

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Central District of California, Los Angeles Division on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. 2:24-cv-3951	DATE FILED 5/10/2024	U.S. DISTRICT COURT for the Central District of California, Los Angeles Division
PLAINTIFF Sandpiper CDN, LLC		DEFENDANT Google LLC
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 8,478,903	7/2/2013	Sandpiper CDN, LLC
2 8,595,778	11/26/2013	Sandpiper CDN, LLC
3 8,645,517	2/4/2014	Sandpiper CDN, LLC
4 8,719,886	5/6/2014	Sandpiper CDN, LLC
5 9,021,112	4/28/2015	Sandpiper CDN, LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☒ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10,924,573	2/16/2021	Sandpiper CDN, LLC
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy



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.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/284,791	02/16/2021	10924573	0137-US-II-C2	7424

83579 7590 01/27/2021
LEVEL 3 COMMUNICATIONS, LLC
Attn: Patent Docketing
1025 Eldorado Blvd.
Broomfield, CO 80021

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):

Christopher Newton, Thousand Oaks, CA;
Level 3 Communications, LLC, Broomfield, CO
Laurence Lipstone, Calabasas, CA;
David Fullagar, Boulder, CO;

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 16/284,791	Confirmation No.	: 7424
First Applicant	: NEWTON	Art Unit	: 2452
Filed	: February 25, 2019	Examiner	: Patrice L. Winder
Title	: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Docket No.	: 0137-US-I1-C2		

Submitted Via EFS-Web

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE

Dear Sir:

Applicant acknowledges the Notice of Allowance in the present application by the Examiner with appreciation. Applicant notes that the reasons for allowance set forth in the Notice of Allowance are not the only reasons that the claims are allowable. As the Examiner's reasons for allowance are not exhaustive, such reasons for allowance do not establish an estoppel against Applicant with regard to the scope of any claim in the present application or any related applications, including without limitation any continuation applications claiming priority to the present application.

If there are any questions, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,

Date: January 12, 2021

/Thomas A. Froats/
Thomas A. Froats, Reg. No. 66,609
USPTO Customer No. 83579
Level 3 Communications, LLC
1025 Eldorado Blvd.
Broomfield, Colorado 80021
Tel: 720-888-3530

Electronic Acknowledgement Receipt	
EFS ID:	41619159
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Thomas Andrew Froats/Kathleen McInnish
Filer Authorized By:	Thomas Andrew Froats
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	12-JAN-2021
Filing Date:	25-FEB-2019
Time Stamp:	12:17:58
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Post Allowance Communication - Incoming	0137-US-I1-C2_csra.pdf	19227	no	1
			4349b3fa4aed57f858a821c05fa222e0689cd53		

Warnings:

Information:	
Total Files Size (in bytes):	19227
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.	

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
16284791	25-Feb-2019	Christopher Newton	0137-US-11-C2	7424

TITLE OF INVENTION :

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Regular Undiscounted	Utility under 35 USC 111(a)	2452	203000	PATRICE WINDER
Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
\$1200	\$0	\$1200	31-Mar-2021	\$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
83579 LEVEL 3 COMMUNICATIONS, LLC Attn: Patent Docketing 1025 Eldorado Blvd. Broomfield CO 80021 UNITED STATES 720-888-3381 ~~patent.docketing@centurylink.com~~	
☐ Change of correspondence address requested, system generated AIA/122-EFS form attached	☐ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status**Change in Entity Status**

Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.

Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.



Applicant asserting small entity status. See 37 CFR 1.27.

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



Applicant changing to regular undiscounted fee status.

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



Document Description: Issue Fee Payment (PTO-85B)

3.The Following Fee(s) Are Submitted:☒ Issue Fee☐ I authorize USPTO to apply my previously paid issue fee to the current fees due☐ Publication Fee☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____☐ Advance Order - # of copies _____

If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number 603290.

☒ The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed**NOTE: If no name is listed, no name will be printed**

For printing on the patent front page, list to be displayed as entered

1.

2.

3.

5.Assignee Name(s) and Residence Data To Be Printed

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

Name	City	State	Country	Category
Level 3 Communications, LLC	Broomfield	COLORADO	united states	other

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/Thomas A. Froats/	Date	01-12-2021
Name	Thomas Andrew Froats	Registration Number	66609

Electronic Patent Application Fee Transmittal				
Application Number:		16284791		
Filing Date:		25-Feb-2019		
Title of Invention:		HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
First Named Inventor/Applicant Name:		Christopher Newton		
Filer:		Thomas Andrew Froats/Kathleen McInnish		
Attorney Docket Number:		0137-US-I1-C2		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1200

Electronic Acknowledgement Receipt	
EFS ID:	41619129
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Thomas Andrew Froats/Kathleen McInnish
Filer Authorized By:	Thomas Andrew Froats
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	12-JAN-2021
Filing Date:	25-FEB-2019
Time Stamp:	12:17:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$1200
RAM confirmation Number	E20211BC17150138
Deposit Account	603290
Authorized User	Kathleen McInnish
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.20 (Post Issuance 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	Issue Fee Payment (PTO-85B)	Web85b.pdf	45952	no	2
			abd722c3b5c5dbd7c4707612e41b9a0ac8542755		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32563	no	2
			fed4b4c93e203fe0ec4af5f92776ec54cc8e99f4		
Warnings:					
Information:					
Total Files Size (in bytes):			78515		
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.					



UNITED STATES PATENT AND TRADEMARK OFFICE

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

83579 7590 12/31/2020
LEVEL 3 COMMUNICATIONS, LLC
Attn: Patent Docketing
1025 Eldorado Blvd.
Broomfield, CO 80021

EXAMINER

WINDER, PATRICE L

ART UNIT

PAPER NUMBER

2452

DATE MAILED: 12/31/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/284,791	02/25/2019	Christopher Newton	0137-US-11-C2	7424

TITLE OF INVENTION: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1200	\$0.00	\$0.00	\$1200	03/31/2021

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

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

HOW TO REPLY TO THIS NOTICE:

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

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

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

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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

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

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

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

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

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

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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

83579 7590 12/31/2020
LEVEL 3 COMMUNICATIONS, LLC
Attn: Patent Docketing
1025 Eldorado Blvd.
Broomfield, CO 80021

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.
16/284,791	02/25/2019	Christopher Newton	0137-US-II-C2	7424

TITLE OF INVENTION: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1200	\$0.00	\$0.00	\$1200	03/31/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
WINDER, PATRICE L	2452	709-203000

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. _____



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.
16/284,791	02/25/2019	Christopher Newton	0137-US-11-C2	7424
83579 7590 12/31/2020 LEVEL 3 COMMUNICATIONS, LLC Attn: Patent Docketing 1025 Eldorado Blvd. Broomfield, CO 80021			EXAMINER WINDER, PATRICE L	
			ART UNIT 2452	PAPER NUMBER
DATE MAILED: 12/31/2020				

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

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

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

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

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

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

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

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/284,791	Applicant(s) Newton et al.	
	Examiner PATRICE L WINDER	Art Unit 2452	AIA (FITF) Status No

-- 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 9-17-2020.
☐ 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 1-20. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
a) ☐ All b) ☐ Some *c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
* Certified copies not received: _____.

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

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.
Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

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

Attachment(s)

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

/Patrice L Winder/ Primary Examiner, Art Unit 2452	
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DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Allowable Subject Matter

2. Claims 1-20 are allowed.
3. The following is an examiner's statement of reasons for allowance:

The prior art of record fails to teach or suggest "receiving an instruction to not cache the resource at the first server of the first tier of servers when the portion of the resource is obtained from the content server of the content delivery network" as recited in the claims.

The closest prior art is Raju et al., 7,552,233 B2, hereafter referred to as Raju. Raju teaches a policy for managing caching content at the edge of a network. Based on the configured rules of the policy whether to cache the content item is determined. Determining whether is cache a content item is different from "sending an instruction to not cache the content item" as recited in the claims.

The other closest prior art of record is Swildens et al., US 2004/0221019 A1, hereafter referred to as Swildens. Swildens teaches a popularity service for determining the popularity of a content item. Whether the content item is cached is determined based on the popularity value. Accessing the popularity value is different from "sending an instruction to not cache the content item" as recited in the claims.

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

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to PATRICE L WINDER whose telephone number is (571)272-3935. The examiner can normally be reached on M-F 10am-6pm.

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, Thu Nguyen can be reached on 571-272-6967. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <https://ppair-my.uspto.gov/pair/PrivatePair>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-

Application/Control Number: 16/284,791
Art Unit: 2452

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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.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

Issue Classification 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

CPC						
Symbol					Type	Version
H04L	/	67	/	2814	F	2013-01-01
H04L	/	67	/	1014	I	2013-01-01
H04L	/	67	/	1097	I	2013-01-01
H04L	/	67	/	2842	I	2013-01-01
H04N	/	21	/	25891	I	2013-01-01
H04N	/	7	/	17354	I	2013-01-01
H04N	/	21	/	23106	I	2013-01-01
H04N	/	21	/	23103	I	2013-01-01
H04N	/	21	/	222	I	2013-01-01
H04N	/	21	/	472	I	2013-01-01

CPC Combination Sets					
Symbol		Type	Set	Ranking	Version
	/		/		

NONE (Assistant Examiner) (Date)		Total Claims Allowed: 20	
/Patrice L Winder/ Primary Examiner, Art Unit 2452 (Primary Examiner)		19 December 2020 (Date)	O.G. Print Claim(s) 1
			O.G. Print Figure 3

U.S. Patent and Trademark Office

Part of Paper No.: 20201219

Issue Classification 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

INTERNATIONAL CLASSIFICATION			
CLAIMED			
H04L29/08	/	29	/ 08
H04N21/258	/	21	/ 258
H04N7/173	/	7	/ 173
H04N21/231	/	21	/ 231
H04N21/222	/	21	/ 222
H04N21/472	/	21	/ 472
NON-CLAIMED			
	/		/

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

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

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 20	
/Patrice L Winder/ Primary Examiner, Art Unit 2452 (Primary Examiner) _____ (Date) _____		19 December 2020 O.G. Print Claim(s) 1	O.G. Print Figure 3

U.S. Patent and Trademark Office

Part of Paper No.: 20201219

Issue Classification 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

☒ 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

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 20	
/Patrice L Winder/ Primary Examiner, Art Unit 2452 (Primary Examiner) _____ (Date) 19 December 2020		O.G. Print Claim(s) 1	O.G. Print Figure 3

<i>Search Notes</i> 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

CPC - Searched*		
Symbol	Date	Examiner
(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	06/23/2020	plw
(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	12/11/2020	plw

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.

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<i>Search Notes</i> 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

Search Notes		
Search Notes	Date	Examiner
Assignee and inventor name search (using EAST) - see attached search history	06/23/2020	plw
limited text search of claims (using EAST) - see attached search history	06/23/2020	plw
limited text search of CPC subgroups (using EAST) - see attached search history	06/24/2020	plw
US Patents and PG Publications (using EAST) - see attached search history	06/29/2020	plw
US Patents and PG Publications (using EAST) - see attached search history	07/06/2020	plw
DERWENT WPI, EPO, JPO and IBM Technical Bulletins (using EAST) - see attached search history	07/20/2020	plw
Assignee and inventor name search (using EAST) - see attached search history	12/11/2020	plw
limited text search of CPC subgroups above (using EAST) - see attached search history	12/11/2020	plw
DERWENT WPI, EPO, JPO and IBM Technical Bulletins (using EAST) - see attached search history	12/11/2020	plw
US Patents and PG Publications (using EAST) - see attached search history	12/11/2020	plw

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	text search of CLAIMS (using EAST) - see attached search printout	12/19/2020	plw

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	681	((("LEVEL") near3 ("3") near3 ("COMMUNICATIONS") near3 ("LLC"))).AS,AANM.	USPAT	OR	ON	2020/12/11 17:21
S2	501	((("Newton") near3 ("Christopher"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:21
S3	172	((("Lipstone") near3 ("Laurence"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:21
S4	86	((("Fullagar") near3 ("David"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:21
S5	108	(S1 or S2 or S3 or S4) and (buzz or buzzworthy or hot\$4 or popular\$5 or "most" near2 request\$3).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:21
S6	38	S5 and ((cluster\$3 or group\$3 or hierarch\$4 or layer or tier) near10 (cache or server or service)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:22
S7	8	S6 and ((bit or field or flag or indicat\$3 or policy or rule) near20 (cach\$3 or "not" near2 cach\$3)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:22
S8	0	S6 and ((bit or field or flag or indicat\$3 or policy or rule) near20 (deactivat\$3 or disabl\$3 or "not" near2 cach\$3)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/12/11 17:23
S9	50,797	(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	US-PGPUB; USPAT	OR	ON	2020/12/11 17:24
S10	20,411	(cdn or content near2 delivery near2 network or cloud) same2 ((cach\$3 or stor\$3) near10 (content or file or media! or multimedia or object) near20 (cluster\$3 or group\$3 or hierarch\$5 or intermedia\$5 or layer or level or tier))	US-PGPUB; USPAT	OR	ON	2020/12/11 17:24
S11	1,175	S10 same5 ((bit or field or flag or indicat\$3 or policy or rule) near20 (cach\$3 or (deactivat\$3 or disabl\$3 or "not") near2 cach\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 17:29
S12	609	S9 and S11	US-PGPUB; USPAT	OR	ON	2020/12/11 17:32

S13	98	S12 and (@ad<"20100913" or @rld<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 17:33
S14	139	S10 same5 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 17:40
S15	49	S9 and S14	US-PGPUB; USPAT	OR	ON	2020/12/11 17:42
S16	7	S15 and (@ad<"20100913" or @rld<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 17:42
S17	153	S10 same6 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 17:43
S18	618	S10 same6 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or setting or "whether") near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 17:47
S19	238	S9 and (S17 or S18)	US-PGPUB; USPAT	OR	ON	2020/12/11 17:51
S20	68	S19 and (@ad<"20100913" or @rld<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 17:51
S21	1,825	(cdn or content near2 delivery near2 network or cloud) and ((cach\$3 or stor\$3) near10 (content or file or media! or multimedia or object) near20 (cluster\$3 or group\$3 or hierarch\$5 or intermedia\$5 or layer or level or tier))	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 17:57
S22	0	S21 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 17:58
S23	23	S21 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or "whether") near4 (cach\$3 or stor\$3))	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 17:58
S24	2,545	(cdn or content near2 delivery near2 network or cloud) and ((cach\$3 or stor\$3) near10 (content or file or media! or multimedia or object)) and (network\$3 or proxy or server or service) same (cluster\$3 or group\$3 or	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 18:10

		hierarch\$5 or intermedia\$5 or layer or level or tier)				
S25	2	S24 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 18:17
S26	21	S24 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or "whether") near4 (cach\$3 or stor\$3))	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/12/11 18:19
S27	3,258	(cdn or content near2 delivery near2 network or cloud) same2 ((cach\$3 or (temporar\$3 near4 stor\$3)) near10 (content or file or media! or multimedia or object) near20 (cluster\$3 or group\$3 or hierarch\$5 or intermedia\$5 or layer or level or tier))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:20
S28	9,879	(cach\$3 or (temporar\$3 near4 stor\$3)) same3 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:25
S29	0	S24 and (S27 or S28)	US-PGPUB; USPAT	OR	ON	2020/12/11 18:28
S30	4,895	(S27 or S28) and (cdn or content near2 delivery near2 network or cloud)	US-PGPUB; USPAT	OR	ON	2020/12/11 18:29
S31	3,414	S30 and ((cach\$3 or (temporar\$3 near4 stor\$3)) near10 (content or file or media! or multimedia or object) near20 (cluster\$3 or group\$3 or hierarch\$5 or intermedia\$5 or layer or level or tier))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:29
S32	64,587	((cach\$3 or (temporar\$3 near4 stor\$3)) near10 (content or file or media! or multimedia or object)) same2 ((cluster\$3 or group\$3 or hierarch\$5 or intermedia\$5 or layer or level or tier) near10 (cache or device or proxy or server or service or storage))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:33
S33	3,327	S31 and S32	US-PGPUB; USPAT	OR	ON	2020/12/11 18:39
S34	699	S33 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 18:39
S35	5,367	(S27 or S28) and S32	US-PGPUB; USPAT	OR	ON	2020/12/11 18:40

S36	3,596	S35 and (cdn or content near2 delivery near2 network or cloud)	US-PGPUB; USPAT	OR	ON	2020/12/11 18:40
S37	723	S36 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 18:43
S38	874	S32 same6 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (bypass\$3 or deactivat\$3 or disabl\$3 or "not" or prevent\$3 or prohibit\$5 or restrict\$4 or skip\$4) near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:44
S39	5,546	S32 same6 ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or setting or "whether") near4 (cach\$3 or stor\$3))	US-PGPUB; USPAT	OR	ON	2020/12/11 18:48
S40	451	S38 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 18:53
S41	3,041	S39 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/12/11 18:53
S42	303	(S40 or S41) and (cdn or content near2 delivery near2 network or cloud)	US-PGPUB; USPAT	OR	ON	2020/12/11 18:53
S43	78	S42 and ((buzz or buzzworthy or hot\$4 or popular\$5 or "most" near2 request\$3) near10 (content or file or media! or multimedia or object))	US-PGPUB; USPAT	OR	ON	2020/12/11 19:26

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S44	7,864	((buzz or buzzworthy or hot\$4 or popular\$5 or "most" near2 request\$3) near10 (content or file or media! or multimedia or object)).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:15
S45	697	S44 and (cdn or content near2 (delivery or network) or cloud).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:16
S46	209	S45 and (cach\$3 or proxy or intermedia\$5 near2 storage).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:17
S47	7	S46 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or setting or "whether") near4 (cach\$3 or stor\$3)).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:17
S48	596	S44 and (cach\$3 or proxy or intermedia\$5 near2 storage).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:18

S49	83	S48 and ((buzz or buzzworthy or hot\$4 or popular\$5 or "most" near2 request\$3) near3 (server or service or comput\$3 near3 (device or node))).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:19
S50	1	S49 and ((bit or code or field or flag or indicat\$3 or policy or rule) near20 (activat\$3 or enabl\$3 or setting or "whether") near4 (cach\$3 or stor\$3)).clm.	US-PGPUB; USPAT	OR	ON	2020/12/19 11:20

12/19/2020 12:20:09 PM

C:\Users\pwinder\Documents\EAST\Workspaces\16284791_20201211.wsp

Bibliographic Data

Application No: 16/284,791

Foreign Priority claimed: ☐ Yes ☒ No

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

Verified and Acknowledged:

Examiner's Signature

Initials

Title:

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
02/25/2019	709	2452	0137-US-I1-C2
RULE			

APPLICANTS

Level 3 Communications, LLC, Broomfield, CO,

INVENTORS

Christopher Newton, Thousand Oaks, CA, UNITED STATES

Laurence Lipstone, Calabasas, CA, UNITED STATES

David Fullagar, Boulder, CO, UNITED STATES

CONTINUING DATA

This application is a CON of 15645584 07/10/2017 PAT 10218806

15645584 is a CON of 12880324 09/13/2010 PAT 9762692

12880324 is a CIP of 12408681 03/21/2009 PAT 8930538

12408681 has PRO of 61042412 04/04/2008

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

03/12/2019

STATE OR COUNTRY

UNITED STATES

ADDRESS

LEVEL 3 COMMUNICATIONS, LLC

Attn: Patent Docketing

1025 Eldorado Blvd.

Broomfield, CO 80021

UNITED STATES

FILING FEE RECEIVED

\$1,720

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce	
Electronic Petition Request	TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT		
Application Number	16284791		
Filing Date	25-Feb-2019		
First Named Inventor	Christopher Newton		
Attorney Docket Number	0137-US-I1-C2		
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action ☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.			
Owner		Percent Interest	
Level 3 Communications, LLC		100%	
The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s) 10462252 as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns. In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later: - expires for failure to pay a maintenance fee; - is held unenforceable; - is found invalid by a court of competent jurisdiction; - is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321; - has all claims canceled by a reexamination certificate; - is reissued; or - is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer. ☒ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.			

☐ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status: ☐ Small Entity ☐ Micro Entity ☒ Regular Undiscounted	
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ☒ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number <u>66609</u> ☐ A sole inventor ☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ☐ A joint inventor; all of whom are signing this request	
Signature	/Thomas A. Froats/
Name	Thomas A. Froats

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
 Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal				
Application Number:		16284791		
Filing Date:		25-Feb-2019		
Title of Invention:		HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
First Named Inventor/Applicant Name:		Christopher Newton		
Filer:		Thomas Andrew Froats/Kathleen McInnish		
Attorney Docket Number:		0137-US-I1-C2		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				170

Doc Code: DISQ.E.FILE

Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16284791

Filing Date: 25-Feb-2019

Applicant/Patent under Reexamination: Newton

Electronic Terminal Disclaimer filed on December 17, 2020

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	41416886
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Thomas Andrew Froats/Kathleen McInnish
Filer Authorized By:	Thomas Andrew Froats
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	17-DEC-2020
Filing Date:	25-FEB-2019
Time Stamp:	13:32:59
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$170
RAM confirmation Number	E2020BGD32559907
Deposit Account	603290
Authorized User	Kathleen McInnish
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.17 (Patent application and reexamination processing 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	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	33582	no	2
			899c288099b1ed8dab09ca910206681e38df152b		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30766	no	2
			6589aa134142e40bc998e315ba187a68fc3a756b		
Warnings:					
Information:					
Total Files Size (in bytes):			64348		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Christopher Newton et al.

Application No.: 16/284,791

Filed: February 25, 2019

Title: Handling Long-Tail Content in a
Content Delivery Network (CDN)

Customer No.: 83579

Confirmation No.: 7424

Examiner: Patrice L. Winder

Art Unit: 2452

VIA EFS

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT AND REMARKS

Dear Examiner:

In response to the Non-Final Office Action issued on July 24, 2020, please amend the
above-identified patent application as follows:

AMENDMENTS TO THE CLAIMS

Please replace the claims as filed with the claims set forth below. This listing of claims will replace all prior versions, and listings, of claims in the application:

LISTING OF CLAIMS:

1. (Currently Amended) A method of content delivery in a content delivery network comprising:

receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a resource available from the content delivery network;

accessing a popularity service associated with the content delivery network to determine a popularity designation associated with the requested resource;

requesting the resource from a second server of the content delivery network;

processing, at the first server of the first tier of servers, a redirect instruction from the second server of the content delivery network to obtain the resource from a content server of the content delivery network;

receiving an instruction to not cache the portion of the resource at the first server of the first tier of servers when the portion of the resource is obtained from the content server of the content delivery network; and

providing the obtained resource to the requesting device.

2. (Currently Amended) The method as recited in claim 1 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular, ~~the method further comprising: receiving an instruction to not cache the resource at the~~

~~first server of the first tier of servers when the resource is obtained from the content server of the content delivery network.~~

3. (Original) The method as recited in claim 1 wherein the popularity designation associated with the requested resource indicates that the requested resource is popular, the method further comprising: receiving an instruction to cache the resource at the first server of the first tier of servers when the resource is obtained from the content server of the content delivery network.

4. (Original) The method as recited in claim 1 wherein the second server is a metro mid-tier server of the content delivery network.

5. (Original) The method as recited in claim 1 wherein the second server is a peer server of the first tier of servers of the content delivery network.

6. (Original) The method as recited in claim 1 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.

7. (Original) The method as recited in claim 6 wherein the popularity service is associated with the second server of the content delivery network.

8. (Original) The method as recited in claim 6 wherein the popularity service is associated with the first server of the first tier of servers of the content delivery network.

9. (Original) The method as recited in claim 1 wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers.

10. (Original) The method as recited in claim 3 further comprising:
receiving, at the first server of the first tier of servers of the content delivery network, an additional request for the resource available from the content delivery network;
determining that the resource is cached at the first server of the first tier of servers; and
providing the cached resource from the first server of the first tier of servers in response to the additional request for the resource.

11. (Currently Amended) A content delivery network comprising:
a first tier of servers comprising a first plurality of servers, an edge server of the first tier of servers receiving a request from a requesting device in communication with the first server for a resource available from the content delivery network ;
a second tier of servers comprising a second plurality of servers, a first server of the second plurality of servers receiving a request from the edge server for the content and, in response, transmitting a redirect instruction intended for the requesting device to the edge server to obtain the resource from a content server and transmitting an instruction to not cache the

portion of the resource at the edge server when the portion of the resource is obtained from the content server; and

a popularity service tracking a popularity designation associated with the requested resource;

wherein the edge server processes the redirect instruction to obtain the content from the content server and provides the obtained content to the requesting device.

12. (Currently Amended) The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular ~~and the first server of the second plurality of servers transmits an instruction to not cache the resource at the content server of the first tier of servers when the resource is obtained from the content server.~~

13. (Original) The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is popular and the first server of the second plurality of servers transmits an instruction to cache the resource at the content server of the first tier of servers when the resource is obtained from the content server.

14. (Original) The content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a metro mid-tier server of the content delivery network.

15. (Original) The content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a peer server of the first tier of servers of the content delivery network.

16. (Original) The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.

17. (Original) The content delivery network as recited in claim 16 wherein the popularity service is associated with the first server of the second plurality of servers of the content delivery network.

18. (Original) The content delivery network as recited in claim 16 wherein the popularity service is associated with the content server of the first tier of servers of the content delivery network.

19. (Currently Amended) A method of content delivery in a content delivery network comprising:

receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a resource available from the content delivery network;

accessing a popularity service associated with the first server of the first tier of the content delivery network to determine a popularity designation associated with the requested resource;

receiving an instruction to not cache the resource at the first server of the first tier of servers when the portion of the resource is obtained from the content server of the content delivery network;

requesting the resource from a second server of the content delivery network based at least on the popularity designation associated with the requested resource; and
providing the obtained resource to the requesting device.

20. (Original) The method as recited in claim 19 wherein the second server of the content delivery network is a content server storing the requested content.

REMARKS

Claims 1-20 are pending in the present application, with claims 1, 11, and 20 being independent claims.

A recitation from claims 2 and 12 has been removed and incorporated into base claims 1 and 11, respectively, and a similar recitation incorporated into claim 20.

Double Patenting

Claim 11 is rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claim 8 of U.S. Patent No. 8,930,538. Claims 1, 2, 4-7, 11, 12, and 14-18 are rejected on the ground of nonstatutory double patenting as allegedly being unpatentable over claims 1-7 9-14 of U.S. Patent No. 10,348,848. In order to expedite prosecution, a terminal disclaimer is filed concurrently with this amendment over U.S. Patent Nos. 8,930,538 and 10,348,848. Withdrawal of the rejections is respectfully requested.

35 U.S.C. § 103

Claims 1, 3-8, 10, 11, and 14-20 are rejected under pre-AIA 35 U.S.C. § 103(a) as allegedly being unpatentable over Raju et al. (U.S. Patent No. 7,552,233, hereinafter “Raju”) in view of Swildens et al. (U.S. Patent Publication No. 2004,0221019, hereinafter “Swildens”). Claims 9 and 12-13 are rejected under pre-AIA 35 U.S.C. § 103(a) as allegedly being unpatentable over Raju and Swildens and further in view of Outten et al. (U.S. Patent No. 7,024,466, hereinafter “Outten”). The Applicant respectfully traverses this rejection.

Independent claim 1 of the present application, from which claims 2-10 depend incorporates the recitation from claim 2 of “receiving an instruction to not cache the portion of

the resource at the first server of the first tier of servers when the portion of the resource is obtained from the content server of the content delivery network.” Independent claims 11 and 19, from which claims 12-18 and 20 depend, respectively, have incorporated a similar recitation. The above recitation from claim 2 is not rejected under 35 U.S.C. § 103. As such, each of the independent claims, and thus each of the pending claims of the present application, recite subject matter that is patentable over the cited references.

Accordingly, the Applicant respectfully submits that claims 1-20 are patentable over the cited references. Withdrawal of the rejection is respectfully requested.

Conclusion

In light of the foregoing, the Applicant respectfully requests withdrawal of the rejections and that a timely Notice of Allowance be issued in this case.

The Applicant believes no fees or petitions are due with this filing. However, should any fees or petitions be necessary, please consider this a request therefor and authorization to charge Deposit Account No. 60-3290 as appropriate. The Office is invited to contact the undersigned at the number listed below for any questions or concerns or to expedite prosecution.

Respectfully submitted,

Date: September 17, 2020

/Thomas A. Froats/
Thomas A. Froats
Registration No. 66,609
USPTO Customer No. 83,579
1025 Eldorado Blvd.
Broomfield, Colorado 80021
Tel: 720-888-3530

Electronic Acknowledgement Receipt	
EFS ID:	40590846
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Thomas Andrew Froats/Kathleen McInnish
Filer Authorized By:	Thomas Andrew Froats
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	17-SEP-2020
Filing Date:	25-FEB-2019
Time Stamp:	16:34:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		0137_US_I1_C2_Response_to_NFOA.pdf	46556	yes	9
			3dc82551f8788358416b0f0791e6e3421552ba90		

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	7
	Applicant Arguments/Remarks Made in an Amendment	8	9
Warnings:			
Information:			
Total Files Size (in bytes):		46556	
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.			

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce
Electronic Petition Request	TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	
Application Number	16284791	
Filing Date	25-Feb-2019	
First Named Inventor	Christopher Newton	
Attorney Docket Number	0137-US-I1-C2	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)	
☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action ☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.		
Owner	Percent Interest	
Level 3 Communications, LLC	100%	
The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s) 8930538 10348848 as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns. In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later: - expires for failure to pay a maintenance fee; - is held unenforceable; - is found invalid by a court of competent jurisdiction; - is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321; - has all claims canceled by a reexamination certificate; - is reissued; or - is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.		

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ☒ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number <u>66609</u> ☐ A sole inventor ☐ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ☐ A joint inventor; all of whom are signing this request	
Signature	/Thomas A. Froats/
Name	Thomas A. Froats

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
 Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal				
Application Number:		16284791		
Filing Date:		25-Feb-2019		
Title of Invention:		HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
First Named Inventor/Applicant Name:		Christopher Newton		
Filer:		Thomas Andrew Froats/Kathleen McInnish		
Attorney Docket Number:		0137-US-I1-C2		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				160

Doc Code: DISQ.E.FILE

Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16284791

Filing Date: 25-Feb-2019

Applicant/Patent under Reexamination: Newton

Electronic Terminal Disclaimer filed on September 17, 2020

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt	
EFS ID:	40590802
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Thomas Andrew Froats/Kathleen McInnish
Filer Authorized By:	Thomas Andrew Froats
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	17-SEP-2020
Filing Date:	25-FEB-2019
Time Stamp:	16:33:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$160
RAM confirmation Number	E20209GG33102002
Deposit Account	603290
Authorized User	Kathleen McInnish
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.17 (Patent application and reexamination processing fees)	

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	33639	no	2
			84fe68118a97f055108009935b7c3d546ee68749		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30841	no	2
			f60607629a21ab86b3feb872f6f5c8532a1a7f09		
Warnings:					
Information:					
Total Files Size (in bytes):			64480		
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/284,791		Filing Date 02/25/2019		☐ To be Mailed		
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO										
APPLICATION AS FILED - PART I										
		(Column 1)	(Column 2)							
FOR		NUMBER FILED	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), (l), 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(j))		minus 20 =	*	x \$100 =						
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*	x \$460 =						
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))										
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL						
APPLICATION AS AMENDED - PART II										
		(Column 1)	(Column 2)	(Column 3)						
AMENDMENT	09/17/2020	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)			
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	x \$100 =		0		
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0	x \$460 =		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			
AMENDMENT		(Column 1)	(Column 2)	(Column 3)						
		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".					/NICOLE L NICHOLSON/					
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".										
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.										

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/284,791	02/25/2019	Christopher Newton	0137-US-11-C2	7424
83579	7590	07/24/2020	EXAMINER	
LEVEL 3 COMMUNICATIONS, LLC			WINDER, PATRICE L	
Attn: Patent Docketing				
1025 Eldorado Blvd.			ART UNIT	
Broomfield, CO 80021			PAPER NUMBER	
			2452	
			NOTIFICATION DATE	
			DELIVERY MODE	
			07/24/2020	
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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):

patent.docketing@centurylink.com

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(I)(1) - 706.02(I)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

3. Claim 11 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 8 of U.S. Patent No. 8,930,538 B2. Although the claims at issue are not identical, they are not patentably distinct from each other because the relabeling of the parent servers is an obvious variation.
4. Claims 1-2, 4-7, 11-12 and 14-18 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-7 and 9-14 of U.S. Patent No. 10,348,848 B2. Although the claims at issue are not identical, they are not patentably distinct from each other because the omission of limitations is an obvious variation.

Present application	USPN 8,930,538 B2	USPN 10,348,848 B2
11. A content delivery network comprising: a first tier of servers comprising a first plurality of servers, an edge server of the first tier of servers receiving a request from a requesting device in	8. A content delivery framework comprising: a plurality of edge servers forming a first tier of servers; and a plurality of parent servers forming a second tier of servers, said parent	

communication with the first server for a resource available from the content delivery network ; a second tier of servers comprising a second plurality of servers, a first server of the second plurality of servers receiving a request from the edge server for the content and, in response, transmitting a redirect instruction intended for the requesting device to the edge server to obtain the resource from a content server; and a popularity service tracking a popularity designation associated with the requested resource; wherein the edge server processes the redirect instruction to obtain the	servers being distinct from said edge servers; and at least one popularity service, implemented at least in part by hardware in combination with software, and constructed and adapted to obtain information from at least some of said edge servers about requests for content that has been specifically designated to be handled based on popularity of the content, and to provide said edge servers with information about which tier of servers should handle those requests for content, said popularity service making determinations based, at least in part, on a measure of	
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content from the content server and provides the obtained content to the requesting device.	popularity of requested content.	
1. A method of content delivery in a content delivery network comprising: receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a resource available from the content delivery network; accessing a popularity service associated with the content delivery network to determine a popularity designation associated with the requested resource; requesting the resource from a second server of the		1. A method of content delivery in a content delivery network comprising: receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a portion of a resource available from the content delivery network; determining whether the portion of the resource is an initial portion of the resource; accessing a popularity service associated with the content delivery network to determine a

content delivery network; processing, at the first server of the first tier of servers, a redirect instruction from the second server of the content delivery network to obtain the resource from a content server of the content delivery network; and providing the obtained resource to the requesting device. 2. The method as recited in claim 1 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular, the method further comprising: receiving an instruction to not cache the resource at the first		popularity designation associated with the resource, wherein the popularity designation associated with the resource indicates that the resource is not popular; requesting the portion of the resource from a second server of the content delivery network; processing, at the first server of the first tier of servers, a redirect instruction from the second server of the content delivery network to obtain the portion of the resource from a content server of the content delivery network; receiving an instruction to not cache the portion of
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server of the first tier of servers when the resource is obtained from the content server of the content delivery network.		the resource at the first server of the first tier of servers when the portion of the resource is obtained from the content server of the content delivery network; and providing, from the first server of the first tier of servers, the obtained portion of the resource to the requesting device.
4. The method as recited in claim 1 wherein the second server is a metro mid-tier server of the content delivery network.		2. The method of claim 1 wherein the second server is a metro mid-tier server of the content delivery network.
5. The method as recited in claim 1 wherein the second server is a peer server of the first tier of servers of the content delivery network.		3. The method of claim 1 wherein the second server is a peer server of the first tier of servers of the content delivery network.

6. The method as recited in claim 1 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.		4. The method of claim 1 wherein the popularity designation associated with the resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.
7. The method as recited in claim 6 wherein the popularity service is associated with the second server of the content delivery network.		5. The method of claim 4 wherein the popularity service is associated with the second server of the content delivery network.
8. The method as recited in claim 6 wherein the popularity service is associated with the first		6. The method of claim 4 wherein the popularity service is associated with

server of the first tier of servers of the content delivery network.		the first server of the first tier of servers of the content delivery network.
9. The method as recited in claim 1 wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers.		7. The method of claim 1 wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers.
11. A content delivery network comprising: a first tier of servers comprising a first plurality of servers, an edge server of the first tier of servers receiving a request from a requesting device in communication with the first server for a resource available from the content delivery network ; a second		9. A content delivery network comprising: a first plurality of servers, an edge server of the first plurality of servers receiving a request from a requesting device in communication with the first server for a portion of a

tier of servers comprising a second plurality of servers, a first server of the second plurality of servers receiving a request from the edge server for the content and, in response, transmitting a redirect instruction intended for the requesting device to the edge server to obtain the resource from a content server; and a popularity service tracking a popularity designation associated with the requested resource; wherein the edge server processes the redirect instruction to obtain the content from the content server and provides the obtained content to the requesting device.		resource available from the content delivery network; a second plurality of servers, a first server of the second plurality of servers receiving a request from the edge server for the portion of the resource and, in response, transmitting a redirect instruction to the edge server to obtain the portion of the resource from a content server and transmitting an instruction to not cache the portion of the resource at the edge server when the portion of the resource is obtained from the content server; and a popularity service tracking a
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12. The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular and the first server of the second plurality of servers transmits an instruction to notcache the resource at the content server of the first tier of servers when the resource is obtained from the content server.		popularity designation associated with the resource only when the portion of the resource is an initial portion of the resource, wherein the popularity designation associated with the resource indicates that the resource is not popular; wherein the edge server processes the redirect instruction to obtain the portion of the resource from the content server and provides the obtained portion of the resource to the requesting device.
14. The content delivery network as recited in claim 11 wherein the first server of the second plurality of		10. The content delivery network of claim 9 wherein the first server of the second

servers is a metro mid-tier server of the content delivery network.		plurality of servers is a metro mid-tier server of the content delivery network.
15. The content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a peer server of the first tier of servers of the content delivery network.		11. The content delivery network of claim 9 wherein the first server of the second plurality of servers is a peer server of the first plurality of servers of the content delivery network.
16. The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.		12. The content delivery network of claim 9 wherein the popularity designation associated with the resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.

17. The content delivery network as recited in claim 16 wherein the popularity service is associated with the first server of the second plurality of servers of the content delivery network.		13. The content delivery network of claim 12 wherein the popularity service is associated with the first server of the second plurality of servers of the content delivery network.
18. The content delivery network as recited in claim 16 wherein the popularity service is associated with the content server of the first tier of servers of the content delivery network.		14. The content delivery network of claim 12 wherein the popularity service is associated with the content server of the first plurality of servers of the content delivery network.

Claim Rejections - 35 USC § 103

5. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

7. Claims 1, 3-8, 10-11, 14-20 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Raju et al., USPN 7,552,233 B2 (hereafter referred to as Raju) in view of Swildens et al., USPAP 2004/0221019 A1 (hereafter referred to as Swildens).

Regarding claim 11, Raju teaches a content delivery network (implements content delivery network by a topology of web routers and information object repositories, column 13, lines 39-46) comprising:

a first tier of servers comprising a first plurality of servers (first region of servers providing content that are located close to the “edge” of the network, column 10, lines 39-48), an edge server of the first tier of servers receiving a request from a requesting device in communication with the first server for a resource available from the content delivery network (client attempts to obtain a content object from web server, column 11, lines 51-56);

a second tier of servers comprising a second plurality of servers (a second region of servers implemented as a plurality of information object repositories, column 10, lines 49-54), a first server of the second plurality of servers receiving a request from the edge server for the content (column 11, lines 57-61) and, in response, transmitting a redirect instruction intended for the requesting device to the edge server to obtain the resource from a content server (redirection instruction interpreted as providing the address of an information object repository, column 11, lines 62-66; claim 1, lines 1-8); and wherein the edge server processes

the redirect instruction to obtain the content from the content server and provides the obtained content to the requesting device (claim 5). Raju does not specifically a popularity service tracking a popularity designation associated with the requested resource. However, in the same field of endeavor, Swildens teaches a popularity service tracking a popularity designation associated with the requested resource (paragraphs 124-125). It would have been obvious to one of ordinary skill in the art before the invention was made to modify Raju to substitute the popularity service from Swildens for the caching decision from Raju and thereby establishing a policy for caching information objects. The motivation is to tailor the parameters for determining whether to cache based on customer selections and the statistics of past files requested (Swildens, paragraphs 42-43). [Claim 1 recites a method similar to claim 11 above. Claim 19 recites a method including a content server similar to claim 11 above. Claims 1 and 19 are rejected on a similar rationale.]

Regarding dependent claim 14, Raju-Swildens teaches the content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a metro mid-tier server of the content delivery network (Raju, the local server and optimal information object repository are connected through a metropolitan network indicating either a tier in a metropolitan network, column 13, lines 16-23). [Claim 14 is rejected on the same rationale.]

Regarding dependent claim 15, Raju-Swildens teaches the content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a peer server of the first tier of servers of the content delivery network (Raju, An overlay virtual network (VON) interconnects of the web routers and a subset of the web routers are neighbors for a

neighborhood, column 14, lines 9-15. The address of a peer server is included as a neighbor in the neighbor table, column 18, lines 27-38.) [Claim 5 is rejected on the same rationale.]

Regarding dependent claim 16, Raju-Swildens teaches the content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold (Swildens, the report sent to the edge server indicates the files that meet the popularity criteria, paragraph 126-127). [Claim 6 is rejected on the same rationale.]

Regarding dependent claim 17, Raju-Swildens teaches the content delivery network as recited in claim 16 wherein the popularity service is associated with the first server of the second plurality of servers of the content delivery network (Swildens, the customer receives the report on popularity and the file popularity profile is associated with the edge servers, staging site and origin/content server. The origin servers included in a group, paragraphs 54-55, 58). [Claim 7 is rejected on the same rationale.]

Regarding dependent claim 18, Raju-Swildens teaches the content delivery network as recited in claim 16 wherein the popularity service is associated with the content server of the first tier of servers of the content delivery network (Swildens, the customer receives the report on popularity and the file popularity profile is associated with the edge servers, staging site and origin/content server, paragraphs 54-55, 58). [Claim 8 is rejected on the same rationale.]

Regarding dependent claim 10, Raju-Swildens teaches the method as recited in claim 3 further comprising: receiving, at the first server of the first tier of servers of the content delivery network, an additional request for the resource available from the content delivery

network (Raju, receiving a client request for an information object that was previously cached, column 10, lines 39-48); determining that the resource is cached at the first server of the first tier of servers (Raju, determining a hit, column 10, lines 49-61); and providing the cached resource from the first server of the first tier of servers in response to the additional request for the resource (Raju, receiving the information object from the edge like server, column 10, lines 49-57).

Regarding dependent claim 20, Raju-Swildens teaches the method as recited in claim 19 wherein the second server of the content delivery network is a content server storing the requested content.

8. Claims 9 and 12-13 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Raju and Swildens as applied to claim 11 above, and further in view of Outten et al., USPN 7,024,466 B2 (hereafter referred to as Outten).

Regarding dependent claim 9, Raju-Swildens teaches the method as recited in claim 1, similar to the network of claim 11, above. Raju-Swildens does not specifically teach wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers. However, in the same field of endeavor, Outten teaches wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers (Figure 2, column 9, lines 31-49). It would have been obvious to one of ordinary skill in the art before the invention was made to modify Raju-Swildens to substitute distinct tiers from Outten and thereby expand adaptation into a different network topology. The motivation would have been to implement in other well-known network layouts (Outten, paragraph 18).

Regarding dependent claim 12, Raju-Swildens teaches the content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular (Swildens, popularity predicted based on the edge server log files and reports are given to the edge servers, paragraph 137). Raju-Swildens does not specifically teach the first server of the second plurality of servers transmits an instruction to notcache the resource at the content server of the first tier of servers when the resource is obtained from the content server. However, in the same field of endeavor, Outten teaches wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular (indicating the cold level for the resource, column 13, lines 58-67) and the first server of the second plurality of servers transmits an instruction to notcache the resource at the content server of the first tier of servers when the resource is obtained from the content server (using the attached levels as an instruction interpreted to determine to not cache a resource, higher levels indicate that the resource is restricted from the edge server, column 13, lines 65-67; column 14, lines 1-16). It would have been obvious to one of ordinary skill in the art before the invention was made to modify the combination of Raju-Swildens to substitute instructions for caching from Outten for popularity indications from Raju-Swildens to thereby provide granularity information for the determination of whether to cache the information objects. The motivation is to conserve network resources by not caching information objects not frequently requested (Outten, column 2, lines 16-25; column 14, lines 35-45). [Claim 2 is rejected on the same rationale.]

Regarding dependent claim 13, Raju-Swildens teaches the content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource

indicates that the requested resource is popular (paragraph 137). Raju-Swildens does not teach the first server of the second plurality of servers transmits an instruction to cache the resource at the content server of the first tier of servers when the resource is obtained from the content server. However, in the same field of endeavor, Outten teaches wherein the popularity designation associated with the requested resource indicates that the requested resource is popular (indicating the hot level for the resource, column 13, lines 58-67) and the first server of the second plurality of servers transmits an instruction to cache the resource at the content server of the first tier of servers when the resource is obtained from the content server (using the attached levels as an instruction interpreted to determine to cache a resource, lower levels indicate that the resource is to be cached at edge servers, column 13, lines 65-67; column 14, lines 1-16). It would have been obvious to one of ordinary skill in the art before the invention was made to modify Raju-Swildens to substitute caching instructions from Outten and thereby establish granularity for determining policies for caching information objects. The motivation is to conserve network resources by not caching information objects not frequently requested (Outten, column 2, lines 16-25; column 14, lines 35-45). [Claim 3 is rejected on the same rationale.]

Conclusion

9. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Please see the attached pto-892 for other pertinent prior art of record.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to PATRICE L WINDER whose telephone number is (571)272-3935. The examiner can normally be reached on M-F 11am-8pm.

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, Thu Nguyen can be reached on 571-272-6967. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <https://ppair-my.uspto.gov/pair/PrivatePair>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Patrice L Winder/
Primary Examiner, Art Unit 2452

Notice of References Cited	Application/Control No. 16/284,791		Applicant(s)/Patent Under Reexamination Newton et al.	
	Examiner PATRICE L WINDER		Art Unit 2452	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-20040221019-A1	11-2004	Swildens, Eric Sven-Johan	H04L67/1008	709/217
*	B	US-7024466-B2	04-2006	Outten; Todd Avery	G06F21/10	709/203
*	C	US-7133905-B2	11-2006	Dilley; John A.	H04L29/06	709/219
*	D	US-7274658-B2	09-2007	Bornstein; Claudson F.	H04L45/00	370/227
*	E	US-7552233-B2	06-2009	Raju; Jyoti	G06F12/1483	709/238
*	F	US-20110320592-A1	12-2011	Kemmerer, JR.; Frederick Charles	H04L67/2852	709/224
*	G	US-8332484-B2	12-2012	Afergan; Michael M.	H04L67/14	709/218
*	H	US-8417816-B2	04-2013	Esteban; Jairo O.	H04L67/2842	709/226
*	I	US-8949533-B2	02-2015	Puthalath; Hareesh	H04L67/1095	711/119
*	J	US-10462252-B2	10-2019	Newton; Christopher	H04L67/2842	1/1
	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	
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 20200720

<i>Search Notes</i> 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

CPC - Searched*		
Symbol	Date	Examiner
(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	06/23/2020	plw

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
Assignee and inventor name search (using EAST) - see attached search history	06/23/2020	plw
limited text search of claims (using EAST) - see attached search history	06/23/2020	plw
limited text search of claims (using EAST) - see attached search history	06/24/2020	plw
US Patents and PG Publications (using EAST) - see attached search history	06/29/2020	plw
US Patents and PG Publications (using EAST) - see attached search history	07/06/2020	plw
DERWENT WPI, EPO, JPO and IBM Technical Bulletins (using EAST) - see attached search history	07/20/2020	plw

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<i>Search Notes</i> 	Application/Control No. 16/284,791	Applicant(s)/Patent Under Reexamination Newton et al.
	Examiner PATRICE L WINDER	Art Unit 2452

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use as many sheets as necessary)				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	~~Not Yet Assigned~~
Sheet	1	of	1	Attorney Docket No: 0137-US-I1-C2	

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OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		Summons to attend oral proceedings, dated May 8, 2019", Application No. 09727342.9, filed March 21, 2019; Dkt. No. 0137-EP-01 , 6 pgs.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	~~2447~~
				Examiner Name	Not Yet Assigned
(Use as many sheets as necessary)					
Sheet	8	of	25	Attorney Docket No: 0137-US-I1-C2	

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				First Named Inventor	Christopher Newton
				Art Unit	~~2447~~
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	~~2447~~
				Examiner Name	Not Yet Assigned
(Use as many sheets as necessary)					
Sheet	22	of	25	Attorney Docket No: 0137-US-I1-C2	

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		KARGER, D. et al., "Consistent Hashing and Random Trees: Distributed Caching Protocols for Relieving Hot Spots on the World Wide Web", In Proc. 29th Annual ACM Symp. on Theory of Computing 1997-05-01, 654-663	
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	"7552233".pn. and (request\$3 or retriev\$3) near10 cach\$3	US-PGPUB; USPAT	OR	ON	2020/07/20 12:48
L2	1	"7552233".pn. and (clients! or requestors!)	US-PGPUB; USPAT	OR	ON	2020/07/20 12:50
L4	1	"10348848".pn.	US-PGPUB; USPAT	OR	ON	2020/07/20 13:26
L5	2,792	cach\$3 and (cold or long near2 tail or buzzworthy or hot or hotness or popular\$5)	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/07/20 14:03
L6	20	I5 and (hierarch\$4 or level or tier) near10 (server or service or proxy or cach\$3) and (peer or neighbor or neighborhood or leaf or child\$4 or parent) near10 (server or service or proxy or cach\$3)	FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/07/20 14:06

EAST Search History (Interference)

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	602	((("LEVEL") near3 ("3") near3 ("COMMUNICATIONS") near3 ("LLC"))).AS,AANM.	USPAT	OR	ON	2020/06/23 17:46
S4	81	((("Fullagar") near3 ("David"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 17:49
S3	160	((("Lipstone") near3 ("Laurence"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 17:49
S2	469	((("Newton") near3 ("Christopher"))).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 17:49
S5	100	(S1 or S2 or S3 or S4) and (hot\$4 or popular\$5 or "most" near2 request\$3).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 17:51
S6	12	S5 and ((hierarch\$4 or layer or tier) near10 (cache or server or service)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 17:55
S7	592	(S1 or S2 or S3 or S4) and ((hot\$4 or popular\$5) or (cach\$3 or server or service)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 18:48
S8	42	(S1 or S2 or S3 or S4) and ((hot\$4 or popular\$5) near10 (cach\$3 or server or service)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 18:49
S9	12	S8 and ((hierarch\$4 or layer or tier) near10 (cache or server or service)).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 19:01
S10	31	S8 and (cdn or content near2 delivery).clm.	US-PGPUB; USPAT; USOCR	OR	ON	2020/06/23 19:48
S11	25	S10 and (cach\$3 or edge near2 (gateway or router or server or service)).clm.	US-PGPUB;	OR	ON	2020/06/23 19:49

			USPAT; USOCR			
S12	48,261	(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	US- PGPUB; USPAT	OR	ON	2020/06/23 20:04
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S14	2,416	S12 and S13	US- PGPUB; USPAT	OR	ON	2020/06/23 20:06
S15	683	S14 and (re\$1direct\$3 or re\$1rout\$3 or forward\$3) near10 (origin\$2 or source)	US- PGPUB; USPAT	OR	ON	2020/06/23 20:09
S16	249	S15 and (@ad<"20100913" or @rlad<"20100913")	US- PGPUB; USPAT	OR	ON	2020/06/23 20:10
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S17	551	S15 and ((hierarch\$4 or layer or tier or topology) near10 (cache or server or service))	US- PGPUB; USPAT	OR	ON	2020/06/23 20:11
S22	247	S21 and ((hierarch\$4 or layer or peer or tier or topology) near10 (cache or server or service))	US- PGPUB; USPAT	OR	ON	2020/06/23 20:14
S21	289	S15 and S20	US- PGPUB; USPAT	OR	ON	2020/06/23 20:14
S20	10,056	((calculat\$3 or determin\$6 or evaluat\$3 or judg\$6 or criteria or rank\$3 or threshold or policy) near10 (hot\$4 or popular\$5 or "most" near2 request\$3) near10 (content or document or file))	US- PGPUB; USPAT	OR	ON	2020/06/23 20:14
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S24	966	S12 and S13 and S20	US- PGPUB; USPAT	OR	ON	2020/06/23 20:26

S25	515	S24 and ((fabric or hierarch\$4 or layer or mesh or peer or tier or topology) near10 (server or service))	US-PGPUB; USPAT	OR	ON	2020/06/23 20:27
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S29	0	S25 and "not" near10 cach\$3	US-PGPUB; USPAT	OR	ON	2020/06/23 20:36
S28	0	S25 and "not" near4 cach\$3	US-PGPUB; USPAT	OR	ON	2020/06/23 20:36
S31	435,284	((hierarch\$4 or layer or peer or tier or topology) near10 (server or service) or cdn or content near2 delivery near2 (network\$3 or system))	US-PGPUB; USPAT	OR	ON	2020/06/24 19:37
S30	48,261	(H04L67/2814 or H04L67/1014 or H04L67/1097 or H04L67/2842 or H04N21/25891 or H04N7/17354 or H04N21/23106 or H04N21/23103 or H04N21/222 or H04N21/472).cpc.	US-PGPUB; USPAT	OR	ON	2020/06/24 19:37
S32	12,428	((calculat\$3 or determin\$6 or evaluat\$3 or judg\$6 or criteria or rank\$3 or threshold or policy) near20 (buzz\$3 or hot or hotness! or popular\$5 or viral or (frequent\$2 or "most") near4 request\$3) near10 (content or document or file))	US-PGPUB; USPAT	OR	ON	2020/06/24 19:38
S33	4,490	request\$3 near10 (content or document or file) near10 (server or service or node) same3 (divert\$3 or re\$1direct\$3 or re\$1rout\$3) near10 (origin\$2 or source or (content or document or file) near3 (server or service or node))	US-PGPUB; USPAT	OR	ON	2020/06/24 19:44
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S34	142	S30 and S31 and S32 and S33	US-PGPUB; USPAT	OR	ON	2020/06/24 19:47
S36	129,375	request\$3 near10 (content or document or file) near20 (origin\$2 or source or (content or document or file) near3 (server or service or node))	US-PGPUB; USPAT	OR	ON	2020/06/24 20:01

S37	741	S30 and S31 and S32 and S36	US-PGPUB; USPAT	OR	ON	2020/06/24 20:03
S38	149	S37 and (block\$3 or prevent\$3 or prohibit\$4 or skip\$4) near10 (add\$3 or addition or insert\$3 or stor\$3) near10 cach\$3	US-PGPUB; USPAT	OR	ON	2020/06/24 20:04
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S40	289	S31 and S32 and S33 and S36	US-PGPUB; USPAT	OR	ON	2020/06/24 20:16
S42	14	S41 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/06/24 20:17
S41	21	S40 and (bypass\$3 or prevent\$3 or prohibit\$4 or skip\$4) near10 (add\$3 or addition or insert\$3 or stor\$3) near10 cach\$3	US-PGPUB; USPAT	OR	ON	2020/06/24 20:17
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S49	40	(S46 or S47) and S48	US-PGPUB; USPAT	OR	ON	2020/06/29 13:59

S50	24	S49 and (divert\$3 or re\$1direct\$3 or re\$1rout\$3)	US-PGPUB; USPAT	OR	ON	2020/06/29 14:46
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S52	419,350	(request\$3 near10 (audiovisual or content or document or file or media! or multimedia or object or video)) same2 (cache or proxy or host or server or service or edge or border)	US-PGPUB; USPAT	OR	ON	2020/07/06 15:22
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S56	728	S55 and (@ad<"20100913" or @rlad<"20100913")	US-PGPUB; USPAT	OR	ON	2020/07/06 15:35
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EAST Search History (Interference)

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7/20/2020 1:10:03 PM

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PTO/SB/08a (01-08)

Approved for use through 07/31/2012. OMB 0651-0031

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

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number..

Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	~~2447~~
				Examiner Name	Patrice L. Winder
Sheet	1	of	1	Attorney Docket No: 0137-US-I1-C2	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /plw/

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No	Foreign Patent Document	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ²

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		European Decision to Refuse, dated February 7, 2020, Application No. 09727342.9, filed March 21, 2009; Dkt. No. 0137-EP-01, 15 pgs.	

EXAMINER

/Patrice L Winder/

DATE CONSIDERED

06/23/2020

Substitute Disclosure Statement Form (PTO-1449)
 * EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional) ² Applicant is to place a check mark here if English language Translation is attached

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /plw/

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.

Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Patrice L. Winder
Sheet	1	of	1	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No	Foreign Patent Document	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ²

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		European Decision to Refuse, dated February 7, 2020, Application No. 09727342.9, filed March 21, 2009; Dkt. No. 0137-EP-01, 15 pgs.	

EXAMINER

DATE CONSIDERED

Substitute Disclosure Statement Form (PTO-1449)

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. ¹ Applicant's unique citation designation number (optional) ² Applicant is to place a check mark here if English language Translation is attached

Electronic Acknowledgement Receipt	
EFS ID:	38610542
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	David Dewey Wier/Kathleen McInnish
Filer Authorized By:	David Dewey Wier
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	18-FEB-2020
Filing Date:	25-FEB-2019
Time Stamp:	11:57:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	137USI1C2_IDS.pdf	37007	no	5
			98f7470226d4e6fc8a930285c2d881b09eb67c92		

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	137US11C2_sb08.pdf	29294	no	1
			43451afb952cc19da3caf46bf0833258a244ea0		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Other Reference-Patent/App/Search documents	EP_097273429_Decision_7Feb20_0137EP01.pdf	1207961	no	15
			45a9bfe8b06cf2d14afe6c9321ca36190e0b3610		
Warnings:					
Information:					
Total Files Size (in bytes):			1274262		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 16/284,791	Confirmation No.	: 7424
First Applicant	: NEWTON et al.	Art Unit	: 2452
Filed	: February 25, 2019	Examiner	: Patrice Winder
Title	: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Docket No.	: 0137-US-I1-C2		

Submitted Via EFS-Web

**SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
PURSUANT TO 37 C.F.R. §§ 1.56, 1.97, AND 1.98**

Sir:

The Examiner is respectfully requested to consider the patents, patent applications, publications, or other information cataloged on the enclosed Form (e.g., PTO-1449, PTO-892, PTO/SB/08, etc.) during examination of the above-identified patent application. The order of presentation of the references should not be construed as an indication of importance. These references are submitted for the Examiner's consideration and are submitted pursuant to an Applicant's duty of disclosure under 37 C.F.R. § 1.56.

Copies of all of the cited documents:

- ☐ are enclosed unless otherwise indicated on the enclosed Form PTO/SB/08a.
- ☐ have been previously furnished to the Office in prior application No. ____, filed ____, which the present application relies upon for an earlier effective filing date under 35 U.S.C. § 120. Therefore, no copies of the cited documents are included herewith pursuant to 37 C.F.R. § 1.98(d); MPEP § 609(III)(A)(2).
- ☒ are enclosed unless they are U.S. patents or U.S. patent application publications pursuant to 37 C.F.R. § 1.98(a).

**I
BASIS**

This information disclosure statement is filed pursuant to

- ☒ 37 C.F.R. § 1.97(b).
This information disclosure statement is filed either (1) within three months of the filing date of a national application other than a continued prosecution application under 37 C.F.R. § 1.53(d); (2) within three months of the date of entry of the national stage as set forth in 37 C.F.R. § 1.491 in an international application; (3) before the mailing date of a first Office action on the merits; (4) concurrently with the filing of a request for continued examination under 37 C.F.R. § 1.114; or (5) before the mailing of a first Office action after the filing of a request for continued examination under 37 C.F.R. § 1.114, whichever event occurs last.

Accordingly, this information disclosure statement requires no fee and no certification.

- ☐ 37 C.F.R. § 1.97(c).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing date of any of (1) a final action under 37 C.F.R. § 1.113; (2) a notice of allowance under 37 C.F.R. § 1.311; or (3) an action that otherwise closes prosecution in the application.

Accordingly, this information disclosure statement requires either the fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c), or a statement under 37 C.F.R. § 1.97(e).

- ☐ 37 C.F.R. § 1.97(d).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(c) since a:

- ☐ final action under 37 C.F.R. § 1.113
☐ notice of allowance under 37 C.F.R. § 1.311

was mailed to the Applicant on _____.

Accordingly, this information disclosure statement requires the fee set forth in 37 C.F.R. § 1.17(p) to consider an information disclosure statement under 37 C.F.R. § 1.97(d), and a statement under 37 C.F.R. § 1.97(e).

If this statement crosses in the mail with an Office action, or is otherwise not in the indicated category of 37 C.F.R. § 1.97, it is respectfully requested that this statement be treated in the next appropriate category and made of record. To the extent required, please treat this paper as a conditional petition for acceptance of the information disclosure statement.

II FEES

Any required fee is being paid as indicated below:

- ☒ No fee is due.
- ☐ The \$240 fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c) or (d) is due.
- ☐ This fee is paid by credit card.
- ☐ Please charge the required fee to Deposit Account No. 505063.
- ☒ The Commissioner is hereby authorized to charge any additional required fees or credit any overpayments associated with this information disclosure statement to the account.

III CERTIFICATION

Pursuant to 37 C.F.R. § 1.97(e), I state as follows:

- ☒ No statement is necessary.
- ☐ Each item of information contained in this information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(1).
- ☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, no item of information contained in this information disclosure statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(2).

Pursuant to 37 C.F.R. § 1.704(d), I state as follows:

- ☐ Each item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart application, and this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this information disclosure statement.

IV FOREIGN LANGUAGE REFERENCES

Pursuant to 37 C.F.R. § 1.98(a)(3)(i), any information disclosure statement filed under 37 C.F.R. § 1.97 shall include a concise explanation of the relevance, as it is presently understood by the individual designated in § 1.56(c) most knowledgeable about the content of the information, of each patent, publication, or other information listed that is not in the English language. The concise explanation may be either separate from the specification or incorporated therein. In compliance with the rules, the Applicant states as follows:

- ☐ No concise explanation is required since all cited references are in English.
- ☐ A concise explanation of the relevance of one or more foreign language references is attached.
- ☐ According to the procedural policy adopted by the PTO with regard to disclosure requirements, the Applicant is satisfying the disclosure requirement pursuant to MPEP § 609.04(a)(III) by submitting herewith the following:
 - ☐ English language versions of any non-English language documents.
 - ☐ English language versions of one or more search reports or other actions by one or more foreign patent offices in one or more counterpart foreign applications, which indicate the degree of relevance found by the foreign office(s).
 - ☐ Pursuant to 37 C.F.R. § 1.98(a)(3)(ii), a copy of a translation is not submitted herewith because a written English-language translation of a non-English-language document, or portion thereof, is not within the possession, custody, or control of, or is readily available to any individual designated in § 1.56(c).

The Applicant has not analyzed these documents and, therefore, declines to comment on their relevance at this time.

- ☐ One or more English language abstracts for the non-English language references are also enclosed.

V REMARKS

It is respectfully requested that:

- (1) The Examiner sign the enclosed Form to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

- (2) The citations for the cited information be printed on any patent that issues from this application.

The submission of this information disclosure statement by the Applicant shall not be construed as a representation that a search has been performed or that no other material information under 37 C.F.R. § 1.56 exists. See 37 C.F.R. § 1.97(g).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, material to the patentability of one or more of the pending claims in this application pursuant to 37 C.F.R. § 1.56(b), unless specifically designated by the Applicant as such. See 37 C.F.R. § 1.97(h).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, or even qualifies as “prior art” under 35 U.S.C. § 102 with respect to this invention, unless specifically designated by the Applicant as such.

Notwithstanding any statements by the Applicant, the Examiner is urged to form his or her own conclusion regarding the relevance of the cited information.

VI CONCLUSION

The Examiner is encouraged to contact the undersigned attorney to discuss any questions concerning this information disclosure statement or any of the information cited or referred to herein.

Respectfully submitted,

Date: February 18, 2020

/DDW/
David D. Wier, Reg. No. 48,229
USPTO Customer No. 83579
Level 3 Communications, LLC
1025 Eldorado Blvd.
Broomfield, Colorado 80021
Tel: 720-888-3539



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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/284,791	02/25/2019	Christopher Newton	0137-US-11-C2

CONFIRMATION NO. 7424

83579

LEVEL 3 COMMUNICATIONS, LLC

Attn: Patent Docketing

1025 Eldorado Blvd.

Broomfield, CO 80021

PUBLICATION NOTICE



OC000000111949257

Title:HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

Publication No.US-2019-0320034-A1

Publication Date:10/17/2019

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 Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO.	TOT CLAIMS	IND CLAIMS
16/284,791	02/25/2019	2447	1720	0137-US-11-C2	20	3

CONFIRMATION NO. 7424

UPDATED FILING RECEIPT



0000000109339784

83579

LEVEL 3 COMMUNICATIONS, LLC

Attn: Patent Docketing

1025 Eldorado Blvd.

Broomfield, CO 80021

Date Mailed: 07/11/2019

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)

Christopher Newton, Thousand Oaks, CA;

Laurence Lipstone, Calabasas, CA;

David Fullagar, Boulder, CO;

Applicant(s)

Level 3 Communications, LLC, Broomfield, CO

Power of Attorney: The patent practitioners associated with Customer Number 83579

Domestic Priority data as claimed by applicant

This application is a CON of 15/645,584 07/10/2017 PAT 10218806

which is a CON of 12/880,324 09/13/2010 PAT 9762692

which is a CIP of 12/408,681 03/21/2009 PAT 8930538

which claims benefit of 61/042,412 04/04/2008

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: 03/12/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/284,791**

Projected Publication Date: 10/17/2019

Non-Publication Request: No

Early Publication Request: No
Title

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

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

page 2 of 4

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 Assets Control, 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 16/284,791				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760			
TOTAL CLAIMS (37 CFR 1.16(j))	20	minus 20 = *				x 100 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *				x 460 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
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		TOTAL	1720			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			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.										

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re the Application of:

Inventor(s)	: Christopher Newton et al.	
Appln. No.	: 16/284,791	Confirmation No.: 7424
Filed	: February 25, 2019	Group Art Unit: 2447
Title	: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)	Examiner: Not Yet Assigned

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

MAIL STOP Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

Applicant in the above-captioned application hereby responds to a "Notice to File Corrected Application Papers" dated March 14, 2019, received from the U.S. Patent and Trademark Office (USPTO). The USPTO has determined the application is not in compliance with 37 C.F. R. §1.52(b) because the line spacing on the specification, claims, and/or abstract is not 1½ or double spaced.

In response thereto, Applicant submits a marked-up and a clean copy of the specification with the correct 1½ line spacing, correctly spell out the filing dates throughout the specification and corrects minor grammatical errors. The changes add no new matter. Applicant has reviewed the Notice to File Corrected Application Papers, and submits that this paper is responsive to all points raised therein.

This response is accompanied by a two-month Petition for Extension of Time and required fee. The Applicant believes no additional fees or petitions are due with this filing. However, should any such fees or petitions be required, please consider this a request therefor and authorization to charge Deposit Account No. 50-1662 as necessary.

If the Examiner should require any additional information or amendment, please contact the undersigned attorney.

Respectfully submitted,

Dated: July 9, 2019

By: /Derek D. Donahoe, Reg. #59507//
Derek D. Donahoe, Registration No. 59507
Attorney for Assignee
USPTO Customer No. 83579

Polsinelli PC
1401 Lawrence Street, Suite 2300
Denver, CO 80202
Phone: 303-256-2766

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.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)		Docket Number (Optional) 0137-US-11-C2
Application Number 16/284,791	Filed February 25, 2019	
For HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Art Unit 2447	Examiner Not Yet Assigned	

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	<u>Fee</u>	<u>Small Entity Fee</u>	<u>Micro Entity Fee</u>	
☐ One month (37 CFR 1.17(a)(1))	\$200	\$100	\$50	\$ _____
☒ Two months (37 CFR 1.17(a)(2))	\$600	\$300	\$150	\$ <u>600</u>
☐ Three months (37 CFR 1.17(a)(3))	\$1,400	\$700	\$350	\$ _____
☐ Four months (37 CFR 1.17(a)(4))	\$2,200	\$1,100	\$550	\$ _____
☐ Five months (37 CFR 1.17(a)(5))	\$3,000	\$1,500	\$750	\$ _____

☐ 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 has already been authorized to charge fees in this application to a Deposit Account.
☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to
 Deposit Account Number 50-1662.
☒ 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 59507.
☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Derek D. Donahoe, Reg. #59507/

Signature

Derek D. Donahoe

Typed or printed name

2019-07-09

Date

303-256-2766

Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). 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 6 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: Mail Stop PCT, 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 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.

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application is a continuation of and claims the benefit of priority from U.S. Patent Application No. 15/645,584, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed July 10, 2017, the entire contents of which are fully incorporated by reference herein for all purposes. Application no. 15/645,584 is a continuation of and claims the benefit of priority from U.S. Patent Application No. 12/880,324, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed September 13, 2010, the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/880,324 is a continuation-in-part (CIP) of and claims the benefit of priority from U.S. Patent Application No. 12/408,681, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed March 21, 2009 (now U.S. Patent No. 8,930,538 issued January 6, 2015), the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/408,681 claims priority as a non-provisional application from U.S. Provisional Application No. 61/042,412, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed April 4, 2008 the entire contents of which are fully incorporated by reference herein for all purposes.

[0002] This application is also related to the following co-owned and co-pending patent applications, the contents of each of which are fully incorporated herein by reference for all purposes: Application No. 10/073,938 filed February 14, 2002, Application No. 11/715,316 filed March 8, 2007, Application No. 11/978,656 filed October 30, 2007, Application No. 11/980,672 filed October 31, 2007, Application No. 10/259,497 filed September 30, 2002, Application No. 11/932,162 filed October 31, 2007, Application No. 11/976,648 filed October 26, 2007, and Application No. 12/390,560 filed February 23, 2009.

FIELD OF THE INVENTION

[0003] This invention relates to content delivery, to content delivery networks (CDNs), and to frameworks and systems using CDNs.

DETAILED DESCRIPTION**GLOSSARY**

[0004] As used herein, unless stated otherwise, the following terms or abbreviations have the following meanings:

1. IP means Internet Protocol.
2. “IP address” means an address used in the Internet Protocol to identify electronic devices such as servers and the like.
3. HTTP means Hypertext Transfer Protocol.
4. URL means Uniform Resource Locator.
5. DNS means Domain Name System.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Furthermore, like referenced numerals designate corresponding parts throughout the several views.

[0006] **Fig. 1** depicts a general hierarchical, multi-tiered content delivery network (CDN);

[0007] **Fig. 2** shows the logical organization of servers into groups or clusters in a CDN;

[0008] **Fig. 3** depicts a content delivery framework (CDF) using a content delivery network (CDN);

[0009] Fig. 4 depicts the operation of a two-level content delivery network in a content delivery framework;

[0010] Fig. 5 is a flowchart showing operation of the popularity services of the CDN of Fig. 4;

[0011] Fig. 6 is an exemplary data structure for maintaining the popularity data for a particular popularity server; and

[0012] Fig. 7 is a flowchart showing processing steps of a multi-tiered content delivery network.

OVERVIEW

[0013] The Internet and the so-called World Wide Web (the “WWW”) have become ubiquitous. Thousands or even tens of thousands of so-called content providers (publishers) now use the Internet (and, particularly, the WWW) to provide all sorts of content to tens or even hundreds of thousands of clients all over the world.

[0014] In order to offload the job of serving some or all of their content, many content providers now subscribe to so-called content delivery networks (CDNs). Using a CDN, some (or all) of a content provider’s content can be served to clients from the CDN (i.e., from one or more servers in the CDN) instead of from the content provider’s server(s). In a caching CDN, content that is served may also be cached on some or all of the CDN servers, either before being served or in response to specific requests for that content.

[0015] The term content as used herein means any kind of data, in any form, regardless of its representation and regardless of what it represents. Content may include, without limitation, static and/or dynamic images, text, audio content, including streamed audio, video content, including streamed video, web pages, computer programs, documents, files, and the like. Some content may be embedded in other content, e.g., using markup languages such as HTML and XML. Content includes content which is created or formed or composed specifically in response to a particular request. The term “resource” is sometimes used herein to refer to content.

[0016] Certain publishers can have large content libraries in which only a small proportion of the content (the so-called “short head”) is popular enough to benefit from serving through a caching CDN, while the majority of the content (the so-called “long tail”) is accessed only occasionally and not generally worth caching (or even serving from an edge server). This situation would be typical for a content publisher with a very large music or video library. Some music content — the popular content — may be regularly requested, whereas other music — the not popular (also referred to as unpopular) content — may be seldom if ever requested.

[0017] Content can become popular (by various measures of popularity) or fade into relative obscurity dynamically, so a content library cannot easily be explicitly partitioned. Instead, the CDN tracks popularity of certain content, and selectively migrates content toward the edge (i.e., toward the tier 1 servers) as that content becomes popular.

[0018] A CDN may have one or more tiers of servers, organized hierarchically. **Fig. 1** depicts a content delivery network **100** that includes multiple tiers of servers. Specifically, the CDN **100** of Fig. 1 shows j tiers of servers, denoted Tier 1, Tier 2, Tier 3, ..., Tier j . Each tier of servers may comprise a number of servers organized into server groups (sometimes referred to as server clusters). The Tier 1 servers are also referred to as edge servers, and Tier 1 is sometimes also referred to as the “edge” or the “edge of the CDN.” The Tier 2 servers (when present in a CDN) are also referred to as parent servers.

[0019] Furthermore, content stored in any of the intermediate tier servers (e.g., tier 2, tier 3, ... tier j in **Fig. 1**) may be logically partitioned across two or more servers in the respective tier group. For example, a first portion (or subset) of a content provider’s library may be stored on a first parent server in Group 1, a second portion may be stored on a second server in Group 1, and the last third may be stored on a third server in Group 1. Various partitioning methodologies are described in further detail below. In operation, the partitioning of content libraries across servers in an intermediate tier of a CDN provides a type of preemptive load-balancing such that certain parent servers are only responsible for handling a pre-defined subset of a content provider’s library. In other words, redirected requests from the client to a parent/intermediate tier are

distributed within the tier in accordance with the particular partitioning methodology being implemented.

[0020] For example, in the CDN **100** of **Fig. 1**, Tier 1 has n groups of servers (denoted “Edge Server Group 1”, “Edge Server Group 2”, “...”, “Edge Server Group n ”); tier 2 (the parent servers’ tier) has m server groups (the i -th group being denoted “Parent Server Group i ”); and tier 3 has k server groups, and so on. Preferably each tier has the same number of server groups.

[0021] Fig. 2 shows the logical organization / grouping of servers in a CDN of Fig. 1. In the exemplary CDN of **Fig. 2**, each tier of servers has the same number (n) of server groups. Those of skill in the art will know and understand, upon reading this description, that each server group may have the same or a different number of servers. Additionally, the number of servers in a server group may vary dynamically. For example, additional servers may be added to a server group to deal with increased load on the group.

[0022] The servers in a server group may be homogenous or heterogeneous, and each server in a server group may comprise a cluster of physical servers sharing the same name and/or network address. An example of such a cluster is described in co-pending and co-owned patent application no. 61/064,339 (titled “Load-balancing cluster”, filed February 28, 2008), the entire contents of which are incorporated herein by reference for all purposes.

[0023] Servers in the same tier and the same group are referred to as peers or peer servers.

[0024] A typical CDN has only one or two tiers of servers. A CDN with only one tier will have only edge servers, whereas a CDN with two tiers will have edge servers and parent servers. (At a minimum, a CDN should have at least one tier of servers — the edge servers.)

[0025] The grouping of servers in a tier may be based, e.g., on their physical or geographical location. For example, a particular CDN may have six groups — four groups of servers in the United States, Group 1 for the West Coast, Group 2 for the mid-

west, Group 3 for the northeast and Group 4 for the south east; and one group each for Europe and Asia.

[0026] A particular CDN server is preferably in only one server group.

[0027] In general, some or all of the servers in each tier can exchange data with some or all of the servers in each other tier. Thus, some or all of the parent servers can exchange information with some or all of the edge servers. For the sake of simplicity, in the drawings, each tier of servers is shown as being operationally connectable to each other tier. In some CDNs, however, it may be preferable that the servers in a particular tier can only exchange information with other servers in the same group (i.e., with peer servers) and/or with other servers in the same group in a different tier. For example, in some CDNs, the edge servers in edge server group *k*, can exchange information with each other and with all servers in parent server group *k*, and so on.

[0028] A content provider's / customer's server (or servers) are also referred to as origin servers. A content provider's origin servers may be owned and/or operated by that content provider or they may be servers provided and/or operated by a third party such as a hosting provider. The hosting provider for a particular content provider may also provide CDN services to that content provider.

[0029] A CDN may also include a CDN origin/content cache tier which may be used to cache content from the CDN's subscribers (i.e., from the CDN subscribers' respective origin servers). Those of skill in the art will know and understand, upon reading this description, that a CDN can support one or more subscribers, i.e., that a CDN can function as a shared infrastructure supporting numerous subscribers. The CDN origin tier may also consist of a number of servers, and these servers may also be organized (physically and logically) into a number of regions and/or groups. The server(s) in the CDN origin tier obtain content from the subscribers' origin servers, either on an as needed basis (a pull) or in advance (via a push).

[0030] A popularity service **102** (described in greater detail below) is associated with one or more of the server groups in one or more tiers. In a presently preferred exemplary embodiment, some of the parent server groups have popularity services **102** associated therewith. Although shown as a separate component of the group, the

popularity service **102** may be integrated into one of the servers in the group. In some cases, the popularity service may have its own server, distinct from any of the CDN servers. The terms “popularity service” and “popularity server” are used interchangeable herein.

[0031] In operation, when a client requests content that is to be served using a content delivery framework, the client may be served that content from a server in the CDN or, in some cases, from the subscriber/customer’s origin server.

[0032] A client may be directed to a CDN and/or to a server in the CDN in any manner using any kind of server selector system **104**. As understood by those of skill in the art, the server selector system **104** generally operates to direct a client’s requests for content to an appropriate server in order for that content to be served to the requesting client. An appropriate server may be one which is close to the client (by some measure of cost) and/or one which is not too heavily loaded. All sorts of conditions may be applied to the term “appropriate”, and all sorts of information and tests, both static and dynamic, may be used to determine an appropriate server. The server selector system **106** may, e.g., include or operate fully or partially in Domain Name Service (DNS) servers, standalone devices, or a combination thereof. For example, the server selector system **106** may comprise a single level DNS server that selects an appropriate server based at least in part on some combination of the location of the requesting client and the load on some or all of the CDN servers. Those of skill in the art will know and understand, upon reading this description, that a client’s location in a network such as the Internet may sometimes only be roughly determined, and the term “location of the client” is generally taken to be a network location corresponding to the client’s network service provider.

[0033] Although shown as a component in the drawings, the server selector **106** may comprise numerous components. For example, some or all of the server selection may be based on anycast routing, and the server selector **106** may then include routers and associated tables.

[0034] In a presently preferred embodiment the server selector **106** is an intelligent traffic manager (ITM) / adaptive traffic controller (ATC) such as described in co-pending

U.S. patent application no. 10/259,497, filed September 30, 2002, and titled “Configurable Adaptive Global Traffic Control And Management,” (published as US 2003-0065762 A1); and in U.S. patent application no. 11/976,648, filed October 26, 2007, titled “Policy-based content delivery network selection,” (collectively the “ITM applications”), the entire contents of each of which have been incorporated herein by reference for all purposes. In some embodiments the server selector **106** may include a “best” or “optimal” server selector such as disclosed in U.S. Patent No. 6,185,598 titled, “Optimized Network Resource Location,” the entire contents of which are incorporated herein by reference for all purposes. The ‘598 patent refers to CDN servers as so-called repeater servers, and describes a so-called “Best Repeater Selector (BRS) mechanism”.

[0035] Fig. 3 shows a content delivery framework **300** with a two-level hierarchical CDN consisting of a tier of edge servers (Tier 1) and a tier of parent servers (Tier 2). Some or all of the edge servers can communicate with some or all of the parent servers. The edge servers are divided into n edge server groups, and the parent servers are divided into m parent server groups. In a presently preferred embodiment, the value of m is equal to the value of n , *i.e.*, in this presently preferred embodiment there are the same number of edge server groups as there are parent server groups. A CDN origin/content cache tier stores subscriber content which it obtains from the various subscribers’ origin servers. At least one of the parent server groups (in the drawing, Group 1) has a popularity service **102-1** associated therewith. Preferably more than one parent server group has an associated popularity service, and more preferably each parent server group has an associated popularity service.

[0036] Although shown in a parent tier, the popularity service may be located anywhere in the system, including in the edge tier.

[0037] The popularity service may be used by certain, though not necessarily all, content. When only certain content uses the popularity service, content should be designated in order to use the popularity service.

[0038] Some or all of the edge servers in a group may use a popularity service to manage the long-tail content of various subscribers. Each edge server that uses a

popularity service is referred to as being bound to that popularity service. An edge server that is bound to a popularity service is sometimes referred to herein as a “longtail coserver.”

[0039] Figs. 4 and 5 show the operation of the popularity services of the CDN of **Fig. 3**.

[0040] When a client **106** requests content (e.g., using an HTTP GET request), that request is directed (e.g., by server selector **104-1**) to an edge server in order for the content to be served to the client. For certain designated content a popularity check is interposed into the fill side of the caching operation. **Fig. 4** illustrates the flow of messages and data in the content delivery framework **300**, and **Fig. 5** is a flowchart show operation of the popularity services of the CDN of **Fig. 4**. For the sake of this particular explanation, assume that the client’s request has been directed to edge server **108**. (Those of skill in the art will know and understand, upon reading this description, that the client’s initial request may be directed to any tier in the CDN hierarchy, including, e.g., to the parent tier.) This server is selected using the server selection mechanisms **104-1** associated with the CDN, e.g., using one or more DNS servers and selecting an edge server based on such factors as the location of the requesting client, the load on the network, network traffic conditions, CDN policies, subscriber policies, and the like.

[0041] A client **104** requests content from an edge server **108** (at **500** in **Fig. 5**). The request from the client **104** arrives at edge server **108** (**S1** in **Fig. 4**). The edge server **108** checks to see if object is present (locally or on a peer) and fresh (at **502**). If so, the edge server **108** serves the object to the client **104** from the cache (**S2, 504**), obtaining the object from a peer, if necessary.

[0042] In some embodiments, the system may distinguish between on-net and off-net peers and same-switch peers. An on-net peer is a peer on the same backbone network; an off-net peer is a peer located on a different backbone network; and a same-switch peer is a peer directly connected to the same switch as the agent performing the check. In some embodiments, the edge server **108** may only look for the object on some of its peers (e.g., only on same-switch peers) (at **502**).

[0043] If the object is not available on the edge server **108** or on a peer, the edge server **108** ascertains whether this object is served based on its popularity (i.e., whether this object has been designated so that the object's popularity will be used to determine where it will be served from) (at **506**). If so, then the request is sent to the popularity service **102** associated with the edge server **108**, in this case, to the popularity server for the this group (**S3a**).

[0044] The determination as to whether this object is designated to be served from a different location, depending on its popularity (at **506**), may be made based, at least in part, on the name (hostname) used to request the object.

[0045] It is preferably to allow for a mix of edge servers, some performing popularity checking (as described above), while others do not. For those that are not running the popularity service, the name (hostname) used to request an object will resolve to a parent server (that may or may not provide popularity services). If the parent server does not provide popularity services, then the content will be obtained by the edge server from that parent server, and the content will be served to the client. On the other hand, if that parent server does provide popularity services, it can determine whether or not the edge server is a Longtail coserver based, e.g., on the IP (Internet Protocol) address of the edge server. For no-coservers, the parent server can handle the request without any popularity processing.

[0046] A request for content may be an initial request for an object or it may be a request for another part of an object, the initial part having already been served to the client. If the request is for the first part of the object (at **508**), e.g., the request includes a request for the first byte of the resource (i.e., it is not a range request that starts after the beginning of the file), the popularity service **102** determines (as described below) if the object is currently popular. First, the popularity count for the current period is incremented (at **510**). Based on its determination, the popularity service **102** returns one of three possible responses to the edge server **108** (**S3b**):

1. If the object has not reached a first minimal level of popularity (at **512**): the popularity service sends the edge server an instruction (e.g., HTTP 302) to

redirect the client's request to the origin server (or to the CDN origin cache) (if origin redirects are enabled) (at **514**).

2. If the object's popularity has exceeded the first / minimal level of popularity but has not yet exceeded a second, mid-tier threshold (at **516**): the popularity service sends the edge server an instruction (e.g., HTTP 302) to redirect the client's request to a parent server (if mid-tier redirects are enabled) (at **518**). Note that the redirect processing may further involve a determination of which particular parent server is responsible for storing the requested content. Such a determination would be based on how the distinct subsets of a content provider's library are partitioned across parent servers in the same intermediate tier. Further note that it is also possible for subsets of a content provider's library to be partitioned across servers residing in different intermediate tiers of a content delivery network.

3. If the object's popularity has exceeded the mid-tier threshold (i.e., the object is popular): The popularity service sends the edge server an instruction to serve the content itself (at **520**). In a presently preferred implementation, the popularity service sends the edge server a redirect (HTTP 302) with a "follow me" flag set, to the origin server or, if there is one, to the parent tier.

[0047] If the edge server **108** receives a redirect from the popularity service **102** without the "follow me" flag set (cases 1 and 2 above), it simply forwards the redirect to the client **104** (**S4a, 522, 524**). If the edge server **108** receives a "follow me" redirect, it obtains and caches the resource (at **526**) and serves it to the client (at **528**).

[0048] If the popularity service **102** is unreachable, unresponsive, or returns a status code indicating an error (other than HTTP 404), the object is served out of the edge's cache server (and an alert condition is raised).

[0049] Once content has been cached at an edge server, the edge server will send notifications (e.g., in the form of revalidations) to the popularity service every time it gets another request for that content. E.g., with reference to the flowchart of **Fig. 5**, if the edge server **108** determines (at **502**) that it has the requested content (or can obtain it from a peer), then, in addition to serving the content (at **504**), it also instructs the

popularity server to increment the object's popularity count for the current period (at **530**). This process keeps the popularity servers up to date on the relative popularity of content being served in their region.

[0050] In presently preferred embodiments, the server selection mechanism **104** does not rendezvous clients to parent servers/caches. In other words, in these embodiments, client requests are always initially directed by the server selection mechanism to an edge server. In these cases, when a request for a resource arrives at a parent server/cache, that request should preferably be served (and filled if necessary) unconditionally (since any request from a client is assumed to be the result of a redirect served by an edge server).

[0051] In an embodiment where the server selector **104** can direct client requests directly to parent servers (or to any tier other than the edge tier), a server obtaining a client request may choose to redirect that request, e.g., based on popularity. However, those of skill in the art will know and understand, upon reading this description, that it is advisable to track the redirection of a request to avoid circular and/or infinite redirection. One way to avoid such a problem is to limit the number of levels of redirection (i.e., to limit the number of redirects to follow). In a presently preferred implementation, if no final server is selected after following, e.g., thirty two redirects, an error is issued. In some embodiments, if no final sever is selected after a predefined number of redirects, then the last server reached may be used to serve the content. One way to prevent looping is to use different server names (aliases) or IP addresses when redirecting requests so that a server receiving a request can tell whether or not it is a redirect. Those of skill in the art will know and understand, upon reading this description, that information can be transferred between servers using, e.g., HTTP headers or the like.

[0052] Those of skill in the art will know and understand, upon reading this description, that in a multi-tier CDN, the popularity service may be located at any tier, or there may be popularity services at more than one tier.

[0053] The middle (Parent) tier is optional.

[0054] Step (4a) may reply with content (if popular), or with a redirect to a parent or origin server (if not), in which the client will make another request (5a or 5b) to that tier to obtain the content.

[0055] If the request is an HTTP GET request or the like, it is forwarded to the popularity service. HTTP POST requests should always be forwarded directly to the origin, since that is where they will need to be processed, and the response to a POST request should not be cached. It may sometimes be preferable to direct GET requests to a different origin server than POST requests.

[0056] While the invention has been described with reference to the HTTP protocol, those of skill in the art will know and understand, upon reading this description, that different and/or other protocols may be used and are contemplated by the inventors. HTTP is described in various documents, e.g., Hypertext Transfer Protocol -- HTTP/1.1, RFC 2616, Network Working Group, the entire contents of which are incorporated herein by reference.

[0057] Those of skill in the art will know and understand, upon reading this description, that different thresholds may be established for each tier in the CDN. Further, those of skill in the art will know and understand, upon reading this description, that each content item may have its own thresholds associated therewith. In this manner, the system can check all content for popularity, with the default thresholds being zero. In this manner, every request will automatically cause the popularity to exceed the threshold and will cause the content to be cached.

[0058] By positioning Popularity Servers regionally (paired with parent cache servers), popularity and cache tiers can be managed independently, on a regional basis. Content that is popular in one region / group may not be popular in another region/group (especially if each region / group corresponds to a geographic and/or political region).

[0059] We consider it desirable that rendezvous to popularity servers prioritize so-called “regional” proximity, so that clients within the same region will tend to cast their popularity “votes” within that region and get consistent treatment of popular resources. However, if there are multiple parent cache servers available, there will generally be no attempt to rendezvous particular clients to particular parents.

DEFINING & MEASURING POPULARITY

[0060] In preferred embodiments, popularity of an object/resource is measured based on the number of times that object/resource is requested in various time periods. **Fig. 6** is an exemplary data structure for maintaining the popularity data for a particular popularity server. The data structure **600** in **Fig. 6** is a so-called tally hash structure.

[0061] In preferred embodiments, some or all edge servers are associated with (or bound to) popularity servers. An edge server that is bound to a popularity server is sometimes referred to as a bound Longtail coserver. Each popularity server in the system allocates a tally hash structure 800 per bound Longtail coserver. A configuration provides the number of resource (hash) slots to allocate. For a presently preferred implementation, the number of hash slots is on the order of 100 million slots per coserver. Each slot is divided into a number of time buckets, preferably 16 time buckets, each bucket being represented by, e.g., a 4-bit unsigned integer. Those of skill in the art will know and understand, upon reading this description, that the selection of the size of the value in each time bucket depends on policy decisions about bounds for the popularity thresholds, and for keeping very popular resources at the edge. The size, however, is heavily influenced by a need for compactness. One 8-byte word can store all time buckets for one resource slot, and therefore, 800 MB would be required per property, and five to eight such properties could be managed per popularity server without paging.

[0062] Each time bucket represents a time period, preferably a number of seconds.

[0063] The mapping of requests/content to slots is based on some function of the object name and perhaps other information associated with the request for the object. Preferably the mapping of objects to slots is based on a hash or message digest function (such as MAD or the like) over the object name (and preferably including some parts of the query string). Each slot may therefore represent one or more resources. Each time a query/request arrives at a popularity server for an object, the hash is computed and the slot in the table 800 (for the appropriate co-server) is determined, and the counts in that slot are used. In event of a hash collision, it is therefore possible that one bucket will be receiving and representing counts for more than one object.

Since this result is generally undesirable (since it could result in cache fills and edge caching of unpopular objects), the number of buckets should be chosen to be as large as practical.

[0064] Those of skill in the art will know and understand, upon reading this description, that different and / or other data structures may be used to implement the popularity counting. For example, since in most cases the total number of resources is expected to far exceed the number of popular resources, a balanced b-tree may be preferable to a hash table. In addition, it is possible to reduce the size of the hash slot by using only some part of the hash. However, reducing the number of bytes of the hash used can result in more name collisions.

[0065] Although described above with respect to popularity, those of skill in the art will know and understand, upon reading this description, that other factors may be used along with (or instead of) popularity to determine whether or not to redirect requests. A rule base may be used to augment and/or override the popularity measures for certain resources. The rules in the rule base may be static or dynamic and may be set by the CDN administrator and/or the subscriber. For example, a subscriber may not want to pay for certain content to be served from the edge, regardless of its popularity, and may set a rule accordingly (this particular result could also be achieved by setting the thresholds for that particular content to prevent it from ever being cached at the edge).

[0066] Occasional log mining could be used to look for hash collisions in actual subscriber content libraries, and the hash function and bucket sizes could be tuned as needed.

[0067] At each time bucket boundary, the popularity service will logically “rotate” the buckets and zero out the oldest tally data for each object.

[0068] Whenever a coserver’s enrollment in the popularity service changes (added or dropped, or perhaps hints changed), the data structures are to be updated.

[0069] The popularity of a given object may be determined as a weighted sum of its popularity over successive time periods. More recent time periods may be given higher weights.

[0070] In order to determine which content is to be managed by the popularity service, the CDN operator and/or the subscriber may specify:

- The tiers at which the content will be managed — edge, intermediate (i.e., parent), or origin (subscriber's or storage tier). In order to be meaningful, at least one of intermediate and origin service should be enabled.
- content that is to be managed based on its popularity, rather than simply always being served from a cache.

[0071] There are several reasons why a publisher /subscriber may not want the so-called "long-tail" content served from a caching CDN service, for example:

- If cache fills are done from the subscriber's origin server and the subscriber pays for cache fill bandwidth, unnecessary fills for unpopular resources increase bandwidth costs without providing any value.
- Serving an unpopular resource through a CDN cache adds latency (due to the cache fill), and risks forcing actually popular resources out of cache, potentially causing thrashing. The result is lower efficiency and the risk of degraded service.

[0072] For related or similar reasons, a CDN provider generally also does not want to serve long-tail content from an edge cache:

- If cache fills are done from origin storage, unnecessary cache fills consume bandwidth both from the storage and cache systems, increasing (doubling) the internal cost to serve. This lowers efficiency, requiring relatively more bandwidth internally to serve the same content to the outside.
- The second argument above also applies from the CDN's perspective: a CDN operator wants to minimize latency as well as the risk of thrashing in order to satisfy all of its subscribers.

NAMES, ADDRESSES & CONFIGURATION DATA

[0073] As is well known, each server in a network may be addressed by means of one or more network address (e.g., Internet Protocol or IP addresses). Each server in a

network may also be known by one or more names (so-called hostnames — fully qualified domain names). Hostnames may be mapped to one or more IP addresses. A hostname may correspond to (and thus resolve to) more than one server.

[0074] A system such as ITM (described in the ITM patent applications mentioned above), allows a kind of hostname (called a supertype) to refer to multiple servers, and resolves the supertype to a nearby server.

[0075] Preferably the server selection mechanism is ITM, and each popularity server will have supertype that resolves to reach nearby popularity server.

[0076] When a popularity server shares or is co-located with a parent server, the parent server may use the name by which it was addressed to determine whether to direct a request to the popularity service. That is, parent cache servers that provide popularity service may recognize requests that use one of the aliases reserved for popularity requests, and call into the popularity service to make the fill/no fill decision and return a redirect as described above.

[0077] As noted earlier, if the server selector mechanism does not send initial requests to non-edge servers, then all parent cache servers must recognize requests that have been redirected and serve the requested resource, filling it from the origin (or another tier), if necessary.

[0078] A servers hostnames are also referred to as its aliases. Each Longtail coserver preferably has at least two aliases (three if a parent cache/server tier is used): the published supertype, the hostname used for popularity service requests, and (if used) the hostname used for parent cache redirects.

[0079] Popularity servers will preferably be reached via an ITM supertype, and ITM will monitor for the service's availability across the set of servers. Popularity servers should be reached using real IP addresses, and not virtual IPs, and will not necessarily be redundant within a cluster. Redundancy can be provided by having multiple servers per supertype. However, preferably there will be no attempt to synchronize the popularity tallies on popularity servers, with the expected desirable effect of managing popularity separately on a "regional" basis, the granularity being determined by the

number and distribution of popularity servers deployed. Should a popularity server fail, this could cause a discontinuity in popularity responses as a new server becomes active for a given edge location, but this may be mitigated (for very popular resources) by periodic background refreshes.

[0080] Information about the resources and caching strategy include the following:

- the expected total number of resources associated with this coserver.
- the number of buckets used to store hit counts for each resource.
- the number of seconds that each bucket represents. Every time this interval goes by, the count in the oldest bucket is thrown out and a new bucket is started with a count of zero.
- when the sum of all buckets for a given resource reaches this number on any popularity server, the parent caches (if any) that use that server will start to cache the resource.
- when the sum of all buckets for a given resource reaches this number on any popularity server, the edge caches that use that server will start to cache the resource.
- the hash algorithm to apply to the resource names (optional). If not specified, a default algorithm (e.g. MD5) will be used.
- the maximum number of this coserver's resources that should be in cache at an edge at any given time. This value may be ignored in certain embodiments.
- the maximum number of this coserver's resources that should be in cache at a parent at any given time. This value may be ignored in certain embodiments.

[0081] Preferably resources should not be pre-expired on parent cache servers, as that will cause unnecessary requests to the origin server or queries to peer caches.

[0082] Those of skill in the art will know and understand, upon reading this description, that a decision to serve at a given tier that is based only on popularity counts, will not take into account capacity to serve at that tier — so this scheme could overload an origin server or parent tier if they do not have sufficient capacity. Further, if

popularity is measured in terms of absolute thresholds on numbers of requests, and if the library is sufficiently large, this could cause cache thrashing at the parent or edge tiers.

[0083] Authentication with the origin cache or server, if needed, should be done by the server that receives the initial request from the client. During processing of a redirected request.

[0084] Various documents, including patents and patent applications, have been incorporated by reference into this application. In case of any conflict between an incorporated document and the present application, the present application, including any definitions herein, will control.

[0085] Thus is provided a feature that allows a CDN to be responsive to increasing or decreasing “popularity” of content by shaping where in the CDN content is positioned and served from.

[0086] FIG. 7 is a flowchart **700** of processing steps associated with a multi-tiered content delivery network.

[0087] In step **705**, a first server in a first tier of servers obtains a request from a client for a resource. In one embodiment, the resource is available as part of a content provider’s library (e.g., the resource may be a digital movie requested from an on-line streaming movie provider).

[0088] In step **710**, if the resource is not available at the first server or at a peer of the first server, and additionally if it is determined that the resource is popular (using processing and functionality previously described), then the first server obtains the resource and serves it to the client. For example, the first server may obtain the resource from an origin server and/or a parent server (in any intermediate tier between the first server and the origin server).

[0089] In step **715**, if the resource is determined not to be popular (again, using processing and functionality previously described), the client is directed to a second server in a second tier of servers (e.g., any intermediate tier) distinct from the first tier of servers. In this example embodiment, the second server comprises a first portion (or

subset) of the content provider's library. For the purposes of this example, the first portion comprises at least the resource that was requested by the client. Furthermore, the second tier includes at least one other server that comprises a second portion of the content provider's library. According to one example embodiment, the first portion is distinct from the second portion (i.e., the portions/subsets of the library do not overlap, or overlap only minimally).

[0090] In another example embodiment, the portions of the content provider's library are logically partitioned across servers in the second tier. For example, the portions/subsets of a content provider's library can be partitioned alphabetically across servers in the second tier based on a naming convention associated with each distinct resource in the content provider's library (e.g., digital movies having titles beginning with **A-F** are stored on server A in a second/intermediate tier, digital movies having titles beginning with **G-R** are stored on server B in the second/intermediate tier, and digital movies having titles beginning with **S-Z** are stored on server C in the second/intermediate tier).

[0091] Assume, for example, that a content provider's library comprises multiple content-types (e.g., movies, video games, music, software patches, etc.). Per one example embodiment, it would be advantageous to store a proportionate amount of each content type on each participating intermediate tier server (e.g., 60% movies, 30% video games, 10% software downloads on each participating server in the tier). In such a scenario, if the demand for a particular content-type increases during a given time period (and/or demand for a different content-type declines), then such fluctuations in demand will generally affect each participating server proportionately.

[0092] Noted that resources may be partitioned across multiple servers by naming convention (e.g., alphabetically) as well as having proportionally distributed content per server (e.g., by content-type). With this in mind, it should be further noted that logical partitioning of resources/content among intermediate servers is not limited to just alphabetic naming convention segmentation and/or content-type proportionality. It is contemplated that the partitioning may be based on various metrics such as, but not limited to, numeric hash values (e.g., MD5) associated with content/resource URLs, the

size or file type of a resource, other identifiers associated with other various naming conventions (e.g., numerical, alphanumerical, proprietary, encrypted/mangled, etc.), the relative size and traffic behavior of various resources in a content provider's library or the content provider's library as a whole, and the like.

[0093] In step **720**, the step of directing the client to a second server in the second tier is performed in response to a determination of which second server actually stores the first portion. In one example, the server that stores the first portion (or, for that matter, any portion that comprises the requested resource) is identified using a hash function (similar to the processing and functionality previously described).

[0094] In step **725**, the second server that stores the first portion serves the resource to the client.

[0095] The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment or embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly and legally entitled.

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)**CROSS-REFERENCE TO RELATED APPLICATIONS**

[0001] This application is a continuation of and claims the benefit of priority from U.S. Patent Application No. 15/645,584, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed July 10, 2017, the entire contents of which are fully incorporated by reference herein for all purposes. Application no. 15/645,584 is a continuation of and claims the benefit of priority from U.S. Patent Application No. 12/880,324, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed September 13, 2010, the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/880,324 is a continuation-in-part (CIP) of and claims the benefit of priority from U.S. Patent Application No. 12/408,681, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed March 21, 2009 (now U.S. Patent No. 8,930,538 issued January 6, 2015), the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/408,681 claims priority as a non-provisional application from U.S. Provisional Application No. 61/042,412, entitled “HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN),” filed April 4, 2008 the entire contents of which are fully incorporated by reference herein for all purposes.

[0002] This application is also related to the following co-owned and co-pending patent applications, the contents of each of which are fully incorporated herein by reference for all purposes: Application No. 10/073,938 filed ~~02-14-2002~~ February 14, 2002, Application No. 11/715,316 filed ~~03-08-2007~~ March 8, 2007, Application No. 11/978,656 filed ~~10-30-2007~~ October 30, 2007, Application No. 11/980,672 filed ~~10-31-2007~~ October 31, 2007, Application No. 10/259,497 filed ~~09-30-2002~~ September 30, 2002, Application No. 11/932,162 filed ~~10-31-2007~~ October 31, 2007, Application No. 11/976,648 filed ~~10-26-2007~~ October 26, 2007, and Application No. 12/390,560 filed ~~02-23-2009~~ February 23, 2009.

FIELD OF THE INVENTION

[0003] This invention relates to content delivery, to content delivery networks (CDNs), and to frameworks and systems using CDNs.

DETAILED DESCRIPTION**GLOSSARY**

[0004] As used herein, unless stated otherwise, the following terms or abbreviations have the following meanings:

1. IP means Internet Protocol.
2. “IP address” means an address used in the Internet Protocol to identify electronic devices such as servers and the like.
3. HTTP means Hypertext Transfer Protocol.
4. URL means Uniform Resource Locator.
5. DNS means Domain Name System.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] The present invention can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Furthermore, like referenced numerals designate corresponding parts throughout the several views.

[0006] **Fig. 1** depicts a general hierarchical, multi-tiered content delivery network (CDN);

[0007] **Fig. 2** shows the logical organization of servers into groups or clusters in a CDN;

[0008] **Fig. 3** depicts a content delivery framework (CDF) using a content delivery network (CDN);

[0009] Fig. 4 depicts the operation of a two-level content delivery network in a content delivery framework;

[0010] Fig. 5 is a flowchart showing operation of the popularity services of the CDN of Fig. 4;

[0011] Fig. 6 is an exemplary data structure for maintaining the popularity data for a particular popularity server; and

[0012] Fig. 7 is a flowchart showing processing steps of a multi-tiered content delivery network.

OVERVIEW

[0013] The Internet and the so-called World Wide Web (the “WWW”) have become ubiquitous. Thousands or even tens of thousands of so-called content providers (publishers) now use the Internet (and, particularly, the WWW) to provide all sorts of content to tens or even hundreds of thousands of clients all over the world.

[0014] In order to offload the job of serving some or all of their content, many content providers now subscribe to so-called content delivery networks (CDNs). Using a CDN, some (or all) of a content provider’s content can be served to clients from the CDN (i.e., from one or more servers in the CDN) instead of from the content provider’s server(s). In a caching CDN, content that is served may also be cached on some or all of the CDN servers, either before being served or in response to specific requests for that content.

[0015] The term content as used herein means any kind of data, in any form, regardless of its representation and regardless of what it represents. Content may include, without limitation, static and/or dynamic images, text, audio content, including streamed audio, video content, including streamed video, web pages, computer programs, documents, files, and the like. Some content may be embedded in other content, e.g., using markup languages such as HTML and XML. Content includes content which is created or formed or composed specifically in response to a particular request. The term “resource” is sometimes used herein to refer to content.

[0016] Certain publishers can have large content libraries in which only a small proportion of the content (the so-called “short head”) is popular enough to benefit from serving through a caching CDN, while the majority of the content (the so-called “long tail”) is accessed only occasionally and not generally worth caching (or even serving from an edge server). This situation would be typical for a content publisher with a very large music or video library. Some music content — the popular content — may be regularly requested, whereas other music — the not popular (also referred to as unpopular) content — may be seldom if ever requested.

[0017] Content can become popular (by various measures of popularity) or fade into relative obscurity dynamically, so a content library cannot easily be explicitly partitioned. Instead, the CDN tracks popularity of certain content, and selectively migrates content toward the edge (i.e., toward the tier 1 servers) as that content becomes popular.

[0018] A CDN may have one or more tiers of servers, organized hierarchically. **Fig. 1** depicts a content delivery network **100** that includes multiple tiers of servers. Specifically, the CDN **100** of Fig. 1 shows j tiers of servers, denoted Tier 1, Tier 2, Tier 3, ..., Tier j . Each tier of servers may comprise a number of servers organized into server groups (sometimes referred to as server clusters). The Tier 1 servers are also referred to as edge servers, and Tier 1 is sometimes also referred to as the “edge” or the “edge of the CDN.” The Tier 2 servers (when present in a CDN) are also referred to as parent servers.

[0019] Furthermore, content stored in any of the intermediate tier servers (e.g., tier 2, tier 3, ... tier j in **FIG. 1**) may be logically partitioned across two or more servers in the respective tier group. For example, a first portion (or subset) of a content provider’s library may be stored on a first parent server in Group 1, a second portion may be stored on a second server in Group 1, and the last third may be stored on a third server in Group 1. Various partitioning methodologies are described in further detail below. In operation, the partitioning of content libraries across servers in an intermediate tier of a CDN provides a type of preemptive load-balancing such that certain parent servers are only responsible for handling a pre-defined subset of a content provider’s library. In other words, redirected requests from the client to a parent/intermediate tier are

distributed within the tier in accordance with the particular partitioning methodology being implemented.

[0020] For example, in the CDN **100** of **Fig. 1**, Tier 1 has n groups of servers (denoted “Edge Server Group 1”, “Edge Server Group 2”, “...”, “Edge Server Group n ”); tier 2 (the parent servers’ tier) has m server groups (the i th group being denoted “Parent Server Group i ”); and tier 3 has k server groups, and so on. Preferably each tier has the same number of server groups.

[0021] Fig. 2 shows the logical organization / grouping of servers in a CDN of Fig. 1. In the exemplary CDN of **Fig. 2**, each tier of servers has the same number (n) of server groups. Those of skill in the art will know and understand, upon reading this description, that each server group may have the same or a different number of servers. Additionally, the number of servers in a server group may vary dynamically. For example, additional servers may be added to a server group to deal with increased load on the group.

[0022] The servers in a server group may be homogenous or heterogeneous, and each server in a server group may comprise a cluster of physical servers sharing the same name and/or network address. An example of such a cluster is described in co-pending and co-owned patent application no. 61/064,339 (titled “Load-balancing cluster”, filed 02/28/2008 February 28, 2008), the entire contents of which are incorporated herein by reference for all purposes.

[0023] Servers in the same tier and the same group are referred to as peers or peer servers.

[0024] A typical CDN has only one or two tiers of servers. A CDN with only one tier will have only edge servers, whereas a CDN with two tiers will have edge servers and parent servers. (At a minimum, a CDN should have at least one tier of servers — the edge servers.)

[0025] The grouping of servers in a tier may be based, e.g., on their physical or geographical location. For example, a particular CDN may have six groups — four groups of servers in the United States, Group 1 for the West Coast, Group 2 for the

mid-west, Group 3 for the northeast and Group 4 for the south east; and one group each for Europe and Asia.

[0026] A particular CDN server is preferably in only one server group.

[0027] In general, some or all of the servers in each tier can exchange data with some or all of the servers in each other tier. Thus, some or all of the parent servers can exchange information with some or all of the edge servers. For the sake of simplicity, in the drawings, each tier of servers is shown as being operationally connectable to each other tier. In some CDNs, however, it may be preferable that the servers in a particular tier can only exchange information with other servers in the same group (i.e., with peer servers) and/or with other servers in the same group in a different tier. For example, in some CDNs, the edge servers in edge server group *k*, can exchange information with each other and with all servers in parent server group *k*, and so on.

[0028] A content provider's / customer's server (or servers) are also referred to as origin servers. A content provider's origin servers may be owned and/or operated by that content provider or they may be servers provided and/or operated by a third party such as a hosting provider. The hosting provider for a particular content provider may also provide CDN services to that content provider.

[0029] A CDN may also include a CDN origin/content cache tier which may be used to cache content from the CDN's subscribers (i.e., from the CDN subscribers' respective origin servers). Those of skill in the art will know and understand, upon reading this description, that a CDN can support one or more subscribers, i.e., that a CDN can function as a shared infrastructure supporting numerous subscribers. The CDN origin tier may also consist of a number of servers, and these servers may also be organized (physically and logically) into a number of regions and/or groups. The server(s) in the CDN origin tier obtain content from the subscribers' origin servers, either on an as needed basis (a pull) or in advance (via a push).

[0030] A popularity service **102** (described in greater detail below) is associated with one or more of the server groups in one or more tiers. In a presently preferred exemplary embodiment, some of the parent server groups have popularity services **102** associated therewith. Although shown as a separate component of the group, the

popularity service **102** may be integrated into one of the servers in the group. In some cases, the popularity service may have its own server, distinct from any of the CDN servers. The terms “popularity service” and “popularity server” are used interchangeable herein.

[0031] In operation, when a client requests content that is to be served using a content delivery framework, the client may be served that content from a server in the CDN or, in some cases, from the subscriber/customer’s origin server.

[0032] A client may be directed to a CDN and/or to a server in the CDN in any manner using any kind of server selector system **104**. As understood by those of skill in the art, the server selector system **104** generally operates to direct a client’s requests for content to an appropriate server in order for that content to be served to the requesting client. An appropriate server may be one which is close to the client (by some measure of cost) and/or one which is not too heavily loaded. All sorts of conditions may be applied to the term “appropriate”, and all sorts of information and tests, both static and dynamic, may be used to determine an appropriate server. The server selector system **106** may, e.g., include or operate fully or partially in Domain Name Service (DNS) servers, standalone devices, or a combination thereof. For example, the server selector system **106** may comprise a single level DNS server that selects an appropriate server based at least in part on some combination of the location of the requesting client and the load on some or all of the CDN servers. Those of skill in the art will know and understand, upon reading this description, that a client’s location in a network such as the Internet may sometimes only be roughly determined, and the term “location of the client” is generally taken to be a network location corresponding to the client’s network service provider.

[0033] Although shown as a component in the drawings, the server selector **106** may comprise numerous components. For example, some or all of the server selection may be based on anycast routing, and the server selector **106** may then include routers and associated tables.

[0034] In a presently preferred embodiment the server selector **106** is an intelligent traffic manager (ITM) / adaptive traffic controller (ATC) such as described in co-pending

U.S. patent application no. 10/259,497, filed ~~09-30-2002~~ September 30, 2002, and titled “Configurable Adaptive Global Traffic Control And Management,” (published as US 2003-0065762 A1); and in U.S. patent application no. 11/976,648, filed ~~10-26-2007~~ October 26, 2007, titled “Policy-based content delivery network selection,” (collectively the “ITM applications”), the entire contents of each of which have been incorporated herein by reference for all purposes. In some embodiments the server selector **106** may include a “best” or “optimal” server selector such as disclosed in U.S. Patent No. 6,185,598 titled, “Optimized Network Resource Location,” the entire contents of which are incorporated herein by reference for all purposes. The ‘598 patent refers to CDN servers as so-called repeater servers, and describes a so-called “Best Repeater Selector (BRS) mechanism”.

[0035] Fig. 3 shows a content delivery framework **300** with a two-level hierarchical CDN consisting of a tier of edge servers (Tier 1) and a tier of parent servers (Tier 2). Some or all of the edge servers can communicate with some or all of the parent servers. The edge servers are divided into n edge server groups, and the parent servers are divided into m parent server groups. In a presently preferred embodiment, the value of m is equal to the value of n , *i.e.*, in this presently preferred embodiment there are the same number of edge server groups as there are parent server groups. A CDN origin/content cache tier stores subscriber content which it obtains from the various subscribers’ origin servers. At least one of the parent server groups (in the drawing, Group 1) has a popularity service **102-1** associated therewith. Preferably more than one parent server group has an associated popularity service, and more preferably each parent server group has an associated popularity service.

[0036] Although shown in a parent tier, the popularity service may be located anywhere in the system, including in the edge tier.

[0037] The popularity service may be used by certain, though not necessarily all, content. When only certain content uses the popularity service, content should be designated in order to use the popularity service.

[0038] Some or all of the edge servers in a group may use a popularity service to manage the long-tail content of various subscribers. Each edge server that uses a

popularity service is referred to as being bound to that popularity service. An edge server that is bound to a popularity service is sometimes referred to herein as a “longtail coserver.”

[0039] Figs. 4 and 5 show the operation of the popularity services of the CDN of **Fig. 3**.

[0040] When a client **106** requests content (e.g., using an HTTP GET request), that request is directed (e.g., by server selector **104-1**) to an edge server in order for the content to be served to the client. For certain designated content a popularity check is interposed into the fill side of the caching operation. **Fig. 4** illustrates the flow of messages and data in the content delivery framework **300**, and **Fig. 5** is a flowchart show operation of the popularity services of the CDN of **Fig. 4**. For the sake of this particular explanation, assume that the client’s request has been directed to edge server **108**. (Those of skill in the art will know and understand, upon reading this description, that the client’s initial request may be directed to any tier in the CDN hierarchy, including, e.g., to the parent tier.) This server is selected using the server selection mechanisms **104-1** associated with the CDN, e.g., using one or more DNS servers and selecting an edge server based on such factors as the location of the requesting client, the load on the network, network traffic conditions, CDN policies, subscriber policies, and the like.

[0041] A client **104** requests content from an edge server **108** (at **500** in **Fig. 5**). The request from the client **104** arrives at edge server **108** (**S1** in **Fig. 4**). The edge server **108** checks to see if object is present (locally or on a peer) and fresh (at **502**). If so, the edge server **108** serves the object to the client **104** from the cache (**S2, 504**), obtaining the object from a peer, if necessary.

[0042] In some embodiments, the system may distinguish between on-net and off-net peers and same-switch peers. An on-net peer is a peer on the same backbone network; an off-net peer is a peer located on a different backbone network; and a same-switch peer is a peer directly connected to the same switch as the agent performing the check. In some embodiments, the edge server **108** may only look for the object on some of its peers (e.g., only on same-switch peers) (at **502**).

[0043] If the object is not available on the edge server **108** or on a peer, the edge server **108** ascertains whether this object is served based on its popularity (i.e., whether this object has been designated so that the object's popularity will be used to determine where it will be served from) (at **506**). If so, then the request is sent to the popularity service **102** associated with the edge server **108**, in this case, to the popularity server for the this group (**S3a**).

[0044] The determination as to whether this object is designated to be served from a different location, depending on its popularity (at **506**), may be made based, at least in part, on the name (hostname) used to request the object.

[0045] It is preferably to allow for a mix of edge servers, some performing popularity checking (as described above), while others do not. For those that are not running the popularity service, the name (hostname) used to request an object will resolve to a parent server (that may or may not provide popularity services). If the parent server does not provide popularity services, then the content will be obtained by the edge server from that parent server, and the content will be served to the client. On the other hand, if that parent server does provide popularity services, it can determine whether or not the edge server is a Longtail coserver based, e.g., on the IP (Internet Protocol) address of the edge server. For no-coservers, the parent server can handle the request without any popularity processing.

[0046] A request for content may be an initial request for an object or it may be a request for another part of an object, the initial part having already been served to the client. If the request is for the first part of the object (at **508**), e.g., the request includes a request for the first byte of the resource (i.e., it is not a range request that starts after the beginning of the file), the popularity service **102** determines (as described below) if the object is currently popular. First, the popularity count for the current period is incremented (at **510**). Based on its determination, the popularity service **102** returns one of three possible responses to the edge server **108** (**S3b**):

1. If the object has not reached a first minimal level of popularity (at **512**): the popularity service sends the edge server an instruction (e.g., HTTP 302) to

redirect the client's request to the origin server (or to the CDN origin cache) (if origin redirects are enabled) (at **514**).

2. If the object's popularity has exceeded the first / minimal level of popularity but has not yet exceeded a second, mid-tier threshold (at **516**): the popularity service sends the edge server an instruction (e.g., HTTP 302) to redirect the client's request to a parent server (if mid-tier redirects are enabled) (at **518**). Note that the redirect processing may further involve a determination of which particular parent server is responsible for storing the requested content. Such a determination would be based on how the distinct subsets of a content provider's library are partitioned across parent servers in the same intermediate tier. Further note that it is also possible for subsets of a content provider's library to be partitioned across servers residing in different intermediate tiers of a content delivery network.

3. If the object's popularity has exceeded the mid-tier threshold (i.e., the object is popular): The popularity service sends the edge server an instruction to serve the content itself (at **520**). In a presently preferred implementation, the popularity service sends the edge server a redirect (HTTP 302) with a "follow me" flag set, to the origin server or, if there is one, to the parent tier.

[0047] If the edge server **108** receives a redirect from the popularity service **102** without the "follow me" flag set (cases 1 and 2 above), it simply forwards the redirect to the client **104** (**S4a, 522, 524**). If the edge server **108** receives a "follow me" redirect, it obtains and caches the resource (at **526**) and serves it to the client (at **528**).

[0048] If the popularity service **102** is unreachable, unresponsive, or returns a status code indicating an error (other than HTTP 404), the object is served out of the edge's cache server (and an alert condition is raised).

[0049] Once content has been cached at an edge server, the edge server will send notifications (e.g., in the form of revalidations) to the popularity service every time it gets another request for that content. E.g., with reference to the flowchart of **Fig. 5**, if the edge server **108** determines (at **502**) that it has the requested content (or can obtain it from a peer), then, in addition to serving the content (at **504**), it also instructs the

popularity server to increment the object's popularity count for the current period (at **530**). This process keeps the popularity servers up to date on the relative popularity of content being served in their region.

[0050] In presently preferred embodiments, the server selection mechanism **104** does not rendezvous clients to parent servers/caches. In other words, in these embodiments, client requests are always initially directed by the server selection mechanism to an edge server. In these cases, when a request for a resource arrives at a parent server/cache, that request should preferably be served (and filled if necessary) unconditionally (since any request from a client is assumed to be the result of a redirect served by an edge server).

[0051] In an embodiment where the server selector **104** can direct client requests directly to parent servers (or to any tier other than the edge tier), a server obtaining a client request may choose to redirect that request, e.g., based on popularity. However, those of skill in the art will know and understand, upon reading this description, that it is advisable to track the redirection of a request to avoid circular and/or infinite redirection. One way to avoid such a problem is to limit the number of levels of redirection (i.e., to limit the number of redirects to follow). In a presently preferred implementation, if no final server is selected after following, e.g., thirty two redirects, an error is issued. In some embodiments, if no final sever is selected after a predefined number of redirects, then the last server reached may be used to serve the content. One way to prevent looping is to use different server names (aliases) or IP addresses when redirecting requests so that a server receiving a request can tell whether or not it is a redirect. Those of skill in the art will know and understand, upon reading this description, that information can be transferred between servers using, e.g., HTTP headers or the like.

[0052] Those of skill in the art will know and understand, upon reading this description, that in a multi-tier CDN, the popularity service may be located at any tier, or there may be popularity services at more than one tier.

[0053] The middle (Parent) tier is optional.

[0054] Step (4a) may reply with content (if popular), or with a redirect to a parent or origin server (if not), in which the client will make another request (5a or 5b) to that tier to obtain the content.

[0055] If the request is an HTTP GET request or the like, it is forwarded to the popularity service. HTTP POST requests should always be forwarded directly to the origin, since that is where they will need to be processed, and the response to a POST request should not be cached. It may sometimes be preferable to direct GET requests to a different origin server than POST requests.

[0056] While the invention has been described with reference to the HTTP protocol, those of skill in the art will know and understand, upon reading this description, that different and/or other protocols may be used and are contemplated by the inventors. HTTP is described in various documents, e.g., Hypertext Transfer Protocol -- HTTP/1.1, RFC 2616, Network Working Group, the entire contents of which are incorporated herein by reference.

[0057] Those of skill in the art will know and understand, upon reading this description, that different thresholds may be established for each tier in the CDN. Further, those of skill in the art will know and understand, upon reading this description, that each content item may have its own thresholds associated therewith. In this manner, the system can check all content for popularity, with the default thresholds being zero. In this manner, every request will automatically cause the popularity to exceed the threshold and will cause the content to be cached.

[0058] By positioning Popularity Servers regionally (paired with parent cache servers), popularity and cache tiers can be managed independently, on a regional basis. Content that is popular in one region / group may not be popular in another region/group (especially if each region / group corresponds to a geographic and/or political region).

[0059] We consider it desirable that rendezvous to popularity servers prioritize so-called “regional” proximity, so that clients within the same region will tend to cast their popularity “votes” within that region and get consistent treatment of popular resources. However, if there are multiple parent cache servers available, there will generally be no attempt to rendezvous particular clients to particular parents.

DEFINING & MEASURING POPULARITY

[0060] In preferred embodiments, popularity of an object/resource is measured based on the number of times that object/resource is requested in various time periods. **Fig. 6** is an exemplary data structure for maintaining the popularity data for a particular popularity server. The data structure **600** in **Fig. 6** is a so-called tally hash structure.

[0061] In preferred embodiments, some or all edge servers are associated with (or bound to) popularity servers. An edge server that is bound to a popularity server is sometimes referred to as a bound Longtail coserver. Each popularity server in the system allocates a tally hash structure 800 per bound Longtail coserver. A configuration provides the number of resource (hash) slots to allocate. For a presently preferred implementation, the number of hash slots is on the order of 100 million slots per coserver. Each slot is divided into a number of time buckets, preferably 16 time buckets, each bucket being represented by, e.g., a 4-bit unsigned integer. Those of skill in the art will know and understand, upon reading this description, that the selection of the size of the value in each time bucket depends on policy decisions about bounds for the popularity thresholds, and for keeping very popular resources at the edge. The size, however, is heavily influenced by a need for compactness. One 8-byte word can store all time buckets for one resource slot, and therefore, 800 MB would be required per property, and five to eight such properties could be managed per popularity server without paging.

[0062] Each time bucket represents a time period, preferably a number of seconds.

[0063] The mapping of requests/content to slots is based on some function of the object name and perhaps other information associated with the request for the object. Preferably the mapping of objects to slots is based on a hash or message digest function (such as MAD or the like) over the object name (and preferably including some parts of the query string). Each slot may therefore represent one or more resources. Each time a query/request arrives at a popularity server for an object, the hash is computed and the slot in the table 800 (for the appropriate co-server) is determined, and the counts in that slot are used. In event of a hash collision, it is therefore possible that one bucket will be receiving and representing counts for more than one object.

Since this result is generally undesirable (since it could result in cache fills and edge caching of unpopular objects), the number of buckets should be chosen to be as large as practical.

[0064] Those of skill in the art will know and understand, upon reading this description, that different and / or other data structures may be used to implement the popularity counting. For example, since in most cases the total number of resources is expected to far exceed the number of popular resources, a balanced b-tree may be preferable to a hash table. In addition, it is possible to reduce the size of the hash slot by using only some part of the hash. However, reducing the number of bytes of the hash used can result in more name collisions.

[0065] Although described above with respect to popularity, those of skill in the art will know and understand, upon reading this description, that other factors may be used along with (or instead of) popularity to determine whether or not to redirect requests. A rule base may be used to augment and/or override the popularity measures for certain resources. The rules in the rule base may be static or dynamic and may be set by the CDN administrator and/or the subscriber. For example, a subscriber may not want to pay for certain content to be served from the edge, regardless of its popularity, and may set a rule accordingly (this particular result could also be achieved by setting the thresholds for that particular content to prevent it from ever being cached at the edge).

[0066] Occasional log mining could be used to look for hash collisions in actual subscriber content libraries, and the hash function and bucket sizes could be tuned as needed.

[0067] At each time bucket boundary, the popularity service will logically “rotate” the buckets and zero out the oldest tally data for each object.

[0068] Whenever a coserver’s enrollment in the popularity service changes (added or dropped, or perhaps hints changed), the data structures are to be updated.

[0069] The popularity of a given object may be determined as a weighted sum of its popularity over successive time periods. More recent time periods may be given higher weights.

[0070] In order to determine which content is to be managed by the popularity service, the CDN operator and/or the subscriber may specify:

- The tiers at which the content will be managed — edge, intermediate (i.e., parent), or origin (subscriber's or storage tier). In order to be meaningful, at least one of intermediate and origin service should be enabled.
- content that is to be managed based on its popularity, rather than simply always being served from a cache.

[0071] There are several reasons why a publisher /subscriber may not want the so-called "long-tail" content served from a caching CDN service, for example:

- If cache fills are done from the subscriber's origin server and the subscriber pays for cache fill bandwidth, unnecessary fills for unpopular resources increase bandwidth costs without providing any value.
- Serving an unpopular resource through a CDN cache adds latency (due to the cache fill), and risks forcing actually popular resources out of cache, potentially causing thrashing. The result is lower efficiency and the risk of degraded service.

[0072] For related or similar reasons, a CDN provider generally also does not want to serve long-tail content from an edge cache:

- If cache fills are done from origin storage, unnecessary cache fills consume bandwidth both from the storage and cache systems, increasing (doubling) the internal cost to serve. This lowers efficiency, requiring relatively more bandwidth internally to serve the same content to the outside.
- The second argument above also applies from the CDN's perspective: a CDN operator wants to minimize latency as well as the risk of thrashing in order to satisfy all of its subscribers.

NAMES, ADDRESSES & CONFIGURATION DATA

[0073] As is well known, each server in a network may be addressed by means of one or more network address (e.g., Internet Protocol or IP addresses). Each server in a

network may also be known by one or more names (so-called hostnames — fully qualified domain names). Hostnames may be mapped to one or more IP addresses. A hostname may correspond to (and thus resolve to) more than one server.

[0074] A system such as ITM (described in the ITM patent applications mentioned above), allows a kind of hostname (called a supertype) to refer to multiple servers, and resolves the supertype to a nearby server.

[0075] Preferably the server selection mechanism is ITM, and each popularity server will have supertype that resolves to reach nearby popularity server.

[0076] When a popularity server shares or is co-located with a parent server, the parent server may use the name by which it was addressed to determine whether to direct a request to the popularity service. That is, parent cache servers that provide popularity service may recognize requests that use one of the aliases reserved for popularity requests, and call into the popularity service to make the fill/no fill decision and return a redirect as described above.

[0077] As noted earlier, if the server selector mechanism does not send initial requests to non-edge servers, then all parent cache servers must recognize requests that have been redirected and serve the requested resource, filling it from the origin (or another tier), if necessary.

[0078] A servers hostnames are also referred to as its aliases. Each Longtail coserver preferably has at least two aliases (three if a parent cache/server tier is used): the published supertype, the hostname used for popularity service requests, and (if used) the hostname used for parent cache redirects.

[0079] Popularity servers will preferably be reached via an ITM supertype, and ITM will monitor for the service's availability across the set of servers. Popularity servers should be reached using real IP addresses, and not virtual IPs, and will not necessarily be redundant within a cluster. Redundancy can be provided by having multiple servers per supertype. However, preferably there will be no attempt to synchronize the popularity tallies on popularity servers, with the expected desirable effect of managing popularity separately on a "regional" basis, the granularity being determined by the

number and distribution of popularity servers deployed. Should a popularity server fail, this could cause a discontinuity in popularity responses as a new server becomes active for a given edge location, but this may be mitigated (for very popular resources) by periodic background refreshes.

[0080] Information about the resources and caching strategy include the following:

- the expected total number of resources associated with this coserver.
- the number of buckets used to store hit counts for each resource.
- the number of seconds that each bucket represents. Every time this interval goes by, the count in the oldest bucket is thrown out and a new bucket is started with a count of zero.
- when the sum of all buckets for a given resource reaches this number on any popularity server, the parent caches (if any) that use that server will start to cache the resource.
- when the sum of all buckets for a given resource reaches this number on any popularity server, the edge caches that use that server will start to cache the resource.
- the hash algorithm to apply to the resource names (optional). If not specified, a default algorithm (e.g. MD5) will be used.
- the maximum number of this coserver's resources that should be in cache at an edge at any given time. This value may be ignored in certain embodiments.
- the maximum number of this coserver's resources that should be in cache at a parent at any given time. This value may be ignored in certain embodiments.

[0081] Preferably resources should not be pre-expired on parent cache servers, as that will cause unnecessary requests to the origin server or queries to peer caches.

[0082] Those of skill in the art will know and understand, upon reading this description, that a decision to serve at a given tier that is based only on popularity counts, will not take into account capacity to serve at that tier — so this scheme could overload an origin server or parent tier if they do not have sufficient capacity. Further, if

popularity is measured in terms of absolute thresholds on numbers of requests, and if the library is sufficiently large, this could cause cache thrashing at the parent or edge tiers.

[0083] Authentication with the origin cache or server, if needed, should be done by the server that receives the initial request from the client. During processing of a redirected request.

[0084] Various documents, including patents and patent applications, have been incorporated by reference into this application. In case of any conflict between an incorporated document and the present application, the present application, including any definitions herein, will control.

[0085] Thus is provided a feature that allows a CDN to be responsive to increasing or decreasing “popularity” of content by shaping where in the CDN content is positioned and served from.

[0086] FIG. 7 is a flowchart **700** of processing steps associated with a multi-tiered content delivery network.

[0087] In step **705**, a first server in a first tier of servers obtains a request from a client for a resource. In one embodiment, the resource is available as part of a content provider’s library (e.g., the resource may be a digital movie requested from an on-line streaming movie provider).

[0088] In step **710**, if the resource is not available at the first server or at a peer of the first server, and additionally if it is determined that the resource is popular (using processing and functionality previously described), then the first server obtains the resource and serves it to the client. For example, the first server may obtain the resource from an origin server and/or a parent server (in any intermediate tier between the first server and the origin server).

[0089] In step **715**, if the resource is determined not to be popular (again, using processing and functionality previously described), the client is directed to a second server in a second tier of servers (e.g., any intermediate tier) distinct from the first tier of servers. In this example embodiment, the second server comprises a first portion (or

subset) of the content provider's library. For the purposes of this example, the first portion comprises at least the resource that was requested by the client. Furthermore, the second tier includes at least one other server that comprises a second portion of the content provider's library. According to one example embodiment, the first portion is distinct from the second portion (i.e., the portions/subsets of the library do not overlap, or overlap only minimally).

[0090] In another example embodiment, the portions of the content provider's library are logically partitioned across servers in the second tier. For example, the portions/subsets of a content provider's library can be partitioned alphabetically across servers in the second tier based on a naming convention associated with each distinct resource in the content provider's library (e.g., digital movies having titles beginning with **A-F** are stored on server A in a second/intermediate tier, digital movies having titles beginning with **G-R** are stored on server B in the second/intermediate tier, and digital movies having titles beginning with **S-Z** are stored on server C in the second/intermediate tier).

[0091] Assume, for example, that a content provider's library comprises multiple content-types (e.g., movies, video games, music, software patches, etc.). Per one example embodiment, it would be advantageous to store a proportionate amount of each content type on each participating intermediate tier server (e.g., 60% movies, 30% video games, 10% software downloads on each participating server in the tier). In such a scenario, if the demand for a particular content-type increases during a given time period (and/or demand for a different content-type declines), then such fluctuations in demand will generally affect each participating server proportionately.

[0092] Noted that resources may be partitioned across multiple servers by naming convention (e.g., alphabetically) as well as having proportionally distributed content per server (e.g., by content-type). With this in mind, it should be further noted that logical partitioning of resources/content among intermediate servers is not limited to just alphabetic naming convention segmentation and/or content-type proportionality. It is contemplated that the partitioning may be based on various metrics such as, but not limited to, numeric hash values (e.g., MD5) associated with content/resource URLs, the

size or file type of a resource, other identifiers associated with other various naming conventions (e.g., numerical, alphanumerical, proprietary, encrypted/mangled, etc.), the relative size and traffic behavior of various resources in a content provider's library or the content provider's library as a whole, and the like.

[0093] In step **720**, the step of directing the client to a second server in the second tier is performed in response to a determination of which second server actually stores the first portion. In one example, the server that stores the first portion (or, for that matter, any portion that comprises the requested resource) is identified using a hash function (similar to the processing and functionality previously described).

[0094] In step **725**, the second server that stores the first portion serves the resource to the client.

[0095] The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment or embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly and legally entitled.

Electronic Patent Application Fee Transmittal				
Application Number:		16284791		
Filing Date:		25-Feb-2019		
Title of Invention:		HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
First Named Inventor/Applicant Name:		Christopher Newton		
Filer:		Derek D. Donahoe/Janae Allabastro		
Attorney Docket Number:		0137-US-I1-C2		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension - 2 months with \$0 paid	1252	1	600	600
Miscellaneous:				
Total in USD (\$)				600

Electronic Acknowledgement Receipt	
EFS ID:	36528392
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	Derek D. Donahoe/Janae Allabastro
Filer Authorized By:	Derek D. Donahoe
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	09-JUL-2019
Filing Date:	25-FEB-2019
Time Stamp:	12:23:42
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 600
RAM confirmation Number	070919INTEFSW00012126501662
Deposit Account	501662
Authorized User	Janae Allabastro
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 1.20 (Post Issuance 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	Applicant Response to Pre-Exam Formalities Notice	0137-US-I1-C2_Response.pdf	18825	no	2
			679828438f9e6d1feb3d2c83d7cfd38b8f02dd4c		
Warnings:					
Information:					
2	Extension of Time	0137-US-I1-C2_2EOT.pdf	122751	no	2
			9d738c6909ea86cec03c61a79fd6c6b2c45fa883		
Warnings:					
Information:					
3	Specification	0137-US-I1-C2_SubSpec-Clean.pdf	162993	no	21
			8acecad46a110f7727c0f574e52dec794b741e36		
Warnings:					
Information:					
4	Specification	0137-US-I1-C2_SubSpec-Markedup.pdf	171773	no	21
			48ad718a3c644f4afde9d57286bb7f79f3854c24		
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	31064	no	2
			e122715ae780c2b03993364d50502ee9a45f22f7		
Warnings:					
Information:					
Total Files Size (in bytes):			507406		

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.

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.

Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	1	of	1	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No	Foreign Patent Document	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T ²

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		Summons to attend oral proceedings, dated May 8, 2019", Application No. 09727342.9, filed March 21, 2019; Dkt. No. 0137-EP-01 , 6 pgs.	

EXAMINER

DATE CONSIDERED

Substitute Disclosure Statement Form (PTO-1449)

* EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant. 1 Applicant's unique citation designation number (optional) 2 Applicant is to place a check mark here if English language Translation is attached

Electronic Acknowledgement Receipt	
EFS ID:	36089931
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	David Dewey Wier/Kathleen McInnish
Filer Authorized By:	David Dewey Wier
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	22-MAY-2019
Filing Date:	25-FEB-2019
Time Stamp:	17:33:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	137USI1C2_IDS.pdf	37442	no	5
			d8510d49061440e4edc48a075cb69f63cb62a3f4		

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	137US11C2_sb08.pdf	29330	no	1
			3f7b30b73c8beb10538f0559af473371ce4409c1		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Other Reference-Patent/App/Search documents	EP_097273429_Summons_8May19_137EP01.pdf	729945	no	6
			41a10edc551741a2fcb7810687fd66c86299149f		
Warnings:					
Information:					
Total Files Size (in bytes):			796717		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 16/284,791	Confirmation No.	: 7424
First Applicant	: NEWTON et al.	Art Unit	: 2447
Filed	: February 25, 2019	Examiner	: Not Yet Assigned
Title	: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Docket No.	: 0137-US-I1-C2		

Submitted Via EFS-Web

**SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT
PURSUANT TO 37 C.F.R. §§ 1.56, 1.97, AND 1.98**

Sir:

The Examiner is respectfully requested to consider the patents, patent applications, publications, or other information cataloged on the enclosed Form (e.g., PTO-1449, PTO-892, PTO/SB/08, etc.) during examination of the above-identified patent application. The order of presentation of the references should not be construed as an indication of importance. These references are submitted for the Examiner's consideration and are submitted pursuant to an Applicant's duty of disclosure under 37 C.F.R. § 1.56.

Copies of all of the cited documents:

- ☐ are enclosed unless otherwise indicated on the enclosed Form PTO/SB/08a.
- ☐ have been previously furnished to the Office in prior application No. ____, filed ____, which the present application relies upon for an earlier effective filing date under 35 U.S.C. § 120. Therefore, no copies of the cited documents are included herewith pursuant to 37 C.F.R. § 1.98(d); MPEP § 609(III)(A)(2).
- ☒ are enclosed unless they are U.S. patents or U.S. patent application publications pursuant to 37 C.F.R. § 1.98(a).

**I
BASIS**

This information disclosure statement is filed pursuant to

- ☒ 37 C.F.R. § 1.97(b).
This information disclosure statement is filed either (1) within three months of the filing date of a national application other than a continued prosecution application under 37 C.F.R. § 1.53(d); (2) within three months of the date of entry of the national stage as set forth in 37 C.F.R. § 1.491 in an international application; (3) before the mailing date of a first Office action on the merits; (4) concurrently with the filing of a request for continued examination under 37 C.F.R. § 1.114; or (5) before the mailing of a first Office action after the filing of a request for continued examination under 37 C.F.R. § 1.114, whichever event occurs last.

Accordingly, this information disclosure statement requires no fee and no certification.

- ☐ 37 C.F.R. § 1.97(c).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing date of any of (1) a final action under 37 C.F.R. § 1.113; (2) a notice of allowance under 37 C.F.R. § 1.311; or (3) an action that otherwise closes prosecution in the application.

Accordingly, this information disclosure statement requires either the fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c), or a statement under 37 C.F.R. § 1.97(e).

- ☐ 37 C.F.R. § 1.97(d).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(c) since a:

- ☐ final action under 37 C.F.R. § 1.113
☐ notice of allowance under 37 C.F.R. § 1.311

was mailed to the Applicant on _____.

Accordingly, this information disclosure statement requires the fee set forth in 37 C.F.R. § 1.17(p) to consider an information disclosure statement under 37 C.F.R. § 1.97(d), and a statement under 37 C.F.R. § 1.97(e).

If this statement crosses in the mail with an Office action, or is otherwise not in the indicated category of 37 C.F.R. § 1.97, it is respectfully requested that this statement be treated in the next appropriate category and made of record. To the extent required, please treat this paper as a conditional petition for acceptance of the information disclosure statement.

II FEES

Any required fee is being paid as indicated below:

- ☒ No fee is due.
- ☐ The \$240 fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c) or (d) is due.
- ☐ This fee is paid by credit card.
- ☐ Please charge the required fee to Deposit Account No. 505063.
- ☒ The Commissioner is hereby authorized to charge any additional required fees or credit any overpayments associated with this information disclosure statement to the account.

III CERTIFICATION

Pursuant to 37 C.F.R. § 1.97(e), I state as follows:

- ☒ No statement is necessary.
- ☐ Each item of information contained in this information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(1).
- ☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, no item of information contained in this information disclosure statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(2).

Pursuant to 37 C.F.R. § 1.704(d), I state as follows:

- ☐ Each item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart application, and this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this information disclosure statement.

IV FOREIGN LANGUAGE REFERENCES

Pursuant to 37 C.F.R. § 1.98(a)(3)(i), any information disclosure statement filed under 37 C.F.R. § 1.97 shall include a concise explanation of the relevance, as it is presently understood by the individual designated in § 1.56(c) most knowledgeable about the content of the information, of each patent, publication, or other information listed that is not in the English language. The concise explanation may be either separate from the specification or incorporated therein. In compliance with the rules, the Applicant states as follows:

- ☐ No concise explanation is required since all cited references are in English.
- ☐ A concise explanation of the relevance of one or more foreign language references is attached.
- ☐ According to the procedural policy adopted by the PTO with regard to disclosure requirements, the Applicant is satisfying the disclosure requirement pursuant to MPEP § 609.04(a)(III) by submitting herewith the following:
 - ☐ English language versions of any non-English language documents.
 - ☐ English language versions of one or more search reports or other actions by one or more foreign patent offices in one or more counterpart foreign applications, which indicate the degree of relevance found by the foreign office(s).
 - ☐ Pursuant to 37 C.F.R. § 1.98(a)(3)(ii), a copy of a translation is not submitted herewith because a written English-language translation of a non-English-language document, or portion thereof, is not within the possession, custody, or control of, or is readily available to any individual designated in § 1.56(c).

The Applicant has not analyzed these documents and, therefore, declines to comment on their relevance at this time.

- ☐ One or more English language abstracts for the non-English language references are also enclosed.

V REMARKS

It is respectfully requested that:

- (1) The Examiner sign the enclosed Form to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

- (2) The citations for the cited information be printed on any patent that issues from this application.

The submission of this information disclosure statement by the Applicant shall not be construed as a representation that a search has been performed or that no other material information under 37 C.F.R. § 1.56 exists. See 37 C.F.R. § 1.97(g).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, material to the patentability of one or more of the pending claims in this application pursuant to 37 C.F.R. § 1.56(b), unless specifically designated by the Applicant as such. See 37 C.F.R. § 1.97(h).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, or even qualifies as “prior art” under 35 U.S.C. § 102 with respect to this invention, unless specifically designated by the Applicant as such.

Notwithstanding any statements by the Applicant, the Examiner is urged to form his or her own conclusion regarding the relevance of the cited information.

VI CONCLUSION

The Examiner is encouraged to contact the undersigned attorney to discuss any questions concerning this information disclosure statement or any of the information cited or referred to herein.

Respectfully submitted,

Date: May 22, 2019

/DDW/
David D. Wier, Reg. No. 48,229
USPTO Customer No. 83579
Level 3 Communications, LLC
1025 Eldorado Blvd.
Broomfield, Colorado 80021
Tel: 720-888-2140
Fax: 720-888-5619



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
16/284,791	02/25/2019	2447	1720	0137-US-11-C2	20	3

CONFIRMATION NO. 7424

FILING RECEIPT



0000000108321891

83579
LEVEL 3 COMMUNICATIONS, LLC
Attn: Patent Docketing
1025 Eldorado Blvd.
Broomfield, CO 80021

Date Mailed: 03/14/2019

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)

Christopher Newton, Thousand Oaks, CA;
Laurence Lipstone, Calabasas, CA;
David Fullagar, Boulder, CO;

Applicant(s)

Level 3 Communications, LLC, Broomfield, CO

Power of Attorney: The patent practitioners associated with Customer Number 83579

Domestic Priority data as claimed by applicant

This application is a CON of 15/645,584 07/10/2017 PAT 10218806
which is a CON of 12/880,324 09/13/2010 PAT 9762692
which is a CIP of 12/408,681 03/21/2009 PAT 8930538
which claims benefit of 61/042,412 04/04/2008

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: 03/12/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/284,791**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No
Title

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

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 Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

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

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/284,791				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760			
TOTAL CLAIMS (37 CFR 1.16(j))	20	minus 20 = *			OR	x 100 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = *			OR	x 460 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
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		TOTAL	1720			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	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))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
TOTAL ADD'L FEE								OR	TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	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))							OR		
	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
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	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/284,791	02/25/2019	Christopher Newton	0137-US-11-C2

CONFIRMATION NO. 7424

FORMALITIES LETTER

83579
LEVEL 3 COMMUNICATIONS, LLC
Attn: Patent Docketing
1025 Eldorado Blvd.
Broomfield, CO 80021



Date Mailed: 03/14/2019

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.

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.

/afessehayel

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒

Practitioners associated with Customer Number:

83579

OR

☐

Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number

Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☐

The address associated with Customer Number:

OR

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

Assignee Name and Address: LEVEL 3 COMMUNICATIONS, LLC
1025 Eldorado Blvd.
Broomfield, CO 80021

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	/David D. Wier/	Date	2019-03-07
Name	David D. Wier	Telephone	720.888.3539
Title	Vice President		

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Level 3 Communications, LLC

Application No./Patent No.: 16284791

Filed/Issue Date: 2019-02-25

Titled: Handling Long-Tail Content in a Content Delivery Network

Level 3 Communications, LLC, a Limited Liability Company

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

☐ The extent (by percentage) of its ownership interest is ____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☒ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 048437, Frame 0302, or for which a copy thereof is attached.

B. ☐ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

2. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). 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 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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/David D. Wier/

2019-03-07

Signature

Date

David D. Wier

48,229

Printed or Typed Name

Title or Registration Number

[Page 2 of 2]

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.

Doc Code: ECOMM.AUTH/ECOMM.WTDW

Doc Description: Internet Communications Authorized/Internet Communications Authorization Withdrawn

PTO/SB/439 (11-15)

**AUTHORIZATION FOR INTERNET
COMMUNICATIONS IN A PATENT
APPLICATION OR REQUEST TO
WITHDRAW AUTHORIZATION FOR
INTERNET COMMUNICATIONS**

Application No.	16284791
Filing Date	2019-02-25
First Named Inventor	NEWTON
Art Unit	2447
Examiner Name	Not Yet Assigned
Practitioner Docket No.	0137-US-11-C2

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

I. To authorize permission for Internet Communications.

☒ Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03)

II. To withdraw authorization for Internet Communications.

☐ The authorization given on _____, to the USPTO to communicate with the undersigned and any practitioner in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via Internet communications such as video conferencing, instant messaging, or electronic mail is hereby withdrawn. I understand that the withdrawal is effective when approved rather than when received.

I am the

☐ applicant.

☒ attorney or agent of record. Registration number 48,229.

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

/DDW/
Signature

2019-03-07
Date

David D. Wier
Typed or printed name

720-888-3539
Telephone Number

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

Electronic Acknowledgement Receipt	
EFS ID:	35355794
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	David Dewey Wier/Kathleen McInnish
Filer Authorized By:	David Dewey Wier
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	07-MAR-2019
Filing Date:	
Time Stamp:	15:35:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA.pdf	80537	no	2
			155e3abf47136e0e00ead085551f1ba84900b68c		

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	137USI1C2_373c.pdf	118308	no	3
			4793ebd16012a36128c996123b6e7c6866999984		
Warnings:					
Information:					
3	Internet Communications Authorized	137USI1C2_EcommAuth.pdf	74751	no	2
			e3606b4619d9866f30c7b434d6bc9efd6d2145fe		
Warnings:					
Information:					
Total Files Size (in bytes):			273596		
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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	1	of	25	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		20010027491	Oct 4, 2001	Terretta, M	
		20010029525	Oct 11, 2001	Lahr, Nils B.	
		20010049732	Dec 6, 2001	Raciborski, N. F., et al.	
		20010051980	Dec 13, 2001	Raciborski, Nathan F., et al.	
		20010056500	Dec 27, 2001	Farber, David A., et al.	
		20020010798	Jan 24, 2002	Ben-Shaul, Israel et al.	
		20020016831	Feb 7, 2002	Peled, Ariel et al.	
		20020016835	Feb 7, 2002	Gamerman, G	
		20020018449	Feb 14, 2002	Ricciulli, Livio	
		20020023164	Feb 14, 2002	Lahr, Nils B.	
		20020023165	Feb 21, 2002	Lahr, Nils B.	
		20020040404	Apr 4, 2002	Lahr, Nils B.	
		20020042817	Apr 11, 2002	Lahr, Nils B.	
		20020046273	Apr 18, 2002	Lahr, Nils B., et al.	
		20020046405	Apr 18, 2002	Lahr, Nils B.	
		20020049857	Apr 25, 2002	Farber, David A., et al.	
		20020059592	May 16, 2002	Kiraly, Jozsef	
		20020066038	May 30, 2002	Mattsson, Ulf	
		20020073199	Jun 13, 2002	Levine, Matthew et al.	
		20020078233	Jun 20, 2002	Biliris, Alexandros et al.	
		20020082999	Jun 27, 2002	Lee, Cheol-Woong et al.	
		20020083124	Jun 27, 2002	Knox, Christopher R., et al.	
		20020087797	Jul 4, 2002	Adrangi, F	
		20020089470	Jul 11, 2002	Raman, Mithila et al.	
		20020092026	Jul 11, 2002	Janniello, James P., et al.	
		20020099850	Jul 25, 2002	Farber, David A., et al.	
		20020116444	Aug 22, 2002	Chaudhri, Imran et al.	
		20020124080	Sep 5, 2002	Leighton, F. T.	
		20020129134	Sep 12, 2002	Leighton, F. T., et al.	
		20020131645	Sep 19, 2002	Hamilton, Chris H.	
		20020133537	Sep 19, 2002	Lau, F	
		20020143798	Oct 3, 2002	Lisiecki, Philip A., et al.	

EXAMINER

DATE CONSIDERED

Substitute Disclosure Statement Form (PTO-1449)

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	2	of	25	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		20020143888	Oct 3, 2002	Lisiecki, Philip A., et al.	
		20020147774	Oct 10, 2002	Lisiecki, Philip A., et al.	
		20020152318	Oct 17, 2002	Menon, Satish N., et al.	
		20020163882	Nov 7, 2002	Bornstein, Claudson F., et al.	
		20020174168	Nov 21, 2002	Beukema, Bruce L., et al.	
		20020184357	Dec 5, 2002	Traversat, Bernard A., et al.	
		20020198953	Dec 26, 2002	O'Rourke, B. P., et al.	
		20020199016	Dec 26, 2002	Freedman, Avraham T.	
		20030009444	Jan 9, 2003	Eidler, Christopher W., et al.	
		20030018966	Jan 23, 2003	Cook, David H., et al.	
		20030028623	Feb 6, 2003	Hennessey, Wade L., et al.	
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		20030031176	Feb 13, 2003	Sim, S. Y.	
		20030055972	Mar 20, 2003	Fuller, William T., et al.	
		20030061263	Mar 27, 2003	Riddle, Guy	
		20030061280	Mar 27, 2003	Bulson, Jason A., et al.	
		20030065703	Apr 3, 2003	Aborn, Justin	
		20030065762	Apr 3, 2003	Stolorz, Paul E., et al.	
		20030078888	Apr 24, 2003	Lee, Cheol-Woong et al.	
		20030078889	Apr 24, 2003	Lee, Cheol-Woong et al.	
		20030079027	Apr 24, 2003	Slocombe, Michael et al.	
		20030095660	May 22, 2003	Lee, Chang Y., et al.	
		20030105604	Jun 5, 2003	Ash, Leslie E., et al.	
		20030112792	Jun 19, 2003	Cranor, C. D., et al.	
		20030140111	Jul 24, 2003	Pace, Charles P., et al.	
		20030149581	Aug 7, 2003	Chaudhri, Imran et al.	
		20030154239	Aug 14, 2003	Davis, Andrew T., et al.	
		20030158923	Aug 21, 2003	Burkhart, Reed	
		20030158928	Aug 21, 2003	Knox, Christopher R., et al.	
		20040010588	Jan 15, 2004	Slater, Alastair M., et al.	
		20040022194	Feb 5, 2004	Ricciulli, Livio	

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Substitute Disclosure Statement Form (PTO-1449)

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	3	of	25	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		20040064832	Apr 1, 2004	Tsukidate, Ryota et al.	
		20040139097	Jul 15, 2004	Farber, David A., et al.	
		20040162871	Aug 19, 2004	Pabla, Kuldipsingh A., et al.	
		20040177148	Sep 9, 2004	Tsimelzon Jr., Mark	
		20040205162	Oct 14, 2004	Parikh, Jay G.	
		20040221019	Nov 4, 2004	Swildens, Eric S., et al.	
		20050010653	Jan 13, 2005	McCanne, Steve	
		20050021863	Jan 27, 2005	Jungck, P. J.	
		20050033858	Feb 10, 2005	Swildens, Eric S., et al.	
		20050038851	Feb 17, 2005	Kriegsman, Mark E.	
		20050060493	Mar 17, 2005	Krissell, D et al.	
		20050100027	May 12, 2005	Leinwand, Allan S., et al.	
		20050114296	May 26, 2005	Farber, David A., et al.	
		20050240966	Oct 27, 2005	Hindle, J et al.	
		20050262104	Nov 24, 2005	Robertson, Niel et al.	
		20060015574	Jan 19, 2006	Seed, Steven L., et al.	
		20060112176	May 25, 2006	Liu, Zaide E., et al.	
		20060143293	Jun 29, 2006	Freedman, Avraham T.	
		20070055764	Mar 8, 2007	Dilley, J. A., et al.	
		20080065724	Mar 13, 2008	Seed, Steven L., et al.	
		20080071859	Mar 20, 2008	Seed, Steven L., et al.	
		20080147866	Jun 19, 2008	Stolorz, Paul E., et al.	
		20080215718	Sep 4, 2008	Stolorz, Paul E., et al.	
		20090254661	Oct 8, 2009	Fullagar, David et al.	
		20100169772	Jul 1, 2010	Stallings, H et al.	
		20100257258	Oct 7, 2010	Liu, Zaide et al.	
		20100312861	Dec 9, 2010	Kolhi, J et al.	
		20100332595	Dec 30, 2010	Fullagar, David et al.	
		20110099290	Apr 28, 2011	Swildens, Eric S., et al.	
		20110145386	Jun 16, 2011	Stolorz, Paul E., et al.	
		20170339241	Nov 23, 2017	Newton, Christopher	
		4495570	Jan 22, 1985	Kitajima, Hiroyuki et al.	

EXAMINER

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Substitute Disclosure Statement Form (PTO-1449)

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Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	4	of	25	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		4591983	May 27, 1986	Bennett, James S., et al.	
		4594704	Jun 10, 1986	Ollivier, Y.	
		4726017	Feb 16, 1988	Krum, H. et al.	
		4803641	Feb 7, 1989	Hardy, S. et al.	
		4839798	Jun 13, 1989	Eguchi, H. et al.	
		4847784	Jul 11, 1989	Clancey, W. J.	
		4920432	Apr 24, 1990	Eggers, D. et al.	
		4922417	May 1, 1990	Churm, B. et al.	
		4943932	Jul 24, 1990	Lark, J. S., et al.	
		4949187	Aug 14, 1990	Cohen, J. M.	
		4949248	Aug 14, 1990	Caro, M. A.	
		5029232	Jul 2, 1991	Nall, D. C.	
		5130792	Jul 14, 1992	Tindell, E. G., et al.	
		5132992	Jul 21, 1992	Yurt, P. et al.	
		5136716	Aug 4, 1992	Harvey, G. et al.	
		5172413	Dec 15, 1992	Bradley, G. C., et al.	
		5191573	Mar 2, 1993	Hair, A. R.	
		5253275	Oct 12, 1993	Yurt, P. et al.	
		5253341	Oct 12, 1993	Rozmanith, A. et al.	
		5287499	Feb 15, 1994	Nemes, R. M.	
		5287537	Feb 15, 1994	Newmark, R. J., et al.	
		5291554	Mar 1, 1994	Morales, F.	
		5341477	Aug 23, 1994	Pitkin, R. P., et al.	
		5371532	Dec 6, 1994	Gelman, A. et al.	
		5410343	Apr 25, 1995	Coddington, C. D., et al.	
		5414455	May 9, 1995	Hooper, D. F., et al.	
		5442389	Aug 15, 1995	Blahut, D. E., et al.	
		5442390	Aug 15, 1995	Hooper, D. F., et al.	
		5442749	Aug 15, 1995	Northcutt, J. D., et al.	
		5471622	Nov 28, 1995	Eadline, D. J.	
		5475615	Dec 12, 1995	Lin, K. D.	
		5508732	Apr 16, 1996	Bottomley, J. F., et al.	

EXAMINER

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Substitute Disclosure Statement Form (PTO-1449)

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Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	5	of	25	Attorney Docket No: 0137-US-I1-C2	

US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		5515511	May 7, 1996	Nguyen, T. et al.	
		5519435	May 21, 1996	Anderson, M. H.	
		5528281	Jun 18, 1996	Grady, J. et al.	
		5539621	Jul 23, 1996	Kikinis, D.	
		5542087	Jul 30, 1996	Neimat, M. et al.	
		5544313	Aug 6, 1996	Shachnai, H. et al.	
		5544327	Aug 6, 1996	Dan, A. et al.	
		5550577	Aug 27, 1996	Verbiest, W. J., et al.	
		5550863	Aug 27, 1996	Yurt, P. et al.	
		5550982	Aug 27, 1996	Long, J. E., et al.	
		5557317	Sep 17, 1996	Nishio, M. et al.	
		5568181	Oct 22, 1996	Greenwood, David G., et al.	
		5572643	Nov 5, 1996	Judson, D. H.	
		5590288	Dec 31, 1996	Castor, P. F., et al.	
		5592611	Jan 7, 1997	Midgely, C. W., et al.	
		5594910	Jan 14, 1997	Filepp, R. et al.	
		5603026	Feb 11, 1997	Demers, A. J., et al.	
		5614940	Mar 25, 1997	Cobbley, David A., et al.	
		5619648	Apr 8, 1997	Canale, L. M., et al.	
		5623656	Apr 22, 1997	Lyons, K. B.	
		5625781	Apr 29, 1997	Cline, T. L., et al.	
		5627829	May 6, 1997	Gleeson, B. J., et al.	
		5630067	May 13, 1997	Kindell, C. N., et al.	
		5633999	May 27, 1997	Clowes, R. F., et al.	
		5634006	May 27, 1997	Baugher, M. J., et al.	
		5638443	Jun 10, 1997	Stefik, M. J., et al.	
		5644714	Jul 1, 1997	Kikinis, D.	
		5646676	Jul 8, 1997	Dewkett, T. J., et al.	
		5649186	Jul 15, 1997	Ferguson, G. J.	
		5659729	Aug 19, 1997	Nielsen, J.	
		5666362	Sep 9, 1997	Chen, C. T., et al.	
		5671279	Sep 23, 1997	Elgamal, T.	

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				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
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Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		5675734	Oct 7, 1997	Hair, A. R.	
		5682512	Oct 28, 1997	Tetrack, R. S.	
		5699513	Dec 16, 1997	Feigen, R. et al.	
		5712979	Jan 27, 1998	Graber, T. E., et al.	
		5715453	Feb 3, 1998	Stewart, G.	
		5721914	Feb 24, 1998	DeVries, L. R.	
		5734719	Mar 31, 1998	Tsevdos, James T., et al.	
		5734831	Mar 31, 1998	Sanders, J. B.	
		5740423	Apr 14, 1998	Logan, J. R., et al.	
		5742762	Apr 21, 1998	Scholl, Thomas H., et al.	
		5751961	May 12, 1998	Smyk, D.	
		5761507	Jun 2, 1998	Govett, I. R.	
		5761663	Jun 2, 1998	Lagarde, K. C., et al.	
		5764906	Jun 9, 1998	Edelstein, M. et al.	
		5774660	Jun 30, 1998	Brendel, J. et al.	
		5774668	Jun 30, 1998	Choquier, P. et al.	
		5777988	Jul 7, 1998	Cisneros, Arturo	
		5777989	Jul 7, 1998	McGarvey, J.	
		5778187	Jul 7, 1998	Monteiro, Antonio M., et al.	
		5781909	Jul 14, 1998	Logan, James et al.	
		5784058	Jul 21, 1998	LaStrange, T. E., et al.	
		5796952	Aug 18, 1998	Davis, O. et al.	
		5799141	Aug 25, 1998	Galipeau, K. J., et al.	
		5802106	Sep 1, 1998	Packer, R. L.	
		5802291	Sep 1, 1998	Balick, M. et al.	
		5812769	Sep 22, 1998	Graber, T. E., et al.	
		5815662	Sep 29, 1998	Ong, L	
		5815664	Sep 29, 1998	Asano, K.	
		5819092	Oct 6, 1998	Ferguson, Charles H., et al.	
		5828847	Oct 27, 1998	Gehr, C. R., et al.	
		5832069	Nov 3, 1998	Waters, David B., et al.	
		5832506	Nov 3, 1998	Kuzma, A. J.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
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				Art Unit	2447
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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		5832514	Nov 3, 1998	Norin, S. et al.	
		5835718	Nov 10, 1998	Blewett, C. D.	
		5845090	Dec 1, 1998	Collins, Theodore J., et al.	
		5845303	Dec 1, 1998	Templeman, M. L.	
		5856974	Jan 5, 1999	Gervais, J. L., et al.	
		5862339	Jan 19, 1999	Bonnaure, P. P., et al.	
		5867706	Feb 2, 1999	Martin, Sean J., et al.	
		5867799	Feb 2, 1999	Lang, A. K., et al.	
		5870546	Feb 9, 1999	Kirsch, S. T.	
		5870559	Feb 9, 1999	Leshem, E. et al.	
		5878212	Mar 2, 1999	Civanlar, S. et al.	
		5884038	Mar 16, 1999	Kapoor, R.	
		5890171	Mar 30, 1999	Blumer, T. P., et al.	
		5893116	Apr 6, 1999	Simmonds, C. D., et al.	
		5894554	Apr 13, 1999	Lowery, K. et al.	
		5896533	Apr 20, 1999	Ramos, D. et al.	
		5898456	Apr 27, 1999	Wahl, S.	
		5903723	May 11, 1999	Beck, R. D., et al.	
		5907704	May 25, 1999	Gudmundson, N. K., et al.	
		5913028	Jun 15, 1999	Wang, F. et al.	
		5913033	Jun 15, 1999	Grout, G. B.	
		5918010	Jun 29, 1999	Appleman, K. H., et al.	
		5919247	Jul 6, 1999	Van Hoff, Arthur et al.	
		5920701	Jul 6, 1999	Miller, C. K., et al.	
		5931904	Aug 3, 1999	Banga, Gaurav	
		5933832	Aug 3, 1999	Suzuoka, T. et al.	
		5933835	Aug 3, 1999	Adams, Robert et al.	
		5935207	Aug 10, 1999	Logue, J. D., et al.	
		5940831	Aug 17, 1999	Takano, H.	
		5944780	Aug 31, 1999	Chase, J. S.	
		5951694	Sep 14, 1999	Choquier, Philippe et al.	
		5956489	Sep 21, 1999	San Andres, R. J., et al.	

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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		5956716	Sep 21, 1999	Kenner, B. et al.	
		5958008	Sep 28, 1999	Pogrebisky, M. et al.	
		5961596	Oct 5, 1999	Takubo, S. et al.	
		5966440	Oct 12, 1999	Hair, A. R.	
		5968121	Oct 19, 1999	Logan, K. W., et al.	
		5973696	Oct 26, 1999	Agranat, I. D., et al.	
		5978791	Nov 2, 1999	Farber, D. A., et al.	
		5983214	Nov 9, 1999	Lang, A. K., et al.	
		5983227	Nov 9, 1999	Nazem, F. et al.	
		5987606	Nov 16, 1999	Cirasole, P. et al.	
		5991809	Nov 23, 1999	Kriegsman, M. E., et al.	
		5996025	Nov 30, 1999	Day	
		6002720	Dec 14, 1999	Yurt, P. et al.	
		6003030	Dec 14, 1999	Kenner, B. et al.	
		6012090	Jan 4, 2000	Chung, Pi-Yu. et al.	
		6014686	Jan 11, 2000	Elnozahy, E. N., et al.	
		6014698	Jan 11, 2000	Griffiths, M. J.	
		6016509	Jan 18, 2000	Dedrick, Rick	
		6016512	Jan 18, 2000	Huitema, Christian	
		6018516	Jan 25, 2000	Packer, R. L.	
		6021426	Feb 1, 2000	Douglis, F.	
		6023470	Feb 8, 2000	Lee, Warren S., et al.	
		6029175	Feb 22, 2000	Chow, Yen-whei et al.	
		6029176	Feb 22, 2000	Cannon, M. E.	
		6035332	Mar 7, 2000	Ingrassia, M. I., et al.	
		6038216	Mar 14, 2000	Packer, R. L.	
		6038310	Mar 14, 2000	Hollywood, S. et al.	
		6041324	Mar 21, 2000	Earl, J. R., et al.	
		6044405	Mar 28, 2000	Driscoll, E. J., et al.	
		6046980	Apr 4, 2000	Packer, R. L.	
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				Art Unit	2447
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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
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		6065051	May 16, 2000	Steele, D. W., et al.	
		6065062	May 16, 2000	Periasamy, R. et al.	
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		6078943	Jun 20, 2000	Yu, P. S.	
		6081829	Jun 27, 2000	Sidana, A. S.	
		6081835	Jun 27, 2000	Antcliff	
		6081840	Jun 27, 2000	Zhao, Yan	
		6085193	Jul 4, 2000	Malkin, P. K., et al.	
		6092112	Jul 18, 2000	Fukushige, Y.	
		6092204	Jul 18, 2000	Baker, B. S., et al.	
		6094680	Jul 25, 2009	Hokanson, T. E.	
		6094706	Jul 25, 2000	Factor, Michael E., et al.	
		6098078	Aug 1, 2000	Gehani, N. H.	
		6098096	Aug 1, 2000	Tsirigotis, Panagiotis et al.	
		6105028	Aug 15, 2000	Sullivan, D. J., et al.	
		6108673	Aug 22, 2000	Brandt, M. L., et al.	
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		6112231	Aug 29, 2000	DeSimone, A. et al.	
		6112239	Aug 29, 2000	Kenner, B. et al.	
		6112240	Aug 29, 2000	Pogue, M. A., et al.	
		6115357	Sep 5, 2000	Packer, R. L., et al.	
		6115752	Sep 5, 2000	Chauhan, A.	
		6119143	Sep 12, 2000	Dias, D. M., et al.	
		6125388	Sep 26, 2000	Reisman, R. R.	
		6125394	Sep 26, 2000	Rabinovich, Michael	
		6128601	Oct 3, 2000	Van Horne, P. et al.	
		6128623	Oct 3, 2000	Mattis, Peter et al.	
		6128660	Oct 3, 2000	Grimm, S. M., et al.	
		6130890	Oct 10, 2000	Leinwand, A. S., et al.	
		6131095	Oct 10, 2000	Low, Colin et al.	
		6134583	Oct 17, 2000	Herriot, R. G.	

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				First Named Inventor	Christopher Newton
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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		6144375	Nov 7, 2000	Jain, R. C., et al.	
		6144702	Nov 7, 2000	Yurt, P. et al.	
		6151624	Nov 21, 2000	Teare, K. et al.	
		6154744	Nov 28, 2000	Kenner, B. et al.	
		6154753	Nov 28, 2000	McFarland, J. A.	
		6157648	Dec 5, 2000	Volt, Eric A., et al.	
		6161137	Dec 12, 2000	Johnson, Frank E., et al.	
		6163779	Dec 19, 2000	Mantha, M. L., et al.	
		6173311	Jan 9, 2001	Hassett, G. P., et al.	
		6173322	Jan 9, 2001	Hu, Wei-Ming	
		6178160	Jan 23, 2001	Bolton, D. W., et al.	
		6181867	Jan 30, 2001	Kenner, B. et al.	
		6185598	Feb 6, 2001	Farber, David A., et al.	
		6185619	Feb 6, 2001	Joffe, R. L., et al.	
		6189030	Feb 13, 2001	Kirsch, S. T., et al.	
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		6195680	Feb 27, 2001	Goldszmidt, German S., et al.	
		6205120	Mar 20, 2001	Packer, R. L., et al.	
		6212565	Apr 3, 2001	Gupta, Amit	
		6226618	May 1, 2001	Downs	
		6226642	May 1, 2001	Beranek, M. J., et al.	
		6230196	May 8, 2001	Guenthner, T. J., et al.	
		6233623	May 15, 2001	Jeffords, Jason et al.	
		6240462	May 29, 2001	Agraharam, Sanjay et al.	
		6249810	Jun 19, 2001	Kiraly, J.	
		6256675	Jul 3, 2001	Rabinovich, M.	
		6263313	Jul 17, 2001	Milsted	
		6266335	Jul 24, 2001	Bhaskaran, Sajit	
		6266699	Jul 24, 2001	Sevcik, M.	
		6269394	Jul 31, 2001	Kenner, B. et al.	
		6272566	Aug 7, 2001	Craft	
		6275470	Aug 14, 2001	Ricciulli, L.	

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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
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		6286045	Sep 4, 2001	Griffith, M. J., et al.	
		6298041	Oct 2, 2001	Packer, R. L.	
		6314565	Nov 6, 2001	Kenner, B. et al.	
		6317787	Nov 13, 2001	Boyd, William G., et al.	
		6324580	Nov 27, 2001	Jindal, Anita et al.	
		6324582	Nov 27, 2001	Sridhar, Manickam R., et al.	
		6330602	Dec 11, 2001	Law, E. K., et al.	
		6332157	Dec 18, 2001	Mighdoll, Lee S., et al.	
		6338044	Jan 8, 2002	Cook, D. et al.	
		6343298	Jan 29, 2002	Savchenko, Alexander V., et al.	
		6345294	Feb 5, 2002	O'Toole, James et al.	
		6347085	Feb 12, 2002	Kelly, K. C., et al.	
		6351775	Feb 26, 2002	Yu, P. S.	
		6351776	Feb 26, 2002	O'Brien, Brett et al.	
		6360256	Mar 19, 2002	Lim, S. B.	
		6370571	Apr 9, 2002	Medin, M. S.	
		6370580	Apr 9, 2002	Kriegsman, M. E.	
		6389462	May 14, 2002	Cohen, Ariel et al.	
		6398245	Jun 4, 2002	Gruse	
		6405252	Jun 11, 2002	Gupta, A. K., et al.	
		6405257	Jun 11, 2002	Gersht, A. et al.	
		6412000	Jun 25, 2002	Riddle, Guy et al.	
		6415280	Jul 2, 2002	Farber, D. A., et al.	
		6415368	Jul 2, 2002	Glance, Natalie S., et al.	
		6418421	Jul 9, 2002	Hurtado	
		6421714	Jul 16, 2002	Rai, Girish et al.	
		6421726	Jul 16, 2002	Kenner, B. et al.	
		6427170	Jul 30, 2002	Sitaraman, Aravind et al.	
		6430618	Aug 6, 2002	Karger, D. et al.	
		6442588	Aug 27, 2002	Clark, Neal H., et al.	
		6453319	Sep 17, 2002	Mattis, Peter et al.	

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US PATENT DOCUMENTS					
Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		6456630	Sep 24, 2002	Packer, R. L., et al.	
		6460082	Oct 1, 2002	Lumelsky	
		6460085	Oct 1, 2002	Toporek, J. D., et al.	
		6463454	Oct 8, 2002	Lumelsky, Leon et al.	
		6463508	Oct 8, 2002	Wolf	
		6466949	Oct 15, 2002	Yang, Mike et al.	
		6470389	Oct 22, 2002	Chung, Pi-Yu et al.	
		6473405	Oct 29, 2002	Ricciulli, L.	
		6480893	Nov 12, 2002	Kriegsman, M. E.	
		6484143	Nov 19, 2002	Swildens, E. S., et al.	
		6484204	Nov 19, 2002	Rabinovich, M.	
		6487555	Nov 26, 2002	Bharat, Krishna A., et al.	
		6490580	Dec 3, 2002	Dey, J. K., et al.	
		6493707	Dec 10, 2002	Dey, J. K., et al.	
		6496856	Dec 17, 2002	Kenner, B. et al.	
		6502125	Dec 31, 2002	Kenner, B. et al.	
		6502205	Dec 31, 2002	Yanai, Moshe et al.	
		6502215	Dec 31, 2002	Raad, G. B., et al.	
		6505248	Jan 7, 2003	Casper, B. J., et al.	
		6529477	Mar 4, 2003	Toporek, J. D., et al.	
		6553413	Apr 22, 2003	Leighton, F T., et al.	
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		6557054	Apr 29, 2003	Reisman, R. R.	
		6564251	May 13, 2003	Katariya, S. et al.	
		6577595	Jun 10, 2003	Counterman, R. C.	
		6581090	Jun 17, 2003	Lindbo, S. et al.	
		6584083	Jun 24, 2003	Toporek, J. D., et al.	
		6587837	Jul 1, 2003	Spagna	
		6591288	Jul 8, 2003	Edwards, Keith R., et al.	
		6591299	Jul 8, 2003	Riddle, G. et al.	
		6594260	Jul 15, 2003	Aviani Jr, J. A., et al.	
		6598121	Jul 22, 2003	Challenger, J. R., et al.	

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Examiner Initial *	Cite No	Document Number	Publication Date	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		6611862	Aug 26, 2003	Reisman, R. R.	
		6625643	Sep 23, 2003	Colby, K. W., et al.	
		6651141	Nov 18, 2003	Adrangi, Farid	
		6654344	Nov 25, 2003	Toporek, J. D., et al.	
		6654807	Nov 25, 2003	Farber, David A., et al.	
		6658464	Dec 2, 2003	Reisman, R. R.	
		6665706	Dec 16, 2003	Kenner, B. et al.	
		6678659	Jan 13, 2004	Van Kommer, Robert	
		6691148	Feb 10, 2004	Zinky, J. A., et al.	
		6694358	Feb 17, 2004	Swildens, E. S., et al.	
		6699418	Mar 2, 2004	Okada, K. et al.	
		6708137	Mar 16, 2004	Carley, S.	
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		6732237	May 4, 2004	Jacobs, L. et al.	
		6741563	May 25, 2004	Packer, R. L.	
		6741990	May 25, 2004	Nair, Sandeep R., et al.	
		6751673	Jun 15, 2004	Shaw, D. M.	
		6754699	Jun 22, 2004	Swildens, E. S., et al.	
		6754706	Jun 22, 2004	Swildens, E. S., et al.	
		6763377	Jul 13, 2004	Belknap	
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		6778502	Aug 17, 2004	Ricciulli, L.	
		6785704	Aug 31, 2004	McCanne, Steve	
		6799221	Sep 28, 2004	Kenner, B. et al.	
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		6842604	Jan 11, 2005	Cook, D. et al.	
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		6859840	Feb 22, 2005	Singal, S. S., et al.	
		6870851	Mar 22, 2005	Leinwand, A. S., et al.	
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				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	14	of	25	Attorney Docket No: 0137-US-I1-C2	

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EXAMINER

DATE CONSIDERED

Substitute Disclosure Statement Form (PTO-1449)

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Substitute for form 1449A/PTO					
INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(Use as many sheets as necessary)</i>				<i>Complete if Known</i>	
				Application Number	16/284,791
				Filing Date	Feb 25, 2019
				First Named Inventor	Christopher Newton
				Art Unit	2447
				Examiner Name	Not Yet Assigned
Sheet	22	of	25	Attorney Docket No: 0137-US-I1-C2	

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.	T ²
		KARGER, D. et al., "Consistent Hashing and Random Trees: Distributed Caching Protocols for Relieving Hot Spots on the World Wide Web", In Proc. 29th Annual ACM Symp. on Theory of Computing 1997-05-01, 654-663	
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				Application Number	16/284,791
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				Art Unit	2447
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Sheet	23	of	25	Attorney Docket No: 0137-US-I1-C2	

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Examiner Initials*	Cite No ¹	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, page(s), volume-issue number(s), publisher, city and/or country where published.		T ²
		MOURAD, et al., "Scalable Web Server Architectures", iscc, 2nd IEEE Symposium on Computers and Communications (ISCC '97) 1997-07-01, pp. 12-16		
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		PARRIS, C. et al., "A Dynamic Connection Management Scheme for Guaranteed Performance Services in Packet-Switching Integrated Services Networks", UC Berkeley Computer Science Division Tech. Report TR-93-005 1993-01-01, 37 pgs.		
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		RABIN, M. O. Efficient dispersal of information for security, load balancing, and fault tolerance", J.ACM 36, 2, pp. 335-348		

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				Art Unit	2447
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(Use as many sheets as necessary)					
Sheet	24	of	25	Attorney Docket No: 0137-US-I1-C2	

OTHER DOCUMENTS -- NON PATENT LITERATURE DOCUMENTS			
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		RABINOVICH, M. et al., "Dynamic Replication on the Internet Work Project No. 3116-17-7006", AT&T Labs Research	
		RABINOVICH, M. et al., "RaDaR: A Scalable Architecture for a Global Web Hosting Service", WWW8 1999-05-01,	
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		WESSELS, D. Configuring Hierarchical Squid Caches", , 62 pgs.	

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		WESSELS, DUANE Intelligent Caching for World-Wide Web Objects", Masters Thesis, University of Colorado (also presented at INET '95 in June '95) 1995-01-01, 1-85	
		WESSELS, D. et al., "Internet Cache Protocol (ICP), Version 2", Internet Engineering Task Force (IETF) Request for Comments (RFC) 2186, pp. 1-9	
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Electronic Acknowledgement Receipt	
EFS ID:	35345400
Application Number:	16284791
International Application Number:	
Confirmation Number:	7424
Title of Invention:	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
First Named Inventor/Applicant Name:	Christopher Newton
Customer Number:	83579
Filer:	David Dewey Wier/Kathleen McInnish
Filer Authorized By:	David Dewey Wier
Attorney Docket Number:	0137-US-I1-C2
Receipt Date:	06-MAR-2019
Filing Date:	
Time Stamp:	17:32:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	137USI1C2_IDS.pdf	37584	no	5
			1a6e82971313301aeecc6c5fdb2cfa1a7b501b1		

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	137US11C2_sb08.pdf	269616	no	25
			89eea0aff0151ca2a9e8c69abcbdd111e851d5d7		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
Total Files Size (in bytes):			307200		
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.					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	: 16/284,791	Confirmation No.	: 7424
First Applicant	: NEWTON et al.	Art Unit	: 2447
Filed	: February 25, 2019	Examiner	: Not Yet Assigned
Title	: HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Docket No.	: 0137-US-I1-C2		

Submitted Via EFS-Web

**INFORMATION DISCLOSURE STATEMENT
PURSUANT TO 37 C.F.R. §§ 1.56, 1.97, AND 1.98**

Sir:

The Examiner is respectfully requested to consider the patents, patent applications, publications, or other information cataloged on the enclosed Form (e.g., PTO-1449, PTO-892, PTO/SB/08, etc.) during examination of the above-identified patent application. The order of presentation of the references should not be construed as an indication of importance. These references are submitted for the Examiner's consideration and are submitted pursuant to an Applicant's duty of disclosure under 37 C.F.R. § 1.56.

Copies of all of the cited documents:

☐ are enclosed unless otherwise indicated on the enclosed Form PTO/SB/08a.

☒ have been previously furnished to the Office in prior application No. 15/645,584, filed July 10, 2017, which the present application relies upon for an earlier effective filing date under 35 U.S.C. § 120. Therefore, no copies of the cited documents are included herewith pursuant to 37 C.F.R. § 1.98(d); MPEP § 609(III)(A)(2).

☐ are enclosed unless they are U.S. patents or U.S. patent application publications pursuant to 37 C.F.R. § 1.98(a).

**I
BASIS**

This information disclosure statement is filed pursuant to

- ☒ 37 C.F.R. § 1.97(b).
This information disclosure statement is filed either (1) within three months of the filing date of a national application other than a continued prosecution application under 37 C.F.R. § 1.53(d); (2) within three months of the date of entry of the national stage as set forth in 37 C.F.R. § 1.491 in an international application; (3) before the mailing date of a first Office action on the merits; (4) concurrently with the filing of a request for continued examination under 37 C.F.R. § 1.114; or (5) before the mailing of a first Office action after the filing of a request for continued examination under 37 C.F.R. § 1.114, whichever event occurs last.

Accordingly, this information disclosure statement requires no fee and no certification.

- ☐ 37 C.F.R. § 1.97(c).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(b), but before the mailing date of any of (1) a final action under 37 C.F.R. § 1.113; (2) a notice of allowance under 37 C.F.R. § 1.311; or (3) an action that otherwise closes prosecution in the application.

Accordingly, this information disclosure statement requires either the fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c), or a statement under 37 C.F.R. § 1.97(e).

- ☐ 37 C.F.R. § 1.97(d).
This information disclosure statement is filed after the period specified in 37 C.F.R. § 1.97(c) since a:

- ☐ final action under 37 C.F.R. § 1.113
☐ notice of allowance under 37 C.F.R. § 1.311

was mailed to the Applicant on _____.

Accordingly, this information disclosure statement requires the fee set forth in 37 C.F.R. § 1.17(p) to consider an information disclosure statement under 37 C.F.R. § 1.97(d), and a statement under 37 C.F.R. § 1.97(e).

If this statement crosses in the mail with an Office action, or is otherwise not in the indicated category of 37 C.F.R. § 1.97, it is respectfully requested that this statement be treated in the next appropriate category and made of record. To the extent required, please treat this paper as a conditional petition for acceptance of the information disclosure statement.

II FEES

Any required fee is being paid as indicated below:

- ☒ No fee is due.
- ☐ The \$240 fee specified in 37 C.F.R. § 1.17(p) for submission of an information disclosure statement under 37 C.F.R. § 1.97(c) or (d) is due.
- ☐ This fee is paid by credit card.
- ☐ Please charge the required fee to Deposit Account No. 505063.
- ☒ The Commissioner is hereby authorized to charge any additional required fees or credit any overpayments associated with this information disclosure statement to the account.

III CERTIFICATION

Pursuant to 37 C.F.R. § 1.97(e), I state as follows:

- ☒ No statement is necessary.
- ☐ Each item of information contained in this information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(1).
- ☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to my knowledge after making reasonable inquiry, no item of information contained in this information disclosure statement was known to any individual designated in 37 C.F.R. § 1.56(c) more than three months prior to the filing of this information disclosure statement. 37 C.F.R. § 1.97(e)(2).

Pursuant to 37 C.F.R. § 1.704(d), I state as follows:

- ☐ Each item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart application, and this communication was not received by any individual designated in 37 C.F.R. § 1.56(c) more than thirty days prior to the filing of this information disclosure statement.

IV FOREIGN LANGUAGE REFERENCES

Pursuant to 37 C.F.R. § 1.98(a)(3)(i), any information disclosure statement filed under 37 C.F.R. § 1.97 shall include a concise explanation of the relevance, as it is presently understood by the individual designated in § 1.56(c) most knowledgeable about the content of the information, of each patent, publication, or other information listed that is not in the English language. The concise explanation may be either separate from the specification or incorporated therein. In compliance with the rules, the Applicant states as follows:

- ☐ No concise explanation is required since all cited references are in English.
- ☐ A concise explanation of the relevance of one or more foreign language references is attached.
- ☐ According to the procedural policy adopted by the PTO with regard to disclosure requirements, the Applicant is satisfying the disclosure requirement pursuant to MPEP § 609.04(a)(III) by submitting herewith the following:
 - ☐ English language versions of any non-English language documents.
 - ☐ English language versions of one or more search reports or other actions by one or more foreign patent offices in one or more counterpart foreign applications, which indicate the degree of relevance found by the foreign office(s).
 - ☐ Pursuant to 37 C.F.R. § 1.98(a)(3)(ii), a copy of a translation is not submitted herewith because a written English-language translation of a non-English-language document, or portion thereof, is not within the possession, custody, or control of, or is readily available to any individual designated in § 1.56(c).

The Applicant has not analyzed these documents and, therefore, declines to comment on their relevance at this time.

- ☐ One or more English language abstracts for the non-English language references are also enclosed.

V REMARKS

It is respectfully requested that:

- (1) The Examiner sign the enclosed Form to evidence that the cited information has been fully considered by the Patent and Trademark Office during the examination of this application; and

- (2) The citations for the cited information be printed on any patent that issues from this application.

The submission of this information disclosure statement by the Applicant shall not be construed as a representation that a search has been performed or that no other material information under 37 C.F.R. § 1.56 exists. See 37 C.F.R. § 1.97(g).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, material to the patentability of one or more of the pending claims in this application pursuant to 37 C.F.R. § 1.56(b), unless specifically designated by the Applicant as such. See 37 C.F.R. § 1.97(h).

The submission of this information disclosure statement by the Applicant shall not be construed as an admission that any information cited or referred to herein is, or is considered to be, or even qualifies as “prior art” under 35 U.S.C. § 102 with respect to this invention, unless specifically designated by the Applicant as such.

Notwithstanding any statements by the Applicant, the Examiner is urged to form his or her own conclusion regarding the relevance of the cited information.

VI CONCLUSION

The Examiner is encouraged to contact the undersigned attorney to discuss any questions concerning this information disclosure statement or any of the information cited or referred to herein.

Respectfully submitted,

Date: March 6, 2019

/JCS/
Jonathan C. Siekmann, Reg. No. 58,259
USPTO Customer No. 83579
Level 3 Communications, LLC
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Broomfield, Colorado 80021
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-11-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
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		
	Christopher		Newton			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
City	Thousand Oaks	State/Province	CA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	1025 Eldorado Blvd.					
Address 2						
City	Broomfield	State/Province	CO			
Postal Code	80021	Country	US			
Inventor	2				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Laurence		Lipstone			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
City	Calabasas	State/Province	CA	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	1025 Eldorado Blvd.					
Address 2						
City	Broomfield	State/Province	CO			
Postal Code	80021	Country	US			
Inventor	3				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	David		Fullagar			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		0137-US-I1-C2	
		Application Number			
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)				
City	Boulder	State/Province	CO	Country of Residence	US
Mailing Address of Inventor:					
Address 1	1025 Eldorado Blvd.				
Address 2					
City	Broomfield	State/Province	CO		
Postal Code	80021	Country i	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	83579
Email Address	patent.docketing@level3.com Add Email Remove Email

Application Information:

Title of the Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
Attorney Docket Number	0137-US-I1-C2	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)		Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application 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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-I1-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

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	83579		

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	
		Continuation of		15645584	
Filing or 371(c) Date (YYYY-MM-DD)		2017-07-10			
Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15645584	Continuation of	12880324	2010-09-13	9762692	2017-09-12
Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12880324	Continuation in part of	12408681	2009-03-21	8930538	2015-01-06
Prior Application Status		Expired		Remove	
Application Number		Continuity Type		Prior Application Number	
		Claims benefit of provisional		61042412	
Filing or 371(c) Date (YYYY-MM-DD)		2008-04-04			
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.					
Add					

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-I1-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

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

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

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	0137-US-11-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-I1-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant	1		Remove
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
		Clear	
Assignee	Legal Representative under 35 U.S.C. 117		Joint Inventor
Person to whom the inventor is obligated to assign.		Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	Level 3 Communications, LLC		
Mailing Address Information For Applicant:			
Address 1	1025 Eldorado Blvd.		
Address 2			
City	Broomfield	State/Province	CO
Country	US	Postal Code	80021
Phone Number		Fax Number	
Email Address	patent.docketing@level3.com		
Additional Applicant Data may be generated within this form by selecting the Add button.			Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-11-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

Assignee 1				
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.				
Remove				
If the Assignee or Non-Applicant Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information For Assignee including Non-Applicant Assignee:				
Address 1				
Address 2				
City		State/Province		
Country i		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add				

Signature:[Remove](#)

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

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

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

Signature	/JCS/		Date (YYYY-MM-DD)	2019-02-25
First Name	Jonathan	Last Name	Siekman	Registration Number
				58259
Additional Signature may be generated within this form by selecting the Add button. Add				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	0137-US-I1-C2
		Application Number	
Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		

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 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.

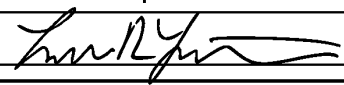
DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
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 <u>15/645,584</u> filed on <u>July 10, 2017</u>. The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Christopher Newton</u> Date (Optional): <u>7 November, 2017</u> Signature: <u></u>	
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

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

Title of Invention	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
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 <u>15/645,584</u> filed on <u>July 10, 2017</u>. The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Laurence Lipstone</u> Date (Optional): <u>11/10/17</u> Signature: 	
Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

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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	HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)
-------------------------------	---

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 15/645,584filed on July 10, 2017

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

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

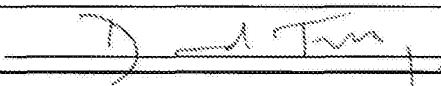
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

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

LEGAL NAME OF INVENTORInventor: David Fullagar

Date (Optional):

4/20/2018Signature: 

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

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

HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)

CROSS-REFERENCE TO RELATED APPLICATIONS

5 [0001] This application is a continuation of and claims the benefit of priority from U.S. Patent Application No. 15/645,584, entitled "HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)," filed July 10, 2017, the entire contents of which are fully incorporated by reference herein for all purposes. Application no. 15/645,584 is a continuation of and claims the benefit of priority from U.S. Patent Application No. 12/880,324, entitled "HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)," filed September 13, 2010, the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/880,324 is a continuation-in-part (CIP) of and claims the benefit of priority from U.S. Patent Application No. 12/408,681, entitled "HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)," filed March 21, 2009 (now U.S. Patent No. 10 8,930,538 issued January 6, 2015), the entire contents of which are fully incorporated by reference herein for all purposes. Application No. 12/408,681 claims priority as a non-provisional application from U.S. Provisional Application No. 61/042,412, entitled "HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)," filed April 4, 2008, the entire contents of which are fully incorporated by reference herein for all purposes.

15 [0002] This application is also related to the following co-owned and co-pending patent applications, the contents of each of which are fully incorporated herein by reference for all purposes: Application No. 10/073,938 filed 02-14-2002, Application No. 11/715,316 filed 03-08-2007, Application No. 11/978,656 filed 10-30-2007, Application No. 11/980,672 filed 10-31-2007, Application No. 10/259,497 filed 09-30-2002, Application No. 11/932,162 filed 10-31-2007, 20 Application No. 11/976,648 filed 10-26-2007, and Application No. 12/390,560 filed 02-23-2009.

FIELD OF THE INVENTION

25 [0003] This invention relates to content delivery, to content delivery networks (CDNs), and to frameworks and systems using CDNs.

DETAILED DESCRIPTION

GLOSSARY

5 **[0004]** As used herein, unless stated otherwise, the following terms or abbreviations have the following meanings:

1. IP means Internet Protocol.
2. "IP address" means an address used in the Internet Protocol to identify electronic devices such as servers and the like.
- 10 3. HTTP means Hypertext Transfer Protocol.
4. URL means Uniform Resource Locator.
5. DNS means Domain Name System.

BRIEF DESCRIPTION OF THE DRAWINGS

15 **[0005]** The present invention can be better understood with reference to the following drawings. The elements of the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the present invention. Furthermore, like referenced numerals designate corresponding parts throughout the several views.

20 **[0006]** **Fig. 1** depicts a general hierarchical, multi-tiered content delivery network (CDN);

[0007] **Fig. 2** shows the logical organization of servers into groups or clusters in a CDN;

[0008] **Fig. 3** depicts a content delivery framework (CDF) using a content delivery network (CDN);

[0009] **Fig. 4** depicts the operation of a two-level content delivery network in a content delivery framework;

5 [0010] **Fig. 5** is a flowchart showing operation of the popularity services of the CDN of **Fig. 4**;

[0011] **Fig. 6** is an exemplary data structure for maintaining the popularity data for a particular popularity server; and

[0012] **Fig. 7** is a flowchart showing processing steps of a multi-tiered
10 content delivery network.

OVERVIEW

[0013] The Internet and the so-called World Wide Web (the “WWW”) have become ubiquitous. Thousands or even tens of thousands of so-called content
15 providers (publishers) now use the Internet (and, particularly, the WWW) to provide all sorts of content to tens or even hundreds of thousands of clients all over the world.

[0014] In order to offload the job of serving some or all of their content, many content providers now subscribe to so-called content delivery networks
20 (CDNs). Using a CDN, some (or all) of a content provider’s content can be served to clients from the CDN (i.e., from one or more servers in the CDN) instead of from the content provider’s server(s). In a caching CDN, content that is served may also be cached on some or all of the CDN servers, either before being served or in response to specific requests for that content.

25 [0015] The term content as used herein means any kind of data, in any form, regardless of its representation and regardless of what it represents.

Content may include, without limitation, static and/or dynamic images, text, audio content, including streamed audio, video content, including streamed video, web pages, computer programs, documents, files, and the like. Some content may be embedded in other content, e.g., using markup languages such as HTML and XML. Content includes content which is created or formed or composed specifically in response to a particular request. The term “resource” is sometimes used herein to refer to content.

[0016] Certain publishers can have large content libraries in which only a small proportion of the content (the so-called “short head”) is popular enough to benefit from serving through a caching CDN, while the majority of the content (the so-called “long tail”) is accessed only occasionally and not generally worth caching (or even serving from an edge server). This situation would be typical for a content publisher with a very large music or video library. Some music content – the popular content – may be regularly requested, whereas other music – the not popular (also referred to as unpopular) content – may be seldom if ever requested.

[0017] Content can become popular (by various measures of popularity) or fade into relative obscurity dynamically, so a content library cannot easily be explicitly partitioned. Instead, the CDN tracks popularity of certain content, and selectively migrates content toward the edge (i.e., toward the tier 1 servers) as that content becomes popular.

[0018] A CDN may have one or more tiers of servers, organized hierarchically. **Fig. 1** depicts a content delivery network **100** that includes multiple tiers of servers. Specifically, the CDN **100** of Fig. 1 shows j tiers of servers, denoted Tier 1, Tier 2, Tier 3, ..., Tier j . Each tier of servers may comprise a number of servers organized into server groups (sometimes referred to as server clusters). The Tier 1 servers are also referred to as edge servers, and Tier 1 is sometimes also referred to as the “edge” or the “edge of the CDN.” The Tier 2 servers (when present in a CDN) are also referred to as parent servers.

[0019] Furthermore, content stored in any of the intermediate tier servers (e.g., tier 2, tier 3, ... tier j in FIG. 1) may be logically partitioned across two or more servers in the respective tier group. For example, a first portion (or subset) of a content provider's library may be stored on a first parent server in Group 1, a second portion may be stored on a second server in Group 1, and the last third may be stored on a third server in Group 1. Various partitioning methodologies are described in further detail below. In operation, the partitioning of content libraries across servers in an intermediate tier of a CDN provides a type of preemptive load-balancing such that certain parent servers are only responsible for handling a pre-defined subset of a content provider's library. In other words, redirected requests from the client to a parent/intermediate tier are distributed within the tier in accordance with the particular partitioning methodology being implemented.

[0020] For example, in the CDN 100 of Fig. 1, Tier 1 has n groups of servers (denoted "Edge Server Group 1", "Edge Server Group 2", ..., "Edge Server Group n "); tier 2 (the parent servers' tier) has m server groups (the i -th group being denoted "Parent Server Group i "); and tier 3 has k server groups, and so on. Preferably each tier has the same number of server groups.

[0021] Fig. 2 shows the logical organization / grouping of servers in a CDN of Fig. 1. In the exemplary CDN of Fig. 2, each tier of servers has the same number (n) of server groups. Those of skill in the art will know and understand, upon reading this description, that each server group may have the same or a different number of servers. Additionally, the number of servers in a server group may vary dynamically. For example, additional servers may be added to a server group to deal with increased load on the group.

[0022] The servers in a server group may be homogenous or heterogeneous, and each server in a server group may comprise a cluster of physical servers sharing the same name and/or network address. An example of such a cluster is described in co-pending and co-owned patent application no.

61/064,339 (titled "Load-balancing cluster", filed 02/28/2008), the entire contents of which are incorporated herein by reference for all purposes.

[0023] Servers in the same tier and the same group are referred to as peers or peer servers.

5 **[0024]** A typical CDN has only one or two tiers of servers. A CDN with only one tier will have only edge servers, whereas a CDN with two tiers will have edge servers and parent servers. (At a minimum, a CDN should have at least one tier of servers – the edge servers.)

10 **[0025]** The grouping of servers in a tier may be based, e.g., on their physical or geographical location. For example, a particular CDN may have six groups – four groups of servers in the United States, group 1 for the West Coast, group 2 for the mid-west, Group 3 for the northeast and Group 4 for the south east; and one group each for Europe and Asia.

[0026] A particular CDN server is preferably in only one server group.

15 **[0027]** In general, some or all of the servers in each tier can exchange data with some or all of the servers in each other tier. Thus, some or all of the parent servers can exchange information with some or all of the edge servers. For the sake of simplicity, in the drawings, each tier of servers is shown as being operationally connectable to each other tier. In some CDNs, however, it may be
20 preferable that the servers in a particular tier can only exchange information with other servers in the same group (i.e., with peer servers) and/or with other servers in the same group in a different tier. For example, in some CDNs, the edge servers in edge server group k , can exchange information with each other and with all servers in parent server group k , and so on.

25 **[0028]** A content provider's / customer's server (or servers) are also referred to as origin servers. A content provider's origin servers may be owned and/or operated by that content provider or they may be servers provided and/or operated by a third party such as a hosting provider. The hosting provider for a

particular content provider may also provide CDN services to that content provider.

[0029] A CDN may also include a CDN origin/content cache tier which may be used to cache content from the CDN's subscribers (i.e., from the CDN subscribers' respective origin servers). Those of skill in the art will know and understand, upon reading this description, that a CDN can support one or more subscribers, i.e., that a CDN can function as a shared infrastructure supporting numerous subscribers. The CDN origin tier may also consist of a number of servers, and these servers may also be organized (physically and logically) into a number of regions and/or groups. The server(s) in the CDN origin tier obtain content from the subscribers' origin servers, either on an as needed basis (a pull) or in advance (via a push).

[0030] A popularity service **102** (described in greater detail below) is associated with one or more of the server groups in one or more tiers. In a presently preferred exemplary embodiment, some of the parent server groups have popularity services **102** associated therewith. Although shown as a separate component of the group, the popularity service **102** may be integrated into one of the servers in the group. In some cases, the popularity service may have its own server, distinct from any of the CDN servers. The terms "popularity service" and "popularity server" are used interchangeable herein.

[0031] In operation, when a client requests content that is to be served using a content delivery framework, the client may be served that content from a server in the CDN or, in some cases, from the subscriber/customer's origin server.

[0032] A client may be directed to a CDN and/or to a server in the CDN in any manner using any kind of server selector system **104**. As understood by those of skill in the art, the server selector system **104** generally operates to direct a client's requests for content to an appropriate server in order for that content to be served to the requesting client. An appropriate server may be one

which is close to the client (by some measure of cost) and/or one which is not too heavily loaded. All sorts of conditions may be applied to the term “appropriate”, and all sorts of information and tests, both static and dynamic, may be used to determine an appropriate server. The server selector system **106** may, e.g.,
5 include or operate fully or partially in Domain Name Service (DNS) servers, standalone devices, or a combination thereof. For example, the server selector system **106** may comprise a single level DNS server that selects an appropriate server based at least in part on some combination of the location of the
10 the art will know and understand, upon reading this description, that a client’s location in a network such as the Internet may sometimes only be roughly determined, and the term “location of the client” is generally taken to be a network location corresponding to the client’s network service provider.

[0033] Although shown as a component in the drawings, the server
15 selector **106** may comprise numerous components. For example, some or all of the server selection may be based on anycast routing, and the server selector **106** may then include routers and associated tables.

[0034] In a presently preferred embodiment the server selector **106** is an
intelligent traffic manager (ITM) / adaptive traffic controller (ATC) such as
20 described in co-pending U.S. patent application no. 10/259,497, filed 09-30-2002, and titled “Configurable Adaptive Global Traffic Control And Management,” (published as US 2003-0065762 A1); and in U.S. patent application no. 11/976,648, filed 10-26-2007, titled “Policy-based content delivery network selection,” (collectively the “ITM applications”), the entire contents of each of
25 which have been incorporated herein by reference for all purposes. In some embodiments the server selector **106** may include a “best” or “optimal” server selector such as disclosed in U.S. Patent No. 6,185,598 titled, “Optimized Network Resource Location,” the entire contents of which are incorporated herein by reference for all purposes. The ‘598 patent refers to CDN servers as so-called

repeater servers, and describes a so-called “Best Repeater Selector (BRS) mechanism”.

[0035] Fig. 3 shows a content delivery framework 300 with a two-level hierarchical CDN consisting of a tier of edge servers (Tier 1) and a tier of parent servers (Tier 2). Some or all of the edge servers can communicate with some or all of the parent servers. The edge servers are divided into n edge server groups, and the parent servers are divided into m parent server groups. In a presently preferred embodiment, the value of m is equal to the value of n , *i.e.*, in this presently preferred embodiment there are the same number of edge server groups as there are parent server groups. A CDN origin/content cache tier stores subscriber content which it obtains from the various subscribers’ origin servers. At least one of the parent server groups (in the drawing, Group 1) has a popularity service 102-1 associated therewith. Preferably more than one parent server group has an associated popularity service, and more preferably each parent server group has an associated popularity service.

[0036] Although shown in a parent tier, the popularity service may located anywhere in the system, including in the edge tier.

[0037] The popularity service may be used by certain, though not necessarily all, content. When only certain content uses the popularity service, content should be designated in order to use the popularity service.

[0038] Some or all of the edge servers in a group may use a popularity service to manage the long-tail content of various subscribers. Each edge server that uses a popularity service is referred to as being bound to that popularity service. An edge server that is bound to a popularity service is sometimes referred to herein as a “longtail coserver.”

[0039] Figs. 4 and 5 show the operation of the popularity services of the CDN of Fig. 3.

[0040] When a client **106** requests content (e.g., using an HTTP GET request), that request is directed (e.g., by server selector **104-1**) to an edge server in order for the content to be served to the client. For certain designated content a popularity check is interposed into the fill side of the caching operation.

5 **Figure 4** illustrates the flow of messages and data in the content delivery framework **300**, and **Fig. 5** is a flowchart show operation of the popularity services of the CDN of **Fig. 4**. For the sake of this particular explanation, assume that the client's request has been directed to edge server **108**. (Those of skill in the art will know and understand, upon reading this description, that the client's
10 initial request may be directed to any tier in the CDN hierarchy, including, e.g., to the parent tier.) This server is selected using the server selection mechanisms **104-1** associated with the CDN, e.g., using one or more DNS servers and selecting an edge server based on such factors as the location of the requesting client, the load on the network, network traffic conditions, CDN policies,
15 subscriber policies, and the like.

[0041] A client **104** requests content from an edge server **108** (at **500** in **Fig. 5**). The request from the client **104** arrives at edge server **108** (**S1** in **Fig. 4**). The edge server **108** checks to see if object is present (locally or on a peer) and fresh (at **502**). If so, the edge server **108** serves the object to the client **104** from
20 the cache (**S2, 504**), obtaining the object from a peer, if necessary.

[0042] In some embodiments, the system may distinguish between on-net and off-net peers and same-switch peers. An on-net peer is a peer on the same backbone network; an off-net peer is a peer located on a different backbone network; and a same-switch peer is a peer directly connected to the same switch
25 as the agent performing the check. In some embodiments, the edge server **108** may only look for the object on some of its peers (e.g., only on same-switch peers) (at **502**).

[0043] If the object is not available on the edge server **108** or on a peer, the edge server **108** ascertains whether this object is served based on its

popularity (i.e., whether this object has been designated so that the object's popularity will be used to determine where it will be served from) (at **506**). If so, then the request is sent to the popularity service **102** associated with the edge server **108**, in this case, to the popularity server for the this group (**S3a**).

- 5 **[0044]** The determination as to whether this object is designated to be served from a different location, depending on its popularity (at **506**), may be made based, at least in part, on the name (hostname) used to request the object.

- 10 **[0045]** It is preferably to allow for a mix of edge servers, some performing popularity checking (as described above), while others do not. For those that are not running the popularity service, the name (hostname) used to request an object will resolve to a parent server (that may or may not provide popularity services). If the parent server does not provide popularity services, then the content will be obtained by the edge server from that parent server, and the content will be served to the client. On the other hand, if that parent server does
- 15 provide popularity services, it can determine whether or not the edge server is a Longtail coserver based, e.g., on the IP (Internet Protocol) address of the edge server. For no-coservers, the parent server can handle the request without any popularity processing.

- 20 **[0046]** A request for content may be an initial request for an object or it may be a request for another part of an object, the initial part having already been served to the client. If the request is for the first part of the object (at **508**), e.g., the request includes a request for the first byte of the resource (i.e., it is not a range request that starts after the beginning of the file), the popularity service **102** determines (as described below) if the object is currently popular. First, the
- 25 popularity count for the current period is incremented (at **510**). Based on its determination, the popularity service **102** returns one of three possible responses to the edge server **108** (**S3b**):

1. If the object has not reached a first / minimal level of popularity (at **512**): the popularity service sends the edge server an instruction (e.g., HTTP

302) to redirect the client's request to the origin server (or to the CDN origin cache) (if origin redirects are enabled) (at **514**).

2. If the object's popularity has exceeded the first / minimal level of popularity but has not yet exceeded a second, mid-tier threshold (at **516**):
5 the popularity service sends the edge server an instruction (e.g., HTTP 302) to redirect the client's request to a parent server (if mid-tier redirects are enabled) (at **518**). Note that the redirect processing may further involve a determination of which particular parent server is responsible for storing the requested content. Such a determination would be based on
10 how the distinct subsets of a content provider's library are partitioned across parent servers in the same intermediate tier. Further note that it is also possible for subsets of a content provider's library to be partitioned across servers residing in different intermediate tiers of a content delivery network.

15 3. If the object's popularity has exceeded the mid-tier threshold (i.e., the object is popular): The popularity service sends the edge server an instruction to serve the content itself (at **520**). In a presently preferred implementation, the popularity service sends the edge server a redirect (HTTP 302) with a "follow me" flag set, to the origin server or, if there is
20 one, to the parent tier.

[0047] If the edge server **108** receives a redirect from the popularity service **102** without the "follow me" flag set (cases 1 and 2 above), it simply forwards the redirect to the client **104** (**S4a**, **522**, **524**). If the edge server **108** receives a "follow me" redirect, it obtains and caches the resource (at **526**) and
25 serves it to the client (at **528**).

[0048] If the popularity service **102** is unreachable, unresponsive, or returns a status code indicating an error (other than HTTP 404), the object is served out of the edge's cache server (and an alert condition is raised).

[0049] Once content has been cached at an edge server, the edge server will send notifications (e.g., in the form of revalidations) to the popularity service every time it gets another request for that content. E.g., with reference to the flowchart of **Fig. 5**, if the edge server **108** determines (at **502**) that it has the requested content (or can obtain it from a peer), then, in addition to serving the content (at **504**), it also instructs the popularity server to increment the object's popularity count for the current period (at **530**). This process keeps the popularity servers up to date on the relative popularity of content being served in their region.

[0050] In presently preferred embodiments, the server selection mechanism **104** does not rendezvous clients to parent servers/caches. In other words, in these embodiments, client requests are always initially directed by the server selection mechanism to an edge server. In these cases, when a request for a resource arrives at a parent server/cache, that request should preferably be served (and filled if necessary) unconditionally (since any request from a client is assumed to be the result of a redirect served by an edge server).

[0051] In an embodiment where the server selector **104** can direct client requests directly to parent servers (or to any tier other than the edge tier), a server obtaining a client request may choose to redirect that request, e.g., based on popularity. However, those of skill in the art will know and understand, upon reading this description, that it is advisable to track the redirection of a request to avoid circular and/or infinite redirection. One way to avoid such a problem is to limit the number of levels of redirection (i.e., to limit the number of redirects to follow). In a presently preferred implementation, if no final server is selected after following, e.g., thirty two redirects, an error is issued. In some embodiments, if no final sever is selected after a predefined number of redirects, then the last server reached may be used to serve the content. One way to prevent looping is to use different server names (aliases) or IP addresses when redirecting requests so that a server receiving a request can tell whether or not it is a redirect. Those of skill in the art will know and understand, upon reading this description, that

information can be transferred between servers using, e.g., HTTP headers or the like.

[0052] Those of skill in the art will know and understand, upon reading this description, that in a multi-tier CDN, the popularity service may be located at any
5 tier, or there may be popularity services at more than one tier.

[0053] The middle (Parent) tier is optional.

[0054] Step (4a) may reply with content (if popular), or with a redirect to a parent or origin server (if not), in which the client will make another request (5a or 5b) to that tier to obtain the content.

10 **[0055]** If the request is an HTTP GET request or the like, it is forwarded to the popularity service . HTTP POST requests should always be forwarded directly to the origin, since that is where they will need to be processed, and the response to a POST request should not be cached. It may sometimes be preferable to direct GET requests to a different origin server than POST
15 requests.

[0056] While the invention has been described with reference to the HTTP protocol, those of skill in the art will know and understand, upon reading this description, that different and/or other protocols may be used and are contemplated by the inventors. HTTP is described in various documents, e.g.,
20 Hypertext Transfer Protocol -- HTTP/1.1, RFC 2616, Network Working Group, the entire contents of which are incorporated herein by reference.

[0057] Those of skill in the art will know and understand, upon reading this description, that different thresholds may be established for each tier in the CDN. Further, those of skill in the art will know and understand, upon reading this
25 description, that each content item may have its own thresholds associated therewith. In this manner, the system can check all content for popularity, with the default thresholds being zero. In this manner, every request will automatically

cause the popularity to exceed the threshold and will cause the content to be cached.

5 **[0058]** By positioning Popularity Servers regionally (paired with parent cache servers), popularity and cache tiers can be managed independently, on a regional basis. Content that is popular in one region / group may not be popular in another region/group (especially if each region / group corresponds to a geographic and/or political region).

10 **[0059]** We consider it desirable that rendezvous to popularity servers prioritize so-called “regional” proximity, so that clients within the same region will tend to cast their popularity “votes” within that region and get consistent treatment of popular resources. However, if there are multiple parent cache servers available, there will generally be no attempt to rendezvous particular clients to particular parents.

15 **DEFINING & MEASURING POPULARITY**

20 **[0060]** In preferred embodiments, popularity of an object/resource is measured based on the number of times that object/resource is requested in various time periods. **Fig. 6** is an exemplary data structure for maintaining the popularity data for a particular popularity server. The data structure **600** in **Fig. 6** is a so-called tally hash structure.

25 **[0061]** In preferred embodiments, some or all edge servers are associated with (or bound to) popularity servers. An edge server that is bound to a popularity server is sometimes referred to as a bound Longtail coserver. Each popularity server in the system allocates a tally hash structure 800 per bound Longtail coserver. A configuration provides the number of resource (hash) slots to allocate. For a presently preferred implementation, the number of hash slots is on the order of 100 million slots per coserver. Each slot is divided into a number of time buckets, preferably 16 time buckets, each bucket being represented by,

e.g., a 4-bit unsigned integer. Those of skill in the art will know and understand, upon reading this description, that the selection of the size of the value in each time bucket depends on policy decisions about bounds for the popularity thresholds, and for keeping very popular resources at the edge. The size, however, is heavily influenced by a need for compactness. One 8-byte word can store all time buckets for one resource slot, and therefore, 800 MB would be required per property, and five to eight such properties could be managed per popularity server without paging.

10 **[0062]** Each time bucket represents a time period, preferably a number of seconds.

15 **[0063]** The mapping of requests/content to slots is based on some function of the object name and perhaps other information associated with the request for the object. Preferably the mapping of objects to slots is based on a hash or message digest function (such as MAD or the like) over the object name (and preferably including some parts of the query string). Each slot may therefore represent one or more resources. Each time a query/request arrives at a popularity server for an object, the hash is computed and the slot in the table 800 (for the appropriate co-server) is determined, and the counts in that slot are used. In event of a hash collision, it is therefore possible that one bucket will be receiving and representing counts for more than one object. Since this result is generally undesirable (since it could result in cache fills and edge caching of unpopular objects), the number of buckets should be chosen to be as large as practical.

25 **[0064]** Those of skill in the art will know and understand, upon reading this description, that different and / or other data structures may be used to implement the popularity counting. For example, since in most cases the total number of resources is expected to far exceed the number of popular resources, a balanced b-tree may be preferable to a hash table. In addition, it is possible to reduce the size of the hash slot by using only some part of the hash. However,

reducing the number of bytes of the hash used can result in more name collisions.

5 **[0065]** Although described above with respect to popularity, those of skill in the art will know and understand, upon reading this description, that other factors may be used along with (or instead of) popularity to determine whether or not to redirect requests. A rule base may be used to augment and/or override the popularity measures for certain resources. The rules in the rule base may be static or dynamic and may be set by the CDN administrator and/or the subscriber. For example, a subscriber may not want to pay for certain content to be served from the edge, regardless of its popularity, and may set a rule accordingly (this particular result could also be achieved by setting the thresholds for that particular content to prevent it from ever being cached at the edge).

15 **[0066]** Occasional log mining could be used to look for hash collisions in actual subscriber content libraries, and the hash function and bucket sizes could be tuned as needed.

[0067] At each time bucket boundary, the popularity service will logically “rotate” the buckets and zero out the oldest tally data for each object.

20 **[0068]** Whenever a coserver’s enrollment in the popularity service changes (added or dropped, or perhaps hints changed), the data structures are to be updated.

[0069] The popularity of a given object may be determined as a weighted sum of its popularity over successive time periods. More recent time periods may be given higher weights.

25 **[0070]** In order to determine which content is to be managed by the popularity service, the CDN operator and/or the subscriber may specify:

- The tiers at which the content will be managed – edge, intermediate (i.e., parent), or origin (subscriber's or storage tier). In order to be meaningful, at least one of intermediate and origin service should be enabled.

- content that is to be managed based on its popularity, rather than simply always being served from a cache.

[0071] There are several reasons why a publisher /subscriber may not want the so-called “long-tail” content served from a caching CDN service, for example:

- If cache fills are done from the subscriber's origin server and the subscriber pays for cache fill bandwidth, unnecessary fills for unpopular resources increase bandwidth costs without providing any value.

- Serving an unpopular resource through a CDN cache adds latency (due to the cache fill), and risks forcing actually popular resources out of cache, potentially causing thrashing. The result is lower efficiency and the risk of degraded service.

[0072] For related or similar reasons, a CDN provider generally also does not want to serve long-tail content from an edge cache:

- If cache fills are done from origin storage, unnecessary cache fills consume bandwidth both from the storage and cache systems, increasing (doubling) the internal cost to serve. This lowers efficiency, requiring relatively more bandwidth internally to serve the same content to the outside.

- The second argument above also applies from the CDN's perspective: a CDN operator wants to minimize latency as well as the risk of thrashing in order to satisfy all of its subscribers.

NAMES, ADDRESSES & CONFIGURATION DATA

[0073] As is well known, each server in a network may be addressed by means of one or more network address (e.g., Internet Protocol or IP addresses). Each server in a network may also be known by one or more names (so-called
5 hostnames – fully qualified domain names). Hostnames may be mapped to one or more IP addresses. A hostname may correspond to (and thus resolve to) more than one server.

[0074] A system such as ITM (described in the ITM patent applications mentioned above), allows a kind of hostname (called a supename) to refer to
10 multiple servers, and resolves the supename to a nearby server.

[0075] Preferably the server selection mechanism is ITM, and each popularity server will have supename that resolves to reach nearby popularity server.

[0076] When a popularity server shares or is co-located with a parent
15 server, the parent server may use the name by which it was addressed to determine whether to direct a request to the popularity service. That is, parent cache servers that provide popularity service may recognize requests that use one of the aliases reserved for popularity requests, and call into the popularity service to make the fill/no fill decision and return a redirect as described above.

20 **[0077]** As noted earlier, if the server selector mechanism does not send initial requests to non-edge servers, then all parent cache servers must recognize requests that have been redirected and serve the requested resource, filling it from the origin (or another tier), if necessary.

[0078] A servers hostnames are also referred to as its aliases. Each
25 Longtail coserver preferably has at least two aliases (three if a parent cache/server tier is used): the published supename, the hostname used for popularity service requests, and (if used) the hostname used for parent cache redirects.

[0079] Popularity servers will preferably be reached via an ITM supertype, and ITM will monitor for the service's availability across the set of servers. Popularity servers should be reached using real IP addresses, and not virtual IPs, and will not necessarily be redundant within a cluster. Redundancy
5 can be provided by having multiple servers per supertype. However, preferably there will be no attempt to synchronize the popularity tallies on popularity servers, with the expected desirable effect of managing popularity separately on a "regional" basis, the granularity being determined by the number and distribution of popularity servers deployed. Should a popularity server fail, this
10 could cause a discontinuity in popularity responses as a new server becomes active for a given edge location, but this may be mitigated (for very popular resources) by periodic background refreshes.

[0080] Information about the resources and caching strategy include the following:

- 15 – the expected total number of resources associated with this coserver.
- the number of buckets used to store hit counts for each resource.
- the number of seconds that each bucket represents. Every time this interval goes by, the count in the oldest bucket is thrown out and a new bucket is started with a count of zero.
- 20 – when the sum of all buckets for a given resource reaches this number on any popularity server, the parent caches (if any) that use that server will start to cache the resource.
- when the sum of all buckets for a given resource reaches this number on any popularity server, the edge caches that use that server will start to
25 cache the resource.
- the hash algorithm to apply to the resource names (optional). If not specified, a default algorithm (e.g. MD5) will be used.

- the maximum number of this coserver's resources that should be in cache at an edge at any given time. This value may be ignored in certain embodiments.
- the maximum number of this coserver's resources that should be in cache at a parent at any given time. This value may be ignored in certain embodiments.

[0081] Preferably resources should not be pre-expired on parent cache servers, as that will cause unnecessary requests to the origin server or queries to peer caches.

[0082] Those of skill in the art will know and understand, upon reading this description, that a decision to serve at a given tier that is based only on popularity counts, will not take into account capacity to serve at that tier – so this scheme could overload an origin server or parent tier if they do not have sufficient capacity. Further, if popularity is measured in terms of absolute thresholds on numbers of requests, and if the library is sufficiently large, this could cause cache thrashing at the parent or edge tiers.

[0083] Authentication with the origin cache or server, if needed, should be done by the server that receives the initial request from the client. During processing of a redirected request.

[0084] Various documents, including patents and patent applications, have been incorporated by reference into this application. In case of any conflict between an incorporated document and the present application, the present application, including any definitions herein, will control.

[0085] Thus is provided a feature that allows a CDN to be responsive to increasing or decreasing “popularity” of content by shaping where in the CDN content is positioned and served from.

[0086] FIG. 7 is a flowchart 700 of processing steps associated with a multi-tiered content delivery network.

[0087] In step 705, a first server in a first tier of servers obtains a request from a client for a resource. In one embodiment, the resource is available as part of a content provider's library (e.g., the resource may be a digital movie requested from an on-line streaming movie provider).

[0088] In step 710, if the resource is not available at the first server or at a peer of the first server, and additionally if it is determined that the resource is popular (using processing and functionality previously described), then the first server obtains the resource and serves it to the client. For example, the first server may obtain the resource from an origin server and/or a parent server (in any intermediate tier between the first server and the origin server).

[0089] In step 715, if the resource is determined not to be popular (again, using processing and functionality previously described), the client is directed to a second server in a second tier of servers (e.g., any intermediate tier) distinct from the first tier of servers. In this example embodiment, the second server comprises a first portion (or subset) of the content provider's library. For the purposes of this example, the first portion comprises at least the resource that was requested by the client. Furthermore, the second tier includes at least one other server that comprises a second portion of the content provider's library. According to one example embodiment, the first portion is distinct from the second portion (i.e., the portions/subsets of the library do not overlap, or overlap only minimally).

[0090] In another example embodiment, the portions of the content provider's library are logically partitioned across servers in the second tier. For example, the portions/subsets of a content provider's library can be partitioned alphabetically across servers in the second tier based on a naming convention associated with each distinct resource in the content provider's library (e.g., digital movies having titles beginning with A-F are stored on server A in a

second/intermediate tier, digital movies having titles beginning with G-R are stored on server B in the second/intermediate tier, and digital movies having titles beginning with S-Z are stored on server C in the second/intermediate tier).

5 **[0091]** Assume, for example, that a content provider's library comprises multiple content-types (e.g., movies, video games, music, software patches, etc.). Per one example embodiment, it would be advantageous to store a proportionate amount of each content type on each participating intermediate tier server (e.g., 60% movies, 30% video games, 10% software downloads on each participating server in the tier). In such a scenario, if the demand for a particular
10 content-type increases during a given time period (and/or demand for a different content-type declines), then such fluctuations in demand will generally affect each participating server proportionately.

15 **[0092]** Noted that resources may be partitioned across multiple servers by naming convention (e.g., alphabetically) as well as having proportionally distributed content per server (e.g., by content-type). With this in mind, it should be further noted that logical partitioning of resources/content among intermediate servers is not limited to just alphabetic naming convention segmentation and/or content-type proportionality. It is contemplated that the partitioning may be based on various metrics such as, but not limited to, numeric hash values (e.g.,
20 MD5) associated with content/resource URLs, the size or file type of a resource, other identifiers associated with other various naming conventions (e.g., numerical, alphanumerical, proprietary, encrypted/mangled, etc.), the relative size and traffic behavior of various resources in a content provider's library or the content provider's library as a whole, and the like.

25 **[0093]** In step 720, the step of directing the client to a second server in the second tier is performed in response to a determination of which second server actually stores the first portion. In one example, the server that stores the first portion (or, for that matter, any portion that comprises the requested resource) is

identified using a hash function (similar to the processing and functionality previously described).

[0094] In step 725, the second server that stores the first portion serves the resource to the client.

5 **[0095]** The foregoing description has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed. Obvious modifications or variations are possible in light of the above teachings. The embodiment or embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of
10 ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to
15 which they are fairly and legally entitled.

CLAIMS

We claim:

1. A method of content delivery in a content delivery network comprising:
receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a resource available from the content delivery network;
accessing a popularity service associated with the content delivery network to determine a popularity designation associated with the requested resource;
requesting the resource from a second server of the content delivery network;
processing, at the first server of the first tier of servers, a redirect instruction from the second server of the content delivery network to obtain the resource from a content server of the content delivery network; and
providing the obtained resource to the requesting device.
2. The method as recited in claim 1 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular, the method further comprising: receiving an instruction to not cache the resource at the first server of the first tier of servers when the resource is obtained from the content server of the content delivery network.
3. The method as recited in claim 1 wherein the popularity designation associated with the requested resource indicates that the requested resource is popular, the method further comprising: receiving an instruction to cache the resource at the first server of the first tier of servers when the resource is obtained from the content server of the content delivery network.
4. The method as recited in claim 1 wherein the second server is a metro mid-tier server of the content delivery network.
5. The method as recited in claim 1 wherein the second server is a peer server of the first tier of servers of the content delivery network.
6. The method as recited in claim 1 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.

7. The method as recited in claim 6 wherein the popularity service is associated with the second server of the content delivery network.

8. The method as recited in claim 6 wherein the popularity service is associated with the first server of the first tier of servers of the content delivery network.

9. The method as recited in claim 1 wherein the content delivery network further comprises a second tier of servers distinct from the first tier of servers, and wherein the second server is in the second tier of servers.

10. The method as recited in claim 3 further comprising:
receiving, at the first server of the first tier of servers of the content delivery network, an additional request for the resource available from the content delivery network;
determining that the resource is cached at the first server of the first tier of servers; and
providing the cached resource from the first server of the first tier of servers in response to the additional request for the resource.

11. A content delivery network comprising:
a first tier of servers comprising a first plurality of servers, an edge server of the first tier of servers receiving a request from a requesting device in communication with the first server for a resource available from the content delivery network ;
a second tier of servers comprising a second plurality of servers, a first server of the second plurality of servers receiving a request from the edge server for the content and, in response, transmitting a redirect instruction intended for the requesting device to the edge server to obtain the resource from a content server; and
a popularity service tracking a popularity designation associated with the requested resource;
wherein the edge server processes the redirect instruction to obtain the content from the content server and provides the obtained content to the requesting device.

12. The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is not popular and the first server of the second plurality of servers transmits an instruction to not

cache the resource at the content server of the first tier of servers when the resource is obtained from the content server.

13. The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource indicates that the requested resource is popular and the first server of the second plurality of servers transmits an instruction to cache the resource at the content server of the first tier of servers when the resource is obtained from the content server.

14. The content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a metro mid-tier server of the content delivery network.

15. The content delivery network as recited in claim 11 wherein the first server of the second plurality of servers is a peer server of the first tier of servers of the content delivery network.

16. The content delivery network as recited in claim 11 wherein the popularity designation associated with the requested resource comprises an indication whether a current popularity value for the resource exceeds a first predetermined popularity threshold.

17. The content delivery network as recited in claim 16 wherein the popularity service is associated with the first server of the second plurality of servers of the content delivery network.

18. The content delivery network as recited in claim 16 wherein the popularity service is associated with the content server of the first tier of servers of the content delivery network.

19. A method of content delivery in a content delivery network comprising:
receiving, at a first server of a first tier of servers of the content delivery network, a request from a requesting device for a resource available from the content delivery network;
accessing a popularity service associated with the first server of the first tier of the content delivery network to determine a popularity designation associated with the requested resource;

receiving an instruction to not cache the resource at the first server of the first tier of servers;

requesting the resource from a second server of the content delivery network based at least on the popularity designation associated with the requested resource; and
providing the obtained resource to the requesting device.

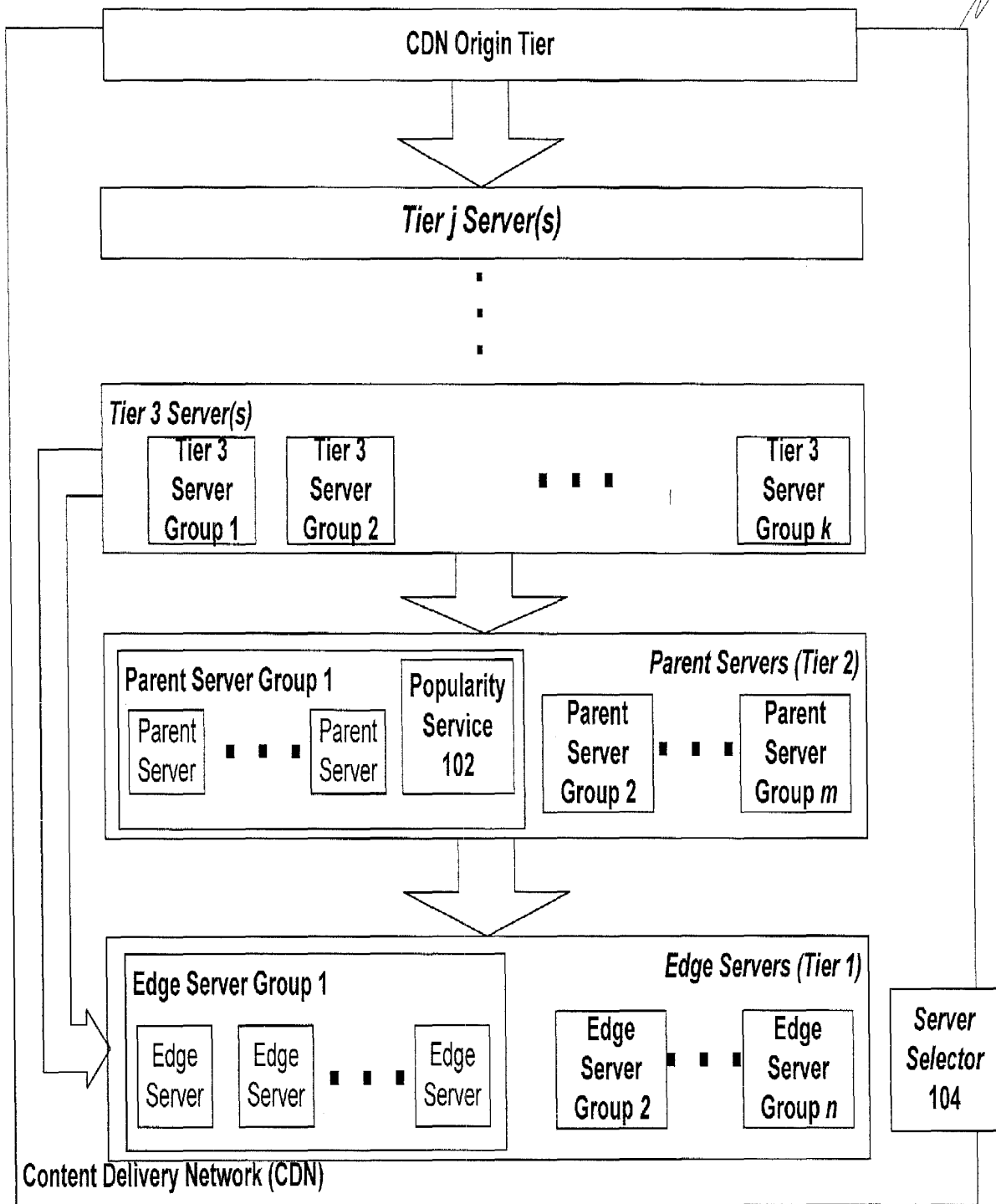
20. The method as recited in claim 19 wherein the second server of the content delivery network is a content server storing the requested content.

ABSTRACT OF THE DISCLOSURE

A content delivery network has at least a first tier of servers. A content delivery method includes, at a first server in the first tier of servers, obtaining a request from a client for a resource. If the resource is available at the first server or at a peer of the first server, then the resource is served to the client from the first server. Otherwise, it is determined whether the resource is popular, and if the resource is determined to be popular, then the first server obtains the resource and the first server serves the resource to the client. If the resource is determined not to be popular, the client is directed to a second server, not in the first tier of servers, and the second server serves the resource to the client. The second server may be in a second tier of servers or it may be an origin server.

FIG. 1

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FIG. 2

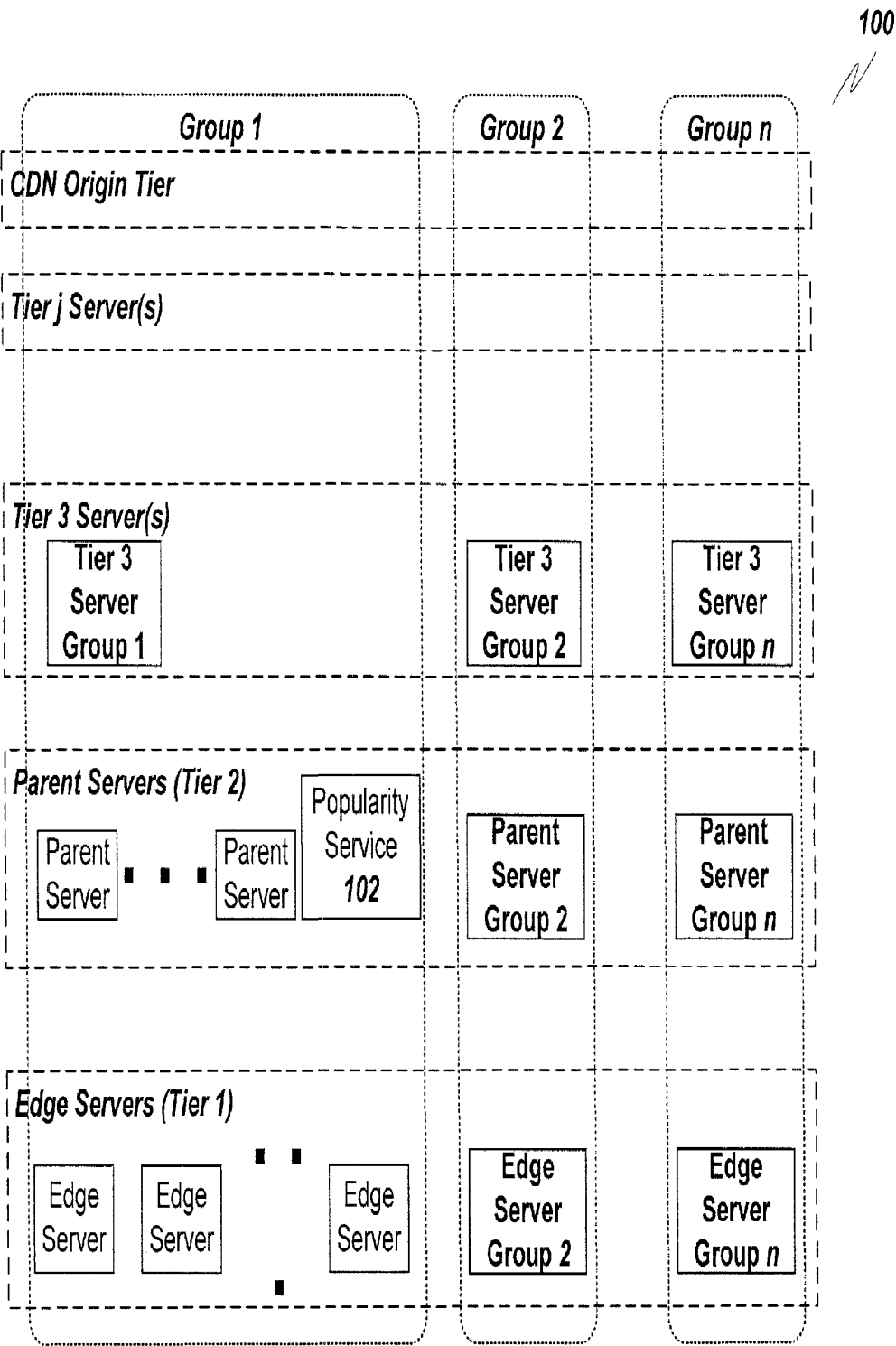


FIG. 3

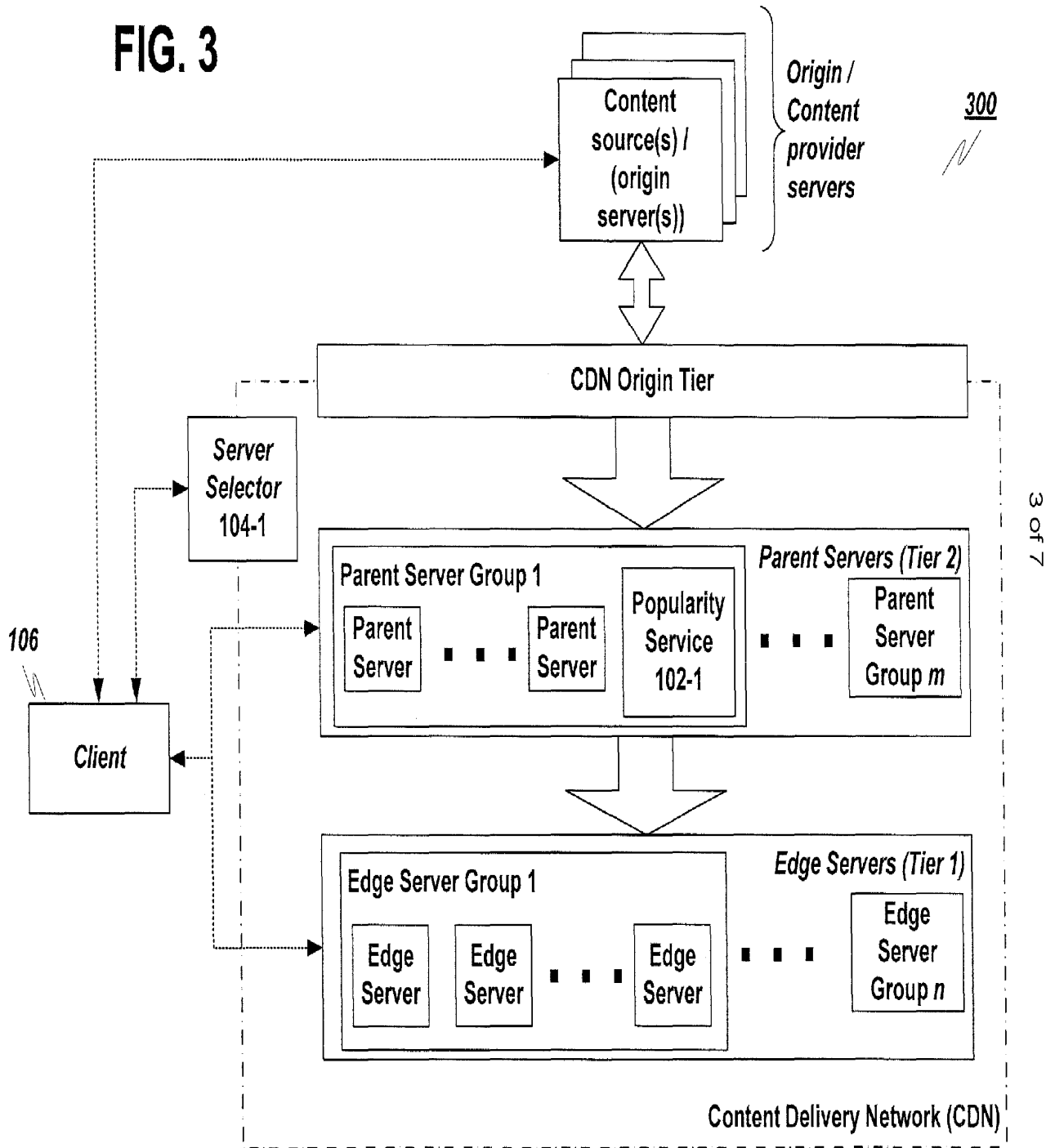
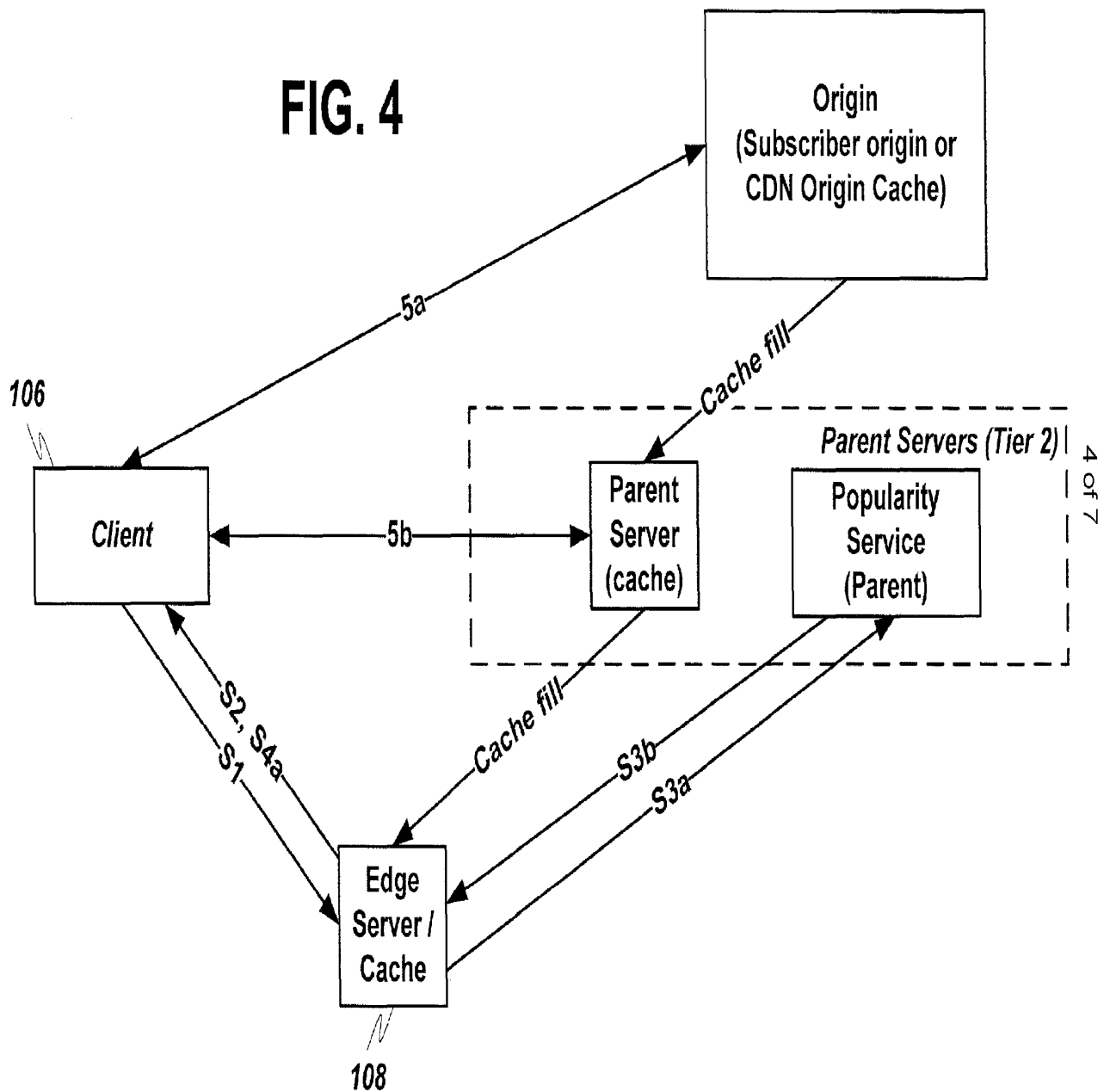


FIG. 4



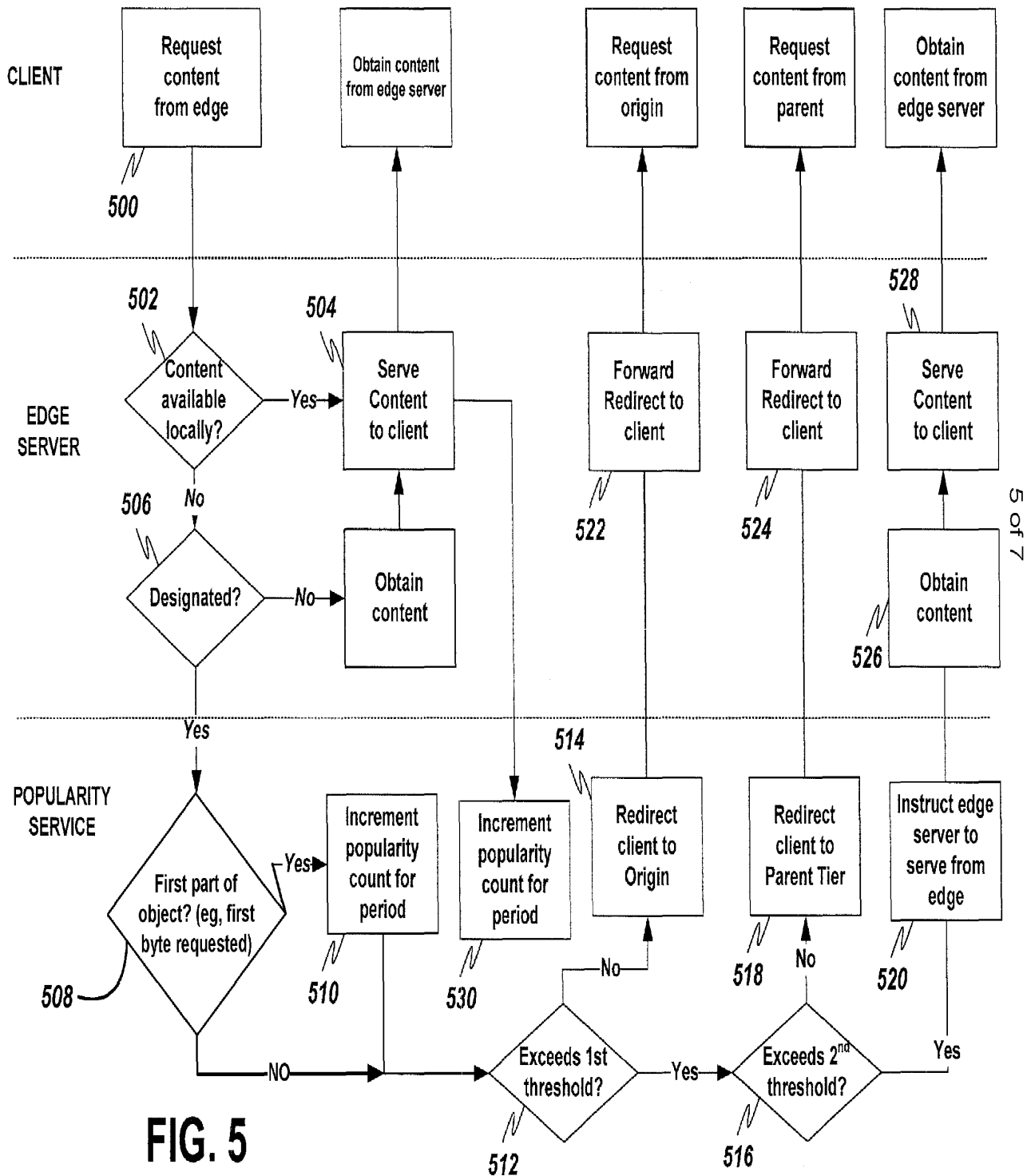
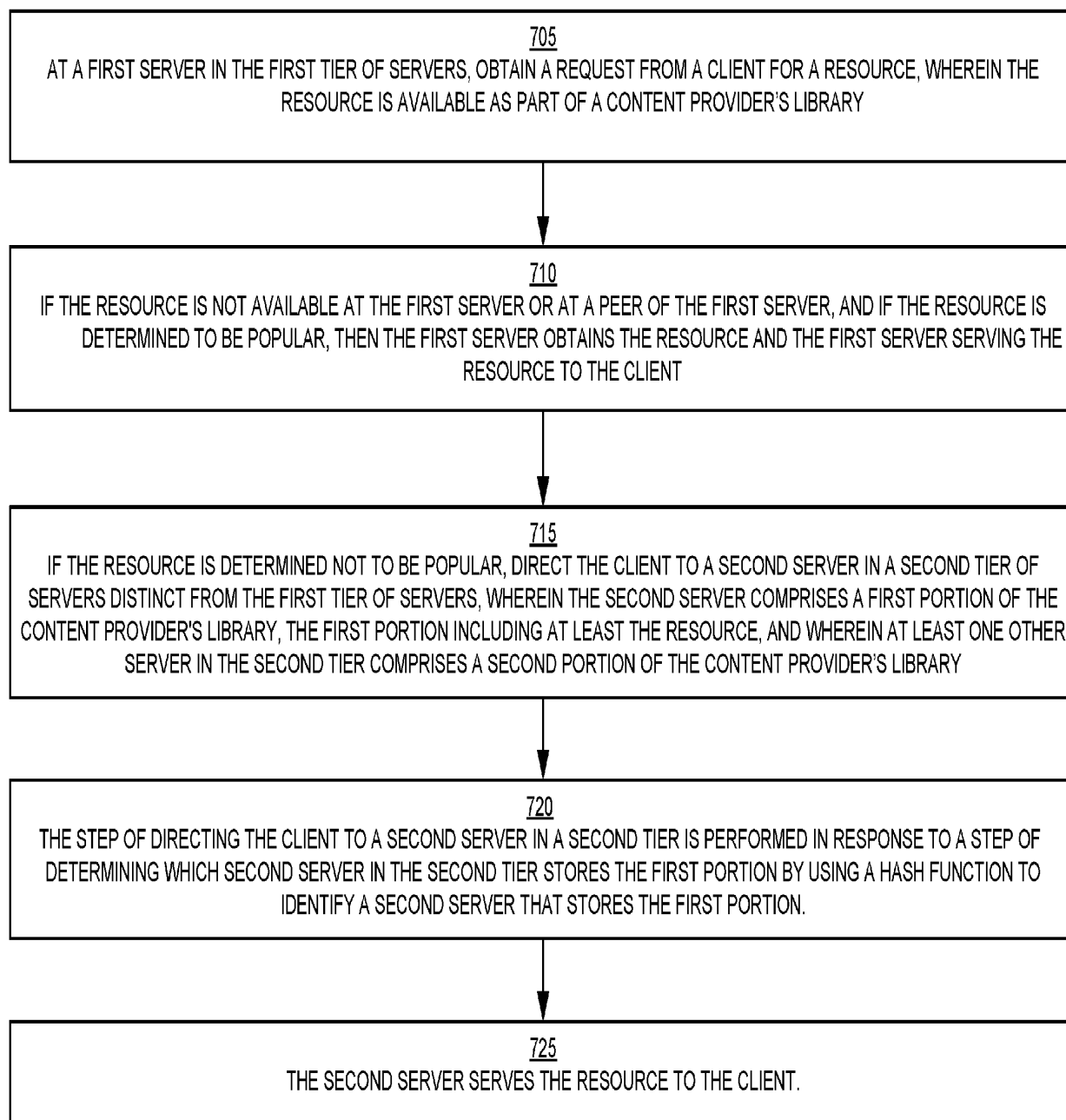


FIG. 6

600	SLOT	Time Bucket 1	Time Bucket 2	...	Time Bucket 16
				...	
				...	
				...	

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FIG. 7

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		HANDLING LONG-TAIL CONTENT IN A CONTENT DELIVERY NETWORK (CDN)		
First Named Inventor/Applicant Name:		Christopher Newton		
Filer:		Jonathan C. Siekmann		
Attorney Docket Number:		0137-US-I1-C2		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1720

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	0137_US_I1_C2_ADS.pdf	1256441	no	9
			37e117aa677f8c49749fee9e287a2c85a0107de		
Warnings:					
Information:					
2	Oath or Declaration filed	0137_US_I1_C2_Oaths.pdf	252727	no	3
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Warnings:					
Information:					
3		0137_US_I1_C2_Specification.pdf	200658	yes	29
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	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	24	
	Claims		25	28	
	Abstract		29	29	
Warnings:					
Information:					
4	Drawings-only black and white line drawings	0137_US_I1_C1_Figures.pdf	158609	no	7
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Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	35058	no	2
			6f125c38f9d99e397b314d488c5a2498ca4ddb67		

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