8441868

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE

United States Patent and Trademark Office

December 18, 2023

THIS IS TO CERTIFY THAT ANNEXED IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF THE FILE WRAPPER AND CONTENTS OF:

APPLICATION NUMBER: ***17/141,631***
FILING DATE: ***January 05, 2021***
PATENT NUMBER: ***11039218***
ISSUE DATE: ***June 15, 2021***

UNITED STATES PATENT AND TRADEMARK OFFICE · DEPARTMENT OF COMMERCE

Certified by

Kathi

Performing the Functions and Duties of the
Under Secretary of Commerce
for Intellectual Property
and Director of the United States
Patent and Trademark Office

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Kevin APRIL	Nonprovisional Application Number (if known):	
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Joseph Teja, Jr./	Date 1/5/2021
Name (Print/Typed) Joseph Teja Jr.	Practitioner Registration Number 45157

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☐ *Total of _____ forms are submitted.

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. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to 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)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

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 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kevin		APRIL	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
New York	NY	US

Mailing Address of Inventor:

Address 1	174 E90 PH3
Address 2	

City	State/Province	Postal Code	Country
New York	NY	110128	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Peter		AZUOLAS	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Philadelphia	PA	US

Mailing Address of Inventor:

Address 1	330 South 15th Street, Apartment IF
Address 2	

City	State/Province	Postal Code	Country
Philadelphia	PA	19102	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Philip	Nicholas	SCHUPAK	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

City	Brooklyn	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	138 Joralemon Street, Apartment 2F
Address 2	

City	Brooklyn	State/Province	NY
Postal Code	11201	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Brian		SILSTON	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	New York	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	155 West 68th Street, Apartment 6527
Address 2	

City	New York	State/Province	NY
Postal Code	10023	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

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	149890		
Email Address	docketing@smithbaluch.com	Add Email	Remove Email

Application Information:

Title of the Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION		
Attorney Docket Number	SGIC-001US04	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	56	Suggested Figure for Publication (if any)	2

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. 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	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

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 number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

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).
Either enter 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 Number	US Patent Practitioner	◯ Limited Recognition (37 CFR 11.9)
Customer Number	149890		

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 benefit claim 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		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	17027219	2020-09-21

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
17027219	Continuation of	16580552	2019-09-24	10805687	2020-10-13

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
16580552	Continuation of	16267887	2019-02-05	10425697	2019-09-24

Prior Application Status	Pending	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16267887	Continuation of	PCTUS2017045801	2017-08-07

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS2017045801	Claims benefit of provisional	62518506	2017-06-12

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS2017045801	Claims benefit of provisional	62485878	2017-04-14

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS2017045801	Claims benefit of provisional	62435361	2016-12-16

Prior Application Status	Expired	Remove

Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCTUS2017045801	Claims benefit of provisional	62371558	2016-08-05

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING 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).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

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	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

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 1 — Remove

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.

Clear

● 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:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	SportsCastr.LIVE LLC		
Mailing Address Information For Applicant:			
Address 1	595 MADISON AVE., 19TH FLOOR		
Address 2			
City	New York	**State/Province**	NY
Country	US	Postal Code	10022
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

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.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

Assignee 1

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.

Remove

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 i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

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	/Joseph Teja, Jr./			Date (YYYY-MM-DD)	2021-01-05
First Name	Joseph	Last Name	Teja, Jr.	Registration Number	45157

Additional Signature may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US04
	Application Number	
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION	

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 22313-1450.**

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. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to 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)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

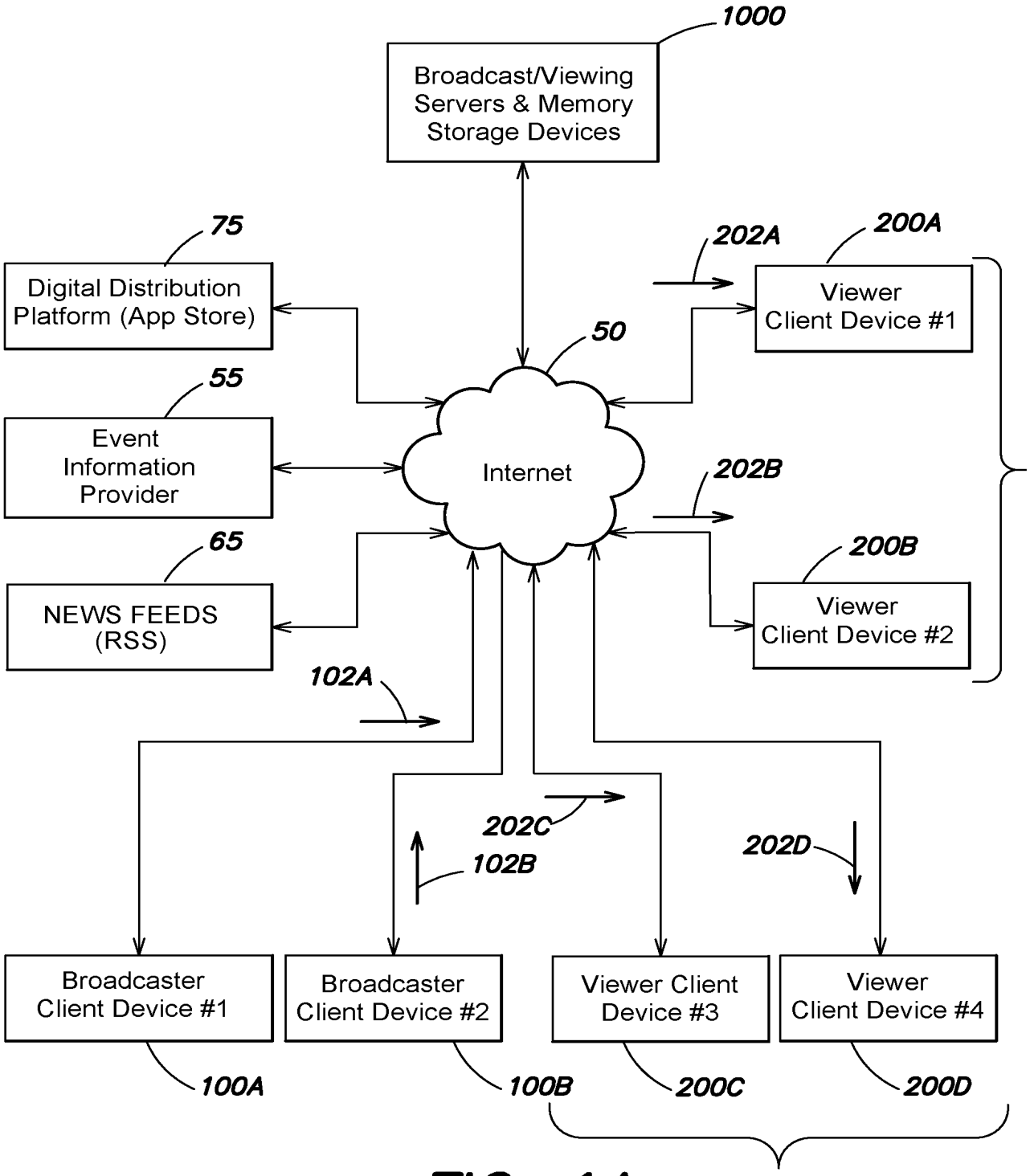

1000
Broadcast/Viewing Servers & Memory Storage Devices
75
Digital Distribution Platform (App Store)
55
Event Information Provider
65
NEWS FEEDS (RSS)
50
Internet
202A
200A
Viewer Client Device #1
202B
200B
Viewer Client Device #2
102A
202C
102B
202D
Broadcaster Client Device #1
Broadcaster Client Device #2
Viewer Client Device #3
Viewer Client Device #4
100A
100B
200C
200D

FIG. 1A

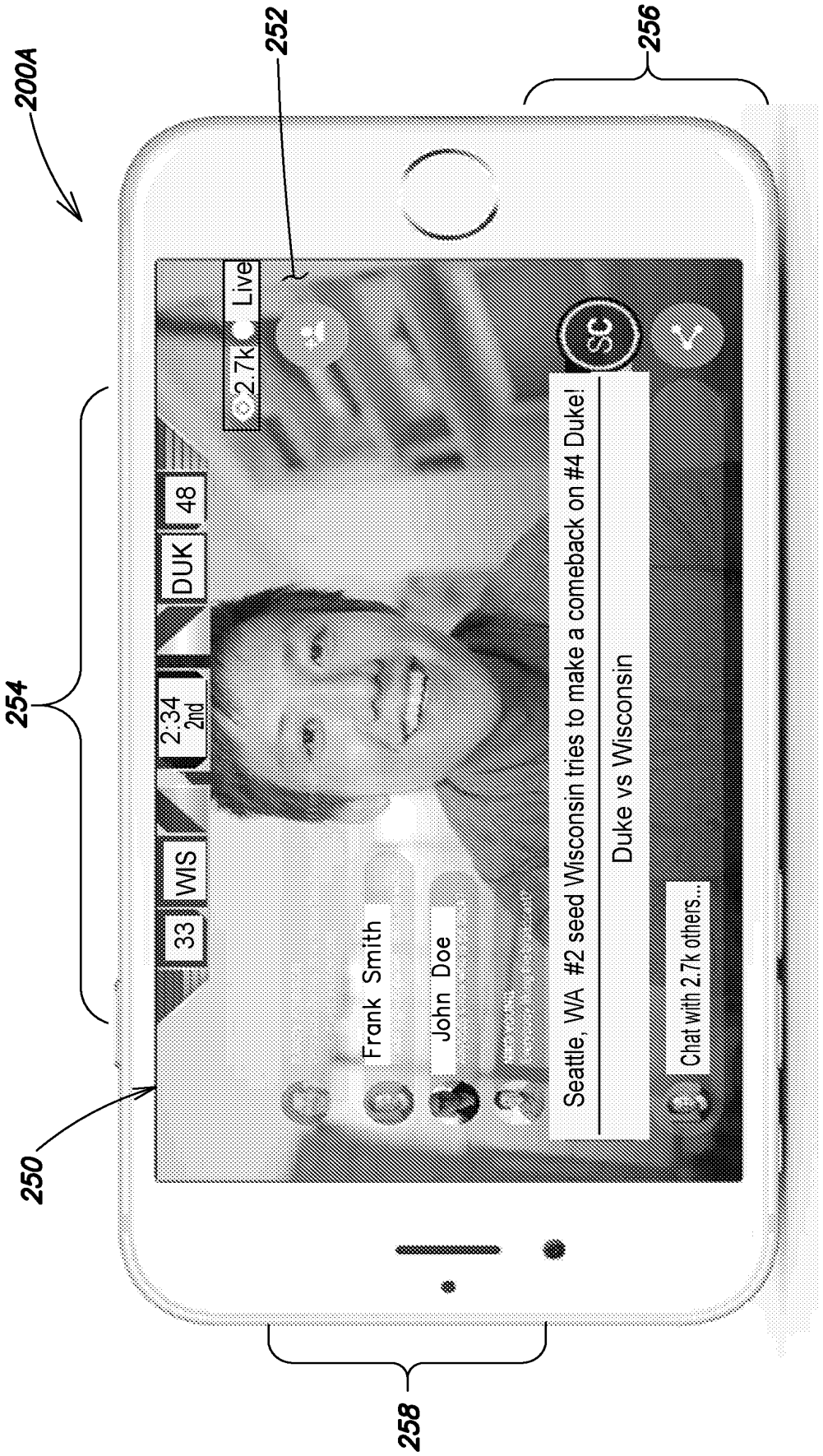

200A
252
256
254
250
258
33
WIS
2:34
2nd
DUK
48
2.7k
Live
Frank Smith
John Doe
Seattle, WA #2 seed Wisconsin tries to make a comeback on #4 Duke!
Duke vs Wisconsin
Chat with 2.7k others...

FIG. 1B

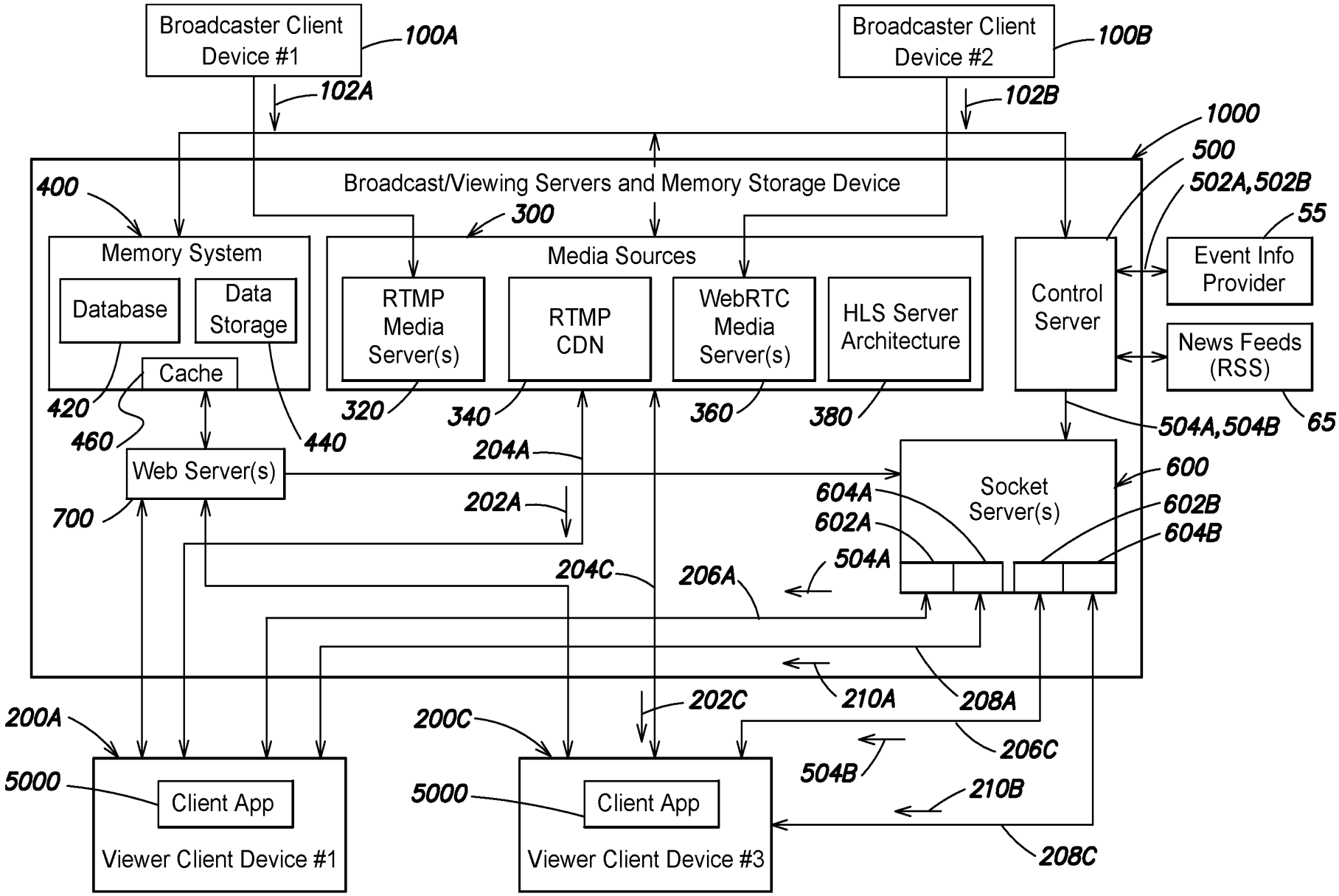

Broadcaster Client Device #1
100A
Broadcaster Client Device #2
100B
102A
102B
1000
500
502A,502B
55
400
Broadcast/Viewing Servers and Memory Storage Device
300
Memory System
Database
Data Storage
Cache
Media Sources
RTMP Media Server(s)
RTMP CDN
WebRTC Media Server(s)
HLS Server Architecture
Control Server
Event Info Provider
News Feeds (RSS)
420
460
440
320
340
360
380
504A,504B
65
204A
202A
Web Server(s)
700
Socket Server(s)
600
604A
602A
602B
604B
504A
204C
206A
210A
208A
202C
200A
200C
206C
504B
210B
5000
Client App
Viewer Client Device #1
Viewer Client Device #3
208C

FIG. 2

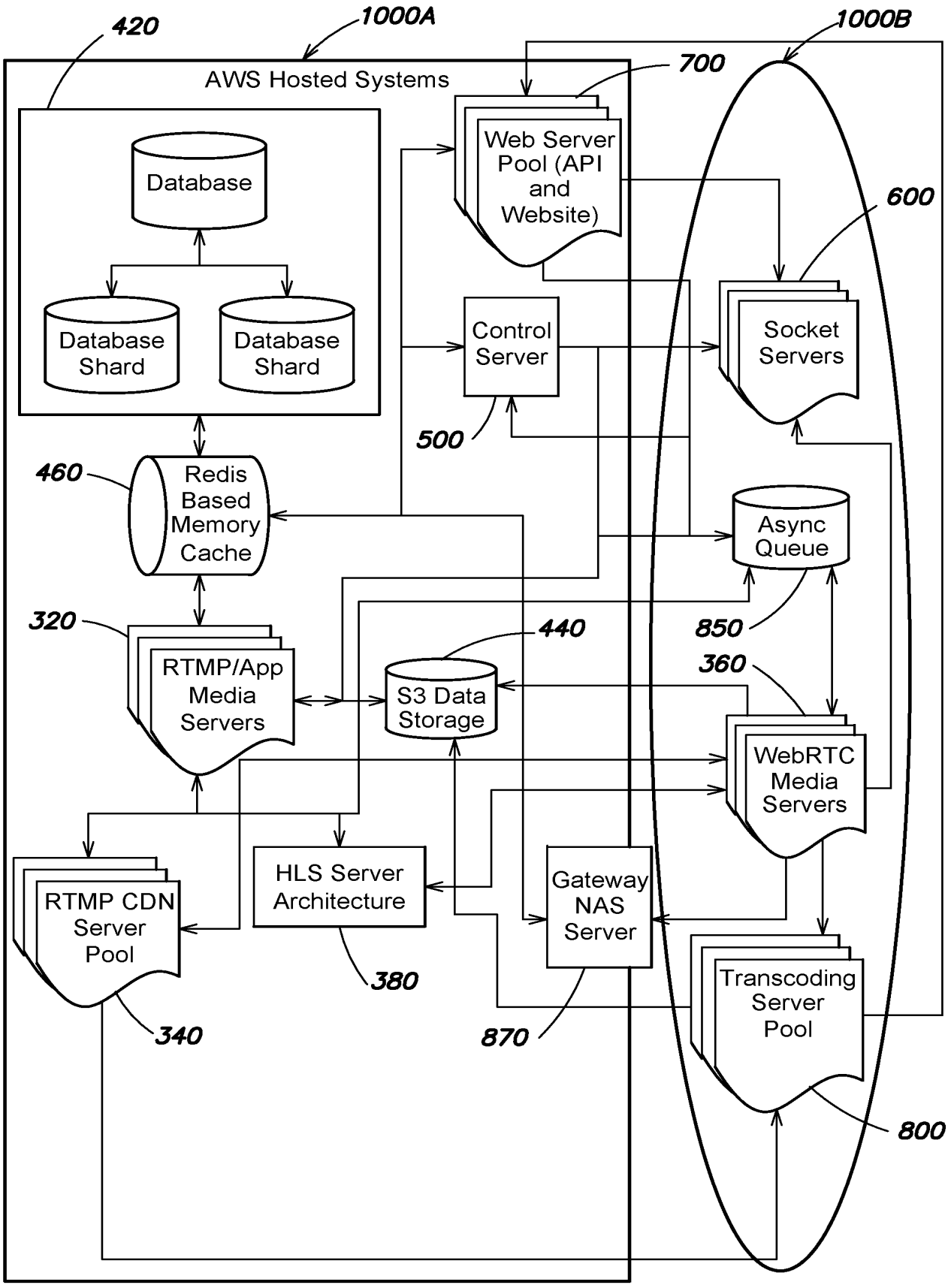

420
1000A
1000B
AWS Hosted Systems
700
Database
Web Server Pool (API and Website)
600
Database Shard
Database Shard
Control Server
Socket Servers
500
460
Redis Based Memory Cache
Async Queue
320
440
850
360
RTMP/App Media Servers
S3 Data Storage
WebRTC Media Servers
RTMP CDN Server Pool
HLS Server Architecture
Gateway NAS Server
380
340
870
Transcoding Server Pool
800

FIG. 3

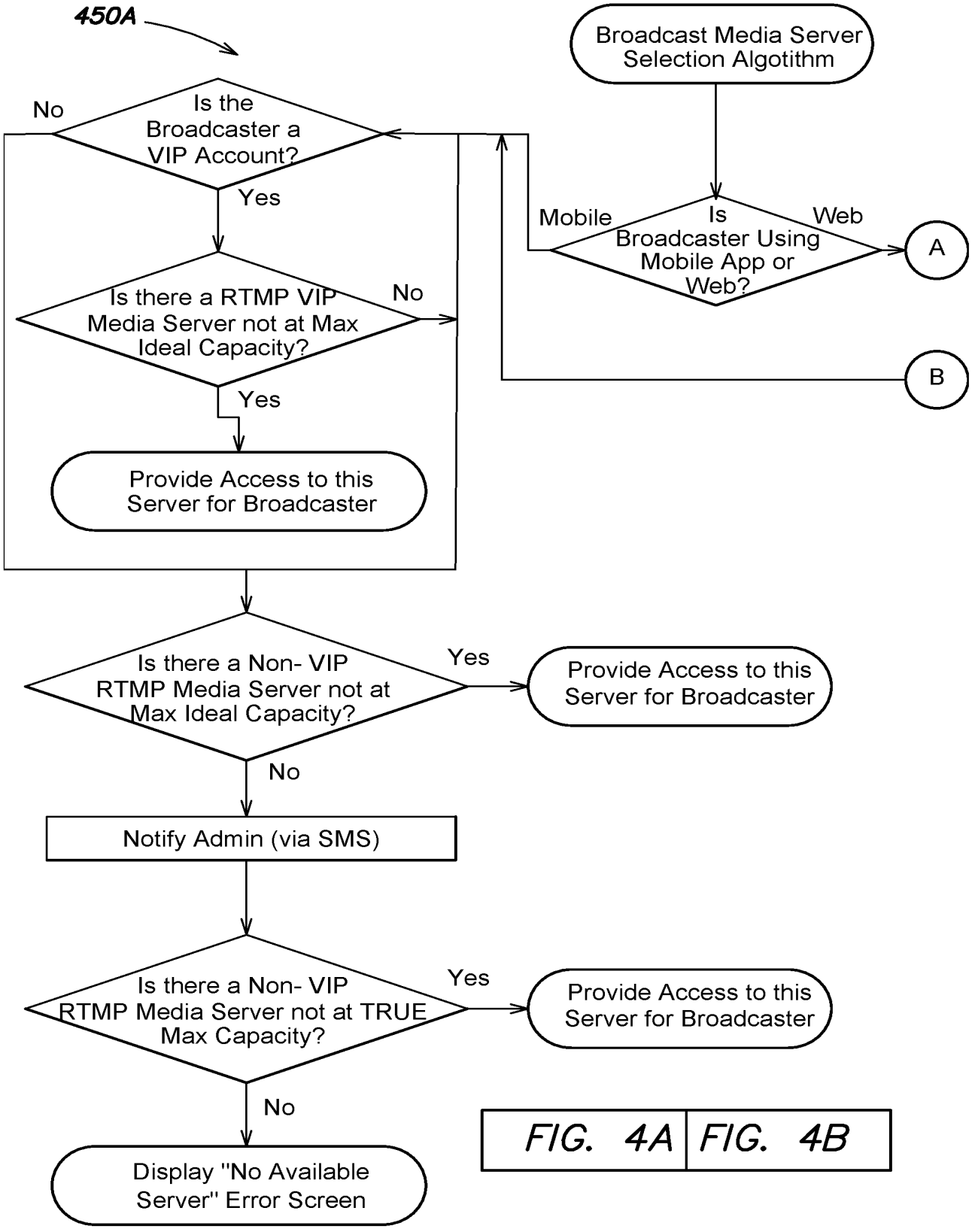


FIG. 4A | FIG. 4B

FIG. 4A

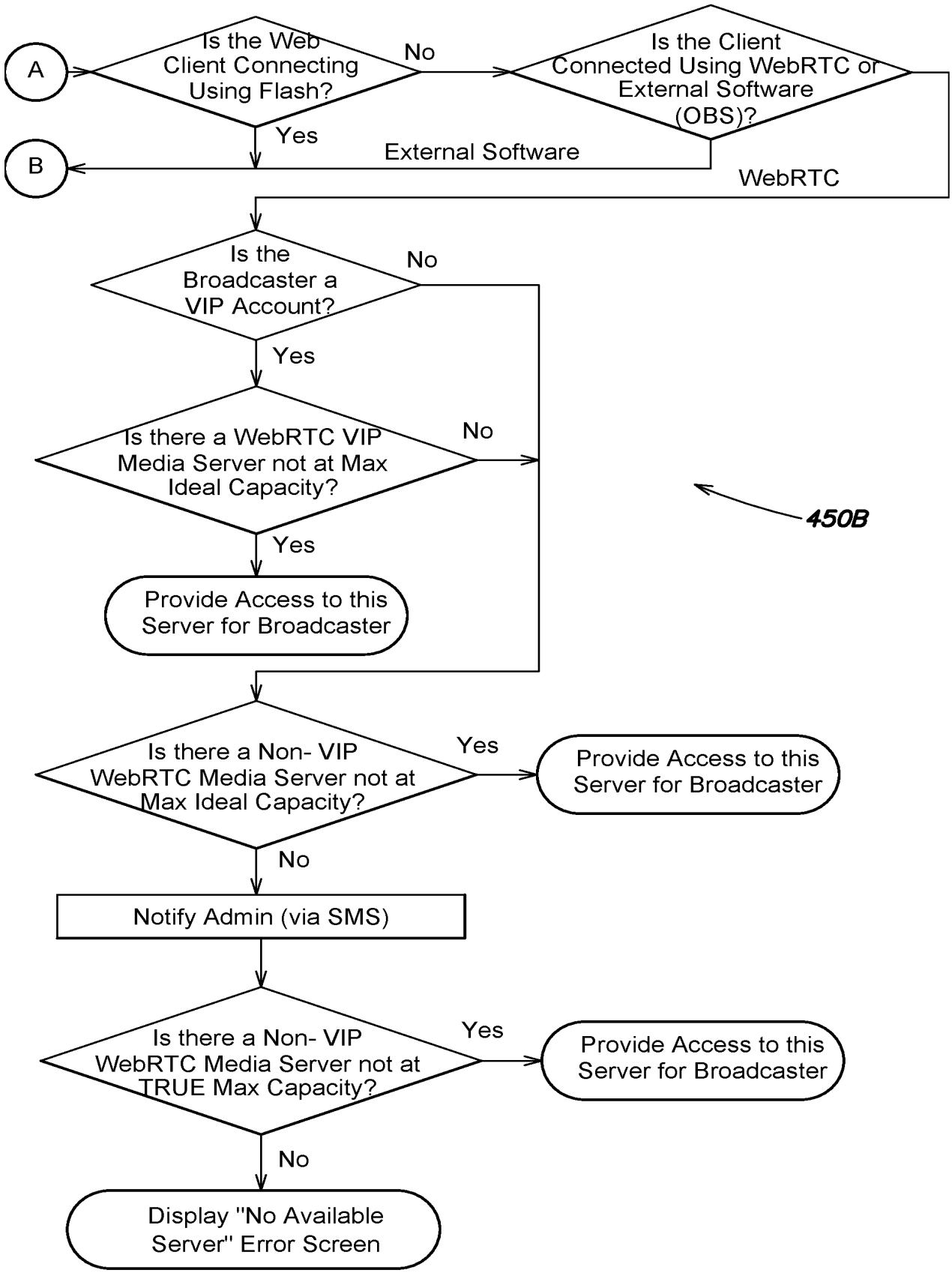

A
Is the Web Client Connecting Using Flash?
No
Is the Client Connected Using WebRTC or External Software (OBS)?
Yes
External Software
B
WebRTC
Is the Broadcaster a VIP Account?
No
Yes
Is there a WebRTC VIP Media Server not at Max Ideal Capacity?
No
Yes
Provide Access to this Server for Broadcaster
450B
Is there a Non- VIP WebRTC Media Server not at Max Ideal Capacity?
Yes
Provide Access to this Server for Broadcaster
No
Notify Admin (via SMS)
Is there a Non- VIP WebRTC Media Server not at TRUE Max Capacity?
Yes
Provide Access to this Server for Broadcaster
No
Display "No Available Server" Error Screen

FIG. 4B

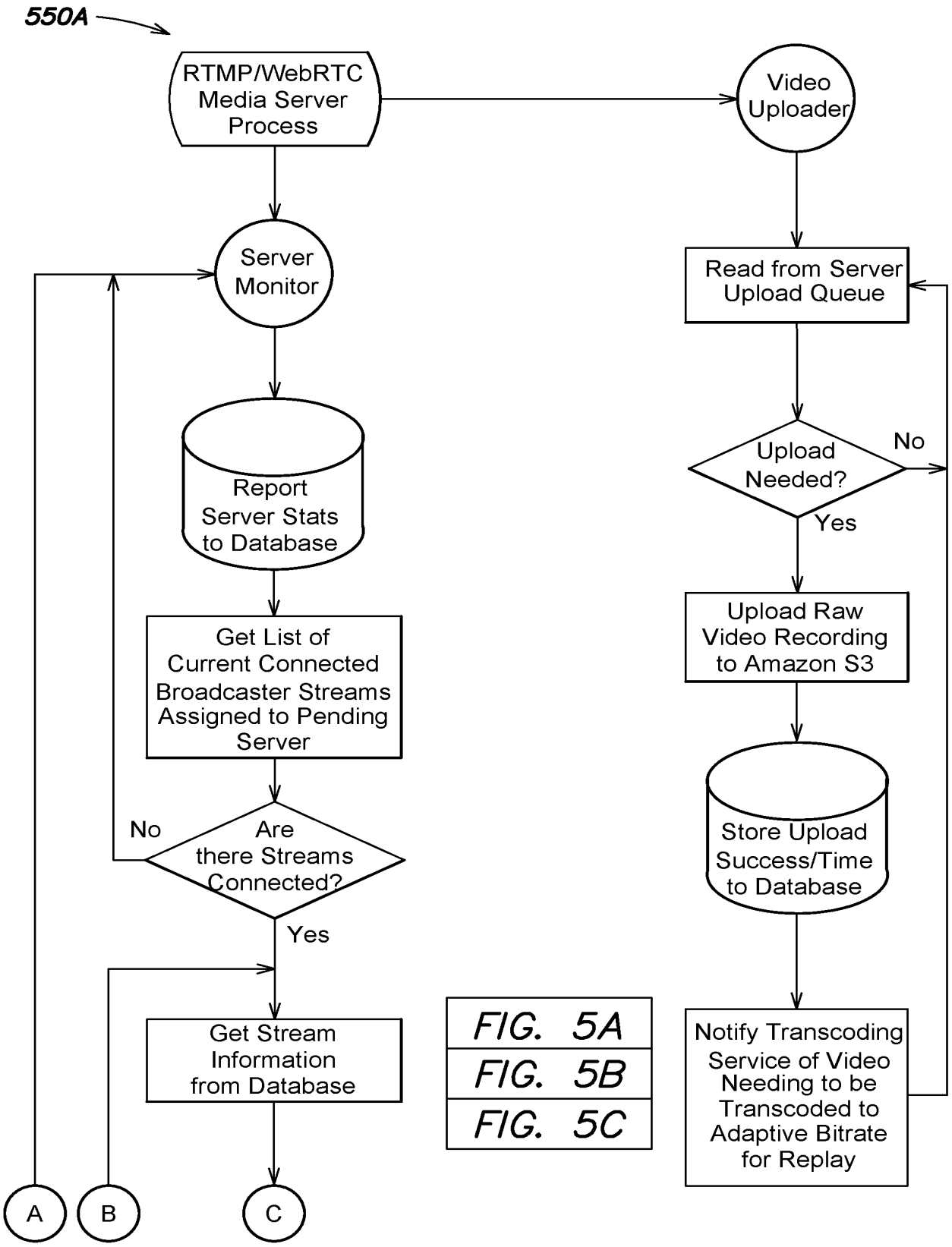


FIG. 5A
FIG. 5B
FIG. 5C

FIG. 5A

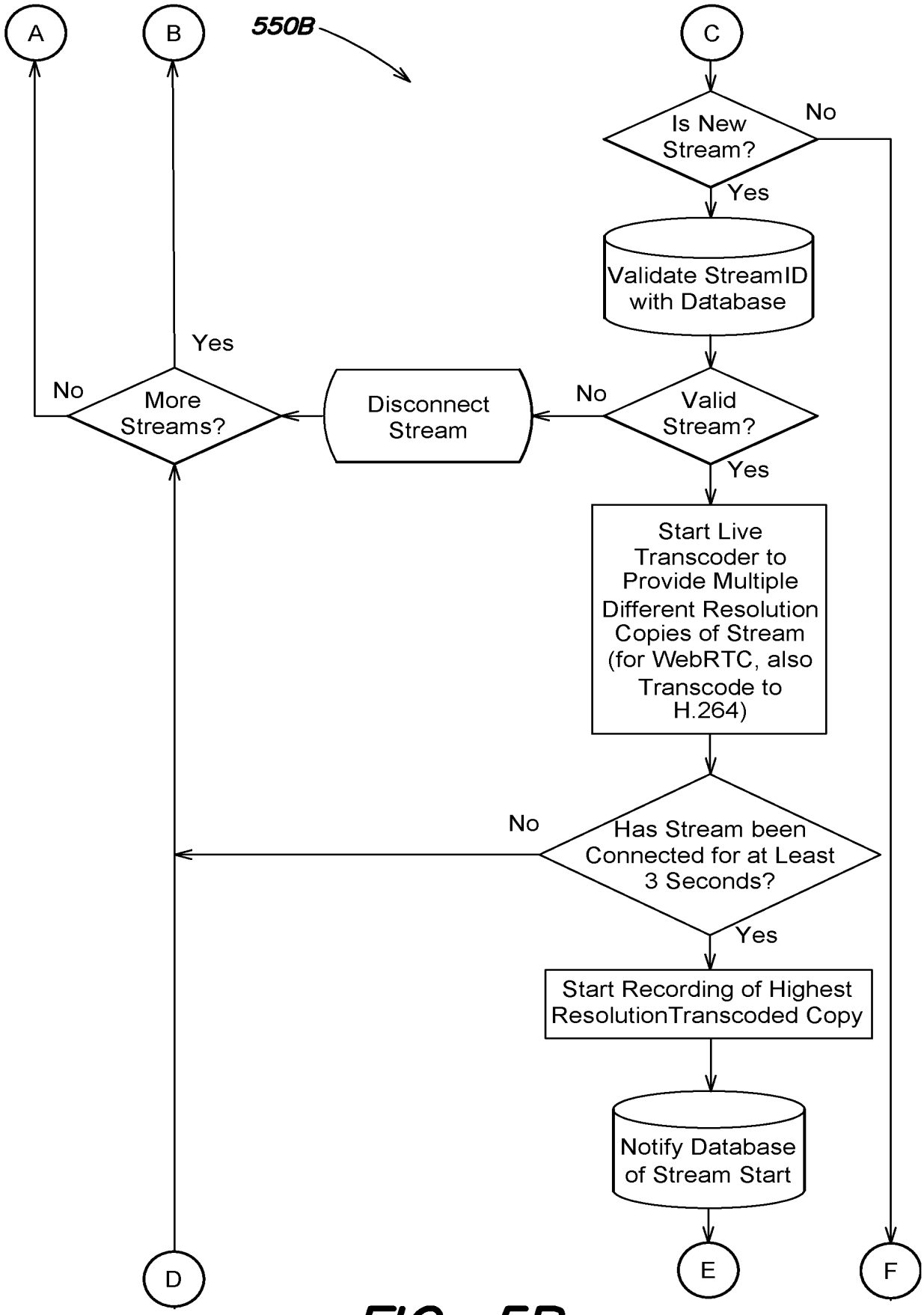

A
B
550B
C
Is New Stream?
No
Yes
Validate StreamID with Database
Yes
No
More Streams?
Disconnect Stream
No
Valid Stream?
Yes
Start Live Transcoder to Provide Multiple Different Resolution Copies of Stream (for WebRTC, also Transcode to H.264)
No
Has Stream been Connected for at Least 3 Seconds?
Yes
Start Recording of Highest ResolutionTranscoded Copy
Notify Database of Stream Start
D
E
F

FIG. 5B

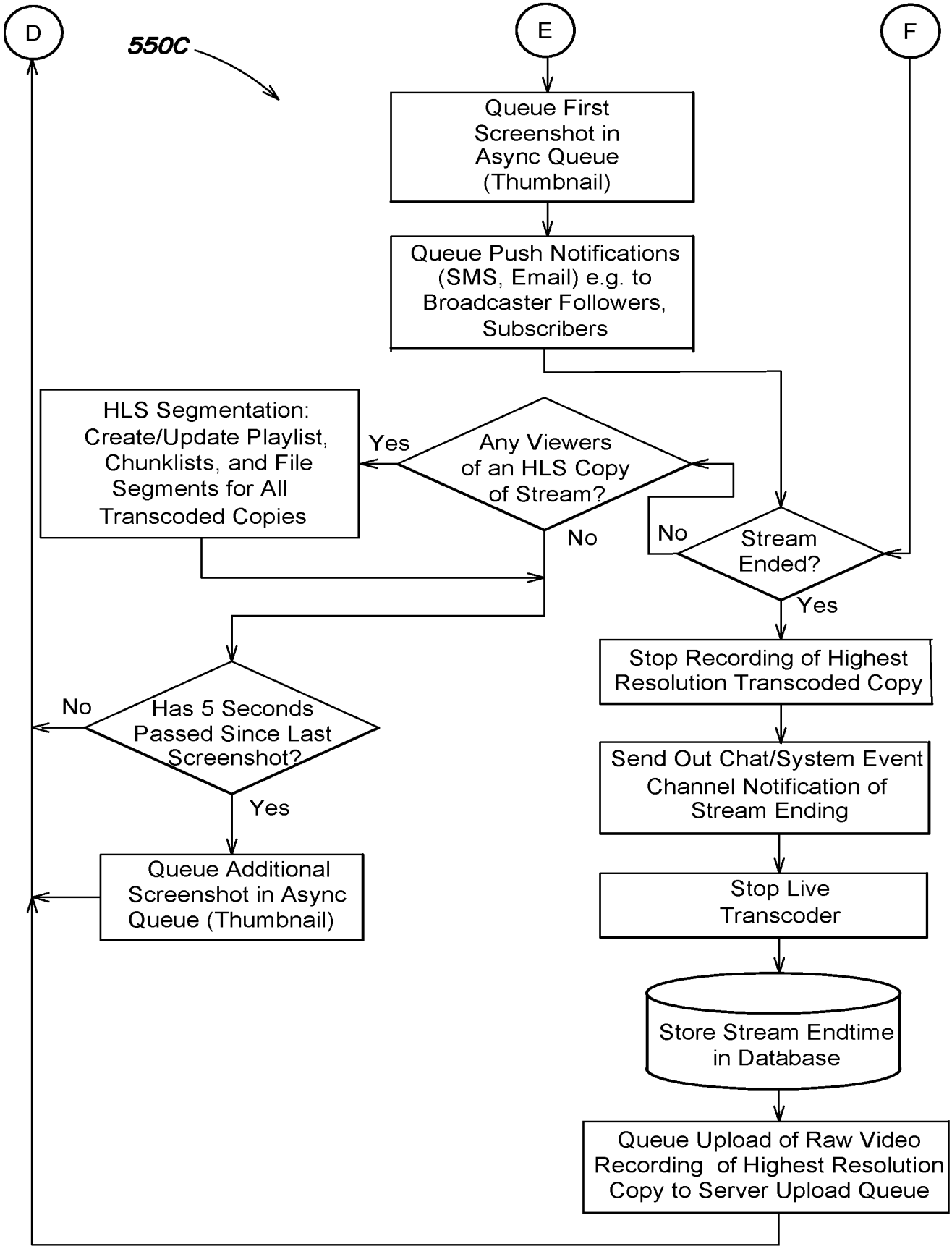

D
550C
E
F
Queue First Screenshot in Async Queue (Thumbnail)
Queue Push Notifications (SMS, Email) e.g. to Broadcaster Followers, Subscribers
HLS Segmentation: Create/Update Playlist, Chunklists, and File Segments for All Transcoded Copies
Yes
Any Viewers of an HLS Copy of Stream?
No
No
Stream Ended?
Yes
Stop Recording of Highest Resolution Transcoded Copy
No
Has 5 Seconds Passed Since Last Screenshot?
Yes
Send Out Chat/System Event Channel Notification of Stream Ending
Queue Additional Screenshot in Async Queue (Thumbnail)
Stop Live Transcoder
Store Stream Endtime in Database
Queue Upload of Raw Video Recording of Highest Resolution Copy to Server Upload Queue

FIG. 5C

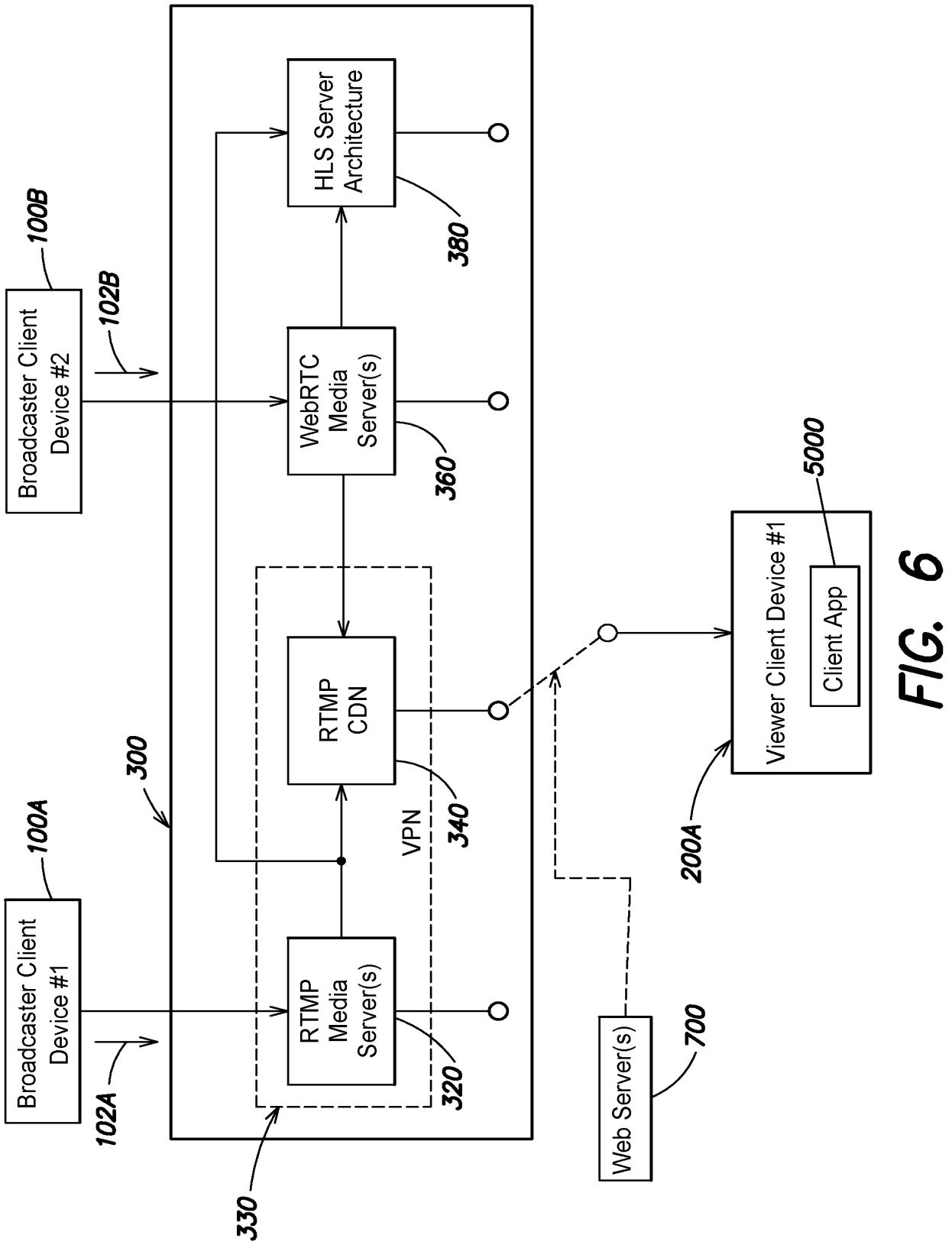

Broadcaster Client Device #1
100A
102A
Broadcaster Client Device #2
100B
102B
300
330
RTMP Media Server(s)
320
RTMP CDN
340
VPN
WebRTC Media Server(s)
360
HLS Server Architecture
380
Web Server(s)
700
Viewer Client Device #1
5000
Client App
200A

FIG. 6

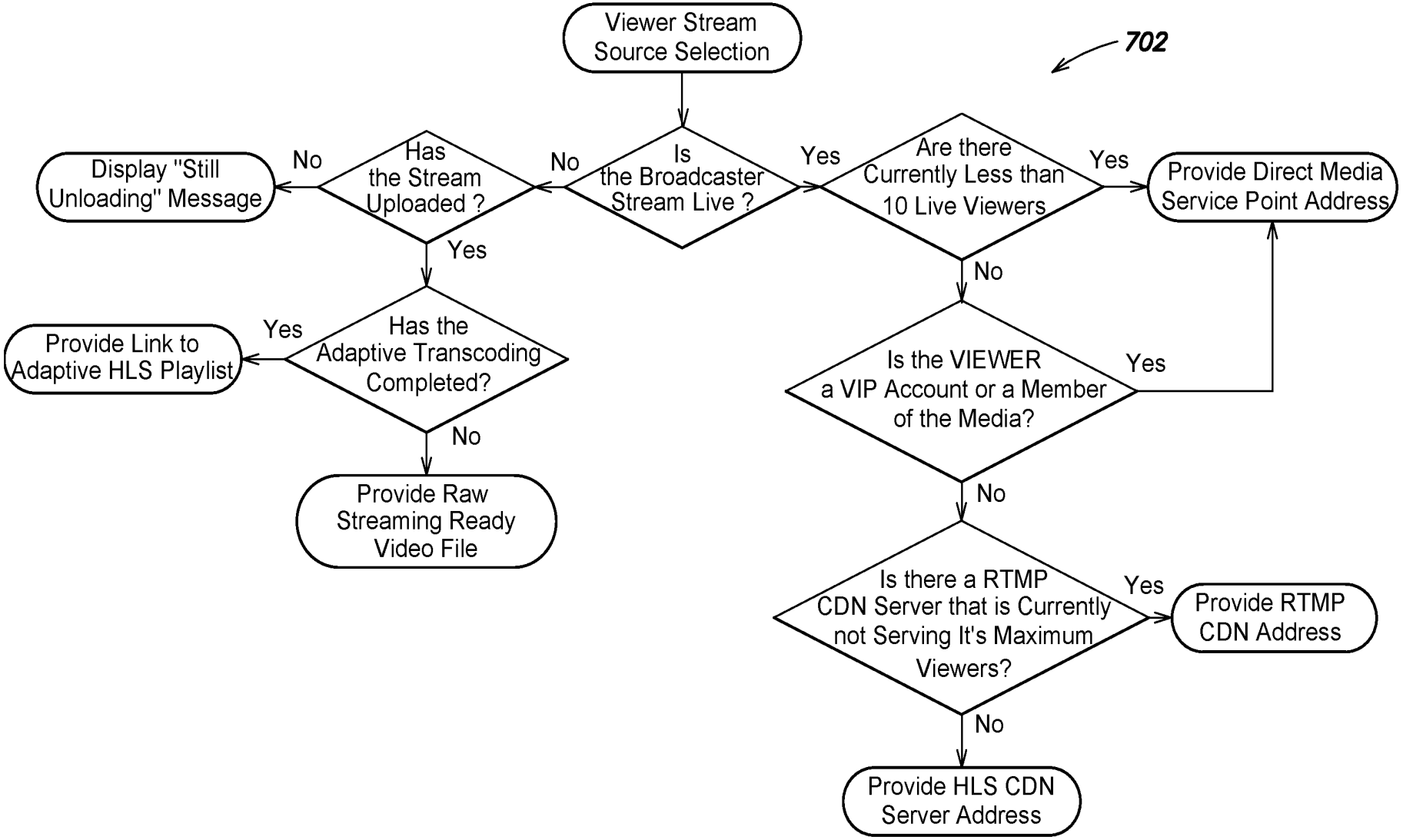

Viewer Stream Source Selection
702
Is the Broadcaster Stream Live ?
No
Has the Stream Uploaded ?
No
Display "Still Unloading" Message
Yes
Has the Adaptive Transcoding Completed?
Yes
Provide Link to Adaptive HLS Playlist
No
Provide Raw Streaming Ready Video File
Yes
Are there Currently Less than 10 Live Viewers
Yes
Provide Direct Media Service Point Address
No
Is the VIEWER a VIP Account or a Member of the Media?
Yes
No
Is there a RTMP CDN Server that is Currently not Serving It's Maximum Viewers?
Yes
Provide RTMP CDN Address
No
Provide HLS CDN Server Address

FIG. 7

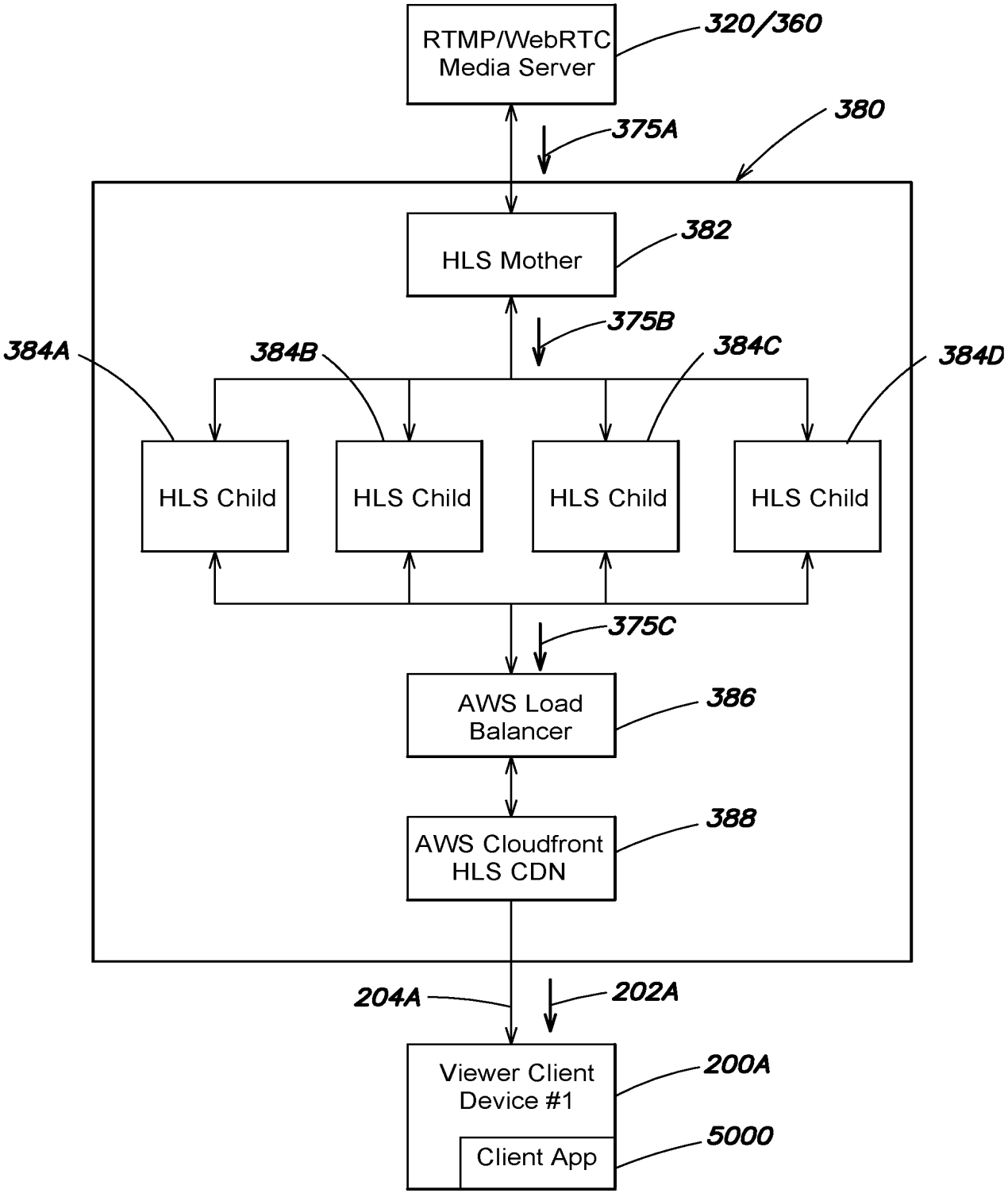

RTMP/WebRTC Media Server
320/360
380
375A
HLS Mother
382
375B
384A
384B
384C
384D
HLS Child
HLS Child
HLS Child
HLS Child
375C
AWS Load Balancer
386
AWS Cloudfront HLS CDN
388
204A
202A
Viewer Client Device #1
200A
Client App
5000

FIG. 8

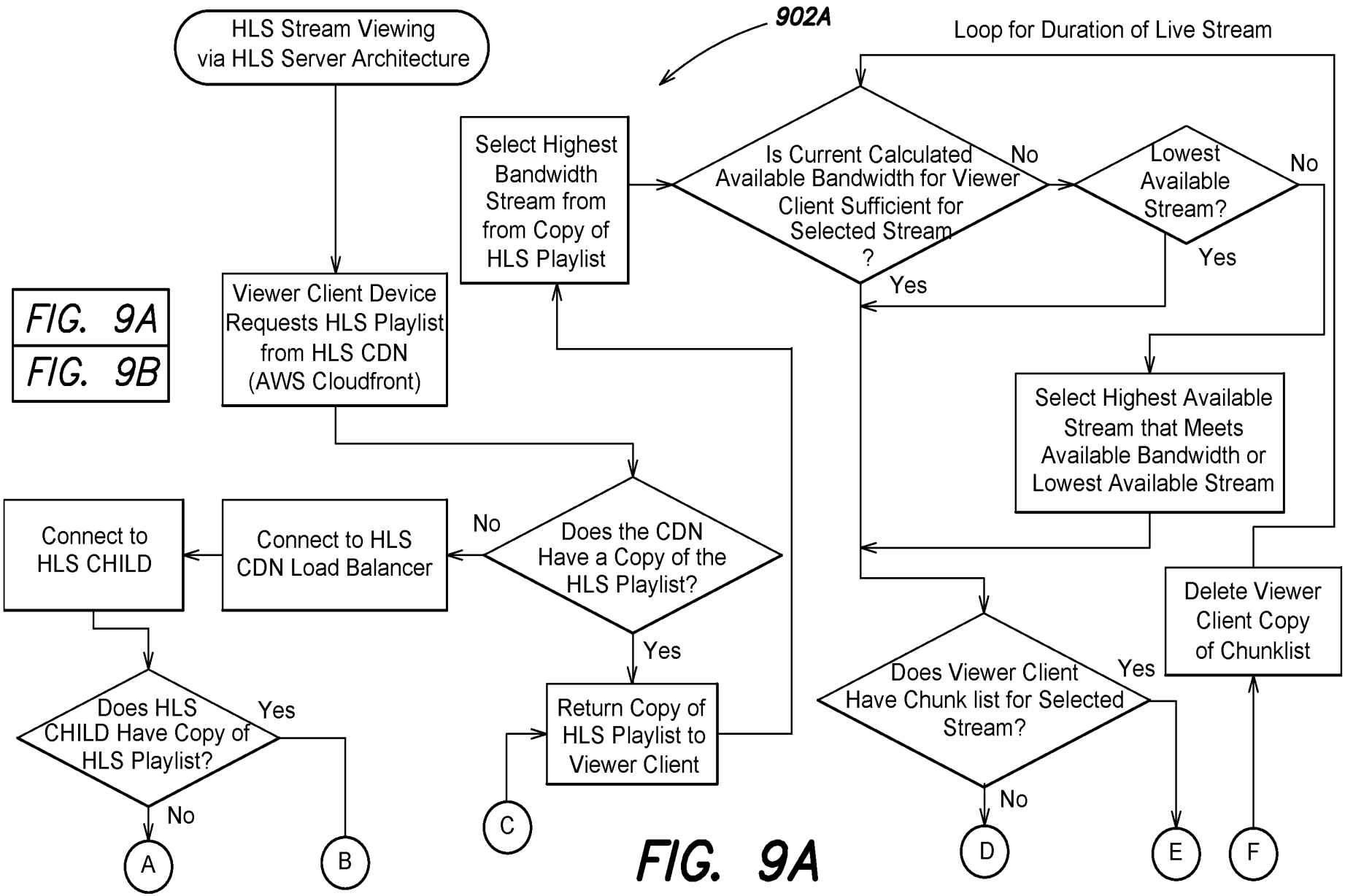


FIG. 9A

FIG. 9B

FIG. 9A

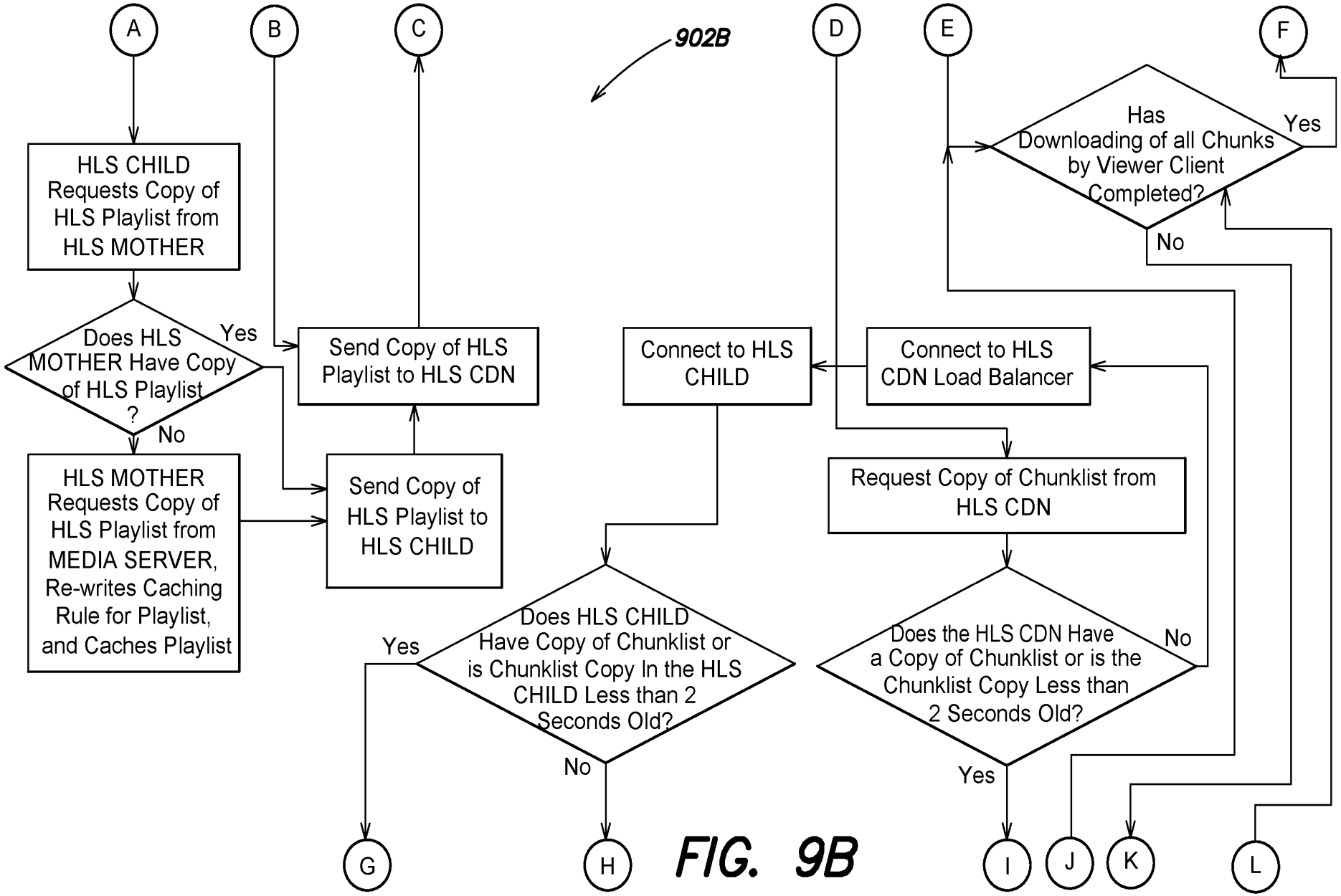

902B
A
B
C
D
E
F
HLS CHILD Requests Copy of HLS Playlist from HLS MOTHER
Does HLS MOTHER Have Copy of HLS Playlist ?
Yes
No
Send Copy of HLS Playlist to HLS CDN
HLS MOTHER Requests Copy of HLS Playlist from MEDIA SERVER, Re-writes Caching Rule for Playlist, and Caches Playlist
Send Copy of HLS Playlist to HLS CHILD
Connect to HLS CHILD
Connect to HLS CDN Load Balancer
Request Copy of Chunklist from HLS CDN
Has Downloading of all Chunks by Viewer Client Completed?
Yes
No
Does HLS CHILD Have Copy of Chunklist or is Chunklist Copy In the HLS CHILD Less than 2 Seconds Old?
Yes
No
Does the HLS CDN Have a Copy of Chunklist or is the Chunklist Copy Less than 2 Seconds Old?
No
Yes
G
H
I
J
K
L

FIG. 9B

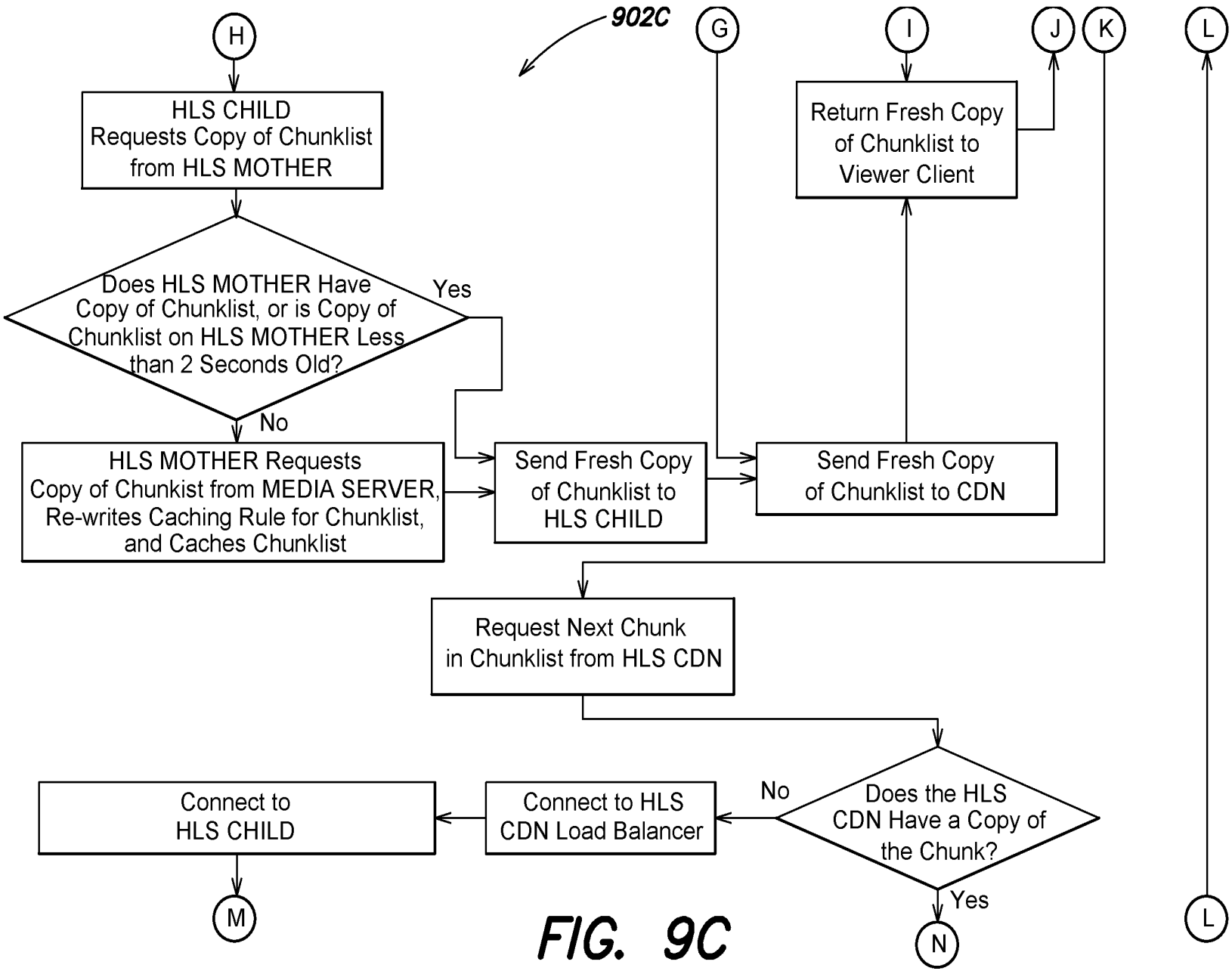

902C
H
HLS CHILD
Requests Copy of Chunklist
from HLS MOTHER
Does HLS MOTHER Have
Copy of Chunklist, or is Copy of
Chunklist on HLS MOTHER Less
than 2 Seconds Old?
Yes
No
HLS MOTHER Requests
Copy of Chunkist from MEDIA SERVER,
Re-writes Caching Rule for Chunklist,
and Caches Chunklist
Send Fresh Copy
of Chunklist to
HLS CHILD
G
Send Fresh Copy
of Chunklist to CDN
I
Return Fresh Copy
of Chunklist to
Viewer Client
J
K
L
Request Next Chunk
in Chunklist from HLS CDN
Does the HLS
CDN Have a Copy of
the Chunk?
No
Yes
N
Connect to HLS
CDN Load Balancer
Connect to
HLS CHILD
M
L

FIG. 9C

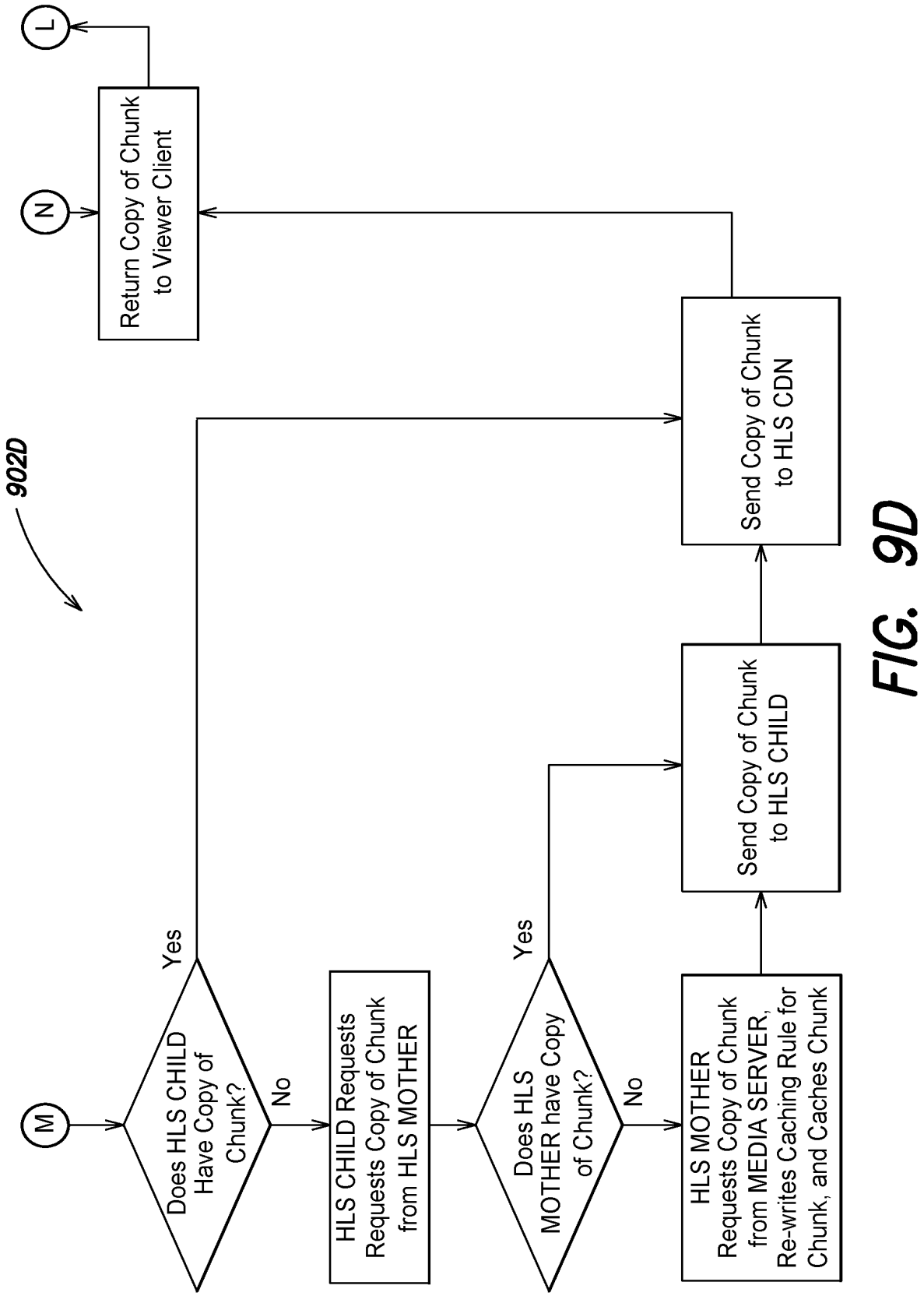

902D
M
Does HLS CHILD Have Copy of Chunk?
Yes
No
HLS CHILD Requests Copy of Chunk from HLS MOTHER
Does HLS MOTHER have Copy of Chunk?
Yes
No
HLS MOTHER Requests Copy of Chunk from MEDIA SERVER, Re-writes Caching Rule for Chunk, and Caches Chunk
Send Copy of Chunk to HLS CHILD
Send Copy of Chunk to HLS CDN
N
Return Copy of Chunk to Viewer Client
L

FIG. 9D

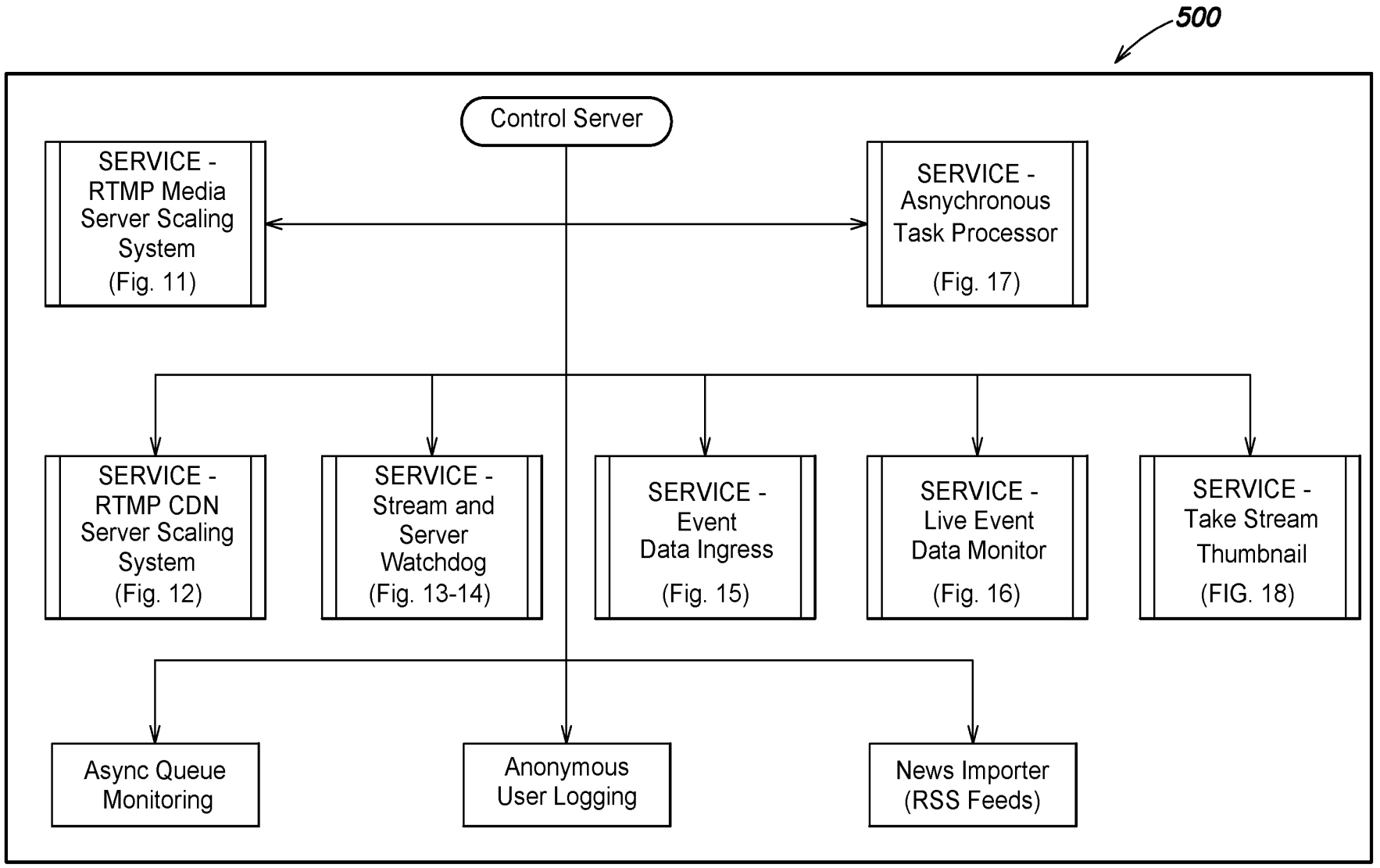

500
Control Server
SERVICE - RTMP Media Server Scaling System (Fig. 11)
SERVICE - Asnychronous Task Processor (Fig. 17)
SERVICE - RTMP CDN Server Scaling System (Fig. 12)
SERVICE - Stream and Server Watchdog (Fig. 13-14)
SERVICE - Event Data Ingress (Fig. 15)
SERVICE - Live Event Data Monitor (Fig. 16)
SERVICE - Take Stream Thumbnail (FIG. 18)
Async Queue Monitoring
Anonymous User Logging
News Importer (RSS Feeds)

FIG. 10

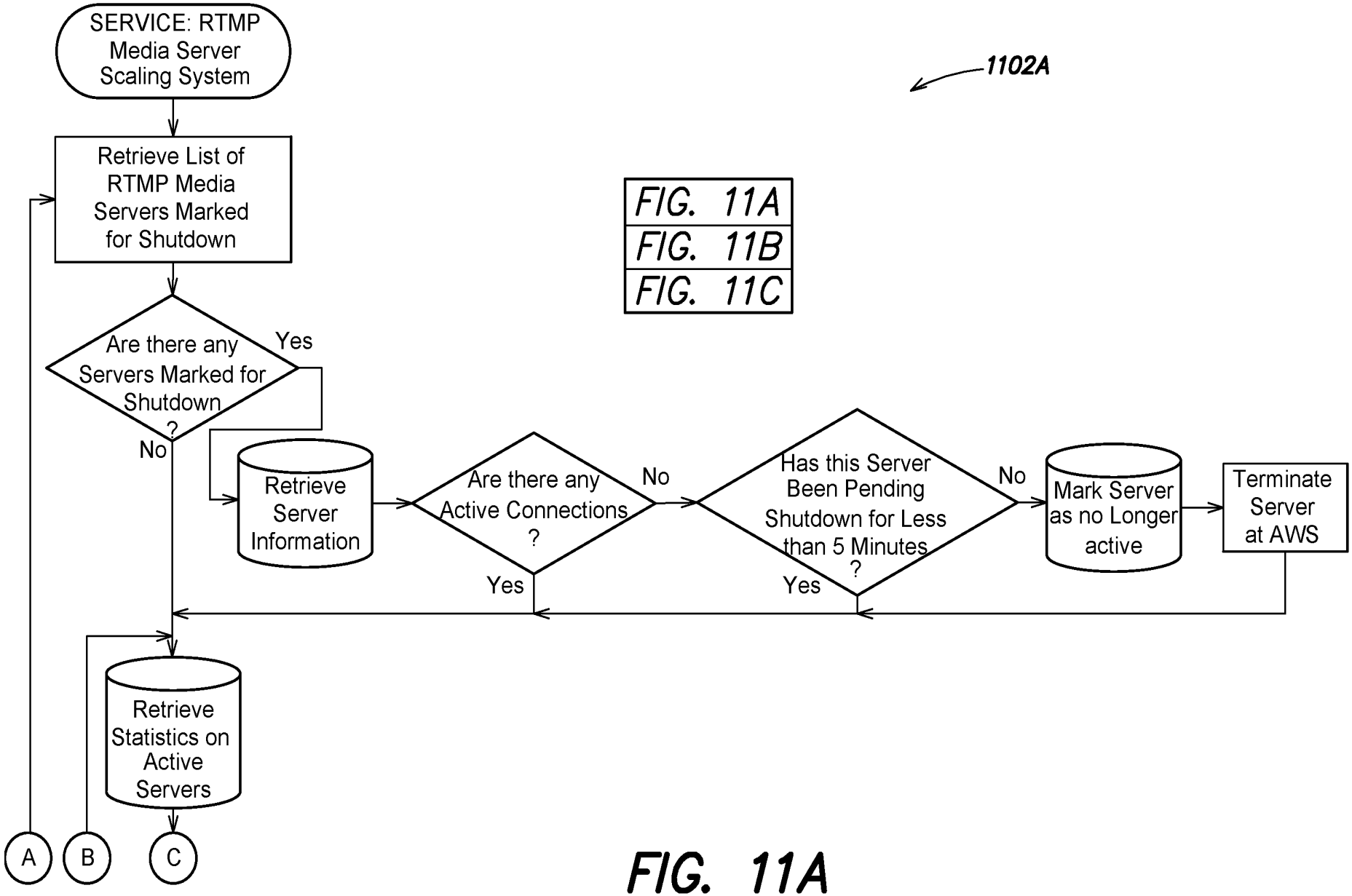


FIG. 11A
FIG. 11B
FIG. 11C

FIG. 11A

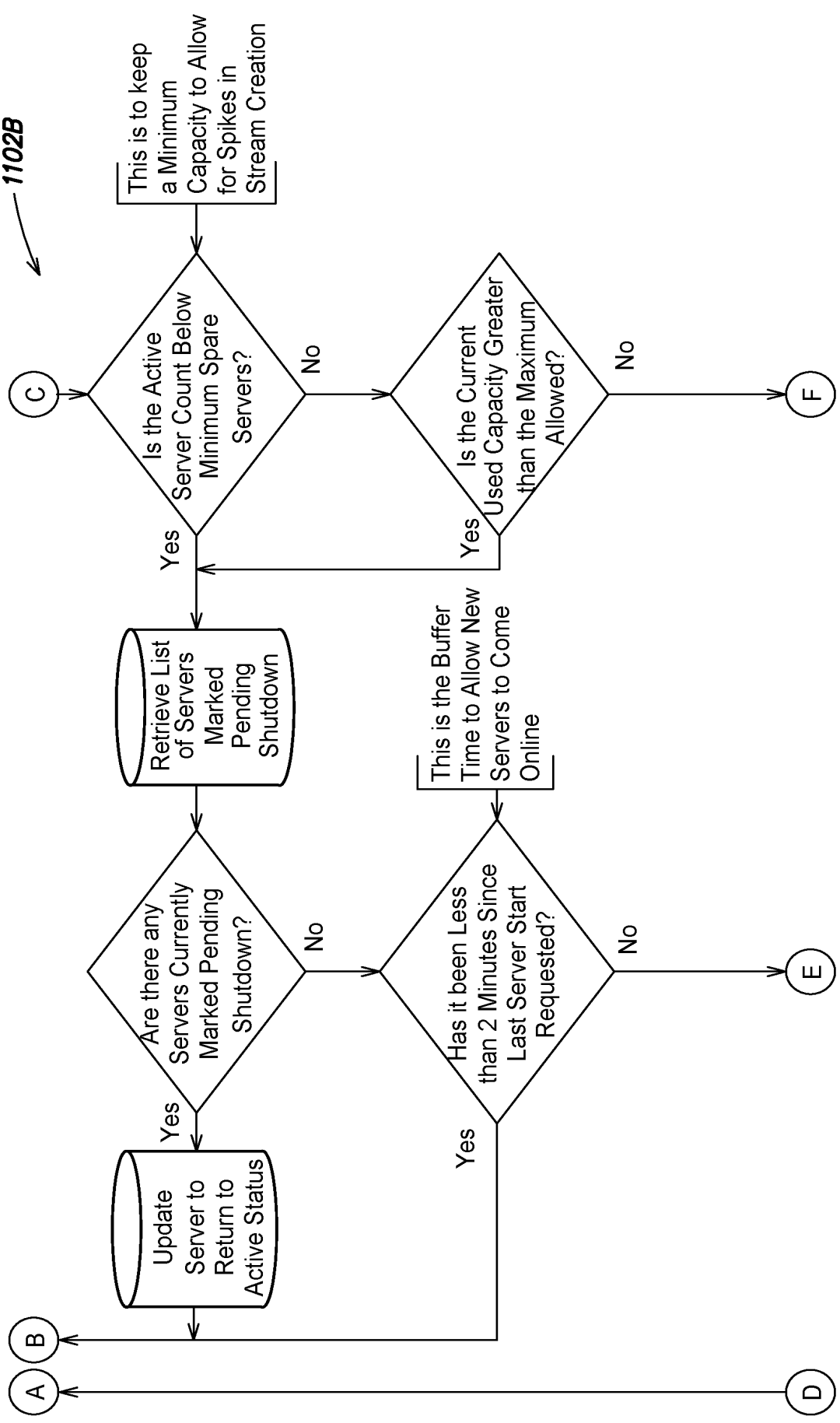

1102B
This is to keep a Minimum Capacity to Allow for Spikes in Stream Creation
C
Is the Active Server Count Below Minimum Spare Servers?
No
Is the Current Used Capacity Greater than the Maximum Allowed?
No
F
Yes
Yes
Retrieve List of Servers Marked Pending Shutdown
This is the Buffer Time to Allow New Servers to Come Online
Are there any Servers Currently Marked Pending Shutdown?
No
Has it been Less than 2 Minutes Since Last Server Start Requested?
No
E
Yes
Update Server to Return to Active Status
Yes
B
A
D

FIG. 11B

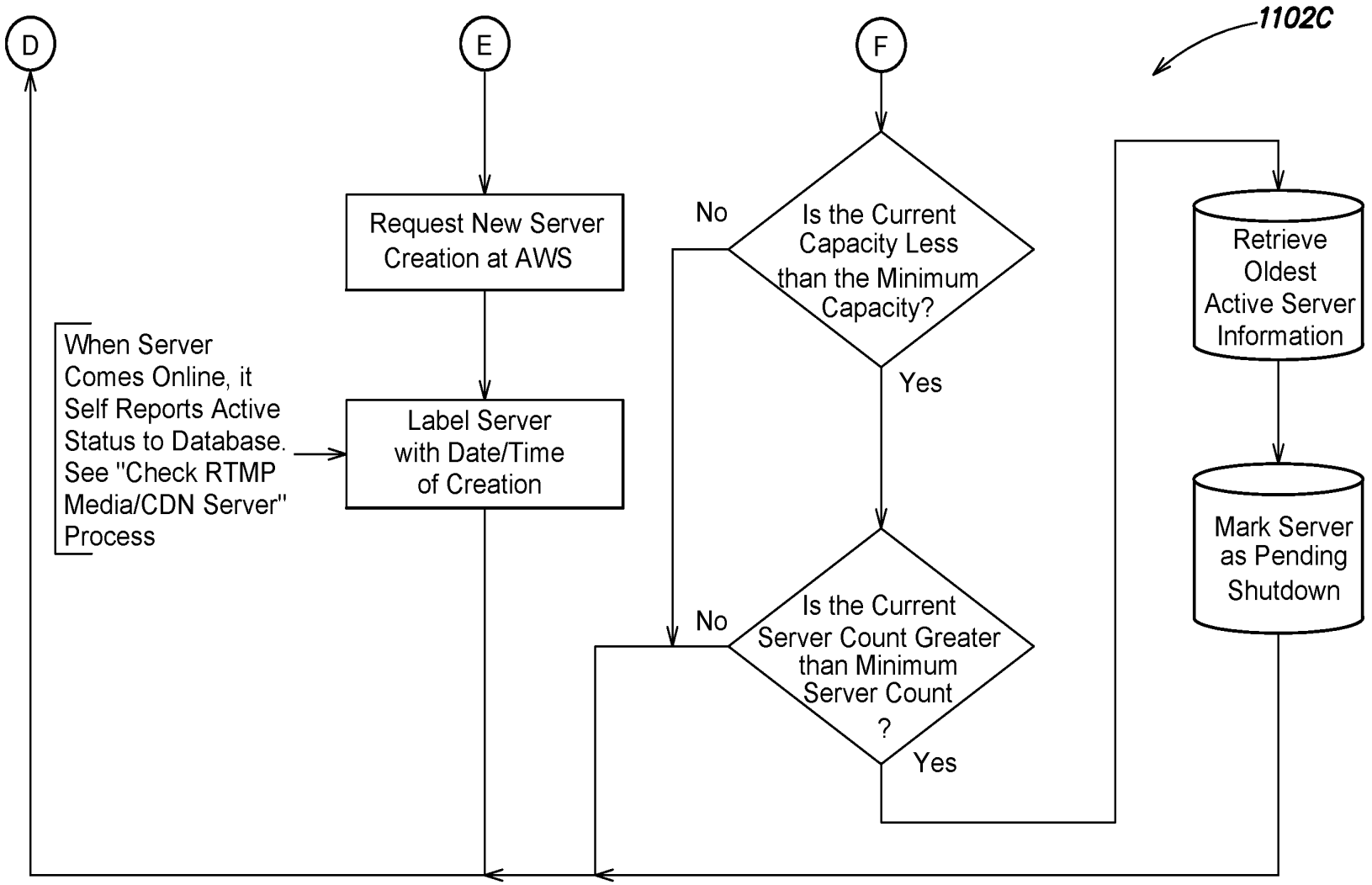

1102C
D
E
F
Request New Server Creation at AWS
When Server Comes Online, it Self Reports Active Status to Database. See "Check RTMP Media/CDN Server" Process
Label Server with Date/Time of Creation
No
Is the Current Capacity Less than the Minimum Capacity?
Yes
Retrieve Oldest Active Server Information
Mark Server as Pending Shutdown
No
Is the Current Server Count Greater than Minimum Server Count ?
Yes

FIG. 11C

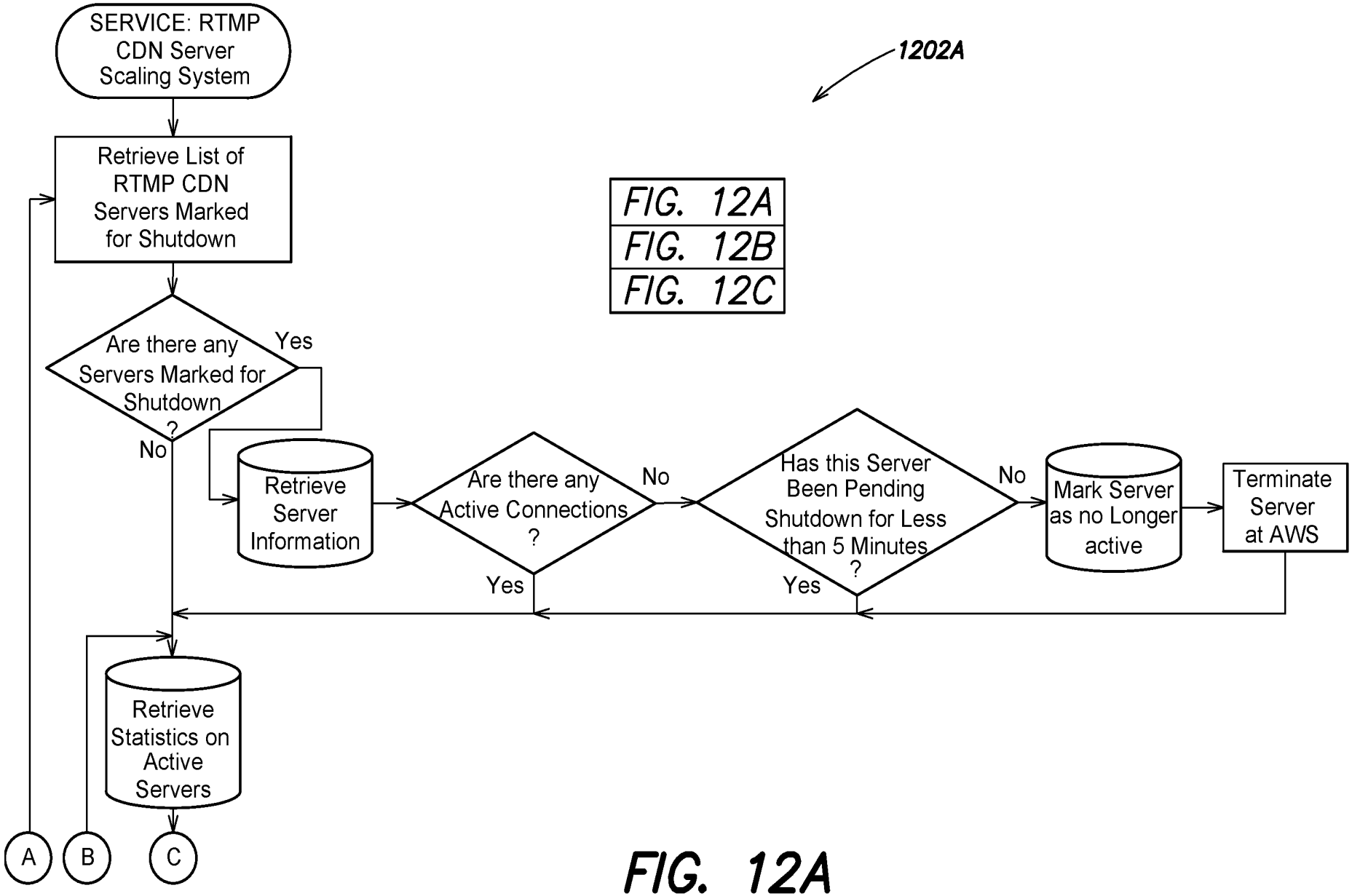


FIG. 12A
FIG. 12B
FIG. 12C

FIG. 12A

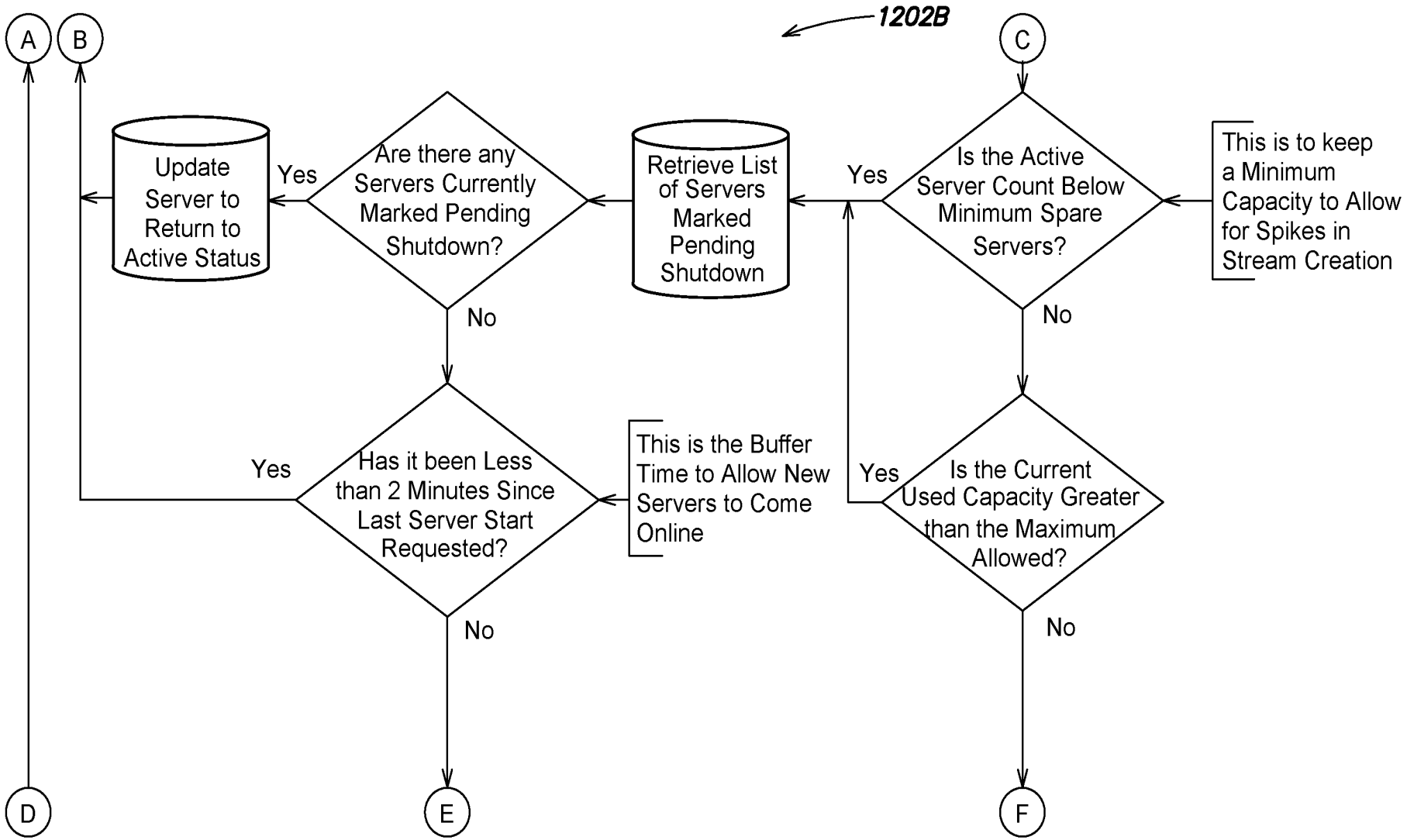

1202B
A
B
C
D
E
F
Update Server to Return to Active Status
Yes
Are there any Servers Currently Marked Pending Shutdown?
No
Retrieve List of Servers Marked Pending Shutdown
Yes
Is the Active Server Count Below Minimum Spare Servers?
No
This is to keep a Minimum Capacity to Allow for Spikes in Stream Creation
Yes
Has it been Less than 2 Minutes Since Last Server Start Requested?
No
This is the Buffer Time to Allow New Servers to Come Online
Yes
Is the Current Used Capacity Greater than the Maximum Allowed?
No

FIG. 12B

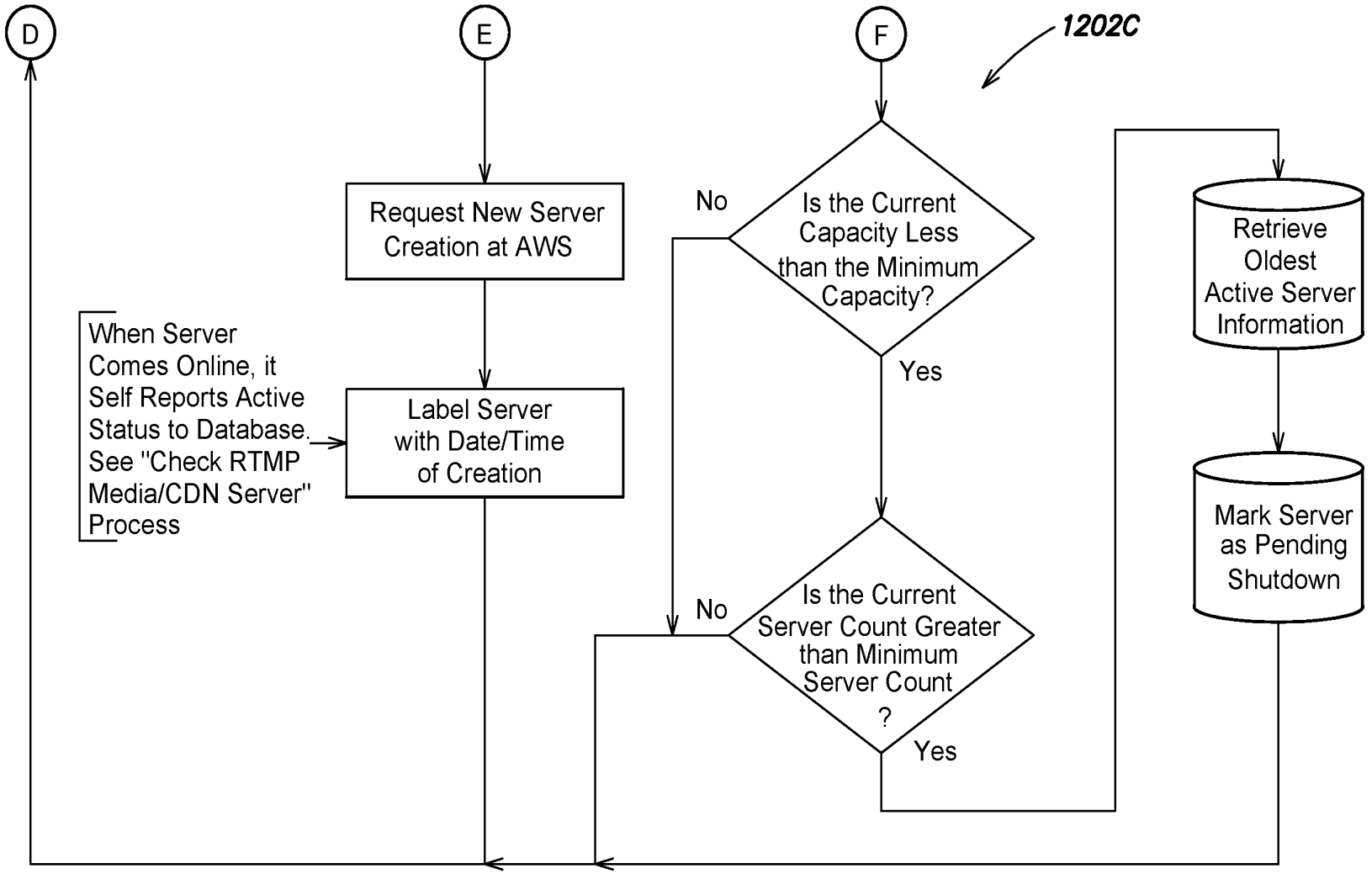

D
E
F
1202C
Request New Server Creation at AWS
When Server Comes Online, it Self Reports Active Status to Database. See "Check RTMP Media/CDN Server" Process
Label Server with Date/Time of Creation
No
Is the Current Capacity Less than the Minimum Capacity?
Yes
Retrieve Oldest Active Server Information
Mark Server as Pending Shutdown
No
Is the Current Server Count Greater than Minimum Server Count ?
Yes

FIG. 12C

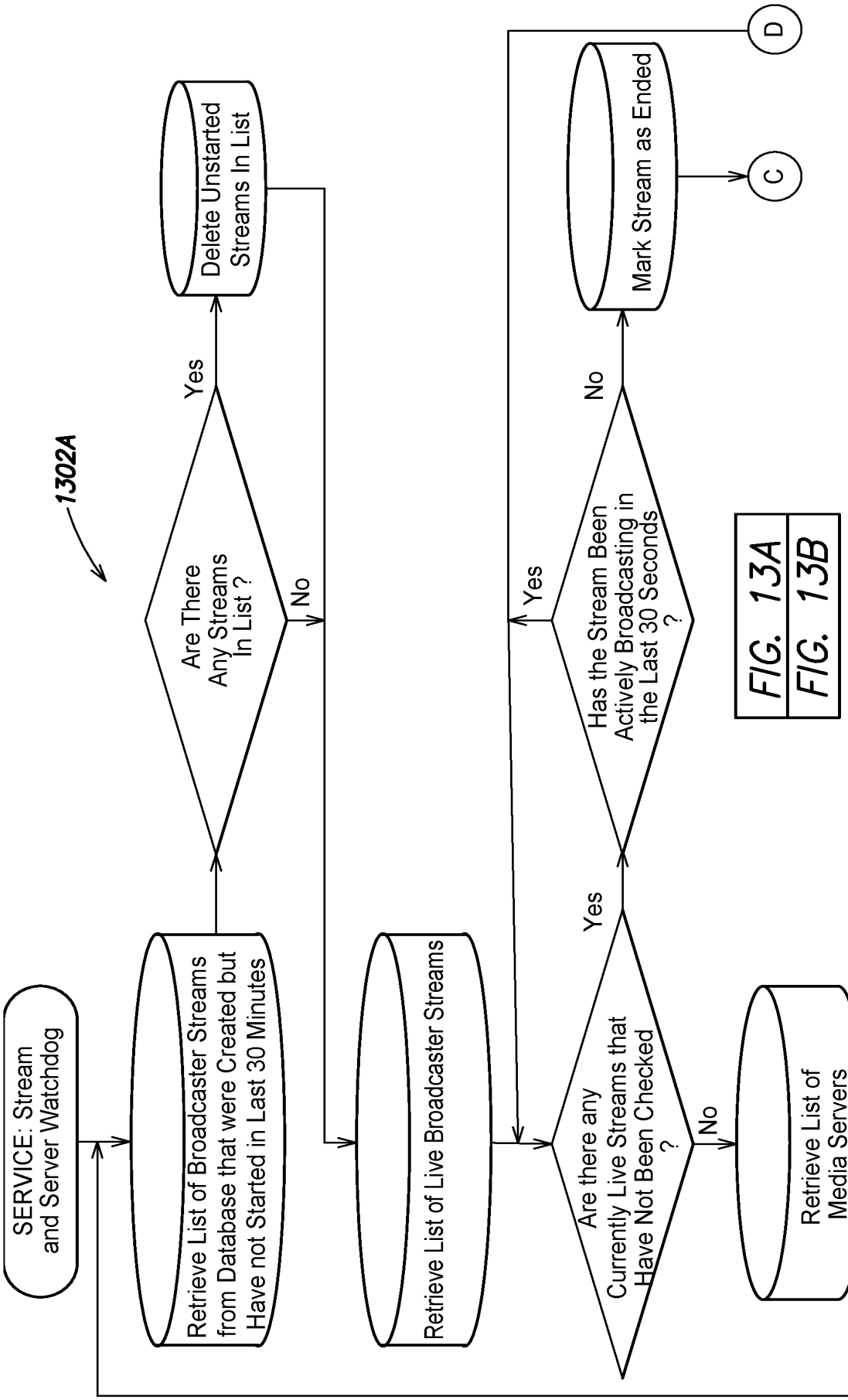


FIG. 13A

FIG. 13A
FIG. 13B

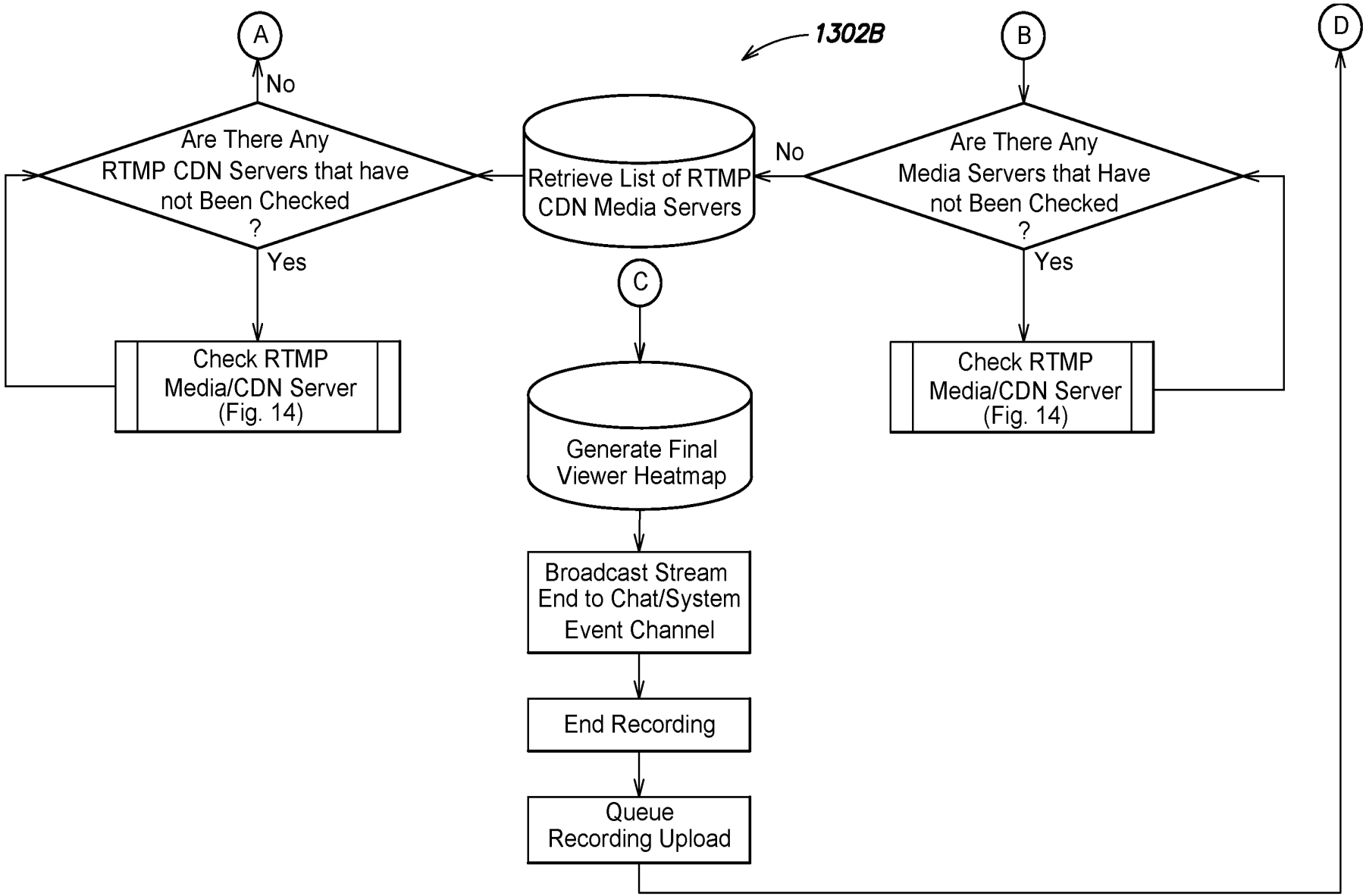

1302B
A
No
Are There Any RTMP CDN Servers that have not Been Checked ?
Yes
Check RTMP Media/CDN Server (Fig. 14)
Retrieve List of RTMP CDN Media Servers
No
B
Are There Any Media Servers that Have not Been Checked ?
Yes
Check RTMP Media/CDN Server (Fig. 14)
D
C
Generate Final Viewer Heatmap
Broadcast Stream End to Chat/System Event Channel
End Recording
Queue Recording Upload

FIG. 13B

FIG. 14A
FIG. 14B

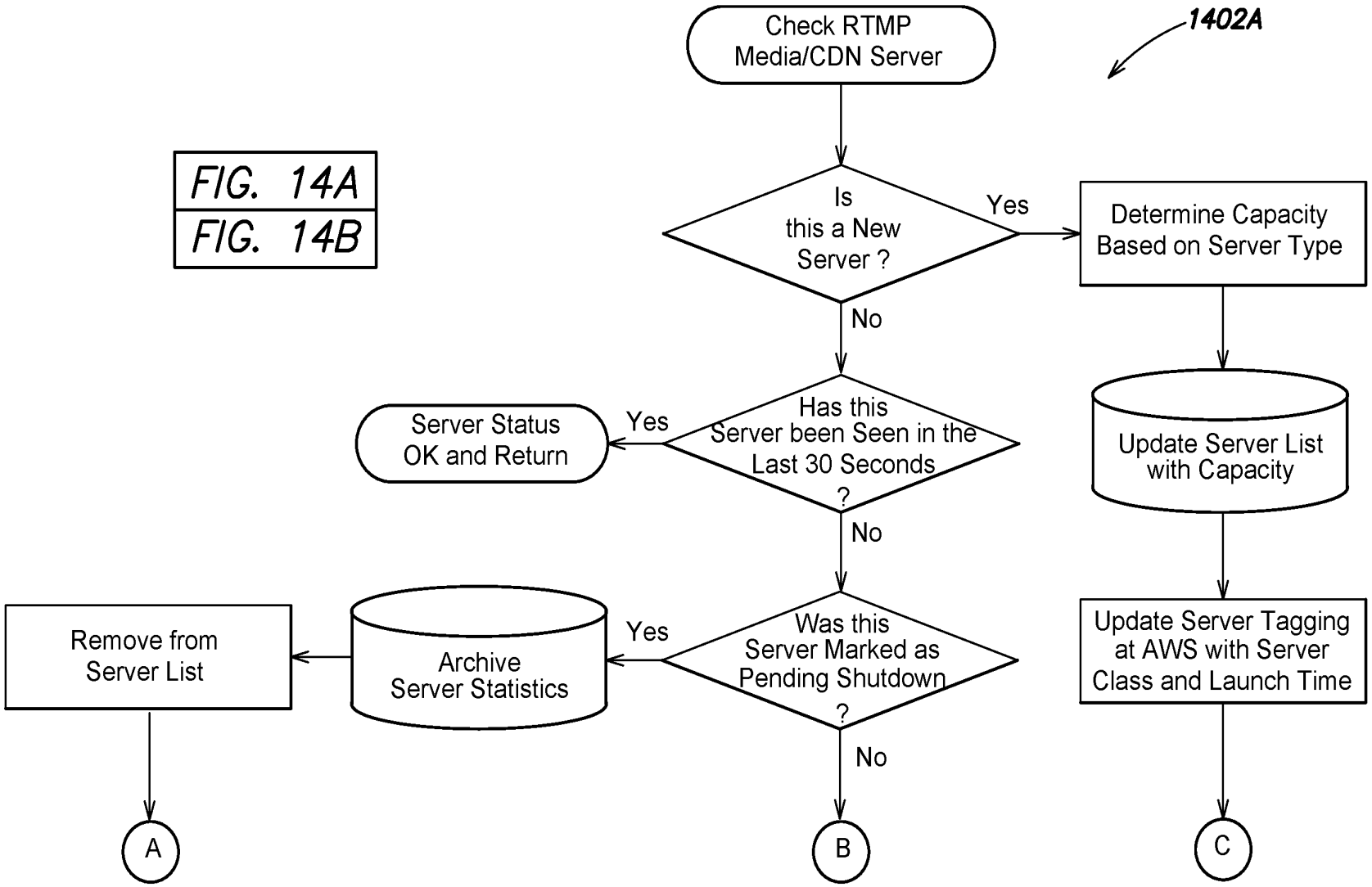


FIG. 14A

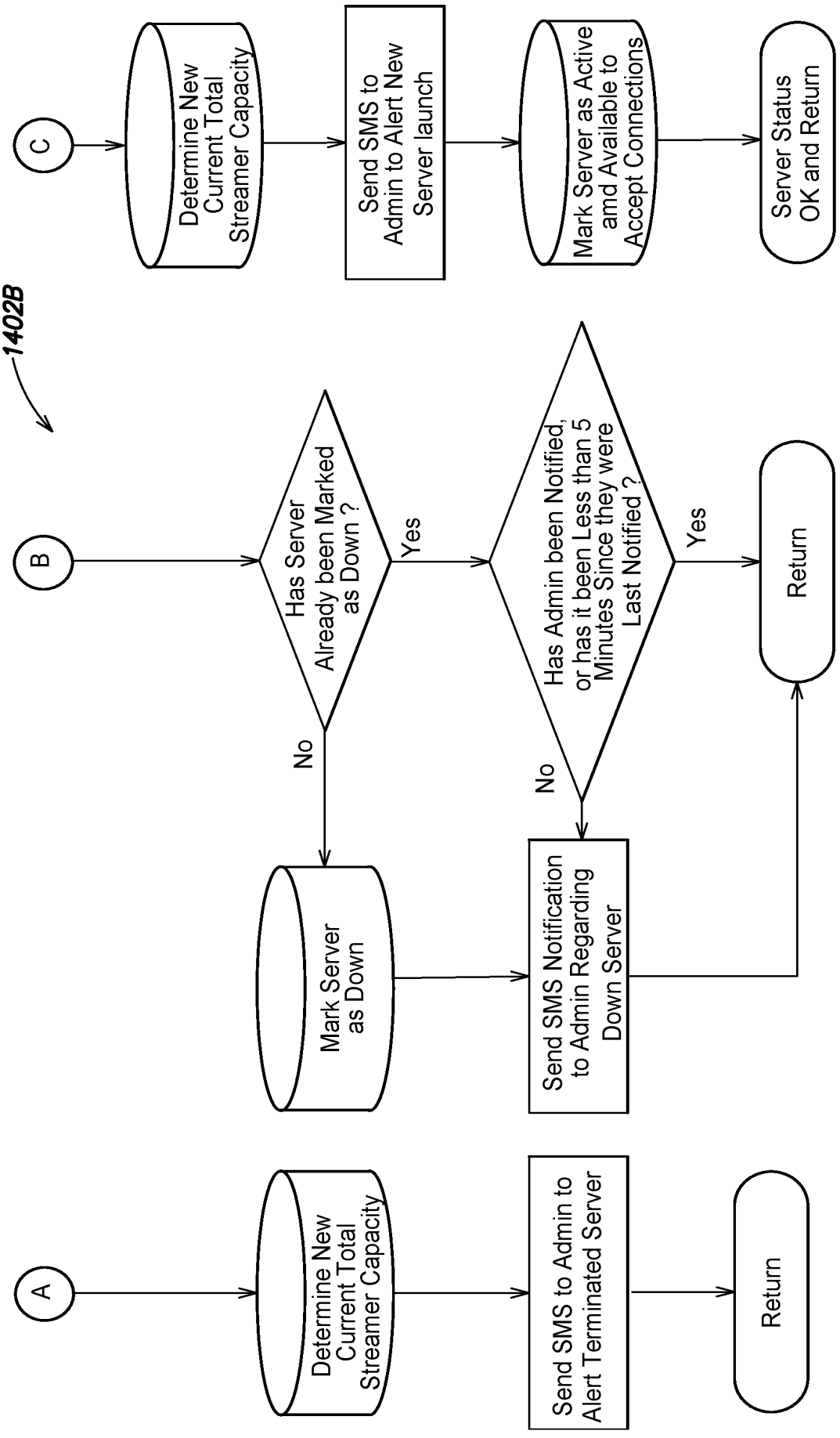

1402B
A
B
C
Determine New Current Total Streamer Capacity
Send SMS to Admin to Alert Terminated Server
Return
Has Server Already been Marked as Down ?
Yes
No
Mark Server as Down
Has Admin been Notified, or has it been Less than 5 Minutes Since they were Last Notified ?
Yes
No
Send SMS Notification to Admin Regarding Down Server
Return
Determine New Current Total Streamer Capacity
Send SMS to Admin to Alert New Server launch
Mark Server as Active amd Available to Accept Connections
Server Status OK and Return

FIG. 14B

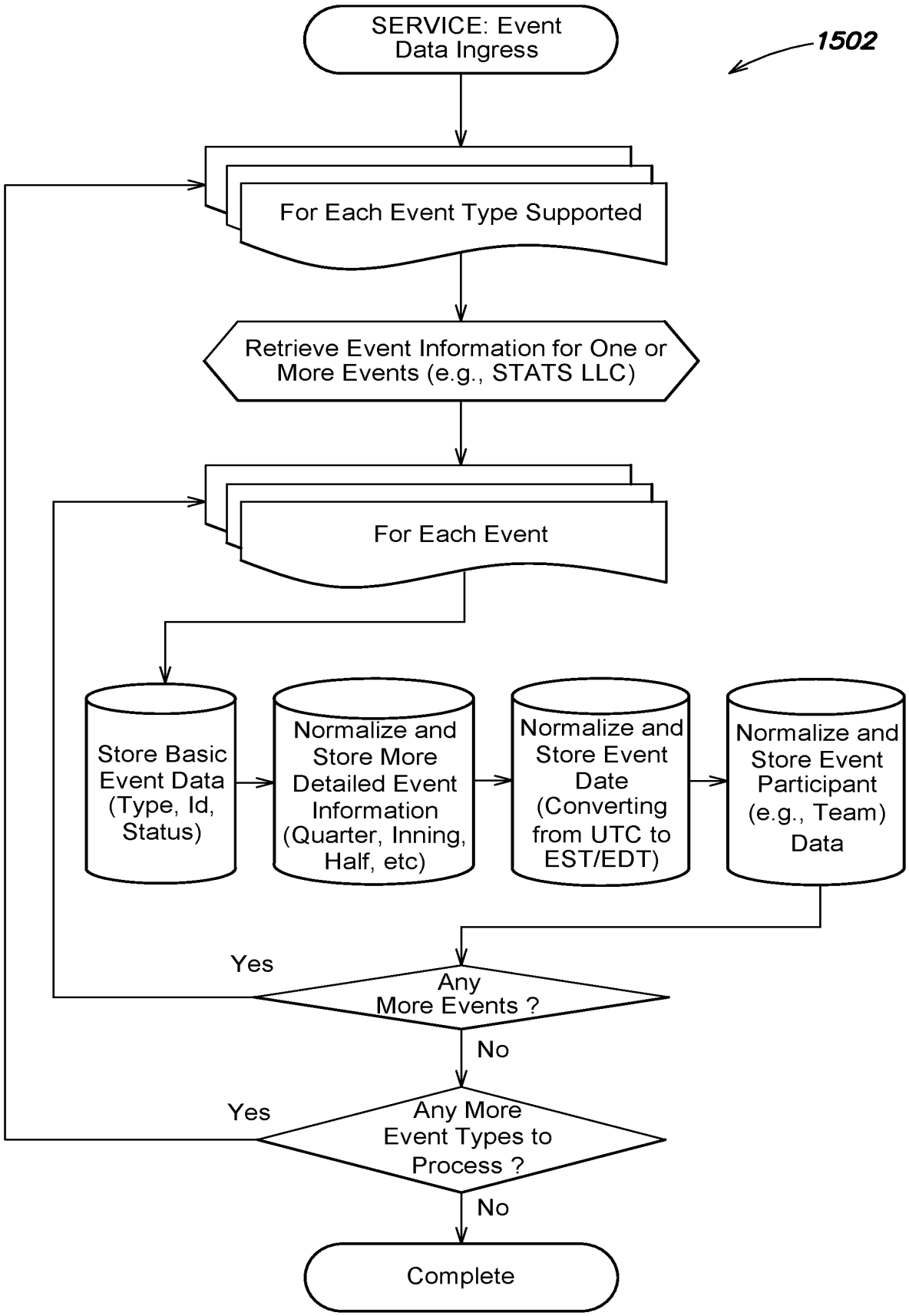

SERVICE: Event Data Ingress
1502
For Each Event Type Supported
Retrieve Event Information for One or More Events (e.g., STATS LLC)
For Each Event
Store Basic Event Data (Type, Id, Status)
Normalize and Store More Detailed Event Information (Quarter, Inning, Half, etc)
Normalize and Store Event Date (Converting from UTC to EST/EDT)
Normalize and Store Event Participant (e.g., Team) Data
Yes
Any More Events ?
No
Yes
Any More Event Types to Process ?
No
Complete

FIG. 15

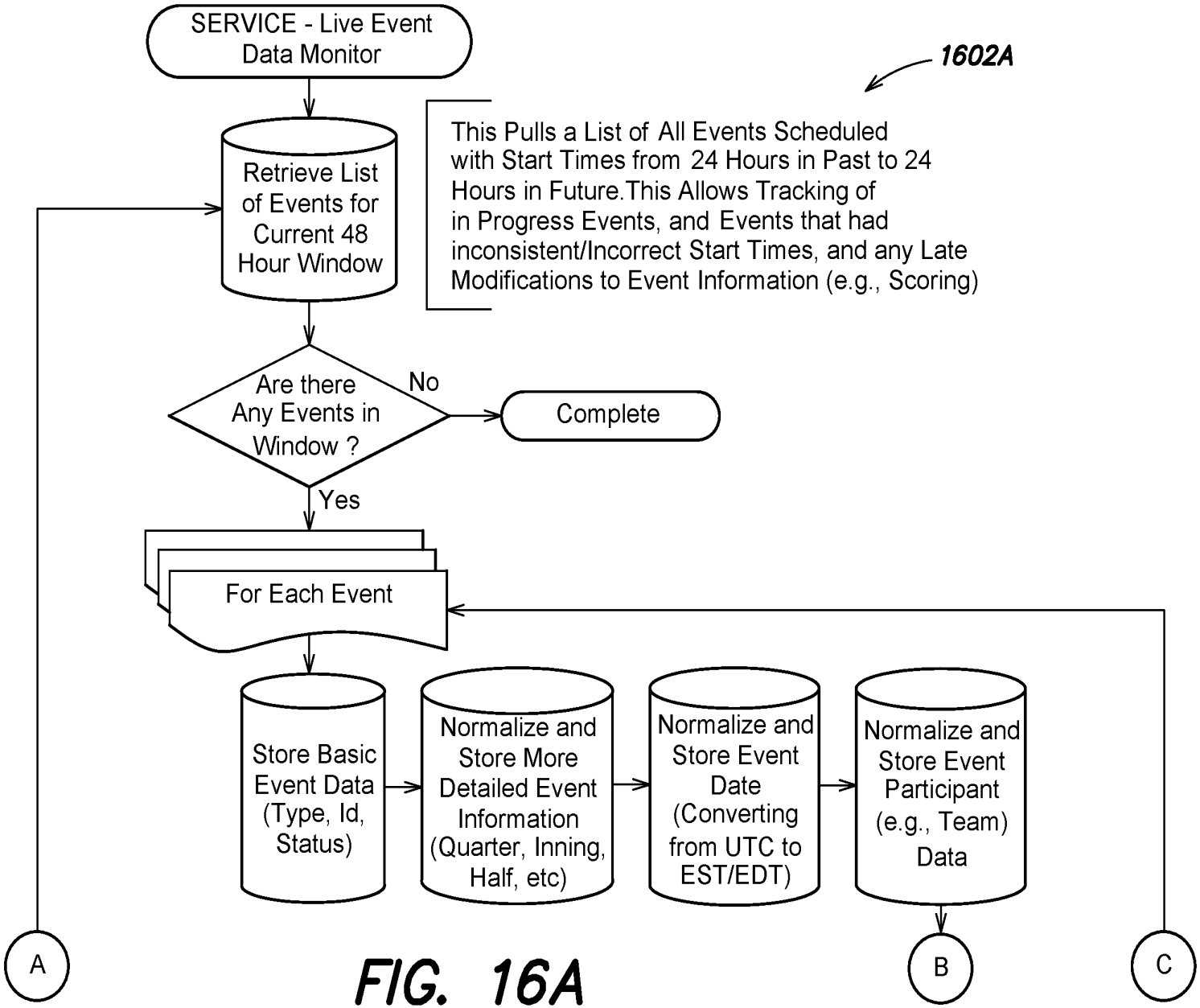


FIG. 16A

FIG. 16A
FIG. 16B

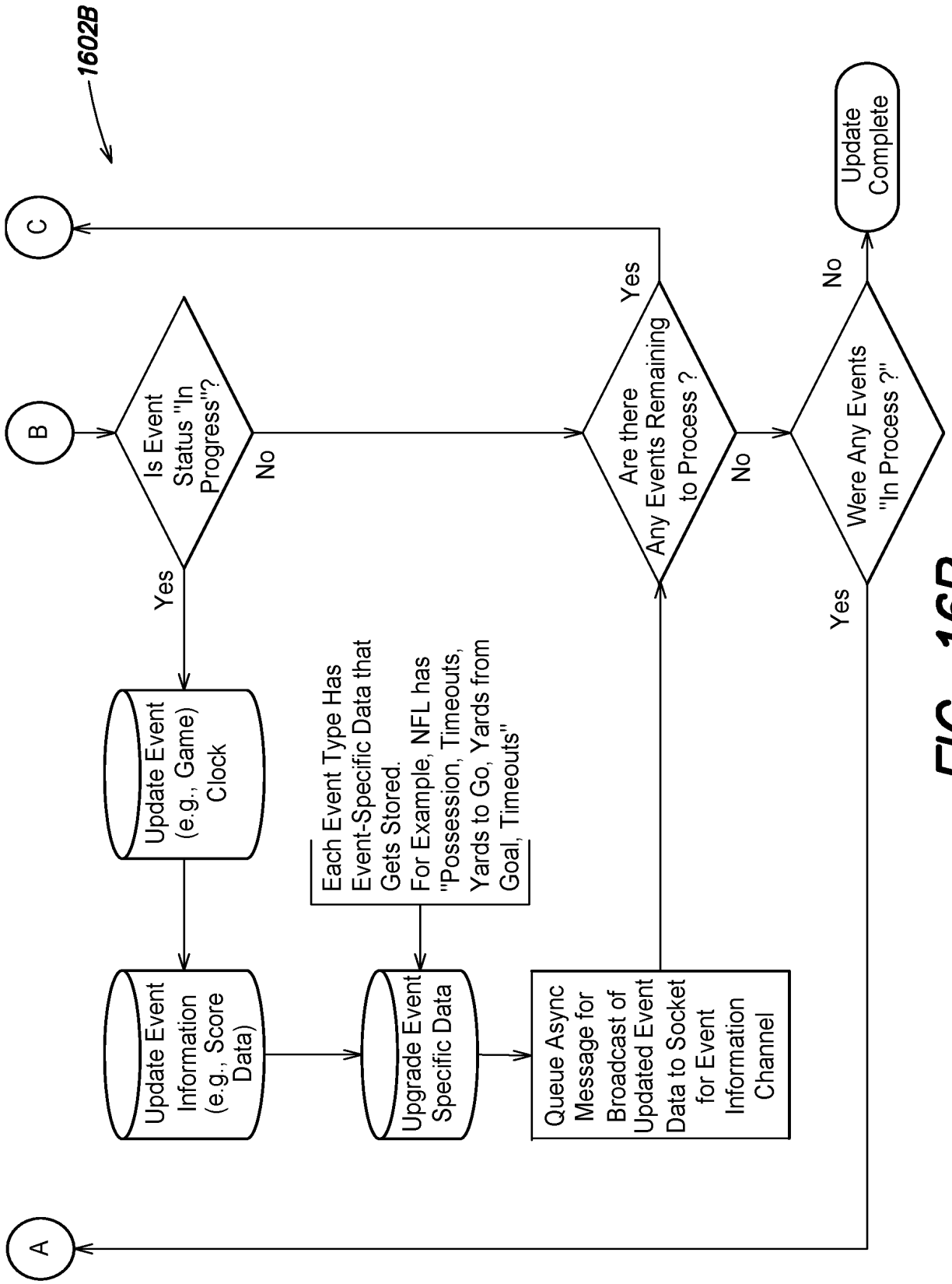

1602B
C
B
A
Is Event Status "In Progress"?
Yes
No
Are there Any Events Remaining to Process ?
Yes
No
Were Any Events "In Process ?"
Yes
No
Update Complete
Update Event (e.g., Game) Clock
Update Event Information (e.g., Score Data)
Each Event Type Has Event-Specific Data that Gets Stored.
For Example, NFL has "Possession, Timeouts, Yards to Go, Yards from Goal, Timeouts"
Upgrade Event Specific Data
Queue Async Message for Broadcast of Updated Event Data to Socket for Event Information Channel

FIG. 16B

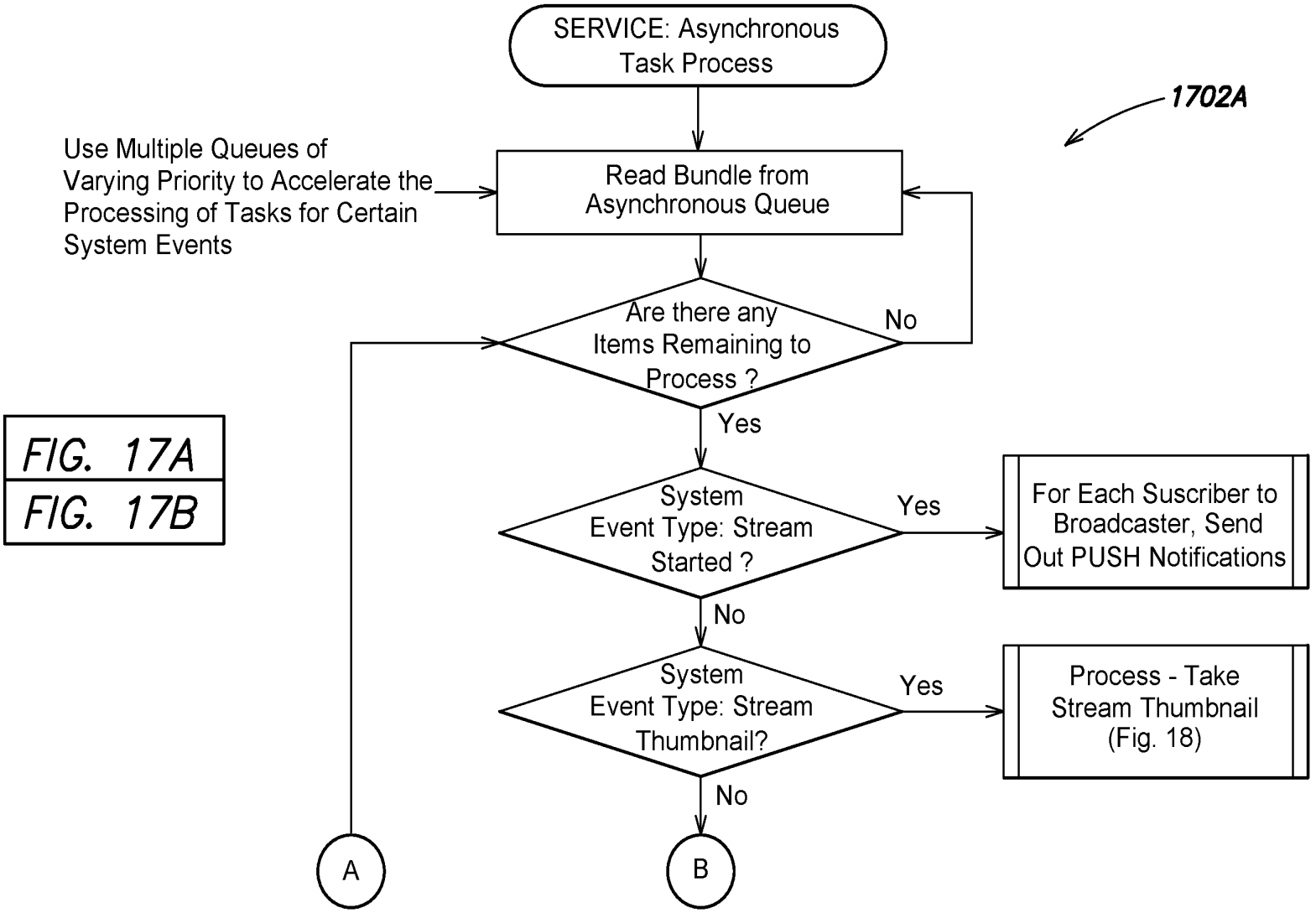


FIG. 17A
FIG. 17B

FIG. 17A

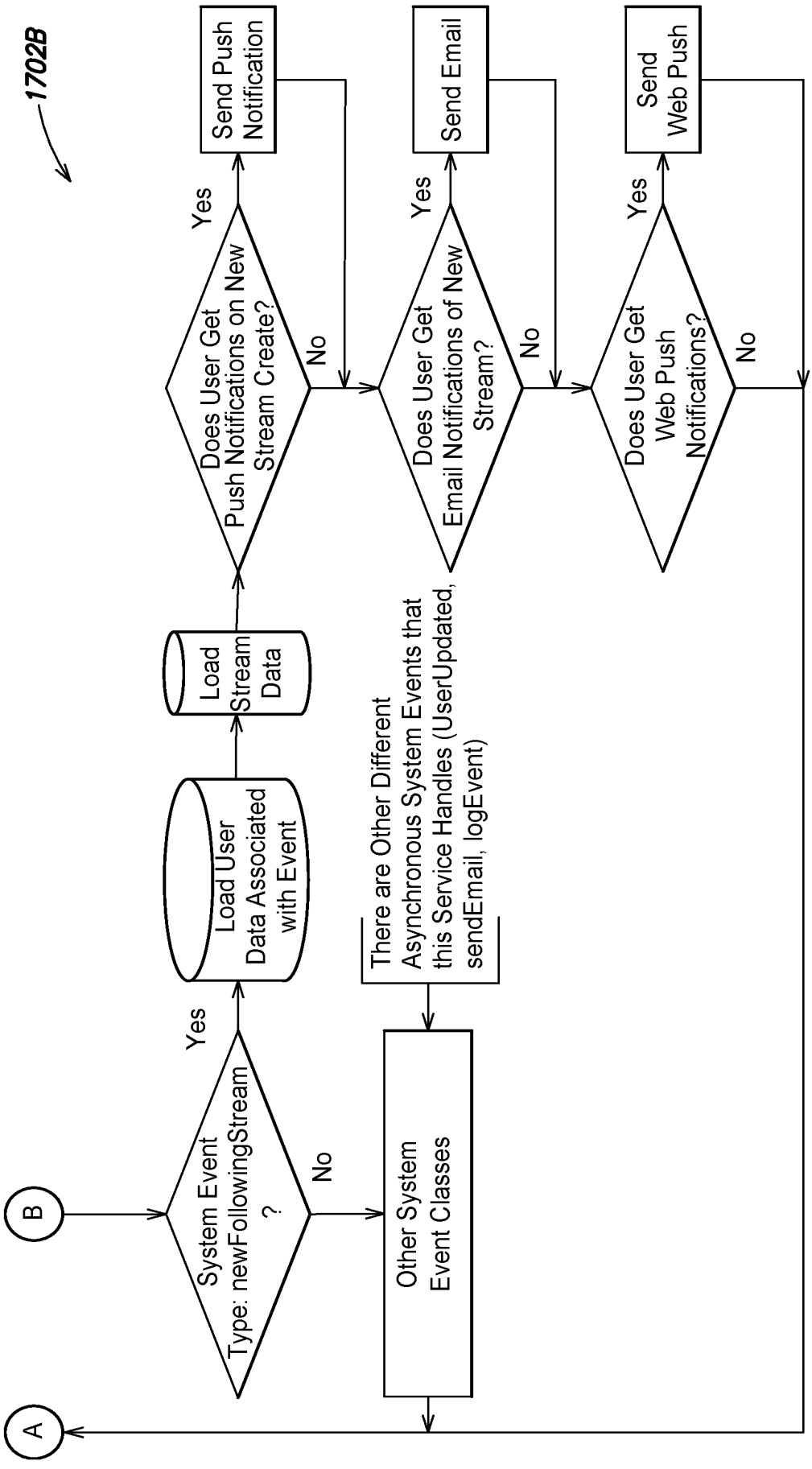

1702B
B
A
System Event Type: newFollowingStream ?
Yes
No
Load User Data Associated with Event
Load Stream Data
Other System Event Classes
There are Other Different Asynchronous System Events that this Service Handles (UserUpdated, sendEmail, logEvent)
Does User Get Push Notifications on New Stream Create?
Yes
No
Send Push Notification
Does User Get Email Notifications of New Stream?
Yes
No
Send Email
Does User Get Web Push Notifications?
Yes
No
Send Web Push

FIG. 17B

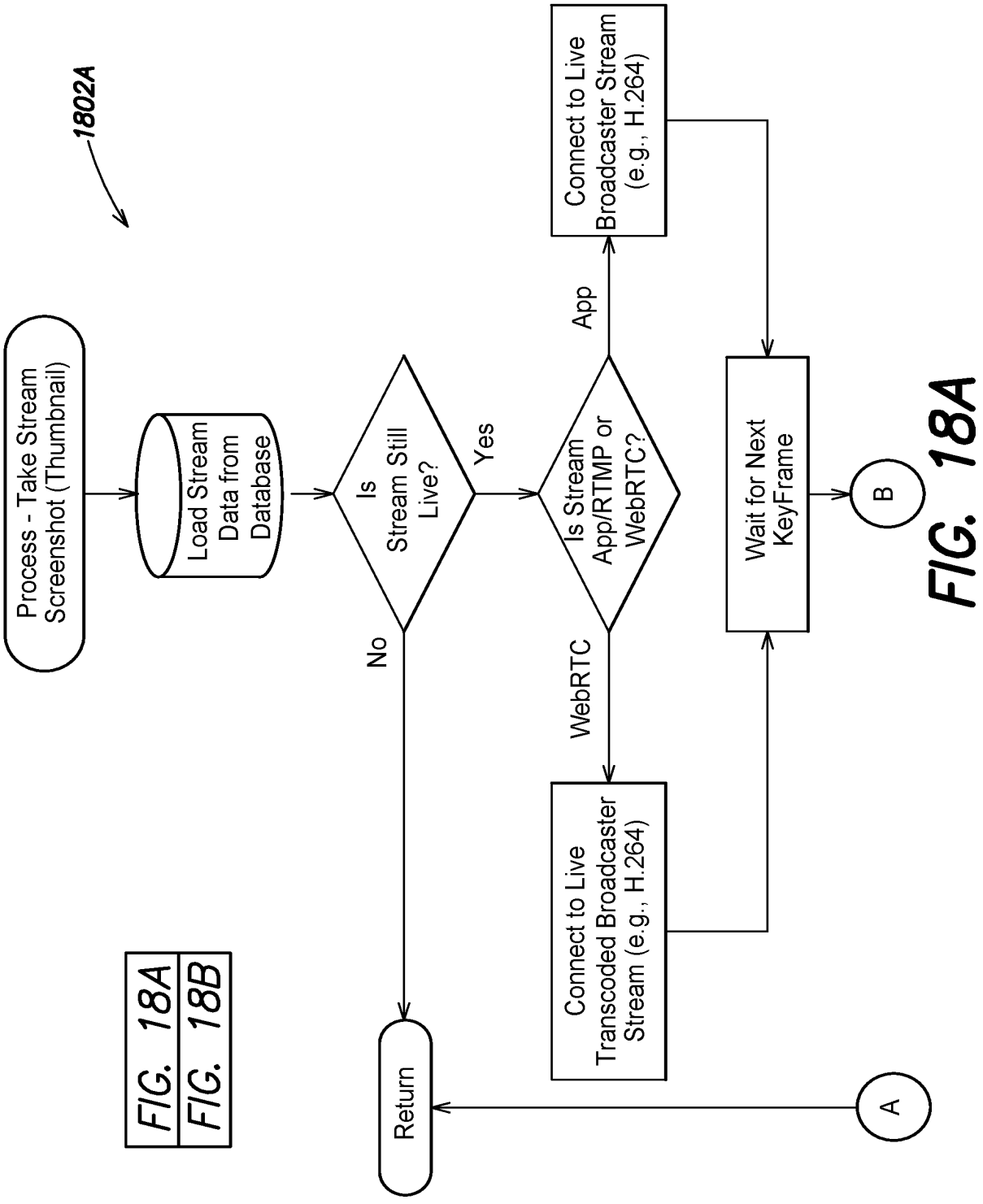


FIG. 18A

FIG. 18A
FIG. 18B

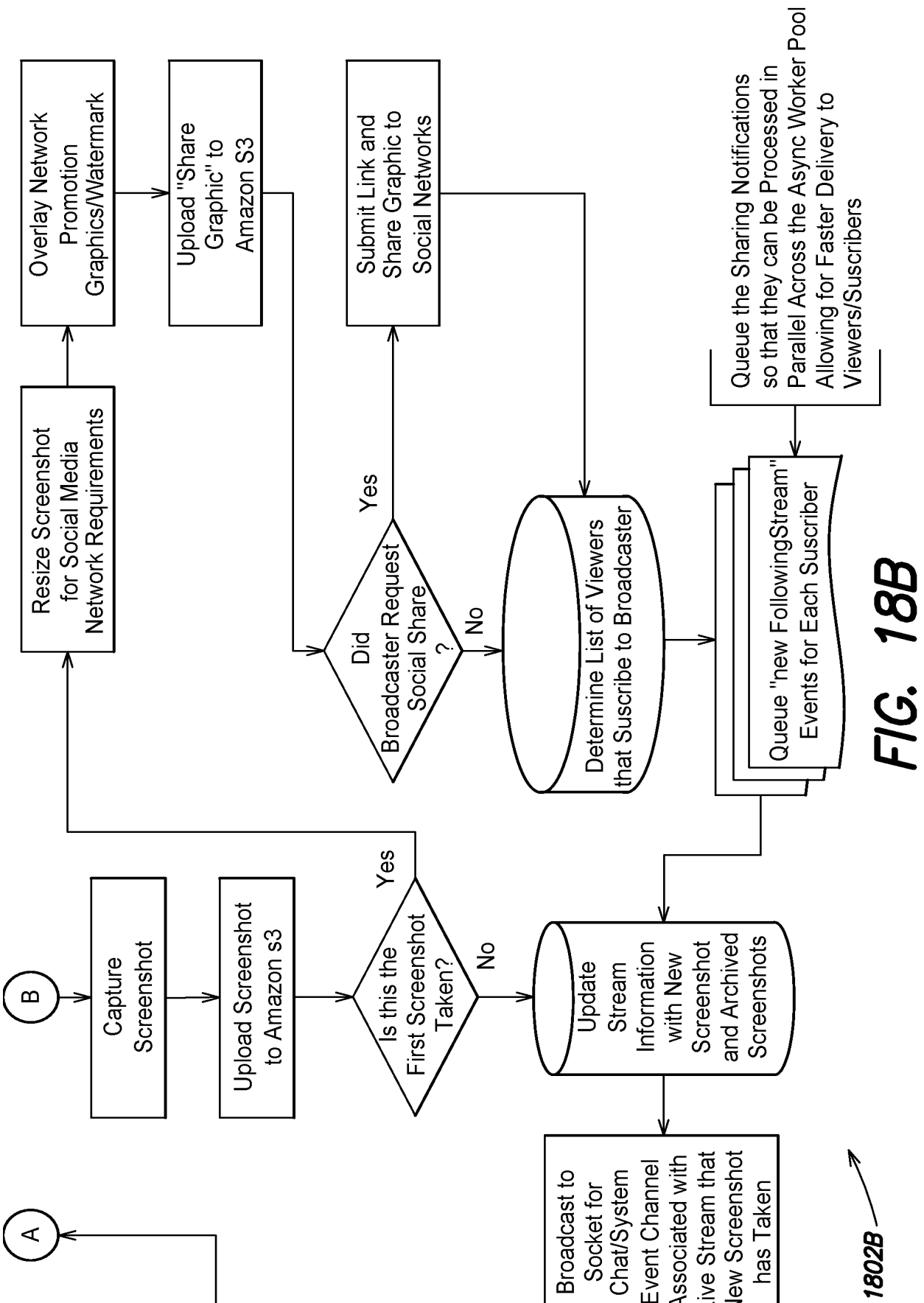

A
B
Capture Screenshot
Upload Screenshot to Amazon s3
Is this the First Screenshot Taken?
Yes
No
Resize Screenshot for Social Media Network Requirements
Overlay Network Promotion Graphics/Watermark
Upload "Share Graphic" to Amazon S3
Did Broadcaster Request Social Share ?
Yes
No
Submit Link and Share Graphic to Social Networks
Determine List of Viewers that Suscribe to Broadcaster
Queue "new FollowingStream" Events for Each Suscriber
Queue the Sharing Notifications so that they can be Processed in Parallel Across the Async Worker Pool Allowing for Faster Delivery to Viewers/Suscribers
Update Stream Information with New Screenshot and Archived Screenshots
Broadcast to Socket for Chat/System Event Channel Associated with Live Stream that New Screenshot has Taken
1802B

FIG. 18B

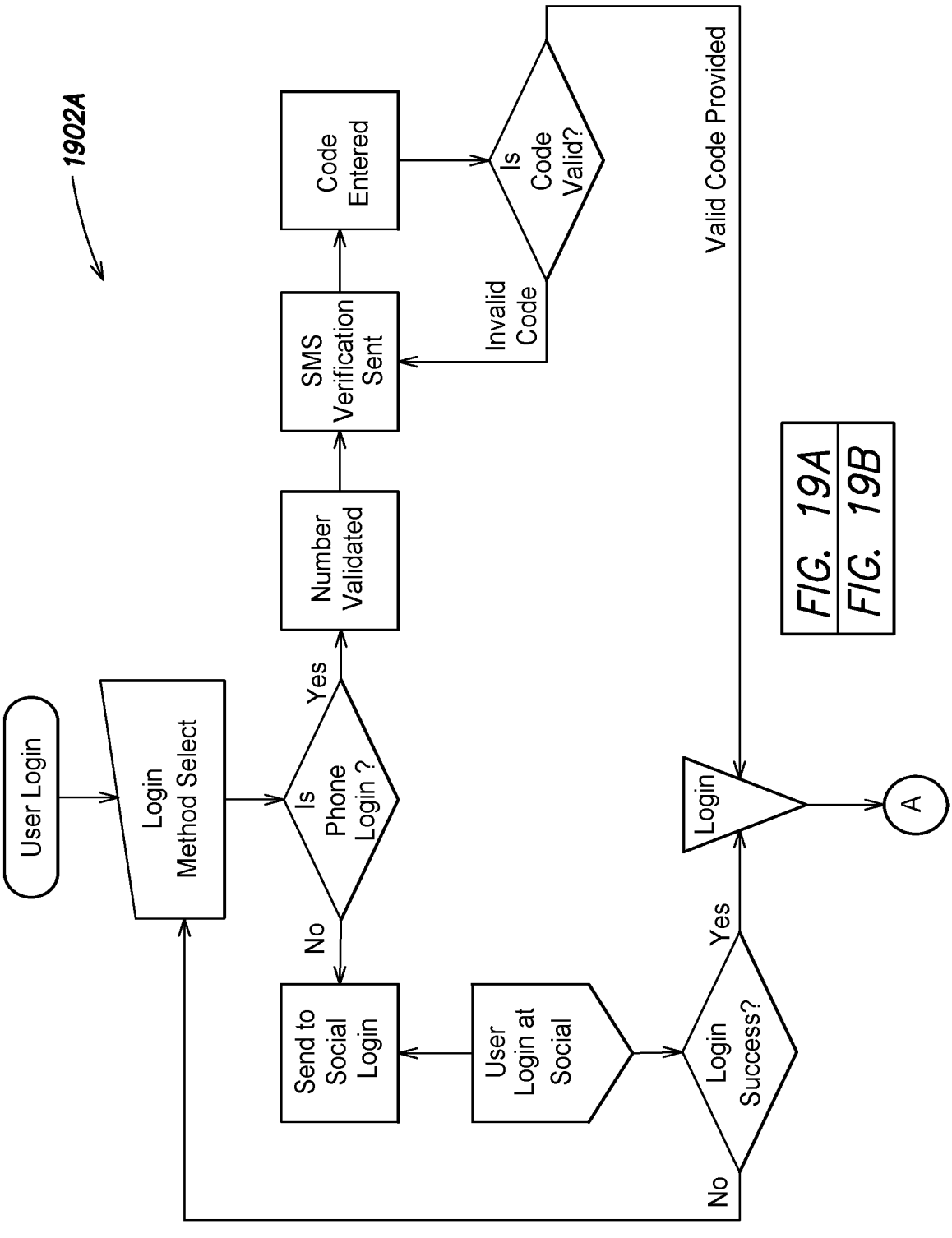


FIG. 19A

FIG. 19A
FIG. 19B

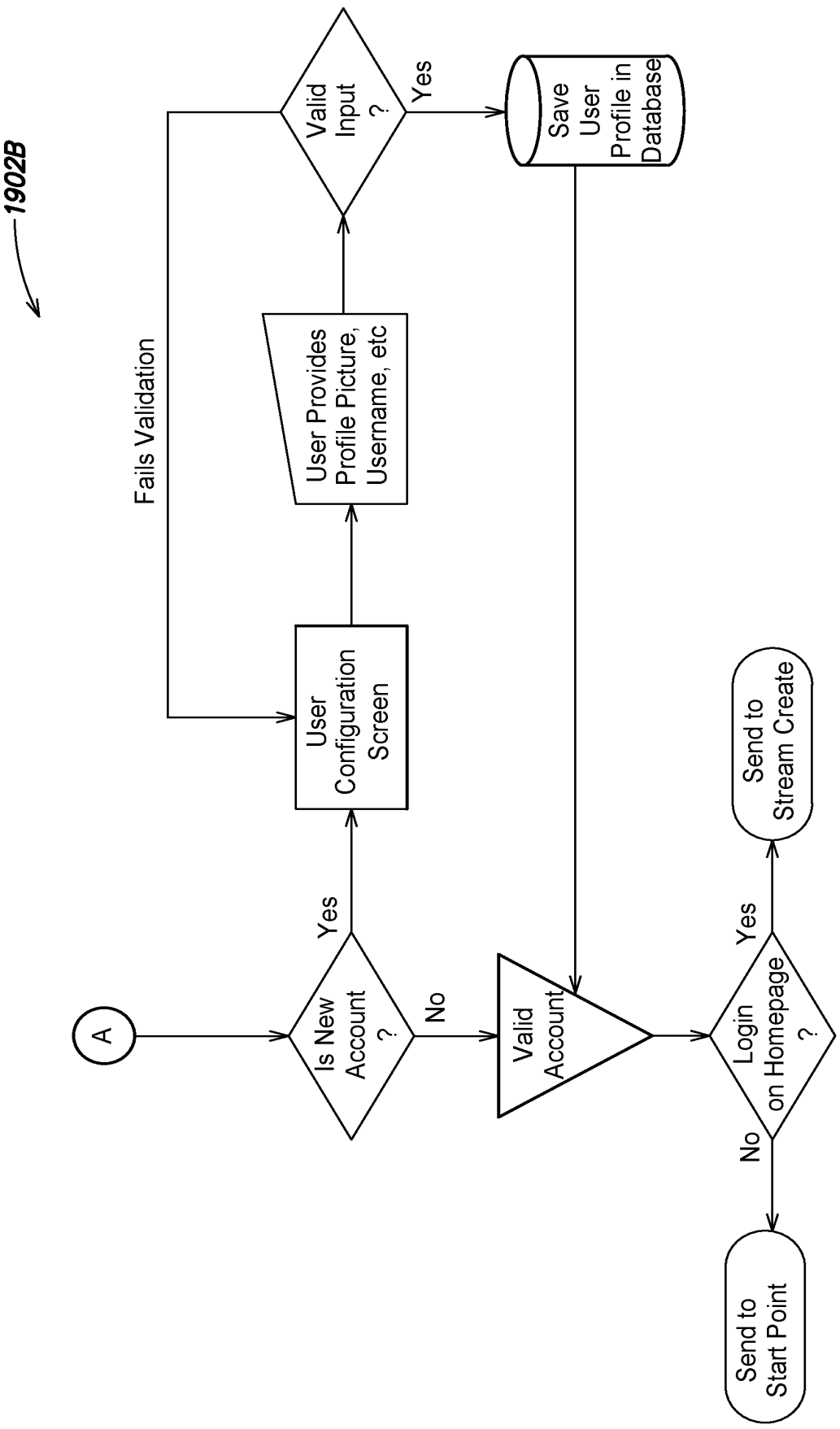

1902B
A
Is New Account ?
Yes
No
User Configuration Screen
User Provides Profile Picture, Username, etc
Valid Input ?
Yes
Fails Validation
Save User Profile in Database
Valid Account
Login on Homepage ?
Yes
No
Send to Stream Create
Send to Start Point

FIG. 19B

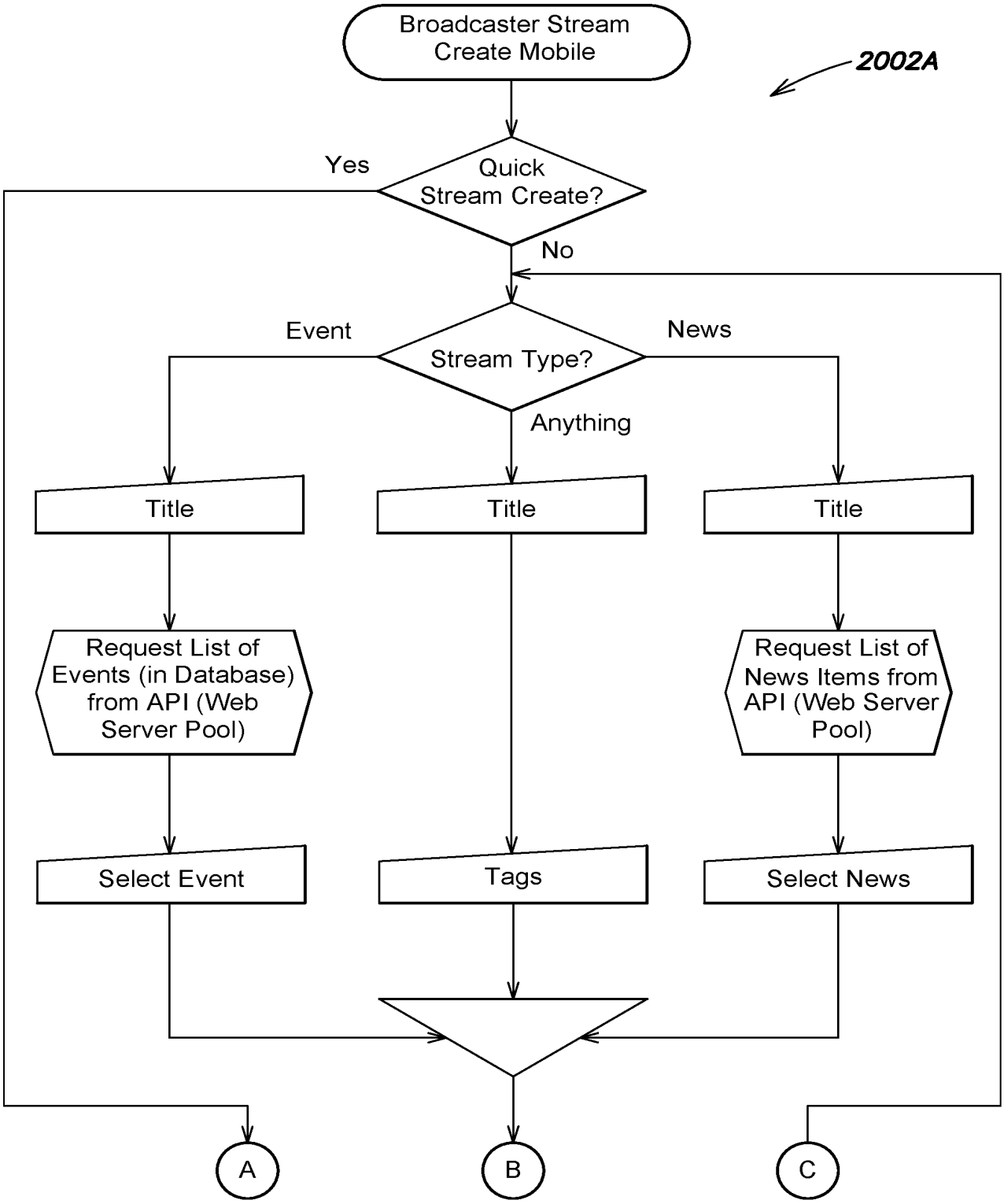


FIG. 20A
FIG. 20B

FIG. 20A

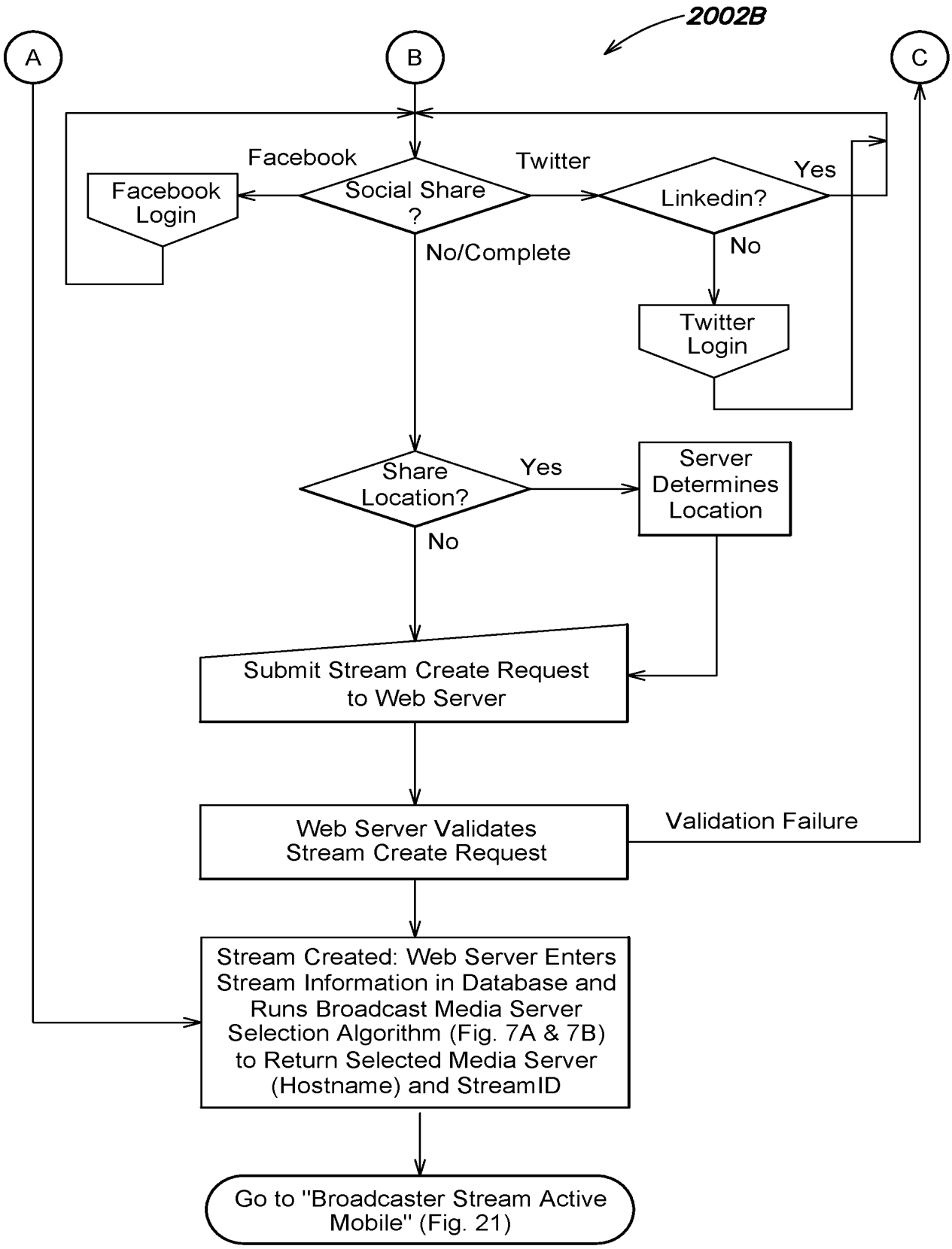

2002B
A
B
C
Facebook
Twitter
Yes
Facebook Login
Social Share ?
Linkedin?
No/Complete
No
Twitter Login
Share Location?
Yes
Server Determines Location
No
Submit Stream Create Request to Web Server
Web Server Validates Stream Create Request
Validation Failure
Stream Created: Web Server Enters Stream Information in Database and Runs Broadcast Media Server Selection Algorithm (Fig. 7A & 7B) to Return Selected Media Server (Hostname) and StreamID
Go to "Broadcaster Stream Active Mobile" (Fig. 21)

FIG. 20B

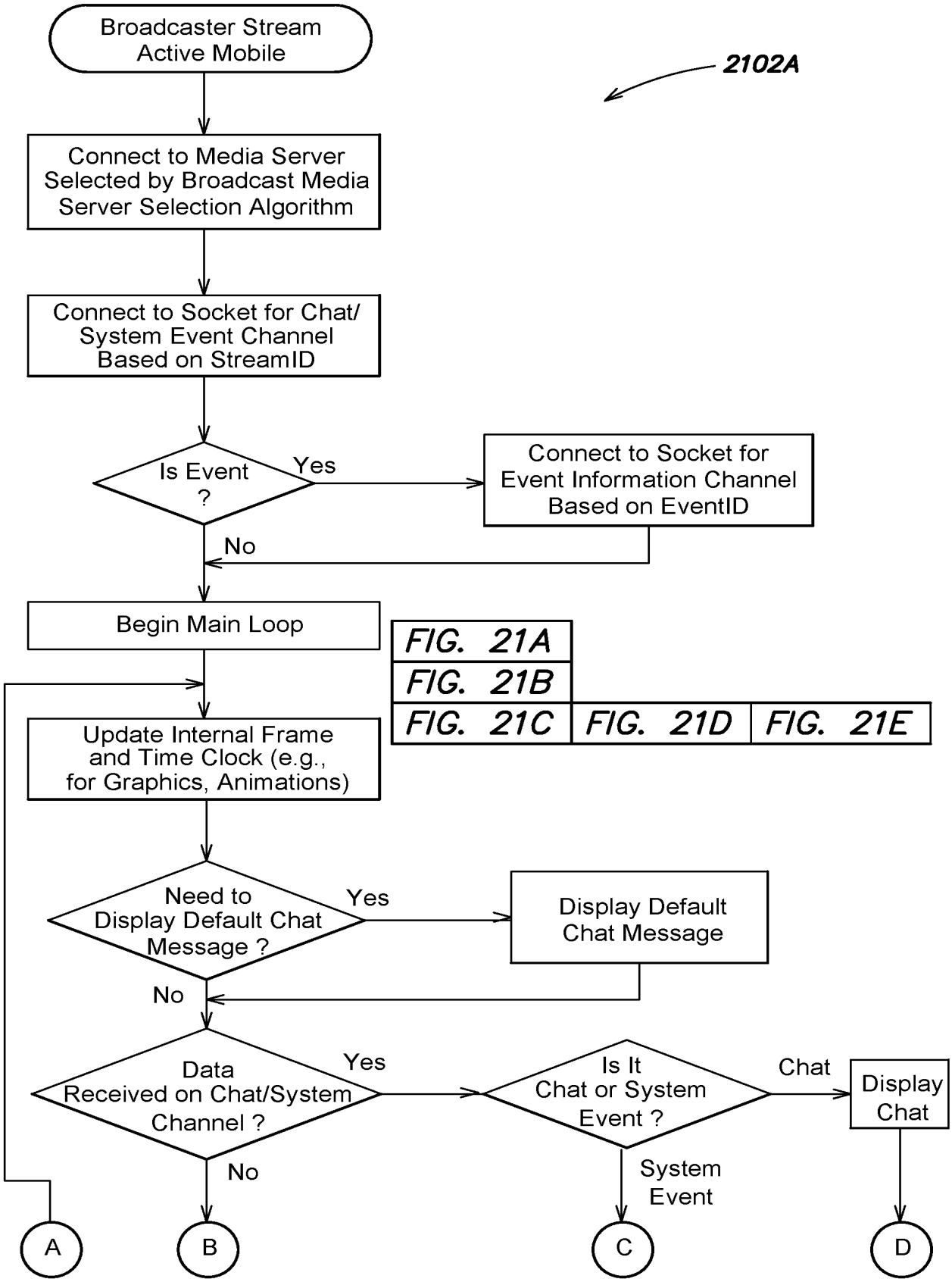


FIG. 21A
FIG. 21B
FIG. 21C | FIG. 21D | FIG. 21E

FIG. 21A

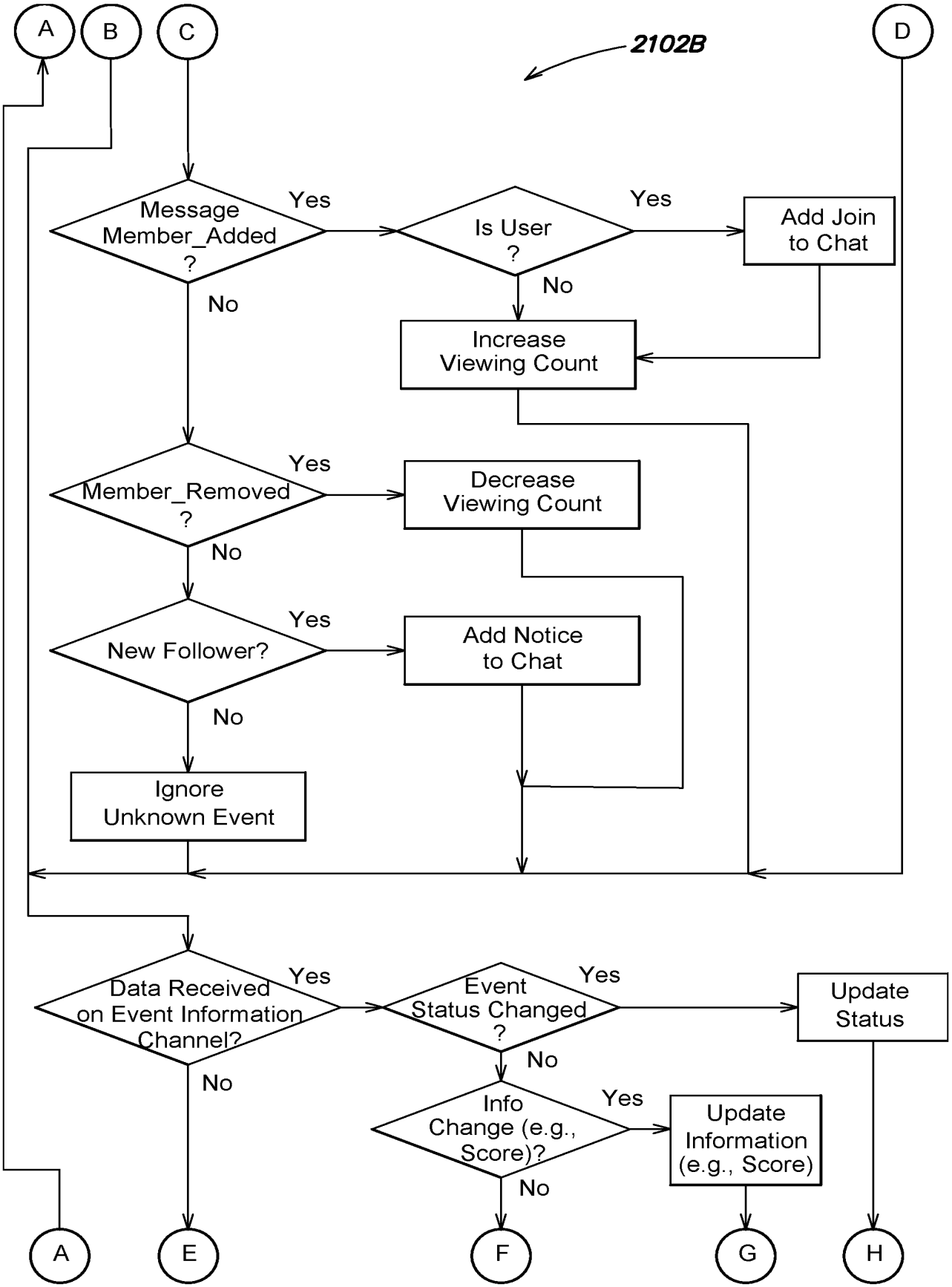

A
B
C
D
2102B
Message Member_Added ?
Yes
No
Is User ?
Yes
No
Add Join to Chat
Increase Viewing Count
Member_Removed ?
Yes
No
Decrease Viewing Count
New Follower?
Yes
No
Add Notice to Chat
Ignore Unknown Event
Data Received on Event Information Channel?
Yes
No
Event Status Changed ?
Yes
No
Update Status
Info Change (e.g., Score)?
Yes
No
Update Information (e.g., Score)
A
E
F
G
H

FIG. 21B

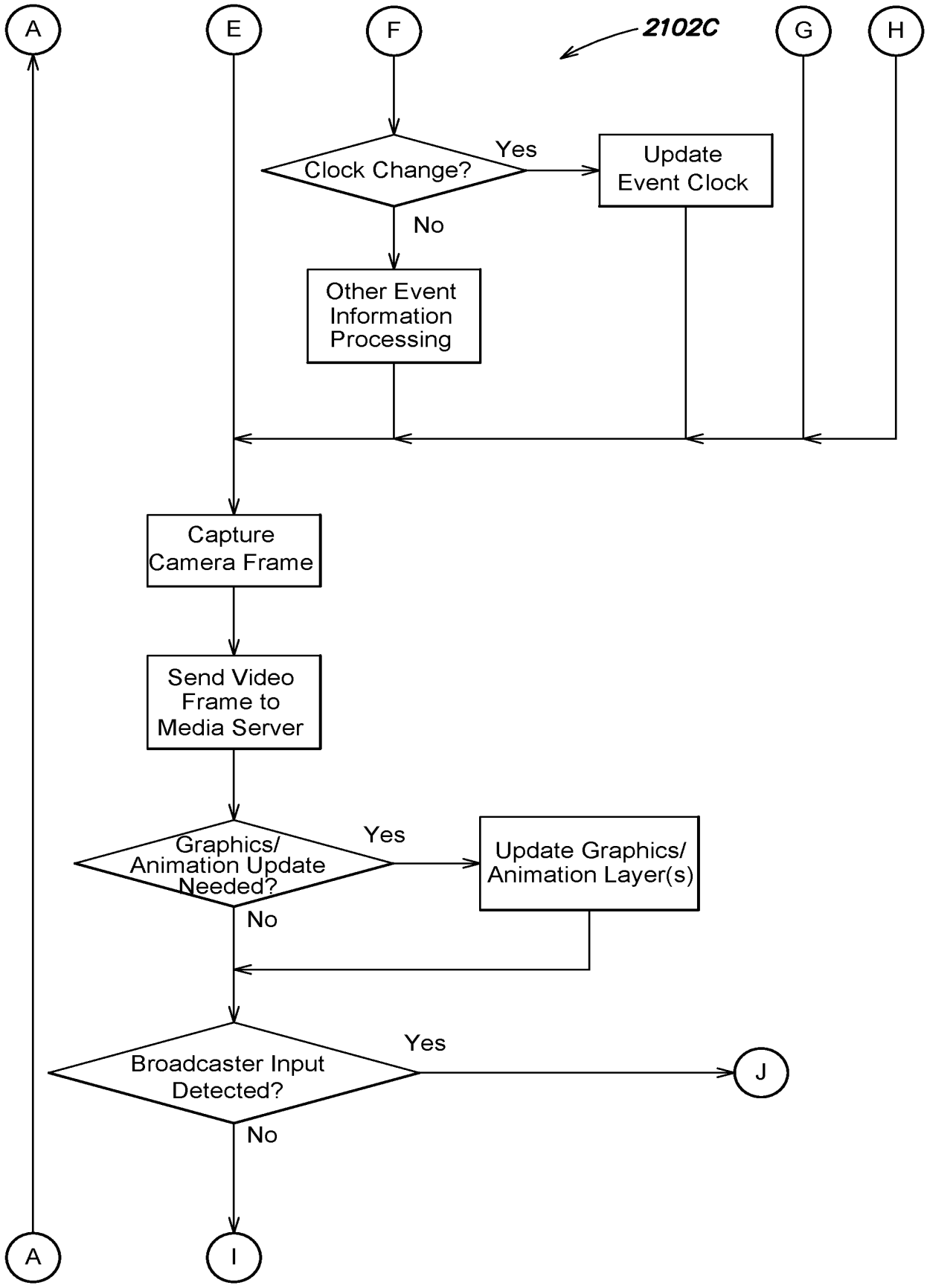

A
E
F
2102C
G
H
Clock Change?
Yes
Update Event Clock
No
Other Event Information Processing
Capture Camera Frame
Send Video Frame to Media Server
Graphics/ Animation Update Needed?
Yes
Update Graphics/ Animation Layer(s)
No
Broadcaster Input Detected?
Yes
J
No
A
I

FIG. 21C

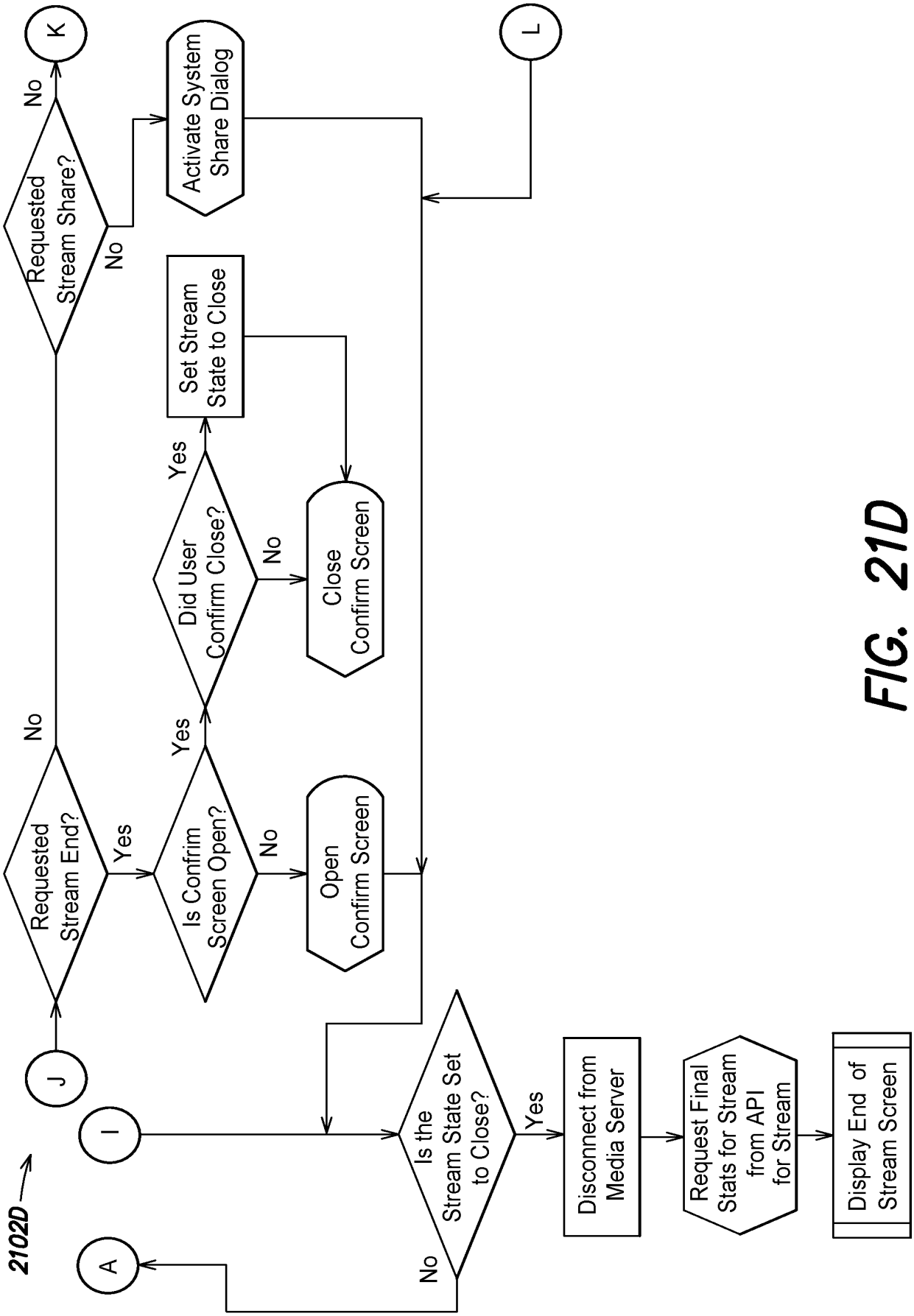

2102D
A
I
J
K
L
Is the Stream State Set to Close?
No
Yes
Disconnect from Media Server
Request Final Stats for Stream from API for Stream
Display End of Stream Screen
Requested Stream End?
No
Yes
Is Confrim Screen Open?
Yes
No
Open Confirm Screen
Did User Confirm Close?
Yes
No
Close Confirm Screen
Set Stream State to Close
Requested Stream Share?
No
Yes
Activate System Share Dialog

FIG. 21D

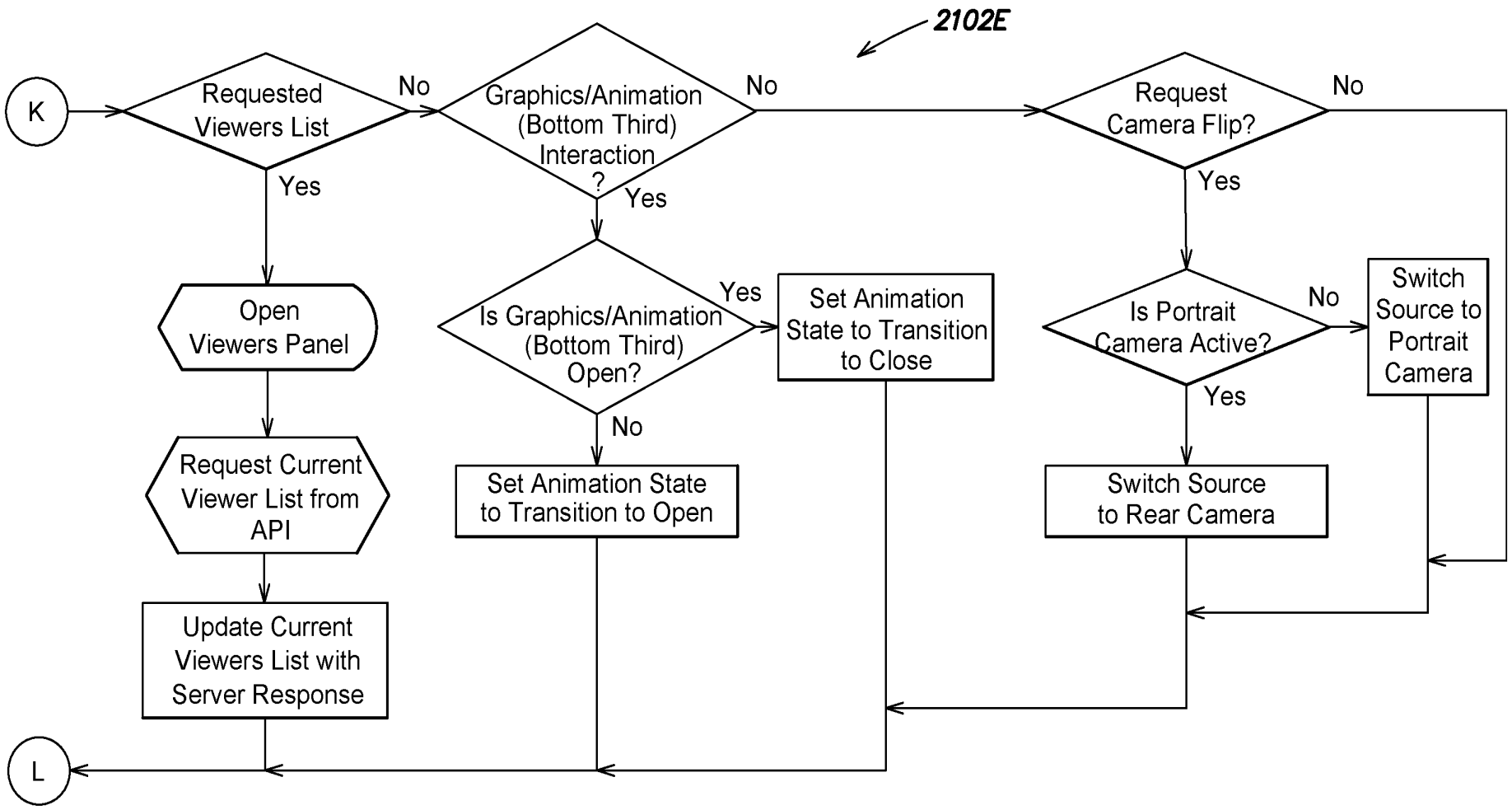

2102E
K
Requested Viewers List
No
Graphics/Animation (Bottom Third) Interaction ?
No
Request Camera Flip?
No
Yes
Yes
Yes
Open Viewers Panel
Is Graphics/Animation (Bottom Third) Open?
Yes
Set Animation State to Transition to Close
Is Portrait Camera Active?
No
Switch Source to Portrait Camera
Yes
No
Request Current Viewer List from API
Set Animation State to Transition to Open
Switch Source to Rear Camera
Update Current Viewers List with Server Response
L

FIG. 21E

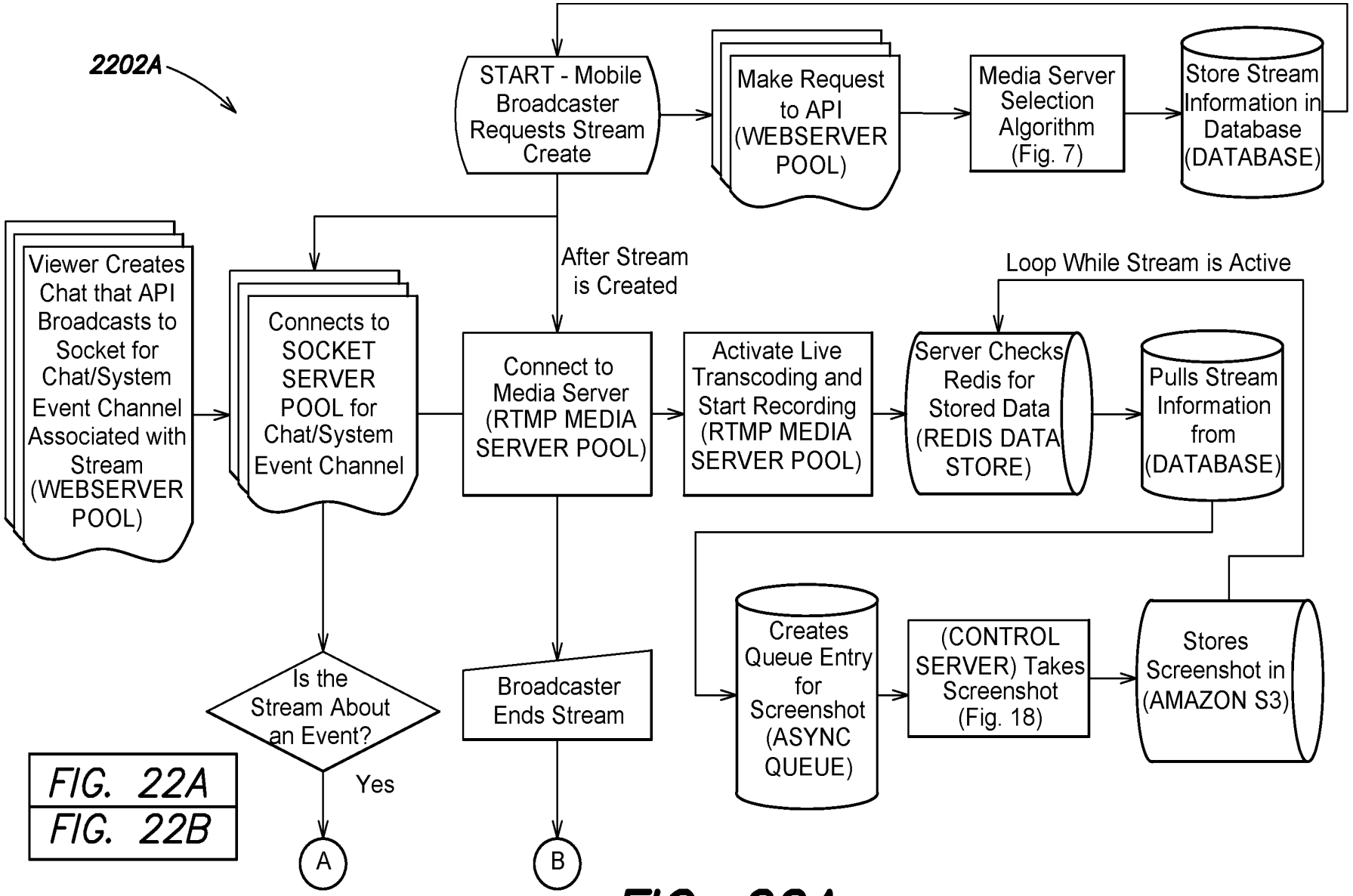


FIG. 22A
FIG. 22B

FIG. 22A

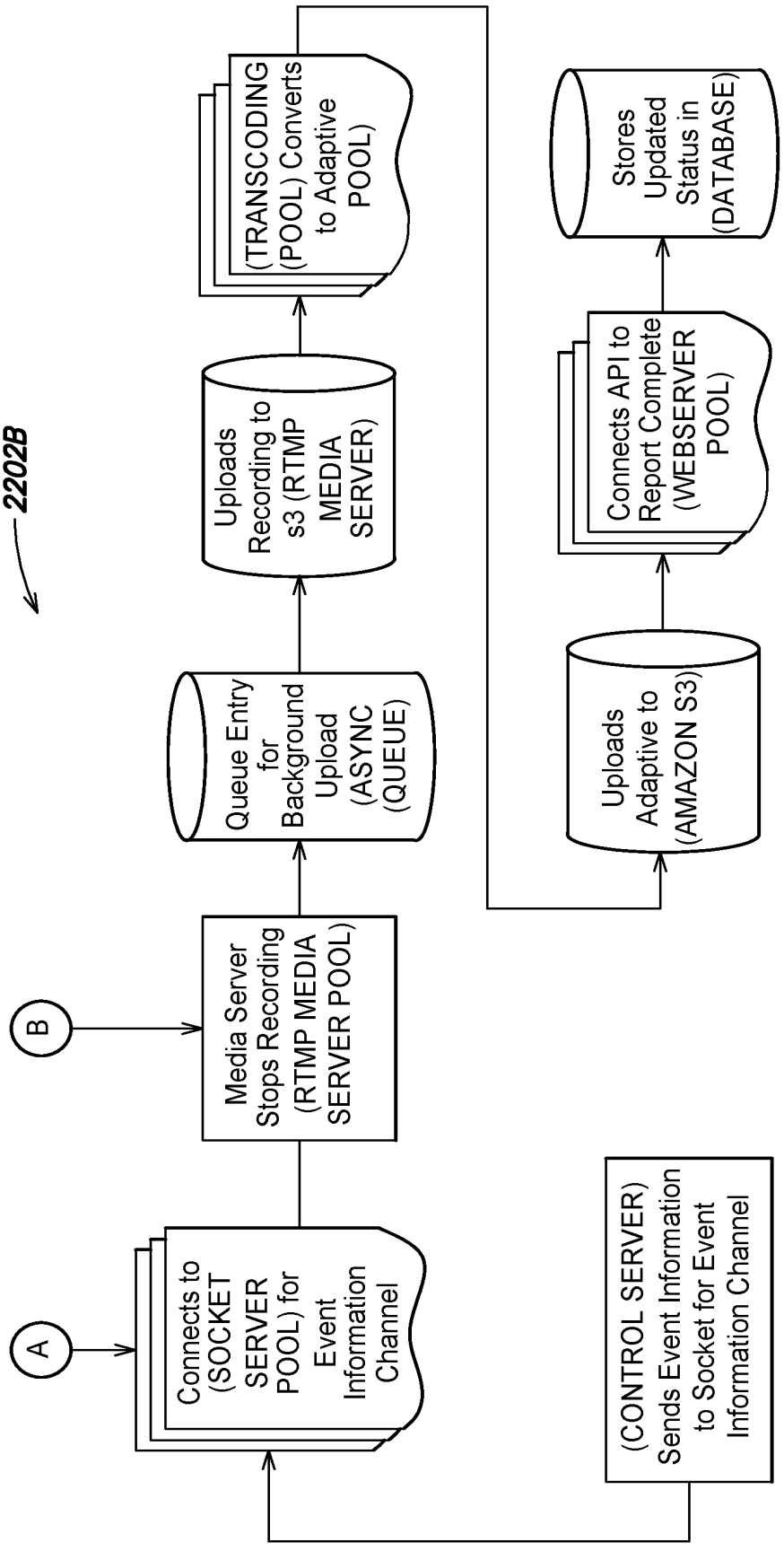

2202B
A
B
Connects to (SOCKET SERVER POOL) for Event Information Channel
Media Server Stops Recording (RTMP MEDIA SERVER POOL)
Queue Entry for Background Upload (ASYNC (QUEUE)
Uploads Recording to s3 (RTMP MEDIA SERVER)
(TRANSCODING (POOL) Converts to Adaptive POOL)
(CONTROL SERVER) Sends Event Information to Socket for Event Information Channel
Uploads Adaptive to (AMAZON S3)
Connects API to Report Complete (WEBSERVER POOL)
Stores Updated Status in (DATABASE)

FIG. 22B

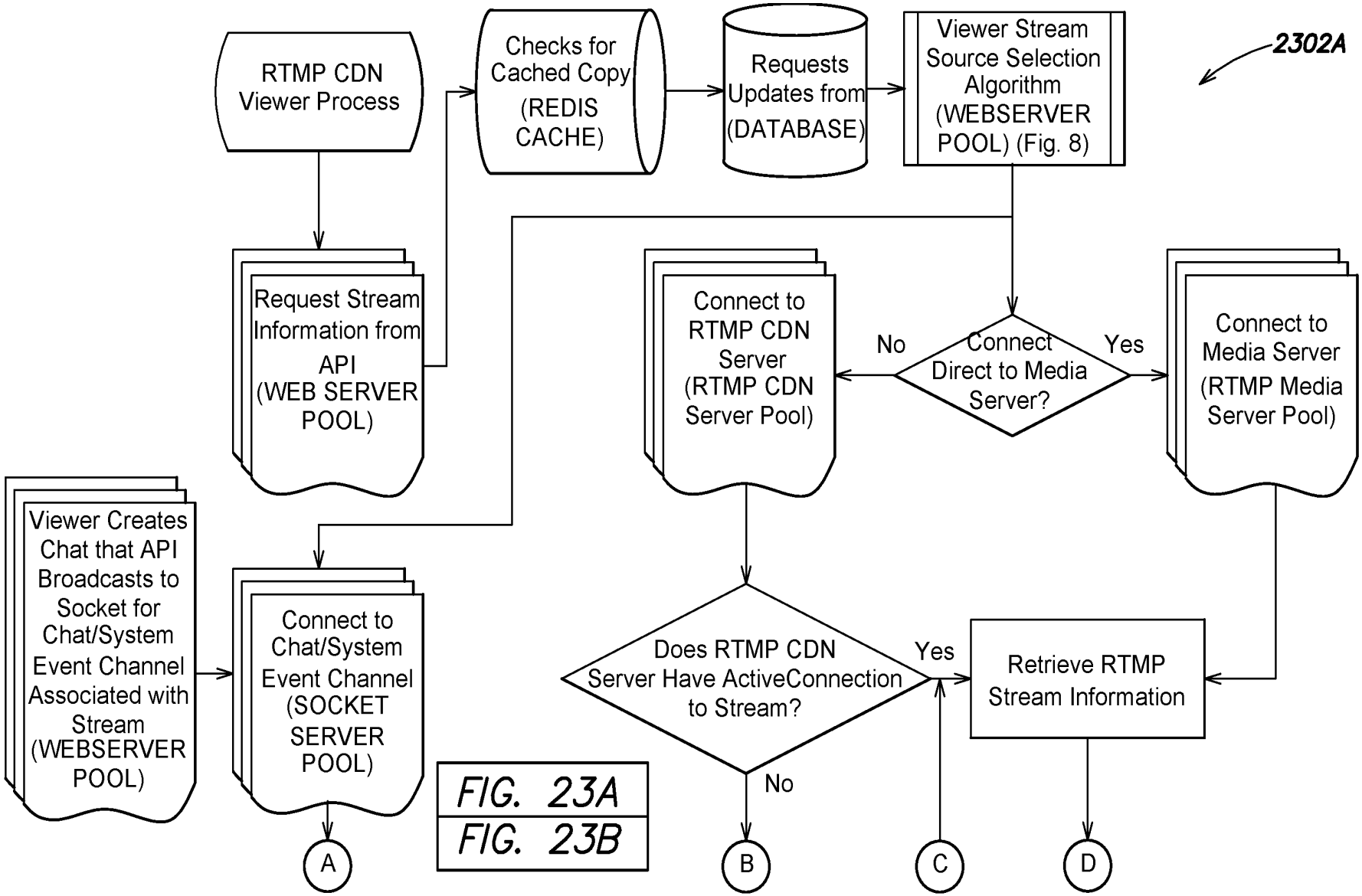


FIG. 23A
FIG. 23B

FIG. 23A

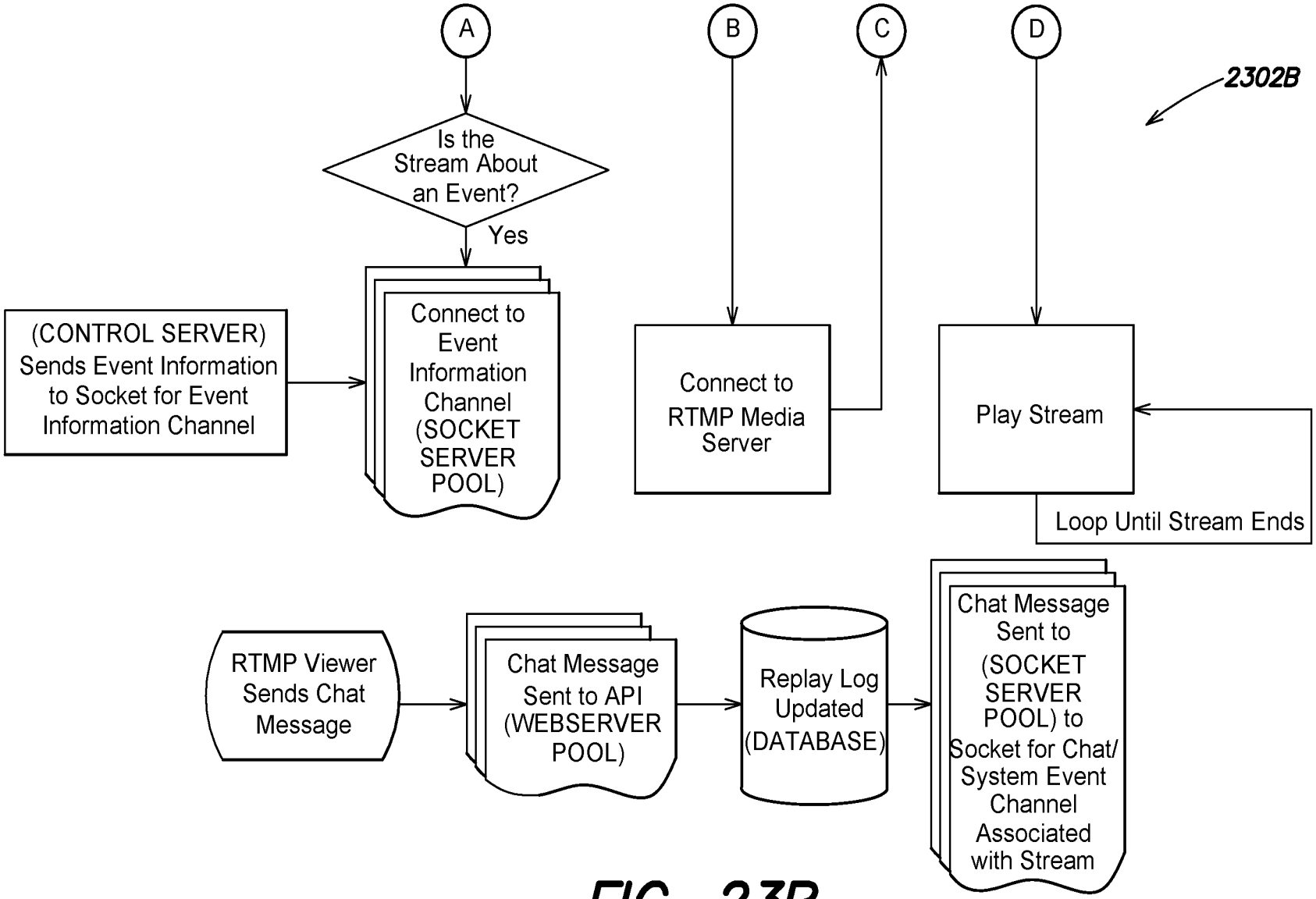

A
B
C
D
2302B
Is the Stream About an Event?
Yes
(CONTROL SERVER) Sends Event Information to Socket for Event Information Channel
Connect to Event Information Channel (SOCKET SERVER POOL)
Connect to RTMP Media Server
Play Stream
Loop Until Stream Ends
RTMP Viewer Sends Chat Message
Chat Message Sent to API (WEBSERVER POOL)
Replay Log Updated (DATABASE)
Chat Message Sent to (SOCKET SERVER POOL) to Socket for Chat/ System Event Channel Associated with Stream

FIG. 23B

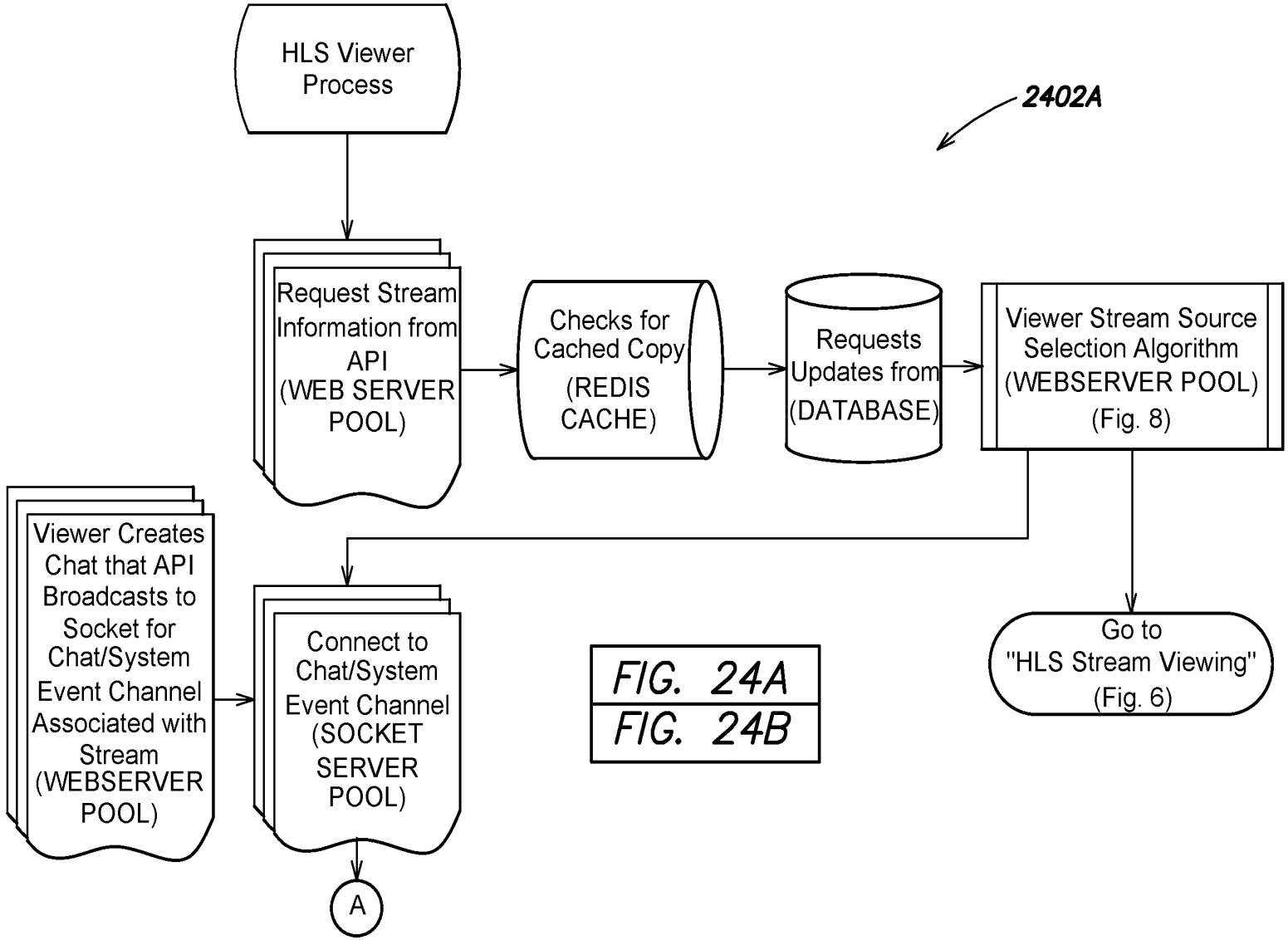


FIG. 24A
FIG. 24B

FIG. 24A

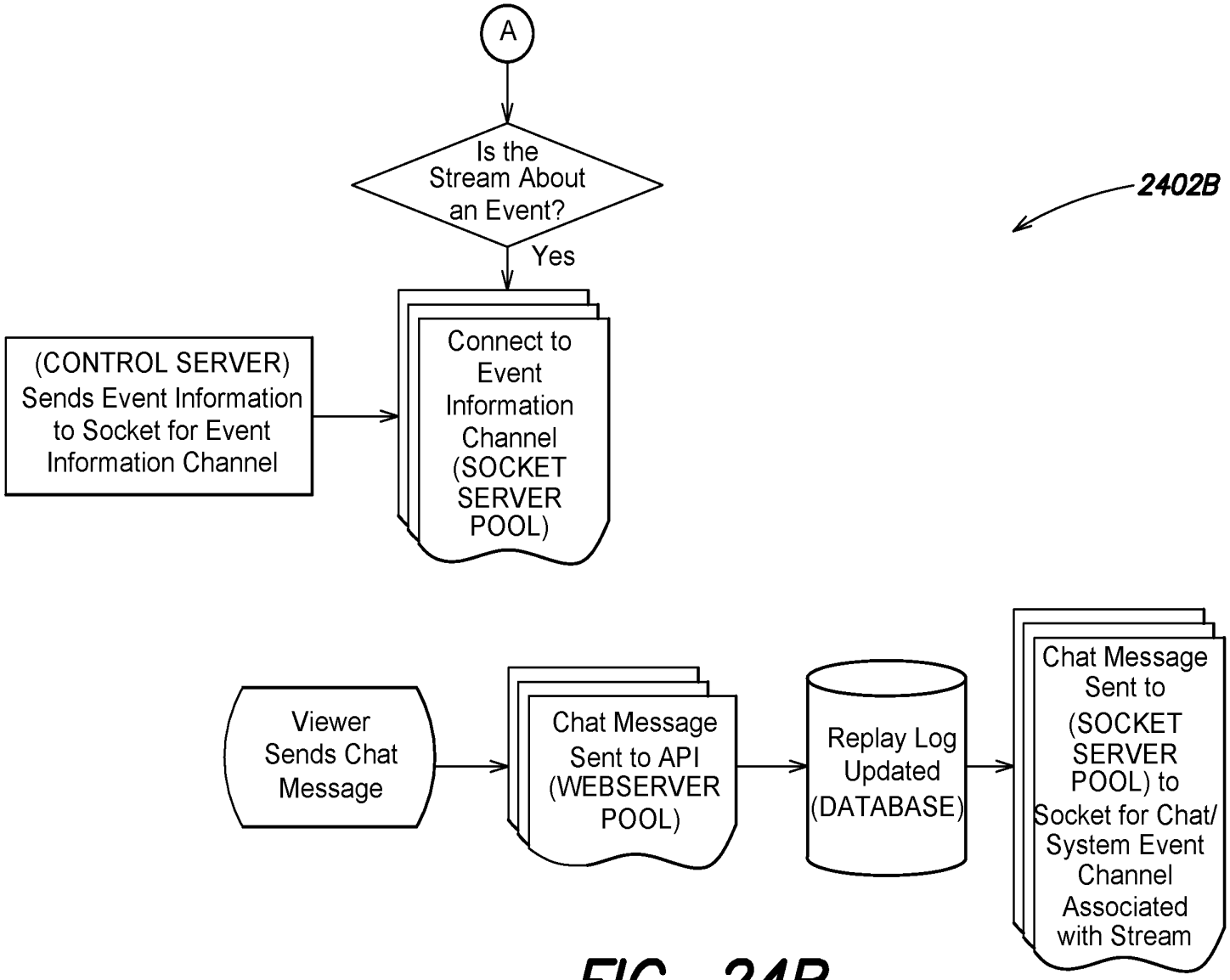

A
Is the Stream About an Event?
Yes
2402B
(CONTROL SERVER) Sends Event Information to Socket for Event Information Channel
Connect to Event Information Channel (SOCKET SERVER POOL)
Viewer Sends Chat Message
Chat Message Sent to API (WEBSERVER POOL)
Replay Log Updated (DATABASE)
Chat Message Sent to (SOCKET SERVER POOL) to Socket for Chat/ System Event Channel Associated with Stream

FIG. 24B

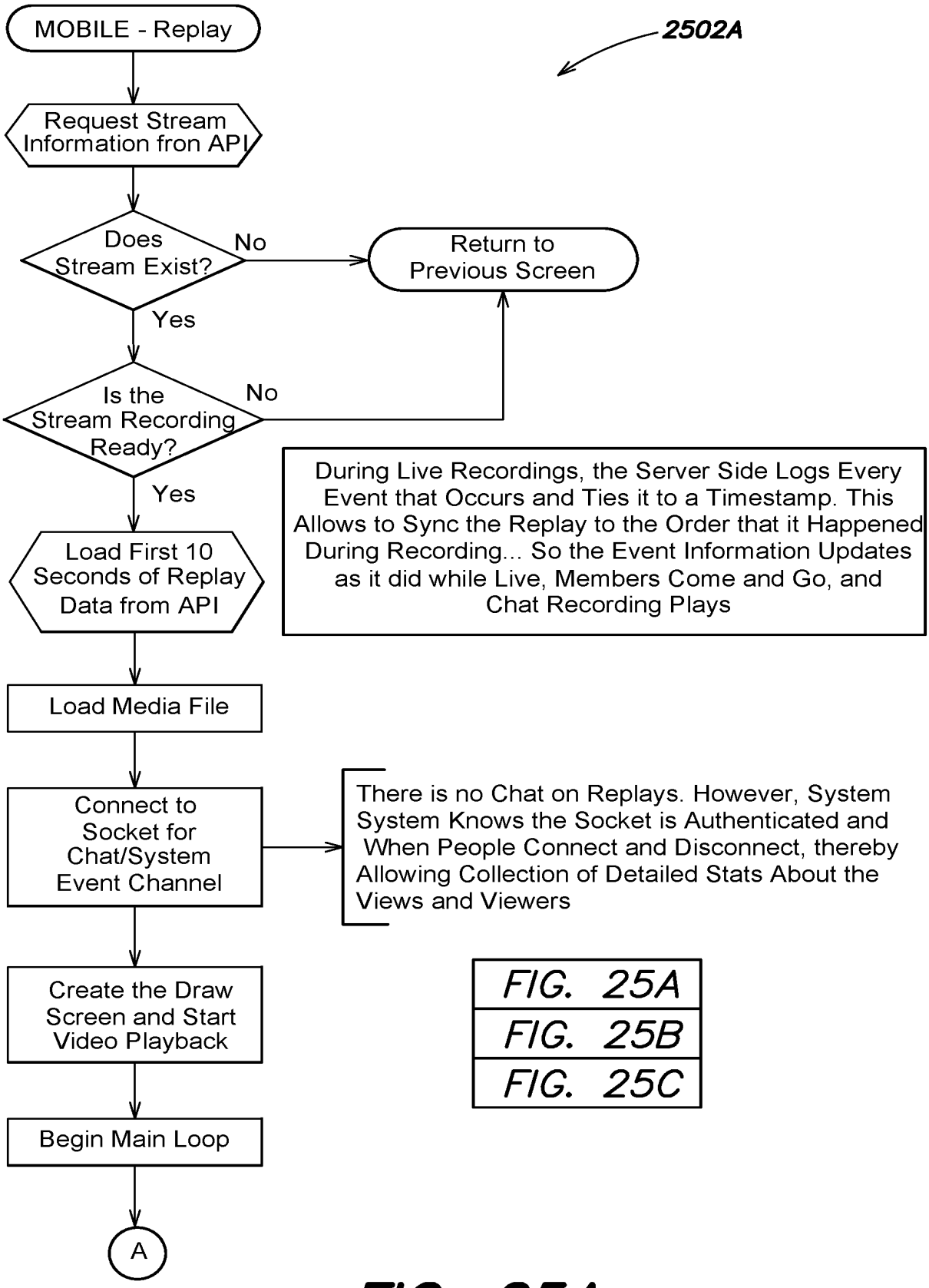


FIG. 25A
FIG. 25B
FIG. 25C

FIG. 25A

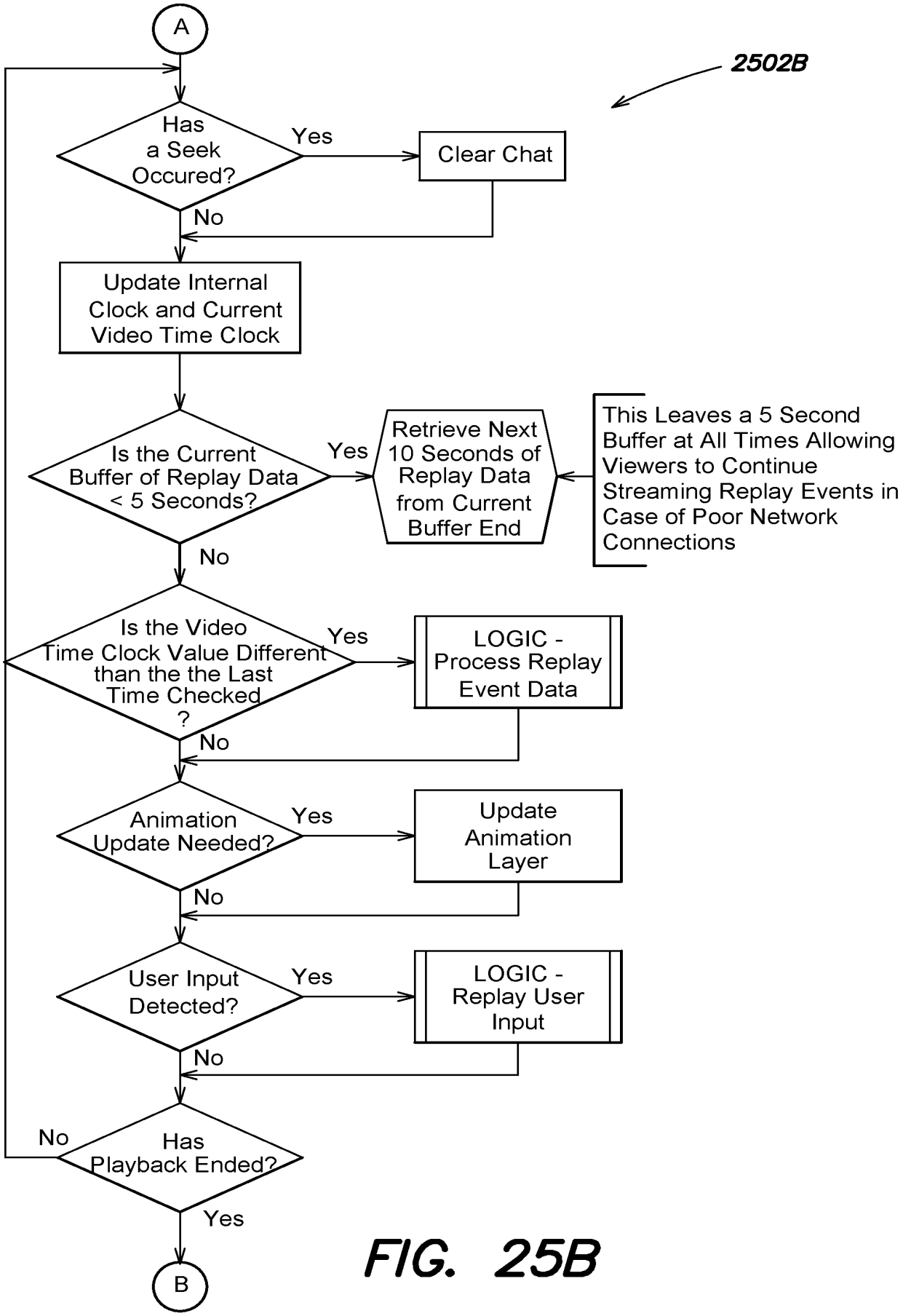

A
2502B
Has a Seek Occured?
Yes
Clear Chat
No
Update Internal Clock and Current Video Time Clock
Is the Current Buffer of Replay Data < 5 Seconds?
Yes
Retrieve Next 10 Seconds of Replay Data from Current Buffer End
This Leaves a 5 Second Buffer at All Times Allowing Viewers to Continue Streaming Replay Events in Case of Poor Network Connections
No
Is the Video Time Clock Value Different than the the Last Time Checked ?
Yes
LOGIC - Process Replay Event Data
No
Animation Update Needed?
Yes
Update Animation Layer
No
User Input Detected?
Yes
LOGIC - Replay User Input
No
Has Playback Ended?
No
Yes
B

FIG. 25B

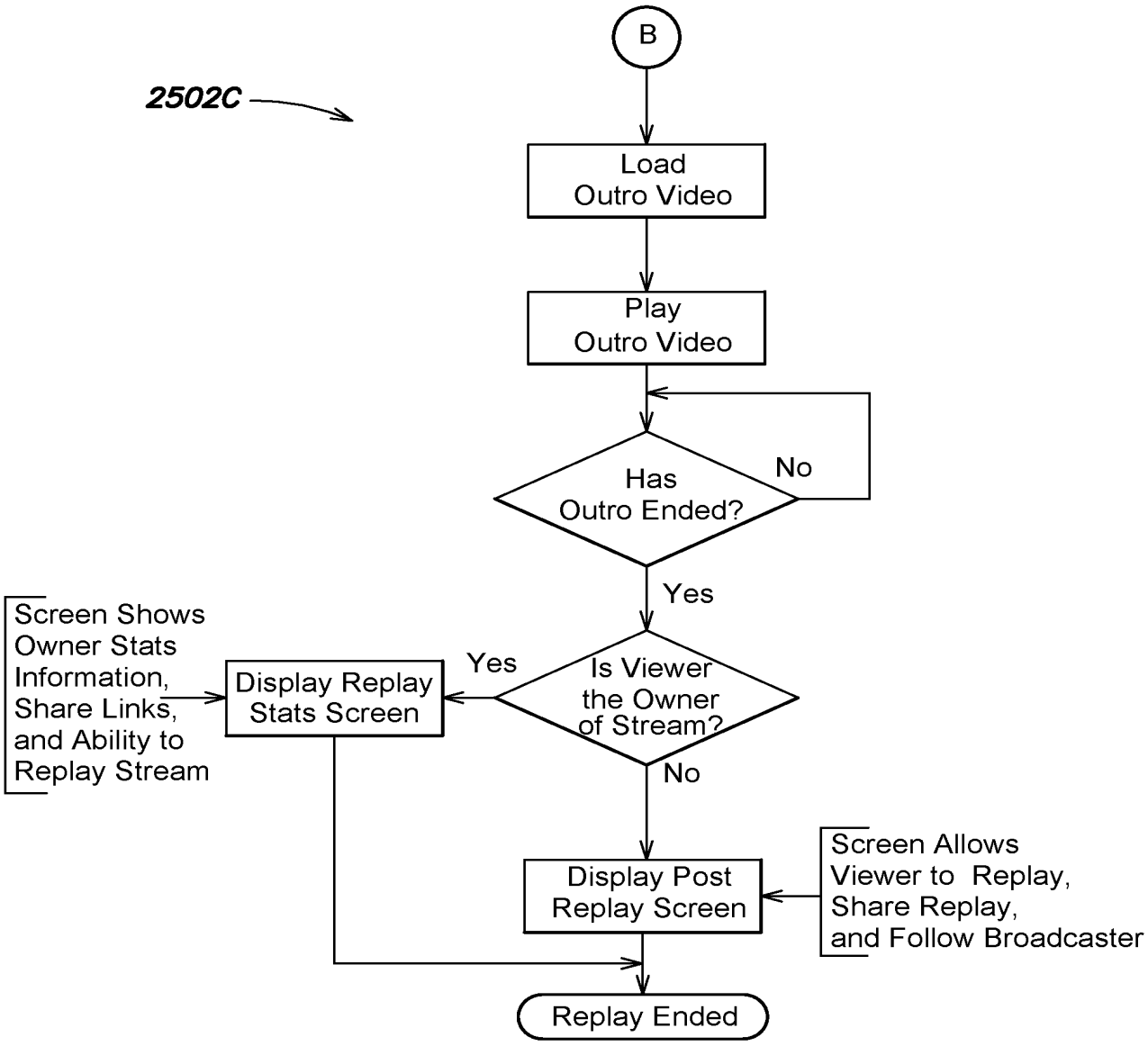

2502C
B
Load Outro Video
Play Outro Video
Has Outro Ended?
No
Yes
Is Viewer the Owner of Stream?
Yes
Display Replay Stats Screen
Screen Shows Owner Stats Information, Share Links, and Ability to Replay Stream
No
Display Post Replay Screen
Screen Allows Viewer to Replay, Share Replay, and Follow Broadcaster
Replay Ended

FIG. 25C

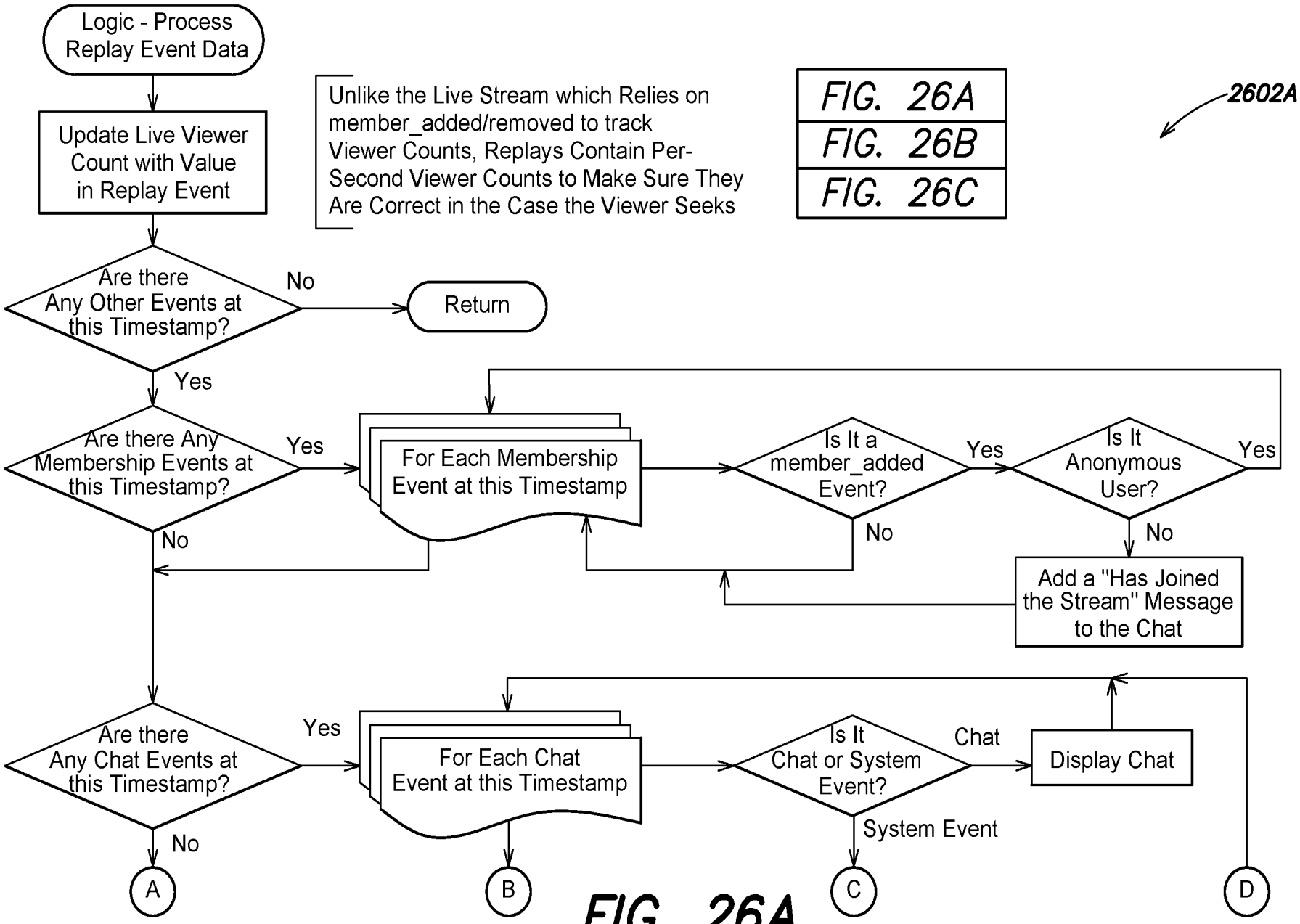

Logic - Process Replay Event Data
Update Live Viewer Count with Value in Replay Event
Unlike the Live Stream which Relies on member_added/removed to track Viewer Counts, Replays Contain Per-Second Viewer Counts to Make Sure They Are Correct in the Case the Viewer Seeks
FIG. 26A
FIG. 26B
FIG. 26C
2602A
Are there Any Other Events at this Timestamp?
No
Return
Yes
Are there Any Membership Events at this Timestamp?
Yes
No
For Each Membership Event at this Timestamp
Is It a member_added Event?
Yes
No
Is It Anonymous User?
Yes
No
Add a "Has Joined the Stream" Message to the Chat
Are there Any Chat Events at this Timestamp?
Yes
No
For Each Chat Event at this Timestamp
Is It Chat or System Event?
Chat
System Event
Display Chat
A
B
C
D

FIG. 26A

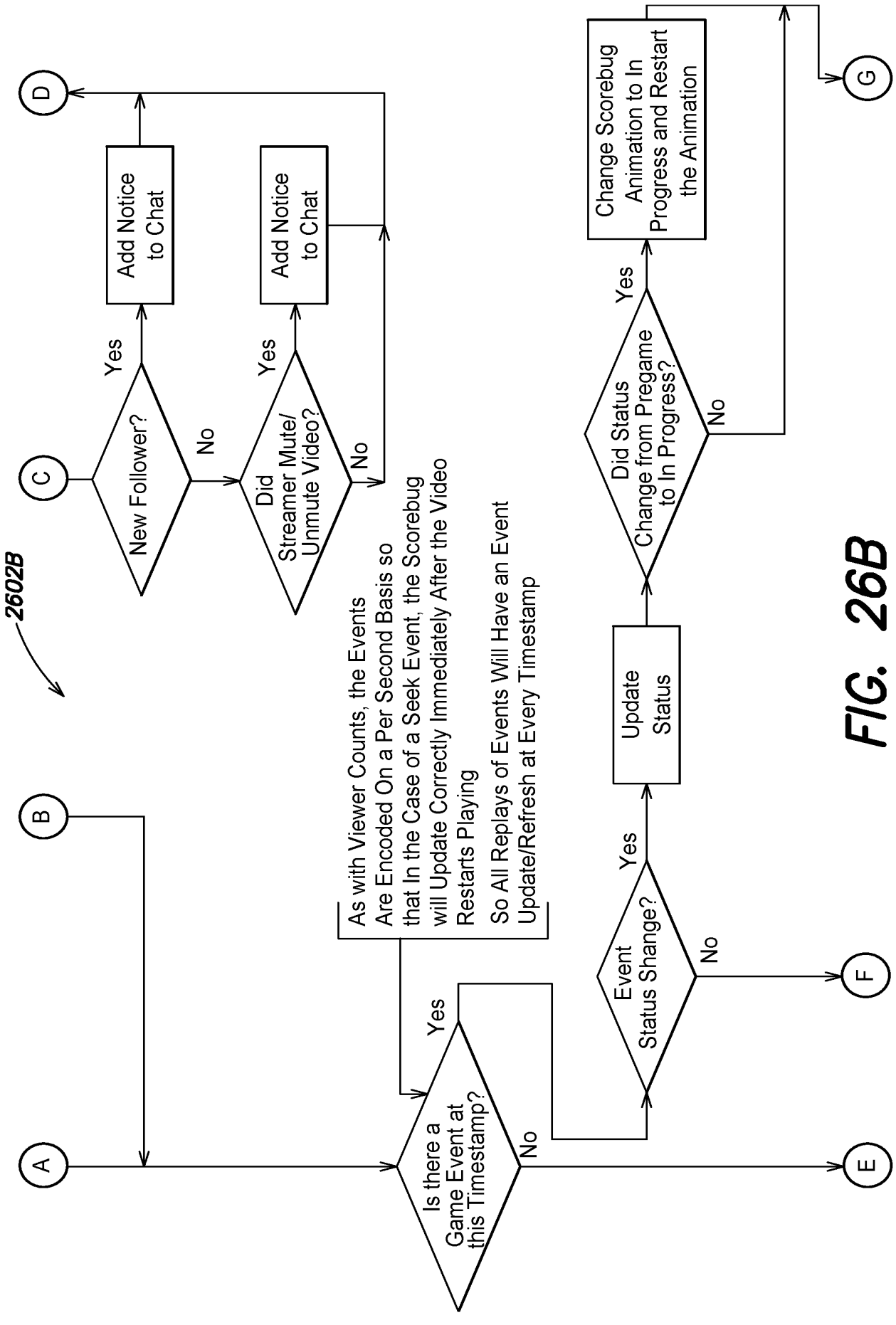

2602B
A
B
C
D
E
F
G
Is there a Game Event at this Timestamp?
Yes
No
As with Viewer Counts, the Events Are Encoded On a Per Second Basis so that In the Case of a Seek Event, the Scorebug will Update Correctly Immediately After the Video Restarts Playing
So All Replays of Events Will Have an Event Update/Refresh at Every Timestamp
Event Status Shange?
Yes
No
Update Status
Did Status Change from Pregame to In Progress?
Yes
No
Change Scorebug Animation to In Progress and Restart the Animation
New Follower?
Yes
No
Add Notice to Chat
Did Streamer Mute/ Unmute Video?
Yes
No
Add Notice to Chat

FIG. 26B

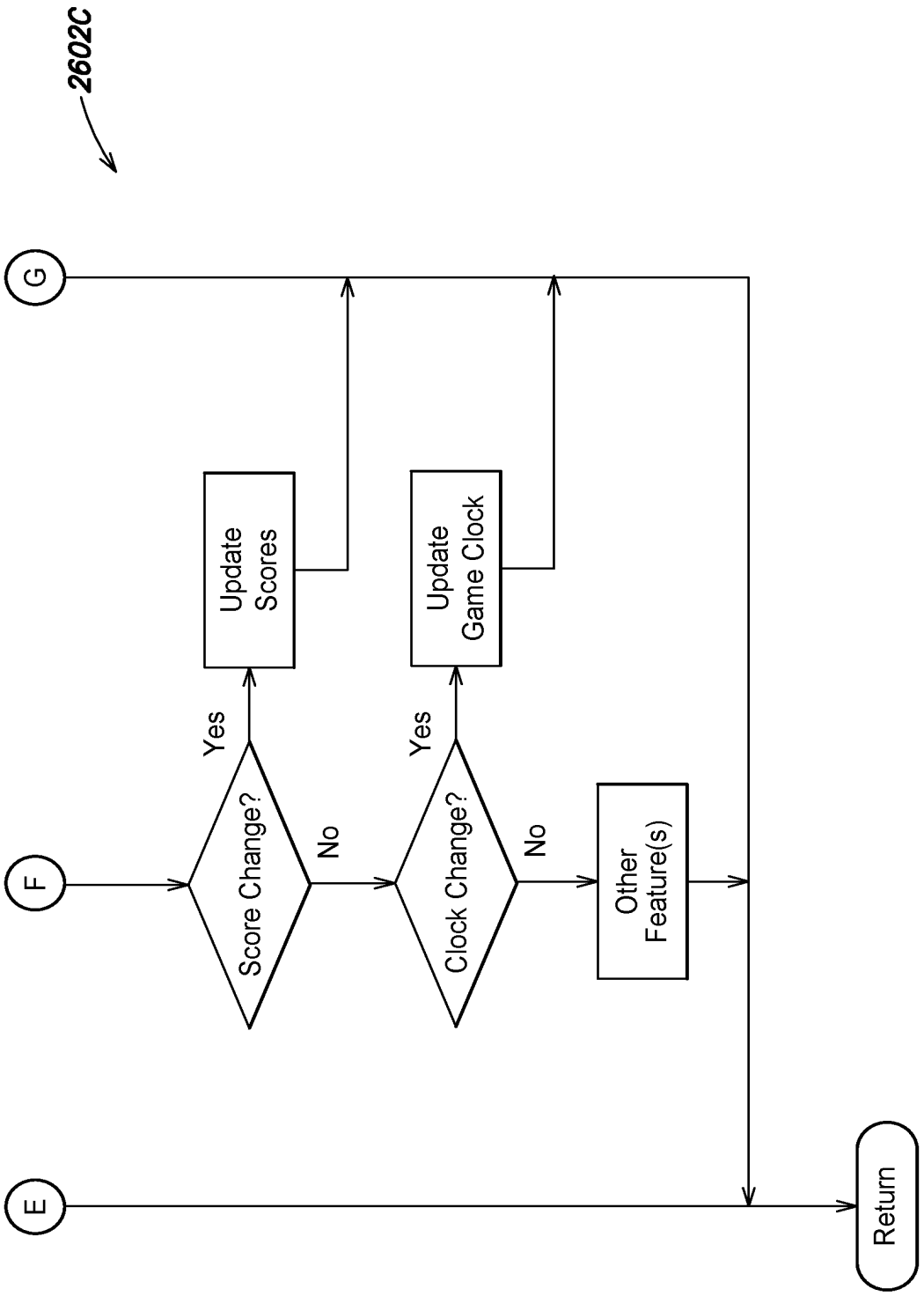

2602C
G
F
E
Update Scores
Update Game Clock
Yes
Yes
Score Change?
Clock Change?
No
No
Other Feature(s)
Return

FIG. 26C

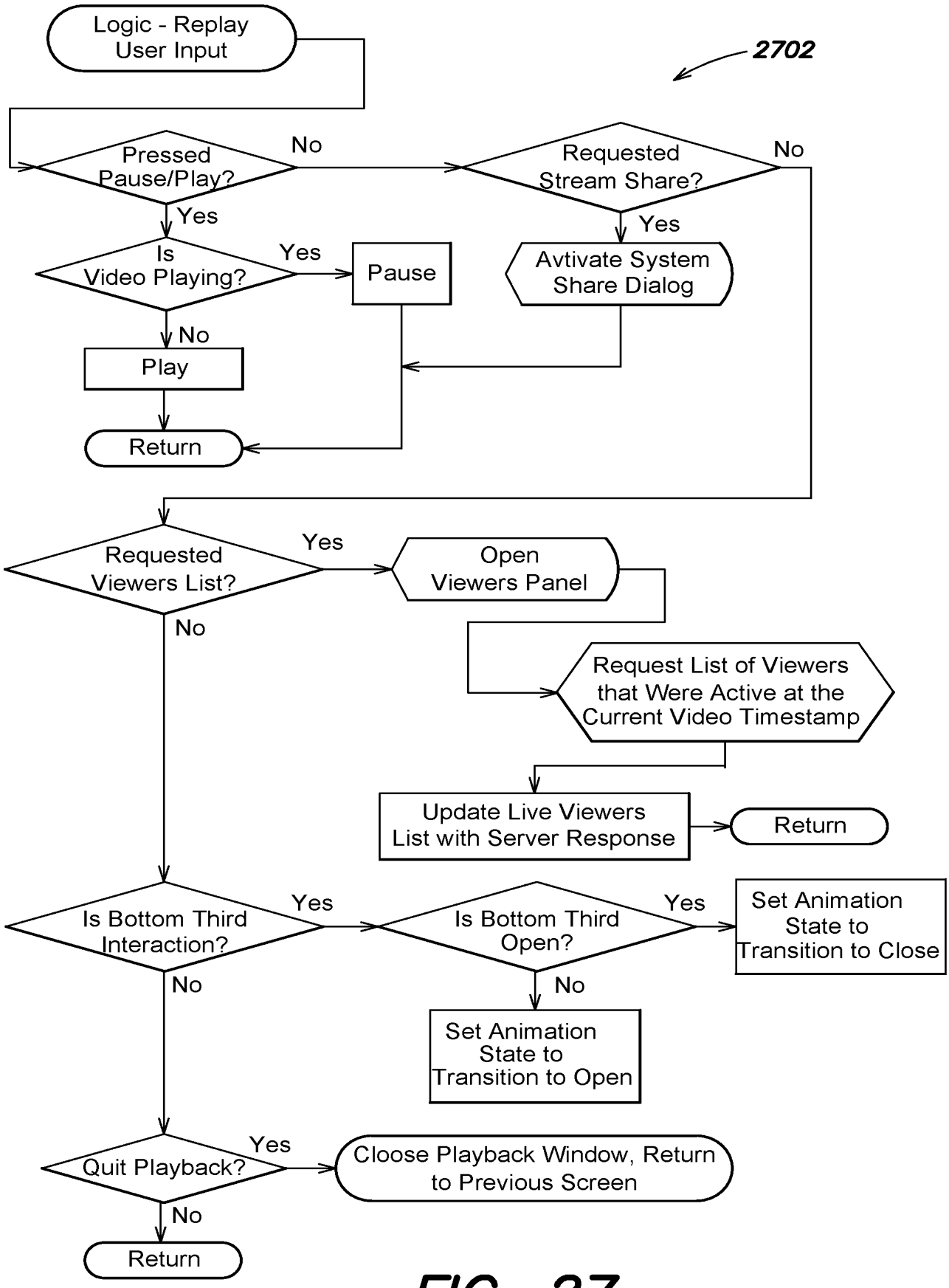

Logic - Replay User Input
2702
Pressed Pause/Play?
No
Yes
Is Video Playing?
Yes
Pause
No
Play
Return
Requested Stream Share?
No
Yes
Avtivate System Share Dialog
Requested Viewers List?
Yes
Open Viewers Panel
No
Request List of Viewers that Were Active at the Current Video Timestamp
Update Live Viewers List with Server Response
Return
Is Bottom Third Interaction?
Yes
No
Is Bottom Third Open?
Yes
No
Set Animation State to Transition to Close
Set Animation State to Transition to Open
Quit Playback?
Yes
No
Cloose Playback Window, Return to Previous Screen
Return

FIG. 27

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

PTO/AIA/82B (07-13)
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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.)

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OR

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

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☐ Firm or Individual Name					
Address					
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Country					
Telephone		Email			

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

SportsCastr.LIVE LLC

☐ 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	Kevin April		
Title	CEO		

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 1.131, 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.

SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application is a Continuation Application of U.S. Application No. 17/027,219, filed 9/21/2020, and entitled SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS, which is a Continuation Application of U.S. Application No. 16/580,552, filed September 24, 2019, and entitled "SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS," which is a continuation of U.S. Application No. 16/267,887, filed February 5, 2019, entitled "SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS," which is a Bypass Continuation Application of International Patent Application No. PCT/US2017/045801, filed August 7, 2017, entitled "SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS," which claims a priority benefit to the following U.S. provisional patent applications: U.S. Provisional Patent Application Serial No. 62/371,558, filed August 5, 2016, entitled "SYSTEMS, APPARATUS, AND METHODS FOR LIVE COMMENTARY;" U.S. Provisional Patent Application Serial No. 62/435,361, filed December 16, 2016, entitled "SYSTEMS, APPARATUS, AND METHODS FOR LIVE COMMENTARY;" U.S. Provisional Patent Application Serial No. 62/485,878, filed April 14, 2017, entitled "SYSTEMS, APPARATUS, AND METHODS FOR LIVE STREAMING, RECORDING, AND REPLAY OF BROADCAST VIDEO AND/OR AUDIO VIA THE INTERNET;" and U.S. Provisional Patent Application Serial No. 62/518,506, filed June 12,

2017, entitled "SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS VIA MULTIPLE INTERNET CHANNELS AND AN HTTP LIVE STREAMING (HLS) CACHING SERVER ARCHITECTURE." Each of the above-identified applications is hereby incorporated herein by reference in its entirety.

BACKGROUND

[0002] The public's access to the Internet, as well as the amount of bandwidth for Internet users, increased greatly in the mid-1990s to the early 2000s. The available Internet bandwidth allowed for the streaming of both recorded audio and recorded video content to a user's home. Also, additional increase of Internet access was sparked by the rise of the smartphone and the ability for smartphones to access the Internet on-the-go. In 2005, YouTube™ began to offer Internet users the ability to upload, edit, view, rate, share and comment on a wide variety of user-generated and corporate media video content. Examples of such content include video clips, television show clips, music videos, audio recordings, movie trailers, video blogs, short original videos, and educational videos. Within one year of its inception, YouTube™ reached 65 thousand daily video uploads, with 100 million daily views.

[0003] The first Internet live video streaming platform in the United States, aptly called Livestream, was launched in 2007. Livestream, as well as other nascent live video streaming platforms, were content agnostic, and over time Internet viewers desired more specialized, content-specific, and niche live video streaming platforms. To accommodate evolving viewer demand, various live video streaming platforms have launched since Livestream; examples of such more specialized platforms include Twitch.tv (a live video streaming platform for creative arts and gaming content, which launched in 2011), and musical.ly (a live video streaming platform designed for music video content, which launched in 2014).

[0004] Live video streaming platforms have also aimed to attract social network users, and social networking platforms have evolved to include live video streaming capabilities. For example, Twitch.tv includes social networking components, and in 2015 the social media platform Twitter acquired the live video streaming platform Periscope. Other social media platforms have followed suit, with both Facebook and Instagram implementing live video

streaming capabilities into their mobile applications in 2016. The widespread use of smartphones enables users of these social media platforms to share live videos with their social network.

SUMMARY

[0005] In spite of the proliferation of live video streaming over the Internet, the Inventors have recognized and appreciated various technological problems in conventional techniques for transmission of digital content via the Internet that adversely impact the live video streaming viewer experience. One such technological problem relates to viewer "latency," i.e., the delay between a first user generating a live video stream for transmission via the Internet and a second user receiving a copy of the live video stream via the Internet for viewing. For example, the live video streaming platform Twitch.tv has a latency of approximately 15 seconds, and Facebook's live streaming platform has an average latency of approximately 10 seconds. Other technological challenges for live video streaming arising from shortcomings in conventional techniques, as recognized and appreciated by the Inventors, include, for example, the difficulties in providing relatively low latency copies of live video streams with relatively high quality (e.g., high definition HD and high bit rate, such as 2 to 5 megabits per second), synchronizing such low latency and high quality copies of a live video stream amongst multiple viewers (particularly as the number of viewers of a given live video stream significantly increases), and allowing for different classes or types of viewers to flexibly access copies of a live video stream via different live streaming formats (which may lead to different qualities of service).

[0006] With these various technological challenges in mind, the present disclosure relates generally to inventive systems, apparatus, and methods for facilitating one or more broadcasters to create/provide video and/or audio (also referred to herein as a "broadcast") and allow one or more viewers to consume the video and/or audio, either by receiving a copy of a live stream representing the video and/or audio essentially in real-time as created/provided by a given broadcaster, or by retrieving and playing a recording of the live stream at a later time. In the context of essentially real-time viewing of live streams, in various implementations the inventive systems, apparatus and methods discussed in detail herein address one or more technological problems relating to viewer latency, synchronization amongst different numbers of viewers, and

providing scalable and flexible access to live streams to different classes/types of viewers and/or with different qualities of service.

[0007] With reference to FIG. 1A, in various implementations a given broadcaster uses a network-connected client device (e.g., a first smart phone or other personal computing device communicatively coupled to the Internet) to generate a live stream of digital content corresponding to the video and/or audio created/provided by the broadcaster, wherein the live stream is transmitted to an inventive server and memory storage architecture (additional details of the server and memory storage architecture are shown, for example, in FIGS. 2 and 3). The inventive server and memory storage architecture processes the broadcaster's live stream to generate multiple copies of the live stream which are provided to respective viewers, and also records the live stream and stores the recording for later replay. One or more viewers using different network-connected client devices (e.g., a second and third smart phone or other personal computing device communicatively coupled to the Internet) may communicatively couple to the server and memory storage architecture to receive a copy of the live stream of the digital content as a real-time or essentially real-time consumer of the broadcast created/provided by the broadcaster, or retrieve and play a recording of the live stream generated by the broadcaster client device (and recorded by the server and memory storage architecture). In some implementations, a given broadcaster themselves may view their own broadcast as a viewer on the same client device (e.g., by opening a separate tab on their client device and connecting to the server and memory storage architecture as both a broadcaster and a viewer). In one aspect, the inventive server and memory storage architecture allows any number of broadcasters to generate respective live streams of digital content, and any number of viewers to receive respective copies of a given broadcaster's live stream of digital content. In another aspect, the inventive server and memory storage architecture allows a given viewer of a first broadcaster's live stream to effectively switch in essentially real-time to view one or more other broadcasters' live streams.

[0008] In some implementations, the inventive systems, apparatus, and methods further facilitate a social platform in tandem with broadcasting video and/or audio to one or more viewers, in which a given broadcaster and their viewer(s) may communicate with one another (e.g., via chat messages) in essentially real-time during a broadcast. In one aspect, one or more chat messages, as well as various viewer-related information (e.g., name, surname, profile

photo), may be displayed on respective client devices used by the broadcaster and the one or more viewers as the video and/or audio is rendered on the respective client devices.

[0009] In some implementations, the video and/or audio created/provided by one or more broadcasters is video-based commentary about a live event being observed by a given broadcaster. In various aspects, the broadcaster may take the role of a main commentator for the event, or a "color commentator" (e.g., analyst or summarizer) for the event; in a given role, the broadcaster may describe the event as it occurs (e.g., provide chronological or "play-by-play" updates to "call" the event), and/or may provide expert analysis, background or anecdotal information about the event and/or participants in the event, and/or relevant statistics regarding the event, participants in the event, or related events. FIG. 1B illustrates a display of an example client device, in which a broadcaster is providing video-based commentary about a sports game, and in which chat messages from one or more viewers, event information about the sports game, and other graphics and/or animations are displayed together with the broadcaster's video-based commentary.

[0010] Examples of various activities constituting events according to the present disclosure include, but are not limited to, a variety of sports games (e.g., professional, semi-professional, intramural, community-oriented) or sporting activities (e.g., exercise-related activities, physical training activities, fishing, hunting), musical performances, theatrical performances, other artistic or entertainment-oriented activities, speeches or presentations, political activities (e.g., election-related activities, campaign-related activities, public or "town hall" meetings, public marches or demonstrations), military activities, professional activities (e.g., meetings or conferences), academic or educational activities (e.g., academic presentations or lectures, research activities, medical or scientific procedures, ceremonies), cooking or baking activities, competitive activities (e.g., racing activities), game-related activities (e.g., online gaming, board games, chess matches, role-playing games), social activities, and news-related activities. In one aspect, the video-based commentary provided by one or more broadcasters about the event and consumed by one or more viewers may provide a "second screen" experience for the viewers; in particular, in some implementations, the viewers may consume the video-based commentary about the event on their respective client devices as they are watching the event itself on another device (e.g., a television), or watching and/or participating in the event at the event's venue.

[0011] As discussed in greater detail below, in various aspects the inventive systems, apparatus and methods described herein provide an improvement in computer network functionality by facilitating scalable and appreciably low-latency viewing of copies of multiple broadcasters' live streams of video-based commentary about an event by significant numbers of viewers as the event unfolds. Particularly in the context of a "second screen" experience relating to a live event, discernible delay between the observation of the event itself and a given broadcaster's video-based commentary would significantly undermine viewer experience. Accordingly, the inventive systems, apparatus and methods described herein specifically address multiple technological problems in conventional techniques relating to transport of digital content via the Internet by providing multiple technological solutions to ensure a low-latency viewing experience for significant numbers of viewers.

[0012] In such implementations relating to video-based commentary about events, the inventive systems, apparatus and methods disclosed herein further may facilitate display, on respective client devices used by the broadcaster and the one or more viewers, of various event information in tandem with the video-based commentary rendered on the respective client devices. For example, in connection with sports games, displayed event information may include, but is not limited to, one or more of team information (e.g., team names, abbreviations and/or logos), score information (e.g., with essentially real-time score updates synchronized with the video-based commentary), player information, venue information, game status information (e.g., on-base, at-bat, timeouts, fouls, pole position, yards-to-go, yards-to-goal, down), team statistics, player statistics and the like. In some implementations, such event information about a sports game may be rendered in the display of a client device as a "scorebug" that may include for example, team abbreviations or logos, team scores, game status (e.g., period, quarter, inning), and actual or elapsed time for the game, with updates to one or more information elements in essentially real-time as the game progresses. It should be readily appreciated that for other types of events, a wide variety of information germane to the event may be displayed as event information (e.g., with essentially real-time updates of evolving information as the event progresses) together with the rendering of the video-based commentary on respective client devices. In another aspect, various event information or other information germane to a given broadcaster's video-based commentary may be rendered on a viewer client device in a "lower

third" (also sometimes referred to as a "bottom third") of a display (e.g., as an overlay to the video-based commentary).

[0013] In view of the foregoing, in other aspects the inventive systems, apparatus and methods described herein provide additional improvements in computer network functionality by facilitating scalable and appreciably low-latency synchronization of displayed event information with multiple broadcasters' live streams of video-based commentary about an event as viewed by significant numbers of viewers as the event unfolds. Particularly in the context of a "second screen" experience relating to a live event, discernible delay between the observation of the event itself and the status of event information displayed in tandem with a given broadcaster's video-based commentary would significantly undermine viewer experience. Accordingly, the inventive systems, apparatus and methods described herein specifically address multiple technological problems in conventional techniques relating to transport of digital content via the Internet by providing multiple technological solutions to ensure not only a low-latency viewing experience for significant numbers of viewers (e.g., relative to the event about which a broadcaster is providing video-based commentary), but appropriate synchronization of event information across all broadcasters of an event and their associated viewers.

[0014] In some implementations as discussed herein, these technological solutions contemplate multiple Internet communication channels to provide relevant and synchronized information to client devices (as would be readily appreciated in the relevant arts, a "communication channel" refers to a physical or logical connection over a transmission medium to convey information signals from one or more senders to one or more receivers). For example, in one implementation, a first "video" Internet communication channel (e.g., between a media server or other media source and a client device) conveys the digital content corresponding to the video-based commentary provided by the broadcaster and consumed by one or more viewers, and a second "event information" Internet communication channel (e.g., between a particular socket of a socket server and the client device) conveys the event information. In other implementations, an additional "chat/system event" Internet communication channel (e.g., between another socket of a socket server and the client device) is employed to convey chat information and other information relating to system events regarding a particular broadcaster's live stream. In one aspect, connections between client devices and a particular socket of a socket server are persistent authenticated connections, so that the number of users (broadcasters and

viewers) connected to a particular socket (e.g., and currently watching a particular live stream and/or particular event) may be tracked.

[0015] In some implementations, the inventive systems, apparatus, and methods further facilitate a variety of screen animations (e.g., motion graphics), customized displays or screen backgrounds, and other special effects graphics (e.g., augmented reality) that are generally associated with the video and/or audio created by a broadcaster, and rendered by client devices in tandem with a given broadcaster's video and/or audio.

[0016] In some implementations in which the broadcaster may be creating/providing video and/or audio content about an event, one or more such screen animations, customized displays or screen backgrounds, and other special effects graphics may be related to some aspect of the event. For example, as noted above, a "scorebug" providing information about a sporting event may be presented on a viewer's display with a variety of motion or other special effects graphics. In one aspect, the information provided by such a scorebug is derived from the synchronized event information that is received by the client device on an event information Internet communication channel that is separate from the video content representing the video-based commentary. In another aspect, the scorebug and/or other special effects graphics or animations may be rendered in the display of the client device pursuant to execution of a client app or program on the client device (rather than having these display elements integrated into the broadcaster's live stream itself). In other aspects, one or more such screen animations and other special effects may be provided in a lower/bottom third of a client device's display, and may be interactive (e.g., in that a user of a client device may select or thumb-over an animation, special effect and/or scorebug to retrieve additional information and/or initiate other animations/graphics) and/or user-customizable (e.g., a broadcaster may select from one of multiple background displays so that they may appear to be in any of a variety of locations or venues, customize their video-based commentary with a broadcaster-generated lower third, and/or add create/provide introduction videos to be shown before their live stream begins).

[0017] In yet other aspects, screen animations, customized displays or screen backgrounds, and/or other special effects graphics may be related to one or more of advertising or branding (e.g., by sponsors of a broadcaster, sponsors of an event about which a broadcaster is providing commentary, participants in the event itself, etc.), premium features and digital gifts (e.g.,

provided by one or more viewers to one or more broadcasters or other viewers). For example, in some implementations, via a client app or software program executing on a client device, users will be able to purchase digital gifts for other users (e.g., a viewer following a particular broadcaster may purchase digital beers, various digital concession stand items, ticker tapes, penalty flags, etc.), and the digital gifts will appear in the broadcaster's profile and/or be represented on a display (e.g., as an icon or sprite) together with the broadcaster's video-based commentary. In one implementation, information regarding digital gifts may be communicated between client devices and the server and memory storage architecture via a chat/system event Internet communication channel associated with a given broadcaster's live stream of digital content.

[0018] In some implementations, the video and/or audio created/provided by one or more broadcasters may relate to various types of news, other types of current or past events, and various topics of interest about which a given broadcaster wishes to provide commentary. For example, a given broadcaster, or multiple broadcasters (which may be globally-distributed broadcasters, e.g., a first broadcaster in Europe, a second broadcaster in Africa, and a third broadcaster in Asia) may wish to broadcast about an ongoing, recent or past event (e.g., news about a bombing, a fire, an arrest, an economic development, a political or military development, or any of the other activities discussed above) or a particular topic of interest (e.g., healthy eating or dieting, gardening, religion, dating, politics, culture, art, music, playing a musical instrument, learning a language, auto repair, real estate, business, economics, legal issues, global warming, space exploration, a particular TV program or series, a particular entertainment or sports personality, video games, hobbies, etc.). As noted above, various event information regarding the ongoing, recent or past event (or particular topic of interest) may be provided to respective viewer devices, in tandem with the video-based commentary, in a variety of form factors and in a manner that ensures appropriate synchronization of event information across all broadcasters of an event and their associated viewers.

[0019] Thus, in various examples discussed in greater detail below, systems, apparatus, and methods are disclosed for obtaining, substantially in real time, via at least one communication interface over at least one network, an audio and/or visual feed generated by a broadcaster client device during at least one live event, wherein the audio and/or visual feed includes commentary associated with the at least one live event, and a separate event data feed including real time

information associated with the at least one live event. The commentary and the real time information associated with the at least one live event are transmitted via at least one processor communicatively coupled to the at least one communication interface, so as to provide, substantially in real time, streaming content via the at least one communication interface over the at least one network to at least one display device for concurrent display of the commentary and a graphical ticker based on the real time information associated with the event. The disclosed systems, apparatus, and methods are enhanced tools for real-time broadcasting of user-generated content associated with one or more live events and community engagement that are unavailable from existing video hosting websites.

[0020] Glossary

[0021] USER: a person who interfaces, via a mobile app or web portal accessed on a client device communicatively coupled to the Internet, with one or more of the various servers and corresponding server functionality described herein.

[0022] REGISTERED USER: A user that provides profile information and validation credentials to establish a user account so as to access, via a login process using the validation credentials, the one or more of the various servers and corresponding server functionality described herein.

[0023] ANONYMOUS USER: A non-registered user that has access, without requiring a login process, to a limited feature set based on the server functionality described herein.

[0024] BROADCASTER: A registered user that creates/provides video and/or audio (also referred to herein in some instances as "video-based commentary") for consumption by one or more viewers.

[0025] EVENT: An activity about which a broadcaster may create/provide video and/or audio as the activity occurs (i.e., in "real-time"). Examples of activities constituting events according to the present disclosure include, but are not limited to, a variety of sports games (e.g., professional, semi-professional, intramural, community-oriented) or sporting activities (e.g., exercise-related activities, physical training activities, fishing, hunting), musical performances, theatrical performances, other artistic or entertainment-oriented activities, speeches or presentations, political activities (e.g., election-related activities, campaign-related activities,

public or "town hall" meetings, public marches or demonstrations), military activities, professional activities (e.g., meetings or conferences), academic or educational activities (e.g., academic presentations or lectures, research activities, medical or scientific procedures, ceremonies), cooking or baking activities, competitive activities (e.g., racing activities), game-related activities (e.g., online gaming, board games, chess matches, role playing games), social activities, and news-related activities. Video and/or audio created/provided by a broadcaster about an event may be referred to herein as "video-based commentary." In some implementations, the video and/or audio created/provided by one or more broadcasters may relate to various types of news, other types of current, recent or past events, and various topics of interest about which a given broadcaster wishes to provide commentary (e.g., news about a bombing, a fire, an arrest, an economic development, a political or military development, or any of the other activities discussed above, healthy eating or dieting, gardening, religion, dating, politics, culture, art, music, playing a musical instrument, learning a language, auto repair, real estate, business, economics, legal issues, global warming, space exploration, a particular TV program or series, a particular entertainment or sports personality, video games, hobbies, etc.).

[0026] VIEWER: A registered user or anonymous user that consumes video and/or audio created/provided by a broadcaster, via essentially real-time access to a live stream of digital content representing the video and/or audio, or via retrieval and playing of a recording of the live stream of digital content.

[0027] LIVE STREAM: Digital content (e.g., digital video and/or digital audio) that is transferred between at least two network-connected devices in real-time or essentially real-time as the corresponding video and/or audio codified as the digital content is created/provided by a broadcaster. Thus, a network-connected client device used by the broadcaster may generate a live stream of digital content corresponding to the video and/or audio created/provided by the broadcaster, and a viewer using a different network-connected client device may receive a copy of a live stream of the digital content as a real-time or essentially real-time consumer of the video and/or audio created/provided by the broadcaster. In some implementations, the video and/or audio created/provided by the broadcaster and represented in a live stream may be video-based commentary relating to an event. A live stream of digital content may have a variety of data formats (e.g., H.264 MPEG-4 Advanced Video Coding video compression; VP8 video compression) and transmission protocols, including persistent/continuous streaming transmission

protocols (e.g., real time streaming protocol "RTSP;" real time messaging protocol "RTMP;" web real-time communication "WebRTC"), as well as segmented and/or adaptive bitrate (ABR) protocols (e.g., Apple's HTTP Live Streaming "HLS;" Microsoft's HTTP Smooth Streaming "MSS;" Adobe's HTTP Dynamic Streaming "HDS;" standards-based ABR protocol "MPEG-DASH").

[0028] FOLLOWER: A registered user who is notified when a particular broadcaster is online.

[0029] SUBSCRIBER: A follower of a particular broadcaster that has paid for access to additional features and/or content not available to a follower (e.g., subscriber-specific chat channels).

[0030] VIP MEMBER: an admin-designated registered user that has additional access rights and high priority access to live stream media servers.

[0031] MEDIA MEMBER: an admin-designated registered user that is a media professional. In some implementations, the media member designation is used during some live streams to facilitate filtering and prioritization of comments/chat message for response by the broadcaster of the live stream.

[0032] ADMIN USER: a staff account flagged with administrative powers.

[0033] PRIVATE PROFILE: a profile for a user that has designated their content as private, only allowing direct link access to live/replay streams and archive access to broadcasters that the user has followed.

[0034] RAW VIDEO: A recording made by a media server of a live stream generated by a broadcaster. In one example implementation in which a broadcaster client device generates a video stream in H.264/AAC format and the media server is a Real Time Messaging Protocol (RTMP) media server, the raw video is produced by the RTMP media server by recording the broadcaster's live stream directly (to provide a 720p high definition feed or even higher definition feed). In another example in which a broadcaster client device generates a video stream in VP8/WebRTC format and the media server is a WebRTC media server, the WebRTC media server first transcodes the live stream from the broadcaster into a H.264 720p high

definition (or even higher definition feed) and then records the transcoded feed to provide the raw video.

[0035] In sum, one inventive example is directed to a system (1000) for providing a first plurality of copies (202A, 202B) of a first broadcaster's live stream of digital content (102A) including first live sporting event video-based commentary from a first broadcaster client device (100A) to a first plurality of viewer client devices (200A, 200B), and for providing a second plurality of copies (202C, 202D) of a second broadcaster's live stream of digital content (102B) including second live sporting event video-based commentary from a second broadcaster client device (100B) to a second plurality of viewer client devices (200C, 200D). The system comprise: A) a plurality of media sources (300) to: receive the first broadcaster's live stream of digital content (102A) and the second broadcaster's live stream of digital content (102B); provide a first copy (202A) of the first plurality of copies to a first viewer client device (200A) of the first plurality of viewer client devices via a first video Internet communication channel (204A) between the plurality of media sources and the first viewer client device of the first plurality of viewer client devices; and provide a first copy (202C) of the second plurality of copies to a first viewer client device (200C) of the second plurality of viewer client devices via a second video Internet communication channel (204C) between the plurality of media sources and the first viewer client device of the second plurality of viewer client devices. The system further comprises: B) a control server (500) to periodically retrieve, via the Internet and from an event information provider (55), first event information (502A) germane to a first live sporting event, wherein the first event information includes first score information (504A) for the first live sporting event. The system further comprises: C) at least one socket server (600) communicatively coupled to the control server to: receive from the control server at least the first score information; and transmit the first score information (504A) to at least the first viewer client device (200A) of the first plurality of viewer client devices via a first event information Internet communication channel (206A) between at least one first event socket (602A) of the at least one socket server and the first viewer client device of the first plurality of viewer devices, wherein the at least one first event socket corresponds to the first event information germane to the first live sporting event.

[0036] Another inventive example is directed to a system (1000) for providing a first plurality of copies (202A, 202B) of a first broadcaster's live stream of digital content (102A) including

first video-based commentary about a first live sporting event from a first broadcaster client device (100A) to a first plurality of viewer client devices (200A, 200B), and for providing a second plurality of copies (202C, 202D) of a second broadcaster's live stream of digital content (102B) including second video-based commentary about a second live sporting event from a second broadcaster client device (100B) to a second plurality of viewer client devices (200C, 200D). The system comprises: A) a plurality of media sources (300) to: receive the first broadcaster's live stream of digital content (102A) and the second broadcaster's live stream of digital content (102B); provide a first copy (202A) of the first plurality of copies to a first viewer client device (200A) of the first plurality of viewer client devices via a first Internet communication channel (204A) between the plurality of media sources and the first viewer client device of the first plurality of viewer client devices; and provide a first copy (202C) of the second plurality of copies to a first viewer client device (200C) of the second plurality of viewer client devices via a second Internet communication channel (204C) between the plurality of media sources and the first viewer client device of the second plurality of viewer client devices. The system further comprises: B) a control server (500) to periodically retrieve, via the Internet and from an event information provider (55), first event information (502A) germane to the first live sporting event and second event information (502B) germane to the second live sporting event. The system further comprises: C) at least one socket server (600) communicatively coupled to the control server to: receive from the control server at least some of the first event information (502A) and at least some of the second event information (502B), wherein: the at least some of the first event information includes first score information for the first sporting event; and the at least some of the second event information includes second score information for the second sporting event; and transmit at least the first score information the at least some of the first event information (502A) to the first viewer client device (200A) of the first plurality of viewer client devices via a third Internet communication channel (206A) between at least one first event socket (602A) of the at least one socket server and the first viewer client device of the first plurality of viewer devices; and transmit at least the second score information of the at least some of the second event information (502B) to the first viewer client device (200C) of the second plurality of viewer client devices via a fourth Internet communication channel (206C) between at least one second event socket (602B) of the at least one socket server and the first viewer client device of the second plurality of viewer devices.

[0037] It should be appreciated that all combinations of the foregoing concepts and additional concepts discussed in greater detail below (provided such concepts are not mutually inconsistent) are contemplated as being part of the inventive subject matter disclosed herein. In particular, all combinations of claimed subject matter appearing at the end of this disclosure are contemplated as being part of the inventive subject matter disclosed herein. It should also be appreciated that terminology explicitly employed herein that also may appear in any disclosure incorporated by reference should be accorded a meaning most consistent with the particular concepts disclosed herein.

[0038] Other systems, processes, and features will become apparent to those skilled in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, processes, and features be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039] The skilled artisan will understand that the drawings primarily are for illustrative purposes and are not intended to limit the scope of the inventive subject matter described herein. The drawings are not necessarily to scale; in some instances, various aspects of the inventive subject matter disclosed herein may be shown exaggerated or enlarged in the drawings to facilitate an understanding of different features. In the drawings, like reference characters generally refer to like features (e.g., functionally similar and/or structurally similar elements).

[0040] FIG. 1A is a block diagram showing respective elements of a system to facilitate live streaming of digital content (video and/or audio) from multiple broadcasters to multiple viewers, according to some inventive implementations.

[0041] FIG. 1B illustrates a display of an example client device in the system of FIG. 1A, showing various displayed content according to some inventive implementations.

[0042] FIG. 2 is a block diagram of the broadcast/viewing servers and memory storage devices shown in FIG. 1A according to some inventive implementations.

[0043] FIG. 3 is a block diagram showing additional details of the various interconnections between the respective components of the servers and memory storage devices shown in FIG. 2, according to some inventive implementations.

[0044] FIGS. 4A and 4B show a process flow diagram illustrating a broadcast media server selection algorithm according to one inventive implementation, which in some examples may be performed by one or more web servers shown in FIGS. 2 and 3.

[0045] FIGS. 5A through 5C show a process flow illustrating a media server process for the media servers shown in FIGS. 2 and 3, according to one inventive implementation.

[0046] FIG. 6 is a block diagram illustrating the selective coupling of an example viewer client device to one of the media sources of the servers and memory storage devices shown in FIGS. 2 and 3, according to some inventive implementations.

[0047] FIG. 7 is a process flow diagram illustrating a viewer stream source selection algorithm according to one inventive implementation, which in some examples may be performed by the one or more web servers shown in FIGS. 2, 3 and 6.

[0048] FIG. 8 is a block diagram showing additional details of the HLS server architecture of the servers and memory storage devices shown in FIGS. 2, 3 and 6, according to some inventive implementations.

[0049] FIGS. 9A through 9D show a process flow illustrating an HLS stream viewing process performed by the HLS server architecture shown in FIG. 8, according to one inventive implementation.

[0050] FIG. 10 illustrates some of the functionality (e.g., services and other processes) performed by the control server shown in FIGS. 2 and 3, according to one inventive implementation.

[0051] FIGS. 11A through 11C show a process flow diagram illustrating an RTMP media server scaling system service method performed by the control server of FIG. 10, according to one inventive implementation.

[0052] FIGS. 12A through 12C show a process flow diagram illustrating an RTMP CDN server scaling system service method performed by the control server of FIG. 10, according to one inventive implementation.

[0053] FIGS. 13A and 13B show a process flow diagram illustrating a stream and server watchdog service method performed by the control server of FIG. 10, according to one inventive implementation.

[0054] FIGS. 14A and 14B show a process flow diagram illustrating a check RTMP media/CDN server method performed by the control server of FIG. 10 (e.g., as part of the method shown in FIGS. 13A and 13B), according to one inventive implementation.

[0055] FIG. 15 shows a process flow diagram illustrating an event data ingress service method performed by the control server of FIG. 10, according to one inventive implementation.

[0056] FIGS. 16A and 16B show a process flow diagram illustrating a live event data monitor service method performed by the control server of FIG. 10, according to one inventive implementation.

[0057] FIGS. 17A and 17B show a process flow diagram illustrating an asynchronous task service method performed by the control server of FIG. 10, according to one inventive implementation.

[0058] FIGS. 18A and 18B show a process flow diagram illustrating a process for taking a screenshot (thumbnail) of a live stream, performed by the control server of FIG. 10, according to one inventive implementation.

[0059] FIGS. 19A and 19B show a process flow diagram illustrating a user login process according to one inventive implementation, which in some examples may be performed by a client device and facilitated by one or more web servers shown in FIGS. 2 and 3.

[0060] FIGS. 20A and 20B show a process flow diagram illustrating a mobile broadcaster stream create process according to one inventive implementation, which in some examples may be performed by a broadcaster client device shown in FIG. 1A and facilitated by one or more web servers shown in FIGS. 2 and 3.

[0061] FIGS. 21A, 21B, 21C, 21D, and 21E show a process flow illustrating a mobile broadcaster active stream process according to one inventive implementation, which in some examples may be performed at least in part by a broadcaster client device shown in FIG. 1A.

[0062] FIGS. 22A and 22B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for the processes shown in FIGS 20A and 20B, and FIGS. 21A-21E, according to one inventive implementation.

[0063] FIGS. 23A and 23B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for a live stream RTMP media server or RTMP CDN viewer, according to one inventive implementation.

[0064] FIGS. 24A and 24B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for a live stream HLS viewer, according to one inventive implementation.

[0065] FIGS. 25A, 25B, and 25C show a process flow illustrating a mobile client live stream replay method, according to one inventive implementation.

[0066] FIGS. 26A, 26B, and 26C show a process flow illustrating an event data replay process called in the method of FIGS. 25A, 25B and 25C, according to one inventive implementation.

[0067] FIG. 27 shows a process flow illustrating a user input replay process called in the method of FIGS. 25A, 25B and 25C, according to one inventive implementation.

DETAILED DESCRIPTION

[0068] Following below are more detailed descriptions of various concepts related to, and implementations of, inventive systems, methods and apparatus for scalable low-latency viewing of broadcast digital content streams of live events, and synchronization of event information with viewed streams, via multiple Internet channels. It should be appreciated that various concepts introduced above and discussed in greater detail below may be implemented in various manners, and that examples of specific implementations and applications are provided primarily for illustrative purposes.

[0069] I. Overview

[0070] The present disclosure describes inventive systems, apparatus, and methods for connecting followers of live events (e.g., sports, performances, speeches, etc.), including commentators, spectators, and/or participants in live events (e.g., athletes, performers, politicians, etc.). In some example implementations, the inventive systems, apparatus and methods further provide a social platform for sharing and contributing multimedia associated with live events.

[0071] Live streaming is used herein to refer to delivery and/or receipt of content in real-time, as events happen, or substantially in real time, as opposed to recording content to a file before being able to upload the file to a media server, or downloading the entire file to a device before being able to watch and/or listen to the content. Streaming media is used herein to refer to multimedia (e.g., digital video and/or audio media) that is delivered between two or more network-connected devices in real time or substantially in real time. Streaming may apply to continuously updated media content other than video and audio including, but not limited to, a live ticker, closed captioning, and real-time text. An end-user (e.g., a viewer) may watch and/or listen to media streamed over a network (e.g., the Internet) using a user output interface such as a display and/or over a speaker communicatively coupled with, for example, a desktop computer, notebook or laptop computer, smart television, set-top box, Blu-ray™ player, game console, digital media player, smartphone (e.g., iOS or Android), or another network-connected interactive device.

[0072] In some implementations, a network platform receives and provides multimedia (e.g., digital video content and/or digital audio content) associated with a live event. The multimedia may be captured by one or more broadcasters present at the live event. A broadcaster present at the live event may stream video and/or audio content to the network platform in real time or substantially in real time during the live event. For example, a broadcaster may capture video of a sporting event, such as a local high school football game, using a video camera, smartphone camera, etc. The video may include audio and/or visual commentary from the broadcaster. One or more viewers (either present or not present at the event) may stream video and/or audio of the event to watch and/or listen in real time or substantially in real time during the live event to the broadcaster's commentary. Alternatively, a broadcaster present at the live event may record video and/or audio content for delayed streaming or uploading to the network platform during or after the live event, and a viewer may download the broadcaster's recording of the live event and the video and/or audio commentary for delayed viewing and/or listening.

[0073] In some implementations, a broadcaster may or may not be present at a live event to still generate multimedia content (broadcaster commentary) associated with the event during the event. For example, a broadcaster may generate audio or visual content about the event while simultaneously following the event via a live broadcast by a third party (e.g., television, radio,

Internet, etc.). The multimedia content may or may not include or be integrated with video and/or audio from the event itself.

[0074] In some implementations, a network platform is capable of integrating user-generated (broadcaster-generated) multimedia with real-time data (e.g., "event information") collected by the user or a third party. For example, a live competitive event may be integrated with scores for the event. Other real-time data may include but is not limited to alerts, statistics, trivia, polls, news, broadcaster and/or viewer messages, and/or advertising associated with or relevant to the event, a participant in the event, a location of the event, a date/time of the event, etc. In one implementation, a network platform allows a user to select content, for example, news articles, and create onscreen elements for simultaneous viewing of the content.

[0075] Audio and/or visual indications and content may be integrated with user-generated multimedia for simultaneous presentation. The presentation may be in real-time or substantially in real-time. For example, audio indications may be presented with digital video media, and/or visual content may be presented with digital audio media. In some implementations, audio and/or visual indications and content are presented simultaneously with digital audio and/or video media using multiple tracks and/or display frames or overlays. For example, digital video media of a basketball game or of a broadcaster providing play-by-play audio commentary for the game may be displayed with an overlay of a real-time scoreboard and/or ticker. Alternatively, the real-time scoreboard and/or ticker may be presented in a separate frame.

[0076] Audio and/or visual indications and content may be modifiable and/or interactive. For example, traditional news and sports broadcasting may insert audio and/or visual indications and content into an outgoing digital audio and/or video media stream. The receiving client devices have been assumed to be "dumb," that is, only capable of displaying the audio and/or video media as received. In contrast, in inventive implementations disclosed herein "smart" client devices allow audio and/or visual indications and content to be rendered on the client side, which allows for real-time modification and interaction with viewers and/or listeners. That is, client-side rendering allows for interactivity with elements and enhanced features not available to traditional broadcasting.

[0077] FIG. 1A is a block diagram of a system according to one inventive implementation, including multiple client devices (e.g., broadcaster client devices 100A and 100B, viewer client

devices 200A, 200B, 200C and 200D), broadcast/viewing servers and memory storage devices 1000 (e.g., serving as the network platform noted above), an event information provider 55, one or more news feeds (RSS feeds) 65, and a digital distribution platform (app store) 75 all communicatively coupled via the Internet 50. Each of the client devices 100A, 100B, 200A, 200B, 200C, 200D may download from the digital distribution platform 75 an app or software program that becomes resident on the client device (i.e., a client app) and performs at least some of the various broadcaster and viewer functionality described herein in connection with broadcasting live streams of digital content and viewing copies of broadcasted live streams, exchanging chat messages amongst broadcasters and one or more viewers, logging system events and providing system event messages to broadcasters and viewers, collecting and maintaining/updating event information and providing event information to broadcasters and viewers in a synchronized manner, providing and updating various animation and special effects graphics, and replaying of recorded streams.

[0078] Although FIG. 1A illustrates two broadcaster client devices and four viewer client devices, it should be appreciated that various numbers of client devices (broadcaster client devices and viewer client devices) are contemplated by the systems, apparatus and methods disclosed herein, and those shown in FIG. 1A are for purposes of illustration. More specifically, a given broadcaster may have virtually any number of viewers using respective viewer client devices to receive copies of the broadcaster's live stream of digital content via the servers and memory storage devices 1000; similarly, the system may accommodate virtually any number of broadcasters providing live streams of digital content to the servers and memory storage devices 1000, wherein each broadcaster has multiple viewers receiving copies of the broadcaster's live stream of digital content. In the example shown in FIG. 1A, a first broadcaster client device 100A provides a first live stream of digital content 102A, and a first plurality of viewer client devices 200A and 200B (grouped by a first bracket) receive respective copies 202A and 202B of the first broadcaster's live stream of digital content. Similarly, a second broadcaster client device 100B provides a second live stream of digital content 102B, and a second plurality of viewer client devices 200C and 200D (grouped by a second bracket) receive respective copies 202C and 202D of the second broadcaster's live stream of digital content. With respect to events or news that may be germane to a given broadcaster's live stream of digital content, the broadcast/viewing servers and memory storage devices 1000 may retrieve various event

information from the event information provider 55 (e.g., STATS LLC), and various news from news feeds (RSS) 65, and in turn convey various event information and/or news to one or more client devices.

[0079] As discussed in further detail below, a variety of digital content format and transmission protocols are contemplated herein for the broadcaster live streams 102A and 102B output by the broadcaster client devices 100A and 100B respectively, as well as the copies of the live streams 202A, 202B, 202C and 202D received by respective viewer client devices 200A, 200B, 200C and 200D. For example, the first broadcaster client device 100A may be a mobile broadcaster client device (e.g., a smartphone) and output a live stream of digital content 102A having an H.264 MPEG-4 Advanced Video Coding (AVC) video compression standard format, via real time messaging protocol (RTMP) transport for continuous streaming over the Internet (e.g., via a persistent connection to a first media server of the servers and memory storage devices 1000). The second broadcaster client device 100B may be a web-based device (e.g., a desktop computer) and output a live stream of digital content 102B having a VP8 video compression format, transmitted via the web real-time communication (WebRTC) protocol for continuous streaming over the Internet (e.g., via a persistent connection to a second media server of the servers and memory storage devices 1000). The copies of the live streams 202A, 202B, 202C and 202D may be transmitted by the servers and memory storage devices 1000 as continuous streams using RTMP or WebRTC, or using segmented and/or adaptive bitrate (ABR) protocols (e.g., Apple's HTTP Live Streaming "HLS;" Microsoft's HTTP Smooth Streaming "MSS;" Adobe's HTTP Dynamic Streaming "HDS;" standards-based ABR protocol "MPEG-DASH").

[0080] FIG. 1B illustrates a display 250 of an example viewer client device 200A in the system of FIG. 1A, showing various displayed content according to some inventive implementations. It should be appreciated that one or more elements of the various content discussed in connection with FIG. 1B similarly may be provided on the display of a broadcaster client device. In the example of FIG. 1B, a broadcaster is providing video-based commentary relating to a live sporting event, and the display 250 of the viewer client device 200A includes various content elements including the broadcaster's video-based commentary 252, event information 254 relating to the live sporting event about which the broadcaster is providing the video-based commentary, chat messages 258 from one or more viewers consuming the

broadcaster's video-based commentary, and various graphics, special effects and/or animation elements 256 (e.g., some of which are rendered in a "lower third" of the display 250).

[0081] More specifically, as shown in FIG. 1B, the client device 200A renders in the display 250 (pursuant to execution of a client app or software program) a first broadcaster's video-based commentary 252. As discussed above in connection with FIG. 1A, the first broadcaster's video-based commentary 252 is codified in a live stream of digital content 102A provided by the first broadcaster client device 100A to the servers and memory storage devices 1000, and a copy 202A of the first broadcaster's live stream is received by the viewer client device 200A from the servers and memory storage devices 1000. The display also includes event information 254 in the form of a "scorebug," wherein the scorebug includes indicators for the teams participating in the live sporting event, score information for the live sporting event, and event status (e.g., time clock, period or quarter, etc.). In various implementations discussed in further detail below, the scorebug may be animated, may include one or more special effects graphics elements, and/or may be interactive (e.g., the viewer may press or thumb-over one or more portions of the scorebug to launch further graphics or animations, receive additional information about the live sporting event, or navigate to another Internet location to receive additional information relating to the live sporting event).

[0082] The display 250 in FIG. 1B also includes lower-third content 256 comprising additional graphics, special effects and/or animation elements which similarly may be interactive; such elements may include a broadcaster-selected title for the broadcast, as well as text commentary from the broadcaster or event-related news. Additionally, as shown in the left portion of the display 250, the display may include one or more chat messages 258 from different viewers of the broadcaster's video-based commentary, including responses from the broadcaster themselves; as seen in FIG. 1B, the chat messages 258 may include the name of the viewer, a viewer photo, and the chat message content itself.

[0083] In some implementations, the network platform provided by the servers and memory storage devices 1000 maintains user profiles for broadcasters and viewers. Each user profile may be associated with, for example, a user email address, user device, or other unique identifier. Each user profile interface (e.g., "page" such as a webpage) may include and/or be customized with content (e.g., a profile photo, descriptive text, user-generated multimedia, favorite team

imagery, etc.). In some implementations, the network platform further allows for the creation of "team" profiles; for example, event participants (e.g., individuals, groups, parties, teams, bands, schools, etc.) may share a "team" profile, wherein the team profile interface (e.g., "page" such as a webpage) may aggregate relevant content (e.g., news or current events about a particular event or team, such as polls, trivia, photo galleries, etc.) and provide further opportunities for users to contribute and connect with each other. The network platform may provide user preference options to further define a team profile interface with recommendations and/or alerts specific to a particular user (e.g., to prominently feature recent activity of a particular user).

[0084] With respect to social media-related features, as noted above the network platform provides chat capabilities such that users may engage in live public and/or private chat sessions. For example, in some implementations, users may request permission (or be allowed) to send each other private and/or public messages (e.g., direct messages). Furthermore, users may be able to purchase private and/or public virtual gifts (e.g., digital images of beers, penalty flags, etc., or profile/content enhancements like ticker tape) or provide "sponsorships" for other users. Public gifts received by a user may be displayed on the user's profile and/or with his or her content.

[0085] In some implementations, users are able to publicly and/or privately comment on, rate, "like," or otherwise indicate their opinions on live events, event-associated topics, user profiles, team profiles, and user-generated content. Users may be able to use # hashtags within their messages, chat sessions, comments, and/or other activity to link to messages, chat sessions, comments, and/or other activity happening among other users and/or teams. Users may be able to use @ symbols within their messages, chat sessions, comments, and/or other activity to tag other users, event participants, and teams.

[0086] In some implementations, a network platform provides a directory of live events. The directory interface may be presented as a listing, drop-down menu, keyword search bar, etc. The directory interface may include and/or distinguish between different categories of events. For example, the directory interface may include and/or distinguish between events that are scheduled, underway, and/or completed. The directory interface also may include and/or distinguish between different or particular types of events (e.g., live sports versus live music, baseball versus hockey, professional versus collegiate, National League versus American

League, etc.); different or particular participants in the events (e.g., team, coach, athlete, owner, school, etc.); and/or different or particular locations of the events (e.g., country, region, state, county, town, district, etc.). As discussed in greater detail below, in one implementation a dedicated control server of the network platform periodically retrieves a variety of event information from one or more event information providers (e.g., for sports events, ESPN, STATS LLC), and populates a database of the network platform with information on available events so as to provide the directory of live events to a user.

[0087] In some implementations, the network platform may provide user preference options to further define an event directory interface with recommendations and/or alerts specific to a particular user. The network platform may request the location of a user or permission to access the geo-location of the user's device in order to recommend events nearby. The network platform may track and interpret patterns in the user's use of the platform to predict and recommend events specific to the user.

[0088] In some implementations, after a user selects an event, the network platform provides a directory of other users who are present at the event and/or generating media associated with the event. The directory interface may be presented as a listing, drop-down menu, keyword search bar, etc. Selection of another user from the event-specific directory allows connection to, communication with, and/or access to media generated by that user. Thus, a user is able to discover and connect with similar users. The network platform may provide user preference options to further define a user directory interface with recommendations and/or alerts specific to a particular user. For example, in some implementations, users can discover other users based in part on one or more of the location of respective users, an event about which the broadcaster is providing commentary, a title of a broadcaster's live stream, and topics or other users that have been identified (e.g., in chat messages relating to a given broadcaster's live stream and/or a particular user's profile, using # hashtags or @ symbols).

[0089] In some implementations, the popularity of an event and/or broadcaster is monitored, displayed, and/or used in real-time or substantially in real-time. For example, a number of video servers may be scaled based on demand and/or usage by client devices, including broadcasters and/or viewers. Worker servers may be used for distributed monitoring and capturing screenshots/thumbnails of video streams. In another example, client media source selection of

live stream copies, such as Real-Time Messaging Protocol (RTMP) versus HTTP Live Streaming (HLS), may be based on demand and/or usage levels (e.g., number of viewers requesting copies of a given broadcaster's live stream, capacity of media servers and/or content delivery network).

[0090] II. Servers and Memory Storage Devices

[0091] Having provided an overview of the information flow and general functionality enabled by the various elements shown in FIG. 1A, additional details of the servers and memory storage devices 1000 are now discussed, with reference initially to FIG. 2.

[0092] In particular, FIG.2 is a block diagram providing another perspective of the system shown in FIG. 1A, showing example communication connections between the broadcaster client devices 100A and 100B and the servers and memory storage devices 1000, example connections between the servers and memory storage devices 1000 and the viewer client devices 200A and 200C, and some structural details of the servers and memory storage devices 1000. Some of the broadcaster/viewer client devices that are mobile devices (e.g., smartphones) have downloaded a client app 5000 (e.g., from the digital distribution platform or app store 75 shown in FIG. 1A) which is resident in memory of the client device and executed by a processor of the client device. For purposes of simplifying the illustration, only the viewer client devices 200A and 200C explicitly show the client app 5000 resident on the client devices; it should be appreciated, however, that one or more mobile broadcaster client devices also have the client app 5000 installed thereon.

[0093] As shown in FIG. 2, in one inventive implementation the servers/memory storage devices 1000 include one or more web servers 700 (also referred to herein as a "web server pool") that support an Applications Programming Interface (API) to facilitate communications between the servers/memory storage devices 1000 and one or more mobile broadcaster/viewer client device executing the client app 5000, and also facilitate communications to and from web-based client devices (that access the web server(s) via a web portal at a particular URL). In this role, as discussed in further detail below, much of the instructive communication between the client devices and the servers/memory storage devices 1000 occurs via the web server(s) 700. For example, it is via the web server(s) 700 that client devices create new live streams for broadcast and get access to media servers, receive access to view other broadcasters' live streams

via one of multiple different media sources, receive event information associated with broadcasters' live streams and send and receive chat messages, log on and create or update user profiles (or other profiles such as team profiles), and access other social media-related functionality (e.g., digital gift giving) to interact with other users. The web server(s) 700 are communicatively coupled to a memory system 400 that includes a database 420, data storage 440, and one or more memory caches 460 to store various information (e.g., user profile information, stream information, event information, recorded live streams, etc.) germane to the operation of the servers and memory storage devices 1000 and the various client devices.

[0094] The servers/memory storage devices 1000 further comprise a plurality of media sources 300 (e.g., computer servers including one or more processors, memory, and one or more communication interfaces) that receive a live stream of video-based commentary from a given broadcaster client device, and provide copies of the live stream of video-based commentary to one or more viewer client devices. As shown in FIG. 2, in one implementation the media sources 300 are communicatively coupled to the memory system 400, and may comprise one or more Real Time Messaging Protocol (RTMP) media servers 320, an RTMP Content Delivery Network (CDN) 340 (which itself includes a plurality of content delivery network servers), one or more WebRTC media servers 360, and an inventive HTTP Live Streaming (HLS) caching and amplifying server architecture 380. Additional details of the media sources 300 are discussed below in connection with FIGS. 3 through 6, and particular details of media server processes (performed by the RTMP media servers 320 and the WebRTC media servers 360) are discussed below in connection with FIGS. 5A, 5B and 5C. As also discussed below, in one implementation the web server(s) 700 select a particular media server of the media sources 300 to which a given broadcaster connects to provide the broadcaster's live stream of digital content, and the web server(s) 700 also select a particular media source of the media sources 300 to which a given viewer connects to receive a copy of a given broadcaster's live stream; further details of a broadcast media server selection algorithm and a viewer stream source selection algorithm implemented by the web server(s) 700 are provided below in connection with FIGS. 6 and 7.

[0095] The servers/memory storage devices 1000 shown in FIG. 2 further comprise a control server 500 coupled to the memory system 400, the event information provider 55, and the news feeds (RSS) 65 (e.g., via the Internet). In one aspect, the control server 500 periodically retrieves

various event information from the event information provider 55 and/or news from the news feeds 65 that is germane to respective broadcasters' video-based commentary. In another aspect, the control system 500 may store at least some portion of retrieved event information and/or news in the memory system 400. More generally, as discussed below in connection with FIG. 10, the control server 500 implements a number of services/processes that govern functionality of other servers and devices in the servers/memory storage devices 1000; examples of such control system services/processes include, but are not limited to: an RTMP media server scaling process to add or remove servers from the one or more RTMP media servers 320 of the media sources 300 (see FIG. 11); an RTMP CDN server scaling process to add or remove servers from the RTMP CDN 340 of the media sources 300 (see FIG. 12); a live stream and media server watchdog process (see FIGS. 13-14); an event data ingress process (see FIG. 15); a live event data monitor process (see FIG. 16); an asynchronous task processor (see FIG. 17); and a live stream thumbnail/screenshot acquisition process (see FIG. 18).

[0096] With reference again to FIG. 2, the servers/memory storage devices 1000 further comprise one or more socket servers 600 communicatively coupled to the web server(s) 700 and the control server 500. In one aspect, the socket server(s) 600 facilitate communication, to one or more broadcaster client devices and one or more viewer client devices, of synchronized event information retrieved by the control server 500 and associated with video-based commentary relating to a particular event. In particular, one or more sockets of the socket server(s) dedicated to the particular event allow respective client devices to establish an event information channel with the socket server(s), such that the event information (e.g., in the form of "event messages") is shared in a synchronized manner by all broadcasters/viewers following the particular event.

[0097] In FIG.2, the socket server(s) 600 also facilitate communication, between a given broadcaster of a live stream of video-based commentary and corresponding viewers of copies of the live stream, of chat messages and/or system event information (also referred to collectively simply as "chat information") relating to the broadcaster's live stream. In particular, one or more sockets of the socket server(s) 600 dedicated to the particular broadcaster's live stream allow respective client devices used by the broadcaster and their viewers to establish a chat/system event channel with the socket server(s), such that chat messages/system event information is shared in a synchronized manner by the broadcaster of the live stream and corresponding viewers of copies of the live stream. Chat messages sent on a given chat/system event channel may be

displayed as text on all broadcaster/viewer client devices connected to the socket(s) dedicated to the particular broadcaster's live stream, whereas system event information may be received (but not necessarily displayed itself) by all client devices connected to the socket(s) dedicated to the particular broadcaster's live stream, and provide the client device with relevant data or instructions to take some action. As discussed further below, examples of the types of system event information or "system messages" that may be broadcast by the socket(s) dedicated to the particular broadcaster's live stream include, but are not limited to, indications of viewers joining or leaving a broadcast, an indication of a new follower of a broadcaster, indications relating to the purchase of digital gifts and types of digital gifts (which may cause some display or audio event on the client device), indications relating to "likes" (e.g., cheers, handclaps, or applause icons, or audio of crowds cheering), and other data/instructions relating to various social networking functionality.

[0098] In one aspect, connections between a given client device and a particular socket of a socket server are persistent authenticated connections (e.g., with IP-based fingerprint identifiers for anonymous users). The authenticated connection allows the servers and media storage devices 1000 to track how many users are connected to a particular socket at any given time (and hence how many users are viewing a copy of a particular broadcaster's live stream, and/or how many users are viewing a copy of a live stream relating to a particular event). In another aspect, the various "messages" (e.g., event messages, chat messages, system messages) that are carried on the respective channels between a given client device and corresponding sockets of the socket server(s) are data packets including various event information, chat to be displayed, or system events (e.g., "new viewer," "disconnected viewer," "stream muted, "stream ended").

[0099] With reference again for the moment to FIG. 1A, recall that in the example arrangement depicted in FIG. 1A a first broadcaster client device 100A provides a first live stream of digital content 102A, and a first plurality of viewer client devices 200A and 200B (grouped by a first bracket) receive respective copies 202A and 202B of the first broadcaster's live stream of digital content. Similarly, a second broadcaster client device 100B provides a second live stream of digital content 102B, and a second plurality of viewer client devices 200C and 200D (grouped by a second bracket) receive respective copies 202C and 202D of the second broadcaster's live stream of digital content. Turning now again to FIG. 2, and taking only the viewer client devices 200A and 200C into consideration for purposes of illustration, the example

implementation shown in FIG. 2 contemplates that the first broadcaster is providing video-based commentary about a first live sporting event, and the second broadcaster is providing video-based commentary about a second (different) live sporting event, such that the first viewer client device 200A receives the copy 202A of the first broadcaster's live stream of digital content 102A relating to the first sporting event (and provided by the first broadcaster client device 100A), and that the second viewer client device 200C receives the copy 202C of the second broadcaster's live stream of digital content 102B relating to the second sporting event (and provided by the second broadcaster client device 100B). Also, in the example of FIG. 2, the first broadcaster's live stream 102A is an RTMP stream received by the RTMP media server(s) 320, and the second broadcaster's live stream 102B is a WebRTC stream received by the WebRTC media server(s) 360. The media sources 300 provide the copy 202A of the first broadcaster's live stream 102A to the first viewer client device 200A via a first video Internet communication channel 204A, and provide the copy 202C of the second broadcaster's live stream 102B to the second viewer client device 200C via a second video Internet communication channel 204C (further details of the role of the web server(s) 700 in selecting a particular media source of the media sources 300 to which each viewer client device connects to establish a video Internet communication channel are discussed below in connection with FIGS. 6 and 7).

[0100] In the example of FIG. 2, as noted above the control server 500 periodically retrieves, via the Internet and from the event information provider 55, first event information 502A germane to the first live sporting event, wherein the first event information includes at least first score information 504A for the first live sporting event. The control server further retrieves second event information 502B germane to the second live sporting event, wherein the second event information includes at least second score information 504B for the second live sporting event. The control server passes at least the first score information 504A and the second score information 504B to the socket server(s) 600. In turn, the socket server(s) 600 establish one or more first event sockets 602A dedicated to the first event information and one or more second event sockets 602B dedicated to the second event information.

[0101] As discussed further below, the web server(s) 700 provide to the first viewer client device 200A a first event identifier (a first EventID) that corresponds to the first event socket 602A; the web server(s) 700 also provide to the second viewer client device 200C a second event identifier (a second EventID) that corresponds to the second event socket 602B. The first viewer

client device 200A uses the first EventID to connect to the first event socket 602A (e.g., via a first URL including the first EventID in a path of the URL), and the second viewer client device 200C uses the second EventID to connect to the second event socket 602B (e.g., via a second URL including the second EventID in a path of the URL). The first score information 504A is then transmitted to the first viewer client device 200A via a first event information Internet communication channel 206A between the first event socket 602A and the first viewer client device 200A, and the second score information 504B is transmitted to the second viewer client device 200C via a second event information Internet communication channel 206C between the second event socket 602B and the second viewer client device 200C.

[0102] In a manner similar to that described above in connection with the first and second event information, in the example of FIG. 2 chat messages and other system event information ("chat information") may be distributed to viewers of each broadcaster via respective dedicated sockets of the socket server(s) 600. In particular, the socket server(s) 600 similarly establish one or more first chat/system event sockets 604A dedicated to the first broadcaster's live stream of digital content 102A and one or more second chat/system event sockets 642B dedicated to the second broadcaster's live stream of digital content 102B. The web server(s) 700 provide to the first viewer client device 200A a first stream identifier (a first StreamID) that corresponds to the first chat/system event socket 604A; the web server(s) 700 also provide to the second viewer client device 200C a second stream identifier (a second StreamID) that corresponds to the second chat/system event socket 604B. The first viewer client device 200A uses the first StreamID to connect to the first chat/system event socket 604A (e.g., via a first URL including the first StreamID in a path of the URL), and the second viewer client device 200C uses the second StreamID to connect to the second chat/system event socket 604B (e.g., via a second URL including the second StreamID in a path of the URL). The first chat information 210A is then transmitted to the first viewer client device 200A via a first chat/system event Internet communication channel 208A between the first chat/system event socket 604A and the first viewer client device 200A, and the second chat information 210B is transmitted to the second viewer client device 200C via a second chat/system event Internet communication channel 208C between the second chat/system event socket 604B and the second viewer client device 200C.

[0103] For purposes of simplifying the illustration in FIG. 2, the broadcaster client devices 100A and 100B are shown only providing respective live streams 102A and 102B directly to

different media servers 320 and 360; however, it should be appreciated that the broadcaster client devices 100A and 100B have additional communication connections to the socket server(s) 600 and the web server(s) 700, similar to those shown in FIG. 2 between the example viewer client devices 200A and 200C and the socket server(s) 600 and web server(s) 700, so that the broadcaster client devices may similarly receive event information and chat information on different communication channels respectively dedicated to the event information and chat information.

[0104] In view of the foregoing, it may be appreciated from FIG. 2 that, in one example implementation, there are three different communication channels between a given broadcaster/viewer client device and the broadcast/viewing servers and media storage devices 1000, namely: 1) a video communication channel (e.g., 204A, 204C) between the client device and the media sources 300 to receive a copy of a broadcaster's live stream of digital content; 2) an event information communication channel (e.g., 206A, 206C) between the client device and one or more particular sockets of the socket server(s) 600 dedicated to a particular event; and 3) a chat/system event communication channel (e.g., 208A, 208C) between the client device and one or more particular sockets of the socket server(s) 600 dedicated to a particular broadcaster's live stream of digital content.

[0105] In the example of FIG. 2, the first and second broadcasters provide to their respective viewing audiences video-based commentary regarding different live sporting events. However, as discussed elsewhere in this disclosure, it should be appreciated that the events about which the broadcasters provide video-based commentary are not limited to live sporting events, but may relate to a wide variety of other events, news, and/or particular topics of interest. Additionally, it should be appreciated that the first and second broadcasters (and additional broadcasters) may provide to their respective viewing audiences video-based commentary about the same live event; in this case, the servers and media storage devices 1000 provide the appropriate connectivity such that viewers of the same live event may effectively switch between different broadcasters' video-based commentary about the event, participate in different chat information exchanges associated with each broadcaster's live stream, and all share the same event information in a synchronized manner.

[0106] In particular, with reference again to the example of FIG. 2, consider an implementation in which both the first broadcaster's live stream of digital content 102A and the second broadcaster's live stream of digital content 102B include the broadcasters' respective video-based commentary about the first live sporting event. In this situation, the web server(s) 700 would provide to both the first viewer client device 200A and the second viewer client device 200C the first event identifier (the first EventID) that corresponds to the one or more first event sockets 602A of the socket server(s) 600, and both of the first viewer client device 200A and the second viewer client device 200B would use the first EventID to connect to the one or more first event sockets 602A (e.g., via a first URL including the first EventID in a path of the URL). In this manner, the first score information 504A would then be transmitted to both the first viewer client device 200A via the first event information Internet communication channel 206A between the one or more first event sockets 602A and the first viewer client device 200A, and to the second viewer client device 200C via a second event information Internet communication channel 206C between the one or more first event sockets 602A and the second viewer client device 200C. Thus, both of the viewer client devices in this scenario would receive the same event/score information for the first live sporting event in a synchronized manner from the socket server(s).

[0107] At the same time, however, the respective viewer client devices 200A and 200C would be connected to different chat/system event sockets of the socket server(s) corresponding to the different broadcasters' live streams; in particular, the web server(s) 700 would provide to the first viewer client device 200A the first stream identifier (the first StreamID) that corresponds to the first chat/system event socket 604A and provide to the second viewer client device 200C the second stream identifier (the second StreamID) that corresponds to the second chat/system event socket 604B. As discussed in the previous example, the first viewer client device 200A would use the first StreamID to connect to the first chat/system event socket 604A (e.g., via a first URL including the first StreamID in a path of the URL), and the second viewer client device 200C would use the second StreamID to connect to the second chat/system event socket 604B (e.g., via a second URL including the second StreamID in a path of the URL). The first chat information 210A would then be transmitted to the first viewer client device 200A via a first chat/system event Internet communication channel 208A between the first chat/system event socket 604A and the first viewer client device 200A, and the second chat information 210B would be

transmitted to the second viewer client device 200C via a second chat/system event Internet communication channel 208C between the second chat/system event socket 604B and the second viewer client device 200C.

[0108] FIG. 3 is a block diagram showing additional details of various interconnections between the respective components of the servers and memory storage devices 1000 shown in FIG. 2, according to some inventive implementations. In the example of FIG. 3, some of the components of the servers and memory storage devices (e.g., 1000A) are hosted by a first web hosting service (e.g., Amazon Web Services AWS), while one or more other components of the servers and memory storage devices (1000B) may be hosted by a different web hosting service and/or generally accessible via the Internet. In yet other implementations, a single web hosting service may host all of the servers and memory storage devices. In addition to the various components shown in the example of FIG. 2, FIG. 3 also shows that the servers and memory storage devices 1000 may further include a transcoder server pool 800 (e.g., that may be employed for transcoding of recordings of a given broadcaster's live stream of digital content, for later replay via adaptive bitrate protocols), an asynchronous queue 850 (e.g., for queuing of various messages and instructions to be acted upon by an asynchronous task processor implemented by the control server 500), and a gateway NAS server 870 (e.g., to facilitate communications between a WebRTC media server pool and other elements of the servers and memory storage devices 1000A that may be hosted by the first web hosting service). Additionally, FIG. 3 illustrates that the database 420 may include a main database and multiple database shards, in which portions of data are placed in relatively smaller shards, and the main database acts as a directory for the database shards (in some implementations, the main database also stores some de-normalized data, for example, to facilitate cross-server searching).

[0109] III. Technological Solutions to Improve Computer Network Functionality, Increase Computer Processing Efficiency and Reduce Computer Memory Requirements

[0110] In developing the inventive systems, apparatus and methods disclosed herein, including the servers and memory storage devices 1000 shown in FIGS. 2 and 3 as well as the client app 5000 executed by mobile client devices, the Inventors recognized and appreciated multiple technological problems with conventional techniques for transmission of digital content via the Internet. As introduced above and discussed in further detail below, the Inventors have

addressed and overcome these technological problems with innovative technological solutions to effectively realize the various technical features described herein. Examples of these technological solutions include, but are not limited to, improving computer network functionality (e.g., improving the speed of content transfer from broadcaster devices to viewer devices and synchronization of various content amongst multiple client devices), and improving processing efficiency of broadcaster and viewer client devices via execution of the client app 5000, while at the same time reducing memory storage requirements for the client app 5000 on the client devices.

[0111] More specifically, examples of the technological problems addressed by the inventive solutions provided by the servers and memory storage devices 1000 and client app 5000 include, but are not limited to: 1) how to provide relatively low latency copies of live streams of broadcaster digital content to multiple viewers of each of multiple broadcasters (e.g., broadcaster-to-viewer delay time on the order of ten seconds or less, or on the order of two-to-three seconds or less), and with relatively high quality and reliability (e.g., high definition HD and high bit rate, such as 2 to 5 megabits per second); 2) how to synchronize such low latency and high quality copies of broadcaster live streams of digital content with event information associated with the digital content (as well as chat information associated with a given broadcaster) amongst the multiple viewers of each broadcaster, irrespective of the number of viewers (e.g., 10 viewers, 1,000 viewers, or 10,000 viewers); 3) how to allow different classes/types of viewers (e.g., VIP users, premium subscribers, media professionals, registered users, anonymous users, web/desktop users, mobile users), and increasing numbers of viewers, to flexibly access each broadcaster's content with different live streaming formats (e.g., continuous streaming protocols such as real time messaging protocol or "RTMP," web real-time communication or "WebRTC;" segmented protocols such as HTTP live streaming or "HLS," HTTP Smooth Streaming or "MSS," HTTP Dynamic Streaming or "HDS," standards-based ABR protocol "MPEG-DASH") and with different qualities of service; 4) how to effectively render "studio-quality" screen animations and special effects graphics (e.g., including "scorebugs" for sporting events) on displays of mobile client devices via a client app with a small memory footprint (e.g., less than 100 megabytes, such that the client app is downloadable via cellular networks); and 5) how to provide for viewing of a recording of a broadcaster's live stream as if the viewer was watching the live stream in essentially real-time (e.g., while

recreating chat messages and event information updates). Various aspects of the technological solutions to these respective technological problems are discussed in turn below.

[0112] 1) Latency Considerations

[0113] With respect to latency considerations, the inventive systems, methods and apparatus disclosed herein contemplate particular parameters for the generation of a live stream of digital content by a broadcaster client device so as to induce only relatively low "client side" latency. To this end, in example implementations the client app 5000 installed and executing on a given client device selects an appropriate keyframe interval (e.g., 30 frames) for generating a broadcaster's live stream of digital content to ensure relatively low client side-induced end-to-end digital content latency.

[0114] In other aspects relating to reducing latency, particular parameters and techniques for handling live streams are contemplated for the servers and memory storage devices 1000 disclosed herein (e.g., adjusting buffer sizes and transcoder settings in media servers; employing hardware-accelerated transcoding of broadcaster live streams via graphic card processing to provide for adaptive bitrate copies of live streams). Furthermore, in some example implementations, the RTMP CDN 340 shown in FIGS. 2 and 3 comprises an innovative auto-scaling RTMP CDN server pool, coupled to a media server pool that receives live streams from respective broadcasters (e.g., either RTMP or WebRTC), to facilitate delivery of low-latency live streams to a larger number of multiple viewers. Additionally, for RTMP broadcasters, the RTMP media server(s) 320 in some implementations is/are on the same network as the RTMP CDN 340 (e.g., the RTMP media server(s) are communicatively coupled to the RMTP CDN servers as a virtual private network (VPN), see VPN 330 in FIG. 6) so as to facilitate low latency communications. For WebRTC broadcasters, although in some implementations the WebRTC media server(s) 360 may not be hosted by the same service as the RTMP CDN 340 (e.g., see FIG. 3), the WebRTC media server(s) are coupled to the RTMP CDN via high speed/low latency connections. The RTMP CDN servers essentially make further copies of transcoded live streams received from the media server (e.g., without any other processing or alteration) and pass on the respective further copies to multiple viewers ("direct pass-through amplification"). In this manner, the RTMP CDN servers introduce appreciably low latency (e.g., on the order of less than 150 milliseconds) and facilitate a significantly greater number of viewers than could be

otherwise served by the media server itself. These exemplary aspects (as well as other aspects discussed in further detail below) provide for appreciably low latency introduced by the media servers and RTMP CDN (e.g., on the order of about 500 milliseconds or even less) and client-introduced digital content latency (e.g., on the order of about one-to-two seconds for continuous streaming consumers).

[0115] 2) Synchronization of Live Streams and Event Information

[0116] Yet another technical implementation challenge overcome by the inventive concepts disclosed herein relates to the display of event information updates (if present, e.g., if the broadcast is associated with an event), as well as screen animations and other special effects graphics that may be generally associated with the video and/or audio associated with a live stream, in a manner that is synchronized across multiple live streams with appreciably low latency. This is a particularly relevant consideration given that the systems, apparatus and methods disclosed herein are contemplated in some implementations as supporting multiple broadcasters providing video-based commentary for the same event, and each of these broadcasters may have multiple viewers of their broadcast – and thus, the technical challenge is to provide the same event information, and periodic updates to this event information, in a synchronized and low-latency manner to all of these broadcasters and viewers interested in following the same event. In exemplary implementations (e.g., as discussed above in connection with FIG. 2), this technical challenge is overcome with technological solutions implemented on both the client devices and the server architecture to which the client devices are communicatively coupled involving the use of multiple communication channels respectively dedicated to video/audio content from a given broadcaster, event information germane to an event about which any broadcaster may be providing video-based commentary, and chat information (chat messages and/or system event messages) shared amongst the broadcaster and their associated viewers.

[0117] In various inventive implementations disclosed herein (e.g., as introduced above in connection with FIG. 2), event information and updates to event information are provided to broadcaster client devices and viewer client devices via a socket-based "event information channel" dedicated to the event, and separate from the copy of the live stream of video-based commentary provided on a "video channel." Thus, all viewers (and broadcasters) of the event,

regardless of which live stream they may be generating or watching, connect to one or more sockets of a socket server that is/are dedicated to the event, such that all live streams relating to the event are similarly synchronized to event information and updates to same. Notably, if a viewer switches amongst different broadcasters of the same event (the viewer originally watches a first live stream from a first broadcaster of the event, and later selects a second live stream from a second broadcaster of the same event), the event information and updates to same (and any screen animations and special effects graphics that incorporate the event information) remain synchronized with all live streams from the different broadcasters, providing for a smooth second-screen experience across multiple broadcasters and viewers.

[0118] The technical challenge of displaying event information and updates to same in a synchronized and low-latency manner amongst multiple viewers is also addressed in part by using a single control server 500 in the server and memory storage devices 500 to gather and parse live event information captured in real-time. For example, for sporting events, game information may be obtained by the single control server from a dedicated third-party provider (e.g., STATS LLC, which is a sports statistics, technology, data, and content company that provides content to multimedia platforms, television broadcasters, leagues and teams, fantasy providers, and players). This single point of entry of event information into the server architecture, as provided by the control server, prevents synchronization errors inherent in network communications. Once a change in event status has been detected (e.g., if a play clock updates), the control server provides these changes to the one or more sockets dedicated to the event (to which all viewers and broadcasters of video-based commentary regarding the event are communicatively coupled), resulting in a single synchronized update to all client devices and thereby significantly mitigating client-by-client latency and/or synchronization issues.

[0119] 3) Flexible and Scalable Access to Broadcaster Content by Multiple Classes/Types of Viewers

[0120] The inventive systems, methods and apparatus disclosed herein and shown in FIGS. 2 and 3 further contemplate the ability to flexibly select the source of a copy of a broadcaster's live stream to be provided to respective multiple viewers from one of a number of possible media sources 300, namely: 1) the media server receiving the live stream in the first instance from a broadcaster (e.g., an RMTP media server 320 or a WebRTC media server 360); 2) an auto-

scaling RTMP CDN server pool 340; or 3) an innovative HTTP Live Streaming (HLS) server architecture 360. Thus, multiple live stream transmission formats, protocols, and access endpoints are contemplated for different types and numbers of viewers that may receive copies of broadcasters' live streams at different bitrates and with different qualities of service. As noted above, in some implementations the web server(s) 700 implement a viewer stream source selection algorithm which selects an appropriate media source for a given viewer based on, for example, the type of user (e.g., VIP users, premium subscribers, media professionals) and the number of viewers of a particular broadcaster's live stream. Further details of viewer stream source selection for respective viewer client devices are discussed further below in connection with FIGS. 6 and 7.

[0121] Another salient element of the flexibility and scale-ability provided by the media sources 300 of the servers and memory storage devices 1000 shown in FIGS. 2 and 3 relates to the HLS caching and amplifying server architecture 360. Conventionally, as would be readily appreciated by those of skill in the relevant arts, HLS is not designed to be cacheable at the server level, and hence synchronization issues arise in connection with providing multiple HLS copies of a live stream to respective viewers. In particular, in conventional implementations, each HLS copy of the live stream is somewhere in a "window" of time (an HLS "buffer length") relative to the original live stream (e.g., delayed from the original stream by some amount of time within an overall time window). This uncertainty results in the possibility of a first viewer of a first HLS copy of a live stream actually seeing the video content some time earlier than or later than a second viewer receiving a second HLS copy of the live stream, i.e., the respective viewers are not synchronized.

[0122] In exemplary implementations described herein, this technical problem is solved by employing an inventive HLS caching and amplifying server architecture 360, which is discussed in further detail below in connection with FIGS. 8, 9A, 9B, 9C and 9D. The HLS server architecture includes a "mother" server and one or more "child" servers, disposed between a media server and a content delivery network (CDN), in which the HLS mother server acts as a single "virtual viewer" from a given media server's perspective. Based on a single copy of an HLS file suite for a given broadcaster's live stream as provided by a media server and received by a mother caching server of the HLS server architecture, the mother server caches and passes on copies of the elements of the file suite (as requested) to one or more child servers, which in

turn cache and pass on copies of the elements of the file suite to one or more geographically-distributed servers of a conventional (e.g., global) CDN (serving as an HLS CDN in tandem with the mother-child server architecture). In this manner, the mother and child servers of the HLS architecture act as caching and amplifying servers, so that identical HLS streams may be served from the HLS CDN server pool to multiple viewers of a given broadcast in a significantly narrower synchronization window than conventionally possible. In particular, in one example implementation discussed in greater detail below in connection with FIGS. 6A, 6B, 6C, and 6D, all HLS viewers receiving a copy of a broadcaster's live stream via the HLS server architecture including a mother caching server and one or more child caching servers are at most less than one HLS file segment duration out of synchronization with each other; this phenomenon is referred to herein as "viewer segment concurrency." Based on the viewer segment concurrency provided by the inventive HLS server architecture, respective viewers of a given broadcast may be out of synchronization with one another by less than approximately one or two seconds at most.

[0123] 4) Client-side Rendering of On-screen Interactive Animations, Special Effects and/or Event Information

[0124] By way of background, in conventional sports broadcasting, game information (also sometimes referred to as a "scorebug"), as well as screen animations and other special effects graphics, are hard-embedded into the live stream of the game broadcast itself that is received by viewers. Unlike conventional scorebugs, screen animations, and/or other special effects graphics that are hard-embedded into live streams of a sports broadcast, in various inventive implementations disclosed herein graphics and effects are generated by the client device itself, separate from a given broadcaster's video-based commentary, and then integrated with (e.g., superimposed or overlaid on) the broadcaster's video-based commentary when rendered on the display of the client device. As shown for example in FIG. 1B, various graphics may be rendered on different portions of the display, for example, along a top or side of the display or in a "lower third" of the display.

[0125] For mobile client devices, the client app 5000 executing on the device is particularly configured to render a variety of "studio-quality" graphics while nonetheless maintaining a small file size for the client app (e.g., less than 100 megabytes, and in some instances from

approximately 60-70 megabytes); this affords an exciting and dynamic broadcaster and viewer experience on mobile client devices, while still allowing the modestly-sized client app to be readily downloaded (e.g., from a digital distribution platform or "app store" 75) to a client device via a cellular network. In some implementations, maintaining a modest file size for the client app while providing high-quality graphics, animations and other special effects is accomplished in part by designing animated graphics and special effects as a series of individual frames (still-frame images) that are hard-coded in the client app, and rendering the series of individual frames on the display in a "stop-motion" style according to an animation timer set in the client device (e.g., 15 frames per second). In some implementations, "sprite sheets" may be used for graphics elements; in yet other implementations, the transparency of individual frames may be set on a pixel-by-pixel basis as may be required in some applications to provide for suitable overlay on the broadcaster's video-based commentary.

[0126] In another aspect, client-side rendering of screen animations and/or other special effects graphics allows such animations and graphics to be user-interactive; for example, a user (broadcaster or viewer) on a client device may "select" a screen animation/special effect graphic (e.g., via a touch-sensitive display screen of the client device) and launch additional graphics or initiate some other functionality on the client device.

[0127] For example, as discussed above with respect to live events about which a given broadcaster may be providing video-based commentary, event information and updates to event information are provided to broadcaster client devices and viewer client devices via a socket-based "event information channel" dedicated to the event, and separate from the copy of the live stream of video-based commentary provided on a "video channel." Providing one or more sockets dedicated to the event information and separate from the live stream of video-based commentary provides for user-interactive features in connection with the event information, and/or the screen animations/special effects graphics incorporating the event information; for example, the user may select (e.g., thumb-over) the screen animation/special effect graphic including the event information and obtain access to additional (and in some cases more detailed) information relating to the event (e.g., a drill down on more granular event information, or a redirect to a web site or other app related to the particular event).

[0128] 5) Replay of Recorded Broadcaster Live Streams with Recreated Chat Messages and Event Information Updates

[0129] Another technical implementation challenge addressed by the technological solutions disclosed herein relates to the ability of a viewer to watch a recording of a live stream generated by a broadcaster client device (also referred to herein as a "video replay" of the live stream, or simply "replay") as if the viewer was watching the live stream in essentially real-time (as it was being generated by the broadcaster client device), while also allowing the viewer to "seek" to different points in the video replay. In one aspect of video replay, the broadcaster themselves may assume the role of a post-broadcast viewer of the recorded broadcast.

[0130] In exemplary implementations, a technological solution for overcoming the technical implementation challenge of replaying a recorded live stream and also recreating various chat messages and event information updates (if present) as they occurred during the originally broadcast live stream is based, at least in part, on having the socket-based communication techniques act in a "fully-authenticated" fashion, for example, by dynamically creating "anonymous accounts" for non-registered or "anonymous" users. By creating such accounts for anonymous users, a replay log may be created that logs when any given viewer (as a registered user or anonymous user) joins and leaves a particular broadcast. Additionally, the replay log may include additional information, such as user-generated chat information, system messages, and event information updates, respectively synchronized with timestamps associated with the live stream as originally generated by the broadcaster client device.

[0131] During replay of a recording of the live stream, the viewer client device requests a segment of this replay log and, using the timestamps in the recording of the live stream, replays not only the digital content in the live stream but also recreates chat messages, system-related messages and event information updates (if present) in the same order and relative time of occurrence as if the viewer were watching the live stream in essentially real-time when originally broadcasted by the broadcaster. As the replay advances, the viewer client device requests additional segments of the log, keeping an in-memory buffer to smooth out any possible Internet connectivity issues. Such a replay log also allows for "seeking," i.e., when a viewer fast forwards or rewinds; under these seeking circumstances, the viewer client device may retrieve the appropriate segment(s) of the replay log for the new viewing point, and continue to not only

replay the recording of the live stream from the new viewing point but also recreate (in the same order and relative time) chat messages, system-related messages and event information updates (if present) as if the viewer were watching the live stream in essentially real-time.

[0132] Having outlined some of the various technological solutions provided by the inventive systems, apparatus and methods disclosed herein to technological problems with conventional approaches to live streaming of digital content, the discussion now turns to additional details of respective components of the servers and memory storage devices 1000 shown in FIGS. 1A, 2 and 3, as well as the functionality of the client app 5000 executed by client devices.

[0133] IV. Broadcaster Media Server Selection

[0134] FIGS. 4A and 4B show a process flow diagram 450A and 450B illustrating a broadcast media server selection algorithm according to one inventive implementation, which in some examples may be performed by the web server(s) 700 shown in FIGS. 2 and 3. As noted above, in one implementation a mobile broadcaster client device (e.g., a smartphone) outputs a live stream of digital content having an H.264 MPEG-4 Advanced Video Coding (AVC) video compression standard format, via real time messaging protocol (RTMP) transport for continuous streaming over the Internet, whereas a web-based broadcaster client device (e.g., a desktop computer) outputs a live stream of digital content 102B having a VP8 video compression format, transmitted via the web real-time communication (WebRTC) protocol for continuous streaming over the Internet.

[0135] In the process shown in FIGS. 4A and 4B, the web server(s) 700 know whether the broadcaster client device requesting access to a media server is a mobile client (H.264/RTMP) or a web-based client (VP8/WebRTC) based on header information in the communications to the web server from the client device. For mobile clients, the web server provides access to (e.g., provides the address of an endpoint for) one of the RTMP media servers 320 of the media sources 300, and for web-based clients generating VP8/WebRTC live streams of digital content, the web server provides access to one of the WebRTC media servers 360 of the media sources 300. If a web-based client is connecting via Adobe Flash or other external software, the client may be treated similarly to the process for mobile clients.

[0136] In some implementations, multiple media servers of the RTMP media servers 320 are segregated into at least one VIP media server and at least one non-VIP media server; similarly,

some of the WebRTC media servers 360 are segregated into at least one VIP media server and at least one non-VIP media server. A given broadcaster may be directed to a VIP or non-VIP media server based on their user status (e.g., as a VIP user), and/or the availability of a particular server (e.g., based on available server capacity, in terms of total utilized connection bandwidth to the media server). In one aspect, to allow for some headroom in media server capacity, the "ideal capacity" of the server may be taken as approximately 60% of the true maximum capacity of the media server. If all non-VIP media servers exceed ideal capacity (but are at less than true maximum capacity), the process may send an internal administrative message (e.g., via SMS or email) to a system administrator to warn of a significant broadcaster load. In the event that no non-VIP servers are available to a given broadcaster (because all non-VIP servers are at true maximum capacity), the process displays "No Available Server" as an error message on the display of the broadcaster client device.

[0137] V. Media Server Process

[0138] FIGS. 5A through 5C show a process flow 550A, 550B, 550C, and 550D illustrating a media server process for the RTMP and WebRTC media servers 320 and 360 shown in FIGS. 2 and 3, according to one inventive implementation. These process flows include a "server monitor" process and a "video uploader" process that each of the RTMP and WebRTC media servers implements as they receive and process live streams from various broadcasters.

[0139] Regarding the "server monitor" process, a given media server periodically reports server statistics to be stored in the database 420, and queries the database to obtain a list of broadcaster streams that have been assigned to, and are connected to, the media server. For newly connected streams, the media server validates the stream information (e.g., StreamID), with the database, and if the stream is valid the media server starts a live transcoding process to provide different resolution copies of the live stream (e.g., 720p, 360p and 240p transcoded copies); in the case of a WebRTC media server, the media server also transcodes the VP8/WebRTC live stream to H.264 before providing the different resolution transcoded copies. In some implementations, the media server employs hardware-accelerated transcoding of the broadcaster's live stream (e.g., via graphic card processing) to ensure low latency of viewed transcoded copies of the live stream. The media then starts recording the highest resolution transcoded copy (e.g., 720p in the illustrated example) to provide a "raw video" recording, and

notifies the database that the live stream has started and is available for viewing. Thereafter, the media server queues a first screenshot (thumbnail) for the live stream in the asynchronous queue (e.g., see 850 in FIG. 3) for processing by the control server 500 (see FIGS. 18A and 18B), and also queues push notifications to notify subscribers and followers of the broadcaster that the broadcaster is online with a live stream (e.g., by providing a StreamID to the followers/subscribers).

[0140] Thereafter, while the broadcaster continues to provide a live stream, and if there are any HLS viewers (discussed further below in connection with FIGS. 8 and 9A through 9D), the media server begins an HLS segmentation process to create and update an HLS file suite comprising an HLS playlist, HLS chunklists, and HLS file segments for each of the transcoded different resolution copies of the broadcaster's live stream. The media server process also periodically queues in the asynchronous queue (e.g., every five seconds or so) additional screenshots/thumbnails of the live stream. Once the broadcaster has ended the live stream, the media server process stops the recording of the highest resolution transcoded copy, sends out a system message on the chat/system event socket(s) corresponding to the broadcaster's live stream that the stream has ended, stops the live transcoding process, and stores the stream end time in the database 420. The media server process then also queues the upload of the "raw video" recording (the recording of the highest resolution transcoded copy) to the media server upload queue.

[0141] The video uploader process shown in FIG. 5A reads from the media server upload queue and, if there are any entries in the queue, uploads the corresponding raw video recording of the broadcaster's live stream to data storage 440 (e.g., Amazon S3) and stores the upload time to the database 420. The video uploader process also may notify a third-party transcoding service (e.g., see the transcoding server pool 800 in FIG. 3) to provide transcoded different resolution copies of the recorded video to facilitate adaptive bitrate replay for one or more viewers.

[0142] VI. Viewer Stream Source Selection

[0143] FIG. 6 is a block diagram illustrating the media sources 300 and the web server(s) 700 of the servers and memory storage devices 1000 shown in FIGS. 2 and 3, as well as the first and second broadcaster client devices 100A and 100B and one of the viewer client devices 200A, to

facilitate a discussion of the selective coupling of an example viewer client device to one of the media sources, according to some inventive implementations. In tandem with FIG. 6, FIG. 7 is a process flow diagram illustrating a viewer stream source selection algorithm 702 according to one inventive implementation, which in some examples may be performed by the web server(s) 700.

[0144] As depicted representationally in FIG. 6, in one aspect the web server(s) 700 essentially serve as a controllable switch to couple the viewer client device 200A to one of an RTMP media server 320, the RTMP CDN 340 (which is communicatively coupled to the RTMP media server(s) in a virtual private network 330), a WebRTC media server 360 and the HLS serve architecture 360 to receive a copy of broadcaster's live stream of digital content. In the example of FIG. 6, the web server(s) 700 has facilitated a connection between the viewer client device 200A and the RTMP CDN 340 (as shown by the dashed line in FIG. 6). However, as discussed below, the web server(s) 700 may facilitate a connection between the viewer client device 200A and any one of the media sources 300 based at least in part on a number of viewers already receiving copies of the broadcaster's live stream. In one implementation, the database 420 stores user profiles for broadcasters and viewers, in which the user profile may include a user type (e.g., registered user, anonymous user, subscriber of one or more broadcasters, VIP user, media professional or media member, etc.); in this instance, the web server(s) 700 may facilitate a connection between the viewer client device 200A and one of the media servers 300 based at least in part on a type or status of a user of the viewer client device 200A and/or the number of viewers already receiving copies of the live stream.

[0145] More specifically, as shown in the process of FIG. 7, if the viewer client device sends a request to the web server(s) 700 to view a copy of a given broadcaster's live stream (e.g., based on a StreamID for the live stream that the viewer client device received in a push notification), and the web server(s) 700 determine that there are fewer than a first number (e.g., 10) of viewers already receiving copies of the live stream (e.g., based on a viewing count for the stream maintained in the database 420), the web server(s) provide to the viewer client device an address to connect directly to one of the RTMP media servers 320 or one of the WebRTC media servers 360 that is processing the broadcaster's live stream (depending on whether the broadcaster client device is a mobile H.264 or web-based VP8 client device). Irrespective of the number of viewers, the web server(s) 700 also provide an address to the viewer client device to connect

directly to one of the media servers if a user of the viewer client device is a VIP subscriber or media professional. If however the user is not a VIP subscriber or media professional, and there are more than a first number of viewers already receiving copies of the live stream, the web server(s) provide to the viewer client device an address to connect to one of the CDN servers of the RTMP CDN 340. However, if all CDN servers of the RTMP CDN 340 are at their maximum capacity (e.g., as reflected in server statistics stored in the database), the web server(s) 700 provide an address to the viewer client device to connect to the HLS server architecture 360.

[0146] VII. HTTP Live Streaming (HLS) Server Architecture

[0147] FIG. 8 is a block diagram showing additional details of the HLS server architecture 380 of the servers and memory storage devices 1000 shown in FIGS. 2, 3 and 6, according to some inventive implementations. FIGS. 9A through 9D show a process flow illustrating an HLS stream viewing process 902A, 902B, 902C and 902D performed by the HLS server architecture 380 shown in FIG. 8, according to one inventive implementation. As some of the discussion of the HLS server architecture 380 relates to processing of a live stream at a media server, reference is made again to the media server process discussed above in connection with FIGS. 5A, 5B, and 5C.

[0148] HTTP Live Streaming (HLS) is a conventional HTTP-based media streaming communications protocol, in which a live media stream (e.g., video and accompanying audio) is divided up or "segmented" by an HLS media server into a sequence of small files that may be downloaded to a viewer client device via HTTP communications with the HLS media server, wherein each downloaded file represents one short segment or "chunk" of a copy of the live stream. As respective chunks of the copy of the live stream are downloaded and played by the viewer client device, the client device may select from multiple different alternate streams containing the same video/audio material transcoded by the media server at a variety of data rates (e.g., at different resolutions), allowing the HLS streaming session to adapt to the available data bit rate/bandwidth of the client device's connection to the HLS server. HLS connections are, by definition, not persistent connections between the HLS media server and the viewer client device, since requests for and delivery of HLS content uses only standard HTTP transactions. This also allows HLS content to be delivered to multiple viewer client devices over widely available HTTP-based content delivery networks (CDNs).

[0149] With reference again to the media server process in FIGS. 5A, 5B, and 5C, as a broadcaster's live stream is received by a media server it is cached for some amount of time (e.g., 10 to 30 seconds). The broadcaster's live stream typically includes a succession of frames at some frame rate (e.g., 30 frames/sec), and the succession of frames includes multiple "keyframes" associated with video encoding/compression. Such keyframes include the "full" content of an instant of the video, and these keyframes reset the basis of calculation (compression/estimation) for ensuing video information; in conventional video encoding/compression techniques, compressed frames between keyframes essentially include only information representing what has changed in the content between respective frames, and not the entire visual content for corresponding instants of the video. Increasing the frequency of keyframes in the stream of video frames reduces any errors that may be introduced in the compression process, as such errors would have a shorter lifespan (there would be fewer numbers of compressed frames between keyframes).

[0150] As indicated in FIG. 5B, an incoming live stream from a broadcaster and received by a media server (e.g., incoming H.264 from an RTMP broadcaster client, or VP8 from a WebRTC broadcaster client that has been transcoded to H.264) is transcoded (e.g., by the media server) to provide different resolution copies of the live stream at corresponding different bitrates (e.g., to facilitate adaptive bitrate streaming, as noted above). For example, the broadcaster's live stream may be transcoded to provide 720p, 360p and 240p different resolution copies of the live stream. As part of the transcoding process, the media server may be configured such that the keyframe interval for each transcoded copy is a predetermined value, and the keyframe interval for the transcoded copies may be the same as or different than a keyframe interval associated with the broadcaster's incoming live stream. Conventional examples of keyframe intervals that may be configured at a media server for transcoded copies of the live stream range from about 60 frames to 300 frames of video, and in some instances as high as 600 frames (at an exemplary frame rate of 30 frames/second, the associated time durations for such keyframe intervals range from two seconds for a keyframe interval of 60 frames to 10 seconds for a keyframe interval of 300 frames, and in some instances as high as 20 seconds for a keyframe interval of 600 frames).

[0151] As discussed above in connection with FIG. 5C, to implement HLS each of these different resolution copies is divided into small segments of video based in part on the keyframe interval of the copies. More specifically, the media server may be configured to set a target

segment length (duration) of each segment into which the transcoded copy of the live stream is divided. An example of a conventional target segment duration for HLS is 10 seconds; however, as discussed below, in some implementations the media server is particular configured to have a significantly lower target segment duration to facilitate the functionality of the HLS server architecture 380 in processing copies of segmented live streams.

[0152] With reference again to FIG. 5C, the media server ultimately divides each copy of the live stream into respective video segments having a duration that is as close as possible to the target segment duration, with the proviso that a segment must start on and include a keyframe but may include one or more keyframes (i.e., the segment duration in practice is based on the target duration configured in the media server, some multiple of keyframes, and the frame rate of the transcoded copy). For purposes of illustration, and taking a conventional target segment duration of 10 seconds, a frame rate of 30 frames/second, and a keyframe interval of from 60 to 300 frames, each conventional 10 second HLS segment may have 1 keyframe (given a keyframe interval of 300 frames) or up to 5 keyframes (given a keyframe interval of 60 frames).

[0153] For each transcoded different resolution copy of the broadcaster's live stream, the HLS segments of the copy are stored as small files (referred to in HLS as .ts files). Thus, in an example in which there are 720p, 360p and 240p transcoded copies of the live stream, there are three sets of .ts files being generated and stored in memory at the media server as each of the copies are segmented by the media server. For each set of .ts files corresponding to a different resolution copy of the live stream, a "chunklist" is created and maintained by the media server that includes a list of pointers (e.g., relative URLs) to corresponding .ts files stored in memory; accordingly, in the example of three different resolution copies, there would be three different corresponding chunklists.

[0154] The number of pointers in a given chunklist may be referred to as the "HLS window" or "HLS buffer length," and this HLS window/buffer length may be set as a configuration parameter for the media server. One conventional example of an HLS window/buffer length is 10 pointers to corresponding .ts files. The number of pointers in the chunklist multiplied by the duration of the HLS segment represented by each .ts file is referred to as the "HLS latency," because a viewing client that requests an HLS copy (i.e., succession of .ts files) typically does not start downloading a first .ts file representing a video segment until the chunklist is

completely populated with the set number of pointers to corresponding .ts files (the HLS window/buffer length). Given the example above of a conventional target segment duration of 10 seconds, this results in a conventional HLS latency on the order of 100 seconds. This HLS latency also may be viewed as a "buffer time" that provides for stability of the HLS stream in the event of communications issues or interruptions in network connectivity; the latency arising from the segment duration and HLS window/buffer length provides for the overall download and playback time of the .ts file segments before another chunklist is downloaded by a viewer client device, thereby mitigating potential connectivity issues that may occur between the client device and a CDN server during this buffer time (presuming that, under normal circumstances, it is quicker for the client to download a .ts file segment than it is for the client to play the segment). As new .ts files get created in the segmenting process for a given resolution copy of the live stream, the media server puts a new pointer to the newest .ts file into the corresponding chunklist and, once the chunklist is filled the first time with the set number of pointers corresponding to the buffer length, the oldest pointer gets "bumped out" of the chunklist when a new segment/pointer is generated, in a first-in-first-out (FIFO) manner.

[0155] Below is an example of a chunklist that includes six pointers to corresponding .ts files representing HLS video segments:

```
==> curl –v https://we109.media.castr.live/t1/ngrp:397965_all/chunklist_w1844413579_b2096000.m3u8
* Trying 198.204.252.202...
* TCP_NODELAY set
* Connected to we109.media.castr.live (198.204.252.202) port 443 (#0)
* TLS 1.2 connection using TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
* Server certificate: *.media.castr.live
* Server certificate: Go Daddy Secure Certificate Authority – G2
* Server certificate: Go Daddy Root Certificate Authority – G2
> Get /t1/ngrp:397965_all/chunklist_w1844413579_b2096000.m3u8 HTTP/1.1
> Host: we109.media.castr.live
> User-Agent: curl/7.51.0
> Accept: */*
>
< HTTP/1.1 200 OK
< Accept-Ranges: bytes
< Server: WowzaStreaming Engine/4.7.0.01
```

< Cache-Control: no-cache
< Access-Control-Allow-Origin: *
< Access-Control-allow-Credentials: true
< Access-Control-Allow-Methods: OPTIONS, GET, POST HEAD
< Access-Control-Allow-Headers: Content-Type, User-Agent, If-Modified-Since, Cache-Control, Range
< Date: Thu, 08 Jun 207 21:10:47 GMT
< Content-Type: application/vnd.apple.mpegurl
< Content-Length: 368
<
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION: 4
#EXT-X-MEDIA-SEQUENCE:349
#EXTINF:2.352,
media_w1844413579_b2096000_349.ts
#EXTINF:2.04,
media_w1844413579_b2096000_350.ts
#EXTINF:2.002,
media_w1844413579_b2096000_351.ts
#EXTINF:2.001,
media_w1844413579_b2096000_352.ts
#EXTINF:2.001,
media_w1844413579_b2096000_353.ts
#EXTINF:2.001,
media_w1844413579_b2096000_354.ts

[0156] In addition to a chunklist for every different resolution copy of the broadcaster's live stream, the media server also creates an HLS "playlist" file (e.g., having a file extension .m3u8) corresponding to the broadcaster's live stream. The HLS playlist includes a list of the transcoded different resolution copies of the live stream, and for each item in the list the playlist also includes a corresponding bandwidth/bitrate, one or more codecs for encoding the copy of the stream, and a pointer (e.g., relative address or URL) to the corresponding chunklist:

- 720p copy – bitrate – codec(s) – relative URL1 for chunklist1
- 360p copy – bitrate – codec(s) – relative URL2 for chunklist2

- 240p copy – bitrate – codec(s) – relative URL3 for chunklist3

An example of an HLS playlist file is provided below:

```
==> curl –v https://we109.media.castr.live/t1/ngrp:397965_all/playlist.m3u8
* Trying 198.204.252.202...
* TCP_NODELAY set
* Connected to we109.media.castr.live (198.204.252.202) port 443 (#0)
* TLS 1.2 connection using TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
* Server certificate : *.media.castr.live
* Server certificate: Go Daddy Secure Certificate Authority – G2
* Server certificate: Go Daddy Root Certificate Authority – G2
> Get /t1/ngrp:397965_all/playlist.m3u8 HTTP/1.1
> Host: we109.media.castr.live
> User-Agent: curl/7.51.0
> Accept: */*
>
< HTTP/1.1 200 OK
< Accept-Ranges: bytes
< Access-Control-Expose-Headers: Date, Server, Content-Type, Content-Length
< Server: WowzaStreaming Engine/4.7.0.01
< Cache-Control: no-cache
< Access-Control-Allow-Origin: *
< Access-Control-allow-Credentials: true
< Access-Control-Allow-Methods: OPTIONS, GET, POST, HEAD
< Access-Control-Allow-Headers: Content-Type, User-Agent, If-Modified-Since, Cache-Control, Range
< Date: Thu, 08 Jun 207 21:07:51 GMT
< Content-Type: application/vnd.apple.mpegurl
< Content-Length: 368
<
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-STREAM-INF:BANDWIDTH=2296000,CODECS="avc1.77.41,mp4a.40.2",RESOLUTION=1280x720
chunklist_w1844413579_b2096000.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=1031000,CODECS="avc1.77.31,mp4a.40.2",RESOLUTION=640x360
chunklist_w1844413579_b946000.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=449000,CODECS="avc1.66.30,mp4a.40.2",RESOLUTION=426x240
chunklist_w1844413579_b414000.m3u8
```

* Curl_http_done: called premature == 0

* Connection #0 to host we109.media.castr.live left intact

[0157] Thus, the HLS "file suite" corresponding to a broadcaster's live stream includes:

- A playlist of different resolution copies with corresponding pointers to chunklists
- The chunklists, each containing a set of pointers to corresponding .ts files
- The .ts files pointed to in the chunklist for each different resolution copy

[0158] To play an HLS copy of a live stream, the viewer client device first requests a copy of the corresponding HLS playlist file from the media server. Based on the available bandwidth between the viewer client device and the media server at any given time, once the playlist is received the viewer client device selects the most appropriate resolution copy from the playlist having a bit rate that may be accommodated by the available bandwidth; this provides for adaptive bit rate streaming in that, from time to time, the viewer client device may select a different resolution/different bitrate copy of the live stream from the list of copies in the HLS playlist based on changes in the available bandwidth (e.g., quality of connection) between the viewer client device and the media server. Once the desired copy is selected from the playlist based on available bandwidth, the viewer client device then requests from the media server the current chunklist associated with the selected copy of the live stream, based on the corresponding pointer to the chunklist that is present in the playlist. As noted above, the chunklist for each copy of the live stream is continuously updated by the media server (FIFO) as new .ts files are created by the media server. Once the viewer client device retrieves the chunklist, it can then in turn begin retrieving the respective .ts files pointed to in the chunklist (e.g., via corresponding relative URLs) and playing the video segments represented in the .ts files. The viewer client device repeatedly requests the appropriate chunklist from the media server (e.g., after every video segment is played) to retrieve a current version of the chunklist. In the foregoing manner, as noted earlier, data/files are transmitted from the media server to the viewer client device upon request pursuant to HTTP, as opposed to streaming data continuously between the media server and the viewer client device via a persistent data connection.

[0159] Conventionally, for every request from a viewer that a media server receives for an HLS copy of a live stream, the media server creates a new HLS file suite for the requester,

including an HLS playlist, associated chunklists, and sets of .ts files. Typically, such requests for an HLS copy of a live stream would arrive at the media server from respective (e.g., geographically distributed) servers of a CDN that are in turn communicating with respective (e.g., geographically distributed) viewer client devices. As HLS viewer demand increases for copies of a particular broadcaster's live stream, the load (e.g., CPU demand) on the media server increases based on the media server's process for generating a new HLS file suite for each new HLS requester.

[0160] Moreover, given that different viewer client devices may be requesting (via corresponding different CDN servers) an HLS copy of the live stream at different points in time, the Inventors have recognized and appreciated that significant synchronization issues arise amongst respective viewers based at least in part on the media server's process for generating a new HLS file suite for each new request. More specifically, because the media server creates different HLS file suites at different times for different requesters, a first requester viewing a first copy of the live stream likely sees the video content some time earlier than or later than a second requester viewing a second copy of the live stream, because at any given time the respective requesters may be downloading and playing different video segments from their respective chunklists. For conventional HLS applications, this lack of synchronization amongst respective viewers typically would not pose any problems in viewer experience.

[0161] However, the Inventors have recognized and appreciated that in the example context of multiple viewers viewing respective copies of a broadcaster's live stream of video-based commentary regarding a live event, and also receiving and displaying event information as real-time updates about the event, this lack of synchronization amongst respective HLS viewers may significantly and adversely impact viewer experience. For example, particularly in the context of a "second screen experience," two different HLS viewers watching the same event on a first screen and watching the same broadcaster's live video-based commentary on a second screen may see the broadcaster's video-based commentary significantly out of synchronization with the live event on the first screen, and may receive and display event information (e.g., event score updates) on the second screen that are noticeably out of synchronization with the live event and/or the broadcaster's video-based commentary. Furthermore, if both of the viewers happen to be watching the same event together at the event venue on the same first screen (e.g., together in the same room at a gathering or party), they may find that their respective copies of the

broadcaster's video-based commentary are noticeably out of synchronization on their respective viewer client devices.

[0162] In view of the foregoing technical problems relating to HLS viewer synchronization and media server loading, the Inventors have implemented an inventive technical solution via an HLS server architecture 380 that provides caching and amplifying functionality to address the above-noted technical problems. An example of such an HLS server architecture is shown in FIG. 8 and discussed in detail below, and FIGS. 9A through 9D illustrate flow diagrams that outline the process by which a given viewer client device requests and receives an HLS copy of a broadcaster's live stream via the HLS server architecture shown in FIG. 8.

[0163] In considering the various HLS multiple-viewer synchronization issues that are addressed by the HLS server architecture shown in FIG. 8 and the processes outlined in FIGS. 9A through 9D, the Inventors also have considered and addressed the overall latency implications of conventional HLS stream delivery in light of the inventive HLS server architecture disclosed herein. To this end, the Inventors have considered unconventional settings (e.g., at the media server) for various parameters relating to HLS streams such as keyframe interval, target segment duration, and HLS window/buffer length for chunklists. Recall in the discussion above that conventional examples of these parameters respectively include a keyframe interval of from 60 to 300 frames, a target segment duration of 10 seconds, and an HLS window/buffer length of 10 .ts files or "chunks," giving rise to a conventional HLS latency on the order of 100 seconds. Such a latency is practically untenable in the example context of multiple viewers viewing the live event itself in person or on a first screen, viewing respective HLS copies of a broadcaster's live stream of video-based commentary regarding the live event as a second screen experience (which would be 100 seconds out of synchronization with the live event/first screen), and also receiving and displaying on the second screen event information as real-time updates about the event (which would be 100 seconds out of synchronization with the video-based commentary on the second screen).

[0164] The Inventors have recognized and appreciated that the above-mentioned parameters may be specifically selected (e.g., via configuration of the media server) to significantly reduce latency while sufficiently maintaining stability of HLS content delivery. To this end, in one example inventive implementation, the keyframe interval for transcoded copies of the live stream

may be set to 30 frames (i.e., significantly fewer than 60 to 300 frames), the target video segment duration may be set to two seconds (i.e., significantly lower than 10 seconds, and such that the succession of HLS segments respectively have two keyframes each at a frame rate of 30 frames/second), and the HLS window/buffer length may be set to from four to six segments in a chunklist (as opposed to 10 chunks in a chunklist as suggested conventionally). These parameters result in a significantly reduced HLS latency of approximately 8 to 12 seconds, as compared to a conventional HLS latency on the order of 100 seconds

[0165] As shown in FIG. 8, in one implementation an HLS caching and amplifying server architecture 380 includes a "mother" server 382 and may also include one or more "child" servers 384A through 384D, disposed between a media server and an HLS CDN server pool 388, in which the HLS mother server acts as a single "virtual viewer" from a given media server's perspective. While FIG. 8 shows multiple child servers, it should be appreciated that in various inventive implementations the HLS server architecture need not have any child servers, or may only have one child server; however, the inclusion of one or more child servers in the inventive HLS server architecture facilitates enhanced scaling and reduced loading (e.g., CPU usage/bandwidth) on the mother server.

[0166] In example implementations, the HLS mother server, as well as one or more child servers, may be implemented as a customized NGINX-based caching server. Based on a single copy of an HLS file suite 375A (e.g., single playlist, associated chunklist(s), and associated .ts file segments) for a given broadcaster's live stream as provided by a media server 320/360 and received by the mother server 382 of the HLS server architecture, the mother server caches and passes on copies 375B of the elements of the file suite (as requested) to one or more child servers, which in turn cache and pass on copies 375C of the elements of the file suite to one or more geographically-distributed servers of a conventional (e.g., global) CDN (serving as an HLS CDN in tandem with the mother-child server architecture). In this manner, the mother and child servers of the HLS architecture act as caching and amplifying servers, so that identical HLS streams may be served from the HLS CDN server pool to multiple viewers of a given broadcast in a significantly narrower synchronization window than conventionally possible. In particular, in one example implementation, all HLS viewers receiving a copy of a broadcaster's live stream via the HLS server architecture shown in FIG. 8 are at most less than one HLS file segment

duration out of synchronization with each other (referred to herein as "viewer segment concurrency").

[0167] As noted above, in conventional HLS, a viewer client device does not maintain a persistent connection with an HLS media server; similarly, by default, HLS media servers do not allow caching of HLS files (e.g., playlists, chunklists and .ts files). In particular, as illustrated above in the examples of a conventional HLS chunklist and a playlist, these files respectively include an explicit instruction that prevents caching (i.e., "Cache-control: no-cache"). For different types of files, cache-control conventionally may be set for some time period that allows a file to be temporarily stored (i.e., cached) by a requesting server, after which a fresh copy of the file needs to be requested from its origin server by the requesting server; as noted above, however, caching is conventionally prohibited for HLS files by an explicit instruction in the files.

[0168] Unlike conventional HLS, in inventive implementations of the HLS server architecture shown in FIG. 8, when a first requester requests a copy of a given broadcaster's live stream the HLS mother server establishes and maintains a persistent connection to the media server (e.g., the RTMP or WebRTC media server receiving the broadcaster's incoming live stream). In this manner, as long as the broadcaster is generating the live stream, at least one requester is requesting a copy of the live stream, and no matter how many requests may be made by globally-distributed CDN servers for copies of the live stream on behalf of requesting viewer client devices, the media server only sees the load of one requester (i.e., the HLS mother server). In this capacity, the HLS media server does not have to make copies of the HLS file suite to provide for additional requesters of the broadcaster's live stream as would be required in conventional HLS; instead, the HLS mother server requests and receives a single copy of the playlist file from the media server. As discussed further below in connection with FIGS. 9A through 9D, the HLS mother server requests the single copy of the playlist file from the media server in response to a request for the playlist file made by one of the HLS child servers to the mother server. The HLS child server makes such a request to the mother server in response to a request for the playlist file made by a CDN server to the child server on behalf of a requesting viewer client device. In a manner similar to that noted above, an HLS child also may open up and maintain a persistent connection with the HLS mother.

[0169] In an example implementation, when the HLS mother server requests and receives the HLS playlist file from the media server, the HLS mother server re-writes the caching rule in the received playlist file to allow the playlist to be cached for some period of time for which a broadcaster may be expected to provide the live stream (e.g., some number of hours up to 24 hours or 86,400 seconds); in particular, the HLS mother server strips the "Cache-control: no-cache" setting from the received playlist file and replaces it with a new cache-control command having some duration of caching time. The HLS mother server then caches the revised playlist file (for the duration of the new caching time) and typically the playlist file need not be requested again from the media server. A copy of this revised playlist file with a re-written caching rule in turn is provided upon request to one or more of the HLS child servers, which in turn cached the revised playlist file and pass additional copies of the revised playlist file to one or more CDN servers so that the playlist file is ultimately provided to one or more requesting viewer client devices. Based on the re-written caching rule, each of the involved servers may store a copy of the revised playlist file for the duration of the broadcaster's live stream and need not request it again; and again, as noted above, the media server only "sees" one requesting viewer and provides one playlist, no matter how many actual viewers may be requesting a copy of the broadcaster's live stream.

[0170] More specifically, as shown in FIG. 9A, when a given viewing client device wishes to receive a copy of a broadcaster's live stream, the client device first queries a CDN server for a copy of the HLS playlist file corresponding to the broadcaster's live stream. If the CDN server has a copy of the playlist (e.g., based on a previous request from another viewer client device), the CDN server returns the playlist to the currently requesting client device. If however the CDN server does not have a copy of the revised playlist, the CDN server connects to a CDN load balancer 386 and in turn requests a copy of the revised playlist from one of the HLS child servers as determined by the load balancer.

[0171] If the HLS child server has a copy of the revised playlist (e.g., based on a previous request from a CDN server), the HLS child server returns the revised playlist to the currently requesting CDN server (which in turn passes the playlist on to the requesting viewer client device). If however the HLS child server does not have a copy of the revised playlist, the HLS child server requests a copy of the revised playlist from the HLS mother server.

[0172] If the HLS mother has a copy of the revised playlist (e.g., based on a previous request from one of the HLS child servers), the HLS mother server returns the revised playlist to the currently requesting HLS child server. If however the HLS mother server does not have a copy of the playlist (e.g., because this is the first request for a copy of the broadcaster's live stream), the HLS mother server establishes a persistent connection with the appropriate media server (e.g., based on the relative URL for the HLS copy of the stream at a given media server), requests a copy of the playlist, and re-writes the caching rule for the playlist as discussed above. The HLS mother then caches the revised playlist, returns the revised playlist to the currently requesting HLS child server. The child server in turn caches the revised playlist and passes the revised playlist on to the requesting CDN server, which in turn also caches the revised playlist and passes the revised playlist on to the requesting viewer client device.

[0173] As shown in FIGS 9A through 9D, once the viewer client device has the playlist, it selects from the playlist the appropriate resolution copy of the live stream based on the associated bitrate of the copy and the available bandwidth between the viewer client device and the CDN server. Based on the selected copy of the live stream, the viewer client device then requests from the CDN server the corresponding chunklist. In a manner similar to the request for the HLS playlist, each of the CDN server, an HLS child server, and the HLS mother server may be queried in turn for a copy of the corresponding chunklist.

[0174] However, an important distinction between the playlist and a requested chunklist relates to the "freshness" of the chunklist and the re-writing of the chunklist's caching rule by the HLS mother server. In particular, whenever the HLS mother server requests a given chunklist from the media server, the mother server re-writes the caching rule in the received chunklist file to allow the chunklist to be cached for some period of time, for example, the segment duration corresponding to a single .ts file (e.g., two seconds). In particular, the HLS mother server strips the "Cache-control: no-cache" setting from the chunklist file and replaces it with a new cache-control command having some duration of caching time (e.g., corresponding to a segment duration). In one aspect, a caching time corresponding to a segment duration is contemplated given that the chunklist does not change during this duration (and thus, any requests for the chunklist during this duration are generally unnecessary). The HLS mother server then caches the revised chunklist file (for the duration of the new caching time) and a copy of this revised chunklist file with a re-written caching rule in turn is provided upon request to one of the HLS

child servers, which in turn also caches the revised chunklist and passes a copy of the revised chunklist file to a CDN server so that the chunklist file is ultimately provided to the requesting viewer client devices. Based on the re-written caching rule, each of the involved servers may cache a copy of the updated chunklist file for up to but no more than the specified caching time, which ensures that each copy of the chunklist stored on a given server is "fresh" (e.g., within one segment duration) for downloading to the requesting viewer client device, while also mitigating unnecessary resources spent on attending to requests for chunklists during a time period in which there are no changes to the chunklist. In an alternate implementation, a given child server may again re-write the caching rule for a chunklist file to prevent caching of the chunklist by a requesting CDN server (and thereby cause the CDN server to request the chunklist from the child server every time the chunklist is requested from the CDN server by a viewer client device, even if respective requests come from one or more viewer client devices within a segment duration).

[0175] Referring again to FIGS. 9A through 9D, and considering a non-limiting example implementation in which the segment duration corresponding to a .ts file is two seconds and the CDN servers maintain the same revised caching rules as the HLS mother and child servers, FIGS. 9A through 9D illustrates that when a requesting viewer client device does not have a chunklist, it requests the chunklist from a CDN server. If the CDN server does not have the chunklist, or if the chunklist cached on the CDN server is more than two seconds old (i.e., exceeds the cache time), the CDN server requests the chunklist from an HLS child server; otherwise, the CDN server returns a "fresh copy" of the chunklist to the requesting client. A similar process is repeated for the HLS child server and the HLS mother server, i.e., if the HLS child server does not have the chunklist, or if the chunklist cached on the child server is more than two second old, the child server requests the chunklist from the mother server; otherwise the child server returns a fresh copy of the chunklist to the requesting CDN server. If the HLS mother server does not have the chunklist, or if the chunklist cached on the mother server is more than two seconds old, the mother server requests the chunklist from the media server, re-writes the caching rule in the chunklist file, caches the revised chunklist file, and returns a fresh copy of the chunklist to the requesting child server (which in turn passes the fresh copy of the chunklist to the requesting CDN server and the requesting client device).

[0176] Once the requesting viewer client device has a fresh copy of the chunklist, the viewer client device begins requesting the respective .ts files or "chunks" pointed to in the chunklist. In

some respects, as shown in FIGS. 9A through 9D, this process is similar to the processes outlined above for requesting the playlist and requesting one of the chunklists pointed to in the playlist. For example, the requesting viewer client device requests a chunk from a CDN server and, if the CDN server has the requested chunk (e.g., because another requesting viewer previously requested the same chunk from the same CDN server and the CDN server already has the chunk cached), the CDN server returns the chunk to the client device for playing the video segment represented in the chunk. If however the CDN server does not have the chunk cached, it requests the chunk from an HLS child server (e.g., via the CDN load balancer). A similar process is repeated for the HLS child server and the HLS mother server. If ultimately the mother server does not have the chunk cached and needs to request the chunk from the media server (e.g., because this is the first viewer request for this chunk), the mother server requests the chunk from the media server, re-writes the caching rule in the chunk file (e.g., to change the caching rule from "no-cache" to some period of time, for example one hour), caches the revised chunk, and returns a copy of the chunk to the requesting child server (which in turn passes the copy of the chunk to the requesting CDN server and the requesting client device).

[0177] Once the viewer client device has downloaded all chunks pointed to in the chunklist, it plays them in turn, deletes the current copy of the chunklist that the viewer client device has cached, and then again determines the appropriate resolution copy of the live stream to request based on the associated bitrates of the different resolution copies and the available bandwidth between the viewer client device and the CDN server. Typically, it takes less time for a client to download a chunk then to play it; accordingly, if there are network issues, the copy of the stream can keep playing on the viewer client device while it downloads new chunks. For example, if the client successfully downloaded three chunks (six seconds of video) in two seconds of wall clock time, there remains a four second buffer of video at the client device in case the fourth chunk has a delay in retrieval.

[0178] The foregoing process of requesting and receiving an appropriate fresh chunklist based on available bandwidth, and downloading and playing the chunks pointed to in the chunklist, is repeated for the duration of the broadcaster's live stream. For example, if the media server stops receiving the broadcaster's live stream, the media server may provide a message to the HLS mother server (e.g., in response to a request from the mother server for a fresh chunklist) that the live stream has been terminated; alternatively, the media server may provide an empty chunklist

to the HLS media server, which essentially would ultimately terminate the iterative requesting process and the connection between the media server and the mother server would time out.

[0179] In other aspects, the HLS mother server shown in FIG. 8 monitors the current pool of media servers that may be servicing different broadcasters' live streams (e.g., as indicated in the database of the servers/memory storage devices 1000), and self-configures to provide for custom routing (e.g., via relative URLs) between a requesting CDN server and a particular media server to appropriately retrieve a requested HLS copy of a given broadcaster's live stream (i.e., via the appropriate playlist and associated chunklists and .ts files). For example, custom routing functionality of the mother server may allow the targeting of specific media servers via a single entry URL (e.g., https://hls.media.castr.live/we90/t1/ngrp:123456_all/playlist.m3u8 requests retrieval of the adaptive HLS playlist from server "we90" for stream 123456, which the mother server internally translates to https://we90.media.castr.live/t1/mgrp:123456_all/playlist.m3u8 and thereby requests the playlist from the appropriate server, for which, when received, the mother server re-writes the caching rule, caches the revised playlist, and passes on the revised playlist to a requesting child server).

[0180] As noted earlier, in some implementations the HLS CDN shown in FIG. 8 that makes requests to one or more HLS child servers may be provided as the Amazon Cloudfront CDN. In any event, the geographically-distributed servers of the CDN cache to the various elements of the HLS file suite and can serve these from a variety of geographic locations to provide a virtually infinite number of HLS viewers using only a relatively small HLS CDN pool; and, irrespective of the number of CDN servers requesting content on behalf of respective viewers, the CDN serves the content quickly, and the media server sees only a single virtual viewer as the HLS mother server. In one aspect, the different "layers" of servers in the HLS server architecture introduce some degree of latency between a given broadcaster's live stream and the viewer client devices; however, as noted above, all viewer client devices have "viewer segment concurrency," and the overall average latency for all viewers is nonetheless significantly reduced (e.g., as compared to conventional HLS). For example, given an example chunk segment duration of two seconds, and an example HLS window/buffer length of four segments, there may be up to eight seconds of latency introduced by the HLS segmenting process and another approximately two seconds of latency introduced by the transfer of files through the HLS server architecture.

[0181] It should be appreciated that the various concepts discussed herein relating to the HLS server architecture are similarly applicable to other segmented live video streaming protocols (e.g., MSS, HDS, MPEG-DASH) for which inventive server architectures are contemplated by the present disclosure.

[0182] VIII. Control Server and Associated Services/Processes

[0183] FIG. 10 illustrates some of the functionality (e.g., services and other processes) performed by the control server 500 shown in FIGS. 2 and 3, according to one inventive implementation. As noted above, the control server 500 is coupled to the memory system 400, one or more event information providers 55, one or more news feeds (RSS) 65 or other news sources, and the socket server(s) 600. In one aspect, the control server 500 periodically retrieves various event information from the event information provider 55 and/or news from the news feeds 65 that is germane to respective broadcasters' video-based commentary. In another aspect, the control system 500 may store at least some portion of retrieved event information and/or news in the memory system 400. More generally, the control server 500 implements a number of services/processes that govern functionality of other servers and devices in the servers/memory storage devices 1000; examples of such control system services/processes include, but are not limited to: an RTMP media server scaling process to add or remove servers from the one or more RTMP media servers 320 of the media sources 300 (see FIG. 11); an RTMP CDN server scaling process to add or remove servers from the RTMP CDN 340 of the media sources 300 (see FIG. 12); a live stream and media server watchdog process (see FIGS. 13-14); an event data ingress process (see FIG. 15); a live event data monitor process (see FIG. 16); an asynchronous task processor (see FIG. 17); and a live stream thumbnail/screenshot acquisition process (see FIG. 18).

[0184] 1) Server Auto-scaling Systems and Watchdogs

[0185] FIGS. 11A through 11C show a process flow diagram illustrating an RTMP media server scaling system service method 1102A, 1102B and 1102C performed by the control server of FIG. 10, according to one inventive implementation. In the method shown in these figures, the control servers automatically scale the number of RTMP media servers 320 of the media sources that are available for broadcasters based in part on the capacity demand for the servers (e.g., number of broadcasters providing live streams). The control server monitors various media

server statistics that are maintained in the database 420 (e.g., number of active servers in the RTMP media server pool; servers marked for shutdown; individual server information such as server status active/shutdown, numbers of active connections to live streams, current capacity, date/time of when server first came online for availability, etc.) and brings servers in and out of the RTMP media server pool based at least in part on the server statistics. In various aspects, the control server maintains a minimum number of servers (e.g., at least two, or a minimum capacity corresponding to approximately double the cumulative traffic at a particular time) in the RTMP media server pool to allow for spikes in stream creation, and also provides for various buffering times to allow new servers to come online. FIGS. 12A through 12C show a process flow diagram illustrating an RTMP CDN server scaling system service method 1202A, 1202B, and 1202C performed by the control server of FIG. 10, according to one inventive implementation, that is similar in many respects to the method 1102A, 1102B and 1102C performed for the media server scaling service.

[0186] FIGS. 13A and 13B show a process flow diagram illustrating a stream and server watchdog service method 1302A, 1302B performed by the control server of FIG. 10, according to one inventive implementation. The stream watchdog performed by the control server essentially ensures that new streams created by broadcasters are valid and deletes streams that were created but not started, or that have been inactive for some period of time (e.g., 30 seconds). When streams are ended, the method generates final viewer statistics (e.g., stream duration, average number of viewers, maximum number of viewers, number of simultaneous viewers, viewers added, viewers left, etc.), broadcasts a "stream ended" system event message to the chat/system event socket(s) of the socket server(s) dedicated to the broadcaster's live stream, ends the recording of the live stream by the media server, and queues the recording to the video uploader queue of the media server process. The server watchdog portion of the method 1302A, 1302B monitors the RTMP media servers and the servers of the RTMP CDN and invokes the check RTMP Media/CDN server method 1402A, 1402B shown in FIGS. 14A and 14B. As part of the server watchdog process, for new servers the control server determines a capacity of the server (e.g., based on server type), and updates the database 420 with the capacity of respective servers, server class, launch time, status update (e.g., active and available for connections) and determines a total user/streamer capacity based on newly added servers. For servers that are already online, the server watchdog ensures that servers remain active for certain intervals (e.g.,

30 second intervals), automatically removes inactive servers from the pool, and reports active server status back to the database. If servers are marked for shutdown, the server watchdog archives server statistics, removes the server from the active server list stored in the database, and determines an updated total user/streamer capacity based on the removal of the server from the active list.

[0187] 2) Event Information Ingress and Live Event Monitoring

[0188] In some inventive implementations, another significant role of the control server 500 shown in FIGS. 2, 3 and 10 relates to collecting of event information and/or news (e.g., from external Internet providers), maintaining relevant event information and/or news in the database 420 (e.g., to facilitate selection of broadcasters to follow, and/or particular broadcaster live streams to view), and distributing the collected information to multiple broadcaster and viewer client devices in a relatively low-latency and synchronized manner with respect to broadcasters' video-based commentary.

[0189] In some implementations, the technical challenge of displaying event information and updates to same in a synchronized and low-latency manner amongst multiple client devices is addressed in part by using a single control server 500 to gather and parse live event information captured in real-time. For example, for sporting events, game information may be obtained by the single control server from a dedicated third-party provider (e.g., STATS LLC). This single point of entry of event information prevents synchronization errors inherent in network communications. Once a change in event status has been detected (e.g., if a play clock updates), the control server provides these changes to the one or more sockets dedicated to the event (to which all viewers and broadcasters of video-based commentary regarding the event are communicatively coupled), resulting in a single synchronized update to all client devices and thereby significantly mitigating client-by-client latency and/or synchronization issues.

[0190] In some example implementations, the control server 500 implements two service methods relating to event information, namely, an event data ingress service and a live event data monitor service. The event data ingress service is performed with a first periodicity (e.g., once or twice a day) to maintain and update an event list in the database 420. The live event data monitor service is performed with a second and more frequent periodicity (e.g., once a minute) to check for any events that are in progress and, if found, to retrieve fresh data about an in-progress

event from the event information provider (e.g., at an even greater frequency, for example once a second). Similar services may be implemented by the control server 500 to ingest news on particular topics, trending threads, etc.

[0191] FIG. 15 shows a process flow diagram illustrating an event data ingress service method 1502 performed by the control server of FIG. 10, according to one inventive implementation, and FIGS. 16A and 16B show a process flow diagram illustrating a live event data monitor service method 1602A, 1602B performed by the control server of FIG. 10, according to one inventive implementation. In these methods, an event information provider is contemplated as supporting multiple different types of events for furnishing information (various types of sporting events such as basketball, football, baseball, hockey, etc.), and providing information for each instance of an event of a given event type (e.g., information for each of multiple basketball games, each of multiple football games, each of multiple baseball games).

[0192] For each event, the control server retrieves the raw information provided by the event information provider, and in some instances converts and/or compresses the raw information to provide a standardized format of essential data elements for storing in the database 420 and/or distribution to client devices (e.g., via broadcast of event messages having the standardized format to one or more dedicated sockets of the socket server(s) 600). Examples of data elements for event information include, but are not limited to, a type of the event, an identifier for the event (EventID), a status of the event (e.g., pre-game, in-progress, final), score information for the event, team information for the event, a progress indicator or progress details for the event (e.g., quarter, period, inning, half-time; for baseball – balls, strikes, base information; for football – possession, down, yards to go; for basketball – timeouts, fouls), an event date and/or time of the event (e.g., actual or elapsed time information), and event participant data regarding participants in the event. In some examples, the control server further normalizes the event date and/or time to a particular reference frame (e.g., converting from UTC to EST/EDT).

[0193] In the process 1602A and 1602B shown in FIGS. 16A and 16B, the control server particularly queries the event information provider for a list of all events in a particular window around the current time (e.g., a 48 hour window, for events with start times 24 hours in the past through 24 hours in the future), to allow tracking of in-progress events (or identify any events that had inconsistent or incorrect start times or late modifications to event information). For each

in-progress event, an event clock and other event information (e.g., score information, other more detailed information about the event) are updated frequently (e.g., once a second) to provide regular updates of event information messages that are broadcast to one or more dedicated event information sockets of the socket server(s) 600.

[0194] 3) Asynchronous Task Processing

[0195] FIGS. 17A and 17B show a process flow diagram illustrating an asynchronous task service method 1702A, 1702B performed by the control server of FIG. 10, according to one inventive implementation. The control server periodically reads a task or task bundle from the asynchronous queue to initiate various other actions or processes in connection with the serves and memory storage devices 1000. A number of different asynchronous system events may be implemented by this process, only some examples of which are illustrated in FIGS. 17A and 17B. For example, if an entry in the queue relates to a "Stream Started" system event, the asynchronous task processing sends out push notifications (including a StreamID) to followers and subscribers of the stream's broadcaster. Another system event processed by the asynchronous task process is when there is a new follower of a broadcaster's stream ("newFollowingStream"), for which the process loads user data and stream data, and attends to various user notifications as appropriate (e.g., email notifications, web push notifications). The asynchronous task processor is also responsible, in some implementations, for taking periodic screenshots/thumbnails of a live stream (as discussed below in connection with FIGS. 18A and 18B).

[0196] With respect to various push notifications handled by the control server 500 and/or the web server(s) 700 (or other servers of the architecture 1000), it should be appreciated that specific apps on mobile client devices need not be open for a push notification to be received on the client device. Thus the client device may receive and display social media or text message alerts even when the device's screen is locked, and/or when the app pushing the notification is closed. For iOS devices, for example, the Apple Push Notification Service API may be employed to enable the client app 5000 to receive various push notifications.

[0197] With reference again to FIG. 10, the async queue monitoring is an application that runs on the control server and that looks at the current size of the asynchronous queue and will notify an administrator. Typically, the queue of tasks to process is small (e.g., at any given

second it may be between 0-10 items), and if the queue grows to a larger size (e.g., 1000 items) the async queue monitor indicates to a system administrator that there is a problem in the asynchronous task processing (e.g., additional processing resources are required, or a looping event is getting processed and re-added to the queue instead of being removed).

[0198] 4) Acquiring Screenshots/Thumbnails

[0199] FIGS. 18A and 18B show a process flow diagram illustrating a process 1802A, 1802B for taking a screenshot (thumbnail) of a live stream, performed by the control server of FIG. 10, according to one inventive implementation (in other implementations, the web server(s) 700 of other servers of the architecture 1000 may perform the process of taking thumbnails of live streams pursuant to the general technique outlined in FIGS. 18A and 18B).

[0200] With reference again to FIG. 5C and the media server process, the media server process queues to the asynchronous queue a first screenshot for a new live stream, and periodic updates to screenshots (e.g., every five seconds or so) during the duration of the live stream. These screenshot tasks are read by the asynchronous task process 1702A and 1702B discussed above in connection with FIGS. 17A and 17B and implemented by the process shown in FIGS. 18A and 18B.

[0201] In the process 1802A, 1802B, in one implementation screenshots are taken based on a broadcaster's live stream in H.264 (or transcoded to H.284 if the live stream is VP8/WebRTC from a web broadcaster). Screenshots are taken on the next available keyframe after the process is invoked. If the screenshot is not the first one taken, the stream information (e.g., in the database 420) is updated with information relating to the newest screenshot, and the screenshot is added to archived screenshots (e.g., in the data storage 440). The screenshot is then broadcast to the chat/system event socket of the socket server(s) 600 dedicated to the broadcaster's live stream.

[0202] Whenever a screenshot is taken of the broadcaster's live stream (particularly if it is the first screenshot), it may be resized for social media network requirements, and overlaid with graphics, watermarks, or promotional material. If the broadcaster requested for social share in creating the new stream (see discussion below regarding creation of new broadcaster streams), the process submits a link to the resized screenshot (e.g., an address or URL) to the indicated social network platform (e.g., Facebook, Instagram, Twitter, etc.), in some instances together

with a "share graphic." In any case, the process determines the list of users that follow/subscribe to the broadcaster, and queues a system event message (e.g., "new FollowingStream") event for each subscriber to broadcast the first screenshot of the new live stream. As above, the stream information (e.g., in the database 420) is updated with information relating to the screenshot, and the screenshot is archived (e.g., in the data storage 440) and broadcast to the chat/system event socket of the socket server(s) 600 dedicated to the broadcaster's live stream.

[0203] With respect to sharing screenshots with social networks if elected by the broadcaster, in another implementation (not shown in FIGS. 18A and 18B), all screenshots of the broadcaster's live stream that are taken as of a given time are processed by a facial recognition algorithm to provide one of multiple options (e.g., the best of three screenshots) for selection by the broadcaster. For example, the process acquires a screenshot at 1, 3 and 5 seconds, and then every 5 seconds thereafter. The facial recognition algorithm detects candidate screenshots on rolling basis based on, for example, the clarity of the image, the quality of the face that is visible, and if the user is smiling. More specifically, every acquired screenshot is analyzed and then the "best three" are selected and presented as options to the broadcaster/viewer during social share. The broadcaster/viewer selects their preferred image, and the social share endpoint that is ultimately provided by the process to the selected social media platform(s) includes a link (e.g., address or URL) to the screenshot selected by the broadcaster.

[0204] IX. Client-side Features (e.g., functionality of the Client App)

[0205] Having provided various details of the servers and memory storage devices 1000 shown in FIGS. 2 and 3, attention now turns to the functionality of the client devices relating to establishing user profiles (e.g., upon login), creating broadcaster stream sessions and providing live streams from broadcaster client devices to a media server, receiving copies of a live stream at a viewer client device (e.g., from a media server, the RTMP CDN, or the HLS server architecture), providing special effects graphics and animations (including animated real-time "scorebugs") on displays of client devices, and replaying copies of a recorded live stream from a broadcaster.

[0206] As noted earlier, unlike conventional scorebugs, screen animations, and/or other special effects graphics that are hard-embedded into live streams of a sports broadcast, in various inventive implementations disclosed herein graphics and effects are generated by the client

device itself, separate from a given broadcaster's video-based commentary, and then integrated with (e.g., superimposed or overlaid on) the broadcaster's video-based commentary when rendered on the display of the client device. For mobile client devices, the client app 5000 executing on the device is particularly configured to render a variety of "studio-quality" graphics while nonetheless maintaining a small file size for the client app (e.g., less than 100 megabytes, and in some instances from approximately 60-70 megabytes); this allows the modestly-sized client app to be readily downloaded to a client device via a cellular network. In other aspects, client-side rendering of screen animations and/or other special effects graphics allows such animations and graphics to be user-interactive and/or user-customizable.

[0207] FIGS. 19A and 19B show a process flow diagram illustrating a user login process according to one inventive implementation, which in some examples may be performed by a client device and facilitated by one or more web servers 700 shown in FIGS. 2 and 3. As illustrated, a login process may be implemented by phone (via SMS message with code sent to phone, and code validation), of via a social media network platform login process (e.g., Facebook, Twitter, Instagram). For new user accounts, a user may establish a user profile that is stored in the database 420 and that may be referenced by a UserID after creation, and include a user name, profile picture, and a user status or user "type" for the user (e.g., a VIP user or member, a media professional or member of the media).

[0208] 1) Broadcaster processes

[0209] FIGS. 20A and 20B show a process flow diagram illustrating a mobile broadcaster stream create process according to one inventive implementation, which in some examples may be performed by a broadcaster client device (pursuant to execution of the client app 5000) and facilitated by one or more web servers (700) shown in FIGS. 2 and 3. While much of the discussion above relates to an example in which a broadcaster wishes to provide a live stream of digital content including video-based commentary about a particular event, in other implementations the broadcaster may desire to create a live stream about a particular topic of interest (e.g., "anything"), or a news story, for example. For each of these options, the broadcaster may enter a title for the live stream, and the client device may request (e.g., from the web server(s) 700) a list of events or news items for selection by the broadcaster, as well as a pre-populated list of tags (as noted above, event information and/or news may be ingressed by

the control server 500, and some event information and/or news may already be cached in the data cache 460 or stored in the database 420).

[0210] The broadcaster may also enter tags to be associated with the live stream to facilitate searching and various social media functionality (e.g., to allow other users to search for and find the live stream based on various criteria represented by the tags). The broadcaster may also elect other options in the stream creation process, examples of which include, but are not limited to, sharing an announcement of the stream starting on a social network platform, and enabling sharing of their location to other users (e.g., to facilitate viewing of the broadcaster's live stream by viewers based on the location of the broadcaster).

[0211] The broadcaster stream create process then submits a "stream create" request to the web server(s) 700. If the broadcaster selected a particular event from the list of events about which to broadcast, an EventID associated with the event is included in the stream create request. Other contents of the stream create request includes, but is not limited to, an API key (to authenticate the user), the title of the stream, any tags selected, newsID (if news was selected), the broadcasters social network sharing options, and broadcaster location data (if permitted by the broadcaster). The web server(s) 700 in turn validates the API key, assigns a StreamID to the newly created live stream, runs the broadcast media server selection algorithm (e.g., see FIGS. 4A and 4B) to select a media server to which the broadcaster client device connects, and returns to the broadcaster client device the StreamID and the host name ("hostname") for the selected media server. The web server(s) 700 store in the database 420 a variety of stream information for the new live stream, which may include, but is not limited to, the StreamID, the UserID, the EventID, the DBshard, type of stream (RTMP/WebRTC), create time, hostname, title, tags, social notify options and social media platforms, location share option, location (if selected as an option) and, if the stream is associated with an EventID, an archived copy of event information at the stream create time.

[0212] FIGS. 21A, 21B, 21C, 21D, and 21E show a process flow illustrating a mobile broadcaster active stream process 2102A, 2102B, 2102C, 2102D and 2102E according to one inventive implementation, which in some examples may be performed at least in part by a broadcaster client device. In particular, the broadcaster client device accesses the media server selected by the web server(s) 700 via a particular URL (e.g., including the hostname in a path of

the URL), as discussed below in connection with FIGS. 21A through 21E. The broadcaster client device then connects to a particular socket of the socket servers dedicated to the broadcaster's live stream, based in part on the StreamID provided by the web server(s), to establish a chat/system event channel. As noted above, in one aspect connections between client devices and a particular socket of a socket server are persistent authenticated connections, so that the number of users (broadcasters and viewers) connected to a particular socket (e.g., and currently watching a particular live stream and/or particular event) may be tracked. If the broadcaster's live stream is about an event, the broadcaster's client device also connects to a particular socket of the socket servers dedicated to the event, based on the EventID, to establish an event information channel.

[0213] In a "main loop" of the broadcaster client device stream active process (which for mobile clients is executed by the client app 5000), an internal frame and time clock is periodically updated, and is used for animations and special effects graphics and synchronizing of some system messages that are received via the chat/system event socket (e.g., a default chat message displayed on the client device at the beginning of each new stream that says "keep it family friendly!"). The client device then checks to see if any further system messages or chat messages are received on the chat/system event channel, and displays chat messages and/or takes other actions in response to system messages such as "member_added" (increase viewing count), "member_removed" (decrease viewing count), "new follower" (add notice to chat). Although only three system messages and corresponding actions are shown in FIG. 21B, it should be appreciated that additional and/or other types of system messages may be received on the chat/system event channel (e.g., relating to other social networking functionality, and/or digital gifts) and initiate corresponding actions as part of the stream active process.

[0214] The client device next checks to see if any event messages or data is received on the event information channel (e.g., updates to event status, event score information, event clock, other event information). The client device then captures a camera frame for the live stream and sends the frame to the media server. The client device then checks the internal frame and time clock to see if any updates are needed to animations or special effects graphics (e.g., scorebugs) to be rendered on the display of the client device ("graphics/animation layers"). In some implementations, graphics and animations are updated at a rate of between 15-25 frames/second based on the internal frame and time clock. As noted above, in some implementations for mobile

client devices, animated graphics and special effects are hard-coded in the client app as a series of individual frames (still-frame images), and rendered on the display in a "stop-motion" style according to the internal frame and time clock.

[0215] In the stream active process shown in FIG. 21C, the process further queries for broadcaster input, examples of which include a request to end the stream, a request to share the stream, a request to view a list of viewers of copies of the live stream, interaction with the graphics/animations (e.g., "bottom third"), and a request to flip the camera. As also noted above, rendering graphics and animation layers on the client-side provides for user-interaction with the displayed graphics and animation layers. While not shown explicitly in FIG. 21C, as discussed above interactions with graphics/animations ("set animation state to transition to open") may in some implementations launch a variety of other processes including, but not limited to, launching further graphics or animations, receiving additional information about the live sporting event (e.g., by thumbing-over a scorebug), or navigating to another Internet location to receive additional information relating to a live event.

[0216] In FIG. 21D, the stream active process then queries if the stream state is set to close (e.g., in response to a broadcaster's request to end the stream, discussed immediately above). If not, the process returns to updating the internal frame and time clock. If the stream state is set to close, the client device disconnects from the media server, requests final stream statistics from the chat/system event channel, and displays an end of stream screen on the display of the client device.

[0217] FIGS. 22A and 22B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for the processes shown in FIGS 20A and 20B, and FIGS. 21A-21E, as well as the media server processes shown in FIGS. 5A, 5B and 5C, according to one inventive implementation. In essence, FIGS. 22A and 22B provide another perspective and summarize the various process flows and corresponding devices involved in the creation and provision of a live stream of digital content by a broadcaster to a media server, and the processing of the live stream by the media server. Although FIGS. 22A and 22B are directed primarily to the overall process flow for a mobile broadcaster, the functionality and devices shown in these figures applies similarly to web-based broadcasters as well.

[0218] 2) Viewer processes

[0219] FIGS. 23A and 23B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for a live stream RTMP media server or RTMP CDN viewer, according to one inventive implementation. A viewer who is a registered or anonymous user, but has received a StreamID for a particular broadcaster's live stream (e.g., via a push notification) to their viewer client device, may send a request to the web server(s) 700 (via the API) to receive a copy of the broadcaster's live stream. The web server(s) first checks the memory cache 460 for, or requests from the database 420, various stream information corresponding to the StreamID provided by the requesting viewer. The web server(s) then perform(s) the viewer stream source selection algorithm discussed above in connection with FIG. 7 to provide an endpoint to the viewer client device for the appropriate media source from which to obtain a copy of the live stream. In the process shown in FIGS. 23A and 23B, the viewer stream source selection algorithm provides an endpoint (e.g., address or URL) to the viewer client device to establish a video communication channel with either a particular media server of the RTMP media server pool 320, or a particular server of the RTMP CDN 340.

[0220] The viewer client device also connects to the appropriate socket of the socket server(s) dedicated to the live stream to establish a chat/system event channel and thereby receive chat messages and system messages. If the live stream relates to an event, the viewer client device also connects to the appropriate socket of the socket server(s) dedicated to the event to establish an event information channel and thereby receive event messages containing various event information. The viewer using the viewer client device also may send chat messages to the web server API, which the web server directs to the appropriate socket of the socket server(s) dedicated to the live stream for broadcast to other viewers connected to the socket as well as the broadcaster. The web server also updates a replay log with the chat message from the viewer, so that the chat may be recreated if a recording of the broadcaster's live stream is replayed by a viewer at a later time (discussed further below).

[0221] FIGS. 24A and 24B show a communication flow diagram illustrating process flow elements and the server and/or memory storage devices involved in the communication flow for a live stream HLS viewer, according to one inventive implementation. The process shown in

these figures is substantially similar to that outlined above in connection with FIGS. 23A and 23B; the primary difference is that, as a result of the web server(s) performing the viewer stream source selection algorithm (see FIG. 7), the web server(s) return(s) to the viewer client device an endpoint (e.g., address or URL) to establish a video channel with the HLS server architecture 380 rather than a server of the RTMP media server pool 320 or the RTMP CDN 340.

[0222] FIGS. 25A, 25B, and 25C show a process flow illustrating a mobile client live stream replay method, according to one inventive implementation. For replay of a recording of a broadcaster's live stream, the servers and memory storage devices 1000 log all events that occur in connection with a live stream (e.g., chat messages and system event messages, as well as event message) and tie them to a timestamp. This allows synchronization of all events to the replay in the same order that the events occurred during the live stream, as if the viewer were not watching a recording of the live stream but actually watching a copy of the live stream in real time.

[0223] As shown in the figures, the viewer client device couples to the web server(s) via the API to request stream information and, if the stream recording is ready, loads the initial replay data from the API and then loads the media file of the recording. The viewer client device also connects to the chat/system event socket corresponding to the live stream (via a persistent authenticated connection), not to receive chat messages or system event messages (these messages are not present on replay), but rather so that the system knows of the viewer's presence and connection. Playback of the video is then started, and then the internal clock and the current video time clock are updated to provide for appropriate buffering of the video data. As the recording is played back, event data (e.g., chat messages, system messages, event information messages) is processed in one implementation according to FIGS. 26A and 26B, and user inputs are processed in one implementation according to FIG. 27.

[0224] Conclusion

[0225] While various inventive implementations have been described and illustrated herein, those of ordinary skill in the art will readily envision a variety of other means and/or structures for performing the function and/or obtaining the results and/or one or more of the advantages described herein, and each of such variations and/or modifications is deemed to be within the scope of the inventive implementations described herein. More generally, those skilled in the art will readily appreciate that all parameters and configurations described herein are meant to be

exemplary inventive features and that other equivalents to the specific inventive implementations described herein may be realized. It is, therefore, to be understood that the foregoing implementations are presented by way of example and that, within the scope of the appended claims and equivalents thereto, inventive implementations may be practiced otherwise than as specifically described and claimed. Inventive implementations of the present disclosure are directed to each individual feature, system, article, and/or method described herein. In addition, any combination of two or more such features, systems, articles, and/or methods, if such features, systems, articles, and/or methods are not mutually inconsistent, is included within the inventive scope of the present disclosure.

[0226] The above-described implementations can be implemented in multiple ways. For example, implementations may be implemented using hardware, software or a combination thereof. When implemented in software, the software code can be executed on any suitable processor or collection of processors, whether provided in a single computer or distributed among multiple computers. Further, it should be appreciated that a computer may be embodied in any of a number of forms, such as a rack-mounted computer, a desktop computer, a laptop computer, or a tablet computer. Additionally, a computer may be embedded in a device not generally regarded as a computer but with suitable processing capabilities, including a Personal Digital Assistant (PDA), a smart phone or any other suitable portable or fixed electronic device.

[0227] Also, a computer may have one or more input and output devices. These devices can be used, among other things, to present a user interface. Examples of output devices that can be used to provide a user interface include printers or display screens for visual presentation of output and speakers or other sound generating devices for audible presentation of output. Examples of input devices that can be used for a user interface include keyboards, and pointing devices, such as mice, touch pads, and digitizing tablets. As another example, a computer may receive input information through speech recognition or in other audible format. Such computers may be interconnected by one or more networks such as Internet. The various methods or processes outlined herein may be coded as software that is executable on one or more processors that employ any one of a variety of operating systems or platforms. Additionally, such software may be written using any of a number of suitable programming languages and/or programming or scripting tools, and also may be compiled as executable machine language code or intermediate code that is executed on a framework or virtual machine.

[0228] In this respect, various inventive concepts may be embodied as a computer readable memory or storage medium (or multiple computer readable storage media) (e.g., a computer memory, one or more floppy discs, compact discs, optical discs, magnetic tapes, flash memories, circuit configurations in Field Programmable Gate Arrays or other semiconductor devices, or other non-transitory medium or tangible computer storage medium) encoded with one or more programs that, when executed on one or more computers or other processors, perform methods that implement the various implementations of the invention discussed above. The computer readable medium or media can be transportable, such that the program or programs stored thereon can be loaded onto one or more different computers or other processors to implement various aspects of the present invention as discussed above.

[0229] Unless otherwise indicated, the terms "program" or "software" are used herein in a generic sense to refer to any type of computer code or set of computer-executable instructions that can be employed to program a computer or other processor to implement various aspects of implementations as discussed above. Additionally, it should be appreciated that according to one aspect, one or more computer programs that when executed perform methods of the present invention need not reside on a single computer or processor, but may be distributed in a modular fashion amongst a number of different computers or processors to implement various aspects of the present invention.

[0230] Computer-executable instructions may be in many forms, such as program modules, executed by one or more computers or other devices. Generally, program modules include routines, programs, objects, components, data structures, etc., that perform particular tasks or implement particular abstract data types. Typically the functionality of the program modules may be combined or distributed as desired in various implementations.

[0231] Also, data structures may be stored in computer-readable media in any suitable form. For simplicity of illustration, data structures may be shown to have fields that are related through location in the data structure. Such relationships may likewise be achieved by assigning storage for the fields with locations in a computer-readable medium that convey relationship between the fields. However, any suitable mechanism may be used to establish a relationship between information in fields of a data structure, including through the use of pointers, tags or other mechanisms that establish relationship between data elements. In some implementations, a

schema-minimal storage system may be implemented in a relational database environment using key-value storage versus defined data structures.

[0232] With the foregoing in mind, each of the client devices described herein, as well as various servers and other computing devices of the broadcast/viewing servers and memory storage devices shown for example in FIGS. 2 and 3, may comprise one or more processors, one or more memory devices or systems communicatively coupled to the one or more processors (e.g., to store software code and other data), and one or more communication interfaces communicatively coupled to the one or more processors so as to implement the various specific and inventive functionality described herein.

[0233] Also, various inventive concepts may be embodied as one or more methods, of which an example has been provided. The acts performed as part of the method may be ordered in any suitable way. Accordingly, implementations may be constructed in which acts are performed in an order different than illustrated, which may include performing some acts simultaneously, even though shown as sequential acts in illustrative implementations.

[0234] All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety.

[0235] All definitions, as defined and used herein, should be understood to control over dictionary definitions, definitions in documents incorporated by reference, and/or ordinary meanings of the defined terms.

[0236] The indefinite articles "a" and "an," as used herein in the specification and in the claims, unless clearly indicated to the contrary, should be understood to mean "at least one."

[0237] The phrase "and/or," as used herein in the specification and in the claims, should be understood to mean "either or both" of the elements so conjoined, i.e., elements that are conjunctively present in some cases and disjunctively present in other cases. Multiple elements listed with "and/or" should be construed in the same fashion, i.e., "one or more" of the elements so conjoined. Other elements may optionally be present other than the elements specifically identified by the "and/or" clause, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, a reference to "A and/or B", when used in conjunction with open-ended language such as "comprising" can refer, in one implementation, to

A only (optionally including elements other than B); in another implementation, to B only (optionally including elements other than A); in yet another implementation, to both A and B (optionally including other elements); etc.

[0238] As used herein in the specification and in the claims, "or" should be understood to have the same meaning as "and/or" as defined above. For example, when separating items in a list, "or" or "and/or" shall be interpreted as being inclusive, i.e., the inclusion of at least one, but also including more than one, of a number or list of elements, and, optionally, additional unlisted items. Only terms clearly indicated to the contrary, such as "only one of" or "exactly one of," or, when used in the claims, "consisting of," will refer to the inclusion of exactly one element of a number or list of elements. In general, the term "or" as used herein shall only be interpreted as indicating exclusive alternatives (i.e. "one or the other but not both") when preceded by terms of exclusivity, such as "either," "one of," "only one of," or "exactly one of." "Consisting essentially of," when used in the claims, shall have its ordinary meaning as used in the field of patent law.

[0239] As used herein in the specification and in the claims, the phrase "at least one," in reference to a list of one or more elements, should be understood to mean at least one element selected from any one or more of the elements in the list of elements, but not necessarily including at least one of each and every element specifically listed within the list of elements and not excluding any combinations of elements in the list of elements. This definition also allows that elements may optionally be present other than the elements specifically identified within the list of elements to which the phrase "at least one" refers, whether related or unrelated to those elements specifically identified. Thus, as a non-limiting example, "at least one of A and B" (or, equivalently, "at least one of A or B," or, equivalently "at least one of A and/or B") can refer, in one implementation, to at least one, optionally including more than one, A, with no B present (and optionally including elements other than B); in another implementation, to at least one, optionally including more than one, B, with no A present (and optionally including elements other than A); in yet another implementation, to at least one, optionally including more than one, A, and at least one, optionally including more than one, B (and optionally including other elements); etc.

[0240] In the claims, as well as in the specification above, all transitional phrases such as "comprising," "including," "carrying," "having," "containing," "involving," "holding," "composed of," and the like are to be understood to be open-ended, i.e., to mean including but not limited to. Only the transitional phrases "consisting of" and "consisting essentially of" shall be closed or semi-closed transitional phrases, respectively, as set forth in the United States Patent Office Manual of Patent Examining Procedures, Section 2111.03.

CLAIMS

1. A system for controlling a plurality of viewer client devices to receive first digital content relating to a first sporting event and first event information germane to the first sporting event, the first event information including online gaming information, the system comprising:

A) a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and

transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information.

2. The system of claim 1, wherein the first socket address transmitted by the at least one webserver to the first viewer client device includes a first event identifier (first EventID) that corresponds to the first event socket, such that the first viewer client device uses a first URL including the first event identifier (first EventID) in the first URL to connect to the first event socket.

3. The system of claim 1, wherein the first event information Internet communication channel to carry the online gaming information between the first event socket of the at least one socket server and the first viewer client device is established as a persistent connection.

4. The system of claim 1, wherein:

in C), the at least one webserver transmits, to a second viewer client device of the plurality of viewer client devices, the first socket address of the first event socket to establish a second event information Internet communication channel between the first event socket and the second viewer client device; and

in B), the at least one socket server transmits at least some of the first event information, including the online gaming information germane to the first sporting event, to the second viewer client device via the second event information Internet communication channel, such that the online gaming information is shared in a synchronized manner by the first viewer client device and the second viewer client device.

5. The system of claim 4, wherein the first socket address transmitted by the at least one webserver to the second viewer client device includes the first event identifier (first EventID) that corresponds to the first event socket, such that the second viewer client device uses a second URL including the first event identifier (first EventID) in the second URL to connect to the first event socket.

6. The system of claim 4, wherein in A), the control server is a single point of entry for the system to obtain the first event information including the online gaming information to reduce synchronization errors between the first viewer client device and the second viewer client device.

7. The system of claim 6, wherein:

in A), the control server detects a change in status in the first event information and transmits changes in the online gaming information to the at least one socket server; and

in B), the at least one socket server transmits the changes in the online gaming information to the first viewer client device and the second viewer client device via the first

event socket to provide a single synchronized update and mitigate client-by-client latency and/or synchronization issues.

8. The system of claim 4, wherein in C), the at least one webserver transmits to the second viewer client device one of:

the first address of the first media source to establish a second video Internet communication channel between the first media source and the second viewer client device to receive the first digital content relating to the first sporting event; or

a second address of a second media source to establish an alternate second video Internet communication channel between the second media source and the second viewer client device to receive second digital content relating to the first sporting event.

9. The system of claim 8, wherein:

the second client device is a subscriber to one of:

the first media source and/or the first digital content relating to the first sporting event; or

the second media source and/or the second digital content relating to the first sporting event; and

in C), the at least one webserver transmits to the second viewer client device one of:

a first identifier (first StreamID) for the first media source and/or the first digital content as at least a portion of the first address if the second client device is a subscriber to the first media source and/or the first digital content; or

a second identifier (second StreamID) for the second media source and/or the second digital content as at least a portion of the second address if the second client device is a subscriber to the second media source and/or the second digital content.

10. The system of claim 1, wherein:

in B), the at least one socket server further transmits first real-time information relating to the first digital content to at least the first viewer client device of the first plurality of viewer client devices via a first real-time information Internet communication channel between a first real-time information socket of the at least one socket server and the first viewer client device,

wherein the first real-time information socket corresponds to the first digital content relating to the first sporting event; and

in C), the at least one webserver transmits to the first viewer client device a second socket address of the first real-time information socket to establish the first real-time information Internet communication channel.

11. The system of claim 10, wherein the first real-time information relating to the first digital content comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first digital content;

at least one digital gift; and/or

at least one sponsorship.

12. A method for providing, to a first client device, first event information germane to a first sporting event, wherein the first event information includes first online gaming information relating to the first sporting event, the method comprising:

A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel between at least one media source and the first client device, wherein the first video communication channel is different than the first event information communication channel.

13. The method of claim 12, wherein prior to A), the method comprises:

transmitting to the first client device a first event identifier (first Event ID) that corresponds to the first event socket;

receiving from the first client device a first URL including the first event identifier (first EventID) in the first URL; and

communicatively coupling the first client device to the first event socket to establish the first event information communication channel.

14. The method of claim 12, wherein in B), the at least one first instruction transmitted to the first client device includes a first address for the at least one media source, such that the first client device uses the first address to request and receive from the at least one media source the first copy of the first stream of digital content relating to the first sporting event via the first video communication channel, and displays the video relating to the first sporting event based on the received first copy of the first stream of digital content.

15. The method of claim 12, further comprising:

C) transferring first real-time information relating to the first stream of digital content to and from the first client device via a first real-time information communication channel between a first real-time information socket of the at least one socket server and the first client device, wherein the first real-time information comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first stream of digital content;

at least one digital gift; and/or

at least one sponsorship.

16. A method for controlling a first viewer client device to display a video relating to a first sporting event together with first online gaming information germane to the first sporting event, the method comprising:

A) transmitting at least one first instruction to the first viewer client device to cause the first viewer client device to receive a first copy of a first stream of digital content relating to the first sporting event via a first video communication channel; and

B) transmitting at least one second instruction to the first viewer client device to cause the first viewer client device to receive the first online gaming information via a first event information communication channel between a first event socket of at least one socket server and the first viewer client device, wherein the first event information communication channel is different than the first video communication channel.

17. The method of claim 16, wherein prior to A), the method comprises:

receiving from the first viewer client device a first user selection of the first sporting event from a listing of events;

transmitting to the first viewer client device, in response to the first user selection of the first sporting event, a directory of sources generating media associated with the first sporting event; and

receiving from the first viewer client device a second user selection of a first source from the directory of sources generating media associated with the first sporting event,

wherein in A), the at least one first instruction transmitted to the first viewer client device includes a first address for the first source.

18. The method of claim 16, wherein in A), the at least one first instruction transmitted to the first viewer client device includes a first address for a first media source, such that the first viewer client device uses the first address to request and receive from the first media source the first copy of a first stream of digital content relating to the first sporting event via the first video communication channel, and displays the video relating to the first sporting event based on the received first copy of the first stream of digital content.

19. The method of claim 18, wherein in B), the at least one second instruction transmitted to the first viewer client device includes a first event identifier (first Event ID) that corresponds to the first event socket, such that the first viewer client device uses a first URL including the first event identifier (first EventID) in the first URL to connect to the first event socket.

20. The method of claim 19, further comprising:

C) receiving the first URL including the first event identifier in the first URL; and

D) establishing the first event information communication channel between the first event socket and the first viewer client device as a persistent connection.

21. A method, comprising:

A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to:

receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event;

render, on the at least one first display of the first client device, the first video relating to the first sporting event based on the first digital content received on the first communication channel;

receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and

render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel.

22. The method of claim 21, wherein in A), the first instructions transmitted to the first client device include a first address for a first media source, such that the first client device uses the first address to request and receive from the first media source the first digital content via the first video communication channel.

23. The method of claim 22, wherein in A), the first instructions transmitted to the first client device include a first event identifier (first Event ID) that corresponds to a source of the second digital content corresponding to the online gaming information.

24. The method of claim 23, further comprising:

B) receiving from the first client device a first URL including the first event identifier; and

C) establishing the second communication channel between the source of the second digital content and the first client device as a persistent connection based at least in part on B).

25. The method of claim 21, wherein in A), the first instructions transmitted to the first client device cause the at least one first display of the first client device to render the online gaming information relating to the first sporting event as interactive content.

26. The method of claim 25, wherein in A), the first instructions transmitted to the first client device cause the first client device, when a user of the first client device interacts with the interactive content, to:

launch further graphics or animations;

receive additional information about the first sporting event; and/or

navigate to an Internet location.

27. The method of claim 21, further comprising:

B) transmitting second instructions to a second client device that includes at least one second display to cause the at least one second display of the second client device to render the first video or a second video relating to the first sporting event and render the online gaming information relating to the first sporting event, wherein the second instructions transmitted in B) cause the second client device to:

receive, on a third communication channel, the first digital content corresponding to the first video relating to the first sporting event or third digital content corresponding to the second video relating to the first sporting event;

render, on the at least one second display of the second client device, the first video based on the first digital content or the second video based on the third digital content received on the third communication channel;

receive, on a fourth communication channel different from the third communication channel, the second digital content corresponding to the online gaming information; and

render, on the at least one second display of the second client device, the online gaming information based on the second digital content received on the fourth communication channel.

28. The method of claim 27, wherein in B), the second instructions transmitted to the second client device include the first address for the first media source or a second address for a second media source, such that the second client device uses the first address or the second address to request and receive the first digital content from the first media source or the third digital content from the second media source via the third video communication channel.

29. The method of claim 28, wherein in A), the second instructions transmitted to the second client device include the first event identifier (first Event ID) that corresponds to the source of the second digital content corresponding to the online gaming information.

30. The method of claim 27, further comprising:

C) transferring first real-time information relating to the first digital content to and from the first client device via a first real-time information communication channel; and

D) transferring second real-time information relating to the first digital content or the third digital content to and from the second client device via a second real-time information communication channel,

wherein at least one of the first real-time information or the second real-time information comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first digital content or the third digital content;

at least one digital gift; and/or

at least one sponsorship.

ABSTRACT

Instructions are transmitted to a client device that includes a display. The instructions cause the display to render a video relating to a sporting event and also render online gaming information relating to the sporting event. In one example, the instructions cause the first client device to: receive, on a first communication channel, first digital content corresponding to the video relating to the first sporting event; render, on the display of the client device, the video relating to the sporting event based on the first digital content received on the first communication channel; receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and render, on the display of the client device, the online gaming information based on the second digital content received on the second communication channel.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☐ The attached application, or
- ☒ United States application or PCT international application number 16/267,887 filed on 2019-02-05.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Kevin APRIL Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. 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 1 minute 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.

PTO/AIA/01 (06-12)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- ☐ The attached application, or
- ☒ United States application or PCT international application number 16/267,887 filed on 2019-02-05.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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.

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LEGAL NAME OF INVENTOR

Inventor: Peter AZUOLAS Date (Optional): _____

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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PTO/AIA/01 (06-12)
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LEGAL NAME OF INVENTOR

Inventor: Philip Nicholas SCHUPAK Date (Optional): 4/2/19

Signature: PNS

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PTO/AIA/01 (05-12)
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LEGAL NAME OF INVENTOR

Inventor: Brian SILSTON Date (Optional): 4/2/19

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

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

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin April
Filer:	Joseph Teja/Marie Spakowski
Attorney Docket Number:	SGIC-001US04

Filed as Small Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	80	80
UTILITY SEARCH FEE	2111	1	350	350
UTILITY EXAMINATION FEE	2311	1	400	400
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2100	2100
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	2081	1	210	210
Claims:				
CLAIMS IN EXCESS OF 20	2202	10	50	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
INDEPENDENT CLAIMS IN EXCESS OF 3	2201	1	240	240
Miscellaneous-Filing:				
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3950**

Electronic Acknowledgement Receipt

EFS ID:	41556297
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin April
Customer Number:	149890
Filer:	Joseph Teja/Marie Spakowski
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US04
Receipt Date:	05-JAN-2021
Filing Date:	
Time Stamp:	14:53:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$3950
RAM confirmation Number	E202115E54188309
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	TrackOne Request	SGIC-001US04_USPTO_AIA424_.pdf	124556 9848d907f352843ec7b13a76fdecd2b85bf02a04	no	2
Warnings:					
Information:					
2	Application Data Sheet	SGIC-001US04_USPTO_AIA14_.pdf	1874889 ca8385a80521cfded8214ec9cc63492f95fe0ec4	no	10
Warnings:					
Information:					
3	Drawings-other than black and white line drawings	SGIC-001US04_Drawings.pdf	3540976 18688b6f8b0bddfe582eff36052fe254217fdfdb	no	56
Warnings:					
Information:					
4	Power of Attorney	SportsCastr_LIVE_LLC_-_Power_of_Attorney_-_EXECUTED.pdf	139096 16902d0824a90e3c0137a5324d9f5a6d922a5c54	no	1
Warnings:					
Information:					
5		SGIC-001US04_-_Track_1_Continuation_Application.pdf	700354 48807aa0e4e929611cdc08b10b073af311f3f77b	yes	91

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	80
Claims	81	90
Abstract	91	91

Warnings:					
Information:					
6	Oath or Declaration filed	SGIC-001US03_Declarations-EXECUTED.pdf	3562134 d9a385bb5e60de90c6f1d19ffa475e39e8a8f481	no	4
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	45099 37584a811a9d17b5de41960889291e200dffca29	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	9987104		

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 a 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.

SCORE Placeholder Sheet for IFW Content

Application Number: 17141631 Document Date: 01/05/2021

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

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 NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
17/141,631	01/05/2021		1780	SGIC-001US04	30	4

CONFIRMATION NO. 5760

149890
SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

FILING RECEIPT

OC000000123378549

Date Mailed: 02/17/2021

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.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Kevin APRIL, New York, NY;
Peter AZUOLAS, Philadelphia, PA;
Philip Nicholas SCHUPAK, Brooklyn, NY;
Brian SILSTON, New York, NY;

Applicant(s)

SportsCastr.LIVE LLC, New York, NY;

Power of Attorney: The patent practitioners associated with Customer Number 149890

Domestic Priority data as claimed by applicant

This application is a CON of 17/027,219 09/21/2020
which is a CON of 16/580,552 09/24/2019 PAT 10805687
which is a CON of 16/267,887 02/05/2019 PAT 10425697
which is a CON of PCT/US2017/045801 08/07/2017
which claims benefit of 62/518,506 06/12/2017
and claims benefit of 62/485,878 04/14/2017
and claims benefit of 62/435,361 12/16/2016
and claims benefit of 62/371,558 08/05/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

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: 02/12/2021
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 17/141,631**
Projected Publication Date: 05/27/2021
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

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

GRANTED

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor

community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 17/141,631

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	80		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	350		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	400		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10	x 50 =	500	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1	x 240 =	240			
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).			210			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	1780		TOTAL	

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	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
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.

To: docketing@smithbaluch.com,smith@smithbaluch.com,eofficeaction@appcoll.com
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 149890

Feb 17, 2021 04:13:18 AM

Dear PAIR Customer:

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 149890 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:
The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
17141631	APP.FILE.REC	02/17/2021	SGIC-001US04

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE

PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

PTO/SB/08a (02-18)
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 contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17141631
Filing Date	2021-01-05
First Named Inventor	Kevin APRIL
Art Unit	
Examiner Name	
Attorney Docket Number	SGIC-001US04

U.S.PATENTS Remove

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
	1	10425697	B2	2019-09-24	Schupak et al.	Entire Document
	2	10805687	B2	2020-10-13	April et al.	Entire Document
	3	6434621	B1	2002-08-13	Pezzillo et al.	Entire Document
	4	8128503	B1	2012-03-06	Haot et al.	Entire Document
	5	8341662	B1	2012-12-25	Bassett et al.	Entire Document
	6	8549574	B2	2013-10-01	Perlman et al.	Entire Document
	7	8595186	B1	2013-11-26	Mandyam et al.	Entire Document
	8	8874778	B2	2014-10-28	Xu et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	9	9055271	B2	2015-06-09	Verna et al.	Entire Document
	10	9106934	B2	2015-08-11	Horen et al.	Entire Document
	11	9149682	B2	2015-10-06	Dornbush et al.	Entire Document
	12	9251852	B2	2016-02-02	Burns	Entire Document
	13	9288278	B2	2016-03-15	Panje et al.	Entire Document
	14	9509793	B2	2016-11-29	Brown et al.	Entire Document
	15	9516390	B2	2016-12-06	Lau et al.	Entire Document
	16	9584858	B2	2017-02-28	Vinson et al.	Entire Document
	17	9591054	B2	2017-03-07	Thornburgh et al.	Entire Document
	18	9641566	B1	2017-05-02	Hiremath	Entire Document
	19	9654844	B2	2017-05-16	Kim et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	20	9692800	B2	2017-06-27	Gaunt et al.	Entire Document
	21	9706443	B2	2017-07-11	Oyman et al.	Entire Document

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040003101	A1	2004-01-01	Roth et al.	Entire Document
	2	20080022347	A1	2008-01-24	Cohen	Entire Document
	3	20080062318	A1	2008-03-13	Ellis et al.	Entire Document
	4	20080168493	A1	2008-07-10	Allen et al.	Entire Document
	5	20090222754	A1	2009-09-03	Phillips et al.	Entire Document
	6	20100299703	A1	2010-11-25	Altman	Entire Document
	7	20110083144	A1	2011-04-07	Bocharov et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	8	20110090960	A1	2011-04-21	Leontaris et al.	Entire Document
	9	20110280540	A1	2011-11-17	Woodman	Entire Document
	10	20130222597	A1	2013-08-29	Brink et al.	Entire Document
	11	20130227596	A1	2013-08-29	Pettis et al.	Entire Document
	12	20140129680	A1	2014-05-08	Mukherjee	Entire Document
	13	20140359075	A1	2014-12-04	Amidei et al.	Entire Document
	14	20160037215	A1	2016-02-04	Cardona	Entire Document
	15	20160249108	A1	2016-08-25	SEXTON	Entire Document
	16	20160360261	A1	2016-12-08	Makhlouf	Entire Document
	17	20170034237	A1	2017-02-02	Silver	Entire Document
	18	20170099516	A1	2017-04-06	Barbulescu et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	19	20170188054	A1	2017-06-29	Ma et al.	Entire Document
	20	20200162796	A1	2020-05-21	AZUOLAS et al.	Entire Document

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

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]
	1	HASHEMIZADEHNAEINI, Transcoding H.264 Video via FFMPEG encoder. Corso di Laurea Magistrale in Ingegneria delle Telecomunicazioni POLITECNICO DI MILANO. Thesis, 2015, p. 1-100	
	2	International Search Report and Written Opinion in International Patent Application No.: PCT/US2017/045801 mailed October 30, 2019 (Atty. Docket No.: SGIC-001WO01), 18 pages.	
	3	International Search Report and Written Opinion in International Patent Application No.: PCT/US2018/033016 mailed August 6, 2018 (Atty. Docket No.: SGIC-002WO01), 29 pages.	

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

[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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 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).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

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	/Joseph Teja, Jr./	Date (YYYY-MM-DD)	2021-02-23
Name/Print	Joseph Teja, Jr.	Registration Number	45157

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.**

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. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to 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)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference SGIC00101WO	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US 17/45801	International filing date *(day/month/year)* 07 August 2017 (07.08.2017)	(Earliest) Priority Date *(day/month/year)* 05 August 2016 (05.08.2016)
Applicant SPORTSCASTR.LIVE LLC		

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 3 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:

SYSTEMS, APPARATUS, AND METHODS FOR SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS

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. 2

☒ 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.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/45801

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 63-64, 72-73
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (January 2015)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 17/45801

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04N 7/18 (2017.01)
CPC - A63B 2220/806, A63B 71/0605, G07C 1/24, H04N 7/181, H04N 7/188

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.
Y	US 8,595,186 B1 (Mandyam et al.) 26 November 2013 (26.11.2013) entire document (especially col. 25, ln 40-67; col. 26, ln 11-65)	76 --- 1-62, 65-71, 74-75, 77-95
Y	US 2014/0129680 A1 (BitGravity Inc) 08 May 2014 (08.05.2014) (para [0028]-[0029], [0031]-[0032], [0057]-[0068], [0074], [0078])	1-62, 65-71, 74-75
Y	US 2013/0222597 A1 (Brink et al.) 29 August 2013 (29.08.2013) (para [0073]-[0076], [0101]-[0102]; [0109]; Fig. 15, 15A, 25, and 27)	77-95

☐ 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
10 October 2017 (10.10.2017)	30 OCT 2017
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JOSEPH TEJA
COOLEY LLP
1299 PENNSYLVANIA AVENUE, NW
SUITE 700
WASHINGTON, DC 20004

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)*	30 OCT 2017

Applicant's or agent's file reference	FOR FURTHER ACTION
SGIC00101WO	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US 17/45801	07 August 2017 (07.08.2017)	05 August 2016 (05.08.2016)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - H04N 7/18 (2017.01)
CPC - A63B 2220/806, A63B 71/0605, G07C 1/24, H04N 7/181, H04N 7/188

Applicant SPORTSCASTR.LIVE LLC

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	10 October 2017 (10.10.2017)	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 INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

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. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 63-64, 72-73

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search *(specify)*:

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 63-64, 72-73 are so unclear that no meaningful opinion could be formed *(specify)*:

because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed *(specify)*:

☒ no international search report has been established for said claims Nos. 63-64, 72-73

☐ a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

- ☐ furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.
- ☐ furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.
- ☐ pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13*ter*.1(a) or (b).

☐ See Supplemental Box for further details.

Form PCT/ISA/237 (Box No. III) (January 2015)

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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	1-62, 65-71, 74-75, 77-95	YES
	Claims	76	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-62, 65-71, and 74-95	NO
Industrial applicability (IA)	Claims	1-62, 65-71, and 74-95	YES
	Claims	None	NO

2. Citations and explanations:

Claim 76 lacks novelty under PCT Article 33(2) as being anticipated by US 8,595,186 B1 to Mandyam et al. (hereinafter Mandyam).

As per claim 76, Mandyam teaches a system for providing a first copy of a first broadcaster's live stream of digital content including first live sporting event video-based commentary from a first broadcaster client device to a first viewer client device (col. 25, ln 40-60; col. 26, ln 11-24 and 25-65), the system comprising:
means for providing the first copy to the first viewer client device via a first video communication channel between a plurality of media sources and the first viewer client device (e.g. there may be many channels being delivered to different sets of users. Users may be able to select and "tune in" to a specific mobile 1ivecast, col. 25, ln 55-56; e.g. The livecasting server may include multiple subsystems. The first is a data source aggregation module 1910 where various content sources 1920 enter the system through adapters (as described by pull adapters above). Sources 1920 can be automated (RSS feeds) or manual (video clipping), col. 26, ln 12-16; e.g. Content can be transcoded so that the media can by rendered by the various connecting device types, col. 26, ln 21-22; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server, col. 26,ln 37-40);
means for periodically retrieving, via the Internet and from an event information provider, first event information germane to a first live sporting event, wherein the first event information includes first score information for the first live sporting event (e.g. livecasting engine may be used for serving up videos, sports scores, instant messages, stock quotes, or any other information , col. 25, ln 65-67;Within each stream is a collection of channels. Example channels are videos, audio, text commentary, scores, advertisements, etc. Each stream is assigned a unique identifier, col. 26, ln 5-7; e.g. allow users to receive real-time game scores, col. 26, ln 31-32); and
means transmitting the first score information to at least the first viewer client device via a first event information communication channel that is different from the first video communication channel (e.g. there may be many channels being delivered to different sets of users. Users may be able to select and "tune in" to a specific mobile 1ivecast, col. 25, ln 55-56; e.g. engine may take the different media types and match them to form a coherent stream of data including the different channels. An example is video, audio, and text commentary streams that come together so that the streams match their time signatureswith one another, col. 26, ln 26-31; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server. Before the video is sent, it may be marked with a timestamp for the time at which the video is pertinent. So, after the stream enters the system, the video stream can match with the text stream based on the timestamps, col. 26, ln 37-44).

Claims 1-62, 65-71, and 74-75 lack an inventive step under PCT Article 33(3) as being obvious over Mandyam in view of US 2014/0129680 A1 to BitGravity Inc (hereinafter BitGravity).

As per claims 1 and 74-75 Mandyam teaches a system for providing a first copy of a first broadcaster's live stream of digital content including first live sporting event video-based commentary from a first broadcaster client device to a first plurality of viewer client devices (col. 25, ln 40-60; col. 26, ln 11-24 and 25-65), and for providing a second copy of a second broadcaster's live stream of digital content including second live sporting event videobased commentary from a second broadcaster client device to a second plurality of viewer client devices (col. 25, ln 40-60; col. 26, ln 11-24 and 25-65), the system comprising:
A) a plurality of media sources to: receive the first broadcaster's live stream of digital content and the second broadcaster's live stream of digital content (e.g. there may be many channels being delivered to different sets of users. Users may be able to select and "tune in" to a specific mobile 1ivecast, col. 25, ln 55-56; e.g. The livecasting server may include multiple subsystems. The first is a data source aggregation module 1910 where various content sources 1920 enter the system through adapters (as described by pull adapters above). Sources 1920 can be automated (RSS feeds) or manual (video clipping), col. 26, ln 12-16; e.g. Content can be transcoded so that the media can by rendered by the various connecting device types, col. 26, ln 21-22; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server, col. 26,ln 37-40);
provide a first copy to a first viewer client device of the first plurality of viewer client devices via a first video Internet communication channel between the plurality of media sources and the first viewer client device of the first plurality of viewer client devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40); and
provide a first copy to a first viewer client device of the second plurality of viewer client devices via a second video Internet communication channel between the plurality of media sources and the first viewer client device of the second plurality of viewer client devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40).

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Supplemental Box

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Box V, 2: Citations and Explanations

B) a server to periodically retrieve, via the Internet and from an event information provider, first event information germane to a first live sporting event, wherein the first event information includes first score information for the first live sporting event (e.g. livecasting engine may be used for serving up videos, sports scores, instant messages, stock quotes, or any other information , col. 25, ln 65-67;Within each stream is a collection of channels. Example channels are videos, audio, text commentary, scores, advertisements, etc. Each stream is assigned a unique identifier, col. 26, ln 5-7; e.g. allow users to receive real-time game scores, col. 26, ln 31-32; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server, col. 26,ln 37-40; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server. Before the video is sent, it may be marked with a timestamp for the time at which the video is pertinent. So, after the stream enters the system, the video stream can match with the text stream based on the timestamps, col. 26, ln 37-44); and at least the first score information (col. 25, ln 65-67; col. 26, ln 31-32); the at least some of the second event information includes second score information for the second sporting event (col. 25, ln 65-67; col. 26, ln 31-32); and
transmit the first score information to at least the first viewer client device of the first plurality of viewer client devices via a first event information Internet communication channel (col. 25, ln 65-67; col. 26, ln 31-32 and 37-44 ; Fig. 19 and 34); transmit at least the second score information of the at least some of the second event information to the first viewer client device of the second plurality of viewer client devices via a fourth Internet communication channel (col. 25, ln 65-67; col. 26, ln 31-32 and 37-44 ; Fig. 19 and 34); Mandyam fails to teach a first plurality of copies and a second plurality of copies; of the first plurality of copies and of the second plurality of copies; B) a control server to periodically retrieve, via the Internet and from an event information provider , first event information germane to a first live sporting event, wherein the first event information includes first score information for the first live sporting event; and C) at least one socket server communicatively coupled to the control server to: receive from the control server at least the first score information; and between at least one first event socket of the at least one socket server and the first viewer client device of the first plurality of viewer devices, wherein the at least one first event socket corresponds to the first event information germane to the first live sporting event. However, BitGravity, in an analogous art teaches a first plurality of copies and a second plurality of copies (e.g. the live streaming data 3 can be copied and written to hundreds, thousands or tens of thousands of requesting client devices 15, para [0032], [0046]-[0048], [0075]); of the first plurality of copies and of the second plurality of copies (para [0032], [0046]-[0048], [0075]); B) a control server to periodically retrieve, via the Internet and from an event information provider , first event information germane to a first event,
wherein the first event information includes first information for the first live event (e.g. live stream 3 can be delivered over a network 60 (e.g. Internet, WAN, LAN, etc., shown in FIG. 9). The live stream 3 is duplicated by the origin server 5 and sent to edge server(s) 10a-n over the network 60, para [0029]); and C) at least one socket server communicatively coupled to the control server to (para [0029]):
receive from the control server at least the first information (e.g. frame, para [0031]-[0032]; para [0029], [0057]); and
between at least one first event socket of the at least one socket server and the first viewer client device of the first plurality of viewer devices, wherein the at least one first event socket corresponds to the first event information germane to the first sporting event (e.g. Once a grouped stream 70 is selected to be written to the appropriate sockets, the edge server 10 fetches the live streaming data 100 from a memory (e.g. buffer 38) in step S320. Next the edge server 10 writes the live streaming data 100 to each of the sockets associated with the client devices 15 in the grouped stream 70, para [0074]; e.g. football game, para [0057]; e.g. frame, para [0031]-[0032]; para [0029]). It would have been obvious to one of ordinary skill in the art to have modified the system of BitGravity by including the control and socket server as taught by because the modification would maximum efficiency in delivering live streaming data.

As per claims 2-3, 8, Mandyam teaches wherein: the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content from the first broadcaster client device, and the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content from the second broadcaster client device, both relate to the first live sporting event (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40); in C), the at least one socket server further transmits the first score information for the first live sporting event to at least the first viewer client device of the second plurality of viewer client devices via a second event information Internet communication channel between the at least one first event socket of the at least one socket server and the first viewer client device of the second plurality of viewer devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40);
none of the first score information of the first event information is included in the first copy of the first plurality of copies of the first broadcaster's live stream of digital content provided to the first viewer client device of the first plurality of vie\ver client devices via the first video Internet communication channel (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40); and none of the first score information of the first event information is included in the first copy (202C) of the second plurality of copies of the second broadcaster's live stream of digital content provided to the first viewer client device of the second plurality of viewer client devices via the second video Internet cornmunication channel(col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40).

As per claims 4, 6, 9, and 11, Mandyam teaches wherein: in A), the plurality of media sources: provide a second copy to a second viewer client device of the first plurality of viewer client devices via a third video Internet communication channel between the plurality of media sources and the second viewer client device of the first plurality of viewer client devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-40); and provide a second copy to a second viewer client device of the second plurality of viewer client devices via a fourth video Internet communication channel between the plurality of media sources and the second viewer client device of the second plurality of viewer client devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and in transmits at least the first score information of the first event information to the second viewer client device of the first plurality of viewer client devices via a third event information Internet communication channel between the and the second viewer client device of the first plurality of viewer devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); C), and transmits at least the first score information of the first event information to the second viewer client device of the second plurality of viewer client devices (col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44);
BitGravity further teaches of the first plurality of copies and of the second plurality of copies (para [0032], [0046]-[0048], [0075]); the at least one socket server (para [0029], [0031]-[0032], [0057], [0074]): C), the at least one socket server (para [0029], [0031]-[0032], [0057], [0074]):: at least one first event socket of the at least one socket server; the at least one socket server: a fourth event information Internet communication channel between the at least one first event socket of the at least one socket server and the second viewer client device of the second plurality of viewer devices (para [0029], [0031]-[0032], [0057], [0074]).
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As per claims 5, 10, and 45, Mandyam teaches wherein in C),transmits and receives first chat information regarding the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content via at least one first chat/system event Internet communication channel between at least one first chat/system event of and the first viewer client device) of the first plurality of viewer client devices" wherein the at least one first chat/system event corresponds to the first chat information regarding the first live sporting event video-based commentary (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and transmits and receives second chat information regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digita1 content via at least one second chat/system event Internet communication channel between at least one second chat/system event of the and the first viewer client device of the second plurality of viewer client devices, wherein the at least one second chat/system event corresponds to the second chat information regarding the second live sporting event video-based commentary (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44);
wherein: in A), the plurality of media sources: provide a second copy to a second viewer client device of the first plurality of viewer client devices via a third video Internet communication channel between the plurality of media sources and the second viewer client device of the first plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and provide a second copy of the second plurality of copies to a second viewer client device of the second plurality of viewer client devices via a fourth video Internet communication channel between the plurality of media sources and the second viewer client device of the second plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and in C), transmits at least the first score information of the first event information to the second viewer client device of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event and the second viewer client device of the first plurality of viewer devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44);;
transmits and receives the first chat information regarding the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content via at least one third chat/system event Internet communication channel between the at least one first chat/system event and the second viewer client device of the first plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); transmits at least the first score information of the first event information to the second viewer client device of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one first event and the second viewer client device of the second plurality of viewer devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and transmits and receives the second chat information regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content via at least one fourth chat/system event Internet communication channel between the at least one second chat/system event and the second viewer client device of the second plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44).
BitGravity further teaches the at least one socket server further (para [0029], [0031]-[0032], [0057], [0074]). ; at least one socket server (para [0029], [0031]-[0032], [0057], [0074]); event socket (para [0029], [0031]-[0032], [0057], [0074]); he at least one socket server based at least in part on the StreamID (206A) (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068])).

As per claim 7, Mandyam teaches wherein: the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content from the first broadcaster client device relates to a first live sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content from the second broadcaster client device relates to a second live sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44);
in B), the server periodically retrieves, via the Internet and from the event information provider, the first event information germane to the first live sporting event and second event information germane to the second live sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44), wherein: the first event information includes the first score information for the first sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44); and
the second event information includes second score information for the second sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44) and in C), receives from the server at least the second score information and
transmits the second score information to at least the first viewer client device of the second plurality of viewer client devices via a second event information Internet communication channel between at least one second event and the first viewer client device of the second plurality of viewer devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44)., the second event information germane to the second live sporting event (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 12-16, 21-22, 37-44).

As per claims 12, 28-33, 34/(1-11), 38, 41, 46-48, 55-58, 61-62, Mandyam teach the plurality of media sources (col. 26, ln 12-16) comprises: BitGravity further teachess at least one of: at least one real-time messaging protocol (RTMP) media server to receive the first broadcaster's live stream of digital content (para [0035]-[0039]); and
at least one web real time communication (WebRTC) media server to receive the first broadcaster's live stream of digital content (para [0035]-[0039], [0057]); and an HTTP live streaming (HLS) caching server architecture communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server ((para [0035]-[0039], [0057])): the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's have stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS caching server architecture (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTMP media server and the at least one WebRTC media server to receive, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, a first HLS file suite representing the first broadcaster's live stream of digital content(para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and

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a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN (para [0028]-[0029], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the first copy of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HLS file suite (para [0028]-[0029], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the HLS mother server requests, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, only the first HLS file suite representing the first broadcaster's live stream of digital content and no other HLS file suite representing the first broadcaster's live stream of digital content (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the HLS mother server maintains a persistent connection to the at least one of the at least one RTMP media server and the at least one WebRTC media server, during at least a portion of a duration of the first broadcaster's live stream of digital content, to receive respective elements of the first HLS file suite (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the first HLS file suite provided by the at least one of the at least one RMTP media server and the at least one WebRTC media server to the HLS mother server comprises: a first HLS playlist specifying a first plurality of different resolution versions of the first broadcaster's live stream of digital content, the first HLS play list further including a corresponding first plurality of chunklist pointers to first respective chunklists for the first plurality of different resolution versions (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]); the first respective chunklists for the first plurality of different resolution versions, wherein each chunklist of the first respective chunkhsts includes a first plurality of file segment pointers to first respective file segments for each different resolution version of the first plurality of different resolution versions (para [0028], [0032], [0035] -[0039], [0057]-[0061], [0042]); and the first respective file segments for each different resolution version of the first plurality of different resolution versions (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]); the HLS mother server caches the first HLS playlist, the first respective chunklists, and the first respective file segments and passes on to at least one HLS child server of the plurality of HLS child servers at least one first copy of the first HLS play list, the first respective chunklists, and the first respective file segments (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]); the at least one HLS child server of the plurality of HLS child servers server caches the at least one first copy of the first HLS play list, the first respective chunklists, and the first respective file segments and passes on to the HLS CDN at least one second copy of the first HLS play list, the first respective chunklists, and the first respective file segments (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]); and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices is based on the at least one second copy of the first HLS play list, the first respective chunkists, and the first respective file segments (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]). Neither Mandyam nor BitGravity teach the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds; and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six; the first number of the first plurality of file segment pointers in each chunklist is four; the keyframe interval is configured to be less than 60 frames: the keyframe interval is configured to be 30 frames. However, it would have been obvious to one of ordinary skill in the art to have modified the system of Mandyam and BitGravity by including the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds; and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six; the first number of the first plurality of file segment pointers in each chunklist is four; the keyfbe modification would provide a time that is best the type of transmission and/or content.

As per claims 13 and 39, BitGravity teaches wherein: the plurality of media sources omprises the at least one RTM media server (para [0035]-[0039]); the plurality of media sources comprises a virtual private network (VPN) (para [0035]-[0039]); and the VPN includes the at least one RTMP media server and the RTMP CDN (para [0028], [0035]-[0039], [0078]).

As per claim 14, BitGravity teaches wherein: the first broadcaster's live stream of digital content has a video compression format that is one of: H264 advanced video coding (AVC) transmitted via RTMP (para [0003], [0028], [0035]-[0039], [0078]); and VP8 transmitted via WebRTC; and the system further comprises at least one webserver to provide an applications programming interface (API) between the system and the first broadcaster client device, wherein the at least one webserver determines the one of the at least one RTMP media server and the at least one WebRTC media server to receive the first broadcaster's live stream of digital content based at least in part on the video compression format of the first broadcaster's live stream of digital content (para [0003], [0028], [0035]-[0039], [0078]).

As per claims 15, and 35, Mandyam teaches further comprising: first stream information for the first broadcaster's live stream of digital content including the first live sporting event video-based commentary from the first broadcaster client device, wherein the first stream information includes a viewing count indicating a number of the first plurality of copies of the first broadcaster's live stream of digital content provided by the system to the first plurality of viewer client devices ((col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44); and a first user profile for a first viewer using the first viewer client device to receive the first copy of the first plurality of copies of the first broadcaster's live stream of digital content, wherein the first user profile includes a user type for the first user ((col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44).
BitGravity at least one webserver to provide an applications programming interface (API) between the system and each of the first broadcaster client device, the second broadcaster client device, the first plurality of viewer client devices and the second plurality of viewer client devices (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and a memory system communicatively coupled to the at least one webserver, the memory system including a database storing: further teaches wherein the at least one webserver (para [0028]-[0029],[0035]-[0039], [0057]-[0061], [0067]-[0069]): determines an address for the one of: the one of the at least one RTMP media server and the at least one WebRTC media server (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); the one CDN server of the RTMP CDN (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]);

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and the HLS server architecture, to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device, based at least in part on at least one of: the viewing count indicating the number of the first plurality of copies of the first broadcaster's live stream of digital content provided by the system to the first plurality of viewer client devices and the user type for the first user (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and
transmits the address for the one of the one of the at least one RTMP media server and the at least one WebRTC media server; the one CDN server of the RTMP CDN (para [0035]-[0039], [0057]-[0061], [0067]-[0069]);and the HLS server architecture, to the first viewer client device of the first plurality of viewer client devices to establ ish the first video format communication channel (para [0035]-[0039], [0057]-[0061], [0067]-[0069]).

As per claims 16 and 36, BitGravity teaches wherein: the first stream information for the first broadcaster's live stream of digital content forth er includes a stream identifier (StreamID) for the first broadcaster's live stream; and the at least one webserver determines the address for the one of: the one of the at least one RTMP media server and the at least one WebRTC media server; the one CDN server of the RTMP CDN (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068]); and the HLS server architecture, to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device, based at least in part on the StreamID and the at least one of the viewing count and the user type for the first user (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068])).

As per claims 17, 37, and 44, BitGravity teaches wherein: the first stream information for the first broadcaster's live stream of digital content further includes an event identifier for the first live sporting event (para [0039], [0046]-[0050], [0064]-[0068]); and the at least one webserver further: determines a first socket address for the at least one first event socket of the at least one socket server based at least in part on the EventID (para [0039], [0046]-[0050], [0064]-[0068]); and
transmits the first socket address to the first viewer client device of the first plurality of viewer client devices to establish the first event information Internet communication channel (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068])).

As per claim 18, BitGravity teaches wherein: the at least one webserver determines the address for the one of: the one of the at least one RTMP media server (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and the at least one WebRTC media server (para [0035]-[0039], [0057]-[0061], [0067]-[0069]): the one CDN server of the RTMP CDN (para [0028]-[0029], [0057]-[0049], [0078]); and the HLS server architecture, to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device, based at least in part on the user type for the first user (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and the user type for the first user includes one of: a registered user; an anonymous user; a subscriber of the first broadcaster; a VIP user: and a media member (para [0068]-[0072]).

As per claims 19-26 and 27, BitGravity teaches wherein: if the user type is a VIP user or a media member, the at least one webserver: determines the address for the one of the at least one RTMP media server and the at least one WebRTC media server to estabiish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device (para [0035]-[0039], [0057]-[0061], [0067]-[0072]); and transmits the address for the one of the at least one RTMP media server and the at least one WebRTC media server to the first viewer client device to establish the first video Internet communication channel (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); if the user type is not a VIP user or a media member, and the viewing count is less than a first reference number, the at least one webserver (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); determines the address for the one of the at least one RTMP media server and the at least one WebRTC media server to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and transmits the address for the one of the at least one RTMP media server and the at least one WebRTC media server to the first viewer client device to establish the first video Internet communication channel (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); if the user type is not a V1P user or a media member, and the viewing count is equal to or greater than the first reference number and less than a second reference number based on a maximum viewer capacity of the RTJMP CDN, the at least one webserver (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); determines the address for the one CDN server of the RTMP CDN to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and transmits the address for the one CDN server of the RTMP CDN to the first viewer client device to establish the first video Internet communication channel (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and if the user type is not a VIP user or a media member, and the viewing count is greater than the second reference number based on the maximum viewer capacity of the RTMP CDN, the at least one webserver (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); determines the address for the HI,S server architecture to establish the first video Internet communication channel to provide the first copy of the first plurality of copies to the first viewer client device (para [0028]-[0029], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); the first copy of the first plurality of copies of the plurality of copies of the first server and transmits the address for the HLS server architecture to the first viewer client device to establish the first video Internet communication channel (para [0028]-[0029], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]).

As per claim 40, Mandyam teaches first stream information for the first broadcaster's live stream of digital content including the first live sporting event video-based commentary from the first broadcaster client device wherein the first stream information includes a first viewing count indicating a first number of the first plurality of copies of the first broadcaster's live stream of digital content provided by the system to the first plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44); second stream information for the second broadcaster's live stream of digital content including the second live sporting event video-based commentary from the second broadcaster client device, wherein the second stream information includes a second viewing count indicating a second number of the second plurality of copies of the second broadcaster's live stream of digital content provided by the system to the second plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44);

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BitGravity teaches further comprising: at least one webserver to provide an applications programming interface (API) between the system and each of the first broadcaster client device, the second broadcaster client device, the first plurality of viewer client devices and the second plurality of viewer client devices (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and a memory system communicatively coupled to the at least one webserver, the memory system including a database storing (para [0028]-[0029],[0035]-[0039], [0057]-[0061], [0067]-[0069]): wherein the at least one webserver: determines a first address for the one of: the at least one RTMP media server (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server; the first CDN server of the RTMP CDN (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server architecture to establish the first video Internet communication channel to provide the first copy) of the first plurality of copies to the first viewer client device of the first plurality of viewer client devices (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server , based at least in part on at least one of: the first viewing count indicating the first number of the first plurality of copies of the first broadcaster's live stream of digital content provided by the system to the first plurality of viewer client devices (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069]); and the first user type for the first user (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069]); transmits the first address for the one of: the at least one RTMP media server (para [0035]-[0039], [0057]-[0061], [0067]-[069]).; the first CDN server of the RTMP CDN (para [0035]-[0039], [0057]-[0061], [0067]-[0069]).; and the HLS server architecture to the first viewer client device of the first plurality of viewer client devices to establish the first video Internet communication channel(para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); determines a second address for the one of: the at least one WebRTC media server (para [0035]-[0039], [0057]-[0061], [0067]-[0069]).; the first CDN server or the second CDN server of the RTMP CDN (para [0028], [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server architecture to establish the second video Internet communication channel to provide the first copy (202C) of the second plurality of copies to the first viewer client device of the second plurality of viewer client devices (para [0035]-[0039], [0057]-[0061], [0067]-[0069])., based at least in part on at least one of: the second viewing count indicating the second number of the second plurality of copies of the second broadcaster's live stream of digital content provided by the system to the second plurality of viewer client devices (para [0035]-[0039], [0057]-[0061], [0067]-[0069]).; and the second user type for the second user (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); and transmits the second address for the one of: the at least one WebRTC media server (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); the first CDN server or the second CDN server of the RTh1P CDN (para [0035]-[0039], [0057]-[0061], [0067]-[0069], [0078]); and the HLS server architecture to the first viewer client device of the second plurality of viewer client devices to establish the second video Internet communication channel (para [0035]-[0039], [0057]-[0061], [0067]-[0069]).

As per claim 42, BitGravity teaches wherein the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTMP media server and the at least one WebRTC media server to receive, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, a first HLS file suite representing the first broadcaster's live stream of digital content (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]) and a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042]), wherein: the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster"s live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042], [0078]); and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HLS file suite (para [0028], [0032], [0035]-[0039], [0057]-[0061], [0042])

As per claim 43, Mandyam teaches first stream information for the first broadcaster's live stream of digital content including the first live sporting event video-based commentary from the first broadcaster client device (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44), between the system and each of the first broadcaster client device, the second broadcaster client device, the first plurality of viewer client devices and the second plurality of viewer client devices (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44); and BitGravity further teaches a memory system communicatively coupled to the at least one webserver, the memory system including a database storing (para [0028]-[0029],[0035]-[0039], [0057]-[0061], [0067]-[0069]):: wherein the first stream information includes a stream identifier (StreamID) for the first broadcaster's live stream of digital content, further cornprising: wherein the at least one webserver (para [0028]-[0029],[0035]-[0039], [0057]-[0061], [0067]-[0069]): at least one webserver to provide an applications programming interface (API) (para [0035]-[0039], [0057]-[0061], [0067]-[0069]); determines an address for the HLS CDN to establish the first video Internet communication channelto provide the first copy of the first plurality of copies to the first viewer client device, based at least in part on the StreamID for the broadcaster's live stream of digital content (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068]); and transmit the address for the HLS CDN to the first vimver client device of the first plurality of viewer client devices to establish the first video Internet communication channel (para [0028]-[0029]; [0039], [0046]-[0050], [0064]-[0068]).

As per claim 49, BitGravity teaches wherein: the first HLS play list received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a playlist cache-control command (para [0028]-[0029], [0057]-[0061], [0078]); and upon receipt of the first HLS play list, the HLS mother server re-writes the play list cachecontrol cornmand to change a playlist caching time from zero to non-zero (para [0057]-[0061]).

As per claim 50, BitGravity teaches wherein the IU.S rnother server re-writes the play list cachecontrol command to change the play list caching time to less than or equal to 24 hours (para [0028]-[0029], [0057]-[0061], [0078]).

As per claim 51, BitGravity teaches wherein: each chunklist of the first respective chunkhsts received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a chunklist cache-control command (para [0028]-[0029], [0032], [0057]-[0061], [0078]); and upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cachecontrol command to change a chunklist caching time from zero to non-zero (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

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As per claim 52, BitGravity teaches wherein the HLS mother server re-vvrites the chunklist cachecontrol command to change the playlist caching time to a video segment duration for each file segment of the respective file segments (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

As per claim 53, BitGravity teaches wherein: each file segment of the first respective file segments received by the HLS mother server from the at least one of the at least one RTIVIP media server and the at least one WebRTC media server includes a file segment cache-control command (para [0028]-[0029], [0032], [0057]-[0061], [0078]); and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

As per claim 54, BitGravity teaches wherein the HLS mother server re-writes the file segment cachecontrol command to change the file segment caching time to one hour (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

As per claim 59, BitGravity teaches wherein: the first HLS play list received by the HLS mother server from the at least one of the at least one RTJVIP media server and the at least one WebRTC media server includes a playlist cache-control command upon receipt of the first HLS play list, the HLS mother server re-writes the play list cachecontrol command to change a playlist caching time from zero to non-zero (para [0028]-[0029], [0032], [0057]-[0061], [0078]). each chunklist of the first respective chunklists received by the HLS mother server from the at least one of the at least one RTh1P media server and the at least one WebRTC media server includes a chunklist cache-control command (para [0028]-[0029], [0032], [0057]-[0061], [0078]); upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cachecontrol command to change a chunklist caching time from zero to non-zero (para [0028]-[0029], [0032], [0057]-[0061], [0078]); each file segment of the first respective file segments received by the HLS mother server from the at least one of the at least one RTJ\1P media server and the at least one WebRTC media server includes a file segment cache-control command (para [0028]-[0029], [0032], [0057]-[0061], [0078]). and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

As per claim 60, BitGravity teaches wherein the HLS mother server re-writes the chunklist cachecontrol command to change the play list caching time to the video segment duration for each file segment of the respective file segments (para [0028]-[0029], [0032], [0057]-[0061], [0078]).

As per claim 65, Mandyam teaches further comprising a memory system communicatively coupled to the server, the memory system including a database (col. 25, In 55-56; col. 26, In 5-7; col. 33, In 6-17), wherein in B): the event information provider monitors a plurality of types of sporting events (col. 25, In 55-56; col. 26, In 5-7; col. 33, In 6-17); for each type of the plurality of types, the event information provider monitors a plurality of sporting events including the first live sporting event (col. 25, In 55-56; col. 26, In 5-7.; col. 33, In 6-17); and for each type of the plurality of types, and for each sporting event of the plurality of sporting events (col. 25, In 55-56; col. 26, In 5-7), the server: retrieves from the event information provider event data including at least one of: the type of the sporting event (col. 25, In 55-56; col. 26, In 5-7); an event identifier (EventID) for the sporting event; a status of the sporting event (col. 25, In 55-56; col. 26, In 5-7; col. 48, In 30-32); progress details for the sporting event (col. 25, In 55-56; col. 26, In 5-7; col. 48, In 30-32); a date and/or time of the sporting event (col. 25, In 55-56; col. 26, In 5-7); and event participant data regarding participants in the sporting event; normalizes at least the date and/or time of the sporting event to a reference standard time to provide a normalized date and/or time (col. 25, In 55-56; col. 26, In 5-7); and stores the event data and the normalized date and/or time in the database (col. 25, In 55-56; col. 26, In 5-7; col. 33, In 6-17). BitGravity teaches the control server (para [0028]-[0029]).

As pr claim 66 and 69, Mandyam teaches wherein: for each type of the plurality of types, and for each sporting event of the plurality of sporting events, the server further (col. 25, In 55-56; col. 26, In 5-7); normalizes at least one of the progress details for the sporting event and the event participant data regarding participants in the sporting event (col. 25, In 55-56; col. 26, In 5-7); and stores the normalized at least one of the progress details and the event participant data in the database. BitGravity teaches the control server (para [0028]-[0029]).

As per claim 67 and 70, Mandyam teaches wherein theserver re trieves the event data from the event information provider for each type of the plurality of types, and for each sporting event of the plurality of sporting events that has a start time within 24 hours in the past and 24 hours in the future (col. 25, In 55-56; col. 26, In 5-7); for the first live sporting event, the progress details include the first score information (col. 25, In 55-56; col. 26, In 5-7); the server periodically retrieves the progress details from the event information provider and updates the first score information (col. 25, In 55-56; col. 26, In 5-7); and
for each update of the first score information, theserver queues an asynchronous message including the updated first score information for transmission to (col. 25, In 55-56; col. 26, In 5-7).
BitGravity further teaches the control server (para [0028]-[0029]); the at least one first event socket of the at least one socket server para [0031]-[0032]; para [0029], [0057], [0074]).

As per claims 68 and 71, Mandyam teaches wherein: for the first live sporting event, the progress details include the first score information (col. 25, In 55-56; col. 26, In 5-7). the server periodically retrieves the progress details from the event information provider and updates the first score information (col. 25, In 55-56; col. 26, In 5-7). and for each update of the first score information, the control server queues an asynchronous message including the updated first score information for transmission to (col. 25, In 55-56; col. 26, In 5-7). BitGravity further teaches the control server (para [0028]-[0029]); the at least one first event socket of the at least one socket server para [0031]-[0032]; para [0029], [0057], [0074]).

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Claims 77-95 lack an inventive step under PCT Article 33(3) as being obvious over Mandyam in view of US 2013/0222597 A1 to Brink et al. (hereinafter Brink).

As per claim 77, Mandyam teaches a non-transitory computer readable medium encoded with processor-executable instructions that, when executed by at least one processor of a first client device (col. 25, ln 40-60; col. 26, ln 11-24 and 25-65), perform a method comprising:
receiving, via at least one communication interface of the first client device, a first copy of a first broadcaster's live stream of digital content including first video-based commentary about a first live sporting event, wherein the first client device receives the first copy of the first broadcaster's live stream of digital content on a first video communication channel (e.g. there may be many channels being delivered to different sets of users. Users may be able to select and "tune in" to a specific mobile livecast, col. 25, ln 55-56; e.g. The livecasting server may include multiple subsystems. The first is a data source aggregation module 1910 where various content sources 1920 enter the system through adapters (as described by pull adapters above). Sources 1920 can be automated (RSS feeds) or manual (video clipping), col. 26, ln 12-16; e.g. Content can be transcoded so that the media can by rendered by the various connecting device types, col. 26, ln 21-22; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server, col. 26,ln 37-40);
receiving, via the at least one communication interface of the first client device, first score information for the first live sporting event (e.g. livecasting engine may be used for serving up videos, sports scores, instant messages, stock quotes, or any other information , col. 25, ln 65-67;Within each stream is a collection of channels. Example channels are videos, audio, text commentary, scores, advertisements, etc. Each stream is assigned a unique identifier, col. 26, ln 5-7; e.g. allow users to receive real-time game scores, col. 26, ln 31-32), wherein: the first client device receives the first score information on a first event information communication channel different than the first video communication channel (e.g. there may be many channels being delivered to different sets of users. Users may be able to select and "tune in" to a specific mobile 1ivecast, col. 25, ln 55-56; e.g. engine may take the different media types and match them to form a coherent stream of data including the different channels. An example is video, audio, and text commentary streams that come together so that the streams match their time signatures with one another, col. 26, ln 26-31; e.g. first stream that may arrive is a text stream containing text commentary of what happened at a particular time. In the meantime, video may be processed externally (clipped, edited, etc) and then sent to the server. Before the video is sent, it may be marked with a timestamp for the time at which the video is pertinent. So, after the stream enters the system, the video stream can match with the text stream based on the timestamps, col. 26, ln 37-44); and
none of the first score information is included in the first copy of the first broadcaster's live stream of digital content received by the first client device (col. 25, ln 55-56; col. 26, ln 5-7); and
displaying, on a display of the first client device, the first video-based commentary about the first live sporting event, and the first score information for the first live sporting event (Before the video is sent, it may be marked with a timestamp for the time at which the video is pertinent. So, after the stream enters the system, the video stream can match with the text stream based on the timestamps, col. 26, ln 37-44; Fig. 19 and 34). Mandyam fails to teach the first video-based commentary about the first live sporting event, and the first score information for the first live sporting event overlaid on the first video-based commentary. However, Brink, in an analogous art, teaches the first video-based commentary about the first live sporting event, and the first score information for the first live sporting event overlaid on the first video-based commentary (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27). It would have been obvious to one of ordinary skill in the art to have modified the system of Mandyam by including the first video-based commentary about the first live sporting event, and the first score information for the first live sporting event overlaid on the first video-based commentary as taught by Brink because the modification would allow the user to continue watching the video without being interrupted when the score is displayed.

As per claim 78-81, Brink teaches displaying the first score information overlaid on the first video-based commentary comprises displaying a scorebug overlaid on the first video-based commentary, wherein the scorebug includes the first score information (para [0073]-[0076], [0101]-[0102]; [0109]; Fig. 15, 15A, 25, and 27); the scorebug includes a logo of at least one team participating in the first live sporting event (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27); displaying at least one animated graphics element overlaid on the first video-based commentary, wherein the first score information is included in the at least one animated graphics element (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27); the at least one animated graphics element includes a scorebug (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27).

As per claim 82, Mandyam teaches wherein: the processor-executable instructions include data for a plurality of images (col. 20, ln 55-57). Brink further teaches the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element overlaid on the first video-based commentary (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27).

As per claim 83, Neither Mandyam nor Brink explicitly teach wherein the method further comprises rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second. However, it would have been obvious to one of ordinary skill in the art to have modified the system of Mandyam and Brink by including s rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second because the modification would allow the user enough time to see each image as it is displayed on the device.

As per claims 84 and 92, Mandyam teaches wherein the method further comprises updating the displayed first score information in essentially real-time with the first live sporting event (col. 48, ln 30-32).

-Continuation in next supplemental box-

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.
Continuation of:
-Continuation in preceding supplemental box-

As per claim 85, Mandyam teaches wherein the method further comprises: receiving, via the at least one communication interface of the first client device and the first event information channel, first event information for the first live sporting event (col. 25, ln 55-56; col. 26, ln 5-7 and 37-44), wherein the first event information includes the first score information and at least one of: team information for the first live sporting event (col. 48, ln 30-32); status or progress information for the first live sporting event (col. 48, ln 30-32); date and/or time information fix the first live sporting event and participant information for the first live sporting event, and displaying, on the display of the first client device, the first video-based commentary about the first live sporting event. Brink further teaches at least some of the first event information for the first live sporting event overlaid on the first video-based commentary (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27).

As per claim 86-89, Brink teaches wherein the at least some of the first event information is included in the at least one animated graphics element (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27); the team information is included in the at least one animated graphics element (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27); the at least one animated graphics element includes at least one logo for at least one team participating in the first live sporting event (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27); the status or progress information and the date and/or time information is included in the at least one animated graphics element (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27).

As per claim 90-91, Mandyam teaches wherein: the processor-executable instructions include data for a plurality of images (col. 20, ln 55-57); Brink further teaches the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element overlaid on the first video-based commentary (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27). Neither Mandyam nor Brink teach wherein the method further comprises rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second. However, it would have been obvious to one of ordinary skill in the art to have modified the system of Mandyam and Brink by including rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second because the modification would allow the user enough time to see each image as it is displayed on the device.

As per claims 93-94, and 95/(77-92) Mandyam teaches wherein the method further comprises: receiving, via the at least one communication interface of the first client device, first chat information regarding the first broadcaster's live stream of digital content, wherein the first client device receives the first chat information on a first chat/system event communication channel different than the first video communication channel and the first event information channel (col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44); displaying, on the display of the first client device, the first chat information ((col. 23, ln 56-60; col. 25, ln 55-56; col. 26, ln 5-7 and 37-44); Brink teaches overlaid on the first video-based commentary (para [0073]-[0076], [0101]-[0102], [0109]; Fig. 15, 15A, 25, and 27).

Claims 1-62, 65-71, and 74-95 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.

SEARCH HISTORY

Application Number	PCT/US 17/45801
Search Conducted By	RLP
Search Approved By	RLP

US/IPC Classifications Searched	IPC(8): H04N 7/18 (2017.01) CPC: A63B 2220/806, A63B 71/0605, G07C 1/24, H04N 7/181, H04N 7/188
Date Conducted	07 October 2017 (07.10.2017)

Documentation Searched	USPC: 348/157 or 709/203 or 709/231 IPC(8): H04N 7/18 (2017.01) CPC: A63B 2220/806, A63B 71/0605, G07C 1/24, H04N 7/181, H04N 7/188
Search Terms Used	Live streaming, sporting event, score, channel, overlay, socket
Date Conducted	07 October 2017 (07.10.2017)

Electronic Database Searched	PatBase
Files Searched	Full-text: AU BE BR CA CH CN DE DK EP ES FI FR GB IN JP KR SE TH TW US WO Bibliographic: (Europe) AT BA BE BG CH CS CY CZ DD DK EE ES FI GE GR HR HU IE IS IT LT LU LV MC MD MT NL NO PL PT RO RS SE SI SK SM TR UA YU (Asia) EA GC HK ID IL IN KZ MN MY PH RU SG SU TH TJ TW UZ VN (North America) CA CR CU DO GT HN MX NI PA SV TT (South America) AR BR CL CO EC PE UY (Australasia) AU NZ (Africa) AP DZ EG KE MA MW OA ZA ZM ZW
Date	07 October 2017 (07.10.2017)

Conducted	
Search Logic:	

Search 19:	UC=(348/157 or 709/203 or 709/231) (Results 25273)
Search 20:	IC=(H04N7/18) (Results 97847)
Search 21:	CPC=(A63B2220/806 or A63B71/060 or G07C1/24 or H04N7/181 or H04N7/188) (Results 6845)
Search 22:	19 or 20 or 21 (Results 124265)
Search 23:	22 and FT=((live or real-time or (real time)) w7 (event* or stream* or sport* or game* or concert* or video*)) (Results 11583)
Search 24:	23 and FT=((receiv* or transmi* or broadcast*) w7 (copy* or copie* or duplicat* or replicat*)) (Results 861)
Search 25:	24 and FT=((comment* or score*) w7 (event* or stream* or sport* or game* or concert* or video*)) (Results 99)
Search 26:	24 and FT=(socket* wf2 server*) (Results 6)
Search 27:	23 and FT=(socket* wf2 server*) (Results 31)
Search 28:	23 and FT=(socket*) (Results 1137)
Search 29:	28 and FT=((multiple or different or plural* or second) wf4 (channel* or provider* or service*)) (Results 460)

Search 2:	FT=((live or real-time or (real time)) w7 (event* or stream* or sport* or game* or concert* or video*)) (Results 121036)
Search 3:	2 and FT=((receiv* or transmi* or broadcast*) w7 (copy* or copie* or duplicat* or replicat*)) (Results 6879)
Search 4:	3 and FT=((comment* or score*) w7 (event* or stream* or sport* or game* or concert* or video*)) (Results 616)
Search 5:	4 and FT=((overla* or superimpos*) w8 (comment* or score*)) (Results 23)
Search 6:	4 and FT=((game* or (sporting event*)) w8 scor*) (Results 191)
Search 7:	6 and FT=((multiple or different or plural* or second) wf4 (channel* or provider* or service*)) (Results 115)
Search 8:	4 and FT=(socket* w9 server*) (Results 31)
Search 9:	2 and FT=(socket* w9 server*) (Results 1431)
Search 10:	9 and FT=(broadcast* w9 (stream* or live)) (Results 228)

Search 11:	10 not 7 (Results 220)
Search 12:	PN=(US8595186) (Results 1)
Search 13:	6 and 12 (Results 1)
Search 14:	PN=(US20130222597) (Results 1)
Search 15:	2 and FT=(RTMP or (real-time wf2 server*) or ("real time" wf3 server*)) (Results 2330)
Search 16:	15 and FT=(WebRTC) (Results 37)
Search 17:	15 and FT=(cache w8 server*) (Results 277)
Search 18:	15 and FT=((HTTP live streaming) or HLS) (Results 271)

Electronic Database Searched	Google
Files Searched	Google Scholar,
Date Conducted	07 October 2017 (07.10.2017)

Search Logic:

About 21,300 results (0.40 sec) socket server live streaming

About 2,960 results (0.05 sec) socket server live streaming sport OR sporting event OR game

About 1,710 results (0.09 sec) socket server live streaming sport OR sporting event OR game scores

About 1,340 results (0.09 sec) socket server live streaming sport OR sporting event OR game scores channels

About 373 results (0.15 sec) socket server live streaming sport OR sporting event OR game scores channels RTMP OR HLS OR CDN OR WEBRTC

SGIC-002/23WO
328544-2010
D. Hopkins
H. Johnson

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: JOSEPH TEJA
COOLEY LLP
1299 PENNSYLVANIA AVENUE, NW
SUITE 700
WASHINGTON, DC 20004-2400

Received
AUG - 8 2018
Cooley LLP

DOCKETED SMW
Art. 19 Amendments
10/6/18
DEADLINE Resp. to WO
3/16/19

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing *(day/month/year)* 06 AUG 2018	
Applicant's or agent's file reference SGIC00203WO	**FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2018/033016	International filing date *(day/month/year)* 16 May 2018
Applicant SPORTSCASTR.LIVE LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

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

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To: JOSEPH TEJA
COOLEY LLP
1299 PENNSYLVANIA AVENUE, NW
SUITE 700
WASHINGTON, DC 20004-2400

PCT

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

(PCT Rule 44.1)

Applicant's or agent's file reference SGIC00203WO	Date of mailing *(day/month/year)* 06 AUG 2018 **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2018/033016	International filing date *(day/month/year)* 16 May 2018
Applicant SPORTSCASTR.LIVE LLC	

1. ☒ The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the international application (see Rule 46):

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the international search report.

   How? Directly to the International Bureau of WIPO preferably through ePCT or on paper to, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: +41 22 338 82 70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 – 9.011.

2. ☐ The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. ☐ **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:
   - ☐ the protest together with the decision thereon has been transmitted to the International Bureau together with any request to forward the texts of both the protest and the decision thereon to the designated Offices.
   - ☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may **submit comments on an informal basis on the written opinion of the International Searching Authority** to the International Bureau. These comments will be made available to the public after international publication. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established.

   Shortly after the expiration of **18 months from the priority date, the international application will be published** by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before the completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for **entry into the national phase** before those designated Offices. In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months. For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

   Within **22 months from the priority date, the applicant may request that a supplementary international search be carried out** by a different International Searching Authority that offers this service (Rule 45*bis*.1). The procedure for requesting supplementary international search is described in the *PCT Applicant's Guide*, International Phase, paragraphs 8.006-8.032.

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

Form PCT/ISA/220 (July 2017)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference SGIC00203WO	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No. PCT/US2018/033016	International filing date *(day/month/year)* 16 May 2018	(Earliest) Priority Date *(day/month/year)* 16 May 2017
Applicant SPORTSCASTR.LIVE LLC		

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 1 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. 28

   ☒ 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.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2018/033016

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H04L 29/06; H04L 29/08; H04N 7/173; H04N 7/18 (2018.01)
CPC - H04N 21/4307; H04L 65/4069; H04N 5/04 (2018.05)

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
USPC - 348/157; 348/485; 725/135 (keyword delimited)

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	US 2011/0083144 A1 (BOCHAROV et al) 07 April 2011 (07.04.2011) entire document	33, 34
---		---
Y		1-32, 35-52
Y	HASHEMIZADEHNAEINI. "Transcoding H.264 Video via FFMPEG encoder," Corso di Laurea Magistrale in Ingegneria delle Telecomunicazioni, Politecnico di Milano, 2015, pp 1-100, [retrieved on 2018-07-10]. Retrieved from the Internet: <URL: https://www.politesi.polimi.it/bitstream/10589/120003/1/Thesis.pdf>	1-32, 35-52
Y	US 2004/0003101 A1 (ROTH et al) 01 January 2004 (01.01.2004) entire document	12, 16
Y	US 2008/0022347 A1 (COHEN) 24 January 2008 (24.01.2008) entire document	27, 28
A	US 2017/0099516 A1 (AUDIONOW IP HOLDINGS, LLC) 06 April 2017 (06.04.2017) entire document	1-52
A	US 2013/0222597 A1 (BRINK et al) 29 August 2013 (29.08.2013) entire document	1-52
A	US 2016/0037215 A1 (CARDONA) 04 February 2016 (04.02.2016) entire document	1-52
A	US 2008/0062318 A1 (ELLIS et al) 13 March 2008 (13.03.2008) entire document	1-52
A	US 9,641,566 B1 (OPENTEST, INC.) 02 May 2017 (02.05.2017) entire document	1-52

☐ 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
10 July 2018	06 AUG 2018
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	Authorized officer Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: JOSEPH TEJA
COOLEY LLP
1299 PENNSYLVANIA AVENUE, NW
SUITE 700
WASHINGTON, DC 20004-2400

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 06 AUG 2018

Applicant's or agent's file reference
SGIC00203WO

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2018/033016	16 May 2018	16 May 2017

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - H04L 29/06; H04L 29/08; H04N 7/173; H04N 7/18 (2018.01)
CPC - H04N 21/4307; H04L 65/4069; H04N 5/04 (2018.05)

Applicant SPORTSCASTR.LIVE LLC

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, VA 22313-1450 Facsimile No. 571-273-8300	10 July 2018	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/237 (cover sheet) (January 2015)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2018/033016

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:

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2018/033016

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**

1. Statement

Novelty (N)	Claims	1-32, 35-52	YES
	Claims	33, 34	NO
Inventive step (IS)	Claims	None	YES
	Claims	1-52	NO
Industrial applicability (IA)	Claims	1-52	YES
	Claims	None	NO

2. Citations and explanations:

Claims 33 and 34 lack novelty under PCT Article 33(2) as being anticipated by Bocharov et al. (hereinafter Bocharov).

Regarding Claim 33, Bocharov discloses a system for providing a first copy of a first broadcaster's live stream of digital content (paragraph 23 for a live sporting event for having continuous video and audio presentation and paragraph 3 for providing media content items through HTTP server to clients [multiple copies] with less delay) including first live sporting event video-based commentary and integrated audio and/or video of a first live sporting event (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]) from a first broadcaster client device to a first viewer client device (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event), the system comprising: means for providing the audio and/or video of the first live sporting event to the broadcaster client device (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media); means for providing the first copy to the first viewer client device between a plurality of media sources and the first viewer client device (paragraph 23 for a for having the data for the live sport event for commentary for a sport event presentation using multiple sources with paragraph 24 for having ongoing live events that a client can join that is already in progress); means for periodically retrieving, from an event information provider (paragraph 20 for using encoders to reduce the latency of the system with controlling B frames to push fragments of the video more quickly and paragraph 3 for having a host server in Japan and a routing server in California to give clients in New York and New Jersey content without re-requesting the content from the host server in Japan [event provider]), first event information germane to a first live sporting event (paragraph 23 for having a first live sporting event [first event] with first event information with information when a player scores a goal [germane information] and paragraph 4 for having an event such as the opening ceremony of the Olympics for using the internet as a medium for consuming live events), wherein the first event information includes first score information for the first live sporting event (paragraph 23 for having a player scoring or having a significant game event for the live sporting event as the announcer is viewing the live sporting event); and means for transmitting the first score information to at least the first viewer client device (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]) via a first event information communication channel that is different from the first video communication channel (paragraph 23 for giving event information on the live sport event such as a goal scored or a significant game event where the announcer can push a button and modify the live sporting event stream [different channel to add commentary by pushing a button]).

Supplemental Box

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Regarding Claim 34, Bocharov discloses a non-transitory computer readable medium encoded with processor-executable instructions that (paragraph 23 for a live sporting event for having continuous video and audio presentation and paragraph 3 for providing media content items through HTTP server to clients [multiple copies] with less delay), when executed by at least one processor of a first client device, perform a method comprising: receiving, via at least one communication interface of the first client device (paragraph 23 for a for having the data for the live sport event for commentary for a sport event presentation with paragraph 24 for having ongoing live events that a client can join that is already in progress), a first copy of a first broadcaster's live stream of digital content including first video-based commentary about a first live sporting event and integrated audio and/or video of the first live sporting event (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]), wherein the first client device receives the first copy of the first broadcaster's live stream of digital content on a first video communication channel (paragraph 23 for having sporting events with goals as significant game events and paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights [means to store multiple score data so the user can only request highlighted media segments]); receiving, via the at least one communication interface of the first client device (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California), first score information for the first live sporting event (paragraph 23 for having a player scoring or having a significant game event for the live sporting event as the announcer is viewing the live sporting event), wherein: the first client device receives the first score information on a first event information (paragraph 23 for having a first live sporting event [first event] with first event information with information when a player scores a goal [germane information] and paragraph 4 for having an event such as the opening ceremony of the Olympics for using the internet as a medium for consuming live events) communication channel different than the first video communication channel (paragraph 23 for having multiple sources [different communication channels] for aggregating event data and then also having means for both an announcer or another party mark points in the event [two different communication means for two different users for the audio and video fragments]); and none of the first score information is included in the first copy of the first broadcaster's live stream of digital content received by the first client device (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast] and having the announcer push a button to add highlight and goal scoring data for the live sports event); and displaying, on a display of the first client device (paragraph 20 for using encoders to reduce the latency of the system with controlling B frames to push fragments of the video more quickly and paragraph 3 for having a host server in Japan and a routing server in California to give clients in New York and New Jersey content without re-requesting the content from the host server in Japan [event provider]), the first video-based commentary about the first live sporting event (paragraph 23 for giving event information on the live sport event such as a goal scored or a significant game event), at least the video of the first live sporting event (paragraph 23 for getting video fragments from multiple sources for the live sports event and aggregating the data to make them available as a continuous video), and the first score information for the first live sporting event overlaid on at least one of the first video-based commentary and the video of the first live sporting event (paragraph 24 for creating an index portion for different segments of the event based on the current time and paragraph 61 for having means to overlay advertisement data on the main presentation with paragraph 50 for means to super impose score and caption data from the segment [superimposing score information is well known in the art for live sports events]).

Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
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Claims 1-11, 13-15, 17-26, 29-32, and 35-52 lack an inventive step under PCT Article 33(3) as being obvious over Bocharov et al. (hereinafter Bocharov) in view of HASHEMIZADEHNAEINI (hereinafter Hash).

Regarding Claim 1, Bocharov discloses a system for providing a first plurality of copies (paragraph 23 for a live sporting event for having continuous video and audio presentation and paragraph 3 for providing media content items through HTTP server to clients [multiple copies] with less delay) of a first broadcaster's live stream of digital content (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]) including first live sporting event video based commentary and integrated audio and/or video of a first live sporting event (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event), from a first broadcaster client device to a first plurality of viewer client devices (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California), the system comprising: A) at least one media source (paragraph 23 for a for having the data for the live sport event for commentary for a sport event presentation with paragraph 24 for having ongoing live events that a client can join that is already in progress) to: provide the audio and/or video of the first live sporting event to the first broadcaster client device (paragraph 23 for having a commentary [audio] from an announcer [first broadcaster] of a live sporting event); receive the first broadcaster's live stream of digital content (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]) including the first live sporting event video-based commentary and the integrated audio and/or video of the first live sporting event (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event); provide a first copy of the first plurality of copies to a first viewer client device (paragraph 24 for having a client joint a live event [first copy] to a client where the client can catch up with previous portions of the event also paragraph 35 for having a computer or phone as a handheld client device) of the first plurality of viewer client devices via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media) between the plurality of media sources and the first viewer client device of the first plurality of viewer client devices (paragraph 24 for viewing a live event that is in progress by connecting to the system and using the client interface [first viewing client] with paragraph 17 for using a client element 150 for having internet connection to stream encoded fragments); and B) a control server to periodically retrieve, from an event information provider (paragraph 20 for using encoders to reduce the latency of the system with controlling B frames to push fragments of the video more quickly and paragraph 3 for having a host server in Japan and a routing server in California to give clients in New York and New Jersey content without re-requesting the content from the host server in Japan), first event information germane to a first live sporting event (paragraph 23 for having a first live sporting event [first event] with first event information with information when a player scores a goal [germane information] and paragraph 4 for having an event such as the opening ceremony of the Olympics for using the internet as a medium for consuming live events), wherein the first event information includes first score information for the first live sporting event (paragraph 23 for having a player scoring or having a significant game event for the live sporting event as the announcer is viewing the live sporting event); and C) at least one server communicatively coupled to the control server to (paragraph 23 for having an edge server [second server means] and getting first client calls to the edge server and get chunks from the cache, and an origin server [control server]): receive from the control server at least the first score information (paragraph 23 for allowing the announcer viewing a live event to indicate when a player has score and provides the commentary by pushing a button [control means]); and transmit the first score information to at least the first viewer client device of the first plurality of viewer client devices via a first event information internet communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media) between at least one first event of the at least one server and the first viewer client device of the first plurality of viewer devices (paragraph 24 for having a client that can view a live event that is already in progress from the system [server for the live event] with paragraph 13 for having an internet caching structure for viewing live events by multiple clients using tracks of audio video, and using chunks), wherein the at least one first event corresponds to the first event information germane to the first live sporting event (paragraph 23 for giving event information on the live sport event such as a goal scored or a significant game event). Bocharov does not explicitly disclose an event socket and a socket server. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses an event socket and a socket server (page 24 RTMP section, for using RTMP for using a socket connection with a Flash Media Server [socket server] to stream data and messages between the client and server with page 66, rtp section for using sockets to a specified multicast group [event socket for the specified active client] requesting the HTTP connection). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of providing light weight encryption for using the protocol behind firewalls (Hash, page 24, third paragraph).

Regarding Claim 2, Bocharov discloses the at least one media source includes an HTTP live streaming (HLS) caching server architecture (paragraph 4 for having an HTTP based internet caching infrastructure for increasing the viewing of live events) to process an audio/video feed of the first live sporting event and provide at least one copy of the audio/video feed to the first broadcaster client device (paragraph 4 for using a live event such as the opening of the Olympics and allowing the client to view the audio/video of the Olympics for the adoption of the internet as a medium for consuming media content).

Supplemental Box

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Regarding Claim 3, Bocharov discloses the at least one media source comprises: at least one of: at least one media server to receive the first broadcaster's live stream of digital content, and at least one server to receive the first broadcaster's live stream of digital content (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event); and an live streaming caching server architecture communicatively coupled to at least one of the at least one media server (paragraph 34 for having message structures to transmit data in a communication network with paragraph 3 for using the HTTP protocol using a web browser and using proxies for caching data); and the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 4 for watching the Olympics live via the internet) of the first plurality of viewer devices between the first viewer client device and the caching server architecture (paragraph 28 for using HTTP server for getting chunks and receiving chunks from a cache based on the cache lifetime for live TTL settings). Bocharov does not explicitly discloses one of real-time messaging protocol (RTMP) and web real time communication (WebRTC) media server and HLS caching. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses one of real-time messaging protocol (RTMP) and web real time communication (WebRTC) media server and HLS caching (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player and also page 34, figure 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of providing light weight encryption for using the protocol behind firewalls (Hash, page 24, third paragraph).

Regarding Claim 4, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTMP media server and the at least one WebRTC media server to receive, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, a first HLS file suite representing the first broadcaster's live stream of digital content, and a plurality of HLS child servers communicatively coupled to the TLS mother server and an TLS content delivery network wherein: the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN, and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HLS file suite. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTMP media server and the at least one WebRTC media server to receive, from the at least one of the at least one RTMP media server and the at least one WebRTC media server (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player and also), a first HLS file suite representing the first broadcaster's live stream of digital content (page 34, Table 2.2 and first paragraph for using the HLS suite for digital content to minimize time outs and latency in delivering content); and a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network (page 34 Table 2.2 and first paragraph for using HLS for content delivers with page 100 for using HLS streams for adaptive streaming formats for different quality of streaming), wherein: the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN (page 34 Table 2.2 and first paragraph for using the system with Netflix [a well know CDN in the art] and Comcast in 4G broadcasts using HLS for content on client devices and calculating the server closes to the requesting client to reduce latency); and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HLS file suite (page 34 Table 2.2 and first paragraph for keeping content on a CDN server to optimize bandwidth and improve the overall user experience). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving overall user experience (Hash, page 34, first paragraph).

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Regarding Claim 5, Bocharov discloses at least one webserver to provide an applications programming interface (API) between the system and each of the first broadcaster client device (paragraph 30 for using an API with a pre-defined URL for streaming live content to a server to allow the client to precisely stream with paragraph 3 for using a HTTP protocol on the web [having a web server means] for and using caching to reduce latency), the second broadcaster client device (paragraph 23 for allowing the [first broadcaster] and another party [second broadcaster] mark point in the sporting events), the first plurality of viewer client devices and the second plurality of viewer client devices (paragraph 30 for having a client joining a live stream event and allow the client to view previously streamed portions with paragraph 39 for using media streams with client [multiple clients] for using both origin and ingest servers to encode media formats); and a memory system (400) communicatively coupled to the at least one webserver (paragraph 39 for having multiple servers [memory] for ingesting encoders for media streams), the memory system including a database storing (paragraph 22 for using a database for receiving video fragments using cloud based storage services): first stream information for the first broadcaster's live stream of digital content including the first live sporting event video-based commentary from the first broadcaster client device (paragraph 24 for viewing a live event that is in progress by connecting to the system and using the client interface [first viewing client] with paragraph 17 for using a client element 150 for having internet connection to stream encoded fragments), wherein the first stream information includes a stream for the first broadcaster's live stream of digital content (paragraph 40 for having an encoder stream and means to identify the encoder stream and getting the stream data), wherein the at least one webserver (paragraph 30 for using an API with a pre-defined URL for streaming live content to a server to allow the client to precisely stream with paragraph 3 for using a HTTP protocol on the web [having a web server means] for and using caching to reduce latency). Bocharov does not explicitly disclose a StreamID and determines an address for the IHLS CDN to establish the first video communication channel to provide the first copy of the first plurality of copies to the first viewer client device, based at least in part on the StreamID for the broadcaster's live stream of digital content, and transmits the address for the HLS CDN to the first viewer client device of the first plurality of viewer client devices to establish the first video Internet communication channel. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses a StreamID and determines an address for the HLS CDN to establish the first video communication channel to provide the first copy of the first plurality of copies to the first viewer client device (page 24 RTMP section, for using RTMP as a message stream ID for data for audio samples and compressed video data in a message with page 34 Table 2.2 and first paragraph for using the system with Netflix [a well know CDN in the art] and Comcast in 4G broadcasts using HLS for content on client devices and calculating the server closes to the requesting client to reduce latency), based at least in part on the StreamID for the broadcaster's live stream of digital content (page 24 RTMP section, for using RTMP as a proprietary stream protocol for using stream ID and the message payload to using RTMP message communication over the network and page 28, first two paragraph for using a unicast stream and sending it to multicast groups with their own IP addresses for streaming to a group of clients); and transmits the address for the HLS CDN to the first viewer client device of the first plurality of viewer client devices to establish the first video Internet communication channel (page 34 Table 2.2 and first paragraph for keeping content on a CDN server to optimize bandwidth and improve the overall user experience with page 27-28 and Section 2. Multicast for the simultaneous delivery of a stream to multiple users with an IGMP to identify the group members). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving overall user experience (Hash, page 34, first paragraph).

Regarding Claim 6, Bocharov discloses the first stream information for the first broadcaster's live stream of digital content further includes (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event). Bocharov does not explicitly disclose an event identifier (EventID) for the first live sporting event, and the at least one webserver further: determines a first socket address for the at least one first event socket of the at least one socket server based at least in part on the EventID, and transmits the first socket address to the first viewer client device of the first plurality of viewer client devices to establish the first event information Internet communication channel. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses an event identifier (EventID) for the first live sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream); and the at least one webserver further: determines a first socket address for the at least one first event socket of the at least one socket server based at least in part on the EventID (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch using Mycujoo and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming); and transmits the first socket address to the first viewer client device of the first plurality of viewer client devices to establish the first event information Internet communication channel (page 116, and figure 5.26 for having multiple live events as a menu on a client device and with page 27-28 and Section 2. Multicast for the simultaneous delivery of a stream to multiple users with an IGMP to identify the group members). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of making copies on the network only when needed (Hash, page 27, last two paragraphs).

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Regarding Claim 7, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose in C), the at least one socket server further transmits and receives first chat information regarding the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content via at least one first chat/system event Internet communication channel between at least one first chat/system event socket of the at least one socket server and the first viewer client device of the first plurality of viewer client devices, wherein the at least one first chat/system event socket corresponds to the first chat information regarding the first live sporting event video-based commentary, and the at least one webserver further: determines a second socket address for the at least one first chat/system event socket of the at least one socket server based at least in part on the StreamID, and transmits the second socket address to the first viewer client device of the first plurality of viewer client devices to establish the first chat/system event Internet communication channel. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses disclose in C), the at least one socket server further transmits and receives first chat information regarding the first live sporting event video-based commentary included in the first broadcaster's live stream of digital content via at least one first chat/system event Internet communication channel between at least one first chat/system event socket of the at least one socket server and the first viewer client device of the first plurality of viewer client devices (page 89 top section for streaming video using the internet and having a means to chat with other people on board [chat system] and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming), wherein the at least one first chat/system event socket corresponds to the first chat information regarding the first live sporting event video-based commentary (page 89 section 5.1.1 for having a user interface terminal to allow the user to interact with the iES services with page 89 top section for allowing the user to have internet access and stream video along with chatting with other people); and the at least one webserver further: determines a second socket address for the at least one first chat/system event socket of the at least one socket server based at least in part on the StreamID (paragraph 66 for using UDP sockets for multicast groups using a HTTP connection with page 24 RTMP section, for using RTMP as a proprietary stream protocol for using stream ID and the message payload to using RTMP message communication over the network where the client creates its own socket connection and page 28, first two paragraph for using a unicast stream and sending it to multicast groups with their own IP addresses for streaming to a group of clients); and transmits the second socket address to the first viewer client device of the first plurality of viewer client devices to establish the first chat/system event Internet communication channel (page 89 top section for using the chat system as part of the internet with page 94 for having means to send audio video and text messages using the iES manager also page 68-69 Section Environment for using variables in the command line including multiple sockets such as a backlog socket, a multicast socket, a UDP socket buffer, along with a newly accepted socket and determining if the socket buffer should be synched). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving perceive quality of the data stream and enhance bandwidth usage (Hash, page 89, top section).

Regarding Claim 8, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server requests, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, only the first HLS file suite representing the first broadcaster's live stream of digital content and no other HLS file suite representing the first broadcaster's live stream of digital content. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server requests, from the at least one of the at least one RTMP media server and the at least one WebRTC media server (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player), only the first HLS file suite representing the first broadcaster's live stream of digital content and no other HLS file suite representing the first broadcaster's live stream of digital content (page 34, Table 2.2 and first paragraph for using the HLS suite for digital content to minimize time outs and latency in delivering content and page 116, figure 5.26 for having live streams of digital content placed in thumbnails for viewing live broadcasts on a user device). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving overall user experience (Hash, page 34, first paragraph).

Regarding Claim 9, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server maintains a persistent connection to the at least one of the at least one RTMP media server and the at least one WebRTC media server, during at least a portion of a duration of the first broadcaster's live stream of digital content, to receive respective elements of the first HLS file suite. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server maintains a persistent connection to the at least one of the at least one RTMP media server and the at least one WebRTC media server (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability), during at least a portion of a duration of the first broadcaster's live stream of digital content, to receive respective elements of the first HLS file suite (page 34 Table 2.2 and first paragraph for using the system with Netflix [a well know CDN in the art] and Comcast in 4G broadcasts using HLS for content on client devices and calculating the server closes to the requesting client to reduce latency). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of no interruption of video stream playback (Hash, page 16, last paragraph).

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Regarding Claim 10, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the first HLS file suite provided by the at least one of the at least one RTIMP media server and the at least one WebRTC media server to the HLS mother server comprises: a first HLS playlist specifying a first plurality of different resolution versions of the first broadcaster's live stream of digital content, the first HLS playlist further including a corresponding first plurality of chunklist pointers to first respective chunklists for the first plurality of different resolution versions, the first respective chunklists for the first plurality of different resolution versions, wherein each chunklist of the first respective chunklists includes a first plurality of file segment pointers to first respective file segments for each different resolution version of the first plurality of different resolution versions, and the first respective file segments for each different resolution version of the first plurality of different resolution versions, the HLS mother server caches the first IHLS playlist, the first respective chunklists, and the first respective file segments and passes on to at least one HLS child server of the plurality of HLS child servers at least one first copy of the first HLS playlist, the first respective chunklists, and the first respective file segments, and the at least one HLS child server of the plurality of HLS child servers server caches the at least one first copy of the first HLS playlist, the first respective chunklists, and the first respective file segments and passes on to the HLS CDN at least one second copy of the first HLS playlist, the first respective chunklists, and the first respective file segments, wherein the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices is based on the at least one second copy of the first HLS playlist, the first respective chunklists, and the first respective file segments. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the first HLS file suite provided by the at least one of the at least one RTIMP media server and the at least one WebRTC media server to the HLS mother server comprises (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes): a first HLS playlist specifying a first plurality of different resolution versions of the first broadcaster's live stream of digital content (page 17 last paragraph for having balance between speed and resolution for adaptive streaming with multiple bit rates), the first HLS playlist further including a corresponding first plurality of chunklist pointers to first respective chunklists for the first plurality of different resolution versions (page 17 first paragraph for request a chunk from the server at a desired rate and pushing the chunk by estimating the available bandwidth to determine video quality [resolution]); the first respective chunklists for the first plurality of different resolution versions, wherein each chunklist of the first respective chunklists includes a first plurality of file segment pointers to first respective file segments for each different resolution version of the first plurality of different resolution versions (page 17 for using different rates and video quality to send the content chunk to the client device to buffer the chunks for playback and page 17, second paragraph for using chunks with a manifest file [list means] for downloading consecutive chunks for streaming); and the first respective file segments for each different resolution version of the first plurality of different resolution versions (page 21-22 Section HLS for using different bit rates and multiple streams for live broadcasts to allow for dynamic switching between stream based on bandwidth); the HLS mother server caches the first IHLS playlist (page 22 first paragraph for using HLS for media encryption over HTTSP and protecting work with page 90 first paragraph for allowing the user to have TV channels and play lists for video on demand), the first respective chunklists, and the first respective file segments and passes on to at least one HLS child server of the plurality of HLS child servers at least one first copy of the first HLS playlist (page 21 last paragraph for streaming live stream over a HTTP web server using multiple alternate streams that are dynamically switches and page 51 for having the means to fragment video of one minute into 10 second segments and chunk along the GOP boundaries), the first respective chunklists, and the first respective file segments (page 17, second paragraph for using means to down load consecutive chunks to accommodate push stream based on a single client request); and the at least one HLS child server of the plurality of HLS child servers server caches the at least one first copy of the first HLS playlist (page 17, first paragraph for having buffered content chunks to play to avoid playback interruption with page 33, Section CDN for using a content delivery network with means to cache the contents from servers that are dispersed at different geographic locations), the first respective chunklists, and the first respective file segments and passes on to the HLS CDN at least one second copy of the first HLS playlist (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for breaking content into little file segments of short intervals for a live broadcast of a sports event where the content can be a movie or a sports event [multiple copies]), the first respective chunklists, and the first respective file segments, wherein the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event to determine the next segment [chunk] to play based on network conditions using messages) of the first plurality of viewer devices is based on the at least one second copy of the first HLS playlist (page 22 middle section for having content that is many hours in duration such as a sports event that has short intervals for high quality delivery of streaming services [having a list of short intervals or play list of segment for the event is inherent to live streaming a sports event]), the first respective chunklists, and the first respective file segments (page 21 Section HTTP for using a web server to stream video and using it for a light server load to match the user profile to the files speed [number of chunks per unit time] with page 34 Table 2.2 and first paragraph for keeping content on a CDN server to optimize bandwidth and improve the overall user experience). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving overall user experience (Hash, page 34, first paragraph).

Regarding Claim 11, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the first HLS playlist received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a playlist cache-control command, and upon receipt of the first HLS playlist, the HLS mother server re-writes the playlist cache control command to change a playlist caching time from zero to non-zero. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the first HLS playlist received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a playlist cache-control command (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability); and upon receipt of the first HLS playlist, the HLS mother server re-writes the playlist cache control command to change a playlist caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of efficient and high quality streaming services (Hash, page 22, second paragraph).

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Regarding Claim 13, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose each chunklist of the first respective chunklists received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a chunklist cache-control command, and upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cache control command to change a chunklist caching time from zero to non-zero. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses each chunklist of the first respective chunklists received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a chunklist cache-control command (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability); and upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cache control command to change a chunklist caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 17 first paragraph for monitoring the server after the initial request and encoding chunks at a lower rate to allow for measured network conditions and allowing the appropriate bandwidth for each chunk [rewriting chunk control for the cache to change based on network congestion and bandwidth]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of having appropriate bandwidth for the chunks (Hash, page 17, first paragraph).

Regarding Claim 14, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server re-writes the chunklist cache control command to change the playlist caching time to a video segment duration for each file segment of the respective file segments. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server re-writes the chunklist cache control command to change the playlist caching time to a video segment duration for each file segment of the respective file segments (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream and having different cache control commands [changing cache thresholds to compensate for bit rate spikes]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of compensating for bit rate spikes (Hash, page 47, last paragraph).

Regarding Claim 15, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose each file segment of the first respective file segments received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a file segment cache-control command, and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses each file segment of the first respective file segments received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a file segment cache-control command (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability), and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of efficient and high quality streaming services (Hash, page 22, second paragraph).

Regarding Claim 17, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the at least one of the at least one RTMP media server and the at least one WebRTC media server is configurable according to a plurality of IHLS settings for generating the first IHLS file suite, wherein the plurality of ILS settings include: a video segment duration for each file segment of the respective file segments, and an HLS buffer length including a first number of the first plurality of file segment pointers in each chunklist, the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds, and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the at least one of the at least one RTMP media server and the at least one WebRTC media server is configurable according to a plurality of IHLS settings for generating the first HLS file suite (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability), wherein the plurality of ILS settings include: a video segment duration for each file segment of the respective file segments (page 17 first paragraph for request a chunk from the server at a desired rate and pushing the chunk by estimating the available bandwidth to determine video quality [resolution]); and an HLS buffer length including a first number of the first plurality of file segment pointers in each chunklist (page 17, first paragraph for having buffered content chunks to play to avoid playback interruption with page 33, Section CDN for using a content delivery network with means to cache the contents from servers that are dispersed at different geographic locations); the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds (page 17, first paragraph for having multiple video chunks based on the network congestion and bandwidth with page 51 first paragraph for taking a fragment of a video [segment] and cutting it into segments that are 2 – 10 seconds long); and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six (page 17 second paragraph for using seamless server migration for pushing chunks at a rated of adaptation for a flexible approach, and page 51 for taking a one minute video fragment to fit into pockets with key frames and key intervals and using segments of 2-10 seconds [10 seconds is six video segments for the minute]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of server adaptation for push streams (Hash, page 17, second paragraph).

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Regarding Claim 18, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the first number of the first plurality of file segment pointers in each chunk list is four. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the first number of the first plurality of file segment pointers in each chunk list is four (page 51 for taking a one minute video fragment to fit into pockets with key frames and key intervals and using segments of 2-10 seconds [10 seconds is six video segments for the minute] with means to segment chunks into a desired delivery format by cutting the source video into multiples parts of some seconds each). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of chunking segment on video codec boundaries (Hash, page 51, first paragraph).

Regarding Claim 19, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the plurality of HLS settings further include a key frame interval for each different resolution version of the first plurality of different resolution versions of the first copy, and the key frame interval is configured to be less than 60 frames. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the plurality of HLS settings further include a key frame interval for each different resolution version of the first plurality of different resolution versions of the first copy (page 52 for having ideal key frame intervals based on the fps for the video with a key frame interval of 2-4 seconds and page 73 for having an IDR frame video sequence with key frames at 2 based on the fps value); and the key frame interval is configured to be less than 60 frames (page 52 for having a key frame interval of 2-4 seconds and page 73 for having key frames at an auto minimum values of 10-25 [less than 60 frames]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of scene cut detection (Hash, page 73, last paragraph).

Regarding Claim 20, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the key frame interval is configured to be 30 frames. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the key frame interval is configured to be 30 frames (page 52 for having a key frame interval of 2-4 seconds and page 73 for having key frames at an auto minimum values of 10-25 [less than 30 frames]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of scene cut detection (Hash, page 73, last paragraph).

Regarding Claim 21, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the first HLS playlist received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a playlist cache-control command, upon receipt of the first HLS playlist, the HLS mother server re-writes the playlist cache control command to change a playlist caching time from zero to non-zero, each chunklist of the first respective chunklists received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a chunklist cache-control command, upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cache control command to change a chunklist caching time from zero to non-zero, each file segment of the first respective file segments received by the VILS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a file segment cache-control command, and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the first HLS playlist received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a playlist cache-control command (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability); upon receipt of the first HLS playlist, the HLS mother server re-writes the playlist cache control command to change a playlist caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream); each chunklist of the first respective chunklists received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a chunklist cache-control command (page 17, first paragraph for having buffered content chunks to play to avoid playback interruption with page 33, Section CDN for using a content delivery network with means to cache the contents from servers that are dispersed at different geographic locations); upon receipt of the each chunklist, the HLS mother server re-writes the chunklist cache control command to change a chunklist caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 17 first paragraph for monitoring the server after the initial request and encoding chunks at a lower rate to allow for measured network conditions and allowing the appropriate bandwidth for each chunk [rewriting chunk control for the cache to change based on network congestion and bandwidth]); each file segment of the first respective file segments received by the HLS mother server from the at least one of the at least one RTMP media server and the at least one WebRTC media server includes a file segment cache-control command (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability); and upon receipt of the each file segment, the HLS mother server re-writes the file segment cache-control command to change a file segment caching time from zero to non-zero (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of efficient and high quality streaming services (Hash, page 22, second paragraph).

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Regarding Claim 22, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server re-writes the chunklist cache control command to change the playlist caching time to the video segment duration for each file segment of the respective file segments. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server re-writes the chunklist cache control command to change the playlist caching time to the video segment duration for each file segment of the respective file segments (page 33 last paragraph for using the CDN for delivers content on high traffic websites and caching the content based on the location nearest to the user for delivers of the videos with page 47 last paragraph for changing the caching thresholds [cache control] on the client side based on Akamai or HD streaming). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of handling bit rate peaks (Hash, page 47, last paragraph).

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Regarding Claim 23, Bocharov discloses the plurality of media sources comprises: at least one of: at least one real-time messaging protocol (RTIIP) media server (320) to receive the first broadcaster's live stream of digital content (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event). Bocharov does not explicitly disclose at least one web real time communication (WebRTC) media server to receive the first broadcaster's live stream of digital content, and an HTTP live streaming (HLS) caching server architecture communicatively coupled to at least one of the at least one RTIMIP media server and the at least one WebRTC media server, the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS caching server architecture, the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTIIP media server and the at least one WebRTC media server to receive, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, a first HLS file suite representing the first broadcaster's live stream of digital content via a first video communication channel, and a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network, the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN, the first copy of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HILS file suite, the HLS mother server requests, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, only the first HLS file suite representing the first broadcaster's live stream of digital content and no other HLS file suite representing the first broadcaster's live stream of digital content, the HLS mother server maintains a persistent connection to the at least one of the at least one RTMN'P media server and the at least one WebRTC media server, during at least a portion of a duration of the first broadcaster's live stream of digital content, to receive respective elements of the first HLS file suite, the first IHLS file suite provided by the at least one of the at least one RTMP media server and the at least one WebRTC media server to the IHLS mother server comprises: a first IHLS playlist specifying a first plurality of different resolution versions of the first broadcaster's live stream of digital content, the first HLS playlist further including a corresponding first plurality of chunklist pointers to first respective chunklists for the first plurality of different resolution versions, the first respective chunklists for the first plurality of different resolution versions, wherein each chunklist of the first respective chunklists includes a first plurality of file segment pointers to first respective file segments for each different resolution version of the first plurality of different resolution versions, and the first respective file segments for each different resolution version of the first plurality of different resolution versions, the HLS mother server caches the first HLS playlist, the first respective chunklists, and the first respective file segments and passes on to at least one HLS child server of the plurality of HLS child servers at least one first copy of the first IHLS playlist, the first respective chunklists, and the first respective file segments, the at least one HLS child server of the plurality of ILS child servers server caches the at least one first copy of the first ILS playlist, the first respective chunklists, and the first respective file segments and passes on to the HLS CDN at least one second copy of the first HLS playlist, the first respective chunklists, and the first respective file segments, and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices is based on the at least one second copy of the first HLS playlist, the first respective chunklists, and the first respective file segments. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses at least one web real time communication (WebRTC) media server (360) to receive the first broadcaster's live stream of digital content (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes); and an HTTP live streaming (HLS) caching server architecture communicatively coupled to at least one of the at least one RTIMIP media server and the at least one WebRTC media server (page 22 first paragraph for using HLS for media encryption over HTTSP and protecting work with page 90 first paragraph for allowing the user to have TV channels and play lists for video on demand); the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS caching server architecture (page 22, figure 2.9 for having a client device HTTP client and a HTTP server for broadcasting the live stream [digital content] of a sports event using a TCFP/IP network); the HLS caching server architecture comprises: an HLS mother server communicatively coupled to the at least one of the at least one RTIIP media server and the at least one WebRTC media server to receive (page 22 and figure 2.9 for having a HTTP server with hostname port as the HLS server using Apple's live stream solution), from the at least one of the at least one RTMP media server and the at least one WebRTC media server (page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes), a first HLS file suite representing the first broadcaster's live stream of digital content via a first video communication channel (page 22, figure 2.9 for using a communication channel using request and response messages using a network for addressing and routing); and a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network (page 21 last two paragraphs for using HLS for live stream digital content for alternating between streams of different rates and resolutions with different servers for the switched streams for means for playback on different devices); the system establishes the first video Internet communication channel to provide the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device of the first plurality of viewer devices between the first viewer client device and the HLS CDN (page 34, Table 2.2 and first paragraph for using the HLS suite for digital content to minimize time outs and latency in delivering content); and a plurality of HLS child servers communicatively coupled to the HLS mother server and an HLS content delivery network (page 34 Table 2.2 and first paragraph for using HLS for content delivers with page 100 for using HLS streams for adaptive streaming formats for different quality of streaming); the first copy (204A) of the first plurality of copies of the first broadcaster's live stream of digital content is based on the first HLS file suite (page 21 last two paragraphs for using HLS for live stream digital content for alternating between streams of different rates and resolutions); the HLS mother server requests, from the at least one of the at least one RTMP media server and the at least one WebRTC media server, only the first HLS file suite representing the first broadcaster's live stream of digital content and no other HLS file suite representing the first broadcaster's live stream of digital content (page 34 Table 2.2 and first paragraph for using the system with Netflix [a well know CDN in the art] and Comcast in 4G broadcasts using HLS for content on client devices and calculating the server closes to the requesting client to reduce latency); the HLS mother server maintains a persistent connection to the at least one of the at least one RTMN'P media server and the at least one WebRTC media server (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the

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user's connection speed and ability), during at least a portion of a duration of the first broadcaster's live stream of digital content, to receive respective elements of the first HLS file suite (page 21 last two paragraphs for using HLS for live stream digital content for alternating between streams of different rates and resolutions with means to dynamically switch [having a first and second broadcast stream]); the first IHLS file suite provided by the at least one of the at least one RTMP media server and the at least one WebRTC media server to the IHLS mother server comprises (page 34 Table 2.2 and first paragraph for using the system with Netflix [a well know CDN in the art] and Comcast in 4G broadcasts using HLS for content on client devices and calculating the server closes to the requesting client to reduce latency): a first IHLS playlist specifying a first plurality of different resolution versions of the first broadcaster's live stream of digital content (page 17 last paragraph for having balance between speed and resolution for adaptive streaming with multiple bit rates), the first HLS playlist further including a corresponding first plurality of chunklist pointers to first respective chunklists for the first plurality of different resolution versions (page 17 first paragraph for request a chunk from the server at a desired rate and pushing the chunk by estimating the available bandwidth to determine video quality [resolution]); the first respective chunklists for the first plurality of different resolution versions, wherein each chunklist of the first respective chunklists includes a first plurality of file segment pointers to first respective file segments for each different resolution version of the first plurality of different resolution versions (page 17 for using different rates and video quality to send the content chunk to the client device to buffer the chunks for playback and page 17, second paragraph for using chunks with a manifest file [list means] for downloading consecutive chunks for streaming); and the first respective file segments for each different resolution version of the first plurality of different resolution versions (page 21-22 Section HLS for using different bit rates and multiple streams for live broadcasts to allow for dynamic switching between stream based on bandwidth); the HLS mother server caches the first HLS playlist (page 21 last paragraph for streaming live stream over a HTTP web server using multiple alternate streams that are dynamically switches and page 51 for having the means to fragment video of one minute into 10 second segments and chunk along the GOP boundaries), the first respective chunklists, and the first respective file segments and passes on to at least one HLS child server of the plurality of HLS child servers at least one first copy of the first IHLS playlist, the first respective chunklists, and the first respective file segments (page 17, second paragraph for using means to down load consecutive chunks to accommodate push stream based on a single client request); the at least one HLS child server of the plurality of ILS child servers server caches the at least one first copy of the first HLS playlist (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for breaking content into little file segments of short intervals for a live broadcast of a sports event where the content can be a movie or a sports event [multiple copies]), the first respective chunklists, and the first respective file segments and passes on to the HLS CDN at least one second copy of the first HLS playlist, the first respective chunklists, and the first respective file segments (page 17, first paragraph for having buffered content chunks to play to avoid playback interruption with page 33, Section CDN for using a content delivery network with means to cache the contents from servers that are dispersed at different geographic locations); and the first copy of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event to determine the next segment [chunk] to play based on network conditions using messages) of the first plurality of viewer devices is based on the at least one second copy of the first HLS playlist playlist (page 22 middle section for having content that is many hours in duration such as a sports event that has short intervals for high quality delivery of streaming services [having a list of short intervals or play list of segment for the event is inherent to live streaming a sports event]), the first respective chunklists, and the first respective file segments (page 21 Section HTTP for using a web server to stream video and using it for a light server load to match the user profile to the files speed [number of chunks per unit time] with page 34 Table 2.2 and first paragraph for keeping content on a CDN server to optimize bandwidth and improve the overall user experience). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving overall user experience (Hash, page 34, first paragraph).

Regarding Claim 24, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the at least one of the at least one RTMP media server and the at least one WebRTC media server is configurable according to a plurality of HLS settings for generating the first HLS file suite, wherein the plurality of HLS settings include: a video segment duration for each file segment of the respective file segments, and an HLS buffer length including a first number of the first plurality of file segment pointers in each chunklist, the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds, and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the at least one of the at least one RTMP media server and the at least one WebRTC media server is configurable according to a plurality of HLS settings for generating the first HLS file suite (page 34, Table 2.2 for using HLS as a video protocol with service providers and 4G broadcast modes with page 24 RTMP section, for using RTMP as a proprietary stream protocol with flash media player with page 16 last paragraph for providing adaptive stream with no interruption [persistent connection] for playback and considering the user's connection speed and ability), wherein the plurality of HLS settings include: a video segment duration for each file segment of the respective file segments (page 17 first paragraph for request a chunk from the server at a desired rate and pushing the chunk by estimating the available bandwidth to determine video quality [resolution]); and an HLS buffer length including a first number of the first plurality of file segment pointers in each chunklist (page 17, first paragraph for having buffered content chunks to play to avoid playback interruption with page 33, Section CDN for using a content delivery network with means to cache the contents from servers that are dispersed at different geographic locations); the video segment duration for each file segment of the respective file segments is configured to be approximately two seconds (page 17, first paragraph for having multiple video chunks based on the network congestion and bandwidth with page 51 first paragraph for taking a fragment of a video [segment] and cutting it into segments that are 2 – 10 seconds long); and the first number of the first plurality of file segment pointers in each chunklist for the HLS buffer length is one of four, five and six (page 17 second paragraph for using seamless server migration for pushing chunks at a rated of adaptation for a flexible approach, and page 51 for taking a one minute video fragment to fit into pockets with key frames and key intervals and using segments of 2-10 seconds [10 seconds is six video segments for the minute]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of server adaptation for push streams (Hash, page 17, second paragraph).

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Regarding Claim 25, Bocharov discloses a memory system (400) communicatively coupled to the control server (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media), the memory system including a database (paragraph 22 for having means to store the media fragments in a database with cloud based storage), wherein in B): the event information provider monitors a plurality of types of sporting events (paragraph 23 for having sporting events with goals as significant game events and paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights); for each type of the plurality of types, the event information provider monitors a plurality of sporting events including the first live sporting event (paragraph 23 for having a live sporting event that uses goals as highlights and paragraph 4 for having a different type of sporting event such as the opening of the Olympics on the internet); and for each type of the plurality of types, and for each sporting event of the plurality of sporting events (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event), the control server: retrieves from the event information provider event data including at least one of: the type of the sporting event (paragraph 23 for getting event information such as sparse fragment data from a variety of sources to aggregate the data by the server to create a live sporting event with commentary). Bocharov does not explicitly disclose an event identifier (EventiD) for the sporting event, a status of the sporting event, progress details for the sporting event, a date and/or time of the sporting event, and event participant data regarding participants in the sporting event, normalizes at least the date and/or time of the sporting event to a reference standard time to provide a normalized date and/or time, and stores the event data and the normalized date and/or time in the database. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses an event identifier (EventiD) for the sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream); a status of the sporting event, progress details for the sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch using Mycujoo and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming); a date and/or time of the sporting event and event participant data regarding participants in the sporting event (page 116, and figure 5.26 for having multiple live events as a menu on a client device and with page 27-28 and Section 2. Multicast for the simultaneous delivery of a stream to multiple users with an IGMP to identify the group members); normalizes at least the date and/or time of the sporting event to a reference standard time to provide a normalized date and/or time (page 118, first paragraph for having virtual servers with a database to see a schedule [date and time] of important live events using an API to stream the event for quick ramping capacity, page 93 for getting events on TV or radio with giving play list times for certain areas); and stores the event data and the normalized date and/or time in the database (page 115 for having multiple high lights of events that are available to be played as shown by the white arrows [storing the videos in a database is inherent to playing the highlights]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of making copies on the network only when needed (Hash, page 27, last two paragraphs).

Regarding Claim 26, Bocharov discloses for each type of the plurality of types, and for each sporting event of the plurality of sporting events (paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights), the control server further: normalizes at least one of the progress details for the sporting event and the event participant data regarding participants in the sporting event (paragraph 57 for giving progress data of the highlights of the event as the event progresses); and stores the normalized at least one of the progress details and the event participant data in the database (paragraph 57 for having means to request only the media fragments of interest to the client, with paragraph 22 for having means to store the media fragments in a database with cloud based storage).

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Regarding Claim 29, Bocharov discloses a memory system communicatively coupled to the control server (paragraph 20 for using encoders to reduce the latency of the system with controlling B frames to push fragments of the video more quickly and paragraph 3 for having a host server in Japan and a routing server in California to give clients in New York and New Jersey content without re-requesting the content from the host server in Japan [event provider]), the memory system including a database (paragraph 22 for having means to store the media fragments in a database with cloud based storage), wherein in B) the control server: retrieves from the event information provider first event data for the first live sporting event (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event), the first event data including at least one of: the type of the first live sporting event (paragraph 23 for getting event information such as sparse fragment data from a variety of sources to aggregate the data by the server to create a live sporting event with commentary). Bocharov does not explicitly disclose an event identifier (EventID) for the first live sporting event, a status of the first live sporting event, progress details for the first live sporting event, a date and/or time of the first live sporting event, and event participant data regarding participants in the first live sporting event, normalizes at least the date and/or time of the first live sporting event to a reference standard time to provide a normalized date and/or time, and stores the first event data and the normalized date and/or time in the database. Bocharov does not explicitly disclose an event identifier (EventID) for the sporting event, a status of the sporting event, progress details for the sporting event, a date and/or time of the sporting event, and event participant data regarding participants in the sporting event, normalizes at least the date and/or time of the sporting event to a reference standard time to provide a normalized date and/or time, and stores the event data and the normalized date and/or time in the database. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses an event identifier (EventID) for the sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream); a status of the sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch using Mycujoo and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming); progress details for the sporting event, a date and/or time of the sporting event, and event participant data regarding participants in the sporting event (page 116, and figure 5.26 for having multiple live events as a menu on a client device and with page 27-28 and Section 2. Multicast for the simultaneous delivery of a stream to multiple users with an IGMP to identify the group members), normalizes at least the date and/or time of the sporting event to a reference standard time to provide a normalized date and/or time (page 118, first paragraph for having virtual servers with a database to see a schedule [date and time] of important live events using an API to stream the event for quick ramping capacity, page 93 for getting events on TV or radio with giving play list times for certain areas), and stores the event data and the normalized date and/or time in the database (page 115 for having multiple high lights of events that are available to be played as shown by the white arrows [storing the videos in a database is inherent to playing the highlights]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of making copies on the network only when needed (Hash, page 27, last two paragraphs).

Regarding Claim 30, Bocharov discloses in B), the control server further: normalizes at least one of the progress details for the first live sporting event and the event participant data regarding participants in the first live sporting event (paragraph 23 for having significant events such as scoring a goal and allowing the commentator to push a button and aggregate audio data on the event); and stores the normalized at least one of the progress details and the event participant data in the database (paragraph 23 for having sporting events with goals as significant game events and paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights [means to store multiple score data so the user can only request highlighted media segments or stored fragments]).

Regarding Claim 31, Bocharov discloses the progress details include the first score information (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event); the control server periodically retrieves the progress details from the event information provider and updates the first score information (paragraph 23 for pushing a button for updating when a goal is being scored for the announcer); and for each update of the first score information (paragraph 23 for having significant events such as scoring a goal and allowing the commentator to push a button and aggregate audio data on the event), the control server queues an asynchronous message including the updated first score information (paragraph 24 for having a client that can view a live event that is already in progress from the system [server for the live event] with paragraph 13 for having an internet caching structure for viewing live events by multiple clients using tracks of audio video, and using chunks). Bocharov does not explicitly disclose for transmission to the at least one first event socket of the at least one socket server. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses for transmission to the at least one first event socket of the at least one socket server (page 24 RTMP section, for using RTMP for using a socket connection with a Flash Media Server [socket server] to stream data and messages between the client and server with page 66, RTP section for using sockets to a specified multicast group [event socket for the specified active client] requesting the HTTP connection). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of providing light weight encryption for using the protocol behind firewalls (Hash, page 24, third paragraph).

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Regarding Claim 32, Bocharov discloses method for providing a first copy of a first broadcaster's live stream of digital content (paragraph 23 for a live sporting event for having continuous video and audio presentation and paragraph 3 for providing media content items through HTTP server to clients [multiple copies] with less delay) including first live sporting event video-based commentary and integrated audio and/or video of a first live sporting event from a first broadcaster client device (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast] where the announcer can push a button and highlight event information) to a first viewer client device (paragraph 23 for having a live broadcast of a sporting event with an announcer and having the associated commentary for a continuous video and audio presentation with paragraph 25 for having a media event that the client can use for on demand viewing of a media event), the method comprising: providing the audio and/or video of the first live sporting event to the broadcaster client device from at least one media source (paragraph 23 for a for having the data for the live sport event for commentary for a sport event presentation with paragraph 24 for having ongoing live events that a client can join that is already in progress); providing the first copy (202A) to the first viewer client device (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media) between the at least one media source and the first viewer client device (paragraph 23 for having a separate stream [digital content] for a live sporting event [live broadcast]); periodically retrieving, from an event information provider (paragraph 20 for using encoders to reduce the latency of the system with controlling B frames to push fragments of the video more quickly and paragraph 3 for having a host server in Japan and a routing server in California to give clients in New York and New Jersey content without re-requesting the content from the host server in Japan [event provider]), first event information germane to a first live sporting event (paragraph 23 for having a first live sporting event [first event] with first event information with information when a player scores a goal [germane information] and paragraph 4 for having an event such as the opening ceremony of the Olympics for using the internet as a medium for consuming live events), wherein the first event information includes first score information for the first live sporting event (paragraph 23 for having a player scoring or having a significant game event for the live sporting event as the announcer is viewing the live sporting event); and transmitting the first score information (504A) to at least the first viewer client device (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media) via a first event information communication channel (206A) between at least one first event (paragraph 24 for having a client that can view a live event that is already in progress from the system [server for the live event] with paragraph 13 for having an internet caching structure for viewing live events by multiple clients using tracks of audio video, and using chunks) of at least one server and the first viewer client device of the first plurality of viewer devices, wherein the at least one first event corresponds to the first event information germane to the first live sporting event (paragraph 23 for giving event information on the live sport event such as a goal scored or a significant game event). Bocharov does not explicitly teach an event socket and a socket server. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses an event socket and a socket server (page 24 RTMP section, for using RTMP for using a socket connection with a Flash Media Server [socket server] to stream data and messages between the client and server with page 66, RTP section for using sockets to a specified multicast group [event socket for the specified active client] requesting the HTTP connection). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of providing light weight encryption for using the protocol behind firewalls (Hash, page 24, third paragraph).

Regarding Claim 35, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach displaying the first score information comprises displaying a scorebug, wherein the scorebug includes the first score information. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the first score information comprises displaying a scorebug (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section), wherein the scorebug includes the first score information (page 3 top section for using web page with video to highlight football matches live with goals [scores] and unique moments). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 36, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the scorebug includes a logo of at least one team participating in the first live sporting event. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the scorebug includes a logo of at least one team participating in the first live sporting event (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 113-114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section and getting notification of the teams when they are playing). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

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Regarding Claim 37, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the method further comprises: displaying at least one animated graphics element overlaid on at least one of the first video-based commentary and the video of the first live sporting event, wherein the first score information is included in the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the method further comprises: displaying at least one animated graphics element overlaid on at least one of the first video-based commentary and the video of the first live sporting event, wherein the first score information is included in the at least one animated graphics element (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section with arrows and data overlaid on the videos, also, page 3 top section for using web page with video to highlight football matches live with goals [scores] and unique moments). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 38, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the at least one animated graphics element includes a scorebug. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the at least one animated graphics element includes a scorebug (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section with page 3 top section for using web page with video to highlight football matches live with goals [scores] and unique moments). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 39, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the processor-executable instructions include data for a plurality of images, and the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the processor-executable instructions include data for a plurality of images (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons [images] and team participants near the 3F Liga section); and the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element (page 5, first paragraph for having an interactive user experience [rendering interactive images on the user's device display] including animation and images, with page 113-114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section and getting notification of the teams when they are playing). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 40, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second (page 41, first paragraph for rendering video at a rate of 25 frames per second [within the claimed range] for temporal domain samples for digital video). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of discrete representation of images (Hash, page 41, first paragraph).

Regarding Claim 41, Bocharov discloses updating the displayed first score information in a synchronous manner with the displayed video of the first live sporting event (paragraph 24 for creating an index portion for different segments of the event based on the current time and paragraph 61 for having means to overlay advertisement data on the main presentation with paragraph 50 for means to super impose score and caption data from the segment [superimposing score information is well known in the art for live sports events]).

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Regarding Claim 42, Bocharov discloses receiving, via the at least one communication interface of the first client device and the first event information channel (paragraph 23 for a live sporting event for having continuous video and audio presentation and paragraph 3 for providing media content items through HTTP server to clients [multiple copies] with less delay), first event information for the first live sporting event (paragraph 23 for a for having the data for the live sport event for commentary for a sport event presentation with paragraph 24 for having ongoing live events that a client can join that is already in progress), wherein the first event information includes the first score information and at least one of (paragraph 23 for having sporting events with goals as significant game events [scoring goals] and paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights [means to store multiple score data so the user can only request highlighted media segments]) and displaying the first video-based commentary about the first live sporting event, the video of the first live sporting event (paragraph 23 for aggregating sources to create a commentary for the video of the live event and having information on the highlights of the live event for the viewer). Bocharov does not explicitly teach team information for the first live sporting event, status or progress information for the first live sporting event, date and/or time information for the first live sporting event, and participant information for the first live sporting event, and displaying, on the display of the first client device, and at least some of the first event information for the first live sporting event. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses team information for the first live sporting event, status or progress information for the first live sporting event, date and/or time information for the first live sporting event, and participant information for the first live sporting event (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch using Mycujoo and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming, also page 118, first paragraph for having virtual servers with a database to see a schedule [date and time] of important live events using an API to stream the event for quick ramping capacity, page 93 for getting events on TV or radio with giving play list times for certain areas), and displaying, on the display of the first client device (page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream [thumbnails are animated displays on a display device]), and at least some of the first event information for the first live sporting event (page 115 for having multiple high lights of events that are available to be played as shown by the white arrows [storing the videos in a database is inherent to playing the highlights]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of making copies on the network only when needed (Hash, page 27, last two paragraphs).

Regarding Claim 43, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the at least some of the first event information is included in the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the at least some of the first event information is included in the at least one animated graphics element (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream [thumbnails are animated displays on a display device]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 44, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the team information is included in the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the team information is included in the at least one animated graphics element (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 116, and figure 5.26 for having multiple live events with thumbnails for the client to choose one to watch [inherent to a thumbnails is an ID for the event to launch the correct stream [thumbnails are animated displays on a display device]). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 45, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the at least one animated graphics element includes at least one logo for at least one team participating in the first live sporting event. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the at least one animated graphics element includes at least one logo for at least one team participating in the first live sporting event (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 46, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the status or progress information and the date and/or time information is included in the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the at least one animated graphics element includes at least one logo for at least one team participating in the first live sporting event (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

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Regarding Claim 47, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach the processor-executable instructions include data for a plurality of images, and the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the processor-executable instructions include data for a plurality of images (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons [images] and team participants near the 3F Liga section); and the method further comprises: rendering a succession of the plurality of images on the display of the first client device so as to display the at least one animated graphics element (page 5, first paragraph for having an interactive user experience [rendering interactive images on the user's device display] including animation and images, with page 113-114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section and getting notification of the teams when they are playing). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 48, Bocharov discloses the video method as shown above. Bocharov does not explicitly teach rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches rendering the succession of the plurality of images on the display of the first client device at a frame rate of between 15 frames per second and 25 frames per second (page 41, first paragraph for rendering video at a rate of 25 frames per second [within the claimed range] for temporal domain samples for digital video). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of discrete representation of images (Hash, page 41, first paragraph).

Regarding Claim 49, Bocharov discloses updating the displayed first event information in synchronization with the displayed video of the first live sporting event. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches the displayed first event information in synchronization with the displayed video of the first live sporting event (page 5, first paragraph for having an interactive multimedia delivery system with animation and computer graphics for next generation entertainment engagement and page 114 and figure 5.24 for showing the live video stream on the top of the device with team logos, icons and team participants near the 3F Liga section). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of next generation entertainment engagement (Hash, page 5, first paragraph).

Regarding Claim 50, Bocharov discloses receiving, via the at least one communication interface of the first client device, first chat information regarding the first broadcaster's live stream of digital content (paragraph 61 for overlaying advertising on the client device [display means] and paragraph 50 for super imposing text and caption data on the event). Bocharov does not explicitly teach wherein the first client device receives the first chat information on a first chat/system event communication channel different than the first video communication channel and the first event information channel. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches wherein the first client device receives the first chat information on a first chat/system event communication channel different than the first video communication channel and the first event information channel (page 89 top section for streaming video using the internet and having a means to chat with other people on board [chat system] and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving perceive quality of the data stream and enhance bandwidth usage (Hash, page 89, top section).

Regarding Claim 51, Bocharov discloses displaying, on the display of the first client device (paragraph 61 for overlaying advertising on the client device [display means] and paragraph 50 for super imposing text and caption data on the event), the first information overlaid on at least one of the first video-based commentary and the video of the first live sporting event (paragraph 60 for having means to overlay an advertisement on the main presentation to indicate when sparse data will be displayed and the location for the content). Bocharov does not explicitly teach chat information. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches chat information (page 89 top section for streaming video using the internet and having a means to chat with other people on board [chat system] and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving perceive quality of the data stream and enhance bandwidth usage (Hash, page 89, top section).

Supplemental Box

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Regarding Claim 52, Bocharov discloses receiving, via the at least one communication interface of the first client device (paragraph 61 for overlaying advertising on the client device [display means] and paragraph 50 for super imposing text and caption data on the event). Bocharov does not explicitly teach first chat information regarding the first broadcaster's live stream of digital content, wherein the first client device receives the first chat information on a first chat/system event communication channel different than the first video communication channel and the first event information channel ,and displaying, on the display of the first client device, the first chat information overlaid on at least one of the first video-based commentary and the video of the first live sporting event. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and teaches first chat information regarding the first broadcaster's live stream of digital content (page 89 top section for using the chat system as part of the internet with page 94 for having means to send audio video and text messages using the iES manager), wherein the first client device receives the first chat information on a first chat/system event communication channel different than the first video communication channel and the first event information channel (page 89 top section for streaming video using the internet and having a means to chat with other people on board [chat system] and page 24, Section RTMP for creating client socket connection to the Flash media player to allow for real time data streaming); and displaying, on the display of the first client device, the first chat information overlaid on at least one of the first video-based commentary and the video of the first live sporting event (page 89 section 5.1.1 for having a user interface terminal to allow the user to interact with the iES services with page 89 top section for allowing the user to have internet access and stream video along with chatting with other people). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of improving perceive quality of the data stream and enhance bandwidth usage (Hash, page 89, top section).

Claims 12 and 16 lack an inventive step under PCT Article 33(3) as being obvious over Bocharov et al. (hereinafter Bocharov) in view of HASHEMIZADEHNAEINI (hereinafter Hash) and Roth et al. (hereinafter Roth).

Regarding Claim 12, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server re-writes the playlist cache control command to change the playlist caching time. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server re-writes the playlist cache control command to change the playlist caching time (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of efficient and high quality streaming services (Hash, page 22, second paragraph). Bocharov and Hash do not explicitly disclose having the playlist caching time to less than or equal to 24 hours. Roth has a method for improve cache control (abstract) and teaches having the playlist caching time to less than or equal to 24 hours (paragraph 102 for using different factors to determine whether to cache the content stream such as the size, time of day and bandwidth for the proxy server with paragraph 59 for caching events as indications occur such as every hour or based on a threshold umber of events). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Roth for the purpose of ensuring sufficient cache space to store the stream (Roth, paragraph 102).

Regarding Claim 16, Bocharov discloses the live video system as shown above. Bocharov does not explicitly disclose the HLS mother server re-writes the file segment cache control command to change the file segment caching time. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses the HLS mother server re-writes the file segment cache control command to change the file segment caching time (page 22, Section Dynamic Streaming over HTTP for using Apples HLS for the live stream solution for the live broadcast of a sports event with a play back time of multiple hours and page 47 last paragraph for having client side caching at different thresholds [zero to non-zero] based on the variable bit rape and if the CDN can take advantage of the entire 3Mbps stream). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of efficient and high quality streaming services (Hash, page 22, second paragraph). Bocharov and Hash do not explicitly disclose having the playlist caching time to one hour. Roth has a method for improve cache control (abstract) and teaches having the playlist caching time to one hour (paragraph 102 for using different factors to determine whether to cache the content stream such as the size, time of day and bandwidth for the proxy server with paragraph 59 for caching events as indications occur such as every hour [one hour] or based on a threshold umber of events). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Roth for the purpose of ensuring sufficient cache space to store the stream (Roth, paragraph 102).

Claims 27 and 28 lack an inventive step under PCT Article 33(3) as being obvious over Bocharov et al. (hereinafter Bocharov) in view of HASHEMIZADEHNAEINI (hereinafter Hash) and Cohen.

Regarding Claim 27, Bocharov discloses the control server retrieves the event data from the event information provider for each type of the plurality of types (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media). Bocharov and Has do not explicitly disclose for each sporting event of the plurality of sporting events that has a start time within 24 hours in the past and 24 hours in the future. Cohen has an on demand TV method (abstract) and discloses for each sporting event of the plurality of sporting events that has a start time within 24 hours in the past and 24 hours in the future (paragraph 15 for allowing the user to shift through programs in a time period such as the last day and paragraph 37 for getting start times for a football match form 270 broadcasters). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Cohen for the purpose of determining correct start and end times (Cohen paragraph 40).

Supplemental Box

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Regarding Claim 28, Bocharov discloses for the first live sporting event (paragraph 23 for having an announcer [first broadcaster] for data in a separate stream with paragraph 24 for having a client that can join the live event that is already in progress, also paragraph 3 for having multiple viewers such as one in New York and another one in New Jersey, both using the router from California) via a first video communication channel (paragraph 28 for having an internet connection [channel] with servers for chunking the media), the progress details include the first score information (paragraph 23 for having significant events such as scoring a goal and allowing the commentator to push a button and aggregate audio data on the event); the control server periodically retrieves the progress details from the event information provider and updates the first score information (paragraph 23 for having sporting events with goals as significant game events and paragraph 57 for having a second typed of sporting event that highlights interesting media segments using markers to allow for the client to manifest just the media segments that are highlights [means to store multiple score data so the user can only request highlighted media segments]); and for each update of the first score information, the control server queues an asynchronous message including the updated first score information (paragraph 23 for having sporting events with goals as significant game events and allowing the announcer to push a button and comment on the score information). Bocharov does not explicitly disclose for transmission to the at least one first event socket of the at least one socket server. Hash has interactive multimedia systems for video and animation (page 1, last two paragraphs) and discloses for transmission to the at least one first event socket of the at least one socket server (page 24 RTMP section, for using RTMP for using a socket connection with a Flash Media Server [socket server] to stream data and messages between the client and server with page 66, RTP section for using sockets to a specified multicast group [event socket for the specified active client] requesting the HTTP connection). It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Bocharov with the teaching of Hash for the purpose of providing light weight encryption for using the protocol behind firewalls (Hash, page 24, third paragraph).

Claims 1-52 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.

Search History:

Limited Classification Search

The Patent Analyst performed a limited classification search within the following US, IPC, CPC, ECLA, or F-Term classification areas:

CPC Class/Subclass(es): H04N 21/4307; H04L 65/4069; H04N 5/04 (2018.05)

IPC (8) Class/Subclass(es): H04L 29/06; H04L 29/08; H04N 7/173; H04N 7/18 (2018.01)

U.S. Class/Subclass(es): 348/157; 348/485; 725/135

See Global Search Results.

Global Patent Literature Text Search

The Patent Analyst performed the following global text search, which was not limited by classification but may or may not have been limited by other criteria:

Questel Orbit: https://www.orbit.com

#	Search query	Results
1	((SPORTSCASTR+)/PA/OPA)	1
2	((SPORTSCAS+)/PA/OPA)	1
3	(LATENC+ AND SPORT+ AND LIVE+ AND COMMENTAR+)/TI/AB/IW/DESC/ODES/OBJ/ADB/ICLM/TX	485
4	(LATENC+ AND SPORT+ AND LIVE+)/TI/AB/IW/DESC/ODES/OBJ/ADB/ICLM/TX AND (348157)/PCLM	6
5	(348157)/PCLM	199
6	(348485)/PCLM	64
7	(LIVE+ AND SYNCH+)/TI/AB/IW/DESC/ODES/OBJ/ADB/ICLM/TX AND (348485)/PCLM	3
8	(LIVE+ AND SYNCH+)/TI/AB/IW/DESC/ODES/OBJ/ADB/ICLM/TX AND (725135)/PCLM	61
9	(725135)/PCLM	242
10	(H04N-007/18)/IPC	108571
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24	(H04N-021/4307)/CPC	2963
25	(LATENC+ AND SPORT+ AND LIVE+ AND STREAM+ AND COMMENTAR+)/TI/AB/IW/DESC/ODES/OBJ/ADB/ICLM/TX AND (H04N-021/4307)/CPC	12
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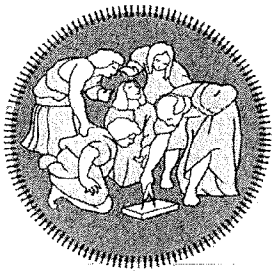
Google Patents: https://patents.google.com

#	Search query	Results
1	autonomously monitoring and managing a fleet of registered autonomous vehicles in a transportation network and dispatching the autonomous vehicles in the fleet to registered users of the transportation network	2210
2	video streaming viewer latency real time	5500
3	sportscastr	3
4	low latency video live sports audio commentary synchronize broadcaster	2480
5	broadcaster's live stream of digital content sports commentary integrate audio	2250
6	broadcaster's live stream of digital content sports commentary integrate audio low latency	1390
7	broadcaster's live stream of digital content sports commentary integrate audio low latency socket track	727
8	broadcaster's live stream of digital content sports event score commentary integrate audio low latency socket track	537

POLITECNICO DI MILANO

Facoltà di Ingegneria dell'Informazione

Corso di Laurea Magistrale in
Ingegneria delle Telecomunicazioni



Transcoding H.264 Video via FFMPEG encoder

Relatore: Prof. Paolo Giacomazzi

Tesina di Laurea di:

SHABNAM HASHEMIZADEHNAEINI

Matr. 754702

Anno Accademico 2014 - 2015

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Abstract

Every day, a large number of videos are uploaded to the video hosting websites such as Youtube and Vimeo where people can watch entire movies immediately.
However if a video is shot in 4k RAW on a professional camera and is intended to be viewed on a website like Youtube, it would need to be scaled down since thirty minutes would amount to roughly 63 Gigabytes of content. It needs to be compressed down to the allowable resolution. The goal is to minimize loss in picture quality while still keeping the file size manageable. This process of reformatting the content to be streamed on Youtube is called transcoding. So by transcoding one digital encoding is converted to another and it is needed when a particular target device does not support the format or does not have enough storage capacity to support the file size or sufferes not enough powerful CPU.
The codec used for compression in video is typically H.264, a standard for providing high definition video at substantially lower bit rates. The x264 Library is used for encoding H.264/MPEG-4 AVC, undergirds some of the most high profile streaming operations on the web, including YouTube, Vimeo and Hulu. When compiled with FFmpeg tool, it is capable to produce high quality compression at relatively high speeds. FFmpeg has been an important encoding tool for more than a decade. It is a powerful, multi-purpose open-source library with a wide range of command lines, which can be effectively utilized in conjuction with programming experience and high performance web servers to stream content to the web world.
Given these introductions, the purpose of this thesis is to go through media based projects with essential need of transcoding and to study H.264 video codec and FFmpeg encodig tool.

Keywords: codec, transcoder, ffmpeg, h.264

Chapter 1

Introduction

This chapter aims to give an introduction to the context of this thesis, illustrating the motivations and problems which are behind this work and to introduce the thesis objectives. The structure of this work is also reported.

1.1 Interactive multimedia systems

Nowadays, interactive multimedia systems are a reality that affect many aspects of human life. The day by day development of related softwares and intelligent components as theoretical aspects also helps the practical systems, which people encounter daily. There are number of fields where multimedia projects could be of use, as business, education, entertainment, home and public places. As you can see in Figure 1.1, in 2016, it is estimated that 76% of the IP traffic will be about videos [1].

As the demand for multimedia and digital content is constantly growing, new interactive multimedia systems are been developed. Interactive multimedia is any computer-delivered electronic system that allows the user to control, combine and manipulate different types of media, such as text, sound, video, computer graphics, and animation. It integrates computer, memory storage, digital (binary) data, telephone, television, and other information technologies and shifts the user's role from observer to participant and are considered the next generation of entertainment engagement systems.

On the other hand, the explosive growth of the Internet and mobile computing introduces two main problems in distributed multimedia applications. The first problem is heterogeneity of client devices and their network connections. The client devices may vary from desktop PCs,

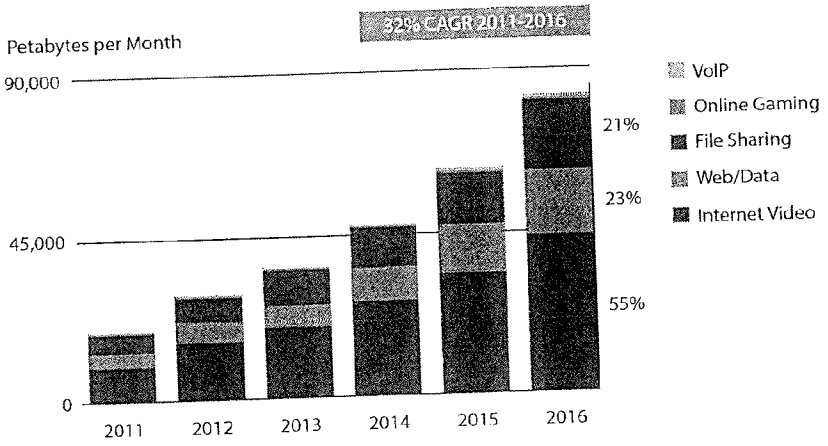


Figure 1.1. IP Traffic

notebook computers, PDAs to mobile phones, which their capabilities also vary a lot, including screen size, color depth and processing power. Furthermore, they may connect to the Internet via different networks, such as wired LAN, wireless LAN or wireless WAN.

The second problem is mobility of clients. The clients may be moving while they are accessing multimedia streams. It may cause a problem because the network connections may change from time to time, ranging from a very good network to a congested network. The two problems described above make it difficult for a multimedia server to provide a streaming service which is appropriate for every client in every situation. A solution to the problems above, which is presented in this thesis, is by converting multimedia streams to the appropriate format on-the-fly. The converting process is also known as transcoding, which means converting multimedia streams from one format to another format.

The purpose of the project described in this thesis, is to develop a prototype multimedia system infrastructure for transcoding multimedia stream and transmit them via a suitable network to the device of end-user.

1.2 iES streaming project

The project is based on different virtual servers as DB-DNS (Database-Dynamic Name server) Server, IAC (Internet Access Controller) Server,

ADS(Advertisement) Server, Web Portal Server, VoIP Server. However the core of the system is Streamer Server which is the subject of this thesis.

In fact we replaced costly American brand encoder/transcoder servers with low ability of remote control, with our iES streamer server. The streamer server with some light modification is also used for web based multimedia projects as Sportube Tv and Mycujoo and etc. However to be brief, this thesis covers just iES system, Sportube Tv and Mycujoo as practical examples.

Sportube Tv is the sport Web TV which broadcasts Sport Events streams LIVE and On Demand and you can find more details in `http://sportube.tv`.

Mycujoo, as it is explained in the following Web page `https://new.mycujoo.tv`, connects football through video. Unique football TVs will allow billions of fans to watch, share and discover live football and on-demand highlights, goals and unique moments.

1.3 Thesis organization

In general, this thesis consists of two main parts, concept part and design part which are organized in six chapters, including the present one, which discusses the background as well as the context of this thesis.

Chapter 2 provides an overview of Interactive Multimedia Delivery Systems, focusing on the acquisition, preparation, distribution and consumption.

Chapter 3 deepens the aspect of content preparation and staging presenting one of the key aspect of an interactive multimedia delivery system, that is the encoding/transcoding needed for the encapsulation of data packets.

Chapter 4 introduce IES Italia company and explores design an implementation of iES multimedia project and iES streamer server in detail.

Chapter 5 presents practical results of the output and efficiency of iES streamer server.

Chapter 6 gives summary of this thesis as a conclusion and some outlooks for the future.

Chapter 2

Interactive Multimedia delivery system

Interactive Multimedia delivery system Interactive multimedia is any computer-delivered electronic system that allows the user to control, combine and manipulate different types of media, such as text, sound, video, computer graphics, and animation. It integrates computer, memory storage, digital (binary) data, telephone, television, and other information technologies and shifts the user's role from observer to participant. They are considered the next generation of entertainment engagement systems.

The idea of our Interactive Multimedia delivery system is to deliver any content over any network for any device.

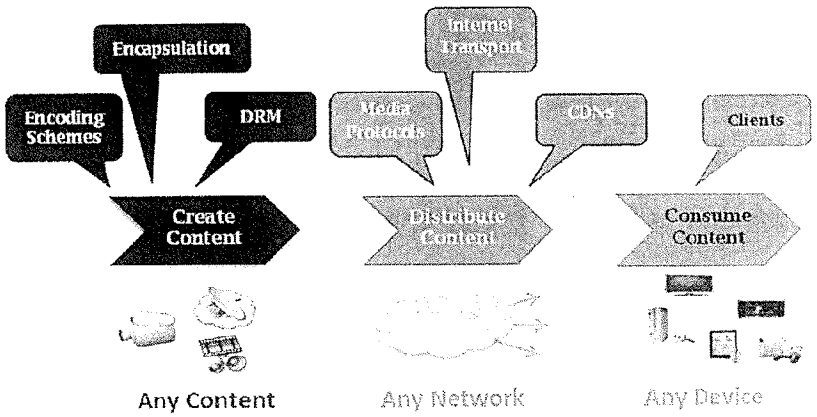


Figure 2.1. Open Digital Media Value Chain

In this chapter we will go through:

1. **Acquisition**: The key word Any Content refers to acquisition of different type of contents like static files uploaded by the user on a Network Storage Server, Live feed streamed by capture device or live Tv channels arriving from satellite or digital terrestrial broadcaster.

2. **Streaming protocols**: Content is primary encoded before arriving to streamer server. Later streamer server will do further transcoding and manipulation if needed and will provide different profiles of each stream based on the level of quality, all ready to be delivered, in the mean time would perform Digital video record of live feeds if it is asked by the provider of the live event. We will go through it in detail in the chapter 3. Meanwhile the Streamer server decides about the protocol of the stream based on the type of consumers.

3. **Distribution**: The key word Any network refers to controlled dedicated Network (LAN, Local Area Network) or Internet. In case of using Internet network, it will also be used CDN(Content Delivery Network) to serve content to end-users with high availability and high performance besides CDN offload the traffic served directly from the streamer server, resulting in possible cost savings.

4. **Consumption**: The key word Any user refers to the final clients and consumers of the streaming which can be any type of device like Net top Box, personal computer and mobile devices such smart phone and tablet.

2.1 Acquisition of input contents

Depending on the field where the multimedia project is going to be used, one or more methods of content acquisition can be used.

2.1.1 Static files

As a multimedia project can be involved with a huge amount of static contents, the storage file should not be the bottleneck of the system.

Static files are usually stored on a local or external Network Storage Server (NSS) which makes it possible to share directories and files with streamer over a network.
Utilization of NSS in multimedia projects has some advantages like:

1. *More reliable backups*: with a network storage system, scheduled backup of all data is much easier. Backups can be made as automatic processes that happen according to the schedule that best supports low peak hours.

2. *Improved storage utilization*: unlike DAS (Directly Attached Storage), which allocates storage resources only to the computer it is attached to, network storage provides a common pool of storage that can be shared by many servers, no matter what file system or operating system they run. This lets us allocate storage where servers need it most, and it eliminates unused storage on an underutilized server.

3. *Centralized data storage and archiving*: data is more easily backed up from systems across the enterprise when it is controlled via a single, centralized platform. Management is also reduced as it is centralized and data availability is increased.

4. *Data protection*: a network storage solution can protect data from user error and malicious intent, theft and system failures.

5. *Simplified storage*: network storage lets us easily add new storage resources anywhere we need them across the enterprise. A new storage can be added without ever powering down a server. This means we can handle some storage admin tasks during normal working hours.

Two main network storage methods which co-exist together are network-attached storage (NAS) and storage-area networks (SAN). The decision of the network storage type for a multimedia project depends on factors like:

- Type of data to be stored
- Usage pattern
- Scaling concerns
- Project budget

SAN (Storage Area Network)
SAN is a high speed network that makes connection between storage devices and servers and so it is useful where high performance, and fast I/O is needed.

Traditionally application servers used to have their own storage devices attached to them. Servers talk to these devices by a protocol known as SCSI (Small Computer System Interface). An FC-SAN, or Fiber Channel

SAN, is a SAN comprised of the Fiber Channel protocol. In fact, Fiber Channel can transport other protocols, like IP, but it is mostly used for transporting SCSI traffic.

Internet Small Computer System Interface (ISCSI) is an IP based protocol on top of TCP/IP for interconnecting storage arrays and hosts. It is used to carry SCSI traffic over IP networks. This is a nice technology for location independent storage, because it can establish connection to a storage device using local area networks as well as Wide area network and does not require special cabling and equipment. To the system using a storage array with ISCSI, the storage appears as a locally attached disk. ISCSI introduces a little bit of CPU load on the server, because the server has to do the extra processing for all storage requests over the network, with the regular TCP.

NAS (Network Attached Storage)

NAS is a device/equipment/server attached to TCP/IP network, that shares its own storage with other's. It uses Ethernet connection for sharing files over the network and so it is accessible over the network through an IP address.

When a file read/write request is sent to a NAS server, the request is sent in the form of a CIFS (Common Internet File System) or NFS (Network File system) requests over the network. The receiving end (NAS device), will then convert it into the local storage I/O command set. This is the reason why a NAS device has its own operating system.
The streamer server is mounted to the directory of static files which is accessible via network.

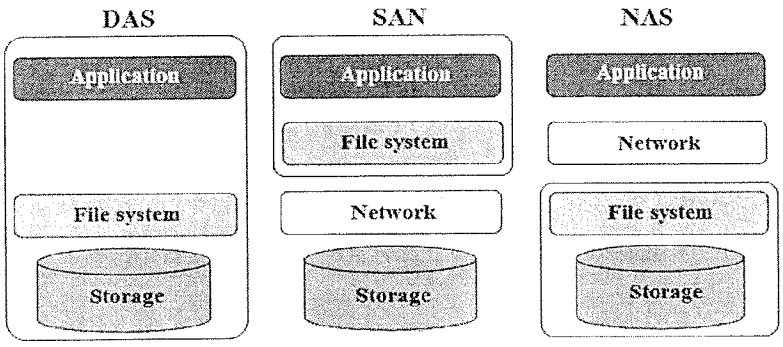


Figure 2.2. Comparison of DAS, SAN and NAS

SAN	NAS
Block level data access	File Level Data access
Fiber channel is the primary media used with SAN	Ethernet is the primary media used with NAS
SCSI is the main I/O protocol	NFS/CIFS is used as the main I/O protocol in NAS
SAN storage appears to the computer as its own storage	NAS appears as a shared folder to the computer
It can have excellent speeds and performance when used with fiber channel media	It can sometimes worsen the performance, if the network is being used for other things as well
Used primarily for higher performance block level data storage	It is used for long distance, small read and write operations

Table 2.1. Major differences between SAN and NAS

2.1.2 Live feed

Live television channels

Digital television is one of the biggest broadcasting media available. All over the world, television companies are rearranging their broadcasting from analogue to digital transmission. Former standard disagreements in the analogue era have led to an agreement of one common European standard for digital television. Countries like USA and Japan have their own similar standards.

DVB

The DVB project is a cooperation of about 250-300 companies worldwide. It is an open standard of European origin but now spreading over the world. With the close cooperation with the industry, the DVB specifications have been market driven.

There are several digital television standards developed by the DVB project group, among which are:

1. DVB-Satellite
2. DVB-Cable
3. DVB-Terrestrial
4. DVB-Handheld
5. DVB-Satellite 2nd Generation

We will go on DVB-Satellite, DVB-Sattelite 2nd Generation and DVB-Terrestrial as our Live television input of our system.

DVB-Satellite The DVB-S (Digital Video Broadcasting — Satellite) standard was published in 1993 by the EBU (European broadcasting union) commission and it became standard for broadcasting of digital television over satellite. Its main purpose is to prepare a digital MPEG transport for satellite transmission. The standard for DVB-S is similar to the standard for DVB-T (Digital Video Broadcasting — Terrestrial), except from using the modulation technique QPSK(Quadrature phase-shift keying) instead of COFDM(Coded Orthogonal Frequency Division Multiplexing). Quaternary PSK modulations technique are more suitable for satellite transmission due to higher bandwidth with small and weak noise transferring channel. The key features in DVB-S are: changing encoding parameters in real time, Variable Coding and Modulation (VCM) and Adaptive Coding and Modulation (ACM).

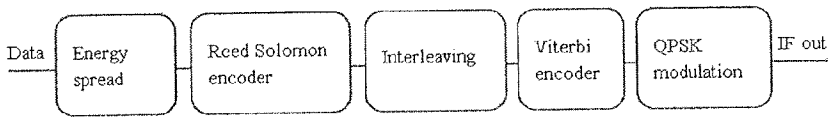


Figure 2.3. DVB-S functional block diagram

Signal coding and channel adaption Video, audio and data information, so called bit waves, are received in the program Multiplexer (MUX). Different packages form a transport stream together with Program Specific Information (PSI). Then the transportation MUX combines the different TV-channels transportation streams to a common Transport Stream (TS), where each stream is supplied with its own identification, a transport- ID "TS-id". A device for energy spread is used for evening out the sequence. The signal moves on to the device called Reed-Solomon encoder. This type

of encoding is called RS (204,188 t=8), meaning that 16 additional bytes are added to the 188 bit package which can correct up to eight incorrect bytes. Burst type interference can be managed with the interleaving encoder, where streams permute byte by byte into 12 different streams. The first has no delay time, the second is delayed by 17 bytes, the third by 34 and so on.

Viterbi encoding, which is a FEC (Forward Error Correction), gives protection against random noise. Least safety is given by 7/8 which adds 1 extra control bit for every 7 bits. Highest safety gives 1/2 which doubles the number of bits. In satellite-TV context a FEC with value of 1/2 is very unusual. After Viterbi encoding the data stream is sent for encoding into Gray coded QPSK.

DVB-Satellite 2nd generation DVB-S2 was developed in the DVB Project in 2003 and became the second generation specification for satellite broadcasting. Combining a variety of modulation formats such as QPSK, 8PSK, 16APSK and 32APSK with the latest developments in channel coding became a great benefit in interactive applications. Broadcasting services are managed with DVB-S and with the flexible VCM(Variable Coding and Modulation). Broadcasting Services (BS) offers great levels of protection for both robust Standard-definition television (SDTV) and less robust High-definition television (HDTV). Along with the existing DVB Return Channel Standard (DVB-RCS), Interactive Services (IS) is designed to operate in both CCM and ACM modes. ACM mode is used here to enable receiving station to control the protection around the traffic addressed toward it. DTV and DSNG uses either CCM or ACM modes for facilitating point-to-point or point-to-multipoint communications of single or multiple MPEG transport streams. ACM is implemented for optimization of transmission parameters for each individual user depending on the path conditions. Even backwards-compatible modes are used for DVB-S Set-Top-Boxes (STB) for continuous work during the transitional period. There are three concepts in the DVB-S2 standard: best transmission performance, total flexibility and reasonable receiver complexity. Using the recent techniques in channel coding and modulation, DVB-S2 can achieve the best performance complexity trade-off, 30% gain capacity over DVB-S. Due to its flexibility, DVB-S2 can cope with any existing satellite transponder characteristics with a large variety of spectrum efficiency and associated CNR(Carrier to Noise ratio) requirements.

Being not limited to MPEG-2 video and audio coding, it is designed to handle a variety of advanced audio-video formats. It can accommodate any

input stream format, single and multiple Transport Streams, continuous bit-streams, ACM and IP packets.

Performance of the DVB-S2 system The system has the characteristics to operate at C/N-ratios from -2.4 dB (using QPSK 1/4) to 16 dB (using 32APSK), depending on the selected code rate and modulation. The distance from the Shannon limit (theoretical maximum information transfer rate of the channel, for a particular noise level) is 0.7 dB to 1.2 dB. Under the same transmission conditions as for DVB-S, DVB-S2 has 2-2.5 dB more robust reception for the same spectrum. A DVB-S2 system can be used in both "single-carrier-per-transponder" and "multi-carriers-per-transponder" FDM configuration.

DVB-Terrestrial In 1998 the terrestrial system was standardized. Due to harder environment, like multipath propagation and different noise characteristics, the terrestrial system needed to be more complex.

The use of the existing VHF (Very high frequency) and UHF (Ultra high frequency) spectrum allocation used by the old analogue system places constraints on bandwidth and protection against Co-Channel Interference (CCI) and Adjacent Channel Interference (ACI). To cope with multipath propagation, COFDM (Coded Orthogonal Frequency-Division Multiplexing) is used with a guard interval, chosen such that the interference from multiple terrestrial signal paths are of less concern. The guard interval can be flexible chosen to allow for different network topologies and frequency efficiency.

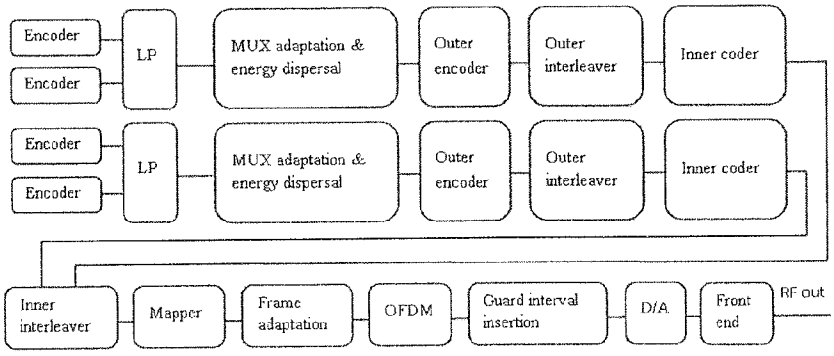


Figure 2.4. DVB-T functional block diagram

Two MPEG streams can be sent simultaneously, one low and one high

priority stream. The high priority stream (low bit rate) is mapped as QPSK and the low priority stream is modulated as either 16-QAM or 64-QAM. The high priority stream is thus more rugged against noisy environments and the broadcaster can choose to send the same program with both a high and a low bit rate. A receiver in very noisy environments, which has problem receiving the low priority stream, allows switching to the high priority stream. The drawback of this implementation is found on the receiver end. The receiver must be adapted to the different transmissions by the broadcaster. The adaption to new coding and mapping when switching between one layer and another takes some time to complete and thus instantaneous switching cannot be done. Usually video and sound freeze a short amount of time (around 0.5s) before lock on the new data stream has been accomplished.

Live events or Live-casting

Distributing live events (web casting) is becoming more popular worldwide. Web casting of live events such as music concerts and sports events e.g live football matches is most commonly used.

Typically, a central server handling streaming services, is responsible for servicing all client requests. We term this as Unicast Streaming Mechanism, where streaming capability is available only at the source. In a large-scale network with a large number of concurrent client requests, streaming from only one source has been proven to be inefficient because of the limitation of streaming server capacity and link bandwidth constraints in the network. As the live content to be distributed remains same, to improve the performance of live web casting terms of serving more clients with the required quality, multicasting mechanisms can be used.

Other techniques are transcoding video of high bit rate to low bit rate or some other video format. However transcoding leads to compromising of video quality. On the other hand Web technologies such as HTML5, Javascript, WebM are used to develop a framework to facilitate live video streaming on any browser without the need of external additions (plug-ins etc). Techniques such as Live HTTP streaming and DASH will be considered and potentially adapted for this purpose.

The Figure 2.5 shows an example of a typical streaming system infrastructure.

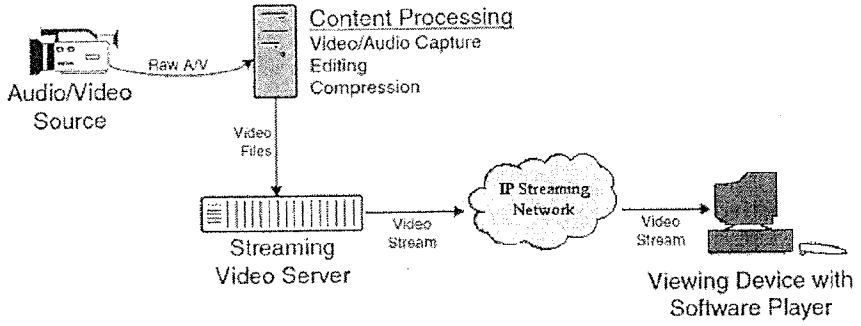


Figure 2.5. A typical streaming system infrastructure

2.1.3 Streaming architecture and technologies

A streaming media file needs to go through several steps so that all the information can be delivered.

The first step in streaming is to shoot the raw audio and video and then capture them to the computer file format. Video capture is the process of converting the analogue video signal, such as the one produced by a video camera, to the digital video. The resulting digital data are computer files referred to as video stream. A variety of computer software programs can be used to then start the video capture process, which copies the video clip from the video camera and stores it on the computer.

The next step is to encode preliminary the captured video in a specific format such as Windows Media Streaming, QuickTime, RealNetworks Real Video, open Broadcaster, Adobe Flash Media Live Encoder and etc. Encoding is a crucial part in streaming preparation; where the appropriate bitrate can be set keeping in mind whether the audience has the necessary hardware and software, and more importantly, the connection speed to support the streaming.

For eventual transcode and to deliver the stream to the network, it needs to be uploaded to a streaming server. The streaming server controls the stream delivery in real time, handles the load in an efficient way and increases the performance. A wide range of multimedia streaming servers are available in the market. Some of them, e.g. QuickTime Streaming Server for Apple (Darwin Streaming Server for Windows and Linux) and VLC, are free of charge. There are also some commercial ones such as Microsoft Windows Media Server from Microsoft, Adobe Flash Media Server, RealNetworks Helix Server, etc.

However a personalized and dedicated stream server can be designed

using softwares as ffmpeg, Thoggen, Ingex and etc to transcode and compress the video file and send it directly to the clients or a web server to publish it.

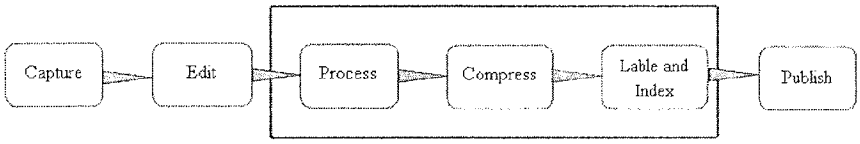


Figure 2.6. Streamer Server: steps of streaming content preparation

2.2 Streaming preparation and Streaming protocols

2.2.1 Transcode

Video transcoding is the process of converting compressed video signals to adapt video characteristics such as video bit rate, video resolution, or video codec, so as to meet the specifications of communication channels and endpoint devices. Video signals are compressed and decompressed with the techniques discussed under the term video coding, with compressed often denoted as enCOder and decompresser as DECoder, which collectively form the term CODEC. Therefore a CODEC is the collection of methods used to compress and decompress digital videos.

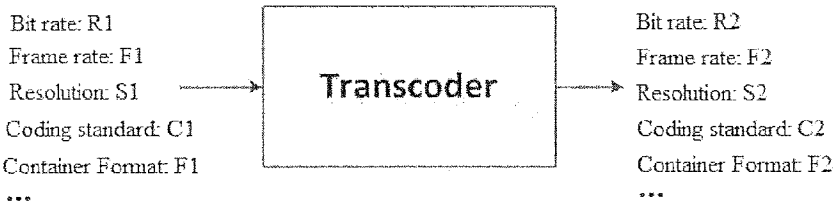


Figure 2.7. A generic compression system

The challenge of streaming video is to find the right balance between bitrate and resolution as it relates to an end-user's connection speed and system ability. There are too many variables that could interrupt playback for us. It is a short list of potential stream killing variables:

- Device and Screen size
- Internet Service Provider Connection Speed or Cap
- Bandwidth available through the wireless router due to distance or usage
- Network traffic to and from the sever hosting the video
- The CPU and GPU abilities on the playing device
- Browser brand and version
- Available plugins such as Flash and Silverlight
- Other programs running in the background

These are just the most relevant variables to consider and, nevertheless, we cannot control them all, we can just take some actions to reduce their effect.
Goals Of Streaming Video:

- Immediate Playback Start
- Uninterrupted Playback (less "buffering")
- Smooth Playback (no frame drops)
- Highest quality possible

Adaptive streaming

Adaptive streaming is a technique of detecting users' bandwidth capabilities in real time and then adjusting the quality of the video stream accordingly. This results in less buffering, fast start times and overall better experience for both high-speed and low-speed connections. Adaptive streaming works by having multiple available bit rates that the player or server (or CDN) can pull based on the users' connection speed and ability. Though the end users would see a smoothly playing video, unknown to them, multiple streams are actually available and may be seamlessly switched to if their connection drops lower or improves. When adaptive streaming is correctly implemented there should be no interruption of playback.

How Adaptive Multi-Bitrate streaming works

ABR systems trade video quality in return for playback fluency to avoid frequent playback interruptions and give users the opportunity to stream videos even when their network is congested. This can be achieved either by allowing the client monitor playback and transfers and request each chunk from the server at the desired rate, or by means of a server monitoring transfers and pushing each chunk out to the client after the initial request is received. Let us refer to these paradigms as client pull and server push . Monitoring transfer rates allows the client or server to measure network conditions and estimate the available bandwidth in order to choose an appropriate rate for each chunk. When the network is congested, chunks encoded at a lower rate will be used. This means that the video quality is reduced, on the other hand, less data is need to be sent for the same duration of content and hopefully the client can receive more frames before running out of buffered content to play, thus avoiding a playback interruption.

Implementing a client pull-based system requires only a basic web server hosting the content chunks, along with a manifest file. A client can then provide a streaming service by simply downloading consecutive chunks for playback at suitable rates. This is a very flexible approach, enabling seamless server migration in case of failure for example, and has relatively low implementation costs. A server push implementation, on the other hand, requires a server that is modified to accommodate push streams and ABR logic. In this case, the client makes a single request for the stream and the server then pushes consecutive chunks out to the client while monitoring transfers and handling rate adaptation. This approach is naturally less scalable since the server must now maintain extra state and perform calculations for each connected client.

Finally a third approach, which can be considered as a hybrid of client pull and server push, is to let the client make requests only when a rate change is necessary. In this case the server continues to send data at the previous rate until it receives a request for a new rate, which will be used after the next chunk boundary. This approach offers the scalability of client pull with less TCP connection overhead, and also allows the server to continue to send data without idle periods spent waiting for new requests.

Adaptive Set

An Adaptive Set is a package of transcodes for the same video that span multiple bit rates and are meant to find a balance between connection speed and resolution. In order for Adaptive Streaming to provide the

optimal viewing experience, all the streams in the Adaptive Set must be in some alignment. Typically, for Desktop and Net Top Box applications, this means that the frame rates, key frame intervals (GOP size), audio sample rates, and so on, should be the same within a set. This is done so that, as the player switches between bit rates a smooth, seamless switch is achieved without any buffering, stuttering or noticeable audio pops.

This is not followed, however, when looking at adaptive sets for mobile. When users are viewing some content on a mobile device, they may be moving in between wireless or cell zones and their signal strength may fluctuate widely. Generally, in this case, the bit rates are desired not only to span possible mobile connections but also to be optimized for maintaining the stream – this may mean hard shifts down in bit rates, so that the end user does not have their mobile player crash. Because of this, as bit rates go lower, the resolution also decreases, as the frame rate does. Every device has different requirements currently according to what they ideally want in an Adaptive Set. This can become overwhelming to video producers, editors and managers as it does, in reality, means that many versions of one video file are needed in order to be playable on multiple devices.

General settings and Concept of transcoding will be discussed in the next chapter.

2.2.2 Streaming Protocols

The streaming server is responsible for distributing media streams to viewers. It takes media content and creates a stream for viewer request.

There are many protocols that have been developed to facilitate real-time streaming of multimedia content. Communication protocols are rules governing how data is communicated, defining elements like the syntax of file headers and data, authentication and error handling. There are dozens of protocols involved in sending a simple data packet over the Internet, and it is important to understand how they work together.

Briefly, the International Organization for Standardization (ISO) created the Open System Interconnection model which defines seven logical layers for communications functions. The lower levels (physical, data link, and network) are generally taken as given.
Streaming protocols involve:

- The transport layer, which is responsible for getting data from one end to the other.
- The session layer, which organizes streaming activity into ongoing

units such as movies and broadcasts.

- The presentation layer, which manages the bridge between information as seen by the application and information as sent over the network.
- The application layer, which is the level at which an application talks to the network.

All streaming protocols are in the application layer, which means that they can use any layer beneath it for plumbing functions like transmitting data packets. This enables protocols within each layer to focus on a particular function, rather than having to recreate the entire stack of functions.

Most Internet activity takes place using the TCP transport protocol. TCP is designed to provide reliable transmission. This means that if a packet is not received, it will make further efforts to get it through. Reliability is a good thing, but it can come at the expense of timeliness. Real-time streaming puts a premium on timely delivery, so it often uses UDP (User Datagram Protocol). UDP is lightweight compared with TCP and will keep delivering information rather than put extra effort into resending lost packets. Some firewalls may block UDP because they are tailored only for TCP communications.

OSI Model			
	Data unit	**Layer**	**Function**
Host layers	Data	7. Application	Provides services directly to applications. The applications can vary, but includes electronic messaging
		6. Presentation	Formats data in order to provide a common interface for applications. This can include encryption services
		5. Session	Establishes end connections between two nodes. Services include establishing whether a connection can be set at full or half duplex-although duplex is actually handled at layer 4
	Segments	4. Transport	General data delivery – connection – oriented or connectionless. Includes full or half duplex, flow control and error recovery services
Media layers	Packet/ Datagram	3. Network	This layer establishes the connection between two nodes through addressing. It includes routing and relaying of data through an Internet work
	Frame	2. Data link	Frame data and handles flow control at this layer. This layer specifies the topology and provides hardware addressing
	Bit	1. Physical	Transmission of the raw bit stream, electrical signaling and hardware interface

Figure 2.8. OSI Model

For example, the Real Time Streaming Protocol (RTSP) is an application-level streaming protocol that can use multiple protocols in the transport layer to transmit its packets, including the Universal Datagram Protocol (UDP) and Transmission Control Protocol (TCP). Sometimes application-level protocols are written specifically for a particular transport protocol, like the Real-Time Transport Protocol (RTP), which is typically built on UDP transport. Selection of transport protocols based on UDP or TCP makes an impact on streaming performance.

Below there is an overview of the most common existing protocols.

HTTP

The Hypertext Transfer Protocol (HTTP) is the simplest and cheapest way to stream video from a website as it is based on a web server that stores files for serving the HTTP streaming. Compared to, for example, RTP or RTSP protocols, the latter ones always require additional tools, resources and skills for handling the streaming. This means tools such as commercial streaming server software and encoding software and hardware or skills and resources to handle the technology used and overcome issues such as bandwidth limitations and firewall restrictions.

There are some limitations to HTTP streaming: HTTP streaming is a good option for websites with modest traffic, i.e. less than about a dozen people viewing at the same time. For heavier traffic another streaming solution should be considered. This is mainly due to the streaming performance as HTTP streaming is not as efficient as other methods and will cause a heavier server load; also, when using HTTP streaming, the end user's connection speed cannot be automatically detected using HTTP, hence it is difficult to dedicate to the user the best profile that matches its speed.

HLS

Apple's HTTP Live Streaming (HLS) is a method for streaming audio and video over HTTP from an ordinary HTTP based web server. While HLS was initially developed for playback on iOS-based devices 3.0 and higher—including iPhone, iPad, iPod touch, and Apple TV—and on desktop computers (Safari on OS X), its use has expanded to OTT (Over-The-Top Content) devices as well as other mobile and tablet devices.

HTTP Live Streaming supports both live broadcasts and prerecorded content (video on demand) and multiple alternate streams at different bit rates and resolutions. HLS allows the client to dynamically switch between

streams depending on bandwidth availability. HLS also provides for media encryption and user authentication over HTTPS, allowing publishers to protect their work.

Dynamic Streaming over HTTP

Dash's creators insist it is not a protocol but an "enabler" which provides formats to enable efficient and high-quality delivery of streaming services over the Internet from conventional web servers. Similar to Apple's HTTP Live Streaming (HLS) solution, MPEG-DASH works by breaking the content into a sequence of small HTTP-based file segments, each segment containing a short interval of playback time of a content that is potentially many hours in duration, such as a movie or the live broadcast of a sports event. While the content is being played back by an MPEG-DASH client, the client automatically selects from the alternatives the next segment to download and play back based on current network conditions.

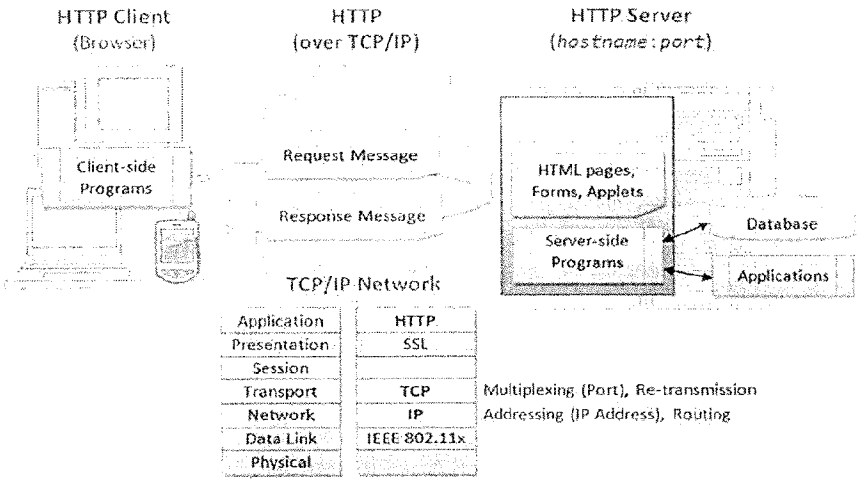


Figure 2.9. HTTP over TCP/IP

RTP

The Real-Time Protocol (RTP) is a transport protocol that provides end-to-end network transport functions for applications transmitting data with real-time properties, such as interactive audio and video. Services that

use RTP include payload type identification, sequence numbering, time stamping and delivery monitoring.

The most important thing RTP does is time stamping that allows to place the incoming audio and video packets in the correct timing order. Applications run RTP on top of the User Datagram Protocol (UDP). RTP includes RTCP (Real-time Transport Control Protocol), a closely linked protocol, to provide a mechanism for reporting feedback on the transmitted real-time data. RTP can be used in the following scenarios: multicast audio conferencing, as well as audio and video conferencing. The protocol has been demonstrated to scale from point-to-point use from multicast sessions with thousands of users, to low-bandwidth cellular telephony applications to the delivery of uncompressed High-Definition Television (HDTV) signals at gigabit rates.

RTCP

The Real-Time Control Protocol (RTCP) is a data transport protocol used in conjunction with RTP for transporting real-time media streams. It includes functions to support synchronization between different media types (e.g., audio and video) and to provide information to streaming applications about network quality, number of viewers, identity of viewers, etc.

RTCP gives feedback to each participant in a RTP session. This feedback can be used to control performance. The messages include reception reports, including number of packets lost and jitter statistics (early or late arrivals). This information can potentially be used by higher layer applications to modify the transmission. Some RTCP messages relate to control of a video conference with multiple participants.

RTSP

The Real-Time Streaming Protocol (RTSP) is an application-level protocol for the control of real-time multimedia data. It provides a tool for users to control video, audio, and multimedia sessions (e.g. play, pause and stop). RTSP does not actually provide the delivery of the video signals; it allows these signals to be controlled by a user. Like a dispatcher for a delivery service, RTSP does not go out and actually deliver packages; it controls when and how packages are delivered by other protocols such as RTP. Basically, RTSP acts as a remote control for the media server.

RTMP

Real Time Messaging Protocol (RTMP) is a proprietary streaming protocol developed by Adobe systems for streaming audio, video and data over the Internet. RTMP uses TCP/IP protocol for streaming and data services. In a typical scenario, a web server delivers the stream over HTTP. The client creates a socket connection to Flash Media Server over RTMP. The connection allows data to stream between client and server in real time.

The server and the client send RTMP messages over the network to communicate with each other. The messages could include audio, video, data, or any other type. The RTMP message has two parts: a message header, which contains message type, length, time stamp and message stream Id, and the message payload, which is the actual data such as audio samples or compressed video data that is contained in the message.

RTMP can be tunneled through HTTP (RTMPT), which may allow it to be used behind firewalls, where straight RTMP is blocked. Other variants are RTMPE (with lightweight encryption), RTMPTE (tunneling and lightweight encryption) and RTMPS (encrypted over SSL).

MMS

Microsoft Media Services (MMS) is Microsoft's proprietary streaming protocol used for transferring real time Multimedia data (audio/video). Client initiates the session with the MMS streaming server using TCP connection. Streaming video can be transported via UDP or TCP (MMSU and MMST protocols). It uses a Fall back Protocol approach. If the client cannot negotiate a good connection using MMS over UDP, it will try for MMS over TCP. If that fails, the connection can be made using a modified version of HTTP (always over TCP). This is not as ideal for streaming as in MMS over UDP, but it ensures connectivity. The default port for MMS is 1755.

SMIL

The Synchronized Multimedia Integration Language (SMIL) was developed to allow the design of websites that combined many different types of media including audio, video, text, and still images. With SMIL, the web page author can control the timing of when objects appear or play and can make the behavior of objects depend on the behavior of other objects. SMIL is a recommended XML markup language approved by the World Wide Web Consortium (W3C), and it uses ".smil" as file extension. SMIL is supported by QuickTime, Real, and Windows Media architectures.

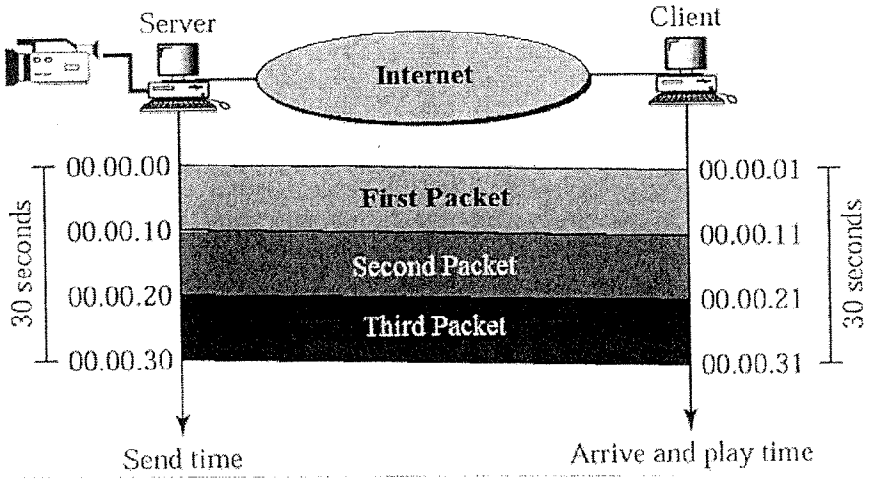


Figure 2.10. Real-Time Multimedia Traffic

SMIL is similar to HTML and can be created using a text-based editor. SMIL scripts can be written and embedded into standard web pages to cause actions or reactions to user inputs. The language has parameters that can define the location and sequence of displays in a sequential fashion and prescribe the content layout, i.e. windows for text, video, and graphics. SMIL can be used as an interactive presentation layer in a multimedia streaming environment. This means that the player will not only show the video stream at the client's end but, for example, text and audio files can be streamed simultaneously as a presentation.

2.3 Streaming Media Distribution

The Internet is growing exponentially while well established LAN and WAN technologies based on IP protocol connect bigger and bigger networks all over the world to the Internet. In fact, Internet has become the platform of most networking activities. This is the primary reason to develop multimedia protocols over the Internet. Another benefit of running multimedia over IP is that users can have integrated data and multimedia service over one single network, without investing on another network hardware and building the interface between two networks.

2.3.1 IP Network

Networks provide communication between computing devices. To communicate properly, all computers (hosts) on a network need to use the same communication protocols. An Internet Protocol network is a network of computers, using Internet Protocol for their communication protocol. All computers within an IP network must have an IP address that uniquely identifies that individual host. An Internet Protocol-based network (an IP Network) is a group of hosts that share a common physical connection and that use Internet Protocol for network layer communication.

Address Types in an IP Network

Within a given range of IP addresses used in every IP network there are special addresses reserved for:

- Host Addresses
- Network Addresses
- Broadcast Addresses

In addition, an IP network has a subnet mask. The subnet mask is a value stored on each computer that allows that computer to identify which IP addresses are within the network, to which they are attached, and which IP addresses are on an outside network.

Host Address

A host's IP address is the address of a specific host on an IP network. All hosts on a network must have a unique IP address. This IP address is usually not the first and the last IP address in the range of network IP addresses, as the first and the last ones in each range are reserved for special functions. Host IP addresses allow network hosts to establish one-to-one direct communication. This one-to-one communication is referred to as unicast communication.

All host IP addresses can be split into two parts: a network part and a host part. The network part of the IP addresses identifies the IP Network of which the host is a member of. The host part uniquely identifies any individual host.

Network Address

The network address is the first IP address in the range of IP addresses. To be more precise, the network address is the address in which all binary

bits in the host portion of the IP address are set to zero. The purpose of the Network address is to allow hosts that provide special network services to communicate. In practice, the network address is rarely used for communication.

Broadcast address

The broadcast IP address is the last IP address in the range of IP addresses. To be more precise, the broadcast address is the IP address in which all binary bits in the host portion of the IP address are set to one. The broadcast address is reserved and allows a single host to make an announcement to all hosts on the network. This is called broadcast communication and the last address in a network is used for broadcasting to all hosts because it is the address where the host portion is all ones. This special address sometimes is also called the "all-hosts address". Some vendors allow you to set an address instead of the last address as the broadcast address.

2.3.2 Delivery Options for Multimedia

There are three common techniques for streaming real-time audio and video over an IP network: unicasting, multicasting and broadcasting.

1. **Unicast**
   A unicast stream is a one-to-one connection between the server and a client, which means that each client receives a distinct stream and only those clients that request the stream receive it. In other words, in unicasting each video stream is sent to exactly one recipient. If multiple recipients want the same video, the source must create a separate unicast stream for each recipient and to do that, it has to know the exact IP address of each destination device. The streams then flow all the way from the source to each destination over the IP network.

2. **Multicast**
   In multicasting, a single video stream is delivered simultaneously to multiple users. Through the use of special protocols, the network is directed to make copies of the video stream for every recipient. This process of copying occurs inside the network rather than at the video source. Copies are made at points in the network only where they are needed.

   Multicasting uses the Internet Group Management Protocol (IGMP) to identify groups and group members. Routers will also use IGMP

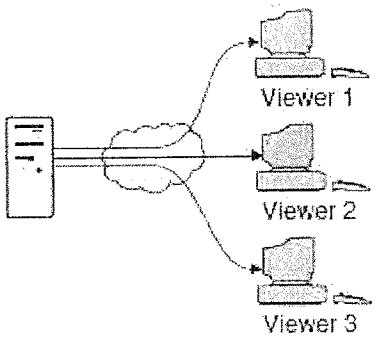


Figure 2.11. IP Unicasting

to send messages to subnets that have group members. The router actually does not keep track of which hosts are members of which group, but only that the subnet contains at least one member for each group. If we have multiple routers, they will communicate and exchange information about multicast groups that they have.

Each host on the network can belong to multiple multicast groups. Hosts can join or leave groups at any time. Multicast groups are identified by special IP addresses between the range of 224.0.0.0 and 239.255.255.255. To each group is assigned its own address. Addresses within the 224.0.0.0 range are reserved for local subnet communications.

When we use a switch to connect hosts, multicast messages are actually forwarded to all hosts on the hub or the switch. Devices actually use MAC addresses to communicate on the local network segment. When the device on the local segment needs to send a multicast message, it will use a frame with a special MAC address. Special multicast addresses in the MAC address begin with 01-00-5E. The remaining portion of the MAC address is a modified format of the multicast IP address. When the switch receives the frame with the multicast MAC address, it will forward the frame out all ports to all connected devices. In this case, even devices that are not members of the original IP multicast group will see the frame. However, devices that do not belong to the IP multicast group will not process the frame since they will check the destination IP address. To avoid this problem in which devices that do not belong to the original IP multicast group still receive packets, it is needed to implement switches that are capable of IGMP snooping. IGMP snooping feature

enables switches to check which device belongs to which multicast group. In that case, when a message arrives to the switch addressed to a specific group using the special frame address, the switch will forward that frame to the individual group members. It will not forward the frame to the devices that are not a member of the group. However, only the switch with IGMP snooping can do that. So, the switch controls forwarding the frames to specific group members. The router keeps track of which subnets have group members.

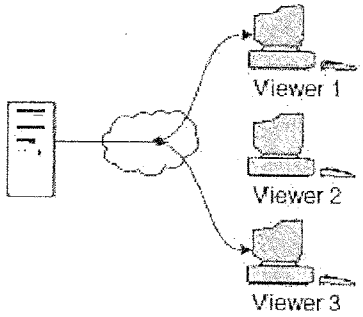


Figure 2.12. IP Multicasting

3. **Broadcast**
   In broadcasting a single packet is sent to every device on the local network. Each device that receives a broadcast packet must process the packet in case there is a message for the device. The destination address in the packet is the special broadcast address. Broadcast packets should not be used for streaming media, since even a small stream could flood every device on the local network with packets that are not of interest to the device. Broadcast packets are usually not propagated by routers from one local network to another, making them undesirable for streaming applications. In true IP multicasting, the packets are sent only to the devices that specifically request to receive them, by joining the multicast.

   As peer to peer traffic will take accordingly a non negligible amount of the global Internet exchange in the near future and although initially peer to peer networks were designed for file sharing, but their dynamic nature makes them challenging for media applications streaming.

4. **peer to peer Live Streaming**
   P2P systems are mostly used for file sharing and file distribution,

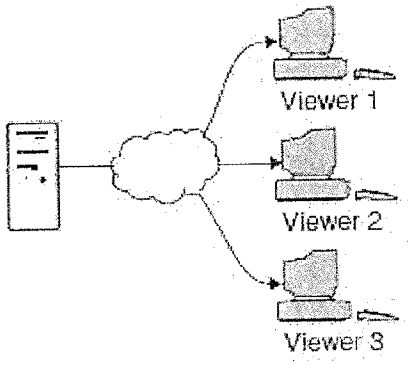


Figure 2.13. Broadcasting

for example, BitTorrent [2], DC++ (Direct Connect Client) [3]. In BitTorrent, a list of the peers currently downloading each file is maintained by a central Web server tracker. Using this list, each peer knows, at any time, a subset of other peers that are downloading the same file. The file is divided into a certain number of pieces (called chunks). Every peer knows which chunks are owned by the peers in its swarm, and explicitly pulls the chunks that it requires. Peers request the chunks which lowest number of peers have (rarest-first download policy), and peers upload chunks first to the peer requesters that are uploading data to them at the fastest rate (tit-for-tat upload policy).This kind of protocols cannot be used directly for live video distribution, because the first chunks of the file are not downloaded first, and therefore the file cannot be run until the download has been completed.

P2P live streaming has to satisfy harder real-time constraints unlike file sharing applications. The other difficulty is dynamic and unpredictable property of nodes joining and leaving the networks. Nowadays some commercial P2P networks for live video distribution are available. The most successful are PPlive with more than 200000 concurrent users on a single channel (reaching an aggregate bit-rate of 100 Gbps), SopCast with more than 100000 concurrent users reported by its developers, Cool-Streaming with more than 25000 concurrent users on a single channel. Freecast, distruStream, Peercast, GoalBit are some examples of open source systems.

2.3.3 Multimedia Access Networks

Streaming media technology involves using streaming technology to access to media files through network transmission, which enables user at client side to download and watch the files in real time.

While traditionally, managed IP-Video delivery has been deployed successfully by several operators worldwide, a more recent Over the Top (OTT) mode of delivery (i.e. not owning the network on which video is delivered) has also seen significant success.

IPTV

(Internet Protocol television) is a traditional way of delivering content over a managed, fully-provisioned network. Though the protocol utilized in streaming the video content is Internet Protocol (hence "IP" in IPTV), this is not the public Internet. It is a private network, not accessible externally. The video streams are delivered within that private network, and accessible only from devices (set-top-boxes) issued by the operator.

IPTV will provide its subscribers with the opportunity to access and interact with a wide variety of high-quality on-demand video content over the Internet protocol.

Multimedia services such as IPTV rely heavily on streaming video techniques. In order a streaming video service to be feasible, it must utilize compression techniques in order to reduce the amount of data being transmitted. Modern compression techniques utilize predictive coding which makes the stream sensitive to information loss. Since streaming video is a real-time service it is also sensitive to information being delayed or received out of order.

Overview of IPTV services: according to ITU-T FG IPTV, IPTV is defined as multimedia services such as television, video, audio, text, graphics and data delivered over IP based network managed to provide the required level of Quality Of Services (QoS) / Quality Of Experience (QoE), security, interactivity and reliability [4].

IPTV services can be classified into 4 major categories: content services, interactive services, commerce services and communication services.

1. *Content services*: these services include not only functionalities to access and delivery the content, but also a functionality to control the delivered content. The content may be broadcasting, multi-media

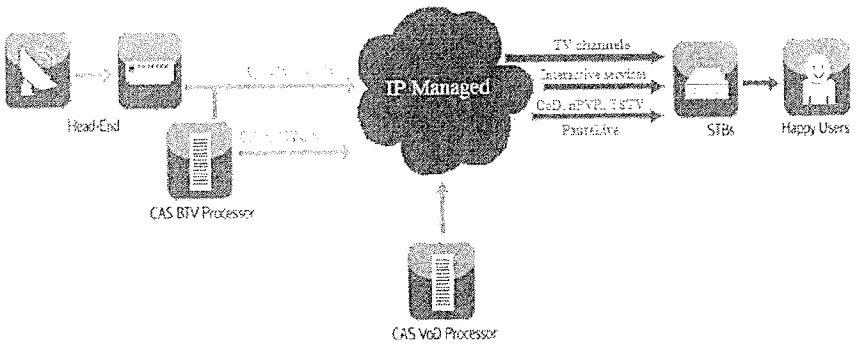


Figure 2.14. IPTV Solution

on demand (Video, Audio, Music) and download-able multimedia content.

2. *Interactive services*: for each individual service there is an independent relation between customer device and the service server.

3. *Government and so on Commerce services*: these services provide the users with the interactive marketplace. They require high level of security and reliability, by the nature of services.

4. *Communication services*: these services, such as Multimedia Message Service (MMS), e-mail, Voice over IP (VoIP) and so on, provide users with the functionality to communicate with others.

OTT

Multimedia services which before were mainly provided by network operators and in dedicated networks (IPTV), have now migrated to the open Internet. The network operators are in many cases left with only providing the broadband access service. This type of service delivery is called Over-The-Top (OTT). The concept of making services able to adapt their network and transport requirements during time of delivery is a strong contribution to success for OTT services.

The OTT service provider side is assumed represented by a CDN (Content Delivery Networks) node, something which is quite common for popular video services today.

In this scenario, it is important that operators provide the end-users with uninterrupted, lag-free videos. One of the key components is to use

a Content Delivery Networks (CDN) solution that reduces traffic in core network, reduces capital expenditure and gives the provider with a cost efficient solution for better quality video content delivery.

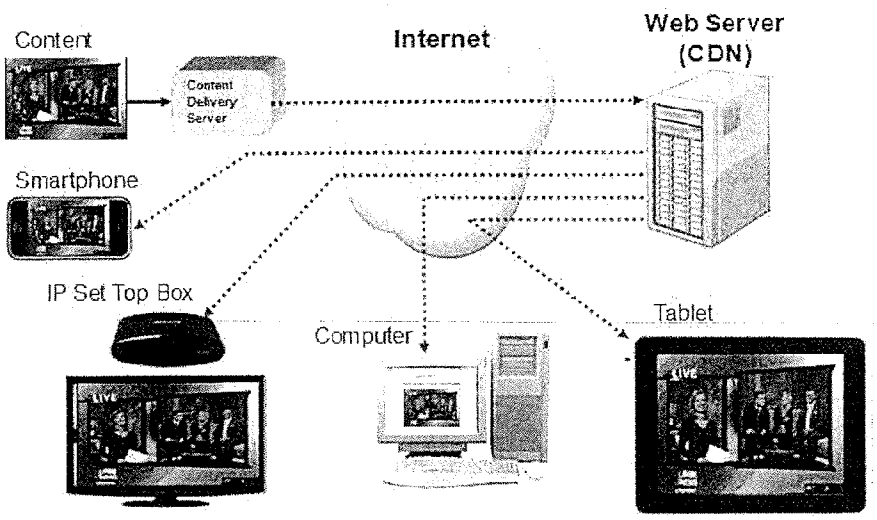


Figure 2.15. OTT Solutions

CDN

A content delivery network (CDN) is a system of distributed servers that deliver web content to a user based on the geographic locations of the user and the origin of the web content delivery server.

This service is effective in speeding the delivery of content of websites with high traffic and websites that have global reach. The closer the CDN server is to the user geographically, the faster the content will be delivered to the user, even when bandwidth is limited or there are sudden spikes in demand. CDNs also provide protection from large surges in traffic, as servers nearest to the website visitor respond to the request. The CDN copies the pages of a website to a network of servers that are dispersed at geographically different locations, caching the contents of the page. When a user requests a web page that is part of a content delivery network, the CDN will redirect the request from the originating site's server to the server in the CDN that is closest to the user and will deliver the cached content.

	OTT	IPTV
Distribution	IP	IP
Video protocol	HLS, HDS, Smooth Streaming, MPEG-Dash	Transport Stream (TS)
Service type	Non-managed but possible Service Providers (xDSL, fiber, cable)	Managed with "best effort"
Constraints	Neutrality constrained by agreements between operators and ISP (e.g. Orange – Netflix et Comcast – Netflix)	Complex infrastructure
Network: routing type	Unicast (Broadcast Mode in 4G)	Multicast

Table 2.2. Differences between OTT and IPTV

CDN management software dynamically calculates which server is located nearest to the requesting client and delivers content based on those calculations. The result is less packet loss, optimized bandwidth and faster performance which minimizes time-outs, latency and jitter, while improving overall user experience (UX). In the event of an Internet attack or malfunction at a junction of the Internet, content that is hosted on a CDN server will remain available to at least some users.

Today, as more aspects of daily life move online, organizations use content delivery network to accelerate static content, dynamic content, mobile content, ecommerce transactions, video, voice, games and so on.

2.4 Streaming media users

Interactive multimedia centers are characterized by an increasing number of multimedia contents and an increasing amount of functionality offered. New types of functionality include recording, time-shifting, convergence with the Internet on-line purchase and so on.

These increases in available multimedia contents and functionality result

in a dense and complex user interface in an environment that typically does not have a desktop for a mouse or keyboard, the standard input devices for the complex user interfaces typical of personal computers. In fact, the typical user input devices to choose multimedia contents and centers, are touch screen monitors or infra-red (IR) remote controls full of pushbuttons, including arrow, keypad and dedicated function buttons.

On the other side, a multimedia device allows a person to deal with a variety of media while eliminating the need to have a separate device for each. People are increasingly interested in dealing with media in easier and faster ways. This has led to the development of a wide range of multimedia devices, which allow a person to create and access various types of media files on a single device. For this purpose, multimedia devices have an almost innumerable variety of applications. They are used in home-entertainment systems and can be extremely powerful educational tools. Educators, for example, have been exceptionally creative in combining some of the exciting elements of video-game applications with selected features of educational material. By doing this, the concept of "edutainment" was created. The goal of using the multimedia edutainment approach is to entertain the user so effectively that the user remains unaware that he or she is actually learning during the process.

2.4.1 Major media screen types

Digital media devices fall into four major categories Television, Computers including desktops, Smart devices such as smart phones and tablets, dedicated Boxes such as Set Top Box (STB).

1. **Televisions:** Television viewing, the grand-daddy of media consumption penetration, is decreased during last years, offering massive volume of multimedia contents in various ways and platforms.

2. **Computers and laptops:** Computers, laptops and netbooks are projected to decrease over the next few years. They are largely driven by consumers opting to buy tablets instead of netbooks.
   Personal computers and laptops, using web browsers and media players, run multimedia contents for users.

3. **Smart devices:** Among the various smart multimedia devices, multimedia smart phones have become the most widespread due to their convenient portability and real-time information sharing, as well as various other built-in features.

Smart devices, using web browser, media players and applications, run multimedia contents for users.

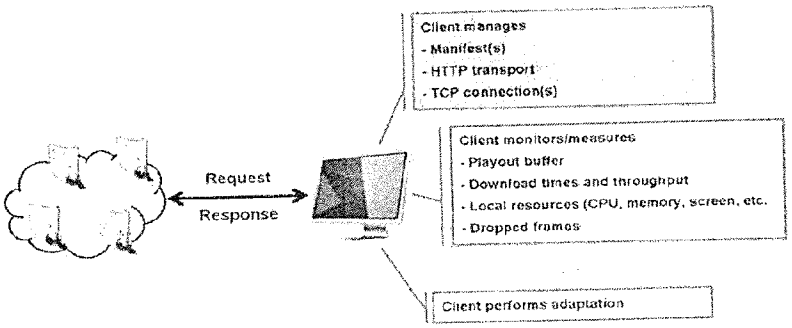


Figure 2.16. Smart Clients

4. **Dedicated Boxes:** Set Top Box is a device that converts video content to analog or digital TV signals. For years, the set-top box (STB) was the cable box that "sat on top" of the TV. Although there is no more flat surface to rest anything, the term lives on. A satellite TV set-top box is officially a satellite receiver, and the box that converts over-the-air digital broadcasts to analog for old TVs is a converter.
   Apple TV, Fire TV, Android TV and Roku boxes connect to the home network for Internet access and convert video from Netflix, Hulu and other providers into TV signals. These media hubs go by many names and may accept local content from the home network as well [5]. In the Internet realm, a set-top box is in fact a specialized computer that can talk to the Internet. It contains a Web browser (which is a Hypertext Transfer Protocol client) and the Internet's main program, TCP/IP. The service to which the set-top box is attached may be through a telephone line as, for example, with Web-TV, or through a Cable-TV company.
   Set top boxes, using applications and media players, run multimedia contents for users. On each type of these mentioned devices, multimedia contents can be run, using web browsers, media players and applications.

Chapter 3

Content Preparation and Staging

3.1 Digital Video

Digital video is a discrete representation of images sampled in spatial and temporal domain. In temporal domain samples are commonly taken at the rate of 25, 30, or more, frames per second. Each video frame is a still image composed of pixels bounded by spatial dimensions. Typical video spatial-resolutions are 1280 x 720 (HD) or 1920 x 1080 (Full HD) pixels.

A pixel has one or more components according to a color space. Commonly used color spaces are RGB and YCrCb.

RGB color space describes the relative proportions of Red, Blue, and Green in a pixel. RGB components are commonly measured in the range of 0-255, that is 8-bits for each component and 24-bits in total.

The YCrCb color space is developed with the human visual system in mind. Human visual perception is less sensitive to colors compared to brightness, hence by exploiting this fact, reduction in number of bits required to store images could be achieved by reducing the chroma resolution. In YCrCb color space, Y is the luminance and it is calculated as the weighted average (kr, kg, kb) of RGB [6]:

$$y - kr * R + kg * G + kb * b \tag{3.1}$$

The color information is calculated as the difference between Y and RGB:

$$\begin{aligned} Cr &= R - Y \\ Cg &= G - Y \\ Cb &= B - Y \end{aligned} \tag{3.2}$$

Compression could be lossless or lossy. A lossless compression preserves the quality so that after decompression the original data is obtained, whereas, in lossy compression, while offering higher compression ratio, the decompressed data is unequal to the original data. Video signals are compressed and decompressed with the techniques discussed under the term video coding, with compressor often denoted as enCOder and decompresser as DECoder, which collectively form the term CODEC. Therefore a CODEC is the collection of methods used to compress and decompress digital videos.



Figure 3.2. Video coding process

The encoder and decoder are based on the same underlining techniques, where the decoder inverses the operation in the encoder. Encoder maximizes compression efficiency by exploiting temporal, spatial, and statistical redundancies.

Different video coding standards are being developed to satisfy the requirements of various applications. They include providing better picture quality, higher coding efficiency and higher error robustness. The Moving Picture Experts Group (MPEG) and Video Coding Experts Group (VCEG) are two major teams collaborating to develop digital video coding standards. The MPEG is a working group of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). It aims at developing standards for compression, processing and representation of moving pictures and audio. MPEG-1 (ISO/IEC 11172) [8] and MPEG-2 (ISO/IEC 14496-10) standards allow wide adoption of commercial products and services such as VCD, DVD, digital television, MP3 players, etc.

The VCEG is a working group of the International Telecommunication Union Telecommunication Standardization Sector (ITU-T). It develops a series of essential standards for video communications over telecommunication networks and computer networks. H.261 videoconferencing standard [9] coding. The following H.263 standard [10], informally known as H.263+ and H.263++, was created to improve the coding efficiency. The most advanced video compression standard in the industry is H.264 (ISO/IEC 13818) which is also known as MPEG-4 Part 10 [11]. H.264

delivers the same quality as MPEG-2 at a third to half the data rate, and when compared to MPEG-4 Part 2, H.264 provides up to four times the frame size at a given data rate [12].

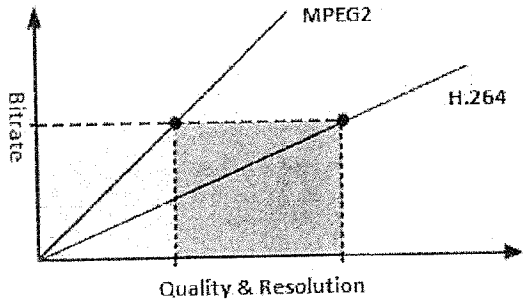


Figure 3.3. H.264 Vs MPEG2

3.2 Transcoding High Efficiency Video Coding

Before diving into the specific device groups and their intended settings, we go through the essentials of transcoding. This section will detail the most commonly used settings in transcod process ranging from GOP size (or I-Frame interval) to resolutions and frame rates and so on.

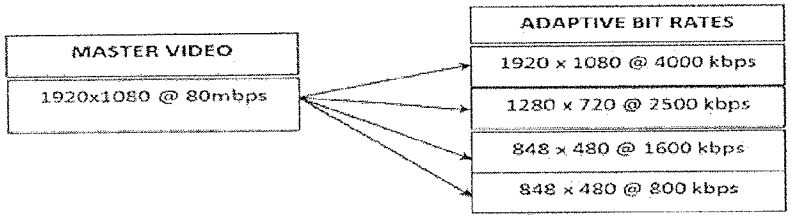
3.2.1 General Settings And Concepts

1 - TRANSCODING
A correctly formatted video/audio master must be converted, or transcoded, in order to be streamed on Internet and viewed. Transcode is the procedure to take an encoded piece of video/audio and then convert them into one or more compressed streams that can then be played in a player on a computer or mobile device, depending on the settings and methods used.

To understand better what transcoding is, we need to first know how digital media are stored. A digital media file generally consists of a container with meta-data information like the dimension and duration of the file, along with any number of tracks. Commonly a media file contains an audio track, a video track, and sometimes a subtitle track. Each of these tracks has been encoded (using a codec) into a format that tries to maximize quality while minimizing file size. These encoded tracks are

interleaved (or multiplexed) into the container, means that they are stored like this: a chunk of audio, a chunk of video, the next chunk of audio, the next chunk of video, and so on. Transcoding is the process of taking digital media, extracting the tracks from the container, decoding those tracks, filtering (e.g. remove noise, scale dimensions, sharpen, etc), encoding the tracks, and multiplexing the new tracks into a new container. It is most commonly done to convert from one format to another (e.g. converting a DivX AVI file to H.264/AAC in MP4 for delivery to mobile devices, set-top devices, and computers).

Use case: a user wishes to take a piece of video shot in 1920 x 1080 and make it playable in an adaptive player on the Internet. In order to do this, the Master Video, which is of a high quality at 1080 in resolution, must be converted to at least 3 or more different bitrates that may scale down in resolution.



Note that the 1920 x 1080 master video, which was created at 80 mbps is converted to four videoas with more compressed bit rates. Though the first on the list is a 1920 x 1080 resolution, the bit rate is only 4000 kbps, much lower than the 80,000 kbps (or 80 Mbps) stream. The next three produced bitrates, scale down from the 1080 resolution to 720 and then 480, making this video playable for a wide range of users and connections.

Transcoding Methods

Different methods can be used to transcode a video which trade quality for time. An Encoder can choose between at least 3 different encoding methods, that effect bit rate and picture quality:

- CBR - Constant Bit Rate (CBR)
- VBR - Variable Bit Rate (VBR)
- 2-PASS VBR - 2-Pass Variable Bit Rate

CBR
As the name suggests this method will encode each frame of video with the same bitrate, no matter what is happening in the frame, or what is changing from frame to frame. Encodes which are done by this method, often have lower visual quality but also lower file sizes. This method is also the fastest in terms of transcode time.

Use case: A news organization may choose to encode CBR, so that the video is outputted quickly enough to make a news deadline, as time is more important than video quality in this case. If they choose CBR, they may decide to encode the video at a medium resolution (say 480) at a mid-level bit rate (say 1200 kbps) so that, they can maintain some level of visual quality.

VBR
Unlike Constant, Variable Bit Rate adjusts the amount of bits, assigned to a frame depending on what the encoder believes is happening in the frame. This means, the bit rate fluctuates over the time, going over the average when a complex frame is encountered. The upper and lower limitation from the average bit rate is determined by setting the Max bit rate and Min bit rate, appropriately.

Use case: When encoding an MP3 track with the VBR method, the encoding software usually allows you to decide on the overall quality of the resulting track that you desire. Passages that are relatively silent or have less audio information are given less bits during encoding, simply because they don't need anything more. More complex and detailed passages containing more audio information, on the other hand, get all the headroom they need.

2-PASS VBR
This is the most recommended method for transcoding when picture quality is important. Like VBR, 2-Pass allows the bit rate to increase for complex scenes (say a rainy scene where every frame is different). Unlike straight VBR, 2- Pass does a little more work. It does a first pass at the encode that creates a log file. This file is then used on a second pass to improve quality on difficult scenes. This results in a higher picture quality (fairly significant compared to 1-Pass) and a more consistent stream with fewer data/bit rate spikes.

Use case: 2-pass encoding is used when the encoding quality is the most important issue. 2-pass encoding cannot be used in real-time encoding, live broadcast or live streaming, as it takes much longer than single-pass encoding, because each pass means one pass through the input data (usually through the whole input file).
2-pass VBR encoding usually is used when target file size is specified. In the case, at the first pass, the encoder analyzes the input file and automatically calculates possible bitrate range and/or average bitrate. In the second pass, the encoder distributes the available bits among the entire video to achieve uniform quality.

2 - BANDWIDTH

In computer networks, bandwidth is used as a synonym for data transfer rate, the amount of data that can be carried from one point to another in a given time period (usually a second). Network bandwidth is usually expressed in bits per second (bps). Modern networks typically have speeds measured in the millions of bits per second (megabits per second, or Mbps) or billions of bits per second (gigabits per second, or Gbps).

3 - BIT RATE

A Bitrate is a measurement of data speed across a network, often in Kilobits per second or kbps (1000 bits per second). This number correlates with potential bandwidth levels that a user may experience and should be in balance to the resolution of the stream.

Use case: A household, whose data plan is limited to 3 Mbps can not handle a bit rate that peaks to over 2500 kbps. There are a couple of reasons why all of the bandwidth can not be used for the streaming. First, an average data rate of around 2500 kbps, may spike to at least 30% or more of the average bitrate at various points in the video stream, if the content creator has transcoded it using variable bit rate, which is a common method. Secondly, the user may have a CPU that cannot take advantage of the entire 3 Mbps, especially if other programs are active in the background. This could be because they have an older system not upgraded. If content provider applies a type of CDN system, which uses client side caching to allow a higher threshold, such as Akamai, for HD HTTP Streaming, bit rate spikes are less problem issue, however if network conditions get worse, those spikes may still present a problem.

Use case: A modern family
A household shares the same wireless Internet connection between four devices, all at the same time. Suppose father is using the Internet on his laptop, mother is using an iPhone streaming Pandora, one child on an Xbox and another one is streaming a movie in the living room on their HD television using a set top box, all on the same wireless connection! Let's hope that the kid watching the movie in the living room, is using adaptive streaming with a wide range of bit rates!

Average Bit Rate

The average bit rate for video, should coincide with the target bandwidth of the end user and should be in balance with the resolution. Just changing a bit rate is not sufficient to deal with bandwidth limitations, and is not recommended. However it is advised that, low bitrates also scale down in resolution, so that the end user has a good balance between image and playback quality.

Use case: It is not advisable to send a mobile smart phone user, a 1080 resolution at a low bitrate of 500kbps, not only because the image quality will be degraded a lot, but also because the end user, though able to handle 500 kbps, does not possess a system that can comfortably handle 1080 lines of resolution, and as a result or the player would crash or would experience a very poor playback.

Max Bit Rate

A Max Bit Rate governs the highest limitation that a variable bit rate may reach and should be within balance of the average and the target connection/device. Max bit rates do not effect Progressive Download, and some services like Akamai have some built in functionalities that limit the impact of bit rate spikes. However, implementing Akamai and Progressive download is not always ideal for the streaming. Potential performance Issues due to a high max bit rate are:

- Frequent or Unwanted Bit Rate Switching
- Playback Stuttering
- Frequent Buffering
- Player Crashing

Industry standards say you should calculate the Max bit rate by taking the Average and adding 50% to that. It is recommended to reduce this even to 30% in order to create a truly consistent stream but still taking advantage of a variable bit rate.

Use case: If a transcoded stream has an Average of 1400 kbps, but spikes at 2600 kbps, that user may experience one of the above performance issues. This especially depends on the bandwidth of the user, it means that when the stream spike is outside over the threshold of the user's bandwidth, user would experience a poor playback.

Adaptive Bit Rate Requirements
Bit rates should be at least 400 kbps apart of each other in an adaptive set for the mid range to high range encodes. The lower encodes can be closer to each other and should scale down in resolution. There is no need to create a low bit rate for 720 and higher resolutions for two primary reasons, first, image quality would be very poor as the loss of detail would become too great, and secondly because a lower bitrate may be being consumed by a mobile device that can not handle a high resolution. For example a 3GS iPhone can not stream 720 or higher resolution video without taxing the devices system and causing poor performance.

4 - RESOLUTIONS The resolution of a video is measured in the height in pixels. A content creator can use any resolution, however there are industry standards to consider. Though larger and newer formats are currently emerging, the preferred resolutions for streaming are:

- 480p – (SD) Standard Definition
- 720p – (hd) mini-high definition
- 1080p – (HD) True High Definition

HD – 1080p
True High Definition, HD, is defined as 1080 lines of horizontal progressive resolution. The highest resolution possible for Internet streaming is 1920 x 1080, or 1080p, where the 'p' stands for progressive. Note that 1080i video also exists and uses an interlaced method similar to standard definition broadcast, and together with 720p is the more common, modern broadcast format. 1080i is not used for Internet streaming.

hd – 720p
In addition to 1080p and 1080i there is also a 720p resolution. This resolution is used to broadcast televisions, live streams and sometimes, independent filmmakers and home videos. It is of a lower resolution than 1080, which makes it easier to transmit and store. This smaller version of High Definition can sometimes be referred to with the lower case acronym, hd. High definition must be at least twice the resolution of Standard Definition Video, which is comprised of 525 lines of resolution.

SD – 480p
Standard Definition, is still used for Internet streaming as it's smaller file sizes and simpler resolution, often meets the right balance for end users to have a positive playback experience. For Internet Streaming a common standard definition resolution is 480 progressive lines of resolution, or 480p.

Resolution Considerations (MOD-16)
When determining which resolution and/or frame size to use , it is important to keep these dimensions divisible by 16. This is because encoders divide the image into 16 x 16 pixel macro blocks. If for some reason 16 is not a possible divisor for a case, it is also okay to use 8 though some loss in quality may occur.

Resolution vs. Dimension
It is easy to get resolution and dimension confused, primarily because they often refer to the same thing. However Resolution refers to the amount of detail the image has, while Dimension refers to the Aspect Ratio of that image. Both are measured in Width and Height. Resolutions should scale according to the desired device and bitrate. It is advisable to not try to scale video up, but rather present it in the original resolution of the master. Scaling up will result in noticeable degradation in picture quality. Likewise it is advisable to not try to fit a larger dimension onto a device that has a smaller resolution. (i.e. trying to fit a 1080 HD image onto an iPhone that can only handle 480 and below).

An Aspect Ratio is indicated by notating the relationship between the width and height in a numerical value. As instance, 178 is actually 1.78, and means that for every 1 unit of height there is 1.78 units of width. A Resolution of 848x480 using this formula, for example, comes to 1.766 or rounded up, 1.78, so simply called 178. As discussed previously, resolutions must be divisible by 16.
Here are some common Theatrical and Broadcast Aspect Ratios:

1.33	Also referred to as Academy Aspect Radio and is 4x3 content
1.78	16x9 Television and the most common Film Aspect Radio
1.66	An older aspect ratio popular with some film-makers and animators
1.85	A very common aspect ratio used a great deal fo 1980-1990's features
2.35	The next most used aspect ratio for theatrical films after 1.78
2.40	A variation on 2.35

Table 3.2. Common Aspect Ratios

5 - GROUP OF PICTURES AND I-FRAME INTERVALS

When transporting files via the Internet, the files need to be fragmented [13] in order to fit into packets. Hence, it seems like a good idea to fragment a video of for instance one minute into multiple parts of some seconds each. Thus, the video/audio source is cut into many short segments with an encoding of the desired delivery format. These segments are typically 2 to 10 seconds long. The length of the segmented chunks are usually along video codec friendly group of pictures (GOP) boundaries. GOP is a group of successive pictures within a coded video stream. When compressing large video sources for transport, a usual technique is to reduce redundancy information in the images the video resource is made of. GOP consists of different kind of picture frames, for example MPEG-2 uses three frame types I, P, and B frames [14]. GOP always begins with a reference picture, an I-frame interval. This is also known as the key frame Key interval or the Instantaneous Decoder Refresh (IDR). Essentially it refers to the need for a reference frame from which guesses can be made about the subsequent frames. Every video segment contains at least one I-frame. The I-frame is the only MPEG-2 frame type which can be fully decompressed without any reference to frames that precedes or follows it. It is also the most data-heavy, requiring the most disk space.

The I-frames are intra coded, means that they can be reconstructed without any reference to other frames. The frames in between Key frames are

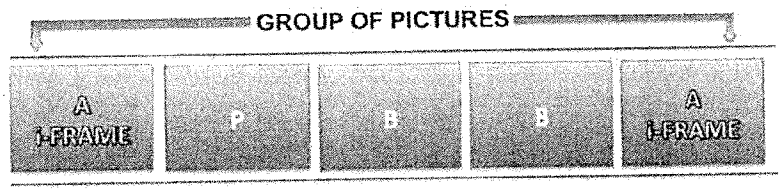


Figure 3.4. Group Of Pictures

called P-Frames (predictive coded picture) and B-Frames (bi-directionally predictive). The P frames are forward predicted from the last I-frame or P-frame, means that it is impossible to reconstruct them without the data of another frame (I or P). B-frames are additional reference frames, that help to improve the quality of P-Frames and the overall look of the stream. The B-frames are both, forward predicted and backward predicted from the last/next I-frame or P-frame, means that there are two other frames necessary to reconstruct them. P-frames and B-frames are referred to as inter coded frames.

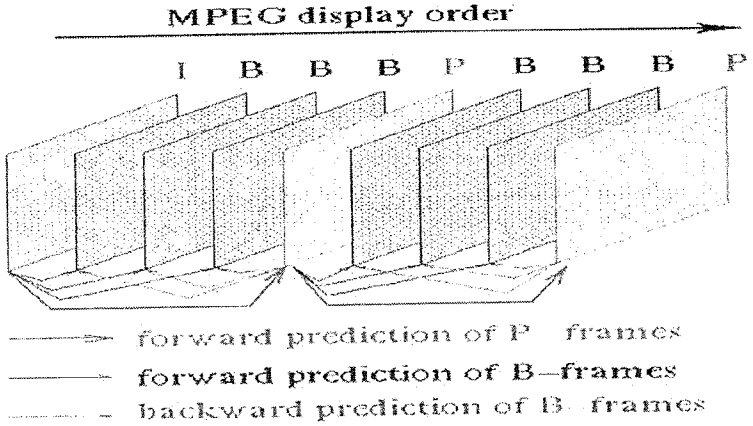


Figure 3.5. An example of frame sequence

Ideal Key Frame intervals, usually are between 2 and 4 seconds. Means that, for a 29.97 fps piece of video, the key frames should be between 60 frames and 120 frames. B-Frame usage should be limited in to 1 to 2 reference frames, going over 3 reference frames may cause poor playback on some players (Quicktime for example). However, if the player supports B-Frame decoding, the number of B-Frames can be increased to increase

picture quality. Though that would increase file size which may slow down loading time and cause some buffering.

6 - BUFFER
The player loads information from a video payload (encoded video asset) before the playback starts. This buffer should be in balance between the bit rate and connection speed. To calculate the Bitrate Buffer Size, must be added at least 50% of the average bitrate, to the average bit rate, so that the buffer would be 150% of average. Important advantages of play out buffering are:

- **Jitter reduction:**
  Variations in network conditions cause the time it takes for packets to travel between identical end-hosts (packet delay) to vary. Such variations can be due to a number of possible causes, including queuing delays, congestion, network overload, link-level retransmissions. Jitter causes jerkiness in playback due to the failure of some frames (group of packets) meet their real-time presentation deadlines, so that they are delayed or skipped. The use of buffering effectively extends the presentation deadlines for all media samples, and in most cases, practically eliminates playback jerkiness due to delay jitter.

- **Error recovery through retransmissions:**
  The extended presentation deadlines for the media samples, allow retransmission to take place when packets are lost. Means that, when UDP is used in place of TCP for transport, since compressed media streams are often sensitive to errors, the ability to recover losses greatly improves streaming media quality.

- **Smoothing throughput fluctuation:**
  Since time varying channel gives rise to time varying throughput, the buffer can provide the streaming live content to sustain when throughput is low. This is required as there is no guarantee that server will reduce its encoding rate based on the drop in the channel.

Some disadvantages of buffering can be, storage requirements at the streaming client and additional delay before playback.

7 - PROFILES
There are three primary encoding methods which are called profiles. These Profiles allow different levels of complexity in the video stream and are useful, if not required, to find the balance between connection and stream. These three levels are:

- *Baseline:* this is the simplest method used and the most limited one. It would be used to set the stream for mid to low end delivery on a mobile device or for videoconferencing, so is compatible with more recorders. The image quality will be limited as neither VBR nor B-Frames are allowed.

- *Main:* an intermediate profile with a medium compression ratio. Main is the default profile setting. This profile is compatible with most recorders and uses fewer bits to compress video than the baseline profile, however, it uses more bits than the high profile. The main profile supports I-frames, P-frames, and B-frames.

- *High:* a complex profile with a high compression ratio. This is the primary profile for high-definition television applications, for example this is the profile adopted for Blu-ray and HD-DVD. The high profile supports I-frames, P-frames, and B-frames.

8 - VIDEO CONTAINER

Once the media data is compressed into suitable formats and reasonable sizes, it needs to be packaged, transported, and presented. A container exists for the purpose of bundling all of the audio, video, and codec files into one organized package. In addition, the container often contains chapter information for DVD or Blu-ray movies, metadata, subtitles, and/or additional audio files such as different spoken languages.

Most consumers may simply want to store video in a way that is easy to stream to other PCs on the network or over the Internet, however it must not look like a pixilated mess. The right container will help to strike the right balance between quality and streamability for each particular need.

Popular video containers are:

- *Advanced Systems Format:* ASF is a Microsoft-based container format. There are various file extensions for ASF files, including .asf, .wma, and .wmv. For example file with a .wmv extension is probably compressed with Microsoft's WMV (Windows Media Video) codec, but the file itself is an ASF container file.

- *Audio Video Interleave:* AVI is an older Microsoft container format. It is still fairly common, but is less used with new projects.

- *QuickTime:* QuickTime is Apple's own container format. QuickTime sometimes gets criticized because codec support (both audio and video) is limited to whatever Apple supports. However Apple is a

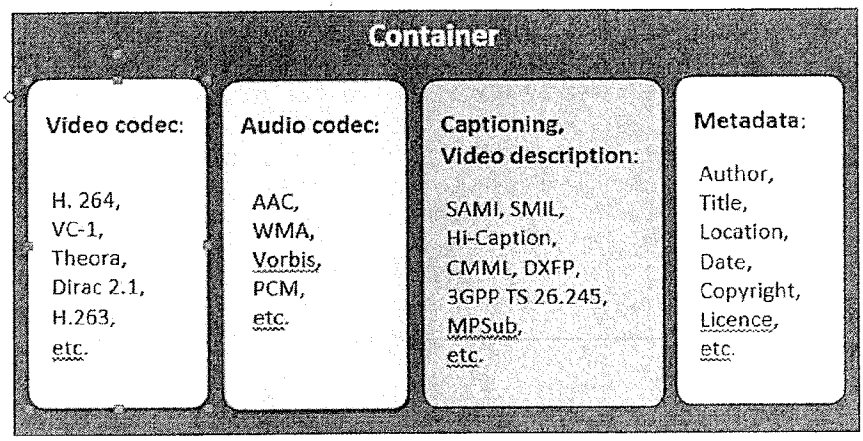


Figure 3.6. Container Format

strong proponent of H.264, so QuickTime files can contain H.264-encoded video.

- *MP4:* MP4 is another container format developed by the Motion Pictures Expert Group, and is more technically known as MPEG-4 Part 14. Video inside MP4 files are encoded with H.264, while audio is usually encoded with AAC, but other audio standards can also be used.

- *MPEG and BDAV MPEG-2 Transport Streams:* These are the container formats used in DVDs and Blu-ray discs, respectively. The VOB (Video Objects) container file format is a subset of the MPEG transport stream, and is used specifically in DVD video creation. MPEG-2 Transport Streams, as the name suggests, uses video compressed with MPEG-2 Part 2 encoders, but it's actually not limited to MPEG-2. MPEG-2 TS data can also be compressed with H.264 and VC-1, since those are also defined as part of the Blu-ray standard. Audio files can be Dolby Digital (AC3) files, Dolby Digital Plus, Dolby Lossless, DTS, DTS HD, and Linear PCM (uncompressed) multichannel audio data.

- *AVCHD:* This is the standard container used by many camcorders. Video captured with these devices is compressed with the H.264 AVC codec. Audio is encoded as Dolby Digital (AC3) or uncompressed linear PCM.

- *Flash:* Adobe's own container format is Flash, which supports a variety of codecs. More recent Flash video is encoded with H.264 video and AAC audio codecs, however not all Flash sites use exclusively these codecs, particularly if the video was created and encoded years ago.

- *Others:* A variety of other formats are widely used, particularly for delivering video over the Internet. These include Matroska (.mkv), OGG (and the related containers OGM and OGV), and DiVX.

3.2.2 Video and playback artifacts

If the settings of a video are not followed appropriately, a variety of playback artifacts or errors may appear. These artifacts may include:

- *Buffering:* if there are huge bit rate spikes, or if file sizes are large for various bit rates, a player may stop playback and pause, loading the video and waiting for system resources to free up. This also may be because the buffer is set too low during transcoding.



Figure 3.7. Buffering Artifact

- *Skips/Drops:* frames of video may drop if signal strength is not sufficient, or if the wrong frame rate was used during transcoding. Resolution may also be a culprit of frame skips. If a user is using an average laptop over a wireless connection at home, 720 and 1080

resolutions will most likely skip frames, creating a choppy playback experience.



Figure 3.8. Frame drop artifact [15]

- *Stutter:* like frame skips, frames are dropping, but the perceived experience is that the video is stuttering. This may appear as if a frame is pausing for a split second before catching up to audio, which normally does not stutter or skip. Audio typically plays back fine even if video artifacts are present as they both, though bundled in the same container, are treated separately.

- *Macro-Blocking (or just Blocking):* the image may appear as a mosaic of blocks, which is often referred to as pixilation. This especially happens on fast motion scenes or scenes with heavy detail like rain.

- *Aliasing:* lower resolutions do not handle diagonal lines very well, which may appear as steps and be jagged rather than smooth diagonals.

- *Banding:* though on a video master an image may appear to have a consistent color, often after transcoding to mid or low bit rates/resolutions, the same color appears as a gradient or a series of bands. This is referred to as banding. An encoder, especially if 1-Pass or CBR is used, may not be able to make difference between subtle



Figure 3.9. Blocking artifact

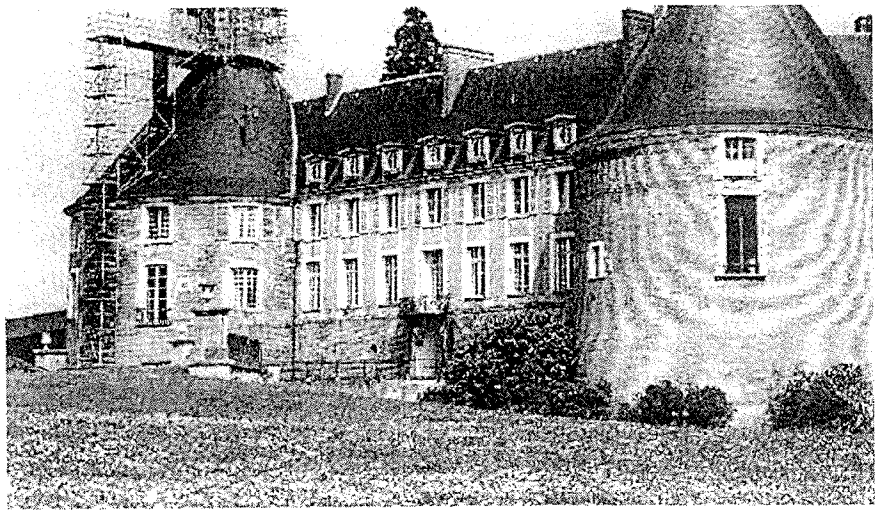


Figure 3.10. Aliasing artifact [16]

color changes. This is most often in sky shots and in animation, the latter is most problematic and challenging for transcoding, especially modern CG based animation (Computer Graphics Animation) [17]. Many transcoders are built in algorithms to deal with banding and over time this issue should be disappeard.



Figure 3.11. Banding artifact [18]

- *Ghosting/Gibbs Effect/Ringing/Mosquito Noise:* the image may seem doubled, with the edges of an object seem to be fluttering, at a high rate. A faint outline around an object can be seen in the video, that appears to fluctuate from frame to frame.

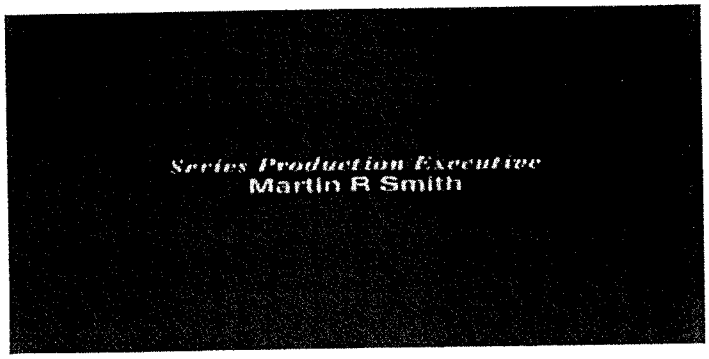


Figure 3.12. Gibbs Effect Artifact [19]

3.3 Digital Audio

All audio formats fall into one of these two broad categories, Uncompressed Audio (PCM) and Compressed Audio Formats.

3.3.1 Uncompressed Audio (PCM, Pulse Coding Modulation)

Uncompressed audio, or linear PCM, is the format which sound-card works with. It consists of a series of "samples". Each sample is a number representing how loud the audio is at a single point in time. One of the most common audio sampling rates is 44.1kHz, which means that we record the level of the signal, 44100 times per second. This is often stored in a 16 bit integer, so we would be storing 88200 bytes per second. If the signal is stereo, then we store a left sample, followed by a right sample, so now we would need 176400 bytes per second. This is the format that audio CDs use.

There are three main variations of PCM audio.

First, there are multiple different sample rates. 44.1kHz is used on audio CDs, while DVDs typically use 48kHz. Lower sample rates are sometimes used for voice communications (e.g. telephony and radio) such as 16kHz or even 8kHz. The quality is degraded, but it is usually good enough for voice (music would not sound so good). Sometimes in professional recording studios, higher sample rates are used, such as 96kHz, although it is debatable what benefits this gives, since 44.1kHz is more than enough to record the highest frequency sound that is audible for human hearing. Most sound-cards will support only a limited subset of sample rates. The most commonly supported values are 8kHz, 16kHz, 22.05kHz, 16kHz, 32kHz, 44.1kHz, and 48kHz.

Second, PCM can be recorded at different bit depths. 16 bit is by far the most common, and the one which is used by default. It is stored as a signed value (-32768 to +32767), and a silent file would contain all 0s. 24 bit is commonly used in recording studios, as it gives plenty of resolution even at lower recording levels, which is desirable to reduce the chance of "clipping". 24 bit can be a pain to work with, as you need to find out whether samples are stored back to back, or whether they have an extra byte inserted to bring them to four byte alignment.

The final bit depth is 32 bit IEEE floating point. Although 32 bits of resolution is overkill for a single audio file, it is extremely useful when files are mixed together. Mixing two 16 bit files, can easily result in overflow, so

typically it is converted to 32 bit floating point (with -1 and 1 representing the min and max values of the 16 bit file), and then mix them together. Now the range could be between -2 and +2, so it might be needed to reduce the overall volume of the mixed file to avoid clipping converting back down to 16 bit.

There are other bit depths, some systems use 20 bit, or 32 bit integer. Some mixing programs use 64 bit double precision floating point numbers rather than 32 bit ones, although it would be very unusual to write audio files to disk at such a high bit depth. But the most common two bit depths are 16 bit PCM and 32 bit floating point.

The third main variation on PCM is the number of channels. This is usually either 1 (mono) or 2 (stereo), but it is possible to have more channels of course (such as 5.1 which is common for movie sound-tracks). The samples for each channel are stored interleaved one after the other, and a pair or group of samples is sometimes referred to as a "frame".

3.3.2 Compressed Audio Formats

There are numerous audio compression formats (also called "codecs"). Their common goal is to reduce the amount of storage space required for audio, since PCM takes up a lot of disk space. To achieve this goal, various compromises are often made to the sound quality, although there are some "lossless" audio formats such as "FLAC" or Apple LossLess (ALAC), which conceptually are similar to zipping a WAV file. They decompress to the exact same PCM which is compressed.

Compressed audio formats fall into two broad categories. One is aimed at simply reducing the file-size whilst retaining as much audio fidelity as possible. This includes formats like MP3, WMA, Vorbis and AAC. They are most often used for music and can often achieve around 10 times size reduction without a particularly noticeable degradation in sound quality. In addition there are formats like Dolby Digital which take into account the need for surround sound in movies.

The other category is codecs designed specifically for voice communications. These are often much more drastic, as they may need to be transmitted in real-time. The quality is greatly reduced, but it allows for very fast transmission. Another consideration that some voice codecs take into account is the processor work required to encode and decode. Mobile processors are powerful enough these days that this is no longer a major consideration, however it explains why some telephony codecs are so rudimentary. One example of this is G.711, or $\mu - law$ and a-law[20][21], which simply converts each 16 bit sample to an 8 bit sample, so in a sense it is still a form

of PCM, although not linear. Other commonly encountered telephony or radio codecs include ADPCM (Adaptive differential pulse-code modulation) [22], GSM 610 (Global System for Mobile Communications) [23], G.722, G.723.1, G.729a [24], IMBE/AMBE(Improved/Advanced Multi-Band Excitation)[25], ACELP (Algebraic code-excited linear prediction)[26]. There are also codecs targeted more for internet telephony scenarios such Skype's codec SILK[27].

3.3.3 Audio Containers

The container is essential for the media player to get information about sample rate, bit depth and number of channels, which are used for the audio file.

Audio containers can be lossy or lossless formats. Here we introduce the most popular ones of each group.
The lossless Formats:

- *WAV and AIFF:* Both WAV and AIFF (Audio Interchange File Format) are uncompressed formats, which means they are exact copies of the original source audio. The two formats are essentially the same quality; they just store the data a bit differently. AIFF is made by Apple, so it is used more often in Apple products, but WAV is pretty much universal. However, since they are uncompressed, they take up a lot of unnecessary space.

- *FLAC:* The Free Lossless Audio Codec(FLAC) is the most popular lossless format, making it a good choice to store music in losslessly. Unlike WAV and AIFF, The audio file is compressed, so it takes up considerably less space and it is still a lossless format, which means the audio quality is still the same as the original source.

- *Apple Lossless:* Also known as ALAC, Apple Lossless is similar to FLAC. It is a compressed lossless file, although it is made by Apple. Its compression is not quite as efficient as FLAC, so files might be bit bigger, but it is fully supported by iTunes and iOS (while FLAC is not).

- *APE:* APE is a very highly compressed lossless file with the most space savings. Its audio quality is the same as FLAC, ALAC, and other lossless files, but it is not compatible with many players. They make the processor to work harder to decode, since they are so highly compressed.

The lossy formats:

- *MP3:* MPEG Audio Layer III, or MP3 for short, is the most common lossy format around. So much lossy so that it has become synonymous with downloaded music. MP3 is not the most efficient format, but it is definitely the most well-supported one, making it the first choice for lossy audio.

- *AAC:* Advanced Audio Coding, also known as AAC, is the standard Audio codec, which often referred to as MPEG-4 Audio. It is similar to MP3, although it is a bit more efficient. That means that files take up less space, but with the same sound quality as MP3.

- *Ogg Vorbis:* The Vorbis format, often known as Ogg Vorbis due to its use of the Ogg container, is a free and open source alternative to MP3 and AAC. Its main draw is that it is not restricted by patents, but that does not affect the user, in fact, despite its similar quality, it is much less popular than MP3 and AAC, meaning fewer players are going to support it.

- *WMA:* Windows Media Audio is Microsoft's own proprietary format, similar to MP3 or AAC.

Chapter 4

General Overview of iES streamer

This thesis is the common part of three projects which are iES system, SportubeTV and Mycujoo. An important part of each of these projects is streaming server, that we are going to call it from now on, iES Streamer.

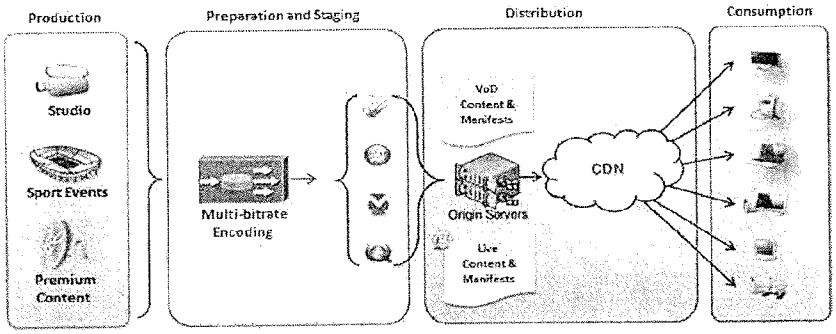


Figure 4.1. IES Streamer

The iES streamer has two approaches of the content preparation, according to the source and the destination of the contents, direct stream and transcoded stream.

- *Direct Stream:* The media is almost compatible with the native client. In this case, the audio/video codecs are directly streamed to the client.

- *Transcoded stream:* If the video or audio format is not compatible with the device of client, then the streamer server has to convert them

to a compatible format which is done by "transcoding" it. Depending on the situation, only the audio may need to be converted, or only the video, or both.

iES Streamer, applies udpxy software package, to relay multicast streaming coming from satellite, to http unicast, on the other hand, handles transcoding process, using FFMPEG software package.

4.1 udpxy

udpxy is a UDP-to-HTTP multicast traffic relay daemon. It forwards UDP traffic from a given multicast subscription to the requesting HTTP client. Udpxy is run on a dedicated address:port, to listen HTTP requests issued by clients. A client request should be structured as:
http://{*address*}:{*port*}/{*cmd*}/{*mgroup_address*}*[SEP]*{*mgroup_port*}
where[28],
[SEP]
| % | ~ | + | − |
{*cmd*}

udp | rtp

where *address* and *port* match the listening address/port combination of udpxy, and *mgroup_address:mgroup_port* identify the multicast group/channel to subscribe to.

udp

udp command will have udpxy probe for known types of payload (such as MPEG-TS and RTP over MPEG-TS).

rtp

rtp command makes udpxy assume RTP over MPEG-TS payload, thus skipping the probes.

udpxy will start a separate client process for each new relay request (within the specified limit on active clients). The client process will relay/forward all network traffic received (via a UDP socket) from the specified multicast group to the requesting HTTP connection.

udpxy also supports a few administrative requests:
status

http://*address:port/status/* to send back an HTML page with daemon status and client statistics.

restart
: http://*://address:port/restart/* to close all *active* connections and restart.

Options udpxy accepts the following options[29]:

-V Enable verbose output [default = disabled]

-S Enable client statistics [default = disabled]

-T Do NOT run as a daemon [default = daemon if root]

-a <*listenaddr*>
: IPv4 address/interface to listen on [default = 0.0.0.0]

-m <*mcast_ifc_addr*>
: IPv4 address/interface of (multicast) source [default = 0.0.0.0]

-c <*clients*>
: Maximum number of clients to accept [default = 3, max = 5000]

-l <*logfile*>
: Log output to file [default = stderr]

-B <*sikeK*>
: Buffer size (65536, 32Kb, 1Mb) for inbound (multicast) data [default = 2048 bytes]

-R <*msgs*>
: Maximum number of messages to buffer (-1 = all) [default = 1]

-H <*sec*>
: Maximum time (in seconds) to hold data in a buffer (-1 = unlimited) [default = 1]

-n <*nice_incr*>
: Nice value increment [default = 0]

-M <*sec*>
: Renew multicast subscription every M seconds (skip if 0) [default = 0]

-P <*port*>
: Port to listen on.

Payload types and handling: udpxy recognizes MPEG-TS and RTP over MPEG-TS payloads within relayed packets. If udpxy encounters RTP payload it automatically 'translates' it to MPEG-TS (by stripping RTP headers) so that media players not recognizing RTP could still play back the stream [30].

Recording MPEG traffic: udpxy includes functionality to record captured traffic as raw MPEG-TS stream into a file. This functionality is enabled through udpxrec: a bundled-in application that is linked together with udpxy (as one executable)[31].

Environment: udpxy utilizes the following environment variables to compliment its command-line options. The variables are considered for the options in such a way that, often do not need to be replaced. If there is a command-line switch that would intersect in functionality with an environment variable, the switch always has higher priority.

UDPXY_RCV_TMOUT
: timeout (sec) on the inbound data stream

UDPXY_DHOLD_TMOUT
: timeout (sec) to hold buffered data before sending/flushing to client(s), default=1;

UDPXY_SREAD_TMOUT
: timeout (sec) to read from the listening socked (handling HTTP requests), default=1;

UDPXY_SWRITE_TMOUT
: timeout (sec) to write to the listening socked (handling HTTP requests), default=1;

UDPXY_SSEL_TMOUT
: timeout (sec) to select(2) [32] in server loop (unused if pselect(2) [32] is employed), default=30;

UDPXY_LQ_BACKLOG
: size of the listener socket's backlog, default=16;

text UDPXY_SRV_RLWMARK
: low watermaek on the receiving (m-cast) socket, default=0 (not set);

UDPXY_SSOCKBUF_NOSYNC
do not sync inbound (UDP) socket's buffer size (with the value set by -B), default=1 (sync);

UDPXY_DSOCKBUF_NOSYNC
do not sync outbound (TCP) socket's buffer size (with the value set by -B), default=1 (sync);

UDPXY_TCP_NODELAY
disable Nagle algorithm on the newly accepted socket (faster channel switching), default=1;

UDPXY_HTTP200_FTR_FILE
append contents of the given text file to the HTTP 200 response, default=none;

UDPXY_HTTP200_FTR_LN
append the text (line) to the HTTP 200 response, default=none;

UDPXY_ALLOW_PAUSES if blocked on a write(2) [33], keep reading data until the buffer (-B <sizeK>) is full, default=disabled;

UDPXY_PAUSE_MSEC allow only N milliseconds of reading data when blocked on a write(2)[34].

UDPXY_CONTENT_TYPE
specify custom Content-Type in HTTP responses[35].

4.2 FFMPEG

Fast Forward Motion Pictures Expert Group (FFmpeg) is a well-known, high performance, cross platform open source library for recording, streaming, and playback of video and audio in various formats, namely, Motion Pictures Expert Group (MPEG), H.264, Audio Video Interleave (AVI), just to name a few. With FFmpeg current licensing options, it is also suitable for both open source and commercial software development. FFmpeg contains over 100 open source codecs for video encoding and decoding. It contains libraries and programs for handling multimedia data. The most notable libraries of FFMPEG are libavcodec, an audio/video codec library, libavformat, an audio/video container mux and demux library, and the FFMPEG command line program for transcoding multimedia files [34].

There are numerous projects known to incorporate with FFmpeg in Entertainment and Health care industry. VLC Media Player, Mplayer, Dr.DivX, Frogger, KMediaFactory, PlayStation Portable Video Converter, PSP Media Player, Quick View 18 Pro, WMA codec for Mac OS X, Xine and etc are currently using the FFmpeg framework for building media players, video editing software and video streaming. AMIDE, a Medical Imaging data analyzer and EM-Manual both use FFmpeg libraries for their audio/video encoding, decoding and analyzing features. FFmpeg has been successfully ported to all Operating Systems including: Linux (all flavors), UNIX, Windows and MAC. FFmpeg framework also provides a command line tool, called ffmpeg to convert one video file format to another. It can also be used for grabbing and encoding in real time from a TV card. ffserver, a FFmpeg tool is an HTTP (RTSP is being developed) multimedia streaming server for live broadcasts. It can also time shift live broadcast. ffplay, is a simple media player based on SDL (Simple DirectMedia Layer [36]) and the FFmpeg libraries. FFmpeg can be hooked up with a number of external libraries to add support for more formats.

We select FFmpeg because it supports real-time H.264 decoding which is relevant to our job. FFMPEG utilizes the features available in the x264 codec, in order to encode H.264.

x264 is an open source library for encoding video streams in H.264/MPEG formats and it is one of the best encoders available for real time encoding. FFMPEG also has an efficient implementation and a stable code base, as evidenced by the inclusion of FFmpeg-based codecs in a number of widely-used video players.

4.2.1 Main features of x264 library

x264 has incorporated many good features [37] for H.264 video standard which provide better visual quality than other available H.264 encoders. Some important features are as follows:

- Adaptive B frame placement
- Usage of B frames for referencing or arbitrary ordering
- CAVLC/CABAC encoding
- 8x8 and 4x4 adaptive spatial transform
- Custom quantization matrices
- Intra: all macro-block types (16x16, 8x8, 4x4, and PCM with all predictions)

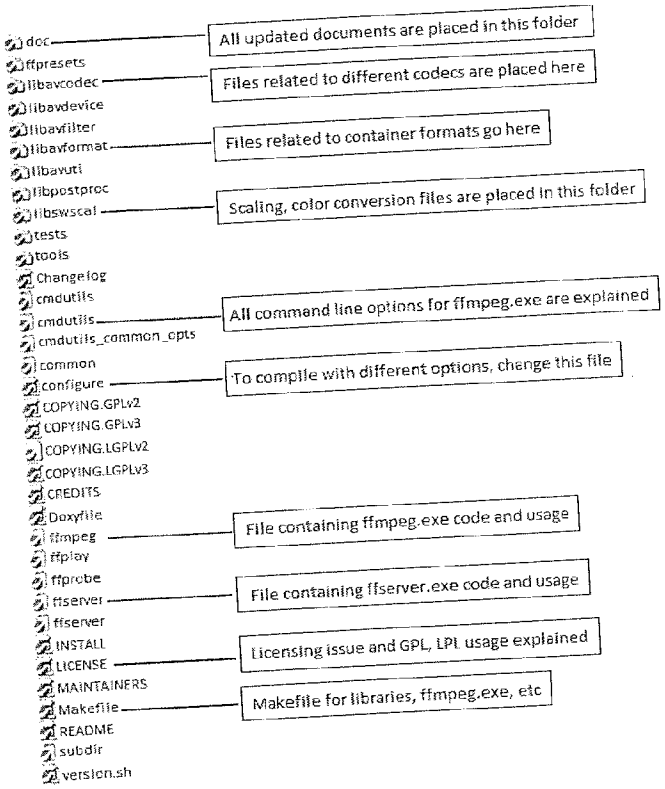


Figure 4.2. FFMPEG directory structure

- Inter P: all partitions (from 16x16 down to 4x4)
- Inter B: partitions from 16x16 down to 8x8 (including skip/direct)
- Interlacing (MBAFF)
- Multiple reference frames
- Rate control: constant quantizer, constant quality, single or multipass ABR, optional VBV
- Scene cut detection
- Spatial and temporal direct mode in B-frames, adaptive mode selection

- Parallel encoding on multiple CPUs
- Predictive lossless mode
- Psy optimizations for detail retention (adaptive quantization, psy-RD, psy-trellis)
- Zones for arbitrarily adjusting bitrate distribution
- Multi-pass encoding

Parameters are set as follows [38]:

- *Profiles:* Profiles give the required settings to an output stream. Once we set any profile for output stream it overrides all previous settings of the user and make it to use settings that are allowed for that profile level. Profile settings should be used according to the decoding device. Profiles supported by x264 are Baseline, Main and High. The higher the complexity of profile, the more CPU power is needed to encode/decode.

  - *Baseline*
    Baseline encodes are the most basic form of encoding. While decoding is much easier, it may also require much higher bit-rates to maintain the same level of quality.
  - *Main*
    The middle ground. Most modern/current devices support this profile.
  - *High Profile*
    For best quality and filesize at the expense of CPU time in both decode and encode.

  Example for command line: --profile main
  Default: not set

- *Preset:* A preset is a collection of options that will provide a certain encoding speed to compression ratio. This parameter in x264 takes over compression efficiency[40]. It trades off between compression and encoding speed. The slower the speed, the better the compression efficiency. If preset is specified, the changes it makes will be applied before all other parameters. Presets supported by x264 are ultrafast, superfast, very fast, faster, fast, medium, slow, slower, very slow.
  Example for command line: --preset fast
  Default: medium

	Baseline	Extended	Main	High	High 10	High 4:2:2	High 4:4:4 Predictive
I and P Slices	Yes	Yes	Yes	Yes	Yes	Yes	Yes
B Slices	No	Yes	Yes	Yes	Yes	Yes	Yes
Multiple Reference Frames	Yes	Yes	Yes	Yes	Yes	Yes	Yes
In-Loop Deblocking Filter	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CAVLC Entropy Coding	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CABAC Entropy Coding	No	No	Yes	Yes	Yes	Yes	Yes
Interlaced Coding (PicAFF, MBAFF)	No	Yes	Yes	Yes	Yes	Yes	Yes
8x8 vs. 4X4 Transform Adaptivity	No	No	No	Yes	Yes	Yes	Yes
Quantization Scaling Matrices	No	No	No	Yes	Yes	Yes	Yes
Separate Cb and Cr QP control	No	No	No	Yes	Yes	Yes	Yes
Separate Color Plane Coding	No	No	No	No	No	No	Yes
Predictive Lossless Coding	No	No	No	No	No	No	Yes
	Baseline	Extended	Main	High	High 10	High 4:2:2	High 4:4:4 Predictive

Figure 4.3. Encoding techniques enabled by profile [39]

- *Keyint:* It defines GOP length by providing the difference between two IDR/I frames for the whole video sequence. IDR frames work as delimiters because no frame can take reference from the frames previous to an IDR frame. It can be kept in such a way that the scenecut detection can decide where to put an IDR frame. It can help compress videos containing very slow movement.

  Example for command line: --keyint 250 //GOP length of 250 frames
  Default: 250

- *Min-keyint:* This is an important parameter for scenecut detection along with keyint. It controls the minimum availability possible of an IDR frame in a video sequence. By default, it is calculated as (keyint/10). The maximum value allowed for min-keyint is (keyint/2)+1.

  Example for command line: --min-keyint 25
  Default: auto (MIN(--keyint / 10, --fps))

- *Scenecut detection:* This feature of x264 sets the threshold for I/IDR frame placement, it allows the encoder to place key IDR/I frames according to the calculation of a metric for scenecut detection. This metric calculates how different the current frame is from the previous frame. If it is more than the percentage mentioned with this parameter, it replaces the frame with an IDR or I key frame, in such a manner that if it is less than min-keyint since the last IDR, the I frame is placed, otherwise, an IDR frame is placed.

Example for command line: --scenecut 40
Default: 40

- *Adaptive B frame placement:* x264 for adaptive B frame placement in the encoding sequence using an algorithem. This provides authority to select between P frame or B frame. Setting of --b-adapt parameter has three modes:
  - First mode is represented by the b-adapt value '0' which disables the adaptive B frame algorithm and chooses B frame always.
  - Second mode is represented by the b-adapt value '1' which provides fast algorithm and wants to use the 16 B frame period. It is also the default parameter that x264 uses for adaptive B frame placement.
  - Third mode uses the b-adapt value of '2', it is a slow but optimal algorithm to decide between P and B frames. In multi-pass encoding, this feature works only in the first pass where the encoder is selecting the types.

  Example for command line: --b-adapt 1 (default)
  Default: 1

- *Frame referencing:* In x264, it allows the use of B-frames as references for other frames. The parameter that enables this feature is b-pyramid. By using B frame as reference, the quantizer can come almost halfway from P to B. Two types of B frames can be available after encoding. B frame can be represented by the symbol 'B' or by 'b' . The difference between them is that 'B' can be used as reference while 'b' cannot. Also, to use this parameter, there should be at least either 2 b-frames or 2 B-frames already available, before starting to use B frame as reference. Modes to use b-pyramid parameter in x264 encoding are as follows:
  - Mode 'none' – This mode does not allow b frames to be used as reference. So, all the B frames are going to be represented by 'b' in display order.
  - Mode 'normal' – This mode allows for many B frames to be used as reference in GOP. This is a default setup during encoding.
  - Mode 'strict'– This mode allows only one B frame to be used as reference in the GOP.

  Example for command line: --b-pyramid normal
  Default: normal

- *Frame size* – This option is to define the frame size for video. It is defined in command line as: -s [frame size], for example –s 352x288 for cif videos.

- *Frame rate* – This option is to define frame rate for a given video. It is defined in command line as: -r [frame rate], for example –r 25.

- *Pass* – This option is to define the pass number for a given video. It is defined in command line as: -pass [n], for example FFMPEG –i xxx.mov –pass 1 –f rawvideo –y /dev/null.

- *RTP mode* This option is used to send the encoded stream using RTP mode to some other destination. In this mode, multiplexing is done after encoding and the de-multiplexing is done before decoding of the stream at the destination. It is defined in command line as: FFMPEG –i [input.264] –vcodec [codec] –f rtp rtp://[ip address]:1000.
  As FFMPEG uses x264 libraries for H.264 encoding, mapping is needed for x264 commands of FFMPEG. The user can define x264 parameters by the FFMPEG command line but for that, 'x264' should be mentioned in the command line before putting x264 commands and ':' should be used before the next x264 command. For example:
  'FFMPEG –i [input.yuv] –pass 1 -x264opts slice-max-size=300:merange=5:keyint=20 -y out.264'

- *Error concealment* – The parameter that defines error concealment in FFMPEG command line is '-ec bit_mask'. The bit_mask is a bit mask of the following values:
  '1' – FF_EC_GUESS_MVS (default=enable)
  '2' – FF_EC_DEBLOCK (default=enable)
  Error concealment schemes act by checking and determining which parts of slices in a given frame are corrupted due to errors. The code discards all data after error and also some data before error within a slice. After the discarding data, based on the undamaged parts of slice and the past frame, the code tries to guess whether concealment is better from the last frame, or from the neighborhood (spatial). Based on this decision, it decides which macroblocks are unknown, lost or corrupted. After this, it estimates the motion vectors for all non-intra macroblocks, those have damaged motion vectors based on their neighboring blocks. After all these steps, all the damaged parts are passed through a deblocking filter to reduce the artifacts. x264 parameter mapping for FFMPEG is as follow:

  --keyint <integer>(x264)

-g <integer>(FFMPEG), This option defines the GOP size in FFMPEG which is defined by the key frame interval value in x264. This is the distance between two key frames (i.e., IDR/I frames). A large GOP size gives more compression but finding scene change and etc. becomes more complex. The default value for this option is 250.

--min-keyint <integer>(x264)

-keyint_min <integer>(FFMPEG), This parameter defines the minimum GOP length, the minimum distance between the key frames. The default value for this parameter is 25.

--scenecut <integer>(x264)

-sc_threshold <integer>(FFMPEG), As already explained above, this parameter adjusts the sensitivity of scenecut detection in x264. The default value is 40.

--bframes <integer>(x264)

-b_strategy <integer>(FFMPEG), This parameter adaptively decides the best number of B frames to be used in encoding for a given video sequence.

--b-pyramid (x264)

-flags2 +bpyramid (FFMPEG), This parameter starts keeping and using B frames for reference in a decoded picture buffer.

--ref <integer>(x264)

-ref <integer>(FFMPEG), This parameters maps the number of reference frames in FFMPEG for a given video sequence. The default value is 6.

--no-deblock (x264)

-flags -loop (FFMPEG), This parameter disables the loop filter for encoding. The default value is -flags +loop (enable loop filter).

--deblock <alpha:beta>(x264)

-deblockalpha <integer>(FFMPEG)

-deblockbeta <integer>(FFMPEG), Deblocking filter is one of the major feature in h.264 and this parameter enables it, which helps in removing blocking artifacts. To enable this parameter, the configuration must have -flags +loop (enable loop filter).

Rate control:

--qp <integer>(x264)

-cqp <integer>(FFMPEG), This parameter gives constant quantizer mode. In reality, the quantizer value for B and I frames comes as different from P frames in this mode as well.

--bitrate <integer>(x264)

-b <integer>(FFMPEG), This parameter defines the bitrate mode and gives the target bitrate to the encoder to achieve. To achieve a target bitrate mentioned by this parameter, the user should use 2-pass mode.

--ratetol <float>(x264)

-bt <float>(FFMPEG), This parameter allows the variance of average bitrate.

--pass <1,2,3>(x264), This parameter is to define the pass in FFMPEG and should always be used with any target bitrate mentioned for given video sequence as -b <integer>.

--partitions <string>(x264) p8x8 , p4x4, p8x8, i8x8, i4x4

-partitions <string>(FFMPEG)

+partp8x8, +partp4x4, +partb8x8, +parti8x8, +parti4x4 This parameter helps in choosing the macrblock partition in h.264 for I, P and B macrblocks.

--weightb (x264)

-flags2 +wpred (FFMPEG), This parameter allows B frames to use weighted prediction for a given video sequence.

--me <dia,hex,umh,esa>(x264)

-me_method <epzs, hex, umh, full>(FFMPEG), These search methods are already explained in Section 4.1.2.1. This parameter enables different motion estimation methods in FFMPEG for a given video sequence.

--merange <integer>(x264)

-me_range <integer>(FFMPEG), This parameter controls the range for motion search.

--subme <integer>(x264)

-subq <integer>(FFMPEG), The function of this parameter is also described above. This parameter is to define the subpixel motion estimation mode[43]. This is the mode that defines where the user can use RDO for a given video sequence.

--mixed-refs (x264)

-flags2 +mixed_refs (FFMPEG), This parameter allows the p8x8 block to select different references for each p8x8 block.

Chapter 5

Experimental evaluation and the specific goals of this project

Who is IES Italia?

"A team of young experts in new technologies and digital solutions, ready to help with the development of business and to create the digital projects that fit your needs!"

With this sentence, IES Italia presents itself on the homepage of their website `www.ies-italia.it`, a brief but complete presentation that perfectly captures the spirit and the dedication of the company in the technology field.

The company is active in three different main areas:

- Development of platforms for digital content distribution as IPTV, smart TV, web portals and mobile applications, digital marketing and social networking
- Cloud Computing and integration of virtualization technologies
- Production, testing, roll-out, commissioning of GSM, UMTS, 4G data networks

Some of the company projects can be listed as:

- iES
  - *Maritime:* Multimedia content and services for the passengers,

communication solutions and business opportunities for navigation companies

- *Hospital-is:* A powerful tool to manage digital content and medical applications, in order to improve communication, comfort and efficiency.
- *iES-Web:* Advanced web platforms to develop websites and portals targeted to content delivery: streaming, widget, applications

- **Kiosk**: Multimedia touchscreen totems, info and promo content and digital signposting
- **iBeacons**: Bluetooth based micro-localization
- **Wi-fi**: Management and configuration of wireless architecture
- **Voice over IP**: Communication through calls and messaging within the network and outwards
- **Location based service**: Geolocation through smartphone, ibeacons configuration and NFC services
- **livereporter**: Solution that allows companies to broadcast live their event for corporate meetings, product presentations or for internal training
- **Sportube** (`http://sportube.tv`): Sport Web TV which broadcasts Sport Events, LIVE and On Demand
- **Mycujoo** (`https://new.mycujoo.tv`): Football web page which allows fans to watch, share and discover live football and on-demand highlights, goals and unique moments

In order to get a clear understanding about system set up for iES stream environment, various parameters and their values used for our different projects, iES system and Mycujoo, will be described in this chapter.

However a brief description of these project will be included to make clear the role of the streamer in each specific project.

5.1 iES system

iES is a concept designed to provide a turnkey mobile data and networking solution. It entails the it includes elements from user experience to

backbone network and everything in between. To summarize, iES at a glance includes:

- Smart data traffic handling system
  - Intelligent handling of the satellite data stream to improve perceived quality and improve effective bandwidth usage
- WiFi network for passengers and crew with user access differentiation
- Mobile marketing and Infotainment for any device such as mobile devices as well as for fixed screens
- OTT services to increase on board revenue generation for the customer. E.g. streaming of video(VOD), TV and music, buying Internet access, chatting with other people on board.

5.1.1 iES front-end and back-end systems

Front end systems
The front end systems are the User Interface (UI) on any terminal where a user interact with the iES services. The UI is made in a responsive design which has the ability to deliver great experiences on every mobile screen and terminal.

The iES system is available to the end user on different interfaces which are described briefly below:

- Web portal
- Applications (mobile device)
- Public Screen
- Cabin TV screen

Web portal for user
The web portal for user enables access to iES for users who have not installed an iES application. The portal will give access to all the same features that the iES application would. This portal will be available on all types of web browsers.
As an end user:

- I will be redirected to the IES ship portal as the default web page in my browser when I first attach my device on the iES wifi network or by typing the URL address in the browser.

- I can check which TV channels, Music play lists and video on demands which are available for viewing.
- I can register and provide name, mail address, password and phone number to my profile.
- When logged in, I can add credits (money) to my iES account by online purchase or voucher pin code from cashier or scratch card.
- I can log in and buy access to content such as TV and music streaming by purchasing a selected package, lasting for the whole trip. I can access latest headline news as part of package.
- I can play an online game in the browser.
- I can change the language of the portal to one of the available languages and I will find that the language I have chosen is remembered in the system the next time I sign in.
- I can check how much money I have in my account (balance).
- I can buy access to the Internet, as separate packages independently from the iES services packages.
- I can download the IES app to my android or IOS device.

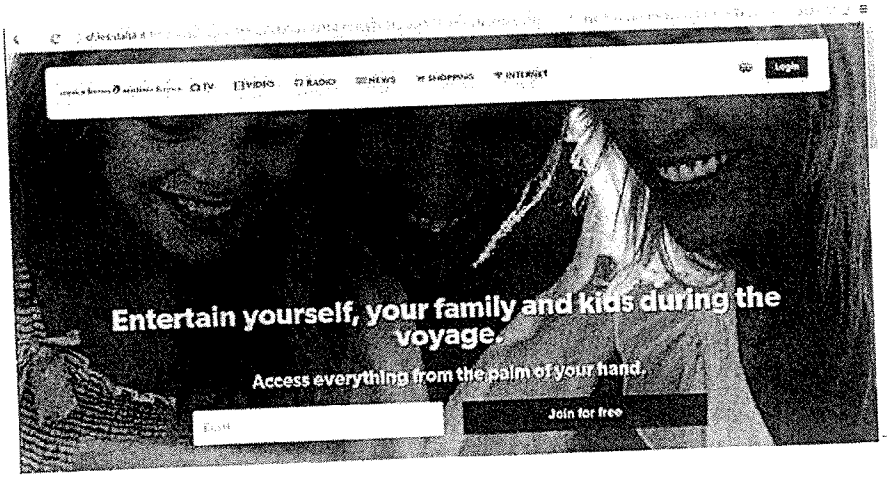


Figure 5.1. iES Web portal



Figure 5.2. iES Web portal - Web TV

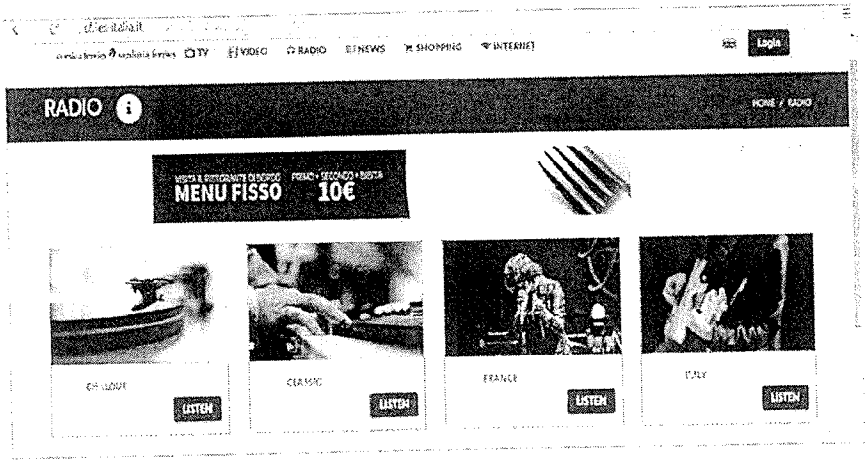


Figure 5.3. iES Web portal - Web Radio

Web portal for iES manager

The web portal for IES manager is the interface for managing all aspects of iES on a given vessel or hospital, such as, but not limited to, control of TV screens; video, audio and text advertisement, TV and music play lists, and user handling.

As an administrator I can:

- log in to the manager through a web browser when my device is connected to the iES Wi-Fi network by entering the URL in the browser and inserting user name and password

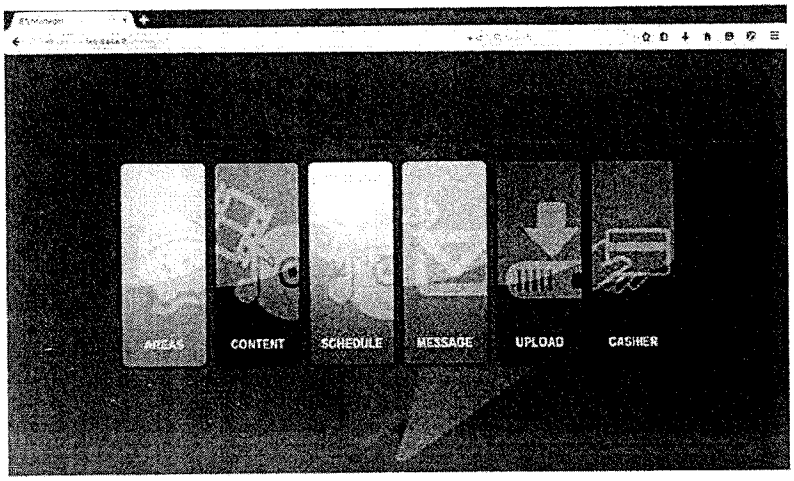


Figure 5.4. iES manager home page

- handle the onboard public TV screens individually
- handle all the onboard public TV screens in a specific area of the ship at the same time
- Turn off/on monitor
- Reboot iES client monitor
- Toggle between TV in full screen and iES screen with defined smaller TV displayed
- Change the volume
- Change TV channel

- Run video, audio, video spots, audio spots, as play list, for all public screens or selected ones
- Take snapshot to get an idea about status of screen

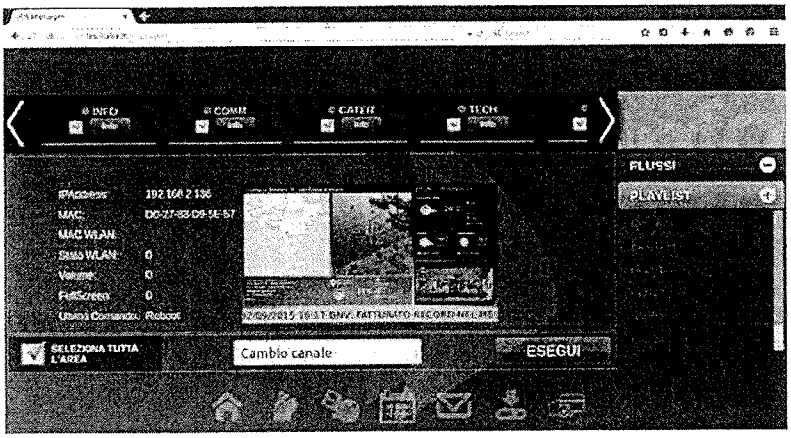


Figure 5.5. iES manager, Control Public screen

- Schedule to run play lists at certain time, in certain area with certain volume

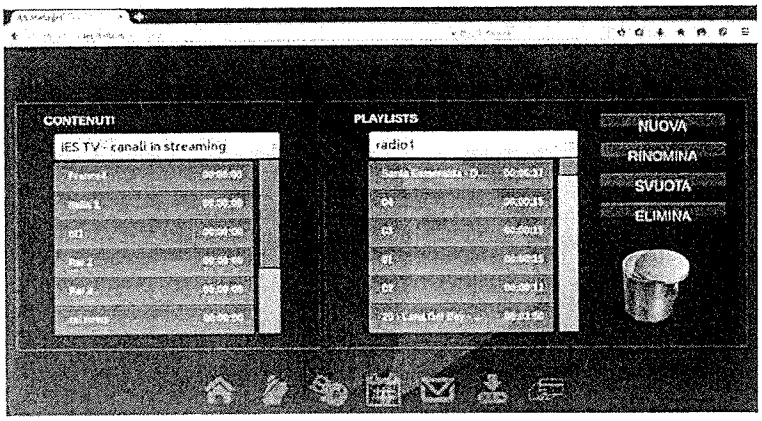


Figure 5.6. iES manager, manage content and playlist

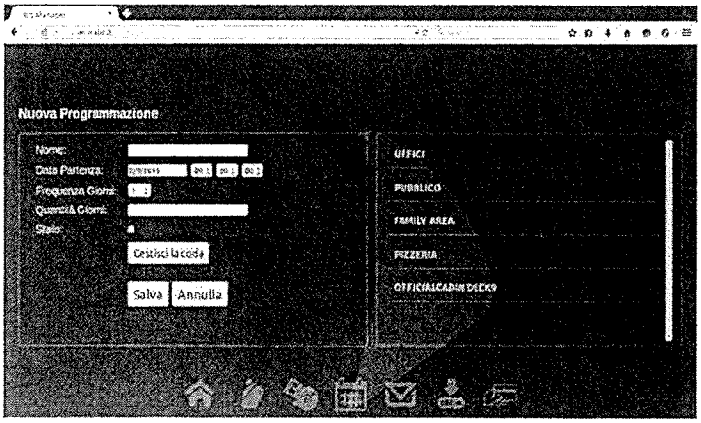


Figure 5.7. iES manager, scheduling playlists

- Send video, audio or text messages to all or some public screens
- Send text message to all devices which are on the ship
- Send text message to all devices which are in a certain area of the ship

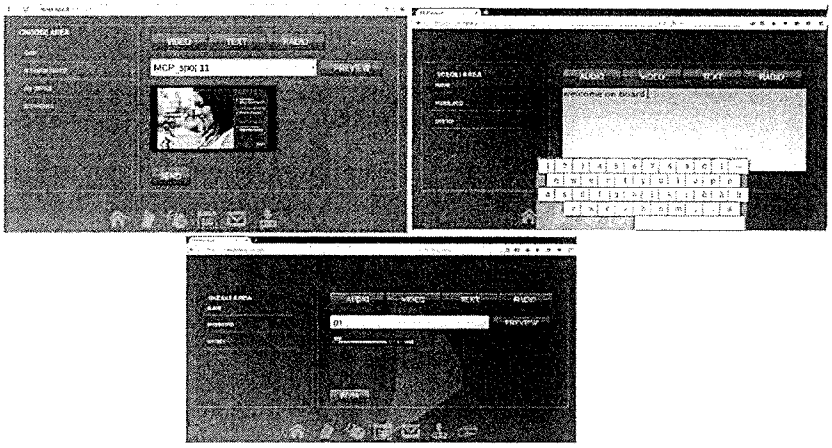


Figure 5.8. iES manager, Audio, video, text and radio messages

- Upload video/audio content (To be used in playlists or as advertisments)

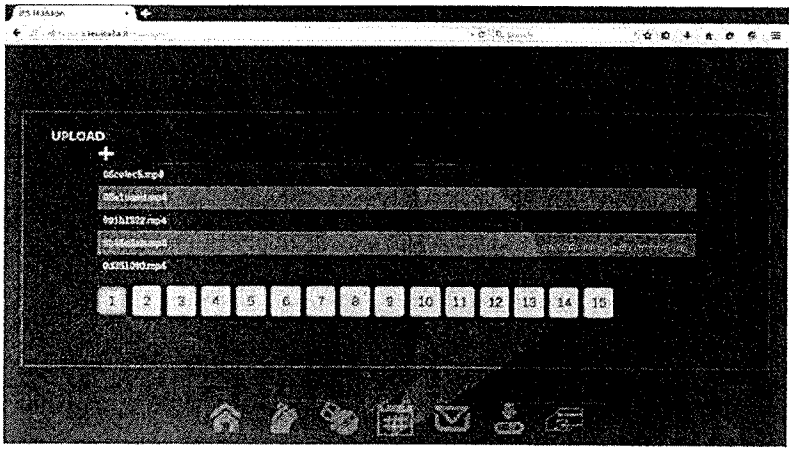


Figure 5.9. iES manager, Upload contents

Applications

The IES front end applications are the user interface (UI) for the Android devices, iOS devices. The IES app. provides the same functionality as the web portal plus iES IPTV application.



Figure 5.10. iES Web portal - Web TV

Cabin screen This consists of the application running on the android net-top boxes that are connected to cabin TV screens, using HDMI port. As an end user in a ship cabin I can:

- check which services and offers are available and buy wanted package.
- check which TV channels are available.
- register and provide name, e-mail, password and phone number to my profile.
- add credits (money) to my IES account, by online purchase or voucher pin code from cashier or scratch card.
- buy access to content such as TV and music streaming, by purchasing a selected package, lasting for the whole trip.
- access latest headline news as part of package.
- change the language of the cabin TV interface to one of the available languages. The language I have chosen is remembered in the system for the next time I sign in.
- check how much credit I have in my account (balance).

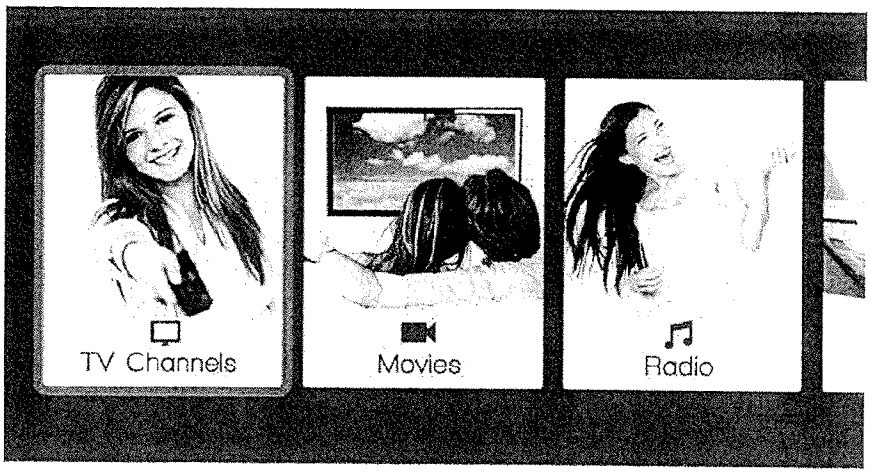


Figure 5.11. iES cabin - Select desired activity



Figure 5.12. iES cabin - VOD

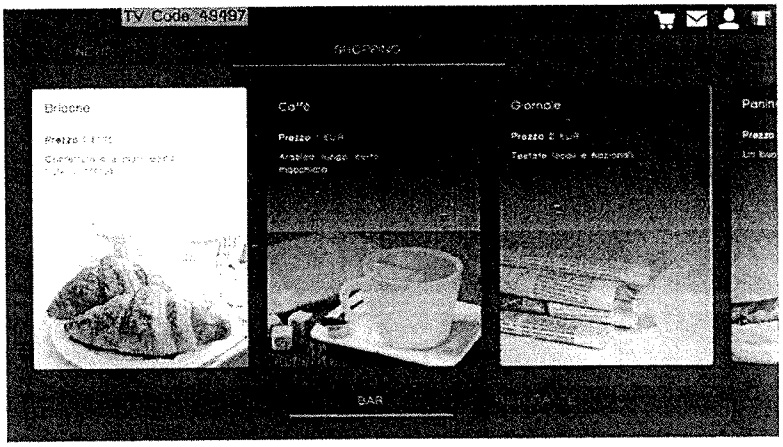


Figure 5.13. iES cabin - Shopping

Real time interactive digital signage
This consists of the application running on the android net-top boxes that are connected to the public TV screens.
As an end user:

- I will see TV screens in public areas with content such as video/TV, weather information, news sticker, ship routing and advertisement.
- I will not be able to change the content, layout or volume on the public screen.



Figure 5.14. iES Public Screen

Back end system
Net-top boxes
This includes choice, and integration of android net-top box hardware. The NTB provides powerful facilities to help to design, structure, and control sophisticated and effective content display.

5.1.2 Server and system design and development

The base server for iES is the heart of the iES system. It handles the integration of 3rd party systems, access points and access control, net-top boxes, payment system, streaming and etc.

– Integration of 3rd party systems

– AppearTV DVBS decoder [44]
This is the system for handling the satellite TV signals as row input of the system. After receiving the satellite TV signals, AppearTV sends them as MPEGTS files to the base Server, as a stream broadcaster on public screens, and Encoder for TV broadcasting on laptops and smart devices.

– Ruckus Access controller and Access points [45]
This is the system for Wi-Fi access, Internet access and device tracking.

– Remote controls
The remote controls are used with the net-top boxes used with cabin TV

under the server and status of ram and disk usage, Tx/Rx of the server and etc.) as soon as it is requested by twisted. These requests and commands can be sent to each single server as well as a group or sub group of the servers.

Exploiting WEBSOCKET [56] over TWISTED, this server serves the public screens all the other contents like weather information, news and advertisements.

Server-Sent Event (SSE) [57] [58] over WebSocket implemented in iES System as push protocol, is a good choice as it is HTTP based API (Application programming interface) [59] dedicated to push, it is implemented in recent browsers (Firefox, Chrome, Safari & Opera) and allows the server to send data to client (one way communication).

IAC (Internet Access Controller) Server

This server presents the iES hotspot as public access point for Internet access.

- When a passenger connects to the visible iES wi-fi network, the IAC DHCP server assigns him an IP and redirects him to the iES web portal, where the passenger can decide to be entertained by package which are ready on iES web portal or iES applications or buy Internet connection or both.

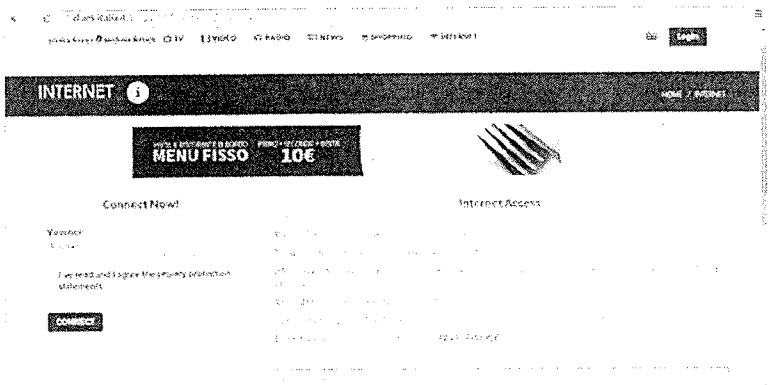


Figure 5.19. iES Web portal – Internet access

- In the current iES system availabel on the ships, passengers can refer to the ship hostess to buy Internet voucher or simply buy it online via iES web portal.

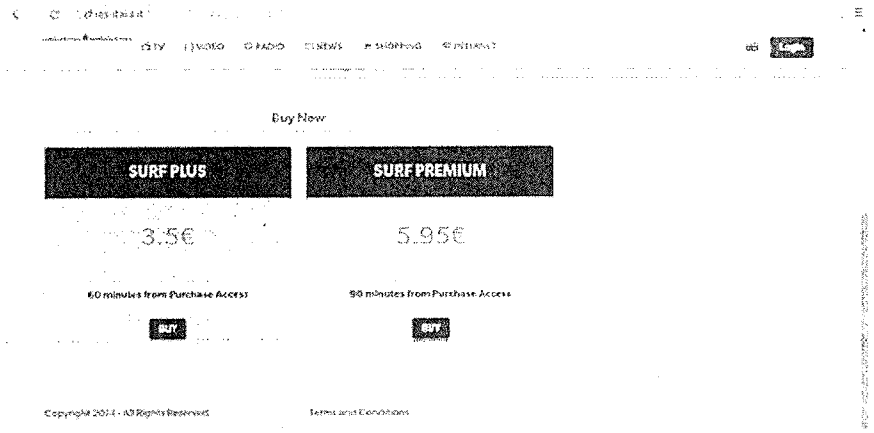


Figure 5.20. iES Web portal – Internet purchase

- IAC server exploits web2py open source framework [60] to generate needed API, to let the ship hostess to sell Internet and maritime Sim cards and charging with money Sim cards easily using a simple Grafic User Interface (GUI).

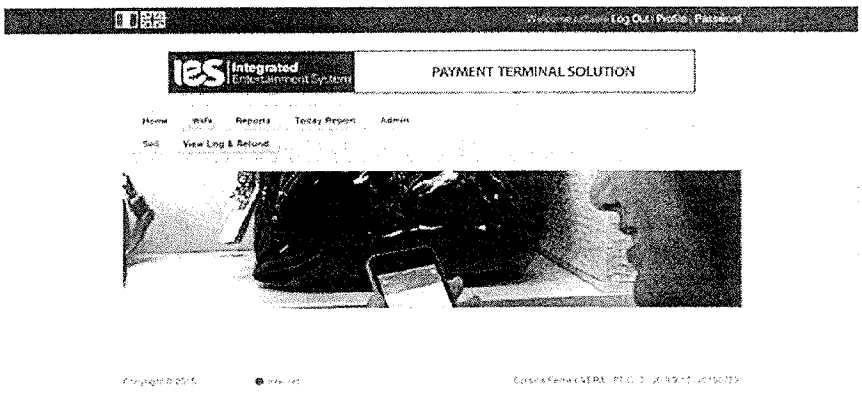


Figure 5.21. iES Payment terminal used by hostess

- By setting up MySQL [61], FreeRadius [62], CoovaChilli [63] and Squid [64], IAC server builds a Captive Portal Hotspot.

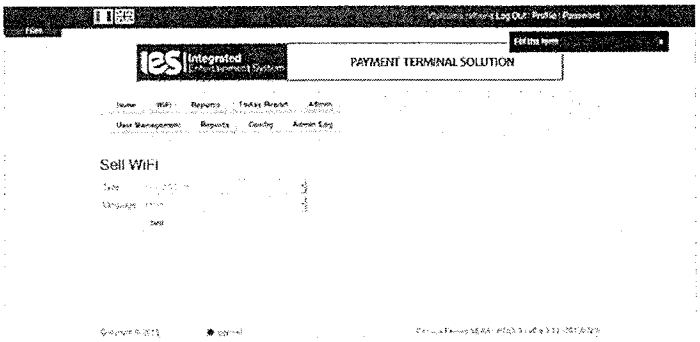


Figure 5.22. iES Payment terminal - sell WiFi

ADS (Advertisement) Server
This server exploits Revive Adserver [65] to send advertisements on public screens, web portal and applications.

IESonBoard (Web Portal Server)
This server is the host of both iES web portal and iES manager webpage. It exploits NGINX web server, which is an open source reverse proxy server for HTTP and HTTPS, as well as a load balancer.

Encoded TV stream, Video and Audio which are streamed toward smart devices and laptops are all managed by NGINX web server. Besides, this server exploits Web2py API platform, to manage full functionality between front-end and back-end.

5.2 Mycujoo

Mycujoo (`https://new.mycujoo.tv/`) as it explains in its landing Web page, democratizes football broadcasting. Fans can watch, interact with and support their favorite football TV while clubs, leagues and federations can easily produce, distribute and monetize their content. The project expects for people to register, watch and broadcast, when they land.

5.2.1 Mycujoo front-end system

Front end systems
Mycujoo is available to the end user over web portal which includes three main categories which are Watch, Support and GoLive.

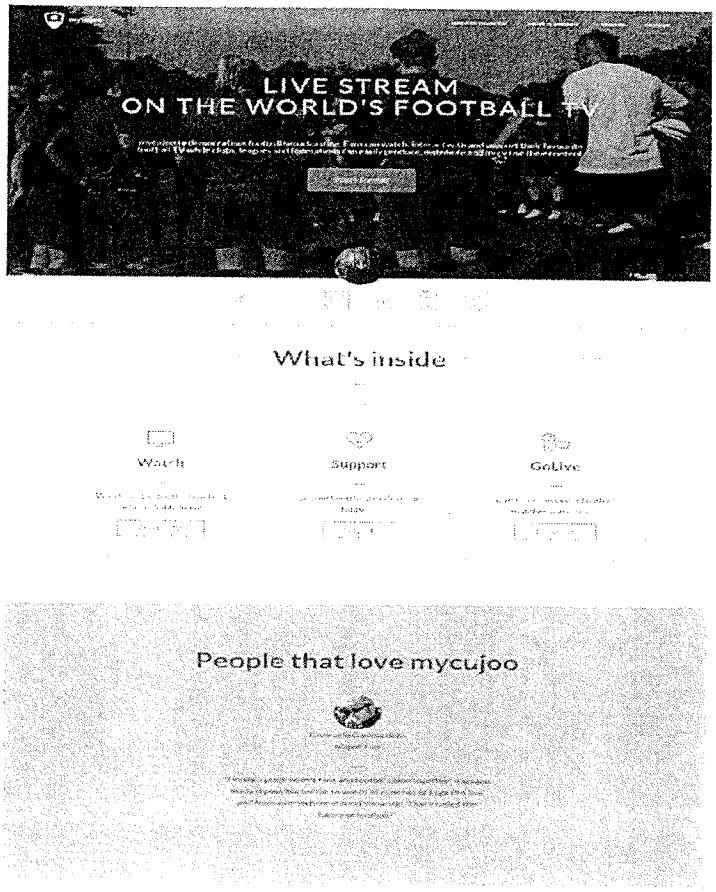


Figure 5.23. Mycujoo

Watch category means that as an end user I can:

- watch live and on demand football related events
- comment and like these videos and events
- create playlists
- share goal celebrations on the wall of the fans
- follow friends, favorite clubs and TVs

Support category means that as an end user I:

- can support my favorite TV

- have access to the selected content 48 hours before others
- can become a part of football broadcasting democratization
- can send private messages to the TV

GoLive category means that as an end user I can:

- upload my content into the platform
- start monetizing my content via Mycujoo ads and supporting tools
- track my followers with my own dedicated analytics system
- broadcast my live events
- personalize my TV and have my sponsors
- embed my TV over my website
- publish me as a camera man and monetize, also help the teams in my area to produce their live content

In fact those who get "GoLive" package on their TV, they become mycujoo partners So they get space for more sponsers and make full match vod category available for free to their viewers.

An unregistered user basically can navigate around the platform but cannot interact, means that he is not blocked by subcription and can watch all the available videos and live events.

A registred user can:

- comment and like videos
- write and post on the fan wall
- follow users and TV's, and this way have a feed, have a playlist and etc
- create a TV
- create amazing playlist for his videos on demand and and share it with his friends
- get notifications of when his team is playing, or the teams he follows have live events
- get access to an exclusive inbox that will give him a feed of what is happening in the platform and will allow him to change messages between his friends and other users



Figure 5.24. Mycujoo home page

- publish himself as a camera man and monetize, meanwhile helping the teams in his area to produce their live content

A Mycujoo supporter, will get all the previous features plus:

- get an exclusive VIP Badge
- get early access to new features
- get access to 10 channels and their exclusive content (such as interviews, trainings, press conferences) as a subscriber
- get the space for more sponsors
- make full match VOD category available for free to his viewers

However what we really are interested in discussing in this thesis are Live events and Camera man sections which are essentially based on stream encoding as the live content must be distributed through Internet.

Live events are another important feature of Mycujoo TV settings. This is where the user can trigger the live broadcasts from external sources and manage them.



Figure 5.25. Mycujoo – Live events

On the other side, for those who create a TV and activate GoLive option, there is an option to have their on Camera man and broadcast live events on their TV. The camera man should have all hardware tools to produce a live broadcast, or agree about this with the club.

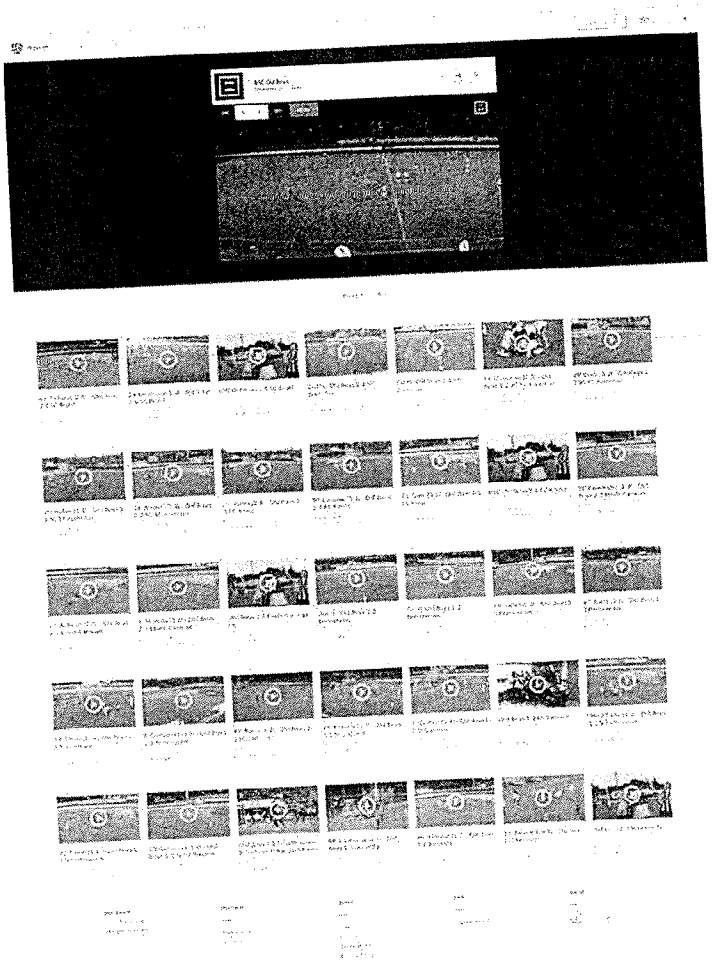


Figure 5.26. Mycujoo – A running live event

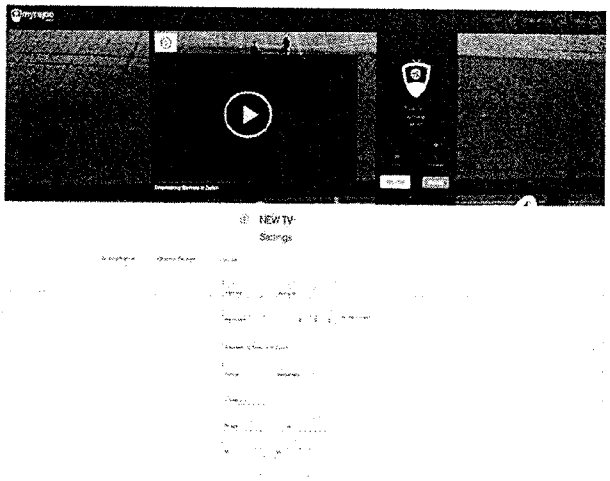


Figure 5.27. Mycujoo – TV Information



Figure 5.28. Mycujoo – Channel setting

Electronic Acknowledgement Receipt

EFS ID:	41994224
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Customer Number:	149890
Filer:	Joseph Teja/Holly Johnson
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US04
Receipt Date:	23-FEB-2021
Filing Date:	05-JAN-2021
Time Stamp:	12:50:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	SGIC001US04_SB08_02_23-2021.pdf	1054752 5d3fd34fb278dfd20afb998c95eefd9913394b05	no	8

Warnings:

Information:					
2	Other Reference-Patent/App/Search documents	SGIC-001WO01_ISR_WO_mailed_10-30-2019.pdf	1289909 748ecd87695bab2a7c3883d9735db53377879a7d	no	18
Warnings:					
Information:					
3	Other Reference-Patent/App/Search documents	SGIC-002WO01_ISR_WO_mailed_08-06-2018_QC.pdf	2440064 eae8d55d048d6a8670866f1c1a8f6e21f95f8ddb	no	28
Warnings:					
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4	Non Patent Literature	HASHEMIZADEHNAEINI_Thesis_2015_QC.pdf	6279626 e0a0021144b09fc8cfd8cb8917f304c45142117d	no	100
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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 a 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.

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04	5760

149890 7590 03/04/2021

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

EXAMINER	

ART UNIT	PAPER NUMBER
2457	

NOTIFICATION DATE	DELIVERY MODE
03/04/2021	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):

docketing@smithbaluch.com
eofficeaction@appcoll.com
smith@smithbaluch.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 17/141,631	**Applicant(s)** APRIL et al.	
	Examiner APRIL M WISE	**Art Unit** OPET	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 05 January 2021 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to undersigned at (571)272-1642.

In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/APRIL M WISE/ Paralegal Specialist, Office of Petitions	

To: docketing@smithbaluch.com,smith@smithbaluch.com,eofficeaction@appcoll.com
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
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Mar 06, 2021 09:46:58 AM

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Application	Document	Mailroom Date	Attorney Docket No.
17141631	TRACK1.GRANT	03/04/2021	SGIC-001US04

To view your correspondence online or update your email addresses, please visit us anytime at https://sportal.uspto.gov/secure/myportal/privatepair.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04	5760

149890 7590 04/13/2021

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

EXAMINER	
CHEN, CAI Y	

ART UNIT	PAPER NUMBER
2425	

NOTIFICATION DATE	DELIVERY MODE
04/13/2021	ELECTRONIC

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Office Action Summary	Application No. 17/141,631	Applicant(s) APRIL et al.	
	Examiner CAI Y CHEN	Art Unit 2425	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 01/05/2021.

☐ 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) 1-30 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) 1-30 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 01/05/2021 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 02/23/2021.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

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

Double Patenting

3. 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 claims at issue 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); and *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 a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit http://www.uspto.gov/forms/. The filing date of the application will determine what form 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

http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

4. Claims 1-20 are provisionally rejected on the ground of nonstatutory double patenting as being unpatentable over claims 15-34 of copending Application No. 17/027,219 (or '219) in view of the following reasons.

This is a provisional nonstatutory double patenting rejection.

Regarding claim 1, this claim is same as claim 2 of the '219, except the slight modification is the first event information is further defined to include the online gaming information.

As for claim 2, this claim is similar to claim 6 of the '219.

For claim 4, this claim is at least meets the same feature of claim 7 of the '219.

As for claim 5, this claim is called for in claim 8 of the '219.

For claim 6, this claim is same as claim 9 of the '219.

As for claims 7, this claim is same as claim 10 of the '219.

For claim 8, this claim is same as claim 11 of the '219.

As for claim 9, this claim is same as claim 12 of the '219.

For claim 10, this claim is derived from claim 13 of the '219.

For claim 11, this claim is similar as claim 14 of the '219.

Regarding claim 12, this claim is same as claim 15 of the '219, except the slight modification is the first event information is further defined to include the online gaming information.

Allowable Subject Matter

Claim 1-30 are allowed.

The following is a statement of reasons for the indication of allowable subject matter:

Regarding claim 1 and its dependents, the art of record either alone or in combination fails to particular disclose or suggest the claim when considered as whole and particularly the concept of claim limitation "A) a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one Webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information."

As to the art of record, Bocharov reference discloses of concept of streaming program content to user's device. However, Bocharov does not teach with respect to the entire or combination claim limitation of "a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one Webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information."

As to the art of record, DeWeese reference discloses of concept of streaming horse race program content and betting information to user's device. However, DeWeese does not teach with respect to the entire or combination claim limitation of "a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device,

wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one Webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information."

As to the art of record, Shoff reference discloses of concept of providing the program information and its supplemental information to the user via two interface. However, Shoff does not teach with respect to the entire or combination claim limitation of "a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one Webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information."

Regarding claim 12 and its dependents, the art of record either alone or in combination fails to particular disclose or suggest the claim when considered as whole and particularly the concept of claim limitation "A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel between at least one media source and the first client device, wherein the first video communication channel is different than the first event information communication channel."

As to the art of record, Bocharov reference discloses of concept of streaming program content to user's device. However, Bocharov does not teach with respect to the entire or combination claim limitation of "A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel

between at least one media source and the first client device, wherein the first video communication channel is different than the first event information communication channel."

As to the art of record, DeWeese reference discloses of concept of streaming horse race program content and betting information to user's device. However, DeWeese does not teach with respect to the entire or combination claim limitation of "A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel between at least one media source and the first client device, wherein the first video communication channel is different than the first event information communication channel."

As to the art of record, Shoff reference discloses of concept of providing the program information and its supplemental information to the user via two interface. However, Shoff does not teach with respect to the entire or combination claim limitation of "A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel between at least one media source and the first client device,

wherein the first video communication channel is different than the first event information communication channel."

Regarding claim 21 and its dependents, the art of record either alone or in combination fails to particular disclose or suggest the claim when considered as whole and particularly the concept of claim limitation "A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to: receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event; render, on the at least one first display of the first client device, the first video relating to the first sporting event based on the first digital content received on the first communication channel; receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel."

As to the art of record, Bocharov reference discloses of concept of streaming program content to user's device. However, Bocharov does not teach with respect to the entire or combination claim limitation of "A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to: receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event; render, on the at least one first display of the first client device, the first video relating to the first sporting event

based on the first digital content received on the first communication channel; receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel."

As to the art of record, DeWeese reference discloses of concept of streaming horse race program content and betting information to user's device. However, DeWeese does not teach with respect to the entire or combination claim limitation of "A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to: receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event; render, on the at least one first display of the first client device, the first video relating to the first sporting event based on the first digital content received on the first communication channel; receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel."

As to the art of record, Shoff reference discloses of concept of providing the program information and its supplemental information to the user via two interface. However, Shoff does not teach with respect to the entire or combination claim limitation of "A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first

client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to: receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event; render, on the at least one first display of the first client device, the first video relating to the first sporting event based on the first digital content received on the first communication channel; receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CAI Y CHEN whose telephone number is (571)270-5679. The examiner can normally be reached on 8:30 AM -4:30 PM.

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, Brian Pendleton can be reached on 571-272-7527. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-

my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CAI Y CHEN/
Primary Examiner, Art Unit 2425

Notice of References Cited	Application/Control No. 17/141,631	Applicant(s)/Patent Under Reexamination APRIL et al.	
	Examiner CAI Y CHEN	Art Unit 2425	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20110086144-A1	04-2011	Arampongpun; Narun	A23G9/26	426/250
*	B	US-20010001160-A1	05-2001	Shoff, Daniel J.	H04N5/44543	725/51
*	C	US-20010039209-A1	11-2001	DeWeese, Toby	G07F17/3288	463/40
	D					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
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NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

✓	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	04/09/2021								
	1	✓								
	2	✓								
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	4	✓								
	5	✓								
	6	✓								
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	29	✓								
	30	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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Search Notes		
Search Notes	Date	Examiner
The inventors searches are performed in East and Edan	04/09/2021	CC
CPC H04L65/60; H04N21/2343; 21/4316; 21/4768; and 21/6125 are text searched	04/09/2021	CC

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	65/60	04/09/2021	CC
H04N	21/2343; 4316; 4768; and 6125	04/09/2021	CC

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	91,916	(H04L65/60.cpc. or H04N21/4316.cpc. or H04N21/2343.cpc. or H04N21/4788.cpc. or H04N21/6125.cpc.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:21
L4	2,521	(sport or gam$3) with (addition$2 or supplement$2) and 3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:22
L7	47	(sport$3 near3 (event or venue or gam$3)) same (internet near5 channel) and 3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:25
L8	1	(internet or url or browser) with ((gam$3 information or betting) with sport) and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:29
L9	29	((gambl$3 information or betting or casino) with sport) and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:29
L12	88	((online gam$3 or gambl$3 or betting)) with (sport) and 3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:32

L13	51	(synchron$5 or sync) and 12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:33
L14	6	(event identifier or event ID or event channel) with (internet address or url) and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:34
L16	192,355	(sport or gam$3) with (addition$2 or supplement$2) and "15"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:35
L21	8	(gambl$3 information or betting or casino) with (sport near4 (event or live)) and 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/09 00:38
S6	78	("20130222597" | "8341662" | "8595186" | "20110090960" | "20160360261" | "20170188054" | "9288278" | "20080168493" | "20090222754" | "20130227596" | "8874778" | "9055271" | "9106934" | "9251852" | "9654844" | "9706443" | "8549574" | "20140129680" | "20160249108" | "9149682" | "9509793" | "9591054" | "9516390" | "9692800").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/06 23:16
S11	7	(url) and shoff.in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/07 12:45
S12	9	deweese.in. and racetrack	US-PGPUB; USPAT; USOCR; FPRS; EPO;	ADJ	ON	2021/04/07 12:46

			JPO; DERWENT; IBM_TDB			
S13	11	("April-Kevin.in" or Azuolas-Peter.in. or Schupak-Philip.in. or Silston-Brian.in.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/08 14:54
S14	15	(April-Kevin.in. or Azuolas-Peter.in. or Schupak-Philip.in. or Silston-Brian.in.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/04/08 14:54

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L15	13,212	(H04L65/60.cpc. or H04N21/4316.cpc. or H04N21/2343.cpc. or H04N21/4788.cpc. or H04N21/6125.cpc.)	USPAT	ADJ	ON	2021/04/09 00:35
L17	1,011	(sport or gam$3) with (addition$2 or supplement$2) and 15	USPAT	ADJ	ON	2021/04/09 00:35
L18	2	(sport$3 near3 (event or venue or gam$3)) same (internet near5 channel) and 17	USPAT	ADJ	ON	2021/04/09 00:35
L19	9	((online gam$3 or gambl$3 or betting)) with (sport) and 17	USPAT	ADJ	ON	2021/04/09 00:36
L20	4	((gambl$3 information or betting or casino) with sport) and 17	USPAT	ADJ	ON	2021/04/09 00:36

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	17141631
Filing Date	2021-01-05
First Named Inventor	Kevin APRIL
Art Unit	
Examiner Name	
Attorney Docket Number	SGIC-001US04

U.S.PATENTS Remove

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
	1	10425697	B2	2019-09-24	Schupak et al.	Entire Document
	2	10805687	B2	2020-10-13	April et al.	Entire Document
	3	6434621	B1	2002-08-13	Pezzillo et al.	Entire Document
	4	8128503	B1	2012-03-06	Haot et al.	Entire Document
	5	8341662	B1	2012-12-25	Bassett et al.	Entire Document
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	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	9	9055271	B2	2015-06-09	Verna et al.	Entire Document
	10	9106934	B2	2015-08-11	Horen et al.	Entire Document
	11	9149682	B2	2015-10-06	Dornbush et al.	Entire Document
	12	9251852	B2	2016-02-02	Burns	Entire Document
	13	9288278	B2	2016-03-15	Panje et al.	Entire Document
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	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	20	9692800	B2	2017-06-27	Gaunt et al.	Entire Document
	21	9706443	B2	2017-07-11	Oyman et al.	Entire Document

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040003101	A1	2004-01-01	Roth et al.	Entire Document
	2	20080022347	A1	2008-01-24	Cohen	Entire Document
	3	20080062318	A1	2008-03-13	Ellis et al.	Entire Document
	4	20080168493	A1	2008-07-10	Allen et al.	Entire Document
	5	20090222754	A1	2009-09-03	Phillips et al.	Entire Document
	6	20100299703	A1	2010-11-25	Altman	Entire Document
	7	20110083144	A1	2011-04-07	Bocharov et al.	Entire Document

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	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	8	20110090960	A1	2011-04-21	Leontaris et al.	Entire Document
	9	20110280540	A1	2011-11-17	Woodman	Entire Document
	10	20130222597	A1	2013-08-29	Brink et al.	Entire Document
	11	20130227596	A1	2013-08-29	Pettis et al.	Entire Document
	12	20140129680	A1	2014-05-08	Mukherjee	Entire Document
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	14	20160037215	A1	2016-02-04	Cardona	Entire Document
	15	20160249108	A1	2016-08-25	SEXTON	Entire Document
	16	20160360261	A1	2016-12-08	Makhlouf	Entire Document
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	First Named Inventor	Kevin APRIL
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	Examiner Name	
	Attorney Docket Number	SGIC-001US04

	19	20170188054	A1	2017-06-29	Ma et al.	Entire Document	
	20	20200162796	A1	2020-05-21	AZUOLAS et al.	Entire Document	

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	1	HASHEMIZADEHNAEINI, Transcoding H.264 Video via FFMPEG encoder. Corso di Laurea Magistrale in Ingegneria delle Telecomunicazioni POLITECNICO DI MILANO. Thesis, 2015, p. 1-100	
	2	International Search Report and Written Opinion in International Patent Application No.: PCT/US2017/045801 mailed October 30, 2019 (Atty. Docket No.: SGIC-001WO01), 18 pages.	
	3	International Search Report and Written Opinion in International Patent Application No.: PCT/US2018/033016 mailed August 6, 2018 (Atty. Docket No.: SGIC-002WO01), 29 pages.	

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	Examiner Name	
	Attorney Docket Number	SGIC-001US04

[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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.Y.C/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 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).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

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	/Joseph Teja, Jr./	Date (YYYY-MM-DD)	2021-02-23
Name/Print	Joseph Teja, Jr.	Registration Number	45157

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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Bibliographic Data

Application No: 17/141,631

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CAI Y CHEN/ (Examiner's Signature) | (Initials)

Title: SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/05/2021	709	2425	SGIC-001US04
RULE			

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CONTINUING DATA

This application is a CON of 17027219 09/21/2020

17027219 is a CON of 16580552 09/24/2019 PAT 10805687

16580552 is a CON of 16267887 02/05/2019 PAT 10425697

16267887 is a CON of PCT/US2017/045801 08/07/2017

PCT/US2017/045801 has PRO of 62518506 06/12/2017

PCT/US2017/045801 has PRO of 62485878 04/14/2017

PCT/US2017/045801 has PRO of 62435361 12/16/2016

PCT/US2017/045801 has PRO of 62371558 08/05/2016

FOREIGN APPLICATIONS

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02/12/2021

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STATE OR COUNTRY

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FILING FEE RECEIVED

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Application	Document	Mailroom Date	Attorney Docket No.
17141631	CTNF	04/13/2021	SGIC-001US04
	892	04/13/2021	SGIC-001US04
	1449	04/13/2021	SGIC-001US04

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed	PTO/SB/25 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION**
Application Number	17141631
Filing Date	05-Jan-2021
First Named Inventor	Kevin APRIL
Attorney Docket Number	SGIC-001US04
Title of Invention	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
SPORTSCASTR.LIVE LLC	100%

The owner(s) of percent interest listed above 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 any patent granted on pending reference Application Number(s)

17027219 filed on 09/21/2020

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◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○	I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.

Applicant claims the following fee status:

◉ Small Entity

○ Micro Entity

○ Regular Undiscounted

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

I certify, in accordance with 37 CFR 1.4(d)(4) that I am:

◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application

Registration Number 45157

○ A sole inventor

○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application

○ A joint inventor; all of whom are signing this request

Signature	/Joseph Teja, Jr./
Name	Joseph Teja, Jr.

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	17141631
Filing Date:	05-Jan-2021
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Filer:	Joseph Teja
Attorney Docket Number:	SGIC-001US04

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	2814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**170**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 17141631

Filing Date: 05-Jan-2021

Applicant/Patent under Reexamination: APRIL

Electronic Terminal Disclaimer filed on April 24, 2021

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

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Electronic Acknowledgement Receipt

EFS ID:	42543690
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Customer Number:	149890
Filer:	Joseph Teja
Filer Authorized By:	
Attorney Docket Number:	SGIC-001US04
Receipt Date:	24-APR-2021
Filing Date:	05-JAN-2021
Time Stamp:	13:13:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20214ND13461079
Deposit Account	
Authorized User	

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	34168 44fe087dd401809bddc3f1a14d64a364d12f2ad2	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30371 89fb915094d100f40823b8b6e2d9d9b3db38c50a	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	64539		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a 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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: APRIL et al.

Application No. 17/141,631

Filed: 2021-01-05

Confirmation No. 5760

Art Unit: 2425

Examiner: CHEN, Cai Y.

Title: SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

RESPONSE TO OFFICE ACTION

In response to the Office Action dated April 13, 2021, Applicant submits the following Remarks, and respectfully requests reconsideration of the application in view thereof.

A **Listing of the Claims** begins on page 2 of this paper. No claims are amended herein.

Remarks begin on page 12 of this paper.

IN THE CLAIMS:

Set forth below in ascending order, with status identifiers, is a complete listing of all claims currently under examination. Changes to any amended claims are indicated by [[double brackets]], ~~strikethrough~~, and/or underlining. This listing also reflects any cancellation and/or addition of claims.

1. (Original) A system for controlling a plurality of viewer client devices to receive first digital content relating to a first sporting event and first event information germane to the first sporting event, the first event information including online gaming information, the system comprising:

A) a control server to periodically retrieve, via the Internet, the first event information germane to the first sporting event;

B) at least one socket server communicatively coupled to the control server to:

receive from the control server at least the first event information; and

transmit at least some of the first event information, including the online gaming information, to at least a first viewer client device of the plurality of viewer client devices via a first event information Internet communication channel between a first event socket of the at least one socket server and the first viewer client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

C) at least one webserver communicatively coupled to the at least one socket server to transmit, to the first viewer client device:

a first Internet address of a first media source to establish a first video Internet communication channel between the first media source and the first viewer client device to carry the first digital content relating to the first sporting event; and

a first socket address of the first event socket to establish the first event information Internet communication channel to carry the online gaming information.

2. (Original) The system of claim 1, wherein the first socket address transmitted by the at least one webserver to the first viewer client device includes a first event identifier (first EventID) that corresponds to the first event socket, such that the first viewer client device uses a

first URL including the first event identifier (first EventID) in the first URL to connect to the first event socket.

3. (Original) The system of claim 1, wherein the first event information Internet communication channel to carry the online gaming information between the first event socket of the at least one socket server and the first viewer client device is established as a persistent connection.

4. (Original) The system of claim 1, wherein:

in C), the at least one webserver transmits, to a second viewer client device of the plurality of viewer client devices, the first socket address of the first event socket to establish a second event information Internet communication channel between the first event socket and the second viewer client device; and

in B), the at least one socket server transmits at least some of the first event information, including the online gaming information germane to the first sporting event, to the second viewer client device via the second event information Internet communication channel, such that the online gaming information is shared in a synchronized manner by the first viewer client device and the second viewer client device.

5. (Original) The system of claim 4, wherein the first socket address transmitted by the at least one webserver to the second viewer client device includes the first event identifier (first EventID) that corresponds to the first event socket, such that the second viewer client device uses a second URL including the first event identifier (first EventID) in the second URL to connect to the first event socket.

6. (Original) The system of claim 4, wherein in A), the control server is a single point of entry for the system to obtain the first event information including the online gaming information to reduce synchronization errors between the first viewer client device and the second viewer client device.

7. (Original) The system of claim 6, wherein:

in A), the control server detects a change in status in the first event information and transmits changes in the online gaming information to the at least one socket server; and

in B), the at least one socket server transmits the changes in the online gaming information to the first viewer client device and the second viewer client device via the first event socket to provide a single synchronized update and mitigate client-by-client latency and/or synchronization issues.

8. (Original) The system of claim 4, wherein in C), the at least one webserver transmits to the second viewer client device one of:

the first address of the first media source to establish a second video Internet communication channel between the first media source and the second viewer client device to receive the first digital content relating to the first sporting event; or

a second address of a second media source to establish an alternate second video Internet communication channel between the second media source and the second viewer client device to receive second digital content relating to the first sporting event.

9. (Original) The system of claim 8, wherein:

the second client device is a subscriber to one of:

the first media source and/or the first digital content relating to the first sporting event; or

the second media source and/or the second digital content relating to the first sporting event; and

in C), the at least one webserver transmits to the second viewer client device one of:

a first identifier (first StreamID) for the first media source and/or the first digital content as at least a portion of the first address if the second client device is a subscriber to the first media source and/or the first digital content; or

a second identifier (second StreamID) for the second media source and/or the second digital content as at least a portion of the second address if the second client device is a subscriber to the second media source and/or the second digital content.

10. (Original) The system of claim 1, wherein:

in B), the at least one socket server further transmits first real-time information relating to the first digital content to at least the first viewer client device of the first plurality of viewer client devices via a first real-time information Internet communication channel between a first real-time information socket of the at least one socket server and the first viewer client device, wherein the first real-time information socket corresponds to the first digital content relating to the first sporting event; and

in C), the at least one webserver transmits to the first viewer client device a second socket address of the first real-time information socket to establish the first real-time information Internet communication channel.

11. (Original) The system of claim 10, wherein the first real-time information relating to the first digital content comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first digital content;

at least one digital gift; and/or

at least one sponsorship.

12. (Original) A method for providing, to a first client device, first event information germane to a first sporting event, wherein the first event information includes first online gaming information relating to the first sporting event, the method comprising:

A) transmitting the first online gaming information to at least the first client device via a first event information communication channel between a first event socket of at least one socket server and the first client device, wherein the first event socket corresponds to the first event information germane to the first sporting event; and

B) transmitting at least one instruction to the first client device to cause the first client device to request a first copy of a first stream of digital content relating to the first sporting event and receive the first copy via a first video communication channel between at least one media source and the first client device, wherein the first video communication channel is different than the first event information communication channel.

13. (Original) The method of claim 12, wherein prior to A), the method comprises:

transmitting to the first client device a first event identifier (first Event ID) that corresponds to the first event socket;

receiving from the first client device a first URL including the first event identifier (first EventID) in the first URL; and

communicatively coupling the first client device to the first event socket to establish the first event information communication channel.

14. (Original) The method of claim 12, wherein in B), the at least one first instruction transmitted to the first client device includes a first address for the at least one media source, such that the first client device uses the first address to request and receive from the at least one media source the first copy of the first stream of digital content relating to the first sporting event via the first video communication channel, and displays the video relating to the first sporting event based on the received first copy of the first stream of digital content.

15. (Original) The method of claim 12, further comprising:

C) transferring first real-time information relating to the first stream of digital content to and from the first client device via a first real-time information communication channel between a first real-time information socket of the at least one socket server and the first client device, wherein the first real-time information comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first stream of digital content;

at least one digital gift; and/or

at least one sponsorship.

16. (Original) A method for controlling a first viewer client device to display a video relating to a first sporting event together with first online gaming information germane to the first sporting event, the method comprising:

A) transmitting at least one first instruction to the first viewer client device to cause the first viewer client device to receive a first copy of a first stream of digital content relating to the first sporting event via a first video communication channel; and

B) transmitting at least one second instruction to the first viewer client device to cause the first viewer client device to receive the first online gaming information via a first event information communication channel between a first event socket of at least one socket server and the first viewer client device, wherein the first event information communication channel is different than the first video communication channel.

17. (Original) The method of claim 16, wherein prior to A), the method comprises:

receiving from the first viewer client device a first user selection of the first sporting event from a listing of events;

transmitting to the first viewer client device, in response to the first user selection of the first sporting event, a directory of sources generating media associated with the first sporting event; and

receiving from the first viewer client device a second user selection of a first source from the directory of sources generating media associated with the first sporting event,

wherein in A), the at least one first instruction transmitted to the first viewer client device includes a first address for the first source.

18. (Original) The method of claim 16, wherein in A), the at least one first instruction transmitted to the first viewer client device includes a first address for a first media source, such

that the first viewer client device uses the first address to request and receive from the first media source the first copy of a first stream of digital content relating to the first sporting event via the first video communication channel, and displays the video relating to the first sporting event based on the received first copy of the first stream of digital content.

19. (Original) The method of claim 18, wherein in B), the at least one second instruction transmitted to the first viewer client device includes a first event identifier (first Event ID) that corresponds to the first event socket, such that the first viewer client device uses a first URL including the first event identifier (first EventID) in the first URL to connect to the first event socket.

20. (Original) The method of claim 19, further comprising:

C) receiving the first URL including the first event identifier in the first URL; and

D) establishing the first event information communication channel between the first event socket and the first viewer client device as a persistent connection.

21. (Original) A method, comprising:

A) transmitting first instructions to a first client device that includes at least one first display to cause the at least one first display of the first client device to render a first video relating to a first sporting event and render online gaming information relating to the first sporting event, wherein the first instructions transmitted in A) cause the first client device to:

receive, on a first communication channel, first digital content corresponding to the first video relating to the first sporting event;

render, on the at least one first display of the first client device, the first video relating to the first sporting event based on the first digital content received on the first communication channel;

receive, on a second communication channel different from the first communication channel, second digital content corresponding to the online gaming information; and

render, on the at least one first display of the first client device, the online gaming information based on the second digital content received on the second communication channel.

22. (Original) The method of claim 21, wherein in A), the first instructions transmitted to the first client device include a first address for a first media source, such that the first client device uses the first address to request and receive from the first media source the first digital content via the first video communication channel.

23. (Original) The method of claim 22, wherein in A), the first instructions transmitted to the first client device include a first event identifier (first Event ID) that corresponds to a source of the second digital content corresponding to the online gaming information.

24. (Original) The method of claim 23, further comprising:

B) receiving from the first client device a first URL including the first event identifier; and

C) establishing the second communication channel between the source of the second digital content and the first client device as a persistent connection based at least in part on B).

25. (Original) The method of claim 21, wherein in A), the first instructions transmitted to the first client device cause the at least one first display of the first client device to render the online gaming information relating to the first sporting event as interactive content.

26. (Original) The method of claim 25, wherein in A), the first instructions transmitted to the first client device cause the first client device, when a user of the first client device interacts with the interactive content, to:

launch further graphics or animations;

receive additional information about the first sporting event; and/or

navigate to an Internet location.

27. (Original) The method of claim 21, further comprising:

B) transmitting second instructions to a second client device that includes at least one second display to cause the at least one second display of the second client device to render the first video or a second video relating to the first sporting event and render the online gaming information relating to the first sporting event, wherein the second instructions transmitted in B) cause the second client device to:

receive, on a third communication channel, the first digital content corresponding to the first video relating to the first sporting event or third digital content corresponding to the second video relating to the first sporting event;

render, on the at least one second display of the second client device, the first video based on the first digital content or the second video based on the third digital content received on the third communication channel;

receive, on a fourth communication channel different from the third communication channel, the second digital content corresponding to the online gaming information; and

render, on the at least one second display of the second client device, the online gaming information based on the second digital content received on the fourth communication channel.

28. (Original) The method of claim 27, wherein in B), the second instructions transmitted to the second client device include the first address for the first media source or a second address for a second media source, such that the second client device uses the first address or the second address to request and receive the first digital content from the first media source or the third digital content from the second media source via the third video communication channel.

29. (Original) The method of claim 28, wherein in A), the second instructions transmitted to the second client device include the first event identifier (first Event ID) that corresponds to the source of the second digital content corresponding to the online gaming information.

30. (Original) The method of claim 27, further comprising:

C) transferring first real-time information relating to the first digital content to and from the first client device via a first real-time information communication channel; and

D) transferring second real-time information relating to the first digital content or the third digital content to and from the second client device via a second real-time information communication channel,

wherein at least one of the first real-time information or the second real-time information comprises:

at least one chat message;

at least one statistic;

trivia;

at least one poll;

news or current event information;

at least one photo;

advertising content;

an indication of a viewer joining or leaving the first digital content or the third digital content;

at least one digital gift; and/or

at least one sponsorship.

REMARKS

In response to the Office Action dated April 13, 2021 in the above-identified application, Applicant respectfully requests reconsideration. All of the issues raised in the Office Action have been carefully considered and are addressed in this response. The application as now presented is believed to be in allowable condition.

1. Status of the Claims and Summary of Amendments

Upon entry of this response, claims 1–30 will be pending in this application, of which claims 1, 12, 16 and 21 are independent claims. No claims are amended herein.

2. Allowed Claims

Applicant notes with appreciation that, on pages 3-11 of the Office Action, claims 1-30 are allowed.

3. Summary of Telephone Interview with Examiner

On or about April 15, 2021, Applicant's undersigned representative Joseph Teja, Jr. spoke with Examiner Chen by telephone to clarify the provisional non-statutory double patenting rejections set forth on page 3 of the Office Action. Examiner Chen clarified that the mention in numbered paragraph 4 of claims 15-34 of copending Application No. 17/027,219 was a typographical error, and that the claims at issue in the '219 application are correctly indicated in the ensuing paragraphs. Applicant appreciates the Examiner's clarification in this regard.

4. Nonstatutory Double Patenting Rejections

On page 3 of the Office Action, claims 1-20 are provisionally rejected on the ground of nonstatutory double patenting as being allegedly obvious over claims 2, 6-8 and 10-15 of copending Application No. 17/027,219. Applicant respectfully disagrees with these rejections. Without acceding to the propriety of these rejections, and solely to advance prosecution toward allowance, Applicant respectfully submits herewith a Terminal Disclaimer to obviate these rejections.

CONCLUSION

Applicant respectfully submits that the application is now in condition for allowance.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17, and 1.21 that may be required by this paper and to credit any overpayment, to Deposit Account No. 60-1876. If an extension of time is required to make this reply timely, please charge the appropriate extension of time fee under 37 C.F.R. § 1.17 to Deposit Account No. 60-1876 if not already paid via EFS.

Dated: April 24, 2021

Respectfully submitted,

Smith Baluch LLP
376 Boylston St, Suite 401
Boston MA 02116

Phone: 617-372-4547

By: /Joseph Teja, Jr./
Joseph Teja, Jr.
Registration No. 45,157

Electronic Acknowledgement Receipt

EFS ID:	42543692
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Customer Number:	149890
Filer:	Joseph Teja
Filer Authorized By:	
Attorney Docket Number:	SGIC-001US04
Receipt Date:	24-APR-2021
Filing Date:	05-JAN-2021
Time Stamp:	13:17:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		SGIC-001US04_Amendment_Reply_to_Office_Action_4-13-2021.pdf	6750978 182b52196ccf1f0adfaa58ed21c568914dec5651	yes	13

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	11
	Applicant Arguments/Remarks Made in an Amendment	12	13
Warnings:			
Information:			
	Total Files Size (in bytes):	6750978	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a 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.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. 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 displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 17/141,631	Filing Date 01/05/2021	☐ 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 $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $240 =	
☐ 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	04/24/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		x $240 =	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".	/PEGGY S YARBOROUGH/
*** 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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17141631
Filing Date	2021-01-05
First Named Inventor	Kevin APRIL
Art Unit	2425
Examiner Name	CHEN, Cai, Y.
Attorney Docket Number	SGIC-001US04

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
	1	10484743	B2	2019-11-19	Cox	Entire Document
	2	10740305	B2	2020-08-11	Barthel et al.	Entire Document
	3	10848792	B2	2020-11-24	Evans	Entire Document

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

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

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

If you wish to add additional Foreign Patent Document citation information please click the Add button

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]
	*	Analyze & Optimize. Maestro 2020. Accessed at https://info.maestro.io/analyze-and-optimize on April 21, 2021. 3 pages.	☐
	*	Around-the-clock action for you sportsbook. BetGenius Brochure. Accessed at https://geniussports.com/sportsbook/content/streaming/ on March 19, 2021. 1 page.	☐
	*	Betradar Live Streaming Brochure 2021. Accessed at https://www.betradar.com/wp-content/uploads/sites/4/2014/11/Betradar-Live-Streaming-Brochure.pdf on April 29, 2021. 7 pages.	☐
	*	Betradar Product Brochure 2021. Accessed at https://www.betradar.com/wp-content/uploads/sites/4/2021/02/Betradar-Product-Brochure-2021.pdf on April 29, 2021. 24 pages.	☐
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	*	Customize & Control. Maestro 2020. Accessed at https://info.maestro.io/customize-and-control on April 21, 2021. 2 pages.	☐
	*	EMPSON, Baseball's Digital Trifecta and How America's Pastime is Setting the Pace for Sports Online. TechCrunch November 4, 2013. Accessed at https://techcrunch.com/2013/11/04/baseballs-digital-trifecta-and-how-americas-pastime-is-setting-the-pace-for-sports-online/. 10 pages.	☐
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

	*	Genius Sports Group Analyst Day Presentation January 2021. Accessed at https://s27.q4cdn.com/552951210/files/doc_downloads/GSG_Analyst_Day_Presentation_January_2021_vFF_2.pdf on April 29, 2021. 52 pages.	☐
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	*	PEREZ, MLB.com At Bat and NHL are first to Launch Personalized App Icons on iOS 10.3. TechCrunch March 28, 2017. Accessed at https://techcrunch.com/2017/03/28/mlb-com-at-bat-and-nhl-are-first-to-launch-personalized-app-icons-on-ios-10-3/. 5 pages.	☐
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	*	Sports Betting. Sportradar. Accessed at https://sportradar.us/betting-services/ on April 21, 2021. 4 pages.	☐
	*	WASHINGTON, Betgenius launches live streaming service for sportsbooks. Genius Sports October 8, 2019. Accessed at https://news.geniussports.com/betgenius-launches-live-streaming-service-for-sportsbooks/ on April 30, 2021. 5 pages.	☐
If you wish to add additional non-patent literature document citation information please click the Add button			

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*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.

* A copy of the reference is not provided pursuant to 37 C.F.R. §1.98(d) because the reference was previously cited and submitted to the Office in U.S. Patent Application Serial No.17/027,219 filed 9/21/2020, to which the above-identified application claims priority under 35 U.S.C. §120.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 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).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

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

☒ A certification statement is not submitted herewith.

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	/Joseph Teja, Jr./	Date (YYYY-MM-DD)	2021-05-03
Name/Print	Joseph Teja Jr.	Registration Number	45157

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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The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to 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)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	17141631
Filing Date:	05-Jan-2021
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Filer:	Joseph Teja/Holly Johnson
Attorney Docket Number:	SGIC-001US04

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	130	130
		Total in USD ($)		**130**

Electronic Acknowledgement Receipt

EFS ID:	42617768
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Customer Number:	149890
Filer:	Joseph Teja/Holly Johnson
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US04
Receipt Date:	03-MAY-2021
Filing Date:	05-JAN-2021
Time Stamp:	16:47:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$130
RAM confirmation Number	E202153G47233243
Deposit Account	
Authorized User	

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1	Information Disclosure Statement (IDS) Form (SB08)	SGIC001US04_SB08_04-30-2021.pdf	118696 078649b8738549c8e040ebbc407d70db8ac8d614	no	6
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
2	Fee Worksheet (SB06)	fee-info.pdf	30486 a63b0836bd5d656bea91fe2888afc3af01b87e01	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	149182		

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 a 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.

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

149890 7590 05/07/2021

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

EXAMINER
CHEN, CAI Y

ART UNIT	PAPER NUMBER
2425	

DATE MAILED: 05/07/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04	5760

TITLE OF INVENTION: SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	08/09/2021

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 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity 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 and an extra copy of the form should be submitted. 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 EFS-Web.

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 including the Patent, advance orders and notification of maintenance fees 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.

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

149890 7590 05/07/2021
SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

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 EFS-Web 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.
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04	5760

TITLE OF INVENTION: SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$600	$0.00	$0.00	$600	08/09/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHEN, CAI Y	2425	709-231000

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/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 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) ❑ Advance Order - # of Copies _____

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

❑ Electronic Payment via EFS-Web ❑ 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

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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.
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.
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. _____

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04	5760

149890 7590 05/07/2021

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
BOSTON, MA 02116

EXAMINER	
CHEN, CAI Y	
ART UNIT	**PAPER NUMBER**
2425	

DATE MAILED: 05/07/2021

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. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to 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)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 17/141,631	Applicant(s) APRIL et al.	
	Examiner CAI Y CHEN	Art Unit 2425	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 04/24/2021.
   ☐ 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 1-30 . 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 05/03/2021.
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 _____.

/CAI Y CHEN/
Primary Examiner, Art Unit 2425

DETAILED ACTION

Notice of Pre-AIA or AIA Status

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

Allowable Subject Matter

Claims 1-30 are allowed.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CAI Y CHEN whose telephone number is (571)270-5679. The examiner can normally be reached on 8:30 AM -4:30 PM.

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, Brian Pendleton can be reached on 571-272-7527. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CAI Y CHEN/
Primary Examiner, Art Unit 2425

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

✓	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	04/09/2021	05/03/2021							
1	1	✓	✓							
2	2	✓	✓							
3	3	✓	✓							
4	4	✓	✓							
5	5	✓	✓							
6	6	✓	✓							
7	7	✓	✓							
8	8	✓	✓							
9	9	✓	✓							
10	10	✓	✓							
11	11	✓	✓							
12	12	✓	✓							
13	13	✓	✓							
14	14	✓	✓							
15	15	✓	✓							
16	16	✓	✓							
17	17	✓	✓							
18	18	✓	✓							
19	19	✓	✓							
20	20	✓	✓							
21	21	✓	✓							
22	22	✓	✓							
23	23	✓	✓							
24	24	✓	✓							
25	25	✓	✓							
26	26	✓	✓							
27	27	✓	✓							
28	28	✓	✓							
29	29	✓	✓							
30	30	✓	✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

CPC - Searched*		
Symbol	Date	Examiner

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
The inventors searches are performed in East and Edan	04/09/2021	CC
CPC H04L65/60; H04N21/2343; 21/4316; 21/4768; and 21/6125 are text searched	04/09/2021	CC
All searches are updated	05/03/2021	CC

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	65/60	04/09/2021	CC
H04N	21/2343; 4316; 4768; and 6125	04/09/2021	CC
H04L	65/60	05/03/2021	CC
H04N	21/2343; 4316; 4768; and 6125	05/03/2021	CC

/CAI Y CHEN/ Primary Examiner, Art Unit 2425	

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

/CAI Y CHEN/ Primary Examiner, Art Unit 2425	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	**Art Unit**
	CAI Y CHEN	2425

CPC						
Symbol					**Type**	**Version**
H04N	/	21	/	6125	F	2013-01-01
H04N	/	21	/	2187	I	2013-01-01
H04L	/	65	/	4076	I	2013-01-01
H04N	/	21	/	4788	I	2013-01-01
H04N	/	21	/	2343	I	2013-01-01
H04N	/	21	/	47217	I	2013-01-01
H04N	/	21	/	4316	I	2013-01-01
H04L	/	65	/	601	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	608	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/CAI Y CHEN/ Primary Examiner, Art Unit 2425	03 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20210503

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

INTERNATIONAL CLASSIFICATION					
CLAIMED					
H04N	/	21	/	23	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/CAI Y CHEN/ Primary Examiner, Art Unit 2425	03 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

Part of Paper No.: 20210503

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	17/141,631	APRIL et al.
	Examiner	Art Unit
	CAI Y CHEN	2425

☐ 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	1	10	10	19	19	28	28								
2	2	11	11	20	20	29	29								
3	3	12	12	21	21	30	30								
4	4	13	13	22	22										
5	5	14	14	23	23										
6	6	15	15	24	24										
7	7	16	16	25	25										
8	8	17	17	26	26										
9	9	18	18	27	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/CAI Y CHEN/ Primary Examiner, Art Unit 2425	03 May 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	17141631
Filing Date	2021-01-05
First Named Inventor	Kevin APRIL
Art Unit	2425
Examiner Name	CHEN, Cai, Y.
Attorney Docket Number	SGIC-001US04

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
	1	10484743	B2	2019-11-19	Cox	Entire Document
	2	10740305	B2	2020-08-11	Barthel et al.	Entire Document
	3	10848792	B2	2020-11-24	Evans	Entire Document

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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							☐

All References Considered Except Where Lined Through. /C.Y.C/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

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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]
	*	Analyze & Optimize. Maestro 2020. Accessed at https://info.maestro.io/analyze-and-optimize on April 21, 2021. 3 pages.	☐
	*	Around-the-clock action for you sportsbook. BetGenius Brochure. Accessed at https://geniussports.com/sportsbook/content/streaming/ on March 19, 2021. 1 page.	☐
	*	Betradar Live Streaming Brochure 2021. Accessed at https://www.betradar.com/wp-content/uploads/sites/4/2014/11/Betradar-Live-Streaming-Brochure.pdf on April 29, 2021. 7 pages.	☐
	*	Betradar Product Brochure 2021. Accessed at https://www.betradar.com/wp-content/uploads/sites/4/2021/02/Betradar-Product-Brochure-2021.pdf on April 29, 2021. 24 pages.	☐
	*	BETRADAR. Sportradar. Accessed at https://www.betradar.com/ on April 21, 2021. 2 pages.	☐
	*	Customize & Control. Maestro 2020. Accessed at https://info.maestro.io/customize-and-control on April 21, 2021. 2 pages.	☐
	*	EMPSON, Baseball's Digital Trifecta and How America's Pastime is Setting the Pace for Sports Online. TechCrunch November 4, 2013. Accessed at https://techcrunch.com/2013/11/04/baseballs-digital-trifecta-and-how-americas-pastime-is-setting-the-pace-for-sports-online/. 10 pages.	☐
	*	Engage & Monetize. Maestro 2020. Accessed at https://info.maestro.io/engage-and-monetize on April 21, 2021. 3 pages.	☐
	*	Esports - Take your fan experience to the next level and build community. Maestro 2020. Accessed at https://info.maestro.io/esports on April 21, 2021. 4 pages.	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

	*	Genius Sports Group Analyst Day Presentation January 2021. Accessed at https://s27.q4cdn.com/552951210/files/doc_downloads/GSG_Analyst_Day_Presentation_January_2021_vFF_2.pdf on April 29, 2021. 52 pages.	☐
	*	Genius Sports Group Investor Presentation October 2020. Accessed at https://news.geniussports.com/wp-content/uploads/2020/10/GSG-Investor-Presentation.pdf on April 29, 2021. 29 pages.	☐
	*	HA, Major League Baseball's "At Bat" App Gets updated to Supported Expanded Instant Replay. TechCrunch March 31, 2014. Accessed at https://techcrunch.com/2014/03/31/mlb-at-bat-expanded-instant-replay/. 4 pages.	☐
	*	LA TECHWATCH, LA Startup Maestro Just Raised $3M to Broadcast eSports at Scale. LA TechWatch Sep 19, 2017. Accessed at https://www.latechwatch.com/2017/09/la-startup-maestro-just-raised-3m-broadcast-esports-scale/. 13 pages.	☐
	*	MLB App. MLB 2021. Accessed at https://www.mlb.com/apps/mlb-app on April 21, 2021. 1 page.	☐
	*	PEREZ, Live Video Viewing up 86% over last year in MLB's At Bat app, thanks for Addition of multitasking. TechCrunch April 15, 2016. Accessed at https://techcrunch.com/2016/04/15/live-video-viewing-up-86-over-last-year-in-mlbs-at-bat-app-thanks-to-addition-of-multitasking/. 4 pages.	☐
	*	PEREZ, MLB.com At Bat and NHL are first to Launch Personalized App Icons on iOS 10.3. TechCrunch March 28, 2017. Accessed at https://techcrunch.com/2017/03/28/mlb-com-at-bat-and-nhl-are-first-to-launch-personalized-app-icons-on-ios-10-3/. 5 pages.	☐
	*	Sports - Personalized fan-first experiences that go beyond the field. Maestro 2020. Accessed at https://info.maestro.io/sports on April 21, 2021. 3 pages.	☐
	*	Sports Betting. Sportradar. Accessed at https://sportradar.us/betting-services/ on April 21, 2021. 4 pages.	☐
	*	WASHINGTON, Betgenius launches live streaming service for sportsbooks. Genius Sports October 8, 2019. Accessed at https://news.geniussports.com/betgenius-launches-live-streaming-service-for-sportsbooks/ on April 30, 2021. 5 pages.	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

EXAMINER SIGNATURE			
Examiner Signature	/CAI Y CHEN/	Date Considered	05/05/2021

*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.

* A copy of the reference is not provided pursuant to 37 C.F.R. §1.98(d) because the reference was previously cited and submitted to the Office in U.S. Patent Application Serial No.17/027,219 filed 9/21/2020, to which the above-identified application claims priority under 35 U.S.C. §120.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	17141631
	Filing Date	2021-01-05
	First Named Inventor	Kevin APRIL
	Art Unit	2425
	Examiner Name	CHEN, Cai, Y.
	Attorney Docket Number	SGIC-001US04

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 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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☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

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

☒ A certification statement is not submitted herewith.

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	/Joseph Teja, Jr./	Date (YYYY-MM-DD)	2021-05-03
Name/Print	Joseph Teja Jr.	Registration Number	45157

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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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

All References Considered Except Where Lined Through. /C.Y.C/
EFS Web 2.1.18

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	92,173	(H04L65/60.cpc. or H04N21/4316.cpc. or H04N21/2343.cpc. or H04N21/4788.cpc. or H04N21/6125.cpc.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:25
L2	47	(sport$3 near3 (event or venue or gam$3)) same (internet near5 channel) and L1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:25
L3	2,534	(sport or gam$3) with (addition$2 or supplement$2) and L1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L4	1	(internet or url or browser) with ((gam$3 information or betting) with sport) and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L5	29	((gambl$3 information or betting or casino) with sport) and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L6	88	((online gam$3 or gambl$3 or betting)) with (sport) and L1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L7	51	(synchron$5 or sync) and L6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L8	6	(event identifier or event ID or event channel) with (internet address or url) and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26

L9	8	(gambl$3 information or betting or casino) with (sport near4 (event or live)) and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:26
L10	40	((gambl$3 information or betting or casino or online gam$3) with sport) and L3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	ADJ	ON	2021/05/03 10:36

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L11	13,282	(H04L65/60.cpc. or H04N21/4316.cpc. or H04N21/2343.cpc. or H04N21/4788.cpc. or H04N21/6125.cpc.)	USPAT	ADJ	ON	2021/05/03 10:39
L12	31,921	(H04L65/60.cpc. or H04N21/4316.cpc. or H04N21/2343.cpc. or H04N21/4788.cpc. or H04N21/6125.cpc.)	US-PGPUB; USPAT	ADJ	ON	2021/05/03 10:39
L13	44	(sport$3 near3 (event or venue or gam$3)) same (internet near5 channel) and L12	US-PGPUB; USPAT	ADJ	ON	2021/05/03 10:40
L14	84	((online gam$3 or gambl$3 or betting)) with (sport) and 12	US-PGPUB; USPAT	ADJ	ON	2021/05/03 10:41
L16	61	((gambl$3 information or betting or casino or online gam$3) with sport) and 14	US-PGPUB; USPAT	ADJ	ON	2021/05/03 10:41

5/3/2021 10:42:46 AM
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17141631	NOA	05/07/2021	SGIC-001US04
	1449	05/07/2021	SGIC-001US04

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
17141631	05-Jan-2021	Kevin APRIL	SGIC-001US04	5760

TITLE OF INVENTION :

SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Small	Utility under 35 USC 111(a)	2425	231000	CAI CHEN

Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
$600	$0	$600	09-Aug-2021	$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
149890 SMITH BALUCH LLP 376 BOYLSTON ST STE 401 BOSTON MA 02116 UNITED STATES 202-669-6207 docketing@smithbaluch.com	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status

Change in Entity Status

○ Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.
Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

◉ 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.

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2.
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Signature	/Joseph Teja, Jr./	**Date**	05-10-2021
Name	Joseph Teja, Jr.	**Registration Number**	45157

Electronic Patent Application Fee Transmittal

Application Number:	17141631
Filing Date:	05-Jan-2021
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Filer:	Joseph Teja/Marie Spakowski
Attorney Docket Number:	SGIC-001US04

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPL ISSUE FEE	2501	1	600	600
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt

EFS ID:	42680582
Application Number:	17141631
International Application Number:	
Confirmation Number:	5760
Title of Invention:	SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION
First Named Inventor/Applicant Name:	Kevin APRIL
Customer Number:	149890
Filer:	Joseph Teja/Marie Spakowski
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US04
Receipt Date:	10-MAY-2021
Filing Date:	05-JAN-2021
Time Stamp:	18:11:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
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1	Issue Fee Payment (PTO-85B)	Web85b.pdf	46057 68226baa07192d396e33a5a88e066e65a6ed8d17	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32205 9400334e020c860ed27bf86c90b0da7f1b6c0d7e	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	78262		

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
17/141,631	06/15/2021	11039218	SGIC-001US04	5760

149890 7590 05/26/2021

SMITH BALUCH LLP
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BOSTON, MA 02116

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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 Application Information Retrieval (PAIR) WEB site (http://pair.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 Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
17/141,631	01/05/2021	Kevin APRIL	SGIC-001US04

CONFIRMATION NO. 5760

149890
SMITH BALUCH LLP
376 BOYLSTON ST
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PUBLICATION NOTICE

OC000000125919029

Title:SYSTEMS, APPARATUS AND METHODS FOR RENDERING DIGITAL CONTENT RELATING TO A SPORTING EVENT WITH ONLINE GAMING INFORMATION

Publication No.US-2021-0160584-A1
Publication Date:05/27/2021

NOTICE OF PUBLICATION OF APPLICATION

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.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

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17141631	ISSUE.NTF	05/26/2021	SGIC-001US04

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