过应用动态速率自适应分析来提高自适应流送中的内容的质量的技术，该动态速率自适应分析基于视频段的给定的时间范围来对从内容服务器获取或下载的每一视频段的质量等级进行优化。分析将与显示内容的计算设备相关联的范围约束和存储缓冲器考虑在内，其中，视频质量优化基于如下约束而被确定：客户端缓冲器被限制在最高等级（例如，针对低延迟的实时流送）和最低等级（例如，针对最小化缓冲欠载运行的可能性的点播流送）之间。与优化的质量等级相关联的编码比特率被选择以用于每一视频段，其中，优化的质量等级只基于针对该内容的视频段的最近时间流中的选定范围内的视频段。

[0014] 不论来自内容服务器的视频内容是恒定比特率（CBR）编码的还是可变比特率（VBR）编码的都可以使用本文中所描述的技术。本文中所描述的技术还避免了链路带宽变化的任意统计模型，但替代地被配置为对任意可能情境的视频质量进行优化（由于每一段的视频质量基于当前缓冲器约束和视频段的有限或选定将来范围而被确定）。可以被实现以用于本文所描述的优化视频段的质量的技术的视频质量评分的一些非限制性示例包括PSNR（峰值信噪比）和负MSE（均方误差或-MSE）、MS-SSIM（多尺度结构相似性）与VQM（视频质量度量）。

[0015] 本文中所描述的自适应流送系统和方法的实施例使用恒定质量、或近乎恒定质量、段（还被称为区块或片段）来甚至在自适应流送的上移和下移期间提供更好的观看体验。在所描述的实施例中，计算设备可以通过选择恒定质量段来直接追踪和优化质量，以使得计算设备在让带宽波动期间维持平稳的质量，因此为其他客户端释放了可能以其他方式来拉取比当前质量等级需要的数据更多的数据而被浪费的带宽。计算设备通过以下方式来实现这一点：(a) 接收可用带宽内的最高质量表示；(b) 当带宽可用时，上移到更高的质量表示（而不是上移到更高的比特率，即使质量可能不被提高）；和/或 (c) 当带宽缺乏时，下移到更低的质量。

[0016] 自适应流送系统一般地落入基于推送的 (push-based) 系统或基于拉取的 (pull-based) 系统。尽管自适应流送系统的某些实施例可以为了基于推送的系统（或者基于推送的系统和基于拉取的系统的组合）的益处而被使用，但本公开的重点在于基于拉取的系统。在基于拉取的自适应流送中，客户端决定接下来要从源（例如，源服务器或内容服务器、缓存服务器等）请求哪个段。该决定可以基于内容段和观测值的各种属性，比如，当前（所观测的或可用的）带宽和客户端缓冲器中的数据量。在当前系统中，适应可以采取请求以不同比特率被编码的段的形式。例如，客户端可以上移或下移（比如，切换到不同的比特率）或者保持在相同的比特率以提供连续的播放。比特率切换决定基于预定调度进行修订，并且然后新的段以确定的比特率被请求。各种目标函数是可能的，并且客户端可以在算法方面存在不同，该算法被用于尝试最大化在可用带宽约束内递送的视频质量。然而，传统系统间的共同特质是使用段编码比特率来作为视频质量的替代变量。

[0017] 在本文所描述的实施例中，不同于使用以各种目标比特率对内容进行编码的编码器，所公开的自适应流送系统的编码器以各种质量等级来对内容进行编码，并且然后基于时距 (temporal duration) 来将所编码的流划分成（或者相似地，分段成）段，段的大小以

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字节计并且取决于编码速率，其进而对应于网络上所需要的传输带宽。质量变化根据预定质量窗来使能对比特率变化的约束。

[0018] 例如，编码器（或者在一些实施例中，诸如服务器之类的另一网络设备）提供由质量等级直接组织的（例如，明确指示的）内容矩阵。换言之，每一表示对应于（单个）质量等级而不是标称比特率或平均比特率。每一段的元数据包括质量等级、以及时距、和以字节计的段的尺寸或段平均比特率中的任一者（其中最后两个是共轭变量——一个共轭变量可以根据另一已知的时距而被计算得出）。此外，计算设备根据自适应流送系统的某些实施例而被配置为通过基于本文中所描述的技术选择下一段来在给定的带宽约束内实现平稳、非递减的质量。

[0019] 在一些实施例中，该基于质量的自适应流送方案可以被嵌入到元数据中以使得现有的计算设备（在不对软件和/或硬件进行修改的情况下）能够发送请求（例如，按照常规所做地，基于时间戳、比特率等），并且网络设备（例如，源服务器或缓存服务器）基于本文中所描述的技术来对具有最高质量等级的段进行访问。

[0020] 这些实施例和其他实施例和/或其他特征在下文中在示例计算机网络环境的上下文中被描述，其中内容出于协助理解本公开的目的而被具体化为视频。应该认识到，代替或者附加到视频的其他内容（例如，音频、数据、图形、图像等），也被认为在实施例的范围内。此外，自适应流送系统的某些实施例下面在使用超文本传输协议（HTTP）的环境中的自适应流送的上下文中被描述。HTTP是针对客户端-服务器计算的请求-响应标准。在HTTP中，Web浏览器作为客户端，而在托管网站或内容的计算机上运行的应用作为服务器。HTTP使用传输控制协议（TCP），该传输控制协议是被用于互联网和其他相似网络的通信协议的互联网协议（IP）系列的一部分。本领域的技术人员应该理解，对多媒体（例如，视频、图形、音频、和/或数据、或者在本文中还以其他方式单独或共同被称为介质内容、或者简单地被称为内容的多媒体）进行分发的其他网络也可以受益于自适应流送系统和方法的某些实施例，并且因此被认为是在本公开的范围内。本领域普通技术人员应该理解，尽管本文公开了一个或多个实施例的细节，但所描述的细节不必是每个实施例的一部分。

[0021] 图1是示例环境（计算机网络100）的示意图，在该示例环境中自适应流送系统和方法的某些实施例可以被实现。本领域普通技术人员应该知道，在本公开的上下文中，图1中所示的计算机网络100只是示意性的，并且不应该被解释为暗指对本公开的范围的任意限制。计算机网络100可以包括多个个人网络，比如，无线网络和/或有线网络。图1中所示的示例计算机网络100包括多个计算设备102、104、105和106（例如，有线和/或无线的设备，比如蜂窝电话、个人数字助手（PDA）、计算机设备或系统（比如膝上型计算机、个人计算机、机顶终端、具有通信能力的电视、DVD/CD记录器等）），该多个计算设备102、104、105和106与一个或多个服务器设备（比如，边缘或缓存服务器设备108）和/或一个或多个上行设备（比如，内容服务器设备114）进行通信。内容服务器设备114被以通信的方式耦合到一个或多个编码设备，比如，编码或转码设备116。在计算机网络100中可以采用另外的服务器。还在一些示例实施例中，内容服务器设备114和编码设备116可以被集成为单个服务器设备。缓存服务器设备108被耦合到上行网络（比如，广域网（WAN）112），在一个实施例中该上行网络包括互联网。在一些实施例中，缓存服务器设备108可以通过诸如局域网（LAN）之类的网络被耦合到计算设备102、104、105和106。其他网络（包括使用与其他传

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输协议或标准进行合并的分组的网络）被认为是在本公开的范围内。缓存服务器设备 108 和内容服务器设备 114 还可以包括一个或多个存储设备（例如，与一个或多个存储设备集成）或者与一个或多个存储设备进行本地通信。

[0022] 缓存服务器设备 108 和计算设备 102、104、105 和 106 之间的通信可以是经由无线连接或有线连接，以非限制性示例的方式包括以太网、令牌环、私人或专有网络、及其他。缓存服务器设备 108 和 / 或内容服务器设备 114 可以包括互联网服务提供商（ISP）设施中的服务器、私有服务器、网关、和 / 或被用于传输流视频文件（以及其他内容，比如数据、音频等）的其他设备或设施。本领域普通技术人员应该理解，另外的计算设备、缓存服务器设备、上行服务器设备和诸如路由器、网桥等之类的其他设备可以被用于计算机网络 100。计算设备 102、104、105 和 106、缓存服务器设备 108 以及内容服务器设备 114 之间的互联网协议（IP）分组的通信可以根据多个不同的协议（（除此以外）包括传输控制协议（TCP）/IP）中的一个或多个而被实现。

[0023] 编码设备 116 被配置有处理器 118、存储器 120（其被配置有（可执行指令或代码的）编码逻辑 122）和通信（或网络）接口（I/O）126，以接收用于编码和分段（还被称为分块或划分）的内容流并且以不同质量等级的段的形式来将经编码的流发送到内容服务器 114。在一个实施例中，通信接口 126 接收数字化的内容流（例如，电影、电视节目或者体育或娱乐事件等的现场直播），并且处理器 118 被编码逻辑 122 配置为以不同质量等级的多个编码表示来对内容流进行编码。例如，一个表示可以包括以 40 分贝（dB）的（例如，以 PSNR-- 峰值信噪比所测量的）质量等级被接收的内容流的编码版本，第二表示可以包括以 35dB 的质量等级被接收的内容流的编码版本，并且第三表示可以包括以 30dB 的质量等级被接收的内容流的编码版本。处理器 118 还被编码逻辑 122 配置为将多个表示中的每一个划分成不同质量等级的段。给定质量等级（例如，40dB）的所有段的元数据（例如，诸如 URL 之类的位置、或者每一段的标识、段大小、质量等级、比特率、时间戳信息等）以各自的表示被列于清单（MFST）124 中。换言之，每个表示对应于不同的质量等级。例如，质量等级 40dB 的段的元数据以一个表示被列于清单中，质量等级 35dB 的段的元数据以第二表示被列出，等等。具体地，清单包括关于每一可用段比特率的视频质量评分的信息（VQ/BR 信息 125）。每一质量等级被明确地指示（例如，与从比特率推断的相反），其中明确的指示对应于质量度量（比如，分贝、峰值信噪比（PSNR）或其他众所周知的质量度量（例如，-MSE、MS-SSIM 或 VQM））。编码设备 116 通过通信接口 126 来向内容服务器设备 114 提供清单 124（或者在一些实施例中，用于在别处组装出清单的信息）和针对各种表示的段。

[0024] 尽管在存储于存储器 120 中的编码软件或固件逻辑 122 的上下文中进行描述，但本领域普通技术人员应该理解，编码 / 分段功能可以被分离在多个模块间，或者在一些实施例中使用硬件或硬件和软件 / 固件的组合而被实现。

[0025] 图 2 是示例内容服务器设备 114 的实施例的框图。本领域普通技术人员应该理解，在本公开的上下文中，图 2 中所示的内容服务器设备 114 只是示意性的，并且不应该被解释为暗指对本公开范围的任何限制。一般地，根据硬件架构，内容服务器设备 114 包括处理设备 202、存储器 204、输入 / 输出（I/O）设备 206 和网络接口 208，其中的每个通过本地接口 210 来以通信的方式进行耦合。处理设备 202 是用于执行软件的硬件设备，具体地其被存储于存储器 204 中。处理设备 202 可以是任意定制的处理器或市场上可买到的处理器、中央

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处理单元（CPU）、与内容服务器设备 114 相关联的若干处理器间的辅助处理器、基于半导体的微处理器（以微芯片或芯片集的形式）、微处理器或一般地用于执行软件指令的任意设备。

[0026] 网络接口 208 包括传输输入和输出的一个或多个设备，例如但不限于，调制器 / 解调器（用于访问另一设备、系统或网络的调制解调器）、无线电频率（RF）收发机或其他类型的收发机、电话接口、网桥、路由器等。

[0027] I/O 设备 206 可以包括输入设备，例如但不限于：键盘、鼠标、扫描仪、麦克风等。此外，I/O 设备 206 还可以包括输出设备，例如但不限于：打印机、显示器等。

[0028] 本地接口 210 可以是，例如但不限于本领域已知的一个或多个总线或其他有线或无线连接。本地接口 210 可以具有为了简单起见而被省略的另外的元件（比如，控制器、缓冲器（缓存）、驱动器、中继器和接收机）以使能通信。此外，本地接口 210 可以包括地址、控制和 / 或数据连接以使能上述组件间适当的通信。

[0029] 在一个实施例中，内容服务器设备 114 还被配置有耦合到本地接口 210 的集成存储设备 212，该存储设备 212 被配置为存储从编码设备 116 接收的多个内容段。在一些实施例中，存储设备 212 可以外部地被耦合到内容服务器设备 114。

[0030] 存储器 204 包括合适的操作系统（O/S）214 和段选择逻辑 216。操作系统 214 实质上控制其他计算机程序（诸如，段选择逻辑 216）的执行，并提供调度、输入输出控制、文件和数据管理、存储器管理以及通信协议和相关的服务。段选择逻辑 216 包括可执行代码（其对针对段的计算设备请求（例如，HTTP 功能）进行响应）和对应于完全或部分（还持续地进行更新的）已完成清单 218 的数据结构，该清单 218 对应于由编码设备 116 发送的清单 124（或本文中的信息）。在一些实现方式中，清单 218 可以是不完整的、还在根据编码设备 116 持续地进行组装和更新的（例如，针对现场直播）。

[0031] 存储设备 212 以不同质量等级的段的形式来存储内容的不同表示。例如，以电影为例，存储设备 212 以第一质量等级（例如，恒定质量（CQ）A#1）存储电影 A 的第一表示，以第二质量等级（比如，CQA#2）将电影 A 的第二表示，等等。每一表示是以给定质量等级的多个段的形式，如由图 2 中针对表示 CQA#N（并且类似地适用于其他表示）的个体、较短块所部分示出的。这些段中的每个通常是可独立解码的（例如，每一段以一个或多个图片组（GoP）的形式），并且一般地持续 2-10 秒，但不限于该持续时间。针对这些不同的质量等级段中的每一个，对于每一段的相关联的元数据的对应的表示在存储于存储器 204 中的清单 218 中被维持。清单 218（与清单 124 相似）还包括关于针对每一电影或其他视频内容的每一可用的段比特率的视频质量评分的信息（VQ/BR 信息 125）。

[0032] 段选择逻辑 216 被配置为对来自计算设备 102、104、105 和 / 或 106（和 / 或到缓存服务器 108）的对清单 218 的请求进行回复，或者选择其某些部分。这些下载或获取请求可以通过相同或不同的服务器连接而被作为用于获取或下载内容段的请求。在一个实施例中，使用具体化为机顶盒的计算设备 105 作为下文中的示例计算设备（应理解类似的原则可应用于其他计算设备），计算设备 105 基于从内容服务器设备 114 获取的清单 218 的列表来请求段。计算设备 105 通过质量等级（不同于比特率）有效地请求段，带来了更平滑的、恒定质量的观看体验。在一些实施例中，清单和所参考的段被从缓存服务器设备 108 获取，由计算机网络 100 中的其他计算设备协助对请求的快速响应和 / 或由请求计算设备 105 协

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助特技模式。

[0033] 在一些实施例中，如以上所解释的，计算设备 105（或者在一些实施例中，传统的计算设备）可以发送传统的请求（不具有对质量等级的明确指示，并且替代地使用比特率和带宽约束，以及其他可能的参数），并且段选择逻辑 216 通过参考清单 218 来确定符合客户端传输带宽约束的最优质量等级、并进行选择、然后发送于所确定的质量等级相对应的段来对请求进行响应。

[0034] 存储器 204 可以包括易失性存储器元件（例如，随机存取存储器（RAM，诸如 DRAM、SRAM、SDRAM 等））和非易失性存储器元件（例如，ROM、硬盘驱动器、磁带、CDROM 等）中的任意一个或组合。此外，存储器 204 可以包括电的、磁的、光学的、半导体的和 / 或其他类型的存储介质。注意到，存储器 204 可以具有分布式架构，其中各种组件彼此间相距较远，这些组件可以由处理设备 202 进行访问。因此，一般地，存储器 204 可以包括一个或多个有形的（非暂态的）计算机可读存储介质（例如，存储器设备），该计算机可读存储介质编码有包括计算机可执行指令的软件，并且当软件被（处理设备 202）执行时可操作来执行本文中所描述的操作。

[0035] 存储器 204 中的软件可以包括一个或多个单独的程序，其中每个包括用于实现逻辑功能的可执行指令的有序列表。在图 2 中所示的实施例中，存储器 210 中的软件包括操作系统 214 和段选择逻辑 216，如上所述。段选择逻辑 216 的功能可以使用单个模块被实现或者被分布在多个模块中。

[0036] 当段选择逻辑 216 进行操作时，处理设备 202 被配置为执行存储在存储器 204 内的段选择逻辑 216、被配置为将数据传输到存储器 204 和从存储器 204 传输数据、以及一般地被配置为对段选择逻辑 216 的操作进行控制。段选择逻辑 216 和 O/S 214，整体地或部分地（但通常是后者），被处理设备 202 读取，并且然后被执行。

[0037] 图 3 是示出示例计算设备 105 的实施例的框图。本领域的技术人员应该理解，在本公开的上下文中，图 3 中所示的计算设备 105 只是示意性的，并且不应该被解释为暗指对本公开的范围的任意限制。相似的功能可以在计算设备 102、104 和 106 中被发现。计算设备 105 包括通信接口 302，该通信接口 302 适用于使能与计算机网络 100 的设备的通信（例如，TCP/IP），并且适用于接收清单（或本文中的信息）以及被请求的段。例如，通信接口 302 可以是适用于通过 IP 网络、同轴电缆网络、HFC 网络和 / 或无线网络及其他进行通信的类型的通信接口。通信接口 302 被耦合到多路输出选择器（本文中，还称作多路分配器）304。多路分配器 304 被配置为对（例如，在分组报头中的）段的元数据和体数据或有效负载数据（诸如视频和 / 或音频帧序列之类的内容）进行解析。元数据可以包括时间戳信息、分组标识符、程序号、质量等级和 / 或对所接收的段进行编码必要的其他信息。段和元数据信息如下面所进一步解释的那样被转发到媒体引擎 306 或者以其他方式被媒体引擎 306 接收。

[0038] 尽管计算设备 105 在诸如 IPTV 和 VoD 之类的各种互联网视频流送实现方式的上下文中被描述，但本领域普通技术人员应该认识到，在一些实施例中计算设备 105 可以包括额外的和 / 或不同的组件。例如，计算设备 105 的一些实施例可以包括被耦合到通信接口 302 的调谐器系统（例如，射频调谐（未示出）），该调谐器系统包括一个或多个调谐器以用于接收通过通信接口 302 接收的传输流。此外，在一些实施例中，解调器可以例如被用于

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对所接收的载波信号进行解调，其中，多路分配器 304 被配置为对一个或多个定义的载波频率的传输流分组进行解析。

[0039] 多路分配器 304 被耦合到总线 305 和媒体引擎 306（还被称为音频 / 视频 (A/V) 处理或解码设备）。在一个实施例中，媒体引擎 306 包括解码逻辑，该解码逻辑包括响应的音频解码器 308 和视频解码器 310 中的一个或多个，解码器其对由通信接口 302 接收的段进行解码，例如，解压缩和重建。当段被回放时，原内容流以无缝的方式被重建。计算设备 105 动态地请求和接收具有恰当质量等级的段。计算设备 102 可以根据可用的接收带宽来适配其内容消耗速率。

[0040] 媒体引擎 306 还包括缓冲器管理功能以基于本文中所描述的技术来协助（例如，与 HTTP 逻辑 325 合作）做出关于需要下移或上移到不同的质量等级的确定。媒体引擎 306 还被耦合到总线 305 和媒体存储器 312，在一个实施例中该媒体存储器 312 包括一个或多个缓冲器 313 以用于临时存储被压缩的和 / 或被重建的图片和 / 或音频帧。在一些实施例中，媒体存储器 312 的缓冲器和 / 或其他缓冲器（例如，网络缓冲器）可以驻留于其他存储器（例如，以下所描述的存储器 322）中，或者被分布在媒体存储器 312 和存储器 322 间。此外，媒体引擎 306 包括质量优化 (QO) 引擎 309，其被用于根据本文中所描述的技术基于对有限数目或选定将来段的分析来确定每段的优化质量。

[0041] 计算设备 105 包括被耦合到总线 305 的额外的组件。例如，计算设备 105 还包括接收机 314（其被配置为（例如，通过直接物理的或无线连接，经由键盘、远程控制、语音激活等来）接收用户输入，以传达用户的请求或命令（例如，用于程序选择、诸如快进、倒带、暂停、频道切换之类的流操纵））、一个或多个处理器 316（示出了一个）（其用于控制计算设备 105 的操作等））、和时钟电路 318，时钟电路 318 包括将在音频、视频、或 A/V 流中接收的系统时钟信息锁定的相位和 / 或频率锁定环电路（或软件、或硬件和软件的组合）以协助解码操作并且为所重建的视听内容的输出计时。

[0042] 在一个实施例中，计算设备 105 还包括存储设备 320（和相关联的控制逻辑）以临时存储内容（例如，连同媒体存储器 312 的（一个或多个）缓冲器 313 所缓冲的内容）和 / 或更永久地存储所记录的内容。计算设备 105 中的存储器 322 包括易失性和 / 或非易失性存储器，并且被配置为存储与操作系统 (O/S) 324 相关联的可执行指令或代码、以及一个或多个应用 326（例如，除了诸如按次计费、音乐、个人视频录像 (PVR)、驱动器软件等之类的其他应用之外还包括交互式编程指南 (IPG)、点播视频 (VoD)、（与广播网络 TV 相关联的）WatchTV、HTTP 逻辑 325）。HTTP 逻辑 325 包括具有 HTTP 客户端功能的一个或多个处理器，并且可以，例如基于来自清单 218 的信息（例如，包括 VQ/BR 信息 125）来生成对段的请求。由 HTTP 逻辑 325 决定上移或下移（或维持）当前的质量等级可以基于来自媒体引擎 306 的反馈（例如，以上所描述的缓冲器等级）和被监控的带宽值。具体地，HTTP 逻辑 325 基于从 QO 引擎 309 接收的信息来生成针对段的请求，其利用本文中所描述的技术来基于对选定范围的将来段的分析来确定段的质量等级。HTTP 逻辑 325 存储所接收的清单（或其中所包括的信息），并且由此获知存储在内容服务器设备 114 处的段的可用的质量等级。因此，在不同表示间的切换（例如，到不同质量等级）通过使用清单中的信息（例如，基于 VQ/BR 信息 125）而被使能。尽管 HTTP 逻辑 325 的功能被描述为软件，但在一些实施例中其可以被配置于硬件或者硬件和软件的组合中。

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[0043] 如以上所指示的，计算设备 105 还被配置有显示和输出逻辑 330，显示和输出逻辑 330 除本领域已知的其他电路之外还包括图形和视频处理管线 (pipeline) 以处理经解码的图片和相关联的音频，并且在显示设备或其他媒体设备上提供表示（例如，显示）或者提供与显示设备或其他媒体设备相关联的表示（例如，显示）。通信端口 332（或多个通信端口）还被包括在计算设备 105 中以用于从其他设备接收信息以及将信息发送到其他设备。例如，通信端口 332 可以描绘 USB（通用串行总线）、以太网、IEEE-1394、串行和 / 或并行的端口等。此外，通信端口 332 可以被配置用于家庭网络（例如，HPNA/MoCA 等）。计算设备 105 还可以包括用于接收模拟视频信号的模拟视频输入端口。

[0044] 本领域普通技术人员应该理解，在本公开的上下文中，计算设备 105 可以包括未示出的其他组件，包括压缩引擎、存储器、解密器、采样器、数字转换器（例如，模数转换器）、多路复用器、条件访问处理器和 / 或应用软件、驱动器软件、互联网浏览器、及其他。此外，尽管 HTTP 逻辑 325 被示为驻留于存储器 322 中，但应该理解在一些实施例中，HTTP 逻辑 325 可以被合并在媒体引擎 306 中或别处（比如，O/S 324 中，及其他位置中）或者与计算设备 105 的其他逻辑相结合。相似地，在一些实施例中，在图 3 中被示出的或者与图 3 相关联地进行描述的组件中的一个或多个的功能可以与另一组件一起被组合为单个集成组件或设备。

[0045] 自适应流送系统的某些实施例可以包括以下各项中的一个或组合的全部或一部分：编码设备 116、缓存服务器 108、内容服务器 114 或者一个或多个计算设备 102、104、105 和 / 或 106。

[0046] 本公开的某些实施例中的 HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 可以在硬件、软件、固件或其组合中实现。在 HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 在软件或固件（统称为，软件代码或软件逻辑、或者简单地逻辑）中实现的实施例中，这些实施例被存储在存储器中，并且由合适的指令执行系统使用计算设备的一个或多个处理器来执行。当 HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 在软件中被实现时，应该注意到，HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 可以被存储在任意计算机可读存储介质上，以供任何计算机相关的系统或方法使用或与之相结合。因此一般地，HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 可以包括一个或多个有形的（非暂态的）计算机可读存储介质（例如，存储器设备），该计算机可读存储介质编码有包括计算机可执行指令的软件，并且当软件被执行时可操作来执行本文中所描述的操作。在本文档的上下文中，计算机可读存储介质是电的、磁的、光学的、半导体的或者其他有形的、物理的设备或装置，该设备或装置可以包含或存储被计算机相关的系统或方法使用的或者与其相关的计算机程序。HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 可以体现于非暂态的计算机可读介质中，以供指令执行系统、装置或设备（比如，基于计算机的系统、包含处理器的系统或者可以从指令执行系统、装置或设备获取指令并执行指令的其他系统）使用或者与之相结合。

[0047] 在 HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 的功能的全部或一部分在硬件中实现的实施例中，HTTP 逻辑 325、媒体引擎 306、编码逻辑 122 和 / 或段选择逻辑 216 的这样的功能可以用本领域周知的以下技术中的任意或组合来实现：（一

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个或多个）离散的逻辑电路（其具有用于实现基于数据信号的逻辑功能的逻辑门）、具有合适的组合逻辑门的专用集成电路（ASIC）、（一个或多个）可编程门阵列（PGA）、现场可编程门阵列（FPGA）等。

[0048] 现在参考图4和图5的流程图来描述描绘的系统来针对使用本文中所描述的并且在图1-3中描绘的系统来优化内容流的段的质量的示例方法。参考图4，在400，编码设备116生成内容流的清单124（其还可以被修改或补充，如同存储在内容服务器114的存储器204内的清单218），其中清单包括针对将被一个或多个计算设备102、104、105、106、108下载的编码的视频段的多个比特率和对应的质量评分。如先前所指出的，内容流可以被例如从存储设备212获得，该存储设备212将内容（例如，电影或其他视频表示）存储于不同质量等级处（例如，将电影A存储于CQA#1、CQA#2…CQA#N处、将电影B存储于CQB#1处等）。在410，响应于计算设备（例如，计算设备105）请求某一内容，内容服务器114向该计算设备提供与所请求内容相关联的清单，以协助计算设备对编码比特率的确定，以该编码比特率、使用本文中所描述的技术、基于质量优化来接收内容流的段。在420，内容流的段基于质量优化、以由计算设备为每个段选定的比特率被提供给计算设备。

[0049] 参考图5，在500，当计算设备处的用户想要观看从内容服务器114可得的内容时，内容流的清单被提供给该计算设备。本文中描述了关于（例如，图3中所描述的）计算设备105的技术。然而，如先前所指出的，具有相似硬件和/或软件组件（包括QO引擎）的任意其他合适的计算设备可以被用于执行本文中所描述的技术。清单包括关于内容流的每一经编码段的每一可用段比特率的视频质量评分的信息（VQ/BR信息125）。在510，对将被计算设备105使用的当前可用的网络带宽做出估计。所估计的网络带宽可以以任意合适的方式（例如，基于任意传统或其他合适的测量或估计方法）由计算设备确定。在520，计算设备105的QO引擎309基于当前缓冲器状态、所估计的网络带宽和选定范围中的内容流的段的质量值（基于如本文所述的那样起作用的在线算法和一个或多个动态编程的算法）来确定优化当前段的质量用于当前段的编码比特率。在530，以确定的优化质量的编码比特率来从内容服务器114下载当前段。在存在针对（在540确定的）流的另一段的情况下，下一段在550被设置为当前段，并且处理在510被重复。

[0050] 注意到，尽管图5中所描述的流程图提供了其中清单最初在计算设备处被接收的步骤，但处理可以被容易地修改，以使得清单在很多时候可以在处理期间由计算设备进行接收。例如，在某些情境下，清单可以定期地被更新，以使得经修改的清单（例如，带有经修改的VQ/BR信息）被提供给计算设备。

[0051] 媒体引擎306的QO引擎309，在520处做出关于当前段的编码比特率时，使用在线算法和一个或多个动态编程算法来进行视频段的比特率选择，其中，基于在选定将来时间窗口或范围上的质量优化分析并且将计算设备105的当前缓冲器约束考虑在内来为每一段选择合适的比特率。在每一速率选择步骤，QO引擎309使用最新的可用信息、解决选定范围内的视频段的优化问题、并且计算可用比特率中用于最紧急的视频段的最优比特率（其中，过程针对每下一段而被重复进行）。在每一步骤中，引擎可用的信息包括（例如，在510基于任意传统的或其他合适的测量或估计方法而确定的）计算设备105的当前估计的链路带宽和（在清单124内提供的）所定义的范围内的视频段的比特率和质量评分。

[0052] QO引擎309在考虑到当前条件（例如，网络带宽条件、缓冲器条件和来自当前段的

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有限数量或范围内的段的质量等级）来为内容流中的每段确定产生优化的质量的比特率时，采用一系列速率选择步骤n（其中，n = 1、2、3…）。用于下载当前视频段的比特率（定义为R(n)）在每一步骤n被确定。针对每一视频段存在有限数量的可用比特率。因此，当前视频段的可用比特率的数量被定义为R(n, l)，其中l = 1、2、3…L，其中L是可用比特率的数量。每一比特率R(n, l)还与视频质量评分Q(n, l)相关联。与当前段的选定比特率R(n)相关联的质量评分被定义为Q(n)。如先前所指出的，视频段的质量评分可以使用任意适当的技术来确定，其中一些非限制性的示例包括PSNR和-MSE。

[0053] QO引擎309所使用的算法是基于将范围上的内容流的视频质量的一些综合测量最大化的。本文中所描述的技术使用两个目标函数来将质量最大化。第一个目标是将平均质量评分最大化，如下式所定义的：

[0054] $$\max \frac{1}{N}\sum_{n} Q(n)$$ （公式1）

[0055] 其中，N是段的数目（例如，范围内段的数目）。

[0056] 第二个目标是将针对段N的数目的最差情况下的质量评分最大化，如下：

[0057] $$\max \min_{n} Q(n)$$ （公式2）

[0058] 对公式1和公式2的扩展将通过以下方式来精确地考虑质量变化：在每一步骤n包含乘法器a(n-1, n)以使得公式1和公式2中的Q(n)被替换为：

[0059] Q'(n) = a(n-1, n)Q(n)， （公式2b）

[0060] 其中，Q(n)对应于初始的Q(n)。当质量已经从一个等级转移到另一等级时，该乘法器a(n-1, n)将整体评分打折扣。例如，如果在步骤n-1和步骤n的视频比特率是从相同质量等级选出的，则设置a(n-1, n) = 1，并且如果在步骤n-1和步骤n的视频比特率是从不同质量等级选出的，则设置a(n-1, n) = 0.8。这种方式下，目标函数考虑平均质量和质量变化。

[0061] 对以上目标（公式1、公式2和公式2b）的第二个扩展将根据幂函数，采取任意的质量评分并将其提高到某一幂次b，也就是，由下式来替换这些公式中的Q(n)：

[0062] $Q''(n) = Q(n)^{b}$ （公式2c）

[0063] 其中，Q(n)对应于初始的Q(n)，并且$b \geq 1$。

[0064] 注意到，先前所描述的算法中的任意一个或多个可以被应用于本文中所描述的目标中的任意一个。视频质量的优化还基于介质存储缓冲器313的约束以及在速率步骤期间进行分析的当前段的范围大小H(n)。缓冲器包括视频段的队列。缓冲器的大小随着在每步新的视频段队列到缓冲器中和旧的视频段以具体的视频播放速率出列随着时间演化。如本文中所描述的，B(0)表示最初的缓冲器大小，并且B(n)是步骤n结束时的客户端缓冲器大小。在视频播放开始之前（即，在缓冲器的任意损耗之前），缓冲器大小被定义为：

[0065] B(n) = B(n-1)+1 （公式3）

[0066] 在视频播放开始之后，缓冲器大小被定义为：

[0067] B(n) = B(n-1)+1-R(n)/W(n) （公式4）

[0068] 其中，W(n)是步骤n的链路带宽，并且R(n)/W(n)是段下载的持续时间。因此，缓冲器的补充或入队是每步一段，而缓冲器的消耗或出队在步骤n结束时的R(n)/W(n)。

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[0069] 缓冲器的下限值（B_L）和缓冲器的上限值（B_H）由引擎 309 定义。除了初始状态（其中 $B(n) < B_L$）之外，当处理当前段时，引擎 309 所使用的算法维护缓冲器大小，以使得 $B_L \leq B(n) \leq B_H$。引擎 309 还尝试收敛到值 $B(n) = B_{ref}$，其中 $B_L \leq B_{ref} \leq B_H$。

[0070] 时间范围大小被 QO 引擎 309 定义为 H(n)，其中 H(n) 可以在 $H(n) \geq 1$ 的条件下改变。例如，时间范围大小对于内容流中的某一数目的段可以是恒定的，但是随着段接近流的终点，H(n) 的值被减少以便不延伸到内容流之外的范围。根据本文中所描述的技术，从当前段到当前段之前的 H(n)-1 步骤，只有段的视频比特率和质量信息被分析以确定对应于当前段的优化的质量的比特率。换言之，只有信息 R(m,l)、Q(m,l)（其中，m = n、n+1、...、n+H(n)-1，并且 l = 1、2、...、L）对由引擎 309 用来确定当前段的 R(n) 的算法是可用的。

[0071] 为了应用算法来确定当前段的 R(n)，QO 引擎 309 使用优化质量在线（OptimizeQualityOnline）算法来通过多个步骤进一步确定比特率。优化质量在线算法如本文中所描述的那样在每一步骤应用进一步的算法，并且被称为范围内最优质量（OptimizeQualityWithinHorizon）。以下输入被提供给优化质量在线算法：

[0072] 全局输入：

[0073] --B_L=缓冲器下限

[0074] --B_H=缓冲器上限

[0075] --B_{ref}=缓冲器参考等级

[0076] --κ_B=缓冲器收敛于 B_{ref}的速度

[0077] 在步骤 n 可用的输入：

[0078] --W(n) =链路带宽（例如，在步骤 n 估计的带宽）

[0079] --B(n-1) =在之前步骤结束时的缓冲器大小

[0080] --H(n) =范围大小，$H(n) \geq 1$

[0081] --R(m,l)、Q(m,l)，其中 m = n、n+1、...、n+H(n)-1，并且 l = 1、2、...、L，

[0082] （针对从当前段到当前段之前的 H(n)-1 步骤处的段、或者到有限范围端点处的段的段的（从清单可得的）比特率和质量信息）

[0083] 算法使用输入信息来确定当前视频段 n 的比特率 R(n)。

[0084] 在每一速率选择步骤 n 处，给定之前提到的输入，引擎 309 使用在本文中被称为范围内优化质量的一个或多个算法来反复地解决优化问题以在范围内的段间最优地分配比特率。（一个或多个）范围内优化质量算法使用以下输入：

[0085] 输入：

[0086] --B_{init}=最初的缓冲器大小

[0087] --B_{final}=最终的缓冲器大小

[0088] --B_L=缓冲器下限

[0089] --B_H=缓冲器上限

[0090] --W =当前估计的带宽

[0091] --H =当前范围大小

[0092] --R(m,l)、Q(m,l)，其中 m = 1、2、...、H，并且 l = 1、2、...、L

[0093] （针对从步骤 1 到步骤 H 的段的比特率和质量信息）

[0094] 使用范围内优化质量，从当前段到当前段之前的 H-1 步骤处的段的段的比特率输

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出被确定（即，R(m) 的值，其中 m = 1、...、H）。（一个或多个）范围内优化质量算法可以产生情境中可接受的结果，在这些情境中某些条件（例如，链路带宽和视频源特性）不改变。

[0095] 然而，实际上，带宽和视频源特性将很可能针对内容流进行改变。因此，根据本文中所描述的技术，引擎 309 只采用当前段的比特率，在当前段中算法被采用，并且在每一之后的步骤处重复相同的算法，以使得每次一个步骤确定段比特率。使用该方法，优化质量在线算法可以如下被应用：

[0096] $--B_{init} = B(n-1)$

[0097] $--B_{final} = B(n-1) + \kappa_B * H(n) * (B_{ref} - B(n-1))$

[0098] $--B_L^{local} = \min(B_L, B(n-1))$

[0099] $--R^{local}(m)$（其中 m = 1、2、...、H）= 范围内优化质量（B_{init}、B_{final}、B_L^{local}、B_H、W(n)、H(n)、R(m, l)、Q(m, l)，其中，m = n、n+1、...、H(n)-1，并且 l = 1、2、...、L）。

[0100] 为当前段选择的比特率 R(n) 然后被输出为 $R^{local}(1)$（也就是，被选择用于 H 个段的群组内的第一段的比特率）。针对下一段（段 n+1），相同的优化质量在线算法被再次应用以获得该段的比特率、之后段的比特率等等。

[0101] 注意到，缓冲器值 B_L^{local} 是 B_{init} 的上限，并且因此可以不同于 B_L，并且范围内最优质量函数要求 $B_L \leq B_{init} \leq B_H$。每一步骤缓冲器向 B_{ref} 的收敛速度由参数 κ_B 来控制。

[0102] 已经定义了针对范围内优化质量函数的输入，在每一步骤 n 为段找到合适的比特率的质量优化是由引擎 309 使用动态编程算法来确定的，以便通过将其分解成可以被反复地解决的更小的子问题来解决问题。如先前所指出的，在步骤 n，段的每一比特率 R(n) 具有如以下所定义的相应的质量评分：

[0103] $Q(n) = Q(R(n))$ （公式 5）

[0104] 公式 5 可以基于缓冲器而被改写为如下：

[0105] $Q((n-1, B(n-1)) \rightarrow (n, B(n))) = Q(R(n))$

[0106] 换言之，通过将缓冲器从步骤 n-1 处的 B(n-1) 移动到步骤 n 处的 B(n)，所得到的质量是 Q(R(n))。Q(R(n)) 的值然后可以使用公式 3 至公式 5 进行估计。

[0107] 相似的质量评分 $Q((m, B(m)) \rightarrow (n, B(n)))$ 可以被定义，其中 n-m > 1。然而，针对该情况，可以存在从 (m,B(m)) 到 (n,B(n)) 的多个可能的路径，其产生不同的质量值。最优的质量评分可以通过所有的质量值而被获得（如 $Q^*((m,B(m)) \rightarrow (n,B(n)))$），其中优化可以以任意合适的方式被定义，比如在平均意义上（例如，将平均质量评分最大化，如在公式 1 中）或者在最差情况意义上（例如，将最差情况的质量评分最大化，如在公式 2 中）。

[0108] 在多项式时间动态编程算法中，问题可以被拆分成更小的子问题以实现更有效的解决方案。在平均意义上使用最优的多项式时间动态编程公式，如下：

[0109]
$$Q^*\left(\left(m,B(m)\right)\rightarrow\left(n,B(n)\right)\right) = \max_{B(s):B_L\leq B(s)\leq B_H} Q^*\left(\left(m,B(m)\right)\rightarrow\left(s,B(s)\right)\right) + Q^*\left(\left(s,B(s)\right)\rightarrow\left(n,B(n)\right)\right)$$

[0110] 其中所有的 m < s < n。

[0111] 针对该公式，从 (m,B(m)) 进行到 (n,B(n)) 需要步骤 s 进行处理。最大的质量一定是子问题的质量的总和，其中所有可能的 $B_L \leq B(s) \leq B_H$。为解决质量优化，更小的子问题可以被解决，然后解决甚至更小的子问题，等等。最后，公式减少到 Q((n-1,B(n-1) → (n,

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B(n))。

[0112] 相似地，针对最差情况意义下的优化，情形如下：

[0113]

$$Q^{*}\left(\left(m,B(m)\right)\rightarrow\left(n,B(n)\right)\right)$$

$$=\max_{B(s):B_{L}\leq B(s)\leq B_{H}}\min\left(Q^{*}\left(\left(m,B(m)\right)\rightarrow\left(s,B(s)\right)\right),Q^{*}\left(\left(s,B(s)\right)\rightarrow\left(n,B(n)\right)\right)\right)$$

[0114] 其中，所有的 m < s < n。

[0115] 比特率解决方案可以以前向或后向递归的方式被实现。现在描述用于在每一步骤 n 使用动态编程算法确定段的比特率的以下两个示例算法：范围内最优质量平均质量 (OptimizeQualityWithinHorizonAverageQuality) 和范围内最优质量最差情况质量 (OptimizeQualityWithinHorizonWorstCaseQuality)。

[0116] 范围内最优质量平均质量

[0117] 在每一步骤 n，针对所有的 R(1，l)，设置 B(0) = B_{init}，以及计算并存储，其中 l = l、...、L：

[0118] Q*((0，B(0)) → (1，B(1))) = Q((0，B(0)) → (1，B(1)))

[0119] 针对 m = 2、3、…、H，计算并存储：

[0120]

$$Q^{*}\left(\left(0,B(0)\right)\rightarrow\left(m,B(m)\right)\right)$$

$$=\max_{B(m-1):B_{L}\leq B(m-1)\leq B_{H}}Q^{*}\left(\left(0,B(0)\right)\rightarrow\left(m-1,B(m-1)\right)\right)$$

$$+Q^{*}\left(\left(m-1,B(m-1)\right)\rightarrow\left(m,B(m)\right)\right)$$

[0121] 针对所有的 B_L ≤ B(m) ≤ B_H，其中 B(m) 的值被量化成离散本 (bin)。

[0122] 优化比特率 R*(m) (m = 1、…、H) 基于 Q*((0，B(0)) → (m，B(m))) 的所计算的值而被确定。例如，清单 124 可以被查询以确定哪些比特率符合所计算的质量评分值。当前段的比特率是 R*(1)。

[0123] 范围内最优质量最差情况质量

[0124] 在每一步骤 n 处，针对所有的 R(1，l)，设置 B(0) = B_{init}，以及计算并存储，其中 l = l、...、L：

[0125] Q*((0，B(0)) → (1，B(1))) = Q((0，B(0)) → (1，B(1)))

[0126] 针对 m = 2、3、…、H，计算并存储：

[0127]

$$Q^{*}\left(\left(0,B(0)\right)\rightarrow\left(m,B(m)\right)\right)$$

$$=\max_{B(m-1):B_{L}\leq B(m-1)\leq B_{H}}\min\left(Q^{*}\left(\left(0,B(0)\right)\rightarrow\left(m-1,B(m-1)\right)\right),\right.$$

$$\left.Q^{*}\left(\left(m-1,B(m-1)\right)\rightarrow\left(m,B(m)\right)\right)\right)$$

[0128] 针对所有的 B_L ≤ B(m) ≤ B_H，其中 B(m) 的值被量化成离散本 (bin)。

[0129] 最优比特率 R*(m) (m = 1、…、H) 基于 Q*((0，B(0)) → (m，B(m))) 的所计算的值而被确定。当前段的比特率是 R*(1)。

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[0130] 如图5中所描述的，响应于在520确定当前段的比特率，在530当前段以所确定的比特率被下载，并且然后处理针对每一后续段被重复（即，重复步骤510-530，包括使用优化质量线上算法和范围内最优质量算法以确定下一视频段的比特率），直到不再需要视频段。

[0131] 图6的示例实施例示意地描绘了由计算设备（例如，图1中所描述的计算设备中的任意一个，比如，膝上型计算机102）以选定编码比特率从内容流的视频段的集合600中选择每一视频段，其中集合600包括以不同比特率编码的段和相应的质量等级（例如，由内容服务器114从存储设备212获取的，比如，电影A）。每一视频段的编码比特率基于本文中所描述的技术进行选择以便当由媒体播放器606（例如，膝上型计算机102的媒体播放器，其以相似的方式被配置并且被配置有与计算设备105的媒体引擎306（包括媒体播放器606的QO引擎）相似的功能）进行播放时对被显示的视频内容的质量进行优化。每一段以所选择的编码比特率被下载，并在其使用媒体播放器606以时间序列被播放之前，被临时存储在存储缓冲器613中。

[0132] 传统的算法只基于视频比特率信息，并且不直接基于段的视频质量来选择下一段的比特率。然而，给定固定的比特率，视频的质量将根据视频内容（例如，高运动或高复杂度的场景（比如，具有复杂图形的动作场景）对比低运动或低复杂度的场景（比如，静止场景））变化。本文中所呈现的技术根据这样的传统的算法进行改进以进一步将段的视频质量考虑在内。

[0133] 尽管本文中所描述的技术是关于在从服务器下载视频内容期间对视频质量进行优化，但注意到，针对优化质量的技术适用于被下载以供在计算设备处使用的任意类型的媒体内容，例如，音频、视频和/或其他类型的内容。

[0134] 因此，本文中所描述的技术提供线上算法和一个或多个动态编程算法，以用于当解决质量优化问题时，通过考虑缓冲器和范围约束来优化自适应流送中的视频（和/或其他内容）的质量。技术适用于CBR和VBR编码的视频内容，并且还可以与被分配给视频段的任意线性视频质量评分值一起来使用（即，技术结合各种类型的视频质量测量）。

[0135] 用于诸如本文中所描述的系统的技术的实现方式通过在计算设备处播放内容流期间提供更高的平均质量或减少质量变化来提高视觉质量。这些技术可以实现将平均视频质量最大化以及将最差情况的质量最大化的算法。此外，任意在线流送视频系统（包括提供点播视频和实时流送服务的系统）可以使用本文中所描述的技术。

[0136] 以上描述只意图是以示例的方式。

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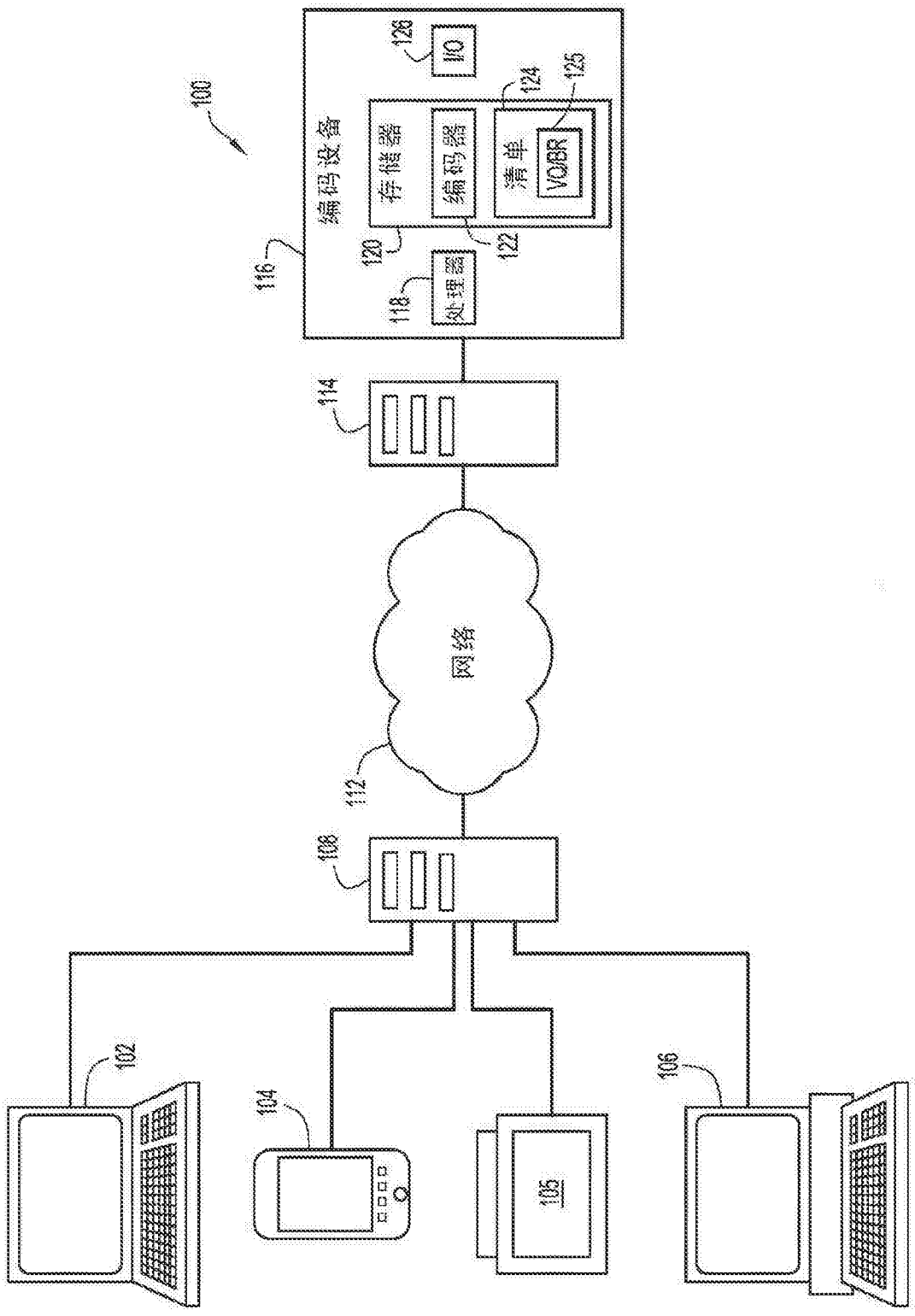


图 1

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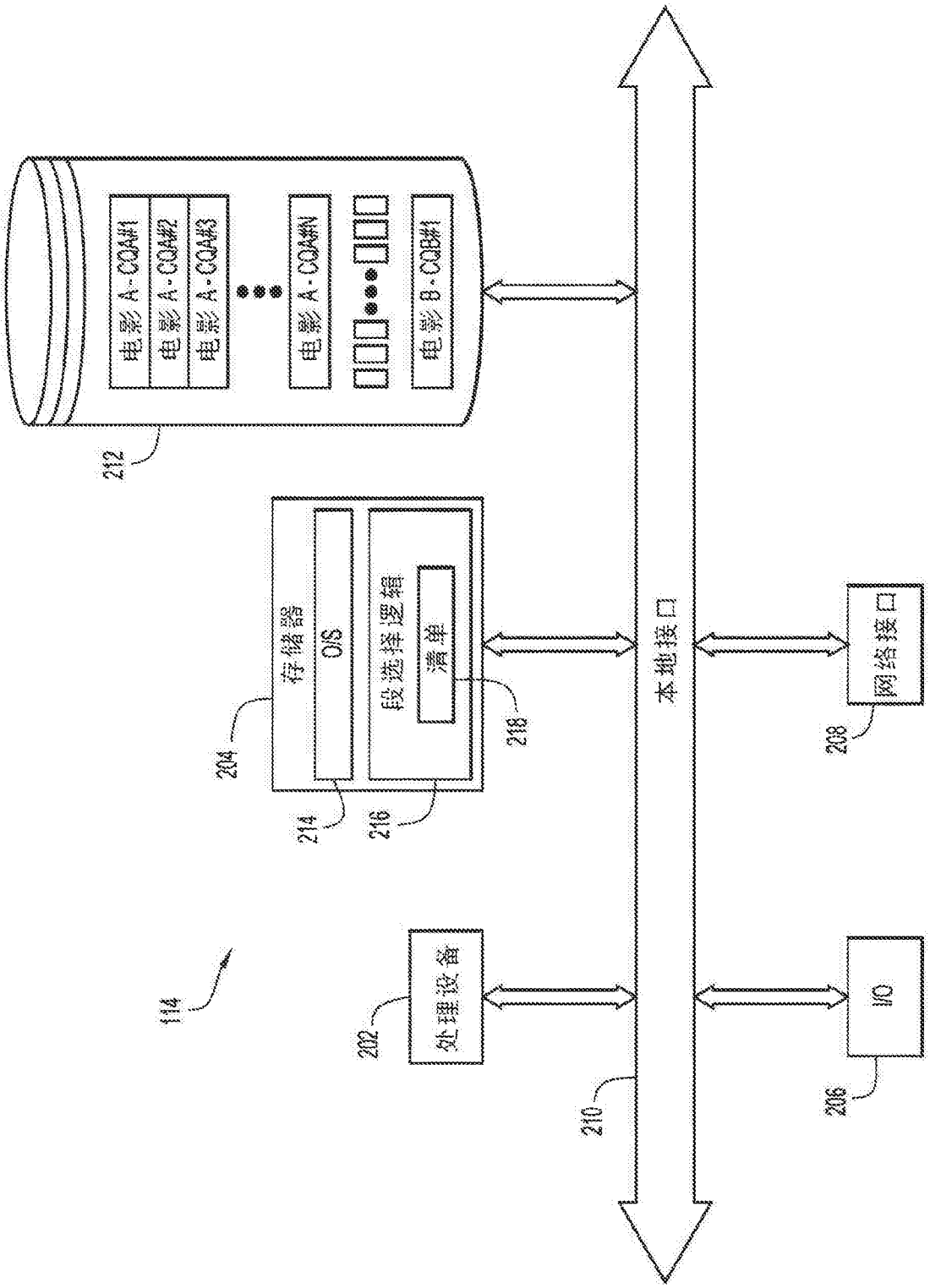


图 2

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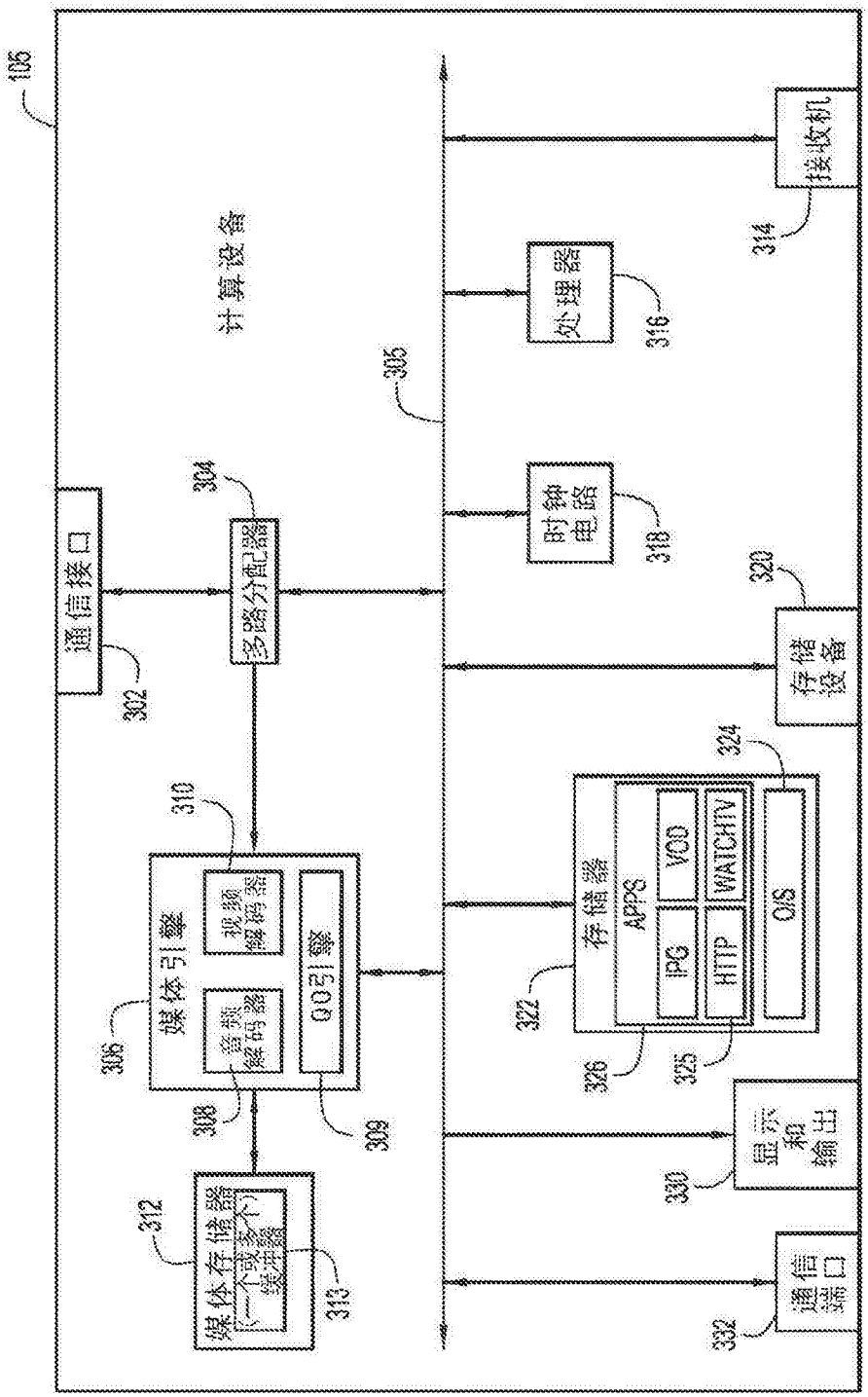


图 3

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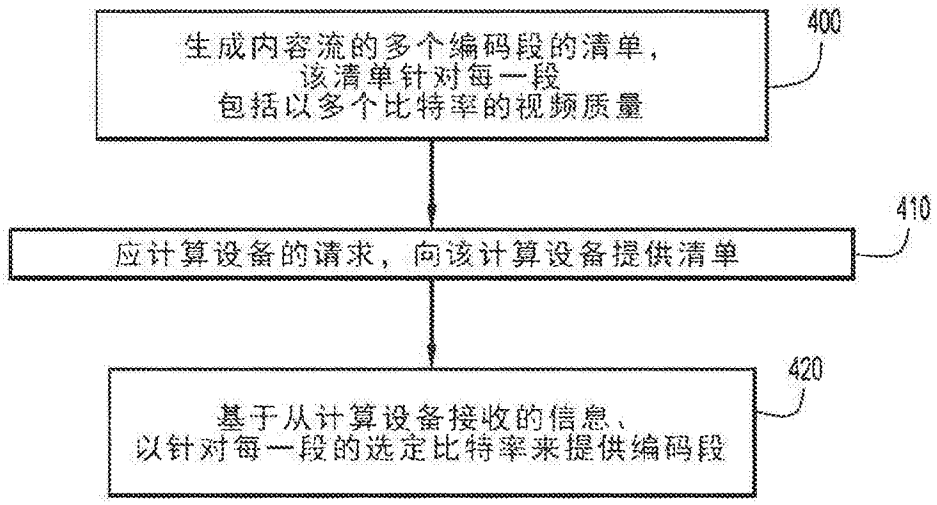


图 4

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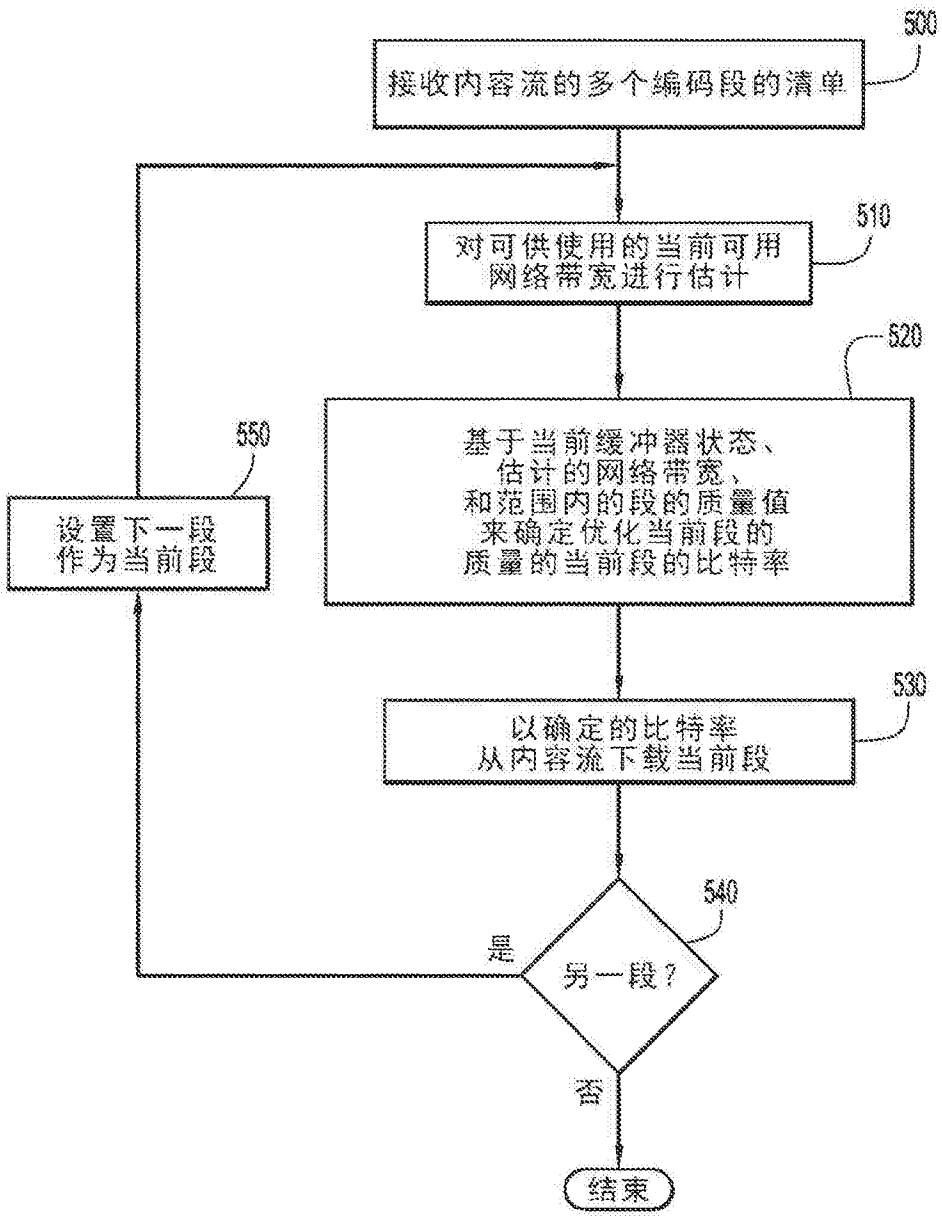


图 5

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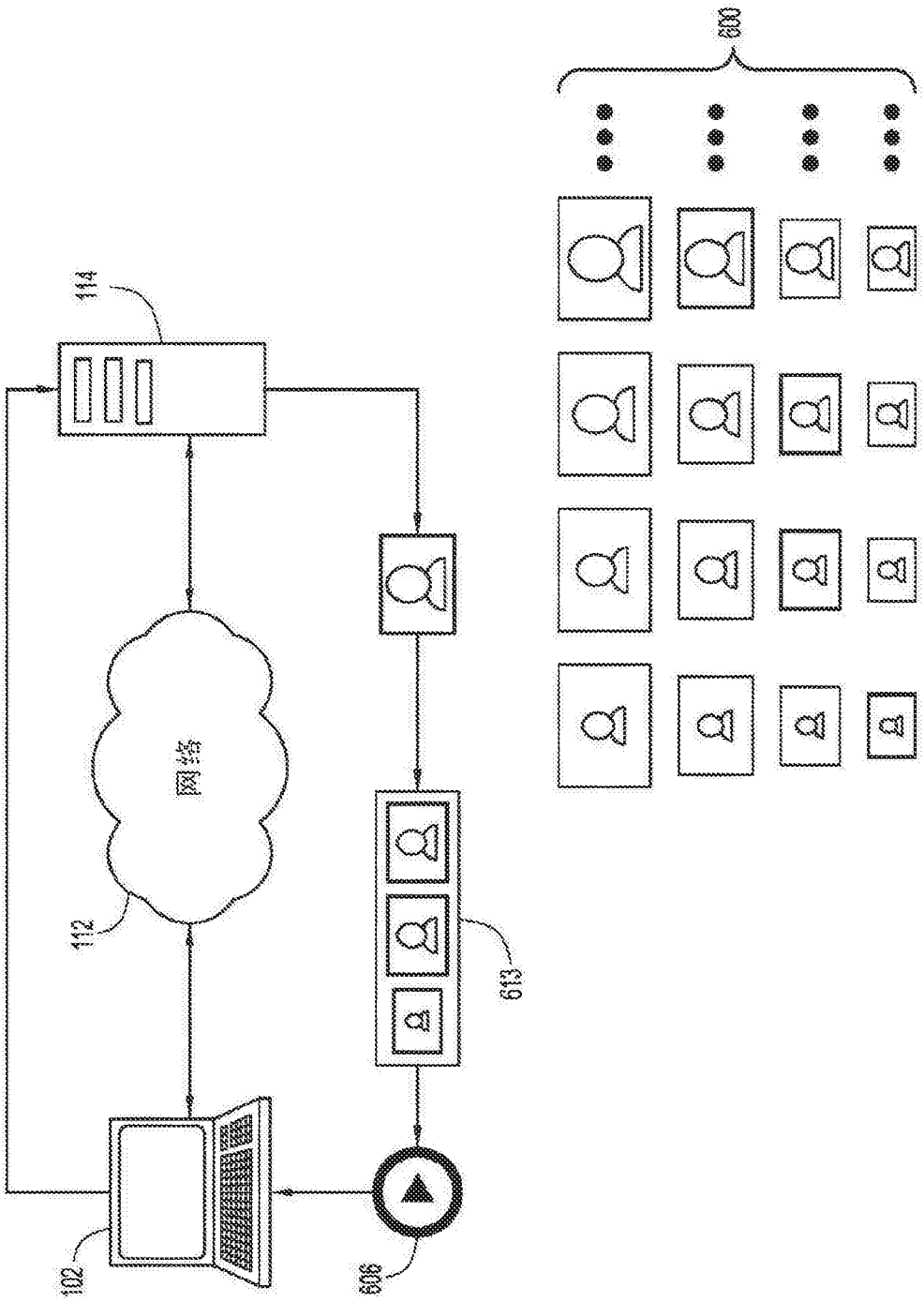


图 6

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Espacenet

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Policy-based image encoding

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Application number: CN20158049900 20150930 Global Dossier

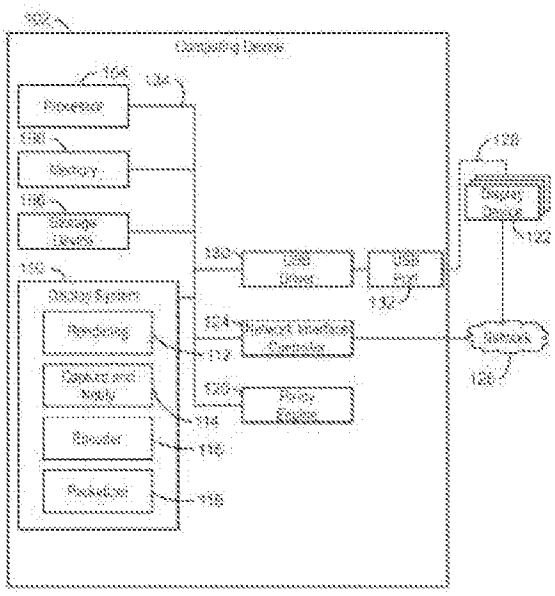
Priority number(s): US201414515175 20141015 ; WO2015US53132 20150930

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Abstract of CN106717001 (A)

Techniques for image rendering are described herein. The techniques may include providing image data to an encoder for transmission to a display. An indication of whether at least a portion of the image data is video data or non-video data is provided. A first policy may be implemented for image data that is video data. The first policy prioritizes transmission of the image data over encoding image quality. A second policy may be implemented for image data that is non-video data. The second policy prioritizes encoded image quality over transmission of the encoded images.

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FIG. 1

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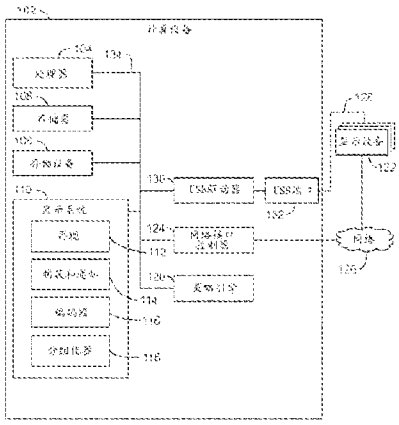
权利要求书3页 说明书8页 附图9页

(54)发明名称

基于策略的图像编码

(57)摘要

本文描述了用于图像再现的技术。技术可以包括向编码器提供图像数据以用于传输到显示器。提供图像数据的至少部分是视频数据还是非视频数据的指示。可以针对作为视频数据的图像数据而实现第一策略。第一策略相比于编码图像质量而优先化图像数据的传输。可以针对作为非视频数据的图像数据而实现第二策略。第二策略相比于经编码的图像的传输而优先化经编码的图像质量。



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1.一种用于基于策略的显示编码的系统，包括逻辑，至少部分地包括硬件逻辑，以：

向编码器提供图像数据以用于传输到显示器；

提供图像数据的至少部分是视频数据还是非视频数据的指示；

在编码器处实现第一策略，其针对作为视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输；并且

在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

2.权利要求1的系统，其中从以下中的一个或多个提供指示：

与用于基于策略的图像编码的系统相关联的操作系统；

与用于基于策略的图像编码的系统相关联的系统的图形栈；或

其任何组合。

3.权利要求1-2的任何组合的系统，其中逻辑的至少部分实现在编码器处，其中编码器逻辑在图像数据的所述部分在要在其上显示图像数据的总显示区域的阈值以下时实现第二策略。

4.权利要求3的系统，其中编码器逻辑通过生成如与预测帧(p-Frame)相对的用于传输的帧内(i-Frame)来实现第二策略，只要图像数据的所述部分在阈值以下。

5.权利要求3的系统，其中编码器逻辑通过鉴于在最大图像质量编码上施加限制的系统约束而提供具有最大图像质量的初始更新来实现第二策略。

6.权利要求5的系统，其中编码器逻辑递增地更新经编码的图像质量，直到以下中的一个或多个：

实现目标质量；

在实现目标质量之前对所显示的图像的改变继续发生；以及

系统约束在随后更新上施加限制。

7.权利要求6的系统，其中编码器逻辑同时针对多个区提供图像质量更新。

8.权利要求1-2的任何组合的系统，其中逻辑的至少部分实现在编码器处，其中编码器逻辑：

追踪针对要显示的图像数据的给定部分实现的质量指示；

追踪针对图像的给定部分实现的进展指示。

9.权利要求1-2的任何组合的系统，其中逻辑：

从编码器下游的组件接收指示图像质量更新是否要被下游组件丢弃的反馈；

基于包括以下的因素而在下游组件处实现附加策略：

第一和第二策略；

系统约束；

来自下游组件的反馈；或

其任何组合。

10.权利要求1-2的任何组合的系统，其中逻辑的至少部分实现在编码器处，其中编码器逻辑基于优先化而标记经编码的数据以便由下游组件可读。

11.一种用于基于策略的显示编码的方法，所述方法包括：

向编码器提供图像数据以用于传输到显示器；

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提供图像数据的至少部分是视频数据还是非视频数据的指示；

在编码器处实现第一策略，其针对作为视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输；以及

在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

12.权利要求11的方法，其中从以下中的一个或多个提供指示：

与用于基于策略的图像编码的系统相关联的操作系统；

与用于基于策略的图像编码的系统相关联的系统的图形栈；或

其任何组合。

13.权利要求11-12的任何组合的方法，还包括在图像数据的所述部分在要在其上显示图像数据的总显示区域的阈值以下时实现第二策略。

14.权利要求13的方法，还包括通过生成如与预测帧(p-Frame)相对的用于传输的帧内(i-Frame)来实现第二策略，只要图像数据的所述部分在阈值以下。

15.权利要求13的方法，还包括通过鉴于在最大图像质量编码上施加限制的系统约束而提供具有最大图像质量的初始更新来实现第二策略。

16.权利要求15的方法，还包括递增地更新经编码的图像质量，直到以下中的一个或多个：

实现目标质量；

在实现目标质量之前对所显示的图像的改变继续发生；以及

系统约束在随后更新上施加限制。

17.权利要求16的方法，还包括同时针对多个区提供图像质量更新。

18.权利要求11-12的任何组合的方法，还包括：

追踪针对要显示的图像数据的给定部分实现的质量指示；

追踪针对图像的给定部分实现的进展指示。

19.权利要求11-12的任何组合的方法，还包括：

从编码器下游的组件接收指示图像质量更新是否要被下游组件丢弃的反馈；

基于包括以下的因素而在下游组件处实现附加策略：

第一和第二策略；

系统约束；

来自下游组件的反馈；或

其任何组合。

20.权利要求11-12的任何组合的方法，还包括基于优先化而标记经编码的数据以便由下游组件可读。

21.一种包括代码的计算机可读介质，所述代码在被运行时，使处理设备实施权利要求11-12的任何组合的方法。

22.一种包括用于实现图像策略的部件的装置，其中部件：

向编码器提供图像数据以用于传输到显示器；

提供图像数据的至少部分是视频数据还是非视频数据的指示；

在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于经编码的图像

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质量而优先化图像数据的传输；并且

在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

23.权利要求22的装置，其中代码在被运行时使处理设备在图像数据的所述部分在要在其上显示图像数据的总显示区域的阈值以下时实现第二策略。

24.权利要求23的装置，其中代码在被运行时使处理设备通过生成如与预测帧(p-Frame)相对的用于传输的帧内(i-Frame)来实现第二策略，只要图像数据的所述部分在阈值以下。

25.权利要求22-23的任何组合的装置，其中代码在被运行时使处理设备通过鉴于在最大图像质量编码上施加限制的系统约束而提供具有最大图像质量的初始更新来实现第二策略。

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基于策略的图像编码

[0001] 对相关申请的交叉引用

本申请要求享有2014年10月15日提交的美国专利申请号14/515,175的提交日的利益，所述申请通过引用并入本文。

技术领域

[0002] 本公开一般涉及图像编码。更具体地，本公开描述了使用基于策略的方案的图像编码。

背景技术

[0003] 计算设备日益被用于查看与计算设备相关联的显示设备上的图像。例如，图像数据可以由图形处理单元再现，或者与要显示在无线显示设备处的操作系统协作。在一些场景中，图像数据由具有编码器的显示系统分组化以提供给外部显示设备。分组化显示系统的一些示例可以包括无线显示系统，其中计算设备可以经由无线通信协议(诸如无线保真(WiFi)、无线吉比特(WiGig)等)向外部显示器提供图像数据。其它分组化显示系统可以包括通用串行总线(USB)协议显示系统。在必须向显示设备传输大量数据的情况下，传输该数据的时间和置于系统上的负载增加，从而造成系统装备的使用和可用带宽的使用方面中的低效率。

附图说明

[0004] 图1是具有基于策略的显示编码系统的计算设备的框图；

图2是图示了应用于视频数据的策略过程的过程流程图；

图3是图示了使用帧内(I-Frame)或预测帧(P-Frame)技术的策略过程的过程流程图；

图4是图示了具有渐进传输的策略过程的过程流程图；

图5是图示了多区更新的图；

图6是图示了监视经编码的更新的图像质量的图；

图7是图示了基于策略的图像编码的功能组件的流程图；

图8是图示了基于策略的图像编码的方法的框图；以及

图9是描绘了配置成实现基于策略的图像编码的计算机可读介质的示例的框图。

具体实施方式

[0005] 本文所公开的主题涉及用于使用基于策略的方案的图像编码的技术。如以上所讨论的，分组化显示系统可以编码和向显示设备传输图像数据。在许多情况下，带宽可能是有限的，并且因此，要传输的大量数据可能增加传输的等待时间，以及作为增加的负载的结果，增加功率消耗。本文所描述的技术包括编码和向显示器传输图像数据的基于策略的方案。当要传输的数据是视频数据(或者换言之，频繁改变的数据)时，第一策略可以相比于更高图像质量而有利于低等待时间传输。当要传输的数据是非视频数据时，或者换言之，当数

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据不频繁改变时，第二策略可以相比于低等待时间而有利于更高的图像质量数据。

[0006] 术语“低等待时间”和“频繁”可以是相对的术语。然而，术语“低等待时间”，如本文所提到的，是相比于否则如果针对频繁改变的给定图像数据类型(即视频数据)而有利于图像质量则将更高的等待时间的低传输时间。例如，如果对于视频数据，图像质量比等待时间优先，则接连的经编码和传输的帧之间的时间可能增加。因此，术语低等待时间可以被理解为与否则如果图像质量被优先或要求在某个阈值处的等待时间的比较。在一些情况下，术语“低等待时间”可以基于指示在此以下的传输等待时间被视为低的时间段的预定阈值。

[0007] 术语“频繁”，如本文所提到的，可以是指阈值改变速率，在此以上图像数据可以被视为高。在一些情况下，术语“频繁”可以由所传输的数据类型确定。例如，作为视频数据的图像数据可以被分类为频繁改变的图像数据，无论改变速率是否满足或超过以上所讨论的阈值。视频数据，如本文所提到的，可以包括与在给定阈值以上频繁改变的数据相关联的自然视频数据。相比之下，非视频数据可以包括在给定阈值以下的数据，并且可以包括与生产力图形中的改变相关联的数据。例如，当与视频数据相比时，对文字处理器应用的改变可能相对不频繁。对与文字处理器应用相关联的图像数据的改变可以是发生在生产力图形中的示例改变之一。生产力图形中的改变的其它示例可以包括发生在文件窗口应用、演示应用、文档查看器应用等中的改变。

[0008] 用户可以以相比于静态或非视频图像数据中的较低图像质量的较少细看来查看视频中的较低图像质量。例如，由于视频数据的每一帧的内容可能随每一个接连帧而改变，因此基于策略的编码可以快速提供经编码的帧，相比于如果要求图像质量保持在设定阈值处则可能发生的等待时间。相比之下，由于非视频数据的每一帧，包括要显示的文字处理器文档的这样帧不频繁改变，基于策略的编码可以相比于低等待时间而有利于图像质量。在该情况下，显示在文字处理器文档图像内的对象可以以高图像质量呈现，甚至以较高等待时间为代价。然而，由于改变不频繁地发生在文字处理器文档图像中，因此图像很可能以相比于其中有利于低等待时间的视频图像数据而言仍旧相对低的等待时间被编码和传输到显示设备。

[0009] 在任何情况下，本文所描述的技术包括基于策略的编码系统，其中优先化可以基于要编码的图像数据的类型或要编码的图像数据的改变频率而改变。以下更加详细讨论的其它实施例包括选择性地更新帧的部分、渐进更新帧或帧的部分、多区更新、质量指示器追踪、渐进指示追踪、分布式反馈、分布式控制等。

[0010] 图1是具有基于策略的显示编码系统的计算设备的框图。计算设备102可以包括处理器104、包括非暂时性计算机可读介质的存储设备106和存储器设备108。计算设备102可以包括显示系统110，其配置成实现与图像显示相关联的组件(诸如再现模块112、捕获和通知模块114、编码器116、分组化器118等)处的策略决定。策略引擎120可以由显示系统110在给定策略的实现期间进行参考。策略引擎120可以是策略架构，其中经分组化的数据流可以取决于图像数据的特性而被不同地编码以便保存能量、增加图像质量、降低等待时间等。在一些情况下，策略引擎可以配置成存储在存储设备106上并且由显示系统110经由处理器104进行参考。在任何情况下，显示系统配置成编码和向一个或多个外部显示设备122传输图像数据。

[0011] 显示设备122可以经由无线连接通过网络接口控制器(NIC)124和网络126而通信

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耦合到计算设备102。在一些情况下，本文所讨论的技术可以实现在有线通信中，如通过虚线128所指示的，其中将图像数据经由通用串行总线(USB)驱动器130和USB端口132提供给外部显示设备122。

[0012] 在实施例中，显示系统110的元件可以实现为逻辑、硬件逻辑或软件，其配置成由处理设备104实施。在再其它的示例中，显示系统110的元件可以是硬件、软件和固件的组合。显示系统110的元件可以配置成独立地、并行地、分布式地或作为更广的过程的部分进行操作。显示系统110的元件可以被视为分离的模块或父代模块的子模块。还可以包括附加的模块。

[0013] 在一些情况下，显示系统110的元件可以实现在计算设备102的其它元件中。例如，再现模块112可以实现在计算设备的操作系统内，并且配置成再现图像数据以用于编码。同样地，捕获和通知模块114可以实现在操作系统内，或者可以是图形栈的部分，其配置成当图像数据是视频数据或非视频数据时进行识别并且通知编码器116。视频与非视频数据关系的该先验知识可以被编码器用于根据一个或多个策略来编码图像数据。

[0014] 如以上所讨论的，策略可以包括第一策略，其中编码器116，针对作为视频数据的图像数据，相比于经编码的图像质量而优先化传输(即低等待时间)。换言之，第一策略可以以潜在较低的图像质量为代价在传输链路的可用带宽约束内传输频繁改变的图像数据。在第二策略中，编码器116，针对非视频数据，相比于低等待时间而优先化图像质量。换言之，第二策略将推迟传输，直到满足某个水平的图像质量，或者力图以比瞬时可用带宽更高的带宽进行传输，从而针对并非频繁改变的图像数据而牺牲低等待时间以得到图像质量。可以实现其它策略，然而，第一和第二策略被实现以针对并非频繁改变的图像数据(诸如文字处理器文档的图像数据)而向用户提供高图像质量，并且针对频繁改变的图像数据(诸如视频)而提供低等待时间。在编码器116编码图像数据之后，分组化器118可以分组化图像数据以用于传输至外部显示设备中的一个或多个。

[0015] 处理器104可以是适配成运行所存储的指令的主存储器。处理器104可以是单核处理器、多核处理器、计算集群或任何数目的其它配置。处理器104可以实现为复杂指令集计算机(CISC)或精简指令集计算机(RISC)处理器、x86指令集兼容处理器、多核或任何其它微处理器或中央处理单元(CPU)。

[0016] 存储器设备108可以包括随机存取存储器(RAM)(例如静态随机存取存储器(SRAM)、动态随机存取存储器(DRAM)、零电容器RAM、硅-氧化物-氮-氧化物-硅SONOS、嵌入式DRAM、扩展数据输出RAM、双数据速率(DDR)RAM、电阻随机存取存储器(RRAM)、参数随机存取存储器(PRAM)等)、只读存储器(ROM)(例如掩模型ROM、可编程只读存储器(PROM)、可擦除可编程只读存储器(EPROM)、电可擦除可编程只读存储器(EEPROM)等)、闪速存储器或任何其它合适的存储器系统。主处理器104可以通过系统总线134(例如外围组件互连(PCI)、工业标准架构(ISA)、PCI-Express、HyperTransport®、NuBus等)连接到包括存储器108和存储设备106的组件。

[0017] 图1的框图不意图指示计算设备102要包括图1中所示的全部组件。另外，计算设备102可以取决于具体实现的细节而包括图1中未示出的任何数目的附加组件。

[0018] 图2是图示了应用于视频数据的策略过程的过程流程图。如以上关于图2所讨论的，第一策略配置成针对作为视频数据的图像数据而优先化图像传输。例如，在202处，可以

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接收图像数据。图像数据可以由操作系统接收。在204处，做出关于图像数据是视频还是非视频的确定。该确定可以由操作系统、图形栈等中的一个或多个做出。在任何情况下，使该确定先验于向编码器提供图像数据和图像数据类型的指示。以上讨论的先验确定将图像数据类型确定从编码器卸载并且允许具有更多处理能力的组件(诸如图形栈、操作系统等)执行该确定。

[0019] 在实施例中，通过图像数据内的改变频率的确定来确定图像数据是视频或非视频。例如，可以将图像数据的改变速率与预定阈值比较。在阈值以上的图像数据被分类为视频数据，而阈值以下的图像数据可以被分类为非视频数据。

[0020] 在块206处，如果图像数据是视频数据，图1的编码器116将优先化图像传输，并且可以潜在地允许图像质量降低。在块208处，如果图像数据是非视频数据，编码器116优先化图像质量，并且可以潜在地允许传输的等待时间增加。

[0021] 图3是图示了使用帧内(I-Frame)或预测帧(P-Frame)技术的策略过程的过程流程图。在一些情况下，第一或第二策略可以基于所检测到的改变是否发生在要显示的区域的足够小的部分中而不同地实现。如图3中所图示的，在302处接收图像数据，其指示从之前传输的帧的图像数据中的改变，并且在304处做出关于经改变的区域是否在预定阈值以上的确定。

[0022] 例如，图像数据可以指示总显示帧的仅20%部分中的改变。如果改变仅影响总显示帧的小百分数，第一策略，其中图像质量优先于低等待时间传输。在图3中，如果所述部分在预定阈值以下，可以生成帧内(i-Frame)以用于传输，如306处所指示的。i-Frame传输可以提供要显示的比在308处生成的p帧经编码的传输更高质量的图像。虽然i-Frame传输可以典型地为高带宽传输，但是如果仅图像数据的小部分改变，则带宽将是相对小的。因此，图3中所图示的策略可以利用较高质量更新，其甚至可以在鉴于带宽约束的情况下快速传输。另外，由于仅发生小改变，因此传输i-Frame可以降低图1的编码器116的计算负载，因为p-Frame编码要求参考之前的帧以确定精确的p-Frame编码传输。

[0023] 图4是图示了具有渐进传输的策略过程的过程流程图。如以上关于图3所讨论的，在一些情况下，第一或第二策略可以基于所检测到的改变是否发生在要显示的区域的足够小的部分中而不同地实现。如图4中所图示的，在402处接收图像数据，并且在404处确定经改变的图像数据是否在区域阈值以上。如果区域在阈值以上，并且在406处确定图像数据是视频数据，根据以上关于图1和2讨论的第一策略，并且如408处所指示的，对图像数据进行编码和传输。如果图像数据不是视频，但是仍旧在经改变的区域阈值以上，根据第二策略传输对图像数据进行编码和传输，如410处所指示的。

[0024] 如果经改变的区域不在阈值以上，则可以生成基本传输，其采用相比于低等待时间而优先化图像质量的第二策略，如412处所指示的。在一些情况下，基本传输可以实现期望的图像质量。然而，如果基本传输不实现期望的图像质量，可以对渐进更新进行编码和传输，直到实现所期望的图像质量，如414处所指示的。在一些情况下，期望的质量可以与预定值相关联，并且当对图像数据进行编码和传输时可以追踪任何给定图像的质量。质量指示器，如以下更加详细讨论的，可以用于追踪已经被编码和传输的图像的质量。

[0025] 基本传输和渐进更新可以使用可缩放视频编码(SVC)来编码。例如，当一个区变成静态时，SVC保真增强层可以用于提供渐进更新。此外或可替换地，在一些情况下，基本传输

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和渐进更新可以使用高级视频编解码器(AVC)来编码，其使用对应的帧水平精化。

[0026] 如以上所讨论的，更新可以是已经改变的当前显示的图像的仅部分的结果。经改变的部分在本文中可以被称为经改变的“区”。以上讨论的选择性区更新可以由诸如图1的显示系统110之类的逻辑来追踪。

[0027] 图5是图示了多区更新的图。本文所描述的技术包括经由SVC层或AVC帧更新多个区。按照定义，区可以要求不同类型的更新，或者如果与给定区相关联的图像数据尚未改变则完全没有更新。

[0028] 如图5中所图示的，显示器500可以包括三个区，包括区502、区504和区506。区502可以是残留显示区域，并且区504和506可以要求图像数据更新。如图5中所指示的，区504可以被提供基本更新，而区506被提供渐进更新。针对区506的渐进更新和针对区504的基本更新可以作为在之前帧时间期间发生的改变的结果而被复用以用于传输。选择性和多区更新随时间的知识和追踪使得图1的编码器116能够执行区特定更新。另外，区特定知识和追踪还可以由图1的显示系统110实现以确定区是否尚未改变，并且因而编码器116可以禁用针对未经改变的区的运动搜索，并且采用用于与未经改变的区相关联的宏块的跳过模式。

[0029] 图6是图示了监视经编码的更新的图像质量的图。如以上所讨论的，诸如图1的显示系统110之类的逻辑可以配置成追踪针对包括宏块集合、扫描线等的区的更新。图1的编码器116还可以配置成追踪区及其相关联的更新的时间和空间特性。更新一般可以在对所显示的图像的区的改变被检测到并且变成活跃内容时开始。更新可以在对所显示的图像的区的改变结束并且变成静态内容时或者在区实现目标图像质量时结束。

[0030] 本文所描述的技术包括用于追踪图像质量以及图像数据和相关联的更新的进展的元数据。图6图示了四个阶段，包括阶段602、阶段604、阶段606和阶段608，作为接收更新并且其中追踪任何给定区的图像质量的给定显示区域内的区的示例。例如，在阶段602处，区A具有图像质量值0，而区Z具有图像质量值3。在该示例中，图像质量值3是目标图像质量值，其中编码器可以确定不要求另外的更新。在随后的阶段中，诸如阶段604，区A具有值1，区Z继续具有值3，并且新的区——区B——具有值0。另外的阶段606和608图示了监视区A、B和Z，直到针对每一个区实现目标值3。

[0031] 在一些情况下，图像质量值零可以指示给定区的内容最近在每一次以上关于图2、3和4讨论的选择性更新时改变。图像质量值1可以是基本更新，并且值2或更高可以指示已经由编码器116编码的渐进更新的数目。

[0032] 在实施例中，SVC可以用于使得能够实现更精细的粒度。具体地，基本更新可以包括每一个帧时间内的多个渐进更新。要指出的是，在图6中，针对背景区(诸如区Z)，其表示驻留在给定目标质量水平3处的所有区，没有更新被编码、分组化或传输。

[0033] 在实施例中，元数据可以由显示系统110收集以追踪何时每一个区被编码、分组化、传输等，以改进显示系统116的鲁棒性和调试能力。具体地，可以追踪指示任何给定更新的进展的元数据。例如，在下一帧的开始处，分组化或传输给定帧中的经编码的更新的失败可以在编码器116处被检测和处置。在SVC的上下文中，这可以在子帧和帧边界二者处应用。

[0034] 图7是图示了基于策略的图像编码的功能组件的流程图。显示系统，诸如图1的显示系统110，可以实现图像数据编码和传输管线。如图7中所指示的，可以在702处编码图像数据。在704处捕获正在改变或者以其它方式被指示为视频数据的图像数据并且在图像数

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据在706处进行编码之前通知编码器116。在708处分组化并且在710处传输经编码的图像数据。策略引擎712可以由显示系统110用作进展，并且监视图像质量数据以实现策略，诸如以上讨论的第一和第二策略。

[0035] 此外，显示系统110可以配置成使得能够实现每一个功能块和相关联的组件处的局部化控制，如714处所指示的。例如，传输块710可以与NIC相关联，诸如NIC 124，其配置成传输经编码和分组化的图像数据更新。NIC 124上利用的热学约束可能造成NIC 124从传输位流丢弃渐进更新以减小无线传输带宽。NIC 124可以配置成基于与策略引擎712相关联的总体系统目标而选择丢弃哪些分组。

[0036] 在一些情况下，局部化控制可以经由更新之中的优先化而实现。例如，在多区更新中的帧/层内和跨帧/层二者，无论何时系统被约束以便针对静态区以较高保真度为代价而确保低等待时间和平滑性，基本更新可以优先于渐进更新。在该场景中，编码器116配置成封装和标记不同更新类型的区。下游组件，诸如分组化器118和NIC 124，可以配置成识别和解析所标记的区，并且基于所标记的区而执行局部化动作，诸如分组丢弃。

[0037] 另外，可以在功能组件块之间提供反馈。例如，NIC 124可以通过防止经分组化的更新的传输的热学条件来约束。如果条件持续超出可配置时间段，NIC 124可以通知编码器116，如716处所指示的。通知可以指示将丢弃渐进更新以避免随后的渐进更新的不必要的编码和分组化。

[0038] 一般而言，显示系统110可以配置成查明给定约束的净影响，诸如来自给定约束的功率消耗影响、热学影响、带宽影响等。例如，无线带宽中的持续丢弃可能负面地影响用户所感知到的质量，其中丢弃渐进更新。从NIC 124到编码器116的反馈可以避免生成如以上所讨论的渐进更新。还可以实现更加集成的方案，其中检测约束并且相应地调谐编码器116。例如，编码器116可以配置成在带宽中的持续丢弃期间生成比否则将发生的更小但相对更渐进的更新。

[0039] 图8是图示了基于策略的图像编码的方法的框图。在802处，向编码器提供图像数据以用于传输到显示器。在块804处提供图像数据的至少部分是视频数据还是非视频数据的指示。针对作为视频数据的图像数据，在编码器处实现第一策略，其相比于经编码的图像质量而优先化图像数据的低等待时间传输，如块806处所指示的。在块808处，针对非视频数据，可以在编码器处实现第二策略，其中第二策略相比于低等待时间传输而优先化经编码的图像质量。

[0040] 图9是描绘了配置成实现基于策略的图像编码的计算机可读介质的示例的框图。计算机可读介质900可以由处理器902通过计算机总线904来访问。在一些示例中，计算机可读介质900可以是非暂时性计算机可读介质。在一些示例中，计算机可读介质可以是存储介质，但是不包括载波、信号等。另外，计算机可读介质900可以包括计算机可执行指令以引导处理器902执行当前方法的步骤。

[0041] 本文所讨论的各种软件组件可以存储在有形、非暂时性、计算机可读介质900上，如图9中所指示的。例如，策略应用906可以配置成向编码器提供图像数据以用于传输到显示器，并且提供图像数据的至少部分是视频数据还是非视频数据的指示。策略应用906还可以配置成在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输，并且在编码器处实现第二策略，其针对作为非视频数

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据的图像数据，相比于传输而优先化经编码的图像质量。

[0042] 示例可以包括诸如方法、用于执行方法的动作的部件、包括指令的至少一个机器可读介质之类的主题，所述指令在由机器执行时使机器执行方法的动作。

[0043] 示例1包括一种用于基于策略的显示编码的系统。系统包括逻辑，至少部分地包括硬件逻辑，以向编码器提供图像数据以用于传输到显示器并且提供图像数据的至少部分是视频数据还是非视频数据的指示。逻辑还配置成在编码器处实现第一策略，其针对作为视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输，并且在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

[0044] 示例2包括一种用于基于策略的显示编码的方法。方法包括向编码器提供图像数据以用于传输到显示器并且提供图像数据的至少部分是视频数据还是非视频数据的指示。方法包括在编码器处实现第一策略，其针对作为视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输，以及在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。在一些情况下，可以实现计算机可读介质以实施示例2的方法。

[0045] 示例3包括包含代码的计算机可读介质，所述代码在被运行时，使处理设备向编码器提供图像数据以用于传输到显示器。代码还可以被实现以提供图像数据的至少部分是视频数据还是非视频数据的指示，并且在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输。代码还可以配置成在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

[0046] 示例4包括一种包括用于实现图像策略的部件的装置。部件向编码器提供图像数据以用于传输到显示器，并且提供图像数据的至少部分是视频数据还是非视频数据的指示。部件还配置成在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输，并且在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

[0047] 示例5包括装置，包括逻辑，至少部分地包括用于实现图像策略的硬件逻辑。逻辑向编码器提供图像数据以用于传输到显示器并且提供图像数据的至少部分是视频数据还是非视频数据的指示。逻辑还配置成在编码器处实现第一策略，其针对作为非视频数据的图像数据，相比于经编码的图像质量而优先化图像数据的传输，并且在编码器处实现第二策略，其针对作为非视频数据的图像数据，相比于传输而优先化经编码的图像质量。

[0048] 实施例是实现或示例。在说明书中对“实施例”、“一个实施例”、“一些实施例”、“各种实施例”或“其它实施例”的参考意味着结合实施例描述的特定特征、结构或特性包括在至少一些实施例中，但是不一定是本技术的全部实施例。“实施例”、“一个实施例”或“一些实施例”的各种出现不一定都是指相同的实施例。

[0049] 并非本文所描述和说明的全部组件、特征、结构、特性等都需要包括在特定的一个或多个实施例中。如果说明书陈述例如组件、特征、结构或特性“可以”、“可能”、“能够”或“可”被包括，不要求包括该特定组件、特征、结构或特性。如果说明书或权利要求提到“一”或“一个”元件，这不意味着仅存在一个元件。如果说明书或权利要求提到“一附加”元件，这

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不排除存在多于一个的附加元件。

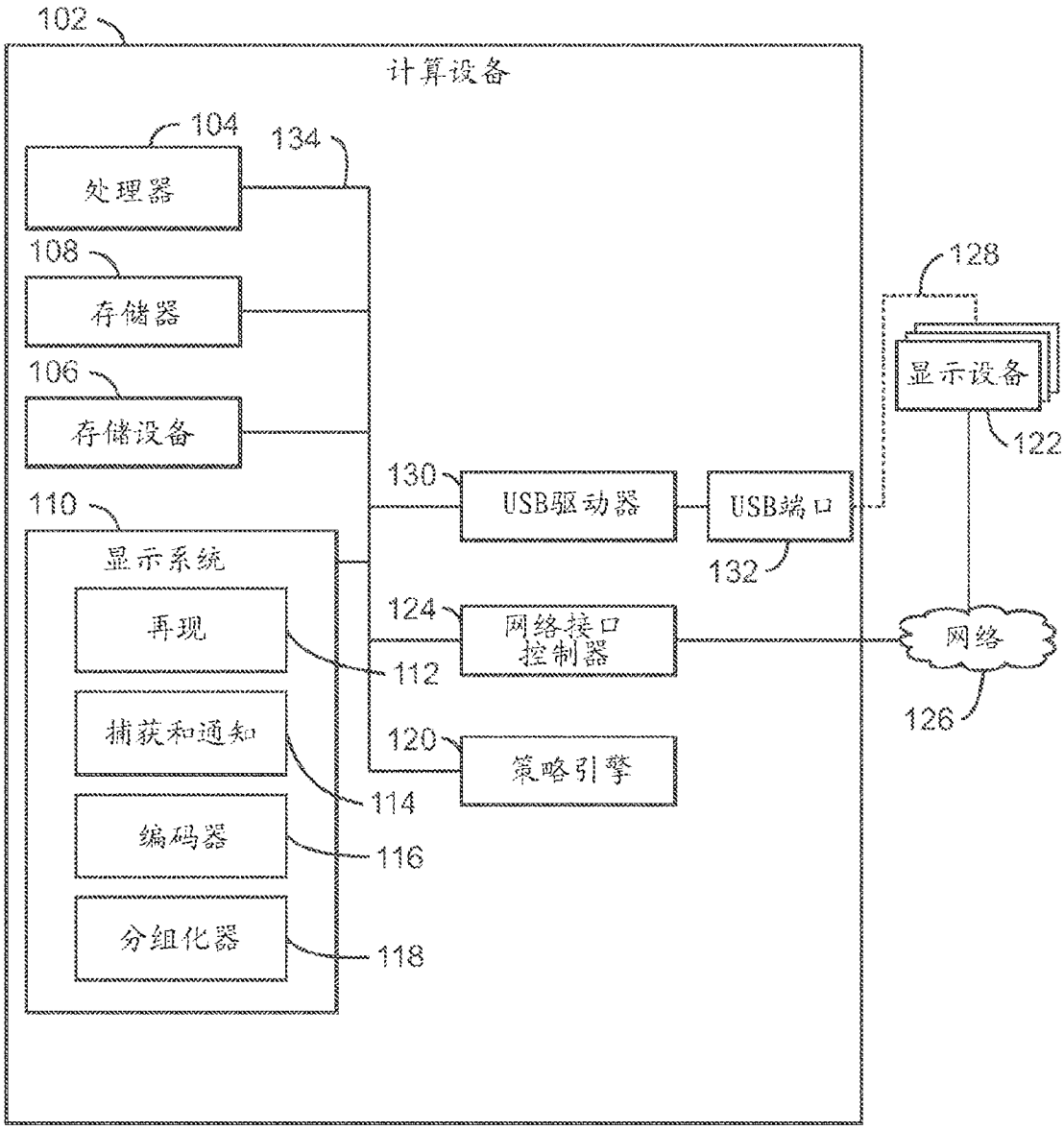
[0050] 要指出的是，尽管已经参照特定实现描述了一些实施例，但是根据一些实施例，其它实现是可能的。此外，在附图中图示和/或本文所描述的电路元件或其它特征的布置和/或次序不需要以所图示和描述的特定方式布置。根据一些实施例，许多其它布置是可能的。

[0051] 在图中示出的每一个系统中，元件在一些情况下可以每一个具有相同的参考标号或不同的参考标号以暗示所表示的元件可以是不同和/或类似的。然而，元件可以足够灵活以具有不同的实现并且与本文所示出或描述的系统中的一些或全部一起工作。图中所示的各种元件可以相同或不同。将哪一个称为第一元件和将哪一个称为第二元件是任意的。

[0052] 要理解到，前述示例中的详情可以使用在一个或多个实施例中的任何地方。例如，以上所描述的计算设备的所有可选特征还可以关于本文所描述的方法或计算机可读介质中的任一个来实现。另外，尽管流程图和/或状态图可能已经在本文中用于描述实施例，但是技术不限于那些图或本文中的对应描述。例如，流程不需要移动通过每一个所图示的块或状态或者以与本文所说明和描述的精确相同的次序。

[0053] 本技术不受限于本文所列出的特定细节。实际上，受益于本公开的本领域技术人员将领会到，可以在本技术的范围内做出从前述描述和附图的许多其它变型。相应地，正是包括对其的任何修改的随附权利要求限定本技术的范围。

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图 1

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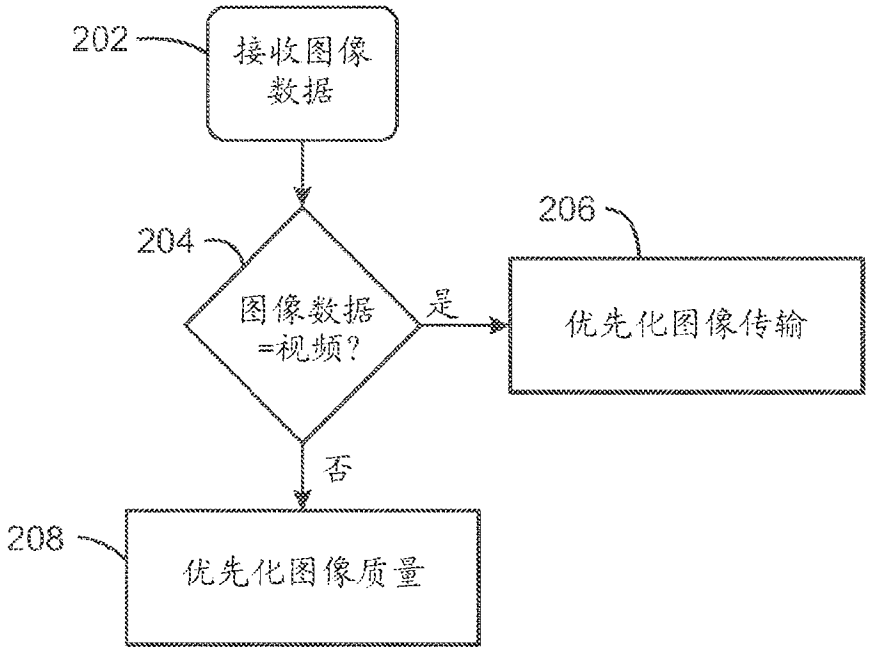


图 2

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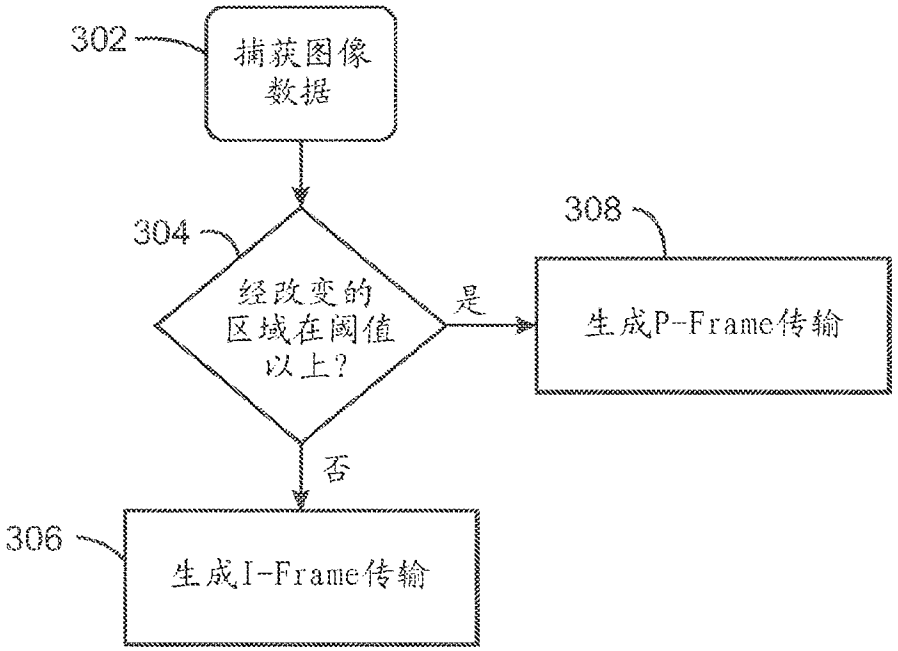
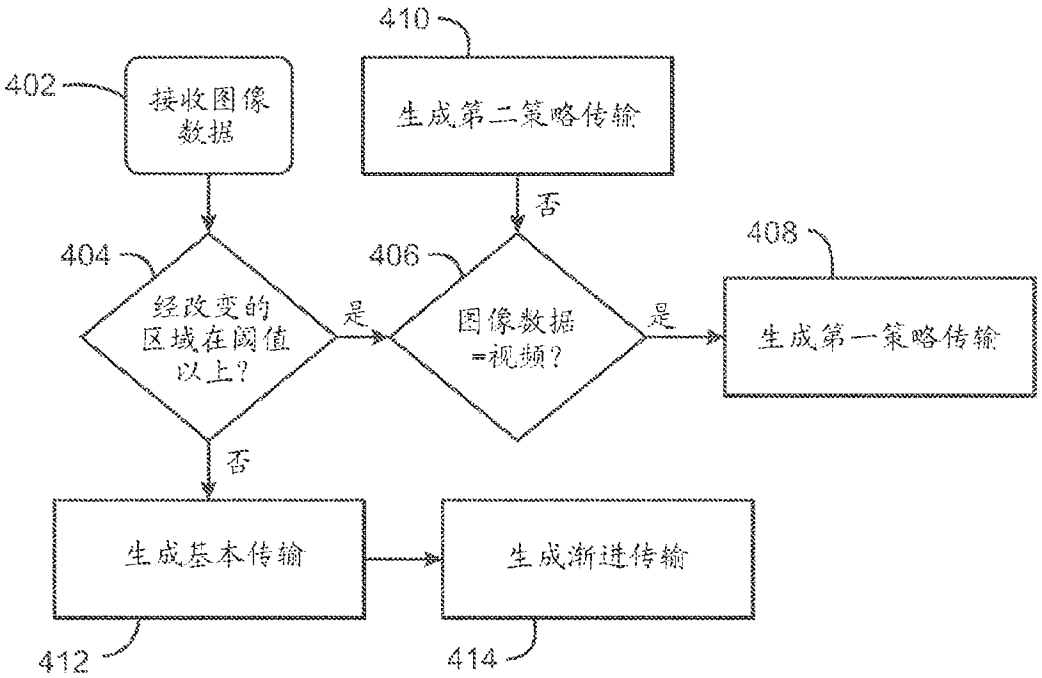


图 3

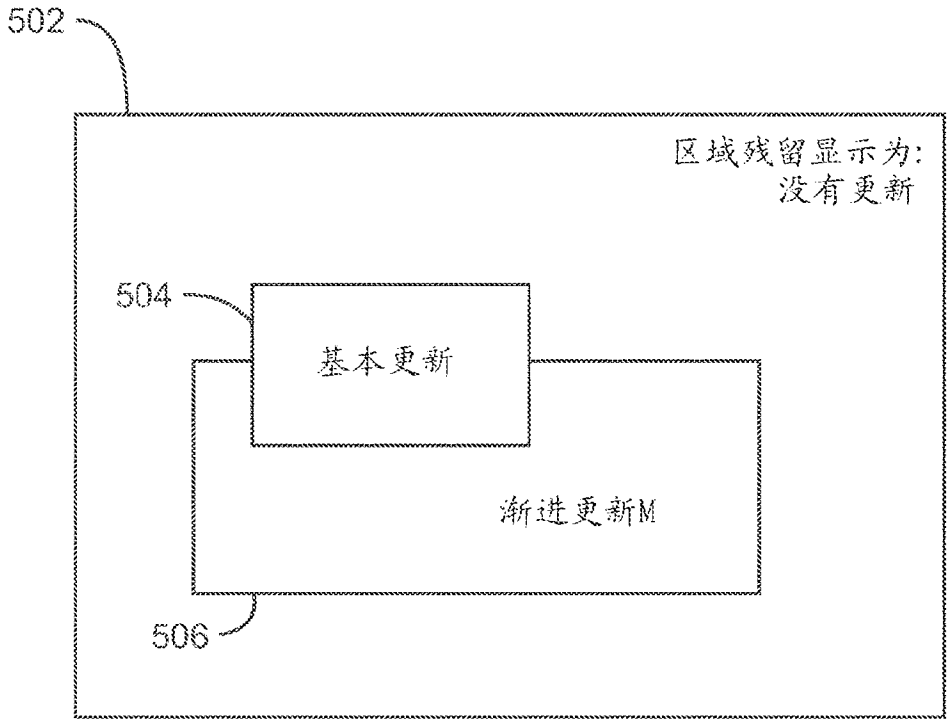
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图 4

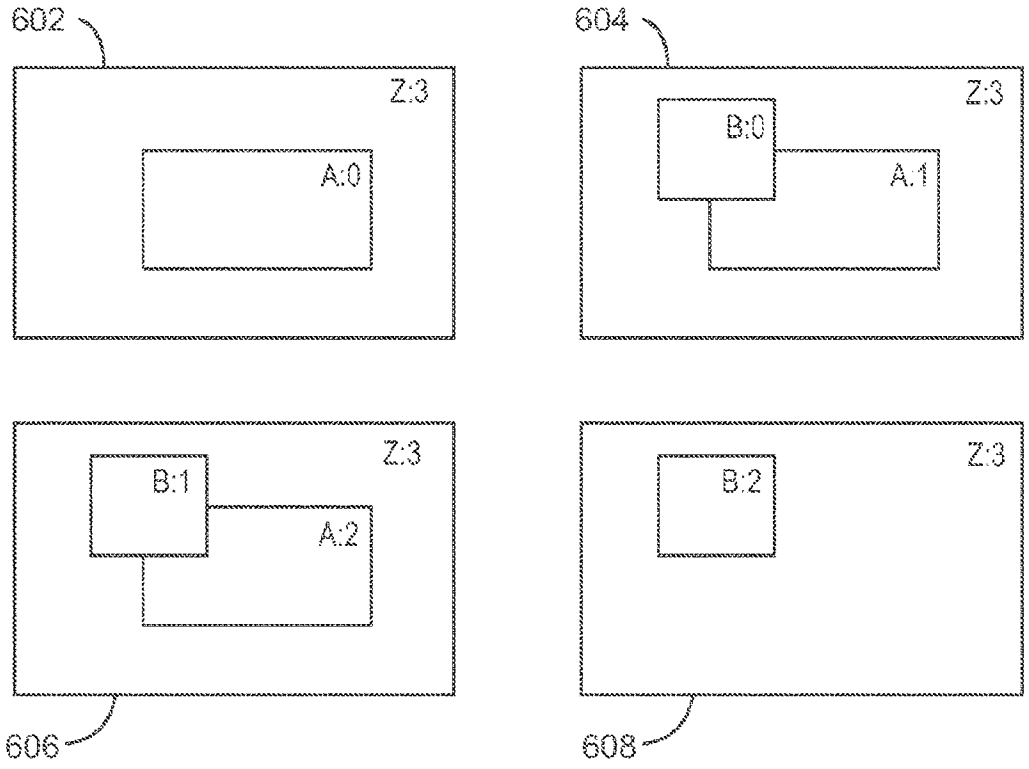
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500

图 5

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600

图 6

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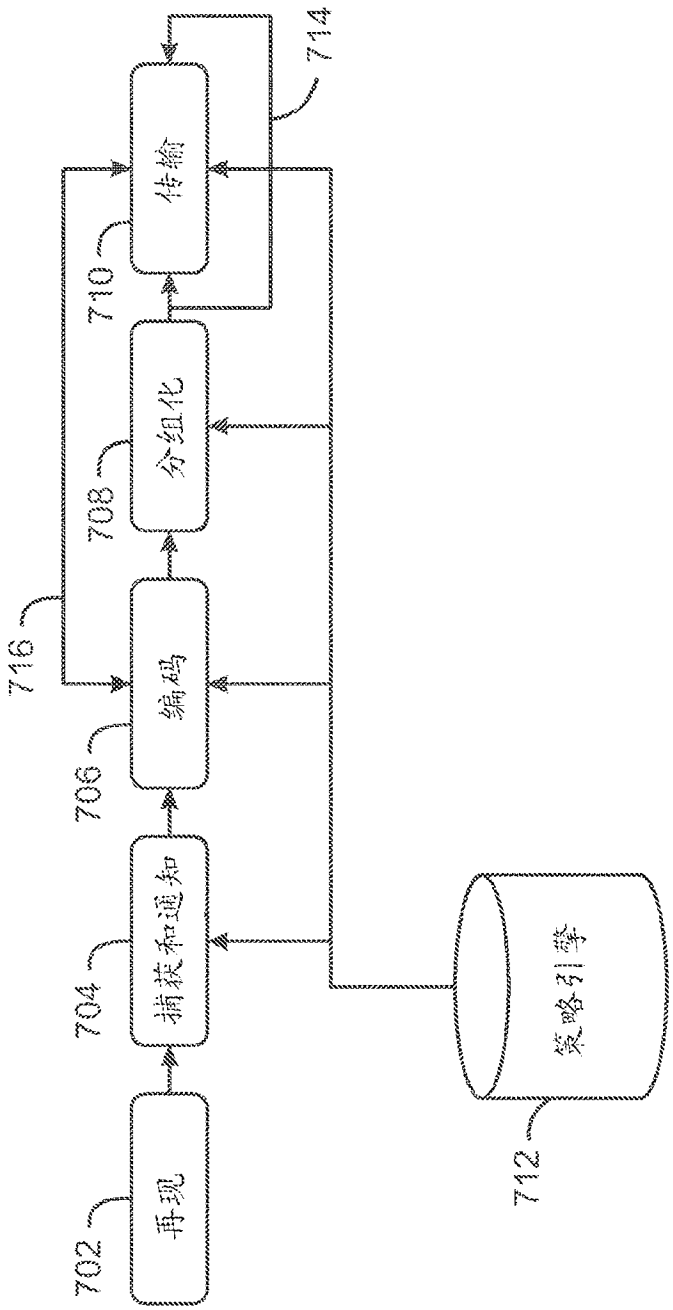
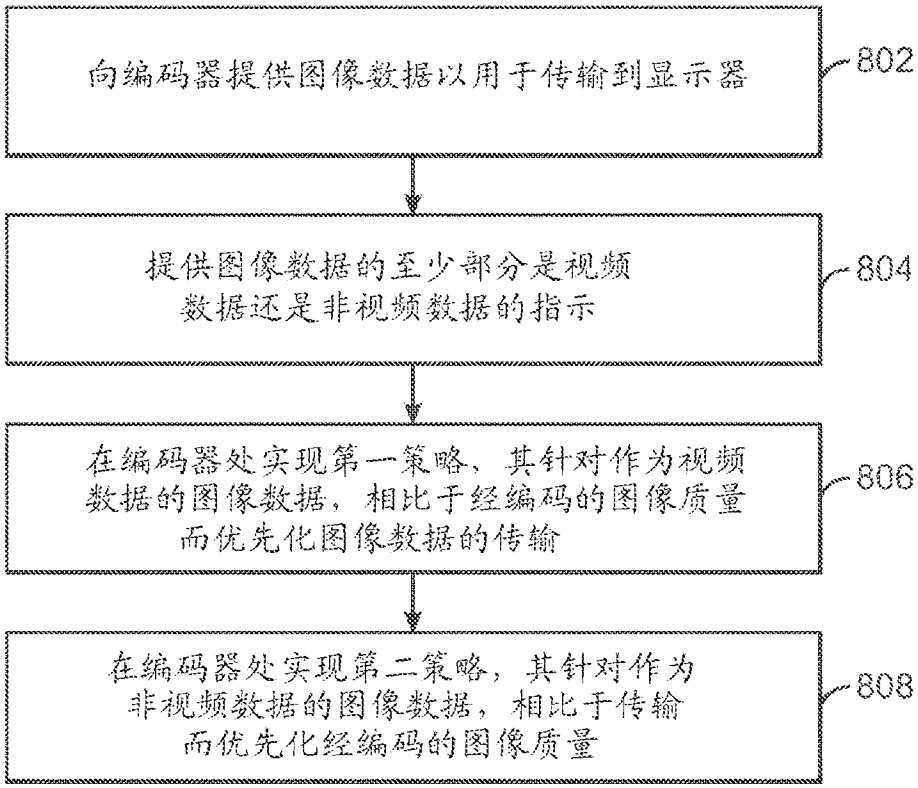


图 7

Pinterest Ex. 1004, Page 159 of 401



800

图 8

Pinterest Ex. 1004, Page 160 of 401

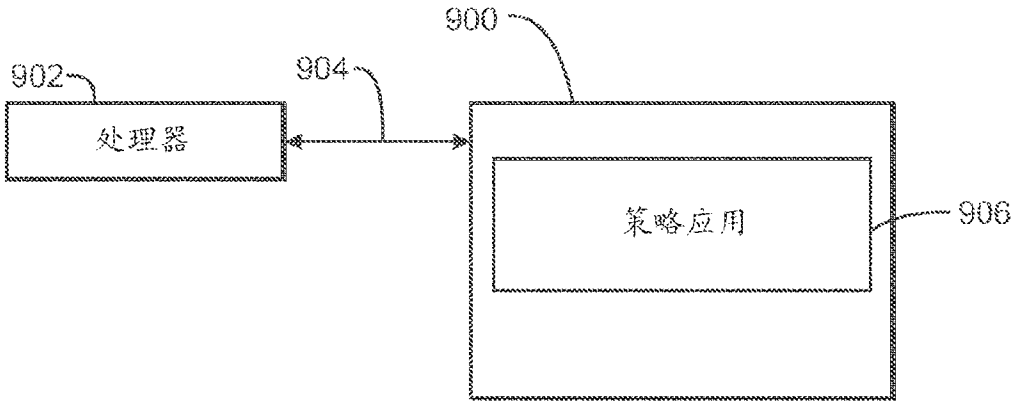


图 9

Pinterest Ex. 1004, Page 161 of 401

PATENT COOPERATION TREATY

From the INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:
MONIQUE M. PERDOK
SCHWEGMAN Lundberg & Woessner, P.A.
P.O Box 2938
Minneapolis, Minnesota 55402 USA

PCT

NOTIFICATION OF TRANSMITTAL OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (CHAPTER II OF THE PATENT COOPERATION TREATY)

(PCT Rule 71.1)

Date of mailing *(day/month/year)*	01 APR 2020
Applicant's or agent's file reference	IMPORTANT NOTIFICATION
20S0.354WO1	

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2018/046723	14 August 2018 (14.08.2018)	08 September 2017 (08.09.2017)

Applicant: OPENTV, INC.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary report on patentability and its annexes, if any, established on the international application.

2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary report on patentability. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the *PCT Applicant's Guide*.

The applicant's attention is drawn to Article 33(5), which provides that the criteria of novelty, inventive step and industrial applicability described in Article 33(2) to (4) merely serve the purposes of international preliminary examination and that "any Contracting State may apply additional or different criteria for the purposes of deciding whether, in that State, the claimed invention is patentable or not" (see also Article 27(5)). Such additional criteria may relate, for example, to exemptions from patentability, requirements for enabling disclosure, clarity and support for the claims.

Name and mailing address of the IPEA/US	Authorized officer
COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: IPEA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA	KIM NGUYEN
Facsimile No. (571)273-8300	Telephone No. (571)272-4441

Form PCT/IPEA/416 (January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 2050.354WO1	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/US2018/046723	International filing date *(day/month/year)* 14 August 2018 (14.08.2018)	Priority date *(day/month/year)* 08 September 2017 (08.09.2017)
International Patent Classification (IPC) or both national classification and IPC IPC: H04W 28/02 CPC: H04W 28/02, 12/06, 28/10; H04N 19/463, 19/30		
Applicant OPENTV, INC.		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet.
3. This report is also accompanied by ANNEXES, comprising:
   a. ☒ *(sent to the applicant and to the International Bureau)* a total of 14 sheets, as follows:
      ☒ sheets of the description, claims and/or drawings which have been amended and/or sheets containing rectifications authorized by this Authority, unless those sheets were superseded or cancelled, and any accompanying letters (see Rules 46.5, 66.8, 70.16, 91.2, and Section 607 of the Administrative Instructions).
      ☐ sheets containing rectifications, where the decision was made by this Authority not to take them into account because they were not authorized by or notified to this Authority at the time when this Authority began to draw up this report, and any accompanying letters (Rules 66.4*bis*, 70.2(e), 70.16 and 91.2).
      ☐ superseded sheets and any accompanying letters, where this Authority either considers that the superseding sheets contain an amendment that goes beyond the disclosure in the international application as filed, or the superseding sheets were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in item 4 of Box No. I and the Supplemental Box (see Rule 70.16(b)).
   b. ☐ *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) _____ containing a sequence listing, in the form of an Annex C/ST.25 text file, as indicated in the Supplemental Box Relating to Sequence Listing (see paragraph 3*ter* of Annex C of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - ☑ Box No. I Basis of the report
   - ☐ Box No. II Priority
   - ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - ☐ Box No. IV Lack of unity of invention
   - ☑ Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
   - ☐ Box No. VI Certain documents cited
   - ☐ Box No. VII Certain defects in the international application
   - ☐ Box No. VIII Certain observations on the international application

Date of submission of the demand	Date of completion of this report
20 December 2018 (20.12.2018)	18 March 2020 (18.03.2020)
Name and mailing address of the IPEA/US COMMISSIONER FOR PATENTS MAIL STOP PCT, ATTN: IPEA/US P.O. BOX 1450 ALEXANDRIA, VA 22313-1450, UNITED STATES OF AMERICA Facsimile No. (571)273-8300	Authorized officer KIM NGUYEN Telephone No. (571)272-4441

Form PCT/IPEA/409 (cover sheet) (January 2015)

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/US2018/046723

Box No. I Basis of the report

1. With regard to the **language**, this report is based on:
   - [x] the international application in the language in which it was filed.
   - [ ] a translation of the international application into _____ which is the language of a translation furnished for the purposes of:
     - [ ] international search (Rules 12.3(a) and 23.1(b))
     - [ ] publication of the international application (Rule 12.4(a))
     - [ ] international preliminary examination (Rules 55.2(a) and/or 55.3(a) and (b))
2. With regard to the **elements** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:
   - [ ] the international application as originally filed/furnished, or
   - [x] the description:
     pages 1-21 as originally filed/furnished.
     pages* _____ received by this Authority on _____
     pages* _____ received by this Authority on _____
   - [x] the claims:
     Nos. _____ as originally filed/furnished.
     Nos.* _____ as amended (together with any statement) under Article 19
     Nos.* 1-20 received by this Authority on 20 December 2018 (20.12.2018)
   - [x] the drawings:
     pages 1/5-5/5 as originally filed/furnished.
     pages* _____ received by this Authority on _____
     pages* _____ received by this Authority on _____
   - [ ] a sequence listing - see Supplemental Box Relating to Sequence Listing.
3. [ ] The amendments have resulted in the cancellation of:
   - [ ] the description, pages _____
   - [ ] the claims, Nos. _____
   - [ ] the drawings, sheets/figs _____
   - [ ] the sequence listing *(specify)*: _____
4. [ ] This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since either they are considered to go beyond the disclosure as filed, or they were not accompanied by a letter indicating the basis for the amendments in the application as filed, as indicated in the Supplemental Box (Rules 70.2(c) and (c-*bis*)):
   - [ ] the description, pages _____
   - [ ] the claims, Nos. _____
   - [ ] the drawings, sheets/figs _____
   - [ ] the sequence listing *(specify)*: _____
5. [ ] This report has been established:
   - [ ] taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rules 66.1(d-*bis*) and 70.2(e)).
   - [ ] without taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91(Rules 66.4*bis* and 70.2(e)).
6. With regard to top-up searches (Rules 66.1*ter* and 70.2(f)):
   - [x] A top-up search was carried out by this Authority on 18 March 2020 (18.03.2020)
     - [ ] Additional relevant documents have been discovered during the top-up search.
   - [ ] No top-up search was carried out by this Authority because it would serve no useful purpose.
7. [ ] Supplementary international search report(s) from Authority(ies) _____ has/have been received and taken into account in establishing this report (Rule 45*bis*.8(b) and (c)).

** If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
PCT/US2018/046723

Box No. V — *Reasoned statement under Article 35(2) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement*

1. Statement

Novelty (N)	Claims	1-20	YES
	Claims		NO
Inventive step (IS)	Claims	1-20	YES
	Claims		NO
Industrial applicability (IA)	Claims	1-20	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

---------- EXPLANATION ----------

Claims 1-20 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest a method as recited in the context of claim 1, and similarly recited in the context of claim 6 or 11.

Claims 1-20 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Amarendra N. Gogoi et al.
Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Docket No.:	2050.354US3	Serial No.:	18/480,918
Filed:	October 4, 2023	Due Date:	September 21, 2024
Examiner:	Stefan Gadomski	Group Art Unit:	2485
Customer No.:	44367	Confirmation No.:	9039

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items (as indicated with an "X"):

X Terminal Disclaimer (1 pg.)
X Amendment and Response under 37 C.F.R. § 1.111 (10 pgs.)
X Information Disclosure Statement (12 pgs.). Copies of Cited References (48).
X Authorization to charge Deposit Account 19-0743 in the amount of **$260.00** to cover the fee for consideration of Information Disclosure Statement under 37 C.F.R. § 1.97(c).
X Authorization to charge Deposit Account 19-0743 in the amount of **$170.00** to cover the fee for the Terminal Disclaimer

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers and please charge any additional fees or credit overpayment to Deposit Account No. 19-0743. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

/ Susan Yee /

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 44367

By: _____
Susan Yee
Reg. No. 41,388

PTO/AIA/26 (04-14)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) 2050.354US3

In re Application of: Amarendra N. Gogoi et al.

Application No.: 18/480,918

Filed: October 4, 2023

For: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

The applicant, **OpenTV, Inc.**, owner of **100** percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent** No. **11,825,139** as the term of said **prior patent** is presently shortened by any terminal disclaimer. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

expires for failure to pay a maintenance fee;
is held unenforceable;
is found invalid by a court of competent jurisdiction;
is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
has all claims canceled by a reexamination certificate;
is reissued; or
is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 41,388

/ Susan Yee /	September 4, 2024
Signature	Date

Susan Yee
Typed or printed name

Attorney of Record	(408) 278-4057
Title	Telephone Number

☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) and application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors: Amarendra N. Gogoi et al. Examiner: Stefan J. Gadomski
Application No.: 18/480,918 Group Art Unit: 2485
Filed: October 4, 2023 Docket No.: 2050.354US3
Confirmation No.: 9039
Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

AMENDMENT & RESPONSE UNDER 37 C.F.R. § 1.111

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

In response to the Non-Final Office Action (*Office Action*) dated June 21, 2024, please consider the remarks herein.

IN THE CLAIMS

No claims have been amended. The undersigned has, however, included the complete set of claims under consideration for the convenience of the Examiner.

1.-15. (Canceled)

16. (Previously Presented) A method performed by a digital receiver, the method comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

17. (Previously Presented) The method of claim 16, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new piece of content; and

determining whether the audio decoder and the video decoder in the playback pipeline are of the types indicated by the codec information.

18. (Previously Presented) The method of claim 17, further comprising:

preserving an entirety of the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being the types indicated by the codec information.

19. (Previously Presented) The method of claim 17, further comprising:

releasing the audio decoder and the video decoder in the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

20. (Previously Presented) The method of claim 17, wherein the detecting the codec information for the new piece of content comprises examining prefetched metadata for the new piece of content.

21. (Previously Presented) The method of any one of claim 16, wherein the transitioning to the new piece of content comprises initiating playback of the new piece of content using a bitrate used for playback of the first piece of content to maintain the bitrate for playback of the new piece of content.

22. (Previously Presented) The method of claim 21, further comprising:

during playback of the new piece of content using the bitrate, detecting whether the new piece of content can maintain playback at the bitrate; and

in response to detecting that the new piece of content cannot continue playback at the bitrate, lowering the bitrate.

23. (Previously Presented) The method of claim 16, further comprising:

based on the first piece of content and the new piece of content not being the same content type, deconstructing the playback pipeline by releasing the source element, the demultiplexer, the audio decoder, and the video decoder; and

creating a new playback pipeline by acquiring other resources that are applicable to a content type of the new piece of content.

24. (Previously Presented) The method of claim 16, wherein the receiving the selection, transitioning to the new piece of content, determining whether the new piece of content is of a same

content type as the first piece of content, and determining whether to preserve is performed by a player of the digital receiver.

25. (Previously Presented) The method of claim 16, wherein the source element initiates the playback of the new piece of content using a same bitrate as the first piece of content and adjusts the bitrate in response to detecting that the new piece of content cannot continue playback at the bitrate.

26. (Previously Presented) A system comprising:

one or more hardware processors; and

a storage device storing instructions that configure the one or more hardware processors to perform operations comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

27. (Previously Presented) The system of claim 26, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new piece of content; and

determining whether the audio decoder and the video decoder in the playback pipeline are of the types indicated by the codec information.

28. (Previously Presented) The system of claim 27, wherein the operations further comprise:

preserving an entirety of the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being the types indicated by the codec information.

29. (Previously Presented) The system of claim 27, wherein the operations further comprise:

releasing the audio decoder and the video decoder in the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

30. (Previously Presented) The system of claim 27, wherein the detecting the codec information for the new piece of content comprises examining prefetched metadata for the new piece of content.

31. (Previously Presented) The system of any one of claim 26, wherein the transitioning to the new piece of content comprises initiating playback of the new piece of content using a bitrate used for playback of the first piece of content to maintain the bitrate for playback of the new piece of content.

32. (Previously Presented) The system of claim 31, wherein the operations further comprise:

during playback of the new piece of content using the bitrate, detecting whether the new piece of content can maintain playback at the bitrate; and

in response to detecting that the new piece of content cannot continue playback at the bitrate, lowering the bitrate.

33. (Previously Presented) The system of claim 26, wherein the operations further comprise:

based on the first piece of content and the new piece of content not being the same content type, deconstructing the playback pipeline by releasing the source element, the demultiplexer, the audio decoder, and the video decoder; and

creating a new playback pipeline by acquiring other resources that are applicable to a content type of the new piece of content.

34. (Previously Presented) The system of claim 26, wherein the source element initiates the playback of the new piece of content using a same bitrate as the first piece of content and adjusts the bitrate in response to detecting that the new piece of content cannot continue playback at the bitrate.

35. (Previously Presented) A machine-storage medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

REMARKS

This communication responds to the *Office Action* dated June 21, 2024. No claims are amended. No claims are presented canceled or added. Claims 1-15 were previously canceled. As a result, claims 16-35 remain pending in this application.

Request for Telephonic Interview

If the present remarks do not result in allowance of all claims and the Examiner believes a conference would help advance prosecution, the undersigned is available, before issuance of any further Office Action, for a telephonic interview to be held between the Examiner and the undersigned, at the Examiner's convenience. The Examiner is requested to phone the undersigned at (408) 278-4057 to arrange a time for such telephonic interview.

Double Patenting Rejection

Claims 16-35 were rejected on the ground of non-statutory double patenting as allegedly being unpatentable over claims 1-8 and 13-19 of U.S. Patent No. 11,825,139.

The undersigned does not admit that the claims are obvious in view of U.S. Patent No. 11,825,139. However, a Terminal Disclaimer in compliance with 37 C.F.R. § 1.321 is enclosed herewith to obviate these rejections.

The Rejection of Claims Under § 101

Claim 35 was rejected under 35 U.S.C. § 101 as allegedly being directed to non-statutory subject matter. The undersigned traverses this rejection. The as-filed Application provides:

> As used herein, the terms "machine-storage medium," "device-storage medium," "computer-storage medium" (referred to collectively as "machine-storage medium 522") mean the same thing and may be used interchangeably in this disclosure. The terms refer to a single or multiple storage devices and/or media (e.g., a centralized or distributed database, and/or associated caches and servers) that store executable instructions and/or data, as well as cloud-based storage systems or storage networks that include multiple storage apparatus or devices. The terms shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media, including memory internal or external to processors. Specific examples of machine-storage media, computer-storage media, and/or device- storage media 522 include non-volatile memory, including by way of example semiconductor memory devices, e.g.,

> erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), FPGA, and flash memory devices, magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM and DVD-ROM: disks. **The terms machine-storage media, computer-storage media, and device-storage media 522 specifically exclude carrier waves, modulated data signals, and other such media, at least some of which are covered under the term "signal medium" discussed below**.[1]
>
> The term "signal medium" or "transmission medium" shall be taken to include any form of modulated data signal, carrier wave, and so forth. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a matter as to encode information in the signal.[2]

As such, the "machine-storage medium" of claim 35 specifically excludes carrier waves and modulated data signals. Thus, the undersigned requests Examiner to withdraw this rejection of claim 35.

Allowable Subject Matter

The *Office Action* indicated that claims 16-35 would be allowable if rewritten or amended to overcome the double patenting rejection(s) and 35 U.S.C. § 101 rejections. Based on the terminal disclaimer filed herewith and the remarks above, the undersigned believes the claims are now in condition for allowance.

Reservation of Rights

In the interest of clarity and brevity, every assertion made in the Office Action may not have been equally addressed. Silence regarding any such assertion does not constitute any admission or acquiescence. All rights not exercised in connection with this response, such as the right to challenge or rebut any tacit or explicit characterization of any reference or of any of the present claims, the right to challenge or rebut any asserted factual or legal basis of any of the rejections, the right to swear behind any cited reference such as provided under 37 C.F.R. § 1.131 or otherwise, or the right to assert co-ownership of any cited reference, are reserved. It is not admitted that any of

[1] As-filed Application at [0047], emphasis added.
[2] *Id.* at [0048].

the cited references or any other references of record are relevant to the present claims, or that they constitute prior art. To the extent that any rejection or assertion is based upon the Examiner's personal knowledge, rather than any objective evidence of record as manifested by a cited prior art reference, timely objection to such reliance on Official Notice is made, and all rights to request that the Examiner provide a reference or affidavit in support of such assertion, as required by MPEP § 2144.03, are reserved. All rights to pursue any cancelled claims in a subsequent patent application claiming the benefit of priority of the present patent application, and to request rejoinder of any withdrawn claim, as required by MPEP § 821.04, are likewise reserved.

CONCLUSION

The undersigned respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone the undersigned at (408) 278-4057 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
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By / Susan Yee /

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Reg. No. 41,388

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18480918
Filing Date	2023-10-04
First Named Inventor	Amarendra N. Gogoi
Art Unit	2485
Examiner Name	Stefan Gadomski
Attorney Docket Number	2050.354US3

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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EXAMINER SIGNATURE

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97(e) to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☒ A certification statement is not submitted herewith.

FEE

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98 (d) (1) is attached.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/ Susan Yee /	Date (YYYY-MM-DD)	2024-09-04
Name/Print	Susan Yee	Registration Number	41,388

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(11) EP 3 679 738 B1

(12) **EUROPEAN PATENT SPECIFICATION**

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(54) **BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION**

BITRATEN- UND PIPELINEKONSERVIERUNG ZUR INHALTSDARSTELLUNG

MAINTIEN DE DÉBIT BINAIRE ET DE PIPELINE POUR LA PRÉSENTATION DE CONTENU

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EP 3 679 738 B1

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Description

FIELD

[0001] The present disclosure generally relates to machines configured to the technical field of special-purpose machines that optimizes a content change process (e.g., channel change) including computerized variants of such special-purpose machines and improvements to such variants, and to the technologies by which such special-purpose machines become improved compared to other special-purpose machines that facilitate optimizing content changes. In particular, the present disclosure addresses systems and methods for preserving a download bitrate and a content playback pipeline during a content change process.

[0002] WO2015/044870 discloses a method of managing adjacent channels in an adaptive streaming environment in which when a client device requests media content associated with a channel, the client device plays the media content, and when a user of the client device changes the channel to a new channel, new media content associated with the new channel is played.

SUMMARY

[0003] The present invention provides a method performed by a digital receiver and a system as defined in the appended claims.

BACKGROUND

[0004] Conventionally, during a switch in content (e.g., caused by a channel change or a selection of a different piece of content), a delay occurs as certain information is obtained before the new piece of content (e.g., program, movie, show) is rendered and displayed. Additionally, for adaptive bitrate streaming content, the content typically starts streaming or download at a low (or lowest) bitrate before slowly increasing in bitrate until an optimum bitrate is achieved. This results in initial video or images being grainy. Furthermore, the delay may be increased by a need to build a content playback pipeline each time a change in content occurs.

BRIEF DESCRIPTION OF DRAWINGS

[0005] Various ones of the appended drawings merely illustrate example embodiments of the present invention and cannot be considered as limiting its scope.

FIG. 1 is a diagram illustrating an example environment for optimizing content changes;

FIG. 2 is a block diagram illustrating an example embodiment of components within a digital receiver in accordance with an example embodiment.

FIG. 3 is a flow diagram of a method for optimizing a content change process in accordance with example embodiments.

FIG. 4 is a flow diagram of a method for preserving a content delivery pipeline in accordance with example embodiments.

FIG. 5 is a diagrammatic representation of a machine in an example form of a computing system within which a set of instructions may be executed for causing the machine to perform any one or more of the methodologies discussed herein, according to an example embodiment.

DETAILED DESCRIPTION

[0006] The description that follows includes systems, methods, techniques, instruction sequences, and computing machine program products that embody illustrative embodiments of the present inventive subject matter. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide an understanding of various embodiments of the inventive subject matter. It will be evident, however, to those skilled in the art, that embodiments of the inventive subject matter may be practiced without some or other of these specific details. In general, well-known instruction instances, protocols, structures, and techniques have not been shown in detail. Examples merely typify possible variations. Unless explicitly stated otherwise, structures (e.g., structural components, such as modules) are optional and may be combined or subdivided, and operations (e.g., in a procedure, algorithm, or other function) may vary in sequence or be combined or subdivided.

[0007] Example embodiments described herein provide systems and methods for optimizing content changes or switch in content being viewed, such as through a channel change or selection of a different piece of content from a watchlist. In some embodiments, the system uses navigational context (e.g., the way a user is interacting with an application) to identify content of (potential) interest to a viewer. The system then prefetches metadata for the content of interest from a content provider and stores the metadata to local cache. The metadata comprises preconditions for rendering and display of a piece of content that include a minimum set of data that a system can obtain without having to decrypt the content. The prefetched metadata may be used, in example embodiments, to determine whether to preserve at least a portion of a content playback pipeline (also referred to herein as a "content deliver pipeline" or simply a "pipeline").

[0008] Conventionally, a same piece of content is broken up into segments (e.g., 10 second segments) and each segment is available in various bitrates. A low bitrate may be grainy, while a high bitrate will normally have better image quality. Typically, when playback of a new piece of content starts, the system does not know the quality of the network bandwidth. As a result, in order to start playback as quickly as possible, conventional systems start with a lowest bitrate. Thus, every time a user switches from one content to the next content, the play-

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back will start with the lowest bitrate and slowly increase or improve according the capability of the network. In contrast, example embodiments, preserve a previous bitrate when switching to a new piece of content. That is, when a user selects a new piece of content to playback (e.g., switching from a previous piece of content to the new piece of content), example embodiments maintain or preserve a (heuristically determined) bitrate used for streaming or downloading the previous piece of content when initiating the playback of the new piece of content. This allows for starting playback as quickly as possible while also providing better image quality from the start.

[0009] Furthermore, in conventional systems, a switch or transition in content typically causes a previous content delivery pipeline to be deconstructed (e.g., resources previous acquired are released). Subsequently, a new pipeline is created for the new piece of content (e.g., new resources are acquired). In contrast, example embodiments may maintain or preserve a portion (or an entire) content delivery pipeline (e.g., comprising a source element, a demultiplexer ("demux"), a video decoder, and an audio decoder) used to obtain the previous piece of content instead of reconstructing a pipeline (e.g., destroying the content delivery pipeline and building a new content delivery pipeline). The preservation of the pipeline also allows for playback of the new content as quickly as possible.

[0010] As a result, one or more of the methodologies described herein facilitate solving the technical problem of optimizing content change (e.g., reducing time for a change in channel or loading of new content) regardless of the delivery channelwhether the content is broadcast (e.g., IPTV and multicast) or over-the-top (OTT). The methodologies include causing playback, by a digital receiver, of a first piece of content and receiving a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content. The methodologies further include determining whether to preserve at least a portion of a playback pipeline when switching to playback of the new piece of content. In some embodiments, preservation of at least a portion of the playback pipeline comprises determining whether to retrain an audio decoder and a video decoder of the pipeline when switching to playback of the new piece of content. Accordingly, one or more of the methodologies discussed herein improves upon latency during content changes while maintaining image quality. It is noted that content changes include a selection of a piece of content for viewing (e.g., from a content access page such as a favorites grid or via a programming guide) as well as channel changes (e.g., linear channels changes).

[0011] With reference to FIG. 1, an embodiment of an example environment 100 that enables optimizing content changes (e.g., reducing latency during channel changes or selection of a piece of content for viewing) is shown. In example embodiments, a digital receiver 102 of a user provides access to digital content and manages content change operations. In one embodiment, the digital receiver 102 is a set-top box. The digital receiver 102 is coupled to a viewing device 104 (e.g., a television or monitor) on which the user can view the digital content. In some embodiments, the digital receiver 102 (e.g., operations of the digital receiver 102) may be combined with the viewing device 104 (e.g., a smart television, a tablet, or smartphone). The components of the digital receiver 102 used to perform operations of example embodiments will be discussed in more detail in connection with FIG. 2 below.

[0012] In some embodiments, the digital receiver 102 accesses (e.g., pulls, receives, retrieves) content via a network 106 from a content distribution network (CDN) server 108. The CDN server 108 may obtain the content from one or more content providers 110 (e.g., servers of the content providers 110). In example embodiments, the CDN server 108 may be associated with a third party service (e.g., Netflix, Hulu, YouTube, Amazon,) that stores and provides content, such as, for example but not limited to, over-the-top (OTT) content, video-on-demand (VOD) content, Internet content, or broadcast content to the digital receiver 102 via the network 106. The content comprises text, images, audio, and/or video content (e.g., movies, television shows, videos), and in some embodiments comprise live (e.g., in real-time) content. In some embodiments, the content providers 110 provide content, over the network 106 directly to the digital receiver 102 for display on the viewing device 104.

[0013] One or more portions of the network 106 may be an ad hoc network, an intranet, an extranet, a virtual private network (VPN), a local area network (LAN), a wireless LAN (WLAN), a wide area network (WAN), a wireless WAN (WWAN), a metropolitan area network (MAN), a portion of the Internet, a portion of the Public Switched Telephone Network (PSTN), a cellular telephone network, a wireless network, a WiFi network, a WiMax network, a satellite network, a cable network, a broadcast network, another type of network, or a combination of two or more such networks. Any one or more portions of the network 106 may communicate information via a transmission or signal medium. As used herein, "transmission medium" refers to any intangible (e.g., transitory) medium that is capable of communicating (e.g., transmitting) instructions for execution by a machine (e.g., by one or more processors of such a machine), and includes digital or analog communication signals or other intangible media to facilitate communication of such software.

[0014] It is noted that the environment 100 shown in FIG. 1 is merely an example. For instance, any number of CDN servers 108 and content providers 110 may be embodied within the environment 100. Additionally, some components of the environment 100 may be combined. For example, the functions of the digital receiver 102 may be embodied within the viewing device 104 to

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form a single device, such as a smart television, tablet, smartphone, or any other device that is capable of obtaining, rendering, and displaying content. Moreover, the functions described herein for any single system or machine may be subdivided among multiple systems or machines.

[0015] Any of the systems or machines (e.g., databases, devices, servers) shown in, or associated with, FIG. 1 may be, include, or otherwise be implemented in a special-purpose (e.g., specialized or otherwise non-generic) computer that has been modified (e.g., configured or programmed by software, such as one or more software modules of an application, operating system, firmware, middleware, or other program) to perform one or more of the functions described herein for that system or machine. For example, a special-purpose computer system able to implement any one or more of the methodologies described herein is discussed below with respect to FIG. 5, and such a special-purpose computer may accordingly be a means for performing any one or more of the methodologies discussed herein. Within the technical field of such special-purpose computers, a special-purpose computer that has been modified by the structures discussed herein to perform the functions discussed herein is technically improved compared to other special-purpose computers that lack the structures discussed herein or are otherwise unable to perform the functions discussed herein. Accordingly, a special-purpose machine configured according to the systems and methods discussed herein provides an improvement to the technology of similar special-purpose machines.

[0016] FIG. 2 is a block diagram illustrating an example embodiment of components within the digital receiver 102 in accordance with an example embodiment. In example embodiments, the digital receiver 102 manages access to content streamed over the network 106. In particular, the digital receiver 102 prefetches metadata, preserves a bitrate used for playback (e.g., streaming or downloading) of a previous piece of content when initiating the playback of a new piece of content, and preserves at least a portion of a content delivery pipeline. To enable these operations, the digital receiver 102 comprises a player 202, a content delivery pipeline 204 (also referred to as "pipeline"), a cache manager 206, and a cache 208, all of which may be configured to communicate with each other (e.g., over a bus, shared memory, or a switch). The digital receiver 102 comprises other components (not shown) that are not pertinent to operations of example embodiments.

[0017] The player 202 is configured to manage the pipeline 204. In example embodiments, the player 204 instantiates (e.g., constructs) the pipeline 204 when a first piece of content is selected for display. A different pipeline may be constructed for each type of content. For example, the player 202 constructs a HTTP Live Streaming (HLS) pipeline for HLS content and constructs a Dynamic Adaptive Streaming over HTTP (DASH) pipeline for DASH content. The player 204 also decides whether to maintain at least a portion of the pipeline 204 or construct a new pipeline when a switch in content occurs (e.g., channel change or selection of new content for viewing). An example method for managing the preservation of the pipeline is discussed in further detail in connection with FIG. 4 below.

[0018] The pipeline 204 is constructed by the player 202 by acquiring appropriate resources for obtaining and processing content data in order to playback selected content. The resources of the pipeline 204 comprise a source element 212, a demultiplexer ("demux") 214, an audio decoder 216, and a video decoder 218. The source element 212 manages the downloading of content data for the selected piece of content. The source element 212 also manages bitrate adaptation at the digital receiver 102. Specifically, the source element 212 remembers a last bitrate that is used for playback of a current/previous piece of content, and continues to use that bitrate for playback of the new content. As such, if the last bitrate is high, the source element 212 will start with the same high bitrate for the new content. If the new content cannot be playback at that bitrate, then the source element 212 will lower the bitrate. For example, if the downloading of the content takes less time than anticipated, there is spare bandwidth and the bitrate can be increased. Conversely, if the download is taking longer than anticipated, then the bitrate is decreased. As such, example embodiments, will start the playback of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing).

[0019] The demux demultiplexes the content data obtained from the CDN server 108 or the content provider 110 to obtain an audio signal and a video signal. The audio signal is transmitted to the audio decoder 216 for processing, while the video signal is transmitted to the video decoder 218 for processing. The results from the audio and video decoders 216 and 218 are output (e.g., transmitted) to the viewing device 104 for presentation to the user.

[0020] The cache manager 206 manages the prefetching of metadata for content that may potentially be selected for playback. In some embodiments, the cache manager 206 predicts content the user may be interested in viewing. For example, a user may be navigating a linear list of channels or programs (e.g., an electronic programming guide; "EPG") in a particular direction (e.g., up or down). In this embodiment, the cache manager 206 predicts a next set of content based on the direction of navigation on the linear list. In another example, the user may be viewing a video-on-demand (VoD) catalog or a watchlist of a user. If the user requests information or hovers over a selection for a piece of content, the cache manager 206 uses this as prediction that the piece of content is of interest to the user. Alternatively, the cache manager may consider all (or some) pieces of content in viewable portion of the catalog or watchlist as content of interest. In any of these cases, the cache manager 206 prefetches the metadata for the content of interest, and

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stores the prefetched data to the cache 208. The metadata may comprise, for example, one or more uniform resource locators (URLs) where the chunks of content are available, URLs for different bit rates, license data (e.g., where to obtain a license from), and codec information. The codec information will be used by the player 202 to determine whether to preserve at least a portion of the pipeline 204, as will be discussed further below. If the user subsequently selects content for which the metadata is already prefetched, then the metadata can be accessed from the cache 208 instead of having to be retrieved over the network 106 from the CDN server 108 or the content provider 110 after selection. This will assist in the reduction of latency in playback.

[0021] Any one or more of the components (e.g., modules, decoders, resources) described herein may be implemented using hardware alone (e.g., one or more processors of a machine) or a combination of hardware and software. For example, any component described herein may physically include an arrangement of one or more of the processors or configure a processor (e.g., among one or more processors of a machine) to perform the operations described herein for that module. Accordingly, different components described herein may include and configure different arrangements of the processors at different points in time or a single arrangement of the processors at different points in time. Each component described herein is an example of a means for performing the operations described herein for that component. Moreover, any two or more of these components may be combined into a single component, and the functions described herein for a single component may be subdivided among multiple components. Furthermore, according to various example embodiments, components described herein as being implemented within a single machine, database, or device may be distributed across multiple machines, databases, or devices.

[0022] FIG. 3 is a flow diagram of an example method 300 for optimizing content change in accordance with example embodiments. In example embodiments, the method 300 is performed in part or in whole by components of the digital receiver 102. Accordingly, the method 300 is described by way of example with reference to the digital receiver 102. However, it shall be appreciated that at least some of the operations of the method 300 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 300 is not intended to be limited to the digital receiver 102.

[0023] In operation 302, a first piece of content is caused to be played by the viewing device 104. In example embodiments, the player 202 constructs the pipeline 204 for obtaining and processing the content data for the first piece of content. In particular, the player 202 acquires the source element 212, the demux 214, the audio decoder 216, and the video decoder 218 to form the pipeline 204. The data content is processed by the pipeline 204 and presented on the viewing device 104.

[0024] In operation 304, metadata for a set of one or more content of interest is prefetched. In example embodiments, the cache manager 206 predicts content of interest of a user and prefetches the metadata for the content of interest. The prefetched data is then stored to the cache 208. The metadata may comprise, but is not limited to, one or more URLs where the chunks of content are available, one or more URL for different bit rates, license data (e.g., where to obtain a license from), and codec information.

[0025] In operation 306, the player 202 receives an indication to switch to a new piece of content for playback. The indication may be received from a control device of the user (e.g., a remote controller). In some embodiments, the user may scroll through an EPG or be viewing a catalog or watchlist, and selects a new piece of content for viewing.

[0026] In operation 308, the digital receiver 102 maintains the bitrate when switching playback to the new piece of content. In example embodiments, when transitioning playback from an ongoing playback operation to a new playback operation, the source element 212 uses a heuristic bitrate derived for playback of the first piece of content for playback of the new piece of content. Thus, the source element 212 attempts to maintain or preserve the bitrate for playback as opposed to starting a new playback from the lowest possible bitrate. If the new piece of content cannot be delivered at that bitrate, then the source element 212 will lower the bitrate. As such, example embodiments, will start the download of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing). This allows playback of the new content at a most optimal bitrate instantly instead of having to heuristically re-compute the optimal bitrate starting from the lowest possible bitrate. Conventionally, the derivation of the optimal bitrate usually requires downloading several segments or chunks of content data resulting in a gradual improvement of picture quality. However, example embodiments that use the previous derived heuristic bitrate maintain the same level of image quality as that of the previous playback from a very beginning of playback for the new content.

[0027] In operation 310, a pipeline preservation process is performed to determine whether to maintain at least a portion of the pipeline used to playback the first piece of content for use with the playback of the new piece of content. Furthermore, if the pipeline is to be maintained or preserve, a determination is made as to whether all the resources of the pipeline should be preserved or only a portion of the pipeline preserved (e.g., only some of the resources are kept and others are released). The pipeline preservation process will be discussed in more detail in connection with FIG. 4.

[0028] FIG. 4 is a flow diagram of an example method 400 for preserving a content delivery pipeline in accordance with example embodiments. In example embodiments, the method 400 is performed in part or in whole

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by the player 202 with respect the resources of the pipeline 204. Accordingly, the method 400 is described by way of example with reference to the player 202 and the pipeline 204. However, it shall be appreciated that at least some of the operations of the method 400 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 400 is not intended to be limited to the player 202 and the pipeline 204.

[0029] In operation 402, in response to receiving the indication to switch playback to new content, the cache manager 206 accesses the prefetched metadata stored in the cache 208 for the new content. The prefetched metadata for the new content may comprise one or more URLs where the new content is available, one or more URLs for different bit rates associated with the new content, license data for the new content, and codec information for the new content. The prefetched metadata may also indicate whether the new content is of a same type as the first piece of content. For example, the first piece of content and the new content may both be in a HTTP Live Streaming (HLS) format or both be in a Dynamic Adaptive Streaming over HTTP (DASH) format.

[0030] In operation 404, the player 202 determines whether the first piece of content and the new content are of the same content type. If the first piece of content and the new content are not of the same type (e.g., first piece of content is in HLS format and the new content is in DASH format), then the resources of the pipeline 204 (e.g., the source element 212, the demux 214, the audio decoder 216, and the video decoder 218) are released in operation 406. Releasing all the resources of the pipeline 204 essentially deconstructs the pipeline 204. The player 202 them creates a new pipeline by acquiring other resources that are applicable to the content type of the new content.

[0031] If in operation 404 the player 202 determines that the first piece of content and the new content are of the same content type (e.g., both are HLS format), then in operation 408, codec information is detected for the new content. In example embodiments, the player 202 examines the prefetched metadata for the new content for the codec information. The codec information indicates types of decoders needed for the new content.

[0032] In operation 410, a determination is made by the player 202 as to whether the types of decoders needed for the new content is the same as the decoders currently in the pipeline 204 for the first piece of content. If the types of decoders needed is the same, then in operation 412 the entire pipeline 204 is preserved. In other words, the resources of the pipeline 204 are maintained and continued to be used to playback the new content.

[0033] However, if in operation 410 the player 202 determines that the new content needs different decoders, then in operation 414, the decoders (e.g., the audio decoder 216 and the video decoder 208) are released. Subsequently in operation 416, a remaining portion of the pipeline 204 (e.g., the source element 212 and the demux 214) are preserved or maintained. In these embodiments, the player 202 acquires a new set of decoders (e.g., a new audio decoder and a new video decoder) applicable to the new content, and adds the new set of decoders to the preserved portion of the pipeline 204.

[0034] While example embodiments are discussed with respect to pipeline and bitrate preservation applicable to both DASH and HLS, example embodiments for preservation of bitrate and the pipeline is applicable for any type of content that is adaptive in nature (e.g., where the content bitrate can change based on bandwidth).

[0035] FIG. 5 is a block diagram illustrating components of a machine 500, according to some example embodiments, able to read instructions 524 from a machine-storage medium 522 (e.g., a non-transitory machine-storage medium, a machine-readable storage medium, a computer-readable storage medium, or any suitable combination thereof) and perform any one or more of the methodologies discussed herein, in whole or in part. Specifically, FIG. 5 shows the machine 500 in the example form of a computer device (e.g., a computer) within which the instructions 524 (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine 500 to perform any one or more of the methodologies discussed herein may be executed, in whole or in part.

[0036] For example, the instructions 524 may cause the machine 500 to execute the flow diagrams of FIGs. 3 and 4. The instructions 524 can transform the general, nonprogrammed machine 500 into a particular machine (e.g., specially configured machine) programmed to carry out the described and illustrated functions in the manner described.

[0037] In alternative embodiments, the machine 500 operates as a standalone device or may be connected (e.g., networked) to other machines. The machine 500 may be a server computer, a client computer, a personal computer (PC), a tablet computer, a laptop computer, a netbook, a set-top box (e.g. STB), a personal digital assistant (PDA), a cellular telephone, a smartphone, a web appliance, a network router, a network switch, a network bridge, a power adapter, or any machine 500 capable of executing the instructions 524, sequentially or otherwise, that specify actions to be taken by that machine 500. Further, while only a single machine 500 is illustrated, the term "machine" shall also be taken to include a collection of machines that individually or jointly execute the instructions 524 to perform any one or more of the methodologies discussed herein.

[0038] The machine 500 includes a processor 502 (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), an application specific integrated circuit (ASIC), a radio-frequency integrated circuit (RFIC), or any suitable combination thereof), a main memory 504, and a static memory 506, which are configured to communicate with each other via a bus 508. The processor 502 may contain mi-

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crocircuits that are configurable, temporarily or permanently, by some or all of the instructions 524 such that the processor 502 is configurable to perform any one or more of the methodologies described herein, in whole or in part. For example, a set of one or more microcircuits of the processor 502 may be configurable to execute one or more modules (e.g., software modules) described herein.

[0039] The machine 500 may further include a graphics display 510 (e.g., a plasma display panel (PDP), a light emitting diode (LED) display, a liquid crystal display (LCD), a projector, a cathode ray tube (CRT), or any other display capable of displaying graphics or video). The machine 500 may also include an alphanumeric input device 512 (e.g., a keyboard or keypad), a cursor control device 514 (e.g., a mouse, a touchpad, a trackball, a joystick, a motion sensor, an eye tracking device, or other pointing instrument), a storage unit 516, a signal generation device 518 (e.g., a sound card, an amplifier, a speaker, a headphone jack, or any suitable combination thereof), and a network interface device 520.

[0040] The storage unit 516 includes the machine-storage medium 522 (e.g., a tangible machine-readable storage medium) on which are stored the instructions 524 embodying any one or more of the methodologies or functions described herein. The instructions 524 may also reside, completely or at least partially, within the main memory 504, within the processor 502 (e.g., within the processor's cache memory), or both, before or during execution thereof by the machine 500. Accordingly, the main memory 504 and the processor 502 may be considered machine-storage media 522 (e.g., tangible and non-transitory machine-storage media).

[0041] In some example embodiments, the machine 500 may be a portable computing device and have one or more additional input components (e.g., sensors or gauges). Examples of such input components include an image input component (e.g., one or more cameras), an audio input component (e.g., a microphone), a direction input component (e.g., a compass), a location input component (e.g., a global positioning system (GPS) receiver), an orientation component (e.g., a gyroscope), a motion detection component (e.g., one or more accelerometers), an altitude detection component (e.g., an altimeter), and a gas detection component (e.g., a gas sensor). Inputs harvested by any one or more of these input components may be accessible and available for use by any of the modules described herein.

EXECUTABLE INSTRUCTIONS AND MACHINE-STORAGE MEDIUM

[0042] The various memories (i.e., 504, 506, and/or memory of the processor(s) 502) and/or storage unit 516 may store one or more sets of instructions and data structures (e.g., software) 524 embodying or utilized by any one or more of the methodologies or functions described herein. These instructions, when executed by processor(s) 502 cause various operations to implement the disclosed embodiments.

[0043] As used herein, the terms "machine-storage medium," "device-storage medium," "computer-storage medium" (referred to collectively as "machine-storage medium 522") mean the same thing and may be used interchangeably in this disclosure. The terms refer to a single or multiple storage devices and/or media (e.g., a centralized or distributed database, and/or associated caches and servers) that store executable instructions and/or data, as well as cloud-based storage systems or storage networks that include multiple storage apparatus or devices. The terms shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media, including memory internal or external to processors. Specific examples of machine-storage media, computer-storage media, and/or device-storage media 522 include non-volatile memory, including by way of example semiconductor memory devices, e.g., erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), FPGA, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks; and CD-ROM and DVD-ROM disks. The terms machine-storage media, computer-storage media, and device-storage media 522 specifically exclude carrier waves, modulated data signals, and other such media, at least some of which are covered under the term "signal medium" discussed below.

SIGNAL MEDIUM

[0044] The term "signal medium" or "transmission medium" shall be taken to include any form of modulated data signal, carrier wave, and so forth. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a matter as to encode information in the signal.

COMPUTER READABLE MEDIUM

[0045] The terms "machine-readable medium," "computer-readable medium" and "device-readable medium" mean the same thing and may be used interchangeably in this disclosure. The terms are defined to include both machine-storage media and signal media. Thus, the terms include both storage devices/media and carrier waves/modulated data signals.

[0046] The instructions 524 may further be transmitted or received over a communications network 526 using a transmission medium via the network interface device 520 and utilizing any one of a number of well-known transfer protocols (e.g., HTTP). Examples of communication networks 526 include a local area network (LAN), a wide area network (WAN), the Internet, mobile telephone networks, plain old telephone service (POTS) networks, and wireless data networks (e.g., WiFi, LTE, and WiMAX networks). The term "transmission medium" shall

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be taken to include any intangible medium that is capable of storing, encoding, or carrying instructions 524 for execution by the machine 500, and includes digital or analog communications signals or other intangible medium to facilitate communication of such software.

[0047] Throughout this specification, plural instances may implement components, operations, or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

[0048] Certain embodiments are described herein as including logic or a number of components, modules, or mechanisms. Modules may constitute either software modules (e.g., code embodied on a machine-storage medium 522 or in a transmission signal) or hardware modules. A "hardware module" is a tangible unit capable of performing certain operations and may be configured or arranged in a certain physical manner. In various example embodiments, one or more computer systems (e.g., a standalone computer system, a client computer system, or a server computer system) or one or more hardware modules of a computer system (e.g., a processor 502 or a group of processors 502) may be configured by software (e.g., an application or application portion) as a hardware module that operates to perform certain operations as described herein.

[0049] In some embodiments, a hardware module may be implemented mechanically, electronically, or any suitable combination thereof. For example, a hardware module may include dedicated circuitry or logic that is permanently configured to perform certain operations. For example, a hardware module may be a special-purpose processor, such as a field-programmable gate array (FPGA) or an ASIC. A hardware module may also include programmable logic or circuitry that is temporarily configured by software to perform certain operations. For example, a hardware module may include software encompassed within a general-purpose processor or other programmable processor. It will be appreciated that the decision to implement a hardware module mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

[0050] Accordingly, the phrase "hardware module" should be understood to encompass a tangible entity, be that an entity that is physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate in a certain manner or to perform certain operations described herein. As used herein, "hardware-implemented module" refers to a hardware module. Considering embodiments in which hardware modules are temporarily configured (e.g., programmed), each of the hardware modules need not be configured or instantiated at any one instance in time. For example, where a hardware module comprises a general-purpose processor configured by software to become a special-purpose processor, the general-purpose processor may be configured as respectively different special-purpose processors (e.g., comprising different hardware modules) at different times. Software may accordingly configure a processor, for example, to constitute a particular hardware module at one instance of time and to constitute a different hardware module at a different instance of time.

[0051] The various operations of example methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented modules that operate to perform one or more operations or functions described herein. As used herein, "processor-implemented module" refers to a hardware module implemented using one or more processors.

[0052] Similarly, the methods described herein may be at least partially processor-implemented, a processor being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors or processor-implemented modules.

[0053] Some portions of the subject matter discussed herein may be presented in terms of algorithms or symbolic representations of operations on data stored as bits or binary digital signals within a machine memory (e.g., a computer memory). Such algorithms or symbolic representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. As used herein, an "algorithm" is a self-consistent sequence of operations or similar processing leading to a desired result. In this context, algorithms and operations involve physical manipulation of physical quantities. Typically, but not necessarily, such quantities may take the form of electrical, magnetic, or optical signals capable of being stored, accessed, transferred, combined, compared, or otherwise manipulated by a machine. It is convenient at times, principally for reasons of common usage, to refer to such signals using words such as "data," "content," "bits," "values," "elements," "symbols," "characters," "terms," "numbers," "numerals," or the like. These words, however, are merely convenient labels and are to be associated with appropriate physical quantities.

[0054] Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "presenting," "displaying," or the like may refer to actions or processes of a

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machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, or optical) quantities within one or more memories (e.g., volatile memory, non-volatile memory, or any suitable combination thereof), registers, or other machine components that receive, store, transmit, or display information. Furthermore, unless specifically stated otherwise, the terms "a" or "an" are herein used, as is common in patent documents, to include one or more than one instance. Finally, as used herein, the conjunction "or" refers to a non-exclusive "or," unless specifically stated otherwise.

[0055] Although an overview of the inventive subject matter has been described with reference to specific example embodiments, various modifications and changes may be made to these embodiments without departing from the broader scope of embodiments of the present invention. For example, various embodiments or features thereof may be mixed and matched or made optional by a person of ordinary skill in the art. Such embodiments of the inventive subject matter may be referred to herein, individually or collectively, by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept if more than one is, in fact, disclosed.

[0056] The embodiments illustrated herein are believed to be described in sufficient detail to enable those skilled in the art to practice the teachings disclosed. Other embodiments may be used and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. The Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments is defined only by the appended claims.

[0057] Moreover, plural instances may be provided for resources, operations, or structures described herein as a single instance. Additionally, boundaries between various resources, operations, modules, engines, and data stores are somewhat arbitrary, and particular operations are illustrated in a context of specific illustrative configurations. Other allocations of functionality are envisioned and may fall within a scope of various embodiments of the present invention. In general, structures and functionality presented as separate resources in the example configurations may be implemented as a combined structure or resource. Similarly, structures and functionality presented as a single resource may be implemented as separate resources. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

Claims

1. A method performed by a digital receiver (102), the method comprising:

causing playback (302) of a first piece of content at a first bitrate;

receiving (306) a selection of a new piece of content for playback during the playback of the first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content by initiating playback of the new piece of content using the first bitrate used for playback of the first piece of content to maintain (308) the first bitrate for playback of the new piece of content; and

if the new piece of content cannot be played back to maintain playback at the first bitrate, lowering the first bitrate.

2. The method of claim 1, wherein, if downloading of the new piece of content for playback takes less time than anticipated, the first bitrate is increased and if downloading of the new piece of content for playback takes longer than anticipated, the first bitrate is lowered.

3. The method of claim 1 or claim 2, further comprising, when the first bitrate is maintained:

determining (404) whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining (408, 410, 412, 414, 416) whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder.

4. The method of claim 3, wherein the determining whether to preserve comprises:

detecting (408) codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether the audio decoder and the video decoder in the pipeline are of the types indicated by the codec information.

5. The method of claim 4, further comprising preserving (412) the entire pipeline in response to the audio decoder and the video decoder in the playback pipeline being the types indicated by the codec information.

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6. The method of claim 4 or claim 5, further comprising:

releasing (414) the audio decoder and the video decoder in the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being different than the types indicated by the codec information; and
obtaining a new audio decoder and a new video decoder based on the codec information.

7. A system comprising:

one or more hardware processors (502); and
a storage device (504) storing instructions that configure the one or more hardware processors (502) to carry out the method of any preceding claim.

8. A machine-readable medium carrying instructions, that when executed by one or more hardware processors of a machine, cause the machine to carry out the method of any one of claims 1 to 6.

Patentansprüche

1. Verfahren, welches durch einen Digitalempfänger (102) ausgeführt wird, wobei das Verfahren umfasst:

Veranlassen von Wiedergabe (302) eines ersten Teils von Inhalt mit einer ersten Bitrate;
Empfangen (306) einer Auswahl eines neuen Teils von Inhalt zur Wiedergabe während der Wiedergabe des ersten Teils von Inhalt;
als Reaktion auf das Empfangen der Auswahl, Übergehen auf den neuen Teil von Inhalt durch Auslösen von Wiedergabe des neuen Teils von Inhalt unter Verwendung der ersten Bitrate, welche zur Wiedergabe des ersten Teils von Inhalt verwendet wurde, um die erste Bitrate zur Wiedergabe des neuen Teils von Inhalt beizubehalten (308); und
falls der neue Teil von Inhalt nicht wiedergegeben werden kann, um Wiedergabe mit der ersten Bitrate beizubehalten, Absenken der ersten Bitrate.

2. Verfahren nach Anspruch 1, wobei, falls Herunterladen des neuen Teils von Inhalt zur Wiedergabe weniger Zeit beansprucht als angenommen, die erste Bitrate erhöht wird, und falls Herunterladen des neuen Teils von Inhalt zur Wiedergabe länger dauert als angenommen, die erste Bitrate abgesenkt wird.

3. Verfahren nach Anspruch 1 oder Anspruch 2, weiter umfassend, wenn die erste Bitrate beibehalten wird:

Bestimmen (404), ob der neue Teil von Inhalt von einem gleichen Inhaltstyp ist wie der ersten Teil von Inhalt; und
auf der Grundlage, dass der neue Teil von Inhalt derselbe Inhaltstyp ist wie der erste Teil von Inhalt, Bestimmen (408, 410, 412, 414, 416), ob zumindest ein Abschnitt einer Wiedergabepipeline, welche zur Wiedergabe des ersten Teils von Inhalt verwendet wurde, bewahrt werden soll, wobei die Wiedergabepipeline ein Quellelement zur Verwaltung des Herunterladens von Inhaltsdaten für den neuen Teil von Inhalt, einen Demultiplexer, einen Audiodecoder und einen Videodecoder umfasst, wobei das Bewahren zumindest des Abschnitts der Wiedergabepipeline Bewahren eines oder mehrerer des Quellelements, des Demultiplexers, des Audiodecoders oder des Videodecoders umfasst.

4. Verfahren nach Anspruch 3, wobei das Bestimmen, ob bewahrt werden soll, umfasst:

Erfassen (408) von Codec-Informationen für den neuen Teil von Inhalt, wobei die Codec-Informationen Typen von Decodern angeben, welche für den neuen Inhalt benötigt werden; und
Bestimmen, ob der Audiodecoder und der Videodecoder in der Pipeline Typen sind, welche durch die Codec-Informationen angegeben sind.

5. Verfahren nach Anspruch 4, weiter Bewahren (412) der gesamten Pipeline als Reaktion darauf umfassend, dass der Audiodecoder und der Videodecoder in der Wiedergabepipeline Typen sind, welche durch die Codec-Informationen angegeben sind.

6. Verfahren nach Anspruch 4 oder Anspruch 5, weiter umfassend:

Freigeben (414) des Audiodecoders und des Videodecoders in der Wiedergabepipeline als Reaktion darauf umfassend, dass der Audiodecoder und der Videodecoder in der Wiedergabepipeline sich von den Typen unterscheiden, welche durch die Codec-Informationen angegeben sind; und
Erhalten eines neuen Audiodecoders und eines neuen Videodecoders auf Basis der Codec-Informationen.

7. System, umfassend:

einen oder mehrere Hardwareprozessoren (502); und
eine Speichervorrichtung (504), welche Anweisungen speichert, welche den einen oder die mehreren Hardwareprozessoren (502) konfigu-

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rieren, um das Verfahren nach einem vorstehenden Anspruch auszuführen.

8. Rechnerlesbares Medium, welches Anweisungen enthält, welche, wenn durch einen oder mehrere Hardwareprozessoren eines Rechners ausgeführt, den Rechner veranlassen, das Verfahren nach einem der Ansprüche 1 bis 6 auszuführen.

Revendications

1. Procédé réalisé par un récepteur numérique (102), le procédé comprenant :

   l'entraînement d'une lecture (302) d'un premier élément de contenu à un premier débit binaire ;
   la réception (306) d'une sélection d'un nouvel élément de contenu pour la lecture pendant la lecture du premier élément de contenu ;
   en réponse à la réception de la sélection, la transition au nouvel élément de contenu en lançant la lecture du nouvel élément de contenu en utilisant le premier débit binaire utilisé pour la lecture du premier élément de contenu pour maintenir (308) le premier débit binaire pour la lecture du nouvel élément de contenu ; et
   si le nouvel élément de contenu ne peut pas être lu pour maintenir la lecture au premier débit binaire, la diminution du premier débit binaire.

2. Procédé selon la revendication 1, dans lequel, si le téléchargement du nouvel élément de contenu pour la lecture prend moins de temps que prévu, le premier débit binaire est augmenté et si le téléchargement du nouvel élément de contenu pour la lecture prend plus de temps que prévu, le premier débit binaire est diminué.

3. Procédé selon la revendication 1 ou la revendication 2, comprenant en outre, quand le premier débit binaire est maintenu :

   la détermination (404) du fait que le nouvel élément de contenu est ou non d'un même type de contenu que le premier élément de contenu ; et sur la base du nouvel élément de contenu qui est du même type de contenu que le premier élément de contenu, la détermination (408, 410, 412, 414, 416) du fait que préserver ou non au moins une partie d'un pipeline de lecture utilisé pour lire le premier élément de contenu, le pipeline de lecture comprenant un élément de source pour gérer le téléchargement de données de contenu pour le nouvel élément de contenu, un démultiplexeur, un décodeur audio et un décodeur vidéo, la conservation d'au moins la partie du pipeline de lecture comprenant la conservation d'un ou plusieurs parmi l'élément de source, le démultiplexeur, le décodeur audio ou le décodeur vidéo.

4. Procédé selon la revendication 3, dans lequel la détermination du fait de conserver ou non comprend :

   la détection (408) d'informations de codec pour le nouvel élément de contenu, les informations de codex indiquant des types de décodeurs nécessaires pour le nouvel élément de contenu ; et la détermination du fait que le décodeur audio et le décodeur vidéo dans le pipeline sont ou non des types indiqués par les informations de codec.

5. Procédé selon la revendication 4, comprenant en outre la conservation (412) du pipeline complet en réponse au décodeur audio et au décodeur vidéo dans le pipeline de lecture qui sont les types indiqués par les informations de codec.

6. Procédé selon la revendication 4 ou la revendication 5, comprenant en outre :

   la libération (414) du décodeur audio et du décodeur vidéo dans le pipeline de lecture en réponse au décodeur audio et au décodeur vidéo dans le pipeline de lecture qui sont différents des types indiqués par les informations de codec ; et
   l'obtention d'un nouveau décodeur audio et d'un nouveau décodeur vidéo sur la base des informations de codec.

7. Système comprenant :

   un ou plusieurs processeurs matériels (502) ; et un dispositif de stockage (504) stockant des instructions qui configurent les un ou plusieurs processeurs matériels (502) pour réaliser le procédé selon une quelconque revendication précédente.

8. Support lisible par machine portant des instructions qui, quand elles sont exécutées par un ou plusieurs processeurs matériels d'une machine, amènent la machine à réaliser le procédé selon l'une quelconque des revendications 1 à 6.

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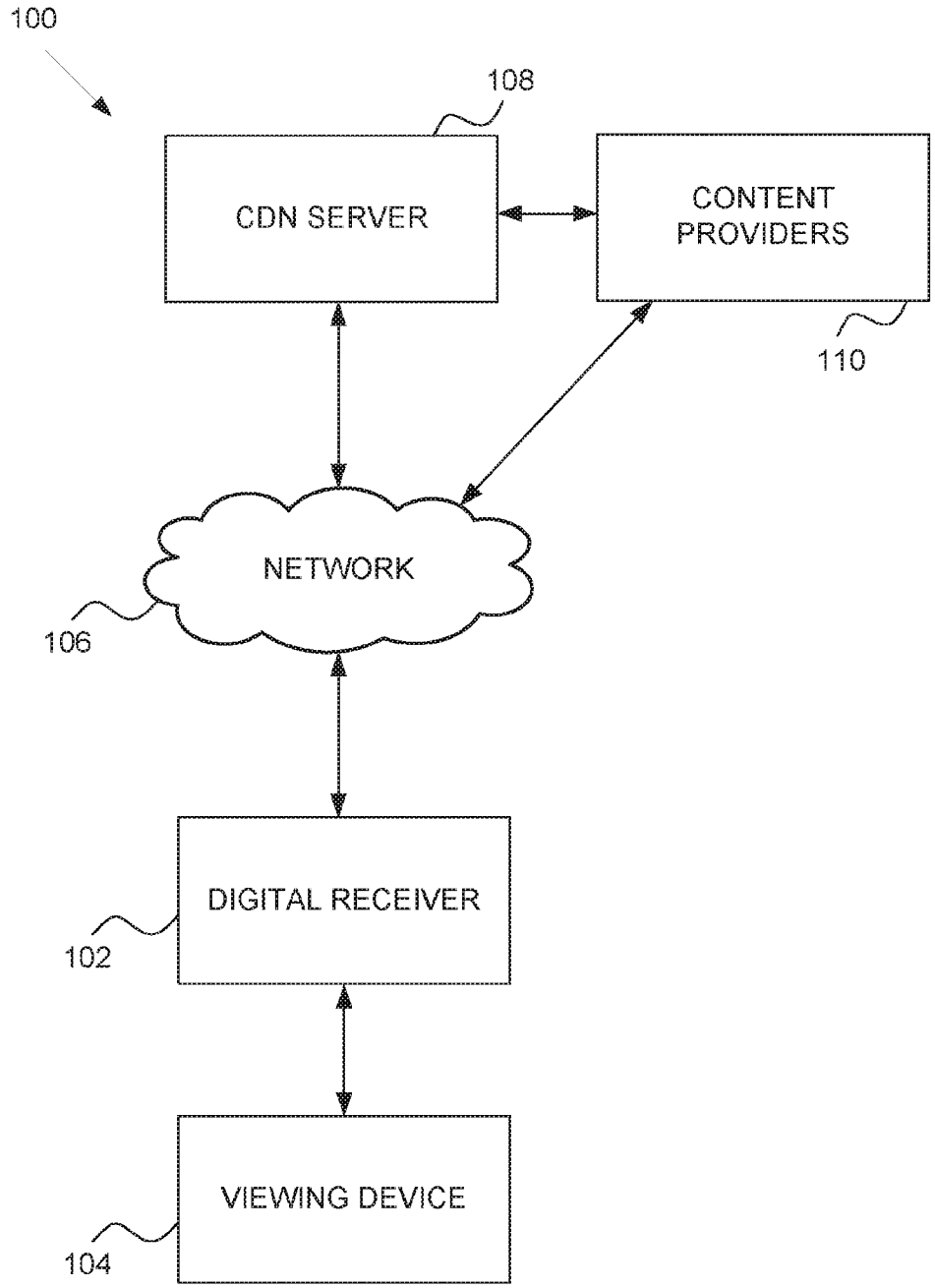


FIG. 1

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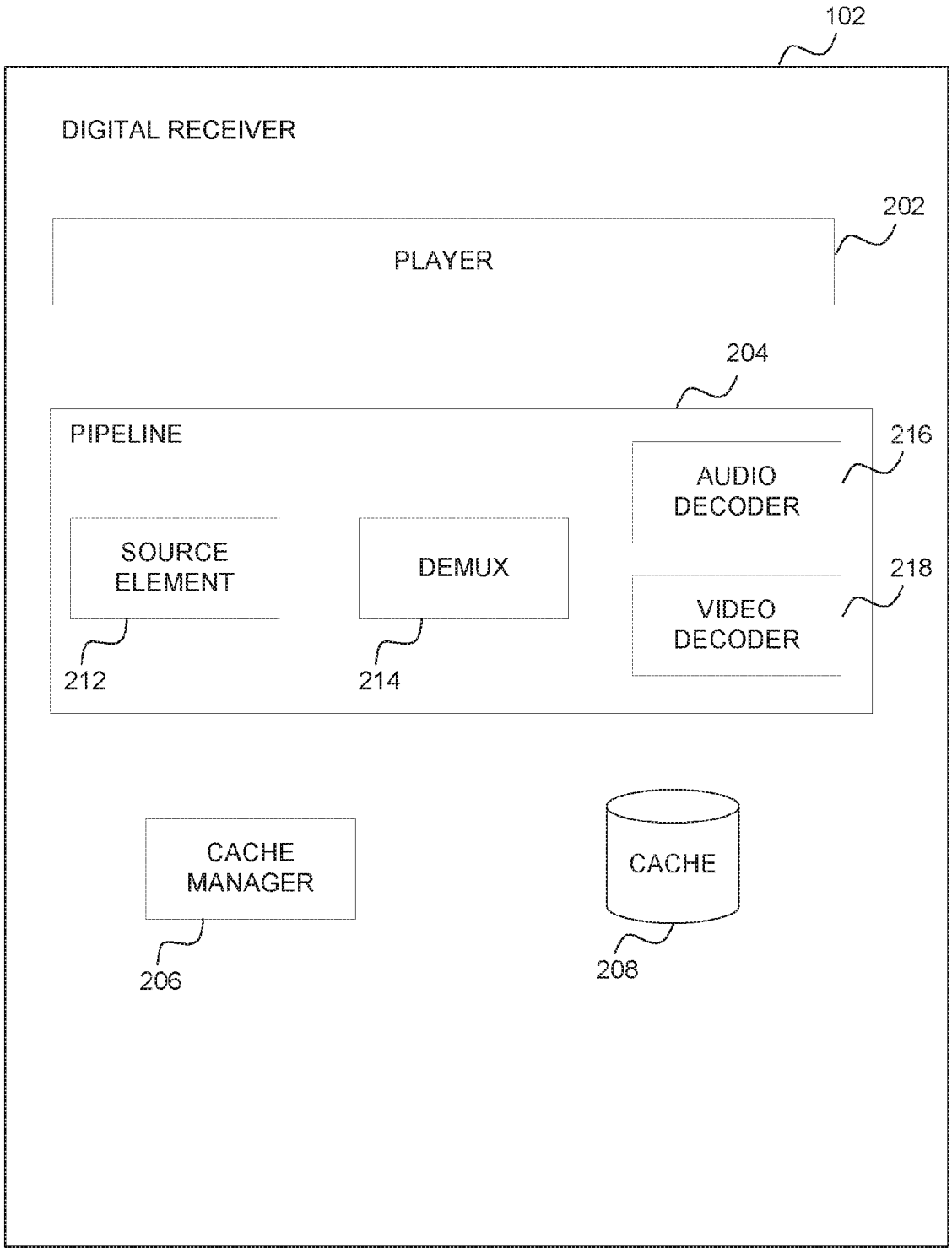


FIG. 2

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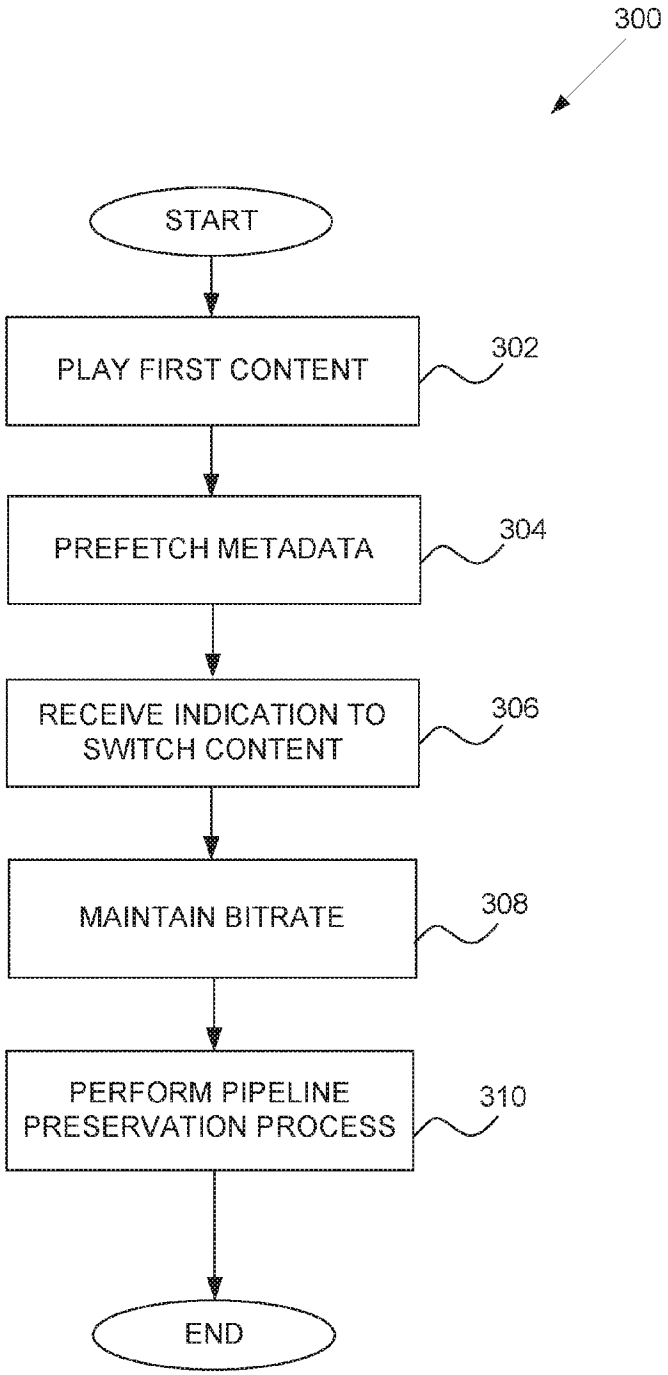


FIG. 3

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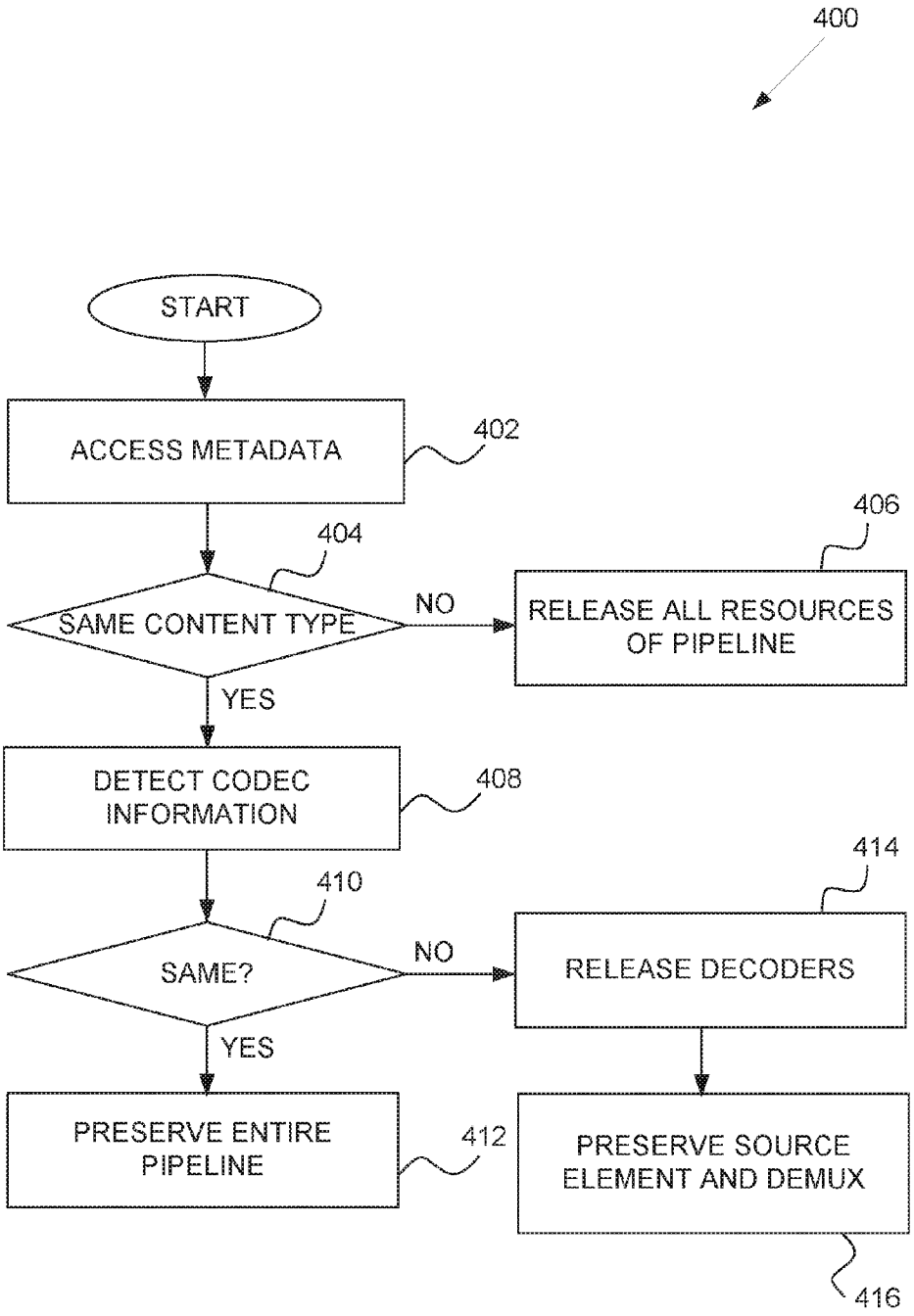


FIG. 4

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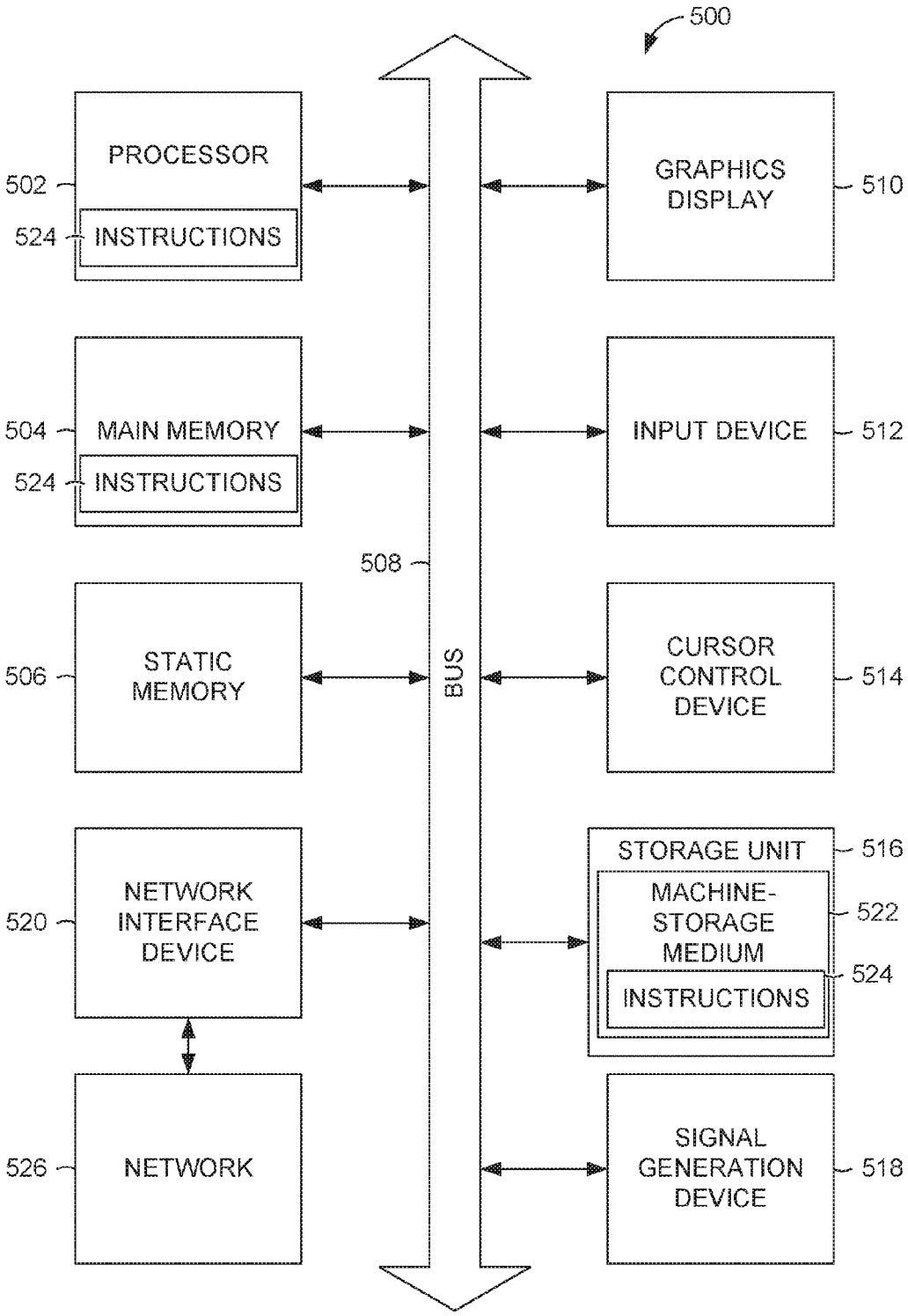


FIG. 5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2015044870 A **[0002]**

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BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

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Applicant(s): 开放电视公司

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- cooperative: **H04W28/02 (EP)**

Application number: CN20188065328 20180814 Global Dossier

Priority number(s): IN201741031917 20170908 ; WO2018US46723 20180814

Also published as: TW201931861 (A) WO2019050660 (A1)

Abstract not available for CN111194565 (A)
Abstract of corresponding document: WO2019050660 (A1)

Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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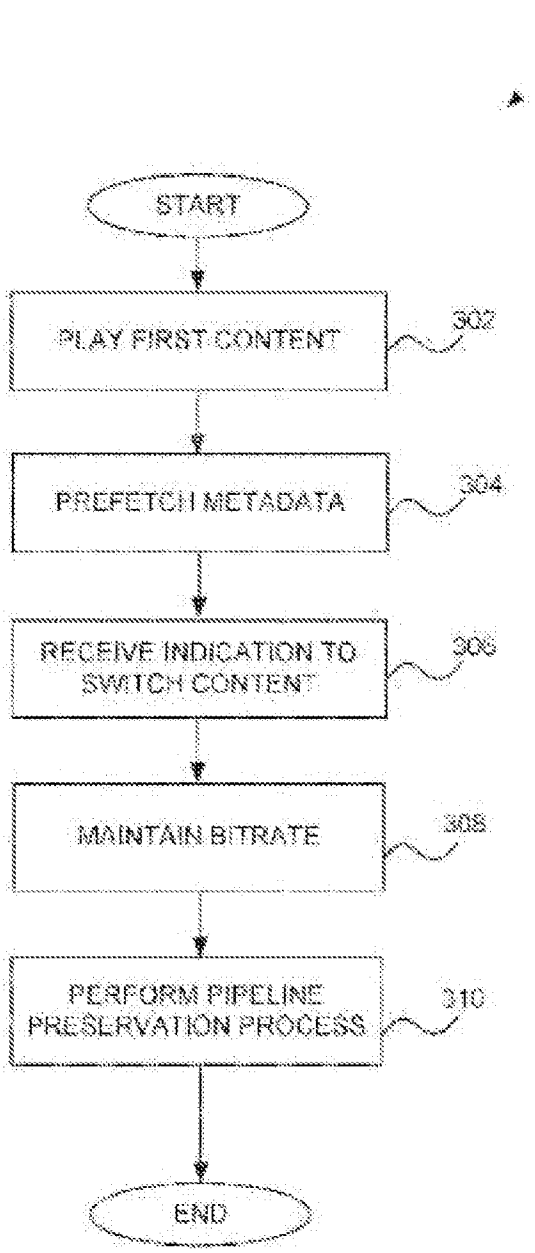


FIG. 3

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H04W 28/02(2006.01)

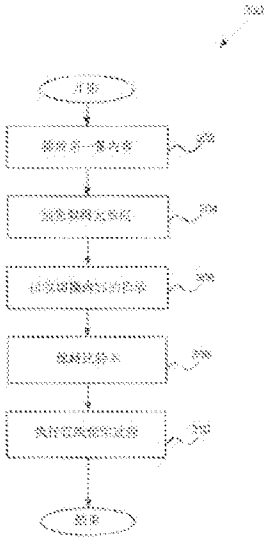
权利要求书2页 说明书11页 附图5页

(54)发明名称

用于内容呈现的比特率和管线保留

(57)摘要

提供了用于优化内容更改过程的系统和方法。在示例性实施方案中，数字接收器使得播放第一段内容。在第一段内容播放期间，数字接收器接收对用于播放的新的一段内容的选择。响应于接收到选择，数字接收器保持用于播放第一段内容的比特率，以开始新的一段内容的播放。



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1.一种方法,其包括:

通过数字接收器,使得播放第一段内容;

在第一段内容播放期间,通过数字接收器接收对用于播放的新的一段内容的选择;以及

响应于接收到选择,通过数字接收器的处理器保持用于播放第一段内容的比特率,以开始新的一段内容的播放。

2.根据权利要求1所述的方法,其进一步包括:

确定新的一段内容是否与第一段内容类型相同;以及

基于新的一段内容与第一段内容的类型相同,确定是否保留播放管线的至少一部分。

3.根据权利要求2所述的方法,其中,确定是否保留包括:

检测新的一段内容的编解码器信息,所述编解码器信息指示新内容所需的解码器的类型;以及

确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

4.根据权利要求3所述的方法,其进一步包括:响应于管线中的音频解码器和视频解码器为由编解码器信息指示的类型,保留整个管线。

5.根据权利要求3所述的方法,其进一步包括:

响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型,释放管线中的音频解码器和视频解码器;以及

基于编解码器信息获得新的音频解码器和新的视频解码器。

6.一种系统,其包括:

一个或更多个硬件处理器;以及

存储设备,其存储配置一个或更多个硬件处理器以执行以下操作的指令,所述操作包括:

通过数字接收器,使得播放第一段内容;

在第一段内容播放期间,通过数字接收器接收对用于播放的新的一段内容的选择;以及

响应于接收到选择,保持用于播放第一段内容的比特率,以开始新的一段内容的播放。

7.根据权利要求6所述的系统,其中,所述操作进一步包括:

确定新的一段内容是否与第一段内容类型相同;以及

基于新的一段内容与第一段内容的类型相同,确定是否保留播放管线的至少一部分。

8.根据权利要求7所述的系统,其中,确定是否保留包括:

检测新的一段内容的编解码器信息,所述编解码器信息指示新内容所需的解码器的类型;以及

确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

9.根据权利要求8所述的系统,其中,所述操作进一步包括:响应于管线中的音频解码器和视频解码器为由编解码器信息指示的类型,保留整个管线。

10.根据权利要求8所述的系统,其中,所述操作进一步包括:

响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型,释放管线中的音频解码器和视频解码器;以及

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基于编解码器信息获得新的音频解码器和新的视频解码器。

11.一种机器可读介质，其存储指令，所述指令在由机器的一个或更多个硬件处理器执行时使机器执行如下操作，所述操作包括：

通过数字接收器，使得播放第一段内容；

在第一段内容播放期间，通过数字接收器接收对用于播放的新的一段内容的选择；以及

响应于接收到选择，保持用于播放第一段内容的比特率，以开始新的一段内容的播放。

12.根据权利要求11所述的机器可读介质，其中，所述操作进一步包括：

确定新的一段内容是否与第一段内容类型相同；以及

基于新的一段内容与第一段内容的类型相同，确定是否保留播放管线的至少一部分。

13.根据权利要求12所述的机器可读介质，其中，确定是否保留包括：

检测新的一段内容的编解码器信息，所述编解码器信息指示新内容所需的解码器的类型；以及

确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

14.根据权利要求13所述的机器可读介质，其中，所述操作进一步包括：响应于管线中的音频解码器和视频解码器为由编解码器信息指示的类型，保留整个管线。

15.根据权利要求13所述的机器可读介质，其中，所述操作进一步包括：

响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型，释放管线中的音频解码器和视频解码器；以及

基于编解码器信息获得新的音频解码器和新的视频解码器。

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用于内容呈现的比特率和管线保留

[0001] 相关申请的交叉引用

[0002] 本申请要求于2017年9月8日提交的印度申请序列No.201741031917的优先权，其全部内容通过引用结合于此。

技术领域

[0003] 本发明总体上涉及配置为优化内容更改过程(例如，频道更改)的专用机器的技术领域的机器，所述机器包括这种专用机器的计算机化变体以及对这些变体的改进，并且涉及与其他有助于优化内容更改的专用机器相比，使得这种专用机器得到改进的技术。具体地，本发明提出了用于在内容更改过程期间保留下载比特率和内容播放管线的系统和方法。

背景技术

[0004] 通常，在(例如，由频道更改或对不同段内容的选择引起的)内容切换期间，由于在渲染和显示新的一段内容(例如，节目、电影、节目)之前要获取某些信息，所以会发生延迟。此外，对于自适应比特率流式传输的内容，该内容通常以低(或最低)比特率开始流式传输或下载，然后缓慢增加比特率直到获得最佳比特率。这导致初始视频或图像呈颗粒状。此外，每次发生内容变化时，都需要建立内容播放管线来增加延迟。

附图说明

[0005] 所附附图中的各个附图仅示出了本发明的示例性实施方案，并且不能视为限制本发明的范围。

[0006] 图1是示出用于优化内容更改的示例性环境的示意图；

[0007] 图2是示出根据示例性实施方案的数字接收器内的组件的示例性实施方案的框图。

[0008] 图3是根据示例性实施方案的用于优化内容更改过程的方法的流程图。

[0009] 图4是根据示例性实施方案的用于保留内容传递管线的方法的流程图。

[0010] 图5是根据示例性实施方案的以计算系统的示例形式的机器的示意图，在该机器中可以执行一组指令以使该机器执行本文所讨论的方法中的任何一种或更多种。

具体实施方式

[0011] 以下描述包括实现本发明主题的示例性实施方案的系统、方法、技术、指令序列和计算机器程序产品。在下面的描述中，出于解释的目的，阐述了许多具体细节以便提供对发明主题的各种实施方案的理解。然而，对于本领域技术人员将显而易见的是，可以在没有这些具体细节中的一些或其他的情况下实践本发明主题的实施方案。通常，不会详细示出众所周知的指令实例、协议、结构和技术。示例仅代表可能的变化。除非另有明确说明，否则结构(例如，结构性组件，诸如模块)是可选的，并且可以被组合或细分，并且操作(例如，在过

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程、算法或其他功能中)可以顺序变化或被组合或细分。

[0012] 本文描述的示例性实施方案提供了用于优化内容更改或切换正在观看的内容的系统和方法,例如通过频道更改或从观看列表中选择不同段内容。在一些实施方案中,系统利用浏览上下文(例如,用户与应用交互的方式)来识别观看者的(潜在)感兴趣的内容。然后,系统从内容提供商预先取得感兴趣内容的元数据,并将元数据存储到本地缓存。元数据包括用于渲染和显示一段内容的前提条件,这些前提条件包括系统无需解密内容即可获取的最小数据集。在示例性实施方案中,可以利用预先取得的元数据来确定是否保留内容播放管线(在本文中也称为"内容传递管线"或简称为"管线")的至少一部分。

[0013] 通常,将同一段内容分成多个片段(例如,10个第二片段),并且每个片段都有不同的比特率。低比特率可能会有颗粒感,而高比特率通常会具有更好的图像质量。典型地,当开始播放新的一段内容时,系统不知道网络带宽的质量。结果,为了尽快开始播放,常规系统以最低的比特率开始。因此,每当用户从一个内容切换到下一个内容时,播放将以最低的比特率开始,并根据网络性能缓慢增加或改善。相反,示例性实施方案在切换到新的一段内容时保留先前的比特率。即,当用户选择新的一段内容进行播放时(例如,从前一段内容切换到新的一段内容),示例性实施方案在开始新的一段内容播放时,维持或保留(启发式确定的)用于流式传输或下载前一段内容的比特率。这使得可以尽快开始播放,同时从开始就提供更好的图像质量。

[0014] 此外,在常规系统中,内容的切换或转换通常使得先前内容的传递管线被解构(例如,先前获取的资源被释放)。随后,为新的一段内容创建新的管线(例如,获取新的资源)。相反,示例性实施方案可以保持或保留用于获得前一段内容的部分(或全部)内容传递管线(例如,包括源元件、解复用器("多路分配器")、视频解码器和音频解码器),而不是重建管线(例如,破坏内容传递管线并建立新内容传递管线)。管线的保留还使得可以尽快播放新内容。

[0015] 结果,本文所述的一种或更多种方法有助于解决优化内容更改的技术问题(例如,减少用于频道更改或新内容的加载的时间),而无论传递信道如何——内容是广播(例如,IPTV和多播)还是互联网电视(over-the-top,OTT)。所述方法包括:通过数字接收器,使得播放第一段内容,并且在第一段内容播放期间,接收对用于播放的新的一段内容的选择。响应于接收到选择,数字接收器保持用于播放第一段内容的比特率,以开始新的一段内容的播放。所述方法进一步包括:在切换到播放新的一段内容时确定是否保留播放管线的至少一部分。在一些实施方案中,保留播放管线的至少一部分包括:当切换到播放新的一段内容时,确定是否重新训练管线的音频解码器和视频解码器。因此,本文所讨论的一种或更多种方法改善了内容更改期间的延时,同时保持了图像质量。应当注意的是,内容更改包括:选择用于观看的一段内容(例如,从诸如收藏夹网格的内容访问页面或通过节目指南)以及频道更改(例如,线性频道更改)。

[0016] 参照图1,示出了示例性环境100的实施方案,该示例性环境100使得能够优化内容更改(例如,减少频道更改或选择用于观看的一段内容期间的延时)。在示例性实施方案中,用户的数字接收器102提供对数字内容的访问并管理内容更改操作。在一个实施方案中,数字接收器102是机顶盒。数字接收器102连接到用户可以在其上观看数字内容的观看设备104(例如,电视或监控器)。在一些实施方案中,数字接收器102(例如,数字接收器102的操

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作)可以与观看设备104(例如,智能电视、平板电脑或智能手机)组合。将结合下面的图2更详细地讨论用于执行示例性实施方案的操作的数字接收器102的组件。

[0017] 在一些实施方案中,数字接收器102经由网络106从内容分发网络(CDN)服务器108访问(例如,拉取、接收、检索)内容。CDN服务器108可以从一个或更多个内容提供商110(例如,内容提供商110的服务器)获得内容。在示例性实施方案中,CDN服务器108可以与第三方服务(例如,Netflix、Hulu、YouTube、亚马逊)相关联,该第三方服务存储和提供诸如如下的内容,但不限于互联网电视(OTT)内容、视频点播(VOD)内容、互联网内容或通过网络106向数字接收器102广播的内容。该内容包括:文本、图像、音频和/或视频内容(例如,电影、电视节目、视频),并且在一些实施方案中,包括实况(例如,实时)内容。在一些实施方案中,内容提供商110通过网络106直接将内容提供给数字接收器102以在观看设备104上显示。

[0018] 网络106的一个或更多个部分可以是:自组织网络、内联网、外联网、虚拟专用网(VPN)、局域网(LAN)、无线LAN(WLAN)、广域网(WAN)、无线WAN(WWAN)、城域网(MAN)、一部分互联网、一部分公共交换电话网(PSTN)、蜂窝电话网络、无线网络、WiFi网络、WiMax网络、卫星网络、电缆网络、广播网络、另一种类型的网络,或两个或多个这种网络的组合。网络106的任何一个或更多个部分可以经由传输介质或信号介质来通信信息。如本文所使用的,"传输介质"是指能够传送(例如,传输)由机器(例如,由该机器的一个或更多个处理器)执行的指令的任何无形(例如,易失性)介质,并且包括数字或模拟通信信号或其他无形介质,以促进这种软件的通信。

[0019] 应当注意的是,图1所示的环境100仅是示例。例如,在环境100内可以实现任何数量的CDN服务器108和内容提供商110。此外,可以组合环境100的一些组件。例如,数字接收器102的功能可以在观看设备104内实现以形成单个设备,例如智能电视、平板电脑、智能电话或能够获取、渲染和显示内容的任何其他设备。此外,本文针对任何单个系统或机器描述的功能可以细分为多个系统或机器。

[0020] 图1所示或与图1相关的任何系统或机器(例如,数据库、设备、服务器)可以为、包括已经修改(例如,通过软件配置或编程,软件诸如应用程序、操作系统、固件、中间件或其他程序的一个或更多个软件模块)的专用(例如,专用或其他非通用)计算机,或以其它方式在该专用计算机中实现,以执行本文所述的该系统或机器的一个或更多个功能。例如,下面参照图5讨论能够实现本文描述的方法中的任何一种或更多种的专用计算机系统,这种专用计算机可以相应地是用于执行本文所讨论的方法中的任何一种或更多种的装置。在此类专用计算机的技术领域内,与缺少本文所述的结构或无法执行本文讨论的功能的其他专用计算机相比,已通过本文所讨论的结构进行修改以执行本文所讨论的功能的专用计算机在技术上得到了改进。因此,根据本文所讨论的系统和方法配置的专用机器对相似的专用机器的技术提供了改进。

[0021] 图2是示出根据示例性实施方案的数字接收器102内的组件的示例性实施方案的框图。在示例性实施方案中,数字接收器102管理对通过网络106流式传输的内容的访问。具体地,数字接收器102预先取得元数据,在开始新的一段内容的播放时保留用于前一段内容的播放(例如,流式传输或下载)的比特率,并保留内容传递管线的至少一部分。为了实现这些操作,数字接收器102包括:播放器202、内容传递管线204(也称为"管线")、高速缓存管理器206和高速缓存208,所有这些都可以配置为彼此通信(例如,通过总线、共享内存或交换

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机)。数字接收器102包括与示例性实施方案的操作无关的其他组件(未示出)。

[0022] 播放器202配置为管理管线204。在示例性实施方案中,当选择第一段内容进行显示时,播放器204实例化(例如,构建)管线204。可以为每种类型的内容构建不同的管线。例如,播放器202为HLS内容构建HTTP实时流式传输(HLS)管线,并且为DASH内容构建基于HTTP的动态自适应流式传输(DASH)管线。当内容发生切换时(例如,频道更改或选择用于观看的新内容),播放器204还决定是保持管线204的至少一部分还是构建新管线。结合下面的图4进一步详细讨论用于管理管线保留的示例性方法。

[0023] 由播放器202通过获取用于获得和处理内容数据的适当资源来构建管线204,以便播放所选内容。管线204的资源包括:源元件212、解复用器("多路分配器")214、音频解码器216和视频解码器218。源元件212管理用于所选段内容的内容数据的下载。源元件212还管理数字接收器102处的比特率适配。具体地,源元件212记住用于播放当前/先前段内容的最后比特率,并且继续利用该比特率来播放新内容。这样,如果最后比特率高,则源元件212将以相同的高比特率开始用于新内容。如果新内容不能以该比特率播放,则源元件212将降低比特率。例如,如果内容的下载所花费的时间小于预期的时间,则存在多余的带宽,并且可以提高比特率。相反,如果下载所花费的时间长于预期的时间,则降低比特率。这样,示例性实施方案将以先前/最后的比特率开始新内容的播放,而不是以较低或最低的比特率开始(并缓慢增加)。

[0024] 解复用器对从CDN服务器108或内容提供商110获得的内容数据进行解复用,以获得音频信号和视频信号。音频信号被发送到音频解码器216进行处理,而视频信号被发送到视频解码器218进行处理。来自音频解码器216和视频解码器218的结果被输出(例如,发送)到观看设备104,以呈现给用户。

[0025] 高速缓存管理器206管理可能潜在地选择用于播放的内容的元数据的预先取得。在一些实施方案中,高速缓存管理器206预测用户可能感兴趣观看的内容。例如,用户可能正在沿特定方向(例如,向上或向下)浏览频道或节目的线性列表(例如,电子节目指南;"EPG")。在该实施方案中,高速缓存管理器206基于线性列表上的浏览方向来预测下一组内容。在另一个示例中,用户可能正在查看视频点播(video-on-demand,VoD)目录或用户的观看列表。如果用户请求信息或将其悬停在对一段内容的选择上,则高速缓存管理器206将其用作用户对这一段内容感兴趣的预测。或者,高速缓存管理器可以将目录或观看列表的可视部分中的所有(或某些)段内容视为感兴趣的内容。在任何这些情况下,高速缓存管理器206预先取得感兴趣内容的元数据,并将预先取得的数据存储到高速缓存208。元数据可以包括,例如,一个或更多个统一资源定位符(URL),其中大量内容可用;用于不同比特率的URL;许可证数据(例如,从何处获得许可证);以及编解码器信息。如下面将进一步讨论的,播放器202将利用编解码器信息来确定是否保留管线204的至少一部分。如果用户随后选择已经预先取得元数据的内容,则可以在选择之后从高速缓存208访问元数据,而不是必须通过网络106从CDN服务器108或内容提供商110中检索元数据。这将有助于减少播放的延迟。

[0026] 本文描述的任何一个或更多个组件(例如,模块、解码器、资源)可以利用硬件(例如,机器的一个或更多个处理器)单独地实现,或利用硬件和软件的组合来实现。例如,本文描述的任何组件可以物理地包括一个或更多个处理器的布置,或者配置处理器(例如,在机器的一个或更多个处理器之中)以执行本文描述的对于该模块的操作。因此,本文描述的不

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同组件可以包括并配置在不同时间点的处理器的不同布置或在不同时间点的处理器的单种布置。本文描述的每个组件是用于执行本文描述的对于该组件的操作的装置的示例。而且，这些组件中的任何两个或更多个可以组合成单个组件，并且本文描述的对于单个组件的功能可以在多个组件之中进行细分。此外，根据各种示例性实施方案，本文描述为在单个机器、数据库或设备内实现的组件可以分布在多个机器、数据库或设备上。

[0027] 图3是根据示例性实施方案的用于优化内容更改的示例性方法300的流程图。在示例性实施方案中，方法300由数字接收器102的组件部分或全部执行。因此，参考数字接收器102通过示例来描述方法300。然而，应当理解的是，方法300的至少一些操作可以被部署在各种其他硬件配置上，或者可以由位于环境100中的其他地方的类似组件来执行。因此，方法300不旨在限于数字接收器102。

[0028] 在操作302，使第一段内容由观看设备104播放。在示例性实施方案中，播放器202构建用于获得和处理第一段内容的内容数据的管线204。具体地，播放器202获取源元件212、解复用器214、音频解码器216和视频解码器218以形成管线204。数据内容由管线204处理并呈现在查看设备104上。

[0029] 在操作304，预先取得用于一个或更多个感兴趣内容的集合的元数据。在示例性实施方案中，高速缓存管理器206预测用户感兴趣的内容并预先取得感兴趣的内容的元数据。然后，将预先取得的数据存储到高速缓存208。元数据可以包括但不限于：一个或更多个URL，其中大量内容可用；用于不同比特率的一个或更多个URL；许可证数据（例如，从何处获得许可证）；以及编解码器信息。

[0030] 在操作306，播放器202接收切换到用于播放的新的一段内容的指示。该指示可以从用户的控制设备（例如，遥控器）接收。在一些实施方案中，用户可以滚动浏览EPG或正在查看目录或观看列表，并选择用于观看的新的一段内容。

[0031] 在操作308，当将播放切换到新的一段内容时，数字接收器102保持比特率。在示例性实施方案中，当将播放从正在进行的播放操作转换到新的播放操作时，源元件212利用为第一段内容的播放而得到的启发式比特率来播放新的一段内容。因此，与从最低可能的比特率开始新的播放相反，源元件212尝试保持或保留用于播放的比特率。如果不能以该比特率传送新的一段内容，则源元件212将降低比特率。这样，示例性实施方案将以先前/最后的比特率开始新内容的下载，而不是以较低或最低的比特率开始（并缓慢增加）。这使得可以立即以最佳比特率播放新内容，而不必从最低可能的比特率开始启发式地重新计算最佳比特率。通常，得到最佳比特率通常需要下载内容数据的几个片段或块，从而导致图像质量的逐渐改善。然而，从新内容播放的最开始，利用先前得到的启发式比特率的示例性实施方案保持了与先前播放的图像质量水平相同的图像质量水平。

[0032] 在操作310，执行管线保留过程以确定是否保持用于播放第一段内容的管线的至少一部分，以用于播放新的一段内容。此外，如果要保持或保留管线，则确定应该保留管线的所有资源还是仅保留一部分管线（例如，仅保持一些资源，而释放其他资源）。将结合图4更详细地讨论管线保留过程。

[0033] 图4是根据示例性实施方案的用于保留内容传递管线的示例性方法400的流程图。在示例性实施方案中，方法400参照管线204的资源的一部分或全部由播放器202来执行。因此，参考播放器202和管线204，通过示例来描述方法400。然而，应当理解的是，方法400的至

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少一些操作可以被部署在各种其他硬件配置上，或者可以由位于环境100中的其他地方的类似组件来执行。因此，方法400不旨在限于播放器202和管线204。

[0034] 在操作402，响应于接收到将播放切换到新内容的指示，高速缓存管理器206访问在高速缓存208中存储的预先取得的用于新内容的元数据。预先取得的用于新内容的元数据可以包括：一个或更多个URL，其中新内容可用；一个或更多个URL，用于与新内容相关联的不同比特率；用于新内容的许可证数据；以及用于新内容的编解码器信息。预先取得的元数据还可以指示新内容是否与第一段内容类型相同。例如，第一段内容和新内容都可以是HTTP实时流式传输(HLS)格式，或者都可以是HTTP上的动态自适应流式传输(DASH)格式。

[0035] 在操作404，播放器202确定第一段内容和新内容是否具有相同的内容类型。如果第一段内容和新内容不具有同一类型(例如，第一段内容是HLS格式，而新内容是DASH格式)，那么在操作406释放管线204的资源(例如，源元件212、解复用器214、音频解码器216和视频解码器218)。释放管线204的所有资源实质上解构了管线204。播放器202通过获取适用于新内容的内容类型的其他资源来创建新管线。

[0036] 如果在操作404播放器202确定出第一段内容和新内容具有相同的内容类型(例如，两者均为HLS格式)，则在操作408，检测用于新内容的编解码器信息。在示例性实施方案中，对于编解码器信息，播放器202检查用于新内容的预先取得的元数据。编解码器信息指示新内容所需的解码器类型。

[0037] 在操作410，由播放器202确定新内容所需的解码器的类型是否与第一段内容的管线204中当前的解码器相同。如果所需的解码器的类型相同，则在操作412，保留整个管线204。换句话说，管线204的资源被保持并继续用于播放新内容。

[0038] 然而，如果在操作410播放器202确定出新内容需要不同的解码器，则在操作414，释放解码器(例如，音频解码器216和视频解码器208)。随后在操作416，保留或保持管线204的其余部分(例如，源元件212和解复用器214)。在这些实施方案中，播放器202获取适用于新内容的新的解码器集合(例如，新的音频解码器和新的视频解码器)，并将新的解码器集合添加到管线204的保留部分。

[0039] 尽管参照可适用于DASH和HLS的管线和比特率保留讨论了示例性实施方案，但是用于保留比特率和管线的示例性实施方案可应用于本质上自适应的任何类型的内容(例如，内容比特率可以基于带宽改变)。

[0040] 图5是示出了根据一些示例性实施方案的机器500的组件的框图，机器500能够从机器存储介质522(例如，非易失性机器存储介质、机器可读存储介质、计算机可读存储介质，或它们的任何合适的组合)读取指令524，并全部或部分地执行本文所讨论的方法中的任何一种或更多种。具体地，图5以计算机设备(例如，计算机)的示例形式示出了机器500，在其中可以全部或部分地实现用于使机器500执行本文讨论的方法中的任何一种或更多种的指令524(例如，软件、程序、应用程序、小程序、应用或其他可执行代码)。

[0041] 例如，指令524可以使机器500执行图3和图4的流程图。指令524可以将通用的、未编程的机器500转换成编程为以所述的方式执行所描述和示出的功能的特定机器(例如，特殊配置的机器)。

[0042] 在替代实施方案中，机器500作为独立设备操作，或者可以连接(例如，联网)到其他机器。机器500可以是服务器计算机、客户端计算机、个人计算机(PC)、平板计算机、膝上

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型计算机、上网本、机顶盒(例如,STB)、个人数字助理(PDA)、蜂窝电话、智能电话、Web设备、网络路由器、网络交换机、网桥、电源适配器或能够顺序或以其他方式执行指令524的任何机器500,指令524指定了该机器500要采取的动作。此外,尽管仅示出了单个机器500,但是术语"机器"也应理解为包括机器的集合,其单独地或共同地执行指令524以执行本文所讨论的方法中的任何一种或更多种。

[0043] 机器500包括:处理器502(例如,中央处理单元(CPU)、图形处理单元(GPU)、数字信号处理器(DSP)、专用集成电路(ASIC)、射频集成电路(RFIC),或其任何合适的组合)、主存储器504和静态存储器506,它们配置为通过总线508彼此通信。处理器502可以包括可由指令524的一些或全部来临时或永久配置的微电路,使得处理器502可以配置为整体或部分执行本文所述方法中的任何一种或更多种。例如,一组处理器502的一个或更多个微电路可以配置为执行本文所述的一个或更多个模块(例如,软件模块)。

[0044] 机器500可以进一步包括:图形显示器510(例如,等离子显示面板(PDP)、发光二极管(LED)显示器、液晶显示器(LCD)、投影仪、阴极射线管(CRT)或任何其他能够显示图形或视频的显示器)。机器500还可以包括:字母数字输入设备512(例如,键盘或小键盘)、光标控制设备514(例如,鼠标、触摸板、轨迹球、操纵杆、运动传感器、眼球跟踪设备或其他指向工具)、存储单元516、信号生成设备518(例如,声卡、放大器、扬声器、耳机插孔或它们的任何合适的组合)以及网络接口设备520。

[0045] 存储单元516包括机器存储介质522(例如,有形的机器可读存储介质),在其上存储了指令524,指令524实现了本文描述的方法或功能中的任何一种或更多种。在由机器500执行指令之前或期间,指令524也可以全部或至少部分地位于主存储器504内、处理器502内(例如,处理器的高速缓冲存储器内)或这两者中。因此,主存储器504和处理器502可以认为是机器存储介质522(例如,有形的和非易失性的机器存储介质)。

[0046] 在一些示例性实施方案中,机器500可以是便携式计算设备,并且具有一个或更多个附加的输入组件(例如,传感器或仪表)。这样的输入组件的示例包括:图像输入组件(例如,一个或更多个摄像机)、音频输入组件(例如,麦克风)、方向输入组件(例如,指南针)、位置输入组件(例如,全球定位系统(GPS)接收器)、方向组件(例如,陀螺仪)、运动检测组件(例如,一个或更多个加速度计)、高度检测组件(例如,高度计)和气体检测组件(例如,气体传感器)。由这些输入组件中的任何一个或更多个输入组件收集的输入可以由本文描述的任何模块访问和使用。

[0047] 可执行指令和机器存储介质

[0048] 各种存储器(即,504、506和/或处理器502的存储器)和/或存储单元516可以存储实现本文描述的方法或功能的一种或更多种、或者由本文描述的方法或功能的一种或更多种利用的一组或更多组指令和数据结构(例如,软件524)。这些指令在由处理器502执行时使得各种操作实施所公开的实施方案。

[0049] 如本文所使用的,术语"机器存储介质"、"设备存储介质"、"计算机存储介质"(统称为"机器存储介质522")表示相同的事物,并且可以在本发明中互换使用。该术语指的是存储可执行指令和/或数据的单个或多个存储设备和/或介质(例如,集中式或分布式数据库和/或关联的高速缓存和服务器),以及包括多个存储装置或设备的基于云的存储系统或存储网络。因此,应将术语理解为包括但不限于固态存储器以及光和磁介质,包括处理器内

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部或外部的存储器。机器存储介质、计算机存储介质和/或设备存储介质522的特定示例包括：非易失性存储器，例如包括半导体存储器件，例如，可擦除可编程只读存储器(EPROM)、电可擦除可编程只读存储器(EEPROM)、FPGA和快闪存储器件；磁盘，例如内部硬盘和可移动磁盘；磁光盘；以及CD-ROM和DVD-ROM磁盘。术语机器存储介质、计算机存储介质和设备存储介质522特别排除载波、调制数据信号和其他这种介质，其中至少一些在下文讨论的术语"信号介质"中涵盖。

[0050] 信号介质

[0051] 术语"信号介质"或"传输介质"应认为包括任何形式的调制数据信号、载波等。术语"调制数据信号"是指这样的信号，该信号的一个或更多个特性设置或更改为在该信号中编码信息。

[0052] 计算机可读介质

[0053] 术语"机器可读介质"、"计算机可读介质"和"设备可读介质"表示相同的事物，并且在本发明中可以互换使用。这些术语定义为既包括机器存储介质又包括信号介质。因此，该术语既包括存储设备/介质又包括载波/调制的数据信号。

[0054] 指令524可以进一步经由网络接口设备520利用传输介质并且利用许多公知的传输协议中的任何一种(例如，HTTP)在通信网络526上发送或接收。通信网络526的示例包括：局域网(LAN)、广域网(WAN)、互联网、移动电话网络、普通老式电话服务(POTS)网络和无线数据网络(例如，WiFi、LTE和WiMAX网络)。术语"传输介质"应认为包括能够存储、编码或运载由机器500执行的指令524的任何无形介质，并且包括数字或模拟通信信号或促进这种软件的通信的其他无形介质。

[0055] 在整个说明书中，多个实例可以实现描述为单个实例的组件、操作或结构。尽管将一种或更多种方法的单独操作示出并描述为单独的操作，但是可以同时执行一个或更多个单独操作，并且不需要按照所示顺序执行操作。在示例性配置中表示为单独组件的结构和功能可以实现为组合结构或组件。类似地，呈现为单个组件的结构和功能可以实现为单独的组件。这些和其他变型、修改、添加和改进落入本文主题的范围内。

[0056] 本文将某些实施方案描述为包括逻辑或多个组件、模块或机制。模块可以构成软件模块(例如，实现在机器存储介质522上或在传输信号中的代码)或硬件模块。"硬件模块"是能够执行某些操作的有形单元，并且可以以某种物理方式进行配置或布置。在各种示例性实施方案中，一个或更多个计算机系统(例如，独立计算机系统、客户端计算机系统或服务器计算机系统)或计算机系统的一个或更多个硬件模块(例如，一个处理器502或一组处理器502)可以通过软件(例如，应用程序或应用程序部分)配置为操作以执行本文所述的某些操作的硬件模块。

[0057] 在一些实施方案中，可以机械地、电子地或其任何合适的组合来实现硬件模块。例如，硬件模块可以包括专用电路或逻辑，该专用电路或逻辑永久地配置为执行某些操作。例如，硬件模块可以是专用处理器，例如现场可编程门阵列(FPGA)或ASIC。硬件模块还可以包括可编程逻辑或电路，该可编程逻辑或电路由软件临时配置为执行某些操作。例如，硬件模块可以包括包含在通用处理器或其他可编程处理器内的软件。应当理解的是，可以由成本和时间考虑来决定在专用且永久配置的电路中或在临时配置的电路(例如，由软件配置)中机械地实现硬件模块。

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[0058] 相应地，短语“硬件模块”应理解为包括有形实体，是物理地构建、永久地配置(例如，硬接线)，或临时地配置(例如，编程)以某种方式操作或执行本文中所述的某些操作的实体。如本文所使用的，“硬件实现的模块”是指硬件模块。考虑其中硬件模块临时配置(例如，编程)的实施方案，每个硬件模块不需要在任何一个时刻配置或实例化。例如，在硬件模块包括由软件配置成为专用处理器的通用处理器的情况下，通用处理器可以在不同时间分别配置为不同的专用处理器(例如，包括不同的硬件模块)。软件可以对处理器进行相应地配置，例如，以在一个时刻上构成特定的硬件模块，并在不同的时刻上构成不同的硬件模块。

[0059] 本文中描述的示例性方法的各种操作可以至少部分地由一个或更多个临时配置(例如，通过软件)或永久配置为执行相关操作的处理器执行。不管是临时配置还是永久配置，这种处理器都可以构成处理器实现的模块，这些模块操作以执行本文所述的一个或更多个操作或功能。如本文所使用的，“处理器实现的模块”是指使用一个或更多个处理器实现的硬件模块。

[0060] 类似地，本文中描述的方法可以至少部分地由处理器实现，处理器是硬件的示例。例如，方法的至少一些操作可以由一个或更多个处理器或处理器实现的模块执行。

[0061] 示例

[0062] 示例1是用于优化内容更改过程的方法。所述方法包括：通过数字接收器，使得播放第一段内容；在第一段内容播放期间，通过数字接收器接收对用于播放的新的一段内容的选择；响应于接收到选择，通过数字接收器的处理器保持用于播放第一段内容的比特率，以开始新的一段内容的播放。

[0063] 在示例2中，示例1的主题可以可选地包括：确定新的一段内容是否与第一段内容类型相同；基于新的一段内容与第一段内容的类型相同，确定是否保留播放管线的至少一部分。

[0064] 在示例3中，示例1-2的主题可以可选地包括：其中，确定是否保留包括：检测新的一段内容的编解码器信息，该编解码器信息指示新的一段内容所需的解码器的类型；确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

[0065] 在示例4中，示例1-3的主题可以可选地包括：响应于管线中的音频解码器和视频解码器是由编解码器信息指示的类型，保留整个管线。

[0066] 在示例5中，示例1-4的主题可以可选地包括：响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型，释放管线中的音频解码器和视频解码器；基于所述编解码器信息获得新的音频解码器和新的视频解码器。

[0067] 示例6是一种优化内容更改过程的系统。所述系统包括：一个或更多个硬件处理器；以及存储设备，其存储用于配置一个或更多个硬件处理器以执行操作的指令，所述操作包括：使得播放第一段内容；在第一段内容播放期间，接收对用于播放的新的一段内容的选择；响应于接收到选择，保持用于播放第一段内容的比特率，以开始新的一段内容的播放。

[0068] 在示例7中，示例6的主题可以可选地包括：确定新的一段内容是否与第一段内容类型相同；基于新的一段内容与第一段内容的类型相同，确定是否保留播放管线的至少一部分。

[0069] 在示例8中，示例6-7的主题可以可选地包括：其中，确定是否保留包括：检测新的

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一段内容的编解码器信息，该编解码器信息指示新内容所需的解码器的类型；确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

[0070] 在示例9中，示例6-8的主题可以可选地包括：响应于管线中的音频解码器和视频解码器是由编解码器信息指示的类型，保留整个管线。

[0071] 在示例10中，示例6-9的主题可以可选地包括：响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型，释放管线中的音频解码器和视频解码器；基于所述编解码器信息获得新的音频解码器和新的视频解码器。

[0072] 示例11是一种机器可读介质，其存储指令，所述指令在由机器的一个或更多个硬件处理器执行时使机器执行操作，所述操作包括：使得播放第一段内容；在第一段内容播放期间，接收对用于播放的新的一段内容的选择；响应于接收到选择，保持用于播放第一段内容的比特率，以开始新的一段内容的播放。

[0073] 在示例12中，示例11的主题可以可选地包括：确定新的一段内容是否与第一段内容类型相同；基于新的一段内容与第一段内容的类型相同，确定是否保留播放管线的至少一部分。

[0074] 在示例13中，示例11-12的主题可以可选地包括：其中，确定是否保留包括：检测新的一段内容的编解码器信息，该编解码器信息指示新内容所需的解码器的类型；确定管线中的音频解码器和视频解码器是否为由编解码器信息指示的类型。

[0075] 在示例14中，示例11-13的主题可以可选地包括：响应于管线中的音频解码器和视频解码器是由编解码器信息指示的类型，保留整个管线。

[0076] 在示例15中，示例11-14的主题可以可选地包括：响应于管线中的音频解码器和视频解码器不同于由编解码器信息指示的类型，释放管线中的音频解码器和视频解码器；基于所述编解码器信息获得新的音频解码器和新的视频解码器。

[0077] 本文中讨论的主题的某些部分可以按照对以位或二进制数字信号存储在机器存储器（例如，计算机存储器）中的数据进行运算的算法或符号表示的方式来呈现。这样的算法或符号表示是数据处理领域的普通技术人员用来将其工作的实质传达给本领域其他技术人员的技术的示例。如本文所使用的，“算法”是导致期望结果的操作或类似处理的自洽序列。在这种情况下，算法和操作涉及对物理量的物理操控。通常，但不是必须，这样的量可以采取能够由机器存储、访问、传输、组合、比较或以其他方式操纵的电、磁或光信号的形式。主要出于通用目的，利用诸如“数据”、“内容”、“位”、“值”、“元素”、“符号”、“字符”、“术语”、“数”、“数字”等的词语来引用这种信号有时会很方便。但是，这些词语仅是方便的标签，并且应与适当的物理量相关联。

[0078] 除非另有明确说明，否则本文中利用诸如“处理”、“计算”、“估算”、“确定”、“呈现”、“显示”等词语进行的讨论可以指操控或转换数据的机器的动作或过程（例如，计算机），所述数据表示为一个或更多个存储器（例如，易失性存储器、非易失性存储器或其任意合适的组合）、寄存器或者接收、存储、传输或显示信息的其他机器组件内的物理（例如，电、磁或光）量的数据。此外，除非另有明确说明，否则如专利文件中公知的，术语“一”或“一个”在本文中用于包括一个或更多个实例。最后，除非另有明确说明，否则如本文所使用的，连词“或”是指非排他性的“或”。

[0079] 尽管已经参考特定示例性实施方案描述了本发明主题的概述，但是在不脱离本发

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明的实施方案的较宽范围的情况下，可以对这些实施方案进行各种修改和改变。例如，本领域普通技术人员可以混合和匹配各种实施方案或其特征，或者使其成为可选的。仅出于方便起见，本文中可以单独地或共同地用术语“发明”来指代发明主题的这些实施方案，并且如果实际上公开了一个以上的发明，则不希望将本申请的范围自动限制为任何单个发明或发明构思。

[0080] 相信本文足够详细地描述了本文中所示的实施方案，以使本领域技术人员能够实践所公开的教导。可以使用其他实施方案并从中得出其他实施方案，使得可以在不脱离本发明的范围的情况下进行结构和逻辑上的替换和改变。因此，不应在限制意义上理解详细描述，并且各种实施方案的范围仅由所附权利要求以及这些权利要求所享有的等同物的全部范围来限定。

[0081] 此外，可以为本文中描述为单个实例的资源、操作或结构提供多个实例。此外，各种资源、操作、模块、引擎和数据存储装置之间的边界在某种程度上是任意的，并且在特定说明性配置的上下文中示出了特定操作。可以设想功能的其他分配，并且其可以落入本发明的各种实施方案的范围内。通常，在示例性配置中呈现为单独资源的结构和功能可以实现为组合结构或资源。类似地，呈现为单个资源的结构和功能可以实现为单独的资源。这些和其他变型、修改、添加和改进落入如所附权利要求所表示的本发明的实施方案的范围内。因此，说明书和附图应认为是说明性的而不是限制性的。

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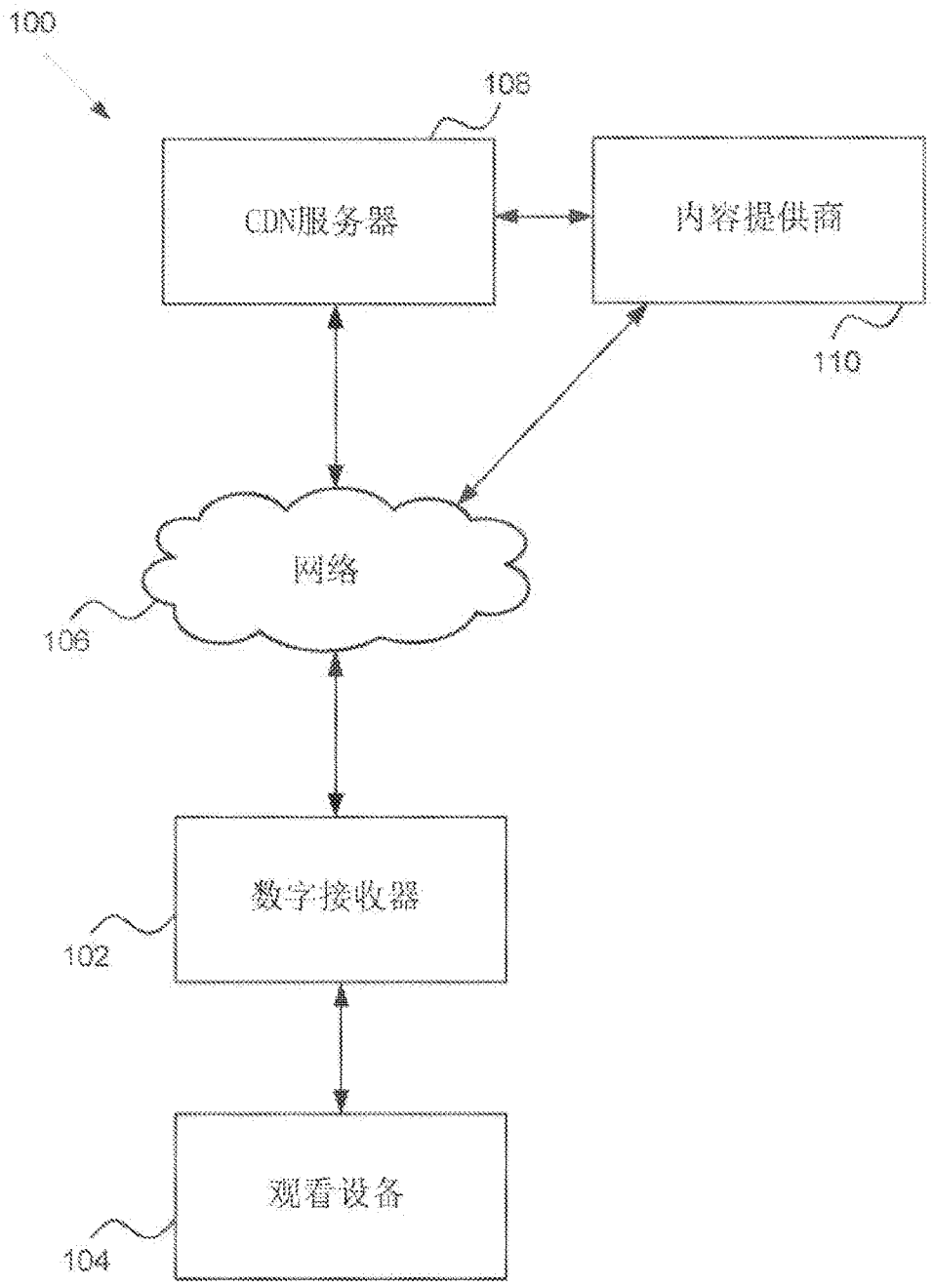


图1

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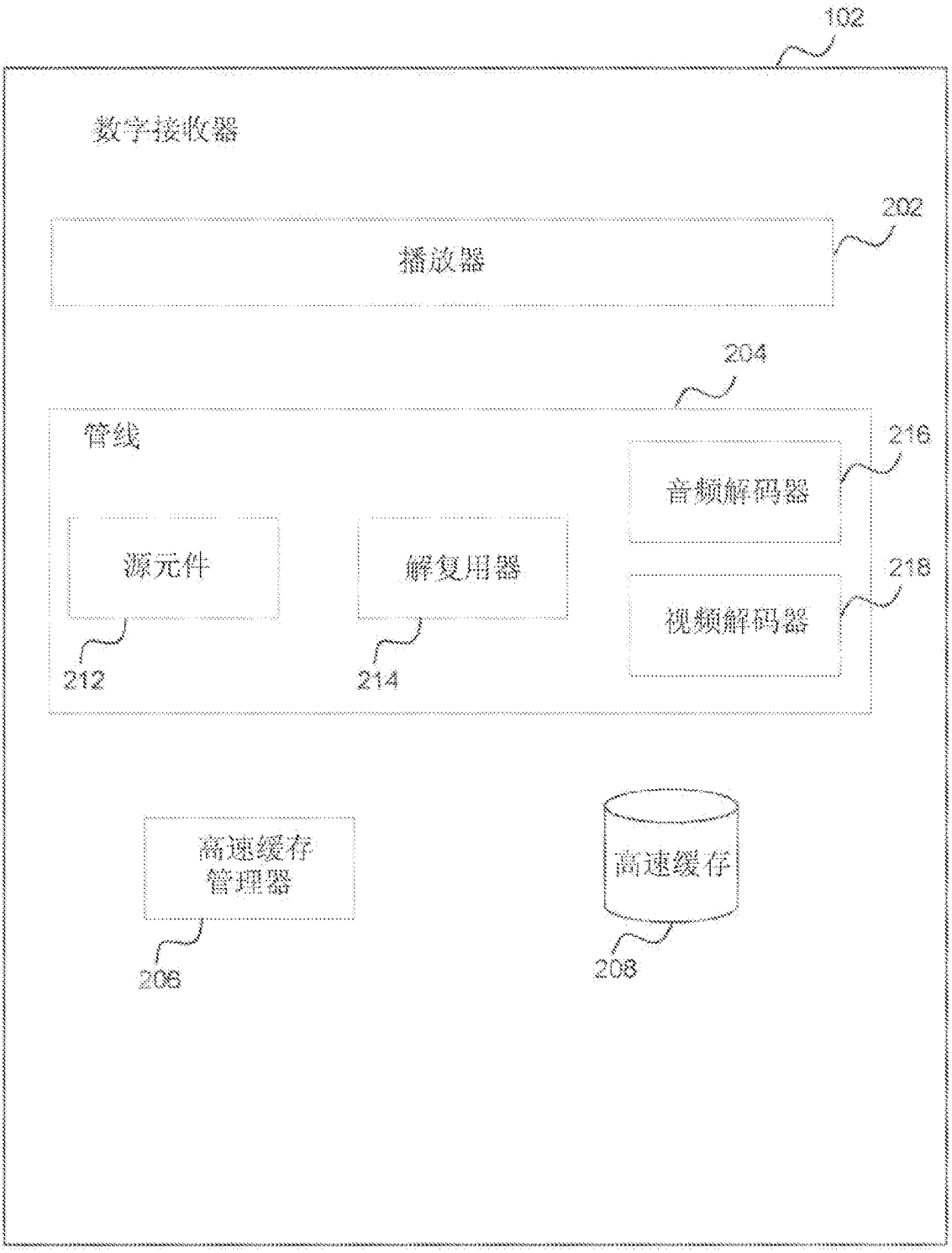


图2

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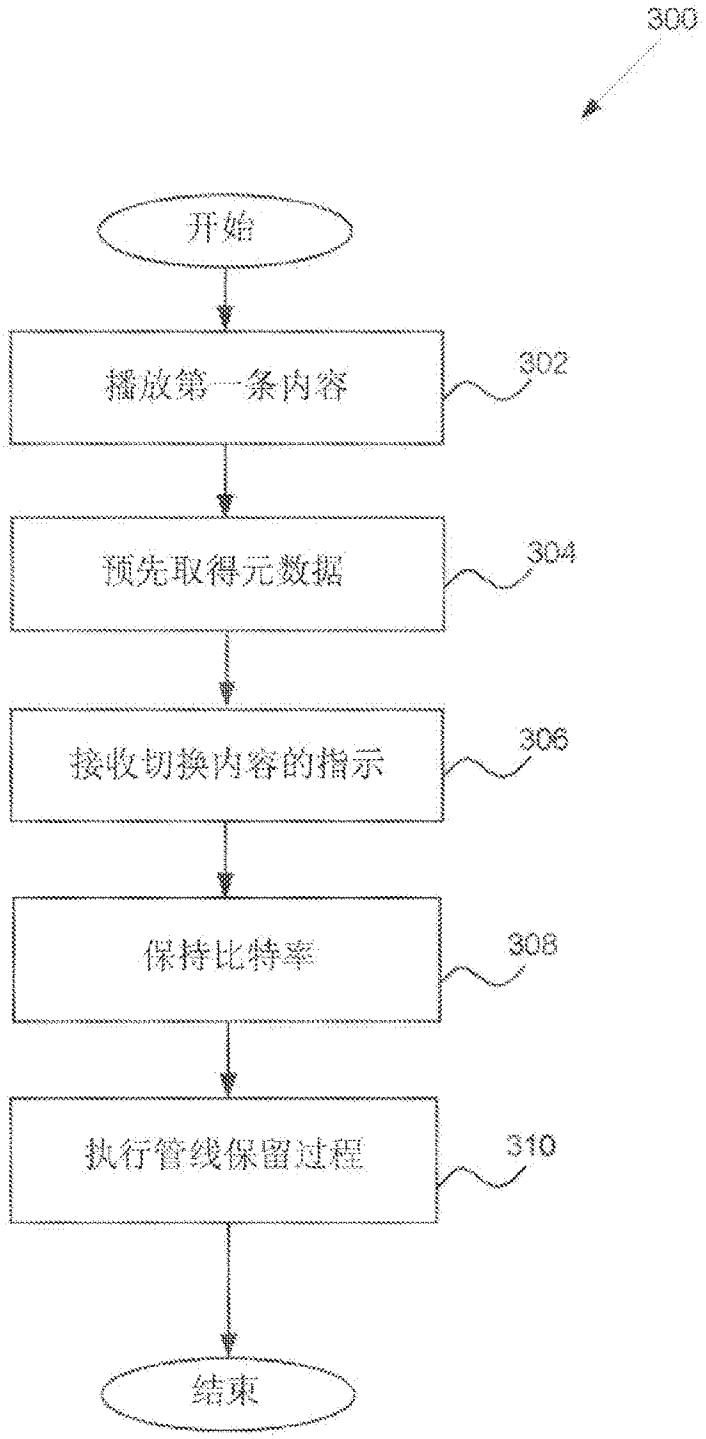


图3

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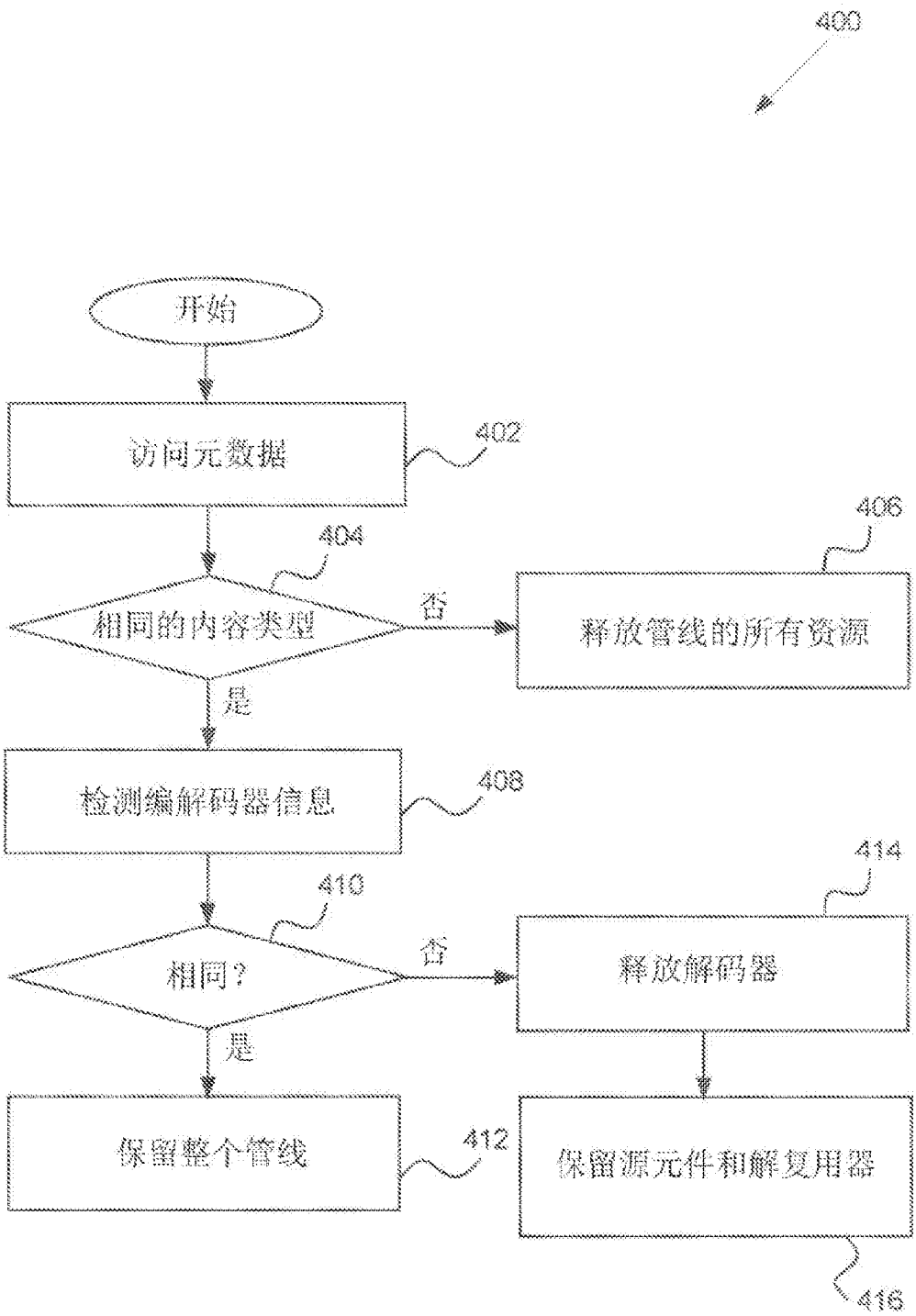


图4

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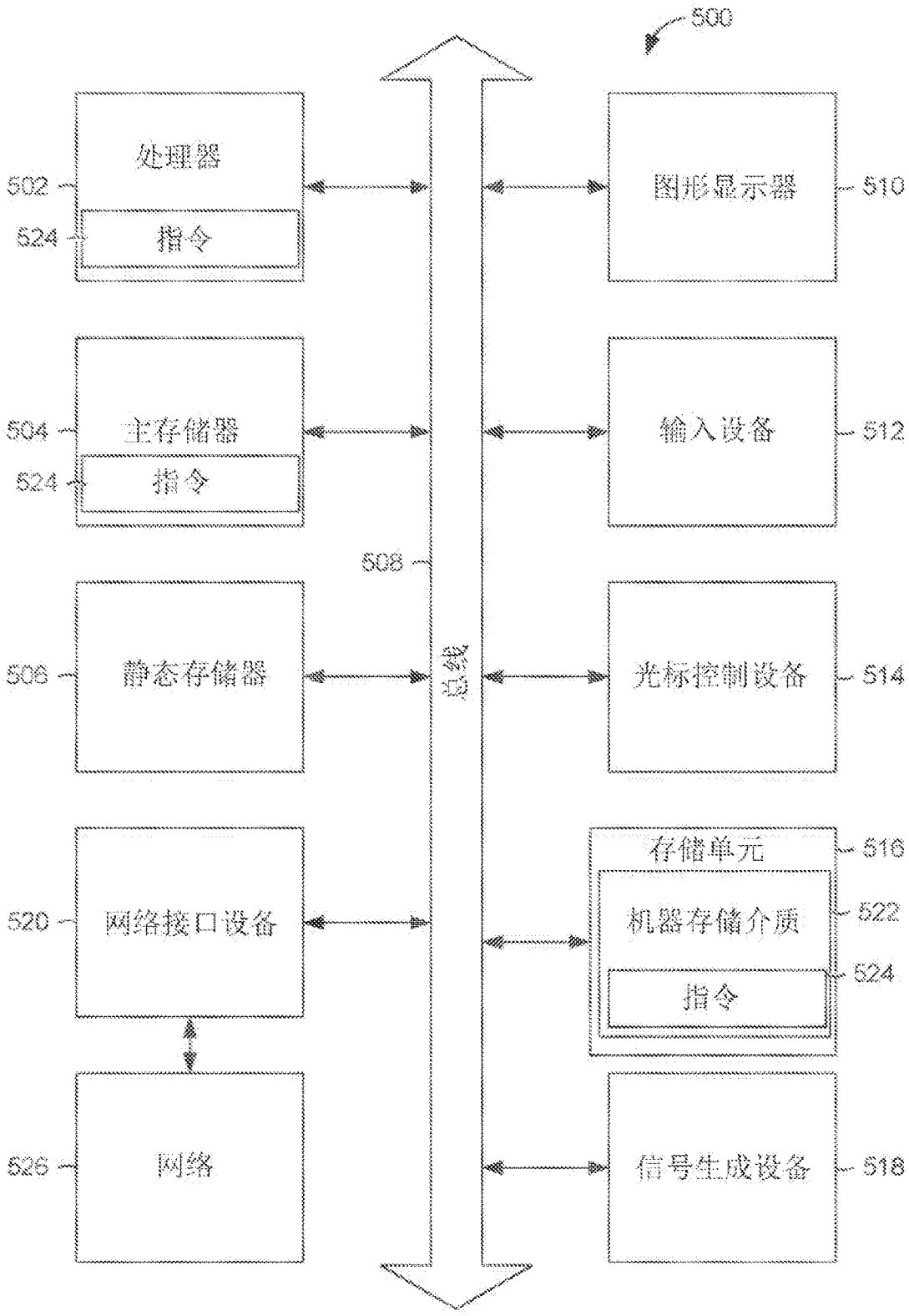


图5

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: MONIQUE M. PERDOK
SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	22 OCT 2018

Applicant's or agent's file reference	FOR FURTHER ACTION
2050-354WO1	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 18/46723	14 August 2018 (14.08.2018)	08 September 2017 (08.09.2017)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - H04W 28/02 (2018.01)
CPC - H04W 28/02; H04W 12/06; H04W 28/10; H04N 19/463; H04N 19/30

Applicant OPENTV, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	26 September 2018	Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE
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International application No.
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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:

☒ the international application in the language in which it was filed.

☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

a. ☐ forming part of the international application as filed:

☐ in the form of an Annex C/ST.25 text file.

☐ on paper or in the form of an image file.

b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. V **Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1 Statement

Novelty (N)	Claims	3-5, 8-10, 13-15	YES
	Claims	1-2, 6-7, 11-12	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	NONE	NO

2. Citations and explanations:

Claims 1-2, 6-7, 11-12 lack novelty under PCT Article 33(2) as being anticipated by US 2011/0296047 A1 to Orr.

Regarding claim 1, Orr discloses a method (method of playing media; para [0031]- "Referring now to FIG. 4, a process is depicted for operation of the computing device of FIG. 1 according to one or more embodiments. Process 400 may be performed by a media player application of a computing device and may be initiated by detection of a user selection of the media player application for playback of one or more media files at block 405"), comprising:

causing playback, by a digital receiver, of a first piece of content (media player playback first media; para [0032]- "Following detection of a user selection at block 405, the computing device may then initiate playback of the user selection at block 410, wherein a first media file is played. Playback by the media player application may include output of audio and/or video data depending on the type of media. In one exemplary embodiment, playback may include a graphical display associated with output levels of audio data. In another embodiment, a visual display and associated audio data may be output based on video data"; para [0033]- "In one embodiment, playback at block 410 may include loading a first media file, reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e.g., bit depth, bit rate, etc.) Further, playback of block 410 may include converting and sending audio data to the media player application");

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content (receiving selection of second media file; para [0035]- "Selection of a media file by the media player application may be based on one or more sources selected by the user and may further be selected based on one or more user preferences. The media player application may be configured to store user preferences for determining media files to subsequently load. Similarly, the media player application can select one or more media files based on media file type"; para [0036]- "At block 420, the application of the computing device may then load data for a second media file at the time period determined at block 405. This pre-loaded data may relate to only a portion of the second media file. In one embodiment, a buffer portion is pre-loaded, the buffer portion relating to only the initial period of the playback for the second media file. As will be discussed in more detail below with reference to FIGS. 5A-5C, the buffer portion may be pre-loaded in the time interval between the time period and the end time of the first media file. It may also be appreciated that header data associated with the media file may additionally be decoded during preloading of the buffer data in order to determine an endpoint of the media file for subsequent determinations of endpoints. The application may additionally buffer data for one or more additional media files); and

in response to the receiving of the selection, maintaining, by a processor of the digital receiver, a bitrate used for playback of the first piece of content to initiate playback of the new piece of content (initiate playback of second media file using already prepared media player application with same audio characteristics including same bit rate"; para [0037]- "At block 425, the application can initiate playback of the second media file following termination of the first media file. By initiating data for the second media file, a seamless transition may be provided for playback wherein data from the second file is played immediately following the first media file without a delay between output of the media file data. In certain embodiments, initiating playback of the second media file at block 425 may be based on the media player application that is already on as described above with reference to block 410. Playback at block 425 may additionally include converting and sending media data to an already prepared media player application. The application can then continue playback of the second media file following termination of the buffer period at block 430. By way of example, the second media file may be loaded after the endpoint of the first media file and during playback of the previously decoded buffer portion. The remaining portion of the second media file may then be output seamlessly following the buffer portion. Accordingly, media files may be seamlessly output by the computing device"; para [0033]- "In one embodiment, playback at block 410 may include loading a first media file, reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e.g., bit depth, bit rate, etc.) Further, playback of block 410 may include converting and sending audio data to the media player application"; para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats. For audio data, media files may be converted to a single audio format, such as 16 bit data at 44.1 kHz stereo by the media player application. This can facilitate providing continuous data and removing possible sources of delay during playback")

---see continuation on supplemental page---

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of
Box No V 2 Citations and Explanations

Regarding claim 2, Orr discloses the method of claim 1 Orr discloses further comprising determining whether the new piece of content is of a same type as the first piece of content (if first media file and second media file are audio files then they are same format, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device Although not shown in FIG 4, process 400 may additionally include displaying output level data of the second media file, during playback of the first media file") and

based on the new piece of content being the same type as the first piece of content determining whether to preserve at least a portion of a playback pipeline (same pipeline is preserved if same audio files are played, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data, media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device")

Regarding claim 6, Orr discloses a system (computer system, para [0025]- "Referring now to the figures, FIG 3 depicts a simplified block diagram of a computing device according to one or more embodiments of the invention In one embodiment, computing device 300 relates to a media player, such as one or more of a personal media player and media player application") comprising

one or more hardware processors and a storage device storing instructions that configure the one or more hardware processors (processors and instructions in memory, para [0025]- "As shown in FIG 3, computing device 300 includes processor 305, memory 310, input/output (I/O) interface 315, and display 320 Processor 305 may be configured to control operation of computing device 300 based on one or more computer executable instructions stored in memory 310, including a media player application for seamless playback of one or more media files Memory 310 may relate to one of RAM and ROM memories and may be configured to store one or more media files, and computer executable instructions for operation of computing device 300 As will be described below in more detail with respect to FIG 8, processor 300 may be configured to perform one or more media player application functions for seamless playback of media files") to perform operations comprising

causing playback, by a digital receiver, of a first piece of content (playback first media file, para [0026]- "Based on a user selection of I/O interface 315, processor 305 may be configured to run and/or select a media player application for playback of one or more media files For example, a user selection may initiate playback of one or more media files stored by memory 310 and/or stored by one or more devices coupled to device 300 via I/O interface 315", para [0032]- "Following detection of a user selection at block 405, the computing device may then initiate playback of the user selection at block 410, wherein a first media file is played Playback by the media player application may include output of audio and/or video data depending on the type of media In one exemplary embodiment, playback may include a graphical display associated with output levels of audio data In another embodiment, a visual display and associated audio data may be output based on video data", para [0033]- "In one embodiment, playback at block 410 may include loading a first media file, reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e g , bit depth, bit rate, etc) Further, playback of block 410 may include converting and sending audio data to the media player application"),

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content (para [0029]- "Computing device 300 may be configured to interoperate with one or more external devices for playback of media files stored on the external devices (e g , portable hard drives, removable memory portable media players, etc) In certain embodiments, device 300 may be configured to wirelessly receive one or more media files from a computing device via I/O interface 315 I/O interface 315 may include one or more ports for receiving media data, including ports for removable memory", para [0035]- "Selection of a media file by the media player application may be based on one or more sources selected by the user and may further be selected based on one or more user preferences The media player application may be configured to store user preferences for determining media files to subsequently load Similarly, the media player application can select one or more media files based on media file type"),

in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content (initiate playback of second media file using already prepared media player application with same audio characteristics including same bitrate, para [0037]- "At block 425, the application can initiate playback of the second media file following termination of the first media file By initiating data for the second media file, a seamless transition may be provided for playback wherein data from the second file is played immediately following the first media file without a delay between output of the media file data In certain embodiments, initiating playback of the second media file at block 425 may be based on the media player application that is already on as described above with reference to block 410 Playback at block 425 may additionally include converting and sending media data to an already prepared media player application The application can then continue playback of the second media file following termination of the buffer period at block 430 By way of example, the second media file may be loaded after the endpoint of the first media file and during playback of the previously decoded buffer portion The remaining portion of the second media file may then be output seamlessly following the buffer portion Accordingly, media files may be seamlessly output by the computing device", para [0033]- "In one embodiment, playback at block 410 may include loading a first media file reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e g , bit depth bit rate etc) Further, playback of block 410 may include converting and sending audio data to the media player application")

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of
Box No V 2 Citations and Explanations

Regarding claim 7, Orr discloses the system of claim 6 Orr discloses wherein the operations further comprise determining whether the new piece of content is of a same type as the first piece of content (if first media file and second media file are audio files then they are same format, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data, media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device Although not shown in FIG 4 process 400 may additionally include displaying output level data of the second media file, during playback of the first media file") and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline (same pipeline is preserved, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data, media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device")

Regarding claim 11, Orr discloses a machine-readable medium storing instructions that when executed by one or more hardware processors of a machine (processor readable medium, para [0024]- "When implemented in software, the elements of the invention are essentially the code segments to perform the necessary tasks The code segments can be stored in a processor readable medium, which may include any medium that can store or transfer information Examples of the processor readable mediums include an electronic circuit, a semiconductor memory device, a read-only memory (ROM) a flash memory or other non-volatile memory, a floppy diskette, a CD-ROM, an optical disk, a hard disk") cause the machine to perform operations compnsing

causing playback, by a digital receiver, of a first piece of content (playback first media file, para [0026]- "Based on a user selection of I/O interface 315, processor 305 may be configured to run and/or select a media player application for playback of one or more media files For example, a user selection may initiate playback of one or more media files stored by memory 310 and/or stored by one or more devices coupled to device 300 via I/O interface 315", para [0032]- "Following detection of a user selection at block 405, the computing device may then initiate playback of the user selection at block 410, wherein a first media file is played Playback by the media player application may include output of audio and/or video data depending on the type of media In one exemplary embodiment, playback may include a graphical display associated with output levels of audio data In another embodiment, a visual display and associated audio data may be output based on video data", para [0033]- "In one embodiment, playback at block 410 may include loading a first media file, reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e g , bit depth, bit rate, etc) Further, playback of block 410 may include converting and sending audio data to the media player application"),

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content (para [0029]- "Computing device 300 may be configured to interoperate with one or more external devices for playback of media files stored on the external devices (e g , portable hard drives, removable memory, portable media players, etc) In certain embodiments, device 300 may be configured to wirelessly receive one or more media files from a computing device via I/O interface 315 I/O interface 315 may include one or more ports for receiving media data, including ports for removable memory"; para [0035]- "Selection of a media file by the media player application may be based on one or more sources selected by the user and may further be selected based on one or more user preferences The media player application may be configured to store user preferences for determining media files to subsequently load Similarly, the media player application can select one or more media files based on media file type"),

in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content (initiate playback of second media file using already prepared media player application with same audio characteristics including same bitrate, para [0037]- "At block 425, the application can initiate playback of the second media file following termination of the first media file By initiating data for the second media file, a seamless transition may be provided for playback wherein data from the second file is played immediately following the first media file without a delay between output of the media file data In certain embodiments, initiating playback of the second media file at block 425 may be based on the media player application that is already on as described above with reference to block 410 Playback at block 425 may additionally include converting and sending media data to an already prepared media player application The application can then continue playback of the second media file following termination of the buffer period at block 430 By way of example, the second media file may be loaded after the endpoint of the first media file and during playback of the previously decoded buffer portion The remaining portion of the second media file may then be output seamlessly following the buffer portion Accordingly, media files may be seamlessly output by the computing device", para [0033]- "In one embodiment, playback at block 410 may include loading a first media file, reading at least a portion of the media data in to a buffer, and turning the media player application on for playback at pre-described audio characteristics (e g , bit depth, bit rate, etc) Further, playback of block 410 may include converting and sending audio data to the media player application")

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Continuation of
Box No V 2 Citations and Explanations
Regarding claim 12, Orr discloses the machine readable medium of claim 11 Orr discloses further wherein the operations further comprises determining whether the new piece of content is of a same type as the first piece of content (if first media file and second media file are audio files then they are same format, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data, media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device Although not shown in FIG 4, process 400 may additionally include displaying output level data of the second media file, during playback of the first media file") and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline (same pipeline is preserved, para [0039]- "Another advantage of the media player application may be conversion of media files to a standard file format by the application, wherein the first and second media files are associated with different file formats For audio data, media files may be converted to a single audio format, such as 16 bit data at 44 1 kHz stereo by the media player application This can facilitate providing continuous data and removing possible sources of delay during playback In certain embodiment, it may be required to convert media files to a single output stream to allow for playback of an audio device")

Claims 3-5, 8-10, 13-15 lack an inventive step under PCT Article 33(3) as being obvious over Orr in view of US 2017/0244924 A1 to Sony Corporation (hereinafter Sony)

Regarding claim 3, Orr discloses the method of claim 2 Orr does not disclose wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information

Sony in the related art of content playback reducing switching delay discloses detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content(detect codec for new content, para [0040]- "FIG 2 is a flow chart that shows an operation of the reception apparatus 100 for storing codec mode information according to one example At step S200, the reception apparatus 100 begins receiving a selected service, for example by tuning to a channel to receive a broadcast signal (or data stream) carrying the service For example, the reception apparatus 100 tunes to the channel in response to a user channel selection or during an initial channel scan At step S202, the reception apparatus 100 determines one or more codec modes for processing the content provided by the service on that channel The one or more codec modes may be signaled in metadata received with the service"), and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information (para [0041] - "Thus, the reception apparatus 100 is able to reduce a delay in switching to content provided by a service or channel in the future by beginning to configure itself to process that service's or channel's content as soon as the service or channel is selected, without the need to extract and processing metadata for that service or channel Further, in certain embodiments, the table is organized based on the codec mode information For example, services or channels that use the same codec mode(s) are grouped together, as further described below", para [0042]- "FIG 3 is a flow chart that shows an operation of the reception apparatus 100 for processing content according to one example At step S300, the reception apparatus 100 receives a service or channel selection from the user For example, the user may input a channel number, which is associated with the service, using a remote control or using the channel up or channel down buttons of the remote control to select a channel The remote control sends control signals to the reception apparatus 100 indicating the channel selection of the user At step S302, the reception apparatus 100 tunes to the channel selected at step S300 to receive a broadcast signal (or data stream) The reception apparatus 100 identifies the one or more codec modes associated with the channel For example, the reception apparatus 100 may use the table stored in the reception apparatus 100 to identify the one or more codec modes As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

It would have been obvious to a person having ordinary skill in the art to modify the method of Orr with the teaching of determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information as disclosed by Sony as this would have provided the advantage for preparing the appropriate decoders for new contents without causing delay (para [0040]-[0042])
---see continuation on supplemental page---

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Regarding claim 4, Orr in view of Sony discloses the method of claim 3 Sony discloses further comprising preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information (para [0042]- "In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

Regarding claim 5, Orr in view of Sony discloses the method of claim 3 Sony discloses further comprising releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information, and obtaining a new audio decoder and a new video decoder based on the codec information (para [0042]- "As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

Regarding claim 8, Orr discloses the system of claim 7 Orr does not disclose wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information

Sony in the related art discloses the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content (detect codec for new content, para [0040]- "FIG 2 is a flow chart that shows an operation of the reception apparatus 100 for storing codec mode information according to one example At step S200, the reception apparatus 100 begins receiving a selected service, for example by tuning to a channel to receive a broadcast signal (or data stream) carrying the service For example, the reception apparatus 100 tunes to the channel in response to a user channel selection or during an initial channel scan At step S202, the reception apparatus 100 determines one or more codec modes for processing the content provided by the service on that channel The one or more codec modes may be signaled in metadata received with the service (e g , in the broadcast signal) For example, the metadata may identify the one or more encoding formats (e g , audio and/or video encoding formats) used to encode the content and/or one or more codecs for decoding the one or more encoding formats In one example, the audio codec mode may include any one or a combination of AC-3, AC-4, MPEG-H, and AAC The video codec mode may include MPEG-2, AVC, and HEVC"); and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information (para [0041] - "Thus, the reception apparatus 100 is able to reduce a delay in switching to content provided by a service or channel in the future by beginning to configure itself to process that service's or channel's content as soon as the service or channel is selected, without the need to extract and processing metadata for that service or channel Further, in certain embodiments, the table is organized based on the codec mode information For example, services or channels that use the same codec mode(s) are grouped together, as further described below", para [0042]- "FIG 3 is a flow chart that shows an operation of the reception apparatus 100 for processing content according to one example At step S300, the reception apparatus 100 receives a service or channel selection from the user For example, the user may input a channel number, which is associated with the service, using a remote control or using the channel up or channel down buttons of the remote control to select a channel The remote control sends control signals to the reception apparatus 100 indicating the channel selection of the user At step S302, the reception apparatus 100 tunes to the channel selected at step S300 to receive a broadcast signal (or data stream) The reception apparatus 100 identifies the one or more codec modes associated with the channel For example, the reception apparatus 100 may use the table stored in the reception apparatus 100 to identify the one or more codec modes As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

It would have been obvious to a person having ordinary skill in the art to modify the system of Orr with the teaching of determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information as disclosed by Sony as this would have provided the advantage for preparing the appropriate decoders for new contents without causing delay (para [0040]-[0042])

---see continuation on supplemental page---

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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No
PCT/US 18/46723

Supplemental Box

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Box No V 2 Citations and Explanations

Regarding claim 9, Orr in view of Sony discloses the system of claim 8 Sony discloses wherein the operations further comprise preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information (para [0042]- "In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

Regarding claim 10, Orr in view of Sony discloses the system of claim 8 Sony discloses wherein the operations further comprise releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information, and obtaining a new audio decoder and a new video decoder based on the codec information (para [0042]- "As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

Regarding claim 13, Orr discloses the machine-readable medium of claim 12 Orr does not disclose wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information
Sony in the related art discloses detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content (detecting codec in new content, para [0040]- "FIG 2 is a flow chart that shows an operation of the reception apparatus 100 for storing codec mode information according to one example At step S200, the reception apparatus 100 begins receiving a selected service, for example by tuning to a channel to receive a broadcast signal (or data stream) carrying the service For example, the reception apparatus 100 tunes to the channel in response to a user channel selection or during an initial channel scan At step S202, the reception apparatus 100 determines one or more codec modes for processing the content provided by the service on that channel The one or more codec modes may be signaled in metadata received with the service (e g , in the broadcast signal) For example, the metadata may identify the one or more encoding formats (e g , audio and/or video encoding formats) used to encode the content and/or one or more codecs for decoding the one or more encoding formats In one example, the audio codec mode may include any one or a combination of AC-3, AC-4, MPEG-H, and AAC The video codec mode may include MPEG-2, AVC, and HEVC"), and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information (para [0041] - "Thus, the reception apparatus 100 is able to reduce a delay in switching to content provided by a service or channel in the future by beginning to configure itself to process that service's or channel's content as soon as the service or channel is selected, without the need to extract and processing metadata for that service or channel Further, in certain embodiments, the table is organized based on the codec mode information For example, services or channels that use the same codec mode(s) are grouped together, as further described below", para [0042]- "FIG. 3 is a flow chart that shows an operation of the reception apparatus 100 for processing content according to one example At step S300, the reception apparatus 100 receives a service or channel selection from the user For example, the user may input a channel number, which is associated with the service, using a remote control or using the channel up or channel down buttons of the remote control to select a channel The remote control sends control signals to the reception apparatus 100 indicating the channel selection of the user At step S302, the reception apparatus 100 tunes to the channel selected at step S300 to receive a broadcast signal (or data stream) The reception apparatus 100 identifies the one or more codec modes associated with the channel For example, the reception apparatus 100 may use the table stored in the reception apparatus 100 to identify the one or more codec modes As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

It would have been obvious to a person having ordinary skill in the art to modify the medium of Orr with the teaching of determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content, and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information as disclosed by Sony as this would have provided the advantage for preparing the appropriate decoders for new contents without causing delay (para [0040]-[0042])
---see continuation on supplemental page--

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of
Box No V 2 Citations and Explanations

Regarding claim 14, Orr in view of Sony discloses the machine-readable medium of claim 13 Sony discloses wherein the operations further comprise preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information (para [0042]- "As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata")

Regarding claim 15, Orr in view of Sony discloses the machine-readable medium of claim 13 Sony discloses wherein the operations further comprise
releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information, and obtaining a new audio decoder and a new video decoder based on the codec information (para [0042]- "As described previously herein, an indication of the one or more codec modes associated with each channel and/or service is stored in the table according to the methodology shown in FIG 2 Further, in response to determining that an indication of the one or more codec modes associated with the channel is not stored in the table, the reception apparatus 100 may extract, or otherwise determine, the one or more codec modes from the metadata In one embodiment, even when the indication of the one or more codec modes is stored, the reception apparatus 100 processes the metadata to confirm whether the stored information is accurate either during or before the reception apparatus 100 configures itself based on the previously indicated one or more codec modes At step S304, the reception apparatus 100 processes the content for presentation to the user For example, the reception apparatus loads one or more codecs, or performs routing, according to the one or more codec modes identified at step S302 to decode the broadcast signal Then, the content is displayed to the user")

Claims 1-15 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry

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Espacenet

TW202415077A Bitrate and pipeline preservation for content presentation

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Classifications:
IPC ***H04N21/23;***

CPC **H04L65/70 (EP,US); H04L65/764 (EP); H04L65/80 (EP); H04N21/23655 (US); H04N21/2662 (US); H04W28/02 (EP);**

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Bitrate and pipeline preservation for content presentation

Abstract

Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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【54】發明名稱：用於內容呈現之位元率及管線保留技術
【21】申請案號：112146227　　【22】申請日：中華民國 107 (2018) 年 08 月 02 日
【30】優先權：2017/09/08　印度　201741031917
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美國
【74】代理人：劉法正；尹重君
【57】發明摘要：

本發明提供用於最佳化一內容改變處理程序之系統及方法。在實例實施例中，一數位接收器致使播放一第一內容片段。該數位接收器在該第一內容片段之該播放期間接收一新內容片段之一選擇以供播放。回應於該接收到該選擇，該數位接收器維持用於播放該第一內容片段之一位元率以起始該新內容片段之播放。

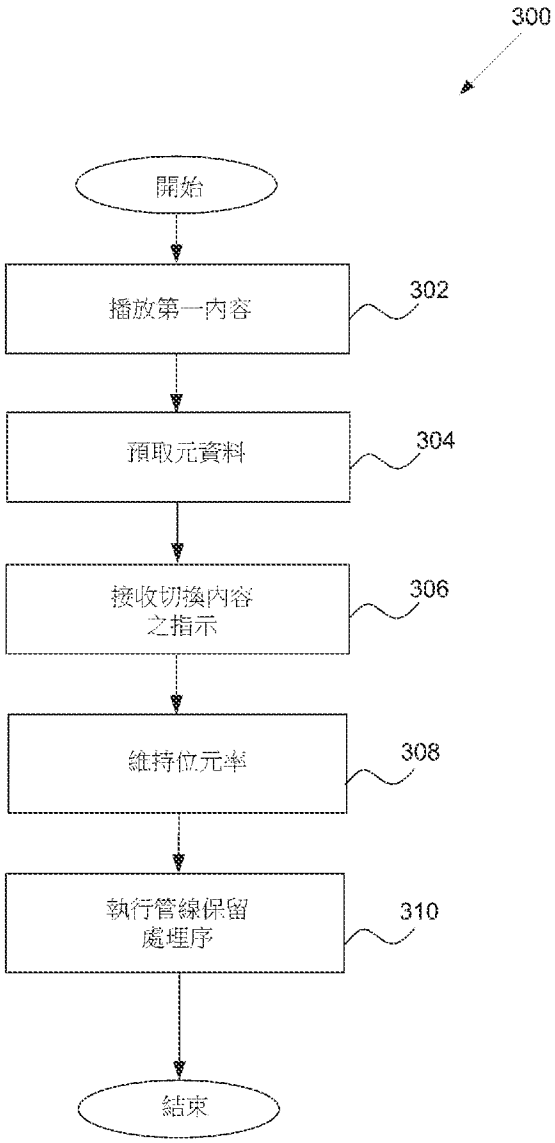
指定代表圖：

Pinterest Ex. 1004, Page 238 of 401

符號簡單說明：

300:實例方法

302、304、306、308、310:操作



【圖3】

Pinterest Ex. 1004, Page 239 of 401

Espacenet

Bibliographic data: CN103354999 (A) — 2013-10-16

System and method for providing network access to antenna feeds

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Applicant(s): AEREO INC ± (AEREO INC, ; AEREO公司)

Classification: - international: ***H04H20/57; H04H60/82; H04N21/214; H04N21/218; H04N21/222; H04N21/239; H04N21/2747; H04N21/41; H04N21/414; H04N21/4363; H04N21/61***

- cooperative: **H04H20/57 (EP, KR, US)**; **H04H60/82 (EP, KR, US)**; **H04N19/40 (EP, US)**; **H04N21/2143 (EP, US)**; **H04N21/2181 (EP, US)**; **H04N21/2221 (EP, US)**; **H04N21/2393 (EP, US)**; **H04N21/2747 (EP, KR, US)**; **H04N21/4126 (EP, KR, US)**; **H04N21/41407 (EP, US)**; **H04N21/4363 (KR)**; **H04N21/43637 (EP, US)**; **H04N21/61 (KR)**; **H04N21/6112 (EP, US)**; **H04N21/6175 (EP, US)**; **H04N5/455 (US)**; H04H60/51 (EP, US); H04H60/70 (EP, US); H04N21/2335 (EP, US); H04N21/25841 (EP, US); H04N21/25866 (EP, US); H04N21/4341 (EP, US); H04N21/4347 (EP, US)

Application number: CN20118065163 20111117 Global Dossier

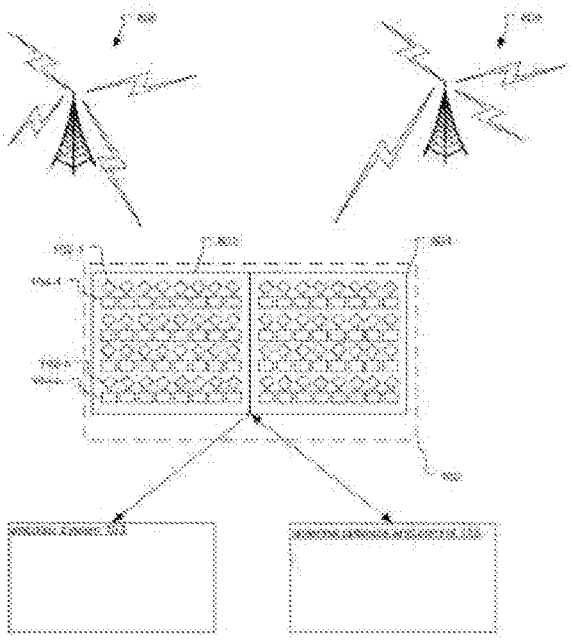
Priority number(s): WO2011US61232 20111117 ; US20100415012P 20101118 ; US20100422950P 20101214 ; US201161533946P 20110913

Also published as: CN103354999 (B) AU2011329767 (A1) BR112013012106 (A2) CA2817367 (A1) EP2641403 (A1) more

Abstract of CN103354999 (A)

A method and system for capturing, storing, and streaming over the air broadcasts based on user requests is disclosed. The system and method utilize subarrays of antenna elements for receiving over the air broadcasts. Processing pipelines are used to demodulate, transcode and index the content transmissions to produce content data that are streamed to users. In this way, the feeds from antennas can be accessed by users over a network connection.

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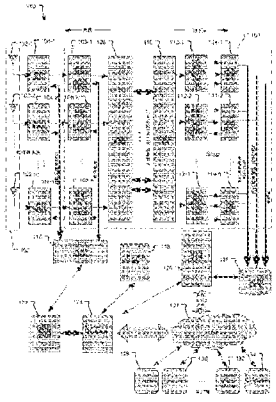
权利要求书7页 说明书15页 附图12页

(54)发明名称

提供天线馈源的网络接入的系统和方法

(57)摘要

本发明公开了一种基于用户请求捕获、储存和流处理无线广播的方法和系统。该系统和方法利用天线单元子阵列接收无线广播。采用处理管线解调、转码和索引内容传输以生成流传输至用户的内容数据。通过此种方法，用户可通过网络连接访问来自天线的馈源。



CN 103354999 A

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1. 一种从空中广播流传输内容传输至用户设备的方法，所述方法包括：

向用户呈现可用的内容传输的列表；

接收来自用户的请求，以从可用的内容传输中接收选定的内容传输；

使用每一独立用户的天线单元接收选定的内容传输；以及

流传输选定的内容传输至用户设备。

2. 根据权利要求 1 所述的方法，进一步包括对天线单元进行调谐以从广播机构接收选定的内容传输。

3. 根据权利要求 1 所述的方法，进一步包括解调来自天线单元的馈电以生成内容传输数据。

4. 根据权利要求 3 所述的方法，进一步包括将内容传输数据转换为不同的编码。

5. 根据权利要求 4 所述的方法，其中将内容传输数据从 MPEG-2 转码为 MPEG-4 编码。

6. 根据权利要求 3 所述的方法，进一步包括把内容传输数据转码为两种或两种以上的不同的分辨率。

7. 根据权利要求 6 所述的方法，进一步包括把已转码的内容传输数据以基于用户设备分辨率所确定的分辨率流传输到用户设备。

8. 根据权利要求 1 所述的方法，进一步包括在把选定的内容传输流传输到用户之前，把选定的内容传输存储在文件存储器中。

9. 根据权利要求 8 所述的方法，其中文件存储器把选定的内容传输储存在对应每一独立用户的单独位置。

10. 根据权利要求 1 所述的方法，进一步包括从可用的天线单元中，根据哪些天线单元被优化于接收用户选定的内容传输，分配该天线单元给用户。

11. 根据权利要求 1 所述的方法，其中可用的内容传输的列表基于在每个用户的地理位置上可用的无线广播。

12. 根据权利要求 1 所述的方法，其中仅对用户流传输选定的内容传输，该选定的内容传输由选定的对应每一独立用户的天线单元接收。

13. 根据权利要求 1 所述的方法，进一步包括当用户请求内容传输时，分配运行中的天线单元。

14. 根据权利要求 1 所述的方法，进一步包括把满足内容传输请求的天线单元专用于用户。

15. 一种流传输内容传输至用户设备的系统，所述系统包括：

应用服务器，其向用户呈现可用的内容传输的列表，其中该应用服务器接收来自用户设备的请求以从可用的内容传输中接收选定的内容传输；

天线控制器，其控制天线单元接收对应每一独立用户的选定的内容传输；以及

流传输服务器，其把选定的内容传输作为内容数据流传输至用户设备。

16. 根据权利要求 15 所述的系统，进一步包括调谐器，其在天线控制器的控制下对天线单元进行调谐以从广播机构中接收选定的内容传输。

17. 根据权利要求 15 所述的系统，进一步包括解调器，其解调并解码来自天线单元的馈电以生成内容数据。

18. 根据权利要求 17 所述的系统，进一步包括转码器，其把内容传输数据转换为不同

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的编码。

19. 根据权利要求 18 所述的系统，其中内容传输数据由转码器从 MPEG-2 编码转换为 MPEG-4 编码

20. 根据权利要求 18 所述的系统，其中转码器把内容传输数据转换为两种或两种以上的不同的分辨率。

21. 根据权利要求 20 所述的系统，其中流传输服务器把已转码的内容数据以基于用户设备分辨率确定的分辨率流传输到用户设备。

22. 根据权利要求 15 所述的系统，进一步包括文件存储器，其在流传输内容数据到用户设备之前存储所述内容数据。

23. 根据权利要求 22 所述的系统，其中文件存储器把内容数据储存在对应每一独立用户的单独位置。

24. 根据权利要求 15 所述的系统，进一步包括天线控制器，其从可用的天线单元中，根据哪些天线单元被优化于接收选定的内容传输，分配该天线单元给用户。

25. 根据权利要求 15 所述的系统，其中应用服务器基于每个用户的地理位置上的可用无线广播提供可用的内容传输的列表。

26. 根据权利要求 15 所述的系统，其中仅对用户流传输选定的内容传输，该选定的内容传输由选定的对应每一独立用户的天线单元接收。

27. 根据权利要求 15 所述的系统，其中天线控制器在用户请求内容传输时分配运行中的天线单元。

28. 根据权利要求 15 所述的系统，其中天线控制器将用于满足内容传输请求的天线单元专用于用户。

29. 一种用于捕获无线广播的系统，所述系统包括：

天线单元子阵列，其接收内容传输的无线广播，每一天线单元子阵列被优化以从不同的广播机构接收无线广播；

应用服务器，其接收用户从广播机构获取内容传输的请求；以及

天线控制器，其根据哪个天线单元子阵列被优化于探测生成用户所请求的内容传输的广播机构，分配独立的天线单元给每一用户。

30. 一种用于捕获无线广播的方法，所述方法包括：

使用天线单元子阵列接收内容传输的无线广播，每一天线单元子阵列被优化以从不同的广播机构接收无线广播；

接收用户从广播机构获取内容传输的请求；以及

根据哪个天线单元子阵列被优化于探测生成内容传输的广播机构，从子阵列中分配独立的天线单元给每一独立的用户。

31. 一种流传输内容传输至用户设备的系统，所述系统包括：

应用服务器，向用户呈现可用的内容传输的列表，其中该应用服务器接收来自用户设备的请求以接收从可用的内容传输中选定的内容传输；

天线控制器，其控制天线单元接收对应每一独立用户的选定内容传输，以及分配当前未被用户使用的天线单元以接收其预期用户将想要在未来观看的内容传输；以及

流传输服务器，其将选定的内容传输作为内容数据流传输到用户设备，且当一用户需

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要观看预期的内容传输中的一个时，将由来自天线单元的馈电所产生的内容数据分配并流传输至该用户。

32. 一种流传输录制的内容传输至用户设备的方法，所述方法包括：

把内容传输作为内容数据存储在广播文件存储器中，该内容数据被唯一地独立分配到每个用户，且该内容数据通过从天线馈源捕获无线广播生成；

向用户呈现录制的内容传输的列表，其中该录制的内容传输为基于每个用户的请求而录制；以及

响应用户的选择，访问录制的内容传输的内容数据并所述把内容数据流传输至对应的用户的用户设备。

33. 根据权利要求 32 所述的方法，其中储存在广播文件储存器中的内容传输由天线单元捕获，该天线单元在每一用户的用户账户的有效期限内唯一地分配到该用户。

34. 根据权利要求 32 所述的方法，其中储存在广播文件储存器中的内容传输由天线单元捕获，该天线单元在内容传输的持续时间内唯一地分配到每一用户。

35. 根据权利要求 32 所述的方法，其中捕获内容传输的天线单元以广播文件储存器中的内容数据来识别。

36. 根据权利要求 32 所述的方法，进一步包括：用户通过用户账户访问广播文件存储器中唯一分配的内容数据。

37. 根据权利要求 32 所述的方法，其中储存录制的内容传输包括以至少两种分辨率储存内容数据。

38. 根据权利要求 37 所述的方法，进一步包括确定用户设备的分辨率，然后选择流传输内容数据的高分辨率或低分辨率版本。

39. 根据权利要求 32 所述的方法，其中通过用户信息识别储存在文件储存器中的每个内容数据，该用户信息识别分配有该内容数据的用户。

40. 根据权利要求 32 所述的方法，其中通过天线信息识别储存在文件储存器中的内容数据，该天线信息识别用于捕获无线广播的天线单元，所述内容数据产生自所述无线广播。

41. 根据权利要求 32 所述的方法，其中通过时间信息识别储存在文件储存器中的内容数据，该时间信息识别无线广播被捕获的时刻，所述内容数据产生自所述无线广播。

42. 一种流传输录制的内容传输的系统，所述系统包括：

应用服务器，提供对单独的用户账户的访问，其中该应用服务器向用户提供录制的内容传输的列表，其中该录制的内容传输基于每个单独用户的请求通过从天线馈源捕获无线广播而录制；以及

流传输服务器，访问录制的内容传输的内容数据，该内容数据被唯一地及单独地分配到每个用户，以及该流传输服务器将内容数据流传输到用户设备。

43. 根据权利要求 42 所述的系统，进一步包括存储内容数据的广播文件存储器。

44. 根据权利要求 43 所述的系统，进一步包括一个或多个天线单元，用于捕获广播文件存储器中的录制的内容传输的无线广播，所述文件存储器识别用于捕获每一无线广播的天线单元。

45. 根据权利要求 43 所述的系统，其中文件存储器以至少两种分辨率储存录制的内容传输。

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46. 根据权利要求 45 所述的系统，其中流传输服务器基于用户设备分辨率以所述分辨率中的一个流传输所述内容传输中的一个。

47. 根据权利要求 43 所述的系统，其中通过用户信息识别储存在文件储存器中的内容数据，该用户信息识别被分配该内容数据的用户。

48. 一种储存录制的内容传输的文件储存器系统，所述系统包括储存的从内容传输产生的内容数据，该内容传输从来自天线馈源的无线广播中捕获。

49. 根据权利要求 48 所述的系统，其中所述内容数据包含的内容传输至少具有两种分辨率。

50. 根据权利要求 48 所述的系统，其中所述内容数据包含的内容传输至少具有三种分辨率。

51. 根据权利要求 48 所述的系统，其中通过用户信息识别储存在文件储存器中的内容数据，该用户信息识别被分配该内容数据的用户。

52. 根据权利要求 48 所述的系统，其中通过天线信息识别储存在文件储存器中的内容数据，该天线信息识别用于捕获无线广播的天线单元。

53. 一种天线系统，包括：

天线单元二维阵列，单独地接收空中广播，该天线单元阵列具有每平方米至少 10 个天线单元的密度；以及

编码器系统，将由单独的天线单元接收的无线广播转换为内容数据，以将其储存在数据储存系统中。

54. 根据权利要求 53 所述的系统，其中天线单元为全向天线单元。

55. 根据权利要求 53 所述的系统，其中天线单元为对称双环天线单元。

56. 根据权利要求 53 所述的系统，进一步包括：

多个所述的天线单元的二维阵列；以及

外壳，支撑彼此相邻的二维阵列。

57. 根据权利要求 56 所述的系统，其中所述天线单元的二维阵列在外壳内构成三维阵列。

58. 根据权利要求 53 所述的系统，其中天线单元的二维阵列和至少一部分编码器系统在同一电路板上实现。

59. 根据权利要求 58 所述的系统，其中编码器系统包括在电路板上实现的解调器。

60. 根据权利要求 53 所述的系统，进一步包括射频调谐器，其用于对二维阵列的天线单元进行调谐。

61. 根据权利要求 60 所述的系统，其中天线单元的二维阵列和射频调谐器在同一电路板上实现。

62. 根据权利要求 61 所述的系统，其中所述电路板包括至少 50 个天线单元。

63. 根据权利要求 53 所述的系统，其中所述天线单元具有每平方米至少 50 个天线单元的密度。

64. 根据权利要求 53 所述的系统，其中天线单元为半球定向天线单元。

65. 一种使用天线单元阵列接收无线广播的方法，所述方法包括：

设置接收无线广播的天线单元的二维阵列，该天线单元阵列具有每平方米至少 10 个

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天线单元的密度；

使用天线单元阵列接收空中广播；以及

将无线广播编码为内容数据以储存在数据储存设备中。

66. 根据权利要求 65 所述的方法，进一步包括：

设置多个天线单元的二维阵列；以及

用外壳容纳彼此相邻的二维阵列。

67. 根据权利要求 66 所述的方法，进一步包括由天线单元的二维阵列构成三维阵列。

68. 根据权利要求 65 所述的方法，进一步包括在同一电路板上实施天线单元的二维阵列和天线单元的射频调谐器。

69. 根据权利要求 65 所述的方法，进一步包括在所述二维阵列中设置至少 50 个天线单元。

70. 根据权利要求 65 所述的方法，其中所述天线单元具有每平方米至少 50 个天线单元的密度。

71. 一种处理天线馈电的系统，所述系统包括：

接收内容的无线广播的天线单元；

天线处理管线，每个管线均从天线单元中解调天线馈电以生成由所述天线单元接收的内容的无线广播的内容数据；

切换系统，选择性地将每个天线单元连接到天线处理管线中的一个，以及

天线控制器，控制切换系统以实现内容数据的生成进而满足用户的内容请求。

72. 根据权利要求 71 所述的系统，其中解调天线馈电的每一管线均包括从解调器群组中选定的解调器以解调来自天线单元的天线馈电。

73. 根据权利要求 72 所述的系统，其中，如果所述解调器群组中没有可用的解调器，所述天线控制器查找可替换的解调器。

74. 根据权利要求 73 所述的系统，其中，如果所述天线控制器找到可替换的解调器，则配置切换系统以把天线单元连接到该可替换的解调器，以构建额外的天线处理管线。

75. 根据权利要求 71 所述的系统，其中天线单元的数量大于天线处理管线的数量。

76. 根据权利要求 71 所述的系统，其中天线单元为临时地分配给用户。

77. 根据权利要求 71 所述的系统，其中天线单元在用户的用户账户的有效期内专用于用户。

78. 根据权利要求 71 所述的系统，其中用于从天线单元解调天线馈电的管线包括射频调谐器，每一射频调谐器均独立可调以使得每一天线单元能够接收不同的内容的无线广播。

79. 根据权利要求 78 所述的系统，其中所述射频调谐器直接地连接至所天线单元。

80. 根据权利要求 78 所述的系统，其中所述射频调谐器通过切换系统选择性地连接到天线单元。

81. 一种处理天线馈电的方法，所述方法包括：

使用天线单元接收内容的无线广播；

提供天线处理管线，从所述天线单元中解调天线馈电以生成由天线单元接收的内容的无线广播的内容数据；

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使用切换系统将每个天线单元连接到天线处理管线中的一个。

82. 根据权利要求 81 所述的方法，进一步包括配置切换系统以生成内容数据进而满足用户的内容请求。

83. 根据权利要求 81 所述的方法，其中解调天线馈电的每一管线均包括解调器，所述方法进一步包括从解调器的群组中选择解调器以从天线单元中解调天线馈电。

84. 根据权利要求 83 所述的方法，进一步包括，如果解调器群组中没有可用的解调器，则查找可替换的解调器。

85. 根据权利要求 84 所述的方法，进一步包括配置切换系统把天线单元连接到可替换的解调器，以构建额外的天线处理管线。

86. 根据权利要求 81 所述的方法，进一步包括临时地分配天线单元给用户。

87. 根据权利要求 81 所述的方法，进一步包括在特定用户的用户账户的有效期内，将天线单元专用于该特定的用户。

88. 根据权利要求 81 所述的方法，其中从天线单元中解调天线馈电的管线包括射频调谐器，每一射频调谐器均独立可调以使得每一天线单元能够接收不同内容的无线广播。

89. 根据权利要求 88 所述的方法，其中射频调谐器直接地连接到天线单元。

90. 根据权利要求 88 所述的方法，其中射频调谐器通过切换系统选择性地连接到天线单元。

91. 一种分配处理管线至天线单元的方法，所述方法包括：

专用地将天线单元分配给用户，该天线单元用于接收内容的无线广播；

响应用户的内容请求，查找可用的处理管线以解调内容的无线广播；以及

根据对处理管线的定位，分配处理管线至用户的专用天线单元以将所述处理管线连接至用户永久性分配的天线单元。

92. 根据权利要求 91 所述的方法，其中处理管线通过切换系统连接至用户永久性分配的天线单元。

93. 根据权利要求 91 所述的方法，其中通过用户永久性分配的天线接收无线内容。

94. 根据权利要求 91 所述的方法，其中分配的处理管线解调作为内容传输的无线内容。

95. 根据权利要求 94 所述的方法，进一步包括流传输内容传输至用户设备。

96. 根据权利要求 91 所述的方法，进一步包括把天线单元租给用户使用。

97. 根据权利要求 91 所述的方法，进一步包括把天线单元出售给用户。

98. 一种接收无线广播的印刷电路板，所述印刷电路板包括：

接收无线广播的天线单元；

天线单元的射频调谐器，所述射频调谐器独立地对天线单元进行调谐以单独地接收无线广播；

解调器，从射频调谐器接收无线广播的单独拷贝并将所述空中广播编码为内容数据；以及

将来自天线单元的馈电连接到不同解调器的选择器开关。

99. 根据权利要求 98 所述的印刷电路板，进一步包括用于把射频调谐器连接到不同天线单元的选择器开关。

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100. 一种流传输内容传输至用户设备的系统，所述系统包括：

应用服务器，向用户呈现可用的内容传输的列表，其中该应用服务器接收来自用户设备的请求以接收从可用的内容传输中选定的内容传输；

天线单元，专用于检测各个用户的内容传输；以及

流传输服务器，其将选定的内容传输作为内容数据流传输至用户设备。

101. 根据权利要求 100 所述的系统，其中天线单元为出售给用户。

102. 根据权利要求 100 所述的系统，其中天线单元为出租给用户。

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提供天线馈源的网络接入的系统和方法

[0001] 相关申请

[0002] 根据美国 35USC119（e），本申请要求 2010 年 11 月 18 日提交的临时专利申请 61/415012、2010 年 12 月 14 日提交的临时专利申请 61/422950 以及 2011 年 9 月 13 日提交的临时专利申请 61/533946 的权益，以上均通过引用全文并入本文中。

技术领域

[0003] 本发明涉及一种提供天线馈源的网络接入的系统和方法。

背景技术

[0004] 无线电视，也被称为地面电视或广播电视，是一种利用穿过大气层的射频（RF）电磁波或辐射的电视内容散布方式。在美国，众所周知的广播无线电视内容的电视网络有 ABC、CBS、FOX、NBC 和 PBS 这些例子。通过一系列的联营电视台，这些网络的广播内容能够覆盖乡村。其结果是，这些电视网络中的每一个均能够进入超过 95% 的美国家庭。

[0005] 电视网一直在寻找各种方式来吸引新客户，增加收视。最近，一些电视网络已经把他们的节目放在线上供人们通过私人和公共数据网络（如 Internet）访问。通常情况下，电视网络将内容上传到他们的网站或其他一些第三方网站，如 HULU.COM，其把内容流传输给用户，有时这是收费的。目前，可用的内容往往是有限的；有时候，最新的剧集不可用或内容已经过时。

[0006] 与此同时，还有大量各种各样的设备可以播放音频和视频内容。除了无处不在的电视，现在许多人在他们的个人电脑和移动计算设备，如智能手机和平板电脑上观看视频。通常是使用用户数据网络、移动电话网络以及公共和私人无线数据网络，通过互联网访问视频内容。此外，现在有一些电视具备网络连接。而且，许多游戏机有能力使用，如 Netflix 公司提供的第三方软件访问视频内容。

发明内容

[0007] 尽管有所有观看视频的新模式，由传统电视网络转播的无线内容，一般地仍是只能通过有线电视订阅、卫星电视系统，或使用家里安装的天线捕捉空中广播信号来获取。对于不订阅有线电视或不具备有线接入的用户，一般都需要他们安装自己的 RF 天线或卫星天线，以捕捉到该广播内容。然后，该捕捉到的内容一般仅适用于在传统的电视上显示。用户通常没有简单的方式使该内容可用于其他具备视频功能的设备上。

[0008] 本系统和方法提供一种方案，使用户能够通过网络连接，如互联网和 / 或服务提供商网络，分别访问独立的天线馈源。每个用户被分配一天线，如他们自己的、分离的、独立的天线，然后，他们能够录制和 / 或流处理来自无线广播的内容传输。这种分配可能在用户开始录制时发生，或者用户可能会被专门分配一个特定的仅由他们独家使用的天线，用于他们的任何和所有的观看和录制。当用户选择内容传输时，独立的天线接收广播内容。基于用户的选择，该系统把内容数据分别存储到每个用户的独立账户，供以后由用户回放和 /

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或把内容数据流传输至各个单独的用户。通过这种方式，用户可以访问广播内容而无需维持他们自己的天线设施，并且可以在缺少直接访问空中广播所需的调谐器和解码器的设备上访问广播内容，例如移动设备。

[0009] 取决于运行模式，天线分配为永久或临时的。在一个模式下，当用户选择接收无线内容，或录制无线内容供以后观看时，相应的天线单元和编码资源被快速分配到用户。然后，当不再需要天线单元后，资源被返回到资源池，并对其他用户变为可用。在其它模式中，用户租赁或购买特定的天线单元，然后所述天线单元被专门分配给特定的用户，再然后所述天线单元用于为这些用户的请求服务。在一个范例中，天线单元在用户帐户的持续期间被租赁给用户。

[0010] 总体而言，在一个方面，本发明提供了一种把内容传输从无线广播流传输到用户设备的方法。该方法包括：向用户呈现可用的内容传输的列表；接收来自用户的从可用的内容传输中接收选定的内容传输的请求；使用每一独立用户的天线单元接收选定的内容传输；以及流处理选定的内容流传输至用户设备。

[0011] 在实施例中，对天线单进行调谐元以从广播机构接收选定的内容传输。对来自天线单元的馈电进行解调来生成内容传输数据。然后把内容传输数据转为不同的编码，例如从 MPEG-2 转换到 MPEG-4 编码。也可把内容传输数据转为两种或更多不同的分辨率。

[0012] 通常情况下，经转码的内容传输数据以基于用户设备分辨率所确定的分辨率流传输到用户设备。

[0013] 在一个实施例中，在把选定的内容传输流传输到用户之前，把选定的内容传输存储在文件存储器中，并且储存在对应每一独立用户的单独的位置。

[0014] 在一个示例中，从可用的天线单元中，根据哪些天线单元为最佳的接收用户选定的内容传输，分配天线单元给用户。

[0015] 通常，可用内容传输的列表基于在每个用户的地理位置上的可用无线广播。

[0016] 在一种模式中，当用户请求内容传输时，天线单元在运行中被分配。在另一个模式中，天线单元专用于用户，用于满足内容传输的请求。

[0017] 总体而言，在另一个方面，本发明提供了一种将内容传输流处理至用户设备的系统。该系统包括一应用服务器，其向用户呈现可用的内容传输的列表，该应用服务器接收来自用户设备的从可用的内容传输中接收选定的内容传输的请求。该系统进一步包括一天线控制器，其控制天线单元接收对应每一独立用户的选定的内容传输，以及包括一流传输服务器，其把选定的内容传输作为内容数据流传输到用户设备。

[0018] 总体而言，在另一个方面，本发明提供了用于捕获无线广播的系统。该系统包括：天线单元子阵列，用于接收内容传输的无线广播，每一天线单元子阵列被优化以从不同的广播机构接收无线广播。该系统进一步包括应用服务器，接收用户的从广播机构获取内容传输的请求，该系统还包括天线控制器，其根据哪个天线单元子阵列为最佳地发现产生用户所请求的内容传输的广播机构，分配独立的天线单元给每一用户。

[0019] 总体而言，在另一个方面，本发明提供了一种用于捕获无线广播的方法。

[0020] 该方法包括：使用天线单元子阵列接收内容传输的空中广播，优化每一天线单元子阵列以从不同的广播机构接收空中广播。该方法进一步包括：接收用户的从广播机构获取内容传输的请求，以及根据哪个子阵列被优化用于发现产生内容传输的广播机构，从子

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阵列中分配独立的天线单元给每一用户以接收内容传输。

[0021] 总体而言，在另一个方面，本发明提供了一种用于把内容传输流处理至用户设备的系统。该系统包括应用服务器，向用户呈现可用的内容传输的列表，该应用服务器接收来自用户设备的从可用的内容传输中接收选定的内容传输的请求。天线控制器控制天线单元接收对应每一独立用户的选定的内容传输，以及分配当前未被用户使用的天线单元以接收预期用户将想要在未来观看的内容传输。最后，流传输服务器将选定的内容传输作为内容数据流传输到用户设备，且当用户需要观看预期的内容传输中的一个时，将由来自天线单元的馈电所产生的内容数据分配并流传输至该用户。

[0022] 内容数据被关联到请求无线广播的用户，然后被存储在存储设备中。如果用户希望实时观看无线广播，则广播文件存储器通常作为缓存器并在流传输内容至用户设备之前暂时存储内容数据。否则，将内容数据关联到每个用户的独立账户，供未来访问以用于以后的播放。

[0023] 总体而言，在一个方面，本发明还提供了把录制的内容传输流处理至用户设备的方法。该方法包括：把内容传输作为内容数据存储在广播文件存储器中，把该内容数据唯一地独立分配到每个用户且通过从天线馈源捕获空中广播生成该内容数据。该方法进一步包括：向用户呈现录制的内容传输的列表，其中该录制的内容传输为基于每个用户的请求而录制；以及响应用户的选择，访问录制的内容传输的内容数据并把内容数据流传输到对应用户的用户设备。

[0024] 在实施例中，使用天线单元捕获在广播文件储存器中储存的内容传输，该天线单元在每一用户的用户账户的有效期限内或仅在内容传输的持续时间内唯一地分配到该用户。

[0025] 优选地，捕获内容传输的天线单元以广播文件储存器中的内容数据来识别。进一步，录制的内容传输优选地以至少两种分辨率储存。

[0026] 一般地，每个储存在文件储存器中的内容数据通过用户信息识别，该用户信息识别被分配内容数据的用户。它们也可通过时间信息来识别，该时间信息识别空中广播被捕获的时间，内容数据从该空中广播产生。

[0027] 总体而言，根据另一个方面，本发明提供了一种用于流传输录制的内容传输的系统。该系统包括应用服务器，提供对用户的单独账户的访问，其中该应用服务器向用户提供录制的内容传输的列表，其中该录制的内容传输为基于每个单独的用户的请求通过从天线馈源捕获空中广播而录制的。该系统进一步包括流传输服务器，访问录制的内容传输的内容数据，该内容数据被唯一地及单独地分配到每个用户，以及该流传输服务器把内容数据流传输到用户设备。

[0028] 总体而言，在另一个方面，本发明提供了一种用于储存录制的内容传输的文件储存器系统，该系统包括从内容传输产生的、储存的内容数据，该内容传输从来自天线馈源的无线广播中捕获。

[0029] 使系统可行的重点是构建一个物理上紧凑的天线系统。

[0030] 总体而言，在一个方面，本发明还提供了一种天线系统，包括单独地接收无线广播的天线单元的二维阵列，该天线单元阵列具有每平方米至少 10 个天线单元的密度，以及一编码器系统，用于把由单独的天线单元接收的无线广播转换为内容数据并储存在数据储存

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系统中。

[0031] 在实施例中，所述天线单元为全向天线单元，且具体地，该天线单元为对称双环天线单元。

[0032] 进一步，多个天线单元的二维阵列优选地配合一外壳使用，该外壳支撑互相邻近的二维阵列。因此，所述多个天线单元的二维阵列在外壳内构成一个三维阵列。

[0033] 在一个现有的示例中，天线单元的二维阵列和编码器系统至少一部分在同一电路板上实现。所述编码器系统包括在电路板上实现的解调器。所述编码器系统还包括射频调谐器，用于调谐二维阵列的天线单元。天线单元的二维阵列和射频调谐器可以在同一电路板上实现。

[0034] 至于密度，该电路板优选地包括至少 50 个天线单元，而天线单元具有每平方米至少 50 个天线单元的密度。

[0035] 总体而言，在另一个方面，本发明提供了一种使用天线单元阵列接收无线广播的方法。该方法包括提供天线单元的二维阵列以接收空中广播，该天线单元阵列具有每平方米至少 10 个天线单元的密度。该方法进一步包括使用天线单元阵列接收无线广播，以及把空中广播编码为内容数据以储存在数据储存设备内。

[0036] 特别地，在天线为租用或指向特定用户的模式中，期望能够最小化特定用户未访问系统时的未使用的资源的数量。当前系统允许编码池，甚至对资源进行微调以使它们可以在天线单元之间分配。

[0037] 总体而言，在一个方面，本发明还提供了一种处理天线馈源的系统。该系统包括用于接收无线广播内容的天线单元，以及天线处理管线，每个管线用于从天线单元中解调天线馈源以产生天线单元接收的无线广播内容的内容数据。该系统进一步包括用于选择性地把每个天线单元连接到天线处理管线中的一个的切换系统，以及天线控制器，控制切换系统允许内容数据的产生以完成用户对内容的请求。

[0038] 总体而言，在另一个方面，本发明提供了一种处理天线馈源的方法。该方法包括使用天线单元接收内容的空中广播，提供天线处理管线以从天线单元中解调天线馈电进而产生天线单元接收的空中广播内容的内容数据，以及使用切换系统把每个天线单元连接到天线处理管线中的一个。

[0039] 总体而言，在另一个方面，本发明提供了一种分配处理管线到天线单元的方法。该方法包括调配用于接收内容的空中广播的天线单元到用户，响应用户对内容的请求，查找可用的处理管线以解调内容的空中广播。该方法进一步包括：当找到处理管线时，分配处理管线到用户的被调予使用的天线单元以连接处理管线到用户的永久性地被分配的天线单元。

[0040] 总体而言，根据另一个方面，本发明提供了一种接收无线广播的印刷电路板。该印刷电路板包括用于接收空中广播的天线单元；用于天线单元的射频调谐器，该射频调谐器独立地调谐天线单元以单独地接收空中广播；解调器，其从射频调谐器接收无线广播的单独的拷贝并把无线广播编码为内容数据；以及选择器开关，其用于把来自天线单元的馈电连接到不同的解调器。

[0041] 总体而言，在另一个方面，本发明提供了一种流传输内容传输到用户设备的系统。该系统包括应用服务器，其向用户呈现可用的内容传输的列表，其中该应用服务器接收来

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自用户设备的请求，以接收从可用的内容传输中选定的内容传输。该系统进一步包括天线单元，其被指派为检测各个用户的内容传输；以及流传输服务器，其把选定的内容传输作为内容数据流传输到用户设备。

[0042] 本发明上述及其它的特征，包括各种不同的新颖结构和部件组合的细节，及其它优点，将在下文中参照附图得到更具体的描述，并在权利要求中指出。应理解，把本发明具体化的独特方法和装置以示例的方式展示，其并不作为对本发明的限制。本发明的原理和特征可在不超出本发明范围的多样和多个实施例中使用。

附图说明

[0043] 在附图中，附图标记指代不同视图的同一部件。附图不进行不必要的按比例缩放；取而代之的是其重点在于说明本发明的原理。在附图中：

[0044] 图 1 所示为用于捕获和配送地面电视内容的系统的方框图；

[0045] 图 2 所示为针对捕获来自不同广播机构的广播而优化的不同天线子阵列的原理图；

[0046] 图 3 所示为插件箱装置的透视原理图，其作为印刷电路板（PCB）上的二维天线阵列的外壳，由此相邻的电路板互相支撑构建一个三维阵列；

[0047] 图 4 所示为印刷电路板上天线的二维阵列的原理图；

[0048] 图 5 所示为 PCB 的侧视图，其显示了 PCB 上平衡环天线和平衡传输线的对称性；

[0049] 图 6A 所示为图 5 的 A-A 处的剖面图；

[0050] 图 6B 所示为图 5 的 B-B 处的剖面图；

[0051] 图 7 所示为一流程图，其显示了用户观看实况流内容、设置未来录制，或观看之前录制的内容的步骤；

[0052] 图 8 所示为一流程图，其显示了用户观看来自回放服务器的、他们之前录制的内容的步骤；

[0053] 图 9 所示为一流程图，其显示了用户安排未来无线广播录制的步骤；

[0054] 图 10 所示为一流程图，其显示了用户在其设备上实时观看无线内容的步骤；

[0055] 图 11 所示为用于把广播内容数据储存在广播文件储存器中的数据库结构；

[0056] 图 12 所示为利用合并的（pooled）接收器资源来捕获和配送电视内容的系统的一个实施例的原理方框图；

[0057] 图 13 所示为一流程图，其图示了应用网络服务器和天线是如何优化和控制位于其它印刷电路板上的资源的搜索。

具体实施方式

[0058] 图 1 显示了根据本发明的原理构造的系统 100，其允许各个用户经由分组网络，例如互联网，从天线接收地面电视内容。该系统允许每个用户单独地访问来自独立分配的天线的馈源，进行录制或实况流传输。

[0059] 在一个典型的实施中，用户经由互联网 127 使用客户端设备 128、130、132、134 访问系统 100。在一个示例中，客户端设备为个人计算机 134，其经由浏览器访问系统 100。通过使用 HTML-5 或程序，例如苹果公司的 Quick time，在个人计算机上显示视频内容。在

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其他示例中，通过移动设备访问系统 100，例如平板计算机，如 iPad，移动计算设备，移动电话，如 iPhone，计算设备，或运行谷歌公司的安卓操作系统的移动计算设备。在此，在一些实施中还使用 HTML-5 来提供视频。其它示例为具有网络接口和浏览能力的电视。除此以外，许多流行的游戏平台和一些电视还具有运行第三方软件的能力和提供网络浏览的能力，其都可以部署为通过网络连从系统 100 访问视频。

[0060] 应用服务器 124 管理这些来自客户端设备 128、130、132、134 的请求或命令。其允许客户端设备的用户选择他们是否想要观看或访问之前录制的内容，如电视节目，设置未来对电视节目广播的录制，或观看实况广播电视节目。在一些示例中，系统 100 还允许用户访问和 / 或录制无线（只有音频）广播。商业管理系统 118 用于验证用户账户，或如果他们还未具有账户则帮助用户设置新账户。

[0061] 如果用户请求观看之前录制的内容，则应用服务器 124 发送用户的命令到流传输服务器 120。流传输服务器 120 从广播文件储存器（或文件储存器）126 取回每个用户的个人之前录制的内容拷贝并把内容数据流传输到客户端设备 128、130、132、134。

[0062] 如果用户请求设置未来的录制或观看电视节目的实况广播，应用服务器 124 与天线优化和控制系统 116 通信以配置广播捕获资源，从而通过保存对应所述未来录制的日期和时间的天线和编码资源，来捕获和录制需要的广播内容。

[0063] 另一方面，如果用户请求观看实况广播，则应用服务器 124 和天线优化和控制系统 116 定位可立即使用的可用天线资源。在当前实施例中，由用户发起的所有内容，在无论其是否用于实况流传输或未来的录制而被回放和流传输到用户之前，临时地储存在流传输服务器 120 和 / 或文件储存器 126 中。这允许用户暂停和重播电视节目的若干部分以及再次观看储存的节目。天线优化和控制系统 116 在整个任何预订的电视节目或连续使用中维持该天线到用户的分配，直到这样的时刻，如用户通过关闭任务或因由控制系统 116 内执行的定时器所维持的预设时间段的到期而释放天线。一个可替换的实施可以使每个天线均被分配到一个特定用户，供该用户唯一使用。

[0064] 系统 100 的广播捕获部分包括天线单元阵列 102 ：102-1、102-2…102-n。这些单元 102-1、102-2…102-n 中的每一个均为独立的天线，其能够捕获不同的地面电视内容广播，以及，通过数字化和编码管线单独地处理那些广播以储存和 / 或在用户设备上实时转播。这样的配置允许为每个用户同时从不同的广播机构进行无线广播的录制。在所示的示例中，仅示出一个天线单元阵列。然而，在一个典型的实施例中，使用多个阵列，以及在一些示例中，该阵列被划分至多个群中。

[0065] 更详细地，天线优化和控制 116 决定天线阵列 102 内哪个天线单元 102-1 到 102-n 可用及被优化来接收用户请求的特定的无线广播。在一些示例中，这通过比较不同天线单元的 RSSI （接收信号强度指示器）数值来完成。RSSI 为对接收的或进来的射频信号的功率的测量值。因此，RSSI 数值越高，接收的信号就越强。

[0066] 在找出最理想的天线单元之后，天线优化和控制 116 指配所述天线单元给用户。天线优化和控制系统 116 然后发信号通知相应的 RF 调谐器 104-1 至 104-n 对被指配的天线单元进行调谐以接收广播。

[0067] 从每一个天线单元 102-1 至 102-n 和与其关联的调谐器 104-1 至 104-n 中接收到的广播作为内容传输并行传输到编码系统 103。编码系统 103 由编码组件组成，该编码组件

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为每个分配的天线 102-1 至 102-n 和调谐器 104-1 至 104-n 对构建并行处理管线。

[0068] 编码系统使用分配到每个处理管线的 ATSC（先进电视系统委员会）解码器阵列 106-1-106-n，把来自天线 102 和调谐器 104 的单独内容传输解调并解码为 MPEG-2 格式。在每一广播载体信号均包含多个内容传输的情况下，天线优化和控制系统 116 发出信号通知 ATSC 解码器（或解调器）106-1 至 106-n 选择包含在载体信号上的所需要的节目。所述内容传输被解码为 MPEG-2 格式的内容传输数据，因为 MPEG-2 目前为对影片和关联的音频信息进行编码的标准格式。

[0069] 来自 ATSC 解码器 106-1 至 106-n 的内容传输数据被发送到多路复用器 108。然后该内容穿过天线传送互联器被传输到分路器开关 110。在一个优选的实施例中，天线传送互联器为 n×10GbE 光学数据传送层。

[0070] 在当前的实施例中，天线阵列 102、调谐器 104-1 至 104-n、解调器 106-1 至 106-n 以及多路复用器 108 位于室外，例如位于建筑物顶部或天线塔上的一个外壳内。针对将会与这样的安装相关联的温度周期变化，这些组件可以做成较为稳固。以及，这些组件相对较为廉价，由此在承受由放电或故意毁坏引起的破坏的情况下，损失可以最小化。

[0071] 使用多路复用器 108、分路器开关 110 以及 n×10GbE 数据传送，把捕获的内容传输数据传送到系统的剩余部分中，其中所述剩余部分优选地位于一个安全位置，例如建筑物的地面棚屋或地下室，其通常还具有更好的外界环境控制。

[0072] 然后每个天线处理管线的内容传输数据被转码为对储存和流处理更有效的格式。在当前的实施例中，由转码器阵列 112-1、112-2…112-n 实行目标为 MPEG-4（也称为 H.264）格式的转码。一般地，多个转码线程运行在单个信号处理核心、FPGA 或 ASIC 类型设备上。

[0073] 内容传输数据被转码为 MPEG-4 格式以减少比特率和数据占用的空间大小。作为结果，内容传输数据至 MPEG-4 编码的转换将减少所述内容的图片质量或分辨率，但这种减少一般地不足以令普通的用户在典型的分辨率下降的视频显示设备上觉察得到。减少了的内容传输大小将使得所述内容传输更易于储存、传送，以及流传输到用户设备。类似地，在当前的实施例中音频被转码为 AAC，其众所周知的是高效率的。

[0074] 在一个实施例中，已转码的内容传输数据被发送到管线的分包器和索引器 114-1、114-2…114-n，其把数据分成包。在当前的实施例中，包协议为 UDP（用户数据报协议），其为无状态的、流传输的协议。UDP 为一简单的传输模型，其提供的服务不太可靠，因为数据报文的到达可能无序、重复或缺失。一般地，这个协议优选用于对时间敏感的传输，例如流传输文件，在这种情况下可以丢弃缺失或重复的包且无需等待延迟的数据包。

[0075] 此外，在该过程中，在内容传输中添加了时间索引信息。然后将内容数据传送到储存文件系统的广播文件储存器 126，其将内容传输储存和 / 或缓存为被用户捕获的各种电视节目的内容数据。

[0076] 在一个可替换的实施例中，把所述内容数据作为 HTTP 实况流或 HTTP 动态流面流传输。这些是取决于客户端设备的流传输协议。HTTP 实况流是由苹果公司实现的基于 HTTP 的媒体流通信协议，作为苹果公司的 QuickTime X 和 iPhone 软件系统的一部分。该媒体流被分割为基于 HTTP 的文件下载数据的序列。

[0077] 图 2 所示为天线阵列 102 的一个实施例的方框图，其包括不同的子阵列 802、804。一般地，不同的子阵列从不同的广播机构 806、808 捕获地面广播。

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[0078] 每个子阵列802、804由上百个或上千个天线单元102-1至102-n，以及调谐器104-1…104-n组成。一般地，所述天线单元和调谐器贴装于印刷电路板(PCB)上且位于一封闭体或外壳内。根据它们的方向和位置，不同的天线子阵列802、804被最优化为从不同的广播机构806、808接收广播。这是因为不同的电视网络使用不同的广播机构或天线806、808来产生射频传输或对无线广播进行编码的载体波。一般地，一方面，广播天线806、808通常在物理上位于沿人部分都市圈周围分布的不同地点。另一方面，优选地，天线阵列102物理尺寸上较小且具有较高的天线密度。这为天线单元102带来较小物理尺寸的需要。然而，较小的天线一般具有较低的功率增益。因此，在一个实施例中，系统100包括两个或更多的天线子阵列802、804，其在物理上互相分离，由此它们可以与不同的广播机构806、808的传输塔搭配使用，这样系统100将检测到来自不同的广播机构806、808的空中广播传输将。

[0079] 在操作中，天线优化和控制系统116决定哪一个天线子阵列802、804最适用于基于各种因素从广播机构806、808处接收需要的内容广播，其中所述各种因素包括广播机构的位置、天线子阵列的位置和/或由子阵列接收的信号强度。然后天线优化和控制系统116从最佳位置上的子阵列802、804中分配可用的天线单元102来接收需要的广播内容。

[0080] 进一步，由于天线单元根据它们可以接收的频率，其物理要求是不同的，在一些实施例中，优选地多个天线子阵列802、804进一步被划分进依据频率范围VHF和UHF的群中。

[0081] 参照图1和2，每个子阵列802、804中的天线单元102的布置有点近似于相控阵列天线。然而，在一相控阵列天线中，天线单元一般地经由共同的源来驱动或连接到共同的检测通道以产生受控的辐射发射或检测模式。相反，在当前的系统中，不同的天线单元102-1至102-n具有可独立寻址的调谐器104-1至104-n，并且受控和最优化以同时在不同的频率下并可能从不同的广播机构806、808处接收不同的无线广播。除此以外，不同的天线102-1至102-n和调谐器104-1至104-n可以同时捕获同一内容传输广播的多个拷贝；这发生于当不同的用户想要录制或观看相同的电视节目时。结果是，每个用户拥有广播内容数据的唯一拷贝，其生成自不同的天线且然后被单独地储存在广播文件储存器126中。此外，如果这些天线单元中的一个在物理上或电气上出现故障并因此被禁用，则特定用户的流传输的产生和接收将被停止。

[0082] 图3所示为插件箱装置151，其容纳天线阵列PCB(或PCB天线阵列)152-1、152-2…152-n。

[0083] 在优选的实施例中，多个PCB天线阵列152-1至152-n安装在插件箱装置中或外壳151中，且天线单元102-1、102-2…102-n为水平朝向。插件箱151一般为在其封闭空间内为PCB天线阵列152-1至152-n提供机械支撑和保护的封闭体或结构。插件箱151一般设计为允许容易地安装和/或移除PCB。除此以外，多个插件箱通常收纳在用架子固定的底盘中(未显示)以进一步在放置插件箱的位置上提高天线单元的密度。

[0084] 插件箱装置151的侧壁、顶壁、底壁和任意前壁150由非导电材料或尽可能少的导电材料制造，以最小化法拉第屏蔽。插件箱151的前壁(图中已移除)提供了罩板，使得安装和移除PCB天线阵列152-1、152-2…152-n成为可能。

[0085] 后壁或后部包括数据传送接口，例如n×10GbaseT光学数据传送连接器，用于传送数据到转码器，该连接器还为PCB天线阵列152-1至152-n提供机械支撑。在一个典型

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的实施例中，插件箱 151 收纳最高至 8 个或 32 个 PCB 天线阵列。然而，在可替换的实施例中，更多或更少的 PCB 天线阵列收纳于插件箱内。

[0086] PCB 天线阵列 152-1 至 152-n 在封闭体内的一般间距为约 1 英寸（2.5 厘米）。这个距离允许 PCB 天线阵列 152-1 至 152-n 具有相对高的密度，同时把天线单元之间有害的干扰减少到可接受的水平。除此以外，在封闭体内的多个 PCB 天线阵列的布置构建出天线的三维阵列以在插件箱放置的位置上最大化天线单元的数量。

[0087] 插件箱 151 内的天线单元 102-1 至 102-n 为水平朝向，以构建水平极化的半全向天线阵列。

[0088] 如果从广播台传输的信号具有在一些局部区域中发生的垂直极化，则应该改变天线单元 102-1 至 102-n 的朝向。

[0089] PCB 天线阵列 152-1、152-2…152-n 由介电绝缘材料制成。这些组件都贴装在 PCB 上并并通过 PCB 上的导电通路（或线路）连接。在一个实施例中，PCB 大约 25 英寸宽、21 英寸长，或约 0.6 米（m）宽、0.5m 长。

[0090] 图 4 所示为 PCB 天线阵列 152 中的天线单元 102-1、102-2…102-n 的二维阵列（显示为方形阵列）的俯视图。

[0091] 在一个优选的实施例中，天线单元 102-1、102-2…102-n 以二维阵列的形式贴装到 PCB152 的两侧。在图 4 中留意到，仅最右列的天线单元被标记。在一个实施例中，每个天线单元 102-1、102-2…102-n 为电气平衡的对称回路。天线单元紧密地间隔排列，在 PCB 天线部上的间隔比 0.1 波长（λ）小得多。在一个优选的实施例中，天线单元 102-1、102-2…102-n 为低功率增益天线。优选低增益天线是因为它们具有宽辐射模式而无需精确地指向发射机构，且一般地在这些频率 / 波长下高集成的阵列需要它们。

[0092] 进一步，优选地，天线单元可以根据频率范围设置在不同的 PCB 上，因为天线单元的物理特性根据其设计的接收频率不同而不同。因此，PCB152 包括 VHF 或 UHF 天线单元。在不同的实施例中，天线单元可以倍增地共振（multiply resonant），且可在相同的 PCB 上倍增地共振。

[0093] 天线单元 102-1、102-2…102-n 通过焊锡连接到 PCB 天线阵列 152 的电子部 154。电子部 154 中设置有接地面 810。在一个优选的实施例中，导电金属接地面始于该电子部并在两个方向上均延伸。

[0094] 设置有平衡传输线 812-1，812-2…812-n，其把每个天线单元 102-1 至 102-n 的信号携带至射频调谐器 104-1 至 104-n 和解调器 106-1 至 106-n。在一个实施例中，每个独立的天线单元 102-1、102-2…102-n 连接到相应的射频调谐器 104-1、104-2…104-n 和解调器 106-1、106-2…106-n。因此，存在有相同数量的天线、射频调谐器以及解调器。

[0095] 在可替换的实施例中，天线单元比调谐器更多，由此天线可在需要时分配到调谐器。这使系统没有偏差或延迟地提供流媒体。这进一步有助于提供一种经济的方法，由此可保证用户在他们约定的使用时间段的整个有效时长内，特定的天线为他们所用，而无论他们是否正在有效地使用该天线。这可以被认为是调谐器池或接收器池。在另一个可替换的实施例中，该系统利用了汇集为池的解调资源。一般地，天线单元比解调器多 3 至 4 倍。然而，那个比例，将根据具有账户的用户的总数量、同时访问系统的用户的平均数量，以及在高峰时间访问系统的用户的数量而变化。

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[0096] 平衡传输线 812 包括两个具有相同的材料类型的均匀导体，他们沿其长度具有相等的阻抗。平衡传输线用作携带信号，因为来自周围环境的干扰噪声平等地导入两条线中，其产生相同方向的电流。然后，通过在传输线的接收端测量信号的区别，发现原始信号。

[0097] 平衡至不平衡变压器或平衡非平衡转换器(请看图 5 的附图标记 914)用于把来自天线单元 102-1、102-2…102-n 的平衡信号转换为不平衡信号。不平衡至平衡的转换通过非平衡组件，例如射频调谐器 104-1、104-2…104-n，使信号得到进一步的处理。

[0098] 在操作中，射频调谐器 104-1、104-2…104-n 调节天线单元 102-1 至 102-n 以接收需要的广播内容传输。解调器 106-1、106-2…106-n 使用 ATSC 解调器 / 解码器把来自天线单元 102-1、102-2…102-n 的独立内容传输解调和解码为 MPEG-2 格式。MPEG-2 是用于影片和关联的音频信息编码的标准格式。

[0099] 在一个典型的实施例中，插件箱装置 151 位于安装在建筑物顶部或天线塔上的封闭箱体内。多路复用器电路 108 和数据传送控制器 160 用于把信号传递到 PCB 光学接口连接器 162。PCB 输出连接器 162 把信号传递到系统 100 的留存器，其一般地位于更安全的位置，例如地面屋舍或建筑物的地下室。

[0100] 在另一个实施例中，每个 PCB 天线阵列 152 包括 80 个双环天线 102-1 至 102-n(总共有 160 个环)。在可替换的实施例中，PCB 上可以加持 80 个天线以上，例如 320 个天线(总共有 640 个环)或 640 个天线单元(总共有 1280 个环)。每个天线大约 0.5 英寸高、0.5 英寸宽，或大约 1 厘米(cm)×1cm，以及具有大约 0.030 英寸或大约 1 毫米(mm)的厚度。当前天线单元被组织成大约 3.3 宽 18 英寸长的，或大约 8cm×50cm 的交错二维矩阵。一般地，该矩阵应小于 1m×1m 且具有 10 个以上的天线单元，以及优选地 50 个以上的单元。天线单元还具有约 0.28 英寸(约 0.7cm)的水平间隔和约 0.62 英寸(1.5cm)的垂直间隔。除此以外，PCB 天线阵列 152 在 1.09 英寸(2.8cm)的光栅(raster)上。在一个可替换的实施例中，PCB 天线阵列 152 在 0.75 英寸(2cm)或更小的光栅上。

[0101] 然而，在其它实施例中，PCB 天线阵列 152 及其天线单元具有不同的尺寸。在一个示例中，PCB 天线阵列 152 的面积相对现有面积减少约 1/4 (可能地 1/8)或更少。对天线单元 102 而言，当被配置为方形环时，3 边的长度优选地小于 1.7 英寸(4.3cm)，所有 4 边的总长为 2.3 英寸(5.8cm)。在小型化的情况下，天线面积至现有尺寸的 1/4，则环的外形也需要改变以维持在 PCB 上的相同的管脚间距且高度降低 1/4。同样地，天线单元和光栅之间的间隔也根据 PCB 尺寸而减少。而其它实施例把面积在几何尺寸上减少至 1/4 到 1/8。

[0102] 图 5 所示为 PCB 天线阵列 152 的一个局部侧视图，其显示了双面 PCB 天线阵列 152 上的平行环天线单元 102 和平衡传输线 812、813 的对称性的一个示例。

[0103] 在一个典型的实施例中，根据需要的驱动阻抗，用于每个天线单元 102 的抽头点(tappoint)位于较远处。然后，在运行频率上驱动两个组件天线单元 102Pi (π)弧度的相位差。通过改变变容二极管 904、906 对的两端的电压来控制天线单元的频率，其中变容二极管 904、906 对连接到两个环天线单元 102 的回路端部。变容二极管为具有可控电容量的二极管，通过改变其端子上施加的电压来调整该可控电容量。在一个可替换的实施例中，以固定电容器和变容二极管来控制每个天线单元的频率。

[0104] 图 5 还示出了连接到平衡非平衡转换器 914 的传输线 812、813。平衡非平衡转换器 914 把平衡信号转换为非平衡信号，使信号能被 PCB 天线阵列 152 的电子部 154 中的组

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件处理。

[0105] 图 6A 所示为图 5 中的 A-A 处的剖面图。图 6A 示出了 PCB 天线阵列 152 的相对两侧上的平衡传输线 812,813 的对称性。一般地,传输线 812,813 为 PCB 板的顶面和底面上形成的铜导电通路。在一个优选的实施例中,一组传输线 812 传递正射频信号而在 PCB 另一侧上的一组对称的传输线 813 传递负射频信号。

[0106] 图 6B 所示为图 5 的 B-B 处的剖面图,其示出环天线单元 102 和调谐变容二极管 904、906 的对称性。

[0107] 图 7 为示出了用户访问系统 100 以及观看实况无线内容、设置未来录制或观看之前录制内容的步骤的流程图。在第一步骤 302 中,通过用户的客户端设备 128、130、132、134 向用户显示输入画面。在下一步骤 304,如果未登录,用户则被要求提供他们的用户姓名和口令以访问独立的用户账户。如果用户姓名和口令不正确,则在步骤 306 中向用户显示出错画面。

[0108] 一旦成功登录,在步骤 308 中商业管理系统 118 确定用户是否被批准计费。如果用户未被批准计费,当系统部署有付费订户模式时,应用服务器 124 则在步骤 310 中向用户显示一推销画面。如果用户被批准计费,应用服务器 124 则在步骤 312 中获取用户的地理位置信息。

[0109] 可以使用多种不同的方法判定和确认每个用户的地理位置。在一个示例中,每个用户的位置将由用户的互联网协议(IP)地址判定。在其它示例中,其在用户构建账户时由用户输入或其在用户提供邮编时判定。同样地,在其它示例中还使用到,用户使用的来自移动电话信号塔的信息,或来自用户设备内的全球定位系统接收器的经纬度坐标。该地理位置信息允许网络应用服务器 124 向每个用户显示基于用户的实际位置或本地市场位置的信息。

[0110] 地理信息是必需的,因为不同的内容在不同的电视市场之间在不同的时间上广播,且一些内容仅在指定的地域性市场对用户开放。例如,一些在纽约开放的内容,其在洛杉矶对用户并不开放。此外,在一些实施例中,系统强制本地化,由此用户仅可以访问来自他们的本地市场的内容传输,或如果用户拥有他们自己的安装于他们的房屋或其他住所的天线则对该用户开放。

[0111] 在下一步骤 314 中,用户可以从他们的独立用户账户中选择他们想要访问的内容类型。每个用户均拥有他们自己的独立账户,通过该账户他们可访问任何实况内容流或设置与该用户的账户关联的未来的录制。同样,之前录制的内容的回放是经由用户的账户来完成并且用户仅可以访问与该用户的账户关联的内容。

[0112] 如果用户选择该用户之前录制的内容,系统则在步骤 316 中向用户显示预录制的画面。如果用户选择未来的录制,则在步骤 320 中向用户显示未来的录制画面以设置未来的录制。如果用户选择实况流媒体内容,则在步骤 318 向用户显示实况流传输画面。

[0113] 图 8 为示出了供用户从流传输服务器 120 观看他们先前录制内容的步骤的流程图。在步骤 316 用户开始于预录制画面,其经由应用网络服务器 124 发送到用户设备。这通常是一网页。在其它示例中,在应用网络服务器 124 和用户设备上运行的应用程序之间使用适当的接口。

[0114] 在第一步骤 402,向用户显示他们之前录制的内容数据的列表。用户仅可以观看他

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们指示系统 100 录制的内容数据，如电视节目。在一些示例中，应用服务器 124 推荐用户可能感兴趣观看或录制的无线内容。不过，用户必须发起请求以录制和保存广播内容。

[0115] 在下一步骤 404，用户选择之前录制的内容数据以添加到播放列表。在步骤 406 流传输服务器 120 在广播文件储存器 126 中找出用户之前录制的内容数据的唯一拷贝。在下一步骤 408，流传输服务器 120 基于用户的设备决定将向用户显示的分辨率。在可替换的实施例中，用户可以选择分辨率，而与设备无关。在另一个可替换的实施例中，客户端设备自动选择通信通道可以稳定提供的最高分辨率。

[0116] 在下一步骤 410 中，流传输服务器 120 流传输播放列表中的内容数据或录制的电视节目到用户的设备，直到完成用户的播放列表。

[0117] 图 9 为示出了供用户预订未来的无线广播录制的步骤的流程图。

[0118] 在步骤 320，用户开始于预约录制的画面，其经由应用网络服务器 124 发送到用户设备。

[0119] 在第一步骤 204，应用服务器 124 基于地理位置信息确定并向用户显示可用的本地内容（在图 7 的步骤 312 获得）以实现本地化。一般地，向用户显示可用的电视网络、当前的广播以及未来广播的日期和时间的列表。

[0120] 在下一步骤 206 中，用户的内容请求被发送到应用服务器 124。然后应用服务器 124 调度在所述内容广播时间上的可用资源或在步骤 208 中通知用户其资源当前不可用。然后在步骤 209 中应用服务器 124 指示天线优化和控制 116 在所需的内容广播的日期和时间上指派最佳的可用天线单元。然而，在用户的天线为永久性地分配的情况下，跳过该步骤。在下一步骤 210，天线优化和控制 116 使天线和接收器关联，并解调广播内容为 MPEG-2 格式。

[0121] 系统 100 允许每个用户单独地安排广播内容的预约录制。除此以外，为每个用户分配独立的天线以接收广播内容。进一步，且一般地，应用服务器 124 基于每个用户的命令调度录制，由此录制的数量总是和预订请求的数量相同。即使当两个用户请求录制完全相同的内容传输时，这也是适用的；系统为每个用户独立地捕获和储存单独的内容传输，因此每个用户在文件储存器 126 中具有他们自己的从单独的天线单元产生的唯一拷贝。

[0122] 在下一步骤 212 中，所述内容传输通过多路复用器和多路分离器被传输到作为接收器的一部分的指定转码器。在下一步骤 214 中，分配转码器 112 同时产生已转码的内容传输数据的高码率 / 分辨率和低码率 / 分辨率视频流。在当前的实施例中，已转码的内容数据被编码为 MPEG-4 格式且其音频被转码为 AAC（先进音频编码）格式。

[0123] 然后在步骤 215，配合时间索引信息把已转码的内容数据同时以高码率 / 分辨率和低码率 / 分辨率的视频内容数据传送到广播文件储存器 126。

[0124] 在一个可替换的实施例中，转码器 112 产生三码率输出。一般地，三码率包括高、中、低码率 / 分辨率的转码后内容数据的输出。而其它实施例可具有更高或更低的输出码率。不同的输出码率 / 分辨率允许系统 100 基于例如网络容量、用户设备以及用户选择等作为示例列出的因素，提供不同的质量视频流。

[0125] 图 10 为示出了供用户在用户设备上实时地，即与所需的电视节目的内容传输的广播同步地观看无线内容的步骤的流程图。

[0126] 用户开始于从应用网络服务器 124 发送到用户设备的实况流传输画面 318。基于

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用户的地理位置，在步骤 602 提供电视节目的可用无线广播的列表。除此以外，还向用户显示广播的日期和时间。在步骤 604 用户可以选择要观看的内容且用户的内容请求被发送至应用服务器 124。在步骤 612 应用服务器 124 请求从天线优化和控制器 116 分配天线单元给每个用户。

[0127] 在步骤 614，如果天线和 / 或调谐器不可用，则应用服务器 124 返回繁忙画面至用户。在步骤 615，如果天线为可用的，则天线优化和控制器 116 针对每个用户的请求选择最佳的可用的天线以接收无线广播。使用哪一个天线是基于多个因素来决定的。例如，广播机构的位置、天线单元的位置、天线的朝向以及信号强度均为用于决定哪一个天线单元将被使用的因素。在用户的天线为永久性地分配，却没有足够资源来支持请求的情况下，系统返回繁忙画面。

[0128] 在选择了天线并接收到无线广播之后，无线广播被编码器系统 103 处理。在步骤 616 内容传输由解码器解码为 MPEG-2 格式。在下一步骤 618，内容传输数据通过多路复用器 108 和多路分离器 110 传输到转码器 112。在一个示例中，在此，分配转码器 112 同时产生高码率和低码率的 MPEG-4，且音频被转码为 AAC（先进音频编码）格式。被分配的索引器 114 配合时间索引信息把已转码的广播内容数据储存到广播文件储存器 126 中。

[0129] 下一步，在步骤 622，流传输服务器 120 对应广播的持续时间把来自广播文件储存器 126 的广播内容数据缓存并流传输到用户的移动设备。

[0130] 在一个实施例中，当前不使用的天线单元被分配用于接收系统预计用户在不久的未来会想要观看的内容广播或电视节目。来自这些分配的天线的馈源不会被发送给任何用户。所产生的内容数据被系统简单地抛弃，因为它们被生成或写入到文件储存器中被连续覆盖的循环缓冲区。然而，当用户需要观看这些节目中的一个时，由来自天线单元的馈源产生的内容数据被分配到该用户及被流传输到该用户。

[0131] 这种方法的优点是，当用户选择观看一个新的电视节目，或在实时流传输的情况下切换到一个不同的电视节目时，系统并不需要等待要填入的编码管线。取而代之的是，仅仅把之前丢弃的内容数据现在发送给用户。当在频道间切换时，例如频道搜索概览（surfing）时提供了更顺畅和更快的传输。

[0132] 图 11 示出已转码的内容数据是如何对应每个独立的用户存储在广播文件存储器 126 中。

[0133] 在所示的示例中，每段录制内容包括用于标识用户的信息和转码后的内容数据。例如，用户标识字段唯一地识别每个用户和 / 或他们的独立的用户账户。从无线广播捕获和转换为内容数据的每个内容传输被关联到请求它的用户。内容标识字段识别内容传输的标题（或姓名）。一般地，内容姓名为被录制的节目、综艺秀或电影的标题。天线标识字段识别出被分配及其后用于捕获用户请求的无线广播的特定的天线单元。网络标识字段指明广播被录制的内容传输的广播机构。视频文件字段包含已转码的内容数据或一般地包含指向该数据位置的指针。指针指明已转码和已储存为高、中和低质量的广播内容数据的储存位置（或多个储存位置）。文件标识字段进一步识别唯一的剧集、电影，或新闻广播。最后，日期和时间标识字段记录无线广播的日期和时间。

[0134] 以一示例说明，用户 1 和用户 2 均具有唯一的用户 ID 和均具有他们的独立的电视节目拷贝。同样，即使两个用户都在相同的时间、在相同的网络上请求录制相同的电视节

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目，两个用户都具有他们自己的广播内容数据和电视节目拷贝。用户 1 仅可以观看储存到其用户 ID 的内容数据且用户 2 仅可以观看储存到其用户 ID 的内容数据的拷贝。同样，还记录了分配到每个用户的特定的天线单元。

[0135] 除此以外，流传输服务器 120 可以产生基于储存广播内容数据和标识字段的报告。该报告包括统计表，可列出一些例子，例如个人使用率、群组使用率、用户的总数量、活跃用户的数量、预订的录制的数量、高峰系统使用率以及整个系统的总使用率。

[0136] 图 12 示出了系统 100 的一个可替换的实施例，其提供对阵列天线单元的网络访问。

[0137] 在该示例中，系统 100 进一步包括由天线优化和控制系统 116 控制的选择器开关 105，用于选择性地把天线 102 和调谐器 104 连接到可用的天线处理管线。

[0138] 在系统 100 中，用于解调和转码的资源被汇集为池且由天线单元共享。该配置允许系统提供服务给更大数量的用户而使用更少的硬件。除此以外，天线单元的密度得以提高，同时通过远程调用那些消耗较大量功率的解调和转码硬件和减少闲置待命中的资源，使功率消耗减少。

[0139] 把资源汇集为池(或超分(oversubscription))是一种可接受的做法，因为用户一般地不在同一时间访问系统。一般地，大部分用户未在当前访问该系统；一些用户正在观看实时流传输的内容，一些用户正在设置未来的广播的录制，以及其他用户正在回放之前录制的内容。因此，系统不需要具有所有用户同时访问该系统的能力。

[0140] 为允许系统利用池化资源，设置了选择器开关 105 或切换系统。天线优化和控制 116 控制选择器开关 105，使由天线单元 102 接收的无线广播可以被资源池中的资源解调和编码。当不再需要解调和编码资源时，它们返回到资源池。

[0141] 因为天线比解调和编码资源更多，天线优化和控制 116 必须保证在分配天线给用户之前或在允许用户访问他们的专用的天线之前，解调资源就可用。因此，当用户做出内容请求时，天线优化和控制 116 确定在相同的天线阵列 PCB 上的解调和编码资源以及天线单元是否可用，或在相同的 PCB 和用户的专用天线上的解调和编码资源是否可用。

[0142] 如果在相同的天线阵列 PCB 上的天线资源不可用，则天线优化和控制系统 116 查找在其他天线阵列 PCB 上的资源。如果没有资源可用，则天线优化和控制 116 通知应用服务器 124，用户的请求此刻无法完成。同样，应用服务器返回信息到用户的设备，系统当前繁忙以及请求此刻无法完成。

[0143] 另一方面，如果解调和编码资源可用，则分配天线单元给用户以及将接收到的广播通过选择器开关 105（或开关矩阵）传输到可用的资源。

[0144] 在一个可替换的实施例中，调谐器 104-1 至 104-n 也被汇集为池。在该配置中，按需分配可用的调谐器到天线单元 102。选择器开关 105 还用于切换天线的射频输出的以及同时选择直接耦合到一起的调谐器和解调器。

[0145] 在一个优选的实施例中，选择器开关 105 的信号输入和输出为低中频信号、高中频率信号、基带信号或任何前述的数字表示。

[0146] 当在一个典型实施中描述相等数量的天线、调谐器、解调器、转码器以及索引器时，在另一个实施例中天线单元的数量超过处理管线的编码资源，大约 3-4 比 1。该配置为许多额外的用户提供额外的服务，而无需相应地增加硬件资源。

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[0147] 在图 1 和图 12 所示实施例的第一运行模式中，天线的分配为临时性分配，例如，其仅在用户当前使用系统 100 来观看单个电视节目时有效，如果系统 100 在每次有用户请求观看或录制无线广播时向用户分配天线单元。因此，每次用户请求不同的空中广播，系统 100 一般向用户分配新的天线单元。

[0148] 在第二运行模式中，天线分配为永久性分配，即为特定用户专用。例如，天线在那些用户的账户有效期内被租用给用户。在其它示例中，天线为实际上已被出售给用户。

[0149] 如果该系统 100 配置为永久性地分配天线给用户，则每个用户将一直使用相同的天线单元来接收无线广播。

[0150] 图 12 的实施例优选为第二运行模式，因为在系统 100 中使用更少的解调器 105 和可能使用调谐器 104。当用户没在访问他们的系统时，仅他们的天线单元 102 没有完全利用。开关 105 允许解调器重新分配到其它但前使用中的天线单元。

[0151] 如果系统 100 配置为永久性地分配天线单元且还利用汇集为池的解调和编码资源，则可以使解调资源在某些时间在相同的天线阵列 PCB 上不可用。在这种情况下，天线优化和控制器 116 在其他天线阵列 PCB 上查找可用的解调器，以及控制选择器开关 105 使位于一个 PCB 上的天线单元连接到位于其他 PCB 上的解调和编码资源。

[0152] 图 13 所示为流程图，其显示了当资源被汇集为池时，应用网络服务器 124 和天线优化和控制器 116 是怎样向用户分配解调和编码资源的。

[0153] 在第一步骤 702，天线优化和控制 116 接收来自应用服务器 124 的请求。一般地，请求由用户从他们的客户端设备 128、130、132、134 上生成。在接收到来自应用服务器 124 的请求之后，天线优化和控制 116 查找可用的资源。

[0154] 在下一步骤 708，天线优化和控制 116 确定作为分配到做出请求的用户的天线单元的相同的天线阵列 PCB 上的资源池中的解调和编码资源是否可用。如果资源为可用的，则在步骤 716 中天线优化和控制 116 为用户分配资源。一般地，这通过配置选择器开关 105 来完成。

[0155] 如果没有资源可用，则在步骤 710 中天线优化和控制 116 在其它天线阵列 PCB 上查找其它可用于接收被请求内容的资源。如果天线优化和控制 116 在任何其它 PCB 上无法找到任何可用的天线和 / 或解调和编码资源，则在步骤 714 中天线优化和控制 116 返回繁忙信息到应用服务器。同样，应用服务器 124 则将返回繁忙信息给请求内容的用户。

[0156] 如果天线和资源位于另一个天线阵列 PCB 上，则在步骤 715 中天线优化和控制 116 配置选择器开关 105 并在步骤 716 中向用户分配可用的解调器。

[0157] 如果用户请求设置未来的录制，也可以执行这些步骤。然而，这些步骤，可以不实时执行；或者其可以在当需要的内容正从广播机构广播时执行。除此以外，该内容可以不传递到用户设备。或者，该内容可以储存在广播文件储存器 126 以由用户在以后访问。

[0158] 本文已经通过引用优选实施例具体地显示和描述了本发明，在不偏离本发明的权利要求所要求范围的前提下，本技术领域人员可以推断其各种形式和细节上的变化。

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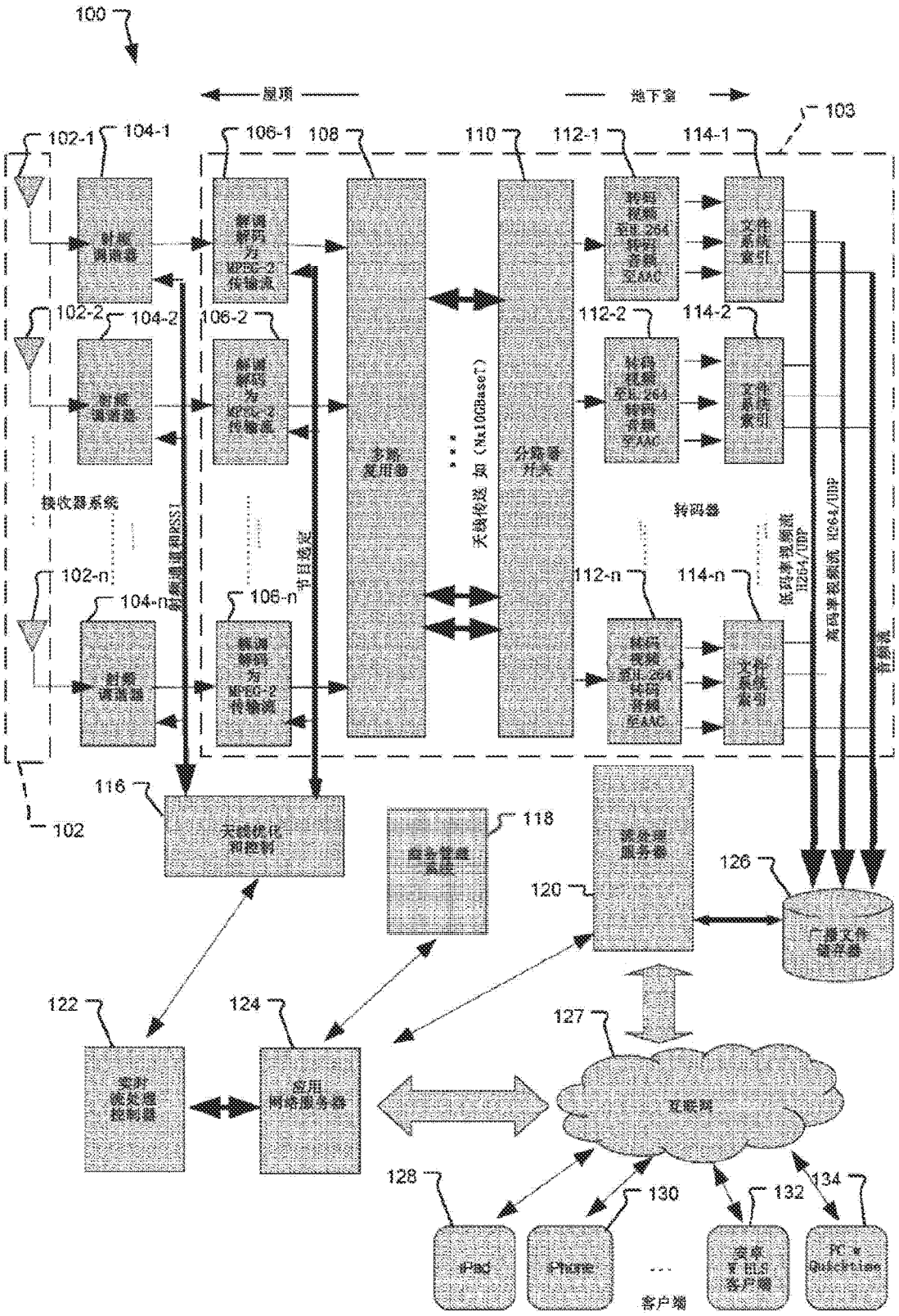


图 1

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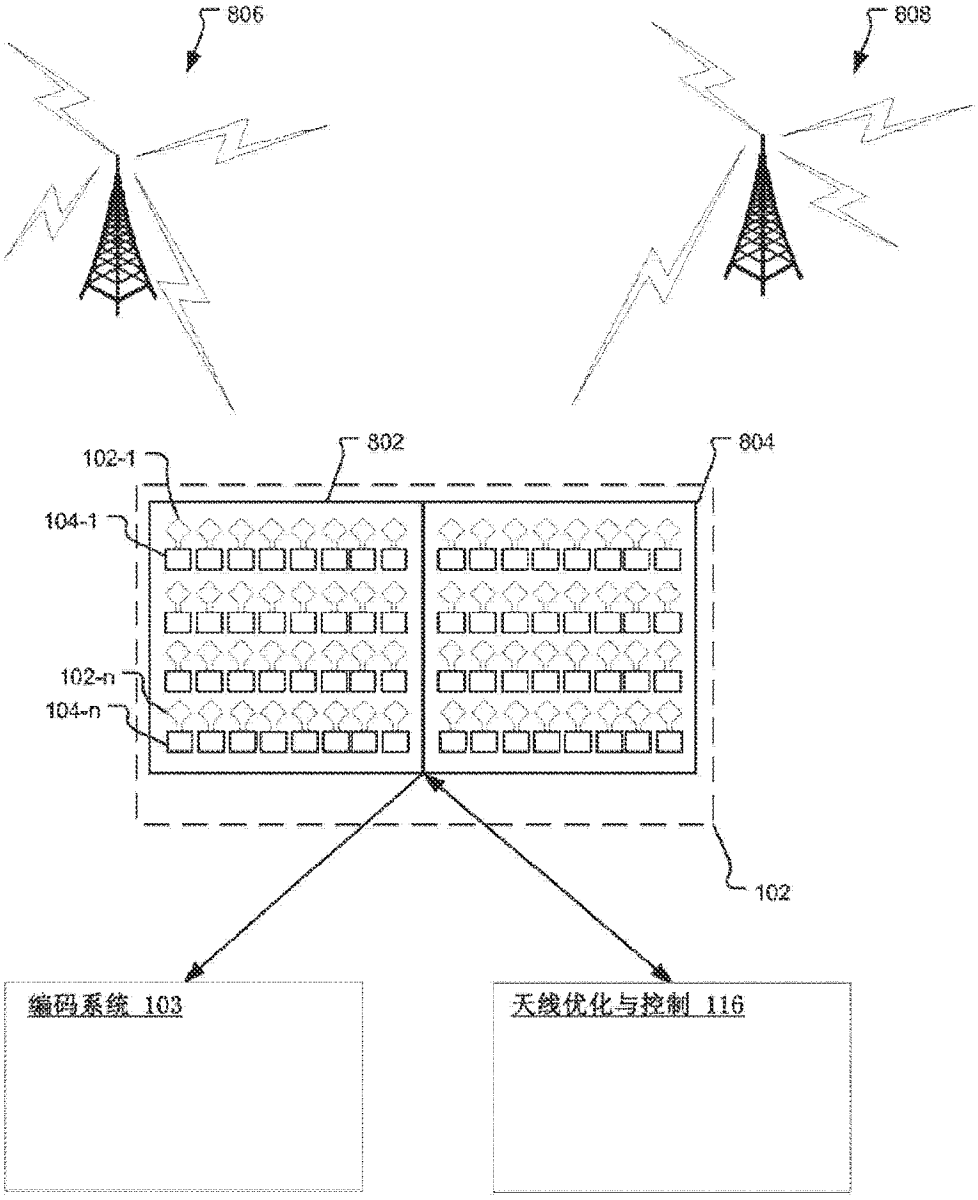


图 2

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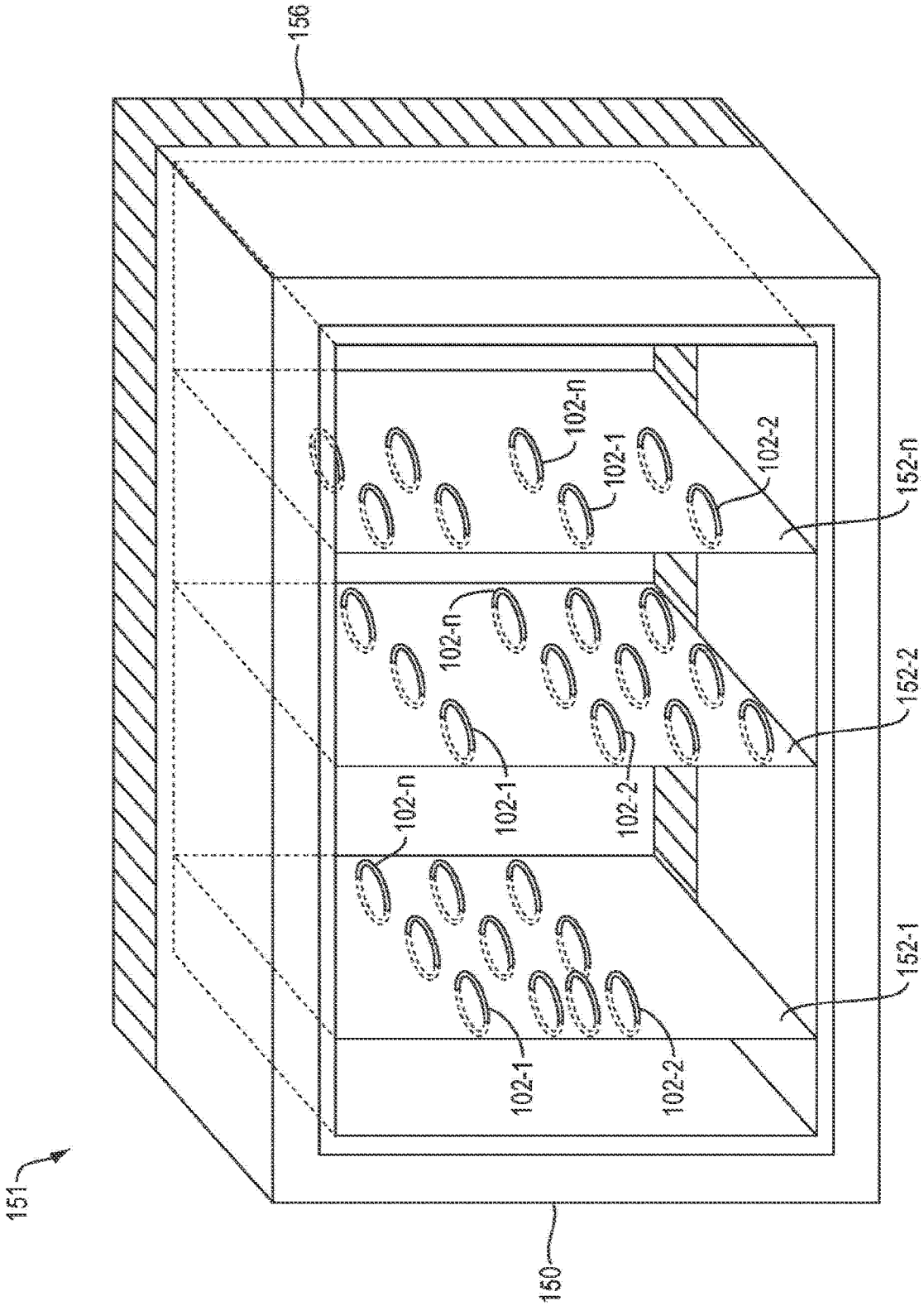


图 3

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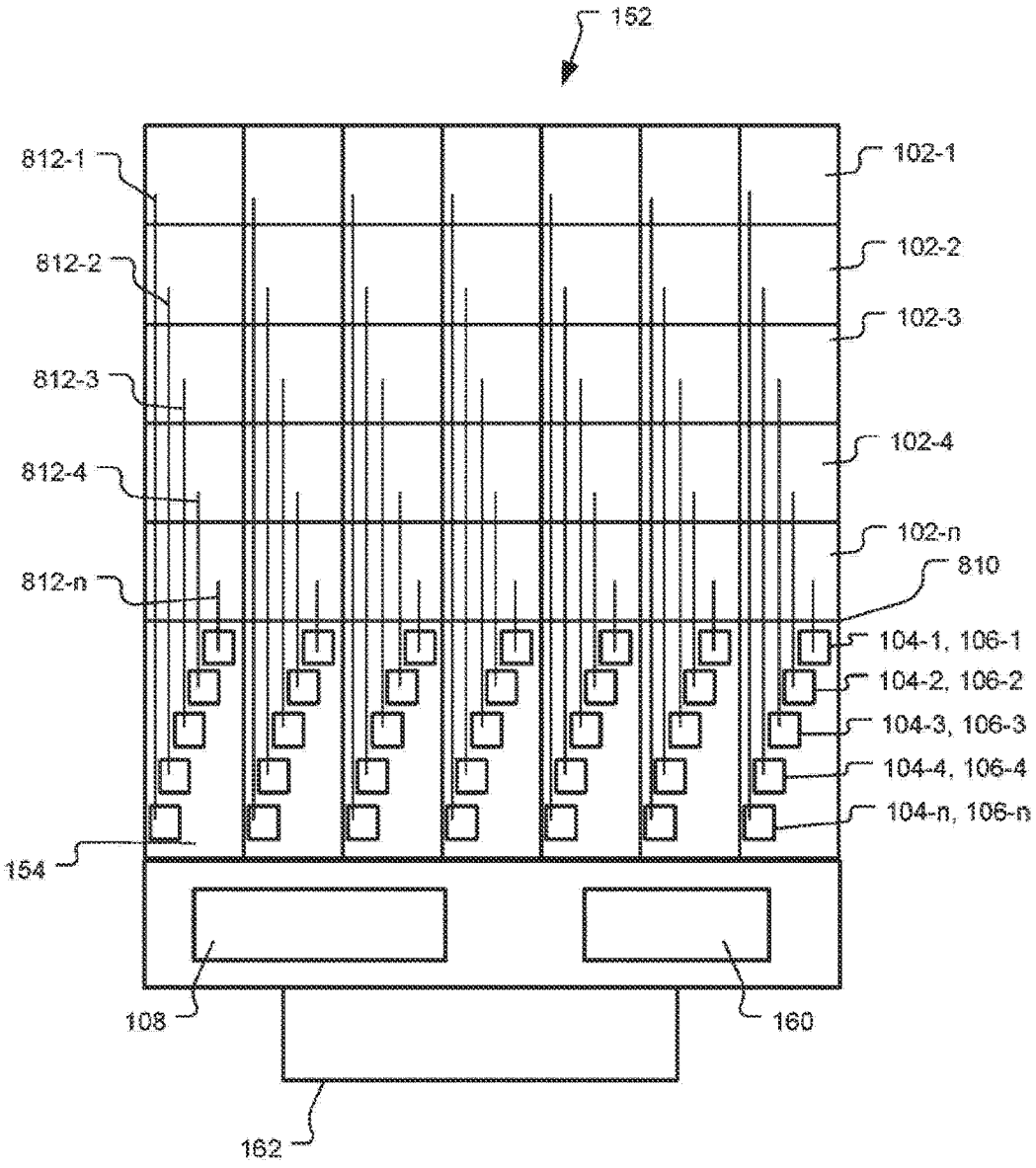


图 4

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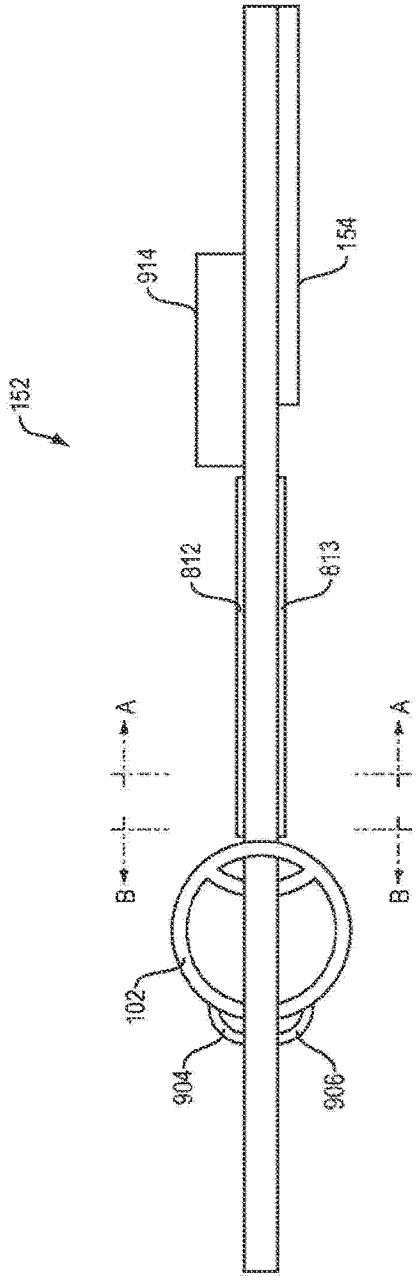


图 5

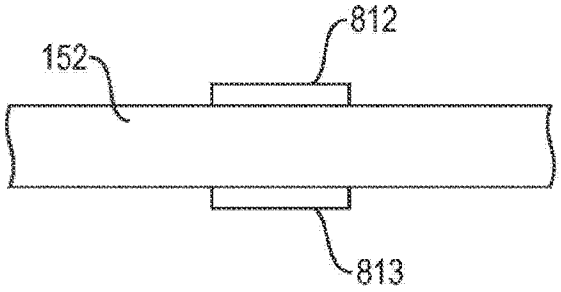


图 6A

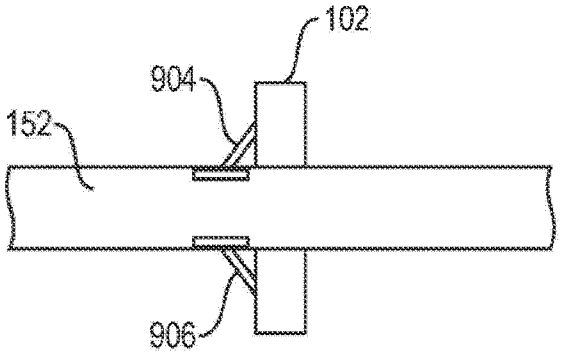


图 6B

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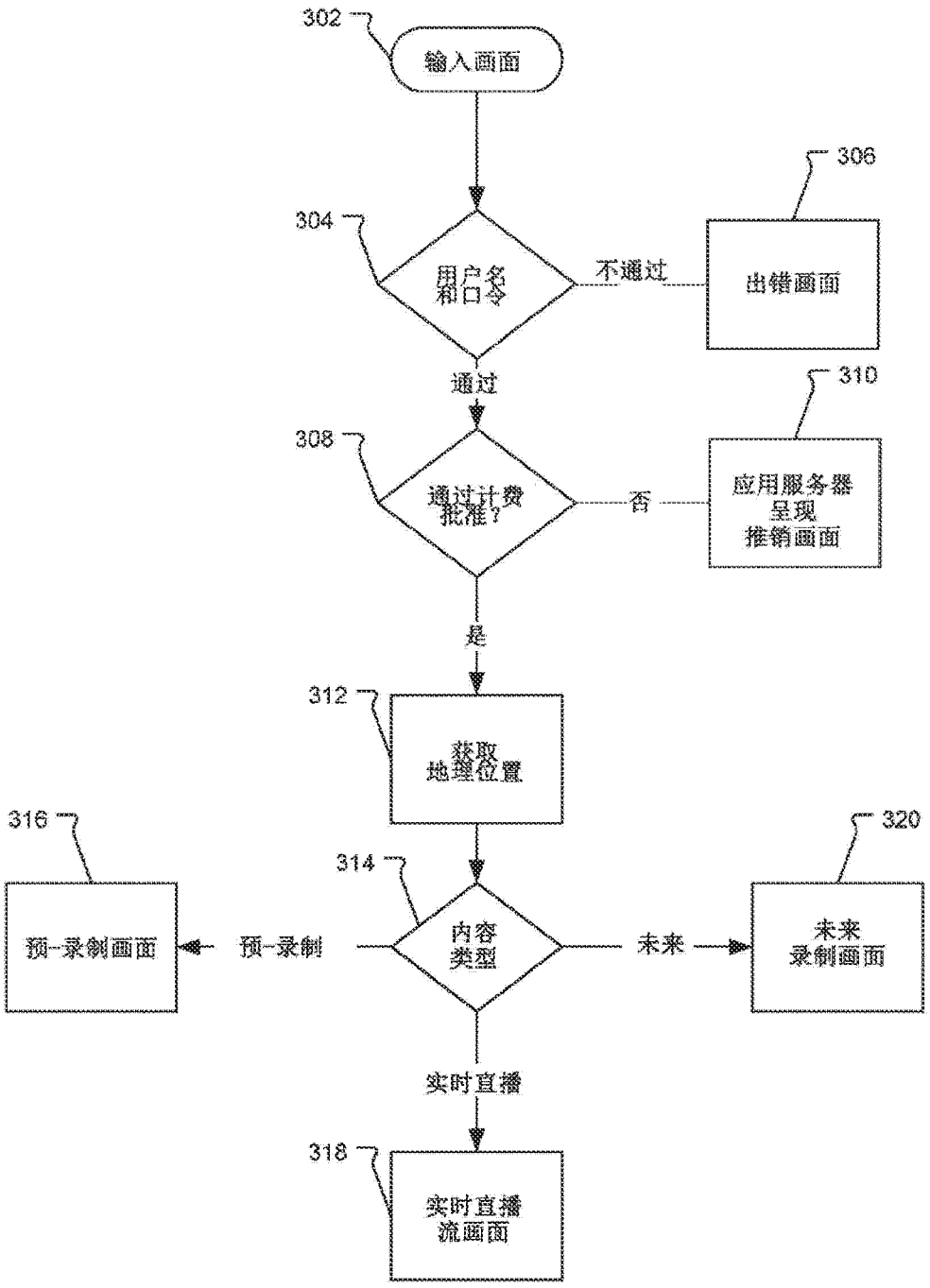


图 7

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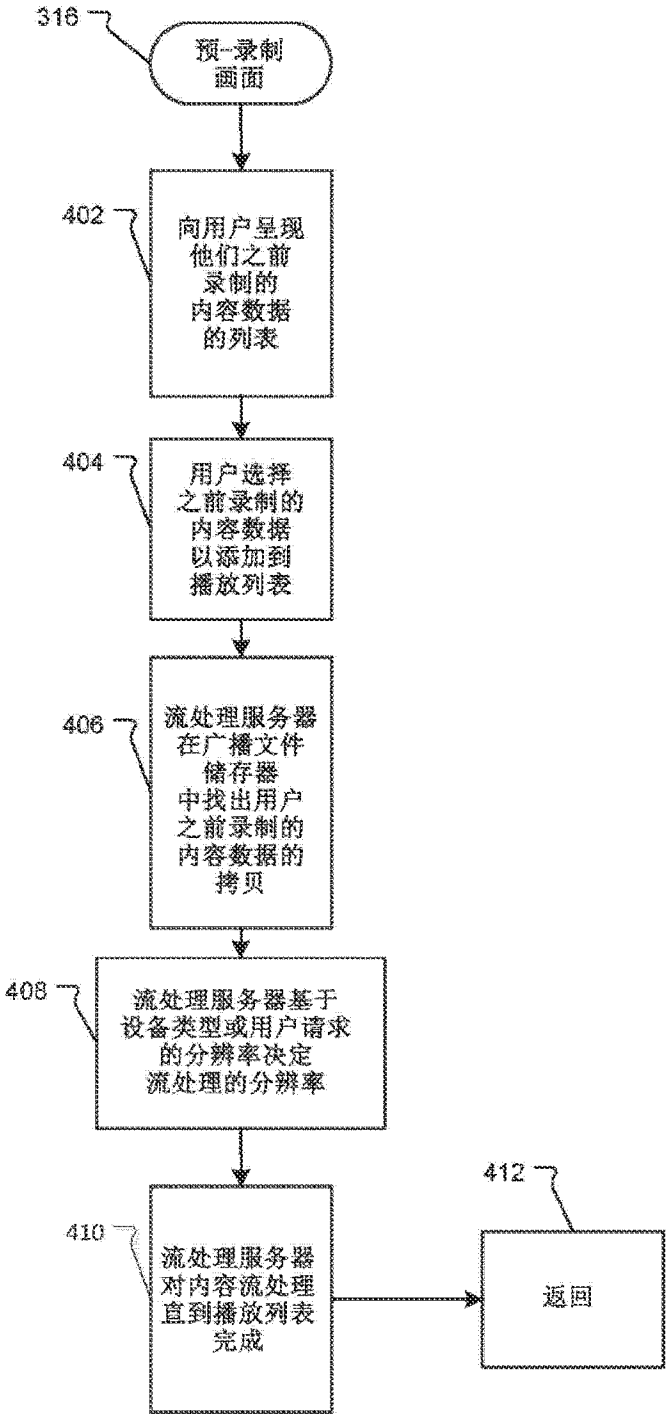


图 8

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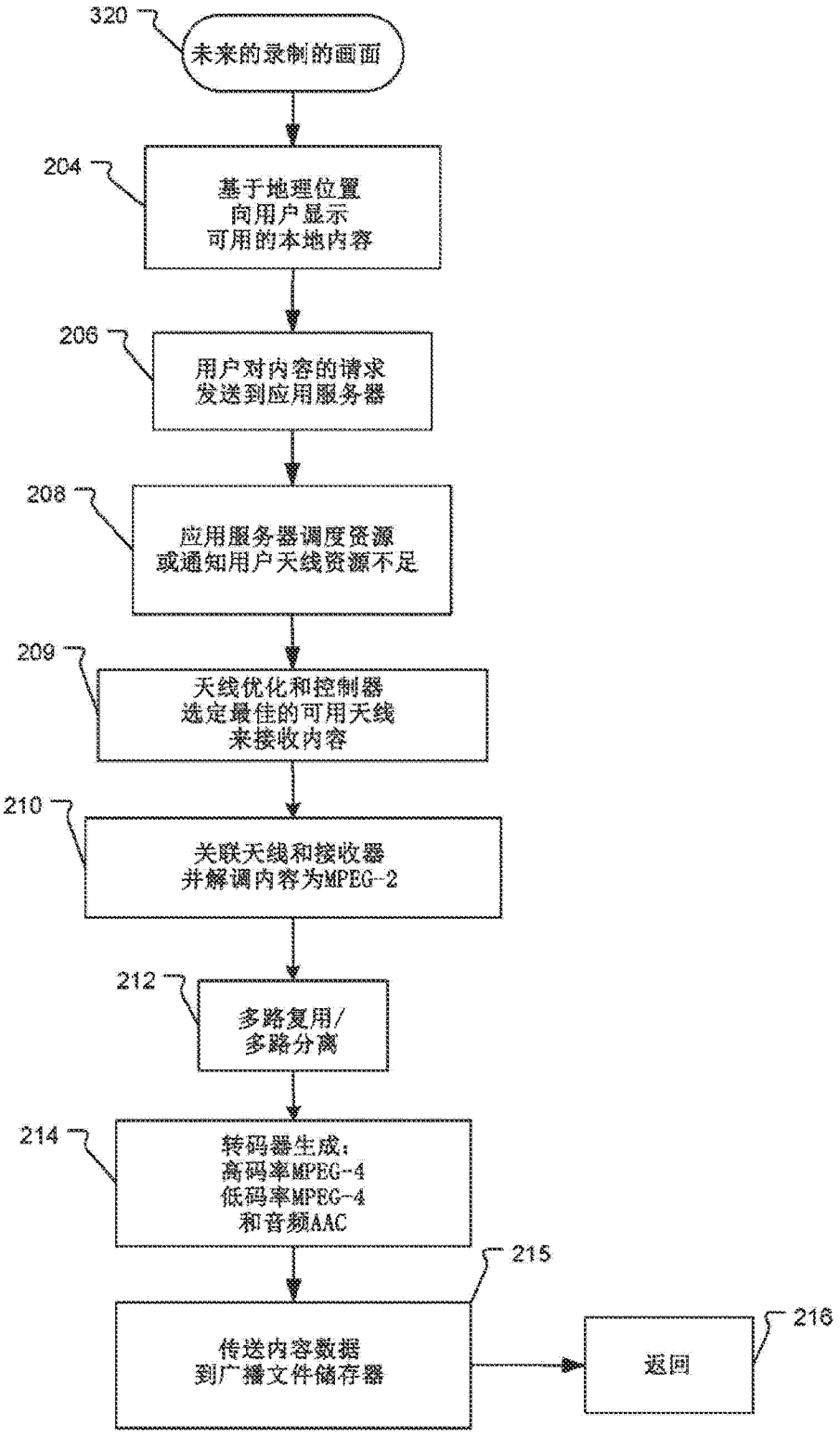


图 9

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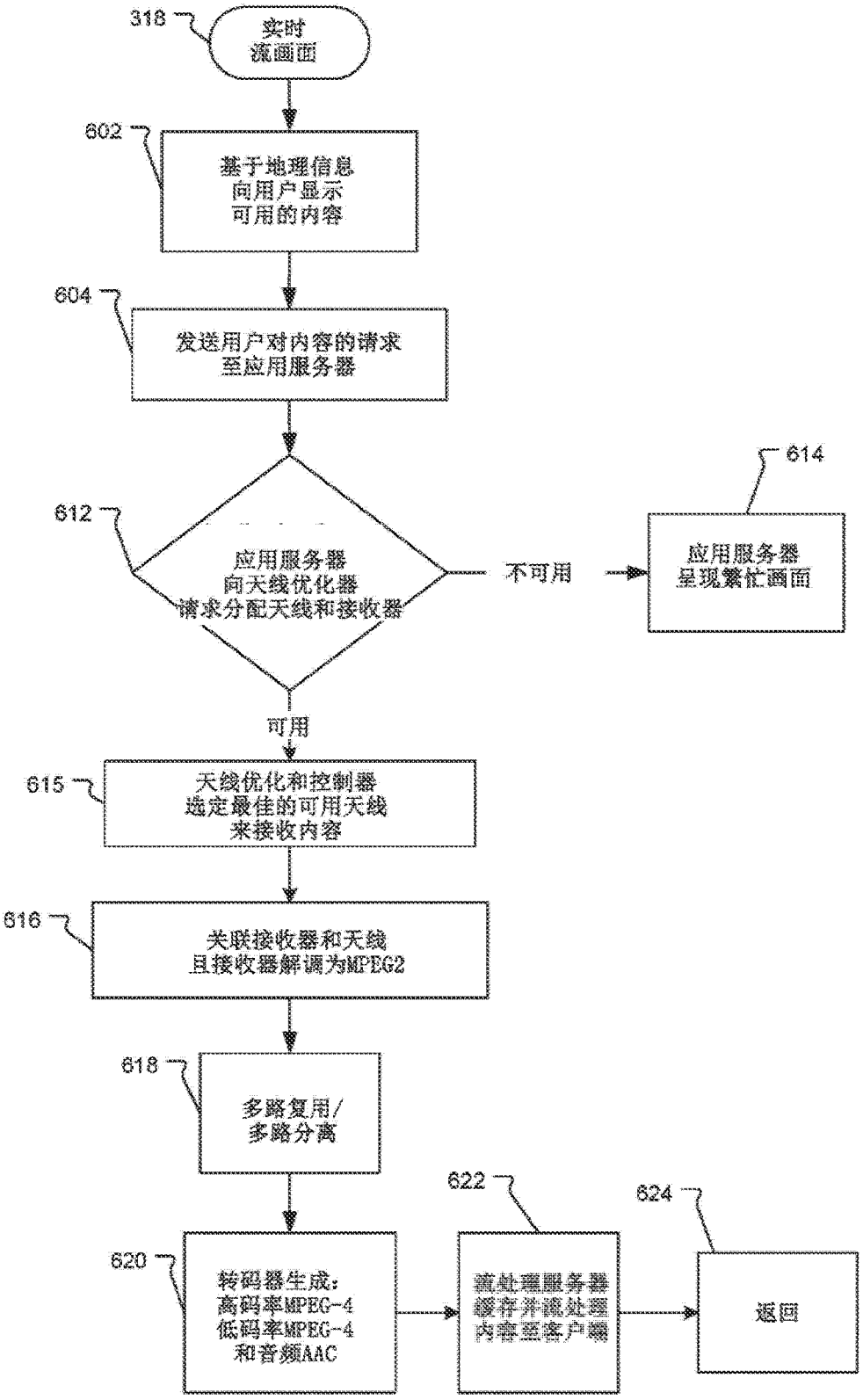


图 10

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广播文件储存器 120

用户 ID	内容 ID	天线 ID	网络 ID	视频文件	文件 ID	时间/日期
用户 1	法律与秩序	天线 1	NBC	文件指针	剧集 123	10am / 10-22-10
用户 2	法律与秩序	天线 2	NBC	文件指针	剧集 123	10am / 10-22-10
用户 3	幸存者	天线 n	CBS	文件指针	剧集 456	3pm / 12-15-10
...	...	...	...	...	...	...
...	...	...	...	...	...	...
用户-n	法律与秩序	天线 45	NBC	文件指针	剧集 123	10am / 10-22-10

图 11

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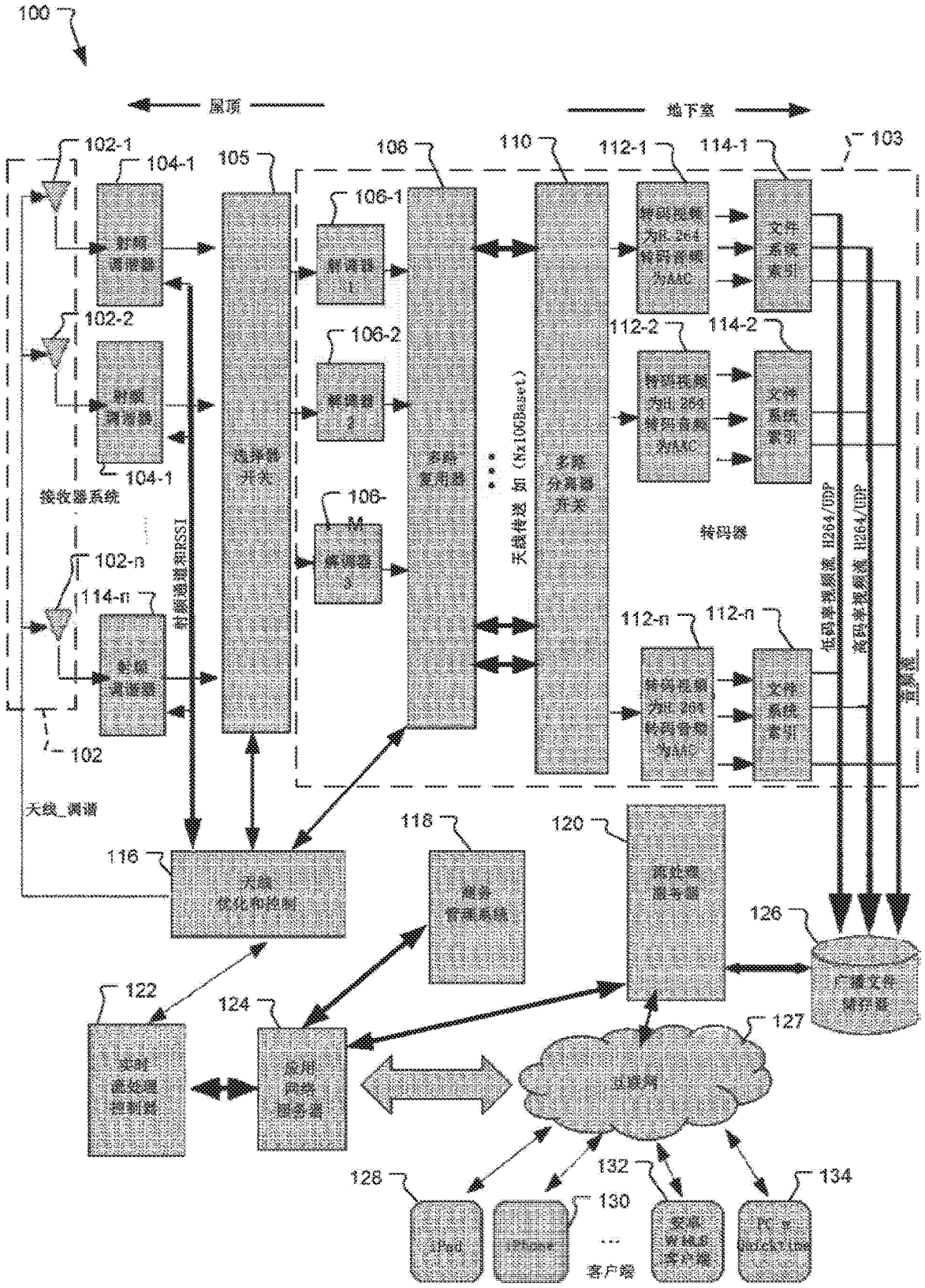


图 12

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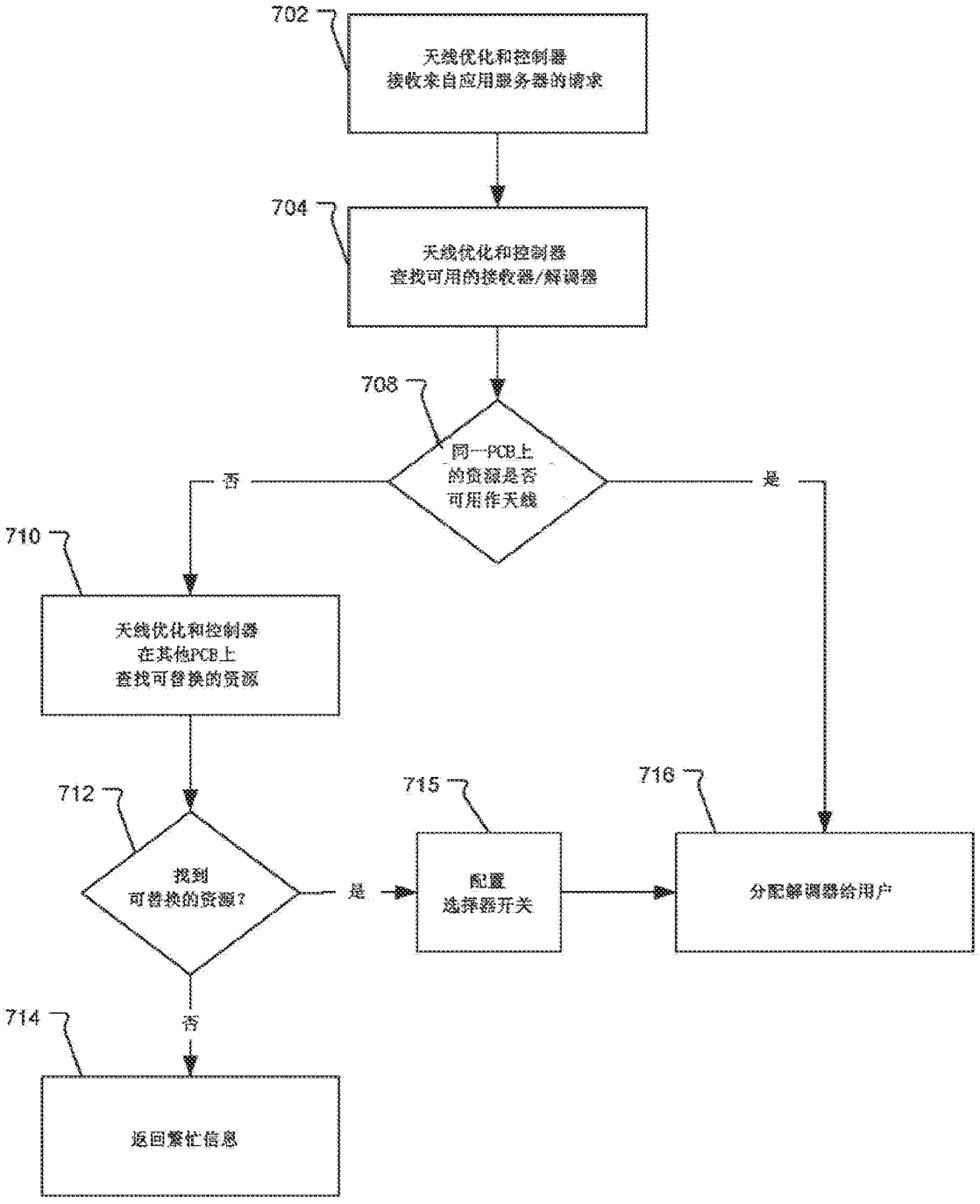


图 13

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3)SWAMI, Ravikant

(57) Abstract :
Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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Espacenet

TW201931861A Bitrate and pipeline preservation for content presentation

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Bitrate and pipeline preservation for content presentation

Abstract

Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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【51】Int. Cl.：　*H04N21/23　(2011.01)*

【54】發明名稱：用於內容呈現之位元率及管線保留技術
BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

【21】申請案號：107126926　　【22】申請日：中華民國 107 (2018) 年 08 月 02 日
【30】優先權：2017/09/08　印度　201741031917

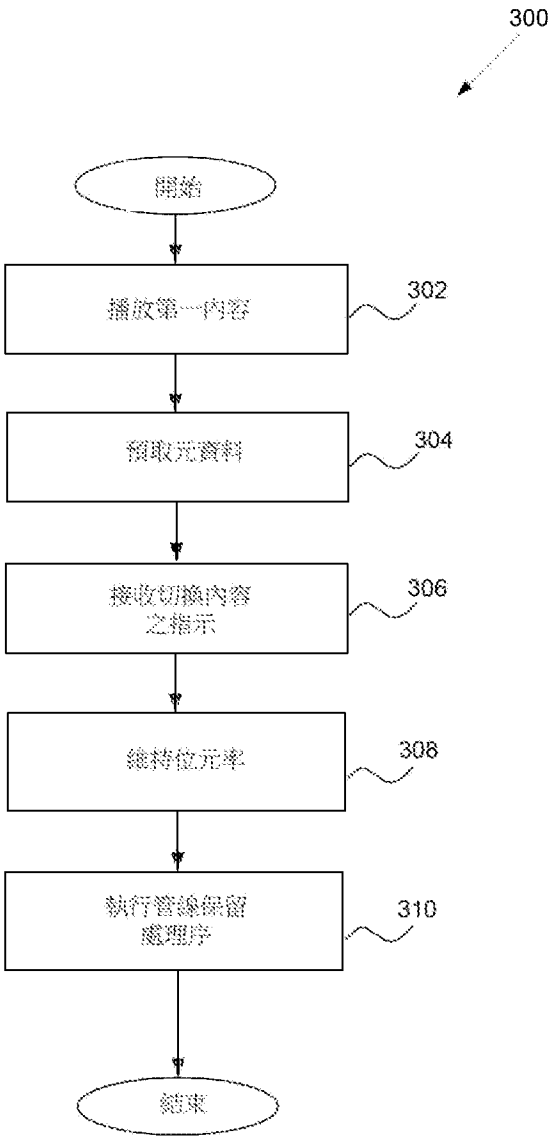
【72】發明人：高戈伊　阿瑪蘭德拉 N. (US) GOGOI, AMARENDRA N.；古普塔　山傑 K. (IN) GUPTA, SANJAY KUMAR；史瓦米　拉維康特 (IN) SWAMI, RAVIKANT
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美國
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【57】發明摘要：

本發明提供用於最佳化一內容改變處理序之系統及方法。在實例實施例中，一數位接收器致使播放一第一內容片段。該數位接收器在該第一內容片段之該播放期間接收一新內容片段之一選擇以供播放。回應於該接收到該選擇，該數位接收器維持用於播放該第一內容片段之一位元率以起始該新內容片段之播放。

指定代表圖：

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【圖3】

符號簡單說明：

300・・・實例方法

302、304、306、308、310・・・操作

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(54) Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

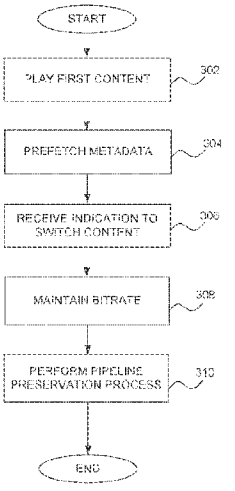


FIG. 3

(57) Abstract: Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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[Continued on next page]

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Published:

— *with international search report (Art. 21(3))*

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

CLAIM OF PRIORITY

[0001] This application claims priority to India Application Serial No. 201741031917, filed on September 8, 2017, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present disclosure generally relates to machines configured to the technical field of special-purpose machines that optimizes a content change process (e.g., channel change) including computerized variants of such special-purpose machines and improvements to such variants, and to the technologies by which such special-purpose machines become improved compared to other special-purpose machines that facilitate optimizing content changes. In particular, the present disclosure addresses systems and methods for preserving a download bitrate and a content playback pipeline during a content change process.

BACKGROUND

[0003] Conventionally, during a switch in content (e.g., caused by a channel change or a selection of a different piece of content), a delay occurs as certain information is obtained before the new piece of content (e.g., program, movie, show) is rendered and displayed. Additionally, for adaptive bitrate streaming content, the content typically starts streaming or download at a low (or lowest) bitrate before slowly increasing in bitrate until an optimum bitrate is achieved. This results in initial video or images being grainy. Furthermore, the delay may be increased by a need to build a content playback pipeline each time a change in content occurs.

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BRIEF DESCRIPTION OF DRAWINGS

[0004] Various ones of the appended drawings merely illustrate example embodiments of the present invention and cannot be considered as limiting its scope.

[0005] FIG. 1 is a diagram illustrating an example environment for optimizing content changes;

[0006] FIG. 2 is a block diagram illustrating an example embodiment of components within a digital receiver in accordance with an example embodiment.

[0007] FIG. 3 is a flow diagram of a method for optimizing a content change process in accordance with example embodiments.

[0008] FIG. 4 is a flow diagram of a method for preserving a content delivery pipeline in accordance with example embodiments.

[0009] FIG. 5 is a diagrammatic representation of a machine in an example form of a computing system within which a set of instructions may be executed for causing the machine to perform any one or more of the methodologies discussed herein, according to an example embodiment.

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DETAILED DESCRIPTION

[0010] The description that follows includes systems, methods, techniques, instruction sequences, and computing machine program products that embody illustrative embodiments of the present inventive subject matter. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide an understanding of various embodiments of the inventive subject matter. It will be evident, however, to those skilled in the art, that embodiments of the inventive subject matter may be practiced without some or other of these specific details. In general, well-known instruction instances, protocols, structures, and techniques have not been shown in detail. Examples merely typify possible variations. Unless explicitly stated otherwise, structures (e.g., structural components, such as modules) are optional and may be combined or subdivided, and operations (e.g., in a procedure, algorithm, or other function) may vary in sequence or be combined or subdivided.

[0011] Example embodiments described herein provide systems and methods for optimizing content changes or switch in content being viewed, such as through a channel change or selection of a different piece of content from a watchlist. In some embodiments, the system uses navigational context (e.g., the way a user is interacting with an application) to identify content of (potential) interest to a viewer. The system then prefetches metadata for the content of interest from a content provider and stores the metadata to local cache. The metadata comprises preconditions for rendering and display of a piece of content that include a minimum set of data that a system can obtain without having to decrypt the content. The prefetched metadata may be used, in example embodiments, to determine whether to preserve at least a portion of a content playback pipeline (also referred to herein as a "content deliver pipeline" or simply a "pipeline").

[0012] Conventionally, a same piece of content is broken up into segments (e.g., 10 second segments) and each segment is available in various bitrates. A low bitrate may be grainy, while a high bitrate will normally have better image quality. Typically, when playback of a new piece of content starts, the system does not know the quality of the network bandwidth. As a result, in order to start playback as quickly as possible, conventional systems start with a lowest bitrate. Thus, every time a user switches from one content to the next content, the playback will start with the lowest bitrate and slowly increase or improve according the capability of the network. In contrast, example

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embodiments, preserve a previous bitrate when switching to a new piece of content That is, when a user selects a new piece of content to playback (e.g., switching from a previous piece of content to the new piece of content), example embodiments maintain or preserve a (heuristically determined) bitrate used for streaming or downloading the previous piece of content when initiating the playback of the new piece of content. This allows for starting playback as quickly as possible while also providing better image quality from the start.

[0013] Furthermore, in conventional systems, a switch or transition in content typically causes a previous content delivery pipeline to be deconstructed (e.g., resources previous acquired are released). Subsequently, a new pipeline is created for the new piece of content (e.g., new resources are acquired). In contrast, example embodiments may maintain or preserve a portion (or an entire) content delivery pipeline (e.g., comprising a source element, a demultiplexer ("demux"), a video decoder, and an audio decoder) used to obtain the previous piece of content instead of reconstructing a pipeline (e.g., destroying the content delivery pipeline and building a new content delivery pipeline). The preservation of the pipeline also allows for playback of the new content as quickly as possible.

[0014] As a result, one or more of the methodologies described herein facilitate solving the technical problem of optimizing content change (e.g., reducing time for a change in channel or loading of new content) regardless of the delivery channel - whether the content is broadcast (e.g., IPTV and multicast) or over-the-top (OTT). The methodologies include causing playback, by a digital receiver, of a first piece of content and receiving a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content. The methodologies further include determining whether to preserve at least a portion of a playback pipeline when switching to playback of the new piece of content. In some embodiments, preservation of at least a portion of the playback pipeline comprises determining whether to retrain an audio decoder and a video decoder of the pipeline when switching to playback of the new piece of content. Accordingly, one or more of the methodologies discussed herein improves upon latency during content changes while maintaining image quality. It is noted that content changes include a selection of a piece of content for viewing (e.g., from a content access

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page such as a favorites grid or via a programming guide) as well as channel changes (e.g., linear channels changes).

[0015] With reference to FIG. 1, an embodiment of an example environment 100 that enables optimizing content changes (e.g., reducing latency during channel changes or selection of a piece of content for viewing) is shown. In example embodiments, a digital receiver 102 of a user provides access to digital content and manages content change operations. In one embodiment, the digital receiver 102 is a set-top box. The digital receiver 102 is coupled to a viewing device 104 (e.g., a television or monitor) on which the user can view the digital content. In some embodiments, the digital receiver 102 (e.g., operations of the digital receiver 102) may be combined with the viewing device 104 (e.g., a smart television, a tablet, or smartphone). The components of the digital receiver 102 used to perform operations of example embodiments will be discussed in more detail in connection with FIG. 2 below.

[0016] In some embodiments, the digital receiver 102 accesses (e.g., pulls, receives, retrieves) content via a network 106 from a content distribution network (CDN) server 108. The CDN server 108 may obtain the content from one or more content providers 110 (e.g., servers of the content providers 110). In example embodiments, the CDN server 108 may be associated with a third party service (e.g., Netflix, Hulu, YouTube, Amazon,) that stores and provides content, such as, for example but not limited to, over-the-top (OTT) content, video-on-demand (VOD) content, Internet content, or broadcast content to the digital receiver 102 via the network 106. The content comprises text, images, audio, and/or video content (e.g., movies, television shows, videos), and in some embodiments comprise live (e.g., in real-time) content. In some embodiments, the content providers 110 provide content, over the network 106 directly to the digital receiver 102 for display on the viewing device 104.

[0017] One or more portions of the network 106 may be an ad hoc network, an intranet, an extranet, a virtual private network (VPN), a local area network (LAN), a wireless LAN (WLAN), a wide area network (WAN), a wireless WAN (WWAN), a metropolitan area network (MAN), a portion of the Internet, a portion of the Public Switched Telephone Network (PSTN), a cellular telephone network, a wireless network, a WiFi network, a WiMax network, a satellite network, a cable network, a broadcast network, another type of network, or a combination of two or more such networks. Any one or more portions of the network 106 may communicate information via a

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transmission or signal medium. As used herein, "transmission medium" refers to any intangible (e.g., transitory) medium that is capable of communicating (e.g., transmitting) instructions for execution by a machine (e.g., by one or more processors of such a machine), and includes digital or analog communication signals or other intangible media to facilitate communication of such software.

[0018] It is noted that the environment 100 shown in FIG. 1 is merely an example. For instance, any number of CDN servers 108 and content providers 110 may be embodied within the environment 100. Additionally, some components of the environment 100 may be combined. For example, the functions of the digital receiver 102 may be embodied within the viewing device 104 to form a single device, such as a smart television, tablet, smartphone, or any other device that is capable of obtaining, rendering, and displaying content. Moreover, the functions described herein for any single system or machine may be subdivided among multiple systems or machines.

[0019] Any of the systems or machines (e.g., databases, devices, servers) shown in, or associated with, FIG. 1 may be, include, or otherwise be implemented in a special-purpose (e.g., specialized or otherwise non-generic) computer that has been modified (e.g., configured or programmed by software, such as one or more software modules of an application, operating system, firmware, middleware, or other program) to perform one or more of the functions described herein for that system or machine. For example, a special-purpose computer system able to implement any one or more of the methodologies described herein is discussed below with respect to FIG. 5, and such a special-purpose computer may accordingly be a means for performing any one or more of the methodologies discussed herein. Within the technical field of such special-purpose computers, a special-purpose computer that has been modified by the structures discussed herein to perform the functions discussed herein is technically improved compared to other special-purpose computers that lack the structures discussed herein or are otherwise unable to perform the functions discussed herein. Accordingly, a special-purpose machine configured according to the systems and methods discussed herein provides an improvement to the technology of similar special-purpose machines.

[0020] FIG. 2 is a block diagram illustrating an example embodiment of components within the digital receiver 102 in accordance with an example embodiment. In example embodiments, the digital receiver 102 manages access to content streamed over the network 106. In particular, the digital receiver 102 prefetches metadata, preserves a

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bitrate used for playback (e.g., streaming or downloading) of a previous piece of content when initiating the playback of a new piece of content, and preserves at least a portion of a content delivery pipeline. To enable these operations, the digital receiver 102 comprises a player 202, a content delivery pipeline 204 (also referred to as "pipeline"), a cache manager 206, and a cache 208, all of which may be configured to communicate with each other (e.g., over a bus, shared memory, or a switch). The digital receiver 102 comprises other components (not shown) that are not pertinent to operations of example embodiments.

[0021] The player 202 is configured to manage the pipeline 204. In example embodiments, the player 204 instantiates (e.g., constructs) the pipeline 204 when a first piece of content is selected for display. A different pipeline may be constructed for each type of content. For example, the player 202 constructs a HTTP Live Streaming (HLS) pipeline for HLS content and constructs a Dynamic Adaptive Streaming over HTTP (DASH) pipeline for DASH content. The player 204 also decides whether to maintain at least a portion of the pipeline 204 or construct a new pipeline when a switch in content occurs (e.g., channel change or selection of new content for viewing). An example method for managing the preservation of the pipeline is discussed in further detail in connection with FIG. 4 below.

[0022] The pipeline 204 is constructed by the player 202 by acquiring appropriate resources for obtaining and processing content data in order to playback selected content. The resources of the pipeline 204 comprise a source element 212, a demultiplexer ("demux") 214, an audio decoder 216, and a video decoder 218. The source element 212 manages the downloading of content data for the selected piece of content. The source element 212 also manages bitrate adaptation at the digital receiver 102. Specifically, the source element 212 remembers a last bitrate that is used for playback of a current/previous piece of content, and continues to use that bitrate for playback of the new content. As such, if the last bitrate is high, the source element 212 will start with the same high bitrate for the new content. If the new content cannot be playback at that bitrate, then the source element 212 will lower the bitrate. For example, if the downloading of the content takes less time than anticipated, there is spare bandwidth and the bitrate can be increased. Conversely, if the download is taking longer than anticipated, then the bitrate is decreased. As such, example embodiments,

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will start the playback of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing).

[0023] The demux demultiplexes the content data obtained from the CDN server 108 or the content provider 110 to obtain an audio signal and a video signal. The audio signal is transmitted to the audio decoder 216 for processing, while the video signal is transmitted to the video decoder 218 for processing. The results from the audio and video decoders 216 and 218 are output (e.g., transmitted) to the viewing device 104 for presentation to the user.

[0024] The cache manager 206 manages the prefetching of metadata for content that may potentially be selected for playback. In some embodiments, the cache manager 206 predicts content the user may be interested in viewing. For example, a user may be navigating a linear list of channels or programs (e.g., an electronic programming guide; "EPG") in a particular direction (e.g., up or down). In this embodiment, the cache manager 206 predicts a next set of content based on the direction of navigation on the linear list. In another example, the user may be viewing a video-on-demand (VoD) catalog or a watchlist of a user. If the user requests information or hovers over a selection for a piece of content, the cache manager 206 uses this as prediction that the piece of content is of interest to the user. Alternatively, the cache manager may consider all (or some) pieces of content in viewable portion of the catalog or watchlist as content of interest. In any of these cases, the cache manager 206 prefetches the metadata for the content of interest, and stores the prefetched data to the cache 208. The metadata may comprise, for example, one or more uniform resource locators (URLs) where the chunks of content are available, URLs for different bit rates, license data (e.g., where to obtain a license from), and codec information. The codec information will be used by the player 202 to determine whether to preserve at least a portion of the pipeline 204, as will be discussed further below. If the user subsequently selects content for which the metadata is already prefetched, then the metadata can be accessed from the cache 208 instead of having to be retrieved over the network 106 from the CDN server 108 or the content provider 110 after selection. This will assist in the reduction of latency in playback.

[0025] Any one or more of the components (e.g., modules, decoders, resources) described herein may be implemented using hardware alone (e.g., one or more processors of a machine) or a combination of hardware and software. For example, any

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component described herein may physically include an arrangement of one or more of the processors or configure a processor (e.g., among one or more processors of a machine) to perform the operations described herein for that module. Accordingly, different components described herein may include and configure different arrangements of the processors at different points in time or a single arrangement of the processors at different points in time. Each component described herein is an example of a means for performing the operations described herein for that component. Moreover, any two or more of these components may be combined into a single component, and the functions described herein for a single component may be subdivided among multiple components. Furthermore, according to various example embodiments, components described herein as being implemented within a single machine, database, or device may be distributed across multiple machines, databases, or devices.

[0026] FIG. 3 is a flow diagram of an example method 300 for optimizing content change in accordance with example embodiments. In example embodiments, the method 300 is performed in part or in whole by components of the digital receiver 102. Accordingly, the method 300 is described by way of example with reference to the digital receiver 102. However, it shall be appreciated that at least some of the operations of the method 300 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 300 is not intended to be limited to the digital receiver 102.

[0027] In operation 302, a first piece of content is caused to be played by the viewing device 104. In example embodiments, the player 202 constructs the pipeline 204 for obtaining and processing the content data for the first piece of content. In particular, the player 202 acquires the source element 212, the demux 214, the audio decoder 216, and the video decoder 218 to form the pipeline 204. The data content is processed by the pipeline 204 and presented on the viewing device 104.

[0028] In operation 304, metadata for a set of one or more content of interest is prefetched. In example embodiments, the cache manager 206 predicts content of interest of a user and prefetches the metadata for the content of interest. The prefetched data is then stored to the cache 208. The metadata may comprise, but is not limited to, one or more URLs where the chunks of content are available, one or more URL for

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different bit rates, license data (e.g., where to obtain a license from), and codec information.

[0029] In operation 306, the player 202 receives an indication to switch to a new piece of content for playback. The indication may be received from a control device of the user (e.g., a remote controller). In some embodiments, the user may scroll through an EPG or be viewing a catalog or watchlist, and selects a new piece of content for viewing.

[0030] In operation 308, the digital receiver 102 maintains the bitrate when switching playback to the new piece of content. In example embodiments, when transitioning playback from an ongoing playback operation to a new playback operation, the source element 212 uses a heuristic bitrate derived for playback of the first piece of content for playback of the new piece of content. Thus, the source element 212 attempts to maintain or preserve the bitrate for playback as opposed to starting a new playback from the lowest possible bitrate. If the new piece of content cannot be delivered at that bitrate, then the source element 212 will lower the bitrate. As such, example embodiments, will start the download of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing). This allows playback of the new content at a most optimal bitrate instantly instead of having to heuristically re-compute the optimal bitrate starting from the lowest possible bitrate. Conventionally, the derivation of the optimal bitrate usually requires downloading several segments or chunks of content data resulting in a gradual improvement of picture quality. However, example embodiments that use the previous derived heuristic bitrate maintain the same level of image quality as that of the previous playback from a very beginning of playback for the new content.

[0031] In operation 310, a pipeline preservation process is performed to determine whether to maintain at least a portion of the pipeline used to playback the first piece of content for use with the playback of the new piece of content. Furthermore, if the pipeline is to be maintained or preserve, a determination is made as to whether all the resources of the pipeline should be preserved or only a portion of the pipeline preserved (e.g., only some of the resources are kept and others are released). The pipeline preservation process will be discussed in more detail in connection with FIG. 4.

[0032] FIG. 4 is a flow diagram of an example method 400 for preserving a content delivery pipeline in accordance with example embodiments. In example embodiments,

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the method 400 is performed in part or in whole by the player 202 with respect the resources of the pipeline 204. Accordingly, the method 400 is described by way of example with reference to the player 202 and the pipeline 204. However, it shall be appreciated that at least some of the operations of the method 400 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 400 is not intended to be limited to the player 202 and the pipeline 204.

[0033] In operation 402, in response to receiving the indication to switch playback to new content, the cache manager 206 accesses the prefetched metadata stored in the cache 208 for the new content. The prefetched metadata for the new content may comprise one or more URLs where the new content is available, one or more URLs for different bit rates associated with the new content, license data for the new content, and codec information for the new content. The prefetched metadata may also indicate whether the new content is of a same type as the first piece of content. For example, the first piece of content and the new content may both be in a HTTP Live Streaming (HLS) format or both be in a Dynamic Adaptive Streaming over HTTP (DASH) format.

[0034] In operation 404, the player 202 determines whether the first piece of content and the new content are of the same content type. If the first piece of content and the new content are not of the same type (e g., first piece of content is in HLS format and the new content is in DASH format), then the resources of the pipeline 204 (e.g., the source element 212, the demux 214, the audio decoder 216, and the video decoder 218) are released in operation 406. Releasing all the resources of the pipeline 204 essentially deconstructs the pipeline 204. The player 202 them creates a new pipeline by acquiring other resources that are applicable to the content type of the new content.

[0035] If in operation 404 the player 202 determines that the first piece of content and the new content are of the same content type (e.g., both are HLS format), then in operation 408, codec information is detected for the new content. In example embodiments, the player 202 examines the prefetched metadata for the new content for the codec information. The codec information indicates types of decoders needed for the new content.

[0036] In operation 410, a determination is made by the player 202 as to whether the types of decoders needed for the new content is the same as the decoders currently in the pipeline 204 for the first piece of content. If the types of decoders needed is the same,

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then in operation 412 the entire pipeline 204 is preserved. In other words, the resources of the pipeline 204 are maintained and continued to be used to playback the new content.

[0037] However, if in operation 410 the player 202 determines that the new content needs different decoders, then in operation 414, the decoders (e.g., the audio decoder 216 and the video decoder 208) are released. Subsequently in operation 416, a remaining portion of the pipeline 204 (e.g., the source element 212 and the demux 214) are preserved or maintained. In these embodiments, the player 202 acquires a new set of decoders (e.g., a new audio decoder and a new video decoder) applicable to the new content, and adds the new set of decoders to the preserved portion of the pipeline 204.

[0038] While example embodiments are discussed with respect to pipeline and bitrate preservation applicable to both DASH and HLS, example embodiments for preservation of bitrate and the pipeline is applicable for any type of content that is adaptive in nature (e.g., where the content bitrate can change based on bandwidth).

[0039] FIG. 5 is a block diagram illustrating components of a machine 500, according to some example embodiments, able to read instructions 524 from a machine-storage medium 522 (e.g., a non-transitory machine-storage medium, a machine-readable storage medium, a computer-readable storage medium, or any suitable combination thereof) and perform any one or more of the methodologies discussed herein, in whole or in part. Specifically, FIG. 5 shows the machine 500 in the example form of a computer device (e.g., a computer) within which the instructions 524 (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine 500 to perform any one or more of the methodologies discussed herein may be executed, in whole or in part.

[0040] For example, the instructions 524 may cause the machine 500 to execute the flow diagrams of FIGs. 3 and 4. The instructions 524 can transform the general, non-programmed machine 500 into a particular machine (e.g., specially configured machine) programmed to carry out the described and illustrated functions in the manner described.

[0041] In alternative embodiments, the machine 500 operates as a standalone device or may be connected (e.g., networked) to other machines. The machine 500 may be a server computer, a client computer, a personal computer (PC), a tablet computer, a laptop computer, a netbook, a set-top box (e.g. STB), a personal digital assistant (PDA),

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a cellular telephone, a smartphone, a web appliance, a network router, a network switch, a network bridge, a power adapter, or any machine 500 capable of executing the instructions 524, sequentially or otherwise, that specify actions to be taken by that machine 500. Further, while only a single machine 500 is illustrated, the term "machine" shall also be taken to include a collection of machines that individually or jointly execute the instructions 524 to perform any one or more of the methodologies discussed herein.

[0042] The machine 500 includes a processor 502 (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), an application specific integrated circuit (ASIC), a radio-frequency integrated circuit (RFIC), or any suitable combination thereof), a main memory 504, and a static memory 506, which are configured to communicate with each other via a bus 508. The processor 502 may contain microcircuits that are configurable, temporarily or permanently, by some or all of the instructions 524 such that the processor 502 is configurable to perform any one or more of the methodologies described herein, in whole or in part. For example, a set of one or more microcircuits of the processor 502 may be configurable to execute one or more modules (e.g., software modules) described herein.

[0043] The machine 500 may further include a graphics display 510 (e.g., a plasma display panel (PDP), a light emitting diode (LED) display, a liquid crystal display (LCD), a projector, a cathode ray tube (CRT), or any other display capable of displaying graphics or video). The machine 500 may also include an alphanumeric input device 512 (e.g., a keyboard or keypad), a cursor control device 514 (e.g., a mouse, a touchpad, a trackball, a joystick, a motion sensor, an eye tracking device, or other pointing instrument), a storage unit 516, a signal generation device 518 (e.g., a sound card, an amplifier, a speaker, a headphone jack, or any suitable combination thereof), and a network interface device 520.

[0044] The storage unit 516 includes the machine-storage medium 522 (e.g., a tangible machine-readable storage medium) on which are stored the instructions 524 embodying any one or more of the methodologies or functions described herein. The instructions 524 may also reside, completely or at least partially, within the main memory 504, within the processor 502 (e.g., within the processor's cache memory), or both, before or during execution thereof by the machine 500. Accordingly, the main

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memory 504 and the processor 502 may be considered machine-storage media 522 (e.g., tangible and non-transitory machine-storage media).

[0045] In some example embodiments, the machine 500 may be a portable computing device and have one or more additional input components (e.g., sensors or gauges). Examples of such input components include an image input component (e.g., one or more cameras), an audio input component (e.g., a microphone), a direction input component (e.g., a compass), a location input component (e.g., a global positioning system (GPS) receiver), an orientation component (e.g., a gyroscope), a motion detection component (e.g., one or more accelerometers), an altitude detection component (e.g., an altimeter), and a gas detection component (e.g., a gas sensor). Inputs harvested by any one or more of these input components may be accessible and available for use by any of the modules described herein.

EXECUTABLE INSTRUCTIONS AND MACHINE-STORAGE MEDIUM

[0046] The various memories (i.e., 504, 506, and/or memory of the processor(s) 502) and/or storage unit 516 may store one or more sets of instructions and data structures (e.g., software) 524 embodying or utilized by any one or more of the methodologies or functions described herein. These instructions, when executed by processor(s) 502 cause various operations to implement the disclosed embodiments.

[0047] As used herein, the terms "machine-storage medium," "device-storage medium," "computer-storage medium" (referred to collectively as "machine-storage medium 522") mean the same thing and may be used interchangeably in this disclosure. The terms refer to a single or multiple storage devices and/or media (e.g., a centralized or distributed database, and/or associated caches and servers) that store executable instructions and/or data, as well as cloud-based storage systems or storage networks that include multiple storage apparatus or devices. The terms shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media, including memory internal or external to processors. Specific examples of machine-storage media, computer-storage media, and/or device-storage media 522 include non-volatile memory, including by way of example semiconductor memory devices, e.g., erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), FPGA, and flash memory devices; magnetic disks such as internal hard disks and removable disks; magneto-optical disks;

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and CD-ROM and DVD-ROM disks. The terms machine-storage media, computer-storage media, and device-storage media 522 specifically exclude carrier waves, modulated data signals, and other such media, at least some of which are covered under the term "signal medium" discussed below.

SIGNAL MEDIUM

[0048] The term "signal medium" or "transmission medium" shall be taken to include any form of modulated data signal, carrier wave, and so forth. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a matter as to encode information in the signal.

COMPUTER READABLE MEDIUM

[0049] The terms "machine-readable medium," "computer-readable medium" and "device-readable medium" mean the same thing and may be used interchangeably in this disclosure. The terms are defined to include both machine-storage media and signal media. Thus, the terms include both storage devices/media and carrier waves/modulated data signals.

[0050] The instructions 524 may further be transmitted or received over a communications network 526 using a transmission medium via the network interface device 520 and utilizing any one of a number of well-known transfer protocols (e.g., HTTP). Examples of communication networks 526 include a local area network (LAN), a wide area network (WAN), the Internet, mobile telephone networks, plain old telephone service (POTS) networks, and wireless data networks (e.g., WiFi, LTE, and WiMAX networks). The term "transmission medium" shall be taken to include any intangible medium that is capable of storing, encoding, or carrying instructions 524 for execution by the machine 500, and includes digital or analog communications signals or other intangible medium to facilitate communication of such software.

[0051] Throughout this specification, plural instances may implement components, operations, or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a

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combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

[0052] Certain embodiments are described herein as including logic or a number of components, modules, or mechanisms. Modules may constitute either software modules (e.g., code embodied on a machine-storage medium 522 or in a transmission signal) or hardware modules. A "hardware module" is a tangible unit capable of performing certain operations and may be configured or arranged in a certain physical manner. In various example embodiments, one or more computer systems (e.g., a standalone computer system, a client computer system, or a server computer system) or one or more hardware modules of a computer system (e.g., a processor 502 or a group of processors 502) may be configured by software (e.g., an application or application portion) as a hardware module that operates to perform certain operations as described herein.

[0053] In some embodiments, a hardware module may be implemented mechanically, electronically, or any suitable combination thereof. For example, a hardware module may include dedicated circuitry or logic that is permanently configured to perform certain operations. For example, a hardware module may be a special-purpose processor, such as a field-programmable gate array (FPGA) or an ASIC. A hardware module may also include programmable logic or circuitry that is temporarily configured by software to perform certain operations. For example, a hardware module may include software encompassed within a general-purpose processor or other programmable processor. It will be appreciated that the decision to implement a hardware module mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

[0054] Accordingly, the phrase "hardware module" should be understood to encompass a tangible entity, be that an entity that is physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate in a certain manner or to perform certain operations described herein. As used herein, "hardware-implemented module" refers to a hardware module. Considering embodiments in which hardware modules are temporarily configured (e.g.,

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programmed), each of the hardware modules need not be configured or instantiated at any one instance in time. For example, where a hardware module comprises a general-purpose processor configured by software to become a special-purpose processor, the general-purpose processor may be configured as respectively different special-purpose processors (e.g., comprising different hardware modules) at different times. Software may accordingly configure a processor, for example, to constitute a particular hardware module at one instance of time and to constitute a different hardware module at a different instance of time.

[0055] The various operations of example methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented modules that operate to perform one or more operations or functions described herein. As used herein, "processor-implemented module" refers to a hardware module implemented using one or more processors.

[0056] Similarly, the methods described herein may be at least partially processor-implemented, a processor being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors or processor-implemented modules.

EXAMPLES

[0057] Example 1 is a method for optimizing a content change process. The method comprises causing playback, by a digital receiver, of a first piece of content; receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and in response to the receiving of the selection, maintaining, by a processor of the digital receiver, a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0058] In example 2, the subject matter of example 1 can optionally include determining whether the new piece of content is of a same type as the first piece of content, and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0059] In example 3, the subject matter of examples 1-2 can optionally include wherein the determining whether to preserve comprises detecting codec information for

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the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0060] In example 4, the subject matter of examples 1-3 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0061] In example 5, the subject matter of examples 1-4 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0062] Example 6 is a system optimizing a content change process. The system includes one or more hardware processors and a storage device storing instructions that configure the one or more hardware processors to perform operations comprising causing playback of a first piece of content; receiving a selection of a new piece of content for playback during the playback of the first piece of content; and in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0063] In example 7, the subject matter of example 6 can optionally include determining whether the new piece of content is of a same type as the first piece of content; and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0064] In example 8, the subject matter of examples 6-7 can optionally include wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0065] In example 9, the subject matter of examples 6-8 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0066] In example 10, the subject matter of examples 6-9 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types

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indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0067] Example 11 is machine-readable medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising causing playback of a first piece of content; receiving a selection of a new piece of content for playback during the playback of the first piece of content, and in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0068] In example 12, the subject matter of example 11 can optionally include determining whether the new piece of content is of a same type as the first piece of content; and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0069] In example 13, the subject matter of examples 11-12 can optionally include wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0070] In example 14, the subject matter of examples 11-13 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0071] In example 15, the subject matter of examples 11-14 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0072] Some portions of the subject matter discussed herein may be presented in terms of algorithms or symbolic representations of operations on data stored as bits or binary digital signals within a machine memory (e.g., a computer memory). Such algorithms or symbolic representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. As used herein, an "algorithm" is a self-consistent sequence of operations or similar processing leading to a desired result. In this context, algorithms and operations involve physical manipulation of physical quantities. Typically, but not

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necessarily, such quantities may take the form of electrical, magnetic, or optical signals capable of being stored, accessed, transferred, combined, compared, or otherwise manipulated by a machine. It is convenient at times, principally for reasons of common usage, to refer to such signals using words such as "data," "content," "bits," "values," "elements," "symbols," "characters," "terms," "numbers," "numerals," or the like. These words, however, are merely convenient labels and are to be associated with appropriate physical quantities.

[0073] Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "presenting," "displaying," or the like may refer to actions or processes of a machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, or optical) quantities within one or more memories (e.g., volatile memory, non-volatile memory, or any suitable combination thereof), registers, or other machine components that receive, store, transmit, or display information. Furthermore, unless specifically stated otherwise, the terms "a" or "an" are herein used, as is common in patent documents, to include one or more than one instance. Finally, as used herein, the conjunction "or" refers to a non-exclusive "or," unless specifically stated otherwise.

[0074] Although an overview of the inventive subject matter has been described with reference to specific example embodiments, various modifications and changes may be made to these embodiments without departing from the broader scope of embodiments of the present invention. For example, various embodiments or features thereof may be mixed and matched or made optional by a person of ordinary skill in the art. Such embodiments of the inventive subject matter may be referred to herein, individually or collectively, by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept if more than one is, in fact, disclosed.

[0075] The embodiments illustrated herein are believed to be described in sufficient detail to enable those skilled in the art to practice the teachings disclosed. Other embodiments may be used and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. The Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments is defined only by the appended claims, along with the full range of equivalents to which such claims are entitled.

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[0076] Moreover, plural instances may be provided for resources, operations, or structures described herein as a single instance. Additionally, boundaries between various resources, operations, modules, engines, and data stores are somewhat arbitrary, and particular operations are illustrated in a context of specific illustrative configurations. Other allocations of functionality are envisioned and may fall within a scope of various embodiments of the present invention. In general, structures and functionality presented as separate resources in the example configurations may be implemented as a combined structure or resource. Similarly, structures and functionality presented as a single resource may be implemented as separate resources. These and other variations, modifications, additions, and improvements fall within a scope of embodiments of the present invention as represented by the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

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CLAIMS

What is claimed is:

1. A method comprising:

causing playback, by a digital receiver, of a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining, by a processor of the digital receiver, a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

2. The method of claim 1, further comprising:

determining whether the new piece of content is of a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

3. The method of claim 2, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

4. The method of claim 3, further comprising preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

5. The method of claim 3, further comprising:

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

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6. A system comprising:

one or more hardware processors; and

a storage device storing instructions that configure the one or more hardware processors to perform operations comprising:

causing playback, by a digital receiver, of a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

7. The system of claim 6, wherein the operations further comprise:

determining whether the new piece of content is of a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

8. The system of claim 7, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

9. The system of claim 8, wherein the operations further comprise preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

10. The system of claim 8, wherein the operations further comprise:

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

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11. A machine-readable medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising:

causing playback, by a digital receiver, of a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

12. The machine-readable medium of claim 11, wherein the operations further comprise:

determining whether the new piece of content is of a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

13. The machine-readable medium of claim 12, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

14. The machine-readable medium of claim 13, wherein the operations further comprise preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

15. The machine-readable medium of claim 13, wherein the operations further comprise:

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

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obtaining a new audio decoder and a new video decoder based on the codec information.

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PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 18/480,918	Filing Date 10/04/2023	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $480 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/04/2024	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/CAROL A BARNES/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3	9039

44367 7590 06/21/2024

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EXAMINER	
GADOMSKI, STEFAN J	

ART UNIT	PAPER NUMBER
2485	

NOTIFICATION DATE	DELIVERY MODE
06/21/2024	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

SLW@blackhillsip.com
uspto@slwip.com

Office Action Summary	Application No. 18/480,918	Applicant(s) Gogoi et al.	
	Examiner STEFAN GADOMSKI	Art Unit 2485	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 10/04/2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 16-35 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 16-35 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 10/04/2023 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Priority

2. This application discloses and claims only subject matter disclosed in prior application no 16/645,598, filed 03/09/2020, and 17/454,169, filed 11/09/2021 and names the inventor or at least one joint inventor named in the prior application. Accordingly, this application constitutes a continuation.

Drawings

3. The drawings were received on 10/04/2023. These drawings are acceptable.

Double Patenting

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*,

140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The filing of a terminal disclaimer by itself is not a complete reply to a nonstatutory double patenting (NSDP) rejection. A complete reply requires that the terminal disclaimer be accompanied by a reply requesting reconsideration of the prior Office action. Even where the NSDP rejection is provisional the reply must be complete. See MPEP § 804, subsection I.B.1. For a reply to a non-final Office action, see 37 CFR 1.111(a). For a reply to final Office action, see 37 CFR 1.113(c). A request for reconsideration while not provided for in 37 CFR 1.113(c) may be filed after final for consideration. See MPEP §§ 706.07(e) and 714.13.

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The actual filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely

online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/apply/applying-online/eterminal-disclaimer.

5. **Claims 16-35 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-8, and 13-19 of U.S. Patent No. 11,825,139 B2.**

Instant Application 18/480,918 Claim 16	**U.S. Patent 11,825,139 B2 Claim 1**
A method performed by a digital receiver, the method comprising:	A method comprising:
receiving a selection of a new piece of content for playback during playback of a first piece of content;	causing playback of a first piece of content using a playback pipeline; receiving, by a digital receiver, a selection of a new piece of content for playback during playback of the first piece of content;
in response to the receiving of the selection, transitioning to the new piece of content, determining whether the new piece of content is of a same content type as the first piece of content; and based on the new piece of content being the same content type as the first piece of content,	in response to the receiving of the selection, transitioning from playback of the first piece of content to the new piece of content; determining whether the new piece of content is of a same content type as the first piece of content; based on the new piece of content being the same content type as the first piece of content,
determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder,	determining whether an audio decoder or a video decoder of the playback pipeline used to play back the first piece of content should be preserved; and based on a determination that the audio decoder and the video decoder should not be preserved,
the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the	preserving a source element and a demultiplexer of the playback pipeline while

demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.	replacing the audio decoder and the video decoder.

Although the claims at issue are not identical, they are not patentably distinct from each other In that the instant application is broader in scope and therefore the entire scope of the reference claim falls within the scope of the examined claim.

In regard to claims 17-25 of the instant application, these claims are rejected as being unpatentable over claims 2-8 and 13 respectively of the issued patent.

Instant Application 18/480,918 Claim 26	**U.S. Patent 11,825,139 B2 Claim 14**
A system comprising: one or more hardware processors; and a storage device storing instructions that configure the one or more hardware processors to perform operations comprising:	A system comprising: one or more hardware processors; and a storage device storing instructions that configure the one or more hardware processors to perform operations comprising:
receiving a selection of a new piece of content for playback during playback of a first piece of content,	causing playback of a first piece of content using a playback pipeline; receiving a selection of a new piece of content for playback during playback of the first piece of content;
in response to the receiving of the selection, transitioning to the new piece of content; determining whether the new piece of content is of a same content type as the first piece of content; and	in response to the receiving of the selection, transitioning from playback of the first piece of content to the new piece of content; determining whether the new piece of content is of a same content type as the first piece of content;
based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for	based on the new piece of content being the same content type as the first piece of content, determining whether an audio decoder and a video decoder of the playback pipeline used to play back the first piece of content should be preserved; and

the new piece of content, a demultiplexer, an audio decoder, and a video decoder,	
the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.	based on a determination that the audio decoder and the video decoder should not be preserved, preserving a source element and a demultiplexer of the playback pipeline while replacing the audio decoder and the video decoder.

Although the claims at issue are not identical, they are not patentably distinct from each other In that the instant application is broader in scope and therefore the entire scope of the reference claim falls within the scope of the examined claim.

In regard to claims 27-34 of the instant application, these claims are rejected as being unpatentable over claims 15-17, 5, 13, 13, 18, and 13 respectively of the issued patent.

Instant Application 18/480,918 Claim 35	**U.S. Patent 11,825,139 B2 Claim 19**
A machine-storage medium storing instruction that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising:	A machine-storage medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising: causing playback of a first piece of content using a playback pipeline;
Receiving a selection of a new piece of content for playback during playback of a first piece of content;	receiving a selection of a new piece of content for playback during playback of the first piece of content;
in response to the receiving of the selection, transitioning to the new piece of content;	in response to the receiving of the selection, transitioning from playback of the first piece of content to the new piece of content;
determining whether the new piece of content is of a same content type as the first piece of content;	determining whether the new piece of content is of a same content type as the first piece of content;
based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a	based on the new piece of content being the same content type as the first piece of content, determining whether an audio decoder of the

portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder,	playback pipeline used to play back the first piece of content should be preserved; and based on a determination that the audio decoder and the video decoder should not be preserved,
the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.	preserving a source element and a demultiplexer of the playback pipeline while replacing the audio decoder and the video decoder.

Although the claims at issue are not identical, they are not patentably distinct from each other In that the instant application is broader in scope and therefore the entire scope of the reference claim falls within the scope of the examined claim.

Claim Rejections - 35 USC § 101

6. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

7. **Claim 35 is rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter.**

The claim(s) does/do not fall within at least one of the four categories of patent eligible subject matter because "machine-storage medium" as claimed, per se do not fit within recognized categories of statutory subject matter. "Machine-storage medium" in light of the supporting disclosure is broad enough to encompass transitory embodiments. Transitory signals

are not within one of the four statutory categories (i.e. non-statutory subject matter). *See* MPEP 2106(I); *In re Nuijten*, 500 F.3d 1346, 1357 (Fed. Cir. 2007). However, claims directed toward a non-transitory computer readable medium may qualify as a manufacture and make the claim patent-eligible subject matter. MPEP 2106(II)(A).

Allowable Subject Matter

8. **Claims 16-35** would be allowable if rewritten or amended to overcome the double patenting rejection(s) and 101 rejections set forth in this Office action.

Citation of Pertinent Prior Art

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

- Li et al. US 2015/0023404 A1 discloses bitrate determination based on available bandwidth
- Giladi et al. US 2015/0019629 A1 discloses DASK content that preserves codes and bitrates

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to STEFAN GADOMSKI whose telephone number is (571)270-5701. The examiner can normally be reached Monday - Friday, 12-8PM EST.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is

encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on 571-272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is availab le to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

STEFAN GADOMSKI
Primary Examiner
Art Unit 2485

/STEFAN GADOMSKI/
Primary Examiner, Art Unit 2485

Notice of References Cited	Application/Control No. 18/480,918	Applicant(s)/Patent Under Reexamination Gogoi et al.	
	Examiner STEFAN GADOMSKI	Art Unit 2485	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-20140359150-A1	2014-12-04	Oran; David R.	H04N21/64761	709/231
*	B	US-20150019629-A1	2015-01-15	Giladi; Alexander	H04L67/02	709/203
*	C	US-20140040498-A1	2014-02-06	OYMAN; OZGUR	H04W4/02	709/231
*	D	US-20150023404-A1	2015-01-22	Li; Zhi	H04L65/612	375/240.02
*	E	US-20080189352-A1	2008-08-07	Mitchell; Robert Scott	H04L1/22	709/201
*	F	US-20040111526-A1	2004-06-10	Baldwin, James Armand	H04N21/44016	348/E5.005
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N	WO-2016099356-A1	2016-06-23	WO	AKRAM A	H04L65/4084
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	Art Unit
	STEFAN GADOMSKI	2485

CPC - Searched*		
Symbol	Date	Examiner
See print out for complete history	06/15/2024	SG

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
PE2E inventor search	06/15/2024	SG
PE2E assignee search	06/15/2024	SG
PE2E text search	06/15/2024	SG
Review of parent case 16/645,598 and 17/454,169	06/15/2024	SG

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/STEFAN GADOMSKI/ Primary Examiner, Art Unit 2485	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/480,918	Gogoi et al.
	Examiner	Art Unit
	STEFAN GADOMSKI	2485

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/15/2024								
	1	-								
	2	-								
	3	-								
	4	-								
	5	-								
	6	-								
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	10	-								
	11	-								
	12	-								
	13	-								
	14	-								
	15	-								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								
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	23	✓								
	24	✓								
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	26	✓								
	27	✓								
	28	✓								
	29	✓								
	30	✓								
	31	✓								
	32	✓								
	33	✓								
	34	✓								
	35	✓								

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	388	((("GOGOI") near3 ("Amarendra")) OR (("GUPTA") near3 ("Sanjay")) OR (("SWAMI") near3 ("Ravikant"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/06/13 01:53 PM
L2	7	L1 AND (playback AND content AND type).CLM.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2024/06/13 01:57 PM
L3	2	((("OPENTV,INC"))).AS, AANM.	(US-PGPUB; USPAT)	OR	ON	ON	2024/06/13 03:09 PM
L4	162968	(H04N21/23655 or H04L65/70 or H04N21/2662 or H04L65/764 or H04L65/80 or H04W28/02).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 03:14 PM
L5	34649	(H04N21/23655 OR H04L65/70 OR H04N21/2662 OR H04L65/764 OR H04L65/80 OR H04W28/02).cpc.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 03:14 PM
L6	2	("11184652" OR "20170034233").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/06/13 03:15 PM
L7	1	("20080195743").pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/06/13 03:17 PM
L8	1	"20170244924".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2024/06/13 03:18 PM
L9	11	("DASH") AND (pipeline SAME bitrate SAME demultiplexer)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO,	OR	ON	ON	2024/06/13 08:59 PM

			RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L10	73	("DASH") AND (pipeline SAME demultiplexer)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:00 PM
L11	1950	("DASH") SAME3 (demultiplexer)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:02 PM
L12	36	("DASH") SAME3 (demultiplexer WITH codec)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:03 PM
L13	9	("DASH") SAME3 (demultiplexer WITH (sav$3 preserv$3))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY,	OR	ON	ON	2024/06/13 09:07 PM

			CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L14	135	("DASH") SAME3 (bitrate WITH (sav$3 preserv$5))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:07 PM
L15	21	("DASH") SAME3 ((demux demultiplexer) WITH (sav$3 preserv$5))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:11 PM
L16	48	("DASH") AND ((demux demultiplexer) WITH (sav$3 preserv$5))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK,	OR	ON	ON	2024/06/13 09:11 PM

			TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L17	2157	((demux demultiplexer) WITH (sav$3 preserv$5))	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 09:12 PM
L18	678	((demux demultiplexer) WITH (sav$3 preserv$5))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:12 PM
L19	0	((demux demultiplexer) WITH (sav$3 preserv$5)) WITH ((content channel) NEAR3 change)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:13 PM
L20	137	((demux demultiplexer) WITH (sav$3 preserv$5)) AND ((content channel) NEAR3 change)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:13 PM
L21	11	((demux demultiplexer) WITH (sav$3 preserv$5)) AND ((content channel) NEAR3 change) AND "DASH"	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:14 PM
L22	44	"DASH" WITH (demux demultiplexer)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:15 PM
L23	87	(receiver decoder) SAME (preserv$3 WITH (demultiplexer demux multiplexer))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:24 PM
L24	235	"DASH" WITH pipeline	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:29 PM
L25	0	"DASH" WITH pipeline WITH rsource	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:30 PM
L26	5	"DASH" WITH pipeline WITH resource	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:30 PM
L27	757	"DASH" AND (pipeline WITH resource)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:30 PM
L28	31	"DASH" SAME3	(US-PGPUB; USPAT;	OR	ON	ON	2024/06/13

		(pipeline WITH resource)	USOCR)				09:30 PM
L29	11	"DASH" SAME3 (demux WITH (sav$3 preserv$3 keep$3))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:36 PM
L30	0	"201313943445".pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:42 PM
L31	0	"2013013943445".pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:42 PM
L32	0	"2015023404".pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:42 PM
L33	1	"20150023404".pn.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 09:42 PM
L34	1076	(maintain$3 WITH (demux demultiplexer))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 10:05 PM
L35	0	(maintain$3 WITH (demux demultiplexer)) SAME (content WITH chang$3)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 10:05 PM
L36	7	(maintain$3 WITH (demux demultiplexer)) SAME (channel WITH chang$3)	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 10:05 PM
L37	1171	((maintain$3 preserv$3) WITH (demux demultiplexer))	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 10:07 PM
L38	108	((maintain$3 preserv$3) WITH (demux demultiplexer)) WITH chang$3	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2024/06/13 10:07 PM
L39	12	EP near2 "3050307"	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2024/06/13 10:39 PM
L40	2	"20110296047".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV,	OR	ON	ON	2024/06/13 10:48 PM

			MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

PE2E SEARCH - Search History (Similarity Search)

No Similarity Results available

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3

CONFIRMATION NO. 9039

44367
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P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

PUBLICATION NOTICE

OC000000070398197

Date Mailed: 03/29/2024

Title:BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Publication No.US-2024-0107090-A1
Publication Date:03/28/2024

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The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/480,918	10/04/2023		1980	2050.354US3	15	3

CONFIRMATION NO. 9039

UPDATED FILING RECEIPT

44367
SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

OC00000066165998

Date Mailed: 12/21/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

Amarendra N. Gogoi, Fremont, CA;
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Applicant(s)

OpenTV, Inc., San Francisco, CA;

Power of Attorney: The patent practitioners associated with Customer Number 44367

Domestic Priority data as claimed by applicant

This application is a CON of 17/454,169 11/09/2021 PAT 11,825,139
which is a CON of 16/645,598 03/09/2020 PAT 11,184,652
which is a 371 of PCT/US2018/046723 08/14/2018

Foreign Applications (You may be eligible to benefit from the Patent Prosecution Highway program at the USPTO. Please see http://www.uspto.gov for more information.)
INDIA 201741031917 09/08/2017 No Access Code Provided

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Pinterest Ex. 1004, Page 330 of 401

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 10/18/2023
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/480,918**
Projected Publication Date: 03/28/2024
Non-Publication Request: No
Early Publication Request: No
Title

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/480,918

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	15 minus 20 =	* 0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x =	0
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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PATENT AND TRADEMARK OFFICE

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	12/19/2023 12:07:26 PM Z ET	2050.354US3

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	CaTina Jensen
PATENT CENTER #	63667456	AUTHORIZED BY	Joseph Wang
CUSTOMER #	44367	FILING DATE	10/04/2023
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Amarendra N. Gogoi

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
DA / 190743	E2023BIC08106116	CaTina Jensen

PRE-AUTHORIZED ACCOUNT	PRE-AUTHORIZED CATEGORY
190743	37 CFR 1.16 (National application filing, search, and examination fees); 37 CFR 1.17 (Patent application and reexamination processing fees); 37 CFR 1.19 (Document supply fees); 37 CFR 1.20 (Post Issuance fees); 37 CFR 1.21 (Miscellaneous fees and charges)

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
1051	SURCHARGE- LATE FILING FEE, SEARCH FEE, EXAMINATION FEE, INVENTOR'S OATH OR DECLARATION, OR APPLICATION FILED WITHOUT AT LEAST ONE CLAIM OR BY REFERENCE	160.00	1	160.00
1111	UTILITY PATENT APPL. SEARCH FEE	700.00	1	700.00
1011	BASIC FILING FEE - UTILITY (PAPER	320.00	1	320.00

	FILING ALSO REQUIRES NON-ELECTRONIC FILING FEE UNDER 1.16(T))			
1311	PATENT APPL. EXAMINATION FEE	800.00	1	800.00
			TOTAL AMOUNT:	**$1,980.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**12/19/2023 12:07:26 PM Z ET**	**2050.354US3**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	CaTina Jensen
PATENT CENTER #	63667456	FILING DATE	10/04/2023
CUSTOMER #	44367	FIRST NAMED INVENTOR	Amarendra N. Gogoi
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Joseph Wang

Documents

TOTAL DOCUMENTS: 4

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2050354US3_MPRESP.pdf		12	-	270 KB
2050354US3_MPRESP-TRAN.LET.pdf	(1-1)	1	Transmittal Letter	88 KB
2050354US3_MPRESP-PEFR.pdf	(2-2)	1	Applicant Response to Pre-Exam Formalities Notice	76 KB
2050354US3_MPRESP-LET..pdf	(3-4)	2	Miscellaneous Incoming Letter	129 KB
2050354US3_MPRESP-A.PE.pdf	(5-12)	8	Preliminary Amendment	114 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2050354US3_MPRESP.pdf	302C8253A7215A347DB437EBB19106550C5EE44EE3394BAD8D911EB2D6420120C2E340D88BB90640BE988D673DC98CFC76CC48C553504B40842C9A328E9BD197
2050354US3_MPRESP-TRAN.LET.pdf	D65E7F21843FC723FE39DD3EBDC9DBAA7F3CA4447C49F8EEBA0DB4BEF497FB7BAC455034FF3EBB391ABE977308E1086AB8F4EE54075336CB358E89E06726F853
2050354US3_MPRESP-PEFR.pdf	E079C71C8D5CC21BD3851E65C065242F35E8B1481602F5730AD1E3110C89418FCDF238F3C860CBEB2F57B34C7E5D7CA08F53C98D6A7B6CE6DC9CA369362697A9
2050354US3_MPRESP-LET..pdf	70914AFB07F01E9573F0148AF1BF51BA82C62E7A9B12FF9D2C382FA63D885B16ADFE80D526313B8B16B212DCD95943DEFB3B47EB6FFC1B7E4D69CBC6ACEF5E96
2050354US3_MPRESP-A.PE.pdf	415C262FE3518C1ED3F85127B9CDDB77334745FDD0C5EEC89CDE5AE3585D0C8FE82DBEA5DC765F054DB92ABC993919995BB0B7FD892C98B3DBF401E7BE27FF89

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Amarendra N. Gogoi et al.
Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Docket No.:	2050.354US3	Serial No.:	18/480,918
Filed:	October 4, 2023	Due Date:	December 20, 2023
Examiner:	Unknown	Group Art Unit:	Unknown
Customer No.:	44367	Confirmation No.:	9039

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the attached:

X Communication Re: Missing Parts (1 pg.)
X Copy Notice to File Missing Parts (2 pgs.)
X Preliminary Amendment (8 pgs.)

X Authorization to charge Deposit Account 19-0743 in the amount of $160.00 to cover the Large Entity Surcharge.
X Authorization to charge Deposit Account 19-0743 in the amount of $1820.00 to cover the Basic Filing, Search, and Exam Fees and any Additional Claims Fee.

If not provided for in a separate paper filed herewith, please consider this a PETITION FOR EXTENSION OF TIME for sufficient number of months to enter these papers, and please charge any additional required fees or credit overpayment to Deposit Account No. 19-0743.

/ Susan Yee /

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer No.: 44367
SY:CMG:clj1

By _____
Susan Yee
Reg. No. 41,388

CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being filed using the USPTO's electronic filing system EFS-Web, and is addressed to: Mail Stop Missing Parts, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on this 19th day of December, 2023.

CaTina Jensen
Name

/CaTina Jensen/
Signature

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s):	Amarendra N. Gogoi et al.	Examiner: Unknown	
Serial No.:	18/480,918	Group Art Unit: Unknown	
Filed:	October 4, 2023	Docket: 2050.354US3	
Customer No.: 44367		Confirmation No.: 9039	
Title:	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION		

COMMUNICATION RE: MISSING PARTS

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Alexandria, VA 22313-1450

In response to the Notice to File Missing Parts, we submit authorization to charge Deposit Account 19-0743 in the amount of $160.00 to cover the Large Entity surcharge, and authorization to charge Deposit Account 19-0743 in the amount of $1820.00 to cover the Large Entity Basic Filing, Search, and Exam Fees and any Additional Claims Fee.

A Preliminary Amendment has been attached for filing.

Applicants assume the application is now in proper order and in condition for examination. Please direct any inquiries to the undersigned at (408) 278-4057. If necessary, please charge any additional fees or credit overpayment to Deposit Account 19-0743.

Respectfully submitted,

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
P.O. Box 2938
Minneapolis, MN 55402
(408) 278-4057

Date Dec 18, 2023

By / Susan Yee /
Susan Yee
Reg. No. 41,388

SY:CMG:clj1

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3

CONFIRMATION NO. 9039

44367
SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

FORMALITIES LETTER

OC000000063442304

Date Mailed: 10/20/2023

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

An application number and filing date have been accorded to the above-identified nonprovisional application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee has not been received.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) has not been received.

  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required (including the fees noted above) are as follows. No entity status discount is in effect. If applicant is qualified for small entity status, a written assertion of small entity status must be submitted to establish small entity status. (See 37 CFR 1.27). If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $**320** basic filing fee.
- $**160** surcharge.
- $**700** search fee.
- $**800** examination fee.
- $(**0**) previous unapplied payment amount.
- $**1980** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be addressed to:

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Alexandria VA 22313-1450

REPLY VIA ELECTRONIC FILING

A reply may be submitted via electronic filing only by registered users of the appropriate USPTO patent electronic filing system and must include:

- A separate document having the document description, "**Applicant response to Pre-Exam Formalities Notice**"; and
- the item(s) for which a reply period is set forth above.

For more information about electronic filing, contact the Patent Electronic Business Center (EBC) 1-866-217-9197 or visit https://www.uspto.gov/ebc

NOTE: If the reply is not being submitted electronically, a copy of this notice must be included.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/cngo/

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors:	Amarendra N. Gogoi *et al.*	Examiner: Unknown
Serial No.:	18/480,918	Group Art Unit: Unknown
Filed:	October 4, 2023	Docket No.: 2050.354US3
Customer No.:	44367	Confirmation No.: 9039
Title:	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

PRELIMINARY AMENDMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Prior to taking up this application for examination, please enter the following amendments.

IN THE SPECIFICATION

Please amend paragraph **[0001]** on page 1 of the specification as follows:

[0001] This application is a continuation of U.S. Patent Application No. 17/454,169 filed on November 9, 2021, which is a continuation of U.S. Patent Application No. 16/645,598, filed on March 9, 2020, which is a U.S. National Stage filing from PCT Application No. PCT/US2018/046723, filed on August 14, 2018, which claims priority to Indian Application Serial No. 201741031917, filed on September 8, 2017, which [[is]]are incorporated herein by reference in ~~its entirety~~ their entireties.

IN THE CLAIMS

Please amend the claims as follows:

1-15. (Canceled)

16. (New) A method performed by a digital receiver, the method comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

17. (New) The method of claim 16, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new piece of content; and

determining whether the audio decoder and the video decoder in the playback pipeline are of the types indicated by the codec information.

18. (New) The method of claim 17, further comprising:

preserving an entirety of the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being the types indicated by the codec information.

19. (New) The method of claim 17, further comprising:

releasing the audio decoder and the video decoder in the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

20. (New) The method of claim 17, wherein the detecting the codec information for the new piece of content comprises examining prefetched metadata for the new piece of content.

21. (New) The method of any one of claim 16, wherein the transitioning to the new piece of content comprises initiating playback of the new piece of content using a bitrate used for playback of the first piece of content to maintain the bitrate for playback of the new piece of content.

22. (New) The method of claim 21, further comprising:

during playback of the new piece of content using the bitrate, detecting whether the new piece of content can maintain playback at the bitrate; and

in response to detecting that the new piece of content cannot continue playback at the bitrate, lowering the bitrate.

23. (New) The method of claim 16, further comprising:

based on the first piece of content and the new piece of content not being the same content type, deconstructing the playback pipeline by releasing the source element, the demultiplexer, the audio decoder, and the video decoder; and

creating a new playback pipeline by acquiring other resources that are applicable to a content type of the new piece of content.

24. (New) The method of claim 16, wherein the receiving the selection, transitioning to the new piece of content, determining whether the new piece of content is of a same content type as the first piece of content, and determining whether to preserve is performed by a player of the digital receiver.

25. (New) The method of claim 16, wherein the source element initiates the playback of the new piece of content using a same bitrate as the first piece of content and adjusts the bitrate in response to detecting that the new piece of content cannot continue playback at the bitrate.

26. (New) A system comprising:

one or more hardware processors; and

a storage device storing instructions that configure the one or more hardware processors to perform operations comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

27. (New) The system of claim 26, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new piece of content, and

determining whether the audio decoder and the video decoder in the playback pipeline are of the types indicated by the codec information.

28. (New) The system of claim 27, wherein the operations further comprise:

preserving an entirety of the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being the types indicated by the codec information.

29. (New) The system of claim 27, wherein the operations further comprise:

releasing the audio decoder and the video decoder in the playback pipeline in response to the audio decoder and the video decoder in the playback pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

30. (New) The system of claim 27, wherein the detecting the codec information for the new piece of content comprises examining prefetched metadata for the new piece of content.

31. (New) The system of any one of claim 26, wherein the transitioning to the new piece of content comprises initiating playback of the new piece of content using a bitrate used for playback of the first piece of content to maintain the bitrate for playback of the new piece of content.

32. (New) The system of claim 31, wherein the operations further comprise:

during playback of the new piece of content using the bitrate, detecting whether the new piece of content can maintain playback at the bitrate, and

in response to detecting that the new piece of content cannot continue playback at the bitrate, lowering the bitrate.

33. (New) The system of claim 26, wherein the operations further comprise:

based on the first piece of content and the new piece of content not being the same content type, deconstructing the playback pipeline by releasing the source element, the demultiplexer, the audio decoder, and the video decoder; and

creating a new playback pipeline by acquiring other resources that are applicable to a content type of the new piece of content.

34. (New) The system of claim 26, wherein the source element initiates the playback of the new piece of content using a same bitrate as the first piece of content and adjusts the bitrate in response to detecting that the new piece of content cannot continue playback at the bitrate.

35. (New) A machine-storage medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising:

receiving a selection of a new piece of content for playback during playback of a first piece of content;

in response to the receiving of the selection, transitioning to the new piece of content;

determining whether the new piece of content is of a same content type as the first piece of content; and

based on the new piece of content being the same content type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline used to play back the first piece of content, the playback pipeline comprising a source element to manage the downloading of content data for the new piece of content, a demultiplexer, an audio decoder, and a video decoder, the preserving of at least the portion of the playback pipeline comprising preserving one or more of the source element, the demultiplexer, the audio decoder, or the video decoder used to obtain the first piece of content for the new piece of content.

REMARKS

The undersigned respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's representative at (408) 278-4057 to facilitate prosecution of this application.

If necessary, please charge any additional fees or deficiencies, or credit any overpayments to Deposit Account No. 19-0743.

Respectfully Submitted,

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Date / Dec 18, 2023 / By / Susan Yee /

Susan Yee
Reg. No. 41,388

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/480,918	10/04/2023		0	2050.354US3	15	3

CONFIRMATION NO. 9039

FILING RECEIPT

44367
SCHWEGMAN LUNDBERG & WOESSNER/OPEN TV
P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

OC00000063442301

Date Mailed: 10/20/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

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Inventor(s)

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Applicant(s)

OpenTV, Inc., San Francisco, CA;

Power of Attorney: The patent practitioners associated with Customer Number 44367

Domestic Priority data as claimed by applicant

This application is a CON of 17/454,169 11/09/2021
which is a CON of 16/645,598 03/09/2020 PAT 11,184,652
which is a 371 of PCT/US2018/046723 08/14/2018

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INDIA 201741031917 09/08/2017 No Access Code Provided

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Projected Publication Date: To Be Determined - pending completion of Missing Parts.
Non-Publication Request: No
Early Publication Request: No
Title

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/480,918

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	320
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	700
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	800
TOTAL CLAIMS (37 CFR 1.16(i))	15 minus 20 =	* 0			OR	x =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x =	0
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1820

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
18/480,918	10/04/2023	Amarendra N. Gogoi	2050.354US3

CONFIRMATION NO. 9039

44367
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P.O. BOX 2938
MINNEAPOLIS, MN 55402-0938

FORMALITIES LETTER

OC000000063442304

Date Mailed: 10/20/2023

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

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An application number and filing date have been accorded to the above-identified nonprovisional application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

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- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) has not been received.

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Kathi Vidal
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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/480,918	**10/04/2023 03:58:30 PM ET**	**2050.354US3**

Title of Invention

BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	9039	FILED BY	Farah O'Sullivan
PATENT CENTER #	62929512	FILING DATE	-
CUSTOMER #	44367	FIRST NAMED INVENTOR	Amarendra N. Gogoi
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	Susan Yee

Documents

TOTAL DOCUMENTS: 9

DOCUMENT		PAGES	DESCRIPTION	SIZE (KB)
2050.354US3 Application As Filed.pdf		42	-	1231 KB
2050.354US3 Application As Filed-TRNA.pdf	(1-1)	1	Transmittal of New Application	108 KB
2050.354US3 Application As Filed-ADS.pdf	(2-8)	7	Application Data Sheet	283 KB
2050.354US3 Application As Filed-OATH.pdf	(9-9)	1	Oath or Declaration filed	306 KB
2050.354US3 Application As Filed-PA...pdf	(10-10)	1	Power of Attorney	147 KB

2050.354US3 Application As Filed-ABST.pdf	(11-11)	1	Abstract	118 KB
2050.354US3 Application As Filed-LET..pdf	(12-12)	1	Miscellaneous Incoming Letter	43 KB
2050.354US3 Application As Filed-SPEC.pdf	(13-33)	21	Specification	249 KB
2050.354US3 Application As Filed-CLM.pdf	(34-37)	4	Claims	91 KB
2050.354US3 Application As Filed-DRW.pdf	(38-42)	5	Drawings-only black and white line drawings	126 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
2050.354US3 Application As Filed.pdf	AD3E44C6C958FEE9B7C00B2EB95A2F52E5DBB5191857BB150780048900A299A07D43434C862DCBDFA8E07EB3AC96FD656C861E97039F82393BB4ECE3AFB6ACC5
2050.354US3 Application As Filed-TRNA.pdf	33E0E3FAA6E48E92521FF722849C3CE7DF6392A23E9F43844E737FFFE1D71C09E6B9042D74B72FB47095F868B86668F6A044367635B6F495056D1E202040BB0C
2050.354US3 Application As Filed-ADS.pdf	9F8B7BC9B05C14FE8FA3AC9F9B4AC130AFBB61FA5C5338080A1521252B1A7DBB9C17818B8AD9556C3D508D7BDCFCEF321BB704AC0C8C75D9190B741F6E574947
2050.354US3 Application As Filed-OATH.pdf	956F69A40EB125924FDA18E1EEDD378A106D9D5694CCE5255967E7332A4EFDA715AFCB960682F756F499AE24CAECE7317C29E89FEF8F559BDD5A48F67734EAA2
2050.354US3 Application As Filed-PA...pdf	63400746256461E4AD168B62F98B62BF456F3575C8033F06664D87993537F99E4DC4CC74322D2F8049358204523B4E8F702F048AA4DB2110D0F422CF8AC49805

2050.354US3 Application As Filed-ABST.pdf	11B0032BA811A4C29C3986AB3807399D15B8DB899F325C0CE E2C0C20488ECED05DDE9C1D68F1C62FF219220E948483ECC 518D7D1DA3BAE9E6414AFB9EB43B867
2050.354US3 Application As Filed-LET..pdf	EACE9AFE27F92A73B8581D9CDCB9DB5939410897794DEF4D 6217A099771CB2E2CC7F87CA1F11639572FDC164D0E97DB00 1084BA2F1B74959FAFA57998E8AC484
2050.354US3 Application As Filed-SPEC.pdf	3042E6DC531E5A4162BBD9EF7E8DC2911D599E4AB6534444F CB9CC71620E7AF09369C22CCB4950EE8593C1652128991B07 1E7928D726B4029FFA34DE224DB082
2050.354US3 Application As Filed-CLM.pdf	ACDB3B65E1DF5FA8C81AFE4B191BDBF40EF6F4FF5458BA8A CF8132E32D8BE9BD9F6EEA32F1D909FC88E1280480456BCE C5943788CFF083E9388AC44ABEED97A9
2050.354US3 Application As Filed-DRW.pdf	F7D27E8C57A3648BCF34733B05BD698FA81435D4CB023E7EF D7AB75A240C8503BD401F6D6D34520680774F5D0B6C3D49E2 B356F5FBD0ECED1E871DD94069A2A1

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Amarendra N. Gogoi et al.
Title: BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION
Attorney Docket No.: 2050.354US3
Customer No.: 44367

PATENT APPLICATION TRANSMITTAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

We are transmitting herewith the following attached items and information (as indicated with an "X"):

X **CONTINUATION under 37 CFR 1.53(b) of prior Patent Application No. 17/454,169 comprising:**
- X Application Data Sheet (7 pgs).
- X Copy of signed Declaration (1 pg) from prior application.
- X Power of Attorney (1 pg).
- X Specification (27 pgs, including claims numbered 1 through 15 and a 1 page Abstract).
- X Formal Drawing(s) (5 sheets).

X Prior application is assigned of record to OpenTV, Inc..

The filing fee (NOT ENCLOSED) will be calculated as follows:

	No. Filed	No. Extra	Rate	Fee
TOTAL CLAIMS	14- 20	0	x $100.00 =	**$0.00**
INDEPENDENT CLAIMS	1 - 3	0	x $480.00 =	**$0.00**
[]MULTIPLE DEPENDENT CLAIMS PRESENTED				**$0.00**
BASIC FEE				**$320.00**
SEARCH FEE				**$700.00**
EXAMINATION FEE				**$800.00**
PRIORITIZED EXAMINATION (Track1) FILING FEE				**$0.00**
PROCESSING FEE (Track 1)				**$0.00**
NON-DOCX FILING FEE				**$0.00**
	No. of pages (75% for e-filing)	**Extra sets of 50 pages**	**Rate**	
APPLICATION SIZE FEE	(24 - 100) / 50	0	$420.00	**$0.00**
TOTAL				**$1,820.00**

THE FILING FEE WILL BE PAID UPON RECEIPT OF THE NOTICE TO FILE MISSING PARTS. If applicable, any papers or fees supplied herewith are considered to be timely filed pursuant to 37 C.F.R. § 1.7(a), the response period falling on a Federal Holiday, Saturday or Sunday being extended to the next succeeding business day.

/ Susan Yee /

SCHWEGMAN LUNDBERG & WOESSNER, P.A.
Customer Number: 44367

By: _____
Susan Yee
Reg. No. 41,388

Date of Deposit: October 4, 2023
This paper or fee is being filed on the date indicated above using the USPTO's electronic filing system EFS-Web, and is addressed to The Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ **Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)**

Inventor Information:

Inventor 1: Amarendra N. Gogoi

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Amarendra	N.	Gogoi	

Residence Information (Select One) ☒ **US Residency** ☐ **Non US Residency** ☐ **Active US Military Service**

City	Fremont	State/Province	CA	Country of Residence	United States of America

Mailing Address of Inventor:

Address 1	275 Sacramento Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94111	Country	United States of America

Inventor 2: Sanjay Kumar Gupta

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Sanjay	Kumar	Gupta	

Residence Information (Select One) ☐ **US Residency** ☒ **Non US Residency** ☐ **Active US Military Service**

City	Bangalore	State/Province		Country of Residence	India

Mailing Address of Inventor:

Address 1	275 Sacramento Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94111	Country	United States of America

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

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This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Inventor 3: Ravikant Swami

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Ravikant		Swami	

Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service

City	Bangalore	State/Province		Country of Residence	India

Mailing Address of Inventor:

Address 1	275 Sacramento Street		
Address 2			
City	San Francisco	State/Province	CA
Postal Code	94111	Country	United States of America

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence Information of this application.

Customer Number	44367
Email Address	request@slwip.com

Application Information:

Title of the Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION		
Attorney Docket Number	2050.354US3	Small Entity Status Claimed ☐	
Application Type	Non-Provisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	5	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

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Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country Publication

Publication Information:

☐ **Request Early Publication (Fee required at time of Request 37 CFR 1.219)**

☐ **Request Not to Publish. I hereby request that the attached application not be published under 35 U.S. C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.**

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Enter either Customer Number or complete the Representative Name section below. If both sections are completed the Customer Number will be used for the Representative Information during processing.

Please Select One:	☒ Customer	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	44367		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c) or 386(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		
Application Number	**Continuity Type**	**Prior Application Number**	**Filing or 371(c) Date (YYYY-MM-DD)**
	continuation of	17/454,169	2021-11-09
Prior Application Status	Patented		
Application Number	**Continuity Type**	**Prior Application Number**	**Filing or 371(c) Date (YYYY-MM-DD)**
17/454,169	continuation of	16/645,598	2020-03-09
Prior Application Status	Expired		
Application Number	**Continuity Type**	**Prior Application Number**	**Filing or 371(c) Date (YYYY-MM-DD)**
16/645,598	a 371 of international	PCT/US2018/046723	2018-08-14

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)i the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Number	Country	Parent Filing Date (YYYY-MM-DD)	Access Code (if applicable)
201741031917	India	2017-09-08	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
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This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant must opt-out of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is ONLY reviewed and processed with the INITIAL filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby grants the USPTO authority to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ **A. Applicant DOES NOT authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.**

☐ **B. Applicant DOES NOT authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.**

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Modified PTO/AIA/14 (01-22)
Approved for use through 05/31/2024. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

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This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant: OpenTV, Inc.

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

☒ Assignee	☐ Legal Representative under 35 U.S.C. 117	☐ Joint Inventor
☐ Person to whom the inventor is obligated to assign	☐ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

☐ Deceased	☐ Legally incapacitated

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here: ☒

Organization Name: OpenTV, Inc.

Prefix	Given Name	Middle Name	Family Name	Suffix

Mailing Address Information:

Address 1	275 Sacramento Street		
Address 2			
City	San Francisco	State/Province	CA
Country	United States of America	Postal Code	94111
Phone Number			
Email Address			

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	2050.354US3
	Application Number	Unknown
Title of Invention	BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	Given Name	Middle Name	Family Name	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		State/Province	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is **a juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/ Susan Yee /			Date (YYYY-MM-DD)	2023-10-04
First Name	Susan	Last Name	Yee	Registration Number	41,388

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-14**

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Box No. VIII (iv) DECLARATION: INVENTORSHIP (only for the purposes of the designation of the United States of America)

The declaration must conform to the following standardized wording provided for in Section 214; see Notes to Boxes Nos. VIII, VIII (i) to (v) (in general) and the specific Notes to Box No. VIII (iv). If this Box is not used, this sheet should not be included in the request.

Declaration of inventorship (Rules 4.17(iv) and 51*bis*.1(a)(iv))
for the purposes of the designation of the United States of America:

I hereby declare that I believe I am the original inventor or an original joint inventor of a claimed invention in the application.

This declaration is directed to the international application of which it forms a part (if filing declaration with application).

This declaration is directed to international application No. PCT/US2018/046723 (if furnishing declaration pursuant to Rule 26*ter*).

I hereby declare that the above-identified international application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Name: Amarendra N. Gogoi

Residence: Fremont, CA, United States of America
(city and either US state, if applicable, or country)

Mailing Address: 275 Sacramento Street, San Francisco, CA 94111, United States of America

Inventor's Signature: Amarendra N Gogoi Date: Sept. 4th, 2018
(The signature must be that of the inventor, not that of the agent)

Name: Sanjay Kumar Gupta

Residence: Bangalore, India
(city and either US state, if applicable, or country)

Mailing Address: RMZ Centennial, Unit 301 & 302, Tower C, 3rd Floor, Mahadevapura Post, ITPL Road, Bangalore, 560 048, India

Inventor's Signature: Sanjay Gupta Date: September 03, 2018
(The signature must be that of the inventor, not that of the agent)

Name: Ravikant Swami

Residence: Bangalore, India
(city and either US state, if applicable, or country)

Mailing Address: RMZ Centennial, Unit 301 & 302, Tower C, 3rd Floor, Mahadevapura Post, ITPL Road, Bangalore, 560 048, India

Inventor's Signature: Ravikant Swami Date: 03-09-2018
(The signature must be that of the inventor, not that of the agent)

☐ This declaration is continued on the following sheet, "Continuation of Box No. VIII (iv)".

Pinterest Ex. 1004, Page 368 of 401

Amended PTO/AIA/82B(07-13)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

☒ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 44367

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

☒ The address associated with the above mentioned Customer Number.
OR
☐ The address associated with Customer Number:
OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

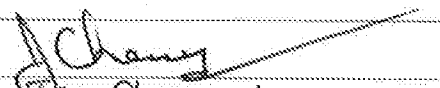
I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

OpenTV, Inc.

☐ Inventor or Joint Inventor (title not required below)
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
☐ Person Who Otherwise Shows Sufficient Proprietary Interest (*e.g.*, a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	
Name	Joe Chernesky		
Title	SVP, IP & Innovation		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☒ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 March 2019 (14.03.2019)

W IP O | PCT

(10) International Publication Number
WO 2019/050660 A1

(51) International Patent Classification:
H04W 28/02 (2009.01)

(21) International Application Number:
PCT/US20 18/046723

(22) International Filing Date:
14 August 2018 (14.08.2018)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20174103 1917 08 September 2017 (08.09.2017) IN

(71) Applicant: **OPENTV, INC.** [US/US]; 275 Sacramento Street, San Francisco, California 941 11 (US).

(72) Inventors: **GOGOI, Amarendra N.;** 275 Sacramento Street, San Francisco, California 941 11 (US). **GUPTA, Sanjay Kumar;** RMZ Centennial, Unit 301 & 302, Tower C, 3rd Floor, Mahadevapura Post, ITPL Road, Bangalore 560 048 (IN). **SWAMI, Ravikant;** RMZ Centennial, Unit 301 & 302, Tower C, 3rd Floor, Mahadevapura Post, ITPL Road, Bangalore 560 048 (IN).

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available):* AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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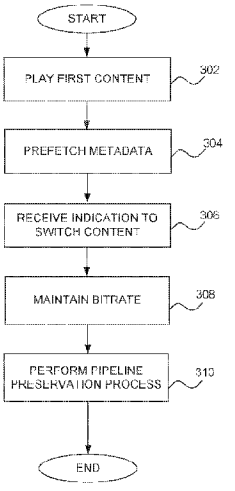


FIG. 3

(57) Abstract: Systems and methods for optimizing a content change process are provided. In example embodiments, a digital receiver causes playback of a first piece of content. The digital receiver receives a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

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[Continued on next page]

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BITRATE AND PIPELINE PRESERVATION FOR CONTENT PRESENTATION

CLAIM OF PRIORITY

[0001] This application claims priority to India Application Serial No. 201741031917, filed on September 8, 2017, which is incorporated herein by reference in its entirety.

FIELD

[0002] The present disclosure generally relates to machines configured to the technical field of special-purpose machines that optimizes a content change process (e.g., channel change) including computerized variants of such special-purpose machines and improvements to such variants, and to the technologies by which such special-purpose machines become improved compared to other special-purpose machines that facilitate optimizing content changes. In particular, the present disclosure addresses systems and methods for preserving a download bitrate and a content playback pipeline during a content change process.

BACKGROUND

[0003] Conventionally, during a switch in content (e.g., caused by a channel change or a selection of a different piece of content), a delay occurs as certain information is obtained before the new piece of content (e.g., program, movie, show) is rendered and displayed. Additionally, for adaptive bitrate streaming content, the content typically starts streaming or download at a low (or lowest) bitrate before slowly increasing in bitrate until an optimum bitrate is achieved. This results in initial video or images being grainy. Furthermore, the delay may be increased by a need to build a content playback pipeline each time a change in content occurs.

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BRIEF DESCRIPTION OF DRAWINGS

[0004] Various ones of the appended drawings merely illustrate example embodiments of the present invention and cannot be considered as limiting its scope.

[0005] FIG. 1 is a diagram illustrating an example environment for optimizing content changes;

[0006] FIG. 2 is a block diagram illustrating an example embodiment of components within a digital receiver in accordance with an example embodiment.

[0007] FIG. 3 is a flow diagram of a method for optimizing a content change process in accordance with example embodiments.

[0008] FIG. 4 is a flow diagram of a method for preserving a content deliver}' pipeline in accordance with example embodiments.

[0009] FIG. 5 is a diagrammatic representation of a machine in an example form of a computing system within which a set of instructions may be executed for causing the machine to perform any one or more of the methodologies discussed herein, according to an example embodiment.

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PET AILED DESCRIPTION

[0010] The description that follows includes systems, methods, techniques, instruction sequences, and computing machine program products that embody illustrative embodiments of the present inventive subject matter. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide an understanding of various embodiments of the inventive subject matter. It will be evident, however, to those skilled in the art, that embodiments of the inventive subject matter may be practiced without some or other of these specific details. In general, well-known instruction instances, protocols, structures, and techniques have not been shown in detail. Examples merely typify possible variations. Unless explicitly stated otherwise, structures (e.g., structural components, such as modules) are optional and may be combined or subdivided, and operations (e.g., in a procedure, algorithm, or other function) may van,' in sequence or be combined or subdivided.

[0011] Example embodiments described herein provide systems and methods for optimizing content changes or switch in content being viewed, such as through a channel change or selection of a different piece of content from a watchlist. In some embodiments, the system uses navigational context (e.g., the way a user is interacting with an application) to identify content of (potential) interest to a viewer. The system then prefetches metadata for the content of interest from a content provider and stores the metadata to local cache. The metadata comprises preconditions for rendering and display of a piece of content that include a minimum set of data that a system can obtain without having to decrypt the content. The prefetched metadata may be used, in example embodiments, to determine whether to preserve at least a portion of a content playback pipeline (also referred to herein as a "content deliver pipeline" or simply a "pipeline").

[0012] Conventionally, a same piece of content is broken up into segments (e.g., 10 second segments) and each segment is available in various bitrates. A low bitrate may be grainy, while a high bitrate will normally have better image quality. Typically, when playback of a new piece of content starts, the system does not know the quality of the network bandwidth. As a result, in order to start playback as quickly as possible, conventional systems start with a lowest bitrate. Thus, every time a user switches from one content to the next content, the playback will start with the lowest bitrate and slowly increase or improve according the capability of the network. In contrast, example

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embodiments, preserve a previous bitrate when switching to a new piece of content. That is, when a user selects a new piece of content to playback (e.g., switching from a previous piece of content to the new piece of content), example embodiments maintain or preserve a (heuristically determined) bitrate used for streaming or downloading the previous piece of content when initiating the playback of the new piece of content. This allows for starting playback as quickly as possible while also providing better image quality from the start.

[0013] Furthermore, in conventional systems, a switch or transition in content typically causes a previous content delivery pipeline to be deconstructed (e.g., resources previous acquired are released). Subsequently, a new pipeline is created for the new piece of content (e.g., new resources are acquired). In contrast, example embodiments may maintain or preserve a portion (or an entire) content delivery pipeline (e.g., comprising a source element, a demultiplexer ("demux"), a video decoder, and an audio decoder) used to obtain the previous piece of content instead of reconstructing a pipeline (e.g., destroying the content delivery pipeline and building a new content delivery pipeline). The preservation of the pipeline also allows for playback of the new content as quickly as possible.

[0014] As a result, one or more of the methodologies described herein facilitate solving the technical problem of optimizing content change (e.g., reducing time for a change in channel or loading of new content) regardless of the delivery channel - whether the content is broadcast (e.g., IPTV and multicast) or over-the-top (OTT). The methodologies include causing playback, by a digital receiver, of a first piece of content and receiving a selection of a new piece of content for playback during the playback of the first piece of content. In response to the receiving of the selection, the digital receiver maintains a bitrate used for playback of the first piece of content to initiate playback of the new piece of content. The methodologies further include determining whether to preserve at least a portion of a playback pipeline when switching to playback of the new piece of content. In some embodiments, preservation of at least a portion of the playback pipeline comprises determining whether to retrain an audio decoder and a video decoder of the pipeline when switching to playback of the new piece of content. Accordingly, one or more of the methodologies discussed herein improves upon latency during content changes while maintaining image quality. It is noted that content changes include a selection of a piece of content for viewing (e.g., from a content access

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page such as a favorites grid or via a programming guide) as well as channel changes (e.g., linear channels changes).

[0015] With reference to FIG. 1, an embodiment of an example environment 100 that enables optimizing content changes (e.g., reducing latency during channel changes or selection of a piece of content for viewing) is shown. In example embodiments, a digital receiver 102 of a user provides access to digital content and manages content change operations. In one embodiment, the digital receiver 102 is a set-top box. The digital receiver 102 is coupled to a viewing device 104 (e.g., a television or monitor) on which the user can view the digital content. In some embodiments, the digital receiver 102 (e.g., operations of the digital receiver 102) may be combined with the viewing device 104 (e.g., a smart television, a tablet, or smartphone). The components of the digital receiver 102 used to perform operations of example embodiments will be discussed in more detail in connection with FIG. 2 below.

[0016] In some embodiments, the digital receiver 102 accesses (e.g., pulls, receives, retrieves) content via a network 106 from a content distribution network (CDN) server 108. The CDN server 108 may obtain the content from one or more content providers 110 (e.g., servers of the content providers 110). In example embodiments, the CDN server 108 may be associated with a third party service (e.g., Netflix, Hulu, YouTube, Amazon,) that stores and provides content, such as, for example but not limited to, over-the-top (OTT) content, video-on-demand (VOD) content, Internet content, or broadcast content to the digital receiver 102 via the network 106. The content comprises text, images, audio, and/or video content (e.g., movies, television shows, videos), and in some embodiments comprise live (e.g., in real-time) content. In some embodiments, the content providers 110 provide content, over the network 106 directly to the digital receiver 102 for display on the viewing device 104.

[0017] One or more portions of the network 106 may be an ad hoc network, an intranet, an extranet, a virtual private network (VPN), a local area network (LAN), a wireless LAN (WLAN), a wide area network (WAN), a wireless WAN (WWAN), a metropolitan area network (MAN), a portion of the Internet, a portion of the Public Switched Telephone Network (PSTN), a cellular telephone network, a wireless network, a WiFi network, a WiMax network, a satellite network, a cable network, a broadcast network, another type of network, or a combination of two or more such networks. Any one or more portions of the network 106 may communicate information via a

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transmission or signal medium. As used herein, "transmission medium" refers to any intangible (e.g., transitory) medium that is capable of communicating (e.g., transmitting) instructions for execution by a machine (e.g., by one or more processors of such a machine), and includes digital or analog communication signals or other intangible media to facilitate communication of such software.

[0018] It is noted that the environment 100 shown in FIG. 1 is merely an example. For instance, any number of CDN servers 108 and content providers 110 may be embodied within the environment 100. Additionally, some components of the environment 100 may be combined. For example, the functions of the digital receiver 102 may be embodied within the viewing device 104 to form a single device, such as a smart television, tablet, smartphone, or any other device that is capable of obtaining, rendering, and displaying content. Moreover, the functions described herein for any single system or machine may be subdivided among multiple systems or machines.

[0019] Any of the systems or machines (e.g., databases, devices, servers) shown in, or associated with, FIG. 1 may be, include, or otherwise be implemented in a special-purpose (e.g., specialized or otherwise non-generic) computer that has been modified (e.g., configured or programmed by software, such as one or more software modules of an application, operating system, firmware, middleware, or other program) to perform one or more of the functions described herein for that system or machine. For example, a special-purpose computer system able to implement any one or more of the methodologies described herein is discussed below with respect to FIG. 5, and such a special-purpose computer may accordingly be a means for performing any one or more of the methodologies discussed herein. Within the technical field of such special-purpose computers, a special-purpose computer that has been modified by the structures discussed herein to perform the functions discussed herein is technically improved compared to other special-purpose computers that lack the structures discussed herein or are otherwise unable to perform the functions discussed herein. Accordingly, a special-purpose machine configured according to the systems and methods discussed herein provides an improvement to the technology of similar special-purpose machines.

[0020] FIG. 2 is a block diagram illustrating an example embodiment of components within the digital receiver 102 in accordance with an example embodiment. In example embodiments, the digital receiver 102 manages access to content streamed over the network 106. In particular, the digital receiver 102 prefetches metadata, preserves a

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bitrate used for playback (e.g., streaming or downloading) of a previous piece of content when initiating the playback of a new piece of content, and preserves at least a portion of a content delivery pipeline. To enable these operations, the digital receiver 102 comprises a player 202, a content delivery pipeline 204 (also referred to as "pipeline"), a cache manager 206, and a cache 208, all of which may be configured to communicate with each other (e.g., over a bus, shared memory, or a switch). The digital receiver 102 comprises other components (not shown) that are not pertinent to operations of example embodiments.

[0021] The player 202 is configured to manage the pipeline 204. In example embodiments, the player 204 instantiates (e.g., constructs) the pipeline 204 when a first piece of content is selected for display. A different pipeline may be constructed for each type of content. For example, the player 202 constructs a HTTP Live Streaming (HLS) pipeline for HLS content and constructs a Dynamic Adaptive Streaming over HTTP (DASH) pipeline for DASH content. The player 204 also decides whether to maintain at least a portion of the pipeline 204 or construct a new pipeline when a switch in content occurs (e.g., channel change or selection of new content for viewing). An example method for managing the preservation of the pipeline is discussed in further detail in connection with FIG. 4 below.

[0022] The pipeline 204 is constructed by the player 202 by acquiring appropriate resources for obtaining and processing content data in order to playback selected content. The resources of the pipeline 204 comprise a source element 212, a demultiplexer ("demux") 214, an audio decoder 216, and a video decoder 218. The source element 212 manages the downloading of content data for the selected piece of content. The source element 212 also manages bitrate adaptation at the digital receiver 102. Specifically, the source element 212 remembers a last bitrate that is used for playback of a current/previous piece of content, and continues to use that bitrate for playback of the new content. As such, if the last bitrate is high, the source element 212 will start with the same high bitrate for the new content. If the new content cannot be playback at that bitrate, then the source element 212 will lower the bitrate. For example, if the downloading of the content takes less time than anticipated, there is spare bandwidth and the bitrate can be increased. Conversely, if the download is taking longer than anticipated, then the bitrate is decreased. As such, example embodiments,

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will start the playback of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing).

[0023] The demux demultiplexes the content data obtained from the CDN server 108 or the content provider 110 to obtain an audio signal and a video signal. The audio signal is transmitted to the audio decoder 216 for processing, while the video signal is transmitted to the video decoder 218 for processing. The results from the audio and video decoders 216 and 218 are output (e.g., transmitted) to the viewing device 104 for presentation to the user.

[0024] The cache manager 206 manages the prefetching of metadata for content that may potentially be selected for playback. In some embodiments, the cache manager 206 predicts content the user may be interested in viewing. For example, a user may be navigating a linear list of channels or programs (e.g., an electronic programming guide; "EPG") in a particular direction (e.g., up or down). In this embodiment, the cache manager 206 predicts a next set of content based on the direction of navigation on the linear list. In another example, the user may be viewing a video-on-demand (VoD) catalog or a watchlist of a user. If the user requests information or hovers over a selection for a piece of content, the cache manager 206 uses this as prediction that the piece of content is of interest to the user. Alternatively, the cache manager may consider all (or some) pieces of content in viewable portion of the catalog or watchlist as content of interest. In any of these cases, the cache manager 206 prefetches the metadata for the content of interest, and stores the prefetched data to the cache 208. The metadata may comprise, for example, one or more uniform resource locators (UHLs) where the chunks of content are available, URLs for different bit rates, license data (e.g., where to obtain a license from), and codec information. The codec information will be used by the player 202 to determine whether to preserve at least a portion of the pipeline 204, as will be discussed further below. If the user subsequently selects content for which the metadata is already prefetched, then the metadata can be accessed from the cache 208 instead of having to be retrieved over the network 106 from the CDN server 108 or the content provider 110 after selection. This will assist in the reduction of latency in playback.

[0025] Any one or more of the components (e.g., modules, decoders, resources) described herein may be implemented using hardware alone (e.g., one or more processors of a machine) or a combination of hardware and software. For example, any

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component described herein may physically include an arrangement of one or more of the processors or configure a processor (e.g., among one or more processors of a machine) to perform the operations described herein for that module. Accordingly, different components described herein may include and configure different arrangements of the processors at different points in time or a single arrangement of the processors at different points in time. Each component described herein is an example of a means for performing the operations described herein for that component. Moreover, any two or more of these components may be combined into a single component, and the functions described herein for a single component may be subdivided among multiple components. Furthermore, according to various example embodiments, components described herein as being implemented within a single machine, database, or device may be distributed across multiple machines, databases, or devices.

[0026] FIG. 3 is a flow diagram of an example method 300 for optimizing content change in accordance with example embodiments. In example embodiments, the method 300 is performed in part or in whole by components of the digital receiver 102. Accordingly, the method 300 is described by way of example with reference to the digital receiver 102. However, it shall be appreciated that at least some of the operations of the method 300 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 300 is not intended to be limited to the digital receiver 102.

[0027] In operation 302, a first piece of content is caused to be played by the viewing device 104. In example embodiments, the player 202 constructs the pipeline 204 for obtaining and processing the content data for the first piece of content. In particular, the player 202 acquires the source element 212, the demux 214, the audio decoder 216, and the video decoder 218 to form the pipeline 204. The data content is processed by the pipeline 204 and presented on the viewing device 104.

[0028] In operation 304, metadata for a set of one or more content of interest is prefetched. In example embodiments, the cache manager 206 predicts content of interest of a user and prefetches the metadata for the content of interest. The prefetched data is then stored to the cache 208. The metadata may comprise, but is not limited to, one or more URLs where the chunks of content are available, one or more URL for

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different bit rates, license data (e.g., where to obtain a license from), and codec information.

[0029] In operation 306, the player 202 receives an indication to switch to a new piece of content for playback. The indication may be received from a control device of the user (e.g., a remote controller). In some embodiments, the user may scroll through an EPG or be viewing a catalog or watchlist, and selects a new piece of content for viewing.

[0030] In operation 308, the digital receiver 102 maintains the bitrate when switching playback to the new piece of content. In example embodiments, when transitioning playback from an ongoing playback operation to a new playback operation, the source element 212 uses a heuristic bitrate derived for playback of the first piece of content for playback of the new piece of content. Thus, the source element 212 attempts to maintain or preserve the bitrate for playback as opposed to starting a new playback from the lowest possible bitrate. If the new piece of content cannot be delivered at that bitrate, then the source element 212 will lower the bitrate. As such, example embodiments, will start the download of the new content at the previous/last bitrate instead of starting at a lower or lowest bitrate (and slowly increasing). This allows playback of the new content at a most optimal bitrate instantly instead of having to heuristically re-compute the optimal bitrate starting from the lowest possible bitrate. Conventionally, the derivation of the optimal bitrate usually requires downloading several segments or chunks of content data resulting in a gradual improvement of picture quality. However, example embodiments that use the previous derived heuristic bitrate maintain the same level of image quality as that of the previous playback from a very beginning of playback for the new content.

[0031] In operation 310, a pipeline preservation process is performed to determine whether to maintain at least a portion of the pipeline used to playback the first piece of content for use with the playback of the new piece of content. Furthermore, if the pipeline is to be maintained or preserve, a determination is made as to whether all the resources of the pipeline should be preserved or only a portion of the pipeline preserved (e.g., only some of the resources are kept and others are released). The pipeline preservation process will be discussed in more detail in connection with FIG. 4.

[0032] FIG. 4 is a flow diagram of an example method 400 for preserving a content delivery pipeline in accordance with example embodiments. In example embodiments,

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the method 400 is performed in part or in whole by the player 202 with respect the resources of the pipeline 204. Accordingly, the method 400 is described by way of example with reference to the player 202 and the pipeline 204. However, it shall be appreciated that at least some of the operations of the method 400 may be deployed on various other hardware configurations or be performed by similar components residing elsewhere in the environment 100. Therefore, the method 400 is not intended to be limited to the player 202 and the pipeline 204.

[0033] In operation 402, in response to receiving the indication to switch playback to new content, the cache manager 206 accesses the prefetched metadata stored in the cache 208 for the new content. The prefetched metadata for the new content may comprise one or more URLs where the new content is available, one or more URLs for different bit rates associated with the new content, license data for the new content, and codec information for the new content. The prefetched metadata may also indicate whether the new content is of a same type as the first piece of content. For example, the first piece of content and the new content may both be in a HTTP Live Streaming (HLS) format or both be in a Dynamic Adaptive Streaming over HTTP (DASH) format.

[0034] In operation 404, the player 202 determines whether the first piece of content and the new content are of the same content type. If the first piece of content and the new content are not of the same type (e.g., first piece of content is in HLS format and the new content is in DASH format), then the resources of the pipeline 204 (e.g., the source element 212, the demux 214, the audio decoder 216, and the video decoder 218) are released in operation 406. Releasing ail the resources of the pipeline 204 essentially deconstructs the pipeline 204. The player 202 them creates a new pipeline by acquiring other resources that are applicable to the content type of the new content.

[0035] If in operation 404 the player 202 determines that the first piece of content and the new content are of the same content type (e.g., both are HLS format), then in operation 408, codec information is detected for the new content. In example embodiments, the player 202 examines the prefetched metadata for the new content for the codec information. The codec information indicates types of decoders needed for the new content.

[0036] In operation 410, a determination is made by the player 202 as to whether the types of decoders needed for the new content is the same as the decoders currently in the pipeline 204 for the first piece of content. If the types of decoders needed is the same,

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then in operation 412 the entire pipeline 204 is preserved. In other words, the resources of the pipeline 204 are maintained and continued to be used to playback the new content.

[0037] However, if in operation 410 the player 202 determines that the new content needs different decoders, then in operation 414, the decoders (e.g., the audio decoder 216 and the video decoder 208) are released. Subsequently in operation 416, a remaining portion of the pipeline 204 (e.g., the source element 212 and the demux 214) are preserved or maintained. In these embodiments, the player 202 acquires a new set of decoders (e.g., a new audio decoder and a new video decoder) applicable to the new content, and adds the new set of decoders to the preserved portion of the pipeline 204.

[0038] While example embodiments are discussed with respect to pipeline and bitrate preservation applicable to both DASH and HLS, example embodiments for preservation of bitrate and the pipeline is applicable for any type of content that is adaptive in nature (e.g., where the content bitrate can change based on bandwidth).

[0039] FIG. 5 is a block diagram illustrating components of a machine 500, according to some example embodiments, able to read instructions 524 from a machine-storage medium 522 (e.g., a non-transitory machine-storage medium, a machine-readable storage medium, a computer-readable storage medium, or any suitable combination thereof) and perform any one or more of the methodologies discussed herein, in whole or in part. Specifically, FIG. 5 shows the machine 500 in the example form of a computer device (e.g., a computer) within which the instructions 524 (e.g., software, a program, an application, an applet, an app, or other executable code) for causing the machine 500 to perform any one or more of the methodologies discussed herein may be executed, in whole or in part.

[0040] For example, the instructions 524 may cause the machine 500 to execute the flow diagrams of FIGs. 3 and 4. The instructions 524 can transform the general, non-programmed machine 500 into a particular machine (e.g., specially configured machine) programmed to carry out the described and illustrated functions in the manner described.

[0041] In alternative embodiments, the machine 500 operates as a standalone device or may be connected (e.g., networked) to other machines. The machine 500 may be a server computer, a client computer, a personal computer (PC), a tablet computer, a laptop computer, a netbook, a set-top box (e.g. STB), a personal digital assistant (PDA),

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a cellular telephone, a smartphone, a web appliance, a network router, a network switch, a network bridge, a power adapter, or any machine 500 capable of executing the instructions 524, sequentially or otherwise, that specify actions to be taken by that machine 500. Further, while only a single machine 500 is illustrated, the term "machine" shall also be taken to include a collection of machines that individually or jointly execute the instructions 524 to perform any one or more of the methodologies discussed herein.

[0042] The machine 500 includes a processor 502 (e.g., a central processing unit (CPU), a graphics processing unit (GPU), a digital signal processor (DSP), an application specific integrated circuit (ASIC), a radio-frequency integrated circuit (RFIC), or any suitable combination thereof), a main memory 504, and a static memory 506, which are configured to communicate with each other via a bus 508. The processor 502 may contain microcircuits that are configurable, temporarily or permanently, by some or all of the instructions 524 such that the processor 502 is configurable to perform any one or more of the methodologies described herein, in whole or in part. For example, a set of one or more microcircuits of the processor 502 may be configurable to execute one or more modules (e.g., software modules) described herein.

[0043] The machine 500 may further include a graphics display 510 (e.g., a plasma display panel (PDP), a light emitting diode (LED) display, a liquid crystal display (LCD), a projector, a cathode ray tube (CRT), or any other display capable of displaying graphics or video). The machine 500 may also include an alphanumeric input device 512 (e.g., a keyboard or keypad), a cursor control device 514 (e.g., a mouse, a touchpad, a trackball, a joystick, a motion sensor, an eye tracking device, or other pointing instrument), a storage unit 516, a signal generation device 518 (e.g., a sound card, an amplifier, a speaker, a headphone jack, or any suitable combination thereof), and a network interface device 520.

[0044] The storage unit 516 includes the machine-storage medium 522 (e.g., a tangible machine-readable storage medium) on which are stored the instructions 524 embodying any one or more of the methodologies or functions described herein. The instructions 524 may also reside, completely or at least partially, within the main memory 504, within the processor 502 (e.g., within the processor's cache memory), or both, before or during execution thereof by the machine 500. Accordingly, the main

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memory 504 and the processor 502 may be considered machine-storage media 522 (e.g., tangible and non-transitory machine-storage media).

[0045] In some example embodiments, the machine 500 may be a portable computing device and have one or more additional input components (e.g., sensors or gauges). Examples of such input components include an image input component (e.g., one or more cameras), an audio input component (e.g., a microphone), a direction input component (e.g., a compass), a location input component (e.g., a global positioning system (GPS) receiver), an orientation component (e.g., a gyroscope), a motion detection component (e.g., one or more acceierometers), an altitude detection component (e.g., an altimeter), and a gas detection component (e.g., a gas sensor). Inputs han'ested by any one or more of these input components may be accessible and available for use by any of the modules described herein.

EXECUTABLE INSTRUCTIONS AND MACHINE-STORAGE MEDIUM

[0046] The various memories (i.e., 504, 506, and/or memory of the processor(s) 502) and/or storage unit 516 may store one or more sets of instructions and data structures (e.g., software) 524 embodying or utilized by any one or more of the methodologies or functions described herein. These instructions, when executed by processors) 502 cause various operations to implement the disclosed embodiments.

[0047] As used herein, the terms "machine-storage medium," "device-storage medium," "computer-storage medium" (referred to collectively as "machine-storage medium 522") mean the same thing and may be used interchangeably in this disclosure. The terms refer to a single or multiple storage devices and/or media (e.g., a centralized or distributed database, and/or associated caches and servers) that store executable instructions and/or data, as well as cloud-based storage systems or storage networks that include multiple storage apparatus or devices. The terms shall accordingly be taken to include, but not be limited to, solid-state memories, and optical and magnetic media, including memory internal or external to processors. Specific examples of machine-storage media, computer-storage media, and/or device- storage media 522 include non-volatile memory, including by way of example semiconductor memory devices, e.g., erasable programmable read-only memory (EPROM), electrically erasable programmable read-only memory (EEPROM), FPGA, and flash memory devices, magnetic disks such as internal hard disks and removable disks; magneto-optical disks;

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and CD-ROM and DVD-ROM: disks. The terms machine-storage media, computer-storage media, and device-storage media 522 specifically exclude carrier waves, modulated data signals, and other such media, at least some of which are covered under the term "signal medium" discussed below.

SIGNAL MEDIUM:

[0048] The term "signal medium" or "transmission medium" shall be taken to include any form of modulated data signal, carrier wave, and so forth. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a matter as to encode information in the signal.

COMPUTER READABLE MEDIUM

[0049] The terms "machine-readable medium," "computer-readable medium" and "device-readable medium" mean the same thing and may be used interchangeably in this disclosure. The terms are defined to include both machine-storage media and signal media. Thus, the terms include both storage devices/media and carrier waves/modulated data signals.

[0050] The instructions 524 may further be transmitted or received over a communications network 526 using a transmission medium via the network interface device 520 and utilizing any one of a number of well-known transfer protocols (e.g., HTTP). Examples of communication networks 526 include a local area network (LAN), a wide area network (WAN), the Internet, mobile telephone networks, plain old telephone service (POTS) networks, and wireless data networks (e.g., WiFi, LTE, and WiMAX networks). The term "transmission medium" shall be taken to include any intangible medium that is capable of storing, encoding, or carrying instructions 524 for execution by the machine 500, and includes digital or analog communications signals or other intangible medium to facilitate communication of such software.

[0051] Throughout this specification, plural instances may implement components, operations, or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a

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combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

[0052] Certain embodiments are described herein as including logic or a number of components, modules, or mechanisms. Modules may constitute either software modules (e.g., code embodied on a machine-storage medium 522 or in a transmission signal) or hardware modules. A "hardware module" is a tangible unit capable of performing certain operations and may be configured or arranged in a certain physical manner. In various example embodiments, one or more computer systems (e.g., a standalone computer system, a client computer system, or a server computer system) or one or more hardware modules of a computer system (e.g., a processor 502 or a group of processors 502) may be configured by software (e.g., an application or application portion) as a hardware module that operates to perform certain operations as described herein.

[0053] In some embodiments, a hardware module may be implemented mechanically, electronically, or any suitable combination thereof. For example, a hardware module may include dedicated circuitry or logic that is permanently configured to perform certain operations. For example, a hardware module may be a special-purpose processor, such as a field-programmable gate array (FPGA) or an ASIC. A hardware module may also include programmable logic or circuitry that is temporarily configured by software to perform certain operations. For example, a hardware module may include software encompassed within a general-purpose processor or other programmable processor. It will be appreciated that the decision to implement a hardware module mechanically, in dedicated and permanently configured circuitry, or in temporarily configured circuitry (e.g., configured by software) may be driven by cost and time considerations.

[0054] Accordingly, the phrase "hardware module" should be understood to encompass a tangible entity, be that an entity that is physically constructed, permanently configured (e.g., hardwired), or temporarily configured (e.g., programmed) to operate in a certain manner or to perform certain operations described herein. As used herein, "hardware-implemented module" refers to a hardware module. Considering embodiments in which hardware modules are temporarily configured (e.g.,

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programmed), each of the hardware modules need not he configured or instantiated at any one instance in time. For example, where a hardware module comprises a general-purpose processor configured by software to become a special-purpose processor, the general-purpose processor may be configured as respectively different special-purpose processors (e.g., comprising different hardware modules) at different times. Software may accordingly configure a processor, for example, to constitute a particular hardware module at one instance of time and to constitute a different hardware module at a different instance of time.

[0055] The various operations of example methods described herein may be performed, at least partially, by one or more processors that are temporarily configured (e.g., by software) or permanently configured to perform the relevant operations. Whether temporarily or permanently configured, such processors may constitute processor-implemented modules that operate to perform one or more operations or functions described herein. As used herein, "processor-implemented module" refers to a hardware module implemented using one or more processors.

[0056] Similarly, the methods described herein may be at least partially processor-implemented, a processor being an example of hardware. For example, at least some of the operations of a method may be performed by one or more processors or processor-implemented modules.

EXAMPLES

[0057] Example 1 is a method for optimizing a content change process. The method comprises causing playback, by a digital receiver, of a first piece of content, receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and in response to the receiving of the selection, maintaining, by a processor of the digital receiver, a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0058] In example 2, the subject matter of example 1 can optionally include determining whether the new piece of content is of a same type as the first piece of content, and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0059] In example 3, the subject matter of examples 1-2 can optionally include wherein the determining whether to preserve comprises detecting codec information for

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the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0060] In example 4, the subject matter of examples 1-3 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0061] In example 5, the subject matter of examples 1-4 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0062] Example 6 is a system optimizing a content change process. The system includes one or more hardware processors and a storage device storing instructions that configure the one or more hardware processors to perform operations comprising causing playback of a first piece of content; receiving a selection of a new piece of content for playback during the playback of the first piece of content; and in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0063] In example 7, the subject matter of example 6 can optionally include determining whether the new piece of content is of a same type as the first piece of content, and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0064] In example 8, the subject matter of examples 6-7 can optionally include wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0065] In example 9, the subject matter of examples 6-8 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0066] In example 10, the subject matter of examples 6-9 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types

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indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0067] Example 11 is machine-readable medium storing instructions that when executed by one or more hardware processors of a machine, cause the machine to perform operations comprising causing playback of a first piece of content; receiving a selection of a new piece of content for playback during the playback of the first piece of content, and in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

[0068] In example 12, the subject matter of example 11 can optionally include determining whether the new piece of content is of a same type as the first piece of content; and based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

[0069] In example 13, the subject matter of examples 11-12 can optionally include wherein the determining whether to preserve comprises detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

[0070] In example 14, the subject matter of examples 11-13 can optionally include preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

[0071] In example 15, the subject matter of examples 11-14 can optionally include releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and obtaining a new audio decoder and a new video decoder based on the codec information.

[0072] Some portions of the subject matter discussed herein may be presented in terms of algorithms or symbolic representations of operations on data stored as bits or binary digital signals within a machine memory (e.g., a computer memory). Such algorithms or symbolic representations are examples of techniques used by those of ordinary skill in the data processing arts to convey the substance of their work to others skilled in the art. As used herein, an "algorithm" is a self-consistent sequence of operations or similar processing leading to a desired result. In this context, algorithms and operations involve physical manipulation of physical quantities. Typically, but not

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necessarily, such quantities may take the form of electrical, magnetic, or optical signals capable of being stored, accessed, transferred, combined, compared, or otherwise manipulated by a machine. It is convenient at times, principally for reasons of common usage, to refer to such signals using words such as "data," "content," "bits," "values," "elements," "symbols," "characters," "terms," "numbers," "numerals," or the like. These words, however, are merely convenient labels and are to be associated with appropriate physical quantities.

[0073] Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "presenting," "displaying," or the like may refer to actions or processes of a machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, or optical) quantities within one or more memories (e.g., volatile memory, non-volatile memon,', or any suitable combination thereof), registers, or other machine components that receive, store, transmit, or display information. Furthermore, unless specifically stated otherwise, the terms "a" or "an" are herein used, as is common in patent documents, to include one or more than one instance. Finally, as used herein, the conjunction "or" refers to a non-exclusive "or," unless specifically stated otherwise.

[0074] Although an overview of the inventive subject matter has been described with reference to specific example embodiments, various modifications and changes may be made to these embodiments without departing from the broader scope of embodiments of the present invention. For example, various embodiments or features thereof may be mixed and matched or made optional by a person of ordinary skill in the art. Such embodiments of the inventive subject matter may be referred to herein, individually or collectively, by the term "invention" merely for convenience and without intending to voluntarily limit the scope of this application to any single invention or inventive concept if more than one is, in fact, disclosed.

[0075] The embodiments illustrated herein are believed to be described in sufficient detail to enable those skilled in the art to practice the teachings disclosed. Other embodiments may be used and derived therefrom, such that structural and logical substitutions and changes may be made without departing from the scope of this disclosure. The Detailed Description, therefore, is not to be taken in a limiting sense, and the scope of various embodiments is defined only by the appended claims, along with the full range of equivalents to which such claims are entitled.

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[0076] Moreover, plural instances may be provided for resources, operations, or structures described herein as a single instance. Additionally, boundaries between various resources, operations, modules, engines, and data stores are somewhat arbitrary, and particular operations are illustrated in a context of specific illustrative configurations. Other allocations of functionality are envisioned and may fall within a scope of various embodiments of the present invention. In general, structures and functionality presented as separate resources in the example configurations may be implemented as a combined structure or resource. Similarly, structures and functionality presented as a single resource may be implemented as separate resources. These and other variations, modifications, additions, and improvements fall within a scope of embodiments of the present invention as represented by the appended claims. The specification and drawings are, accordingly, to be regarded in an illustrative rather than a restrictive sense.

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CLAIMS

What is claimed is:

1. A method comprising:

causing playback, by a digital receiver, of a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining, by a processor of the digital receiver, a bitrate used for playback of the first piece of content to initiate playback of the new piece of content.

2. The method of claim 1, further comprising:

determining whether the new piece of content is of a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to preserve at least a portion of a playback pipeline.

3. The method of claim 2, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

4. The method of claim 3, further comprising preserving the entire pipeline in response to the audio decoder and the video decoder in the pipeline being the types indicated by the codec information.

5. The method of claim 3, further comprising:

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

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6. A system comprising:

one or more hardware processors, and

a storage device storing **instructions** that configure the one or more hardware processors to perform operations comprising:

causing playback, by a digital receiver, of a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content **for** playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining a bitrate used for playback of the first piece of content to initiate playback **of the** new piece of content.

7. The system **of** claim 6, wherein the operations further comprise:

determining whether the new piece of content is **of** a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to **preserve at** least a portion of a playback pipeline.

8. The system of claim 7, wherein the determining whether to preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by **the** codec information.

9. The system of claim 8, wherein the operations further comprise preserving the entire pipeline in response to **the** audio decoder and **the** video decoder **in the** pipeline being the types indicated **by** the codec information.

10. The system of claim 8, wherein the operations further comprise:

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

obtaining a new audio decoder and a new video decoder based on the codec information.

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11. A machine-readable medium storing **instructions** that when executed by one or more hardware processors of a machine, cause the machine to **perform** operations comprising:

causing playback, by a digital receiver, **of** a first piece of content;

receiving, by the digital receiver, a selection of a new piece of content for playback during the playback of the first piece of content; and

in response to the receiving of the selection, maintaining a **bitrate** used for playback of the first piece of content to initiate playback of the new piece of content.

12. The machine-readable medium of claim 11, wherein the operations further comprise;

determining whether the new piece of content is of a same type as the first piece of content; and

based on the new piece of content being the same type as the first piece of content, determining whether to **preserve at** least a portion of a playback pipeline.

13. The machine-readable medium of claim 12, wherein **the** determining whether **to** preserve comprises:

detecting codec information for the new piece of content, the codec information indicating types of decoders needed for the new content; and

determining whether an audio decoder and a video decoder in the pipeline are of the types indicated by the codec information.

14. The machine-readable medium of claim 13, wherein **the** operations further comprise **preserving** the entire pipeline **in** response to the audio decoder and the video decoder **in the** pipeline being the types indicated by **the** codec information.

15. The machine-readable medium of claim 13, wherein the operations further comprise;

releasing the audio decoder and the video decoder in the pipeline in response to the audio decoder and the video decoder in the pipeline being different than the types indicated by the codec information; and

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obtaining a new audio decoder and a new video decoder based on the codec information.

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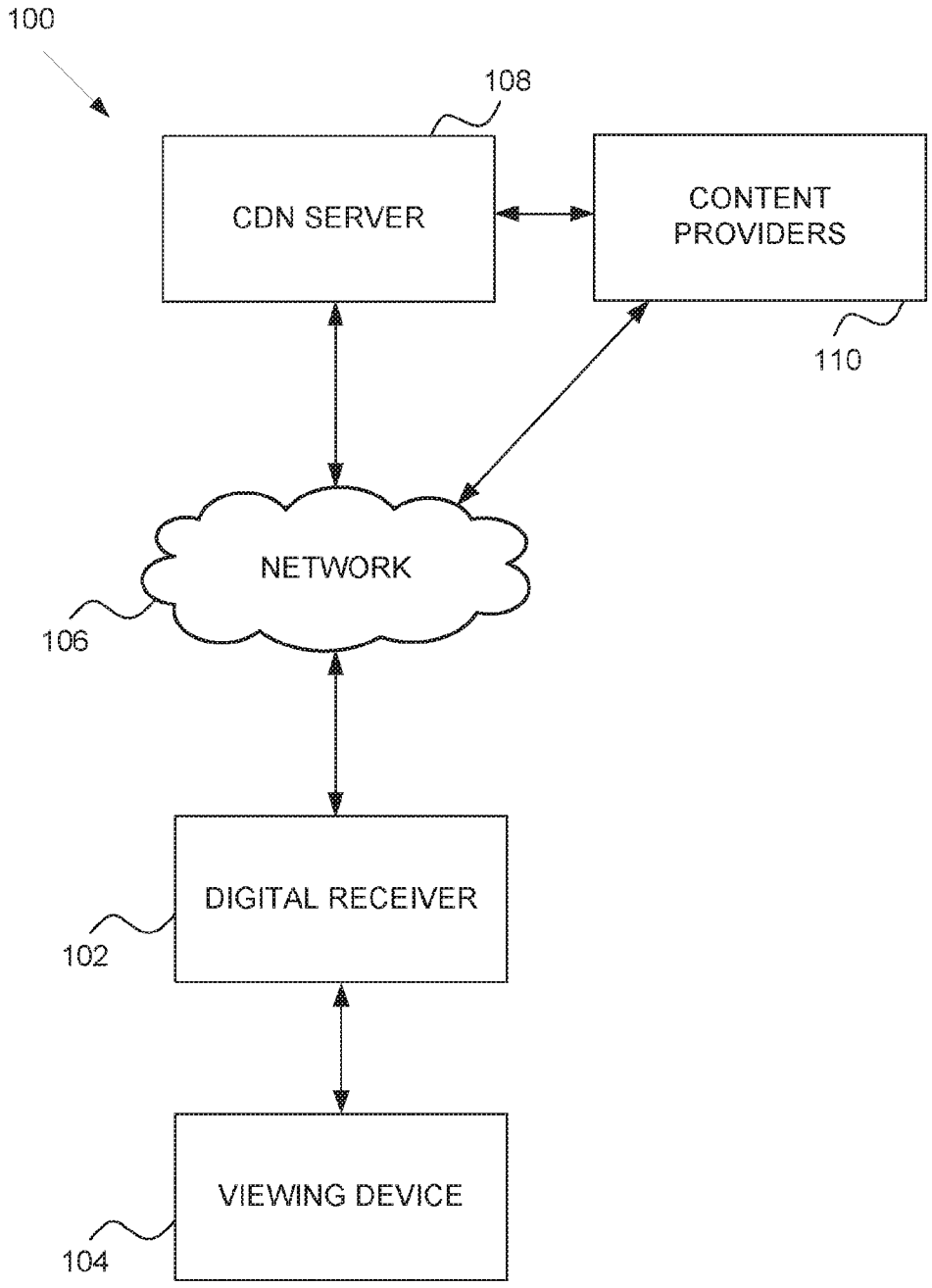

100
108
CDN SERVER
CONTENT PROVIDERS
110
NETWORK
106
DIGITAL RECEIVER
102
VIEWING DEVICE
104

FIG. 1

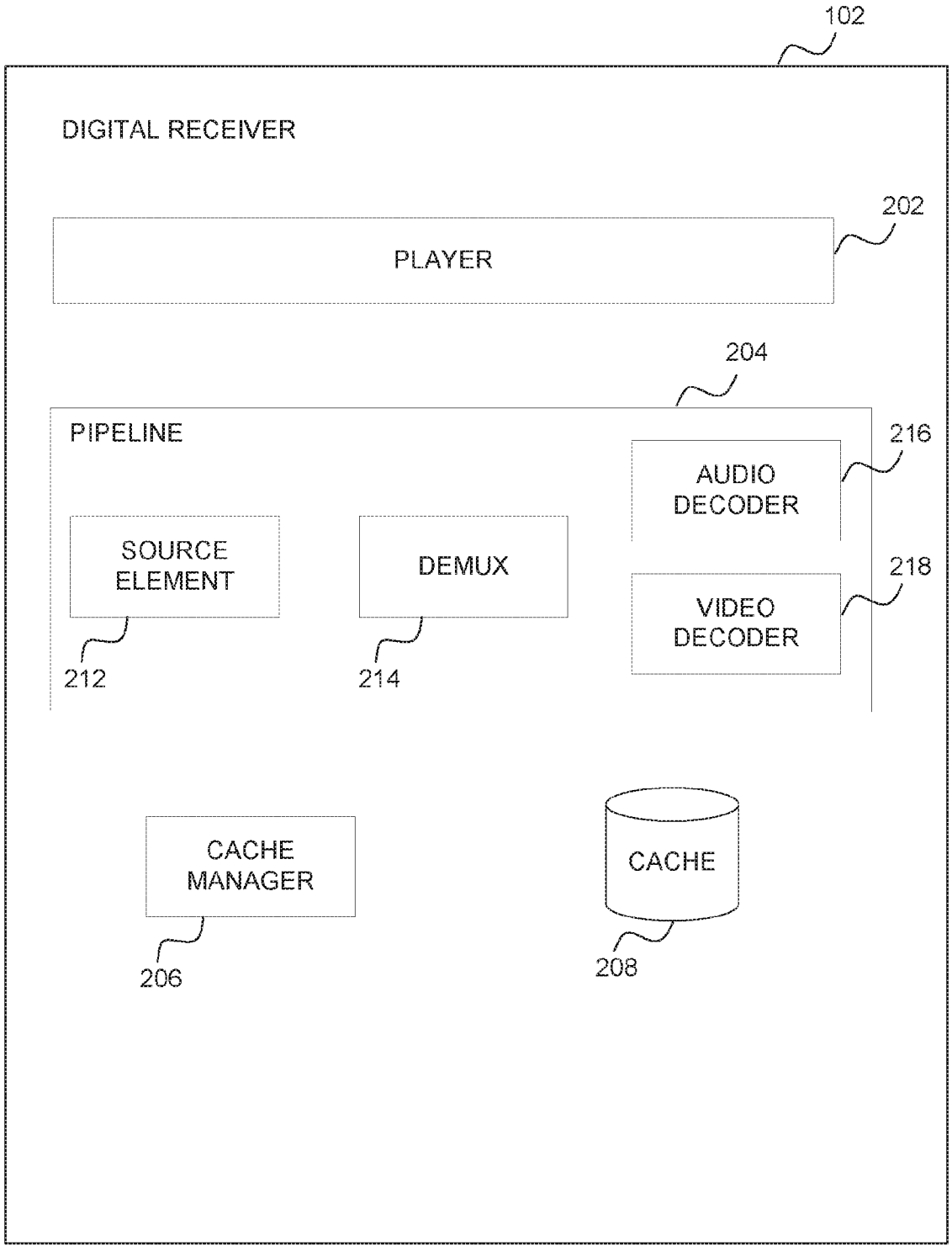

102
DIGITAL RECEIVER
202
PLAYER
204
PIPELINE
216
AUDIO DECODER
218
VIDEO DECODER
SOURCE ELEMENT
212
DEMUX
214
CACHE MANAGER
206
CACHE
208

FIG. 2

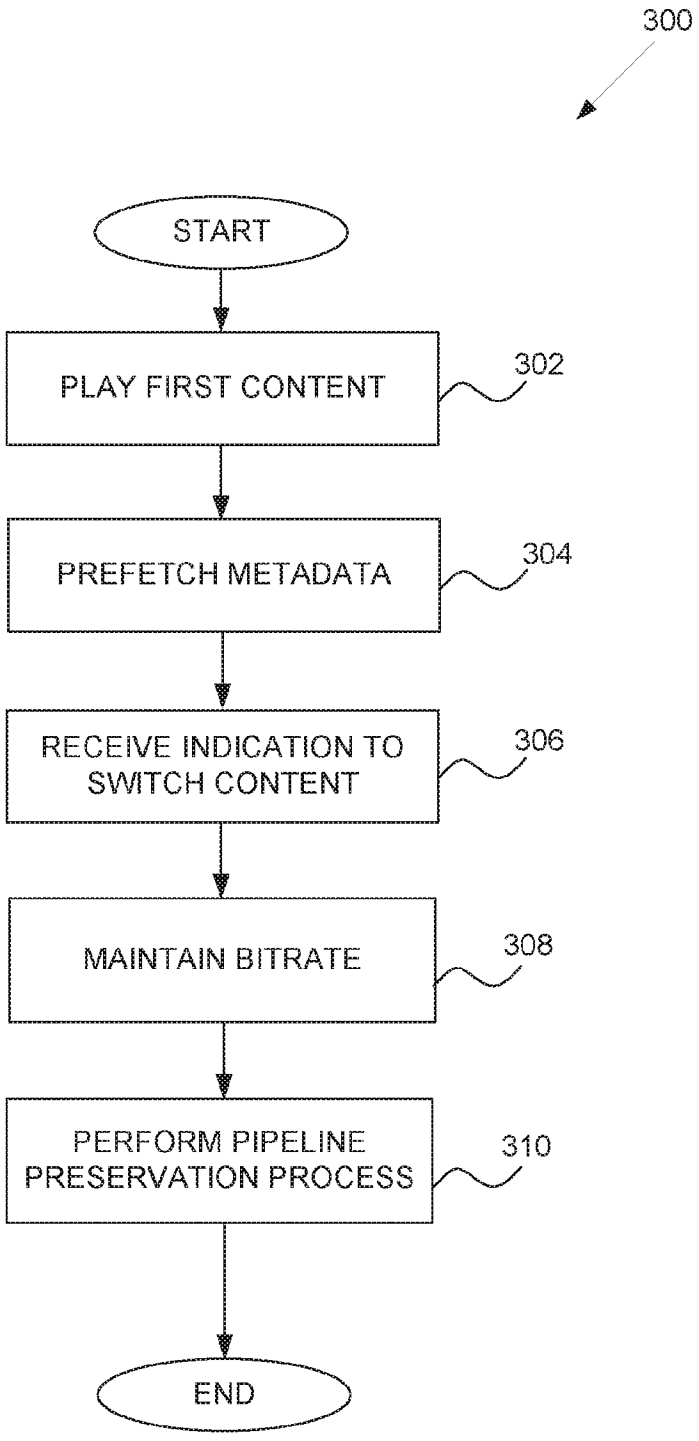

300
START
PLAY FIRST CONTENT
302
PREFETCH METADATA
304
RECEIVE INDICATION TO SWITCH CONTENT
306
MAINTAIN BITRATE
308
PERFORM PIPELINE PRESERVATION PROCESS
310
END

FIG. 3

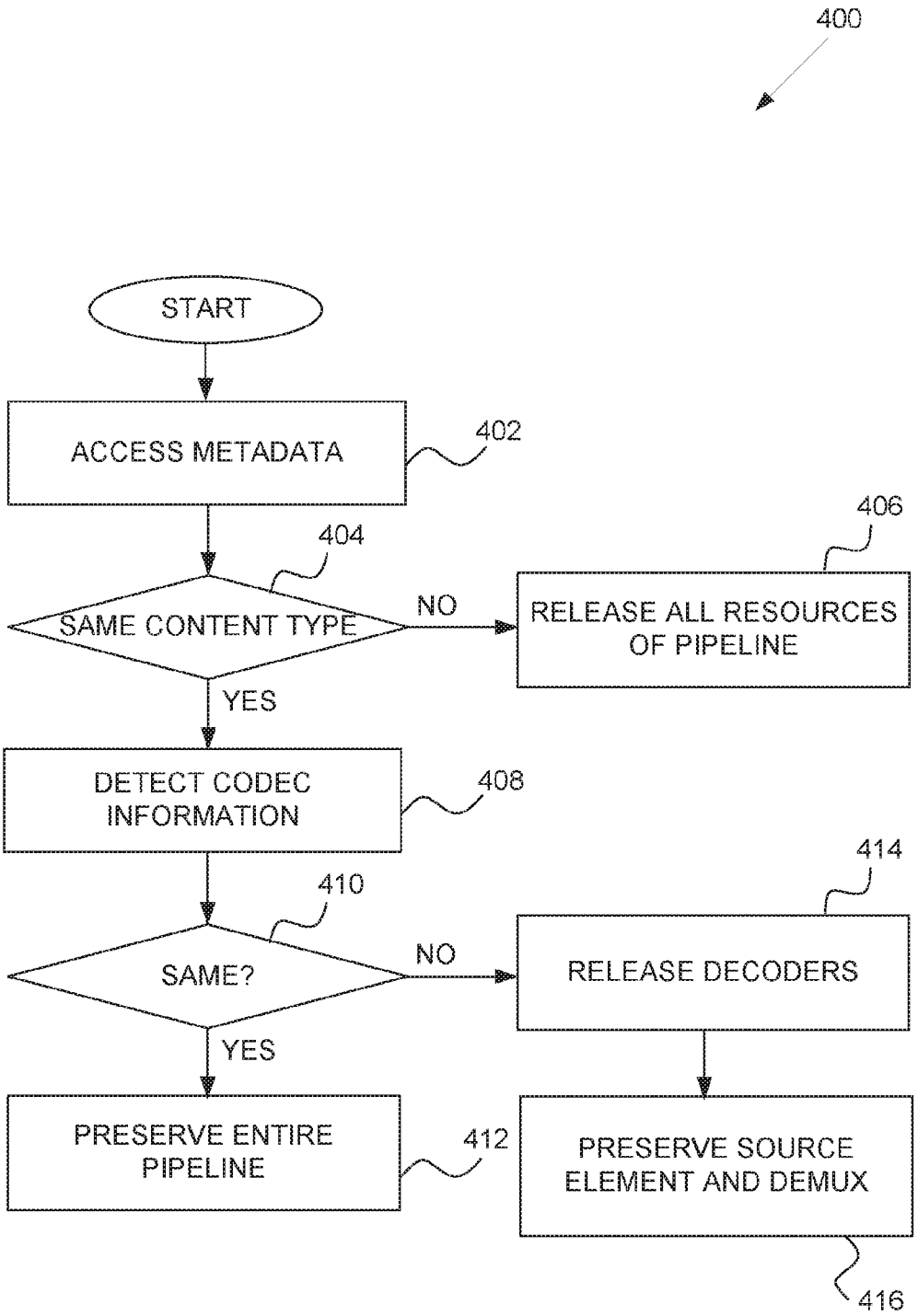

400
START
ACCESS METADATA
402
404
SAME CONTENT TYPE
NO
406
RELEASE ALL RESOURCES OF PIPELINE
YES
DETECT CODEC INFORMATION
408
410
SAME?
NO
414
RELEASE DECODERS
YES
PRESERVE ENTIRE PIPELINE
412
PRESERVE SOURCE ELEMENT AND DEMUX
416

FIG. 4

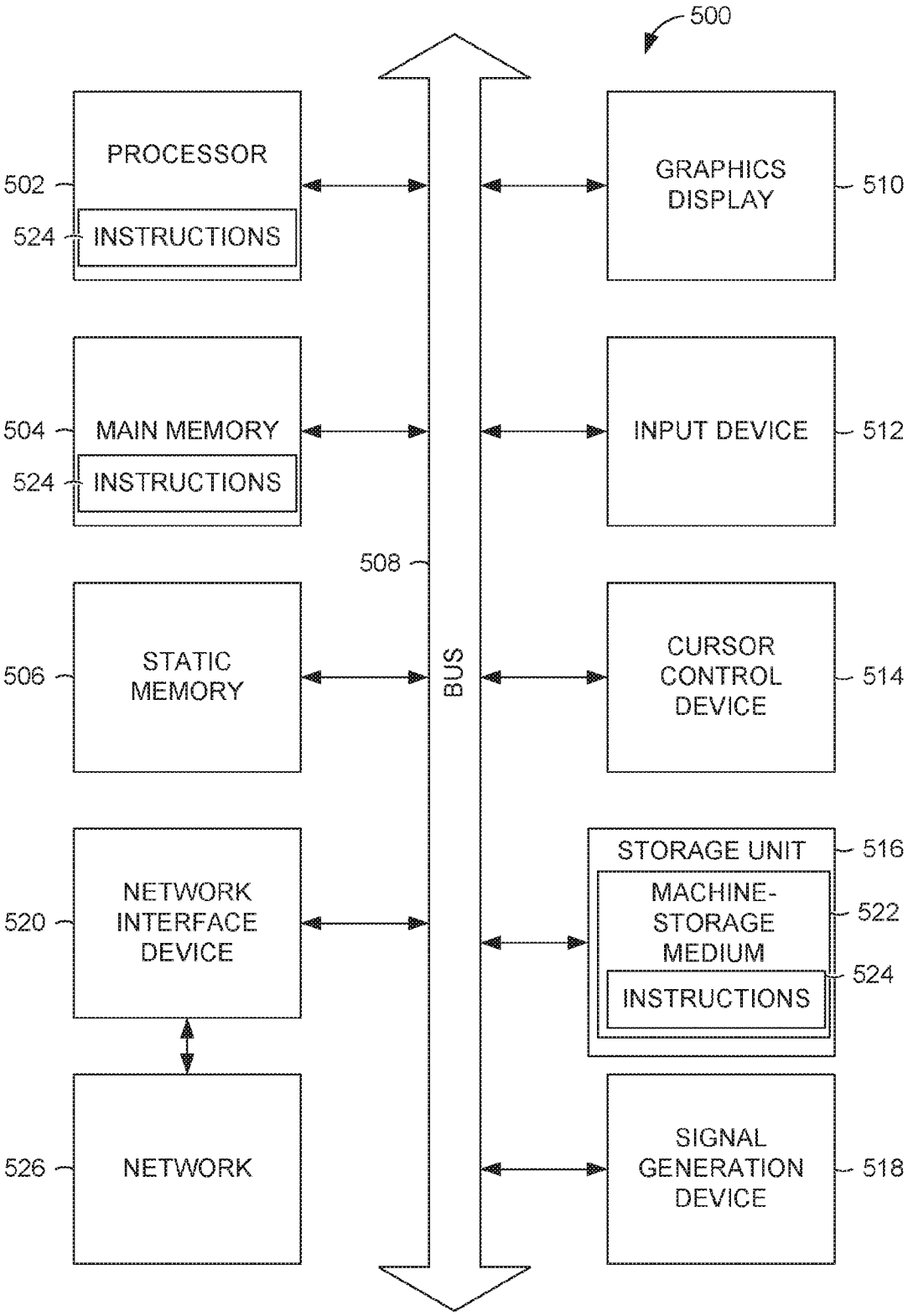

500
PROCESSOR
502
524
INSTRUCTIONS
MAIN MEMORY
504
524
INSTRUCTIONS
STATIC MEMORY
506
508
BUS
NETWORK INTERFACE DEVICE
520
NETWORK
526
GRAPHICS DISPLAY
510
INPUT DEVICE
512
CURSOR CONTROL DEVICE
514
STORAGE UNIT
516
MACHINE-STORAGE MEDIUM
522
524
INSTRUCTIONS
SIGNAL GENERATION DEVICE
518

FIG. 5