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: ***16/267,887***
FILING DATE: ***February 05, 2019***
PATENT NUMBER: ***10425697***
ISSUE DATE: ***September 24, 2019***

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:	Schupak	Nonprovisional Application Number (if known):	Filed Herewith
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.		

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 2/5/2019
Name (Print/Typed) Joseph Teja, Jr.	Practitioner Registration Number 45,157

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 1 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.

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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-001US01
	Application Number	
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	

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
	Philip	Nicholas	SCHUPAK	

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

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 2 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

Inventor 3 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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
	Application Number	
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City	New York	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	174 E90 PH3		
Address 2			
City	New York	State/Province	NY
Postal Code	110128	Country	US

Inventor 4 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	Philadelphia	State/Province	PA	Country of Residence	US

Mailing Address of Inventor:

Address 1	330 South 15th Street, Apartment IF		
Address 2			
City	Philadelphia	State/Province	PA
Postal Code	19102	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 SCALABLE LOW-LATENCY VIEWING OF BROADCAST DIGITAL CONTENT STREAMS OF LIVE EVENTS, AND SYNCHRONIZATION OF EVENT INFORMATION WITH VIEWED STREAMS, VIA MULTIPLE INTERNET CHANNELS		
Attorney Docket Number	SGIC-001US01	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

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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	PCTUS2017045801	2017-08-07

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
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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	

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.			

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			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.			

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

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☐ 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-001US01
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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	

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.

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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

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		
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.

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.

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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.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

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

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Joseph Teja, Jr./			Date (YYYY-MM-DD)	2019-02-05
First Name	Joseph	Last Name	Teja, Jr.	Registration Number	45157

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

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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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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.

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

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application 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 (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 comprising:

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;

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; and

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.

2. The system of claim 1, 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;

in C), the at least one socket server further transmits the first score information (504A) for the first live sporting event to at least the first viewer client device (200C) of the second plurality of viewer client devices via a second event information Internet communication channel (206C) between the at least one first event socket (602A) of the at least one socket server and the first viewer client device of the second plurality of viewer devices.

3. The system of claim 2, wherein:

none of the first score information (504A) of the first event information (502A) is included in the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital content (102A) provided to the first viewer client device (200A) of the first plurality of viewer client devices via the first video Internet communication channel (204A); and

none of the first score information (504A) of the first event information (502A) is included in the first copy (202C) of the second plurality of copies of the second broadcaster's live stream of digital content (102B) provided to the first viewer client device (200C) of the second plurality of viewer client devices via the second video Internet communication channel (204C).

4. The system of claim 2, wherein:

in A), the plurality of media sources:

provide a second copy (202B) of the first plurality of copies to a second viewer client device (200B) 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; and

provide a second copy (202D) of the second plurality of copies to a second viewer client device (200D) 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; and

in C), the at least one socket server:

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200B) of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device of the first plurality of viewer devices; and

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200D) of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device of the second plurality of viewer devices.

5. The system of claim 2, wherein in C), the at least one socket server further:

transmits and receives first chat information (210A) 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 (208A) between at least one first chat/system event socket (604A) of the at least one socket server and the first viewer client device (200A) 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

transmits and receives second chat information (210B) regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content via at least one second chat/system event Internet communication channel (208B) between at least one second chat/system event socket (604B) of the at least one socket server and the first viewer client device (200C) of the second plurality of viewer client devices, wherein the at least one second chat/system event socket corresponds to the second chat information regarding the second live sporting event video-based commentary.

6. The system of claim 5, wherein:

in A), the plurality of media sources:

provide a second copy (202B) of the first plurality of copies to a second viewer client device (200B) 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; and

provide a second copy (202D) of the second plurality of copies to a second viewer client device (200D) 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; and

in C), the at least one socket server:

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200B) of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device of the first plurality of viewer devices;

transmits and receives the first chat information (210A) 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 socket (604A) of the at least one socket server and the second viewer client device (200B) of the first plurality of viewer client devices;

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200D) of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device of the second plurality of viewer devices; and

transmits and receives the second chat information (210B) 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 socket (604B) of the at least one socket server and the second viewer client device (200D) of the second plurality of viewer client devices.

7. The system of claim 1, further comprising a memory system (400) communicatively coupled to the control server, the memory system including a database (420), wherein in B) the control server:

retrieves from the event information provider first event data for the first live sporting event, the first event data including at least one of:

the type of the first live sporting event;

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.

8. The system of claim 7, wherein 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; and

stores the normalized at least one of the progress details and the event participant data in the database.

9. The system of claim 7, wherein:

the progress details include the first score information;

the control server periodically retrieves the progress details from the event information provider and updates the first score information; 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 the at least one first event socket of the at least one socket server.

10. The system of claim 1, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server (320) to receive the first broadcaster's live stream of digital content (102A); and

at least one web real time communication (WebRTC) media server (360) to receive the first broadcaster's live stream of digital content (102A); and

an HTTP live streaming (HLS) caching server architecture (380) communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server; and

the system establishes the first video Internet communication channel (204A) to provide the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (200A) of the first plurality of viewer devices between the first viewer client device (200A) and the HLS caching server architecture (380).

11. The system of claim 10, wherein the HLS caching server architecture comprises:

an HLS mother server (382) 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 (375A) representing the first broadcaster's live stream of digital content (102A); and

a plurality of HLS child servers (384A, 384B) communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (388),

wherein:

the system establishes the first video Internet communication channel (204A) to provide the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital

content to the first viewer client device (200A) of the first plurality of viewer devices between the first viewer client device (200A) and the HLS CDN (388); and

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 (375A).

12. The system of claim 11, further comprising:

at least one webserver (700) 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; and

a memory system (400) communicatively coupled to the at least one webserver, the memory system including a database (420) storing:

first stream information for the first broadcaster's live stream of digital content (102A) including the first live sporting event video-based commentary from the first broadcaster client device (100A), wherein the first stream information includes a stream identifier (StreamID) for the first broadcaster's live stream of digital content,

wherein the at least one webserver:

determines an address for the HLS CDN to establish the first video Internet communication channel (204A) 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 (200A) of the first plurality of viewer client devices to establish the first video Internet communication channel (204A).

13. The system of claim 12, wherein:

the first stream information for the first broadcaster's live stream of digital content (102A) further includes 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 (602A) 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 (200A) of the first plurality of viewer client devices to establish the first event information Internet communication channel (206A).

14. The system of claim 13, wherein:

in C), the at least one socket server further transmits and receives first chat information (210A) 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 (208A) between at least one first chat/system event socket (604A) of the at least one socket server and the first viewer client device (200A) 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 (604A) 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 (200A) of the first plurality of viewer client devices to establish the first chat/system event Internet communication channel (208A).

15. The system of claim 11, wherein 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 (375A) 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.

16. The system of claim 15, wherein 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.

17. The system of claim 1, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server (320) to receive the first broadcaster's live stream of digital content (102A); and

at least one web real time communication (WebRTC) media server (360) to receive the first broadcaster's live stream of digital content (102A); and

an HTTP live streaming (HLS) caching server architecture (380) communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server;

the system establishes the first video Internet communication channel (204A) to provide the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (200A) of the first plurality of viewer devices between the first viewer client device (200A) and the HLS caching server architecture (380);

the HLS caching server architecture comprises:

an HLS mother server (382) 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 (375A) representing the first broadcaster's live stream of digital content (102A); and

a plurality of HLS child servers (384A, 384B) communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (388);

the system establishes the first video Internet communication channel (204A) to provide the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (200A) of the first plurality of viewer devices between the first viewer client device (200A) and the HLS CDN (388);

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 (375A);

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 (375A) 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 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;

the first HLS file suite (375A) provided by the at least one of the at least one RTMP 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 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 (375B) of the first HLS playlist, the first respective chunklists, and the first respective file segments;

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 (375C) of the first HLS playlist, the first respective chunklists, and the first respective file segments; and

the first copy (202A) of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device (200A) of the first plurality of viewer devices is based on the at least one second copy (375C) of the first HLS playlist, the first respective chunklists, and the first respective file segments.

18. The system of claim 17, wherein:

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.

19. 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 comprising:

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;

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; and

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.

20. The system of claim 19, wherein:

in A), the plurality of media sources:

provide a second copy (202B) of the first plurality of copies to a second viewer client device (200B) 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; and

provide a second copy (202D) of the second plurality of copies to a second viewer client device (200D) 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; and

in C), the at least one socket server:

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200B) of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device (200B) of the first plurality of viewer devices; and

transmits at least the second score information (504B) of the second event information (502B) to the second viewer client device (200D) of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one second event socket (602B) of the at least one socket server and the second viewer client device (200D) of the second plurality of viewer devices.

21. The system of claim 19, wherein in C), the at least one socket server further:

transmits and receives first chat information (210A) 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 (208A) between at least one first chat/system event socket (604A) of the at least one socket server and the first viewer client device (200A) 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

transmits and receives second chat information (210B) regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content via at least one second chat/system event Internet communication channel (208B) between at least one second chat/system event socket (604B) of the at least one socket server and the first viewer client device (200C) of the second plurality of viewer client devices, wherein the at least one second chat/system event socket corresponds to the second chat information regarding the second live sporting event video-based commentary.

22. The system of claim 21, wherein:

in A), the plurality of media sources:

provide a second copy (202B) of the first plurality of copies to a second viewer client device (200B) 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; and

provide a second copy (202D) of the second plurality of copies to a second viewer client device (200D) 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; and

in C), the at least one socket server:

transmits at least the first score information (504A) of the first event information (502A) to the second viewer client device (200B) of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket (602A) of the at least one socket server and the second viewer client device (200B) of the first plurality of viewer devices;

transmits and receives the first chat information (210A) 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 socket (604A) of the at least one socket server and the second viewer client device (200B) of the first plurality of viewer client devices;

transmits at least the second score information (504B) of the second event information (502B) to the second viewer client device (200D) of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one second event socket (602B) of the at least one socket server and the second viewer client device (200D) of the second plurality of viewer devices; and

transmits and receives the second chat information (210B) 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 socket (604B) of the at least one socket server and the second viewer client device (200D) of the second plurality of viewer client devices.

23. A method for providing a first copy (202A) 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 viewer client device (200A), the method comprising:

A) providing the first copy (202A) to the first viewer client device (200A) via a first video communication channel (204A) between a plurality of media sources and the first viewer client device;

B) periodically retrieving, 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; and

C) transmitting the first score information (504A) to at least the first viewer client device (200A) via a first event information communication channel (206A) between at least one first event socket (602A) of 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.

24. The method of claim 23, further comprising:

D) transmitting and receiving first chat information (210A) 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 (208A) between at least one first chat/system event socket (604A) of the at least one socket server and the first viewer client device (200A) 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.

25. The method of claim 23, wherein B) comprises:

B1) periodically updating the first score information; and

B2) for each updating of the first score information, queueing an asynchronous message including the updated first score information for transmission to the at least one first event socket of the at least one socket server.

26. The method of claim 24, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server (320) to receive the first broadcaster's live stream of digital content (102A); and

at least one web real time communication (WebRTC) media server (360) to receive the first broadcaster's live stream of digital content (102A); and

an HTTP live streaming (HLS) caching server architecture (380) communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server, wherein the HLS caching server architecture comprises:

an HLS mother server (382) 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 (375A) representing the first broadcaster's live stream of digital content (102A); and

a plurality of HLS child servers (384A, 384B) communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (388); and

A) comprises providing the first copy (202A) to the first viewer client device (200A) via the first video communication channel (204A) between the HLS CDN (388) and the first viewer client device, wherein the first copy (202A) is based on the first HLS file suite (375A) received by the HLS mother server.

27. A system for providing a first copy 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 viewer client device (200A), the system comprising:

means for providing the first copy (202A) to the first viewer client device (200A) via a first video communication channel (204A);

means for periodically retrieving, 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; and

means for transmitting the first score information (504A) to at least the first viewer client device (200A) via a first event information communication channel (206A) that is different from the first video communication channel.

28. The system of claim 27, further comprising:

means for transmitting and receiving first chat information (210A) 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 (208A) that is different from the first video communication channel (204A) and the first event information communication channel (206A).

29. The system of claim 27, wherein the means for periodically retrieving includes means for updating the first score information and queueing an asynchronous message including the updated first score information for transmission on the first event information communication channel.

30. The system of claim 27, wherein the means for providing the first copy (202A) to the first viewer client device (200A) via a first video communication channel (204A) comprises:

an HTTP live streaming (HLS) mother server (382) to receive a first HLS file suite (375A) representing the first broadcaster's live stream of digital content (102A); and

a plurality of HLS child servers (384A, 384B), communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) (388), to provide the first copy (202A) to the first viewer client device (200A) via the first video communication channel (204A) between the HLS CDN (388) and the first viewer client device, wherein the first copy (202A) is based on the first HLS file suite (375A) received by the HLS mother server.

ABSTRACT

Multiple broadcasters create live streams of digital content relating to live events, and multiple viewers of each broadcaster receive copies of the live streams. Viewer latency is significantly reduced, and event information relating to live events is synchronized amongst all broadcasters and viewers of live streams relating to the same event. Scalable and flexible access to live streams is provided to different types and numbers of viewers with different qualities of service. A social media platform is provided in tandem with live streaming of digital content relating to live events, to allow a given broadcaster and their associated viewers to communicate with one another, comment on the event and/or the broadcaster's live stream, and send digital gifts. In one example, the broadcasters' digital content includes video-based commentary regarding live sporting events, and studio-quality graphics and animations (including animated synchronized scorebugs) are provided on mobile client devices in tandem with the broadcasters' video-based commentary and social networking functionality.

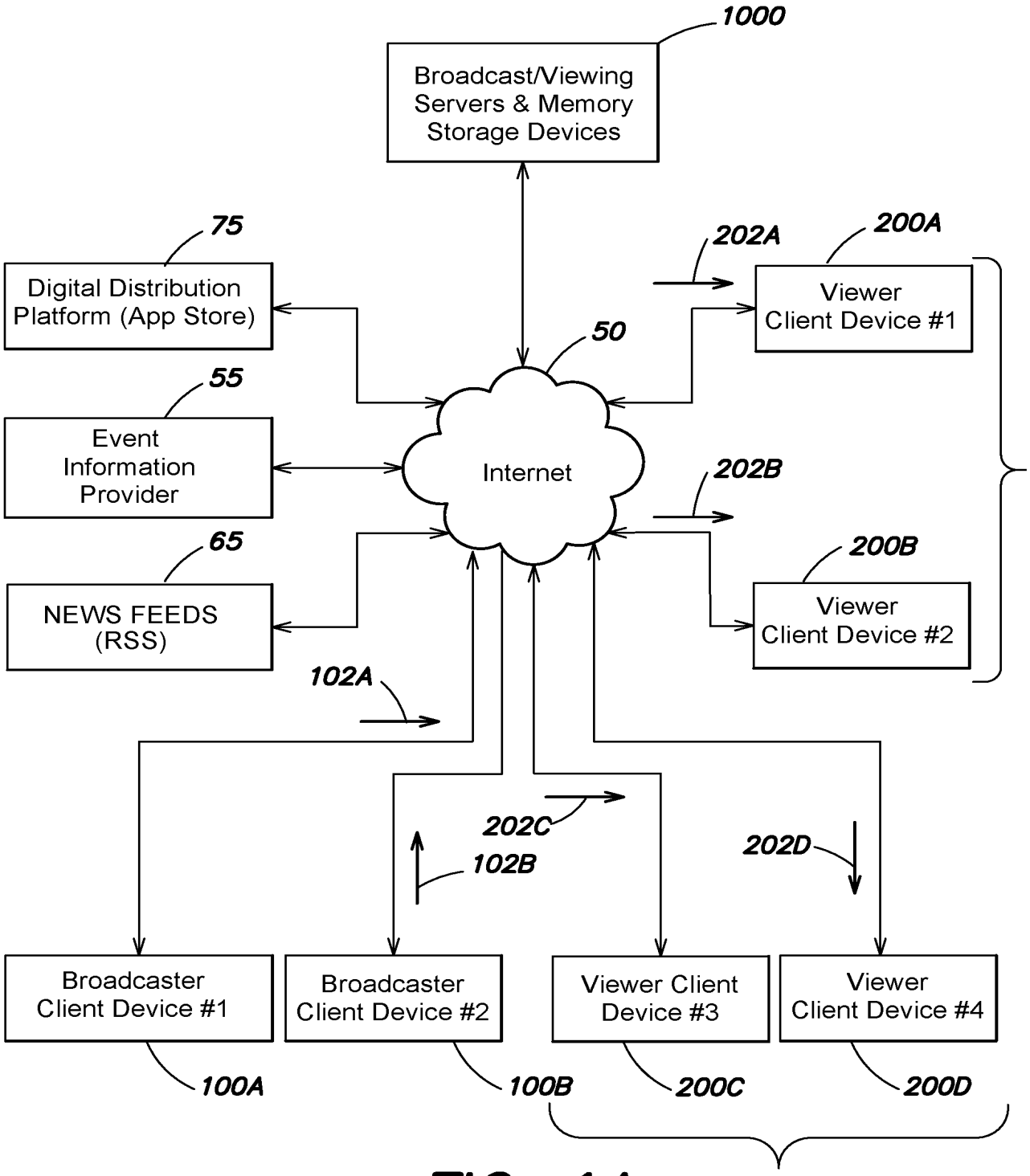

1000
Broadcast/Viewing Servers & Memory Storage Devices
75
Digital Distribution Platform (App Store)
55
Event Information Provider
65
NEWS FEEDS (RSS)
50
Internet
202A
200A
Viewer Client Device #1
202B
200B
Viewer Client Device #2
102A
202C
102B
202D
Broadcaster Client Device #1
Broadcaster Client Device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

FIG. 1A



FIG. 1B

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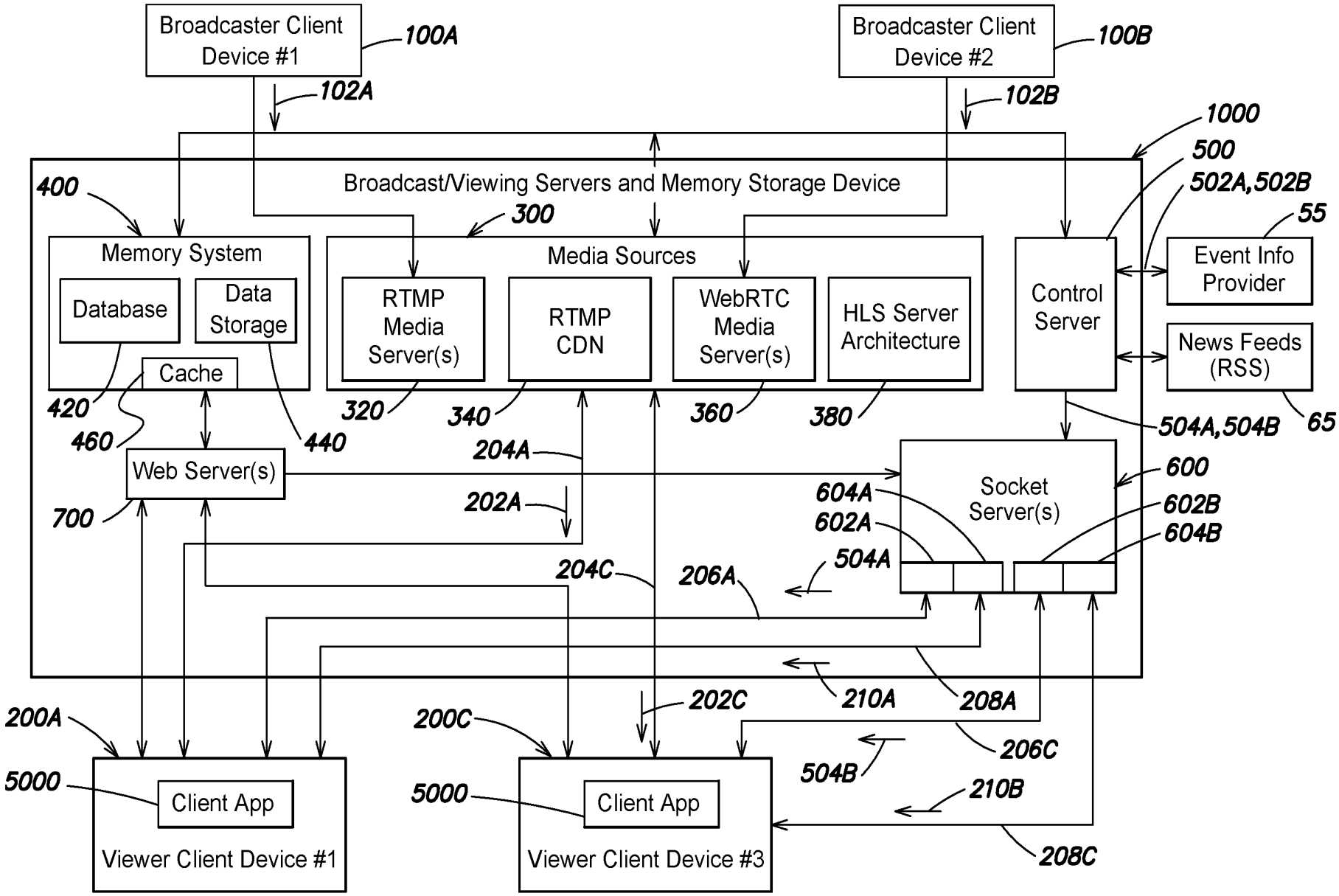


FIG. 2

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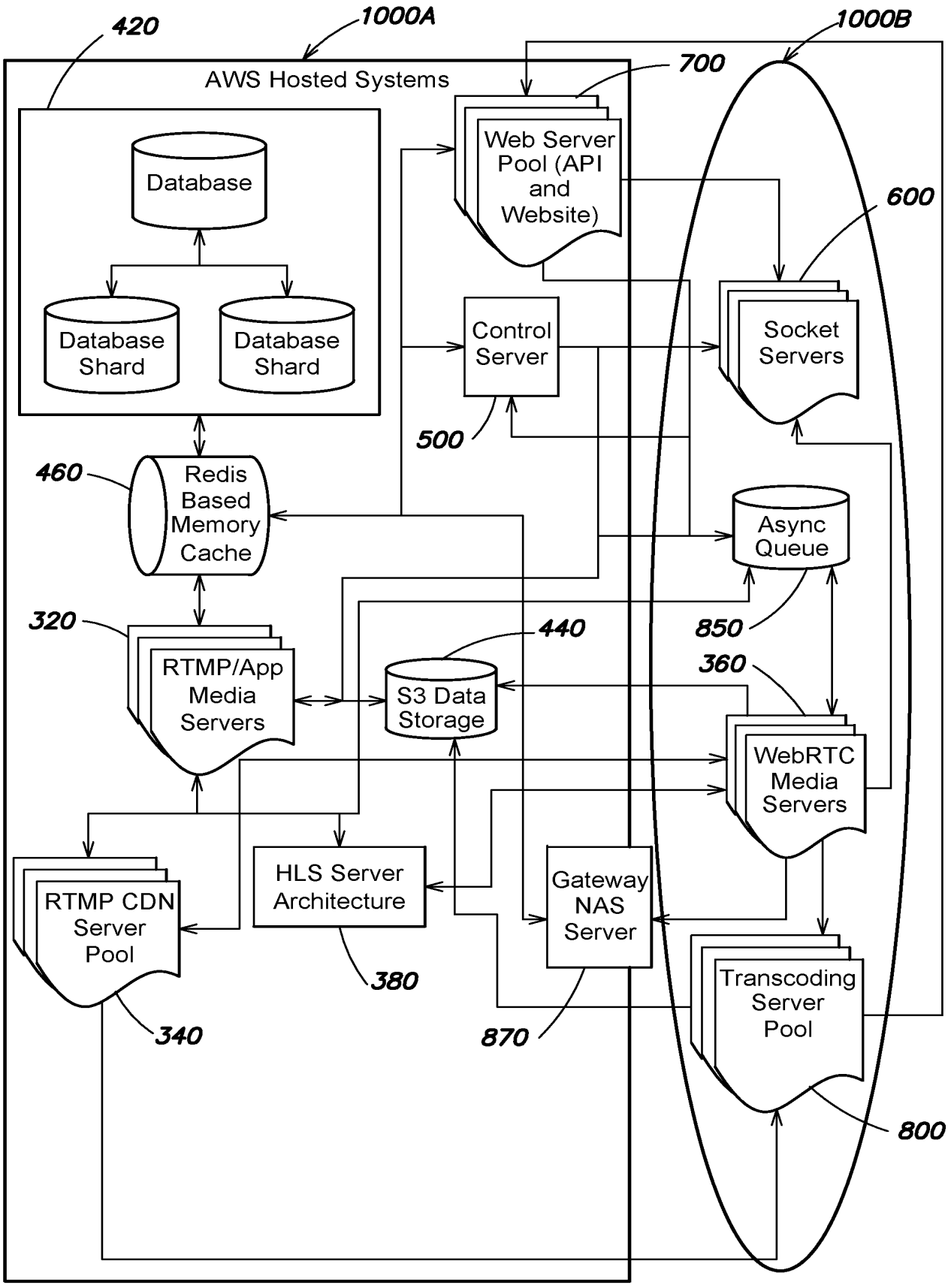

420
1000A
1000B
AWS Hosted Systems
700
Database
Web Server Pool (API and Website)
600
Database Shard
Database Shard
Control Server
Socket Servers
500
460
Redis Based Memory Cache
Async Queue
320
440
850
360
RTMP/App Media Servers
S3 Data Storage
WebRTC Media Servers
RTMP CDN Server Pool
HLS Server Architecture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

FIG. 3

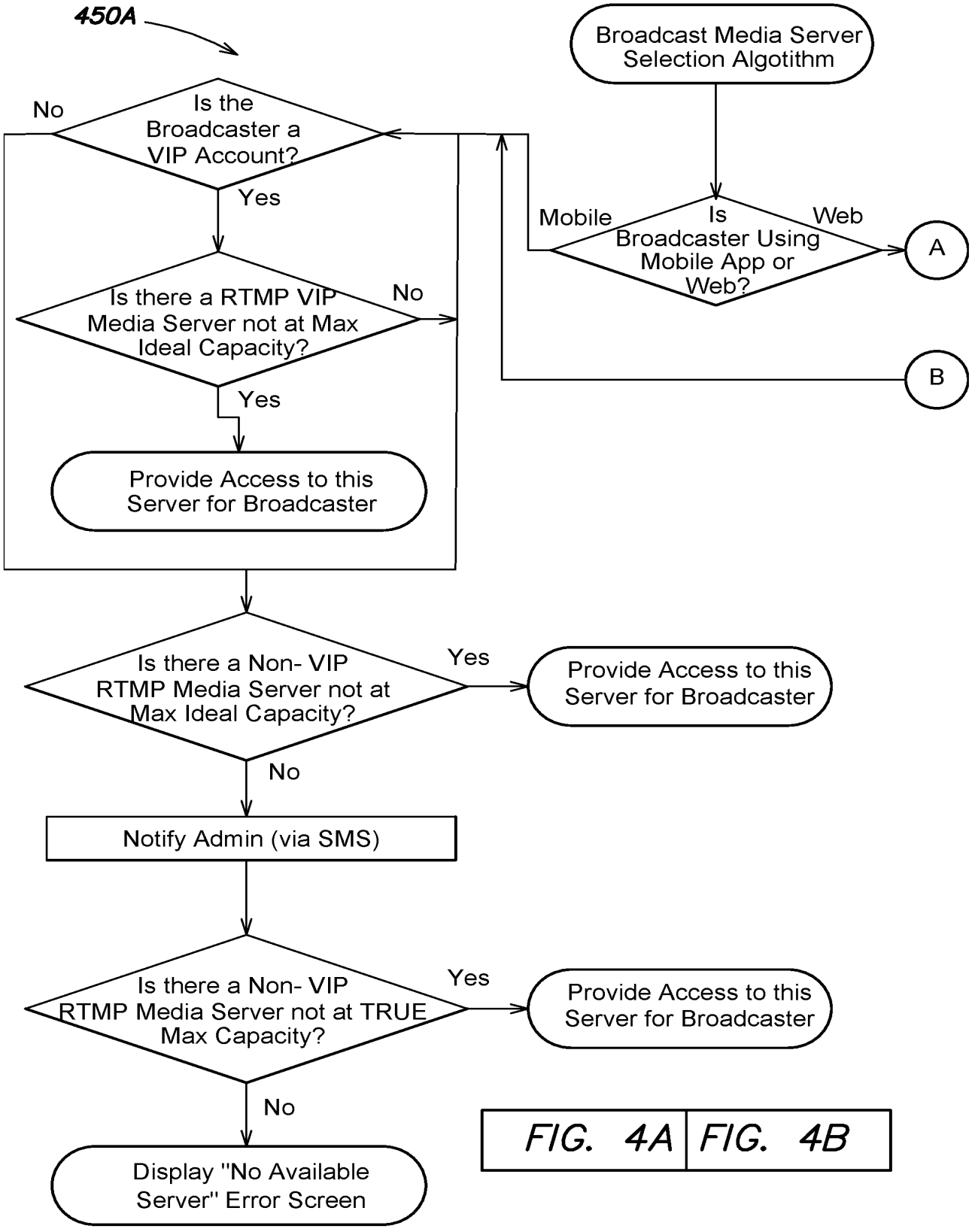


FIG. 4A | FIG. 4B

FIG. 4A

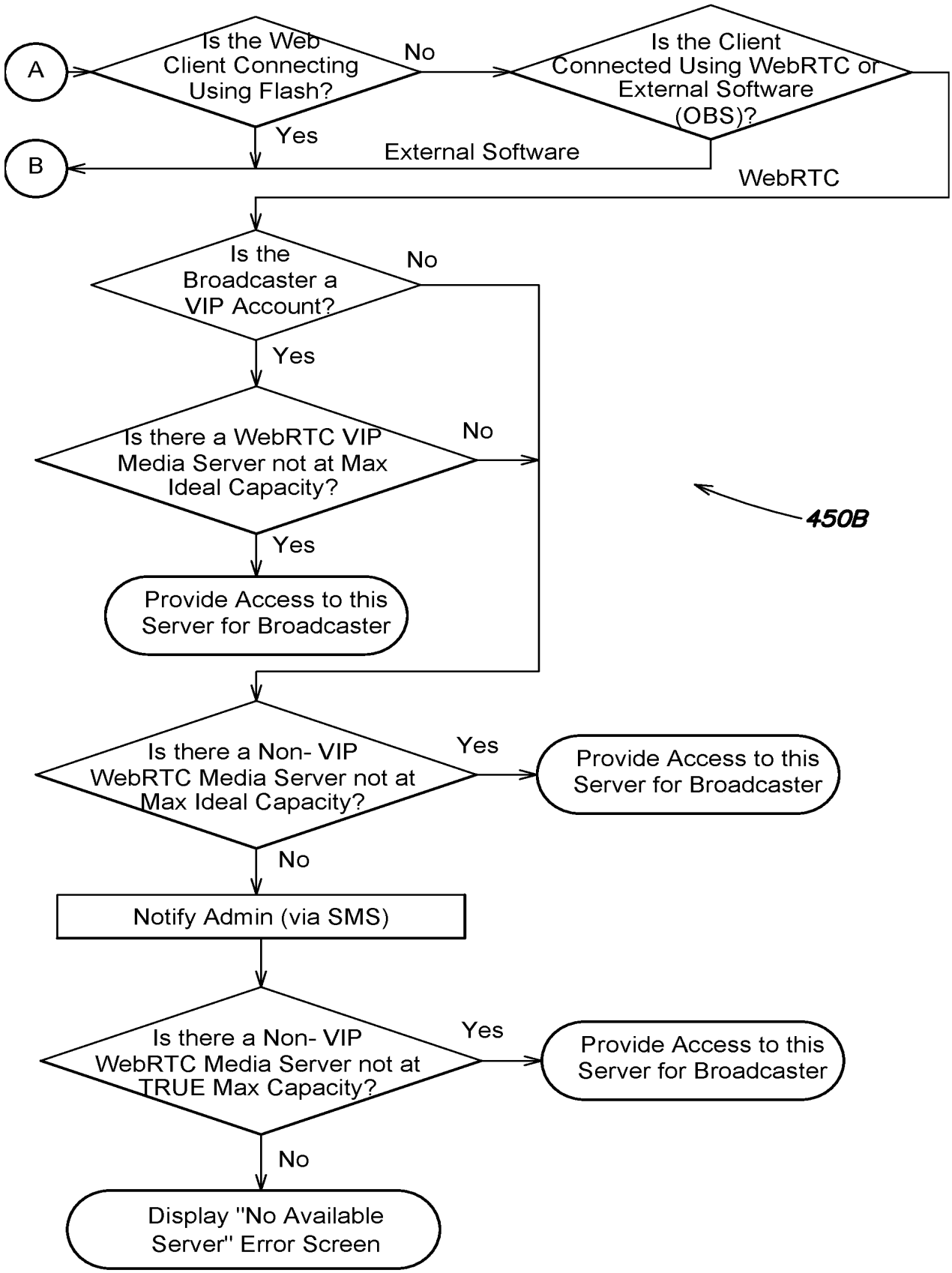

A
Is the Web Client Connecting Using Flash?
No
Is the Client Connected Using WebRTC or External Software (OBS)?
Yes
External Software
B
WebRTC
Is the Broadcaster a VIP Account?
No
Yes
Is there a WebRTC VIP Media Server not at Max Ideal Capacity?
No
Yes
Provide Access to this Server for Broadcaster
450B
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

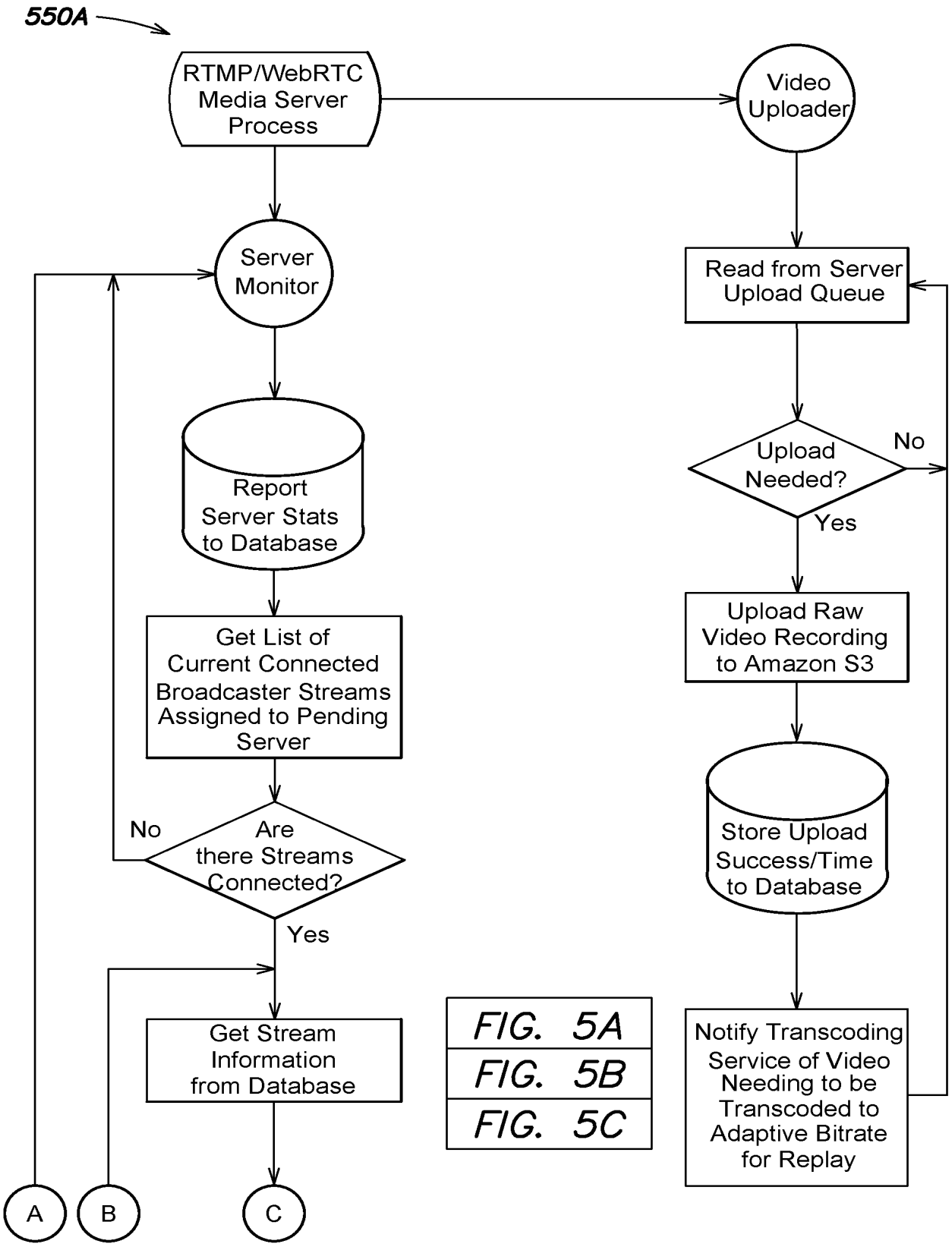


FIG. 5A
FIG. 5B
FIG. 5C

FIG. 5A

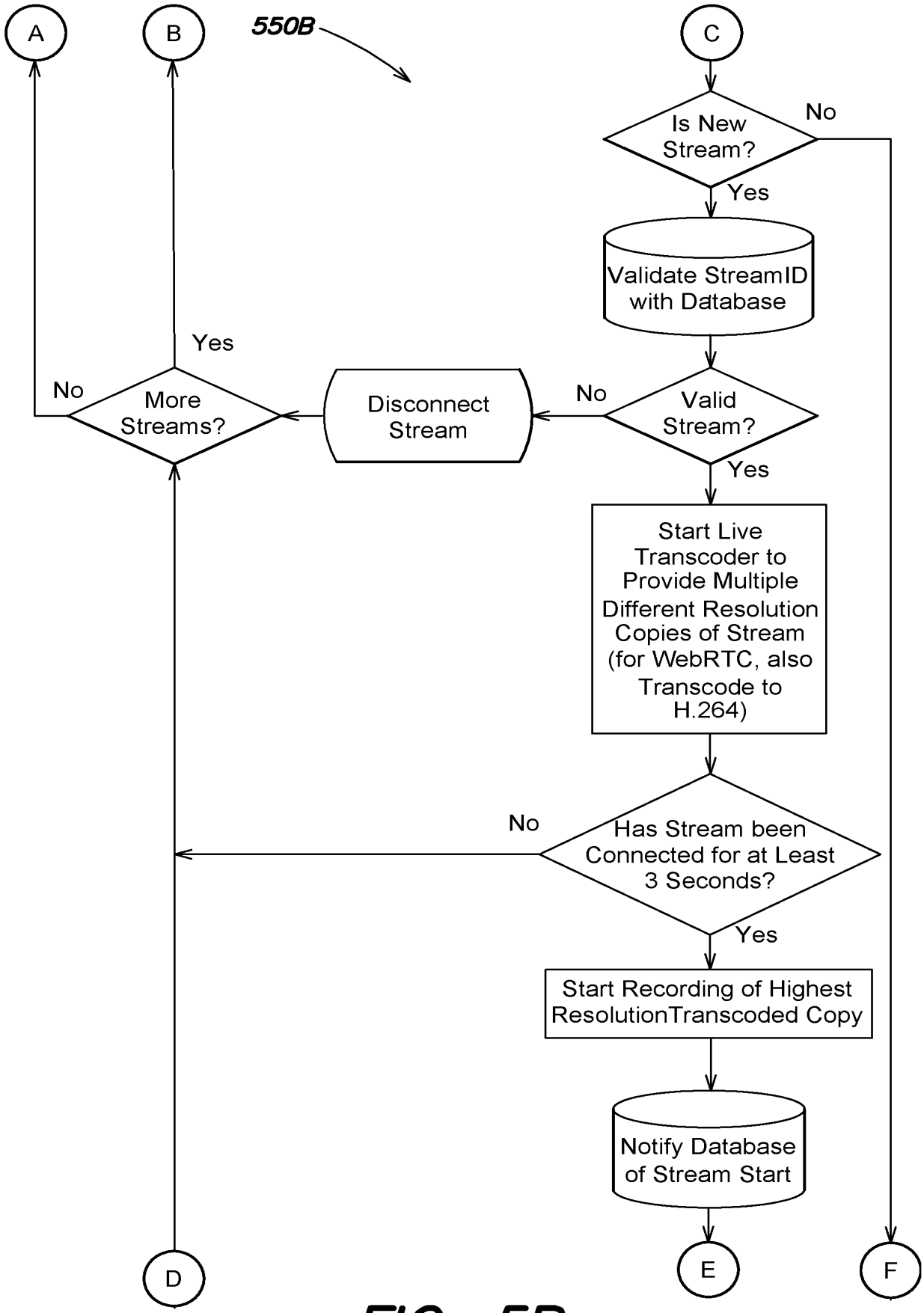

A
B
550B
C
Is New Stream?
No
Yes
Validate StreamID with Database
Yes
No
More Streams?
Disconnect Stream
No
Valid Stream?
Yes
Start Live Transcoder to Provide Multiple Different Resolution Copies of Stream (for WebRTC, also Transcode to H.264)
No
Has Stream been Connected for at Least 3 Seconds?
Yes
Start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

FIG. 5B

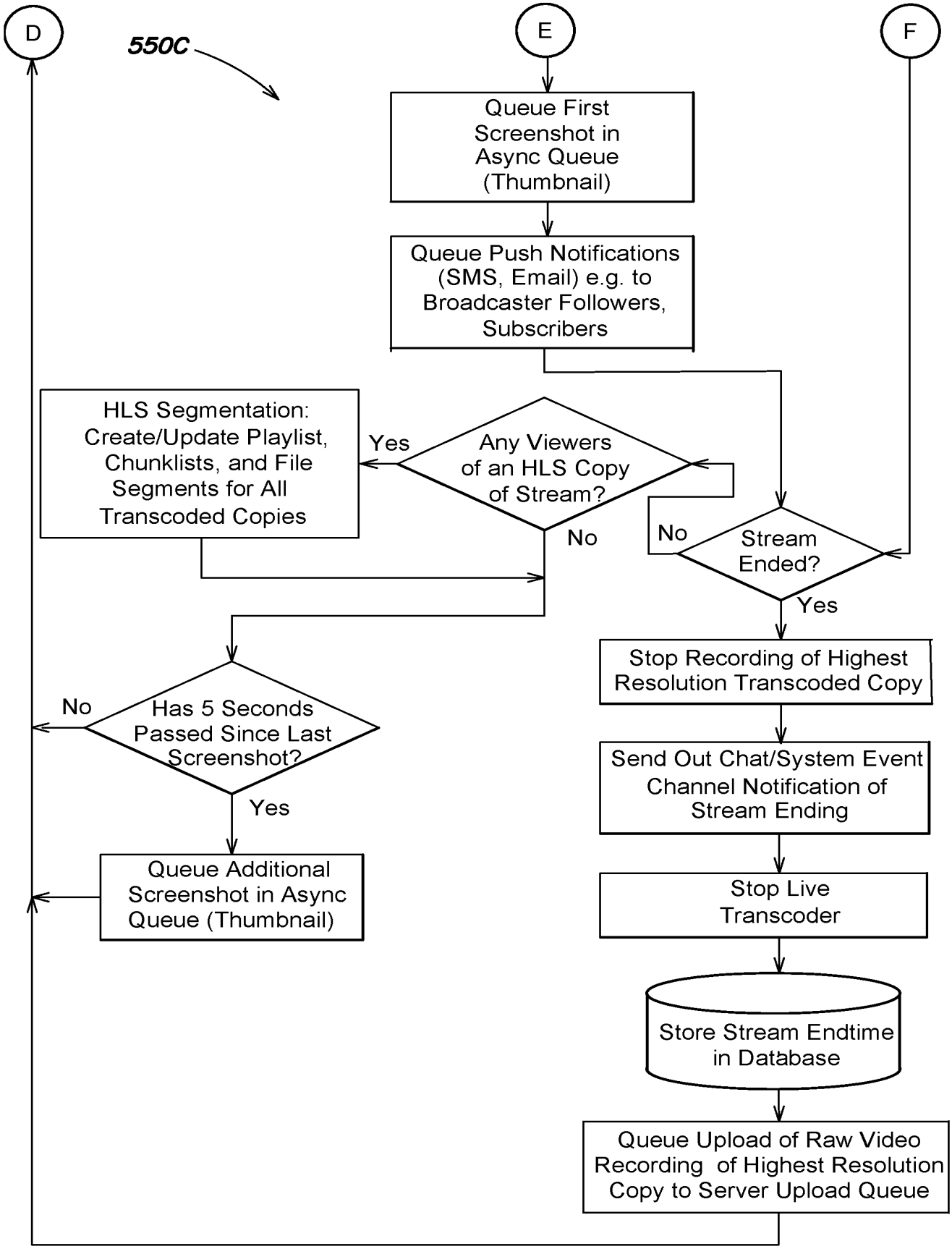

D
550C
E
F
Queue First Screenshot in Async Queue (Thumbnail)
Queue Push Notifications (SMS, Email) e.g. to Broadcaster Followers, Subscribers
HLS Segmentation: Create/Update Playlist, Chunklists, and File Segments for All Transcoded Copies
Yes
Any Viewers of an HLS Copy of Stream?
No
No
Stream Ended?
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

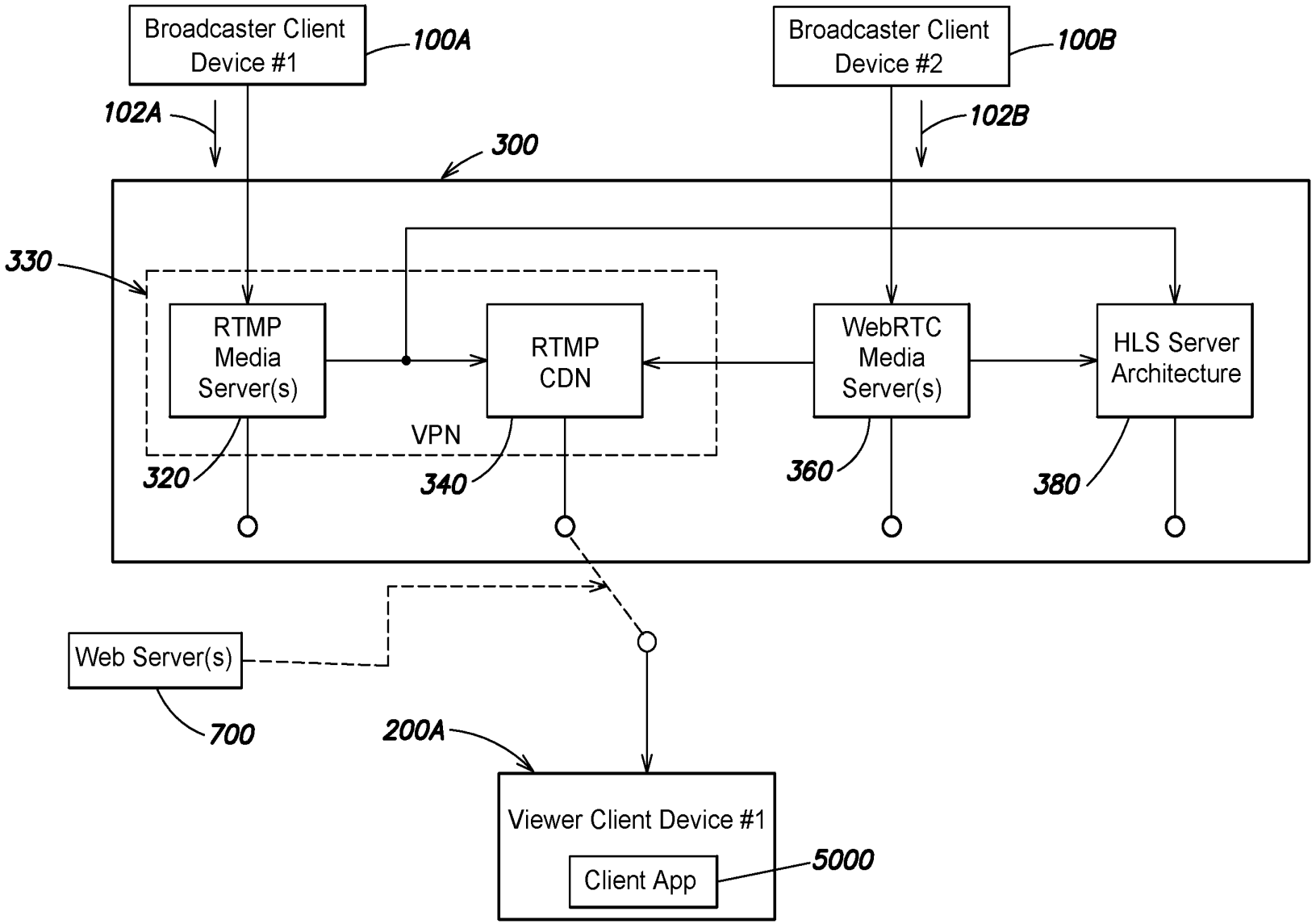


FIG. 6

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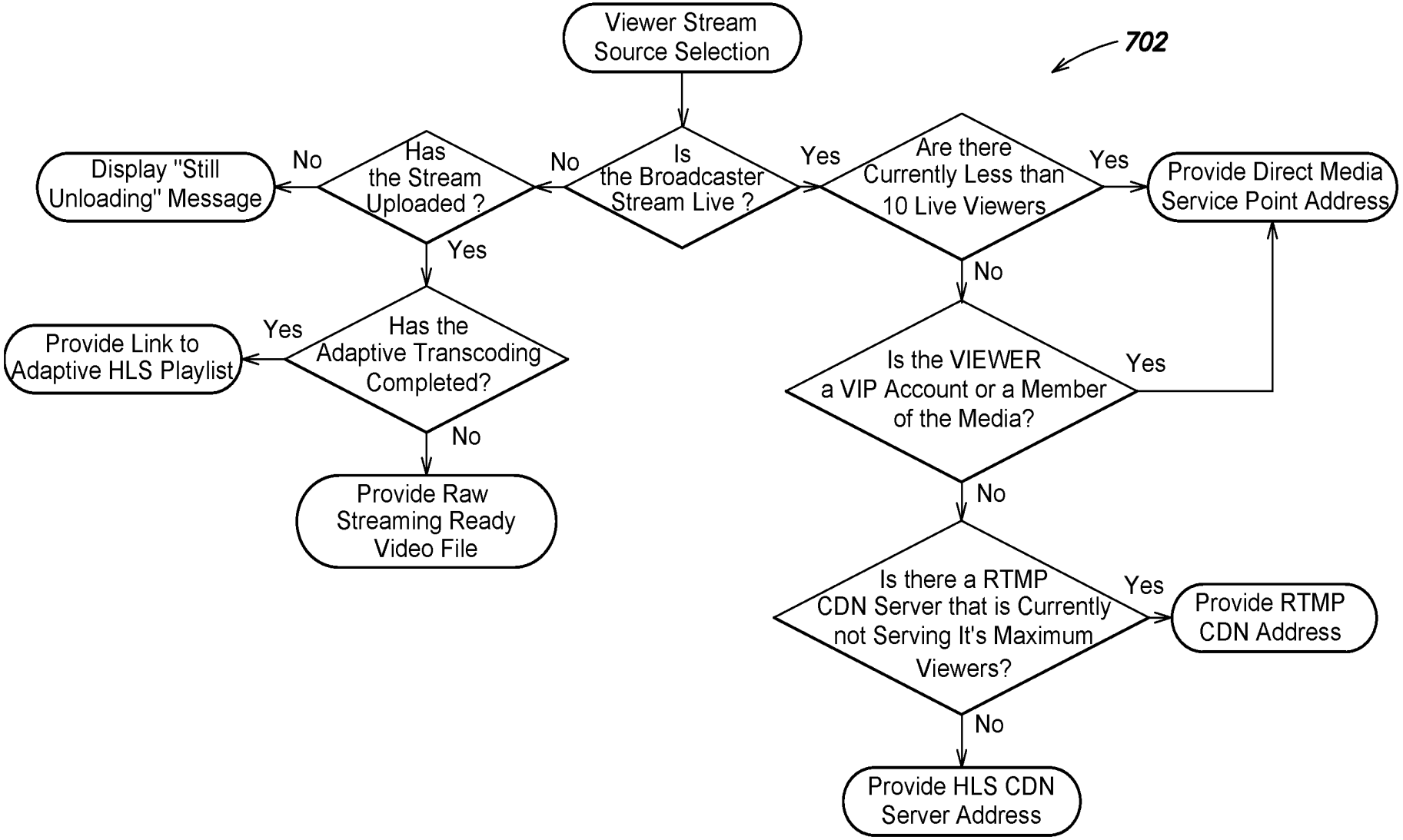


FIG. 7

Genius Sports Ex. 1008
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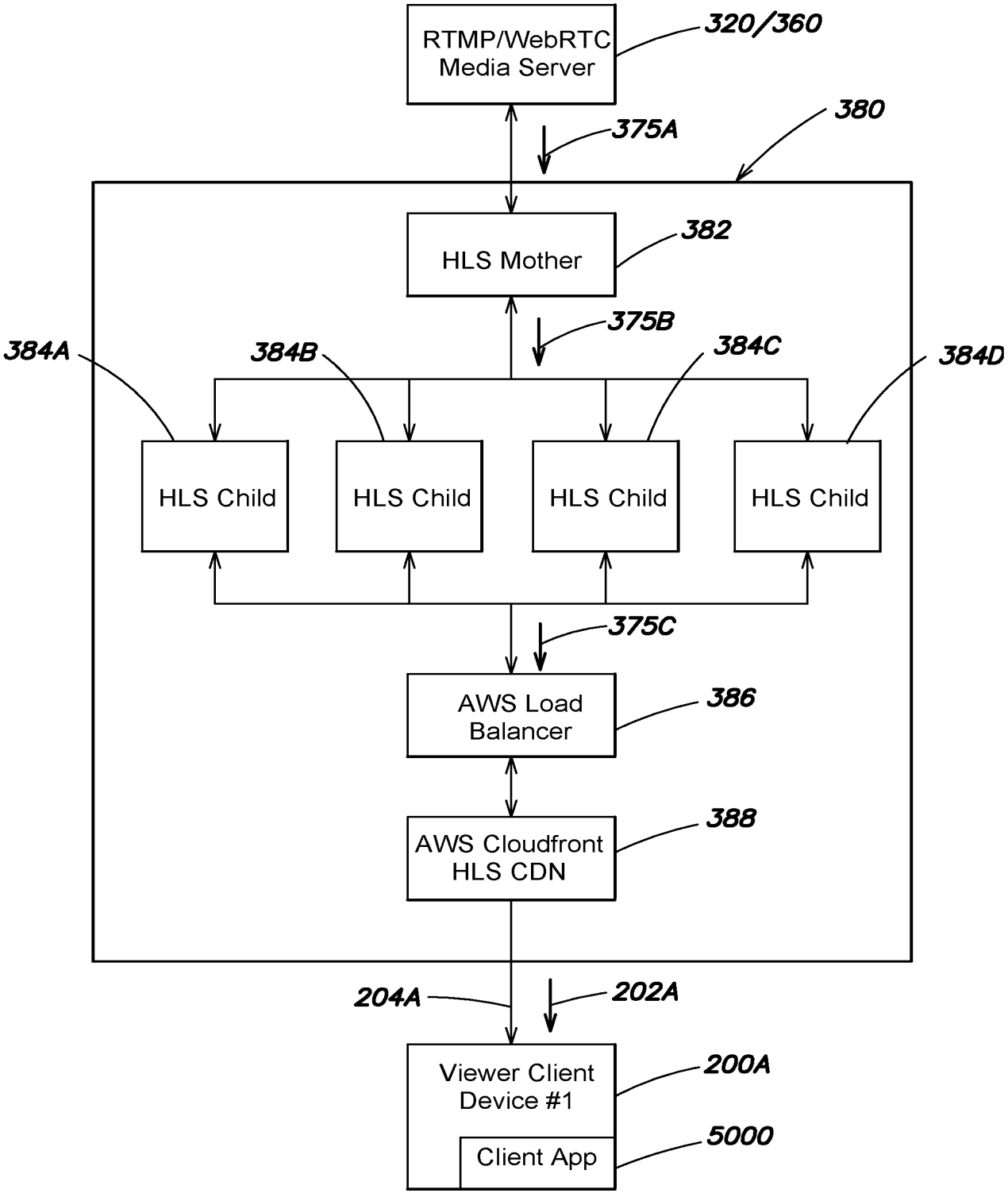

RTMP/WebRTC Media Server
320/360
380
375A
HLS Mother
382
375B
384A
384B
384C
384D
HLS Child
HLS Child
HLS Child
HLS Child
375C
AWS Load Balancer
386
AWS Cloudfront HLS CDN
388
204A
202A
Viewer Client Device #1
200A
Client App
5000

FIG. 8

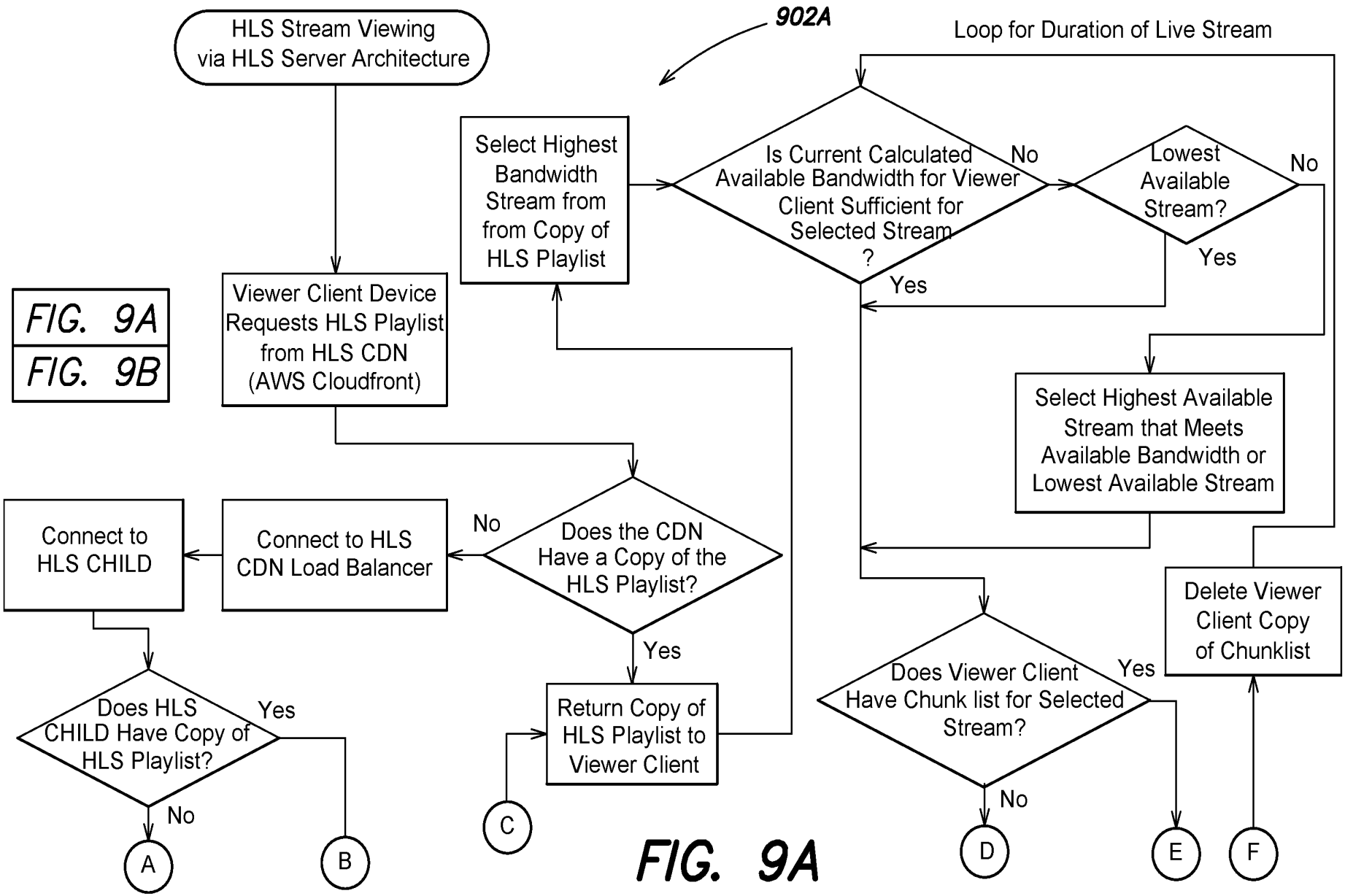


FIG. 9A

FIG. 9A

FIG. 9B

Genius Sports Ex. 1008
p. 123

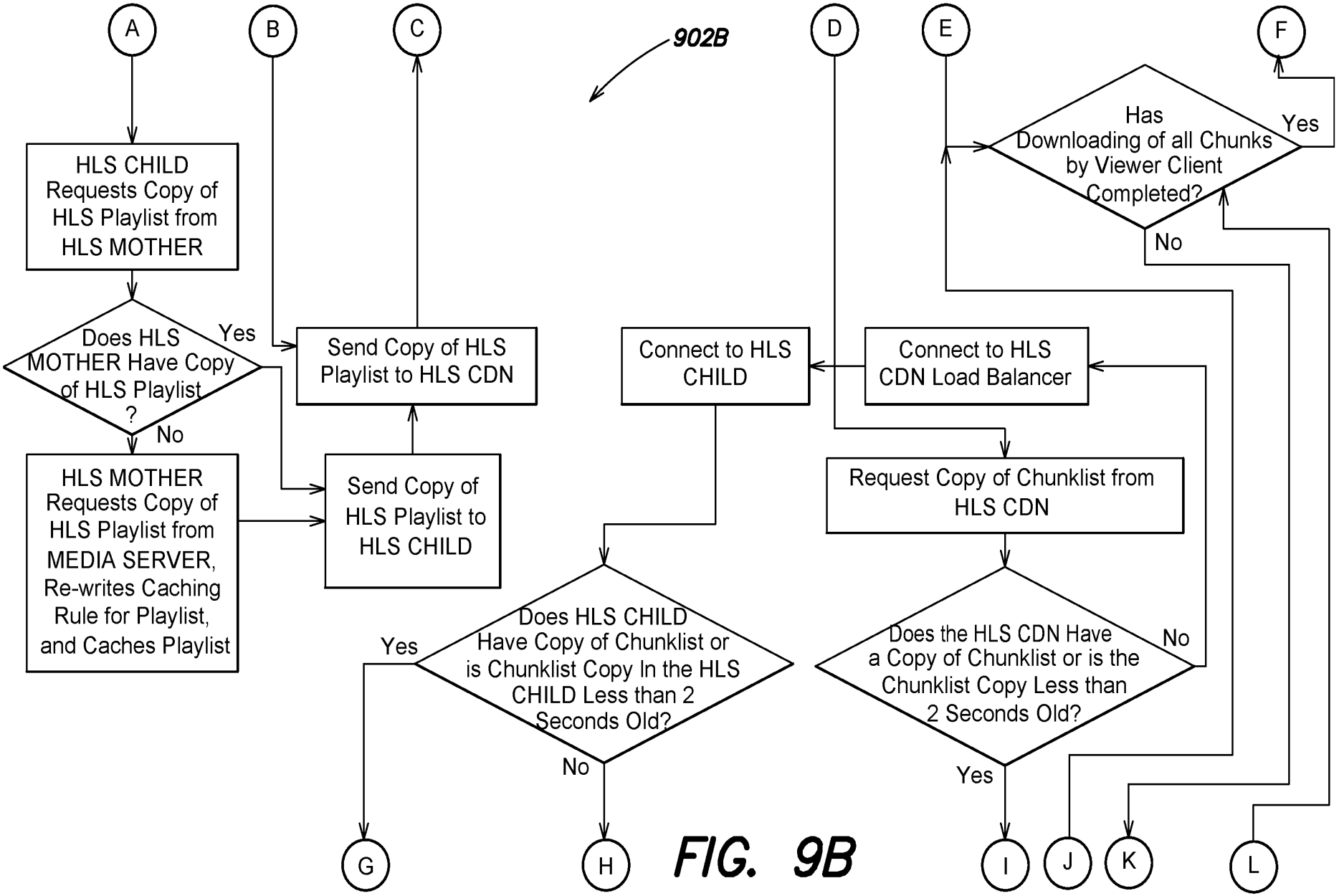


FIG. 9B

Genius Sports Ex. 1008
p. 124

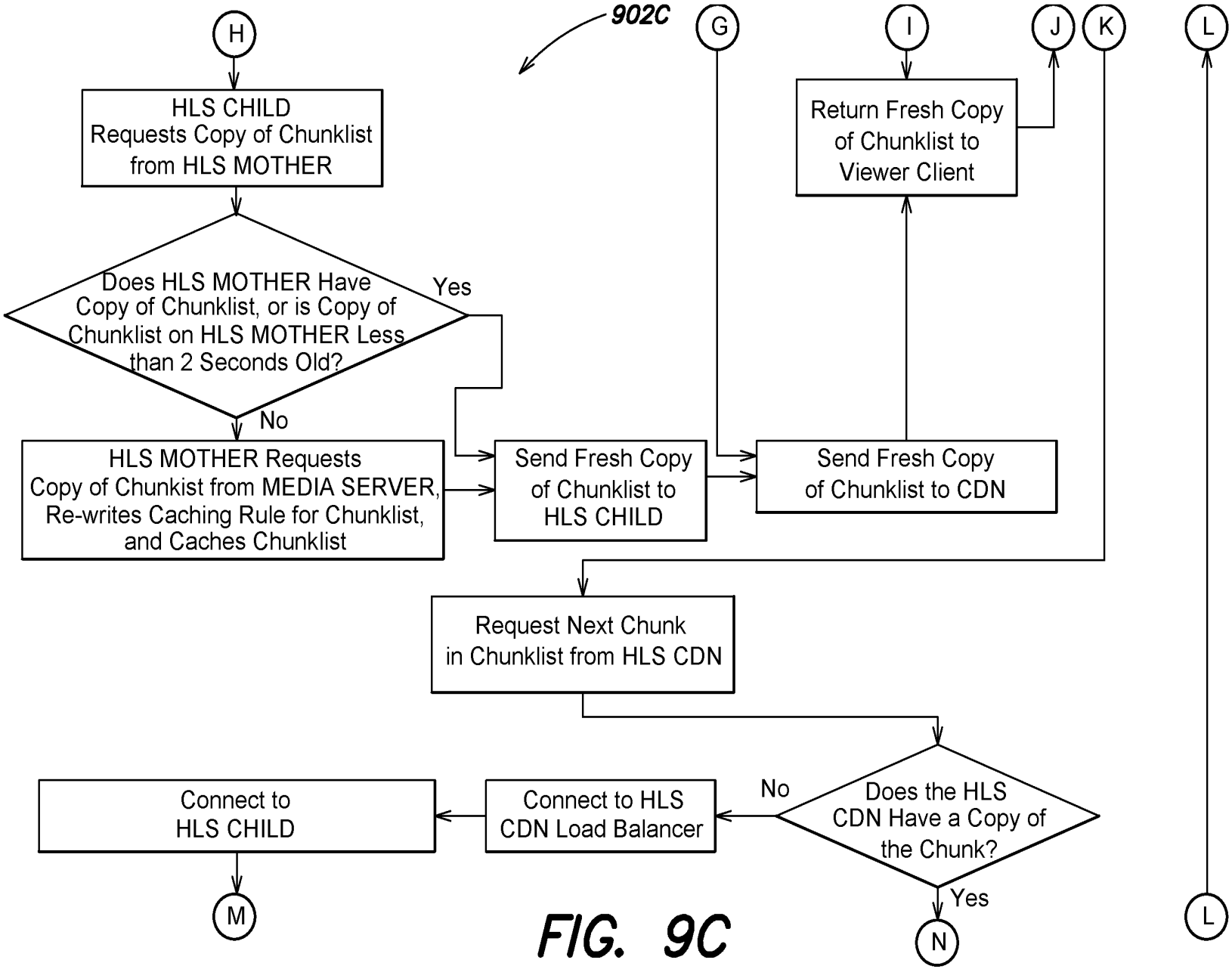


FIG. 9C

Genius Sports Ex. 1008
p. 125

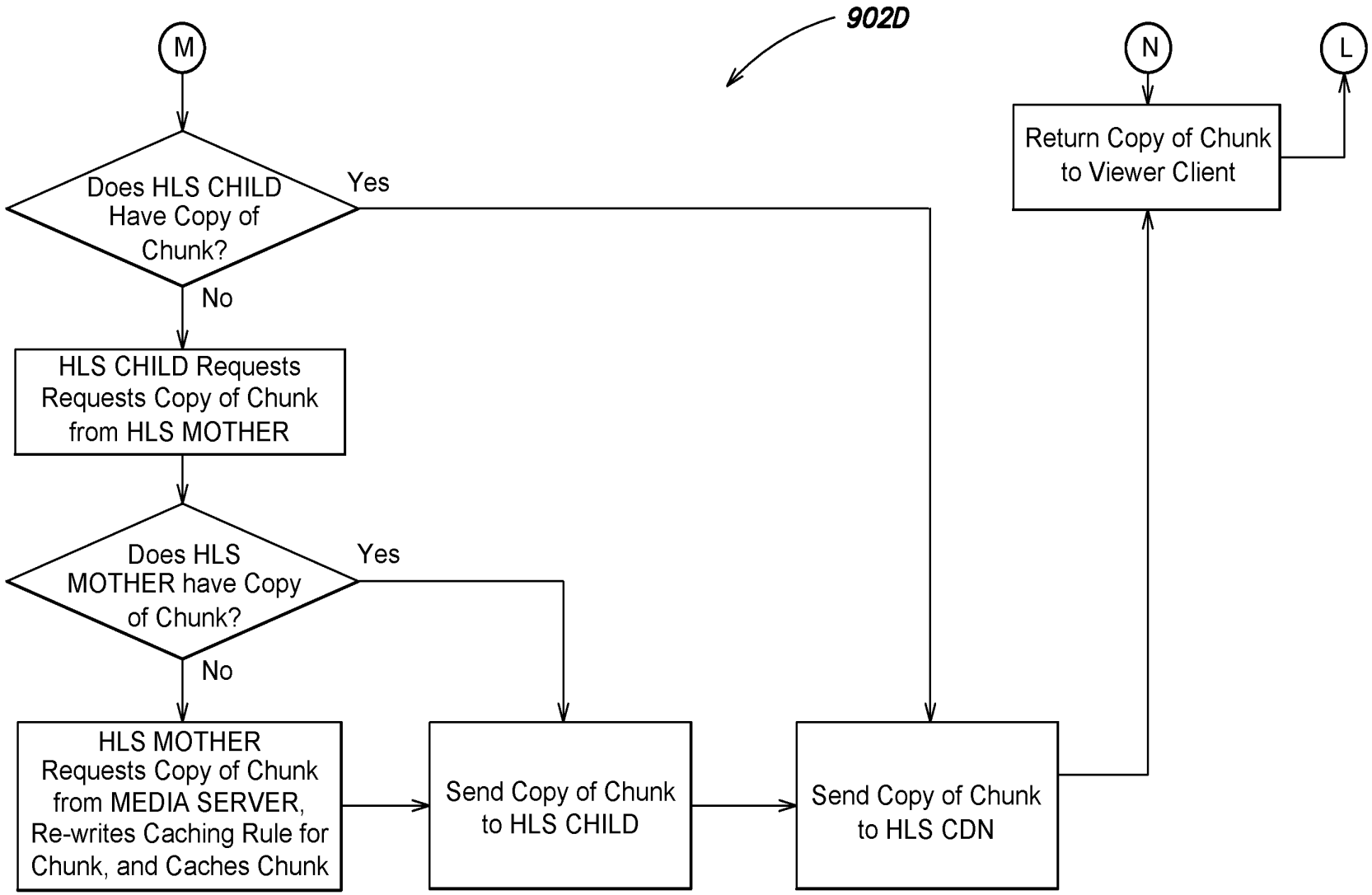


FIG. 9D

Genius Sports Ex. 1008
p. 126

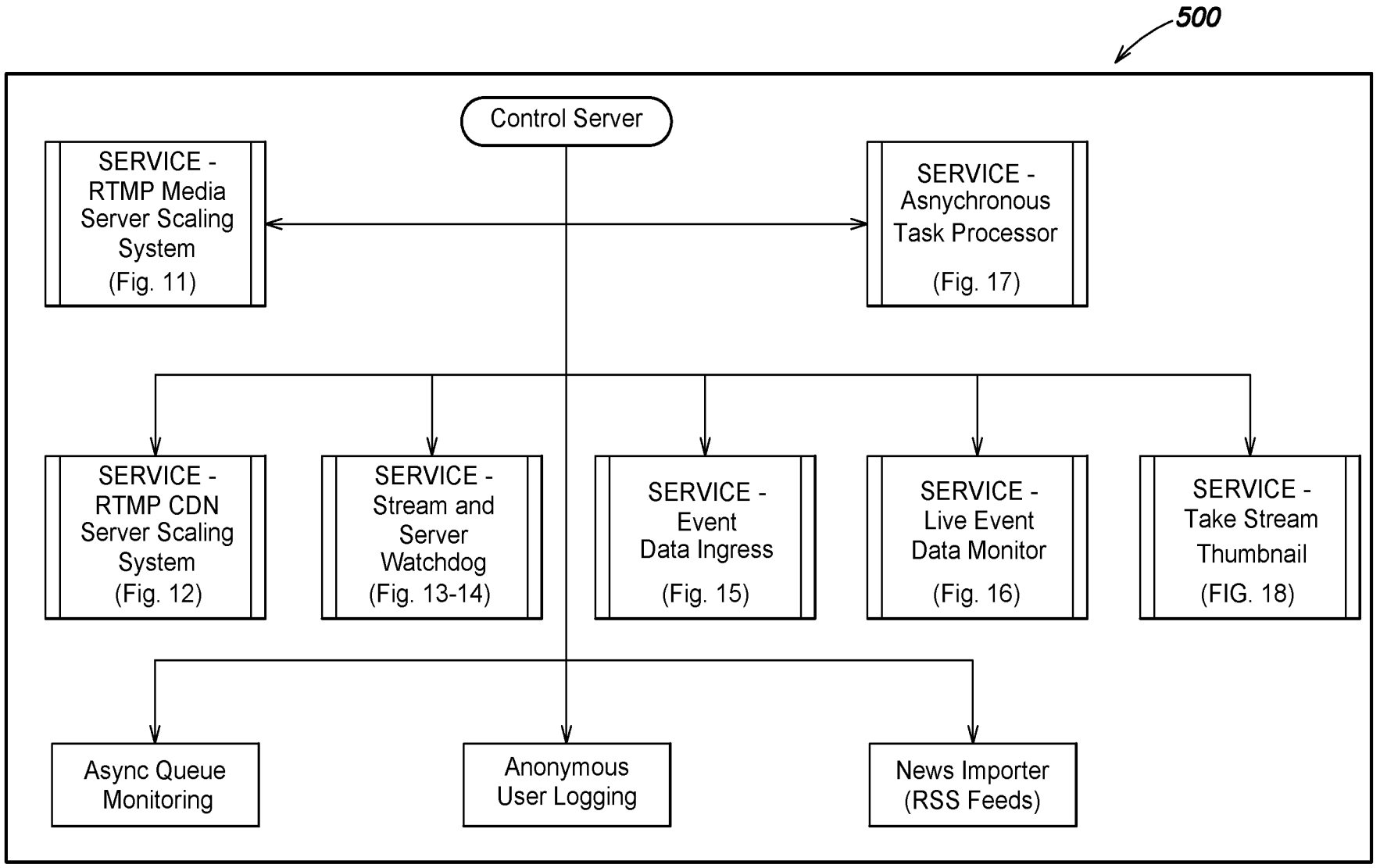


FIG. 10

Genius Sports Ex. 1008
p. 127

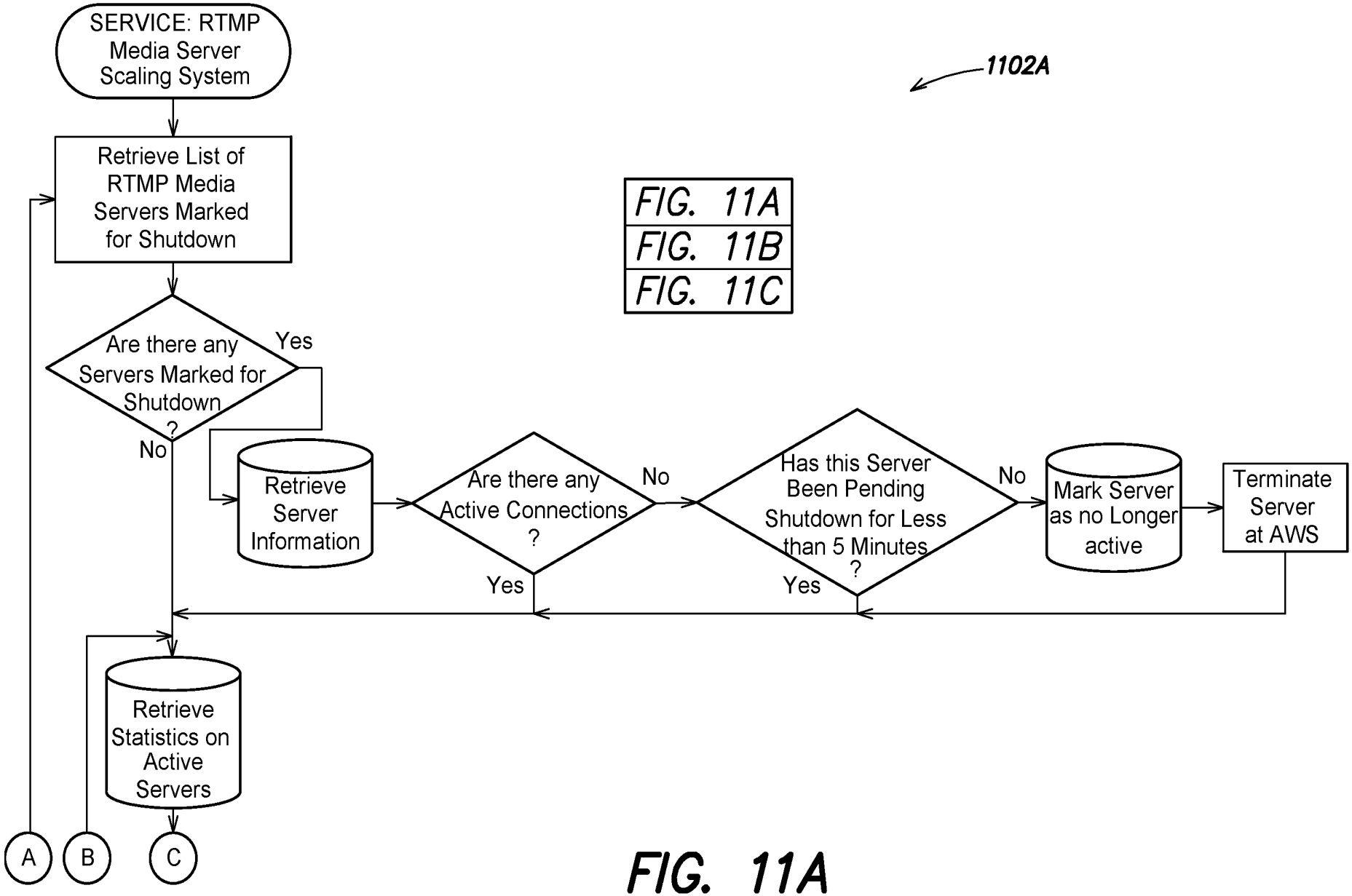


FIG. 11A
FIG. 11B
FIG. 11C

FIG. 11A

Genius Sports Ex. 1008
p. 128

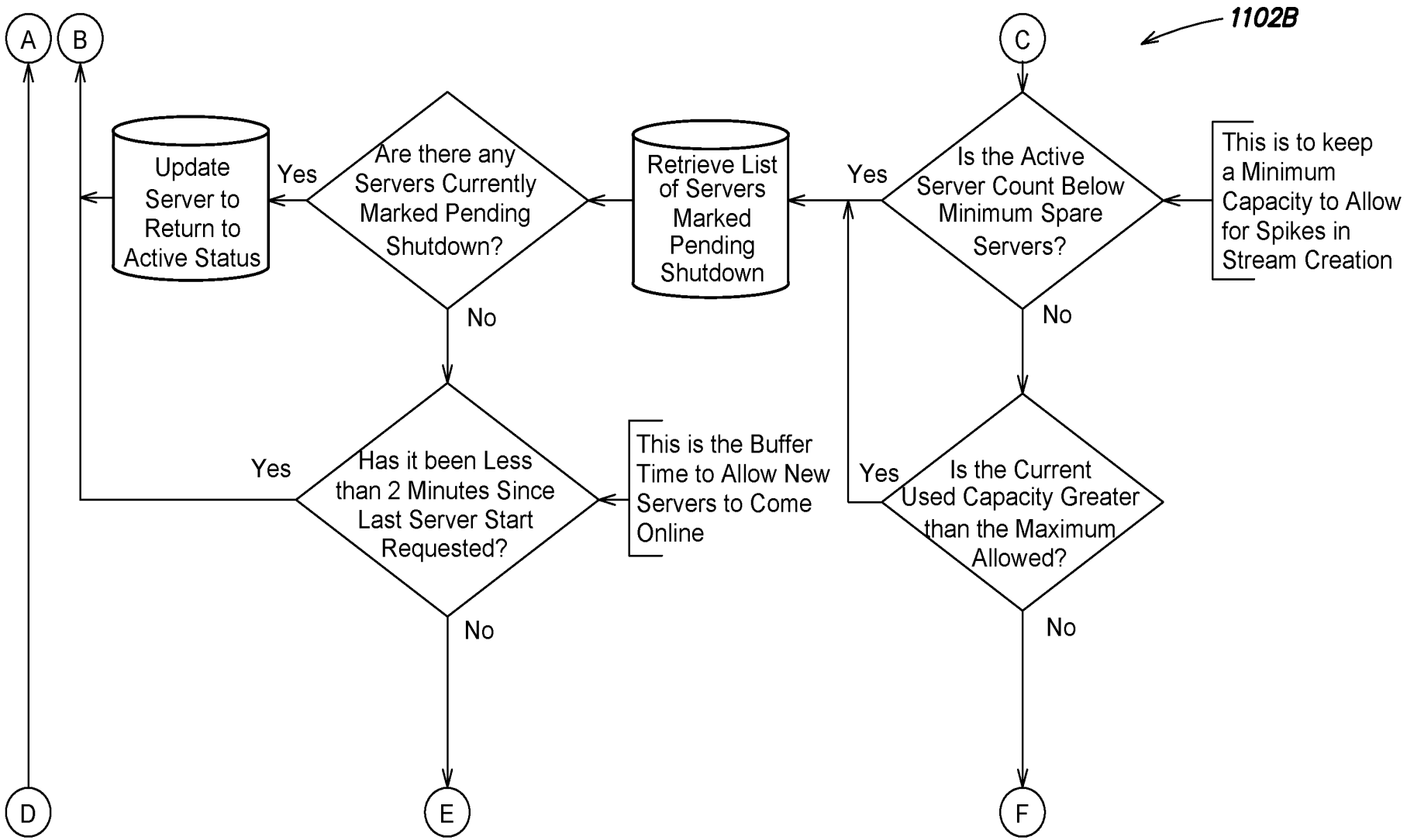


FIG. 11B

Genius Sports Ex. 1008
p. 129

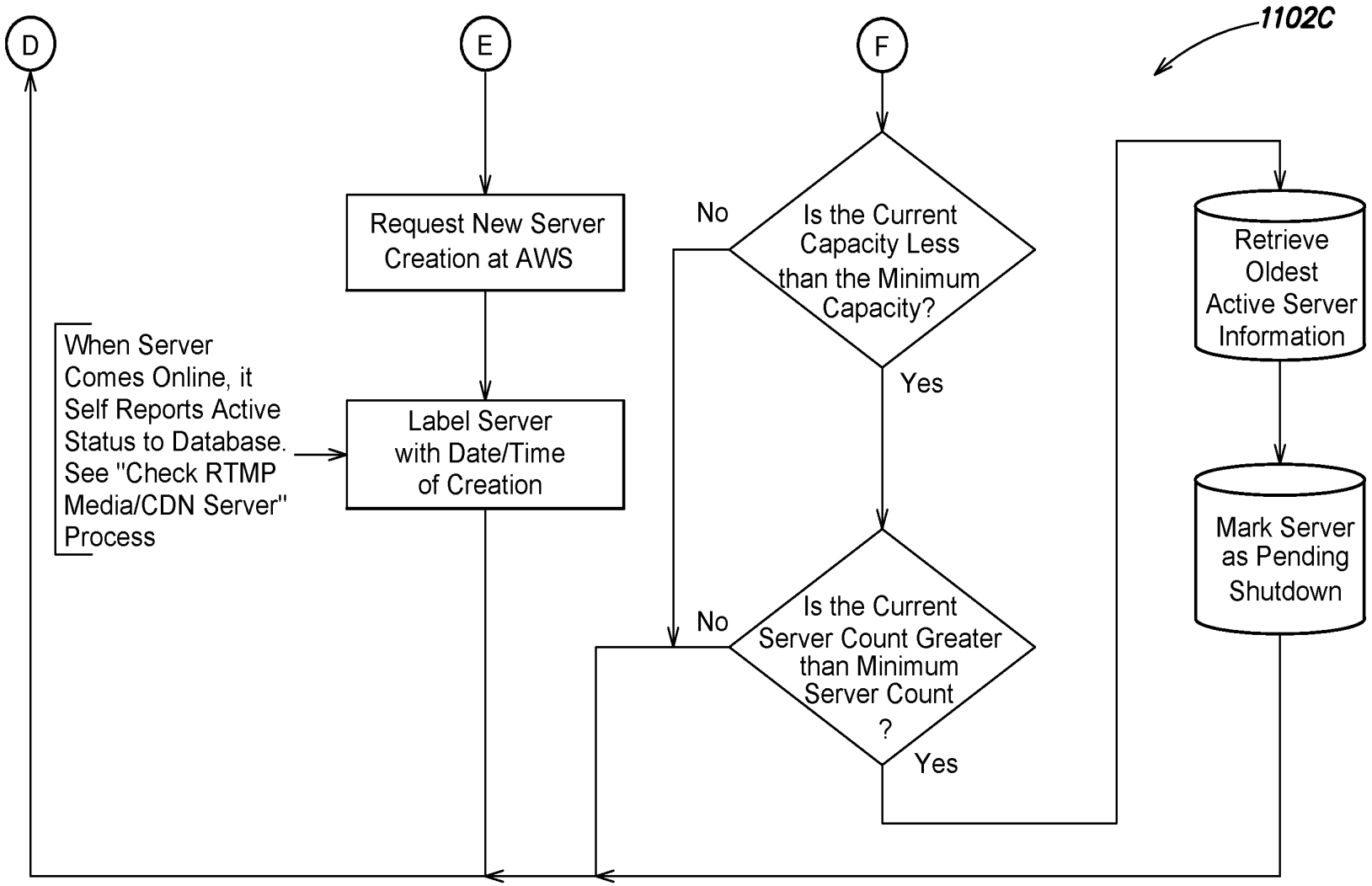


FIG. 11C

Genius Sports Ex. 1008
p. 130

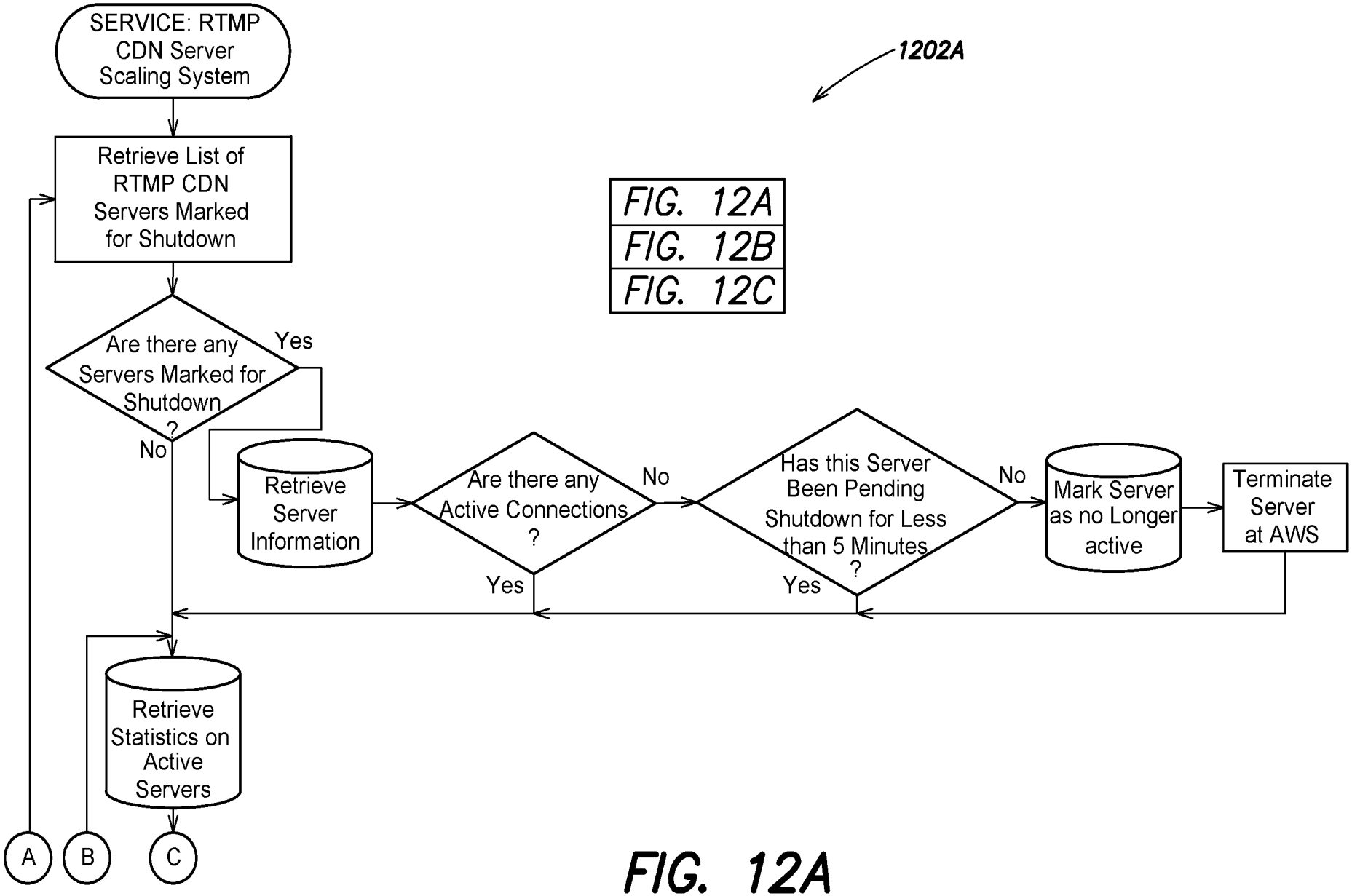


FIG. 12A
FIG. 12B
FIG. 12C

FIG. 12A

Genius Sports Ex. 1008
p. 131

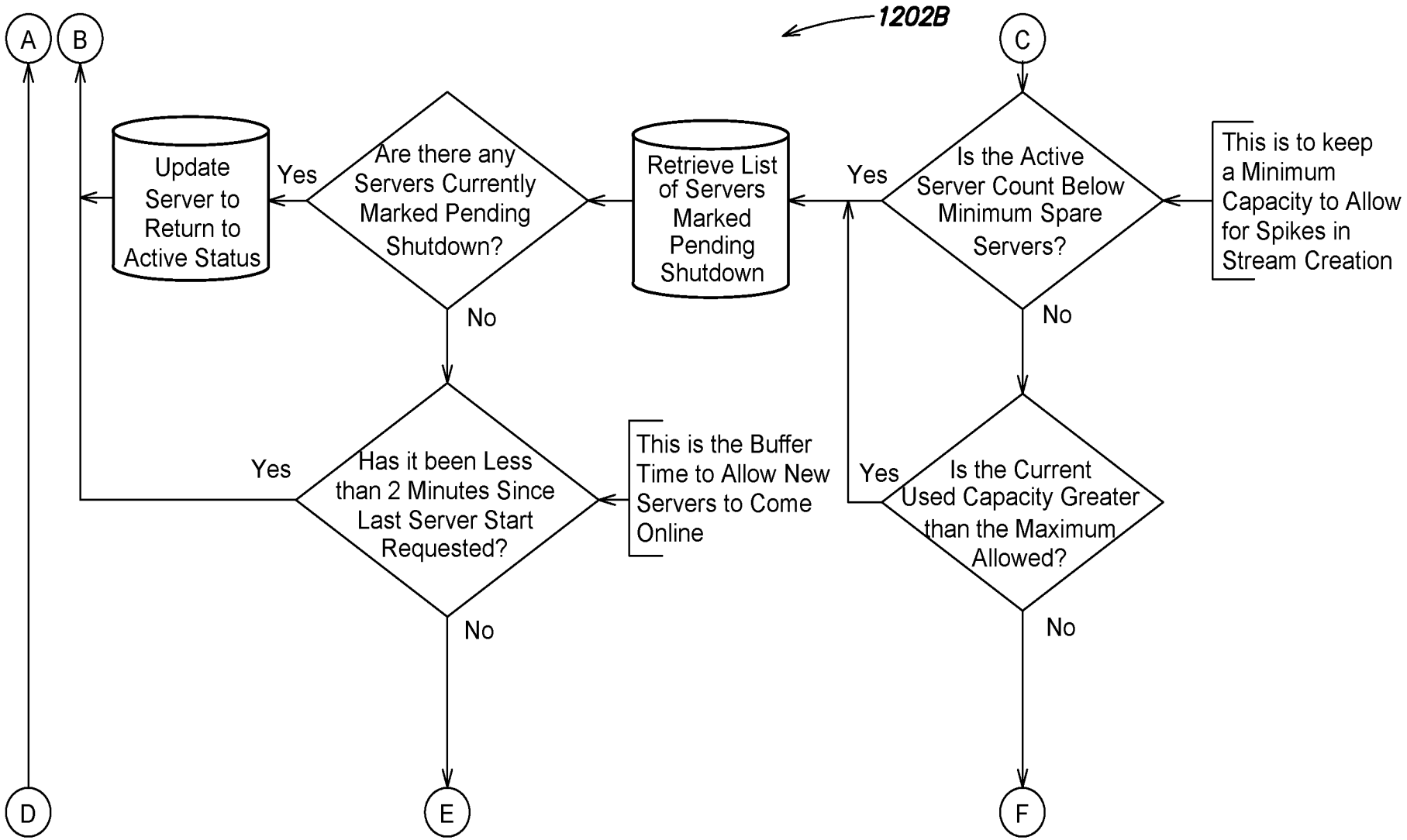


FIG. 12B

Genius Sports Ex. 1008
p. 132

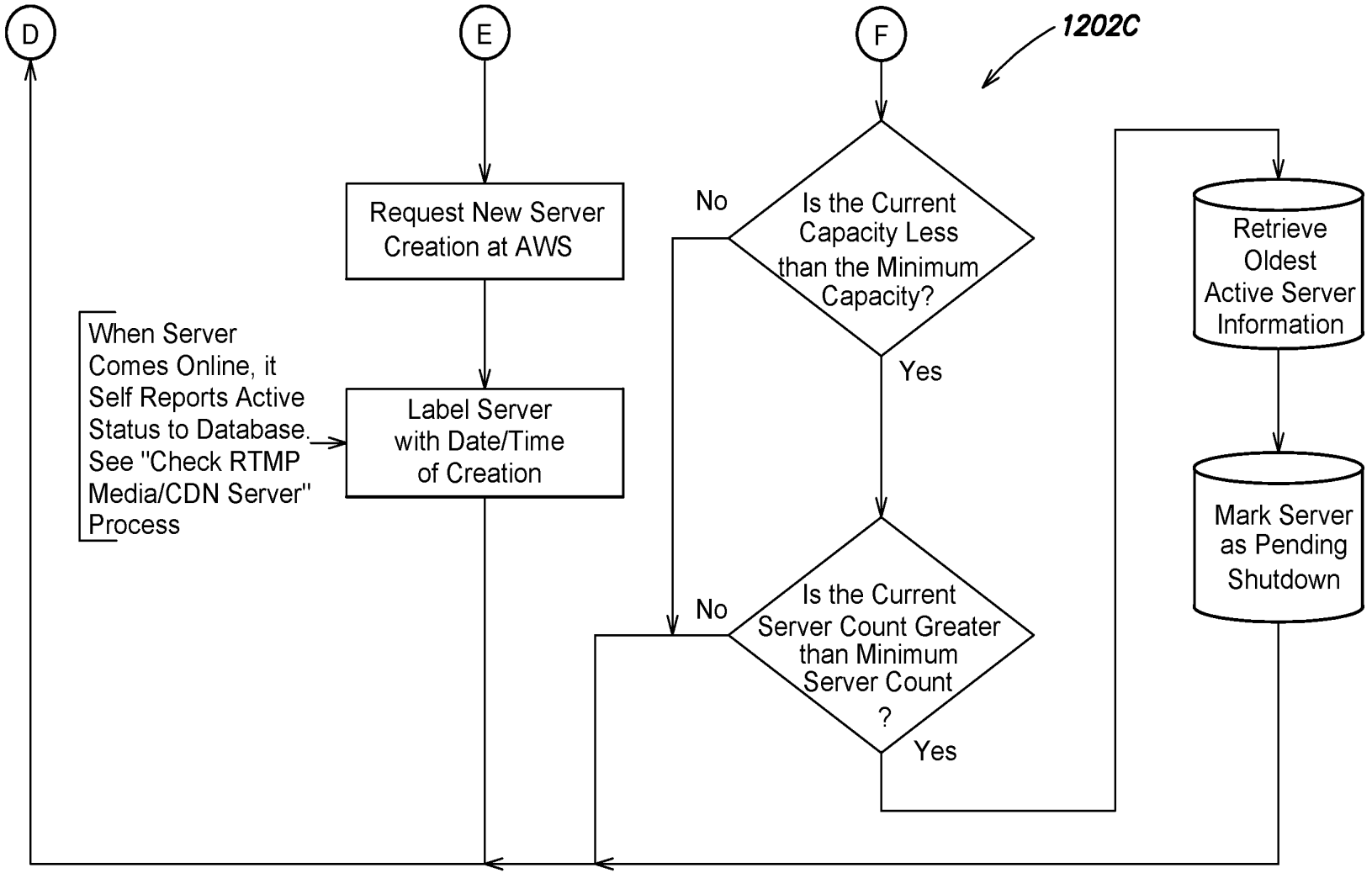


FIG. 12C

Genius Sports Ex. 1008
p. 133

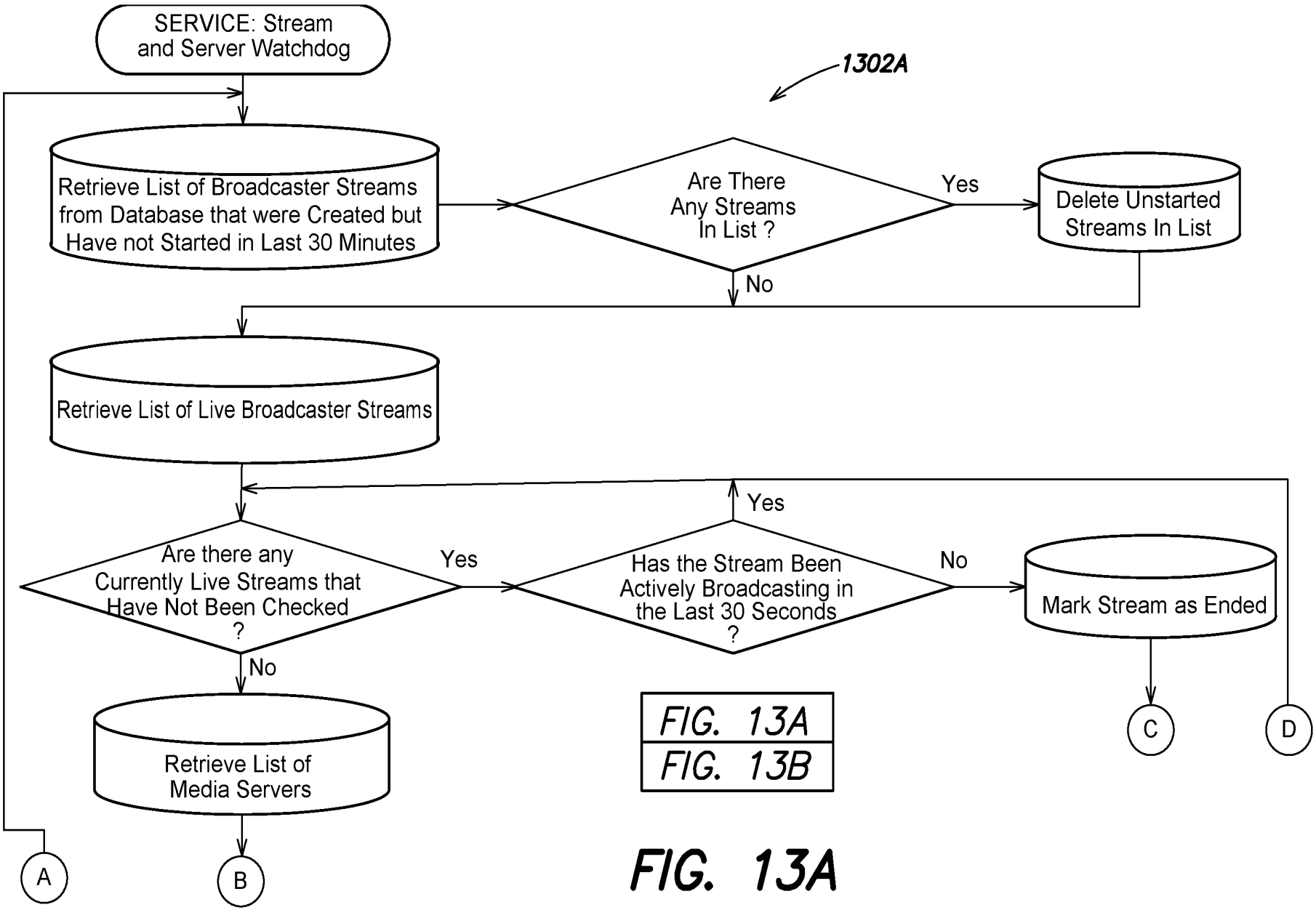


FIG. 13A
FIG. 13B

FIG. 13A

Genius Sports Ex. 1008
p. 134

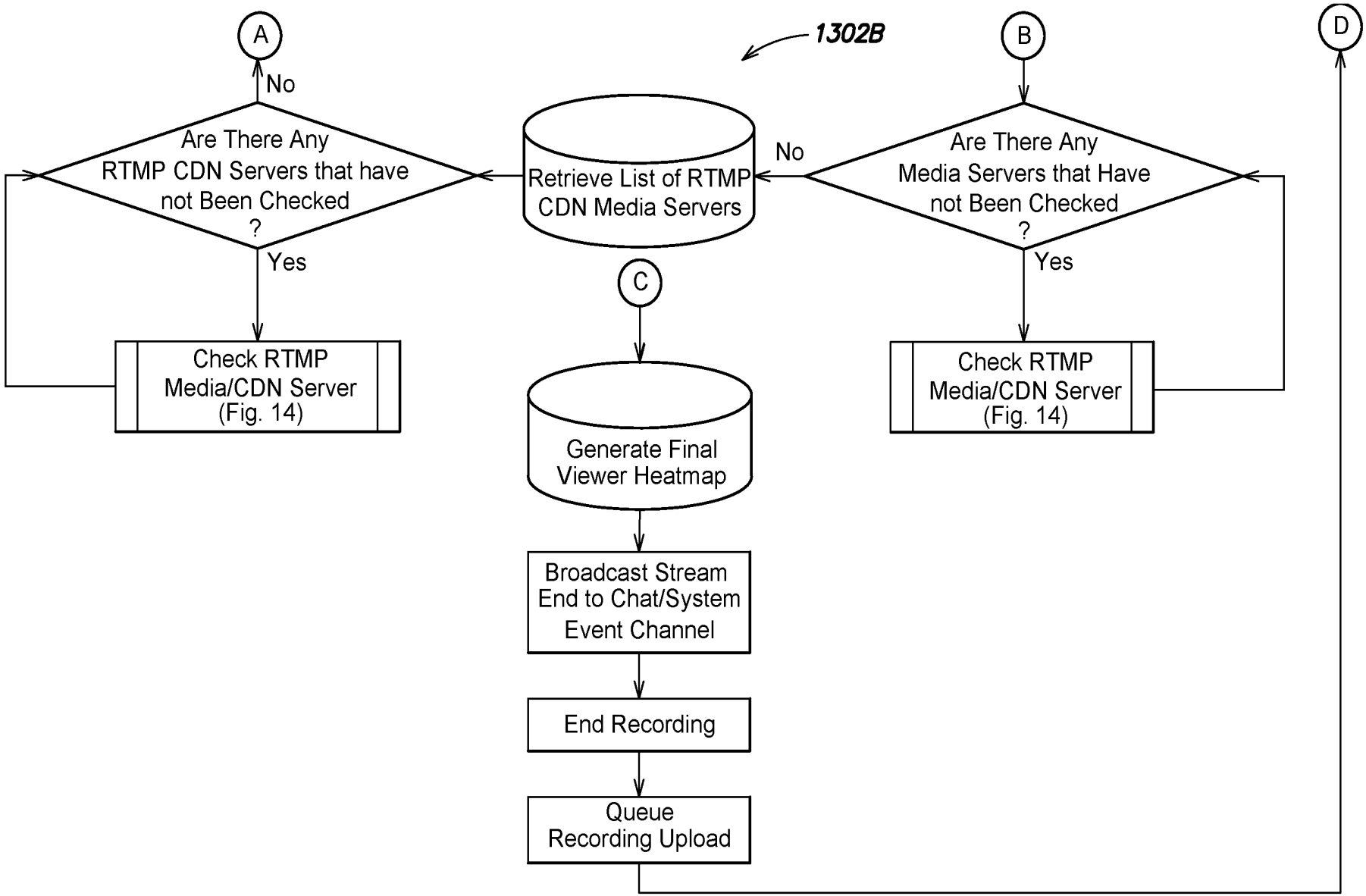


FIG. 13B

Genius Sports Ex. 1008
p. 135

FIG. 14A
FIG. 14B

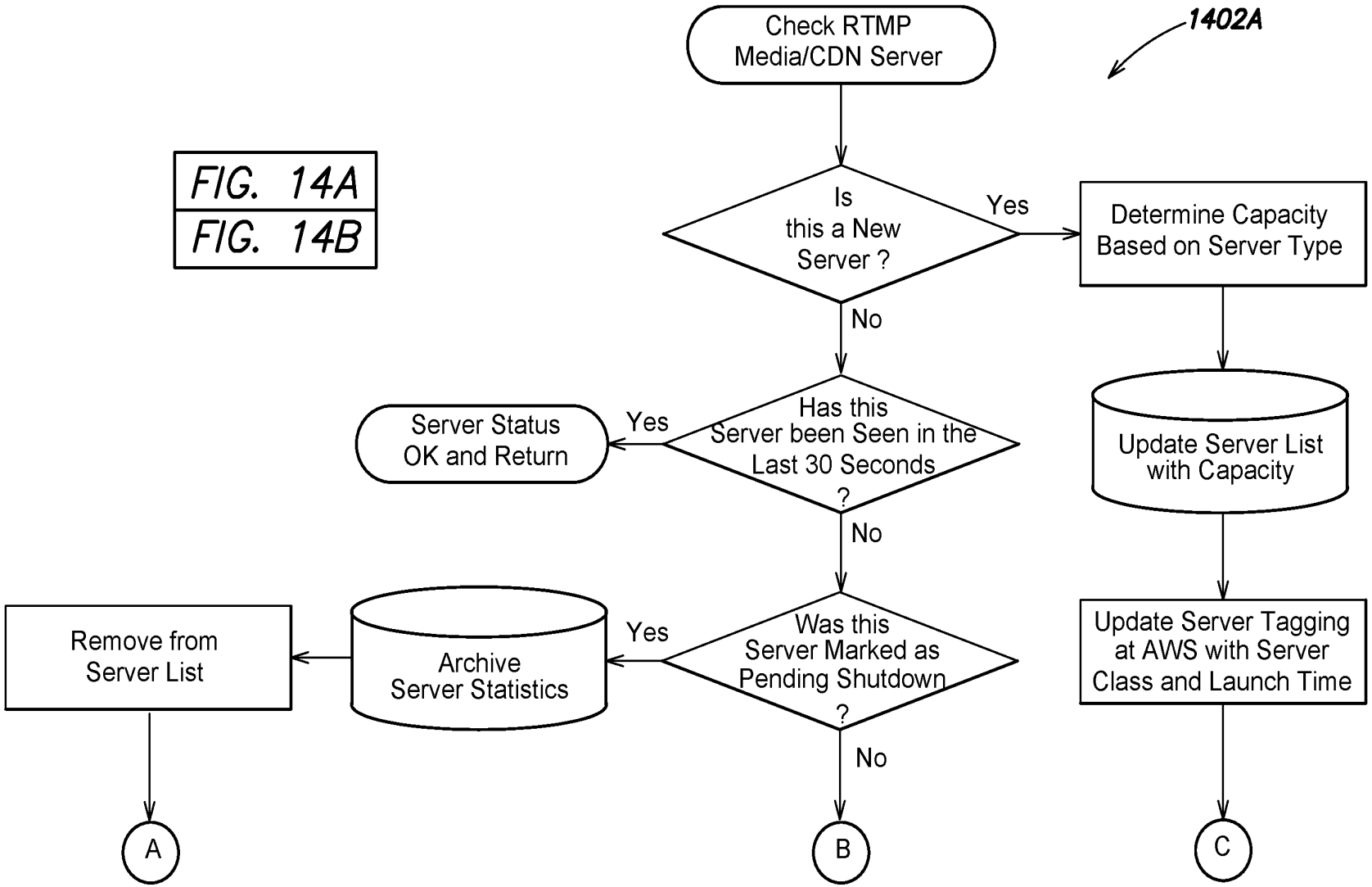


FIG. 14A

Genius Sports Ex. 1008
p. 136

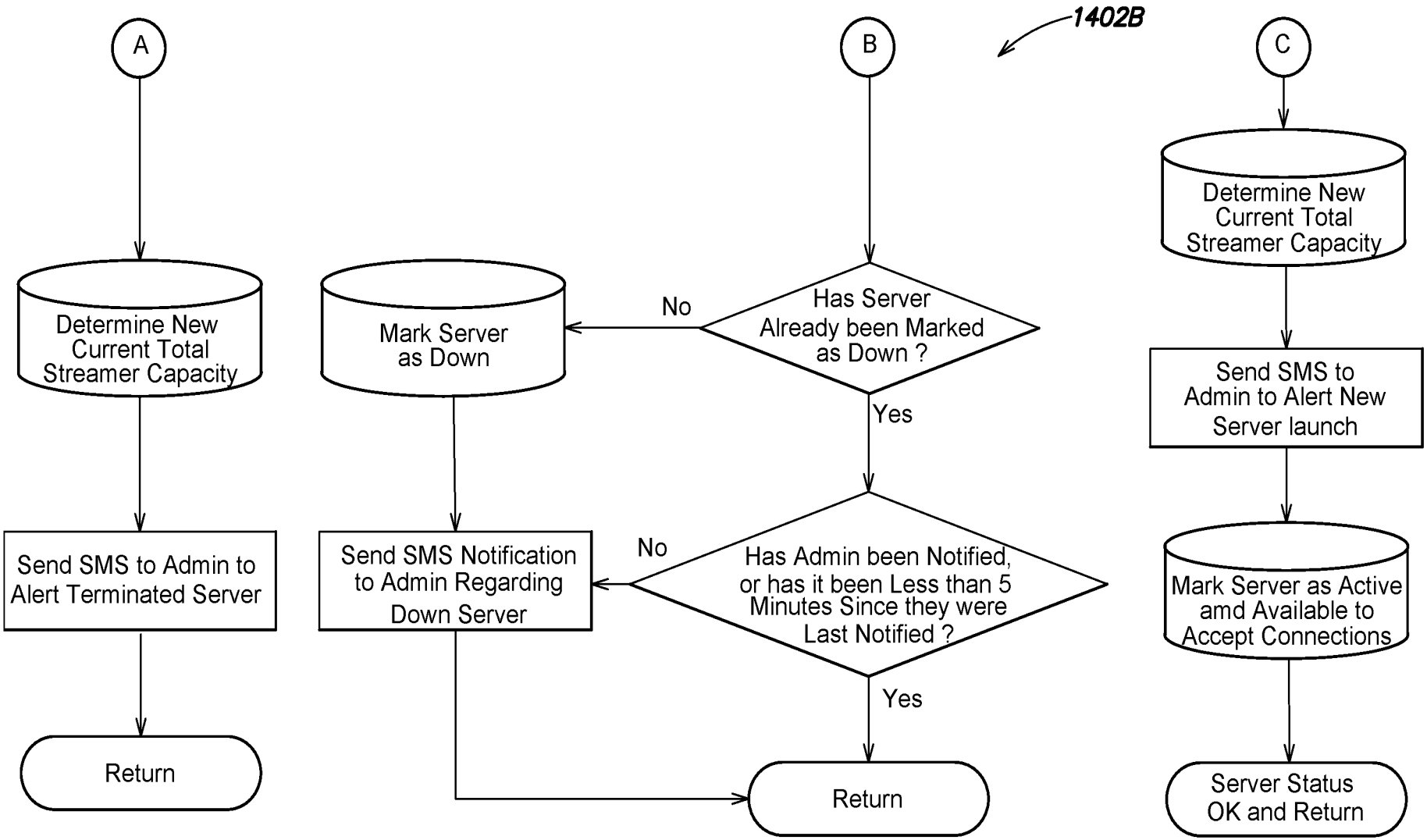


FIG. 14B

Genius Sports Ex. 1008
p. 137

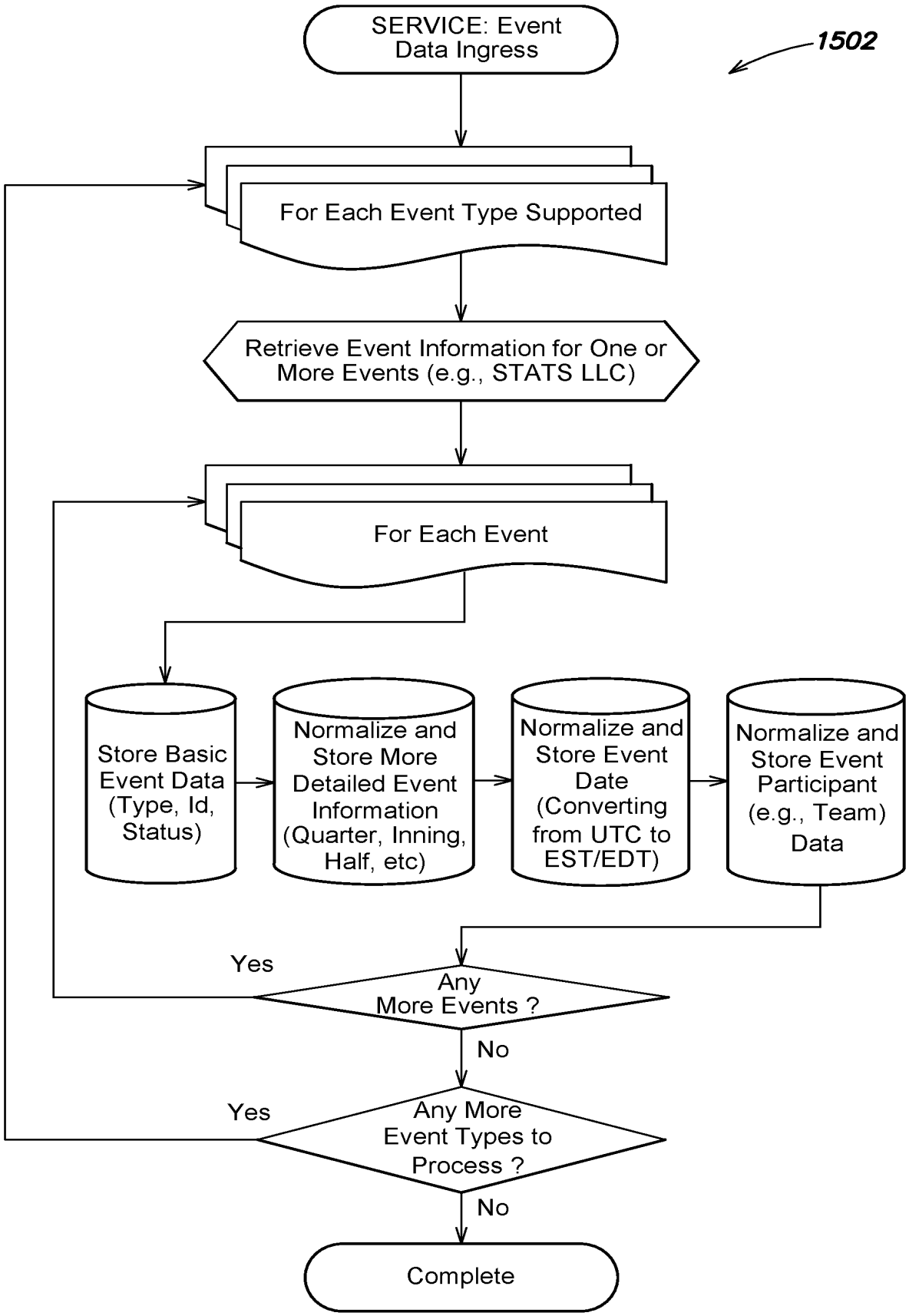

SERVICE: Event Data Ingress
1502
For Each Event Type Supported
Retrieve Event Information for One or More Events (e.g., STATS LLC)
For Each Event
Store Basic Event Data (Type, Id, Status)
Normalize and Store More Detailed Event Information (Quarter, Inning, Half, etc)
Normalize and Store Event Date (Converting 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

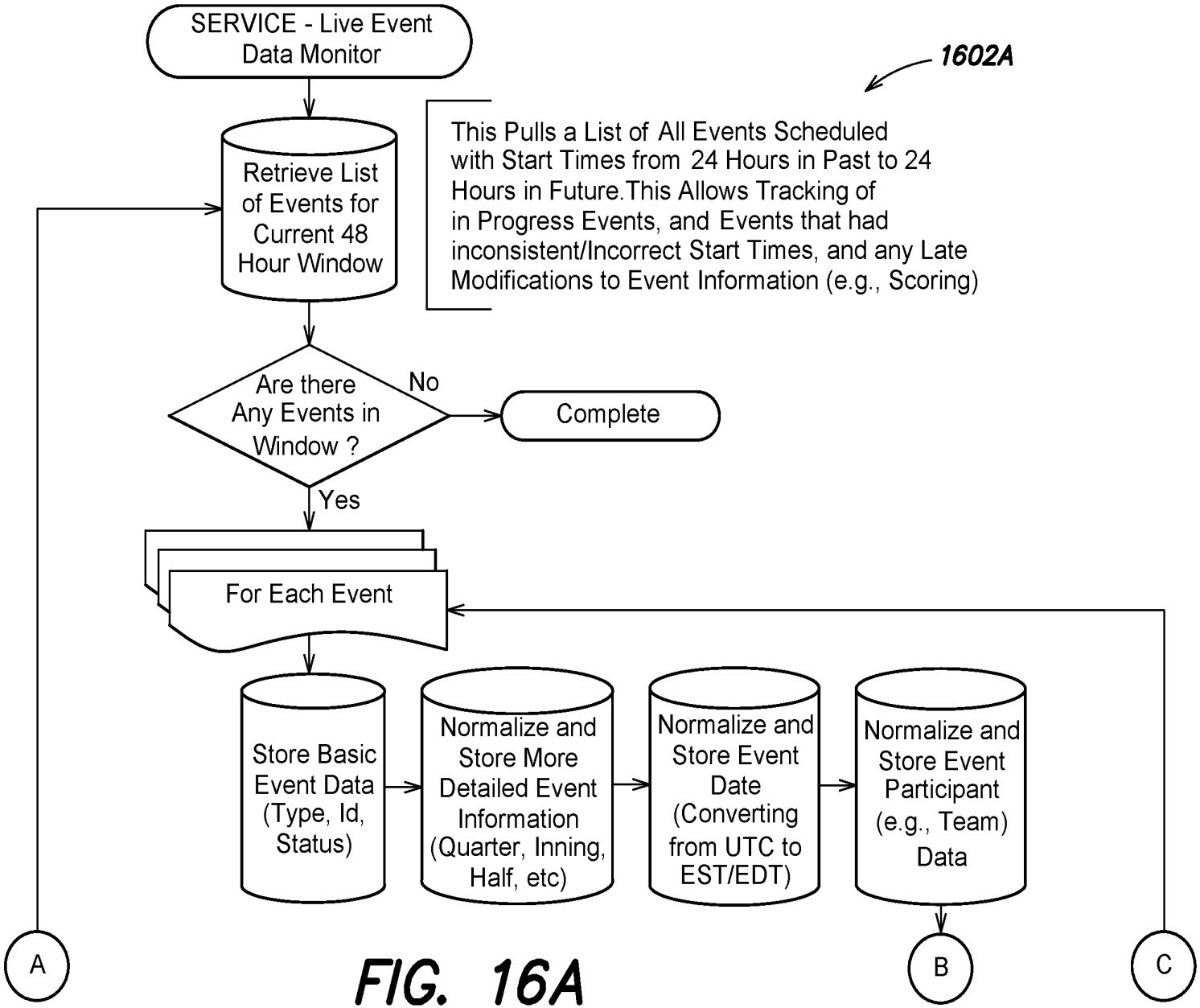


FIG. 16A
FIG. 16B

FIG. 16A

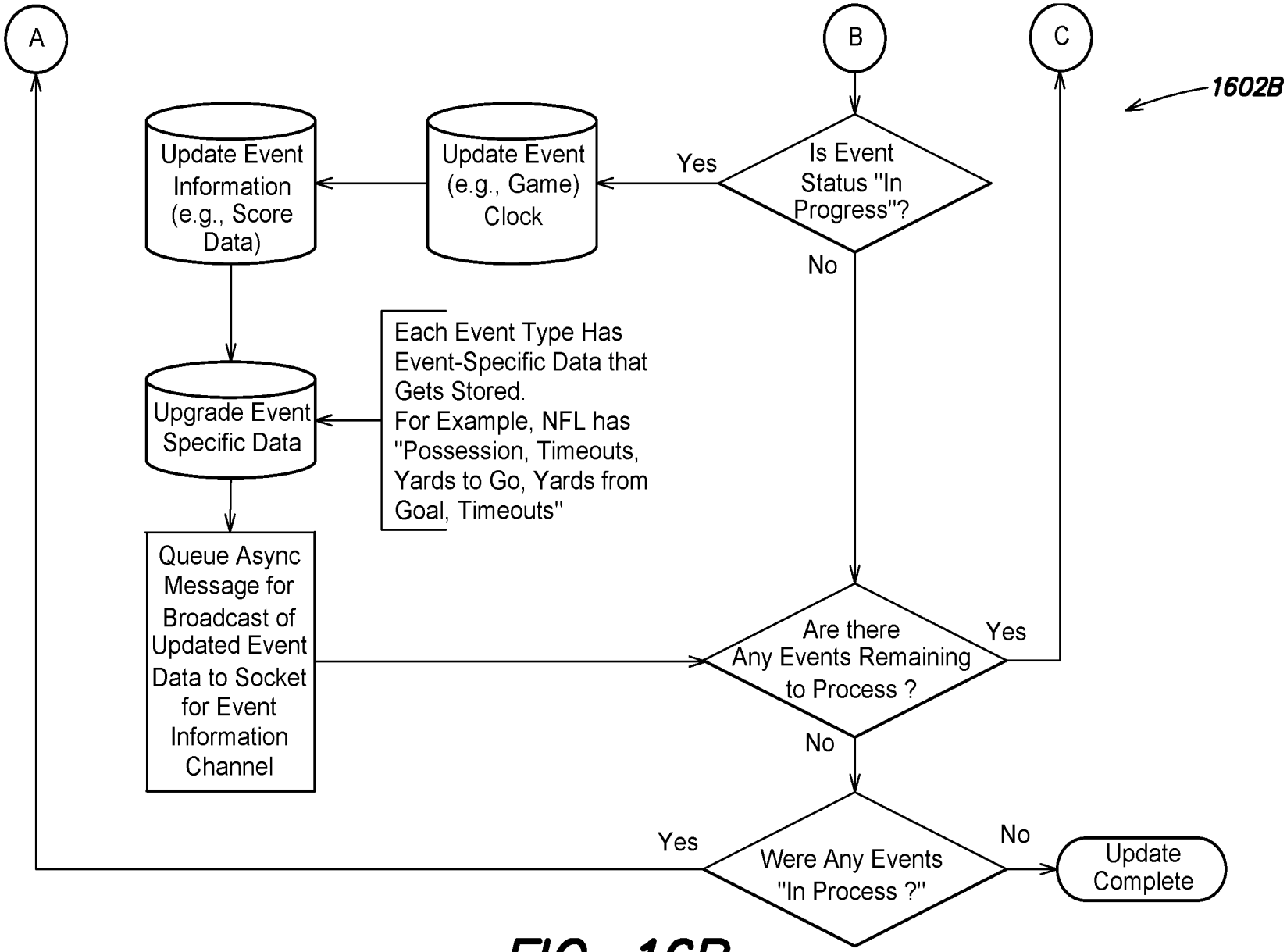


FIG. 16B

Genius Sports Ex. 1008
p. 140

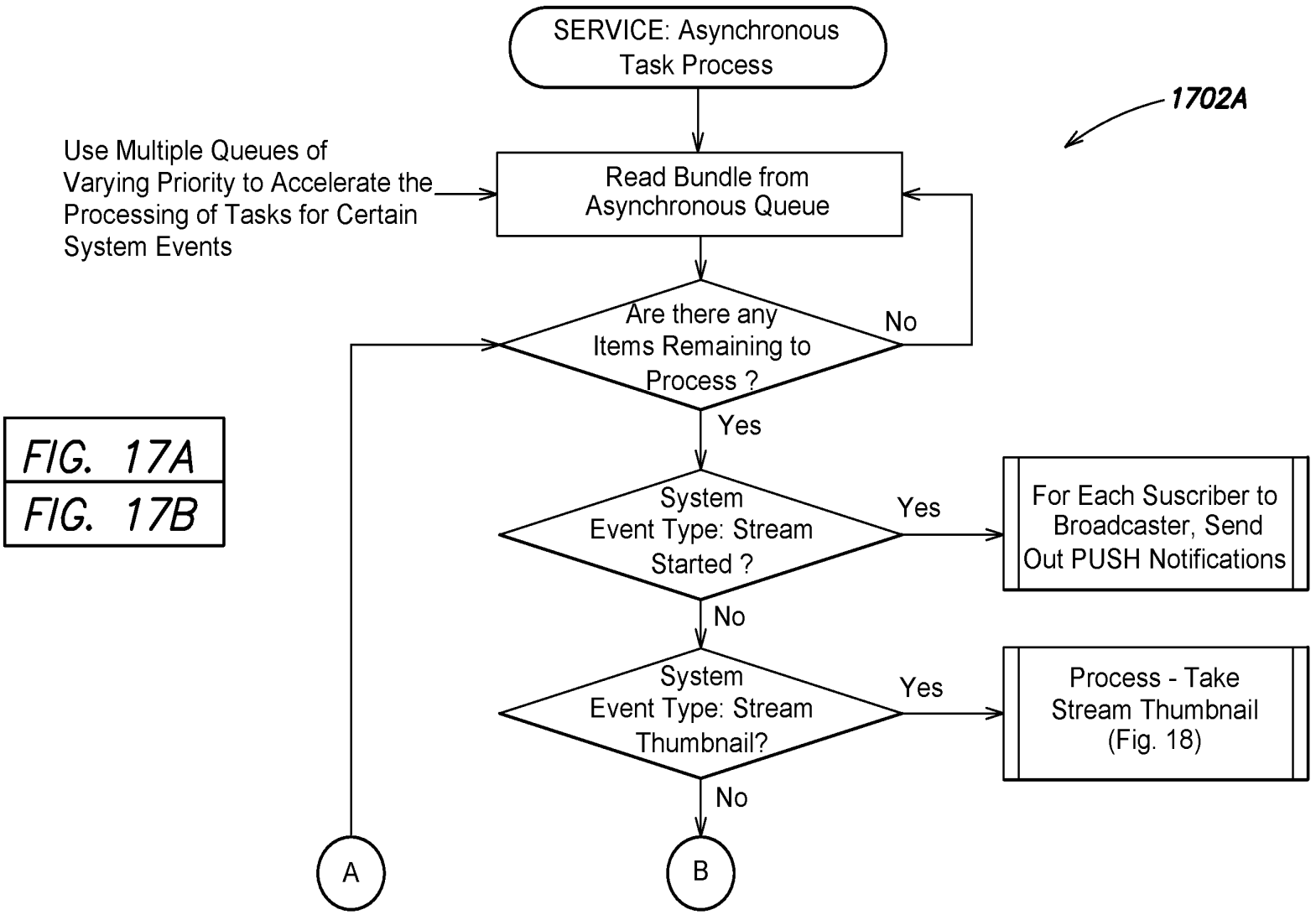


FIG. 17A
FIG. 17B

FIG. 17A

Genius Sports Ex. 1008
p. 141

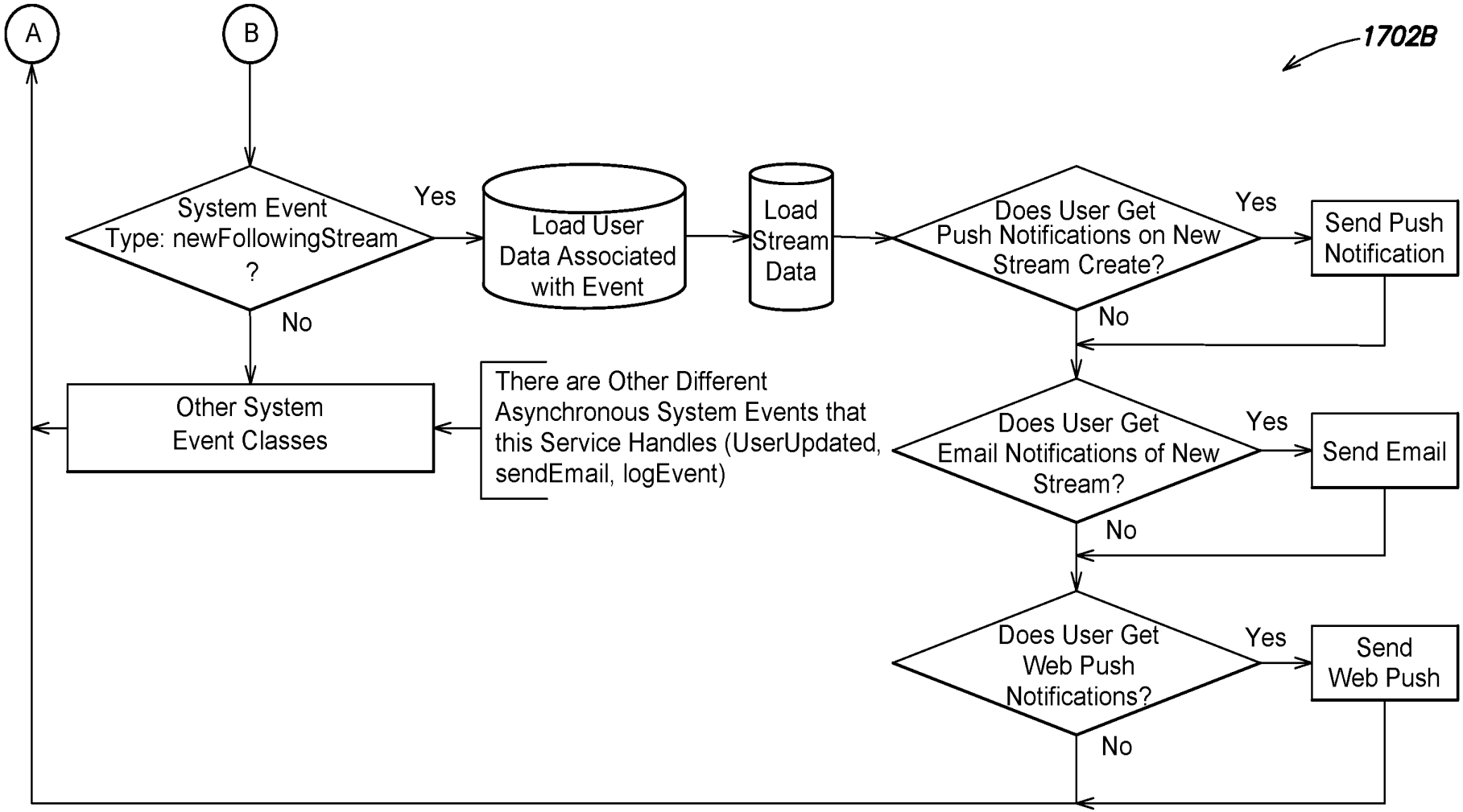


FIG. 17B

Genius Sports Ex. 1008
p. 142

FIG. 18A
FIG. 18B

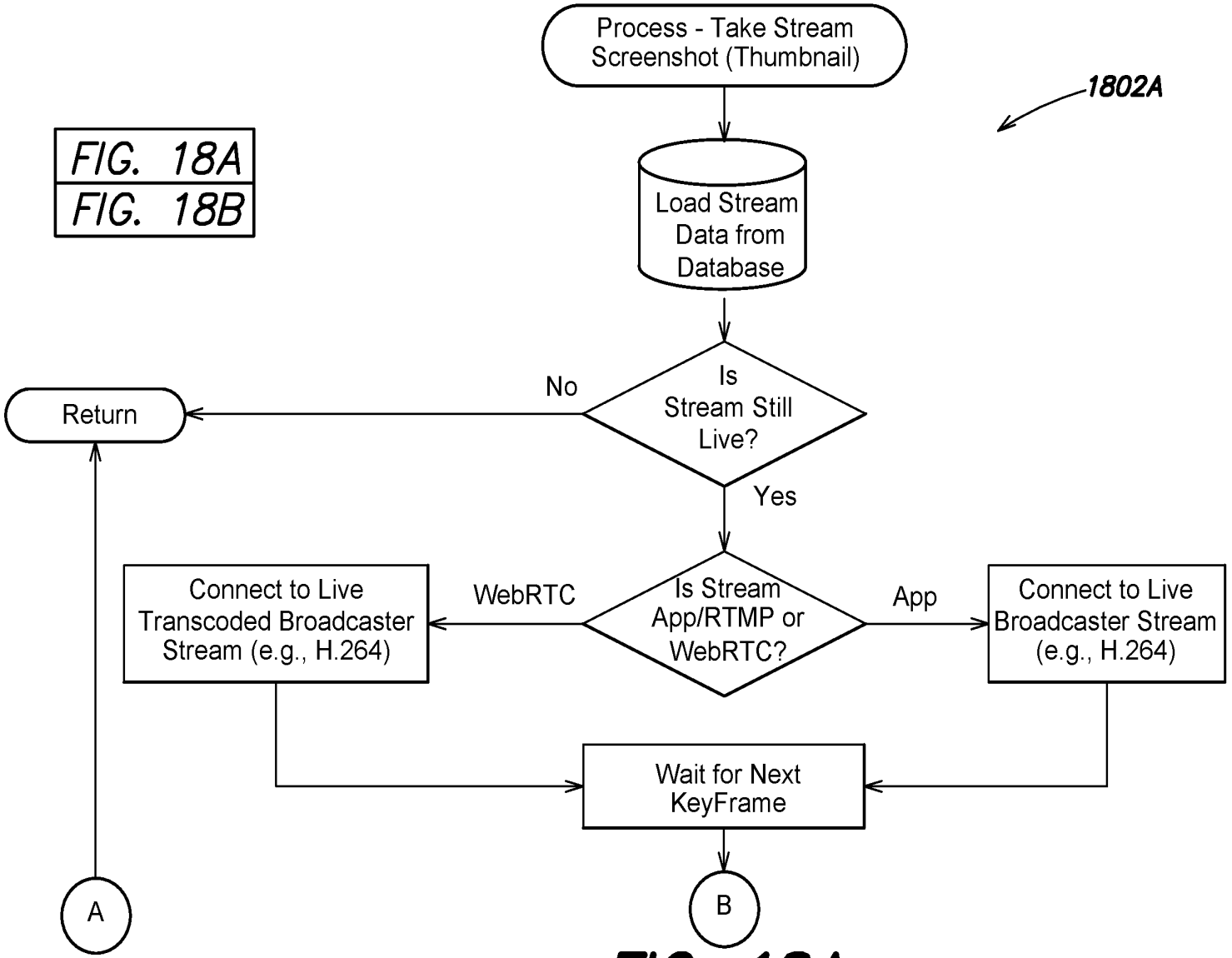


FIG. 18A

Genius Sports Ex. 1008
p. 143

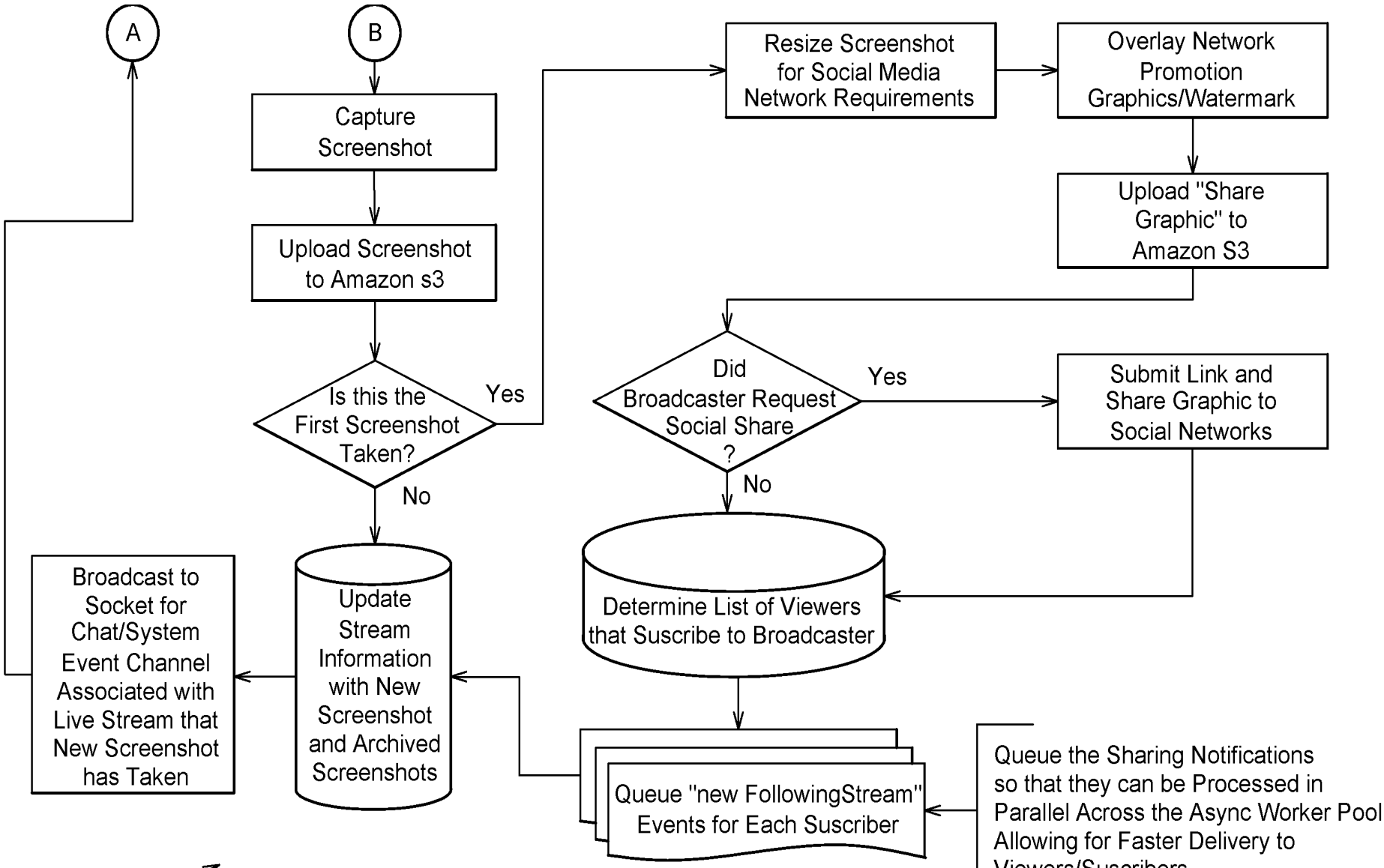


FIG. 18B

Genius Sports Ex. 1008
p. 144

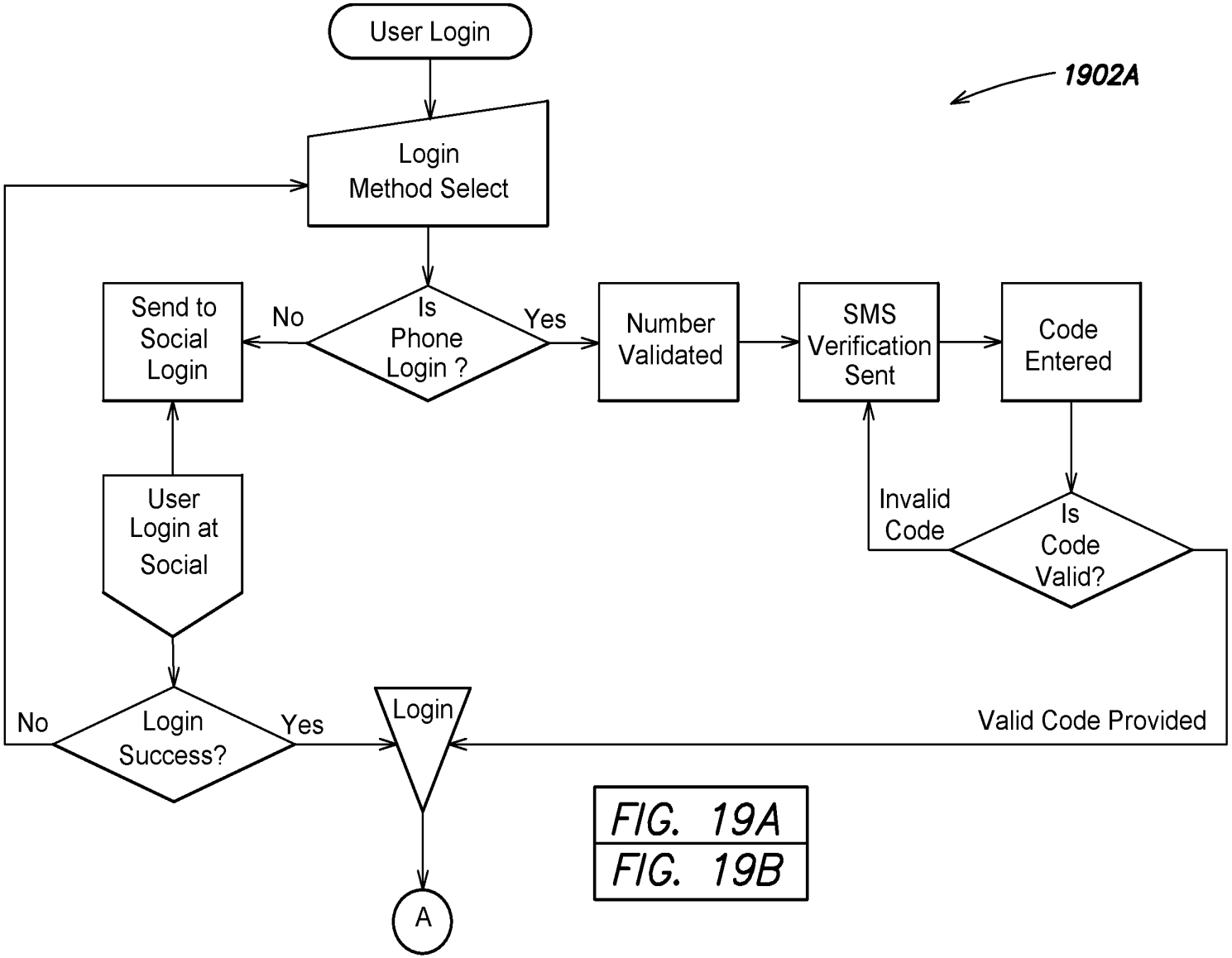


FIG. 19A
FIG. 19B

FIG. 19A

Genius Sports Ex. 1008
p. 145

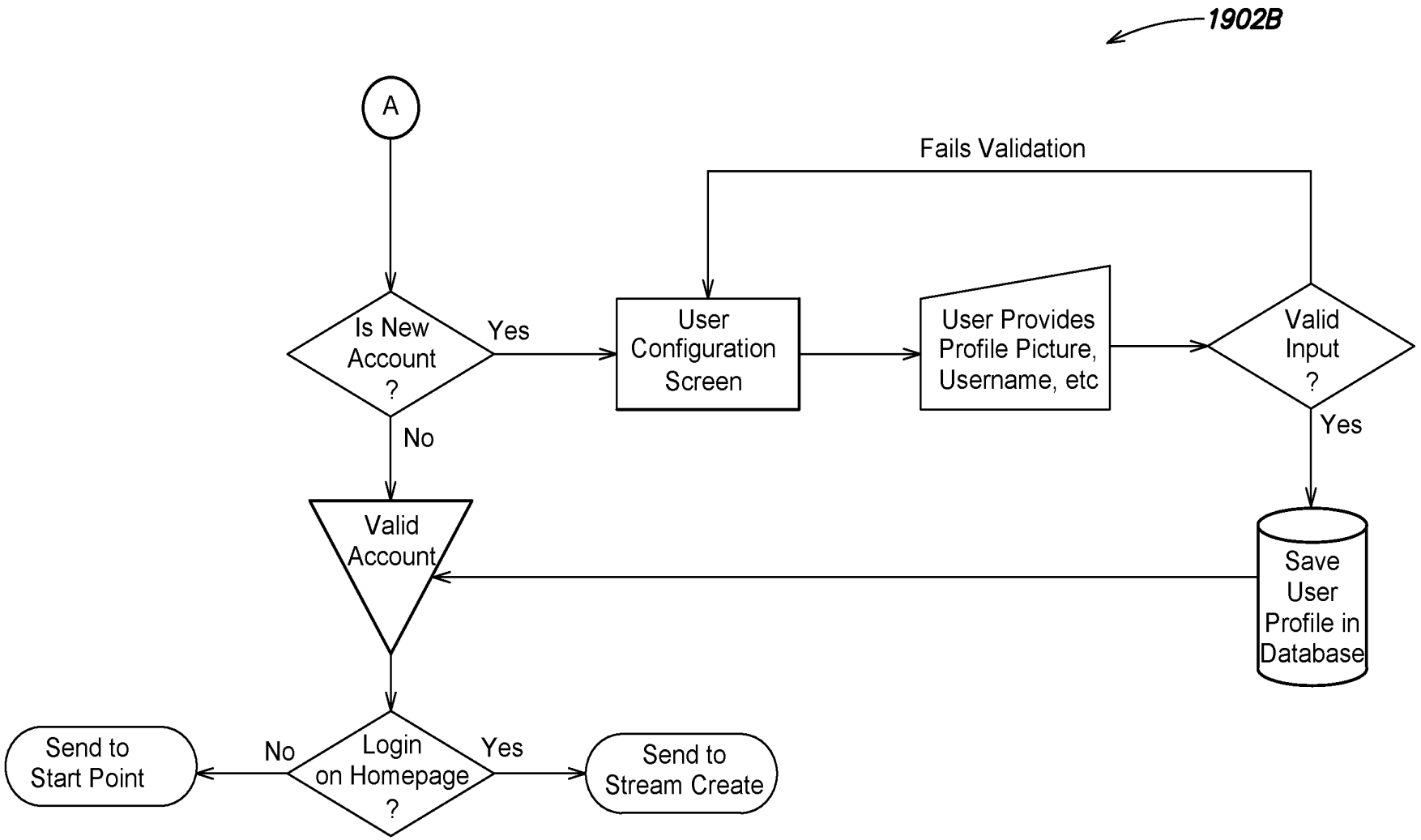


FIG. 19B

Genius Sports Ex. 1008
p. 146

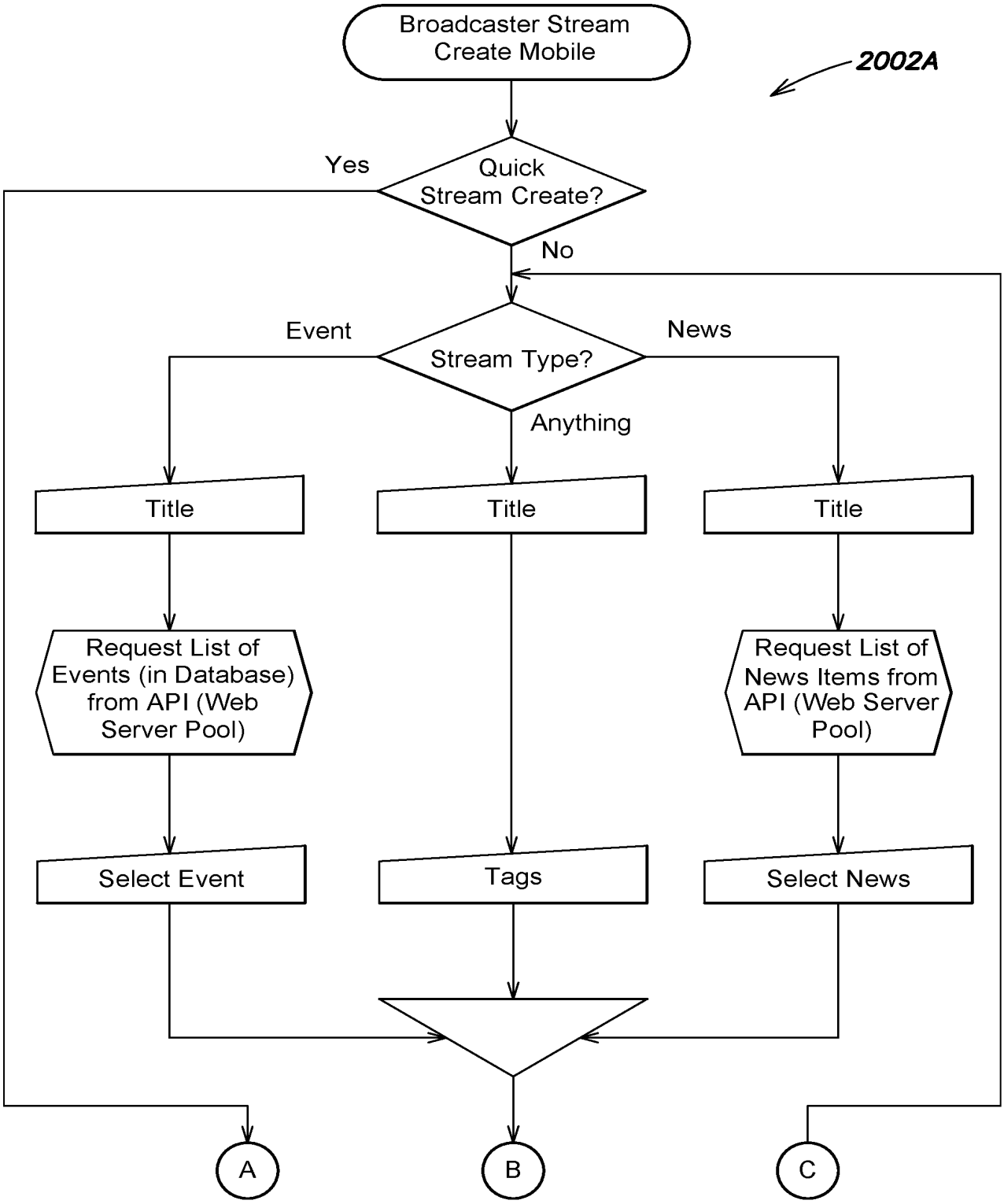


FIG. 20A
FIG. 20B

FIG. 20A

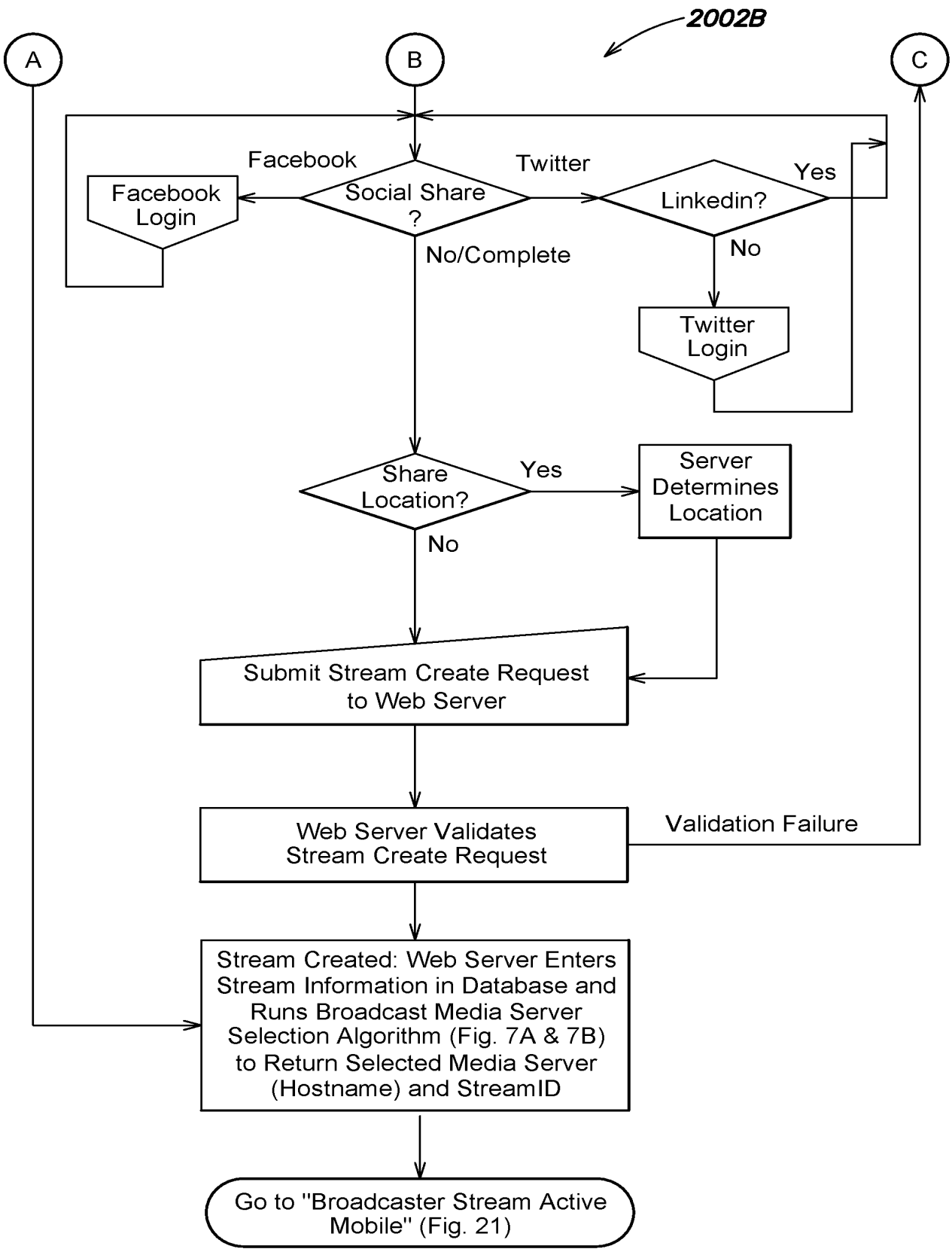

2002B
A
B
C
Facebook
Twitter
Yes
Facebook Login
Social Share ?
Linkedin?
No/Complete
No
Twitter Login
Share Location?
Yes
Server Determines Location
No
Submit Stream Create Request to Web Server
Web Server Validates Stream Create Request
Validation Failure
Stream Created: Web Server Enters Stream Information 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

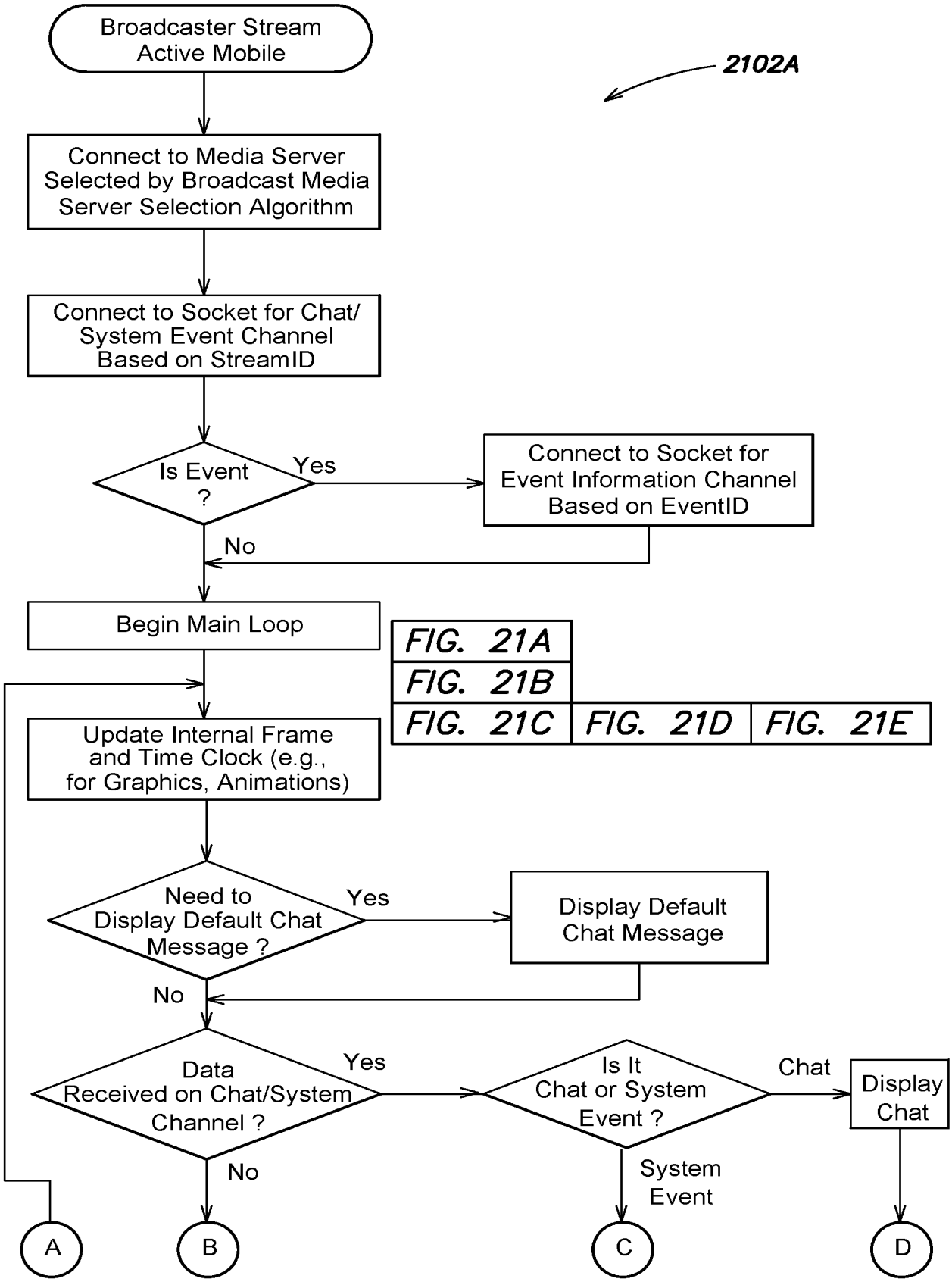

Broadcaster Stream Active Mobile
2102A
Connect to Media Server Selected by Broadcast Media Server Selection Algorithm
Connect to Socket for Chat/ System Event Channel Based on StreamID
Is Event ?
Yes
Connect to Socket for Event Information Channel Based on EventID
No
Begin Main Loop
FIG. 21A
FIG. 21B
FIG. 21C
FIG. 21D
FIG. 21E
Update Internal Frame and Time Clock (e.g., for Graphics, Animations)
Need to Display Default Chat Message ?
Yes
Display Default Chat Message
No
Data Received on Chat/System Channel ?
Yes
Is It Chat or System Event ?
Chat
Display Chat
No
System Event
A
B
C
D

FIG. 21A

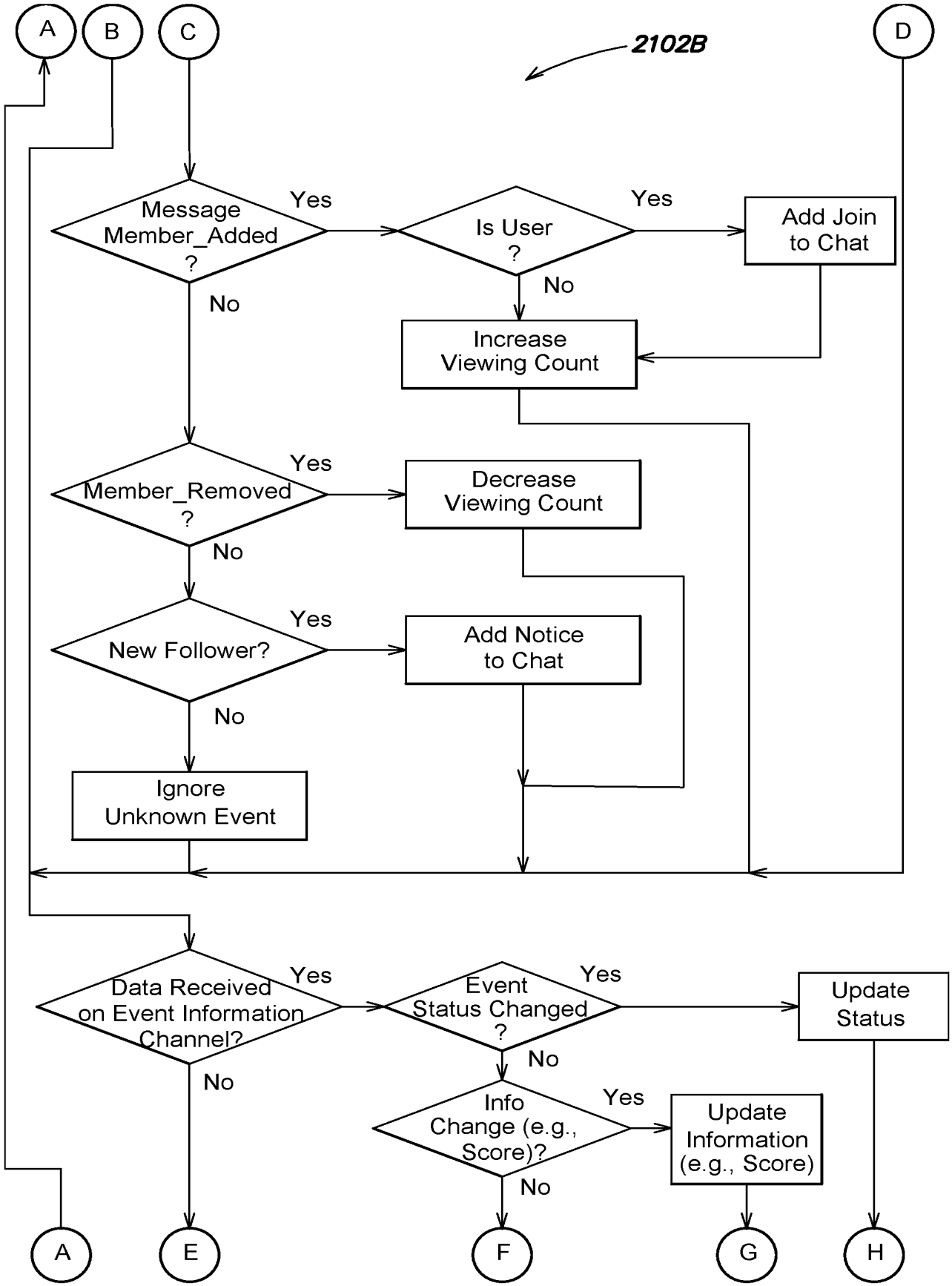

A
B
C
D
2102B
Message Member_Added ?
Yes
No
Is User ?
Yes
No
Add Join to Chat
Increase Viewing Count
Member_Removed ?
Yes
No
Decrease Viewing Count
New Follower?
Yes
No
Add Notice to Chat
Ignore Unknown Event
Data Received on Event Information Channel?
Yes
No
Event Status Changed ?
Yes
No
Update Status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

FIG. 21B

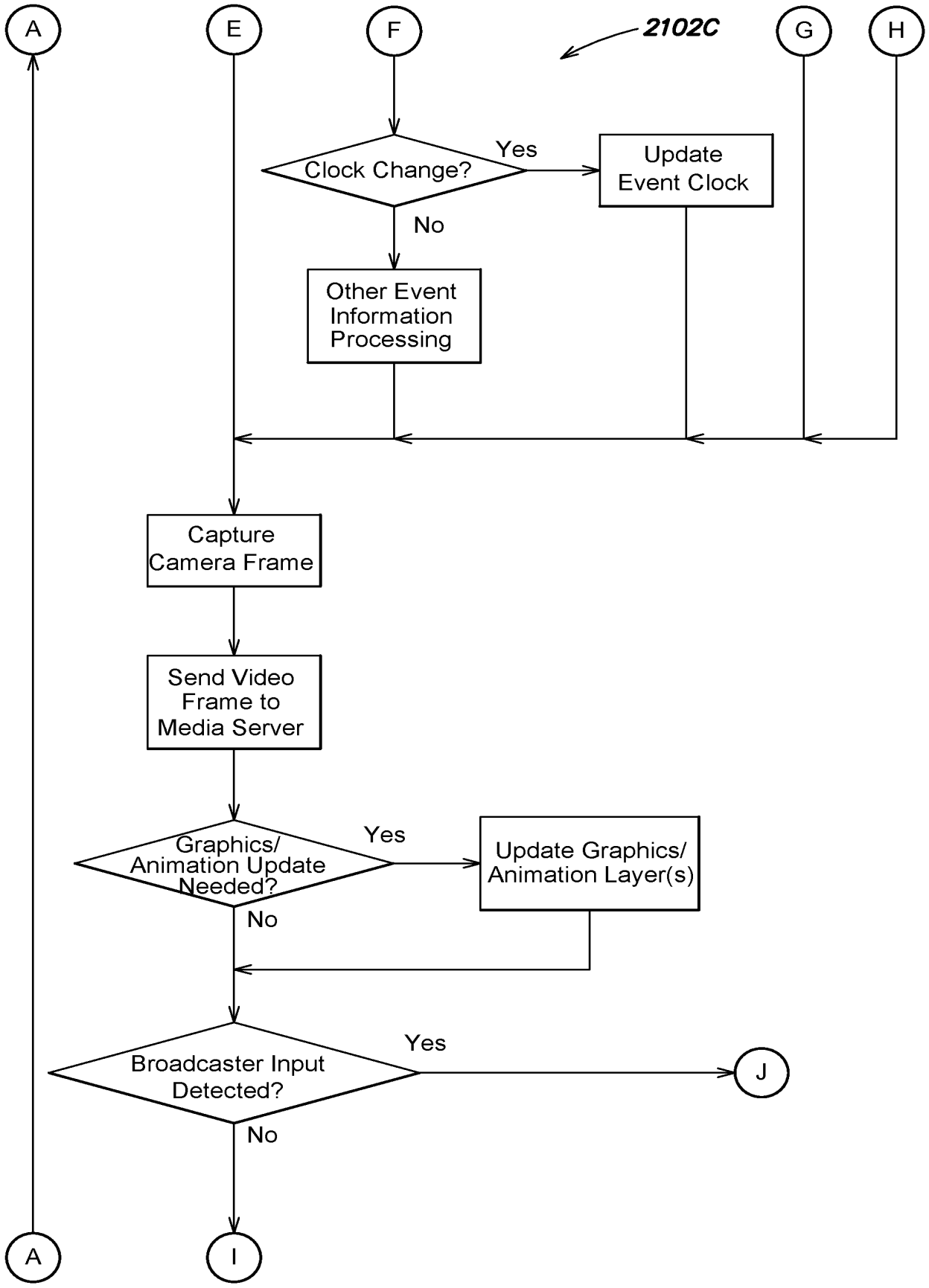

A
E
F
2102C
G
H
Clock Change?
Yes
Update Event Clock
No
Other Event Information Processing
Capture Camera Frame
Send Video Frame to Media Server
Graphics/ Animation Update Needed?
Yes
Update Graphics/ Animation Layer(s)
No
Broadcaster Input Detected?
Yes
J
No
A
I

FIG. 21C

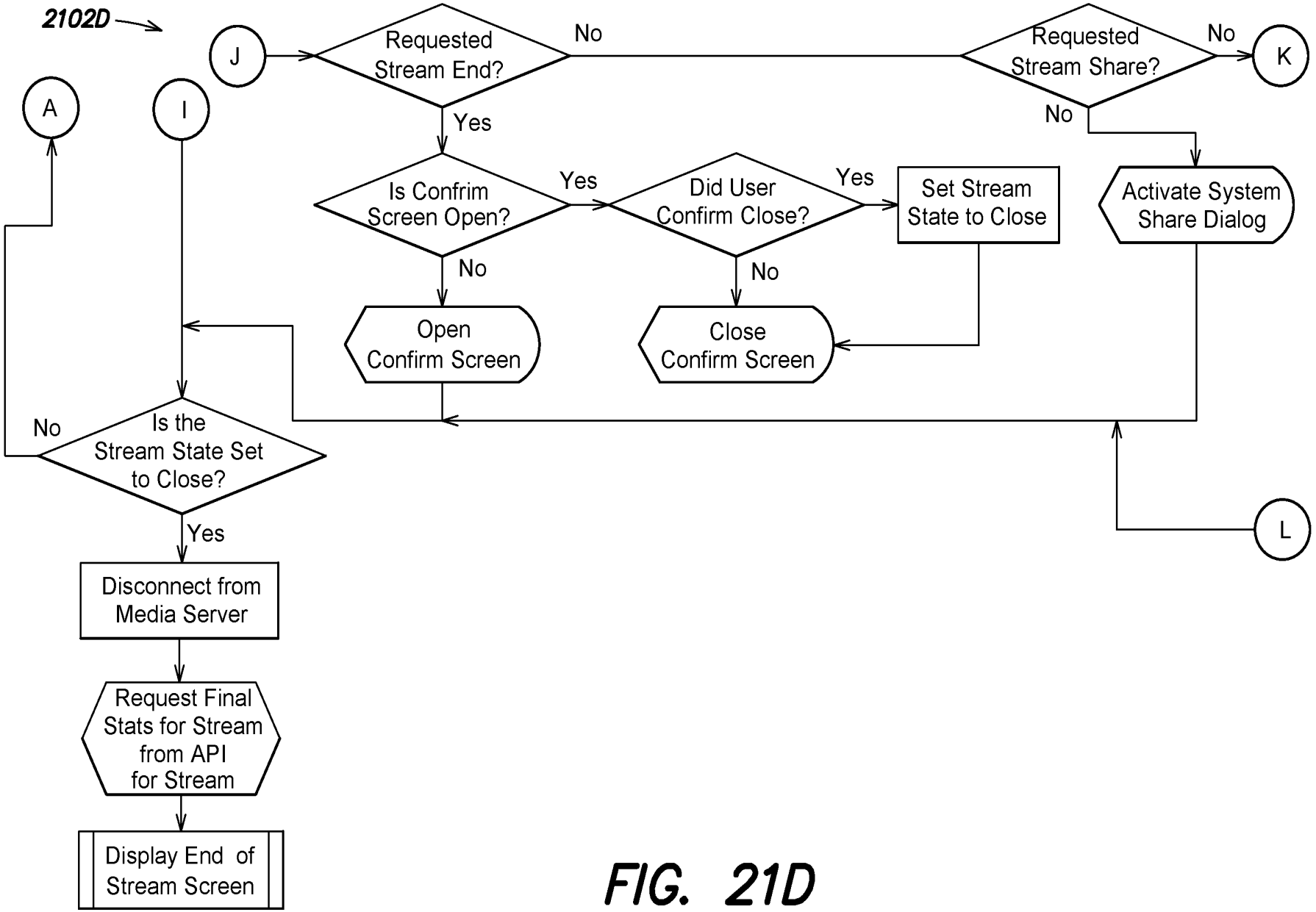


FIG. 21D

Genius Sports Ex. 1008
p. 152

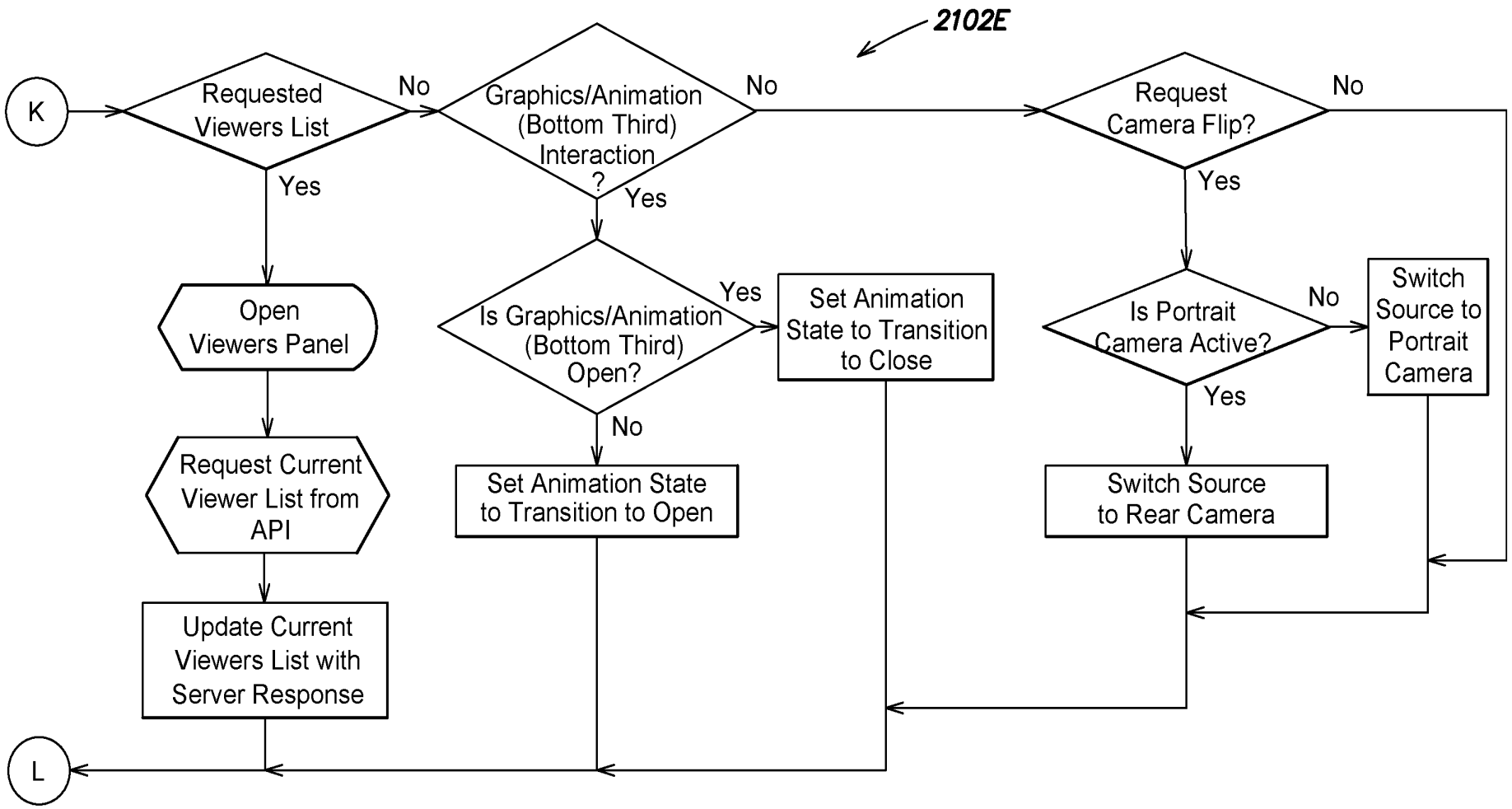


FIG. 21E

Genius Sports Ex. 1008
p. 153

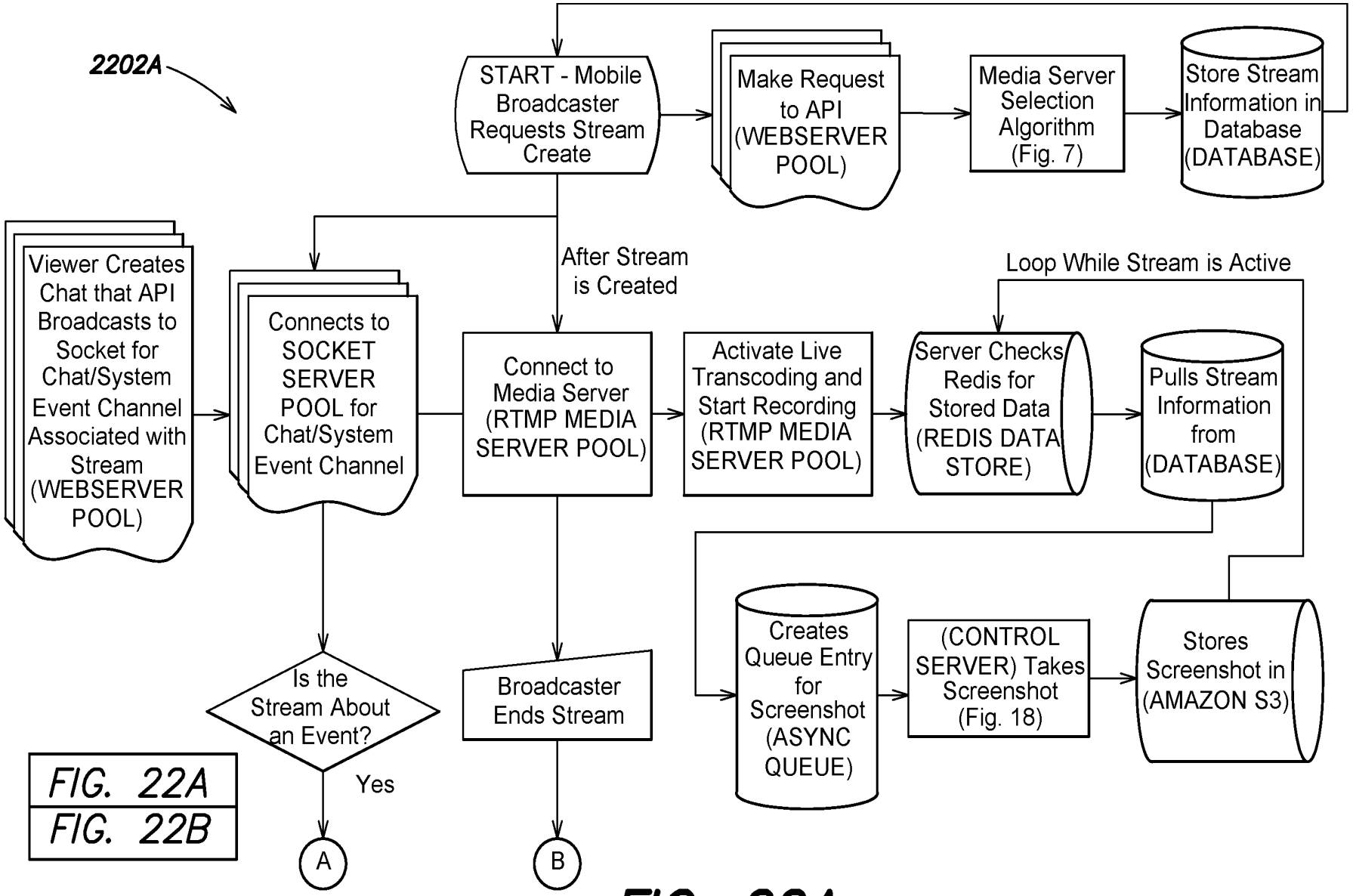


FIG. 22A
FIG. 22B

FIG. 22A

Genius Sports Ex. 1008
p. 154

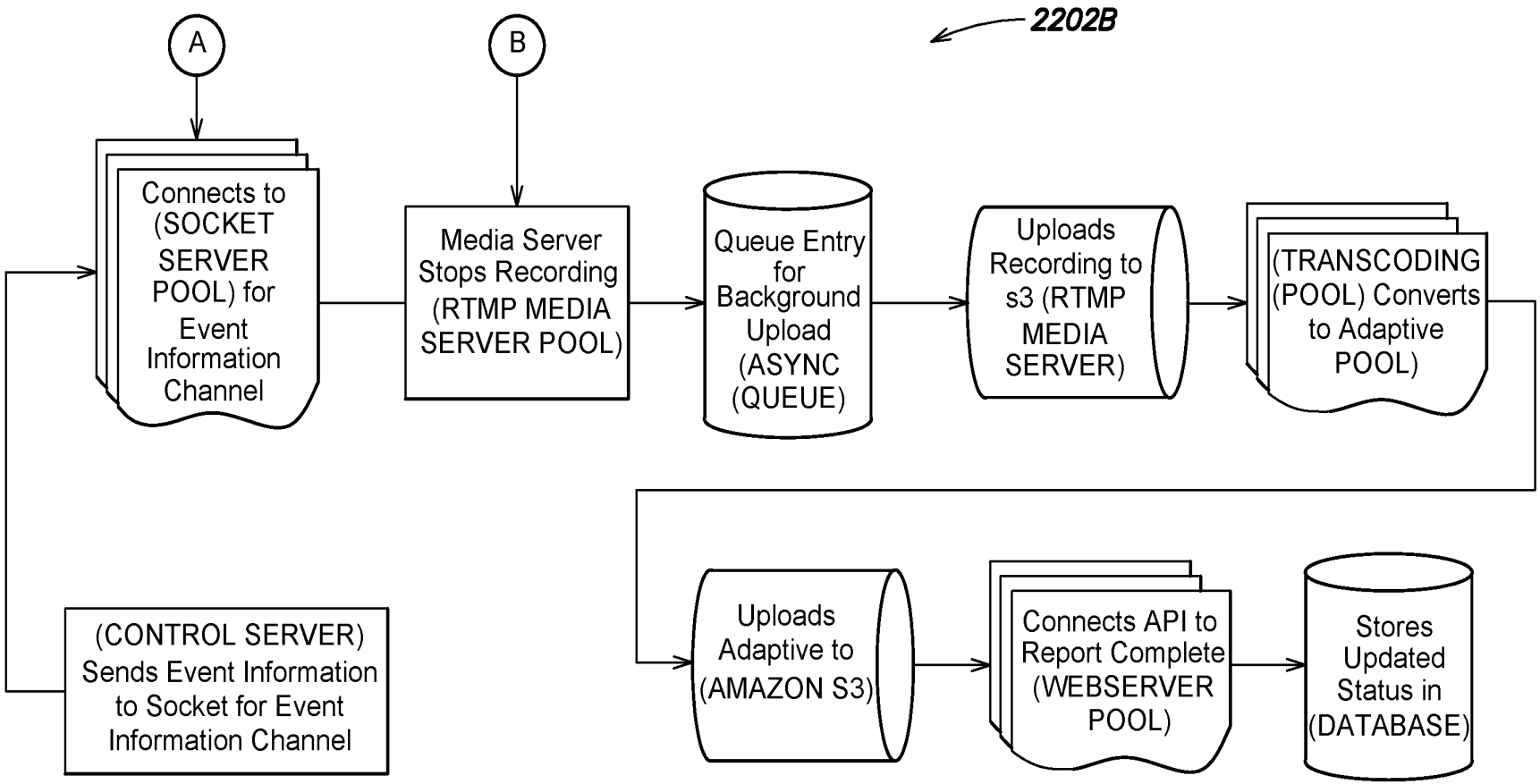


FIG. 22B

Genius Sports Ex. 1008
p. 155

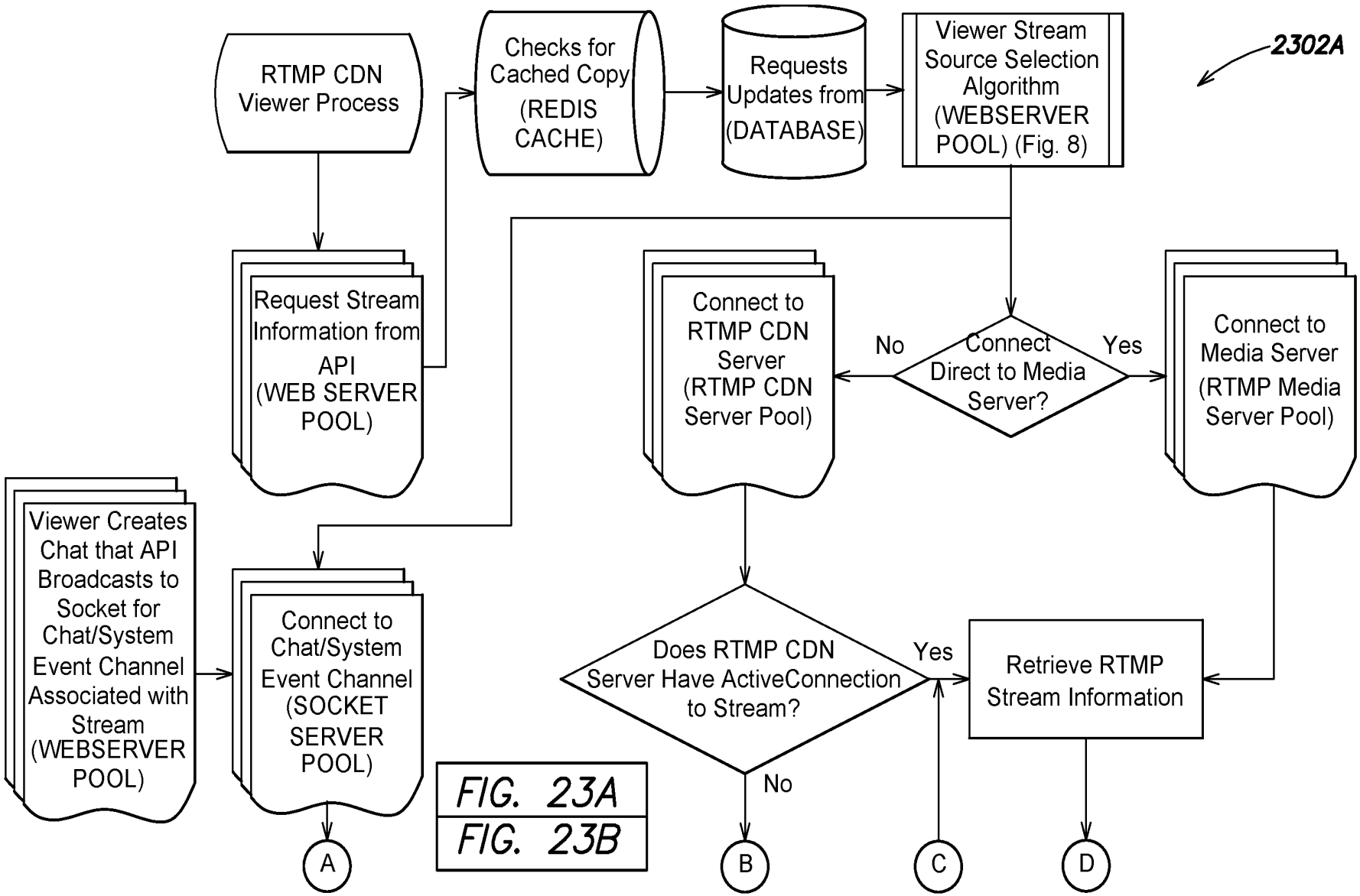


FIG. 23A
FIG. 23B

FIG. 23A

Genius Sports Ex. 1008
p. 156

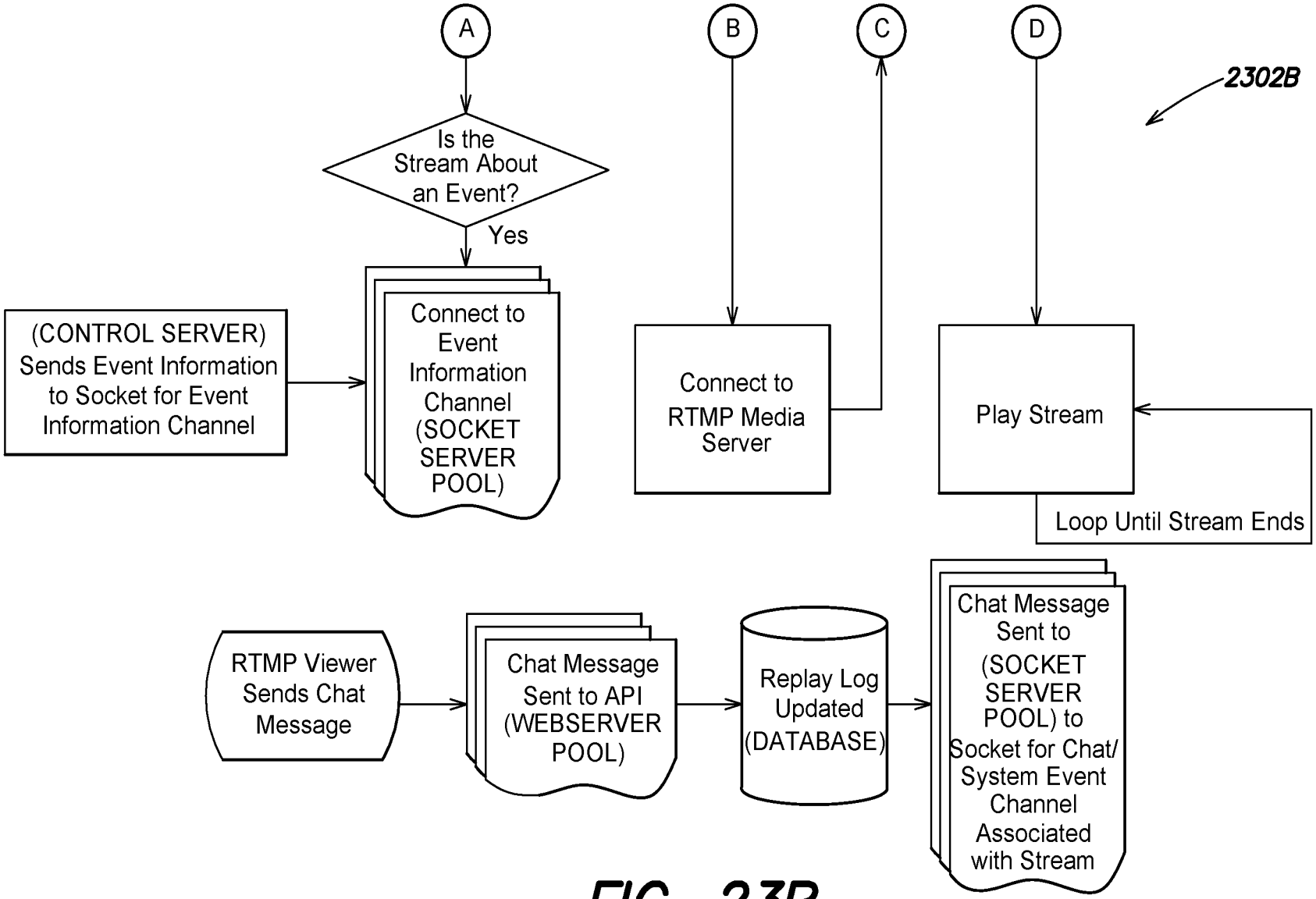


FIG. 23B

Genius Sports Ex. 1008
p. 157

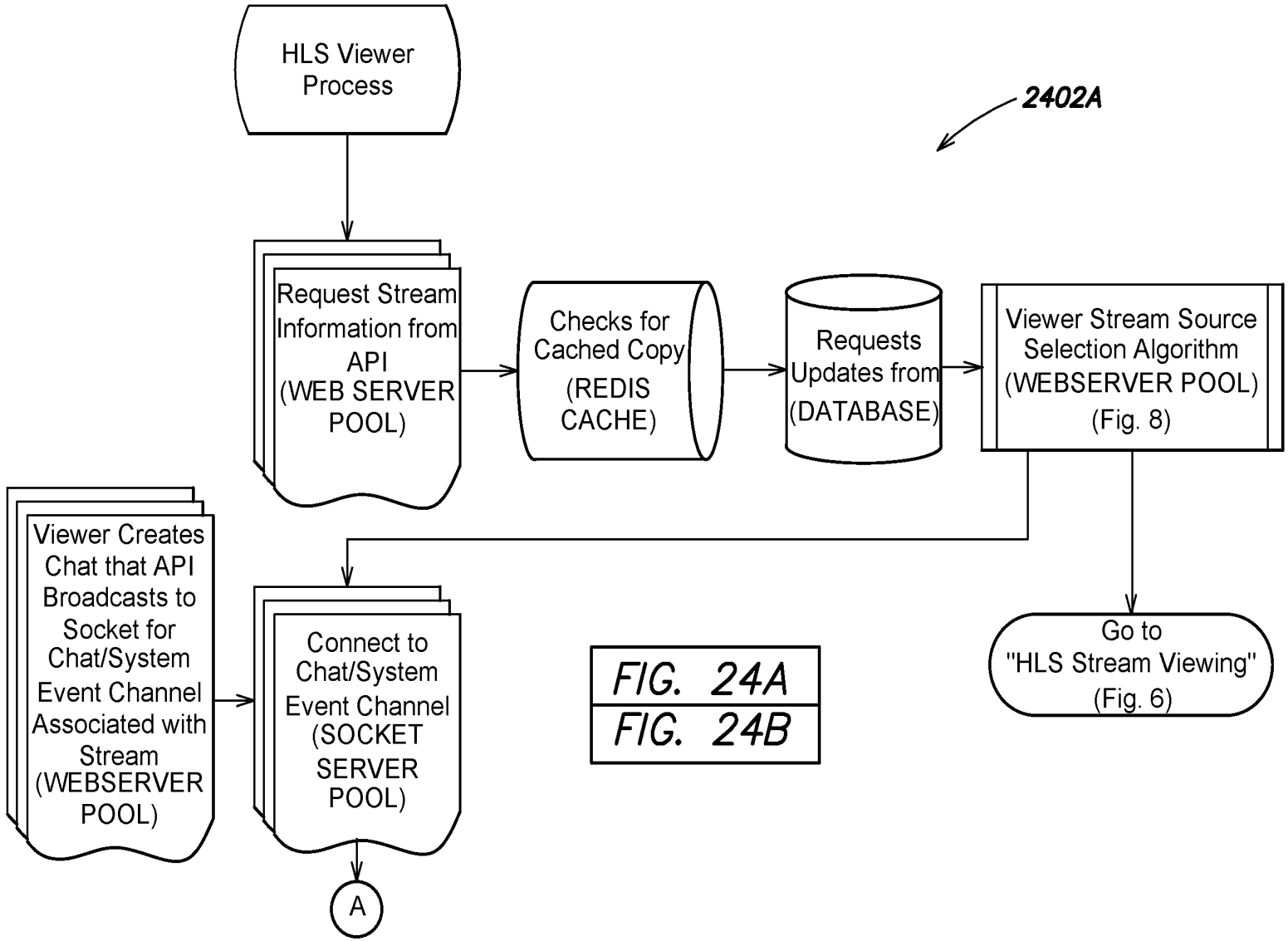


FIG. 24A
FIG. 24B

FIG. 24A

Genius Sports Ex. 1008
p. 158

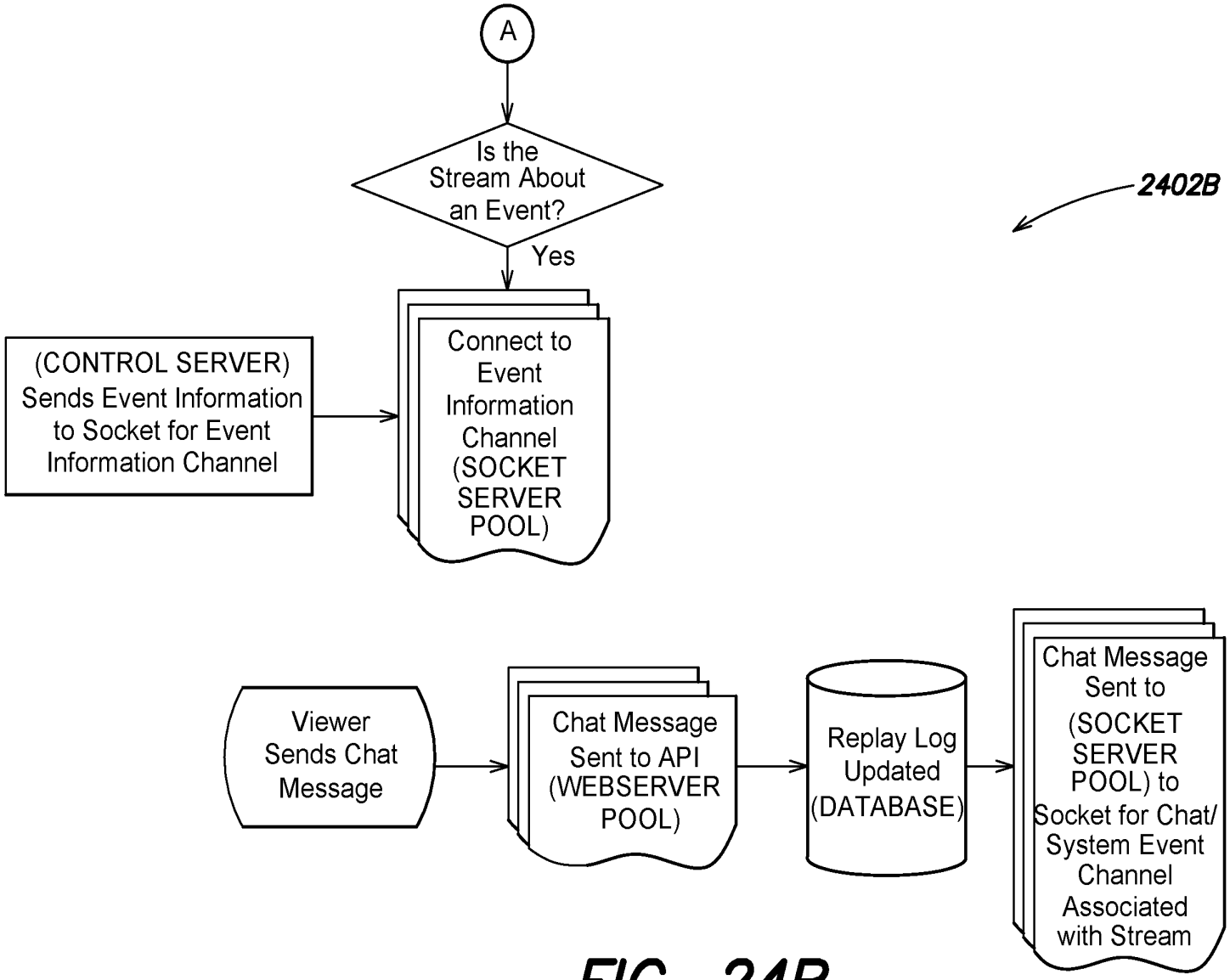


FIG. 24B

Genius Sports Ex. 1008
p. 159

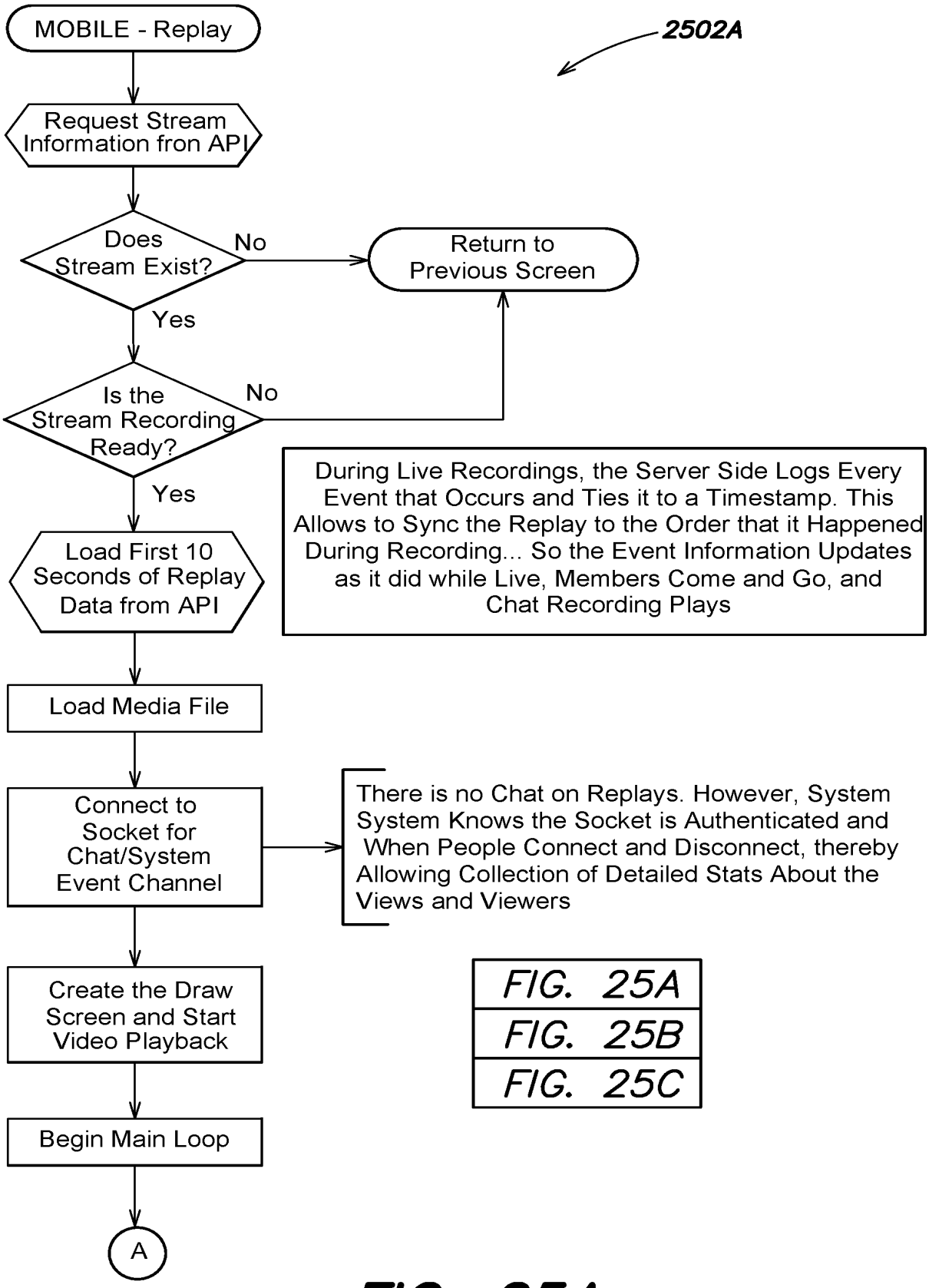


FIG. 25A
FIG. 25B
FIG. 25C

FIG. 25A

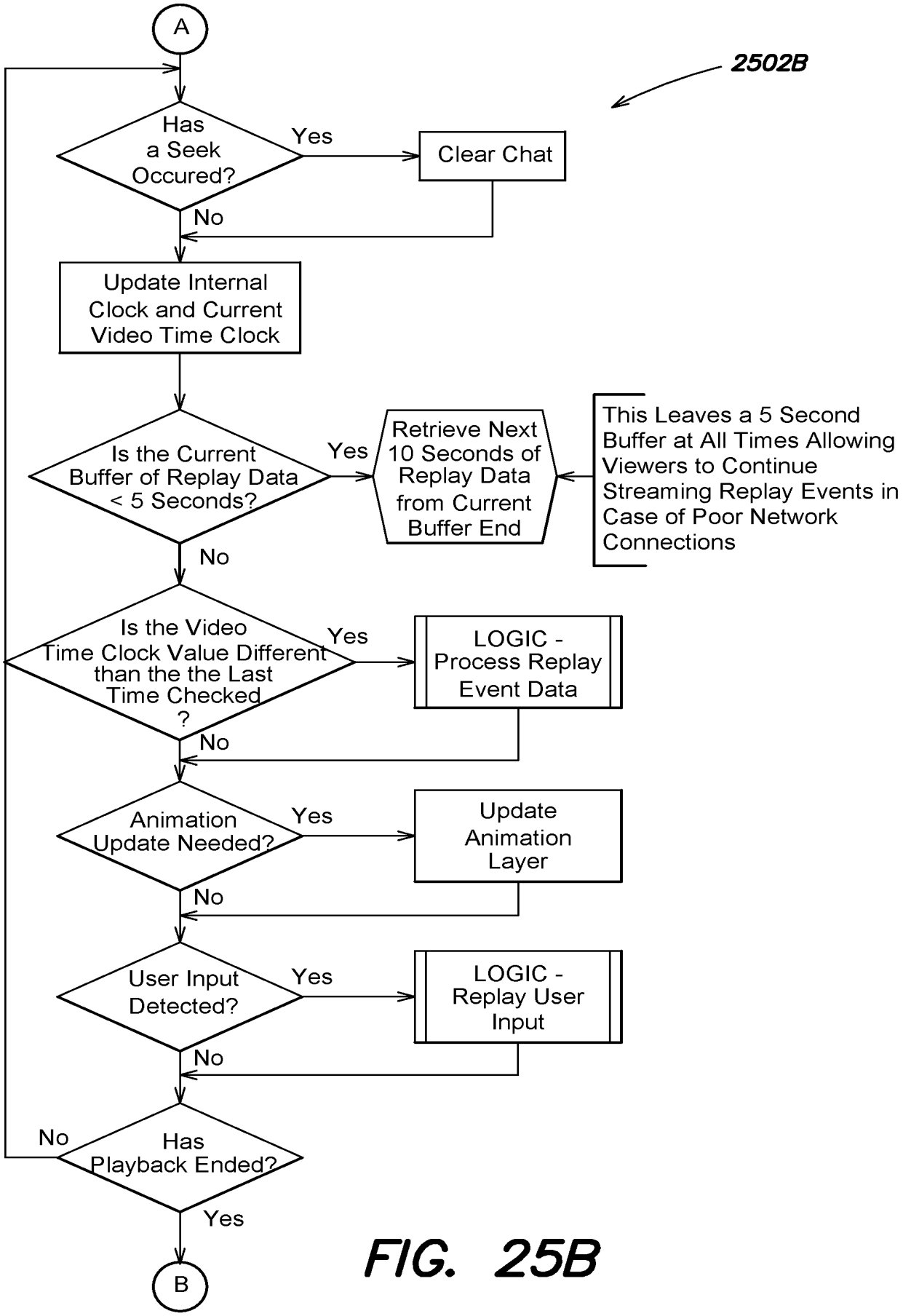

A
2502B
Has a Seek Occured?
Yes
Clear Chat
No
Update Internal Clock and Current Video Time Clock
Is the Current Buffer of Replay Data < 5 Seconds?
Yes
Retrieve Next 10 Seconds of Replay Data from Current Buffer End
This Leaves a 5 Second Buffer at All Times Allowing Viewers to Continue Streaming Replay 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

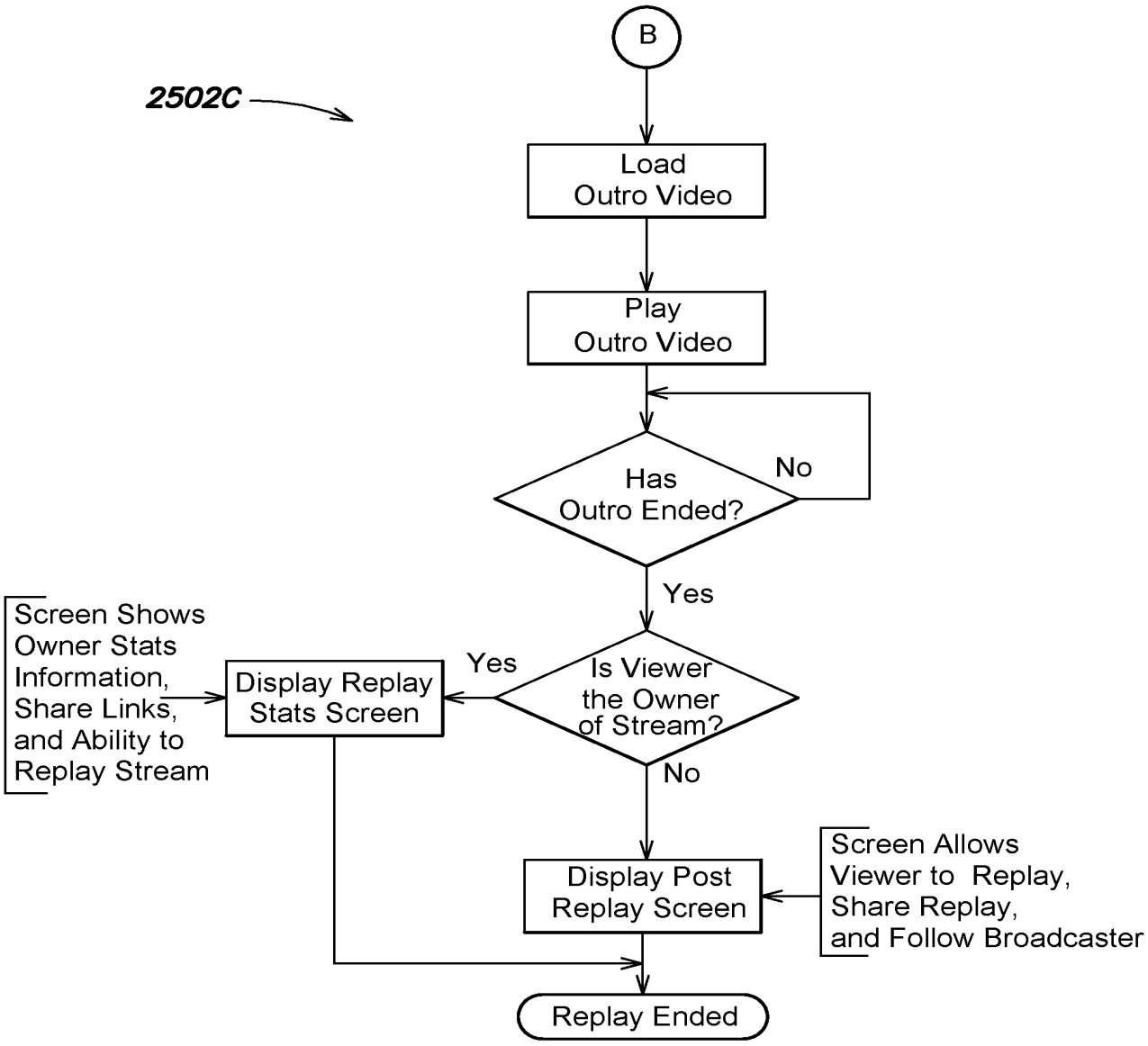

2502C
B
Load Outro Video
Play Outro Video
Has Outro Ended?
No
Yes
Is Viewer the Owner of Stream?
Yes
Display Replay Stats Screen
Screen Shows Owner Stats Information, Share Links, and Ability to Replay Stream
No
Display Post Replay Screen
Screen Allows Viewer to Replay, Share Replay, and Follow Broadcaster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

FIG. 25C

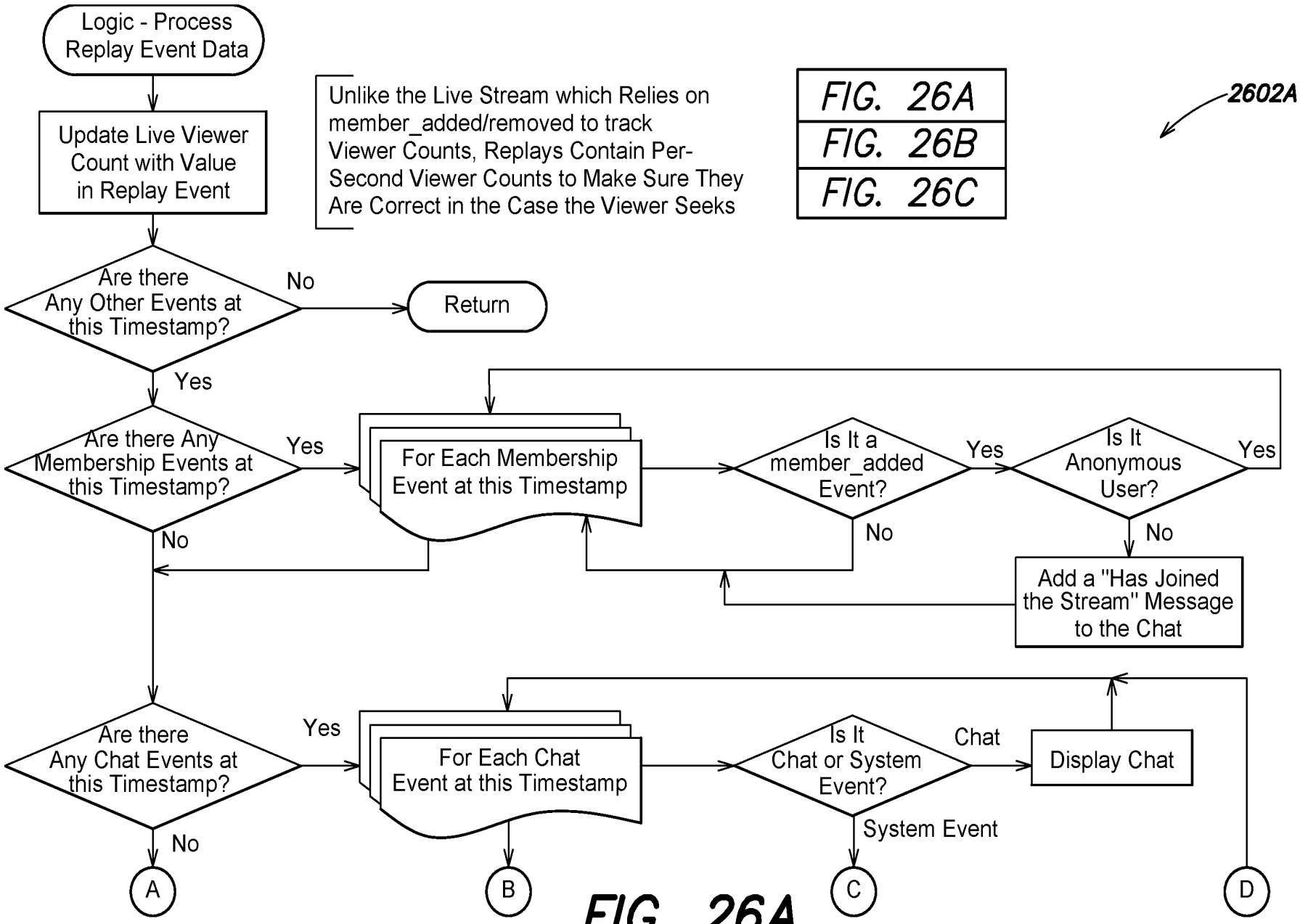


FIG. 26A

Genius Sports Ex. 1008
p. 163

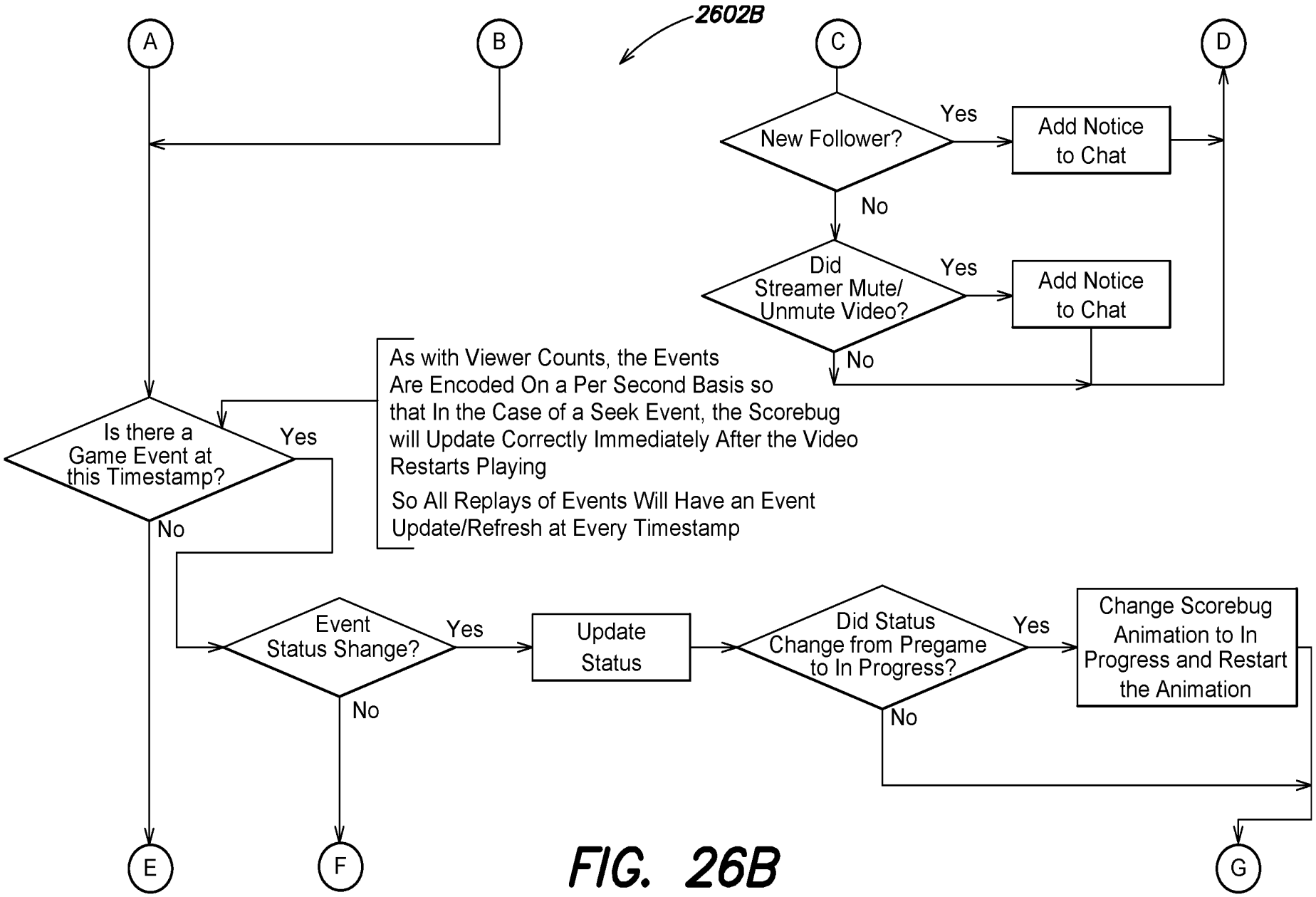


FIG. 26B

Genius Sports Ex. 1008
p. 164

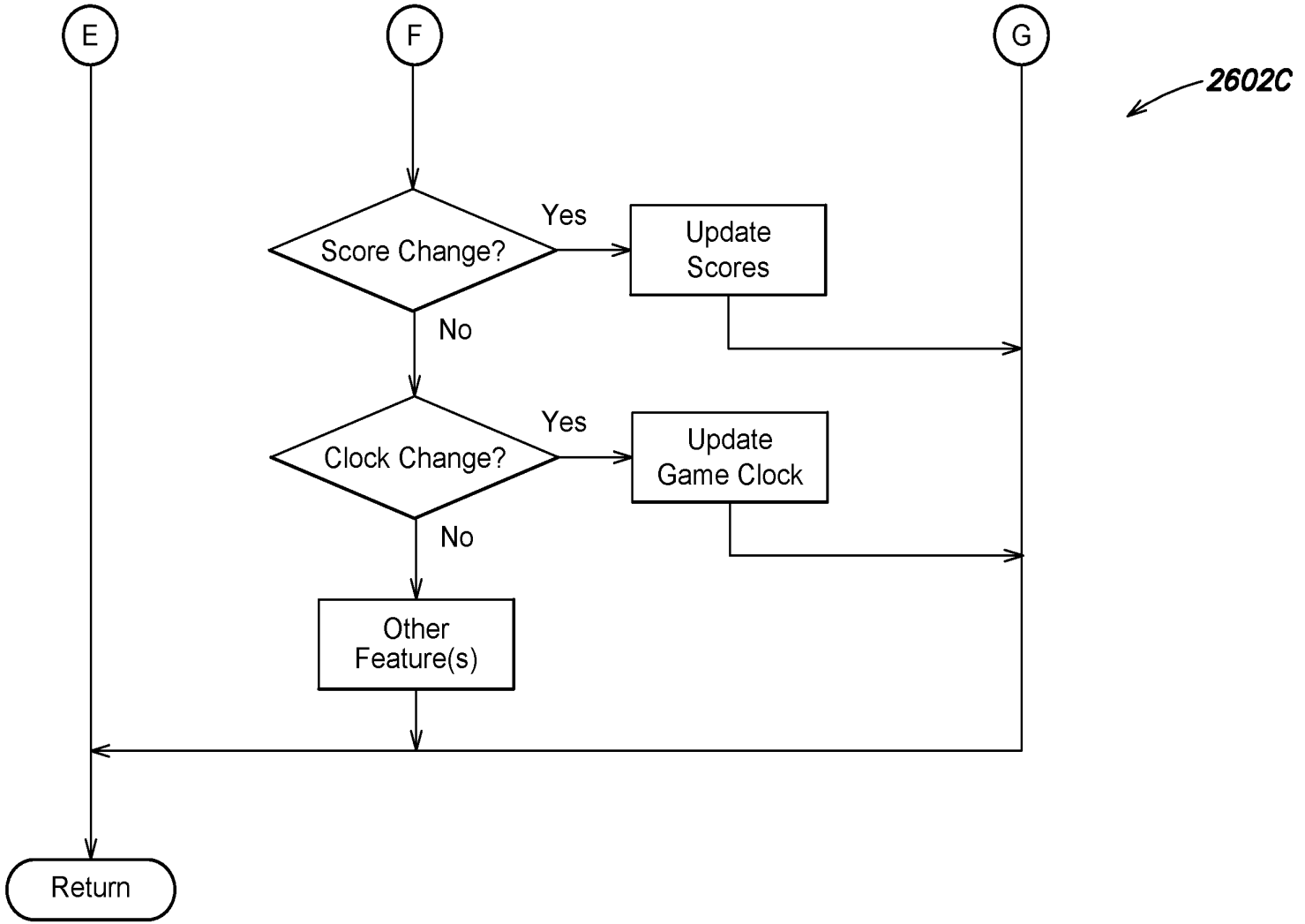


FIG. 26C

Genius Sports Ex. 1008
p. 165

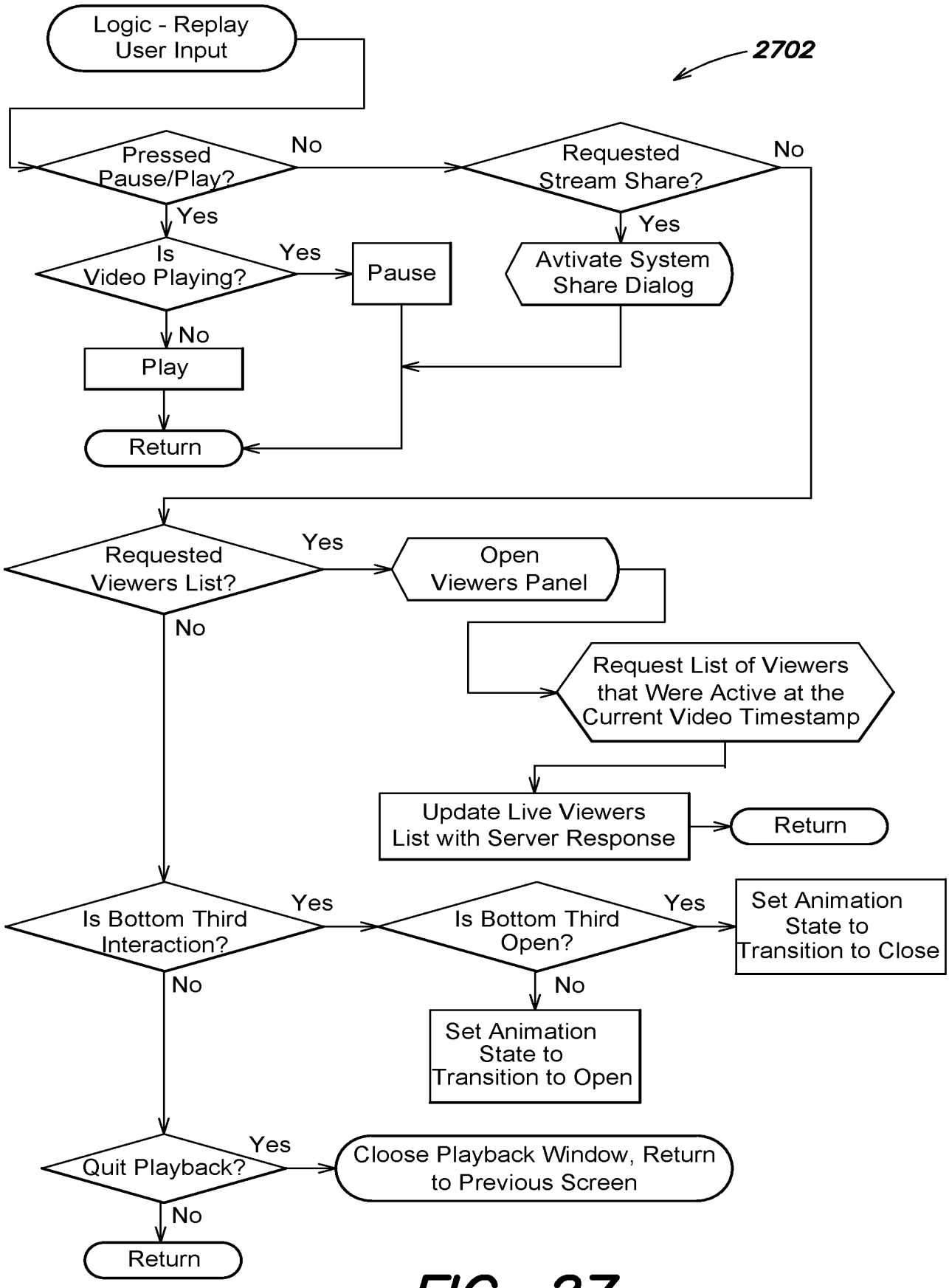

Logic - Replay User Input
2702
Pressed Pause/Play?
No
Yes
Is Video Playing?
Yes
Pause
No
Play
Return
Requested Stream Share?
No
Yes
Avtivate System Share Dialog
Requested Viewers List?
Yes
Open Viewers Panel
No
Request List of Viewers that Were Active at the Current Video Timestamp
Update Live Viewers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

FIG. 27

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.

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.

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
SGIC00101WO

FOR FURTHER ACTION
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:

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

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.

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

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).

-Continuation in 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:
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]).
-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:
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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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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

Supplemental Box

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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).

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WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US 17/45801

Supplemental Box

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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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2019-02-05
First Named Inventor	SCHUPAK, Philip Nicholas
Art Unit	
Examiner Name	
Attorney Docket Number	SGIC-001US01

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	8549574	B2	2013-10-01	Perlman et al.	Entire Document
	2	8595186	B1	2013-11-26	Mandyam et al.	Entire Document
	3	8874778	B2	2014-10-28	Xu et al.	Entire Document
	4	9055271	B2	2015-06-09	Verna et al.	Entire Document
	5	9106934	B2	2015-08-11	Horen et al.	Entire Document
	6	9149682	B2	2015-10-06	Dornbush et al.	Entire Document
	7	9251852	B2	2016-02-02	Burns	Entire Document
	8	9509793	B2	2016-11-29	Brown et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

	9	9516390	B2	2016-12-06	Lau et al.	Entire Document
	10	9591054	B2	2017-03-07	Thornburgh et al.	Entire Document
	11	9654844	B2	2017-05-16	Kim et al.	Entire Document
	12	9692800	B2	2017-06-27	Gaunt et al.	Entire Document
	13	9706443	B2	2017-07-11	Oyman et al.	Entire Document
	14	8341662	B1	2012-12-25	Bassett et al.	Entire Document
	15	9288278	B2	2016-03-15	Panje et al.	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
	1	20080168493	A1	2008-07-10	Allen et al.	Entire Document
	2	20090222754	A1	2009-09-03	Phillips et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

	3	20130222597	A1	2013-08-29	Brink et al.	Entire Document
	4	20140129680	A1	2014-05-08	Mukherjee	Entire Document
	5	20160249108	A1	2016-08-25	SEXTON	Entire Document
	6	20160360261	A1	2016-12-08	Makhlouf	Entire Document
	7	20170188054	A1	2017-06-29	Ma et al.	Entire Document

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

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	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							☐

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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]
	1	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.	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

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)	2019-02-05
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.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Filer:	Joseph Teja/Lindsey Lovato
Attorney Docket Number:	SGIC-001US01

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	75	75
UTILITY SEARCH FEE	2111	1	330	330
UTILITY EXAMINATION FEE	2311	1	380	380
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2000	2000
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	2202	10	50	500
INDEPENDENT CLAIMS IN EXCESS OF 3	2201	1	230	230

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous-Filing:				
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3585**

Electronic Acknowledgement Receipt

EFS ID:	35060089
Application Number:	16267887
International Application Number:	
Confirmation Number:	6840
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Customer Number:	149890
Filer:	Joseph Teja/Lindsey Lovato
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US01
Receipt Date:	05-FEB-2019
Filing Date:	
Time Stamp:	15:07:33
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$3585
RAM confirmation Number	020619INTEFSW15080600
Deposit Account	601876
Authorized User	Lindsey Lovato

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

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	TrackOne Request	SGIC-001US01_TrackOneRequest.pdf	148784 d664a366be015448ca3f08e84dee8ec467fc18f5	no	2
Warnings:					
Information:					
2	Application Data Sheet	SGIC-001US01_ADS.pdf	128493 4cce15f3089493054c0e6ac347419093a8884f23	no	10
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
3		SGIC-001US01_Application.pdf	421256 8e8331d179a8fa9f81e426dfcf7a62823bcfb327	yes	97

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	79
Claims	80	96
Abstract	97	97

Warnings:					
Information:					
4	Drawings-only black and white line drawings	SGIC-001US01_Drawings.pdf	3424774 86e99eea1c8cac186f02c42cb338710d78d687cb	no	56
Warnings:					
Information:					

5	Non Patent Literature	SGIC-001WO01_ISR_WO_maile d_10-30-2019.pdf	1289909 748ecd87695bab2a7c3883d9735db53377 879a7d	no	18
Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	SGIC001US01_SB08_02-05-201 9.pdf	74965 8d05e07952b4fb5f1fe9426838757c8931bc be8b	no	6
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
7	Fee Worksheet (SB06)	fee-info.pdf	43272 b2bf50f18b589a9c316fd2ac137410e9912b bcd2	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	5531453	

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.

CD Submission Review Results

Internal Worksheet Only - Do Not Scan

Application Number	16267887	Receipt Date	Feb 5, 2019

X	New Application		Response To Notice	Date Of Response

[ ] Jumbo – Large tables are included on the CD

[X] **There are no problems with the CDs in the submission.**

Items checked below are to be selected in the PALM Pre-Exam CD problem list.

Omitted Items

	Files on compact disc are unreadable:
	Disc(s) of either set not readable:
	Disc(s) do not contain file names listed:
	Amended CD missing unamended files
	Missing compact discs

Missing Parts

	Disc(s) do not contain file names listed
	Discs contains files that are non-ASCII files:
	Only one copy of the CD, no duplicate:
	Wrong media type, e.g., CD-RW:
	The transmittal letter and specification do not list information:
	Both disc(s) contain unreadable files:
	One disc(s) contain unreadable files:
	Compact disc(s) contain viruses, but are still readable:
	EFS/Paper Submission:
	Table does not maintain data in proper alignment:
	Not proper subject matter for CD's:

Informality

	No statement in transmittal letter that CD's are the same:
	No incorporation by reference statement for the CD's:
	CD's not labeled "Copy 1" and "Copy 2":
	Deficient CD packaging:
	Deficient Labeling on CD's:
	The transmittal letter does not list information:
	The specification does not list information:
	Table less than 51 pages submitted on CD:

File Directory Attachment

	Copy of file directory listing is attached and should be mailed to applicant
	Copy of file directory listing is not attached
	Copy of file directory listing is not attached because it is over one page long

Additional Comments

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 16267887 Document Date: 02/05/2019

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 eDAN using the Supplemental Content tab, or via the SCORE web page.
- External customers may access SCORE content via PAIR using the Supplemental Content tab.

Form Revision Date: August 26, 2013

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
16/267,887	02/05/2019	2447	1795	SGIC-001US01	30	4

CONFIRMATION NO. 6840

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

FILING RECEIPT

OC000000108136000

Date Mailed: 02/26/2019

Receipt is acknowledged of this non-provisional 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 APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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**

Inventor(s)

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

Applicant(s)

SportsCastr.LIVE, New York, NY

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application 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: 02/22/2019
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/267,887**
Projected Publication Date: To Be Determined - pending completion of Corrected Papers
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

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

Preliminary Class

709

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

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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).

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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: 16/267,887

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	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		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 230 =	230			
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).			200			
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	1715		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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01

CONFIRMATION NO. 6840

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

FORMALITIES LETTER

OC000000106130001

Date Mailed: 02/26/2019

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125, is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). The specification, claims, and/or abstract page(s) submitted is not acceptable and cannot be scanned or properly stored because:
  - The line spacing on the specification, claims, and/or abstract is not 1½ or double spaced (see 37 CFR 1.52(b)).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Philip Nicholas Schupak
  Brian SILSTON
  Kevin APRIL
  Peter AZUOLAS

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

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

/amanalac/

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 02/25/2019

MTEKLEMI SALE #00000022 Mailroom Dt: 02/05/2019 601876 16267887

01	FC : 2051	80.00	DA
02	FC : 2081	200.00	DA

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

Feb 26, 2019 03:58:21 AM

Dear PAIR Customer:

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
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Application	Document	Mailroom Date	Attorney Docket No.
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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Schupak	Confirmation No.:	6840
Application No.:	16/267,887	Group Art Unit:	N/A
Filed:	2019-02-05	Examiner:	N/A

For: 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

VIA EFS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO THE NOTICE TO FILE CORRECTED APPLICATION PAPERS

In response to the Notice to File Corrected Application Papers dated February 26, 2019, enclosed are the following:

[X] Substitute Specification – MARKED

[X] Substitute Specification – CLEAN

Applicant confirms no new matter has been added by way of the substitute specifications submitted.

Dated: March 6, 2019

Respectfully submitted,
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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

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application 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.

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

CROSS-REFERENCES TO RELATED APPLICATIONS

[0001] The present application 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.

Electronic Acknowledgement Receipt

EFS ID:	35337263
Application Number:	16267887
International Application Number:	
Confirmation Number:	6840
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Customer Number:	149890
Filer:	Jonathan Kien-Kwok Tong/Lindsey Lovato
Filer Authorized By:	Jonathan Kien-Kwok Tong
Attorney Docket Number:	SGIC-001US01
Receipt Date:	06-MAR-2019
Filing Date:	05-FEB-2019
Time Stamp:	11:28:51
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	Transmittal Letter	SGIC-001US01_ResponsetoNoticetoFileCorrectedAppPapers.pdf	94309 4a27b9d0b855fd99b8d79e328e268d0a3a6895ee	no	1

Warnings:

Information:					
2	Specification	SGIC-001US01-SUBSPEC-MARKED.pdf	478515 e877931bcc8cb7a570af3247bd7f0602fb1ee157	no	80
Warnings:					
Information:					
3	Specification	SGIC-001US01-SUBSPEC-CLEAN.pdf	477675 0c606ee7e987c1b8d05a87d765e990649b38fa3c	no	80
Warnings:					
Information:					
			Total Files Size (in bytes):	1050499	

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.

<u>New Applications Under 35 U.S.C. 111</u>
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.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
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.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/267,887	02/05/2019	2447	1795	SGIC-001US01	30	4

CONFIRMATION NO. 6840

UPDATED FILING RECEIPT

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

OC000000106428677

Date Mailed: 03/08/2019

Receipt is acknowledged of this non-provisional 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 APPLICANT, 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 Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections 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**

Inventor(s)

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

Applicant(s)

SportsCastr.LIVE, New York, NY

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application 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: 02/22/2019
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/267,887**
Projected Publication Date: 06/13/2019
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

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

Preliminary Class

709

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).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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NOT GRANTED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01

CONFIRMATION NO. 6840

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

INFORMAL NOTICE

OC000000106428678

Date Mailed: 03/08/2019

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Philip Nicholas Schupak
  Brian SILSTON
  Kevin APRIL
  Peter AZUOLAS

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

/rnegga/

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/267,887

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	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		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 230 =	230			
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).			200			
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	1715		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,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 149890

Mar 08, 2019 04:28:01 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.

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	APP.FILE.REC	03/08/2019	SGIC-001US01
	M327	03/08/2019	SGIC-001US01

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

Thank you for prompt attention to this notice,

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

149890 7590 03/12/2019

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

EXAMINER	
ART UNIT	PAPER NUMBER
2447	

NOTIFICATION DATE	DELIVERY MODE
03/12/2019	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
smith@smithbaluch.com

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 16/267,887	**Applicant(s)** Schupak et al.	
	Examiner BRIAN W BROWN	**Art Unit** OPET	**AIA (First Inventor to File) Status** Yes

1. THE REQUEST FILED 05 February 2019 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 BRIAN BROWN at (571)272-5338.

In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/BRIAN W BROWN/ Petitions Examiner, OPET	

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

Mar 13, 2019 03:36:48 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.

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	TRACK1.GRANT	03/12/2019	SGIC-001US01

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.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

149890 7590 05/02/2019

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

EXAMINER	
SALL, EL HADJI MALICK	

ART UNIT	PAPER NUMBER
2457	

NOTIFICATION DATE	DELIVERY MODE
05/02/2019	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
smith@smithbaluch.com

Office Action Summary	Application No. 16/267,887	Applicant(s) Schupak et al.	
	Examiner EL HADJI SALL	Art Unit 2457	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 02/05/2019.

☐ 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 _____ 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 02/05/2019.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

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.

DETAILED ACTION

1. This action is in response to the application filed on February 5, 2019 Claims 1-30 are pending. Claims 1-30 represent 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.

Claim Objections

2. Claims 1-30 are objected to because of the following informalities: Applicant refer the cited elements in the claims by their corresponding number in the drawing. Such as "a system (100), digital content (102A), broadcast client device (100A) or viewer client device (200A)', which is not necessary. Appropriate correction is required.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. Claims 1-30 are rejected under 35 U.S.C. 101 because the claimed invention is directed to an abstract idea without significantly more. The claims recite "media sources…, receiving broadcaster's live stream…, providing copy…, control server to periodically retrieve event information…, receiving score information…, and

transmitting the score information..." This judicial exception is not integrated into a practical application because the generically recited computer elements, such as "a a viewer client device or broadcast client device", do not add a meaningful limitation to the abstract idea because they amount to simply implementing the abstract idea on a computer. The claims do not include additional elements that are sufficient to amount to significantly more than the judicial exception because the identified additional elements (i.e. "view client device and broadcast client device"), when considered separately and in combinations, they do not add significantly more (also known as an "inventive concept") to the exception. In this case, the additional limitations only implement receive, provide and transmit score information. These are well-understood, routine, conventional computer functions as recognized by the court decisions listed in MPEP § 2106.05(d).

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to EL HADJI SALL whose telephone number is (571)272-4010. The examiner can normally be reached on Monday-Friday 8:00-8:30 (flexible).

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, Ario Etienne can be reached on 5712724001. 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 http://pair-direct.uspto.gov. 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.

/EL HADJI M SALL/
Primary Examiner, Art Unit 2457

Notice of References Cited	Application/Control No. 16/267,887	Applicant(s)/Patent Under Reexamination Schupak et al.	
	Examiner EL HADJI SALL	Art Unit 2457	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-20110280540-A1	11-2011	Woodman; Nicholas D.	H04N5/765	386/201
*	B	US-9584858-B2	02-2017	Vinson; Michael	H04N21/44213	1/1
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	Art Unit
	EL HADJI SALL	2457

CPC - Searched*		
Symbol	Date	Examiner
(H04L 65/608) (H04N 21/2187) (H04N 21/47217) (H04N 21/6125)	04/28/2019	ES

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
Continuity Search	04/28/2019	ES
Inventor Search	04/28/2019	ES
Non Patent Litterature Search	04/28/2019	ES
East Search	04/28/2019	ES
CPC Search	04/28/2019	ES

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

/EL HADJI M SALL/ Primary Examiner, Art Unit 2457	

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	Art Unit
	EL HADJI SALL	2457

✓	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	04/28/2019								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
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	26	✓								
	27	✓								
	28	✓								
	29	✓								
	30	✓								

Bibliographic Data

Application No: 16/267,887

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /EL HADJI M SALL/ ES

Examiner's Signature | Initials

Title: 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

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/05/2019	709	2457	SGIC-001US01
RULE			

APPLICANTS

SportsCastr.LIVE, New York, NY,

INVENTORS

Philip Nicholas Schupak Brooklyn, NY, UNITED STATES

Brian SILSTON New York, NY, UNITED STATES

Kevin APRIL New York, NY, UNITED STATES

Peter AZUOLAS Philadelphia, PA, UNITED STATES

CONTINUING DATA

This application 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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02/22/2019

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

SMITH BALUCH LLP

376 BOYLSTON ST

STE 401
BOSTON, MA 02116
UNITED STATES

FILING FEE RECEIVED

$3,585

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	758969	(H04L 65/608) (H04N 21/2187) (H04N 21/47217) (H04N 21/6125)	US-PGPUB; USPAT	OR	ON	2019/04/28 20:48
S2	22	("20080168493" | "20090222754" | "20130222597" | "20140129680" | "20160249108" | "20160360261" | "20170188054" | "8341662" | "8549574" | "8595186" | "8874778" | "9055271" | "9106934" | "9149682" | "9251852" | "9288278" | "9509793" | "9516390" | "9591054" | "9654844" | "9692800" | "9706443").PN.	US-PGPUB; USPAT	OR	OFF	2019/04/28 20:49
S3	18	S1 and S2	US-PGPUB; USPAT	OR	ON	2019/04/28 20:49
S4	0	transmit$5 with score with germane	US-PGPUB; USPAT	OR	ON	2019/04/28 20:51
S5	76	transmit$5 with score and germane	US-PGPUB; USPAT	OR	ON	2019/04/28 20:52
S6	0	transmit$5 with score and germane with sport$5	US-PGPUB; USPAT	OR	ON	2019/04/28 20:52
S7	23	germane with sport$5	US-PGPUB; USPAT	OR	ON	2019/04/28 20:52
S8	0	S3 and S7	US-PGPUB; USPAT	OR	ON	2019/04/28 20:52
S9	7748	broadcast$5 with live with stream$5	US-PGPUB; USPAT	OR	ON	2019/04/28 21:00
S10	0	S9 and sproting near event	US-PGPUB; USPAT	OR	ON	2019/04/28 21:01
S11	1765	S9 and sporting	US-PGPUB; USPAT	OR	ON	2019/04/28 21:01
S12	1689	S9 and sporting near6 event	US-PGPUB; USPAT	OR	ON	2019/04/28 21:01
S13	1656	S9 and sporting near event	US-PGPUB; USPAT	OR	ON	2019/04/28 21:01
S14	168	S13 and viewer with client	US-PGPUB; USPAT	OR	ON	2019/04/28 21:04

S15	0	S13 and viewer with client same video with communication with channel	US-PGPUB; USPAT	OR	ON	2019/04/28 21:05
S16	11	S13 and viewer with client same video with communication	US-PGPUB; USPAT	OR	ON	2019/04/28 21:05
S17	7	S16 and @ad< "20160805"	US-PGPUB; USPAT	OR	ON	2019/04/28 21:06
S18	2	copy with live with stream$5 and view with communication with channel	US-PGPUB; USPAT	OR	ON	2019/04/28 21:20
S19	2	S18 and @ad< "20160805"	US-PGPUB; USPAT	OR	ON	2019/04/28 21:21

4/ 28/ 2019 11:43:48 PM
C:\ Users\ esall\ Documents\ EAST\ Workspaces\ 16267887.wsp

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	2019-02-05
First Named Inventor	SCHUPAK, Philip Nicholas
Art Unit	
Examiner Name	
Attorney Docket Number	SGIC-001US01

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
/E.M.S/	1	8549574	B2	2013-10-01	Perlman et al.	Entire Document
	2	8595186	B1	2013-11-26	Mandyam et al.	Entire Document
	3	8874778	B2	2014-10-28	Xu et al.	Entire Document
	4	9055271	B2	2015-06-09	Verna et al.	Entire Document
	5	9106934	B2	2015-08-11	Horen et al.	Entire Document
	6	9149682	B2	2015-10-06	Dornbush et al.	Entire Document
	7	9251852	B2	2016-02-02	Burns	Entire Document
	8	9509793	B2	2016-11-29	Brown et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

/E.M.S/	9	9516390	B2	2016-12-06	Lau et al.	Entire Document
	10	9591054	B2	2017-03-07	Thornburgh et al.	Entire Document
	11	9654844	B2	2017-05-16	Kim et al.	Entire Document
	12	9692800	B2	2017-06-27	Gaunt et al.	Entire Document
	13	9706443	B2	2017-07-11	Oyman et al.	Entire Document
	14	8341662	B1	2012-12-25	Bassett et al.	Entire Document
	15	9288278	B2	2016-03-15	Panje et al.	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
/E.M.S/	1	20080168493	A1	2008-07-10	Allen et al.	Entire Document
/E.M.S/	2	20090222754	A1	2009-09-03	Phillips et al.	Entire Document

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

/E.M.S/	3	20130222597	A1	2013-08-29	Brink et al.	Entire Document
/E.M.S/	4	20140129680	A1	2014-05-08	Mukherjee	Entire Document
/E.M.S/	5	20160249108	A1	2016-08-25	SEXTON	Entire Document
/E.M.S/	6	20160360261	A1	2016-12-08	Makhlouf	Entire Document
/E.M.S/	7	20170188054	A1	2017-06-29	Ma et al.	Entire Document

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FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	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							☐

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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]
/E.M.S/	1	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.	☐

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

EXAMINER SIGNATURE			
Examiner Signature	/EL HADJI M SALL/	Date Considered	04/28/2019

*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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2019-02-05
	First Named Inventor	SCHUPAK, Philip Nicholas
	Art Unit	
	Examiner Name	
	Attorney Docket Number	SGIC-001US01

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)	2019-02-05
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 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.

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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: 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.

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LEGAL NAME OF INVENTOR

Inventor: Peter AZUOLAS Date (Optional): _____

Signature: _____

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LEGAL NAME OF INVENTOR

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

Signature: PNS

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LEGAL NAME OF INVENTOR

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

Signature:

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EFS ID:	35928054
Application Number:	16267887
International Application Number:	
Confirmation Number:	6840
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Customer Number:	149890
Filer:	Joseph Teja/Lindsey Lovato
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US01
Receipt Date:	06-MAY-2019
Filing Date:	05-FEB-2019
Time Stamp:	16:07:49
Application Type:	Utility under 35 USC 111(a)

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	SGIC-001US01_Declarations-EXECUTED.pdf	670711 b870fc703412decbbe004125f9ce45341c10054f	no	4

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Docket No. SGIC-001US01

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Philip Nicholas SCHUPAK

Application No. 16/267,887

Filed: 2019-02-05

Confirmation No. 6840

Art Unit: 2457

Examiner: El Hadji Malick Sall

Title: 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

AMENDMENT AND RESPONSE TO OFFICE ACTION

In response to the Office Action dated May 2, 2019, Applicant submits the following Amendments and Remarks, and respectfully requests reconsideration of the application in view thereof.

Amendments to the Claims are reflected in the listing of the claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 19 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. (Currently Amended) 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 comprising:

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;

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; and

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.

2. (Currently Amended) The system of claim 1, 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;

in C), the at least one socket server further transmits the first score information ~~(504A)~~ for the first live sporting event to at least the first viewer client device ~~(200C)~~ of the second plurality of viewer client devices via a second event information Internet communication channel ~~(206C)~~ between the at least one first event socket ~~(602A)~~ of the at least one socket server and the first viewer client device of the second plurality of viewer devices.

3. (Currently Amended) The system of claim 2, wherein:

none of the first score information ~~(504A)~~ of the first event information ~~(502A)~~ is included in the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content ~~(102A)~~ provided to the first viewer client device ~~(200A)~~ of the first plurality of viewer client devices via the first video Internet communication channel ~~(204A)~~; and

none of the first score information ~~(504A)~~ of the first event information ~~(502A)~~ is included in the first copy ~~(202C)~~ of the second plurality of copies of the second broadcaster's live stream of digital content ~~(102B)~~ provided to the first viewer client device ~~(200C)~~ of the second plurality of viewer client devices via the second video Internet communication channel ~~(204C)~~.

4. (Currently Amended) The system of claim 2, wherein:

in A), the plurality of media sources:

provide a second copy ~~(202B)~~ of the first plurality of copies to a second viewer client device ~~(200B)~~ 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; and

provide a second copy ~~(202D)~~ of the second plurality of copies to a second viewer client device ~~(200D)~~ 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; and

in C), the at least one socket server:

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device of the first plurality of viewer devices; and

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device of the second plurality of viewer devices.

5. (Currently Amended) The system of claim 2, wherein in C), the at least one socket server further:

transmits and receives first chat information ~~(210A)~~ 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 ~~(208A)~~ between at least one first chat/system event socket ~~(604A)~~ of the at least one socket server and the first viewer client device ~~(200A)~~ 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

transmits and receives second chat information ~~(210B)~~ regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content via at least one second chat/system event Internet communication channel ~~(208B)~~ between at least one second chat/system event socket ~~(604B)~~ of the at least one socket server and

the first viewer client device ~~(200C)~~ of the second plurality of viewer client devices, wherein the at least one second chat/system event socket corresponds to the second chat information regarding the second live sporting event video-based commentary.

6. (Currently Amended) The system of claim 5, wherein:

in A), the plurality of media sources:

provide a second copy ~~(202B)~~ of the first plurality of copies to a second viewer client device ~~(200B)~~ 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; and

provide a second copy ~~(202D)~~ of the second plurality of copies to a second viewer client device ~~(200D)~~ 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; and

in C), the at least one socket server:

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device of the first plurality of viewer devices;

transmits and receives the first chat information ~~(210A)~~ 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 socket ~~(604A)~~ of the at least one socket server and the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices;

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device of the second plurality of viewer devices; and

transmits and receives the second chat information ~~(210B)~~ 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 socket ~~(604B)~~ of the at least one socket server and the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices.

7. (Currently Amended) The system of claim 1, further comprising a memory system ~~(400)~~ communicatively coupled to the control server, the memory system including a database ~~(420)~~, wherein in B) the control server:

retrieves from the event information provider first event data for the first live sporting event, the first event data including at least one of:

the type of the first live sporting event;

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.

8. (Original) The system of claim 7, wherein 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; and

stores the normalized at least one of the progress details and the event participant data in the database.

9. (Original) The system of claim 7, wherein:

the progress details include the first score information;

the control server periodically retrieves the progress details from the event information provider and updates the first score information; 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 the at least one first event socket of the at least one socket server.

10. (Currently Amended) The system of claim 1, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server ~~(320)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

at least one web real time communication (WebRTC) media server ~~(360)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

an HTTP live streaming (HLS) caching server architecture ~~(380)~~ communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server; and

the system establishes the first video Internet communication channel ~~(204A)~~ to provide the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device ~~(200A)~~ of the first plurality of viewer devices between the first viewer client device ~~(200A)~~ and the HLS caching server architecture ~~(380)~~.

11. (Currently Amended) The system of claim 10, wherein the HLS caching server architecture comprises:

an HLS mother server ~~(382)~~ 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 ~~(375A)~~ representing the first broadcaster's live stream of digital content ~~(102A)~~; and

a plurality of HLS child servers ~~(384A, 384B)~~ communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) ~~(388)~~,

wherein:

the system establishes the first video Internet communication channel ~~(204A)~~ to provide the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device ~~(200A)~~ of the first plurality of viewer devices between the first viewer client device ~~(200A)~~ and the HLS CDN ~~(388)~~; and

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 ~~(375A)~~.

12. (Currently Amended) The system of claim 11, further comprising:

at least one webserver ~~(700)~~ 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; and

a memory system ~~(400)~~ communicatively coupled to the at least one webserver, the memory system including a database ~~(420)~~ storing:

first stream information for the first broadcaster's live stream of digital content ~~(102A)~~ including the first live sporting event video-based commentary from the first broadcaster client device ~~(100A)~~, wherein the first stream information includes a stream identifier (StreamID) for the first broadcaster's live stream of digital content,

wherein the at least one webserver:

determines an address for the HLS CDN to establish the first video Internet communication channel ~~(204A)~~ 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 ~~(200A)~~ of the first plurality of viewer client devices to establish the first video Internet communication channel ~~(204A)~~.

13. (Currently Amended) The system of claim 12, wherein:

the first stream information for the first broadcaster's live stream of digital content ~~(102A)~~ further includes 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 ~~(602A)~~ 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 ~~(200A)~~ of the first plurality of viewer client devices to establish the first event information Internet communication channel ~~(206A)~~.

14. (Currently Amended) The system of claim 13, wherein:

in C), the at least one socket server further transmits and receives first chat information ~~(210A)~~ 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 ~~(208A)~~ between at least one first chat/system event socket ~~(604A)~~ of the at least one socket server and the first viewer client device ~~(200A)~~ 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 ~~(604A)~~ 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 ~~(200A)~~ of the first plurality of viewer client devices to establish the first chat/system event Internet communication channel ~~(208A)~~.

15. (Currently Amended) The system of claim 11, wherein 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 ~~(375A)~~ 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.

16. (Original) The system of claim 15, wherein 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.

17. (Currently Amended) The system of claim 1, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server ~~(320)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

at least one web real time communication (WebRTC) media server ~~(360)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

an HTTP live streaming (HLS) caching server architecture ~~(380)~~ communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server;

the system establishes the first video Internet communication channel ~~(204A)~~ to provide the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device ~~(200A)~~ of the first plurality of viewer devices between the first viewer client device ~~(200A)~~ and the HLS caching server architecture ~~(380)~~;

the HLS caching server architecture comprises:

an HLS mother server ~~(382)~~ 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 ~~(375A)~~ representing the first broadcaster's live stream of digital content ~~(102A)~~; and

a plurality of HLS child servers ~~(384A, 384B)~~ communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) ~~(388)~~;

the system establishes the first video Internet communication channel ~~(204A)~~ to provide the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device ~~(200A)~~ of the first plurality of viewer devices between the first viewer client device ~~(200A)~~ and the HLS CDN ~~(388)~~;

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 ~~(375A)~~;

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 ~~(375A)~~

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 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;

the first HLS file suite ~~(375A)~~ provided by the at least one of the at least one RTMP 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 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 ~~(375B)~~ of the first HLS playlist, the first respective chunklists, and the first respective file segments;

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 ~~(375C)~~ of the first HLS playlist, the first respective chunklists, and the first respective file segments; and

the first copy ~~(202A)~~ of the first plurality of copies of the first broadcaster's live stream of digital content to the first viewer client device ~~(200A)~~ of the first plurality of viewer devices is based on the at least one second copy ~~(375C)~~ of the first HLS playlist, the first respective chunklists, and the first respective file segments.

18. (Original) The system of claim 17, wherein:

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.

19. (Currently Amended) 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 comprising:

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;

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; and

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.

20. (Currently Amended) The system of claim 19, wherein:

in A), the plurality of media sources:

provide a second copy ~~(202B)~~ of the first plurality of copies to a second viewer client device ~~(200B)~~ 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; and

provide a second copy ~~(202D)~~ of the second plurality of copies to a second viewer client device ~~(200D)~~ 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; and

in C), the at least one socket server:

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device ~~(200B)~~ of the first plurality of viewer devices; and

transmits at least the second score information ~~(504B)~~ of the second event information ~~(502B)~~ to the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one second event socket ~~(602B)~~ of the at least one socket server and the second viewer client device ~~(200D)~~ of the second plurality of viewer devices.

21. (Currently Amended) The system of claim 19, wherein in C), the at least one socket server further:

transmits and receives first chat information ~~(210A)~~ 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 ~~(208A)~~ between at least one first chat/system event socket ~~(604A)~~ of the at least one socket server and the first viewer client device ~~(200A)~~ 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

transmits and receives second chat information ~~(210B)~~ regarding the second live sporting event video-based commentary included in the second broadcaster's live stream of digital content via at least one second chat/system event Internet communication channel ~~(208B)~~ between at least one second chat/system event socket ~~(604B)~~ of the at least one socket server and the first viewer client device ~~(200C)~~ of the second plurality of viewer client devices, wherein the at least one second chat/system event socket corresponds to the second chat information regarding the second live sporting event video-based commentary.

22. (Currently Amended) The system of claim 21, wherein:

in A), the plurality of media sources:

provide a second copy ~~(202B)~~ of the first plurality of copies to a second viewer client device ~~(200B)~~ 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; and

provide a second copy ~~(202D)~~ of the second plurality of copies to a second viewer client device ~~(200D)~~ 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; and

in C), the at least one socket server:

transmits at least the first score information ~~(504A)~~ of the first event information ~~(502A)~~ to the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices via a third event information Internet communication channel between the at least one first event socket ~~(602A)~~ of the at least one socket server and the second viewer client device ~~(200B)~~ of the first plurality of viewer devices;

transmits and receives the first chat information ~~(210A)~~ 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 socket ~~(604A)~~ of the at least one socket server and the second viewer client device ~~(200B)~~ of the first plurality of viewer client devices;

transmits at least the second score information ~~(504B)~~ of the second event information ~~(502B)~~ to the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices via a fourth event information Internet communication channel between the at least one second event socket ~~(602B)~~ of the at least one socket server and the second viewer client device ~~(200D)~~ of the second plurality of viewer devices; and

transmits and receives the second chat information ~~(210B)~~ 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 socket ~~(604B)~~ of the at least one socket server and the second viewer client device ~~(200D)~~ of the second plurality of viewer client devices.

23. (Currently Amended) A method for providing a first copy ~~(202A)~~ 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 viewer client device ~~(200A)~~, the method comprising:

A) providing the first copy ~~(202A)~~ to the first viewer client device ~~(200A)~~ via a first video communication channel ~~(204A)~~ between a plurality of media sources and the first viewer client device;

B) periodically retrieving, 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; and

C) transmitting the first score information ~~(504A)~~ to at least the first viewer client device ~~(200A)~~ via a first event information communication channel ~~(206A)~~ between at least one first event socket ~~(602A)~~ of 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.

24. (Currently Amended) The method of claim 23, further comprising:

D) transmitting and receiving first chat information ~~(210A)~~ 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 ~~(208A)~~ between at least one first chat/system event socket ~~(604A)~~ of the at least one socket server and the first viewer client device ~~(200A)~~ 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.

25. (Original) The method of claim 23, wherein B) comprises:

B1) periodically updating the first score information; and

B2) for each updating of the first score information, queueing an asynchronous message including the updated first score information for transmission to the at least one first event socket of the at least one socket server.

26. (Currently Amended) The method of claim 24, wherein:

the plurality of media sources comprises:

at least one of:

at least one real-time messaging protocol (RTMP) media server ~~(320)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

at least one web real time communication (WebRTC) media server ~~(360)~~ to receive the first broadcaster's live stream of digital content ~~(102A)~~; and

an HTTP live streaming (HLS) caching server architecture ~~(380)~~ communicatively coupled to at least one of the at least one RTMP media server and the at least one WebRTC media server, wherein the HLS caching server architecture comprises:

an HLS mother server ~~(382)~~ 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 ~~(375A)~~ representing the first broadcaster's live stream of digital content ~~(102A)~~; and

a plurality of HLS child servers ~~(384A, 384B)~~ communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) ~~(388)~~; and

A) comprises providing the first copy ~~(202A)~~ to the first viewer client device ~~(200A)~~ via the first video communication channel ~~(204A)~~ between the HLS CDN ~~(388)~~ and the first viewer client device, wherein the first copy ~~(202A)~~ is based on the first HLS file suite ~~(375A)~~ received by the HLS mother server.

27. (Currently Amended) A system for providing a first copy 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 viewer client device ~~(200A)~~, the system comprising:

means for providing the first copy ~~(202A)~~ to the first viewer client device ~~(200A)~~ via a first video communication channel ~~(204A)~~;

means for periodically retrieving, 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; and

means for transmitting the first score information ~~(504A)~~ to at least the first viewer client device ~~(200A)~~ via a first event information communication channel ~~(206A)~~ that is different from the first video communication channel.

28. (Currently Amended) The system of claim 27, further comprising:

means for transmitting and receiving first chat information ~~(210A)~~ 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 ~~(208A)~~ that is different from the first video communication channel ~~(204A)~~ and the first event information communication channel ~~(206A)~~.

29. (Original) The system of claim 27, wherein the means for periodically retrieving includes means for updating the first score information and queueing an asynchronous message including the updated first score information for transmission on the first event information communication channel.

30. (Currently Amended) The system of claim 27, wherein the means for providing the first copy ~~(202A)~~ to the first viewer client device ~~(200A)~~ via a first video communication channel ~~(204A)~~ comprises:

an HTTP live streaming (HLS) mother server ~~(382)~~ to receive a first HLS file suite ~~(375A)~~ representing the first broadcaster's live stream of digital content ~~(102A)~~; and

a plurality of HLS child servers ~~(384A, 384B)~~, communicatively coupled to the HLS mother server and an HLS content delivery network (HLS CDN) ~~(388)~~, to provide the first copy ~~(202A)~~ to the first viewer client device ~~(200A)~~ via the first video communication channel ~~(204A)~~ between the HLS CDN ~~(388)~~ and the first viewer client device, wherein the first copy ~~(202A)~~ is based on the first HLS file suite ~~(375A)~~ received by the HLS mother server.

REMARKS

In response to the Office Action dated May 2, 2019, 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, 19, 23 and 27 are independent claims.

In this paper, claims 1-7, 10-15, 17, 19-24, 26-28, and 30 are amended to address claim objections due to informalities in the claims. Specifically, claims 1-7, 10-15, 17, 19-24, 26-28, and 30 are amended to remove reference numbers (referencing elements in drawings) associated with corresponding claimed elements.

No new matter is added by the amendments herein.

2. Summary of Telephone Interview with Examiner

Applicant's representative Joseph Teja, Jr., Nisha Somnath, and inventor Peter Azoulas appreciate the courtesies extended by Examiner El Hadji Malick Sall in granting and conducting a telephone interview on May 16, 2019, to discuss proposed amendments in response to the Office Action.

During the telephone interview, Examiner Sall acknowledged that he understood the Applicant's position on the rejections under 35 U.S.C. § 101. In particular, Examiner Sall noted that Applicant's comments set forth in the Interview Agenda dated May 15, 2019 (which is incorporated herein by reference in their entirety) appear to overcome the patent subject matter eligibility rejections under 35 U.S.C. § 101. As part of this discussion, Examiner Sall acknowledged that the claimed system includes physical components that in combination perform multiple complex functions relating to the practical application of synchronizing low-latency digital broadcast streams and event information from live events.

Examiner Sall understandably reserved final judgment as to the allowability of the claims pending review of the formal response as filed, and noted that he would need to update his search upon further consideration of the claims.

The foregoing summary of the Examiner telephone interview is not intended to limit the claims in any manner. In particular, the Examiner is respectfully encouraged to evaluate the patentability of all claims based solely on the specific language recited in each claim.

3. Objections to Claims

On page 2 of the Office Action, claims 1-30 were objected to because the cited elements in the claims are referred to by their corresponding numbers in the drawings. Applicant is amending the claims herein to address this objection. Accordingly, withdrawal of the objection is respectfully requested.

CONCLUSION

It is respectfully believed that all of the rejections set forth in the Office Action have been addressed. However, the absence of a reply to a specific rejection, objection, or comment set forth in the Office Action does not signify agreement with or concession of that rejection, objection, or comment. In addition, there may be reasons for patentability of any or all pending claims (or other claims) that have not been expressed. Furthermore, nothing in this paper should be construed as an intent to concede any issue with regard to any claim.

Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

Dated: May 20, 2019

Respectfully submitted,

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Electronic Acknowledgement Receipt

EFS ID:	36053582
Application Number:	16267887
International Application Number:	
Confirmation Number:	6840
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Customer Number:	149890
Filer:	Nisha Somnath/Lindsey Lovato
Filer Authorized By:	Nisha Somnath
Attorney Docket Number:	SGIC-001US01
Receipt Date:	20-MAY-2019
Filing Date:	05-FEB-2019
Time Stamp:	11:00:49
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-001US01_Amendment_Reply_to_Office_Action.pdf	211811 20019116ea09a5bba08aaf88105943a858d21328	yes	21

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	18
	Applicant Arguments/Remarks Made in an Amendment	19	21
Warnings:			
Information:			
	Total Files Size (in bytes):	211811	

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

149890 7590 05/22/2019

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

EXAMINER	
SALL, EL HADJI MALICK	

ART UNIT	PAPER NUMBER
2457	

NOTIFICATION DATE	DELIVERY MODE
05/22/2019	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
smith@smithbaluch.com

Applicant-Initiated Interview Summary	**Application No.** 16/267,887	**Applicant(s)** Schupak et al.	
	Examiner EL HADJI SALL	**Art Unit** 2457	**AIA (FITF) Status** Yes

All participants (applicant, applicants representative, PTO personnel):

(1) EL HADJI SALL.

(2) Joseph Teja.

(3) Nisha Somnath.

(4) Peter Azuolas.

Date of Interview: 16 May 2019.

Type: ☑ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☑ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☑ No.
If Yes, brief description: _____.

Issues Discussed ☑101 ☐112 ☐102 ☐103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1.

Identification of prior art discussed: n/a.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Discussed the 101 issues and response to the 101 included in the agenda. It appears to overcome the 101 rejection. Examiner will respond upon receipt of Applicants reply. No agreement was made As for the claim objections, Applicant will fix the issues..

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/EL HADJI M SALL/ Primary Examiner, Art Unit 2457	

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiners responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicants correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,-
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicants record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiners version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, Interview Record OK on the paper recording the substance of the interview along with the date and the examiners initials.

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

May 22, 2019 03:40:15 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.

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	INTV.SUM.APP	05/22/2019	SGIC-001US01

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,

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

PTO/SB/06 (09-11)
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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 16/267,887	Filing Date 02/05/2019	☐ 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 $230 =	
☐ 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	05/20/2019	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 $230 =	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".	/DONNA D SMALLS LOGAN/
*** 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.**

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

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01

CONFIRMATION NO. 6840

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

PUBLICATION NOTICE

OC00000108899794

Title: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

Publication No.US-2019-0182554-A1
Publication Date:06/13/2019

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.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

To: docketing@smithbaluch.com,smith@smithbaluch.com,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
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Jun 14, 2019 03:25:20 AM

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	NTC.PUB	06/13/2019	SGIC-001US01

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NOTICE OF ALLOWANCE AND FEE(S) DUE

149890 7590 06/26/2019

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

EXAMINER
SALL, EL HADJI MALICK

ART UNIT	PAPER NUMBER
2457	

DATE MAILED: 06/26/2019

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

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

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	09/26/2019

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 06/26/2019

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.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

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

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	09/26/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
SALL, EL HADJI MALICK	2457	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. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

149890 7590 06/26/2019

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

EXAMINER	
SALL, EL HADJI MALICK	
ART UNIT	**PAPER NUMBER**
2457	

DATE MAILED: 06/26/2019

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.

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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.
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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.
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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. 16/267,887	Applicant(s) Schupak et al.	
	Examiner EL HADJI SALL	Art Unit 2457	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 05/20/2019.
   ☐ 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 areply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

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

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

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

Attachment(s)

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

/EL HADJI M SALL/
Primary Examiner, Art Unit 2457

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.

The following is a statement of reasons for the indication of allowable subject matter:

The prior art, in combination with all the other limitations of the claims, fail to teach "a system for providing a first plurality of copies 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, and for providing a second plurality of copies of a second broadcaster's live stream of digital content including second live sporting event video-based commentary from a second broadcaster client device to a second plurality of viewer client devices, 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; provide a first copy of the first plurality of copies 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; and provide a first copy of the second plurality of copies 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; 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 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 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," as in claims 1, 19, 23 and 27.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to EL HADJI SALL whose telephone number is (571)272-4010. The examiner can normally be reached on Monday-Friday 8:00-8:30 (flexible).

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, Ario Etienne can be reached on 5712724001. 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 http://pair-direct.uspto.gov. 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.

/EL HADJI M SALL/
Primary Examiner, Art Unit 2457

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	Art Unit
	EL HADJI SALL	2457

CPC - Searched*		
Symbol	Date	Examiner
(H04L 65/608) (H04N 21/2187) (H04N 21/47217) (H04N 21/6125)	06/10/2019	ES

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
Updated Non Patent Litterature Search	06/10/2019	ES
Updated East Search	06/10/2019	ES
Updated CPC Search	06/10/2019	ES

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04L	65/608	06/10/2019	ES

/EL HADJI M SALL/ Primary Examiner, Art Unit 2457	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	**Art Unit**
	EL HADJI SALL	2457

CPC						
Symbol					**Type**	**Version**
H04N	/	21	/	6125	F	2013-01-01
H04L	/	65	/	608	I	2013-01-01
H04N	/	21	/	47217	I	2013-01-01
H04N	/	21	/	2187	I	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/EL HADJI M SALL/ Primary Examiner, Art Unit 2457	10 June 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20190610

Genius Sports Ex. 1008
p. 445

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	**Art Unit**
	EL HADJI SALL	2457

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04N21/61	/	21	/	61
H04L29/06	/	29	/	06
H04N21/472	/	21	/	472
H04N21/2187	/	21	/	2187

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	30	
/EL HADJI M SALL/ Primary Examiner, Art Unit 2457	10 June 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20190610

Genius Sports Ex. 1008
p. 446

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/267,887	Schupak et al.
	Examiner	**Art Unit**
	EL HADJI SALL	2457

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

CLAIMS

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

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 30	
/EL HADJI M SALL/ Primary Examiner, Art Unit 2457 (Primary Examiner)	10 June 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

U.S. Patent and Trademark Office

Part of Paper No.: 20190610

Genius Sports Ex. 1008
p. 447

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	772648	(H04L 65/608) (H04N 21/2187) (H04N 21/47217) (H04N 21/6125)	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L2	22	("20080168493" | "20090222754" | "20130222597" | "20140129680" | "20160249108" | "20160360261" | "20170188054" | "8341662" | "8549574" | "8595186" | "8874778" | "9055271" | "9106934" | "9149682" | "9251852" | "9288278" | "9509793" | "9516390" | "9591054" | "9654844" | "9692800" | "9706443").PN.	US-PGPUB; USPAT	OR	OFF	2019/06/10 12:14
L3	18	L1 and L2	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L4	0	transmit$5 with score with germane	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L5	80	transmit$5 with score and germane	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L6	0	transmit$5 with score and germane with sport$5	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L7	23	germane with sport$5	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L8	0	L3 and L7	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L9	7898	broadcast$5 with live with stream$5	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L10	0	L9 and sproting near event	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L11	1830	L9 and sporting	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L12	1753	L9 and sporting near6 event	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L13	1717	L9 and sporting near event	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L14	176	L13 and viewer with client	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14

L15	0	L13 and viewer with client same video with communication with channel	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L16	11	L13 and viewer with client same video with communication	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L17	7	L16 and @ad<"20160805"	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L18	2	copy with live with stream$5 and view with communication with channel	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14
L19	2	L18 and @ad<"20160805"	US-PGPUB; USPAT	OR	ON	2019/06/10 12:14

6/ 10/ 2019 12:17:04 PM
C:\ Users\ esall\ Documents\ EAST\ Workspaces\ 16267887.wsp

Bibliographic Data

Application No: 16/267,887

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /EL HADJI M SALL/ ES

Examiner's Signature Initials

Title: 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

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/05/2019	709	2457	SGIC-001US01
RULE			

APPLICANTS

SportsCastr.LIVE, New York, NY,

INVENTORS

Philip Nicholas Schupak Brooklyn, NY, UNITED STATES

Brian SILSTON New York, NY, UNITED STATES

Kevin APRIL New York, NY, UNITED STATES

Peter AZUOLAS Philadelphia, PA, UNITED STATES

CONTINUING DATA

This application 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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02/22/2019

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STATE OR COUNTRY

UNITED STATES

ADDRESS

SMITH BALUCH LLP

376 BOYLSTON ST

STE 401
BOSTON, MA 02116
UNITED STATES

FILING FEE RECEIVED

$3,585

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Jun 26, 2019 04:18:33 AM

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	NOA	06/26/2019	SGIC-001US01

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

Doc Code: R48.REQ
Document Description: Request under Rule 48 correcting inventorship

PTO/AIA/40 (04-15)
Approved for use through 11/30/2020. OMB 0651-0031
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REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

Application Number	16/267,887
Filing Date	2019-02-05
First Named Inventor	Philip Nicholas SCHUPAK
Art Unit	2457
Examiner Name	El Hadji Malick SALL
Practitioner Docket Number	SGIC-001US01

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Applicant hereby **requests that the inventorship be corrected or changed, or that the name of the inventor or a joint inventor, or the order of the names of joint inventors, be changed,** in the above-identified application. **Note**: 37 CFR 1.48 applies to any request to correct inventorship filed on or after September 16, 2012, regardless of the application filing date. **Do not submit this form after payment of the issue fee or if the application has been patented.** See 37 CFR 1.324 for correction of inventorship in a patent.

Please check the applicable box(es) below.

For a nonprovisional application:

☐ 1. This request is to correct or change the inventorship in a **nonprovisional** application (**under 37 CFR 1.48(a)**) and includes:

☐ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the Manual of Patent Examining Procedure (MPEP) section 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☐ The processing fee set forth in 37 CFR 1.17(i). $ _____

☐ An inventor is being added. An inventor's oath or declaration by any actual inventor who has not yet executed an oath or declaration is required (see 37 CFR 1.48(b)). See MPEP 602.01(a) for information about an inventor's oath or declaration for an application filed on/after September 16, 2012 (*e.g.*, form **PTO/AIA/01**). For information about an inventor's oath or declaration for an application filed before September 16, 2012 (*e.g.*, form **PTO/SB/01**), see MPEP 602.01(b).

☐ This request is being filed after the first Office action on the merits has been given or mailed (see 37 CFR 1.48(c) and 1.17(d)). Check one of the following:

☐ This request to correct or change the inventorship is due solely to the cancellation of claims in the application.

OR

☐ The fee set forth in 37 CFR 1.17(d) is due (in addition to the fee set forth in 37 CFR 1.17(i)). $ _____

This collection of information is required by 37 CFR 1.48. 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 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.**

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

PTO/AIA/40 (04-15)
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U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CORRECTION IN A PATENT APPLICATION RELATING TO INVENTORSHIP OR AN INVENTOR NAME, OR ORDER OF NAMES, OTHER THAN IN A REISSUE APPLICATION (37 CFR 1.48)

☒ 2. This request is to correct or update the name of the inventor or a joint inventor, or the order of names of joint inventors, in a **nonprovisional** application (**under 37 CFR 1.48(f)**) and includes:

☒ An application data sheet in accordance with 37 CFR 1.76(c) identifying the complete inventive entity, including the corrected or updated name of the inventor, or the new order of names shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). See the MPEP 601.05(a) for information about filing an ADS in an application filed on/after September 16, 2012. For information about filing a Supplemental ADS in an application filed before September 16, 2012, see MPEP 601.05(b).

☒ The processing fee set forth in 37 CFR 1.17(i). $ 70.00

For a provisional application:

☐ This request is to change or correct the inventorship, or correct or update the name of the inventor or a joint inventor, in a **provisional** application (**under 37 CFR 1.48(d)**) and includes:

☐ **Attached hereto** is a request, signed by a party set forth in 37 CFR 1.33(b), that identifies each inventor by his or her legal name, in the preferred order.

☐ The processing fee set forth in 37 CFR 1.17(q). $ _____

Fee Payment Information:

☒ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. _____.

☒ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ Applicant*

☒ attorney or agent of record
Registration number 45,157

☐ attorney or agent acting under 37 CFR 1.34
Registration number _____

Signature /Joseph Teja, Jr./

Typed or printed name Joseph Teja, Jr.

Date August 7, 2019

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

☒ ** Total of 1 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.

Electronic Patent Application Fee Transmittal

Application Number:	16267887
Filing Date:	05-Feb-2019
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Filer:	Joseph Teja/Lindsey Lovato
Attorney Docket Number:	SGIC-001US01

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:				
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
UTILITY APPL ISSUE FEE	2501	1	500	500
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**570**

Electronic Acknowledgement Receipt

EFS ID:	36804723
Application Number:	16267887
International Application Number:	
Confirmation Number:	6840
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
First Named Inventor/Applicant Name:	Philip Nicholas Schupak
Customer Number:	149890
Filer:	Joseph Teja/Lindsey Lovato
Filer Authorized By:	Joseph Teja
Attorney Docket Number:	SGIC-001US01
Receipt Date:	07-AUG-2019
Filing Date:	05-FEB-2019
Time Stamp:	10:30:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$570
RAM confirmation Number	E201987A30582483
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	Issue Fee Payment (PTO-85B)	SGIC-001US01_Issue_Fee_Transmittal.pdf	169535 54cfca96de2878f0d289ca12bc7c579ae65d2f20	no	1
Warnings:					
Information:					
2	Transmittal Letter	SGIC-001US01_CommentsOnReasonForAllowance_20190807.pdf	97453 09e81ce9a93bb54cca266166f9758dc6d5af5683	no	2
Warnings:					
Information:					
3	Application Data Sheet	SGIC-001US01_CorrectedADS.pdf	783773 b98318bdd6028569d0f35d0958b851dd83547c73	no	11
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
4	Request under Rule 48 correcting inventorship	SGIC-001US01_USPTO_AIA40.pdf	183922 c7ab69455f75facd05dbef79791bad695b28fc59	no	3
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	32740 35eb308ec69189e1999ff953650dd6dc9398289b	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1267423		

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.

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 06/26/2019
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.
16/267,887	02/05/2019	Philip Nicholas Schupak	SGIC-001US01	6840

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

APP. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	09/26/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
SALL, EL HADJI MALICK	2457	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 Smith Baluch LLP
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: SportsCastr.LIVE

(B) RESIDENCE: (CITY and STATE OR COUNTRY): New York, NY

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 /Joseph Teja, Jr./ Date August 7, 2019

Typed or printed name Joseph Teja, Jr. Registration No. 45,157

Attorney Docket No. SGIC-001US01 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

First Inventor:	Philip Nicholas SCHUPAK	Confirmation No.:	6840
Application No.:	16/267,887	Group Art Unit:	2457
Filed:	2019-02-05	Examiner:	El Hadji Malick SALL

For: 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

Via EFS or Mail Stop Issue Fee
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE

These comments on Statement of Reasons for Allowance under 37 C.F.R. § 1.104 are intended to be responsive to the Statement of Reasons for allowance included on pages 6 and 8 of the Notice of Allowance dated June 26, 2019. Entry of the Statement into the record should not be construed as any agreement with or acquiescence in the reasoning stated by the Examiner. Each of the claims stands on its own merits and is patentable because of the combination it recites and not because of the presence or absence of any one particular element.

The Examiner's statement was not prepared by Applicant and only contains the Examiner's possible positions in one or more reasons for allowability. Thus, any interpretation with respect to the Examiner's Statement of Reasons for Allowance should not be imputed to the Applicant.

This statement commenting on the reasons for allowance is timely submitted.

Dated: August 7, 2019

Respectfully submitted,
SMITH BALUCH LLP

SMITH BALUCH LLP
376 Boylston St., Suite 401
Boston, MA 02116

Tel: 617-372-4547

By: /Joseph Teja, Jr./
Joseph Teja Jr.
Reg. No.45157

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-001US01
	Application Number	16/267,887
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	

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
	Philip	Nicholas	SCHUPAK	

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

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 2 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

Inventor 3 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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
	Application Number	
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	

City	New York	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	174 E90 PH3
Address 2	

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

Inventor 4 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	Philadelphia	State/Province	PA	Country of Residence	US

Mailing Address of Inventor:

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

City	Philadelphia	State/Province	PA
Postal Code	19102	Country	US

Inventor 5 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	New York	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	174 E90 PH3
Address 2	

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

Inventor 6 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	Philadelphia	State/Province	PA	Country of Residence	US

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
	Application Number	16/267,887
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	

Mailing Address of Inventor:

Address 1	330 South 15th Street, Apartment lF		
Address 2			
City	Philadelphia	**State/Province**	PA
Postal Code	19102	**Country**	US

Inventor 7 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

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 8 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

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-001US01
	Application Number	16/267,887
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	

Email Address	docketing@smithbaluch.com	Add Email	Remove Email

Application Information:

Title of the 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		
Attorney Docket Number	SGIC-001US01	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

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		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
	Application Number	16/267,887
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	

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	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.

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
	Application Number	16/267,887
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	

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

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

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-001US01
	Application Number	16/267,887
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	

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.

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-001US01
	Application Number	16/267,887
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	

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

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		
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.

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.

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
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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.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

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

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Joseph Teja, Jr./			Date (YYYY-MM-DD)	2019-08-07
First Name	Joseph	Last Name	Teja, Jr.	Registration Number	45157

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

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
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	SGIC-001US01
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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	

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.

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/267,887	02/05/2019	2457	1795	SGIC-001US01	30	4

CONFIRMATION NO. 6840

UPDATED FILING RECEIPT

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

OC000000110378348

Date Mailed: 08/14/2019

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, New York, NY

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application 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.

Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No
** **SMALL ENTITY** **
Title

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

Preliminary Class

709

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).

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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).

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technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/267,887	02/05/2019	Kevin April	SGIC-001US01

CONFIRMATION NO. 6840

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

37 CFR 1.48 ACKNOWLEDGEMENT LETTER

OC000000110376347

Date Mailed: 08/14/2019

NOTICE OF ACCEPTANCE OF REQUEST UNDER 37 CFR 1.48(a)

This is in response to the applicant's request under 37 CFR 1.48(a) submitted on 08/07/2019.

The request under 37 CFR 1.48(a) to correct the inventorship, to correct or update the name of an inventor, or to correct the order of names of joint inventors is accepted.

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

/ylueng/

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

Aug 14, 2019 03:28:06 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.

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	APP.FILE.REC	08/14/2019	SGIC-001US01
	R48.REQ.G	08/14/2019	SGIC-001US01

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,

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

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United States Patent and Trademark Office
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/267,887	09/24/2019	10425697	SGIC-001US01	6840

149890 7590 09/04/2019

SMITH BALUCH LLP
376 BOYLSTON ST
STE 401
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):

SportsCastr.LIVE, New York, NY
Kevin April, New York, NY;
Peter Azuolas, Philadelphia, PA;
Philip Nicholas SCHUPAK, Brooklyn, NY;
Brian Silston, New York, NY;

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

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

Sep 05, 2019 03:27:45 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.

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Application	Document	Mailroom Date	Attorney Docket No.
16267887	ISSUE.NTF	09/04/2019	SGIC-001US01

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