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.
15/977,766	03/19/2019	10237773	RALEP032C1C12C2C1	8228

106963 7590 02/27/2019

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

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):

Gregory G. Raleigh, Woodside, CA;
Headwater Research LLC, Tyler, TX;
James Lavine, Corte Madera, CA;
Alireza Raissinia, Monte Sereno, CA;

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

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)

106963 7590 12/10/2018

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
UNITED STATES OF AMERICA

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.

Jennifer Smith	Jennifer Smith (Typed or printed name)
	(Signature)
	1/25/19 (Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2CI	8228

TITLE OF INVENTION: Device-Assisted Services for Protecting Network Capacity

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	03/11/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
ANWAR, MOHAMMAD S	2463	370-230000

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 James E. Harris
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: Headwater Research LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Tyler, TX

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

4a. Fees submitted: X Issue Fee ___ Publication Fee (if required) ___ Advance Order - # of Copies ____

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

X Electronic Payment via EFS-Web ___ Enclosed check ___ Non-electronic payment by credit card (Attach form PTO-2038)

X The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 505876

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 1/25/19

Typed or printed name James E. Harris Registration No. 40013

Electronic Patent Application Fee Transmittal

Application Number:	15977766
Filing Date:	11-May-2018
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Filer:	James E. Harris/Jennifer Smith
Attorney Docket Number:	RALEP032C1C12C2C1

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	500	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**500**

Electronic Acknowledgement Receipt	
EFS ID:	34959481
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Jennifer Smith
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	25-JAN-2019
Filing Date:	11-MAY-2018
Time Stamp:	11:43:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$500
RAM confirmation Number	012519INTEFSW00009490505876
Deposit Account	505876
Authorized User	James Harris
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)	RTF_Fee_Trnasmittal.pdf	468374 dc7e7f4d76dabf99dff9b2c6d691de976da420e5	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30501 df6842fa3fa483e87d74bea32ca304bea1058d17	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	498875		

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

106963 7590 12/10/2018

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

EXAMINER
ANWAR, MOHAMMAD S

ART UNIT	PAPER NUMBER
2463	

DATE MAILED: 12/10/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1	8228

TITLE OF INVENTION: Device-Assisted Services for Protecting Network Capacity

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	03/11/2019

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

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

HOW TO REPLY TO THIS NOTICE:

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

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

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

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

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

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

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

PART B - FEE(S) TRANSMITTAL

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

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

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

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

106963 7590 12/10/2018
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

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.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1	8228

TITLE OF INVENTION: Device-Assisted Services for Protecting Network Capacity

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	03/11/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
ANWAR, MOHAMMAD S	2463	370-230000

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.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1	8228

106963 7590 12/10/2018

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

EXAMINER	
ANWAR, MOHAMMAD S	
ART UNIT	**PAPER NUMBER**
2463	

DATE MAILED: 12/10/2018

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. 15/977,766	Applicant(s) Raleigh et al.	
	Examiner MOHAMMAD S ANWAR	Art Unit 2463	AIA 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 10/18/2018.
   ☐ 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 2-21 (re#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 areply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

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

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

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

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 07/25/2018.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/MOHAMMAD S ANWAR/
Primary Examiner, Art Unit 2463

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	Art Unit
	MOHAMMAD S ANWAR	2463

CPC - Searched*		
Symbol	Date	Examiner
H04W28/0289, H04L47/20,H04L47/245,H04L47/803,H04L47/805	07/13/2018	MA

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
EAST SEARCH	07/13/2018	MA
INVENTOR NAME SEARCH	07/13/2018	MA
Updated Search	11/13/2018	MA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04W	28/0289	07/13/2018	MA

/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	Art Unit
	MOHAMMAD S ANWAR	2463

CPC						
Symbol					Type	Version
H04W	/	24	/	08	F	2013-01-01
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H04L	/	41	/	0893	I	2013-01-01
H04L	/	41	/	5054	I	2013-01-01
H04L	/	47	/	803	I	2013-01-01
H04L	/	47	/	822	I	2013-01-01
H04L	/	47	/	824	I	2013-01-01
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H04L	/	47	/	14	I	2013-01-01
H04L	/	47	/	805	I	2013-01-01
H04W	/	28	/	0268	I	2013-01-01
H04W	/	12	/	08	I	2013-01-01
H04W	/	28	/	0289	I	2013-01-01
H04W	/	48	/	16	I	2013-01-01
H04W	/	80	/	04	I	2013-01-01
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H04M	/	15	/	66	I	2013-01-01
H04M	/	15	/	8016	I	2013-01-01
H04M	/	15	/	8055	I	2013-01-01
H04M	/	15	/	81	I	2013-01-01
H04L	/	41	/	5006	I	2013-01-01
H04L	/	41	/	5029	I	2013-01-01

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	13 November 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

U.S. Patent and Trademark Office — Part of Paper No.: 20181113

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	**Art Unit**
	MOHAMMAD S ANWAR	2463

CPC							
Symbol						**Type**	**Version**
H04L	/	12	/	1492		I	2013-01-01
H04L	/	12	/	1496		I	2013-01-01
H04L	/	41	/	0896		I	2013-01-01
H04W	/	28	/	0284		I	2013-01-01
H04L	/	67	/	16		I	2013-01-01
H04W	/	48	/	02		I	2013-01-01
H04W	/	24	/	00		A	2013-01-01
H04W	/	36	/	14		A	2013-01-01
Y02D	/	70	/	00		A	2018-01-01
H04L	/	47	/	2425		A	2013-01-01
H04L	/	41	/	5022		A	2013-01-01
H04W	/	4	/	24		A	2013-01-01
Y02D	/	70	/	1262		A	2018-01-01
Y02D	/	70	/	164		A	2018-01-01
Y02D	/	70	/	142		A	2018-01-01
Y02D	/	70	/	144		A	2018-01-01
Y02D	/	70	/	23		A	2018-01-01
Y02D	/	70	/	146		A	2018-01-01
Y02D	/	70	/	22		A	2018-01-01
Y02D	/	70	/	122		A	2018-01-01
Y02D	/	70	/	124		A	2018-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	13 November 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

U.S. Patent and Trademark Office — Part of Paper No.: 20181113

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	Art Unit
	MOHAMMAD S ANWAR	2463

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04W28/02	/	28	/	02
H04W4/24	/	4	/	24
H04L12/14	/	12	/	14
H04W12/08	/	12	/	08

NON-CLAIMED				
H04L12/24	/	12	/	24
H04L29/08	/	29	/	08
H04M15/00	/	15	/	00

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	13 November 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

U.S. Patent and Trademark Office — Part of Paper No.: 20181113

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	**Art Unit**
	MOHAMMAD S ANWAR	2463

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

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1	9	10	18	19										
1	2	10	11	19	20										
2	3	11	12	20	21										
3	4	12	13												
4	5	13	14												
5	6	14	15												
6	7	15	16												
7	8	16	17												
8	9	17	18												

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	13 November 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	27

U.S. Patent and Trademark Office — Part of Paper No.: 20181113

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	**Art Unit**
	MOHAMMAD S ANWAR	2463

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

CLAIMS

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

CLAIM		DATE								
Final	Original	07/13/2018	11/13/2018							
	1	-	-							
1	2	✓	=							
2	3	✓	=							
3	4	✓	=							
4	5	✓	=							
5	6	✓	=							
6	7	✓	=							
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16	17	✓	=							
17	18	✓	=							
18	19	✓	=							
19	20	✓	=							
20	21	✓	=							

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

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15977766
Filing Date	2018-05-11
First Named Inventor	Gregory G. Raleigh
Art Unit	2464
Examiner Name	Ngo, Ricky Quoc
Attorney Docket Number	RALEP032C1C12C2C1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6370139	B2	2002-04-09	Redmond	
	2	6732176	B1	2004-05-04	Stewart et al.	
	3	6842628	B1	2005-01-11	Arnold et al.	
	4	6970927	B1	2005-11-29	Stewart et al.	
	5	7200551	B1	2007-04-03	Senez	
	6	7433362	B2	2008-10-07	Mallya et al.	
	7	7467160	B2	2008-12-16	McIntyre	
	8	7505756	B2	2009-03-17	Bahl	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.S.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

	9	7522549	B2	2009-04-21	Karaoguz et al.	
	10	7551921	B2	2009-06-23	Petermann	
	11	7606918	B2	2009-10-20	Holzman et al.	
	12	7644414	B2	2010-01-05	Smith et al.	
	13	7822849	B2	2010-10-26	Titus	
	14	7849170	B1	2010-12-07	Hargens et al.	
	15	7979896	B2	2011-07-12	McMurtry et al.	
	16	8108680	B2	2012-01-31	Murray	
	17	8266249	B2	2012-09-11	Hu	
	18	8463194	B2	2013-06-11	Erlenback et al.	
	19	8500533	B2	2013-08-06	Lutnick et al.	

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	20	8535160	B2	2013-09-17	Lutnick et al.	
	21	8595186	B1	2013-11-26	Mandyam et al.	
	22	8615507	B2	2013-12-24	VARADARAJULU et al.	
	23	8656472	B2	2014-02-18	McMurtry et al.	
	24	8804695	B2	2014-08-12	Branam	
	25	8845415	B2	2014-09-30	Lutnick et al.	
	26	8949382	B2	2015-02-03	Cornett et al.	
	27	8955038	B2	2015-02-10	Nicodemus et al.	
	28	9105031	B2	2015-08-11	Shen et al.	
	29	9313708	B2	2016-04-12	Nam et al.	
	30	9363285	B2	2016-06-07	Kitamura	

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	First Named Inventor	Gregory G. Raleigh
	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

	31	9418381	B2	2016-08-16	Ahuja et al.	
	32	9501803	B2	2016-11-22	Bilac et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020013844	A1	2002-01-31	Garrett et al.	
	2	20020022483	A1	2002-02-21	Thompson et al.	
	3	20040019564	A1	2004-01-29	Goldthwaite et al.	
	4	20040116140	A1	2004-06-17	Babbar et al.	
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	6	20040167958	A1	2004-08-26	Stewart et al.	
	7	20070111740	A1	2007-05-17	Wandel	

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	First Named Inventor	Gregory G. Raleigh
	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

	8	20070191006	A1	2007-08-16	Carpenter	
	9	20070254646	A1	2007-11-01	Sokondar	
	10	20100069074	A1	2010-03-18	Kodialam et al.	
	11	20100113020	A1	2010-05-06	Subramanian et al.	
	12	20100142478	A1	2010-06-10	Forssell et al.	
	13	20150181628	A1	2015-06-25	Haverinen et al.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	20040053858	KR		2004-06-25	Electronics and Telecommunications Research Instit		

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NON-PATENT LITERATURE DOCUMENTS Remove

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

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	Application Number	15977766
	Filing Date	2018-05-11
	First Named Inventor	Gregory G. Raleigh
	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

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EXAMINER SIGNATURE

Examiner Signature	/MOHAMMAD S ANWAR/	Date Considered	11/13/2018

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

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

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	Filing Date	2018-05-11
	First Named Inventor	Gregory G. Raleigh
	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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

OR

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

See attached certification statement.

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

A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-07-25
Name/Print	James E. Harris	Registration Number	40013

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

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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.

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.S.A/

Bibliographic Data

Application No: 15/977,766

Foreign Priority claimed: ○ Yes ◉ No

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

Verified and Acknowledged: /MOHAMMAD S ANWAR/ Examiner's Signature | Initials

Title: Device-Assisted Services for Protecting Network Capacity

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/11/2018	370	2463	RALEP032C1C12C2C1
RULE			

APPLICANTS

Headwater Research LLC, Tyler, TX, UNITED STATES

INVENTORS

Gregory G. Raleigh Woodside, CA, UNITED STATES

James Lavine Corte Madera, CA, UNITED STATES

Alireza Raissinia Monte Sereno, CA, UNITED STATES

CONTINUING DATA

This application is a CON of 15681726 08/21/2017

15681726 is a CON of 14687715 04/15/2015 PAT 9749899

14687715 is a CON of 14082040 11/15/2013 PAT 9609544

13134028 is a CIP of 13134005 05/25/2011 PAT 8635335

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12694455 has PRO of 61264120 11/24/2009

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13134005 is a CIP of 12380780 03/02/2009 PAT 8839388

12695021 is a CIP of 12380780 03/02/2009 PAT 8839388

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12380780 has PRO of 61207739 02/13/2009

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12380778 has PRO of 61207393 02/10/2009

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12380780 has PRO of 61206354 01/28/2009

12380778 has PRO of 61206354 01/28/2009

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

06/04/2018

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

ADDRESS

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
UNITED STATES

FILING FEE RECEIVED

$3,055

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	0	background adj service$1 with deferred adj time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:10
S2	1	background adj service$1 with time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:10
S3	0	background adj service$1 with time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:11
S4	70	background adj service$1 and time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12
S5	0	background adj network adj service$1 and time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12
S6	0	background adj network adj service$1 adj usage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12
S7	0	WWAN and congestion and busy and backgound and time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:14
S8	104	WWAN and congestion and busy and	US-PGPUB;	OR	OFF	2018/07/13

		background and time adj slot$1	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			09:14
S9	138	"8589541"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 11:14
S10	126	"8589541" and capacity	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:16
S11	109	"8589541" and capacity and preference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:18
S12	104	"8589541" and capacity and preference and priorit$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:21
S13	69	"8589541" and capacity and preference and priorit$3 and slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 14:51
S14	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 14:56
S15	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:20
S16	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	OFF	2018/07/13 15:23

			IBM_TDB			
S17	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:27
S18	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:30
S19	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:33
S20	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:37
S21	115	(H04W28/0289 or H04M15/41 or H04L47/2475 or H04L41/5029 or H04L12/1492 or H04L47/803 or H04W24/08 or H04M15/43 or H04L41/5054 or H04L47/824 or H04W28/0284 or H04L47/20 or H04L47/14 or H04M15/66 or H04L41/0896 or H04W48/04 or H04W28/0268 or H04W52/0264 or H04W28/20 or H04W4/50 or H04W12/08 or H04M15/44 or H04L41/5006 or H04W80/04 or H04W48/06 or H04L12/1496 or H04L41/0893 or H04L47/805 or H04W52/0212 or H04W24/02 or H04M15/8055 or H04M15/81 or H04W48/16 or H04M15/8016 or H04L47/822 or H04L47/2425 or H04L41/5022 or Y02D70/00 or H04W36/14 or H04W24/00).cpc. and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:41
S22	83	Raleigh.inv. and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:41

11/13/2018 11:41:29 AM
C:\Users\manwar\Documents\EAST\Workspaces\15977766.wsp

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	15977766
Filing Date	11-May-2018
First Named Inventor	Gregory Raleigh
Attorney Docket Number	RALEP032C1C12C2C1
Title of Invention	Device-Assisted Services for Protecting Network Capacity

☒ 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
Headwater Research 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)

8589541

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 40013 ○ 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	/James E. Harris/
Name	James E. Harris

*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:	15977766
Filing Date:	11-May-2018
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Filer:	James E. Harris/Jennifer Smith
Attorney Docket Number:	RALEP032C1C12C2C1

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	2814	1	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.: 15977766

Filing Date: 11-May-2018

Applicant/Patent under Reexamination: Raleigh

Electronic Terminal Disclaimer filed on October 18, 2018

☒ 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:	34051985
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Jennifer Smith
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	18-OCT-2018
Filing Date:	11-MAY-2018
Time Stamp:	16:24:38
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$160
RAM confirmation Number	101918INTEFSW00003065505876
Deposit Account	505876
Authorized User	James Harris
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)	

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	33357 4ceeac84125636 9b7132e704b9de8e3ef27 3b463	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30756 95fb6dc0c654fa50773b68204024cfd092cb d289	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	64113		

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.

Electronic Acknowledgement Receipt	
EFS ID:	34052263
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Jennifer Smith
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	18-OCT-2018
Filing Date:	11-MAY-2018
Time Stamp:	16:32:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Amendment/Req. Reconsideration-After Non-Final Reject	P032C1C12C2C1_responsetoOA.pdf	107895 8f4f369b4c6fb71eddf9b535d5ff01589b1b5b15	no	9

Warnings:

Information:	
Total Files Size (in bytes):	107895

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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Raleigh et al.	Examiner:	Anwar, Mohammad S.
Serial No.:	15/977,766	Art Unit:	2463
Filed:	May 11, 2018	Conf. No.:	8228
Title:	Device-Assisted Services for Protecting Network Capacity		

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

AMENDMENT AND RESPONSE

In response to the Office Action dated July 19, 2018, the no-fee deadline for response being October 19, 2018, please amend the above-identified application as follows:

Amendments to the Claims begin on page 2.

Remarks begin on page 7.

AMENDMENTS TO THE CLAIMS

1. (Canceled)

2. (Currently Amended) A wireless end-user device, comprising:
a processor;
a Wireless Wide-Area Network (WWAN) modem, to communicate data for network service usage activities between the wireless end-user device and a WWAN; and
a non-transitory computer-readable storage medium storing instructions that, when provided to the processor, cause the processor to
receive respective requests from a plurality of applications on the device to access the WWAN for background network service usage activities associated with the respective applications,
based at least in part on a current WWAN network busy state, select a corresponding current service usage control policy for the background network service usage activities,
determine respective deferred time slots for each of the background network service usage activities based on the current service usage control policy, wherein at least one such service usage control policy specifies that during a time when the current WWAN network busy state indicates network congestion, a selected subset of the background network service usage activities are deferred until network congestion is no longer indicated, and
allow each of the background network service usage activities to access the WWAN during the respective deferred time slot for that background network service usage activity.

3. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to classify the respective requests with respective priorities, and the at least one such service usage control policy determines the selected subset of the background network service usage activities based on the respective priorities of the respective requests.

4. (Previously Presented) The wireless end-user device of claim 3, wherein to classify the respective requests with respective priorities comprises maintaining a network capacity-controlled services list indicating one or more applications having a network capacity control, and assigning a respective priority to a request based on the network capacity-controlled services list.

5. (Previously Presented) The wireless end-user device of claim 4, wherein the network capacity-controlled services list is based at least in part on user preference selections.

6. (Previously Presented) The wireless end-user device of claim 2, wherein to allow each of the background network service usage activities to access the WWAN during the respective deferred time slot comprises blocking or delaying execution of the application associated with a given background network service usage activity until the respective deferred time slot is reached.

7. (Previously Presented) The wireless end-user device of claim 2, wherein to allow each of the background network service usage activities to access the WWAN during the respective deferred time slot comprises informing an application associated with a given background network service activity when the WWAN is available for that activity.

8. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to, based on at least one selected current service usage policy, defer at least one of the background network service usage activities until a different network, other than the WWAN, is available to communicate data for that at least one of the background network service usage activities.

9. (Previously Presented) The wireless end-user device of claim 8, wherein the different network comprises a specific network selection for that at least one of the background network service usage activities.

10. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, monitoring of user interaction with the device.

11. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, a power state.

12. (Previously Presented) The wireless end-user device of claim 2, wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access Application Programming Interface (API), the API allowing applications to request a time slot demand for a background network service usage activity.

13. (Previously Presented) The wireless end-user device of claim 2, wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access Application Programming Interface (API), the API allowing applications to indicate a data size for a background network service usage activity.

14. (Previously Presented) The wireless end-user device of claim 2, wherein the current network busy state is received from a network element via the WWAN.

15. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to generate the current network busy state.

16. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select the corresponding current

service usage control policy for the background network service usage activities based on a service plan active on the device, in addition to the current WWAN network busy state, the service plan including network busy state-based criteria restrictions that apply to network capacity-controlled services, including one or more of the background network service usage activities.

17. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on a service usage behavior analysis of the activity.

18. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on monitoring power consumption behavior of the activity.

19. (Previously Presented) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on monitoring user interaction with the activity.

20. (Previously Presented) The wireless end-user device of claim 2, the one or more processors further configured to communicate with one or more of the applications through an Application Programming Interface that informs each such application of one or more policies applied to background network service usage activities associated with that application.

21. (Previously Presented) The wireless end-user device of claim 2, wherein to determine respective deferred time slots for each of the background network service usage activities further comprises delaying a time slot for a particular one of the background network

service usage activities at least until a first time delay has occurred since a previous deferred time slot associated with that activity.

REMARKS

Claims 2-21 are pending and were rejected. Claim 2 is amended herein, and claims 2-21 remain active in the application. In view of the claim amendments and the following remarks, Applicant respectfully requests reconsideration.

Claim Rejection – 35 USC §101

Claims 2-21 were rejected under 35 USC §101 as directed to non-statutory subject matter, due to the recitation of the claim element "computer-readable storage medium," which has a broadest reasonable interpretation covering transitory signals. The Examiner suggested this rejection can be overcome by amending the element to read "non-transitory computer-readable storage medium," as long as such is supported by the specification.

Applicant's specification refers to "a computer program product embodied on a computer readable storage medium." Original Specification at [0031]. Applicant submits that the "product embodied on" language is reasonably interpretable to include physical hardware, and would not be understood to include ephemeral signals. The specification also refers to a processor configured to execute instructions stored on and/or provided by a memory coupled to the processor. *Id.* Such language also would be reasonably understood to describe a physical memory device. The specification further refers to a non-volatile memory, *Id.* at [00173], [00234], in various embodiments. Finally, the specification states that as used therein, "a computer-readable medium is intended to include all mediums that are statutory (e.g., in the United States, under 35 U.S.C. 101), and to specifically exclude all mediums that are non-statutory in nature to the extent that the exclusion is necessary for a claim that includes the computer-readable medium to be valid. Known statutory computer-readable mediums include hardware (e.g., registers, random access memory (RAM), non-volatile (NV) storage, to name a few), but may or may not be limited to hardware." *Id.* at [00281].

Based at least on the examples given above, Applicant's original specification supports an amendment to claim 2 reciting that the computer-readable storage medium is non-transitory. Accordingly, Applicant has made a corresponding amendment to claim 2, and Applicant submits that such amendment does not constitute new matter, and fully overcomes the rejection.

Claim Rejection – Double Patenting

Claims 2-21 were rejected under the judicially-created doctrine of nonstatutory double patenting over corresponding claims of U.S. Patent No. 8,589,541. Applicant submits herewith a terminal disclaimer with respect to the '541 patent, which is commonly owned by Headwater Research LLC, and submits that the terminal disclaimer overcomes the nonstatutory double patenting rejection.

CONCLUSION

Applicant respectfully requests entry of these amendments as provided herein. The application is believed to be in condition for allowance, and a Notice of Allowance is hereby respectfully requested. If the Examiner has any questions or needs any additional information, the Examiner is invited to contact the undersigned.

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: October 18, 2018

By: /James E. Harris/

James E. Harris
Reg. No. 40,013
Patent Counsel
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
(903) 201-6212

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: October 18, 2018 By: /Jennifer Smith/
Jennifer Smith

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/977,766	Filing Date 05/11/2018	☐ 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), (i), or (m))	N/A	N/A	N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =	
☐ 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

AMENDMENT	10/18/2018	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0	X $50 =	0
	Independent (37 CFR 1.16(h))	* 1	Minus	***3	= 0	X $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	**0**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =	
	☐ 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.
** 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 number found in the appropriate box in column 1.

LIE
CHERYL CLARK

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1

CONFIRMATION NO. 8228

106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

PUBLICATION NOTICE

OC000000102296885

Title: Device-Assisted Services for Protecting Network Capacity

Publication No.US-2018-0262947-A1
Publication Date:09/13/2018

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

Application Number	15977766
Filing Date	2018-05-11
First Named Inventor	Gregory G. Raleigh
Art Unit	2464
Examiner Name	Ngo, Ricky Quoc
Attorney Docket Number	RALEP032C1C12C2C1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6370139	B2	2002-04-09	Redmond	
	2	6732176	B1	2004-05-04	Stewart et al.	
	3	6842628	B1	2005-01-11	Arnold et al.	
	4	6970927	B1	2005-11-29	Stewart et al.	
	5	7200551	B1	2007-04-03	Senez	
	6	7433362	B2	2008-10-07	Mallya et al.	
	7	7467160	B2	2008-12-16	McIntyre	
	8	7505756	B2	2009-03-17	Bahl	

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	9	7522549	B2	2009-04-21	Karaoguz et al.	
	10	7551921	B2	2009-06-23	Petermann	
	11	7606918	B2	2009-10-20	Holzman et al.	
	12	7644414	B2	2010-01-05	Smith et al.	
	13	7822849	B2	2010-10-26	Titus	
	14	7849170	B1	2010-12-07	Hargens et al.	
	15	7979896	B2	2011-07-12	McMurtry et al.	
	16	8108680	B2	2012-01-31	Murray	
	17	8266249	B2	2012-09-11	Hu	
	18	8463194	B2	2013-06-11	Erlenback et al.	
	19	8500533	B2	2013-08-06	Lutnick et al.	

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	20	8535160	B2	2013-09-17	Lutnick et al.	
	21	8595186	B1	2013-11-26	Mandyam et al.	
	22	8615507	B2	2013-12-24	VARADARAJULU et al.	
	23	8656472	B2	2014-02-18	McMurtry et al.	
	24	8804695	B2	2014-08-12	Branam	
	25	8845415	B2	2014-09-30	Lutnick et al.	
	26	8949382	B2	2015-02-03	Cornett et al.	
	27	8955038	B2	2015-02-10	Nicodemus et al.	
	28	9105031	B2	2015-08-11	Shen et al.	
	29	9313708	B2	2016-04-12	Nam et al.	
	30	9363285	B2	2016-06-07	Kitamura	

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	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

	31	9418381	B2	2016-08-16	Ahuja et al.	
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	2	20020022483	A1	2002-02-21	Thompson et al.	
	3	20040019564	A1	2004-01-29	Goldthwaite et al.	
	4	20040116140	A1	2004-06-17	Babbar et al.	
	5	20040127256	A1	2004-07-01	Goldthwaite et al.	
	6	20040167958	A1	2004-08-26	Stewart et al.	
	7	20070111740	A1	2007-05-17	Wandel	

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	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

	8	20070191006	A1	2007-08-16	Carpenter	
	9	20070254646	A1	2007-11-01	Sokondar	
	10	20100069074	A1	2010-03-18	Kodialam et al.	
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	12	20100142478	A1	2010-06-10	Forssell et al.	
	13	20150181628	A1	2015-06-25	Haverinen et al.	

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	1	20040053858	KR		2004-06-25	Electronics and Telecommunications Research Instit		

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

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	Art Unit	2464
	Examiner Name	Ngo, Ricky Quoc
	Attorney Docket Number	RALEP032C1C12C2C1

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

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See attached certification statement.

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

A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-07-25
Name/Print	James E. Harris	Registration Number	40013

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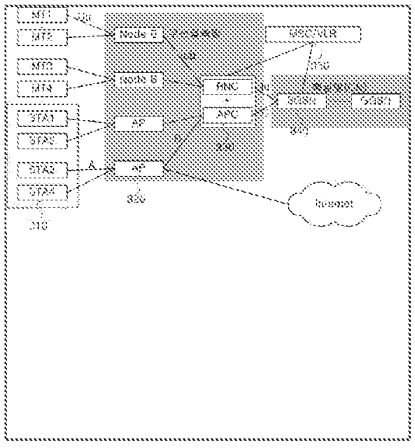
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무선랜과 셀룰러 망의 연동 시스템 및 방법, 그프로그램이 저장된 기록매체

system for linking of wireless and cellular networkand method thereof, its program storing recordingmedium

(51) Int. CL	H04W 48/18(2009.01.01) H04W 88/06(2009.01.01) H04W 84/12(2009.01.01) H04L 29/06(2006.01.01)
(52) CPC	H04W 48/18(2013.01) H04W 88/06(2013.01) H04W 84/12(2013.01) H04L 29/06(2013.01)
(21) Application No.(Date)	1020020080313 (2002.12.16)
(71) Applicant	Electronics and Telecommunications Research Institute
(11) Registration No.(Date)	1004830210000 (2005.04.04)
(65) Unex. Pub. No.(Date)	1020040053858 (2004.06.25)
(11) Publication No.(Date)	(2005.04.15)
(86) Int'l Application No.(Date)	
(87) Int'l Unex. Pub. No.(Date)	
(30) Priority info. (Country / No. / Date)	
Legal Status	**Ended**
Examination Status	Decision to grant (General)
Trial Info	
Kind/Right of Org. Application	/
Right of Org. Application No.(Date)	
Related Application No.	
Request for an examination(Date)	Y(2002.12.16)
Number of examination claims	34



PURPOSE: An interworking system between a WLAN(Wireless LAN) and a cellular phone network is provided to operate an IEEE802.11 physical layer and an AP(Access Point) according to an 802.11e MAC protocol that improves a QoS function, thereby supporting service mobility and supporting dual modes by selectively

interworking a WLAN and a cellular network.CONSTITUTION: A wireless station(310) maintains profile information in the same information type as a mobile terminal, and supports dual modes to connect with a WLAN or to be operated by interworking with a cellular network. If the wireless station(310) requests a call setup and transceives data after the call setup, APs(320) wirelessly connect with the wireless station(310) by using an 802.11 physical layer and an 802.11e MAC function, receive data and a control signal, and transmit the data and the control signal to an APC(330). The APC(330) maintains information necessary for interworking with the cellular network by accessing the APs(320), and connects with an MSC/VLR(350) and an SGSN(340) of the cellular network.© KIPO 2004

10-2004-0053858

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(51) Int. Cl.[7]
H04L 12/46

(11) 공개번호 10-2004-0053858
(43) 공개일자 2004년06월25일

(21) 출원번호 10-2002-0080313
(22) 출원일자 2002년12월16일

(71) 출원인 한국전자통신연구원
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(74) 대리인 유미특허법인

심사청구 : 있음

(54) 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그프로그램이 저장된 기록매체

요약

본 발명은 이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체에 관한 것으로서, 본 발명은 상기 셀룰러 망의 무선 접속망은 무선 접속망 내에서 동일한 인터페이스로 접속하고, 무선랜을 위한 규격을 이용하여 상기 무선 단말기와 무선 접속하여 데이터 및 제어신호를 출력하는 다수의 접속장치, 다수의 접속 장치와 연결되어 접속장치로부터의 데이터 및 제어신호를 전달받아 이를 상기 핵심망으로 전달하고, 핵심망과 무선접속망에서와 동일한 방식으로 접속하는 접속 제어장치를 포함함으로써, 무선랜을 위해 IEEE 802.11 물리계층과, 서비스 품질 기능을 향상시킨 802.11e MAC 프로토콜에 따라 무선 접속 구간을 운용함으로써 서비스의 이동성을 지원할 수 있고, 서비스에 따라 무선랜과 셀룰러 망에 선택적 연동할 수 있어 듀얼 모드 지원이 가능하고, 또한 호 설정을 위한 제어 신호의 실시간 전송 및 사용자 트래픽의 서비스 품질을 보장할 수 있는 효과가 있다.

대표도

도4

색인어

선랜, 셀룰러 망, 무선접속망, 핵심망, 접속장치(AP), 접속제어장치(APC)

명세서

도면의 간단한 설명

도 1은 일반적인 패킷 서비스를 제공하는 W-CDMA 네트워크의 구성을 도시한 것이다.

도 2는 종래 기술에 따른 실시예의 IEEE(Institute of Electrical and Electronics Engineers) 802.11 네트워크의 구성을 도시한 것이다.

도 3은 셀룰러 망 중에서 광대역 코드분할 다중접속(W-CDMA) 망의 접속 인터페이스 구조를 도시한 것이다.

도 4는 본 발명에 따른 실시예의 무선랜과 셀룰러 망의 연동 시스템의 구성을 도시한 것이다.

도 5는 도 3에 의한 W-CDMA 프로토콜의 제어평면 구조를 도시한 것이다.

도 6은 도 3에 의한 W-CDMA 프로토콜의 사용자 평면 구조를 도시한 것이다.

도 7은 도 4에 의한 802.11e 무선랜과 셀룰러 망 중 W-CDMA 망 연동 네트워크의 제어평면 프로토콜 구조를 도시한 것이다.

도 8은 도 4에 의한 802.11e 무선랜과 셀룰러 망 중 W-CDMA 망 연동 네트워크의 사용자 평면 프로토콜 구조를 도시한 것이다.

도 9는 본 발명에 따른 실시예의 무선랜과 셀룰러 망의 연동 방법에 따른 신호 및 데이터 전송 절차를 도시한 것이다.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술분야 및 그 분야의 종래기술

본 발명은 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체에 관한 것으로, 보다 상세하게는 IEEE 802.11를 이용하여 무선랜과 셀룰러 망을 연동하기 위한 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체에 관한 것이다.

도 1은 일반적인 패킷 서비스를 제공하는 W-CDMA 네트워크의 구성을 도시한 것이다.

도 1을 참고하면, 이동통신 가입자는 노트북이나 일반 개인용 컴퓨터와 같은 종단 장치(Terminal Equipment)(10)를 사용하여 이동 전화기(Mobile Terminal, MT)(20)에 접속하여 인터넷 등의 패킷 데이터 서비스를 제공받는다.

이동 전화기(20)는 에어 인터페이스(Air Interface)를 통해 무선 접속망(UMTS Terrestrial Radio Access Network, UTRAN)(30)에 접속하고, UTRAN(30)은 ATM(Asynchronous Transfer Mode) 또는 인터넷 프로토콜망(IP)을 통하여 SGSN(Serving GPRS Support Node)(40)에 접속하며, SGSN(40)은 GGSN(Gateway GPRS Support Node)(50)를 통하여 외부 공중망(Public Data Network, PDN)(70)과 접속된다.

여기서, UMTS는 Universal Mobile Telecommunication System의 약어이고, GPRS는 General Packet Radio Service의 약어이다.

또한, 이동교환기(Mobile Switching Center, MSC)(60)는 UTRAN(30), SGSN(40), GGSN(50)과 통신하면서 이동통신 가입자에게 회선 교환 서비스를 제공하고, 이동 전화기(20)의 위치를 추적한다. 이때, MSC(60)는 이동 전화기(20)의 위치 추적을 위해 가입자 및 이동 전화기(20) 정보를 보관하는 방문자 위치 등록기(Visitor Location Register, VLR)와 연동된다.

도 2는 종래 기술에 따른 실시예의 IEEE(Institute of Electrical and Electronics Engineers) 802.11 네트워크의 구성을 도시한 것이다.

도 2를 참고하면, 다수의 무선 단말기(Mobile Station, STA1)(110)는 노트북이나 PDA(Personal Digital Assistant) 등을 이용하여 하나의 CF(Coordination Function)에 의해서 제어되는 BSS(Basic Service Set)(130)를 이루고, 이는 다시 AP(Access Point)(120)를 통하여 다른 BSS와 DS(Distribution System)(140)를 거쳐 연결된다.

이러한 구조로 이루어진 종래의 셀룰러(Cellular) 망과 802.11 무선랜 망은 현재 별개의 망으로 중복 구축되고 있는 실정이다. 이는 셀룰러 망이 넓은 서비스 영역과 높은 이동성을 지원하지만 서비스 속도가 느리고 비용이 고가인 반면에, 무선랜 망은 좁은 서비스 영역과 낮은 이동성을 지원하지만 비교적 높은 서비스 속도와 저렴한 서비스 비용으로 급속히 확산되고 있기 때문이다.

따라서 종래 기술에 따른 실시예에서는 셀룰러 망과 802.11 무선랜 망의 장점을 이용하여 연동할 수 있는 방안이 아직 제시되지 않고 있으며, 기존의 802.11a/b 망은 셀룰러 망에서 요구하는 QoS(서비스 품질, Quality of Service)를 제공할 수 없는 문제점이 있다.

또한, 종래 기술에 따른 실시예에서 무선랜 망과 셀룰러 망간의 실시간 호 설정이 지원되지 않으며, 서비스의 이동성도 지원되지 않는다는 문제점도 있다.

발명이 이루고자 하는 기술적 과제

본 발명은 위의 문제점을 해결하기 위한 것으로, 본 발명의 목적은 셀룰러 망의 무선 접속망을 무선랜으로 대체하여 셀룰러 망과 무선랜이 연동하여 망간 서비스 이동성과 서비스 품질을 보장하기 위한 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체를 제공하는 것이다.

발명의 구성 및 작용

상기한 바와 같은 목적을 실현하기 위한 본 발명에 따른 무선랜과 셀룰러 망의 연동 시스템의 특징은, 이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 시스템에 있어서, 상기 무선 접속망 내에서 동일한 인터페이스로 접속하고, 무선랜을 위한 규격을 이용하여 상기 무선 단말기와 무선 접속하여 데이터 및 제어신호를 출력하는 다수의 접속장치; 상기 다수의 접속 장치와 연결되어 상기 접속장치로부터의 데이터 및 제어신호를 전달받아 이를 상기 핵심망으로 전달하고, 상기 핵심망과 무선접속망에서와 동일한 방식으로 접속하는 접속 제어장치를 포함한다.

상기 무선 단말기는 무선랜을 위한 규격에서 사용하는 특정 프로토콜 기능과 셀룰러 망에서 사용하는 프로토콜 기능, 및 인터넷 통신 프로토콜 기능을 가진다.

상기 무선 단말기의 프로토콜 중에서 무선 접속구간에서 이용되는 계층(Layer)2 이하의 PDCP(Packet Data Convergence Protocol), RRC(Radio Resource Control), RLC(Radio Link Control)/MAC(Media Access Control) 프로토콜이 IEEE(Institute of Electrical and Electronics Engineers) 802.11e MAC(Medium Access Control) 프로토콜로 대체하고, 나머지 PMM(Packet Mobility Management) 및 SM(Session Management) 프로토콜은 그대로 채용한다.

상기 무선 단말기의 프로토콜 중에서 무선 접속 구간에 이용되는 RRM(Radio Resource Management) 기능을

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추가하여 무선 자원관리 및 이동성을 지원하도록 한다.

상기 무선 단말기는 셀룰러 망 접속을 위해 필요한 프로파일 정보를 상기 이동 단말기와 같은 정보 형태로 유지한다.

상기 무선 단말기는 상기 셀룰러 망에 연동하여 운용되거나 무선랜에 접속하여 운용되도록 듀얼 모드(Dual mode)를 지원한다.

상기 접속장치의 무선랜을 위한 규격은 IEEE(Institute of Electrical and Electronics Engineers) 802.11 물리계층과 802.11e MAC(Medium Access Control) 계층을 이용한다.

상기 접속장치와 접속 제어장치는 유선으로 접속한다. 상기 접속 제어장치는, 상기 무선접속망의 RNC(Radio Network Controller) 기능을 포함한다. 상기 접속 제어장치는, 상기 셀룰러 망과의 연동에 필요한 정보를 유지하며 상기 셀룰러 망 내의 MSC(Mobile Switching Center)/VLR(Visitor Location Register)에 접속한다.

상기 접속장치와 접속 제어장치간의 제어신호는, 상기 무선랜을 위한 규격인 IEEE 802.11e MAC의 기능 중 HCF(Hybrid Coordination Function) 기능 중 HCF Controlled channel access 기능, 또는 PCF(Point Coordination Function) 기능을 이용하여 실시간 전송되도록 한다.

상기 접속장치와 접속 제어장치간의 데이터 전송은, 사용자의 서비스 품질을 고려하여 HCF contention-based channel access(EDCF) 기능을 이용하여 전송한다.

상기 접속장치와 접속 제어장치간의 데이터 전송은, 사용자의 서비스 품질을 고려하지 않고 DCF(Distributed Coordination Function) 기능을 이용하여 전송한다.

상기 접속 제어장치와 무선 단말기는 무선랜과 상기 셀룰러 망간의 이동성을 지원하기 위해 버티컬 핸드오프(Vertical Hand-off) 기능을 지원한다.

한편, 본 발명에 따른 무선랜과 셀룰러 망의 연동 시스템의 특징은, 이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 방법에 있어서, a) 상기 무선 단말기를 초기화하고 상기 무선 단말기와 셀룰러 망, 또는 상기 무선 단말기와 무선랜 간 호 설정을 수행하는 단계; b) 상기 a) 단계에서 호 설정 후, 상기 무선 단말기와 셀룰러 망간 데이터를 전송하는 단계; 및 c) 상기 b) 단계에서 데이터 전송이 완료되면, 설정된 호를 해제하는 단계를 포함한다.

상기 a) 단계 내지 c) 단계는, 상기 무선 단말기와 무선 접속하여 데이터 전송을 수행하는 접속장치가 무선랜을 위해 IEEE(Institute of Electrical and Electronics Engineers) 802.11 물리계층과 802.11e MAC(Medium Access Control) 계층을 이용한다.

상기 접속장치는 802.11e 스펙에 의해 CP(Contention Period) 또는 CFP(Contention Free Period)에 상관없이 CCI(Controlled Contention Interval)을 야기하기 위해 부정기적으로 'CC(Controlled Contention) Control Frame'을 상기 무선 단말기로 전송한다.

상기 CC에는 CCI 내의 CCOP(Controlled Contention OPportunity)의 수(Nccop)와, 각 CCOP의 주기 시간(Duration time) 값을 포함한다.

상기 a) 단계는,

가) 상기 무선 단말기가 메시지 전달을 위해 상기 셀룰러 망에서 야기되는 'CC Control Frame'의 수신을 대기하는 단계; 나) 상기 무선 단말기가 'CC Control Frame'을 수신하면, 'RR(Reservation Request) Frame'을 상기 셀룰러 망으로 전송하여 무선 자원을 예약하는 단계; 다) 상기 나) 단계를 통해 CCI(Controlled Contention Interval) 동안 다수의 무선 단말기로부터'RR Frame'를 전송받은 셀룰러 망은 다음 CCI에 전송하는 'CC Frame'에 해당 무선 단말기의 무선 자원 예약 알림(Ack) 메시지를 전송하는 단계; 라) 상기 셀룰러 망이 'RR Frame'을 승인한 무선 단말기에 대하여 무선 전송 기회를 부여하는 단계; 마) 상기 라) 단계에서 무선 전송 기회를 부여받은 무선 단말기는 상기 셀룰러 망의 핵심망에 등록 절차를 수행하는 단계; 및 바) 상기 마) 단계에서 등록 절차가 완료된 무선 단말기는 데이터 전송을 위해 상기 셀룰러 망과의 세션 연결 설정을 요구하는 단계를 포함한다.

상기 나) 단계에서 'RR Frame'은 TID(Traffic ID)와 무선 전송 기회 기간 값을 포함한다.

상기 다) 단계에서 'Ack 메시지'를 전송받은 무선단말기는 'CC Frame'의 피드백 필드(Feedback Filed) 내 자신의 식별 값으로 무선 자원 예약 요구의 승인을 확인한다.

상기 마) 단계에서 무선 단말기의 등록 절차를 수행하는 단계는, ㄱ) 상기 셀룰러 망의 무선접속망 내에서 상기 무선 단말기와 무선 접속되는 접속장치에 전송된 무선 단말기의 'Attach Request'메시지가 상기 접속장치와 접속되는 접속 제어장치에 전송되는 단계; ㄴ) 상기 ㄱ) 단계에서 'Attach Request'메시지를 전송받은 접속 제어장치는 이 메시지를 상기 핵심망으로 전달하고, 상기 핵심망으로부터 전달되는 'Attach Request/Reject'메시지를 상기 접속장치로 전송하는 단계; 및 ㄷ) 상기 ㄴ) 단계를 통해 접속장치는 'Attach Request/Reject'메시지를 '(QoS Data+)CF-Poll+CF-Ack Frame'을 통하여 상기 무선 단말기로 전송하는 단계를 포함한다.

마) 상기 바) 단계를 통해 상기 무선 단말기의 세션 연결 절차와 등록 절차 사이에 일정 시간 이상이 소요되면, 상기 무선 단말기는 이전의 무선 전송 기회를 종료하고 다시 상기 셀룰러 망으로 다른 무선 전송 기회를 부여받기 위해 세션 연결 제어 메시지를 상기 셀룰러 망으로 전송하는 단계를 포함한다.

상기 바) 단계에서 무선 단말기의 세션 연결 설정 단계는, ㄱ) 상기 무선 단말기는 'QoS Data Frame'을 이용하여 'Active PDP Context Request' 메시지를 상기 셀룰러 망의 무선 접속망으로 전송하는 단계; ㄴ) 상기 ㄱ) 단계를 통해 무선접속망에 전달된 메시지는 핵심망의 SM(Session Management) 계층에 전달되어 데이터 경로 설정에 대한 준비가 이루어지는 단계; 및 ㄷ) 상기 ㄴ) 단계를 통해 핵심망의 SM 계층은

'Activate PDP Context Accept/Reject' 메시지를 상기 무선 접속망을 거쳐 'CF-Poll-Ack Frame'을 통해 상기 무선 단말기로 전달하는 단계를 포함한다.

상기 ㄷ) 단계에서 'Activate PDP Context Accept'메시지를 수신한 무선 단말기는 데이터 경로 설정 요구가 이루어졌음을 확인하고, 무선접속망에 설정된 무선 전송의 기회를 해제한다.

상기 b) 단계는,

상기 a) 단계에서 호 설정이 이루어지면, 상기 무선 단말기는 IEEE 802.11의 DCF(Distributed Coordination Function) 기능, 또는 사용자의 서비스 품질을 고려하여 HCF contention-based channel access(EDCF) 기능을 이용하여 상기 셀룰러 망으로 데이터를 전송한다.

상기 무선 단말기와 셀룰러 망 내에서 무선으로 접속되는 접속장치 간의 데이터 전송은, IEEE 802.11e 스펙에 규정된 CSMA/CA(Carrier Sensing Multiple Access/Collision Avoidance) 알고리즘에 따라 이루어지고, 각 데이터 트래픽에 대한 우선순위는 MAC 계층의 스케줄러에 의해 제어된다.

상기 c) 단계는,

가) 상기 b) 단계에서 데이터 전송이 종료되면, 상기 무선 단말기와 셀룰러 망의 핵심망간 설정된 세션을 종료하기 위해 무선접속망의 호 설정을 예약하는 단계; 나) 상기 가) 단계를 통해 핵심망은 이전에 설정된 데이터 경로를 해제하여 셀룰러 망의 세션을 종료하는 단계; 및 다) 상기 나) 단계에서 세션이 종료되면, 상기 무선 단말기는 전송할 데이터의 유무에 따라 세션을 재설정하거나 등록 해제 절차를 수행하는 단계을 포함한다.

상기 가) 단계는,

ㄱ) 상기 무선 단말기가 메시지 전달을 위해 상기 셀룰러 망에서 아기되는 'CC Control Frame'의 수신을 대기하는 단계; ㄴ) 상기 무선 단말기가 'CC Control Frame'을 수신하면, 'RR(Reservation Request) Frame'을 상기 셀룰러 망으로 전송하여 무선 자원을 예약하는 단계; ㄷ) 상기 ㄴ) 단계를 통해 CCI(Controlled Contention Interval) 동안 다수의 무선 단말기로부터'RR Frame'를 전송받은 셀룰러 망은 다음 CCI에 전송하는 'CC Frame'에 해당 무선 단말기의 무선 자원 예약 알림(Ack) 메시지를 전송하는 단계; ㄹ) 상기 셀룰러 망이 'RR Frame'을 승인한 무선 단말기에 대하여 무선 전송 기회를 부여하는 단계; 및 ㅁ) 상기 ㄹ) 단계에서 무선 전송 기회를 부여받은 무선 단말기는 상기 셀룰러 망의 핵심망에 등록 절차를 수행하는 단계를 포함한다.

상기 나) 단계는, ㄱ) 상기 무선 단말기는 셀룰러 망의 핵심망으로부터 'Deactivate PDP Context Request'메시지를 전달받아 'QoS Data Frame'을 통해 무선접속망으로 전달하는 단계; ㄴ) 상기 ㄱ) 단계에서 무선접속망으로 전달된 메시지는 다시 핵심망으로 전달되므로 상기 핵심망이 이전에 설정된 데이터 경로를 해제한 후에 'Deactivate PDP Context Accept'메시지를 무선접속망으로 전송하는 단계; 및 ㄷ) 상기 ㄴ) 단계에서 메시지를 전송받은 무선 접속망은 'CF-Poll+CF-Ack'을 이용하여 상기 무선 단말기로 전송하는 단계를 포함한다.

상기 다) 단계는, 상기 무선 단말기가 전송할 데이터가 있을 경우에 세션을 재설정하기 위한 절차를 수행하고, 상기 무선 단말기가 전송할 데이터가 없을 경우에 상기 셀룰러 망과의 접속을 종료하기 위해 등록 해제 절차를 수행한다.

상기 무선단말기의 등록 해제 절차는, 상기 무선 단말기의 'Detach Request'메시지가 핵심망으로 전달하여 상기 핵심망으로부터 'Detach Accept'메시지가 상기 무선 접속망으로 수신되면, 상기 무선 접속망이 제어 메시지 전달을 위한 무선 전송의기회가 종료되었음을 상기 무선 단말기로 알린다.

상기 무선 단말기가 셀룰러 망에 연동하여 운영되거나, 무선랜에 접속하여 운영되는 듀얼 모드로 동작한다. 상기 듀얼 모드 지원과 선택은 자동으로 설정 기능하고, 비콘(beacon) 프레임을 이용하여 방송될 수 있다.

무선랜과 셀룰러 망의 연동을 위한 프로그램이 저장된 기록매체의 특징은, 이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동을 위해, 상기 무선 단말기를 초기화하고 상기 무선 단말기와 셀룰러 망, 또는 상기 무선 단말기와 무선랜 간 호 설정을 수행하는 제1 기능; 상기 호 설정 후, 상기 무선 단말기와 셀룰러 망간 데이터를 전송하는 제2 기능; 및 상기 데이터 전송이 완료되면, 설정된 호를 해제하는 제3 기능을 포함한다.

이하 첨부된 도면을 참조하여 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자가 본 발명을 용이하게 실시할 수 있는 바람직한 실시예를 상세히 설명하면 다음과 같다.

도 3은 셀룰러 망 중에서 광대역 코드분할 다중접속(W-CDMA) 망의 접속 인터페이스 구조를 도시한 것이다.

도 3에서, Iu는 핵심망(Core Network, CN)과 무선접속망(UTRAN) 사이의 인터페이스이고, Iur은 UTRAN의 RNC(Radio Network Controller) 사이의 논리적인 인터페이스이며, Iub는 RNC와 노드B 사이의 인터페이스를 각각 나타낸다. 한편, Uu는 UTRAN과 이동국(User Equipment, UE) 사이의 무선 인터페이스를 나타낸다.

여기서, 노드B(Node B)는 하나 또는 그 이상의 셀에서 UE로부터 무선 송수신을 책임지고 있는 논리적인 노드로서, 각각의 셀들을 제어하는 셀 제어장치(Cell Controller)가 포함되어 있다.

도 4는 본 발명에 따른 실시예의 무선랜과 셀룰러 망의 연동 시스템의 구성을 도시한 것이다.

도 4에 도시된 바와 같이, 본 발명에 따른 실시예의 시스템은 이동단말기나 무선단말기(Mobile Station, STA)와 핵심망(CN) 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되고, 무선 접속망 내에 노드B, RNC, 외에 접속장치(Access Point)(320)와 접속 제어장치(Access Point Controller)(330)를 포함하고 있다.

이때, 접속장치(320)는 노드B를 대체한 것이고, 접속 제어장치(330)는 무선접속망 내의 RNC를 대체하거나,

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기존의 RNC 기능에 접속 제어 기능을 포함하도록 RNC를 재설계한 것일 수도 있다.

또한, 접속장치(320)와 접속 제어장치(330)는 유선으로 접속된다.

무선 단말기(310)는 IEEE 802.11 물리계층과 802.11e MAC 계층 프로토콜 기능을 가지며, 계층 3에서 셀룰러 프로토콜 기능(예를 들어, W-CDMA의 PMM, SM 등)을 가지며, 그 상위에 일반적인 인터넷 통신 프로토콜 기능을 갖는다.

한편, 무선 단말기(310)는 셀룰러 망 접속을 위해 필요한 프로파일 정보를 이동 단말기(Mobile Terminal)와 같은 정보 형태로 유지고, 무선 단말기(310)는 셀룰러 망에 연동하여 운용되거나 무선랜에 접속하여 운용되도록 듀얼 모드(Dual mode)를 지원한다.

무선 단말기(310)가 호 설정을 요구하고 호 설정 이후의 데이터를 송수신하면, 접속장치(320)는 무선 단말기(310)와 802.11 물리 계층과 802.11e MAC 기능을 이용하여 무선 접속하여 데이터 및 제어 신호를 수신하고, 이를 접속 제어장치(330)에 전달한다.

이때, 접속장치(320)는 접속 제어장치(330)와 셀룰러 망의 BTS와 BSC 간, 노드 B와 RNC간의 Iub 접속처럼 ATM 프로토콜을 이용하여 접속할 수 있으며, 다른 인터넷 망을 이용하여 접속할 수도 있다.

접속 제어장치(330)는 접속장치와 접속하여 셀룰러 망과의 연동에 필요한 정보를 유지하며 필요시 셀룰러 망의 MSC/VLR(350), SGSN(340) 등에 접속할 수 있다.

이러한 접속 제어장치(330)는 핵심망과 무선접속망간의 인터페이스와 동일한 방식으로 접속하여 다수의 접속장치(320)로부터 데이터 및 제어신호를 전달받아 이를 핵심망으로 전달한다.

한편, 접속 제어장치와 무선 단말기는 무선랜과 상기 셀룰러 망간의 이동성을 지원하기 위해 버티컬 핸드오프(Vertical Hand-off) 기능을 지원한다.

위에서 살펴본 바와 같이, 무선 접속 구간이 기존의 셀룰러 망에서 이용되던 프로토콜을 대신하여 802.11 MAC의 기능에 서비스 품질(QoS) 기능을 향상시킨 802.11e MAC 프로토콜에 따라 운용되고 있다.

도 5는 도 3에 의한 W-CDMA 프로토콜의 제어평면 구조를 도시한 것이고, 도 6은 도 3에 의한 W-CDMA 프로토콜의 사용자 평면 구조를 도시한 것이다. 그리고 도 7은 도 4에 의한 802.11e 무선랜과 셀룰러 망 중 W-CDMA 망 연동 네트워크의 제어평면 프로토콜 구조를 도시한 것이고, 도 8은 도 4에 의한 802.11e 무선랜과 셀룰러 망 중 W-CDMA 망 연동 네트워크의 사용자 평면 프로토콜 구조를 도시한 것이다.

도 5 내지 도 8에 나탄 있듯이, 본 발명에 따른 실시예에서는 노드B와 이동단말기(MT)간 인터페이스, 즉 Uu 인터페이스만이 802.11e를 사용하는 무선랜 구간으로 대체됨을 알 수 있다.

따라서 무선 단말기(310)의 프로토콜 중에서 무선 접속구간에서 이용되는 계층(Layer)2 이하의 PDCP(Packet Data Convergence Protocol), RRC(Radio Resource Control), RLC(Radio Link Control)/MAC(Media Access Control) 프로토콜이 IEEE(Institute of Electrical and Electronics Engineers) 802.11e MAC(Medium Access Control) 프로토콜로 대체하고, 나머지 PMM(Packet Mobility Management) 및 SM(Session Management) 프로토콜은 그대로 채용한다.

그리고 무선 단말기(310)의 프로토콜 중에서 무선 접속 구간에 이용되는 RRM(Radio Resource Management) 기능을 추가하여 무선 자원관리 및 이동성을 지원하도록 한다.

이와 같이 구성되는 본 발명에 따른 실시예의 무선랜과 셀룰러 망의 연동 시스템의 서비스 이용은 제어 신호를 이용한 호 설정 과정과 호 설정 이후의 데이터 전송 과정으로 이루어진다.

먼저, 제어 신호는 실시간 전송을 위해 IEEE 802.11e MAC의 기능 중 HCF(Hybrid Coordination Function) 기능 중 HCF Controlled channel access 기능, 또는 PCF(Point Coordination Function) 기능을 이용하도록 한다.

다음, 데이터 전송 과정은 사용자의 서비스 품질을 고려하여 HCF contention-based channel access(EDCF) 기능을 이용하여 전송하거나, 또는 사용자의 서비스 품질을 고려하지 않고 DCF(Distributed Coordination Function) 기능을 이용하여 전송한다.

도 9는 본 발명에 따른 실시예의 무선랜과 셀룰러 망의 연동 방법에 따른 신호 및 데이터 전송 절차를 도시한 것이다.

도 9는 무선단말기(STA)와 HC(Hybrid Coordinator) 사이의 신호 및 데이터 전송 절차에 관한 것으로서, 802.11e 무선랜에서 HC의 기능은 일반적으로 AP의 기능에 포함된 것으로 간주하고, 도 9에서 무선랜의 호 설정 절차는 이미 이루어져 있는 것으로 가정한다.

먼저, HC는 802.11e 스펙에 의하면 CP(Contention Period)나 CFP(Contention Free Period)에 상관없이 CCI(Controlled Contention Interval)를 야기하기 위하여 부정기적으로 'CC(Controlled Contention) Control Frame'을 전송한다.

이때 CC에는 CCI내의 CCOP(Controlled Contention OPportunity)의 수(Nccop)와 각 CCOP의 'duration time' 값을 포함하고 있다(S100).

한편, 셀룰러 망에 접속하고자 하는 무선단말기(STA)는 HC에 의해 야기되는 CC Control Frame의 수신을 대기한다. CC Control Frame을 수신한 경우에, 무선 단말기(310)는 RR(Reservation Request) frame을 HC로 전송한다.

이때, RR Frame은 TID(Traffic ID)와 TXOP(Transmission OPportunity) duration 값 등을 포함하고 있다(S110).

CCI 동안 여러 무선 단말기(STA)로부터 RR Frame을 수신한 HC는 다음 CCI에 전송하는 CC Frame을 이용하여

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ACK 메시지를 전송하게 된다. 이때 무선 단말기는 CC Frame의 Feedback Field 내의 자신의 AID 값으로 무선 자원 예약 요구가 승인된 것을 확인한다(S120).

HC는 RR을 승인한 무선 단말기(STA)에 대하여 (QoSData+)CF-Poll 메시지를 전송하여 TXOP, 즉 무선 전송의 기회를 부여한다. 이를 수신한 무선 단말기는 QoS Data 프레임을 이용하여 셀룰러 망의 핵심망에 무선 단말기의 등록 절차를 수행한다.

접속장치(320)에 전송된 셀룰러 망 제어 메시지인 Attach Request 메시지는 접속 제어장치(330)를 거쳐 핵심망에 전달된다. 그리고 핵심망으로부터 응답된 Attach Accept 또는 Attach Reject 메시지는 다시 접속 제어장치(330)를 거쳐 접속장치(320)로 전달되며, 여기서 전달된 메시지는 (QoS Data+)CF-Poll+CF-Ack Frame을 통하여 무선단말기로 전송된다.(S130~S150).

무선 단말기(STA)는 등록 절차 이후 데이터 전송의 필요가 있을 때마다 셀룰러 망과의 세션 연결 설정을 요구한다. 이때 세션 연결 절차와 무선 단말기 등록 절차 사이에 시간이 길어질 경우에, 기존의 TXOP를 종료하고 다시 S110~S940의 절차를 거쳐 다른 TXOP를 이용하여 세션 연결 제어 메시지를 전송할 수 있다.

무선 단말기(310)는 접속장치(320)로 세션 연결 설정을 위하여 QoS Data Frame을 이용하여 Activate PDP Context Request 메시지를 전송한다. 접속장치(320)로 전달된 메시지는 접속 제어장치(330)를 거쳐 핵심망의 SM(Session Management) 계층까지 전달되어 데이터 경로 설정이 되도록 한다.

데이터 경로 설정에 대한 준비가 이루어지며, SGSN의 SM 계층은 Activate PDP Context Accept 또는 Reject 메시지를 응답한다. 응답된 메시지는 다시 접속 제어장치(330)를 거쳐 접속장치(320)로 전달되며, 다시 CF-Poll-Ack Frame을 통하여 무선단말기(310)로 최종 전달된다.

이때 무선단말기는 Activate PDP Context Accept 메시지를 수신하는 경우, 데이터 경로 설정 요구가 이루어졌음을 확인하고, 무선접속망에 설정된 TXOP를 해제한다. 이는 CF-End 메시지를 전송함으로써 이루어진다(S160~S190).

앞에서의 절차로 호 설정이 이루어지면, 무선단말기(STA)는 데이터를 전송할 수 있는데, 무선 단말기는 802.11의 DCF 기능에 따라 전송 될 수 있으며 또는 QoS의 보장을 위하여 EDCF 기능에 의해 전송될 수 있다.

이때 무선접속망 ,즉 무선 단말기와 AP간의 데이터 전송은 802.11e 스펙에 규정된 CSMA/CA(Carrier Sensing Multiple Access/Collision Avoidance) 알고리즘에 따라 이루어지며, QoS를 보장하기 위하여 EDCF 기능을 이용할 수 있다. 각 데이터 트랙픽에 대한 우선순위는 MAC 계층의 스케줄러(scheduler)에 의해 제어되는 것으로 본다(S200).

데이터 전송을 종료하고, 현재 셀룰러 망의 핵심망과 설정된 세션을 종료하고자 하는 경우에, 이를 위하여 다시 무선 접속망의 호 설정을 예약해야 하며, 이때 호 설정의 과정은 S100~S130의 과정과 동일하다(S210~S240).

셀룰러 망의 세션 종료를 위하여 무선 단말기는 SM 계층으로부터 Deactivate PDP Context Request 메시지를 전달받아 QoSData Frame에 담아 접속장치(320)로 전송한다.

접속장치(320)로 전달된 메시지는 접속 제어장치(330)를 거쳐 핵심망의 SM 계층으로 전달된다. 이 메시지를 수신한 핵심망의 SGSN은 기존에 설정된 데이터 경로를 해제하고, Deactivate PDP Context Accept로 응답한다. 이 메시지는 접속 제어장치(330)를 거쳐 접속장치(320)로 전달되며, 다시 CF-Poll+CF-Ack Frame을 이용하여 무선단말기로 전달된다(S260~S270).

한편, 세션을 종료한 무선 단말기는 다시 전송할 데이터가 있을 경우 S110에서 S210까지의 절차를 통해 세션을 재설정하고 데이터를 전송할 수 있다. 만약 셀룰러 망과의 접속을 종료하고자 하는 경우에, 무선단말기는 등록 해제 절차를 수행한다.

이때 등록 해제 메시지, 즉 Detach Request 메시지는 핵심망으로 전달되고, 이에 대한 응답 메시지 즉 Detach Accept 메시지를 수신함으로써 이루어진다.

마지막으로 HC는 제어 메시지 전달을 위한 TXOP가 종료되었음을 CF-End Frame을 전송하여 알린다(S280~S310).

한편 무선 단말기는 기존의 802.11e MAC은 기존의 802.11 MAC의 기능에 QoS 기능을 더한 것이므로 도4에서 제시한 바와 같이 기존의 무선랜에 접속하여 필요한 서비스를 지원 받을 수 있다.

이러한 이중 모드 지원과 선택은 사용자의 관여 없이 자동적으로 설정 가능하다. 이러한 서비스의 유형은 비콘(Beacon) 프레임을 이용하여 방송(broadcasting)될 수 있다.

상기 도면과 발명의 상세한 설명은 단지 본 발명의 예시적인 것으로서, 이는 단지 본 발명을 설명하기 위한 목적에서 사용된 것이지 의미한정이나 특허청구범위에 기재된 본 발명의 범위를 제한하기 위하여 사용된 것은 아니다. 그러므로 본 기술 분야의 통상의 지식을 가진 자라면 이로부터 다양한 변형 및 균등한 타 실시예가 가능하다는 점을 이해할 것이다. 따라서 본 발명의 진정한 기술적 보호 범위는 첨부된 특허청구범위의 기술적 사상에 의해 정해져야 할 것이다.

발명의 효과

본 발명에 의한 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체는 무선랜을 위해 IEEE 802.11 물리계층과, 서비스 품질 기능을 향상시킨 802.11e MAC 프로토콜에 따라 무선 접속 구간을 운용함으로써 서비스의 이동성을 지원할 수 있고, 서비스에 따라 무선랜과 셀룰러 망에 선택적 연동할 수 있어 듀얼 모드 지원이 가능한 효과가 있다.

또한, 본 발명에 의한 무선랜과 셀룰러 망의 연동 시스템 및 방법, 그 프로그램이 저장된 기록매체는 호

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설정을 위한 제어 신호의 실시간 전송 및 사용자 트래픽의 서비스 품질을 보장할 수 있는 효과가 있다.

(57) 청구의 범위

청구항 1

이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 시스템에 있어서,

상기 무선 접속망 내에서 동일한 인터페이스로 접속하고, 무선랜을 위한 규격을 이용하여 상기 무선 단말기와 무선 접속하여 데이터 및 제어신호를 출력하는 다수의 접속장치;

상기 다수의 접속 장치와 연결되어 상기 접속장치로부터의 데이터 및 제어신호를 전달받아 이를 상기 핵심망으로 전달하고, 상기 핵심망과 무선접속망에서와 동일한 방식으로 접속하는 접속 제어장치

을 포함하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 2

제 1 항에 있어서,

상기 무선 단말기는 무선랜을 위한 규격에서 사용하는 특정 프로토콜 기능과 셀룰러 망에서 사용하는 프로토콜 기능, 및 인터넷 통신 프로토콜 기능을 가지는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 3

제 2 항에 있어서,

상기 무선 단말기의 프로토콜 중에서 무선 접속구간에서 이용되는 계층(Layer)2 이하의 PDCP(Packet Data Convergence Protocol), RRC(Radio Resource Control), RLC(Radio Link Control)/MAC(Media Access Control) 프로토콜이 IEEE(Institute of Electrical and Electronics Engineers) 802.11e MAC(Medium Access Control) 프로토콜로 대체하고, 나머지 PMM(Packet Mobility Management) 및 SM(Session Management) 프로토콜은 그대로 채용하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 4

제 2 항에 있어서,

상기 무선 단말기의 프로토콜 중에서 무선 접속 구간에 이용되는 RRM(Radio Resource Management) 기능을 추가하여 무선 자원관리 및 이동성을 지원하도록 하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 5

제 1 항에 있어서,

상기 무선 단말기는 셀룰러 망 접속을 위해 필요한 프로파일 정보를 상기 이동 단말기와 같은 정보 형태로 유지하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 6

제 1 항에 있어서,

상기 무선 단말기는 상기 셀룰러 망에 연동하여 운용되거나 무선랜에 접속하여 운용되도록 듀얼 모드(Dual mode)를 지원하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 7

제 1 항에 있어서,

상기 접속장치의 무선랜을 위한 규격은 IEEE(Institute of Electrical and Electronics Engineers) 802.11 물리계층과 802.11e MAC(Medium Access Control) 계층을 이용하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 8

제 1 항에 있어서,

상기 접속장치와 접속 제어장치는 유선으로 접속하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 9

제 1 항에 있어서,

상기 접속 제어장치는,

상기 무선접속망의 RNC(Radio Network Controller) 기능을 포함하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 10

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제 1 항에 있어서,

상기 접속 제어장치는, 상기 셀룰러 망과의 연동에 필요한 정보를 유지하며 상기 셀룰러 망 내의 MSC(Mobile Switching Center)/VLR(Visitor Location Register)에 접속하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 11

제 1 항에 있어서,

상기 접속장치와 접속 제어장치간의 제어신호는,

상기 무선랜을 위한 규격인 IEEE 802.11e MAC의 기능 중 HCF(Hybrid Coordination Function) 기능 중 HCF Controlled channel access 기능, 또는 PCF(Point Coordination Function) 기능을 이용하여 실시간 전송되도록 하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 12

제 1 항에 있어서,

상기 접속장치와 접속 제어장치간의 데이터 전송은, 사용자의 서비스 품질을 고려하여 HCF contention-based channel access(EDCF) 기능을 이용하여 전송하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 13

제 1 항에 있어서,

상기 접속장치와 접속 제어장치간의 데이터 전송은, 사용자의 서비스 품질을 고려하지 않고 DCF(Distributed Coordination Function) 기능을 이용하여 전송하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 14

제 1 항에 있어서,

상기 접속 제어장치와 무선 단말기는 무선랜과 상기 셀룰러 망간의 이동성을 지원하기 위해 버티컬 핸드오프(Vertical Hand-off) 기능을 지원하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 시스템.

청구항 15

이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 방법에 있어서,

a) 상기 무선 단말기를 초기화하고 상기 무선 단말기와 셀룰러 망, 또는 상기 무선 단말기와 무선랜 간 호 설정을 수행하는 단계;

b) 상기 a) 단계에서 호 설정 후, 상기 무선 단말기와 셀룰러 망간 데이터를 전송하는 단계; 및

c) 상기 b) 단계에서 데이터 전송이 완료되면, 설정된 호를 해제하는 단계

를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 16

제 15 항에 있어서,

상기 a) 단계 내지 c) 단계는,

상기 무선 단말기와 무선 접속하여 데이터 전송을 수행하는 접속장치가 무선랜을 위해 IEEE(Institute of Electrical and Electronics Engineers) 802.11 물리계층과 802.11e MAC(Medium Access Control) 계층을 이용하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 17

제 16 항에 있어서,

상기 접속장치는 802.11e 스펙에 의해 CP(Contention Period) 또는 CFP(Contention Free Period)에 상관없이 CCI(Controlled Contention Interval)을 야기하기 위해 부정기적으로 'CC(Controlled Contention) Control Frame'을 상기 무선 단말기로 전송하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 18

제 17 항에 있어서,

상기 CC에는 CCI 내의 CCOP(Controlled Contention OPportunity)의 수(Nccop)와, 각 CCOP의 주기 시간(Duration time) 값을 포함하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 19

제 15 항에 있어서,

상기 a) 단계는,

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가) 상기 무선 단말기가 메시지 전달을 위해 상기 셀룰러 망에서 야기되는 'CC Control Frame'의 수신을 대기하는 단계;

나) 상기 무선 단말기가 'CC Control Frame'을 수신하면, 'RR(Reservation Request) Frame'을 상기 셀룰러 망으로 전송하여 무선 자원을 예약하는 단계;

다) 상기 나) 단계를 통해 CCI(Controlled Contention Interval) 동안 다수의 무선 단말기로부터'RR Frame'를 전송받은 셀룰러 망은 다음 CCI에 전송하는 'CC Frame'에 해당 무선 단말기의 무선 자원 예약 알림(Ack) 메시지를 전송하는 단계;

라) 상기 셀룰러 망이 'RR Frame'을 승인한 무선 단말기에 대하여 무선 전송 기회를 부여하는 단계;

마) 상기 라) 단계에서 무선 전송 기회를 부여받은 무선 단말기는 상기 셀룰러 망의 핵심망에 등록 절차를 수행하는 단계; 및

바) 상기 마) 단계에서 등록 절차가 완료된 무선 단말기는 데이터 전송을 위해 상기 셀룰러 망과의 세션 연결 설정을 요구하는 단계;

를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 20

제 19 항에 있어서,

상기 나) 단계에서 'RR Frame'은 TID(Traffic ID)와 무선 전송 기회 기간 값을 포함하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 21

제 19 항에 있어서,

상기 다) 단계에서 'Ack 메시지'를 전송받은 무선단말기는 'CC Frame'의 피드백 필드(Feedback Filed) 내 자신의 식별 값으로 무선 자원 예약 요구의 승인을 확인하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 22

제 19 항에 있어서,

상기 마) 단계에서 무선 단말기의 등록 절차를 수행하는 단계는,

ㄱ) 상기 셀룰러 망의 무선접속망 내에서 상기 무선 단말기와 무선 접속되는 접속장치에 전송된 무선 단말기의 'Attach Request'메시지가 상기 접속장치와 접속되는 접속 제어장치에 전송되는 단계;

ㄴ) 상기 ㄱ) 단계에서 'Attach Request'메시지를 전송받은 접속 제어장치는 이 메시지를 상기 핵심망으로 전달하고, 상기 핵심망으로부터 전달되는 'Attach Request/Reject'메시지를 상기 접속장치로 전송하는 단계; 및

ㄷ) 상기 ㄴ) 단계를 통해 접속장치는 'Attach Request/Reject'메시지를 '(QoS Data+)CF-Poll+CF-Ack Frame'을 통하여 상기 무선 단말기로 전송하는 단계

를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 23

제 19 항에 있어서,

마) 상기 바) 단계를 통해 상기 무선 단말기의 세션 연결 절차와 등록 절차 사이에 일정 시간 이상이 소요되면, 상기 무선 단말기는 이전의 무선 전송 기회를 종료하고 다시 상기 셀룰러 망으로 다른 무선 전송 기회를 부여받기 위해 세션 연결 제어 메시지를 상기 셀룰러 망으로 전송하는 단계를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 24

제 19 항에 있어서,

상기 바) 단계에서 무선 단말기의 세션 연결 설정 단계는,

ㄱ) 상기 무선 단말기는 'QoS Data Frame'을 이용하여 'Active PDP Context Request' 메시지를 상기 셀룰러 망의 무선 접속망으로 전송하는 단계;

ㄴ) 상기 ㄱ) 단계를 통해 무선접속망에 전달된 메시지는 핵심망의 SM(Session Management) 계층에 전달되어 데이터 경로 설정에 대한 준비가 이루어지는 단계; 및

ㄷ) 상기 ㄴ) 단계를 통해 핵심망의 SM 계층은 'Activate PDP Context Accept/Reject' 메시지를 상기 무선 접속망을 거쳐 'CF-Poll-Ack Frame'을 통해 상기 무선 단말기로 전달하는 단계

를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 25

제 24 항에 있어서,

상기 ㄷ) 단계에서 'Activate PDP Context Accept'메시지를 수신한 무선 단말기는 데이터 경로 설정 요구가 이루어졌음을 확인하고, 무선접속망에 설정된 무선 전송의 기회를 해제하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 26

제 15 항에 있어서,

상기 b) 단계는,

상기 a) 단계에서 호 설정이 이루어지면, 상기 무선 단말기는 IEEE 802.11의 DCF(Distributed Coordination Function) 기능, 또는 사용자의 서비스 품질을 고려하여 HCF contention-based channel access(EDCF) 기능을 이용하여 상기 셀룰러 망으로 데이터를 전송하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 27

제 26 항에 있어서,

상기 무선 단말기와 셀룰러 망 내에서 무선으로 접속되는 접속장치 간의 데이터 전송은, IEEE 802.11e 스펙에 규정된 CSMA/CA(Carrier Sensing Multiple Access/Collision Avoidance) 알고리즘에 따라 이루어지고, 각 데이터 트래픽에 대한 우선순위는 MAC 계층의 스케줄러에 의해 제어되는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 28

제 15 항에 있어서,

상기 c) 단계는,

가) 상기 b) 단계에서 데이터 전송이 종료되면, 상기 무선 단말기와 셀룰러 망의 핵심망간 설정된 세션을 종료하기 위해 무선접속망의 호 설정을 예약하는 단계;

나) 상기 가) 단계를 통해 핵심망은 이전에 설정된 데이터 경로를 해제하여 셀룰러 망의 세션을 종료하는 단계; 및

다) 상기 나) 단계에서 세션이 종료되면, 상기 무선 단말기는 전송할 데이터의 유무에 따라 세션을 재설정하거나 등록 해제 절차를 수행하는 단계

을 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 29

제 28 항에 있어서,

상기 가) 단계는,

ㄱ) 상기 무선 단말기가 메시지 전달을 위해 상기 셀룰러 망에서 아기되는 'CC Control Frame'의 수신을 대기하는 단계;

ㄴ) 상기 무선 단말기가 'CC Control Frame'을 수신하면, 'RR(Reservation Request) Frame'을 상기 셀룰러 망으로 전송하여 무선 자원을 예약하는 단계;

ㄷ) 상기 ㄴ) 단계를 통해 CCI(Controlled Contention Interval) 동안 다수의 무선 단말기로부터'RR Frame'를 전송받은 셀룰러 망은 다음 CCI에 전송하는 'CC Frame'에 해당 무선 단말기의 무선 자원 예약 알림(Ack) 메시지를 전송하는 단계;

ㄹ) 상기 셀룰러 망이 'RR Frame'을 승인한 무선 단말기에 대하여 무선 전송 기회를 부여하는 단계; 및

ㅁ) 상기 ㄹ) 단계에서 무선 전송 기회를 부여받은 무선 단말기는 상기 셀룰러 망의 핵심망에 등록 절차를 수행하는 단계

것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 30

제 28 항에 있어서,

상기 나) 단계는,

ㄱ) 상기 무선 단말기는 셀룰러 망의 핵심망으로부터 'Deactivate PDP Context Request'메시지를 전달받아 'QoS Data Frame'을 통해 무선접속망으로 전달하는 단계;

ㄴ) 상기 ㄱ) 단계에서 무선접속망으로 전달된 메시지는 다시 핵심망으로 전달되므로 상기 핵심망이 이전에 설정된 데이터 경로를 해재한 후에 'Deactivate PDP Context Accept'메시지를 무선접속망으로 전송하는 단계; 및

ㄷ) 상기 ㄴ) 단계에서 메시지를 전송받은 무선 접속망은 'CF-Poll+CF-Ack'을 이용하여 상기 무선 단말기로 전송하는 단계

를 포함하는 무선랜과 셀룰러 망의 연동 방법.

청구항 31

16-10

제 28 항에 있어서,

상기 다) 단계는,

상기 무선 단말기가 전송할 데이터가 있을 경우에 세션을 재설정하기 위한 절차를 수행하고, 상기 무선 단말기가 전송할 데이터가 없을 경우에 상기 셀룰러 망과의 접속을 종료하기 위해 등록 해제 절차를 수행하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 32

제 31 항에 있어서,

상기 무선단말기의 등록 해제 절차는,

상기 무선 단말기의 'Detach Request'메시지가 핵심망으로 전달하여 상기 핵심망으로부터 'Detach Accept'메시지가 상기 무선 접속망으로 수신되면, 상기 무선 접속망이 제어 메시지 전달을 위한 무선 전송의기회가 종료되었음을 상기 무선 단말기로 알리는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 33

제 15 항에 있어서,

상기 무선 단말기가 셀룰러 망에 연동하여 운영되거나, 무선랜에 접속하여 운영되는 듀얼 모드로 동작하는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 34

제 33 항에 있어서,

상기 듀얼 모드 지원과 선택은 자동으로 설정 가능하고, 비콘(beacon) 프레임을 이용하여 방송될 수 있는 것을 특징으로 하는 무선랜과 셀룰러 망의 연동 방법.

청구항 35

이동단말기나 무선 단말기와 핵심망 사이에서 유기적으로 연결되는 셀룰러 망의 무선접속망에 적용되는 무선랜과 셀룰러 망의 연동 방법을 구현한 프로그램이 저장된 기록매체에 있어서,

무선 단말기를 초기화하고 상기 무선 단말기와 셀룰러 망, 또는 상기 무선 단말기와 무선랜 간 호 설정을 수행하는 제1 기능;

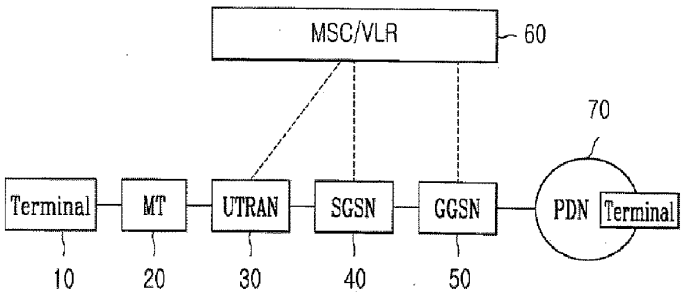
상기 호 설정 후, 상기 무선 단말기와 셀룰러 망간 데이터를 전송하는 제2 기능; 및

상기 데이터 전송이 완료되면, 설정된 호를 해제하는 제3 기능

을 포함하는 프로그램이 저장된 기록매체.

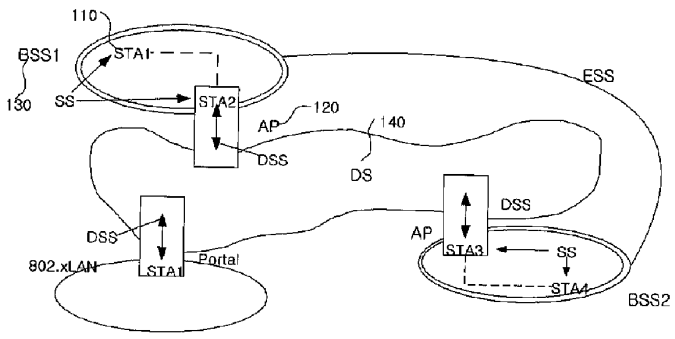
도면

도면1

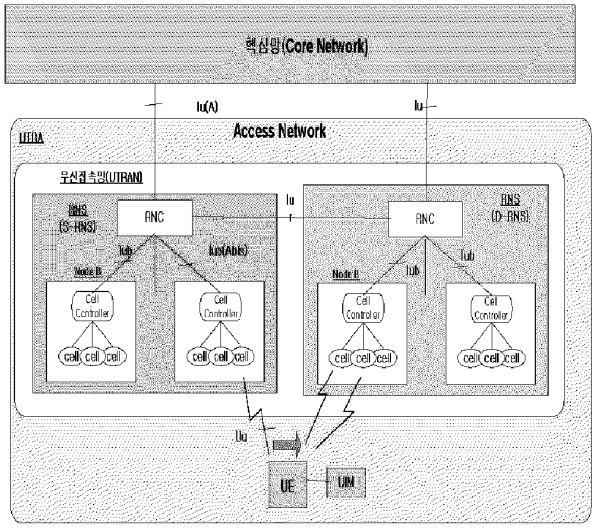


16-11

도면2

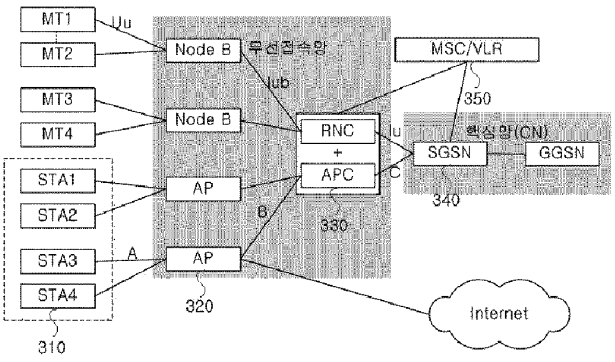

110
BSS1
STA1
130
SS
STA2
ESS
120
AP
140
DSS
DS
DSS
AP
STA3
SS
STA4
BSS2
DSS
802.xLAN
STA1
Portal

도면3

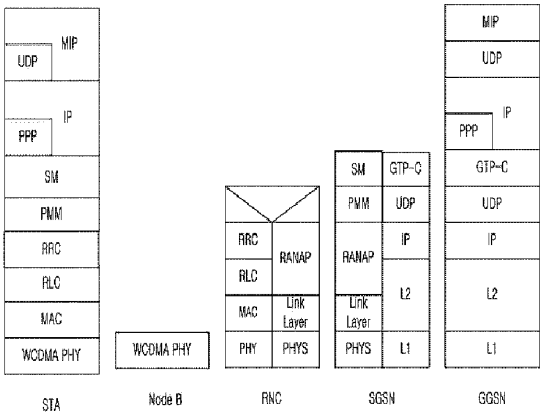

핵심망(Core Network)
Iu(A)
Iu
Access Network
UTRA
무선접속망(UTRAN)
RNS
(S-RNS)
RNC
Iub
Iur(Abis)
Node B
Cell
Controller
cell
Iu
RNC
RNS
(D-RNS)
Iub
Node B
Iu
UE
UIM

16-12

도면4

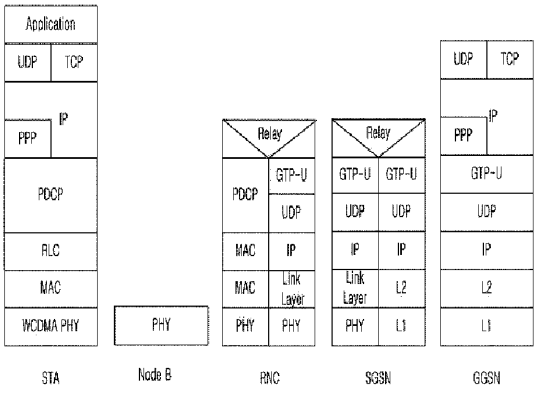

MT1
MT2
MT3
MT4
STA1
STA2
STA3
STA4
310
Uu
Node B
Node B
무선접속망
Iub
RNC
+
APC
AP
AP
320
330
A
B
C
Iu
MSC/VLR
350
핵심망(CN)
SGSN
GGSN
340
Internet

도면5


MIP
UDP
IP
PPP
SM
PMM
RRC
RLC
MAC
WCDMA PHY
STA
WCDMA PHY
Node B
RRC
RLC
MAC
PHY
RANAP
Link Layer
PHYS
RNC
SM
PMM
RANAP
Link Layer
PHYS
GTP-C
UDP
IP
L2
L1
SGSN
MIP
UDP
IP
PPP
GTP-C
UDP
IP
L2
L1
GGSN
제어 평면

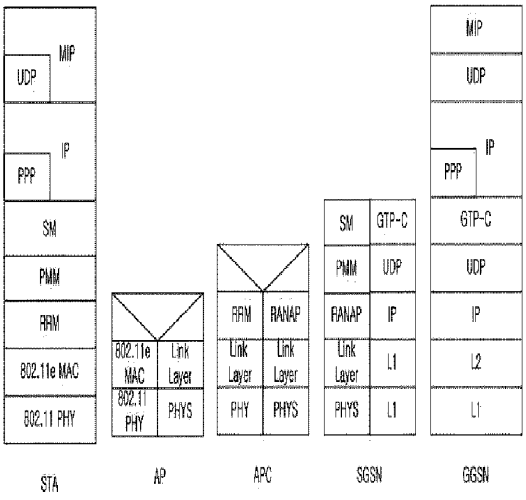
16-13

도면6



사용자 평면

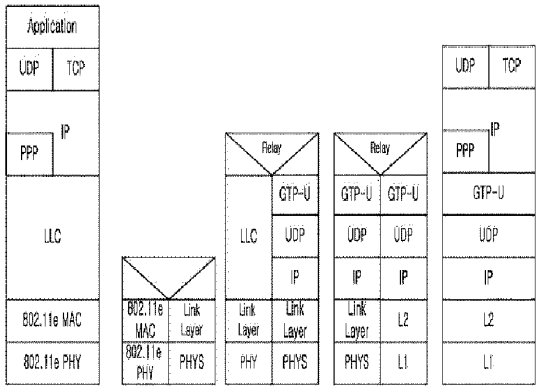
도면7



제어 평면

16-14

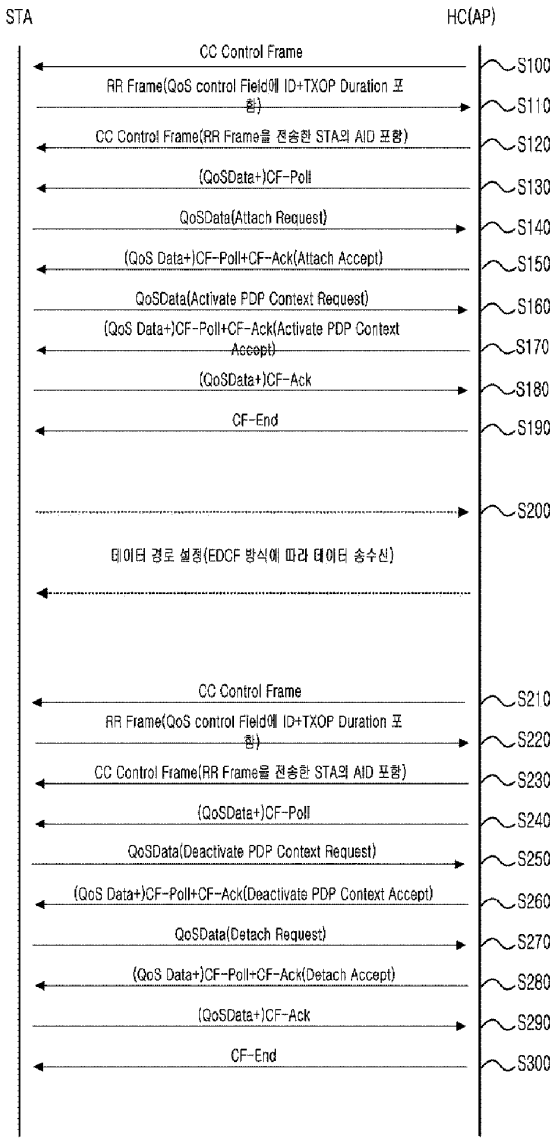
도면8



사용자 평면

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도면9


STA
HC(AP)
CC Control Frame
S100
RR Frame(QoS control Field에 ID+TXOP Duration 포함)
S110
CC Control Frame(RR Frame을 전송한 STA의 AID 포함)
S120
(QoSData+)CF-Poll
S130
QoSData(Attach Request)
S140
(QoS Data+)CF-Poll+CF-Ack(Attach Accept)
S150
QoSData(Activate PDP Context Request)
S160
(QoS Data+)CF-Poll+CF-Ack(Activate PDP Context Accept)
S170
(QoSData+)CF-Ack
S180
CF-End
S190
S200
데이터 경로 설정(EDCF 방식에 따라 데이터 송수신)
CC Control Frame
S210
RR Frame(QoS control Field에 ID+TXOP Duration 포함)
S220
CC Control Frame(RR Frame을 전송한 STA의 AID 포함)
S230
(QoSData+)CF-Poll
S240
QoSData(Deactivate PDP Context Request)
S250
(QoS Data+)CF-Poll+CF-Ack(Deactivate PDP Context Accept)
S260
QoSData(Detach Request)
S270
(QoS Data+)CF-Poll+CF-Ack(Detach Accept)
S280
(QoSData+)CF-Ack
S290
CF-End
S300

16-16

Electronic Patent Application Fee Transmittal					
Application Number:	15977766				
Filing Date:	11-May-2018				
Title of Invention:	Device-Assisted Services for Protecting Network Capacity				
First Named Inventor/Applicant Name:	Gregory G. Raleigh				
Filer:	James E. Harris/Ann Taylor				
Attorney Docket Number:	RALEP032C1C12C2C1				
Filed as Small Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	2806	1	120	120
		Total in USD ($)		**120**

Electronic Acknowledgement Receipt	
EFS ID:	33279278
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	25-JUL-2018
Filing Date:	11-MAY-2018
Time Stamp:	14:06:33
Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$120
RAM confirmation Number	072618INTEFSW00000235505876
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	P032C1C12C2C1.pdf	1054583 663ad6c23f686cd68231943cf5f41c3fdad6540d	no	8
Warnings:					
Information:					
2	Foreign Reference	2102.pdf	1166143 22bd19b8fca35bc95ff2f7d6607b582f7d7d807d	no	18
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30698 24337cddb5ffa65950f3ba7a82a6ae80fcc6b775	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2251424		

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1	8228

106963 7590 07/19/2018

Headwater Research LLC
1011 Pruitt Place
Tyler, TEXAS 75703
UNITED STATES OF AMERICA

EXAMINER	
ANWAR, MOHAMMAD S	

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
07/19/2018	ELECTRONIC

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

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

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

patent@headwaterllc.com

Office Action Summary	Application No. 15/977,766	Applicant(s) Raleigh et al.	
	Examiner MOHAMMAD S ANWAR	Art Unit 2463	AIA Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 11 May 2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

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

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 2-21 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 2-21 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 11 May 2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

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

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

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

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

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

Claim Rejections - 35 USC § 101

2. 35 U.S.C. 101 reads as follows:

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

Claims 2-21 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 2 recites "computer-readable storage medium" referring to any medium that is storing a program executable by a computer. The broadest reasonable interpretation of a claim drawn to a computer readable medium (also called machine readable medium and other such variations) typically covers forms of non-transitory tangible media and transitory propagating signals *per se* in view of the ordinary and customary meaning of computer readable media, particularly when the specification is silent. *See* MPEP 2111.01. In this case, Paragraph [00323] of the specification recites the program storage medium includes any type of media. When the broadest reasonable interpretation of a claim covers a signal *per se*, the claim must be rejected under 35 U.S.C. § 101 as covering non-statutory subject matter. *See In re Nuijten*, 500 F.3d 1346, 1356-57 (Fed. Cir. 2007) (transitory embodiments are not directed to statutory subject matter) and *Interim*

Examination Instructions for Evaluating Subject Matter Eligibility Under 35 U.S.C. § 101, Aug. 24, 2009; p. 2.

A claim drawn to such a computer readable medium that covers both transitory and non-transitory embodiments may be amended to narrow the claim to cover only statutory embodiments to avoid a rejection under 35 U.S.C. § 101 by adding the limitation "non-transitory" to the claim. Such an amendment would typically not raise the issue of new matter, even when the specification is silent because the broadest reasonable interpretation relies on the ordinary and customary meaning that includes signals *per se*. The limited situations in which such an amendment could raise issues of new matter occur, for example, when the specification does not support a non-transitory embodiment because a signal *per se* is the only viable embodiment such that the amended claim is impermissibly broadened beyond the supporting disclosure. *See*, *e.g.*, *Gentry Gallery, Inc. v. Berkline Corp.*, 134 F.3d 1473 (Fed. Cir. 1998).

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the 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(l)(1) - 706.02(l)(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.

4. Claim 2 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses a wireless end-user device, comprising: a processor; a Wireless Wide-Area Network (WWAN) modem, to communicate data for network service usage activities between the wireless end-user device and a WWAN; and a computer-readable storage medium storing instructions that, when provided to the processor, cause the processor to receive respective requests from a plurality of applications on the device to access the WWAN for background network service usage activities associated with the respective applications, based at least in part on a current WWAN network busy state, select a corresponding current service usage control policy for the background network service usage activities, determine respective deferred time slots for each of the background network service usage activities based on the current service usage control policy, wherein at least one such service usage control policy specifies that during a time when the current WWAN network busy state indicates network congestion, a selected subset of the background network service usage activities are deferred until network congestion is no longer indicated, and allow each of the background network service usage activities to access the WWAN during the respective deferred time slot for that background network service usage activity.

Claim 3 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 29 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh

discloses wherein the instructions provided to the processor further cause the processor to classify the respective requests with respective priorities, and the at least one such service usage control policy determines the selected subset of the background network service usage activities based on the respective priorities of the respective requests.

Claim 4 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 25 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to classify the respective requests with respective priorities comprises maintaining a network capacity-controlled services list indicating one or more applications having a network capacity control, and assigning a respective priority to a request based on the network capacity-controlled services list.

Claim 5 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 159 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the network capacity-controlled services list is based at least in part on user preference selections.

Claim 6 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 159 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to allow each of the background network service usage activities to

access the WWAN during the respective deferred time slot comprises blocking or delaying execution of the application associated with a given background network service usage activity until the respective deferred time slot is reached.

Claim 7 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 74 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to allow each of the background network service usage activities to access the WWAN during the respective deferred time slot comprises informing an application associated with a given background network service activity when the WWAN is available for that activity.

Claim 8 is rejected on the ground of nonstatutory double patenting as being unpatentable over claims 74 and 86 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to, based on at least one selected current service usage policy, defer at least one of the background network service usage activities until a different network, other than the WWAN, is available to communicate data for that at least one of the background network service usage activities.

Claim 9 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 53 of U.S. Patent No. 8,589,541. Although the claims at issue

are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the different network comprises a specific network selection for that at least one of the background network service usage activities.

Claim 10 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 28 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, monitoring of user interaction with the device.

Claim 11 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 25 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, a power state.

Claim 12 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 79 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access

Application Programming Interface (API), the API allowing applications to request a time slot demand for a background network service usage activity.

Claim 13 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 82 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access Application Programming Interface (API), the API allowing applications to indicate a data size for a background network service usage activity.

Claim 14 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 138 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the current network busy state is received from a network element via the WWAN.

Claim 15 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 138 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to generate the current network busy state.

Claim 16 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 72 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to select the corresponding current service usage control policy for the background network service usage activities based on a service plan active on the device, in addition to the current WWAN network busy state, the service plan including network busy state-based criteria restrictions that apply to network capacity-controlled services, including one or more of the background network service usage activities.

Claim 17 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 46 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on a service usage behavior analysis of the activity.

Claim 18 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 170 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background

network service activities based on monitoring power consumption behavior of the activity.

Claim 19 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 170 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on monitoring user interaction with the activity.

Claim 20 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 82 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses the one or more processors further configured to communicate with one or more of the applications through an Application Programming Interface that informs each such application of one or more policies applied to background network service usage activities associated with that application.

Claim 21 is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 159 of U.S. Patent No. 8,589,541. Although the claims at issue are not identical, they are not patentably distinct from each other because Raleigh discloses wherein to determine respective deferred time slots for each of the background network service usage activities further comprises delaying a time slot for a

particular one of the background network service usage activities at least until a first time delay has occurred since a previous deferred time slot associated with that activity.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MOHAMMAD S ANWAR whose telephone number is (571)270-5641. The examiner can normally be reached on M-F 8-8 EST.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, MARK RINEHART can be reached on 571-272-3632. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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

USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

MOHAMMAD S. ANWAR
Primary Examiner
Art Unit 2463

/MOHAMMAD S ANWAR/
Primary Examiner, Art Unit 2463

Notice of References Cited	Application/Control No. 15/977,766	Applicant(s)/Patent Under Reexamination Raleigh et al.	
	Examiner MOHAMMAD S ANWAR	Art Unit 2463	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-8589541-B2	11-2013	Raleigh; Gregory G.	H04L41/0893	709/224
*	B	US-20040165596-A1	08-2004	Garcia, Javier Romero	H04L1/0003	370/395.21
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

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

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

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	**Art Unit**
	MOHAMMAD S ANWAR	2463

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

CLAIMS

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

CLAIM		DATE								
Final	Original	07/13/2018								
	1	-								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
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	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/977,766	Raleigh et al.
	Examiner	Art Unit
	MOHAMMAD S ANWAR	2463

CPC - Searched*		
Symbol	Date	Examiner
H04W28/0289, H04L47/20,H04L47/245,H04L47/803,H04L47/805	07/13/2018	MA

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
EAST SEARCH	07/13/2018	MA
INVENTOR NAME SEARCH	07/13/2018	MA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04W	28/0289	07/13/2018	MA

/MOHAMMAD S ANWAR/ Primary Examiner, Art Unit 2463	

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	69	"8589541" and capacity and preference and priorit$3 and slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 14:51
L2	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 14:56
L3	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:20
L4	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:23
L5	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:27
L6	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:30
L7	69	"8589541" and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:33
L8	69	"8589541" and capacity and preference and	US-PGPUB;	OR	OFF	2018/07/13

		priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			15:37
L9	115	(H04W28/0289 or H04M15/41 or H04L47/2475 or H04L41/5029 or H04L12/1492 or H04L47/803 or H04W24/08 or H04M15/43 or H04L41/5054 or H04L47/824 or H04W28/0284 or H04L47/20 or H04L47/14 or H04M15/66 or H04L41/0896 or H04W48/04 or H04W28/0268 or H04W52/0264 or H04W28/20 or H04W4/50 or H04W12/08 or H04M15/44 or H04L41/5006 or H04W80/04 or H04W48/06 or H04L12/1496 or H04L41/0893 or H04L47/805 or H04W52/0212 or H04W24/02 or H04M15/8055 or H04M15/81 or H04W48/16 or H04M15/8016 or H04L47/822 or H04L47/2425 or H04L41/5022 or Y02D70/00 or H04W36/14 or H04W24/00).cpc. and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:41
L10	83	Raleigh.inv. and capacity and preference and priorit$3 and slot$1 and available and polic$3 and API and busy and background and monitor$3 and delay	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 15:41
S1	0	background adj service$1 with deferred adj time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:10
S2	1	background adj service$1 with time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:10
S3	0	background adj service$1 with time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:11
S4	70	background adj service$1 and time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12

S5	0	background adj network adj service$1 and time adj slot$1 and WWAN	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12
S6	0	background adj network adj service$1 adj usage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:12
S7	0	WWAN and congestion and busy and backgound and time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:14
S8	104	WWAN and congestion and busy and background and time adj slot$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 09:14
S9	138	"8589541"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 11:14
S10	126	"8589541" and capacity	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:16
S11	109	"8589541" and capacity and preference	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:18
S12	104	"8589541" and capacity and preference and priorit$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/07/13 12:21

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

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See attached certification statement.

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

☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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

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Bibliographic Data

Application No: 15/977,766

Foreign Priority claimed: ○ Yes ◉ No

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

Verified and Acknowledged: /MOHAMMAD S ANWAR/ Examiner's Signature | Initials

Title: Device-Assisted Services for Protecting Network Capacity

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
05/11/2018	370	2463	RALEP032C1C12C2C1
RULE			

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FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

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Examiner Name	not yet assigned
Attorney Docket Number	RALEP032C1C12C2C1

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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

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See attached certification statement.

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

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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

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	31	7930327	B2	2011-04-19	Craft David et al.	
	32	7930446	B2	2011-04-19	Kesselman, Alex et al.	
	33	7930553	B2	2011-04-19	Satarasinghe et al.	
	34	7933274	B2	2011-04-26	Verma et al.	
	35	7936736	B2	2011-05-03	Proctor, Jr. et al.	
	36	7937069		2011-05-03	RASSAM, Frederic	
	37	7937450	B2	2011-05-03	Janik, Craig M.	
	38	7940685	B1	2011-05-10	Breslau, Lee et al.	
	39	7940751		2011-05-10	Hansen, Christopher J.	
	40	7941184		2011-05-10	PRENDERGAST et al.	
	41	7944948		2011-05-17	Chow, Albert T. et al.	

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	42	7945238	B2	2011-05-17	Baker, Matthew Donald et al.	
	43	7945240		2011-05-17	KLOCK, Jacqueline et al.	
	44	7945945		2011-05-17	Graham, Richard et al.	
	45	7948952		2011-05-24	HURTTA, Tuija et al.	
	46	7948953	B2	2011-05-24	Melkote, Keerti G. et al.	
	47	7948968		2011-05-24	Voit, Eric A. et al.	
	48	7949529		2011-05-24	WEIDER et al.	
	49	7953808		2011-05-31	SHARP et al.	
	50	7953877	B2	2011-05-31	Vemula et al.	
	51	7957020		2011-06-07	MINE, Ryuta et al.	
	52	7957381	B2	2011-06-07	Clermidy et al.	

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	53	7957511		2011-06-07	DRUDIS et al.	
	54	7958029	B1	2011-06-07	Bobich et al.	
	55	7962622		2011-06-14	Friend, John et al.	
	56	7965983		2011-06-21	SWAN, Tim et al.	
	57	7966405	B2	2011-06-21	Sundaresan et al.	
	58	7969950	B2	2011-06-28	Iyer, Pradeep J. et al.	
	59	7970350		2011-06-28	SHEYNMAN, Arnold	
	60	7970426		2011-06-28	Poe, Brian R. et al.	
	61	7974624		2011-07-05	Gallagher, Michael D. et al.	
	62	7975184		2011-07-05	GOFF et al.	
	63	7978627		2011-07-12	TAYLOR, William Scott et al.	

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	64	7978686	B2	2011-07-12	Goyal et al.	
	65	7979069	B2	2011-07-12	Hupp et al.	
	66	7979889	B2	2011-07-12	Gladstone et al.	
	67	7984130		2011-07-19	BOGINENI et al.	
	68	7984511	B2	2011-07-19	Kocher Paul et al.	
	69	7986935		2011-07-26	D'SOUZA et al.	
	70	7987496	B2	2011-07-26	Bryce et al.	
	71	7987510	B2	2011-07-26	Kocher et al.	
	72	7990049	B2	2011-08-02	Shioya, Shunsuke	
	73	8000276	B2	2011-08-16	Scherzer, Shimon et al.	
	74	8000318		2011-08-16	Wiley, William L. et al.	

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	75	8005009		2011-08-23	McKee, Neil et al.	
	76	8005459		2011-08-23	BALSILLIE, Jim	
	77	8005726	B1	2011-08-23	Bao, Yulin	
	78	8005913	B1	2011-08-23	Carlander, Carrie	
	79	8005988		2011-08-23	MAES, Stephane H.	
	80	8010080		2011-08-30	THENTHIRUPERAI et al.	
	81	8010081		2011-08-30	ROSKOWSKI, Steve	
	82	8010082	B2	2011-08-30	Sutaria et al.	
	83	8010990	B2	2011-08-30	Ferguson et al.	
	84	8015133		2011-09-06	WU et al.	
	85	8015234		2011-09-06	LUM et al.	

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	86	8019687		2011-09-13	WANG et al.	
	87	8019820		2011-09-13	Son, Giyeong et al.	
	88	8019846	B2	2011-09-13	Roelens et al.	
	89	8019868		2011-09-13	RAO, Goutham et al.	
	90	8019886	B2	2011-09-13	Harrang, Jeffrey Paul et al.	
	91	8023425		2011-09-20	RALEIGH, Gregory G.	
	92	8024397		2011-09-20	ERICKSON, Richard R. et al.	
	93	8024424	B2	2011-09-20	Freimuth et al.	
	94	8027339	B2	2011-09-27	Short, Joel E. et al.	
	95	8031601	B2	2011-10-04	Feroz et al.	
	96	8032168	B2	2011-10-04	Ikaheimo, Jorma	

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	97	8032409	B1	2011-10-04	Mikurak, Michael G.	
	98	8032899	B2	2011-10-04	Archer, Charles J. et al.	
	99	8036387	B2	2011-10-11	Kudelski et al.	
	100	8036600		2011-10-11	Garrett, Darrin et al.	
	101	8044792	B2	2011-10-25	Orr et al.	
	102	8045973	B2	2011-10-25	Chambers, Michael D.	
	103	8046449	B2	2011-10-25	Yoshiuchi, Hideya	
	104	8050275		2011-11-01	IYER, Jayaraman R.	
	105	8050690	B2	2011-11-01	Neeraj, Chawla	
	106	8050705	B2	2011-11-01	Sicher et al.	
	107	8059530		2011-11-15	Cole, Terry L.	

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	108	8060017	B2	2011-11-15	Schlicht et al.	
	109	8060463		2011-11-15	Spiegel, Joel R.	
	110	8064418	B2	2011-11-22	Maki, Lasse	
	111	8064896		2011-11-22	BELL, Kris M. et al.	
	112	8065365	B2	2011-11-22	Saxena et al.	
	113	8068824		2011-11-29	SHAN, Xueshan et al.	
	114	8068829	B2	2011-11-29	Lemond, Eric et al.	
	115	8073427	B2	2011-12-06	Koch et al.	
	116	8073721		2011-12-06	Lewis, Lundy	
	117	8078140	B2	2011-12-13	Baker, Matthew Donald et al.	
	118	8078163	B2	2011-12-13	Lemond, Eric et al.	

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	119	8085808	B2	2011-12-27	Brusca et al.	
	120	8086398	B2	2011-12-27	Sanchez et al.	
	121	8086497	B1	2011-12-27	Oakes III, Charles Lee	
	122	8086791	B2	2011-12-27	Caulkins, Jason	
	123	8090359		2012-01-03	Proctor Jr., James Arthur et al.	
	124	8090361	B2	2012-01-03	Hagan, Guy R.	
	125	8090616		2012-01-03	Proctor Jr., James Arthur et al.	
	126	8091087	B2	2012-01-03	Ali et al.	
	127	8094551		2012-01-10	HUBER, Kurt Donald et al.	
	128	8095112	B2	2012-01-10	Chow, Richard et al.	
	129	8095124	B2	2012-01-10	Balia, Hinal K.	

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	130	8095640	B2	2012-01-10	Guingo et al.	
	131	8095666		2012-01-10	SCHMIDT et al.	
	132	8098579		2012-01-17	Ray, Amar N. et al.	
	133	8099077		2012-01-17	CHOWDHURY et al.	
	134	8099517		2012-01-17	JIA et al.	
	135	8102814		2012-01-24	RAHMAN, Shahriar I. et al.	
	136	8103285	B2	2012-01-24	Kalhan, Amit	
	137	8104080	B2	2012-01-24	Burns et al.	
	138	8107953	B2	2012-01-31	Zimmerman et al.	
	139	8108520		2012-01-31	Ruutu, Jussi et al.	
	140	8112435	B2	2012-02-07	Epstein et al.	

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	141	8116223		2012-02-14	TIAN, Dan et al.	
	142	8116749		2012-02-14	Proctor Jr., James Arthur et al.	
	143	8116781	B2	2012-02-14	Chen, Xixian et al.	
	144	8122128		2012-02-21	Burke, II, Robert M. et al.	
	145	8122249		2012-02-21	Falk, Rainer et al.	
	146	8125897	B2	2012-02-28	Ray et al.	
	147	8126123		2012-02-28	Cai, Yigang et al.	
	148	8126396	B2	2012-02-28	Bennett, James D.	
	149	8126476	B2	2012-02-28	Vardi, Yosef et al.	
	150	8126722		2010-02-28	ROBB, Terence Alan et al.	
	151	8130793	B2	2012-03-06	Edwards, Stephen K. et al.	

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	152	8131256		2012-03-06	MARTTI, Jyrki et al.	
	153	8131281	B1	2012-03-06	Hildner et al.	
	154	8131840	B1	2012-03-06	Denker, Richard E.	
	155	8131858	B2	2012-03-06	Agulnik et al.	
	156	8132256	B2	2012-03-06	Bari, Farooq	
	157	8134954	B2	2012-03-13	Godfrey, James A. et al.	
	158	8135388		2012-03-13	Gailloux, Michael A. et al.	
	159	8135392		2012-03-13	MARCELLINO et al.	
	160	8135657		2012-03-13	Kapoor, Harsh et al.	
	161	8140690	B2	2012-03-20	Ly et al.	
	162	8144591		2012-03-27	GHAI et al.	

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	163	8145194	B2	2012-03-27	Yoshikawa et al.	
	164	8146142	B2	2012-03-27	Lortz et al.	
	165	8149748	B2	2012-04-03	Bata et al.	
	166	8149823		2012-04-03	Turcan, Diane Brown et al.	
	167	8150394	B2	2012-04-03	Bianconi et al.	
	168	8150431		2012-04-03	Wolovitz, Lionel et al.	
	169	8151205	B2	2012-04-03	Follmann et al.	
	170	8155155		2012-04-10	Chow, Albert T. et al.	
	171	8155620		2012-04-10	Wang, Jun et al.	
	172	8155666	B2	2012-04-10	Alizadeh-Shabdiz, Farshid	
	173	8155670		2012-04-10	Fullam, Scott et al.	

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	174	8156206		2012-04-10	KILEY, Kevin J. et al.	
	175	8159520	B1	2012-04-17	Dhanoa et al.	
	176	8160015		2012-04-17	RASHID, Mohammed H. et al.	
	177	8160056	B2	2012-04-17	Van der Merwe et al.	
	178	8160598	B2	2012-04-17	Savoor, Raghvendra	
	179	8165576		2012-04-24	Raju, Vishwanath et al.	
	180	8166040	B2	2012-04-24	Brindisi, Richard G. et al.	
	181	8166554	B2	2012-04-24	John, Pramod	
	182	8170553		2012-05-01	BENNETT, James D.	
	183	8174378	B2	2012-05-08	Richman et al.	
	184	8174970	B2	2012-05-12	Adamczyk, Maria et al.	

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	185	8175574	B1	2012-05-08	Panda et al.	
	186	8180333	B1	2012-05-15	Wells et al.	
	187	8180881	B2	2012-05-15	Seo et al.	
	188	8180886	B2	2012-05-15	Overcash et al.	
	189	8184530		2012-05-22	SWAN, Tim L. et al.	
	190	8184590		2012-05-22	Rosenblatt, Ariel	
	191	8185088	B2	2012-05-22	Klein et al.	
	192	8185093		2012-05-22	Jheng, Yu-Syuan et al.	
	193	8185127	B1	2012-05-22	Cai, Zheng et al.	
	194	8185152		2012-05-22	GOLDNER, Alla	
	195	8185158		2012-05-22	Tamura, Motoshi et al.	

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	196	8190087	B2	2012-05-29	Fisher et al.	
	197	8190122	B1	2012-05-29	Alexander et al.	
	198	8190675		2012-05-29	TRIBBETT, David	
	199	8191106	B2	2012-05-29	Choyi et al.	
	200	8191116		2012-05-29	Gazzard, Daryl	
	201	8191124	B2	2012-05-29	Wynn et al.	
	202	8194549	B2	2012-06-05	Huber et al.	
	203	8194553		2012-06-05	LIANG, Zhi Yong et al.	
	204	8194572	B2	2012-06-05	Horvath et al.	
	205	8194581	B1	2012-06-05	Schroeder et al.	
	206	8195093		2013-06-05	Garrett, Darrin et al.	

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	207	8195153	B1	2012-06-05	Frencel et al.	
	208	8195163	B2	2012-06-05	Gisby, Doug et al.	
	209	8195661	B2	2012-06-05	Kalavade, Asawaree	
	210	8196199	B2	2012-06-05	Hrastar et al.	
	211	8200163	B2	2012-06-12	Hoffman, George E.	
	212	8200200	B1	2012-06-12	Belser et al.	
	213	8200509	B2	2012-06-12	Kenedy, Andrew Alexander et al.	
	214	8200775		2012-06-12	MOORE, James F.	
	215	8200818	B2	2012-06-12	Freund et al.	
	216	8204190		2012-06-19	Bang, Jung-Hee et al.	
	217	8204505	B2	2012-06-19	Jin et al.	

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	218	8204794		2012-06-19	Peng, Shih-Ta et al.	
	219	8208788	B2	2012-06-26	Ando et al.	
	220	8208919		2012-06-26	KOTECHA, Lalit Ratilal	
	221	8213296		2012-07-03	SHANNON, Frank M. et al.	
	222	8213363		2012-07-03	Ying, Wen-Ping et al.	
	223	8214536		2012-07-03	ZHAO, Wen	
	224	8214890	B2	2012-07-03	Kirovski et al.	
	225	8219134	B2	2012-07-10	Maharajh et al.	
	226	8223655	B2	2012-07-17	Heinz et al.	
	227	8223741	B	2012-07-17	Bartlett et al.	
	228	8224382		2012-07-17	Bultman, Michael J.	

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	229	8224773		2012-07-17	Spiegel, Joel R.	
	230	8228818	B2	2012-07-24	Chase et al.	
	231	8229394	B2	2012-07-24	Karlberg, Johan	
	232	8229914	B2	2012-07-24	Ramer et al.	
	233	8230061		2012-07-24	Hassan, Amer A. et al.	
	234	8233433	B2	2012-07-31	Kalhan, Amit	
	235	8233883		2012-07-31	De Froment, Eric	
	236	8233895		2012-07-31	Tysowski, Piotr Konrad	
	237	8234583	B2	2012-07-31	Sloo et al.	
	238	8238287		2012-08-07	Gopi, Paramesh et al.	
	239	8239520		2012-08-07	GRAH, Adrian	

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	240	8242959	B2	2012-08-14	Mia, Rashidus S. et al.	
	241	8244241		2012-08-14	Montemurro, Michael	
	242	8249601	B2	2012-08-21	Emberson et al.	
	243	8254880	B2	2012-08-28	Aaltonen et al.	
	244	8254915		2012-08-28	Kozisek, Steven E.	
	245	8255515		2012-08-28	MELMAN, David et al.	
	246	8255534	B2	2012-08-28	Assadzadeh, Alireza	
	247	8255689		2012-08-28	KIM, Eun Ah et al.	
	248	8259692	B2	2012-09-04	Bajko, Gabor	
	249	8264965	B2	2012-09-11	Dolganow et al.	
	250	8265004		2012-09-11	Toutonghi, Michael J.	

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	251	8266681		2012-09-11	Deshpande, Sumit B. et al.	
	252	8270955	B2	2012-09-18	Ramer et al.	
	253	8270972	B2	2012-09-18	Otting, Marcia J. et al.	
	254	8271025	B2	2012-09-18	Brisebois et al.	
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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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

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See attached certification statement.

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

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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	122	8559369	B2	2013-10-15	Barkan	
	123	8561138	B2	2013-10-15	Rothman, Michael M. et al.	
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	130	8572117	B2	2013-10-29	Rappaport, Theodore S.	
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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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	42	20030233332	A	2003-12-18	Keeler, James D. et al.	
	43	20030236745		2003-12-25	HARTSELL et al.	
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	47	20040030705		2004-02-12	BOWMAN-AMUAH, Michel K.	
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	52	20040073672		2004-04-15	FASCENDA, Anthony C.	
	53	20040082346		2004-04-29	SKYTT et al.	
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	62	20040137890	A1	2004-07-15	Kalke, Catherine	
	63	20040168052		2004-08-26	CLISHAM et al.	
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	84	20050055291		2005-03-10	BEVENTE et al.	
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	153	20060190314		2006-08-24	HERNANDEZ, Rick	
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	185	20070104126		2007-05-10	CALHOUN et al.	
	186	20070109983	A	2007-05-17	Shankar, Rohit et al.	
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	188	20070130315		2007-06-07	FRIEND et al.	
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	242	20080051076		2008-02-28	O'Shaughnessy, John et al.	
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.S.A/

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/977,766	05/11/2018	Gregory G. Raleigh	RALEP032C1C12C2C1	8228

106963 7590 06/21/2018

Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

EXAMINER
NGO, RICKY QUOC

ART UNIT	PAPER NUMBER
2464	

NOTIFICATION DATE	DELIVERY MODE
06/21/2018	ELECTRONIC

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

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

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

patent@headwaterllc.com

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

Doc Code:
TRACK1.GRANT

Decision Granting Request for Prioritized Examination (Track I or After RCE)	Application No.:15/977,766

1. THE REQUEST FILED May 11, 2018 IS **GRANTED.**

The above-identified application has met the requirements for prioritized examination
A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;
B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;
C. filing a **request for continued examination**;
D. filing a notice of appeal;
E. filing a request for suspension of action;
F. mailing of a notice of allowance;
G. mailing of a final Office action;
H. completion of examination as defined in 37 CFR 41.102; or
I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to Kimberly Inabinet at 571-272-4618.

/Kimberly Inabinet/ Paralegal Specialist, Office of Petitions

U.S. Patent and Trademark Office
PTO-2298 (Rev. 02-2012)

Office of Petitions: Decision Count Sheet

Mailing Month: 6

Application No.: 15977766

15977766

For US serial numbers: enter number only, no slashes or commas. Ex: 10123456
For PCT: enter "51+single digit of year of filing+last 5 numbers", Ex. for PCT/US05/12345, enter 51512345

Deciding Official: Kimberly Inabinet

Count (1) - Palm Credit 15977766

Decision: GRANT

FINANCE WORK NEEDED
☐ Select Check Box for YES

GRANT

Decision Type: 643 - Track One request

643

Notes:

Count (2)

Decision: n/a

FINANCE WORK NEEDED
☐ Select Check Box for YES

Decision Type: NONE

Notes:

Count (3)

Decision: n/a

FINANCE WORK NEEDED
☐ Select Check Box for YES

Decision Type: NONE

Notes:

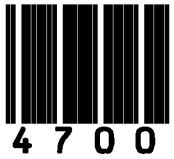
Initials of Approving Official (if required)

If more than 3 decisions, attach 2nd count sheet & mark this box ☐

Printed on: 6/17/2018

Office of Petitions Internal Document - Ver. 5.0

Office of Petitions: Routing Sheet



Application No. 15977766

This application is being forwarded to your office for further processing. A decision has been rendered on a petition filed in this application, as indicated below. For details of this decision, please see the document PET.OP.DEC filed on the same date as this document.

- [X] **GRANTED**
- [ ] **DISMISSED**
- [ ] **DENIED**

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/977,766	05/11/2018		985	RALEP032C1C12C2C1	20	1

CONFIRMATION NO. 8228

106963
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703

FILING RECEIPT

OC000000100010583

Date Mailed: 06/06/2018

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)

Gregory G. Raleigh, Woodside, CA;
James Lavine, Corte Madera, CA;
Alireza Raissinia, Monte Sereno, CA;

Applicant(s)

Headwater Research LLC, Tyler, TX;

Assignment For Published Patent Application

Headwater Research LLC, Tyler, TX

Power of Attorney: The patent practitioners associated with Customer Number 106963

Domestic Priority data as claimed by applicant

This application is a CON of 15/681,726 08/21/2017
which is a CON of 14/687,715 04/15/2015 PAT 9749899
which is a CON of 14/082,040 11/15/2013 PAT 9609544
which is a DIV of 13/134,028 05/25/2011 PAT 8589541
which is a CIP of 12/695,021 01/27/2010 PAT 8346225
and is a CIP of 13/134,005 05/25/2011 PAT 8635335
and claims benefit of 61/381,159 09/09/2010
and claims benefit of 61/381,162 09/09/2010
and claims benefit of 61/384,456 09/20/2010
and claims benefit of 61/389,547 10/04/2010
and claims benefit of 61/385,020 09/21/2010
and claims benefit of 61/387,243 09/28/2010
and claims benefit of 61/387,247 09/28/2010
and claims benefit of 61/407,358 10/27/2010
and claims benefit of 61/418,507 12/01/2010

and claims benefit of 61/418,509 12/01/2010
and claims benefit of 61/420,727 12/07/2010
and claims benefit of 61/422,565 12/13/2010
and claims benefit of 61/422,572 12/13/2010
and claims benefit of 61/422,574 12/13/2010
and claims benefit of 61/435,564 01/24/2011
and claims benefit of 61/472,606 04/06/2011
and claims benefit of 61/348,022 05/25/2010
and said 12/695,021 01/27/2010
claims benefit of 61/252,151 10/15/2009
and claims benefit of 61/252,153 10/15/2009
and is a CIP of 12/380,780 03/02/2009 PAT 8839388
and said 13/134,005 05/25/2011
is a CIP of 12/380,780 03/02/2009 PAT 8839388
and is a CIP of 12/380,778 03/02/2009 PAT 8321526
and said 13/134,028 05/25/2011
is a CIP of 12/695,019 01/27/2010 PAT 8275830
and is a CIP of 12/695,020 01/27/2010 PAT 8406748
and is a CIP of 12/694,445 01/27/2010 PAT 8391834
and is a CIP of 12/694,451 01/27/2010 PAT 8548428
and is a CIP of 12/694,455 01/27/2010 PAT 8402111
and is a CIP of 12/695,980 01/28/2010 PAT 8340634
and said 12/695,019 01/27/2010
claims benefit of 61/270,353 07/06/2009
and claims benefit of 61/264,126 11/24/2009
and said 12/695,020 01/27/2010
claims benefit of 61/275,208 08/25/2009
and claims benefit of 61/237,753 08/28/2009
and said 12/694,455 01/27/2010
claims benefit of 61/264,120 11/24/2009
and said 12/380,780 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009
and said 12/380,778 03/02/2009
claims benefit of 61/206,354 01/28/2009
and claims benefit of 61/206,944 02/04/2009
and claims benefit of 61/207,393 02/10/2009
and claims benefit of 61/207,739 02/13/2009

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: 06/04/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/977,766**

Projected Publication Date: 09/13/2018

Non-Publication Request: No

Early Publication Request: Yes
**** SMALL ENTITY ****
Title

Device-Assisted Services for Protecting Network Capacity

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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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.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/977,766

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	1 minus 3 =	*	x 230 =	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).			200			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	985		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15977766
Filing Date	2018-05-11
First Named Inventor	Raleigh
Art Unit	
Examiner Name	not yet assigned
Attorney Docket Number	RALEP032C1C12C2C1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5131020	A	1992-07-14	Liebesny et al.	
	2	5283904		1994-02-01	CARSON, David G. et al.	
	3	5325532	A	1994-06-28	Crosswy et al.	
	4	5572528	A	1996-11-05	Shuen, Pauline	
	5	5577100		1996-11-19	McGREGOR et al.	
	6	5594777		1997-01-14	Makkonen, Matti et al.	
	7	5617539	A	1997-04-01	Ludwig et al.	
	8	5630159	A	1997-05-13	Zancho, William F.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Examiner Name	not yet assigned
	Attorney Docket Number	RALEP032C1C12C2C1

	9	5633484	A	1997-05-27	Zancho, William F. et al.	
	10	5633868	A	1997-05-27	Baldwin et al.	
	11	5754953	A	1998-05-19	Briancon et al.	
	12	5774532	A	1998-06-30	Gottlieb et al.	
	13	5794142		1998-08-11	VANTTILA et al.	
	14	5814798	A	1998-09-29	Zancho, William F.	
	15	5889477		1999-03-30	Fastenrath, Ulrich	
	16	5892900		1999-04-06	GINTER et al.	
	17	5903845		1999-05-11	BUHRMANN et al.	
	18	5915008	A	1999-06-22	Dulman, Scott	
	19	5915226	A	1999-06-22	Martineau	

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	Attorney Docket Number	RALEP032C1C12C2C1

	20	5933778		1999-08-03	BUHRMANN et al.	
	21	5940472		1999-08-17	NEWMAN et al.	
	22	5974439	A	1999-10-26	Bollella, Gregory	
	23	5983270	A	1999-11-09	Abraham et al.	
	24	6035281		2000-03-07	Crosskey, James P. et al.	
	25	6038452		2000-03-14	Strawczynski, Leo et al.	
	26	6038540	A	2000-03-14	Krist et al.	
	27	6047268		2000-04-04	BARTOLI et al.	
	28	6058434	A	2000-05-02	Wilt et al.	
	29	6061571	A	2000-05-09	Tamura, Hideo	
	30	6064878		2000-05-16	DENKER, John Stewart et al.	

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	First Named Inventor	Raleigh
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	Attorney Docket Number	RALEP032C1C12C2C1

	31	6078953		2000-06-20	VAID et al.	
	32	6081591		2000-06-27	SKOOG, Frederick H.	
	33	6098878		2000-08-08	DENT et al.	
	34	6104700	A	2000-08-15	Haddock, Stephen R. et al.	
	35	6115823	A	2000-09-05	Velasco et al.	
	36	6119933	A	2000-09-19	Wong et al.	
	37	6125391	A	2000-09-26	Meltzer et al.	
	38	6141565	A	2000-10-31	Feuerstein et al.	
	39	6141686		2000-10-31	JACKOWSKI et al.	
	40	6148336		2000-11-14	THOMAS et al.	
	41	6154738		2000-11-28	CALL, Charles Gainor	

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	Art Unit	
	Examiner Name	not yet assigned
	Attorney Docket Number	RALEP032C1C12C2C1

	42	6157636	A	2000-12-05	Voit et al.	
	43	6185576	B1	2001-02-06	Mcintosh, Lowrie	
	44	6198915		2001-03-06	McGREGOR et al.	
	45	6219786	B1	2001-04-17	Cunningham et al.	
	46	6226277		2001-05-01	Chuah, Mooi Choo	
	47	6246870	B1	2001-06-12	Dent et al.	
	48	6263055		2001-07-17	GARLAND et al.	
	49	6292828		2001-09-18	Williams, David L.	
	50	6317584		2001-11-13	ABU-AMARA et al.	
	51	6381316		2002-04-30	JOYCE, Simon James et al.	
	52	6393014	B1	2002-05-21	Daly et al.	

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	First Named Inventor	Raleigh
	Art Unit	
	Examiner Name	not yet assigned
	Attorney Docket Number	RALEP032C1C12C2C1

	53	6397259	B1	2002-05-28	Lincke et al.	
	54	6401113	B2	2002-06-04	Lazaridis et al.	
	55	6418147		2002-07-09	WIEDEMAN, Robert A.	
	56	6438575	B1	2002-08-20	Khan et al.	
	57	6445777	B1	2002-09-03	Clark, Curtis	
	58	6449479		2002-09-10	SANCHEZ, Eduardo	
	59	6466984	B1	2002-10-15	Naveh et al.	
	60	6477670		2002-11-05	Ahmadvand, Nima	
	61	6502131		2002-12-31	VAID, Aseem et al.	
	62	6505114		2003-01-07	LUCIANI, Sergio	
	63	6510152	B1	2003-01-21	Gerszberg et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15977766
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	First Named Inventor	Raleigh
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	First Named Inventor	Raleigh
	Art Unit	
	Examiner Name	not yet assigned
	Attorney Docket Number	RALEP032C1C12C2C1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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

OR

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

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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

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Examiner Name	not yet assigned
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U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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

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

Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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	57	8446831	B2	2013-05-21	Kwan et al.	
	58	8447324		2013-05-21	Shuman, Mohammed Ataur et al.	
	59	8447607	B2	2013-05-21	Weider, Chris et al.	
	60	8447980		2013-05-21	Godfrey, James A. et al.	
	61	8448015	B2	2013-05-21	Gerhart, David	
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	63	8461958	B2	2013-06-11	Saenz et al.	

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	64	8463232	B2	2013-06-11	Tuli et al.	
	65	8468337	B2	2013-06-18	Gaur, Santosh P. et al.	
	66	8472371		2013-06-25	Bari, Farooq et al.	
	67	8477778		2013-07-02	Lehmann Jr., L. Curtis et al.	
	68	8483135		2013-07-09	Cai, Yigang et al.	
	69	8483694	B2	2013-07-09	Lewis et al.	
	70	8484327	B2	2013-07-09	Werner et al.	
	71	8484568	B2	2013-07-09	Rados et al.	
	72	8488597	B2	2013-07-16	Nie et al.	
	73	8489110	B2	2013-07-16	Frank et al.	
	74	8489720	B1	2013-07-16	Morford, Michael et al.	

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	75	8494559	B1	2013-07-23	Malmi	
	76	8495181	B2	2013-07-23	Venkatraman et al.	
	77	8495227		2013-07-23	Kaminsky, David L. et al.	
	78	8495360		2013-07-23	Falk, Rainer et al.	
	79	8495700	B2	2013-07-23	Shahbazi, Majid	
	80	8495743	B2	2013-07-23	Kraemer et al.	
	81	8499087	B2	2013-07-30	Hu, Qingmin	
	82	8503358	B2	2013-08-06	Hanson et al.	
	83	8503455	B2	2013-08-06	Heikens, Heico	
	84	8504032	B2	2013-08-06	Lott et al.	
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	86	8504687	B2	2013-08-06	Maffione et al.	
	87	8504690	B2	2013-08-06	Shah et al.	
	88	8504729		2013-08-06	Pezzutti, David A.	
	89	8505073	B2	2013-08-06	Taglienti et al.	
	90	8509082	B2	2013-08-13	Heinz, John M. et al.	
	91	8514927	B2	2013-08-20	Sundararajan et al.	
	92	8516552	B2	2013-08-20	Raleigh	
	93	8520589		2013-08-27	Bhatt, Yogesh et al.	
	94	8520595	B2	2013-08-27	Yadav et al.	
	95	8521110		2013-08-27	Rofougaran, Ahmadreza	
	96	8521775	B1	2013-08-27	Poh et al.	

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	97	8522039	B2	2013-08-27	Hyndman et al.	
	98	8522249	B2	2013-08-27	Beaule, Stephane	
	99	8522337	B2	2013-08-27	Adusumilli et al.	
	100	8523547	B2	2013-09-03	Pekrul, Merton W.	
	101	8526329	B2	2013-09-03	Mahany, Ronald L. et al.	
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	108	8532610	B2	2013-09-10	Manning Cassett et al.	
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	119	8548428	B2	2013-10-01	Raleigh, Gregory G.	
	120	8549173	B1	2013-10-01	Wu et al.	
	121	8554876	B2	2013-10-08	Winsor, Gerald W.	
	122	8559369	B2	2013-10-15	Barkan	
	123	8561138	B2	2013-10-15	Rothman, Michael M. et al.	
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	130	8572117	B2	2013-10-29	Rappaport, Theodore S.	
	131	8572256	B2	2013-10-29	Babbar, Uppinder Singh	
	132	8583499		2013-11-12	De Judicibus, Dario et al.	
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	137	8601125	B2	2013-12-03	Huang et al.	
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	142	8630314	B2	2014-01-14	York, Frederick John	
	143	8631428	B2	2014-01-14	Scott et al.	
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	152	8666395	B2	2014-03-04	Silver, Andrew	
	153	8667542	B1	2014-03-04	Bertz et al.	
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	196	8868725	B2	2014-10-21	Samba, Augustine S.	
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See attached certification statement.

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

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Signature	/James E. Harris/	Date (YYYY-MM-DD)	2018-05-24
Name/Print	James E. Harris	Registration Number	40013

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

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

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

Electronic Acknowledgement Receipt

EFS ID:	32719603
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	24-MAY-2018
Filing Date:	
Time Stamp:	16:34:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Assignee showing of ownership per 37 CFR 3.73	P032C1C12C2C1_373Stmt.pdf	120000 cc1c19976cdcd2f93b3ae1bb5ff2079e6a4981bb	no	3

Warnings:

Information:					
2	Transmittal Letter	P032C1C12C2C1_IDSLetter.pdf	66041 477a1b164dabc1358b5251c63503fa3312107aff	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	P032CON_IDS1.pdf	1063293 59021706ea3ca9f465441888d8b647f98e61cdb8	no	37
Warnings:					
Information:					
4	Information Disclosure Statement (IDS) Form (SB08)	P032CON_IDS2.pdf	1065473 28a56161805bdc5265acb2a2ecec8daaf306a583	no	40
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	P032CON_IDS3.pdf	1060256 4b9bc8a5db8282d16020a4a3b231f09eb3982bf4	no	31
Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	P032CON_IDS4.pdf	1060137 4324fbcfcc12582bf07c1c7f7dee2ba26a8b330c	no	31
Warnings:					
Information:					
7	Information Disclosure Statement (IDS) Form (SB08)	P032CON_IDS5.pdf	1058458 6590a069cb462c132b0e47ad292d1d27aff524f2	no	25
Warnings:					
Information:					
		Total Files Size (in bytes):	5493658		

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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Headwater Research LLC

Application No./Patent No.: 15/977,766 Filed/Issue Date: May 11, 2018

Titled: Device-Assisted Services for Protecting Network Capacity

Headwater Research 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 _____, Frame _____, 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: Inventors (Raleigh et al.) To: Headwater Partners I LLC

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

   Reel 045793, Frame 0097, or for which a copy thereof is attached.

2. From: Headwater Partners I LLC To: Headwater Research LLC

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

   Reel 045793, Frame 0103, or for which a copy thereof is attached.

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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

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.

/James E. Harris/	May 24, 2018
Signature	Date
James E. Harris	40013
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.
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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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Raleigh et al.	Examiner:	not yet assigned
Serial No.:	15/977,766	Art Unit:	
Filed:	May 11, 2018	Conf. No.:	8228
Title:	Device-Assisted Services for Protecting Network Capacity		

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

INFORMATION DISCLOSURE STATEMENT

The references cited on attached form PTO/SB/08A are being called to the attention of the Examiner. Copies of the references are not enclosed.

In accordance with 37 CFR §1.98(d), copies of the references can be found in related U.S. Patent Application No. 15/681,726, filed August 21, 2017, U.S. Patent Application No. 14/687,715 filed April 15, 2015, U.S. Patent Application No. 14/082,040 filed November 15, 2013, or in U.S. Patent Application No. 13/134,028 filed May 25, 2011, all of which the instant application is from the same direct family. Any foreign or non-patent references not submitted in those family applications are transmitted herewith.

It is respectfully requested that the cited references be expressly considered during the prosecution of this application, and the references be made of record therein and appear among the "references cited" on any patent to issue therefrom.

As provided for by 37 CFR § 1.97(g) and (h), no inference should be made that the information and references cited are prior art merely because they are in this statement and no representation is being made that a search has been conducted or that this statement encompasses all the possible relevant information.

Applicant believes that no fee is required for submission of this statement, but if for any reason an insufficient fee has been paid, please charge the insufficiency to Deposit Account No. **50-5876**.

Respectfully submitted,

Date: May 24, 2018

By: /James E. Harris/

James E. Harris
Reg. No. 40,013
Patent Counsel
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
(903) 201-6212

CERTIFICATE OF ELECTRONIC TRANSMISSION

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being filed electronically via EFS-Web addressed to the Commissioner for Patents on:

Date: May 24, 2018 By: /Ann Taylor/
Ann Taylor

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Raleigh et al.	Examiner:	not yet assigned
Serial No.:	15/977,766	Art Unit:	
Filed:	May 11, 2018	Conf. No.:	8228
Title:	Device-Assisted Services for Protecting Network Capacity		

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

PRELIMINARY AMENDMENT

Prior to examination on the merits, please amend the above-identified application as follows:

Amendments to the Claims begin on page 2.

Remarks begin on page 6.

AMENDMENTS TO THE CLAIMS

1. (Canceled)

2. (New) A wireless end-user device, comprising:
a processor;
a Wireless Wide-Area Network (WWAN) modem, to communicate data for network service usage activities between the wireless end-user device and a WWAN; and
a computer-readable storage medium storing instructions that, when provided to the processor, cause the processor to
receive respective requests from a plurality of applications on the device to access the WWAN for background network service usage activities associated with the respective applications,
based at least in part on a current WWAN network busy state, select a corresponding current service usage control policy for the background network service usage activities,
determine respective deferred time slots for each of the background network service usage activities based on the current service usage control policy, wherein at least one such service usage control policy specifies that during a time when the current WWAN network busy state indicates network congestion, a selected subset of the background network service usage activities are deferred until network congestion is no longer indicated, and
allow each of the background network service usage activities to access the WWAN during the respective deferred time slot for that background network service usage activity.

3. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to classify the respective requests with respective priorities, and the at least one such service usage control policy determines the selected subset of the background network service usage activities based on the respective priorities of the respective requests.

4. (New) The wireless end-user device of claim 3, wherein to classify the respective requests with respective priorities comprises maintaining a network capacity-controlled services list indicating one or more applications having a network capacity control, and assigning a respective priority to a request based on the network capacity-controlled services list.

5. (New) The wireless end-user device of claim 4, wherein the network capacity-controlled services list is based at least in part on user preference selections.

6. (New) The wireless end-user device of claim 2, wherein to allow each of the background network service usage activities to access the WWAN during the respective deferred time slot comprises blocking or delaying execution of the application associated with a given background network service usage activity until the respective deferred time slot is reached.

7. (New) The wireless end-user device of claim 2, wherein to allow each of the background network service usage activities to access the WWAN during the respective deferred time slot comprises informing an application associated with a given background network service activity when the WWAN is available for that activity.

8. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to, based on at least one selected current service usage policy, defer at least one of the background network service usage activities until a different network, other than the WWAN, is available to communicate data for that at least one of the background network service usage activities.

9. (New) The wireless end-user device of claim 8, wherein the different network comprises a specific network selection for that at least one of the background network service usage activities.

10. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, monitoring of user interaction with the device.

11. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select different service usage control policies based at least in part on, in addition to the current WWAN network busy state, a power state.

12. (New) The wireless end-user device of claim 2, wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access Application Programming Interface (API), the API allowing applications to request a time slot demand for a background network service usage activity.

13. (New) The wireless end-user device of claim 2, wherein to receive respective requests from a plurality of applications comprises receiving the requests through an operating system device service access Application Programming Interface (API), the API allowing applications to indicate a data size for a background network service usage activity.

14. (New) The wireless end-user device of claim 2, wherein the current network busy state is received from a network element via the WWAN.

15. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to generate the current network busy state.

16. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to select the corresponding current service usage control policy for the background network service usage activities based on a service plan active on the device, in addition to the current WWAN network busy state, the service

plan including network busy state-based criteria restrictions that apply to network capacity-controlled services, including one or more of the background network service usage activities.

17. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on a service usage behavior analysis of the activity.

18. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on monitoring power consumption behavior of the activity.

19. (New) The wireless end-user device of claim 2, wherein the instructions provided to the processor further cause the processor to apply the current service usage control policy for one or more of the background network service activities based on monitoring user interaction with the activity.

20. (New) The wireless end-user device of claim 2, the one or more processors further configured to communicate with one or more of the applications through an Application Programming Interface that informs each such application of one or more policies applied to background network service usage activities associated with that application.

21. (New) The wireless end-user device of claim 2, wherein to determine respective deferred time slots for each of the background network service usage activities further comprises delaying a time slot for a particular one of the background network service usage activities at least until a first time delay has occurred since a previous deferred time slot associated with that activity.

REMARKS

Claim 1 has been canceled, and new claims 2-21 have been added. No new matter has been added. Applicant respectfully requests the entry of the amendments herein.

The Commissioner is authorized to charge any fee deficiency or credit any overpayment to Deposit Account 50-5876.

Respectfully submitted,

Date: May 14, 2018

By: /James E. Harris/

James E. Harris
Reg. No. 40,013
Patent Counsel
Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703
(903) 201-6212

CERTIFICATE OF ELECTRONIC TRANSMISSION

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Date: May 14, 2018 By: /Ann Taylor/
Ann Taylor

Electronic Acknowledgement Receipt	
EFS ID:	32609333
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	14-MAY-2018
Filing Date:	
Time Stamp:	10:06:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		P032C1C12C2C1_PreliminaryAmendment.pdf	90371 01e98be69652273ae4c474e290cfab388ab3f521	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	6
Warnings:			
Information:			
	Total Files Size (in bytes):	90371	

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
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New International Application Filed with the USPTO as a Receiving Office
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Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

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

First Named Inventor:	Raleigh	Nonprovisional Application Number (if known):	RALEP032C1C12C2C1
Title of Invention:	Device-Assisted Services for Protecting Network Capacity		

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

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

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

3. The applicable box is checked below:

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

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

---OR---

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

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

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

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

Signature /James E. Harris/	Date 2018-05-11
Name (Print/Typed) James E. Harris	Practitioner Registration Number 40013

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

☐ *Total of _____ forms are submitted.

Privacy Act Statement

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

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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
	Gregory	G.	Raleigh	

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

City	Woodside	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	1011 Pruitt Place		
Address 2			
City	Tyler	State/Province	TX
Postal Code	75703	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	James		Lavine	

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

City	Corte Madera	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	1011 Pruitt Place		
Address 2			
City	Tyler	State/Province	TX
Postal Code	75703	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Alireza		Raissinia	

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

City	Monte Sereno	State/Province	CA	Country of Residence	US

Mailing Address of Inventor:

Address 1	1011 Pruitt Place		
Address 2			
City	Tyler	State/Province	TX
Postal Code	75703	Country	US

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

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	106963		
Email Address	patent@headwaterllc.com	Add Email	Remove Email

Application Information:

Title of the Invention	Device-Assisted Services for Protecting Network Capacity		
Attorney Docket Number	RALEP032C1C12C2C1	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	29	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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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	106963		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)	
	Continuation of	15681726	2017-08-21	

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15681726	Continuation of	14687715	2015-04-15	9749899	2017-08-29

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14687715	Continuation of	14082040	2013-11-15	9609544	2017-03-28

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14082040	Division of	13134028	2011-05-25	8589541	2013-11-19

Prior Application Status	Patented	Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13134028	Continuation in part of	12695021	2010-01-27	8346225	2013-01-01

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Prior Application Status	Patented			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13134028	Continuation in part of	13134005	2011-05-25	8635335	2014-01-21

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61381159	2010-09-09

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61381162	2010-09-09

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61384456	2010-09-20

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61389547	2010-10-04

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61385020	2010-09-21

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61387243	2010-09-28

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61387247	2010-09-28

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61407358	2010-10-27

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61418507	2010-12-01
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61418509	2010-12-01
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61420727	2010-12-07
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61422565	2010-12-13
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61422572	2010-12-13
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61422574	2010-12-13
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61435564	2011-01-24
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61472606	2011-04-06
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13134028	Claims benefit of provisional	61348022	2010-05-25

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695021	Claims benefit of provisional	61252151	2009-10-15
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695021	Claims benefit of provisional	61252153	2009-10-15
Prior Application Status	Patented		Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12695021	Continuation in part of	12380780	2009-03-02	8839388	2014-09-16
Prior Application Status	Patented				Remove
13134005	Continuation in part of	12380780	2009-03-02	8839388	2014-09-16
Prior Application Status	Patented				Remove
13134005	Continuation in part of	12380778	2009-03-02	8321526	2012-11-27
Prior Application Status	Patented				Remove
13134028	Continuation in part of	12695019	2010-01-27	8275830	2012-09-25
Prior Application Status	Patented				Remove
13134028	Continuation in part of	12695020	2010-01-27	8406748	2013-03-26
Prior Application Status	Patented				Remove
13134028	Continuation in part of	12694445	2010-01-27	8391834	2013-03-05
Prior Application Status	Patented				Remove
13134028	Continuation in part of	12694451	2010-01-27	8548428	2013-10-01
Prior Application Status	Patented				Remove
13134028	Continuation in part of	12694455	2010-01-27	8402111	2013-03-19

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Prior Application Status	Patented			Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13134028	Continuation in part of	12695980	2010-01-28	8340634	2012-12-25
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695019	Claims benefit of provisional	61270353	2009-07-06
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695019	Claims benefit of provisional	61264126	2009-11-24
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695020	Claims benefit of provisional	61275208	2009-08-25
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12695020	Claims benefit of provisional	61237753	2009-08-28
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12694455	Claims benefit of provisional	61264120	2009-11-24
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61206354	2009-01-28
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61206944	2009-02-04
Prior Application Status	Expired			Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61207393	2009-02-10

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380780	Claims benefit of provisional	61207739	2009-02-13
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61206354	2009-01-28
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61206944	2009-02-04
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61207393	2009-02-10
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
12380778	Claims benefit of provisional	61207739	2009-02-13
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.			Add

Foreign Priority Information:

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

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.			Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

Authorization or Opt-Out of Authorization to Permit Access:

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

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

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

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

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

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

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

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

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

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

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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	Headwater Research LLC		
Mailing Address Information For Applicant:			
Address 1	1011 Pruitt Place		
Address 2			
City	Tyler	**State/Province**	TX
Country	US	Postal Code	75703
Phone Number	903-201-6212	Fax Number	
Email Address	patent@headwaterllc.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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
	Application Number	
Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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. ☒

Organization Name	Headwater Research LLC

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	1011 Pruitt Place		
Address 2			
City	Tyler	**State/Province**	TX
Country i	US	Postal Code	75703
Phone Number	903-201-6212	Fax Number	
Email Address	patent@headwaterllc.com		

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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	RALEP032C1C12C2C1
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Title of Invention	Device-Assisted Services for Protecting Network Capacity	

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DEVICE-ASSISTED SERVICES FOR PROTECTING NETWORK CAPACITY

BACKGROUND

[0001] With the advent of mass market digital communications, applications and content distribution, many access networks such as wireless networks, cable networks and Digital Subscriber Line (DSL) networks are pressed for user capacity, with, for example Evolution-Data Optimized (EVDO), High Speed Packet Access (HSPA), Long Term Evolution (LTE), Worldwide Interoperability for Microwave Access (WiMax), DOCSIS, DSL, and Wireless Fidelity (Wi-Fi) becoming user capacity constrained. In the wireless case, although network capacity will increase with new higher capacity wireless radio access technologies, such as Multiple-Input Multiple-Output (MIMO), and with more frequency spectrum and cell splitting being deployed in the future, these capacity gains are likely to be less than what is required to meet growing digital networking demand.

[0002] Similarly, although wire line access networks, such as cable and DSL, can have higher average capacity per user compared to wireless, wire line user service consumption habits are trending toward very high bandwidth applications and content that can quickly consume the available capacity and degrade overall network service experience. Because some components of service provider costs go up with increasing bandwidth, this trend will also negatively impact service provider profits.

[0003] The foregoing example of trends and issues is intended to be illustrative and not exclusive. Other limitations of the art will become apparent to those of skill in the relevant art upon a reading of the specification and a study of the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a functional diagram of a network architecture for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments.

[0005] FIG. 2 illustrates another functional diagram of another network architecture for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments.

[0006] FIG. 3 illustrates a functional diagram of an architecture including a device based service processor and a service controller for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments.

[0007] FIGS. 4A through 4C illustrates a functional diagram for providing quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0008] FIG. 5 illustrates a functional diagram for generating a QoS activity map for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0009] FIG. 6 illustrates a functional diagram for quality of service (QoS) for device assisted services (DAS) for an end to end coordinated QoS service channel control in accordance with some embodiments.

[0010] FIG. 7 illustrates a flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0011] FIGS. 8A through 8C each illustrate another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0012] FIG. 9 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0013] FIG. 10 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0014] FIG. 11 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments.

[0015] FIG. 12 illustrates a device stack for providing various service usage measurement techniques in accordance with some embodiments.

[0016] FIG. 13 illustrates another device stack for providing various service usage measurement techniques in accordance with some embodiments.

[0017] FIG. 14 illustrates a flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0018] FIG. 15 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0019] FIG. 16 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0020] FIG. 17 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0021] FIG. 18 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0022] FIG. 19 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0023] FIG. 20 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0024] FIG. 21 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0025] FIG. 22 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0026] FIG. 23 illustrates a network capacity controlled services priority level chart for device assisted services (DAS) for protecting network capacity in accordance with some embodiments.

[0027] FIG. 24 depicts a diagram of a network capacity protection system utilizing device-assisted services (DAS).

[0028] FIG. 25 depicts a diagram an example of a differential access control notification system.

[0029] FIG. 26 depicts an example of a computer system on which techniques described in this paper can be implemented.

[0030] FIG. 27 depicts a diagram of an example of a system for application-specific differential network access control.

DETAILED DESCRIPTION

[0031] The invention can be implemented in numerous ways, including as a process; an apparatus; a system; a composition of matter; a computer program product embodied on a computer readable storage medium; and/or a processor, such as a processor configured to execute instructions stored on and/or provided by a memory coupled to the processor. In this specification, these implementations, or any other form that the invention may take, may be referred to as techniques. In general, the order of the steps of disclosed processes may be altered within the scope of the invention. Unless stated otherwise, a component such as a processor or a memory described as being configured to perform a task may be implemented as a general component that is temporarily configured to perform the task at a given time or a specific component that is manufactured to perform the task. As used herein, the term 'processor' refers to one or more devices, circuits, and/or processing cores configured to process data, such as computer program instructions.

[0032] A detailed description of one or more embodiments of the invention is provided below along with accompanying figures that illustrate the principles of the invention. The invention is described in connection with such embodiments, but the invention is not limited to any embodiment. The scope of the invention is limited only by the claims and the invention encompasses numerous alternatives, modifications and equivalents. Numerous specific details are set forth in the following description in order to provide a thorough understanding of the invention. These details are provided for the purpose of example and the invention may be practiced according to the claims without some or all of these specific details. For the purpose of clarity, technical material that is known in the technical fields related to the invention has not been described in detail so that the invention is not unnecessarily obscured.

[0033] As the network capacity gains are less than what is required to meet growing digital networking demand, a network capacity crunch is developing due to increasing network congestion on various wireless networks, such as mobile networks. The increasing popularity of various smart phone devices, net book devices, tablet computing devices, and various other wireless mobile computing devices, which are becoming increasingly popular on 3G, 4G, and other advanced wireless networks, is contributing to the network capacity crunch. Some network carriers have indicated that a relatively small number of users on such devices demand a

disproportionately significant amount of their network capacity. For example, AT&T has recently indicated that about 3 percent of its smart phone device users (e.g., Apple iPhone® users) are generating approximately 40 percent of the operator's data traffic.

[0034] For example, in wireless networks, managing the wireless access connection capacity and network access connection resources is important to maintain network performance as network resources/capacity demand increases. Many network performance measures can be advantageously maintained or improved as network loading increases if capacity management and/or network resource management is employed. For example, these performance measures include network availability; the ability to deliver connections to all devices, users and/or applications seeking connections and enabled for service on the network; network access attempt success rate; the transmission speed experienced by one or more devices, users or applications; the average transmission speed experienced by all devices, users and/or applications; network bit error rate or packet error rate; the time delay from network access request to delivered access connection; the one-way delay or round-trip delay for a transmission; the delay timing jitter for a transmission; the time variation in transmission speed for one or more connections; the ability of the network to deliver various requested/needed levels of Quality of Service (QoS) to devices, users or applications that require differentiated connection QoS classes; the ability of the network to maintain efficiency (e.g., aggregated service throughput measured across all devices, users, and/or applications); the ability of the network to share or distribute a performance measure (e.g., the performance measures listed above) uniformly or fairly across multiple devices, users, and/or applications that all have the same service quality class or the same service plan performance parameters.

[0035] For example, if there is a limited amount of shared bandwidth for a set of user devices (e.g., a set of devices on a wireless network, such as a given base station or base station controller or femto cell or pico cell; or a set of devices on a cable modem networks, etc.), and if multiple and/or all devices allow all applications to indiscriminately access or attempt to access network resources or transmit/receive traffic, then the network can generally become overloaded. As a result, a subset of users/devices or in some cases most or all users/devices obtain poor network performance. As another example, if one or more devices forming a subset of devices on the network allow multiple and/or all applications to indiscriminately access or attempt to access network resources or transmit/receive traffic, then the network can become overloaded.

As a result, a subset of users/devices or in some cases most or all users/devices obtain poor network performance.

[0036] Traditionally, mobile devices typically have specialized designs that are optimized to preserve network capacity and protect network resources from being over taxed. For example, wireless devices that browse the Internet often use specialized protocols such as WAP and data traffic compression or low resolution techniques rather than standard HTTP protocols and traffic used in wired Internet devices.

[0037] However, the wireless devices that implement specialized methods for accessing the Internet and/or other networks often implement complex specifications provided by one or more wireless carriers that own the networks that the device is designed to connect to. Such complex specifications often require time consuming design, testing, and certification processes. These processes in part have the effect of narrowing the base of device suppliers to those qualified and willing to perform the specialized design work required, slowing time to market for new devices, increasing the expense to develop new devices and reducing the types of applications that are supported.

[0038] Device OEMs have recently created wireless devices that are designed more like standard Internet devices and not fully optimized to preserve network capacity and resources. Many wireless service customers desire this type of device, and the OEMs generally want to reduce the complexity and time to market to deliver such devices. In addition, new market needs and new government requirements sometimes require that carriers offer a more open process for bringing new devices onto their network, in which the process does not require all of the specialized design and certification described above. These and various other factors are driving a growing need and trend for less complex and time consuming wireless device design and certification processes.

[0039] This trend has led many carriers to begin selling devices that are designed more as standard Internet service devices that connect to the Internet and other data networks through carrier wireless networks. As the cellular network is opened up to more and more new devices, applications and markets, there is a growing demand to allow general purpose Internet devices and applications to gain access to wireless networks without necessarily going through

specialized design and certification process requirements to make the devices and applications efficient and authorized for access to such wireless networks.

[0040] However, general purpose Internet devices are not as frugal or sparing with wireless network access bandwidth. Moreover, with the advent of always on wide area network connections to the Internet has led to popular Internet services and applications that typically assume very inexpensive access and generally heed no attention to, for example, network busy state. As more general purpose Internet devices are provided for us on various wireless networks (e.g., mobile wireless networks), a high frequency of inefficient wireless network accesses continue to rise, which can reduce network capacity sometimes to levels that hinder access to service for that device (e.g., user, device, software demand) and/or other devices on that wireless network and/or that wireless network segment. As discussed above, judicious use of wireless network bandwidth, capacity, and resources generally results in better service for all users, but at present, device manufacturers and wireless network providers (e.g., wireless network carriers or carriers) have not provided or implemented more intelligent bandwidth usage techniques. These factors generally result in less carrier control of device design, which poses a threat to longer term network capacity and performance preservation as the volume of devices with less optimized wireless designs continues to grow.

[0041] There are many network performance and user performance factors that are impacted by the efficiency of the network, including, for example, overall network congestion; the access network performance experienced by one or more groups of users, devices, applications, network service sources, communication protocols, and/or operating system functions; and/or the performance experienced by a given user, device, application, network service source, communication protocol, and/or operating system function. Under a relatively low capacity demand of a wireless network, network performance as experienced by a group of devices, applications, network service sources, communication protocols, operating system functions, and/or users or by a single device, application, network service source, communication protocol, operating system function, and/or user can degrade somewhat proportionally (e.g., aggregate traffic delivered by the network may be roughly proportional to the peak available network traffic) with incremental increases in network access and/or traffic demand from one or more groups of users, devices, applications, network service sources, communication protocols and/or operating system functions. However, as network resources/network capacity demand

increases (e.g., more wireless network data traffic is demanded in aggregate; more devices are serviced by the network; more users are serviced by the network; more applications are serviced by the network; more network service sources are serviced by the network; more operating system functions are serviced by the network; and/or more differentiated QoS sessions are serviced by the network), network availability/performance can decrease and/or the network may not adequately service one or more users, devices, applications, network service sources, communication protocols, and/or operating system functions, or may not service one or more groups of users, devices, applications, network service sources, communication protocols, and/or operating system functions.

[0042] There are many examples of how increasing network capacity demand can decrease network performance, including for example, to a decrease in average bandwidth offered per device (e.g., one or more users on a device, application, network service source, communication protocol, and/or operating system function executed/implemented on the device); an increase in traffic delivery latency; an increase in traffic delivery latency jitter; insufficient guaranteed or differentiated bandwidth for one or more differentiated QoS and/or dynamic QoS services (e.g., as described herein) to one or more devices, users, applications, network service sources, communication protocols, and/or operating system functions; increased latency for bandwidth reservation services; increased latency for QoS reservation services; performance problems with one or more communication protocols; unacceptable delays in user experience, and/or various other or similar consequences and device or user impacts resulting from reduced network availability and/or reduced network capacity. Examples of network communication protocols that can have degraded performance with excessive network loading or degraded network performance include, for example, Internet protocol (IP), HTML protocols, voice communication protocols including VOIP protocols, real-time video communication protocols, streaming media protocols (e.g., audio, video, etc), gaming protocols, VPN protocols, file download protocols, background service protocols, software update protocols, and/or various other network communication protocols. Thus, is it important to preserve/protect network capacity.

[0043] It is also important to control the number of transactions demanded from a given network resource (e.g., edge network segment, base station, base station controller, MAC resources, pico cell, femto cell, etc.) in a given period of time so that demand does not overcome

the transaction servicing ability of that network resource. For example, network resources that should not be subjected to excess transaction demand can include base station or base station controller resources, media access control (MAC) resources, traffic transport resources, AAA resources, security or authentication resources, home agent (HA) resources, DNS resources, resources that play a part in network discovery, gateway or router resources, data session reservation or establishment resources (e.g., network resources required to manage, set up, conduct, and/or close service sessions, PPP sessions, communication flows, communication streams, QoS flows, radio access bearer reservation resources , tunnels, VPNs, APNs, special service routing, etc.), bandwidth reservation resources, QoS reservation or coordination resources, QoS transport resources, service charging resources, traffic analysis resources, network security resources, and/or various other or similar network resources. In some networks, the network performance degradation due to a given measure of incremental increase in network resource/capacity demand can become relatively large as various network resources become increasingly taxed due to either limited transaction processing capability or limited traffic bandwidth for one or more of the network resources that participate in establishing, servicing, conducting, maintaining, and/or closing the necessary network service connections and/or information exchanges required to conduct a service activity. For example, if the equipment required to establish a PPP session can only handle a certain number of new PPP session openings and/or closings per given period of time, and if device behavior is such that PPP sessions are often opened and/or closed, then the rate of PPP session transactions (e.g., openings and/or closings) can exceed the transaction capacity of the PPP session management resources. This is sometimes referred to as "flooding" or "overloading" a network resource with excess demand or excess connections, and, in such cases, the network resource may begin falling behind in servicing transaction demand in a well controlled manner (e.g., the network resource may continue processing transactions at or near a maximum rate for that network resource), or in some cases, the resource may fall behind transaction demand in a less well controlled manner (e.g., the network resource may become overwhelmed such that its processing rate not only falls below aggregate transaction demand, but the transaction rate processing capability decreases under overload as well). In the PPP session establishment resource example, once the rate of requested transactions exceeds the resource maximum transaction rate, then unmet device

demand can grow to a point where one or more devices experiences delays in connecting to and/or communicating (e.g., sending/receiving data) with the network.

[0044] As another example, in any type of random access bandwidth reservation protocol, MAC protocol, or bandwidth delivery protocol, in a network without proper management and/or control of traffic access reservations and/or transmissions, as the network demand increases there may be more collisions between reservation requests, traffic transmissions, application demands, network service source demands, communication protocol demands, and/or operating system function demands causing a decreasing network efficiency that can degrade user, device, application and/or network service performance so that performance falls below acceptable levels. As another example, in systems in which there is a QoS service session reservation system, uncontrolled and/or unmanaged QoS reservation requests and/or reservation grants can lead to a situation where the QoS reservation resources and/or QoS service delivery resources are over taxed to the point where QoS service performance falls below desired levels. As another example, in networks that require some form of minimum resource allocation for transmissions, reservations, or network resource transactions, the network can become inefficient if one or more devices, applications, network service sources, operating system functions, and/or communication protocols have a relatively high rate of network resource access attempts, network accesses or data transmissions for small transmission payloads (e.g., minimum MAC reservation factors, minimum security overhead factors, minimum QoS reservation factors, minimum time responses for establishing a base station connection, minimum time responses for establishing or closing/being released from a session, etc). Even if the data packet comprising the access event is small, the network resources required to complete the access event are often busy servicing the access event for much longer periods of time than are required for the actual data transmission.

[0045] Another example of device service activity behavior that can have an impact on network performance is the way the device, device subsystem, and/or modem subsystem power cycling or transitions from one power save state to another. For example, establishing a basic connection from a device to a wireless base station consumes base station resources for a period of time and in some cases can also consume other network resources such as AAA, HLR, HA, gateway, billing, and/or charging gateway resources. If a device terminates the connection to the base station when the modem subsystem (e.g., or some other portion of the device) goes from

active connection state to a power save state, then each time the device enters power save state and then exits power save state network resources are consumed, sometimes for time periods measured on the order of seconds or in extreme cases even minutes. If such a device has an aggressive power save algorithm that enters power save state after a short idle period, then the device behavior can consume a proportionally large amount of resources such that the network ability to support multiple devices is diminished, or such that the network cannot support very many similar devices on the network. Another similar example is the establishment of network sessions once the base station connection is established (e.g., establishing a PPP session between the device and a home agent (HA) or other gateway), in which network resources required to open and/or close the network session are ignorantly consumed if a device exhibits aggressive power save state cycling or frequently terminates the data session for other reasons.

[0046] Another example of device service activity behavior that can impact network performance is applications that maintain persistent network communication that generates a relatively high frequency of network data packets. Some applications have persistent signaling that falls into this category. Specific examples include frequent device signaling sequences to update widgets on a desktop; synchronize user data such as calendars, contacts, email, and/or other information/content; check or update email or RSS feeds; access social networking websites or tools; online text, voice or video chat tools; update real-time information; and conduct other repetitive actions. Additional application behavior that can significantly tie up network resources and capacity include, for example, conference meeting services, video streaming, content update, software update, and/or other or similar application behavior. For example, even when the user is not directly interacting with or benefiting from this type of application, the application can be running in the background and continuing to consume potentially significant network resources.

[0047] For example, the types of service activities and/or device behavior that can reduce network capacity and/or network resource availability include software updates for OS and applications, frequent OS and application background network accesses and signaling, frequent network discovery and/or signaling (e.g., EtherType messages, ARP messages, and/or other messaging related to network access), cloud synchronization services, RSS feeds and/or other background information feeds, application (e.g., web browser) or device behavior reporting, background email downloads, content subscription service updates and downloads (e.g.,

music/video downloads, news feeds, etc.), text/voice/video chat clients, virus updates, peer to peer networking applications, inefficient network access sequences during frequent power cycling or power save state cycling, large downloads or other high bandwidth accesses, and/or greedy application programs that continually and/or frequently access the network with small transmissions or requests for information. Various other examples will now be apparent to one of ordinary skill in the art.

[0048] Thus, not only can network capacity, network performance, and/or network resource availability be degraded by high device transmission bandwidth demand, but other types of persistent or frequent traffic resulting from network resource requests, network data accesses or other network interaction can also degrade network capacity, network performance, and/or network resource whether or not the aggregate bandwidth demand as measured by the total data throughput is high or not. Thus, techniques are needed to preserve network capacity by, for example, differentially controlling these types of network service usage activities in various ways depending on the type of service activity requesting network access and/or requesting transactions with network resources.

[0049] Smart phones and similar devices are exacerbating the problem by making frequent queries of the wireless network as such devices move among cell sites to, while in transit, for example, push email, access social networking tools, and/or conduct other repetitive actions. While data traffic is also growing, signaling traffic is outpacing actual mobile data traffic by 30 percent to 50 percent by some estimates. For example, a Yahoo IM user may send a message but then wait a couple of seconds between messages. To preserve battery life, the smart phone typically moves into an idle mode. When the user pushes another message seconds later, the device has to set up a signaling path again, and even when the signaling resource is released by the smart phone, the network typically does not react fast enough to allow for the next station to use resources until several seconds and sometimes minutes. As a result, the base station controller in this example is spending a lot of its resources trying to process the signaling so it cannot perform other tasks, such as allocate additional resources for data network usage, and such inefficiencies exacerbate the data network capacity crunch and dropped calls on such wireless networks.

[0050] One approach used by smart phone vendors to address this problem and save battery life on their devices is to implement a fast dormancy feature, which allows the mobile device to quickly make a query to the radio network controller to release the connection so that it can return to the idle state faster. In other words, the device is relaying the fact that the phone is going dormant saving device resources (e.g., signaling channel) rather than network resources. However, the fast dormancy feature can exacerbate this problem by prematurely requesting a network release only to follow on with a request to connect back to the network or by a request to re-establish a connection with the network.

[0051] Network carriers have typically attempted to manage network capacity using various purely central/core network based approaches. For example, some carriers have indicated a robust capacity planning process and sufficient investment is needed to alleviate this growing capacity crunch. Purely centralized network solutions with no assistance from a device based software agent (or service processor) can have several limitations. For example, for some device applications, OS functions or other service usage activities, if the activity is blocked somewhere in the network behind the base station after over the air (OTA) spectrum bandwidth is consumed to open or begin to open a communication socket, then there can still be an appreciable amount of network capacity or resources consumed even though the data transfer is not allowed to complete. In addition, if the service usage activity is aggressive in re-attempting to establish the network connection to transfer the data, and the network continues to allow the OTA portion of the connection establishment but blocks the connection somewhere in the network, then a large amount of capacity can be consumed by many devices exhibiting such behavior even though no useful service is being allowed. Accordingly, some embodiments for protecting network capacity include controlling network service usage activities at the source of the demand – the device. Furthermore, in some embodiments, service usage is controlled in a manner that delays, prevents, or reduces the frequency of service usage activity re-try attempts to connect to the network.

[0052] In some cases, an additional drawback of purely centralized network solutions to protect network capacity arises when service usage activities are controlled, blocked, throttled, and/or delayed by central network equipment with no mechanisms or support to link to a device user interface (UI) to inform the user what is happening and why it is happening. This can lead to a frustrating user experience and reduced carrier customer satisfaction. Accordingly, in some

embodiments, a device based UI is provided to provide the user with real time or near real time information regarding why a service usage activity is being controlled, blocked, throttled, and/or otherwise controlled in order to protect network capacity. In some embodiments, a UI is provided that also informs the user when there are options to set, control, override, or modify service usage controls for the purpose of protecting network capacity. In some embodiments, such user preference inputs also correspond to a change in service usage billing. In some embodiments, such changes in service usage billing due to capacity sparing service control changes by the user are communicated to the user via a UI notification sequence. In some embodiments, techniques for protecting network capacity employ user warnings when a service usage activity classified for differential user notification policies is likely to cause the user to go over service plan caps (e.g., total data byte count usage caps).

[0053] What is needed is intelligent network monitoring to provide real-time traffic monitoring network service usage (e.g., at the packet level/layer, network stack application interface level/layer, and/or application level/layer) of the wireless network (e.g., radio access networks and/or core networks) and to effectively manage the network service usage for protecting network capacity (e.g., while still maintaining an acceptable user experience). Using Device Assisted Services (DAS) techniques, and in some cases, network assisted/based techniques, to provide for network service usage monitoring of devices, network carriers/operators would be provided greater insight into what devices, which users and what applications, and when and where network congestion problems occur, enabling operators to intelligently add additional resources to certain areas when necessary (e.g., offloading data traffic onto femto cells or WiFi hotspots and adding more network resources), to differentially control network service usage, and/or to differentially charge for network service usage based on, for example, a network busy state, for protecting network capacity.

[0054] Intelligent network monitoring of the wireless network to effectively manage network service usage for protecting network capacity can include providing Device Assisted Services (DAS) for protecting network capacity in accordance with various embodiments described herein. For example, intelligent network monitoring of the wireless network to effectively manage network service usage for protecting network capacity can include differentially controlling over the air software updates and/or performing software updates via wired connections only. As another example, intelligent network monitoring of the wireless

network to effectively manage network service usage for protecting network capacity can include differentially controlling various applications that demand significant network resources or network capacity. As another example, intelligent network monitoring of the wireless network to effectively manage network service usage for protecting network capacity can include managing network access connection requests resulting from repeated power down modes in the modem, which can cause resource intensive re-connection and/or re-authentication processes. As another example, intelligent network monitoring of the wireless network to effectively manage network service usage for protecting network capacity can include techniques for keeping PPP sessions alive to avoid the need to consume network resources to re-establish PPP sessions (e.g., unless the application behavior analysis predicts that a mean access time is long enough for the PPP session to be dropped off and yet not causing overall network resource limitations).

[0055] Unlike traditional QoS techniques, which are used to establish a single end or end to end guaranteed service level(s) on a network, techniques disclosed herein for protecting network capacity facilitate implementation of services on a network to facilitate differential control of certain services to protect network capacity (e.g., to reduce network congestion, network capacity demand, network resource demand; and/or to increase network availability). As also disclosed herein, techniques disclosed herein for protecting network capacity facilitate implementation of services on a network to facilitate differential control of certain services to protect network capacity can also facilitate QoS implementations by maintaining needed levels of network capacity/availability to facilitate delivery of certain QoS levels/classes. For example, techniques disclosed herein for protecting network capacity can aggregate across multiple services and/or devices to facilitate differential control of certain services to protect network capacity. As another example, techniques disclosed herein for protecting network capacity can be used to provide for dynamic QoS classifications (e.g., dynamically assigning/classifying and reassigning/reclassifying (based on various criteria, events, and/or measures) network service usage activities to various QoS levels/classes, such as described herein) to facilitate differential control of certain services to protect network capacity.

[0056] Accordingly, Device Assisted Services (DAS) for protecting network capacity is provided. In some embodiments, DAS for protecting network capacity provides for protection of network capacity (e.g., network congestion and/or network access/resource demand and/or

network availability on an edge element of the network, such as on the Radio Access Network (RAN) of a wireless network, and/or from a device to a base station/base station controller), such as by controlling network service activity usage activities of a device in wireless communication with the network to reduce demands on the network. For example, controlling network service usage activities can include classifying and/or controlling network access requests (e.g., IP address requests), network access reservation requests (e.g., a QoS reservation/sequence), network capacity/resources usage (e.g., bandwidth usage), and/or any other network service usage activities. In some embodiments, applications, OS functions, and/or other network service usage activities that request IP addresses from network address server resources are classified and/or controlled so that the IP address requests are withheld, delayed, time windowed, reduced in frequency, aggregated or otherwise controlled. In some embodiments, such "IP address request control policies" for one or more applications, OS functions, and/or other network service usage activities are set, updated, and/or modified before communicating it over a network connection to a network element (e.g., a service controller or another network element/function). In some embodiments, network service usage activities are generated/requested by applications, operating system (OS) functions, and/or other software/functions executed on a device in communication with the network. In some embodiments, it is desirable to apply a service usage control policy for the network service usage activities to protect network capacity (e.g., reduce network capacity demand). For example, some applications and/or OS functions have limited capabilities to defer certain traffic types based on fixed settings in the application, and such applications and/or OS functions typically cannot optimize network service usage activities based on a current network busy state (e.g., based on changing levels of network capacity and/or network performance available to the device). In some embodiments, the network busy state (e.g., or conversely the network availability state) is a characterization of the congestion (e.g., or conversely available capacity) of the network for one or more device connections. For example, the network busy state can provide a measure of how busy or congested the network or a network segment (e.g., network edge element) is for one or more device connections. As another example, network availability state can provide a measure of what network connection resources are available to one or more device connections. Thus, network busy state and network availability state can be viewed as converse ways of providing similar information, and as described herein with respect to various embodiments, these terms can be used interchangeably.

[0057] In some embodiments, techniques are provided for assigning a priority to a network service usage activity and controlling traffic associated with the network services usage activity based on the assigned priority. In some embodiments, techniques are provided for a implementing a differentiated and dynamic background services classification, for example, as a function of network availability state and/or network busy state.

[0058] In some embodiments, a service usage control policy is used for assisting in network access control of network service usage activities (e.g., deferring some or all of the network capacity demand from these source activities). In some embodiments, some or all of the network capacity demand is satisfied at a point where the network resources or capacity are more available or less busy. In some embodiments, techniques are provided for classifying network service activities associated with one or more applications or OS functions to a background service class and differentially controlling the background service class traffic. In some embodiments, techniques are provided for classifying one or more network service activities associated with an application or OS function to a background service class, while other network service activities associated with that application or OS function are classified to other service classes (e.g., or to different background service class priority levels).

[0059] In some embodiments, techniques are provided for determining a network busy state (e.g., for a network edge element connection to a device, such as for a RAN for the device's current wireless network access and/or to the current base station/base station controller in wireless communication with the device). In some embodiments, techniques are provided for implementing a service usage control policy to differentially control network services traffic based on a network busy state for an activity, a group of activities, or for a service class.

[0060] In some embodiments, DAS for protecting network capacity includes monitoring a network service usage activity of the communications device in network communication; classifying the network service usage activity for differential network access control for protecting network capacity; and associating the network service usage activity with a network service usage control policy based on a classification of the network service usage activity to facilitate differential network access control for protecting network capacity.

[0061] In some embodiments, a network service usage activity is any activity by the device that includes wireless network communication. In some embodiments, an application, an

operating system (OS), and/or other device function generates a network service usage activity. In some embodiments, an application, an operating system (OS), and/or other device function generates one or more network service usage activities. Examples of a network service usage activity include the following: a voice connection (e.g., coded voice connection or voice over IP (VOIP) connection), a device application or widget connection, a device OS function connection, an email text connection, an email download connection, a file download connection, a streaming media connection, a location service connection, a map services connection, a software update (e.g., application, operating system, and/or antimalware software update) or firmware update connection, a device backup connection, an RSS feed connection, a website connection, a connection to a server, a web browser connection, an Internet connection for a device based service activity, establishing a sync service account, a user data synchronization service, a device data synchronization service, a network connection flow or stream, a socket connection, a TCP connection, a destination/port assigned connection, an IP connection, a UDP connection, an HTTP or HTTPS connection, a TLS connection, an SSL connection, a VPN connection, a general network services connection (e.g., establishing a PPP session, authenticating to the network, obtaining an IP address, DNS service), and various other types of connections via wireless network communication as will be apparent to one of ordinary skill in the art.

[0062] In some embodiments, a network service usage activity is classified, associated with, and/or assigned to a background class (e.g., a background service or QoS class) to facilitate differential network service usage control to protect network capacity. In some embodiments, differential network service usage control includes one or more of the following: monitoring network service usage activity; accounting for network service usage activity; reporting network service usage activity; generating a user notification for a network service usage activity; requesting a user preference for control of network service usage activity; accepting a user preference for network service usage activity; implementation of a network service usage activity policy (e.g., block/allow; traffic control techniques, such as throttle, delay, priority queue, time window, suspend, quarantine, kill, remove, and other well known traffic control techniques); implementing UI intercept procedures; generating a network busy state notification; generating a background class notification; generating a user notification for differential network service

usage control of a network service usage activity; and various other techniques as described herein.

[0063] In some embodiments, a network availability state includes a state or measure of availability/capacity of a segment of a network (e.g., a last edge element of a wireless network). In some embodiments, a network busy state includes a state or measure of the network usage level or network congestion of a segment of a network (e.g., a last edge element of a wireless network). In some embodiments, network availability state and network busy state are inverse measures. As used herein with respect to certain embodiments, network availability state and network busy state can be used interchangeably based on, for example, a design choice (e.g., designing to assign background policies based on a network busy state or a network availability state yields similar results, but they are different ways to characterize the network performance and/or capacity and/or congestion). In some embodiments, network availability state and network busy state are dynamic measures as such states change based on network usage activities (e.g., based on a time of day, availability/capacity level, congestion level, and/or performance level). In some embodiments, differential network service usage control of a network service usage activity is based on a network busy state or network availability state.

[0064] In some embodiments, certain network service usage activities are classified as background services. In some embodiments, lower priority and/or less critical (and/or based on various other criteria/measures) network service usage activities are classified as background services based on a network busy state and differentially controlled based on a network busy state to protect network capacity. In some embodiments, differential network service usage control policies are based on a time of day, a network busy state, background services and/or QoS class changes based on a time of day and/or a network busy state, a random back-off for access for certain network service usage activities, a deterministic schedule for certain network service usage activities, a time windowing in which network service usage control policies for one or more service activities or background/QoS classes changes based on time of day, network busy state, a service plan, and various other criteria, measures, and/or techniques as described herein.

[0065] In some embodiments, a network capacity controlled service or network capacity controlled services class includes one or more network services (e.g., background download

services and/or various other types or categories of services as described herein) selected for differential network service usage control for protecting network capacity. In some embodiments, a network capacity controlled services classification includes one or more network services associated with a network capacity controlled service/class priority setting for differential network service usage control for protecting network capacity. In some embodiments, a network capacity controlled service or network capacity controlled services class includes one or more network services associated with a QoS class for differential network service usage control for protecting network capacity. In some embodiments, a network capacity controlled service or network capacity controlled services class includes one or more network services associated with a dynamic QoS class for differential network service usage control for protecting network capacity.

[0066] For example, differentially controlling network service usage activities based on network capacity controlled services or dynamic QoS or QoS classifications can protect network capacity by, for example, improving network performance, increasing network availability, reducing network resources demand, and/or reducing network capacity demand (e.g., based on an individual device, aggregate devices connected to an edge element, and/or aggregate devices connected to many edge elements). In some embodiments, differentially controlling network service usage activities based on network capacity controlled services or dynamic QoS or QoS classifications can protect network capacity while maintaining proper device operation. In some embodiments, differentially controlling network service usage activities based on network capacity controlled services or dynamic QoS or QoS classifications can protect network capacity while maintaining an acceptable user experience (e.g., proper and/or expected device operation, proper and/or software/application/OS/function operation, avoiding (whenever possible) significant adverse impact on device functions, and/or user notifications to keep the user informed of various differential control implemented on the device).

[0067] In some embodiments, dynamic QoS classifications include QoS classifications that can be dynamically modified (e.g., reclassified, reprioritized, upgraded, and/or downgraded) based on various criteria, measures, settings, and/or user input as described herein (e.g., based on a time of day and/or day of week, based on a network busy state, based on a user preference, and/or based on a service plan). In some embodiments, the various techniques described herein

related to DAS for providing network capacity and/or QoS for DAS are applied to dynamic QoS related techniques.

[0068] As wireless networks, such as mobile networks, evolve towards higher bandwidth services, which can include or require, for example, various levels of Quality of Service (QoS) (e.g., conversational, interactive data, streaming data, and/or various (end-to-end) real-time services that may benefit from QoS), demands will increase for converged network services to facilitate such services for end-to-end services between networks (e.g., to allow for control and/or support for such services, for example, QoS support, across network boundaries, such as between wireless networks (such as various service provider networks) and IP networks (such as the Internet), and/or other networks). While various efforts have attempted to address such QoS needs, such as policy management frameworks for facilitating QoS end-to end solutions, there exists a need to facilitate various QoS requirements using Device Assisted Services (DAS).

[0069] Accordingly, Quality of Service (QoS) for Device Assisted Services (DAS) is provided. In some embodiments, QoS for DAS is provided.

[0070] To establish a QoS channel, differentiated services are typically available, in which one class/level of service has a higher priority than another to provide for differentiated services on a network, such as a wireless network. For example, in a wireless network, various network elements/functions can be provisioned and controlled to establish a single end or end to end QoS channel. In some embodiments, a centralized QoS policy coordination and decision function using DAS techniques to assist in coordinating the QoS channel setup and control among the various elements of a wireless network is provided.

[0071] In some embodiments, QoS channel refers to the logical communication channel connected to a device that provides a desired level of QoS service level. For example, the QoS channel can be created with one or more QoS links, in which each link represents a QoS enabled connection that spans a portion of the total end to end network communication path from a near end device to a far end device. For example, the far end device can be on the same network or on a different network, potentially with different access technology and/or a different access network carrier. In some embodiments, the QoS channel includes one or more QoS links in which each link in the channel is QoS enabled, or one or more of the links in the channel is QoS enabled and others are not. As an example, a QoS channel can include the following links: a

first device traffic path link, a first device to access network equipment element link (e.g., 2G/3G/4G wireless base station, WiFi access point, cable network head end, DSLAM, fiber aggregation node, satellite aggregation node, or other network access point/node), a first carrier core network, a long haul IPX network, a second carrier core network, a second device to access network equipment element link, and a second device traffic path link as similarly described herein with respect to various embodiments.

[0072] In some embodiments, each of the links described above has the ability to provide QoS services for that segment of an overall QoS channel. In some embodiments, the device traffic path link and/or the device to access network equipment element link are QoS enabled, but the carrier core network and/or IPX network links are not QoS enabled. In some embodiments, the core network and/or IPX network have sufficient over-provisioning of bandwidth that QoS is not limited by these network elements and, for example, can be limited by the device traffic link and/or the device to access network equipment element link do not have sufficient excess bandwidth making it desirable to QoS enable these QoS channel links. A common example is a 2G/3G/4G wireless network in which a device traffic path link and the device to access network element link (e.g., Radio Access Bearer (RAB)) are QoS enabled while the carrier core network and IPX network links are not (e.g., are provided at a best effort service level or other service levels).

[0073] In some embodiments, a QoS session refers to the QoS enabled traffic for a given device that flows over a QoS channel or QoS link. This QoS traffic supports a QoS service activity. In some embodiments, a QoS service activity includes a device service usage that is requested, configured, or preferably serviced with a given level of QoS. In some embodiments, a device QoS activity is a combination of one or more of the following: application, destination, source, socket (e.g., IP address, protocol, and/or port), socket address (e.g., port number), URL or other similar service identifier, service provider, network type, traffic type, content type, network protocol, session type, QoS identifier, time of day, network capacity (e.g., network busy state), user service plan authorization or standing, roaming/home network status, and/or other criteria/measures as similarly described herein. For example, QoS service activities that are supported by QoS sessions can include VOIP traffic, streaming video traffic, differentiated access bandwidth during busy network periods, real-time interactive traffic, such as network connected multimedia meetings (e.g., shared presentations, picture, video, voice, and/or other

such applications/services), best effort interactive, such as Internet browsing, time sensitive services, such as email message body delivery, near real-time interactive services, such as SMS or push to talk, background download services, such as email downloads and other file transfers (e.g., FTP), and/or truly background download services, such as software updates (e.g., OS or application software updates and/or antimalware updates including content/signature updates).

[0074] In some embodiments, various QoS levels or classes are supported. For example a conversation class can provide for real-time traffic, which is typically very delay sensitive but can tolerate bit errors and packet losses. The conversational class is typically used for Voice Over IP (VOIP) and video telephony, in which users of such services benefit from the short delay features of the conversational class. A streaming class is similar to the conversational class except that the streaming class typically can tolerate more delay than the conversational class. The streaming class is generally used for when one end of the connection is a user (e.g., human user) and the other end is a machine/computer (e.g., for streaming content applications, such as streaming of video, such as movies or other video content). An interactive class is generally intended for traffic that allows delay variation while requiring reasonably low response time (e.g., web browsing or other applications in which the channel can be unused for long periods of time but when a user makes a request for a new page/data, the response time should be reasonably low). A background class is generally used for lowest priority service usages (e.g., typically used for e-mail with and without downloads/attachments, application software updates, OS software updates, and/or other similar applications/functions). In some embodiments, various QoS classes or services are applicable to the conversational class. In some embodiments, various QoS classes or services are also applicable to the streaming class. In some embodiments, various QoS classes or services are also applicable to the interactive class but typically not applicable to the background class. As will now be apparent to one of ordinary skill in the art, various other classes can be provided with lower or higher granularity based on service usage/channel requirements and/or network architectures.

[0075] In some embodiments, a QoS link or a QoS channel supports one QoS session. In some embodiments, a QoS link or a QoS channel supports multiple QoS sessions. In some embodiments, QoS link provisioning is provided to setup the QoS traffic level for a given QoS session or group of QoS sessions.

[0076] In some embodiments, a QoS channel is a single ended QoS channel or an end to end QoS channel. For example, if a QoS channel is end to end, then the QoS channel provisioning is accomplished in a coordinated manner for each QoS enabled link in the QoS channel. If a QoS channel is single ended, then the network elements and/or device participate in provisioning as much of one end of the QoS channel as possible, leaving provisioning of the QoS for the other end of the channel as the responsibility of the device and/or network elements that handle the traffic at the other end of the QoS channel. In some embodiments, a single ended QoS channel includes another single ended QoS channel at the other end. In some embodiments, only one end has single ended QoS channel enablement while the other end of the channel is a best effort service level, which, for example, can be used where one end of the QoS channel has tighter constraints on traffic capacity or quality than the other end (e.g., a VOIP call with one end that is QoS enabled on a 3G wireless network that has relatively tight bandwidth compared to a lightly loaded cable modem network device on the other end which may not need to be QoS enabled in order to achieve adequate voice quality).

[0077] In some embodiments, a QoS request (e.g., a QoS channel request or QoS service request) is a request for a QoS provisioning event to enable a QoS channel for one or more QoS service activities. In some embodiments, QoS availability assessment includes determining whether one or more of the links in a possible QoS channel are available (e.g., based on network capacity and transmission quality) to provision the necessary level of QoS for a requested QoS channel. In some embodiments, a QoS request is initiated by a device, a user, an application, and/or a network element/function as similarly described herein.

[0078] In some embodiments, a service plan refers to the collection of access service capabilities, QoS capabilities, and/or network capacity controlled services that are associated with a communications device. In some embodiments, the access service capabilities, QoS capabilities, and/or network capacity controlled services are determined by the collection of access service control policies for the device. In some embodiments, these service control policies are implemented in the network equipment. In some embodiments, these access service control policies are implemented both in the device and in the network equipment. In some embodiments, these access service control policies are implemented in the device. In some embodiments, there are different levels of service control capabilities (e.g., policies) based on different levels of service plan payments or device standing or user standing. In some

embodiments, there are different levels of service control policies based on network type, time of day, network busy status, and/or other criteria/measures as similarly described herein with respect to various embodiments. In some embodiments, the access control and QoS control policies are based on the type of service activity being sought. In some embodiments, the QoS level and access level available for a given service activity for a given device or user is determined by the policies associated with the service plan. In some embodiments, a QoS authorization assessment is performed to determine whether a device or user has sufficient service plan standing to allow the requested level of QoS.

[0079] In some embodiments, before a QoS channel or link is provisioned (or before a QoS request is responded to or filled), a QoS availability assessment is performed to determine whether sufficient communication channel resources are available to provision the necessary level of QoS for the QoS channel or link. In some embodiments, this QoS availability assessment is determined by assessing the available QoS capacity for one or more necessary QoS links in the channel. For example, the available QoS link capacity can be assessed for one or more of a device traffic path, a device to access network equipment element link, a core network link, and/or an IPX network link. If the QoS assessment shows that the necessary channel capacity and quality are available for the desired QoS level for one or more desired QoS service activities, then a QoS channel request or QoS service request can be granted. In some embodiments, a QoS link or QoS channel reservation process is provided to reserve QoS capacity and quality in advance of link or channel provisioning to ensure that the available QoS resources are not assigned between the time of QoS availability assessment and QoS channel provisioning.

[0080] In some embodiments, the QoS availability assessment is performed after QoS authorization assessment. This prevents the unnecessary exercising of network elements when the device or user does not have sufficient service plan standing to receive the desired level of QoS even if it is available. This can be an important screening function performed on the device in the service processor, or by a centralized network function such as the service controller (e.g., or interchangeably, the home agent; Home Location Register (HLR); Authentication, Authorization, and Accounting (AAA) server/gateway/function; base station; one of the gateways, policy and charging rules function (PCRF), or other network element/function). In

some embodiments, QoS availability is assessed without conducting a QoS authorization assessment or before receiving the response to a QoS authorization assessment.

[0081] In some embodiments, a QoS channel is provisioned to create the QoS channel to support a QoS session (e.g., a QoS service activity). In some embodiments, QoS channel provision includes assigning, routing, and/or otherwise causing the QoS session traffic to flow over one or more QoS links in the assigned QoS channel.

[0082] In some embodiments, device assisted service traffic control and QoS apply readily and directly to the problems of managing a QoS device link for QoS channel provisioning. Accordingly, in some embodiments, a service processor is provided to assist in provisioning the device portion of the QoS channel. In some embodiments, the service processor provisions the device link portion of the QoS channel by placing a higher priority on higher QoS level traffic. In some embodiments, this QoS priority is implemented in a number of ways, including routing the higher priority QoS traffic into first priority in the downstream and/or upstream traffic queues. Upstream traffic queuing is performed directly in some embodiments by transmitting guaranteed bit rate traffic first at higher available throttling rates, differentiated QoS traffic second with a controlled throttling rate, best effort traffic third with possibly lower controlled throttled rates, and/or background traffic fourth when/if bandwidth not needed by the higher levels of QoS traffic and at lower controlled throttling rates. For example, downstream traffic can be handled by queuing traffic and delaying or preventing TCP acknowledgements to be returned for the lower levels of QoS priority, while immediately passing the traffic and TCP acknowledgements for higher levels of QoS priority. The device link portion of the QoS channel is thus provisioned by assigning policies for the queuing priority, delay, throttle rate, and TCP acknowledgement return rate for device traffic in accordance with the bandwidth that is available at any point in time for the device. In some embodiments, various device service processor traffic control capabilities regulate or partially regulate QoS in accordance with a set of network policy instructions, including, in some embodiments, a service plan policy set.

[0083] In some embodiments the device service processor establishes multiple QoS channels through the device traffic path with each QoS channel having traffic control policies as described herein, with each QoS channel policy set creating a different class of QoS. In some embodiments, employing this multiple QoS channel approach, QoS for a given service activity is

provided by routing the traffic for that QoS activity to the appropriate QoS channel with the appropriate QoS policy settings. The routing to the appropriate QoS channel can be provided using various techniques. For example, the routing can be provided by applying a common service traffic control policy set to traffic associated with all QoS service activities that require or request the QoS provided by the common service traffic control policy set. The application of the service traffic control policy set can be accomplished in a number of ways utilizing the embodiments described for the policy implementation agent and the policy control agent described herein. In such embodiments, the problem of assigning a QoS channel to a number of QoS service activities is reduced to applying a pre-determined set of service traffic control policies to each of the QoS service activities, with each pre-determined set of service traffic control policies representing a different QoS class. The device can then manage the overall QoS for all traffic based on the available traffic capacity and quality, the total aggregate traffic demand for each QoS traffic class and the policy rules that determine how each traffic class is provided with differential bit rate and traffic quality as compared to the other traffic classes for a given level of available traffic capacity and quality.

[0084] Based on the aggregate demand for each traffic QoS class, and the traffic capacity and quality level available to the device, the service processor can adjust the total available bit rate or percentage of available traffic capacity for each QoS class. For example, in some embodiments, the aggregate demand for the real-time interactive traffic control class (e.g., services, such as VOIP, emergency communication services or high performance real-time competitive gaming) can be determined, and the QoS routing function on the device (e.g., a QoS router agent/function) can first allocate enough constant bit rate traffic capacity from the available traffic capacity to satisfy these services, with each QoS service activity that requires this QoS class being assigned to this QoS channel. As more QoS service activities require this traffic class, the capacity allocated to the QoS channel out of the available device capacity is increased, and when fewer QoS service activities require this traffic class the capacity for this QoS channel is released. In the event that the device does not have any more available capacity with a guaranteed bit rate QoS level, then additional QoS service activities that desire, require or request this QoS level will not be provided this QoS level, and instead will either be provided with a lower QoS level or will not be allowed to connect to the access network. In some embodiments, there can be a hierarchy among the possible QoS service activities so that if there

is no more capacity available at a given service QoS level, then the available capacity for that QoS class is provided to the service activities requiring that QoS from highest priority to lowest, until the available QoS class capacity is consumed, and then one or more QoS service activities that are too low on the priority list to obtain service with that QoS class are either bumped to a lower QoS class or are denied access. In some embodiments, once the required capacity to satisfy the real-time constant rate traffic needs is satisfied, the remaining capacity available to the device is then divided among the other QoS channel classes in accordance with a priority policy, with the priority policy being based on the relative priority of each service class, the relative priority of each QoS service activity, or a combination of the relative priority of each QoS service class and each QoS service activity. For example, these relative priority policies can vary from device to device based on service plan selection, device type, user standing, user group, device location, device network connection, type of network, time of day, network busy state, and/or other criteria/measures.

[0085] In some embodiments, a QoS link is established between the device and an access network equipment element. For example, such equipment element embodiments can include a 2G/3G/4G wireless base station, a wireless access point, a cable network head end, a DSL network DSLAM, a fiber network device traffic aggregator, a satellite network device traffic aggregator, a frame relay aggregation node, an ATM aggregation node, and/or other network equipment. In some embodiments, a logical communication channel is created between the device and the network equipment element, with the logical communication channel supporting a given level of QoS or QoS class traffic policy set. For example, the logical channel can include a RAB formed between a 2G/3G/4G base station and a wireless end point device. The RAB can be formed by controlling the media access control (MAC) parameters of the base station radio channel so that a given level of QoS class policies can be implemented. For example, the RAB can support constant bit rate, low latency communication traffic for guaranteed bit rate real-time traffic, or a differentiated high priority access channel for streaming traffic, or a best effort random access channel for best effort traffic, or an available unused capacity traffic for background traffic. The QoS channel link created in this manner can be dedicated to a single device, or shared with a subset of devices, or available to all devices. The QoS channel link created in this manner can be used by the device to support a single QoS activity as described herein, or a group of QoS activities as described herein. It will now be apparent to one of

ordinary skill in the art that similar settings for cable head end and cable modem MAC can yield similar QoS classes for QoS links for the cable modem case and that similar techniques can be applied for a wireless access point or a satellite system MAC to achieve similar QoS classes for QoS links. It will also now be apparent to one of ordinary skill in the art that by creating multiple logical channels in the device link, and/or adjusting the available access network capacity and quality for each logical device communication channel in the DSLAM or fiber aggregator, similar QoS class QoS links can be established for the DSL and fiber distribution network cases.

[0086] In some embodiments the device service processor serves to route QoS service activities to the appropriate logical communication channel established for the desired QoS class supported by a QoS link between the device and the access network equipment element. In some embodiments, the device service processor elements (e.g., the policy implementation agent and/or the policy control agent) can be used in some embodiments to assign the same QoS traffic control policies to one or more QoS service activities that require the same QoS level. In a similar manner, in some embodiments, the device service processor elements can be used to assign or route service activity traffic for a given QoS class to the correct logical communication channel between the device and the access network element (e.g., a 2G/3G/4G base station) that supports the traffic control policies for the desired QoS class. For example, a QoS service link that supports guaranteed bit rate and latency can be established with one or more RABs from a base station to the device, and a second QoS service link can be established that supports differentiated preferred access for streaming content using one or more differentiated access RABs, and a third best effort RAB can be used to support best effort traffic. Each of the required RABs is first requested and then provisioned as described herein based on the aggregate required capacity and quality for one or more QoS service activities that require or desire the specific QoS service class associated with the RAB logical channel policy parameters. Once the set of logical QoS channels is thus established, the service processor (e.g., QoS router agent/function) routes the traffic associated with each QoS service activity to the appropriate RAB. In some embodiments, the service processor can detect increases or decreases in aggregate QoS class demand for each QoS class as QoS activities are initiated or terminated for that QoS class, and the service processor can communicate the required increases or decreases in the RAB assignments required to support that logical QoS channel.

[0087] In some embodiments, the access QoS link is established by direct communication from the device in which the device requests the QoS channel or link from the access network equipment element, or the device requests the QoS channel or link from an intermediate networking device, such as a service controller (e.g., or a readily substituted device with similar features, such as a home agent, an HLR, a mobile switching center, a base station, an access gateway, a AAA system, PCRF, or a billing system). In some embodiments, the device service processor bases the QoS channel or link request on an association the device performs to match a QoS service activity with a desired or required QoS class or QoS traffic control policy set. For example, this association of QoS class or QoS traffic control policy set with QoS service activity can be determined by a predefined policy mapping that is stored on the device and used by the service processor. In some embodiments, this policy mapping store is populated and/or updated by a service controller (e.g., or similar function as described herein). In some embodiments, the mapping is determined by a service controller (e.g., or similar function as described herein) based on a report from the device of the QoS service activity that needs the QoS channel or link.

[0088] In some embodiments, the required or desired QoS level for one or more QoS service activities is determined by a set of QoS service traffic control policies that are pre-assigned to various QoS service activities. For example, a given application can be pre-assigned a QoS class. As another example, a web service destination such as a VOIP service site can be assigned a QoS class. As another example, a given application can have one QoS assignment level for general Internet traffic but have a QoS assignment for real-time gaming traffic. As another example, a real-time broadcasting website can have a best effort QoS level assigned to programming information and general browsing and have a differentiated streaming QoS level for broadcast traffic content. In some embodiments, detection of QoS need or QoS assignment request for a given activity can be assigned by a device service processor according to a pre-defined QoS policy rules table (e.g., QoS activity table), or can be determined by a service controller based on information reported by the device, or can be requested by an application through a QoS application interface (e.g., QoS API), or can be determined by the nature of incoming traffic.

[0089] In embodiments, in which both end points in the QoS channel participate in establishing an end to end QoS channel, the required QoS level is determined and/or

communicated by the originating end point. In some embodiments, the required QoS level is determined and/or communicated by the receiving end point. In some embodiments the QoS level is determined and/or communicated by the originating end point service controller (e.g., or the access network element (such as a base station), the HLR, home agent, mobile switching center, AAA, gateway, or other network element/function). In some embodiments, the QoS level is determined and/or communicated by the receiving end point service controller (e.g., or alternatively the access network element (such as a base station), the HLR, home agent, mobile switching center, AAA, gateway, or other network element/function). In some embodiments, the receiving end point service controller (e.g., or the access network element (such as a base station), the HLR, home agent, mobile switching center, AAA, gateway or other network function) and the originating end point service controller (e.g., or other similar function) communicate with one another to coordinate establishment of the QoS channel between the end points.

[0090] In some embodiments, the near end or originating end device service processor contacts the far end or terminating device service processor to initiate a QoS channel. In some embodiments, the initiation of the QoS channel from the near end or originating device is performed automatically by the far end device when its service processor detects that a given level of QoS is needed for the communication between the two devices. In some embodiments, the near end or originating device service processor detects the need for a QoS channel to the far end or terminating device and contacts a central network resources, such as the service controller (e.g., or other equipment element with similar function for this purpose), and the service controller provisions the far end of the QoS channel, either by communicating directly with the far end device or by communicating with the far end device's service controller (e.g., or other equipment element with similar function for this purpose). In some embodiments, in which the far end device service controller is contacted to assist in provisioning the QoS channel, there is a look up function to determine the address of the far end service controller based on a look up index formed from some aspect of the far end device credentials (e.g., phone number, SIM ID, MEID, IMSI, IP address, user name, and/or other device credentials).

[0091] In some embodiments, the mapping of QoS service activity to the desired level of QoS class or QoS traffic control policies is determined by providing a QoS API in the device service processor that applications use to request a QoS class or QoS channel connection. In

some embodiments, an API is provided so that application developers can create application software that uses the standard interface commands to request and set up QoS channels. In some embodiments, the API does one or more of the following: accepts QoS requests from an application, formats the QoS channel request into a protocol appropriate for transmission to network equipment responsible for assessing QoS channel availability (e.g., including possibly the device traffic control system), coordinates with other network elements (e.g., including possibly the device traffic control system) to reserve a QoS channel, coordinates with other network elements (e.g., including possibly the device traffic control system) to provision a QoS channel, informs the application that the desired QoS channel can be created or not, and/or coordinates with other network elements (e.g., including possibly the device traffic control system) to connect the application with the desired QoS channel class. In some embodiments, the QoS API accepts the application QoS request and communicates and possibly coordinates with one or more QoS network equipment elements, such as a base station, cable head end or access point. In some embodiments, the QoS API accepts the QoS request from the application and communicates and possibly coordinates with an intermediate network element, such as a service processor (e.g., or other similar function as described herein). In some embodiments the QoS API assesses the QoS service plan standing for the device or user before sending QoS channel requests to other network elements, and only initiates the QoS request sequence if required service plan authorization is in place. In this manner, the potentially complex process of establishing a QoS channel with all the specific equipment communication protocols that typically need to be supported to assess QoS channel availability and provision the QoS channel are simplified into a limited set of API commands that are easy for an application development community to learn about and use for QoS differentiated services and applications.

[0092] In some embodiments, local traffic control on the device service processor is combined with traffic control in the link between the device and the access network equipment element. In this manner, both the device traffic control path QoS link and the device to access network element QoS link can be coordinated for best device QoS performance results given the available capacity and quality of the access network traffic for the device. In some embodiments, the policies for how the device manages local traffic control, establishes access network element logical channels (e.g., RABs) and routes traffic to and from the access network element logical channels is all determined by predefined policy rules loaded onto the device by

the service controller (or other equivalent network element). In some embodiments, these policies are determined in the service controller itself.

[0093] In some embodiments, a QoS user interface (e.g., QoS UI) is presented to the device user. In some embodiments, the QoS UI notifies the user what level of QoS services the device is authorized to receive based on the service plan selection. In some embodiments, the QoS UI notifies the user what level of QoS services are available on the present network the device is connected to at the present time. In some embodiments, the QoS UI notifies the user when a level of QoS service that is higher than that authorized by the user service plan is required or desirable for a given service activity that the device has initiated. In some embodiments, the QoS UI provides the user with a set of one or more upgrade options to upgrade the service plan to include a higher level of QoS for one or more service activities. In some embodiments, the QoS UI provides the user with an opportunity to specify what level of QoS the user would like to employ for one or more service usage activities. In some embodiments, the QoS UI allows the user to specify a service plan setting that provides differentiated QoS during times when the network is busy. In some embodiments, the QoS UI allows the user to purchase one or more grades of service QoS with either a post-pay for a pre-defined service period and one or more pre-defined service usage limits by QoS class, a pre-pay for one or more pre-defined service usage limits by QoS class, or another payment system for differentiated QoS services. In some embodiments, the QoS UI provides the user with an opportunity to QoS enable or pay for QoS services for a connection that is initiated by an incoming connection to the device.

[0094] In some embodiments, QoS for DAS techniques include verifying that the device is properly implementing the QoS traffic control policies, for example, in accordance with a service plan. This ensures that errors, hacking, user device software settings manipulations, or other malware events do not result in inappropriate levels of QoS for a given device or group of devices. Accordingly, in some embodiments, the traffic control and QoS verification techniques described herein are employed to verify that the proper level of QoS is applied for a given service usage activity in accordance with a QoS priority policy. For example, verification of QoS channel request policy rules behavior can be implemented in a variety of ways including, as an example, monitoring device QoS channel requests and comparing the level of QoS requested with the level of QoS the device is authorized to receive in the service plan in effect for the device. Verification of proper QoS channel usage behavior by a device can be implemented in a

variety of ways including, for example, monitoring network based reports of QoS service usage and comparing the network based reports against the service policy rules that should be in effect given the device service plan. Verification of proper device traffic control to implement a QoS service policy that is in effect can be accomplished in a variety of ways by verifying that the appropriate traffic control policy rules are being properly implemented as described herein. In some embodiments, DAS for protecting network capacity techniques include various verification techniques (e.g., verifying monitoring, traffic controlling, reporting, and/or other functions implemented or performed by the device), as described herein.

[0095] In some embodiments, the QoS router prioritizes traffic on the device. In some embodiments, the QoS router connects the QoS enabled session to the RAB that has the proper QoS level. In some embodiments, one session is routed to the RAB. In some embodiments, more than one session can be routed to an RAB. In some embodiments, multiple RABs providing multiple QoS levels are created to the device, and the QoS router routes each service activity to the RAB dictated by the QoS policy rules in effect on the device.

[0096] In some embodiments, the network collects service usage charges for different QoS classes. In some embodiments, there is differentiated service charging for the different classes of QoS service usage. As an example, since guaranteed bit rate traffic consumes network resources whether the traffic capacity is used or not, there can be a time element involved in the charging calculations. As a more detailed example, guaranteed bit rate services can be charged by the total bandwidth provisioned to the device at a given time multiplied by the amount of time that that bandwidth is made available. In some embodiments, differentiated access traffic that has higher QoS than best effort traffic but is not guaranteed bit rate can be charged at a higher rate than best effort traffic but lower than guaranteed bit rate. In some embodiments, such traffic can be charged based on the time the QoS channel is made available and the total amount of data transmitted over the channel, or can only be based on the total amount of data transmitted over the channel. Best effort traffic is charged in some embodiments based only on the total amount of data used, with the data charges being less than differentiated streaming access services. Background data services in some embodiments are charged at the lowest rate, possibly with only certain times of the day or periods of low network traffic demand being available for such services, and with the service being based on total data transmitted. In some embodiments, all QoS service levels can be charged based on a fixed price for a fixed charging period, possibly

with a service usage cap with additional charges if the service cap is exceeded. In such fixed price scenario embodiments, the price charged is again higher for higher levels of QoS. In some embodiments, the network collects service usage charges for different network capacity controlled service classes. In some embodiments, there is differentiated service charging for the different classes of network capacity controlled service usage, as described herein.

[0097] In some embodiments, the network equipment (e.g., access network element, gateways, AAA, service usage storage systems, home agent, HLR, mobile data center, and/or billing systems) record and report service usage for one or more of the QoS service classes used by the device. In some embodiments, the device service processor records and reports service usage for one or more of the QoS service classes used by the device and reports the QoS service class usage to the service controller (e.g., or another substitute network element). In some embodiments, in which the device is recording reporting usage for one or more QoS service classes, it is important to verify the device service usage reports to ensure that the device usage reports are not distorted, tampered with, and/or otherwise in error. In some embodiments, verifying service usage reports against service usage that should be occurring given the service control policies in place on the device, service processor agent functional operation verification, test service usage events, agent query response sequences, device service processor software protection techniques, device service processor software environment checks, and several other techniques are provides as described herein. For example, using one or more of these verification techniques can provide a verifiable device assisted QoS service usage charging system. As another example, using one or more of these verification techniques can provide a verifiable network capacity controlled service usage charging system. In some embodiments, the network equipment (e.g., access network element, gateways, AAA, service usage storage systems, home agent, HLR, mobile data center, and/or billing systems) record and report service usage for one or more of the network capacity controlled service classes used by the device, as described herein.

[0098] In some embodiments, device assisted traffic control is provided for managing network congestion as follows. For example, when a given base station or group of base stations experience traffic demand that is high relative to the available capacity and/or service quality that can be provided, and such a condition is determined (e.g., detected or reported) based on a network busy state assessment as described below and further herein, then a service controller

(e.g., or another network function) can issue, send, and/or implement traffic control throttling policies to/for the devices in accordance with a measure of the excess traffic demand the one or more base stations is experiencing. For example, the device service processors connected to an overly busy base station can be instructed to reduce the traffic control priority for one or more classes of QoS traffic, reducing the queuing priority, throttling rate, delay and/or access allowance for some or all of one or more classes of traffic. As another example, the device service processors connected to an overly busy base station can be instructed to reduce the traffic control priority for one or more classes of network capacity controlled services traffic, reducing the queuing priority, throttling rate, delay and/or access allowance for some or all of one or more classes of such traffic. As another example, one or more classes of network capacity controlled services traffic, such as background download processes, which can include, for example, software updates can be turned off completely or throttled back significantly. As another example, best effort traffic such as Internet browsing can be throttled or reduced for a group of devices connected to base stations experiencing excess traffic demand. As another example, a policy can be implemented on the devices connected to busy base stations in which the device is allowed to browse or conduct other best effort service activities at a relatively high throttling rate for a period of time, but if the device uses more than a certain amount of service (e.g., total data downloaded and/or uploaded) in a certain period of time then the device may be traffic controlled according to an adaptive throttling policy as described herein. In some embodiments, higher QoS level traffic cannot be throttled in such circumstances, such as VOIP traffic where real-time guaranteed bit rate is important to meet user service needs or expectations, while lower priority traffic such as interactive browsing and/or background download are throttled and/or blocked. In some embodiments, the QoS availability assessment processes described herein are adjusted so that higher QoS channels are not provided and provisioned in times or locations in which a given base station or group of base stations experience excess demand or demand above a given threshold.

[0099] In some embodiments, users or devices that have service plans with higher QoS levels, or service plans with higher priority during busy network periods have different traffic control policies (e.g., for QoS services and/or network capacity controlled services) applied to them that result in a higher level of traffic performance and/or a higher level of QoS service availability. For example, emergency service workers can be given higher traffic control access

policies that result in differentiated services during peak busy times on the network or a portion of the network. In some embodiments, users can obtain a premium service plan for differentiated access during peak busy time periods or may use higher levels of QoS service settings and/or service plans to achieve differentiated service during peak busy periods. As another example, services that demand high levels of QoS classes, such as real-time voice services, instant messaging, push to talk, differentiated video streaming, and/or interactive gaming, are not traffic controlled to the same extent that other lower priority services or lower class service plans are traffic controlled during peak busy times. For example, this type of service differentiation can also be applied based on device type, user group, user standing, user reward zone points, and/or other criteria/measures as similarly described herein.

[00100] In some embodiments, the decision to control (e.g., reduce, increase, and/or otherwise control in some manner) the access traffic control settings as described above is made by the device service processor based on the device's assessment of the network capacity, which can be determined using various techniques as described herein. In some embodiments, the decision to control the access traffic control settings as described above is made by a service controller (e.g., or other interchangeable network equipment element or elements as described herein) connected to the device that provides instructions to the device to adjust the access policy settings. For example, the service controller can obtain the network capacity information from access equipment elements, from device reports of traffic capacity and/or quality as described herein, or from reports on traffic capacity and/or quality obtained from dedicated devices used for the purpose of assessing network capacity. In some embodiments, the decision to control the access traffic control settings as described above is based on the time of day, the day of week, or both to accommodate cyclical patterns in network capacity and traffic demand.

[00101] In some embodiments, a service controller (e.g., or another network equipment element or elements, as described herein) assesses network busy state and then controls device traffic demand by reducing the offered capacity for one or more service classes (e.g., for QoS services and/or network capacity controlled services) supported by the access network equipment elements, such as a wireless base station. In such embodiments, the service controller (e.g., or similar function) gathers the network capacity information with one of the techniques described herein and instructs one or more of the access network equipment elements to reduce the offered capacity for one or more levels of QoS classes and/or network capacity controlled service

classes, to one or more of the devices connected to the access network equipment elements. For example, the determination of which devices to throttle back can be made based on an equal throttling of all devices of a given service plan status, or based on the device traffic usage patterns in the recent past as described herein, or based on a combination of service plan status and recent traffic usage patterns.

[00102] In some embodiments, the device is enabled with ambient services that have differentiated QoS services and/or network capacity controlled services as part of the ambient service offering. For example, ambient QoS techniques can be provided using the pre-assigned QoS policies for a given service activity set within the ambient service, or using an ambient service application that requests QoS through the QoS API. Other embodiments for providing QoS differentiated service activities within ambient service offerings will now be apparent to one of ordinary skill in the art. As another example, ambient network capacity controlled service techniques can be provided using the pre-assigned network capacity controlled policies for a given service activity set within the ambient service, monitoring and dynamically assigned techniques, and/or using an ambient service application that uses API or emulated API techniques, and/or other techniques as described herein.

[00103] In some embodiments, a QoS service control policy is adapted as a function of the type of network the device is connected to. For example, the QoS traffic control policies and/or the QoS service charging policies can be different when the device is connected to a wireless network (e.g., a 3G/4G network where there is in general less available QoS enabled traffic capacity) than when the device is connected to a wired network (e.g., a cable or DSL network where there is in general a higher level of QoS capacity available). In such embodiments, the device service processor and the service controller can coordinate to adapt the QoS service control policies and/or the QoS service charging policies to be different depending on which network the device is connected to. Similarly, the device QoS service control policy and/or QoS service charging policy can also be adapted based on whether the device is connected to a home wireless network or a roaming wireless network. In some embodiments, a network capacity controlled service control policy and/or a network capacity controlled charging policy is adapted as a function of the type of network the device is connected to, as similarly described herein.

[00104] In some embodiments, various of the QoS related techniques and/or network capacity controlled services techniques described herein are performed on the device using DAS techniques and/or on the service controller in secure communication with a verified service processor executed on the device using DAS techniques. In some embodiments, various of the QoS related techniques and/or network capacity controlled services techniques described herein are performed by/in coordination/communication with one or more intermediate network elements/functions for assisting in various techniques (e.g., functions) for QoS techniques and/or network capacity controlled services techniques as described herein.

[00105] FIG. 1 illustrates a functional diagram of a network architecture for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments. In some embodiments, QoS for DAS techniques described herein are implemented using the network architecture shown in FIG. 1. In some embodiments, DAS for protecting network capacity techniques described herein are implemented using the network architecture shown in FIG. 1.

[00106] As shown, FIG. 1 includes a 4G/3G/2G wireless network operated by, for example, a central provider. As shown, various wireless devices 100 are in communication with base stations 125 for wireless network communication with the wireless network (e.g., via a firewall 124), and other devices 100 are in communication with Wi-Fi Access Points (APs) or Mesh 702 for wireless communication to Wi-Fi Access CPE 704 in communication with central provider access network 109. In some embodiments, one or more of the devices 100 are in communication with other network element(s)/equipment that provides an access point, such as a cable network head end, a DSL network DSLAM, a fiber network aggregation node, and/or a satellite network aggregation node. In some embodiments, each of the wireless devices 100 includes a service processor 115 (as shown) (e.g., executed on a processor of the wireless device 100), and each service processor connects through a secure control plane link to a service controller 122 (e.g., using encrypted communications).

[00107] In some embodiments, service usage information includes network based service usage information (e.g., network based service usage measures or charging data records (CDRs), which can, for example, be generated by service usage measurement apparatus in the network equipment), which is obtained from one or more network elements (e.g., BTS/BSCs 125, RAN

Gateways (not shown), Transport Gateways (not shown), Mobile Wireless Center/HLRs 132, AAA 121, Service Usage History/CDR Aggregation, Mediation, Feed 118, or other network equipment). In some embodiments, service usage information includes micro-CDRs. In some embodiments, micro-CDRs are used for CDR mediation or reconciliation that provides for service usage accounting on any device activity that is desired. In some embodiments, each device activity that is desired to be associated with a billing event is assigned a micro-CDR transaction code, and the service processor 115 is programmed to account for that activity associated with that transaction code. In some embodiments, the service processor 115 periodically reports (e.g., during each heartbeat or based on any other periodic, push, and/or pull communication technique(s)) micro-CDR usage measures to, for example, the service controller 122 or some other network element. In some embodiments, the service controller 122 reformats the heartbeat micro-CDR usage information into a valid CDR format (e.g., a CDR format that is used and can be processed by an SGSN or GGSN or other network elements/equipment used/authorized for generating or processing CDRs) and then transmits it to a network element/function for CDR mediation (e.g., CDR Storage, Aggregation, Mediation, Feed 118).

[00108] In some embodiments, CDR mediation is used to account for the micro-CDR service usage information by depositing it into an appropriate service usage account and deducting it from the user device bulk service usage account. For example, this technique provides for a flexible service usage billing solution that uses pre-existing solutions, infrastructures, and/or techniques for CDR mediation and billing. For example, the billing system (e.g., billing system 123 or billing interface 127) processes the mediated CDR feed from CDR mediation, applies the appropriate account billing codes to the aggregated micro-CDR information that was generated by the device, and then generates billing events in a manner that does not require changes to the existing billing systems (e.g., using new transaction codes to label the new device assisted billing capabilities). In some embodiments, network provisioning system 160 provisions various network elements/functions for authorization in the network, such as to authorize certain network elements/functions (e.g., CDR storage, aggregation, mediation, feed 118 or other network elements/functions) for providing micro-CDRs, reformatted micro-CDRs, and/or aggregated or reconciled CDRs.

[00109] As shown in FIG. 1, a CDR storage, aggregation, mediation, feed 118 is provided. In some embodiments, the CDR storage, aggregation, mediation, feed 118 receives, stores,

aggregates and mediates micro-CDRs received from mobile devices 100. In some embodiments, the CDR storage, aggregation, mediation, feed 118 also provides a settlement platform using the mediated micro-CDRs, as described herein. In some embodiments, another network element provides the settlement platform using aggregated and/or mediated micro-CDRs (e.g., central billing interface 127 and/or another network element/function).

[00110] In some embodiments, various techniques for partitioning of device groups are used for partitioning the mobile devices 100 (e.g., allocating a subset of mobile devices 100 for a distributor, an OEM, a MVNO, and/or another partner or entity). As shown in FIG. 1, a MVNO core network 210 includes a MVNO CDR storage, aggregation, mediation, feed 118, a MVNO billing interface 122, and a MVNO billing system 123 (and other network elements as shown in FIG. 1). In some embodiments, the MVNO CDR storage, aggregation, mediation, feed 118 receives, stores, aggregates and mediates micro-CDRs received from mobile devices 100 (e.g., MVNO group partitioned devices).

[00111] Those of ordinary skill in the art will appreciate that various other network architectures can be used for providing device group partitions and a settlement platform, and FIG. 1 is illustrative of just one such example network architecture for which device group partitions and settlement platform techniques described herein can be provided.

[00112] In some embodiments, CDR storage, aggregation, mediation, feed 118 (e.g., service usage 118, including a billing aggregation data store and rules engine) is a functional descriptor for, in some embodiments, a device/network level service usage information collection, aggregation, mediation, and reporting function located in one or more of the networking equipment apparatus/systems attached to one or more of the sub-networks shown in FIG. 1 (e.g., central provider access network 109 and/or central provider core network 110), which is in communication with the service controller 122 and a central billing interface 127. As shown in FIG. 1, service usage 118 provides a function in communication with the central provider core network 110. In some embodiments, the CDR storage, aggregation, mediation, feed 118 function is located elsewhere in the network or partially located in elsewhere or integrated with/as part of other network elements. In some embodiments, CDR storage, aggregation, mediation, feed 118 functionality is located or partially located in the AAA server 121 and/or the mobile wireless center/Home Location Register(HLR) 132 (as shown, in

communication with a DNS/DHCP server 126). In some embodiments, service usage 118 functionality is located or partially located in the base station, base station controller and/or base station aggregator, collectively referred to as base station 125 in FIG. 1. In some embodiments, CDR storage, aggregation, mediation, feed 118 functionality is located or partially located in a networking component in the central provider access network 109, a networking component in the core network 110, the central billing system 123, the central billing interface 127, and/or in another network component or function. This discussion on the possible locations for the network based and device based service usage information collection, aggregation, mediation, and reporting function (e.g., CDR storage, aggregation, mediation, feed 118) can be easily generalized as described herein and as shown in the other figures and embodiments described herein by one of ordinary skill in the art. Also, as shown in FIG. 1, the service controller 122 is in communication with the central billing interface 127 (e.g., sometimes referred to as the external billing management interface or billing communication interface), which is in communication with the central billing system 123. As shown in FIG. 1, an order management 180 and subscriber management 182 are also in communication with the central provider core network 110 for facilitating order and subscriber management of services for the devices 100 in accordance with some embodiments.

[00113] In some embodiments, a service processor download 170 is provided, which provides for periodical downloads/updates of service processors (e.g., service processor 115). In some embodiments, verification techniques include periodically updating, replacing, and/or updating an obfuscated version of the service processor, or performing any of these techniques in response to an indication of a potential compromise or tampering of any service processor functionality (e.g., QoS functionality and/or network capacity controlled services functionality) executed on or implemented on the device 100.

[00114] In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) provides a device/network level service usage information collection, aggregation, mediation, and reporting function. In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) collects device generated/assisted service usage information (e.g., micro-CDRs) for one or more devices on the wireless network (e.g., devices 100); and provides the device generated service usage information in a syntax and a

communication protocol that can be used by the wireless network to augment or replace network generated usage information for the one or more devices on the wireless network. In some embodiments, the syntax is a charging data record (CDR), and the communication protocol is selected from one or more of the following: 3GPP, 3GPP2, or other communication protocols. In some embodiments, as described herein, the CDR storage, aggregation, mediation, feed 118 collects/receives micro-CDRs for one or more devices on the wireless network (e.g., devices 100). In some embodiments, the CDR storage, aggregation, mediation, feed 118 (e.g., or other network elements and/or various combinations of network elements) includes a service usage data store (e.g., a billing aggregator) and a rules engine for aggregating the collected device generated service usage information. In some embodiments, the network device is a CDR feed aggregator, and the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) also aggregates (network based) CDRs and/or micro-CDRs for the one or more devices on the wireless network; applies a set of rules to the aggregated CDRs and/or micro-CDRs using a rules engine (e.g., bill by account, transactional billing, revenue sharing model, and/or any other billing or other rules for service usage information collection, aggregation, mediation, and reporting), and communicates a new set of CDRs for the one or more devices on the wireless network to a billing interface or a billing system (e.g., providing a CDR with a billing offset by account/service). In some embodiments, a revenue sharing platform is provided using various techniques described herein. In some embodiments, QoS usage accounting/charging and/or network capacity controlled services usage accounting/charging is provided using various techniques described herein.

[00115] In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) communicates a new set of CDRs (e.g., aggregated and mediated CDRs and/or micro-CDRs that are then translated into standard CDRs for a given wireless network) for the one or more devices on the wireless network to a billing interface (e.g., central billing interface 127) or a billing system (e.g., central billing system 123). In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) communicates with a service controller (e.g., service controller 122) to collect the device generated service usage information (e.g., micro-CDRs) for the one or more devices on the wireless network. In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or

combinations of network elements) communicates with a service controller, in which the service controller is in communication with a billing interface or a billing system. In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) communicates the device generated service usage information to a billing interface or a billing system. In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) communicates with a transport gateway and/or a Radio Access Network (RAN) gateway to collect the network generated/based service usage information for the one or more devices on the wireless network. In some embodiments, the service controller 122 communicates the device assisted service usage information (e.g., micro-CDRs) to the CDR storage, aggregation, mediation, feed 118 (e.g., or other network elements and/or various combinations of network elements).

[00116] In some embodiments, the CDR storage, aggregation, mediation, feed 118 (e.g., or other network elements and/or various combinations of network elements) performs rules for performing a bill by account aggregation and mediation function. In some embodiments, the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) performs rules for performing a service billing function, as described herein, and/or for performing a service/transactional revenue sharing function, as described herein. In some embodiments, the service controller 122 in communication with the CDR storage, aggregation, mediation, feed 118 (and/or other network elements or combinations of network elements) performs a rules engine for aggregating and mediating the device assisted service usage information (e.g., micro-CDRs). In some embodiments, a rules engine device in communication with the CDR storage, aggregation, mediation, feed 118 (e.g., or other network elements and/or various combinations of network elements) performs a rules engine for aggregating and mediating the device assisted service usage information (e.g., QOS service usage information and/or network capacity controlled services usage information).

[00117] In some embodiments, the rules engine is included in (e.g., integrated with/part of) the CDR storage, aggregation, mediation, feed 118. In some embodiments, the rules engine and associated functions, as described herein, is a separate function/device. In some embodiments, the service controller 122 performs some or all of these rules engine based functions, as described herein, and communicates with the central billing interface 127. In some

embodiments, the service controller 122 performs some or all of these rules engine based functions, as described herein, and communicates with the central billing system 123.

[00118] In some embodiments, a settlement platform service is provided. For example, micro-CDRs can be aggregated and mediated to associate service usage for one or more services used by a communications device (e.g., a user of the communications device). A rules engine or another function can determine a revenue share allocation for the service usage for a particular service to determine the settlement for such service usage for the revenue sharing allocation/model and to distribute accounting and settlement information to one or more of carriers, distribution partners, MVNOs, wholesale partners, and/or other partners or entities. In some embodiments, the service is a transactional service.

[00119] In some embodiments, duplicate CDRs are sent from the network equipment to the billing system 123 that is used for generating service billing. In some embodiments, duplicate CDRs are filtered to send only those CDRs/records for devices controlled by the service controller and/or service processor (e.g., managed devices). For example, this approach can provide for the same level of reporting, lower level of reporting, and/or higher level of reporting as compared to the reporting required by the central billing system 123.

[00120] In some embodiments, a bill-by-account billing offset is provided. For example, bill-by-account billing offset information can be informed to the central billing system 123 by providing a CDR aggregator feed that aggregates the device assisted service usage data feed to provide a new set of CDRs for the managed devices to the central billing interface 127 and/or the central billing system 123. In some embodiments, transaction billing is provided using similar techniques. For example, transaction billing log information can be provided to the central billing interface 127 and/or the central billing system 123.

[00121] In some embodiments, the rules engine (e.g., performed by the service usage 118 or another network element, as described herein) provides a bill-by-account billing offset. For example, device assisted service usage information (e.g., micro-CDRs) includes a transaction type field or transaction code (e.g., indicating a type of service for the associated service usage information). For example, the rules engine can apply a rule or a set of rules based on the identified service associated with the device generated service usage information to determine a bill-by-account billing offset (e.g., a new CDR can be generated to provide the determined bill-

by-account billing offset). In some examples, the determined bill-by-account billing offset can be provided as a credit to the user's service usage account (e.g., a new CDR can be generated with a negative offset for the user's service usage account, such as for network chatter service usage, or transactional service usage, or for any other purposes based on one or more rules performed by the rules engine).

[00122] As another example, for a transactional service, a first new CDR can be generated with a negative offset for the user's service usage account for that transactional service related usage, and a second new CDR can be generated with a positive service usage value to charge that same service usage to the transactional service provider (e.g., Amazon, eBay, or another transactional service provider). In some embodiments, the service controller 122 generates these two new CDRs, and the service usage 118 stores, aggregates, and communicates these two new CDRs to the central billing interface 127. In some embodiments, the service controller 122 generates these two new CDRs, and the service usage 118 stores, aggregates, and communicates these two new CDRs to the central billing interface 127, in which the central billing interface 127 applies rules (e.g., performs the rules engine for determining the bill-by-account billing offset).

[00123] In some embodiments, the service controller 122 sends the device generated CDRs to the rules engine (e.g., a service usage data store and rules engine, such as CDR storage, aggregation, mediation, feed 118), and the rules engine applies one or more rules, such as those described herein and/or any other billing/service usage related rules as would be apparent to one of ordinary skill in the art. In some embodiments, the service controller 122 generates CDRs similar to other network elements, and the rules (e.g., bill-by-account) are performed in the central billing interface 127. For example, for the service controller 122 to generate CDRs similar to other network elements, in some embodiments, the service controller 122 is provisioned on the wireless network (e.g., by network provision system 160) and behaves substantially similar to other CDR generators on the network).

[00124] In some embodiments, the service controller 122 is provisioned as a new type of networking function that is recognized as a valid, authorized, and secure source for CDRs by the other necessary elements in the network (e.g., CDR storage, aggregation, mediation, feed 118). In some embodiments, if the necessary network apparatus only recognize CDRs from certain

types of networking equipment (e.g., a RAN gateway or transport gateway), then the service controller 122 provides authentication credentials to the other networking equipment that indicate that it is one of the approved types of equipment for providing CDRs. In some embodiments, the link between the service controller 122 and the necessary CDR aggregation and mediation equipment is secured, authenticated, encrypted, and/or signed.

[00125] In some embodiments, the CDR storage, aggregation, mediation, feed 118 discards the network based service usage information (e.g., network based CDRs) received from one or more network elements. In these embodiments, the service controller 122 provides the device assisted service usage information (e.g., device based CDRs or micro-CDRs) to the CDR storage, aggregation, mediation, feed 118 (e.g., the CDR storage, aggregation, mediation, feed 118 can just provide a store, aggregate, and communication function(s), as it is not required to mediate network based CDRs and device assisted CDRs), and the device based service usage information is provided to the central billing interface 127 or the central billing system 123.

[00126] In some embodiments, the device based CDRs (e.g., micro-CDRs) and/or new CDRs generated based on execution of a rules engine as described herein are provided only for devices that are managed and/or based on device group, service plan, or any other criteria, categorization, and/or grouping, such as based on ambient service or ambient service provider or transactional service or transactional service provider.

[00127] In some embodiments, QoS for DAS includes a service processor (e.g., any device assisted element/function) that facilitates coordination for and/or provisions wireless access/radio access bearers (e.g., RABs). In some embodiments, the service processor determines whether a request for QoS is authorized (e.g., according to QoS service level, user standing, available local network capacity (e.g., as reported by other device(s) and/or network)). In some embodiments, device QoS capacity demand reports provide and/or augment network capacity demand reports.

[00128] In some embodiments, QoS for DAS includes a service controller (e.g., any network device based service control element/function) that facilitates coordination for and/or provisions wireless access/radio access bearers (e.g., RABs) on a device (e.g., a communications device, such as a mobile wireless communications device and/or an intermediate networking device), on network, and/or on device plus network. In some embodiments, the service

controller provides device QoS capacity demand reports to other network equipment/elements/functions, and then also provisions the RAB channel based on various criteria and determinations.

[00129] In some embodiments, QoS for DAS provides for device assisted monitoring, information, and/or functionality to facilitate QoS without and/or to assist network based monitoring, information, and/or functionality (e.g., Deep Packet Inspection (DPI) and/or provides such monitoring, information, and/or functionality that may not be available via network based monitoring, information, and/or functionality (e.g., encrypted activities on the device may not be accessible by DPI or other network based techniques). For example, QoS for DAS can assist in the QoS setup to facilitate the QoS setup and provide such information that may not otherwise be available using network based only techniques. For example, device assisted activity and/or service monitoring techniques can assist in classifying the QoS for the monitored activity and/or service using, for example, a QoS activity map (e.g., as described herein or other similar techniques). For example, using such device assisted techniques eliminates and/or minimizes DPI or other network based techniques that can give rise to privacy concerns/issues, network neutrality concerns/issues, and/or otherwise may not be able to provide similar or equivalent granular service/activity monitoring, as discussed above, and/or also off loads such processing from the network (e.g., network elements/devices/functionality) to the communications devices (e.g., at least for such communications devices that can perform such functions, based on their processing and/or memory capabilities, as would be apparent to one of ordinary skill in the art). In some embodiments, QoS for DAS includes the service provider for providing an initial authorization/clearance for a QoS request (e.g., using various techniques described herein), and the service controller determines if the QoS request should be authorized (e.g., based on various QoS authorization/clearance/approval criteria (e.g., QoS activity maps and/or QoS request rule) and/or network capacity, as described herein). In some embodiments, QoS for DAS includes the service provider for providing a QoS request including a QoS class to the service controller, and the service controller determines if the QoS request should be authorized, as described herein. In some embodiments, DAS for protecting network capacity provides for device assisted monitoring, information, and/or functionality to facilitate protecting network capacity without and/or to assist network based monitoring, information, and/or functionality (e.g., Deep Packet Inspection (DPI) and/or provides such monitoring, information,

and/or functionality that may not be available via network based monitoring, information, and/or functionality (e.g., encrypted activities on the device may not be accessible by DPI or other network based techniques). In some embodiments, DAS for protecting network capacity provides for device assisted monitoring, information, and/or functionality to facilitate protecting network capacity without solely relying upon DPI and/or without any use or any significant use of DPI wireless network, which conserves network resources and network capacity by controlling device network access behavior at the device instead of deep in the core network at a DPI gateway (e.g., DPI based techniques consume over the air wireless network capacity even if chatty device behavior is blocked at a DPI gateway; in contrast, DAS for protecting network capacity techniques that do not use DPI based techniques for controlling device service usage can, for example, provide a device based usage notification and service selection UI that does not consume over the air wireless network capacity).

[00130] In some embodiments, QoS for DAS and/or DAS for protecting network capacity includes providing or facilitating reports for base station (BTS) for network capacity (e.g., sector, channel, busy state information or network capacity usage/availability, and/or network capacity expected demand) based on, for example, one or more of the following: monitored application usage on the communications device, monitored user activity on the communications device, location of the communications, other available networks, and/or other monitored or determined activity, service usage measure, and/or metric. In some embodiments, at or after execution of an application that is determined to require network service usage (e.g., may require increased wireless network bandwidth, such as based on a service usage activity map), QoS for DAS sends information to the network (e.g., a network controller or other network device element/function) that capacity demand is forthcoming for the communications device (e.g., potentially initiating a provisioning of a QoS radio access bearer (RAB) or other type of RAB).

[00131] In some embodiments, network capacity (e.g., busy state information) is collected from one or more communications devices in communication with a wireless network (e.g., network capacity/usage information measured from each respective communications device's perspective is determined and stored by the service processor on each respective communications device) and reported to the service controller, and the service controller (e.g., or another network element/function) uses this information to determine what resources are available for allocation to various levels of QoS (e.g., to respond to/facilitate various QoS requests) and/or to workload

balance across multiple base stations and/or networks (e.g., wired networks, cellular, Wi-Fi, and/or other wireless networks).

[00132] In some embodiments, the service processor executed on the communications device sends a QoS request (e.g., a wireless network bearer channel reservation request or Radio Access Bearer (RAB) request) to the service controller. The service controller verifies the request using various verification techniques as described herein. In some embodiments, the service controller facilitates coordination of various device QoS requests with one or more base stations (BTSs) in communication with the communications device to provide for the requested QoS reservation to facilitate the new QoS session. In some embodiments, the service controller provides a QoS routing function by, for example, providing various QoS routing instructions to a device service processor (e.g., aggregating, prioritizing, queuing, authorizing, allocating reservations/RABs, denying, re-routing (such as to other BTSs and/or other networks) and/or otherwise managing QoS requests), in which the BTS may or may not be QoS aware. For example, QoS priority can be based on activity (e.g., service usage and/or application), service level, user standing, network capacity, time of day, and/or QoS priority can be purchased on a transaction basis, a session basis, a pre-pay basis or a plan basis. As another example, QoS priority can also vary by device type, user within a group, group, application type, content type, or any other criteria or measure and/or any combination thereof. In some embodiments, the service controller also facilitates coordination of various device QoS requests with other network elements/functions for QoS implementation and management to provide for an end to end QoS solution.

[00133] In some embodiments, QoS can be symmetric for two mobile devices or asymmetric. In some embodiments, QoS resource availability can be from communications devices, BTS(s), other network functions (e.g., service control, service controller and/or any other network elements/functions) or any combination thereof. In some embodiments, the service controller provides QoS demand information to another network element/function. In some embodiments, the service controller provides the central aggregator and policy decision point (PDP). In some embodiments, the service controller controls (e.g., at least in part) QoS related functions for communications devices, BTS(s), and/or a combination of both.

[00134] In some embodiments, charging (e.g., monitoring and/or determining associating charging or billing) for QoS service usage/transactions and/or network capacity controlled services usage/transactions is determined using various techniques described herein. For example, the service processor can assist in charging for QoS and/or network capacity controlled activities. In some embodiments, the service processor uses device assisted Charging Data Records (CDRs) or micro-CDRs to assist in charging for QoS and/or network capacity controlled activities (e.g., using QoS class related transaction codes and/or network capacity controlled related transaction codes), as described herein with respect to various embodiments. In some embodiments, charging for QoS and/or network capacity controlled services is performed in whole or in part by one or more network elements/functions (e.g., service controller, SGSN/GGSN/other gateways, and/or billing interfaces/servers).

[00135] In some embodiments, service usage information includes network based service usage information. In some embodiments, the network based service usage information includes network based CDRs. In some embodiments, service usage information includes device based service usage information. In some embodiments, device based service usage information includes device assisted CDRs, also referred to herein as micro-CDRs, as described herein. In some embodiments, micro-CDRs are used for CDR mediation or reconciliation that provides for service usage accounting on any device activity that is desired (e.g., providing granular service usage information, such as based on application layer service usage monitoring, transaction service usage monitoring, QoS activities/sessions/transactions, network capacity controlled activities/sessions/transactions, and/or other types of service usage information). In some embodiments, each device includes a service processor (e.g., a service processor executed on a processor of a communications device, such as a mobile device or an intermediate networking device that can communicate with a wireless network).

[00136] In some embodiments, each device activity that is desired to be associated with a billing event (e.g., for a QoS related billing event) is assigned a micro-CDR transaction code, and the service processor is programmed to account for that activity associated with that transaction code (e.g., various transaction codes can be associated with service usage associated with certain services, applications, and/or based on QoS classes or priorities, respectively, which can be used for providing granular service usage for these various Internet/network based services/sites/transactions and/or any other Internet/network based services/sites, which can

include transactional based services). For example, using these techniques, as described herein, essentially any type of device activity (e.g., including QoS classes and prioritization and/or network capacity controlled classes and prioritization) can be individually accounted for and/or controlled (e.g., throttled, restricted, and/or otherwise controlled as desired). In some embodiments, the service processor periodically reports (e.g., during each heartbeat or based on any other periodic, push, and/or pull communication technique(s)) micro-CDR usage measures to, for example, a service controller or some other network element/function. In some embodiments, the service controller reformats the heartbeat micro-CDR usage information into a valid CDR format (e.g., a CDR format that is used and can be processed by an SGSN or GGSN or some other authorized network element/function for CDRs) and then transmits the reformatted micro-CDRs to a network element/function for performing CDR mediation.

[00137] In some embodiments, CDR mediation is used to properly account for the micro-CDR service usage information by depositing it into an appropriate service usage account and deducting it from the user device bulk service usage account. For example, this technique provides for a flexible service usage billing solution that uses pre-existing solutions for CDR mediation and billing. For example, the billing system can process the mediated CDR feed from CDR mediation, apply the appropriate account billing codes to the aggregated micro-CDR information that was generated by the device, and then generate billing events in a manner that does not require changes to existing billing systems, infrastructures, and techniques (e.g., using new transaction codes to label the new device assisted billing capabilities).

[00138] In some embodiments, the various QoS techniques performed on or by the communications device (e.g., using a service processor to provide or assist in providing QoS session provisioning, QoS policy management, QoS policy enforcement, and/or QoS accounting/charging, such as QoS charging records and reports) are verified (e.g., using various verification techniques described herein). In some embodiments, the various network capacity controlled services techniques performed on or by the communications device (e.g., using a service processor to provide or assist in providing network capacity controlled services policy management, network capacity controlled services policy enforcement, and/or network capacity controlled services charging, such as network capacity controlled services charging records and reports) are verified (e.g., using various verification techniques described herein).

[00139] For example, a QoS request, QoS related policy rules (e.g., QoS activity map, QoS related service plan and/or service policy settings) and implementation, QoS policy enforcement, and QoS charging are verified (e.g., periodically, per transaction, and/or based on some other criteria/metric). In some embodiments, verification techniques include one or more of the following: compare a network based service usage measure with a first service policy associated with the communications device, compare a device assisted service usage measure with the first service policy, compare the network based service usage measure to the device assisted service usage measure, perform a test and confirm a device assisted service usage measure based on the test, perform a User Interface (UI) notification (e.g., which can include a user authentication, password, question/answer challenge, and/or other authentication technique), and/or other similar verification techniques as will now be apparent to one of ordinary skill in the art. Accordingly, in some embodiments, QoS for DAS "closes the loop" for verification of various QoS related techniques, such as QoS requests, QoS grants, QoS usage, and/or QoS charging. In some embodiments, the service processor and the service controller serve as a verifiable QoS management/coordination system for other QoS elements/functions in network. In some embodiments, if such or other verification techniques determine or assist in determining that a QoS request, QoS report, and/or QoS policy behavior (e.g., or similarly, network capacity controlled services monitoring, reporting, and/or policy behavior) does not match expected requests, reports, and/or policy, then responsive actions can be performed, for example, the communications device (e.g., and/or suspect services) can be suspended, quarantined, killed/terminated, and/or flagged for further analysis/scrutiny to determine whether the device is malfunctioning, needs updating, has been tampered with or compromised, is infected with malware, and/or if any other problem exists.

[00140] In some embodiments, the communications device (e.g., the service processor) maintains a QoS flow table that associates or maps device activity to QoS level/class to RAB/QoS channel, and in some embodiments, the communications device also informs a QoS management network function/element of the relative priority of the QoS flows for the communications device (e.g., based on or using the QoS flow table). In some embodiments, the service controller receives or collects information from the communications device and maintains such a QoS flow table for the communications device and, in some embodiments, the service controller also informs a QoS management network function/element of the relative

priority of the QoS flows for the communications device (e.g., based on or using the QoS flow table). In some embodiments, flows can be assigned to activities originating at the communications device in a transparent way, or simply by activity class or user preference, or using other techniques.

[00141] In some embodiments, the communications device maintains a table of QoS billing rates, scheduled transmission times, and/other QoS related information to implement an overlay MAC at the data networking level to manage QoS on legacy networks that are not QoS MAC enabled and/or do not have the various functionality to support QoS controls (e.g., and such techniques can also be used to provide for QoS functionality across different networks). In some embodiments, QoS related policies are exchanged between roaming and home service controllers to facilitate QoS support while roaming on a non-home network(s).

[00142] In some embodiments, the communications device serves as a network capacity indicator (e.g., collecting network capacity information for a local cell and communicating or reporting that network capacity information to the service controller). For example, permanent local cell communications devices can be placed in local cell areas to augment legacy equipment for such network capacity indicator/reporting functions. Various other techniques for determining network capacity and/or network availability are described herein.

[00143] In some embodiments, service partners and/or service providers can subsidize in whole or in part to upgrade a given user or group of users to better QoS related service level agreement (SLA)/class for a preferred destination. In some embodiments, based on monitored service usage and/or other monitored behavior of the communications device, such subsidized QoS upgrade/offers can be presented to a user of the communications device (e.g., as an incentive/reward for desired or preferred user behavior or for other reasons). Similarly, in some embodiments, these techniques are also applied to network capacity controlled services.

[00144] In some embodiments, QoS charging is based on QoS channel/reservation, service flow, or RAB charging (e.g., single flow per RAB, multi-flow per RAB, multi-RAB per flow). In some embodiments, charging (e.g., for QoS and/or for network capacity controlled services) is based on one or more of the following: network busy state, time criteria, user service class request, traffic volume and class, time and class, network capacity (e.g., network busy state) and class, time of day and class, location, traffic type, application type, application class, destination,

destination type, partner service, and/or other criteria/measures. In some embodiments, QoS charging is verified using the various verification techniques described herein (e.g., test charging events). In some embodiments, network capacity controlled services charging is verified using the various verification techniques described herein (e.g., test charging events). In some embodiments, QoS charging is by data usage (e.g., by Megabyte (MB)), service flow by time by QoS class, speed by time, network busy state, time of day/day of week, service plan, current network, and/or other criteria/measures. In some embodiments, network capacity controlled services charging is by data usage (e.g., by Megabyte (MB)), service flow by time by network capacity controlled services class, speed by time, network busy state, time of day/day of week, service plan, current network, and/or other criteria/measures.

[00145] In some embodiments, QoS for DAS includes coordinating functions with one or more of the following: DAS elements/functions, Radio Access Network (RAN), Transport network, Core network, GRX network, IPX network, and/or other networks/elements/functions.

[00146] FIG. 2 illustrates another functional diagram of another network architecture for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments. In some embodiments, QoS for DAS techniques described herein are implemented using the network architecture shown in FIG. 2. In some embodiments, DAS for protecting network capacity techniques described herein are implemented using the network architecture shown in FIG. 2.

[00147] As shown, FIG. 2 includes various devices 100 including service processors 115. For example, devices 100 can include various types of mobile devices, such as phones, PDAs, computing devices, laptops, net books, tablets, cameras, music/media players, GPS devices, networked appliances, and any other networked device; and/or devices 100 can include various types of intermediate networking devices, as described herein. The devices 100 are in communication with service control 210 and central provider access and core networks 220. Service policies and accounting functions 230 are also provided in communication with the central provider access and core networks 220. For example, devices 100 can communicate via the central provider access and core networks 220 to the Internet 120 for access to various Internet sites/services 240 (e.g., Google sites/services, Yahoo sites/services, Blackberry services,

Apple iTunes and AppStore, Amazon.com, FaceBook, and/or any other Internet service or other network facilitated service).

[00148] In some embodiments, FIG. 2 provides a wireless network architecture that supports various DAS for protecting network capacity techniques as described herein. Those of ordinary skill in the art will appreciate that various other network architectures can be used for providing various DAS for protecting network capacity techniques as described herein, and FIG. 2 is illustrative of just another such example network architecture for which DAS for protecting network capacity techniques as described herein can be provided.

[00149] FIG. 3 illustrates another functional diagram of an architecture 300 including a device based service processor 115 and a service controller 122 for providing quality of service (QoS) for device assisted services (DAS) and/or for providing DAS for protecting network capacity in accordance with some embodiments. In some embodiments, QoS for DAS techniques described herein are implemented using the functions/elements shown in FIG. 3. In some embodiments, DAS for protecting network capacity techniques described herein are implemented using the functions/elements shown in FIG. 3.

[00150] For example, the architecture 300 provides a relatively full featured device based service processor implementation and service controller implementation. As shown, this corresponds to a networking configuration in which the service controller 122 is connected to the Internet 120 and not directly to the access network 1610. As shown, a data plane (e.g., service traffic plane) communication path is shown in solid line connections and control plane (e.g., service control plane) communication path is shown in dashed line connections. As will be apparent to one of ordinary skill in the art, the division in functionality between one device agent and another is based on, for example, design choices, networking environments, devices and/or services/applications, and various different combinations can be used in various different implementations. For example, the functional lines can be re-drawn in any way that the product designers see fit. As shown, this includes certain divisions and functional breakouts for device agents as an illustrative implementation, although other, potentially more complex, embodiments can include different divisions and functional breakouts for device agent functionality specifications, for example, in order to manage development specification and testing complexity and workflow. In addition, the placement of the agents that operate, interact with or monitor the

data path can be moved or re-ordered in various embodiments. For example, the functional elements shown in FIG. 3 are described below with respect to, for example, FIGS. 4, 12, and 13 as well as FIGS. 5 through 11 (e.g., QoS for DAS related embodiments) and FIGS. 14 through 23 (e.g., DAS for protecting network capacity related embodiments).

[00151] As shown in FIG. 3, service processor 115 includes a service control device link 1691. For example, as device based service control techniques involving supervision across a network become more sophisticated, it becomes increasingly important to have an efficient and flexible control plane communication link between the device agents and the network elements communicating with, controlling, monitoring, or verifying service policy. In some embodiments, the service control device link 1691 provides the device side of a system for transmission and reception of service agent to/from network element functions. In some embodiments, the traffic efficiency of this link is enhanced by buffering and framing multiple agent messages in the transmissions. In some embodiments, the traffic efficiency is further improved by controlling the transmission frequency or linking the transmission frequency to the rate of service usage or traffic usage. In some embodiments, one or more levels of security or encryption are used to make the link robust to discovery, eavesdropping or compromise. In some embodiments, the service control device link 1691 also provides the communications link and heartbeat timing for the agent heartbeat function. As discussed below, various embodiments disclosed herein for the service control device link 1691 provide an efficient and secure solution for transmitting and receiving service policy implementation, control, monitoring and verification information with other network elements.

[00152] As shown in FIG. 3, the service controller 122 includes a service control server link 1638. In some embodiments, device based service control techniques involving supervision across a network (e.g., on the control plane) are more sophisticated, and for such it is increasingly important to have an efficient and flexible control plane communication link between the device agents (e.g., of the service processor 115) and the network elements (e.g., of the service controller 122) communicating with, controlling, monitoring, or verifying service policy. For example, the communication link between the service control server link 1638 of service controller 122 and the service control device link 1691 of the service processor 115 can provide an efficient and flexible control plane communication link, a service control link 1653 as shown in FIG. 3, and, in some embodiments, this control plane communication link provides for

a secure (e.g., encrypted) communications link for providing secure, bidirectional communications between the service processor 115 and the service controller 122. In some embodiments, the service control server link 1638 provides the network side of a system for transmission and reception of service agent to/from network element functions. In some embodiments, the traffic efficiency of this link is enhanced by buffering and framing multiple agent messages in the transmissions (e.g., thereby reducing network chatter). In some embodiments, the traffic efficiency is further improved by controlling the transmission frequency and/or linking the transmission frequency to the rate of service usage or traffic usage. In some embodiments, one or more levels of security and/or encryption are used to secure the link against potential discovery, eavesdropping or compromise of communications on the link. In some embodiments, the service control server link 1638 also provides the communications link and heartbeat timing for the agent heartbeat function.

[00153] In some embodiments, the service control server link 1638 provides for securing, signing, encrypting and/or otherwise protecting the communications before sending such communications over the service control link 1653. For example, the service control server link 1638 can send to the transport layer or directly to the link layer for transmission. In another example, the service control server link 1638 further secures the communications with transport layer encryption, such as TCP TLS or another secure transport layer protocol. As another example, the service control server link 1638 can encrypt at the link layer, such as using IPSEC, various possible VPN services, other forms of IP layer encryption and/or another link layer encryption technique.

[00154] As shown in FIG. 3, the service controller 122 includes an access control integrity server 1654 (e.g., service policy security server). In some embodiments, the access control integrity server 1654 collects device information on service policy, service usage, agent configuration, and/or agent behavior. For example, the access control integrity server 1654 can cross check this information to identify integrity breaches in the service policy implementation and control system. In another example, the access control integrity server 1654 can initiate action when a service policy violation (e.g., QoS policy violation and/or a network capacity controlled services policy violation) or a system integrity breach is suspected.

[00155] In some embodiments, the access control integrity server 1654 (and/or some other agent of service controller 122) acts on access control integrity agent 1694 (e.g., service policy security agent) reports and error conditions. Many of the access control integrity agent 1654 checks can be accomplished by the server. For example, the access control integrity agent 1654 checks include one or more of the following: service usage measure against usage range consistent with policies (e.g., usage measure from the network and/or from the device); configuration of agents; operation of the agents; and/or dynamic agent download.

[00156] In some embodiments, the access control integrity server 1654 (and/or some other agent of service controller 122) verifies device service policy implementations by comparing various service usage measures (e.g., based on network monitored information, such as by using IPDRs or CDRs, and/or local service usage monitoring information) against expected service usage behavior given the policies that are intended to be in place (e.g., a QoS policy and/or a network capacity controlled services policy). For example, device service policy implementations can include measuring total QoS data passed, QoS data passed in a period of time, IP addresses, data per IP address, and/or other measures such as location, downloads, email accessed, URLs, and comparing such measures expected service usage behavior given the policies that are intended to be in place.

[00157] In some embodiments, the access control integrity server 1654 (e.g., and/or some other agent of service controller 122) verifies device service policy, and the verification error conditions that can indicate a mismatch in QoS service measure and QoS service policy include one or more of the following: unauthorized network access (e.g., access beyond ambient service policy limits); unauthorized network speed (e.g., average speed beyond service policy limit); network data amount does not match QoS policy limit (e.g., device not stop at limit without re-up/revising service policy); unauthorized network address; unauthorized service usage (e.g., VOIP, email, and/or web browsing); unauthorized application usage (e.g., email, VOIP, email, and/or web); service usage rate too high for plan, and policy controller not controlling/throttling it down; and/or any other mismatch in service measure and service policy. Accordingly, in some embodiments, the access control integrity server 1654 (and/or some other agent of service controller 122) provides a policy/service control integrity service to continually (e.g., periodically and/or based on trigger events) verify that the service control of the device has not

been compromised and/or is not behaving out of policy (e.g., a QoS policy and/or a network capacity controlled services policy).

[00158] As shown in FIG. 3, service controller 122 includes a service history server 1650 (e.g., charging server). In some embodiments, the service history server 1650 collects and records service usage or service activity reports from the Access Network AAA Server 1621 and the Service Monitor Agent 1696. For example, although service usage history from the network elements can in certain embodiments be less detailed than service history from the device, the service history from the network can provide a valuable source for verification of device service policy implementation, because, for example, it is extremely difficult for a device error or compromise event on the device to compromise the network based equipment and software. For example, service history reports from the device can include various service tracking information, as similarly described above. In some embodiments, the service history server 1650 provides the service history on request to other servers and/or one or more agents. In some embodiments, the service history server 1650 provides the service usage history to the device service history 1618 (e.g., CDR feed and CDR mediation). In some embodiments, for purposes of facilitating the activation tracking service functions (described below), the service history server 1650 maintains a history of which networks the device has connected to. For example, this network activity summary can include a summary of the networks accessed, activity versus time per connection, and/or traffic versus time per connection. As another example, this activity summary can further be analyzed or reported to estimate the type of service plan associated with the traffic activity for the purpose of bill sharing reconciliation.

[00159] As shown in FIG. 3, service controller 122 includes a policy management server 1652 (e.g., policy decision point (PDP) server) for managing service usage policies, such as QoS policies and/or a network capacity controlled services policies. In some embodiments, the policy management server 1652 transmits policies to the service processor 115 via the service control link 1653. In some embodiments, the policy management server 1652 manages policy settings on the device (e.g., various policy settings as described herein with respect to various embodiments) in accordance with a device service profile. In some embodiments, the policy management server 1652 sets instantaneous policies on policy implementation agents (e.g., policy implementation agent 1690). For example, the policy management server 1652 can issue policy settings, monitor service usage and, if necessary, modify policy settings. For example, in

the case of a user who prefers for the network to manage their service usage costs, or in the case of any adaptive policy management needs, the policy management server 1652 can maintain a relatively high frequency of communication with the device to collect traffic and/or service measures and issue new policy settings. In this example, device monitored service measures and any user service policy preference changes are reported, periodically and/or based on various triggers/events/requests, to the policy management server 1652. In this example, user privacy settings generally require secure communication with the network (e.g., a secure service control link 1653), such as with the policy management server 1652, to ensure that various aspects of user privacy are properly maintained during such configuration requests/policy settings transmitted over the network. For example, information can be compartmentalized to service policy management and not communicated to other databases used for CRM for maintaining user privacy.

[00160] In some embodiments, the policy management server 1652 provides adaptive policy management on the device. For example, the policy management server 1652 can issue policy settings and objectives and rely on the device based policy management (e.g., service processor 115) for some or all of the policy adaptation. This approach can require less interaction with the device thereby reducing network chatter on the service control link 1653 for purposes of device policy management (e.g., network chatter is reduced relative to various server/network based policy management approaches described above). This approach can also provide robust user privacy embodiments by allowing the user to configure the device policy for user privacy preferences/settings so that, for example, sensitive information (e.g., geo-location data, website history, and/or other sensitive information) is not communicated to the network without the user's approval. In some embodiments, the policy management server 1652 adjusts service policy based on time of day. In some embodiments, the policy management server 1652 receives, requests, and/or otherwise obtains a measure of network availability/capacity and adjusts traffic shaping policy and/or other policy settings based on available network availability/capacity (e.g., a network busy state).

[00161] As shown in FIG. 3, service controller 122 includes a network traffic analysis server 1656. In some embodiments, the network traffic analysis server 1656 collects/receives service usage history for devices and/or groups of devices and analyzes the service usage. In some embodiments, the network traffic analysis server 1656 presents service usage statistics in

various formats to identify improvements in network service quality and/or service profitability. In some embodiments, the network traffic analysis server 1656 estimates the service quality and/or service usage for the network under variable settings on potential service policies. In some embodiments, the network traffic analysis server 1656 identifies actual or potential service behaviors by one or more devices that are causing problems for overall network service quality or service cost. In some embodiments, the network traffic analysis server 1656 estimates the network availability/capacity for the network under variable settings on potential service policies. In some embodiments, the network traffic analysis server 1656 identifies actual or potential service behaviors by one or more devices that are impacting and/or causing problems for overall network availability/capacity.

[00162] As shown in FIG. 3, Service Analysis, Test & Download 122B includes a beta test server 1658 (e.g., policy creation point and beta test server). In some embodiments, the beta test server 1658 publishes candidate service plan policy settings to one or more devices. In some embodiments, the beta test server 1658 provides summary reports of network service usage or user feedback information for one or more candidate service plan policy settings. In some embodiments, the beta test server 1658 provides a mechanism to compare the beta test results for different candidate service plan policy settings or select the optimum candidates for further policy settings optimization, such as for protecting network capacity.

[00163] As shown in FIG. 3, service controller 122 includes a service download control server 1660 (e.g., a service software download control server). In some embodiments, the service download control server 1660 provides a download function to install and/or update service software elements (e.g., the service processor 115 and/or agents/components of the service processor 115) on the device, as described herein.

[00164] As shown in FIG. 3 service controller 122 includes a billing event server 1662 (e.g., micro-CDR server). In some embodiments, the billing event server 1662 collects billing events, provides service plan information to the service processor 115, provides service usage updates to the service processor 115, serves as interface between device and central billing server 1619, and/or provides trusted third party function for certain ecommerce billing transactions.

[00165] As shown in FIG. 3, the Access Network HLR AAA server 1621 is in network communication with the access network 1610. In some embodiments, the Access Network AAA

server 1621 provides the necessary access network AAA services (e.g., access control and authorization functions for the device access layer) to allow the devices onto the central provider access network and the service provider network. In some embodiments, another layer of access control is required for the device to gain access to other networks, such as the Internet, a corporate network and/or a machine to machine network. This additional layer of access control can be implemented, for example, by the service processor 115 on the device. In some embodiments, the Access Network AAA server 1621 also provides the ability to suspend service for a device and resume service for a device based on communications received from the service controller 122. In some embodiments, the Access Network AAA server 1621 also provides the ability to direct routing for device traffic to a quarantine network or to restrict or limit network access when a device quarantine condition is invoked. In some embodiments, the Access Network AAA server 1621 also records and reports device network service usage (e.g., device network service usage can be reported to the device service history 1618).

[00166] As shown in FIG. 3, the device service history 1618 is in network communication with the access network 1610. In some embodiments, the device service history 1618 provides service usage data records used for various purposes in various embodiments. In some embodiments, the device service history 1618 is used to assist in verifying service policy implementation. In some embodiments, the device service history 1618 is used to verify service monitoring. In some embodiments, the device service history 1618 is used to verify billing records and/or billing policy implementation (e.g., to verify service usage charging). In some embodiments, the device service history 1618 is used to synchronize and/or verify the local service usage counter (e.g., to verify service usage accounting).

[00167] As shown in FIG. 3, the central billing 1619 (e.g., central provider billing server) is in network communication with the access network 1610. In some embodiments, the central provider billing server 1619 provides a mediation function for central provider billing events. For example, the central provider billing server 1619 can accept service plan changes. In some embodiments, the central provider billing server 1619 provides updates on device service usage, service plan limits and/or service policies. In some embodiments, the central provider billing server 1619 collects billing events, formulates bills, bills service users, provides certain billing event data and service plan information to the service controller 122 and/or device 100.

[00168] As shown in FIG. 3, in some embodiments, modem selection and control 1811 (e.g., in communication with connection manager 1804 as shown) selects the access network connection and is in communication with the modem firewall 1655, and modem drivers 1831, 1815, 1814, 1813, 1812 convert data traffic into modem bus traffic for one or more modems and are in communication with the modem selection and control 1811. In some embodiments, different profiles are selected based on the selected network connection (e.g., different service profiles/policies for WWAN, WLAN, WPAN, Ethernet and/or DSL network connections), which is also referred to herein as multimode profile setting. For example, service profile settings can be based on the actual access network (e.g., home DSL/cable or work network) behind the Wi-Fi not the fact that it is Wi-Fi (e.g., or any other network, such as DSL/cable, satellite, or T-1), which is viewed as different than accessing a Wi-Fi network at the coffee shop. For example, in a Wi-Fi hotspot situation in which there are a significant number of users on a DSL or T-1 backhaul, the service controller can sit in a service provider cloud or an MVNO cloud, the service controls can be provided by a VSP capability offered by the service provider or the service controller can be owned by the hotspot service provider that uses the service controller on their own without any association with an access network service provider. For example, the service processors can be controlled by the service controller to divide up the available bandwidth at the hotspot according to QoS or user sharing rules (e.g., with some users having higher differentiated priority (e.g., potentially for higher service payments) than other users). As another example, ambient services (e.g., as similarly described herein) can be provided for the hotspot for verified service processors.

[00169] In some embodiments, the service processor 115 and service controller 122 are capable of assigning multiple service profiles associated with multiple service plans that the user chooses individually or in combination as a package. For example, a device 100 starts with ambient services that include free transaction services wherein the user pays for transactions or events rather than the basic service (e.g., a news service, eReader, PND service, pay as you go session Internet) in which each service is supported with a bill by account capability to correctly account for any subsidized partner billing to provide the transaction services (e.g., Barnes and Noble may pay for the eReader service and offer a revenue share to the service provider for any book or magazine transactions purchased from the device 100). In some embodiments, the bill by account service can also track the transactions and, in some embodiments, advertisements for

the purpose of revenue sharing, all using the service monitoring capabilities disclosed herein. After initiating services with the free ambient service discussed above, the user may later choose a post-pay monthly Internet, email, and SMS service. In this case, the service controller 122 would obtain from the billing system 123 in the case of network based billing (e.g., or the service controller 122 billing event server 1622 in the case of device based billing) the billing plan code for the new Internet, email and SMS service. In some embodiments, this code is cross referenced in a database (e.g., the policy management server 1652) to find the appropriate service profile for the new service in combination with the initial ambient service. The new superset service profile is then applied so that the user maintains free access to the ambient services, and the billing partners continue to subsidize those services, the user also gets access to Internet services and may choose the service control profile (e.g., from one of the embodiments disclosed herein). The superset profile is the profile that provides the combined capabilities of two or more service profiles when the profiles are applied to the same device 100 service processor. In some embodiments, the device 100 (service processor 115) can determine the superset profile rather than the service controller 122 when more than one "stackable" service is selected by the user or otherwise applied to the device. The flexibility of the service processor 115 and service controller 122 embodiments described herein allow for a large variety of service profiles to be defined and applied individually or as a superset to achieve the desired device 100 service features.

[00170] As shown in FIG. 3, an agent communication bus 1630 represents a functional description for providing communication for the various service processor 115 agents and functions. In some embodiments, as represented in the functional diagram illustrated in FIG. 3, the architecture of the bus is generally multipoint to multipoint so that any agent can communicate with any other agent, the service controller or in some cases other components of the device, such user interface 1697 and/or modem components. As described below, the architecture can also be point to point for certain agents or communication transactions, or point to multipoint within the agent framework so that all agent communication can be concentrated, or secured, or controlled, or restricted, or logged or reported. In some embodiments, the agent communication bus is secured, signed, encrypted, hidden, partitioned, and/or otherwise protected from unauthorized monitoring or usage. In some embodiments, an application interface agent (not shown) is used to literally tag or virtually tag application layer traffic so that the policy

implementation agent(s) 1690 has the necessary information to implement selected traffic shaping solutions. In some embodiments, an application interface agent (not shown) is in communication with various applications, including a TCP application 1604, an IP application 1605, and a voice application 1602.

[00171] As shown in FIG. 3, service processor 115 includes an API and OS stack interface 1693. In some embodiments, the API and OS stack interface 1693 provides the QoS API functionality as similarly described herein with respect to various embodiments. In some embodiments, a QoS API is used to report back QoS availability to applications. In some embodiments, the API and OS stack interface 1693 provides the network capacity controlled API and/or emulated API functionality as similarly described herein with respect to various embodiments. As shown, service processor 115 also includes a router 1698 (e.g., a QoS router agent/function and/or a network capacity controlled services router agent/function) and a policy decision point (PDP) agent 1692. In some embodiments, the router 1698 provides QoS router functionality as similarly described herein with respect to various embodiments. In some embodiments, the router 1698 provides network capacity controlled services router functionality as similarly described herein with respect to various embodiments. In some embodiments, the QoS router supports multiple QoS channels (e.g., one or more provisioned/allocated QoS links forming a QoS channel between the device and the desired end point, such as an access point/BTS/gateway/network for a single ended QoS channel or other communication device for an end to end QoS channel, depending on the QoS connection/network support/availability/etc.). In some embodiments, the QoS router supports multiple QoS channels, which can each have different QoS classes/levels. In some embodiments, the QoS router routes application/service usage traffic to an appropriate QoS channel. In some embodiments, the QoS router determines the routing/mapping based on, for example, one or more of the following: a QoS API request, a QoS activity map, a user request, a service plan, a service profile, service policy settings, network capacity, service controller or other intermediate QoS network element/function/device, and/or any other criteria/measure, as similarly described herein with respect to various embodiments. In some embodiments, multiple different applications/services are routed to a particular QoS channel using various techniques described herein. In some embodiments, different applications/services are routed to different QoS channels using various techniques described herein. In some embodiments, the QoS router assists in managing and/or optimizing

QoS usage for the communications device. In some embodiments, the QoS router assists in managing and/or optimizing QoS usage across multiple communications devices (e.g., based on network capacity for a given cell area/base station or other access point). In some embodiments, PDP agent 1692 provides the PDP agent functionality as similarly described herein with respect to various embodiments. As shown, architecture 300 also includes a suspend resume interface 320, network QoS provisioning interfaces 330 (e.g., for providing the various QoS techniques described herein), and an activation/suspend resume server 340 and billing interface server 350 in the service controller 122A.

[00172] In some embodiments, device assisted services (DAS) techniques for providing an activity map for classifying or categorizing service usage activities to associate various monitored activities (e.g., by URL, by network domain, by website, by network traffic type, by application or application type, and/or any other service usage activity categorization/classification) with associated IP addresses are provided. In some embodiments, a policy control agent (not shown), service monitor agent 1696 (e.g., charging agent), or another agent or function (or combinations thereof) of the service processor 115 provides a DAS activity map. In some embodiments, a policy control agent (not shown), service monitor agent, or another agent or function (or combinations thereof) of the service processor provides an activity map for classifying or categorizing service usage activities to associate various monitored activities (e.g., by Uniform Resource Locator (URL), by network domain, by website, by network traffic type, by socket (such as by IP address, protocol, and/or port), by socket id (such as port address/number), by port number, by content type, by application or application type, and/or any other service usage activity classification/categorization) with associated IP addresses and/or other criteria/measures. In some embodiments, a policy control agent, service monitor agent, or another agent or function (or combinations thereof) of the service processor determines the associated IP addresses for monitored service usage activities using various techniques to snoop the DNS request(s) (e.g., by performing such snooping techniques on the device 100 the associated IP addresses can be determined without the need for a network request for a reverse DNS lookup). In some embodiments, a policy control agent, service monitor agent, or another agent or function (or combinations thereof) of the service processor records and reports IP addresses or includes a DNS lookup function to report IP addresses or IP addresses and associated URLs for monitored service usage activities. For example, a policy control agent,

service monitor agent, or another agent or function (or combinations thereof) of the service processor can determine the associated IP addresses for monitored service usage activities using various techniques to perform a DNS lookup function (e.g., using a local DNS cache on the monitored device 100). In some embodiments, one or more of these techniques are used to dynamically build and maintain a DAS activity map that maps, for example, URLs to IP addresses, applications to IP addresses, content types to IP addresses, and/or any other categorization/classification to IP addresses as applicable. In some embodiments, the DAS activity map is used for various DAS traffic control and/or throttling techniques as described herein with respect to various embodiments for providing QoS for DAS and/or for providing DAS for protecting network capacity. In some embodiments, the DAS activity map is used to provide the user various UI related information and notification techniques related to service usage as described herein with respect to various embodiments. In some embodiments, the DAS activity map is used to provide service usage monitoring, prediction/estimation of future service usage, service usage billing (e.g., bill by account and/or any other service usage/billing categorization techniques), DAS techniques for ambient services usage monitoring, DAS techniques for generating micro-CDRs, and/or any of the various other DAS related techniques as described herein with respect to various embodiments.

[00173] In some embodiments, all or a portion of the service processor 115 functions disclosed herein are implemented in software. In some embodiments, all or a portion of the service processor 115 functions are implemented in hardware. In some embodiments, all or substantially all of the service processor 115 functionality (e.g., as discussed herein) is implemented and stored in software that can be performed on (e.g., executed by) various components in device 100. In some embodiments, it is advantageous to store or implement certain portions or all of service processor 115 in protected or secure memory so that other undesired programs (e.g., and/or unauthorized users) have difficulty accessing the functions or software in service processor 115. In some embodiments, service processor 115, at least in part, is implemented in and/or stored on secure non-volatile memory (e.g., non volatile memory can be secure non-volatile memory) that is not accessible without pass keys and/or other security mechanisms (e.g., security credentials). In some embodiments, the ability to load at least a portion of service processor 115 software into protected non-volatile memory also requires a secure key and/or signature and/or requires that the service processor 115 software components

being loaded into non-volatile memory are also securely encrypted and appropriately signed by an authority that is trusted by a secure software downloader function, such as service downloader 1663 as shown in FIG. 3. In some embodiments, a secure software download embodiment also uses a secure non-volatile memory. Those of ordinary skill in the art will also appreciate that all memory can be on-chip, off-chip, on-board, and/or off-board.

[00174] FIGS. 4A through 4C illustrates a functional diagram for providing quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, QoS for DAS techniques described herein are implemented using the network architecture shown in FIGS. 4A through 4C.

[00175] Referring to FIG. 4A, in some embodiments, QoS functionality is performed at the communications device 100 using service processor 115 as similarly described herein. For example, the service processor 115 determines whether or not a QoS request is authorized (e.g., based on the associated service plan and/or other criteria/measures). If the QoS request is authorized, then the service processor 115 communicates with the base station (BTS) 125 to send the QoS request (e.g., a RAB or multi-RAB reservation request) to the local BTS. The BTS determines whether to accept or deny the QoS request (e.g., based on network capacity, such as using a first come first service QoS/network bandwidth or best effort access policy or other techniques, and/or other criteria/measures). The BTS responds to the QoS request accordingly. If the QoS request is granted, the QoS session can be initiated as similarly described herein. In some embodiments, the service processor 115 also performs various QoS charging functions using various techniques described herein, and the service processor 115 periodically sends QoS charging records or reports to the service controller 122 (e.g., and/or another network element/function). In some embodiments, the service processor 115 and the QoS related functions performed by the service processor 115 are periodically verified using the various techniques described herein.

[00176] Referring to FIG. 4B, FIG. 4B is similar to FIG. 4A except that the service controller 122 is also shown to be in communication with the service processor 115 of the communications device 100, which can provide for the download and periodically updating of the QoS rules and/or other service plan/profile/policy information that can include QoS related information. In some embodiments, the service processor 115 also performs various QoS

charging functions using various techniques described herein, and the service processor 115 periodically sends QoS charging records or reports to the service controller 122 (e.g., and/or another network element/function). In some embodiments, the service processor 115 and the QoS related functions performed by the service processor 115 are periodically verified using the various techniques described herein.

[00177] Referring to FIG. 4C, at 410, the service processor 115 sends a QoS request to the service controller 122 (e.g., the service processor can also (at least in part) determine whether the QoS request is authorized as similarly described with respect to FIG. 4A). At 420, the service controller 122 sends the QoS request to the BTS 125 if it is determined that the QoS request is authorized using various techniques described herein and/or whether the BTS 125 has network capacity for the QoS request. For example, the service controller can provide a central policy decision point function for QoS related activities (e.g., based on QoS prioritization, network capacity, and/or other criteria/measures/policies). At 430, the service controller 122 communicates the response to the QoS request accordingly. At 440, if the QoS request was approved, the device 100 initiates the QoS session (e.g., using a RAB or multi-RAB reservation) via the BTS 125. In some embodiments, the service processor 115 also performs various QoS charging functions using various techniques described herein, and the service processor 115 periodically sends QoS charging records or reports to the service controller 122 (e.g., and/or another network element/function). In some embodiments, the service processor 115 and the QoS related functions performed by the service processor 115 are periodically verified using the various techniques described herein.

[00178] In some embodiments, QoS techniques as described herein are implemented in the device (e.g., using the service processor 115) and one or more other network elements/functions, such as the BTS 125, service controller 125, RAN, SGSN/GGSN/other gateways and/or other network elements/functions, in which various of the QoS related functions can be distributed or allocated to such network elements/functions based on various design/network architecture approaches as will now be apparent to one of ordinary skill in the art, in which QoS related activities and/or functions at the device 100 are verified using various verification techniques described herein.

[00179] In some embodiments, the device determines QoS availability by directly querying QoS link reservation equipment in the network (e.g., an access point, such as the BTS 125). In some embodiments, the device determines QoS availability based on an intermediate network function that coordinates QoS requests with one or more network QoS link resources. In some embodiments, the device requests a QoS reservation in advance of QoS link establishment with one or more QoS network link resources. In some embodiments, in response to a QoS request, a QoS channel is reported as available only if/after it is determined that the necessary one or more QoS links required to create the QoS channel are available, and, for example, the QoS channel can then be reserved based on a confirmation or automatically be reserved in response to the QoS request.

[00180] FIG. 5 illustrates a functional diagram for generating a QoS activity map for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In particular, FIG. 5 illustrates techniques for mapping a service plan or a set of service plan policies/rules for QoS 510 to a set of QoS activity rules 530. As shown, a set of QoS rules/QoS related device state information 510 (e.g., a set of associated service plan, service plan usage, other state such as network capacity or forecasted demand or time of day/day of week, activity usage, QoS level, and/or user preferences) is mapped using a QoS mapping function to a set of QoS activity rules 530 using various techniques described herein. At 530, activity rules (e.g., activity policy rules instructions) 530 are determined using the mapping function 520. In some embodiments, DAS for network capacity controlled services techniques can similarly be implemented using the techniques described with respect to FIG. 5 (e.g., for generating and implementing a network capacity controlled services activity map).

[00181] In some embodiments, the service plan includes a list of activity policies, and each activity policy in the service plan specifies how the activity policy is modified by rules state information. In some embodiments, each activity policy then becomes the instruction for the engine (e.g., QoS mapping function 520) that maps the activity policy to QoS activity rules 530. In some embodiments, service controller 122 downloads QoS mapping function 520, which is implemented by service processor 115.

[00182] In some embodiments, the service processor determines (e.g., and classifies) application/service usage activity demand with or without granular application/service usage

activity (e.g., depending on various user/service plan/service provider/network/legal and/or other privacy restrictions and/or any other related requirements or settings). For example, policies (e.g., service policy settings and/or service profile settings) can be downloaded to provide such application/service usage activity monitoring rules and a QoS activity map for assigning such monitored activities to various QoS classes or priorities, and, in some embodiments, such monitoring and the QoS activity map can also be implemented using various verification techniques described herein (e.g., periodically audited, tested, compared with network service usage information). In some embodiments, the QoS activity map is based on a service plan, service profile, and/or service policy settings associated with the communications device. In some embodiments, the QoS activity map is based on a device group and/or user group. In some embodiments, the QoS activity map is based on user input (e.g., a user of the communications device can identify QoS classes/service levels for various applications and/or service activities, in response to requests for user input, based on user configurations, user defined rules (e.g., to eliminate or mitigate privacy and/or net neutrality concerns/issues), and/or confirmed monitored user behavior QoS related patterns or preferences). In some embodiments, the QoS activity map includes mappings/associations based on one or more of the following: a user preference for a given destination, destination class, application, application class (e.g., by application class instead of with respect to a specific application can also eliminate or mitigate privacy and/or net neutrality concerns/issues), flow, traffic or flow class, time period, time of day, location, network busy state (e.g., provide QoS when you can, then charge more when busy, notify user of busy state), device type, user type, user plan, user group, user standing, partner service, tokens, service type, and/or other criteria or measures.

[00183] In some embodiments, various techniques described herein are managed for device 100 for incoming and/or outgoing QoS requests. In some embodiments, as shown in FIG. 6, QoS for DAS includes establishing an end to end coordinated QoS service channel control.

[00184] FIG. 6 illustrates a functional diagram for quality of service (QoS) for device assisted services for an end to end coordinated QoS service channel control in accordance with some embodiments. As shown in FIG. 6, a wireless communications device 100A includes a service processor 115A in secure communication with service controller 122A. A wireless communications device 100B includes a service processor 115B in secure communication with service controller 122B. In some embodiments, when, for example, device 100A initiates a QoS

request for a QoS class session in communication with device 100B (e.g., a VOIP call or another application service requiring or possibly using a QoS class/level session, such as a conversational or other QoS type of class/level), as sequence of actions are performed using service controller 122A and service controller 122B to facilitate/setup an end to end coordinated QoS service channel control. In some embodiments, as similarly described herein, assuming that service processor 115A and service controller 122A determine that the QoS request from device 100A is authorized for that device, then the service controller 122A contacts registry 650 (e.g., a device registry, such as an HLR, mobile services center, or other central database or registry including, for example, service controller mappings by device/IP address/other) to determine the service controller associated with/responsible for managing QoS/service control for device 100B. The registry 650 provides the service controller 122B information (e.g., IP address/other address) based on this lookup determination. In some embodiments, service controller 122A then initiates the QoS request with service controller 122B to determine if the device 100B is authorized and/or available for the QoS session requested by device 100A. In some embodiments, service controllers 122A/B communicate with BTSs 125A/B to determine whether the QoS request can be facilitated (e.g., based on network capacity) as similarly described herein. In some embodiments, the service controllers 122A and 122B provide the central QoS coordination function and can request appropriate QoS channels directly from the respective local BTSs. In some embodiments, the service controllers 122A and 122B also communicate with one or more of the following network elements/functions as shown in FIG. 6 in order to facilitate an end to end coordinated QoS service channel control: RAN 610/670, Core Network 620/660, and IPX network 630. In some embodiments, service controllers 122A and 122B communicate with various necessary network elements for provisioning to facilitate session provisioning through the carrier core network as similarly discussed above. In some embodiments, service controllers 122A and 122B communicate with various necessary network elements for provisioning to facilitate session provisioning through the IPX network as similarly discussed above. As will be apparent to one of ordinary skill in the art, QoS for DAS techniques as described herein can be similarly implemented using these or similar techniques to various other network architectures.

[00185] FIG. 7 illustrates a flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. At 702, the process begins. At 704, QoS rules are received or determined (e.g., a service processor receives or requests the QoS

rules, which may be included in service plan, service profile, and/or service policy settings associated with the communications device). In some embodiments, the QoS rules are verified using various techniques as described herein (e.g., periodically updated, replaced, downloaded, obfuscated, and/or tested using by a service controller and/or using other verification techniques). In some embodiments, a QoS API is also used by various applications to initiate a QoS request, as described herein with respect to various embodiments. In some embodiments, the QoS rules are implemented in the form of a QoS activity map in accordance with various embodiments described herein. At 706, the communications device's standing for QoS is determined using various techniques described herein (e.g., based on the service plan, service profile, service policy settings, QoS rules, based on QoS class, current service usage, current billing standing, and/or any other criteria/measure). In some embodiments, in addition to verifying the device/user standing for the QoS request, whether the device is following or in compliance with an assigned QoS reservation request policy is also verified using various techniques described herein. If the device is determined to not be eligible for QoS, then at 708, the device User Interface (UI) provides information concerning the denial/ineligibility for QoS session(s) (e.g., denial/ineligibility explanation and/or options for providing for one or more QoS options, such as a service plan upgrade or payment for a certain/set of/period of time for QoS session(s) access). If the device is determined to be eligible for QoS, then at 710, QoS availability is determined (e.g., based on network capacity, which may be determined at the device, via communication with the service controller, via communication with the BTS, and/or any combination thereof, using the various techniques described herein). If QoS is determined to not be available, then at 712, the UI provides information and/or options concerning the QoS availability (e.g., unavailability explanation and/or options for providing for one or more QoS options, such as a service plan upgrade or payment for a certain/set of/period of time for QoS session(s) access). If QoS is determined to be available, then at 714, a request for network resources for the QoS session is sent to one or more network resources (e.g., service controller, BTS, gateway, core/transport network, IPX/GRX networks, and/or other network elements/functions/resources). At 716, a confirmation of the approved QoS session is received to close the loop for the QoS for DAS (e.g., a QoS schedule is received that provides the QoS session confirmation information, such as a scheduled RAB/multi-RAB and/or other reserved network resource(s) by schedule/other criteria). At 718, one or more verification techniques are

performed to verify the QoS for DAS implementation on the device using various verification techniques described herein (e.g., comparing QoS service usage reports from a network source with the associated device policy; comparing QoS service usage reports from a network source with the QoS service usage reports from the device, and/or using other verification techniques as similarly described herein). At 720, the process is completed.

[00186] FIGS. 8A through 8C each illustrate another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. FIG. 8A illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. At 802, the process begins. In some embodiments, the QoS policies are implemented on the device (e.g., service processor collects/receives an associated service plan that defines/specifies basic policies for QoS, which can include a QoS activity map, which, for example, maps QoS classes based on application, service usage, flow type, destination, time of day, network capacity, and/or other criteria/measures, as similarly described herein). In some embodiments, a QoS API is also used by various applications to initiate a QoS request, as described herein with respect to various embodiments. In some embodiments, the QoS rules are implemented in the form of a verified QoS activity map in accordance with various embodiments described herein. At 804, a QoS request is determined (e.g., by QoS class for a particular associated service/application). In some embodiments, the QoS request is determined at least in part by using the QoS activity map using various techniques described herein, for example, based on service/application usage monitoring on the device (e.g., by the service processor service usage monitoring agent). In some embodiments, the QoS request is determined based on the QoS API. In some embodiments, the QoS request is determined to be associated with an outgoing connection or an incoming connection. At 806, whether the QoS request is authorized is determined (e.g., whether the QoS request supported by the service plan, sufficient charging credit exists for this QoS request, and/or other criteria/measures). If not, then at 808, the UI provides a responsive notification and/or option as similarly described herein. If the QoS request is approved, then at 810, a request for network resources for the QoS session is sent to one or more network resources (e.g., service controller, BTS, gateway, core/transport network, IPX/GRX networks, a/another service controller in communication with another communications device such as for setting up a conversational class QoS connection with the other communications device, and/or other network

elements/functions/resources). If the device is determined to be eligible for QoS, then at 810, QoS availability is determined (e.g., based on network capacity, which may be determined at the device, via communication with the service controller, via communication with the BTS or another network element/function, and/or any combination thereof, using the various techniques described herein). If QoS is determined to not be available, then at 812, the UI provides information and/or options concerning the QoS availability (e.g., unavailability explanation and/or options for providing for one or more QoS options, such as a service plan upgrade or payment for a certain/set of/period of time for QoS session(s) access). If QoS is determined to be available, then at 814, a request for network resources for the QoS session is sent to one or more network resources (e.g., service controller, BTS, gateway, core/transport network, IPX/GRX networks, and/or other network elements/functions/resources, to setup, for example, a QoS end to end connection – coordinate all resources end to end for the approved and verified QoS flow). At 816, a confirmation of the approved QoS session is received to close the loop for the QoS for DAS (e.g., a QoS schedule is received that provides the QoS session confirmation information, such as a scheduled RAB/multi-RAB and/or other reserved network resource(s) by schedule/other criteria). At 818, a QoS router is executed/performed on the communications device to assist in implementing QoS for DAS using various verification techniques described herein (e.g., to perform QoS queuing, throttling, and/or other QoS router related functions as described herein). At 820, verified QoS charging is performed (e.g., at least in part) on the device using various techniques described herein (e.g., using the service processor, such as the charging/service usage monitoring and/or other agents as described herein). In some embodiments, QoS charging records and/or reports are provided to one or more network elements for managing QoS billing and/or other QoS management/billing related service control functions (e.g., to the service controller and/or the billing interface or billing server). In some embodiments, QoS for DAS also facilitates reestablishing the QoS session/connection/channel/stream if the QoS session/connection/channel/stream is lost or goes down, using similar techniques to those described herein as would be apparent to one of ordinary skill in the art. At 822, the process is completed. In some embodiments, the QoS provisioning channel is closed when the device session is over to, for example, free up various resources.

[00187] FIG. 8B illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, QoS for

DAS includes identifying the QoS requirements (e.g., QoS level or QoS class) for a service activity. At 824, the process begins. In some embodiments, the QoS policies are implemented on the device (e.g., service processor collects/receives an associated service plan that defines/specifies basic policies for QoS, which can include a QoS activity map, which, for example, maps QoS classes based on application, service usage, flow type, destination, time of day, network capacity, and/or other criteria/measures, as similarly described herein). In some embodiments, the QoS rules are implemented in the form of a verified QoS activity map in accordance with various embodiments described herein. At 826, the device monitors device activity, such as service/application usage activities. In some embodiments, the device detects the relevant activities based on various service usage monitoring techniques described herein. At 828, a QoS request is determined, for example, using various techniques described herein. At 830, a QoS level is determined based on the application and/or various device monitored service usage/application activities associated with the QoS request using various techniques described herein. For example, the QoS level can be determined using the QoS activity map, which provides a QoS policy defined by a table associating various QoS levels with a variety of activities that include various device monitored service usage/application activities. In some embodiments, the QoS activity map includes QoS level mappings based on one or more of the following: application, destination/source, traffic type, connection type, content type, time of day/day of week, network capacity, activity usage, service plan selection, current standing, user class, device class, home/roaming, network capabilities, and/or other criteria/measures as similarly described herein. In some embodiments, at 832, if the QoS level cannot be determined and/or in order to confirm a QoS level or selection among multiple potential appropriate/approved QoS levels, the UI presents options for a user to select the QoS level. At 834, the QoS request is initiated for the determined QoS level (e.g., QoS class and/or priorities). At 836, the process is completed.

[00188] FIG. 8C illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, QoS for DAS includes determining whether the network should grant the QoS request for a given device activity. At 842, the process begins. At 844, QoS request is determined. At 846, the communications device's standing for QoS is determined using various techniques described herein (e.g., a service processor in combination with a service controller or based on a

communication for authorization of the QoS request sent to the service controller determines whether the QoS request is authorized, which can be based on the service plan, service profile, service policy settings, QoS rules, based on QoS class, current service usage, current billing standing, and/or any other criteria/measure). If the device is determined to not be eligible for QoS, then at 848, the device User Interface (UI) provides information concerning the denial/ineligibility for QoS session(s) (e.g., denial/ineligibility explanation and/or options for providing for one or more QoS options, such as a service plan upgrade or payment for a certain/set of/period of time for QoS session(s) access). If the device is determined to be eligible for QoS, then at 850, QoS availability is determined (e.g., based on network capacity, which may be determined at the device, via communication with the service controller, via communication with the BTS or another network element/function, and/or any combination thereof, using the various techniques described herein). If QoS is determined to not be available, then at 852, the UI provides information and/or options concerning the QoS availability (e.g., unavailability explanation and/or options for providing for one or more QoS options, such as a service plan upgrade or payment for a certain/set of/period of time for QoS session(s) access). If QoS is determined to be available, then at 854, a request for network resources for the QoS session is sent to one or more network resources (e.g., service controller, BTS, gateway, core/transport network, IPX/GRX networks, and/or other network elements/functions/resources can be queried directly and/or a centralized QoS resource/network function/element/database can be queried for determining such network resources and coordinating such scheduling). At 856, a confirmation of the approved QoS session is received to close the loop for the QoS for DAS (e.g., a QoS schedule is received that provides the QoS session confirmation information, such as a scheduled RAB/multi-RAB and/or other reserved network resource(s) by schedule/other criteria). At 858, a QoS router is performed. In some embodiments, the QoS router is performed on the device (e.g., service processor), on a network element/function (e.g., service controller), and/or in combinations thereof. In some embodiments, the QoS router prioritizes multiple QoS requests across a given communications device. In some embodiments, the QoS router prioritizes multiple QoS requests across multiple communications devices and/or across multiple BTSs. In some embodiments, the QoS router performs various QoS class degradation, promotion, and/or other throttling related techniques as similarly described herein (e.g., based on session priority,

network capacity, workload balancing, QoS priority rules, and/or other criteria/measures/rules). At 860, the process is completed.

[00189] FIG. 9 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, QoS for DAS includes QoS session provision for a service activity. At 902, the process begins. At 904, a new QoS session is granted and/or confirmed. At 906, a device service processor (e.g., policy decision point (PDP) agent, also referred to herein as a policy control agent) maps the QoS session grant to a QoS monitoring policy (e.g., based on a service controller provided QoS related policy, based on a service plan associated with the device, user, device/user group, and/or other criteria/measures, as similarly described herein). At 908, the QoS monitoring policy provides commands/instructions to a policy enforcement point (PEP) (e.g., PEP agent, also referred to herein as a policy implementation agent) for managing/enforcing the new QoS priorities/sessions. At 910, the PEP determines whether to allow, block, throttle, and/or queue priority (e.g., and/or otherwise control using various traffic control related techniques) a session based on the QoS monitoring policy. At 912, the process is completed.

[00190] FIG. 10 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, Radio Access Bearer (RAB) support is available, and the following process is performed in accordance with some embodiments. At 1002, the process begins. At 1004, the device service processor detects a QoS request or QoS need (e.g., a QoS API request, a QoS request or need/benefit of QoS session based on service usage monitoring, such as by application and/or another service usage measure/activity). At 1006, the service processor and/or the service processor in communication with the service controller determines if the service plan allows/supports the requested QoS. If not, then at 1008, a UI event is generated (e.g., notifying the device user that such QoS/QoS level/class is not available, and potentially offering a QoS/service plan upgrade/purchase for that QoS/QoS level/class). At 1010, the service processor communicates the QoS request to the service controller (e.g., using a secure service control link or secure communication channel, as similarly described herein) to request the QoS level/class. At 1012, the service controller determines whether network resources are available using various techniques as described herein. In some embodiments, network capacity is determined using various techniques, such as local device measurements; dedicated local device measurement

reports; BTS reports; other network element reports; by assessing, for example, a combination of one or more of available bandwidth, traffic delay or latency, available QoS level, variability in available bandwidth, variability in latency, and/or variability in available QoS level; and/or other techniques as described herein. At 1014, the service controller responds to the QoS request (e.g., grants or denies the QoS request). In some embodiments, another UI event is generated if the QoS request is denied as similarly described herein. At 1016 (assuming the QoS request is granted), the device requests a QoS channel from the BTS. In some embodiments, the request includes a QoS request authorization code received from the service controller. In some embodiments, the service controller provides a notification of the QoS request approval for the communications device to the BTS, so that the BTS can verify the approval of the QoS request. In some embodiments, the BTS confirms the device QoS channel request directly with the service controller. For example, various other techniques for verifying the QoS channel request can also be used as similarly described herein and as would be apparent to one of ordinary skill in the art. In some embodiments, the device service processor and/or service controller provides QoS related reports informing the BTS of how many QoS channels (e.g., RABs) to provision and how many best effort resources to provision based on device demand projections. At 1018 (assuming the QoS channel request is verified), the QoS session is initiated based on an allocated RAB or multi-RAB reservation received from the BTS (e.g., and/or other network elements as similarly described herein). At 1020, the process is completed.

[00191] FIG. 11 illustrates another flow diagram for quality of service (QoS) for device assisted services (DAS) in accordance with some embodiments. In some embodiments, RAB support is not available, and the following process is performed in accordance with some embodiments. At 1102, the process begins. At 1104, the device service processor detects a QoS request or QoS need (e.g., a QoS API request, a QoS request or need/benefit of QoS session based on service usage monitoring, such as by application, or other service usage measure/activity). At 1106, the service processor and/or the service processor in communication with the service controller determines if the service plan allows/supports the requested QoS. If not, then at 1108, a UI event is generated (e.g., notifying the device user that such QoS/QoS level/class is not available, and potentially offering a QoS/service plan upgrade/purchase for that QoS/QoS level/class). At 1110, the service processor communicates the QoS request to the service controller (e.g., using a secure service control link or secure communication channel, as

similarly described herein) to request the QoS level/class. At 1112, the service controller determines whether network resources are available using various techniques as described herein. In some embodiments, network capacity is determined using various techniques, such as local device measurements, BTS reports, other network element reports, and/or other techniques as described herein. In some embodiments, the service controller throttles other devices on the link so that the requested QoS level can be achieved (e.g., as RAB support is not available). In some embodiments, the service controller time slots traffic from the device end in synchronization with a BTS clock or absolute clock to facilitate the requested QoS level and to achieve necessary network capacity to support/facilitate the requested QoS level (e.g., minimizing jitter/inter-packet delay variation) based on current/forecasted network capacity on the link. At 1114, the service controller responds to the QoS request (e.g., grants or denies the QoS request). In some embodiments, another UI event is generated if the QoS request is denied as similarly described herein. At 1116 (assuming the QoS request is granted), the device initiates the QoS session. At 1118, the device service processor and/or the device service processor in secure communication with the service controller monitors and verifies the QoS session using various monitoring and verification techniques described herein (e.g., checks CDRs to determine if the QoS channel is properly implemented by the device). In some embodiments, a UI event is generated to notify the device user if there are potential problems with the QoS session implementation, to periodically inform the user of QoS charging, and/or other events/information related to QoS activities. At 1120, the process is completed.

[00192] FIG. 12 illustrates a device stack for providing various service usage measurement techniques in accordance with some embodiments. FIG. 12 illustrates a device stack providing various service usage measurement from various points in the networking stack for a service monitor agent (e.g., for monitoring QoS related activities and/or for monitoring network capacity controlled services as described herein), a billing agent, and an access control integrity agent to assist in verifying the service usage measures, QoS related activities and functions, and billing reports in accordance with some embodiments. As shown in FIG. 12, several service agents take part in data path operations to achieve various data path improvements, and, for example, several other service agents can manage the policy settings for the data path service, implement billing for the data path service, manage one or more modem selection and settings for access network connection, interface with the user and/or provide

service policy implementation verification. Additionally, in some embodiments, several agents perform functions to assist in verifying that the service control or monitoring policies intended to be in place are properly implemented, the service control or monitoring policies are being properly adhered to, that the service processor or one or more service agents are operating properly, to prevent unintended errors in policy implementation or control, and/or to prevent/detect tampering with the service policies or control. As shown, the service measurement points labeled I through VI represent various service measurement points for service monitor agent 1696 and/or other agents to perform various service monitoring activities. Each of these measurement points can have a useful purpose in various embodiments described herein. For example, each of the traffic measurement points that is employed in a given design can be used by a monitoring agent to track application layer traffic through the communication stack to assist policy implementation functions, such as the policy implementation driver/agent 1690 (e.g., policy enforcement point driver/agent), or in some embodiments the modem firewall agent 1655 or the application interface agent, in making a determination regarding the traffic parameters or type once the traffic is farther down in the communication stack where it is sometimes difficult or impossible to make a complete determination of traffic parameters. The particular locations for the measurement points provided in these figures are intended as instructional examples, and other measurement points can be used for different embodiments, as will be apparent to one of ordinary skill in the art in view of the embodiments described herein. Generally, in some embodiments, one or more measurement points within the device can be used to assist in service control verification and/or device or service troubleshooting.

[00193] In some embodiments, the service monitor agent and/or other agents implement virtual traffic tagging by tracking or tracing packet flows through the various communication stack formatting, processing and encryption steps, and providing the virtual tag information to the various agents that monitor, control, shape, throttle or otherwise observe, manipulate or modify the traffic. This tagging approach is referred to herein as virtual tagging, because there is not a literal data flow, traffic flow or packet tag that is attached to flows or packets, and the book-keeping to tag the packet is done through tracking or tracing the flow or packet through the stack instead. In some embodiments, the application interface and/or other agents identify a traffic flow, associate it with a service usage activity and cause a literal tag to be attached to the traffic or packets associated with the activity. This tagging approach is referred to herein as

literal tagging. There are various advantages with both the virtual tagging and the literal tagging approaches. For example, it can be preferable in some embodiments to reduce the inter-agent communication required to track or trace a packet through the stack processing by assigning a literal tag so that each flow or packet has its own activity association embedded in the data. As another example, it can be preferable in some embodiments to re-use portions of standard communication stack software or components, enhancing the verifiable traffic control or service control capabilities of the standard stack by inserting additional processing steps associated with the various service agents and monitoring points rather than re-writing the entire stack to correctly process literal tagging information, and in such cases, a virtual tagging scheme may be desired. As yet another example, some standard communication stacks provide for unused, unspecified or otherwise available bit fields in a packet frame or flow, and these unused, unspecified or otherwise available bit fields can be used to literally tag traffic without the need to re-write all of the standard communication stack software, with only the portions of the stack that are added to enhance the verifiable traffic control or service control capabilities of the standard stack needing to decode and use the literal tagging information encapsulated in the available bit fields. In the case of literal tagging, in some embodiments, the tags are removed prior to passing the packets or flows to the network or to the applications utilizing the stack. In some embodiments, the manner in which the virtual or literal tagging is implemented can be developed into a communication standard specification so that various device or service product developers can independently develop the communication stack and/or service processor hardware and/or software in a manner that is compatible with the service controller specifications and the products of other device or service product developers.

[00194] It will be appreciated that although the implementation/use of any or all of the measurement points illustrated in FIG. 12 is not required to have an effective implementation, such as was similarly shown with respect to various embodiments described herein, various embodiments can benefit from these and/or similar measurement points. It will also be appreciated that the exact measurement points can be moved to different locations in the traffic processing stack, just as the various embodiments described herein can have the agents affecting policy implementation moved to different points in the traffic processing stack while still maintaining effective operation. In some embodiments, one or more measurement points are provided deeper in the modem stack where, for example, it is more difficult to circumvent and

can be more difficult to access for tampering purposes if the modem is designed with the proper software and/or hardware security to protect the integrity of the modem stack and measurement point(s).

[00195] Referring to FIG. 12, describing the device communications stack from the bottom to the top of the stack as shown, the device communications stack provides a communication layer for each of the modems of the device at the bottom of the device communications stack. Example measurement point VI resides within or just above the modem driver layer. For example, the modem driver performs modem bus communications, data protocol translations, modem control and configuration to interface the networking stack traffic to the modem. As shown, measurement point VI is common to all modem drivers and modems, and it is advantageous for certain embodiments to differentiate the traffic or service activity taking place through one modem from that of one or more of the other modems. In some embodiments, measurement point VI, or another measurement point, is located over, within or below one or more of the individual modem drivers. The respective modem buses for each modem reside between example measurement points V and VI. In the next higher layer, a modem selection & control layer for multimode device based communication is provided. In some embodiments, this layer is controlled by a network decision policy that selects the most desirable network modem for some or all of the data traffic, and when the most desirable network is not available the policy reverts to the next most desirable network until a connection is established provided that one of the networks is available. In some embodiments, certain network traffic, such as verification, control, redundant or secure traffic, is routed to one of the networks even when some or all of the data traffic is routed to another network. This dual routing capability provides for a variety of enhanced security, enhanced reliability or enhanced manageability devices, services or applications. In the next higher layer, a modem firewall is provided. For example, the modem firewall provides for traditional firewall functions, but unlike traditional firewalls, in order to rely on the firewall for verifiable service usage control, such as access control and security protection from unwanted networking traffic or applications, the various service verification techniques and agents described herein are added to the firewall function to verify compliance with service policy and prevent/detect tampering of the service controls. In some embodiments, the modem firewall is implemented farther up the stack, possibly in combination with other layers as indicated in other figures and described herein. In

some embodiments, a dedicated firewall function or layer is provided that is independent of the other processing layers, such as the policy implementation layer, the packet forwarding layer and/or the application layer. In some embodiments, the modem firewall is implemented farther down the stack, such as within the modem drivers, below the modem drivers, or in the modem itself. Example measurement point IV resides between the modem firewall layer and an IP queuing and routing layer (e.g., QoS IP queuing and routing layer and/or a network capacity controlled services queuing and routing layer). As shown, an IP queuing and routing layer is separate from the policy implementation layer where the policy implementation agent implements a portion of the traffic control and/or service usage control policies. As described herein, in some embodiments, these functions are separated so that a standard network stack function can be used for QoS IP queuing and routing and/or for network capacity controlled services queuing and routing, and the modifications necessary to implement the policy implementation agent functions can be provided in a new layer inserted into the standard stack. In some embodiments, the IP queuing and routing layer is combined with the traffic or service usage control layer. For example, a combined routing and policy implementation layer embodiment can also be used with the other embodiments, such as shown in FIG. 12. Measurement point III resides between the IP queuing and routing layer and a policy implementation agent layer. Measurement point II resides between the policy implementation agent layer and the transport layer, including TCP, UDP, and other IP as shown. The session layer resides above the transport layer, which is shown as a socket assignment and session management (e.g., basic TCP setup, TLS/SSL) layer. The network services API (e.g., HTTP, HTTPS, FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), POP3, DNS) resides above the session layer. Measurement point I resides between the network services API layer and an application layer, shown as application service interface agent in the device communications stack of FIG. 12.

[00196] As shown in FIG. 12, the application service interface layer (e.g., QoS application service interface layer and/or network capacity controlled services interface layer) is above the standard networking stack API and, in some embodiments, its function is to monitor and in some cases intercept and process the traffic between the applications and the standard networking stack API. In some embodiments, the application service interface layer identifies application traffic flows before the application traffic flows are more difficult or practically impossible to

identify farther down in the stack. In some embodiments, the application service interface layer in this way assists application layer tagging in both the virtual and literal tagging cases. In the case of upstream traffic, the application layer tagging is straight forward, because the traffic originates at the application layer. In some downstream embodiments, where the traffic or service activity classification relies on traffic attributes that are readily obtainable, such as source address or URL, application socket address, IP destination address, time of day or any other readily obtained parameter, the traffic type can be identified and tagged for processing by the firewall agent or another agent as it initially arrives. In other embodiments, as described herein, in the downstream case, the solution is generally more sophisticated when a traffic parameter that is needed to classify the manner in which the traffic flow is to be controlled or throttled is not readily available at the lower levels of the stack, such as association with an aspect of an application, type of content, something contained within TLS, IPSEC or other secure format, or other information associated with the traffic. Accordingly, in some embodiments the networking stack identifies the traffic flow before it is fully characterized, categorized or associated with a service activity, and then passes the traffic through to the application interface layer where the final classification is completed. In such embodiments, the application interface layer then communicates the traffic flow ID with the proper classification so that after an initial short traffic burst or time period the policy implementation agents can properly control the traffic. In some embodiments, there is also a policy for tagging and setting service control policies for traffic that cannot be fully identified with all sources of tagging including application layer tagging.

[00197] As shown in FIG. 12, a service monitor agent, which is also in communication with the agent communication bus 1630, communicates with various layers of the device communications stack. For example, the service monitor agent, performs monitoring at each of measurement points I through VI, receiving information including application information, service usage and other service related information, and assignment information. An access control integrity agent is in communication with the service monitor agent via the agent communications bus 1630, as also shown.

[00198] FIG. 13 illustrates another device stack for providing various service usage measurement techniques in accordance with some embodiments. FIG. 13 illustrates an embodiment similar to FIG. 12 in which some of the service processor is implemented on the modem and some of the service processor is implemented on the device application processor in

accordance with some embodiments. In some embodiments, a portion of the service processor is implemented on the modem (e.g., on modem module hardware or modem chipset) and a portion of the service processor is implemented on the device application processor subsystem. It will be apparent to one of ordinary skill in the art that variations of the embodiment depicted in FIG. 13 are possible where more or less of the service processor functionality is moved onto the modem subsystem or onto the device application processor subsystem. For example, such embodiments similar to that depicted in FIG. 13 can be motivated by the advantages of including some or all of the service processor network communication stack processing and/or some or all of the other service agent functions on the modem subsystem (e.g., and such an approach can be applied to one or more modems). For example, the service processor can be distributed as a standard feature set contained in a modem chipset hardware of software package or modem module hardware or software package, and such a configuration can provide for easier adoption or development by device OEMs, a higher level of differentiation for the chipset or modem module manufacturer, higher levels of performance or service usage control implementation integrity or security, specification or interoperability standardization, and/or other benefits.

[00199] Referring to FIG. 13, describing the device communications stack from the bottom to the top of the stack as shown, the device communications stack provides a communication layer for modem MAC/PHY layer at the bottom of the device communications stack. Measurement point IV resides above the modem MAC/PHY layer. The modem firewall layer resides between measurement points IV and III. In the next higher layer, the policy implementation agent is provided, in which the policy implementation agent is implemented on the modem (e.g., on modem hardware). Measurement point II resides between the policy implementation agent and the modem driver layer, which is then shown below a modem bus layer. The next higher layer is shown as the IP queuing and routing layer, followed by the transport layer, including TCP, UDP, and other IP as shown. The session layer resides above the transport layer, which is shown as a socket assignment and session management (e.g., basic TCP setup, TLS/SSL) layer. The network services API (e.g., HTTP, HTTPS, FTP (File Transfer Protocol), SMTP (Simple Mail Transfer Protocol), POP3, DNS) resides above the session layer. Measurement point I resides between the network services API layer and an application layer, shown as application service interface agent in the device communications stack of FIG. 13.

[00200] Additional Embodiments of DAS for Protecting Network Capacity

[00201] In some embodiments, DAS for protecting network capacity includes classifying a service activity as a network capacity controlled service and implementing a network capacity controlled services policy. In some embodiments, DAS for protecting network capacity includes device assisted/based techniques for classifying a service activity as a network capacity controlled service and/or implementing a network capacity controlled services policy. In some embodiments, DAS for protecting network capacity includes network assisted/based techniques (e.g., implemented on a network element/function, such as a service controller, a DPI gateway, a BTS/BTSC, etc., or a combination of network elements) for classifying a service activity as a network capacity controlled service and/or implementing a network capacity controlled services policy. In some embodiments, DAS for protecting network capacity includes providing a network access API or an emulated or virtual network access API (e.g., such an API can provide network busy state information and/or other criteria/measures and/or provide a mechanism for allowing, denying, delaying, and/or otherwise controlling network access). In some embodiments, DAS for protecting network capacity includes implementing a service plan that includes a network capacity controlled services policy (e.g., for differential network access control and/or differential charging for network capacity controlled services, which can also be based on a network busy state and/or other criteria/measures).

[00202] In some embodiments, DAS for protecting network capacity techniques also provide improved user privacy and facilitate network neutrality requirements. In contrast, network based techniques (e.g., DPI based techniques) can give rise to user privacy and network neutrality concerns and problems as discussed above. In some embodiments, DAS for protecting network capacity techniques include allowing a user to specify (e.g., permit or not permit) whether the network is aware of the user's Internet behavior (e.g., using UI input). In some embodiments, DAS for protecting network capacity techniques include allowing a user to select how they want their traffic usage and service plan costs to be managed.

[00203] FIG. 14 illustrates a flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1402, the process begins. At 1404, monitoring a network service usage activity of a device in network communication (e.g., wireless network communication) is performed. At 1406, whether the monitored network service usage activity is a network capacity controlled service is determined. At 1408 (the monitored network service usage activity was determined not to be a network

capacity controlled service), the network service usage activity is not classified for differential network access control. At 1410, (the monitored network service usage activity was determined to be a network capacity controlled service), the network service usage activity is classified (e.g., into one or more network capacity controlled services) for differential network access control for protecting network capacity. In some embodiments, classifying the network service usage activity includes classifying the network service usage activity into one or more of a plurality of classification categories for differential network access control for protecting network capacity (e.g., one or more network capacity controlled service classifications and/or a priority state classification, such as a background services classification and/or a background priority state classification). At 1412, associating the network service usage activity with a network capacity controlled services control policy based on a classification of the network service usage activity to facilitate differential network access control for protecting network capacity is performed. At 1414, implementing differential network access control for protecting network capacity by implementing different traffic controls for all or some of the network service usage activities (e.g., based on a network busy state or another criteria/measure) is performed. At 1416, the process is completed.

[00204] FIG. 15 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1502, the process begins. At 1504, monitoring network service usage activities of a device in network communication is performed. At 1506, monitored network service usage activity of the device is reported (e.g., to a network element/function). At 1508, a statistical analysis of a reported network service usage activities across a plurality of devices is performed (e.g., by a network element/function). At 1510, the device receives a network service usage activity classification list (e.g., a network capacity controlled services list, which can be generated, for example, based on the monitored network service usage activities and the statistical analysis as well as other criteria/measures, including, for example, a service plan and/or a network busy state) from the network element. At 1512, implementing differential network access control based on the network service usage activity classification list for protecting network capacity is performed. At 1514, the process is completed. In some embodiments, DAS for protecting network capacity further includes associating the network service usage activity with a network service usage control policy (e.g., a network capacity controlled services policy) based on a classification of

the network service usage activity to facilitate differential network access control for protecting network capacity. In some embodiments, DAS for protecting network capacity further includes differentially controlling the network service usage activity (e.g., network capacity controlled service) based on the service usage activity classification list.

[00205] FIG. 16 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1622, the process begins. At 1624, a first report of network service usage activity of a first device is received (e.g., at a network element/function) from the first device. At 1626, a second report of network service usage activity of a second device (e.g., at a network element/function) from the second device is received. At 1628, a statistical analysis of a plurality of reported service usage activities across a plurality of devices, including the first device and the second device, is performed (e.g., by a network element/function). At 1630, a network service usage activity classification list (e.g., a network capacity controlled services classification list) is sent to the first device (e.g., from a network element/function) for classifying network service usage activities (e.g., network capacity controlled services) based on the network service usage activity classification list for differential network access control for protecting network capacity. At 1632, a network service usage activity classification list is sent to the second device (e.g., from a network element/function) for classifying network service usage activities based on the network service usage activity classification list for differential network access control for protecting network capacity. At 1634, the process is completed. In some embodiments, DAS for protecting network capacity further includes associating the network service usage activity with a service usage control policy (e.g., a network capacity controlled services policy) based on a classification of the network service usage activity to facilitate differential network access control for protecting network capacity. In some embodiments, DAS for protecting network capacity further includes differentially controlling the network service usage activity (e.g., network capacity controlled service) based on the service usage activity classification list (e.g., network capacity controlled services classification list). In some embodiments, classifying network service usage activities is based on which network to which the device is connected. In some embodiments, the network service usage control policy is based on which network to which the device is connected.

[00206] FIG. 17 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1702, the process

begins. At 1704, monitoring a network service usage activity of a plurality of devices in network communication using network based techniques is performed. At 1706, a statistical analysis of monitored network service usage activities across the plurality of devices is performed. At 1708, a network service usage activity classification list (e.g., a network capacity controlled services classification list) is sent to each of the plurality of devices for classifying network service usage activities (e.g., network capacity controlled services) based on the service usage activity classification list for differential network access control for protecting network capacity. At 1710, the process is completed.

[00207] FIG. 18 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1802, the process begins. At 1804, monitoring network service usage activities of a device in network communication is performed. At 1806, associating a network service usage activity (e.g., a network capacity controlled service) with a service usage control policy (e.g., a network capacity controlled services policy) based on a classification of the network service usage activity (e.g., a network capacity controlled services classification list) for differential network access control for protecting network capacity is performed. At 1808, a user notification based on the service usage control policy is generated. At 1810, the process is completed.

[00208] In some embodiments, the service usage control policy includes a service usage notification policy. In some embodiments, the user notification includes one or more of the following: a notification that the application to be downloaded and/or launched is a network capacity controlled service; a list of one or more service activities (e.g., applications, OS/other software functions/utilities, and/or other functions/utilities as described herein) that have a network capacity controlled services classification; type of service policy in effect for one or more network capacity controlled services; notification that a service activity belongs to a network capacity controlled services class; notification that a service activity that is classified as network capacity controlled service can have the service class changed; notification that if the service class is changed for a service activity the service charges will change; notification that one or more networks are available (e.g., one or more alternative networks and/or network busy state information and/or charging information and/or incentives associated with such networks), a service plan upgrade/downgrade offer/option; and an offer for a service plan that rewards a user that responds to the notification a service plan is lower cost/discounted for responding to

notification to use or not to use service activity based on usage level warning notification. In some embodiments, the user notification includes a user preference selection, including one or more of the following: a provision to associate an access policy control with the application (e.g., allow/block, notify of usage, notify of usage at a given threshold, traffic control settings, allow during certain times, allow when network not busy, and/or other policy controls as described herein), an over-ride option for selecting the service usage control policy; a modify option to select the service usage control policy; a select option to select a new service plan (e.g., an option to review and select alternative/new service plan upgrade/downgrade options), and an acknowledgement request (e.g., to confirm/acknowledge receipt of the notification, in which the acknowledgement can be transmitted to a network element/function and/or stored locally for later reference/transmission).

[00209] In some embodiments, before a given device application, process, function, OS service or other service activity is allowed to start, the intention to start is intercepted by a launch manager, the background service policy set or the network protection service policy set for the service activity is retrieved, and any necessary user notification or service launch control policies are implemented prior to allowing the service activity to launch. In such embodiments, a launch intercept manager may be used to implement this functionality. In some embodiments, this launch intercept manager is provided with a list identifying the service activities (e.g., application identifiers, OS function identifiers, aggregate service activity identifiers, and/or component service activity identifiers) that have a launch control policy in effect. In some embodiments, the list of launch control policies includes blocking or delaying launch of the one or more service activities. In some embodiments, the launch control policy includes a user notification before, during or after the service activity is launched. In some embodiments, the user is informed that a service activity that has a background service control policy in effect or a network protection service control policy in effect is attempting to launch, is about to launch or has launched. In a further set of embodiments, the launch is held up until the user is notified and is allowed to decide if they would like to launch the service activity. In some embodiments, the user notification includes a message that the service activity attempting to launch consumes a large amount of service usage and asks the user if they would like to continue (e.g., "This application consumes a large amount of data, would you like to continue?", "This application consumes data even when you are not using it, would you like to continue?" "This application

consumes data while you are roaming which adds cost to your usage bill, would you like to continue?", etc). In some embodiments, the decision on whether or not to launch a service activity is pre-programmed into the list identifying the service activities (e.g., application identifiers, OS function identifiers, aggregate service activity identifiers, and/or component service activity identifiers) that have a launch control policy in effect. In some embodiments a portion of the list is pre-programmed by the user in accordance with user preference for controlling usage of service activities. In some embodiments, a portion of the list is pre-programmed by a network element (e.g., a service controller) in accordance with network background service or network protection service policies specified by a service policy design management system operated by a service provider as described herein. In some embodiments, the policy implementation defined by the list identifying the service activities (e.g., application identifiers, OS function identifiers, aggregate service activity identifiers, and/or component service activity identifiers) that have a launch control policy in effect is verified to ensure that the user or malicious software has not defeated the policy enforcement specified in the list. In some embodiments the list identifying the service activities that have a launch control policy in effect includes launch policies that are a function of one or more of: background service state, network busy state (or performance state or QoS state), type of network the device is connected to, home or roaming connection, time of day or day of week.

[00210] In some embodiments, the various design techniques described herein that allow for intercepting a service activity intention to launch, and applying a background service policy set or a network protection service policy set can be designed into the OS itself. For example, the intercept and policy implementation functions can be designed into the activity manager, broadcast intent manger, media service manager, service manager, or other application or service activity management function in the Android OS. One of ordinary skill in the art will recognize that similarly, the various design techniques described herein that allow for intercepting a service activity intention to launch, and applying a background service policy set or a network protection service policy set can be designed into application launch management functions in the iPhone OS, windows mobile OS, windows PC OS, Blackberry OS, Palm OS, and other OS designs.

[00211] In some embodiments, the pre-launch user notification information indicates one or more of: typical service usage or cost, or projected service usage or cost for the service activity attempting to launch. In some embodiments, the user sets limitations on access for one

or more service activities and once this limit is hit then when the service activities with exceeded limits attempt to launch the user is notified. In some embodiments, the user chooses from a set of service restrictions rather than simply blocking or allowing service activity launch, with example service restrictions including but not limited to: a pre-configured set of restriction policies to chose from (e.g., full access, limited access, highly restricted access or block access), block, throttle, delay, aggregate and hold, limit amount of usage per unit time, cap usage, set limit for additional notification, specify type of network, specify busy state (performance, QoS) or background state, or choose from pre-configured settings options.

[00212] In some embodiments, the user notification occurs after the user attempts to download or load an application onto the device (e.g., an application downloaded from the web or an online application store for a smart phone or other wireless/network computing device, such as an Apple iPhone or iPad, or Google Android/Chrome based device). In some embodiments, the user notification occurs after the user attempts to run the service activity or to initiate usage of a cloud based service/application (e.g., Google or Microsoft cloud service based apps). In some embodiments, the user notification occurs after one or more of the following: the service usage activity hits a usage threshold event, the service usage activity attempts a network service usage that satisfies a pre-condition, an update to a network capacity protection service activity classification list or policy set, and a network message is sent to the device triggering the notification. In some embodiments, the user notification provides information on the service usage activity that is possible, typical, or likely for the service usage activity. In some embodiments, the user notification includes a user option for obtaining more information about the service usage of the service activity (e.g., a message that the service usage activity may result in a high service usage and/or that the service usage activity may or will result in a high service usage as compared in some way to a limit of the current service plan) to make informed user preference settings.

[00213] In some embodiments, a user notification includes displaying (e.g., and as applicable, allowing users to provide UI input) one or more of the following: current and/or past/historical/logged network service usage activity list, current and/or past/historical/logged network capacity controlled service usage activities, current activity policy settings, current or available networks, service plan options (e.g., for how to treat one or more network capacity controlled service traffic types), selection option(s) to assign a network capacity controlled

service activity into a different priority traffic control and/or charging buckets, network service usage by activity (e.g., network capacity controlled services and other services), network busy state (e.g., and with resulting policies in force), service activity policy setting vs. busy state and time/day/week, network service activity priority, network service activity usage statistics (e.g., vs. network busy state and/or network service usage control policy state).

[00214] In some embodiments, a UI notification is displayed when user attempts a network capacity controlled service activity during a network busy state (e.g., that modifies a network capacity controlled services policy). In some embodiments, the UI notification includes information on service plan choice and a network capacity controlled services policy over-ride option (e.g., one time, time window, usage amount, permanent by activity, and/or all), charging information based on a user selection, and/or service plan upgrade information and options.

[00215] In some embodiments, a UI notification is displayed for user input for preferences/configurations for multiple networks (e.g., WiFi, 4G, 3G, and/or other wired or wireless access networks) including charging policy. In some embodiments, a UI notification is displayed when a specified network traffic service usage activity (e.g., based on network capacity controlled services classification, QoS classification, priority classification, time based criteria, network capacity, service plan, charging criteria, and/or other criteria/measures) is being attempted or is occurring and providing options (e.g., allow, block, delay, throttle, and/or other options).

[00216] In some embodiments, a UI fuel gauge is displayed (e.g., to depict current and/or historical network service usage, for example, relative to a service plan for the device, by network, relative to network busy state, time based criteria, and/or other criteria/measures). In some embodiments, a user notification includes a communication sent to the user (e.g., an email, SMS or other text message, voice message/call, and/or other electronic form of communication). In some embodiments, the communication sent to the user includes network service usage information, network capacity controlled service usage related information, and/or an instruction to log into a web page or send a communication for more information (e.g., regarding an information update and/or alert or warning message, such as related to network service usage and/or charging for network service usage).

[00217] In some embodiments, a notification (e.g., a user or network service cloud notification) is generated based on an aggregate service activity reports usage (e.g., allows network provider to generate user notifications and/or to notify application provider/service activity provider). In some embodiments, a notification (e.g., a user or network service cloud notification) is generated based on a publishing of an updated/new network capacity controlled services list based on an aggregate monitored activity (e.g., based on a service plan, velocity, sockets opening frequency/rate (e.g., messaging layer behavior), total data usage, peak busy time usage to formulate or update black list for monitoring, notifying, and/or controlling, which can be applied to one, multiple, group, or all devices). In some embodiments, a notification (e.g., a user or network service cloud notification) is generated based on data usage trends for particular device relative to an associated service plan and/or other comparable devices or data usage thresholds/statistical based data usage measures.

[00218] In some embodiments an application is actually composed of several component applications, processes or functions. Examples of this include but are not limited to: the components of a Java application JAR file; applications that use OS functions; applications that use a proxy service function; applications, functions or processes that coordinate with one another to implement a composite process, function or application; and OS process functions that support an application or overall OS function. In such embodiments it is important to be able to categorize all applications, functions and processes on a device that contribute to the service usage of a service activity so that the service activity can be monitored for service usage, have the service usage accounted for, implement the appropriate user notification when one or more service activity components attempts to start or use the network, implement the appropriate user notification when one or more service activity components reaches a pre-determined service usage level that requires user notification, and implement the appropriate background service or network protection service usage controls as specified herein ((including but not limited to for example: block network access, restrict network access, throttle network access, delay network access, aggregate and hold network access, select for time of day network access restrictions, select network type restrictions, select roaming network access restrictions, select service usage restrictions such as a usage limit, select service cost restrictions such as a cost limit or otherwise place on another form of background service status or network usage restriction as described herein). In the case of service activity components that belong exclusively to one aggregate

service activity (e.g., an application, application JAR file or OS function), this may be accomplished by including each of the component service activities on a list that identifies the service activity components that belong to the aggregate service activity, and then monitoring, possibly controlling and providing user notifications based on the aggregate or component behavior of each service activity in accordance with the policies specified for the aggregate service activity. For example, it is necessary to group all application launch behavior and/or network access behavior under the monitoring, launch, notification, accounting and background service controls or network protection service controls (or other background or network protection service policies as specified herein) in accordance with the background service or network protection service policies for the aggregate application that the JAR file supports. As another example, if an OS network synch or update function utilizes various software components or processes to implement the network synch or update function, then each of the software components or process must be monitored and aggregated under the background service policies or network protection service policies for the aggregate OS synch or update function.

[00219] In some embodiments, this ability to group usage for a related set of service activity components dedicated to an aggregate service activity as described herein is used to improve usage reporting of service activities to a service controller for the purpose of statistically identifying service activities that are candidates for background service policy controls or network protections service policy controls.

[00220] In some cases, multiple applications, processes, functions, OS services or other service activities can utilize a common set of component software applications, processes, functions or OS services. In such cases, in order to implement background service policies and/or network protection service policies for service activity monitoring and accounting, service activity launch control, user notification, or network access control as described herein, it is necessary to associate the specific network access data or information flows to and from the common component software applications, processes or functions that belong to the specific initiating application, process, function or other service activity that is to be managed according to a background service or network protection service policy set. In what follows, a specific set of examples is provided on how to map common component service activity for a set of common OS functions referred to as proxy service functions to a specific application, process, function, OS service or other service activity for the purpose of implementing a background service policy

set or a network protection service policy set as described herein. Once these examples are reviewed, it will be obvious to one of ordinary skill in the art how to apply similar mapping of service activity for a common set of components to a service activity that is to be managed in accordance with a background service policy set or a network protection service policy set as described herein.

[00221] In some embodiments, this ability to group usage for a common set of service activity components as described herein is used to improve usage reporting of service activities to a service controller for the purpose of statistically identifying service activities that are candidates for background service policy controls or network protections service policy controls.

[00222] In some embodiments, a proxy network service manager refers to an intermediary data flow function in a device operating system that sits on a data path between a device application and a device networking stack interface to provide a level of network service abstraction from the network stack interface, a higher level service function above the network stack interface, enhanced or special traffic processing functions, media service transfer management, file download service, HTTP proxy service functions, QoS differentiation, or other similar or related higher level traffic processing. Example Proxy Service Managers include the following: media service manager (e.g., android media service library function), email service manager, DNS function, software download service manager, media download manager (e.g., audio player, streaming media player, movie downloader, media service OS function, etc.), data download service manager, Android "media" library function, Android.net library function, Jave.net library function, Apache library function, other similar software/library functions or services in other device operating systems, SMTP/IMAP/POP proxy, HTTP proxy, IM proxy, VPN service manager, SSL proxy, etc. Herein these alternative network access data flows that are initiated by an application are termed application proxy service flows. In such embodiments an app can sometimes simply request a network access service activity from an OS component such as a proxy service component rather than directly accessing the network. In such embodiments, in order to implement background service controls or user notification of application service usage, it is necessary to monitor the application proxy service flows, classify them as being initiated by or belonging to a particular application or service activity, and implement the proper background service classifications, user notifications, application process launch intercept, background service accounting, and background service usage restrictions as

described herein in accordance with the policies intended for the initiating application or service activity. This is accomplished by inserting service usage monitors that allow a mapping of (i) the initiating application identifier (e.g., app name, app fingerprint, application identification tag, application process number, application credential, or other secure or non-secure application or process identifier) to (ii) the request to the proxy service and subsequently to (iii) the network service flows between the proxy service and the network elements that service the information communications. Once this mapping is accomplished, the service usage flows of the proxy service can then be accounted back to the initiating application, device software process or other service activity, the proper policies can then be applied to each service usage flow for user notification, service activity launch control, service activity background accounting (including variable charge rating dependent on background service state and/or sponsored service charging), service activity background service controls or network usage restrictions as described herein (including but not limited to for example: block network access, restrict network access, throttle network access, delay network access, aggregate and hold network access, select for time of day network access restrictions, select network type restrictions, select roaming network access restrictions, select service usage restrictions such as a usage limit, select service cost restrictions such as a cost limit or otherwise place on another form of background service status or network usage restriction as described herein).

[00223] In some embodiments, this ability to track service usage for an service activity through a proxy service as described herein is used to improve usage reporting of service activities to a service controller for the purpose of statistically identifying service activities that are candidates for background service policy controls or network protections service policy controls.

[00224] In some embodiments, the various design techniques described herein that allow for monitoring, accounting for and/or implementing service policy for component service activities that belong to an aggregate service activity can be designed into the OS itself. For example, in certain current mobile OS implementations (e.g., Android, iPhone, Blackberry, etc) there are some applications available in the market that allow a user to get an estimate for how much data a certain subset of applications are consuming on a wireless service provider network, but it is not possible for the user or application to get an indication of the service usage for certain OS functions, whereas the embodiments disclosed herein will allow for this. As another

example, in certain current mobile OS implementations it is not possible to associate proxy service usage (e.g., media download and media streaming proxy library software functions) with the specific applications that use the proxy service, so while the user can be informed of generic common OS functions or proxy services (e.g., in the case of Android: "media service," "media," "gallery," "Google service framework" and other generic common OS software library functions or proxy services), there is no way for the user to determine what applications widgets or other service activities are actually generating this common service function usage, whereas the invention described herein permits the user full visibility on such usage monitoring examples. Furthermore, if the OS is retrofitted with the intercept and policy implementation functions can be designed into the activity manager, broadcast intent manger, media service manager, service manager, or other application or service activity management function in the Android OS. One or ordinary skill in the art will recognize that similarly, the various design techniques described herein that allow for intercepting a service activity intention to launch, and applying a background service policy set or a network protection service policy set can be designed into application launch management functions in the iPhone OS, Windows mobile OS, Windows PC OS, Blackberry OS, Palm OS, and other OS designs.

[00225] FIG. 19 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 1902, the process begins. At 1904, determining a network busy state of one or more networks is performed. In some embodiments, the one or more networks are selected from an access network, a wired network, and a wireless network. At 1906, classifying a network service usage activity (e.g., a network capacity controlled service) of a device based on the network busy state determination is performed to facilitate differential network access control for protecting network capacity of the one or more networks. In some embodiments, the network busy state is based on one or more of the following: network performance, network congestion, network availability, network resource availability, network capacity, or any other network service usage measure, and one or more time windows (e.g., time based criteria). In some embodiments, protecting network capacity of the one or more networks includes protecting network capacity of a last edge segment of a wireless network (e.g., RAN, BTS, BTSC, and/or other network elements). In some embodiments, the determining and classifying are performed using device assisted/based techniques. In some embodiments, the determining and classifying are performed using network

assisted/based techniques (e.g., implemented on a network element/function, such as a service controller, a DPI gateway, a BTS/BTSC, etc., or a combination of network elements). In some embodiments, the determining and classifying are performed using a combination of device assisted/based techniques and network assisted/based techniques. At 1908, implementing differential traffic controls is performed based on the service usage activity classification for protecting network capacity. At 1910, the process is completed. In some embodiments, a network busy state is determined based on one or more of the following: a time of day, a network reported busy state, and/or a device (e.g., near-end and/or far-end) determined/reported network busy state. In some embodiments, a network busy state is determined using one or more of the following: a network probe, a device query, a network probe report (e.g., including a BTS and/or BTSC), a network probe analysis, a device analysis based on performance of native traffic without probe such as TCP timeout, UDP retransmissions, a multiple network test, a device monitored network congestion based on network service usage activity (e.g., application based network access performance data) performed for a network to which the device is connected and/or one or more alternative networks. In some embodiments, a network congestion state is associated with a network busy state (e.g., a network busy state setting/level). For example, a network congestion level of 40% of network usage can be associated with a network busy state setting of 4, a network congestion level of 80% of network usage can be associated with a network busy state setting of 8, and so forth.

[00226] FIG. 20 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 2002, the process begins. At 2004, monitoring a network service usage activity of a device in network communication is performed. At 2006, classifying the network service usage activity (e.g., based on a classification of the network service usage activity for protecting network capacity, for example, as a network capacity controlled service) for protecting network capacity is performed. At 2008, accounting for network capacity controlled services (e.g., accounting for the network service usage activity based on a classification of the network service usage activity for protecting network capacity) is performed. At 2010, charging for network capacity controlled services is performed. At 2012, the process is completed. In some embodiments, DAS for protecting network capacity further includes classifying the network service usage activity as a network capacity controlled service. In some embodiments, DAS for protecting

network capacity includes differentially accounting and/or differentially charging for network capacity controlled services and foreground services. In some embodiments, the network service usage control policy includes policies for differentially controlling, accounting, and/or charging for network capacity controlled services (e.g., based on a network busy state, a time based criteria, a service plan, network to which the device or network service usage activity is gaining access from, and/or other criteria/measures). In some embodiments, accounting for network capacity controlled services includes differentially collecting service usage for one or more network capacity controlled service classes in which the accounting is modified/varies (e.g., dynamically) based on one or more of the following: network busy state (e.g., modify/credit accounting during network congestion not satisfying the user preference), network service activity, access network (e.g., the network to which the device/service activity is currently connected), user preference selection, time based criteria (e.g., current time of day/day of week/month), associated service plan, option to time window. In some embodiments, charging for network capacity controlled services includes mapping an accounting to a charging report. In some embodiments, charging for network capacity controlled services includes sending the charging report to a network element (e.g., a service controller, a service cloud, a billing interface/server, and/or another network element/function). In some embodiments, charging for network capacity controlled services includes mediating or arbitrating CDRs/IPDRs for network capacity controlled service(s) vs. other network service usage activities or bulk network service usage activities. In some embodiments, charging for network capacity controlled services includes converting a charging report to a billing record or billing action. In some embodiments, charging for network capacity controlled services includes generating a user notification of network capacity controlled service charges upon request or based a criteria/measure (e.g., a threshold charging level and/or a threshold network service usage level). In some embodiments, charging for network capacity controlled services includes charge by application based on a charging policy (e.g., bill by application according to billing policy rules, such as for billing to a user or to a sponsored service provider, carrier, and/or other entity).

[00227] FIG. 21 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. In some embodiments, DAS for protecting network capacity includes providing a device service access API that provides an interface for applications, OS functions, and/or other service usage activities to a

network access connection (e.g., or stack) for providing differential network access for protecting network capacity. In some embodiments, the differential network access is determined by one or more of the following: a service priority of the service usage activity and a network busy state. At 2102, the process begins. At 2104, a device service access API request is received. At 2106, the device service access API request is responded to. In some embodiments, the differential network access (e.g., for network capacity controlled services and/or based on network busy state and/or other criteria/measures) is implemented by one or more of the following: providing network busy state information to the service usage activity, receiving network busy state information, receiving network capacity demands for the service usage activity, receiving a scheduled time/time slot demand from the service usage activity, receiving and/or providing network location and/or physical location information (e.g., base station, communication channel, cell sector, roaming or non-roaming network to which the device is connected, and/or GPS or other physical location data), providing information to the service usage activity informing it when it is allowed to access the network, providing information to the service usage activity informing it what traffic controls must be applied/implemented, providing information to the service usage activity informing it when the network is available to it for access, and providing information to the service usage activity of its scheduled access time/time slot (e.g., based on one or more of the following: priority, network busy state, and time of day) (e.g., with a specified performance level or service level, such as data transfer size, speed, network capacity controlled service priority level, QoS level, data transfer type, scheduling time(s), and/or network connection parameters), and instructing the device and/or service usage activity to transition to a different state (e.g., power save state, sleep state dormant, idle, wait state, and/or an awake state). At 2108, differential network access is implemented. At 2110, the process is completed. In some embodiments, the device service access API is a programmatic interface, a virtual interface, and/or an emulated interface that provides instructions for differential access to a network to protect network capacity, as described herein.

[00228] In some embodiments, the API is served or located on the device, on a network element (e.g., using a secure communication between the device and the network element for the API communication, such as HTTPS, TLS, SSL, an encrypted data connection or SS7 control channel, and/or other well known secure communication techniques), and/or both/partly in both. In some embodiments, a network based API is an API that facilitates an API or other interface

communication (e.g., secure communication as discussed above) between an application executing on the device and a network element and/or service cloud for protecting network capacity. For example, a network API can provide an interface for an application to communicate with a service cloud (e.g., network server) for obtaining network access control information (e.g., network busy state, multiple network information based on available networks and/or network busy state information of available networks, network capacity controlled service priorities and availability, scheduled time/time slots for network access based on network busy state, service plan, network capacity controlled service, and/or other criteria/measures). As another example, a network API can facilitate an application provider, central network/service provider, and/or a third party with access to communicate with the application to provide and/or request information (e.g., physical location of the application, network location of the application, network service usage information for the application, network busy state information provided to the application, and/or other criteria/measures). As yet another example, a network API can facilitate a broadcast to one or more applications, OS functions, and/or devices (e.g., partitioned based on geography, network, application, OS function, and/or any other criteria/measure) with network capacity related information (e.g., network busy state, availability based on network capacity controlled service classification and/or priority level, scheduled time/time slots for certain network capacity controlled service classification and/or priority level, emergency/high priority software/antimalware/vulnerability update and scheduled time/time slots for such software updates, and/or other criteria/measures). In some embodiments, the network access API for protecting network capacity is an open API or standard/required API (e.g., required or standardized for applications for a certain network service provider, such as to be provided via the Verizon application store or the Apple AppStore) published for application and OS developers so that the applications and OS functions are designed to understand and implement the network access API for protecting network capacity. For example, a certification program can be established to provide application and OS developers with test specifications, working implementations, and/or criteria to make sure the network access API is properly implemented and is functioning in accordance with the specified requirements. In some embodiments, the network access API is an interface for communication with a service controller (e.g., service controller 122) or another network element/function (e.g., a service usage API for communication with a service usage server or billing interface/server or

another network element/function that facilitates a secure communication for sending/receiving or otherwise communicating network access related information for protecting network capacity). In some embodiments, the network API provides for sponsored billing (e.g., reverse billing) of all, classified, and/or a subset of network service usage charges to a sponsored partner associated with the network service usage activity (e.g., application) that accesses the network API. In some embodiments, the network API provides for a sponsored service in which the network service usage activity (e.g., application) that accesses the network API provides a sponsored service partner credential to the network API, the credential is used as a billing mechanism to charge the sponsored partner, the user account is mediated to remove the sponsored partner charge, and the network API provides access service and/or information service (e.g., location information, local information, content information, network information, and/or any other information).

[00229] FIG. 22 illustrates another flow diagram for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. At 2202, the process begins. At 2204, network service usage activities of a device are monitored (e.g., using a verified/verifiable service processor). At 2206, a network busy state (e.g., a measure of network capacity, availability, and/or performance) is determined based on the monitored network service usage activities (e.g., using various techniques as described herein). In some embodiments, a service processor on the device is used to determine (e.g., measure and/or characterize) a network busy state experienced by the device (e.g., which can be used to determine the network access control policy for one or more network capacity controlled services). At 2208, a network busy state report is sent to a network element/function (e.g., a service controller and/or another network element/function as described herein). At 2210, the process is completed. In some embodiments, the service processor is verified using various techniques described herein. In some embodiments, the network busy state report includes one or more of the following: data rate, latency, jitter, bit error rate, packet error rate, number of access attempts, number of access successes, number of access failures, QoS level availability, QoS level performance, and variability in any of the preceding parameters. In some embodiments, the network busy state report includes one or more of the following: base station ID, cell sector ID, CDMA ID, FDMA channel ID, TDMA channel ID, GPS location, and/or physical location to identify the edge network element that is associated with the network busy state report to a network element. In

some embodiments, the monitoring of network service usage activities includes measuring the network performance for traffic the device is transmitting/receiving and/or generating network performance testing traffic. In some embodiments, the network busy state is collected (e.g., and/or used to assist, supplement, and/or verify device based network busy state measures) by one or more network elements that can measure and/or report network busy state (e.g., BTS, BTSC, base station monitor, and/or airwave monitor). For example, airwave monitors and/or base station monitors can be provided to facilitate a reliable characterization of network busy state in a coverage area of one or more base stations and/or base station sectors, such as affixed mobile terminals (e.g., trusted terminals that can include additional network busy state monitoring and/or reporting functionality) installed (e.g., temporarily or permanently) in the coverage area of one or more base stations and/or base station sectors (e.g., in which a sector is the combination of a directional antenna and a frequency channel) so that the affixed mobile terminals perform network busy state monitoring and reporting to the service controller, the local base station, and/or other network element(s)/function(s) as similarly described herein. In some embodiments, the permanently affixed mobile terminals provide network monitors for reporting, for example, network busy state, to a central network element, such as the service controller, which can, for example, aggregate such network busy state information to determine network busy state for one or more network coverage areas. In some embodiments, the permanently affixed mobile terminals are always present in these locations where installed and always on (e.g., performing network monitoring), and can be trusted (e.g., the permanently affixed mobile terminals can be loaded with various hardware and/or software credentials). For example, using the permanently affixed mobile terminals, a reliable characterization of network busy state can be provided, which can then be reported to a central network element and aggregated for performing various network busy state related techniques as described herein with respect to various embodiments. In some embodiments, the network element/function uses the network busy state report (e.g., and other network busy state reports from other devices connected to the same network edge element) to determine the network busy state for a network edge element connected to the device. In some embodiments, network element/function sends a busy state report for the network edge element to the device (e.g., and to other devices connected to the same network edge element), which the device can then use to implement differential network access control policies (e.g., for network capacity controlled services) based on the network busy

state. In some embodiments, a network busy state is provided by a network element (e.g., service controller or service cloud) and broadcast to the device (e.g., securely communicated to the service processor).

[00230] FIG. 23 illustrates a network capacity controlled services priority level chart for device assisted services (DAS) for protecting network capacity in accordance with some embodiments. In some embodiments, various applications, OS functions, and/or other utilities/tools installed/loaded onto and/or launched/executing/active on a communications device (e.g., device 100) are classified as network capacity controlled services for protecting network capacity. In some embodiments, one or more of the network capacity controlled services are assigned or classified with network capacity controlled service levels or priority levels for protecting network capacity. In some embodiments, one or more of the network capacity controlled services are dynamically assigned or classified with network capacity controlled service levels or priority levels based on one or more criteria/measures (e.g., dynamic criteria/measures), such as network busy state, current access network, time based criteria, an associated service plan, and/or other criteria/measures. In some embodiments, a higher priority level means that the application or utility/function is granted higher relative priority for network access (e.g., a priority level 10 can provide for guaranteed network access and a priority level 0 can provide a blocked network access, while priority levels between 1 through 9 can provide relatively increasing prioritized network access potentially relative to allocated network access and other services requesting network access).

[00231] As shown in FIG. 23, the network capacity controlled services are dynamically assigned or classified with network capacity controlled service levels or priority levels based on the network busy state of the current access network. For example, an email application, Microsoft Outlook, is assigned different priority levels for protecting network capacity based on the network busy state, as shown: a priority level 6 for a network busy state (NBS) level of 10% (e.g., up to about 10% of the network capacity is being utilized based on current or recently/last measured/detected/determined network capacity/resources usage using various techniques as described herein), a priority level 5 for a network busy state (NBS) level of 25%, a priority level 4 for a network busy state (NBS) level of 50%, a priority level 3 for a network busy state (NBS) level of 75%, and a priority level 2 for a network busy state (NBS) level of 90%. As also shown, an antivirus (AV) software update application/utility/function is assigned different priority levels

for protecting network capacity based on the network busy state: a priority level 9 for a network busy state (NBS) level of 10%, a priority level 7 for a network busy state (NBS) level of 25%, a priority level 5 for a network busy state (NBS) level of 50%, a priority level 3 for a network busy state (NBS) level of 75%, and a priority level 1 for a network busy state (NBS) level of 90%. Various other applications and utilities/functions are shown with various priority level assignments/classifications based on the network busy state levels shown in the network capacity controlled services priority level chart of FIG. 23. As will be apparent to one of ordinary skill in the art, various assignments and/or techniques for dynamically assigning priority levels for network access based on network busy state levels can be applied for protecting network capacity (e.g., based on user preferences, service plans, access networks, a power state of device, a device usage state, time based criteria, and various other factors such as higher priority for urgent software and/or security updates, such as a high priority security or vulnerability software patch or update, and/or urgent or high priority emails or other communications, such as a 911 VOIP call).

[00232] Referring again to FIGS. 1 through 3, DAS for protecting network capacity is implemented using a service processor (e.g., a service processor 115) of the device (e.g., a device 100) using various DAS techniques as described herein to facilitate differential network service access control (e.g., for network capacity controlled services) to assist in protecting network capacity in accordance with some embodiments. In some embodiments, the service processor and/or one or more agents of the service processor is/are verified using one or more of the following verification techniques (e.g., and/or to specifically verify monitoring the network service usage activity, classifying one or more service activities into one or more network capacity controlled service classes, associating the one or more network capacity controlled service classes with one or more differential service activity policies, and/or determining a network busy state): compare a network based service usage measure with a service policy and/or service plan associated with the device, compare a device assisted service usage measure with the service policy and/or service plan associated with the device, compare the network based service usage measure to the device assisted service usage measure, compare a first device assisted service usage measure to a second device assisted service usage measure, verify presence of the service processor and/or one or more agents of the service processor, verify configuration of the service processor, verify service usage activities are reported properly (e.g.,

using test service usages to generate service usage events/reports for analysis and confirmation), verify billing events are reported properly, compare the network based service usage measure with reported device billing data, verify reporting of a test billing event, verify reporting of the communications device reports billing events from a transaction server, verify presence of an activation tracking system, verify device configuration or operation, verify device standing or service plan standing, verify proper operation of the service processor, verify service processor heartbeat response reports, verify monitoring of a test service event, download a new service processor (e.g., and/or one or more agents or new configuration settings of the service processor) and perform integrity checks, verify a service processor code configuration with agent self-diagnosis checks, verify that the communications device uses the first service only after being authorized, verify user standing, verify a network busy state (e.g., compare and/or statistically process network busy state measures from more than one device in which the network busy state monitoring apparatus, for example, is located in a secure execution environment on the device), verify various differential network access control implementations (e.g., network capacity controlled services are properly monitored/determined/detected, controlled, accounted for, and/or charged for), verify various QoS implementations (e.g., as discussed above), and verify an agent communications log. Various other verification techniques are described herein and similar and other verification techniques for providing DAS for protecting network capacity using device based implementations (e.g., service processors and/or other device based agents or software/hardware techniques) will now be apparent to one of ordinary skill in the art in view of the various embodiments described herein.

[00233] In some embodiments, the service processor is secured using various hardware and software techniques described herein, including, for example, implementing all and/or portions of the service processor in a secure virtual machine, protected execution environment, secure storage (e.g., secure memory), secure modem, and/or other secure implementation techniques as described herein and/or other or similar techniques as will now be apparent to one of ordinary skill in the art in view of the various embodiments described herein. For example, the service processor can be implemented in software and executed in a protected area of an OS executed on the device and/or executed in protected execution partitions (e.g., in CPU, APU, SIM chipset, modem, modem secure execution partition, SIM, other hardware function on the device, and/or any combination of the above).

[00234] In some embodiments, a network service usage counter is embedded into a secure execution environment (e.g., a program store in secure non-volatile memory located on a modem card and/or a modem chip not accessible by device applications, secure CPU environment for executing program and/or secure program operation for data path monitoring and/or control that cannot be bypassed by device applications to get to the modem connection to the network) in a device modem (e.g., using measurement points V, VI, and/or other measurement points of FIG. 12). In some embodiments, the service usage counter counts data traffic (e.g., bytes and/or any other measure of service usage, such as file transactions, message transactions, connection time, time of connection or duration of connection, and/or traffic passed or transactions passed for a given QoS or network capacity controlled service priority level), traffic as a function of time, traffic according to a network service activity classification (e.g., by application, destination/source, port, traffic type, content type, time of day, network busy state, and/or any other criteria/measure). In some embodiments, the service usage counter counts data traffic (e.g., as discussed above) while coordinating with a VPN layer established, for example, for both layer-III (e.g., IPSEC) and layer-II (e.g., L2TP tunnel) so that precise over the air service usage measure is counted for billing mediation and/or network service usage charging (e.g., customer billing, sponsored service bill by service and/or any other charging or billing). In some embodiments, the service usage counter counts data traffic (e.g., as discussed above) while coordinating with accelerator software (e.g., a compression/decompression engine) which transforms frames for more efficient over the air transmission. As similarly discussed above, service processor coordination with the accelerator layer facilitates a precise over the air service usage measure for billing mediation and/or network service usage charging. In some embodiments, the service usage counter counts data traffic (e.g., as discussed above) while coordinating with both the VPN layer and accelerator software layer to facilitate a precise over the air service usage measure for billing mediation and/or network service usage charging.

[00235] In some embodiments, the service usage counter reports the service usage to a network element (e.g., a service controller, charging gateway, PCRF, AAA, HA, billing system, mediation system, traffic accounting database, base station or base station controller, and/or another network element/function or central network element/function). In some embodiments, the information reported to the network element is encrypted or signed with a corresponding key known by the network element. In some embodiments, the communication link to the network

element to pass the service usage count is conducted over a wireless network specific channel such as SMS, MMS, SS-7, or another specialized control channel. In some embodiments, the communications link to the network element to pass the service usage count is conducted over a network channel (e.g., via IP, TCP, UDP, HTTP, HTTPS, TLS, SSL, point to point signed variants of TLS or SSL, or another data network channel via the network control channel connection to the device). In some embodiments, the data network control channel traffic is injected into the PPP stream at the modem. In some embodiments, the data network control channel traffic is passed up to the device networking stack for connection to the network. In some embodiments, a signed or encrypted service usage count from the modem subsystem is coordinated to provide a service usage count for a time period that also corresponds to a similar time period for a service processor heartbeat report that includes a service usage measure or count. For example, this provides the service controller or another network element with a secondary set of information that can be used to verify and/or secure the service usage measures reported by the service processor. Various techniques can be used to synchronize the time period for the modem service usage count and the service processor service usage count. For example, the service processor can request a latest count message from the modem, in which the modem counts all service usage since the previous request for latest count until the present request for latest count, encrypts the latest count message so that the service processor or other application software or OS software on the device cannot decode and/or tamper with the message, and the modem service usage counter then passes the encrypted message to the service processor. The service processor can then pass the encrypted service usage count message from the modem to the service controller along with the service processor service usage accounting message(s) for the same or similar time period. The service controller can then decode both service count messages from the secure modem subsystem and the service processor and correlate the two measures to verify the service usage reporting by, for example, looking for discrepancies that would indicate service usage control or charging errors or device service processor tampering. In some embodiments, the secure modem subsystem records byte counts for streams (e.g., and/or flows, socket connections, or combinations of IP destination/source/ports), potentially along with time of day, network busy state, QoS level, and/or other criteria/measures, and reports these counts for each stream that had traffic activity during the current reporting interval. For example, the service controller can then correlate the stream service usage information with the

service usage information provided by the service processor heartbeat service usage report to verify that the service processor service usage report is consistent with the independent measure made in the modem subsystem. In some embodiments, service usage reports (e.g., certified service usage reports) are correlated on the device and/or in the network (e.g., using one or more network elements/functions, such as the service controller).

[00236] In some embodiments, a deeper analysis of traffic can be conducted in the modem subsystem service usage count. For example, a layer 7 analysis of the service usage can be conducted for HTTP or HTTPS traffic flowing through the modem in which the modem subsystem service usage counter performs an HTTP level analysis of the traffic to associate web traffic gets and other transfers with a given higher level service classification (e.g., ad server, content server, proxy server, and/or traffic that is referred by the local host serving up a web page). In some embodiments, the modem subsystem service usage count can be augmented for HTTPS, SSL or TLS traffic by including a trusted proxy server embedded in the modem system. For example, the proxy server can be trusted by the device stack so that the encryption keys for HTTPS, TLS or SSL are known by the proxy server allowing the modem based proxy server, located, for example, in a secure execution environment, to perform layer 7 analysis of encrypted traffic in a manner similar to that described above. In some embodiments, the embedded proxy server generates server SSL certificates for each connection to a specific remote host in real time based on a root certificate trusted by the device (e.g., and/or by network service usage activity, such as by application) and also trusted by the embedded proxy server, and the proxy server then becomes a middle man emulating a remote SSL host on one side and emulating the device (e.g., and/or network service usage activity, such as application) on the other side, decrypting the traffic, analyzing it and re-encrypting before forwarding to and from the remote host. Similarly, as in the case of layer 3 and 4 traffic analysis performed by the modem service usage counting subsystem, the layer 7 service usage count messages can be encrypted and passed to the service controller via various channels. In some embodiments, the layer 7 modem subsystem service usage counting system records service usage counts for a reporting time period that is similar to the reporting time period used by the service processor so that the service controller can correlate the service processor accounting messages against the modem accounting messages with layer 7 information.

[00237] In some embodiments, the secure service usage reporting system elements are located in a secure execution environment that includes the modem driver. In some embodiments, all traffic that gets to the modem for the network traffic being controlled or accounted for is required to go through the secure modem driver so that an independent count can be generated and reported to the service controller as described above without the need to embed the secure service usage counting and reporting elements in the modem.

[00238] In some embodiments, the secure service usage reporting system elements are located in a secure execution environment that includes the modem driver and modem hardware interface controller driver (e.g., USB controller for 2/3/4G and SDIO controller for WiFi). In some embodiments, all traffic that gets to the modem for the network traffic being controlled or accounted for is required to go through the secure modem driver and modem hardware interface controller driver (e.g., USB controller for 2/3/4G and SDIO controller for WiFi) so that precise count can be generated by either the modem driver and/or modem hardware interface controller driver (e.g., USB controller for 2/3/4G and SDIO controller for WiFi) and passed to the secure service usage reporting element to send it to the service controller for customer charging/billing. This scheme provides flexibility (e.g., most of the device software and operation system and its services/applications need not be located/executed in the secure execution environment) while ensuring usage counting to occur securely as it pertains to the customer accounting and billing.

[00239] In some embodiments, the layer 7 proxy server traffic accounting and reporting techniques used for processing HTTPS, TLS, and SSL traffic, as discussed above, are also used in the service processor itself to allow a detailed accounting of encrypted layer 7 traffic by the device. In some embodiments, the information thus obtained is filtered so that private user information is not transmitted to the network (e.g., service controller, PCRF, and/or any other network element/function) but only service usage information sufficient to allow for accounting of service plan usage, to verify service control policy implementation, or to verify service charging policy implementation is transmitted to the network (e.g., service controller, PCRF, and/or any other network element/function). In some embodiments, the layer 7 proxy server for processing secure or in the clear device service usage accounting messages is located in secure hardware execution environments in the device application processor or within secure software partitions in the operating system.

[00240] Various techniques can be used to verify and/or secure service usage controls or service usage charging reports. For example, if the secondary service usage reports indicate that service usage is outside of the service usage policy limits that are intended to be in effect (e.g., based on a service plan and/or service policy associated with the device), then the service controller can indicate an error flag for further analysis and action (e.g., implementing various verification and responsive actions as described herein, such as blocking the activity, throttling the activity, quarantining the device, updating/replacing the service processor, and/or monitoring the device using various additional DAS and/or network assisted monitoring techniques). As another example, if the service usage reports from the service processor do not match up with the secondary service usage reports, then the service controller can indicate an error flag for further analysis and action. For example, the correlation can be based on bulk measures of service usage (e.g., total bytes over a given period of time), or using finer grain measures of service usage (e.g., verifying the accounting between one group of service usage activities, such as application, destination/source, port, content type, time of day, network busy state, QoS level, and/or other criteria/measures) charged to one service plan charging record versus the accounting for another group of service usage activities charged to another service plan charging record. In some embodiments, the correlation process between the two service usage accounting reports is performed continuously on all device traffic in real time or near real time as the usage accounting reports are received. In some embodiments, the usage accounting reports are stored and analyzed or correlated later (e.g., periodically, based on a request or audit, and/or based on certain events, such as threshold network service usage events and/or any other events based on various criteria/measures). In some embodiments, only an audit of a portion of time is used to correlate the two usage accounting reports, which, for example, can reduce network traffic and/or network processing load in the service controller.

[00241] In some embodiments, correlation techniques are applied by the service controller to compare two different service usage measures as described above based on one or more of the following: total amount of data (e.g., bytes for file transfers, sessions, and/or other measures), amount of data per unit time, total number of accesses, number of accesses per unit time or frequency of accesses, accesses during a time interval (e.g., peak time), accesses during a network busy state, access requests, and individual versus group transmissions at a point in time (e.g., each for a given set of destinations or destinations and traffic types).

[00242] In some embodiments, service usage monitoring includes characterizing service usage activities by streams, flows, destination/port, packet inspection, and/or other criteria/measures using the various techniques as described herein and/or other or similar techniques as would be apparent to one of ordinary skill in the art. In some embodiments, service usage monitoring includes characterizing service usage activities by streams, flows, destination/port, packet inspection, and/or other criteria/measures and then correlating to find network service usage behavior patterns that identify likely association of behavior with one or more service activities being managed.

[00243] In some embodiments, DAS for network capacity control includes classifying traffic to determine which network service usage activity(ies) are causing traffic (e.g., increasing network capacity/resources usage beyond a threshold), and then determining if access network service usage activity(ies) are violating any rules (e.g., service usage policies or service plan settings associated with the device/user). In some embodiments, DAS for network capacity control includes generating a list for network capacity controlled services that specifies behavioral characteristics for one or more network service usage activities with expected access limits based on access control policy for each managed network service usage activity (e.g., based on service usage policies or service plan settings associated with the device/user). In some embodiments, DAS for network capacity control includes monitoring and/or controlling network service usage activities based on limits, which, for example, can be based on one or more of the following: total access traffic counters, counters for different types of access traffic, destinations, ports, frequency of accesses, access behavior during a given time, access behavior during a given busy state, access behavior for groups of activities (e.g., verify clumping), and/or other criteria/measures.

[00244] Accordingly, in some embodiments, a second secure and trusted service usage measure is provided that the service controller (e.g., or another network element/function) can use to verify or secure the service control or service charging reports for the service processor. In some embodiments, the secure and trusted service usage measure also provides for enhanced verification and service security in cases, in which, for example, network based service usage measures are available for additional correlation with the service processor service usage reports. In cases in which network based service usage measures are either not available or are only available at widely spaced time intervals (e.g., roaming networks or other networks with no

timely network based service usage measure), these techniques facilitate real time or near real time verification or security for the device assisted service controls and charging.

[00245] In some embodiments, a SIM card performs a portion or all of the secure environment processing described above, with the device modem traffic, or a copy of the device modem traffic, being directed to the SIM secure subsystem for traffic accounting and reporting. In some embodiments, a SIM card is used to store QoS classifications and/or network capacity controlled services classifications for various service usage activities so that the user behavior in using certain network service usage activities and/or the user preferences in controlling certain network service usage activities do not need to be relearned or redownloaded as the user swaps the SIM between different devices. In some embodiments, the SIM keeps a local record of service usage activity for multiple devices that belong to the user or the user family plan, so that the service usage notification and policies can be immediately updated on a given device as the user swaps the SIM from device to device. In some embodiments, the manner in which this service usage history is stored on the SIM is secure so that it cannot be tampered with. In some embodiments, the SIM card is used to implement various application management and/or traffic control techniques described herein. In some embodiments, the SIM card is used to inspect traffic, classify traffic, create reports (e.g., certified service activity usage reports), encrypt the report, send the report to a network element/function, and the network element/function correlates the reports (e.g., using network assisted measures for comparisons and/or using various other techniques as described herein). In some embodiments, a SIM card performs a portion or all of the secure environment processing described above using one or more modem measurement points. For example, the traffic that is to be classified can be routed through the SIM and correlated with what is measured by the modem. In some embodiments, network assisted/based network service usage activity classifications are compared SIM based/assisted classifications for service usage monitoring/reporting verification (e.g., detected inconsistencies in monitored/reported network service usage activities can be identified, such as based on total traffic, streams/flows/sockets activities, and/or other criteria/measures). In some embodiments, the reports include a verified sequence so that reports cannot be spoofed and/or missing reports can be determined.

[00246] In some embodiments, a portion or all of the secure environment processing described above are applied to implement and/or verify QoS for DAS techniques and/or DAS for network capacity controlled services techniques as described herein.

[00247] In some embodiments, the reports include one or more of the following: a number of times the device is cycled from or to a power cycle state in the modem, a number of times during a time window or network busy state, a power cycle versus number of streams initiated during the cycle, and a power cycle versus the streams that are transmitted during that cycle, In some embodiments, device power cycle events trigger generating of a report.

[00248] In some embodiments, monitoring, reporting, control, accounting, charging, and/or policy implementation for network capacity controlled services is verified (e.g., using various verification techniques described herein). If any of the verification techniques determine or assist in determining that the network capacity controlled services monitoring, reporting, control, accounting, and/or charging, and/or policy implementation has been tampered with, disabled, and/or is not properly implemented or functioning, then responsive actions can be performed, for example, the device (e.g., and/or suspect services) can be suspended, quarantined, killed/terminated, and/or flagged for further analysis/scrutiny to determine whether the device is malfunctioning, needs updating, has been tampered with or compromised, is infected with malware, and/or if any other problem exists.

[00249] In some embodiments, the service processor monitors a network service usage activity of a device. In some embodiments, monitoring of the service usage activity includes monitoring for multiple networks (e.g., to determine which networks are available and/or a network busy state of the available networks). In some embodiments monitoring a network service usage activity is performed by and/or assisted by a service cloud (e.g., one or more network elements that provide such a service). In some embodiments, monitoring the network service usage activity includes identifying the network service usage activity, measuring the network service usage of the network service usage activity, and/or characterizing the network service usage of the network service usage activity (e.g., using device assisted/based techniques, network assisted/based techniques, testing/offline monitoring/analysis techniques, and/or a combination thereof).

[00250] In some embodiments, the service processor implements differential network access service control (e.g., for network capacity controlled services), network service usage accounting, network service usage charging, and/or network service usage notification on the device to facilitate DAS for protecting network capacity.

[00251] In some embodiments, the service processor (e.g., a service processor 115) is updated, communicated with, set, and/or controlled by a network element (e.g., a service controller 122). In some embodiments, the service processor receives service policy information from a network function selected from a base station (e.g., a base station 125), a RAN gateway, a core gateway, a DPI gateway, a home agent (HA), a AAA server (e.g., AAA server 121), a service controller, and/or another network function or combinations of network functions as described herein and/or as will now be apparent to one of ordinary skill in the art in view of the various embodiments described herein. In some embodiments, the service processor is updated through over the air or over the network OS software updates or application software updates or device firmware updates. In some embodiments, the service processor uses an IP connection, SMS connection, and/or MMS connection, for a control channel with a service controller. In some embodiments, the service processor queries a service controller to determine the association of a monitored network service usage activity with a network service usage control policy. In some embodiments, the device (e.g., service processor) maintains a network capacity controlled services list and/or network capacity controlled services policy for one or more of the active services (e.g., actively executing and/or previously installed/downloaded to the device) that have been classified as a network capacity controlled service (e.g., as the number of applications continues to grow, as hundreds of thousands of applications are already available on certain platforms, maintaining a list specific and/or a set of policies unique or specific to each application is not efficient). In this embodiment, when a new application is active/launched and/or downloaded to the device, the device can request an updated network capacity controlled services list and/or an updated network capacity controlled services policy accordingly (e.g., and/or periodically refresh such lists/policies).

[00252] In some embodiments, differential network access control for protecting network capacity includes controlling network services traffic generated by the device (e.g., network capacity controlled services based on a network service usage control policy (e.g., a network capacity controlled services policy). In some embodiments, differential network access control

for protecting network capacity includes providing assistance in control of the distribution of bandwidth among devices, network capacity controlled services (e.g., applications, OS operations/functions, and various other network services usage activities classified as network capacity controlled services), a differentiated QoS service offering, a fair sharing of capacity, a high user load network performance, and/or preventing one or more devices from consuming so much network capacity that other devices cannot receive adequate performance or performance in accordance with various threshold and/or guaranteed service levels. In some embodiments, differential network access control for protecting network capacity includes applying policies to determine which network the service activity should be connected to (e.g., 2G, 3G, 4G, home or roaming, WiFi, cable, DSL, fiber, wired WAN, and/or another wired or wireless or access network), and applying differential network access control rules (e.g., traffic control rules) depending on which network to which the service activity is connected. In some embodiments, differential network access control for protecting network capacity includes differentially controlling network service usage activities based on the service usage control policy and a user input (e.g., a user selection or user preference). In some embodiments, differential network access control for protecting network capacity includes differentially controlling network service usage activities based on the service usage control policy and the network the device or network service activity is gaining access from.

[00253] In some embodiments, the network service usage control policy is dynamic based on one or more of the following: a network busy state, a time of day, which network the service activity is connected to, which base station or communication channel the service activity is connected to, a user input, a user preference selection, an associated service plan, a service plan change, an application behavior, a messaging layer behavior, random back off, a power state of device, a device usage state, a time based criteria (e.g., time/day/week/month, hold/delay/defer for future time slot, hold/delay/defer for scheduled time slot, and/or hold/delay/defer until a busy state/availability state/QoS state is achieved), monitoring of user interaction with the service activity, monitoring of user interaction with the device, the state of UI priority for the service activity, monitoring the power consumption behavior of the service activity, modem power cycling or power control state changes, modem communication session set up or tear down, and/or a policy update/modification/change from the network. In some embodiments, the network service usage control policy is based on updated service usage behavior analysis of the

network service usage activity. In some embodiments, the network service usage control policy is based on updated activity behavior response to a network capacity controlled service classification. In some embodiments, the network service usage control policy is based on updated user input/preferences (e.g., related to policies/controls for network capacity controlled services). In some embodiments, the network service usage control policy is based on updates to service plan status. In some embodiments, the network service usage control policy is based on updates to service plan policies. In some embodiments, the network service usage control policy is based on availability of alternative networks. In some embodiments, the network service usage control policy is based on policy rules for selecting alternative networks. In some embodiments, the network service usage control policy is based on network busy state or availability state for alternative networks. In some embodiments, the network service usage control policy is based on specific network selection or preference policies for a given network service activity or set of network service activities.

[00254] In some embodiments, associating the network service usage activity with a network service usage control policy or a network service usage notification policy, includes dynamically associating based on one or more of the following: a network busy state, a time of day, a user input/preference, an associated service plan (e.g., 25 MB data plan, 5G data plan, or an unlimited data plan or other data/service usage plan), an application behavior, a messaging layer behavior, a power state of device, a device usage state, a time based criteria, availability of alternative networks, and a set of policy rules for selecting and/or controlling traffic on one or more of the alternative networks.

[00255] In some embodiments, a network service usage control policy (e.g., a network capacity controlled services policy) includes defining the network service usage control policy for one or more service plans, defining network access policy rules for one or more devices or groups of devices in a single or multi-user scenarios such as family and enterprise plans, defining network access policy rules for one or more users or groups of users, allowing or disallowing network access events or attempts, modulating the number of network access events or attempts, aggregating network access events or attempts into a group of access events or attempts, time windowing network access events or attempts, time windowing network access events or attempts based on the application or function being served by the network access events or attempts, time windowing network access events or attempts to pre-determined time windows,

time windowing network access events or attempts to time windows where a measure of network busy state is within a range, assigning the allowable types of access events or attempts, assigning the allowable functions or applications that are allowed network access events or attempts, assigning the priority of one or more network access events or attempts, defining the allowable duration of network access events or attempts, defining the allowable speed of network access events or attempts, defining the allowable network destinations for network access events or attempts, defining the allowable applications for network access events or attempts, defining the QoS rules for one or more network access events or attempts, defining or setting access policy rules for one or more applications, defining or setting access policy rules for one or more network destinations, defining or setting access policy rules for one or more devices, defining or setting access policy rules for one or more network services, defining or setting access policy rules for one or more traffic types, defining or setting access policy rules for one or more QoS classes, and defining or setting access policy rules based on any combination of device, application, network destination, network service, traffic type, QoS class, and/or other criteria/measures.

[00256] In some embodiments, a network service usage control policy (e.g., a network capacity controlled services policy) includes a traffic control policy. In some embodiments, the traffic control policy includes a traffic control setting. In some embodiments, the traffic control policy includes a traffic control/tier, and the traffic control/tier includes the traffic control setting. In some embodiments, the traffic control policy includes one or more of the following: block/allow settings, throttle settings, adaptive throttle settings, QoS class settings including packet error rate, jitter and delay settings, queue settings, and tag settings (e.g., for packet tagging certain traffic flows). In some embodiments, QoS class settings include one or more of the following: throttle level, priority queuing relative to other device traffic, time window parameters, and hold or delay while accumulating or aggregating traffic into a larger stream/burst/packet/group of packets. In some embodiments, the traffic control policy includes filters implemented as indexes into different lists of policy settings (e.g., using cascade filtering techniques), in which the policy filters include one or more of the following: a network, a service plan, an application, a time of day, and a network busy state. For example, a two dimensional traffic control implementation scheme can be provided using a network busy state and/or a time of day as an index into a traffic control setting (e.g., a certain application's priority

level can be increased or decreased based on a network busy state and/or time of day). In some embodiments, the traffic control policy is used for selecting the network from a list of available networks, blocking or reducing access until a connection is made to an alternative network, and/or modifying or replacing a network stack interface of the device to provide for intercept or discontinuance of network socket interface messages to applications or OS functions.

[00257] In some embodiments, a traffic control setting is selected based on the network service usage control policy. In some embodiments, the traffic control setting is implemented on the device based on the network service usage control policy. In some embodiments, the implemented traffic control setting controls traffic/traffic flows of a network capacity controlled service. In some embodiments, the traffic control setting is selected based on one or more of the following: a time of day, a day of week, a special time/date (e.g., a holiday or a network maintenance time/date), a network busy state, a priority level associated with the network service usage activity, a QoS class associated with the network service usage activity (e.g., emergency traffic), which network the network service activity is gaining access from, which networks are available, which network the network service activity is connected to, which base station or communication channel the network service activity is connected to, and a network dependent set of traffic control policies that can vary depending on which network the service activity is gaining access from (e.g., and/or various other criteria/measures as described herein). In some embodiments, the traffic control setting includes one or more of the following: allow/block, delay, throttle, QoS class implementation, queue, tag, generate a user notification, random back off, clear to send received from a network element, hold for scheduled transmission time slot, selecting the network from the available networks, and blocking or reducing access until a connection is made to an alternative network. In some embodiments, the traffic control setting is selected based on a network capacity controlled services priority state of the network service usage activity and a network busy state. In some embodiments, the traffic control setting is selected based on a network capacity controlled services priority state of the network service usage activity and a network busy state and is global (e.g., the same) for all network capacity controlled services activities or varies based on a network service usage activity priority, user preferences or option selection, an application, a time based criteria, a service plan, a network the device or service activity is gaining access from, a redetermination of a network congestion state

after adapting to a previously determined network busy state, and/or other criteria/measures as described herein.

[00258] In some embodiments, network capacity controlled services traffic (e.g., traffic flows) is differentially controlled for protecting network capacity. For example, various software updates for an OS and one or more applications on the device can be differentially controlled using the various techniques described herein. As another example, security/antimalware software (e.g., antivirus, firewall, content protection, intrusion detection/prevention, and/or other security/antimalware software) can be differentially controlled using the various techniques described herein. As yet another example, network backups/imaging, content downloads (e.g., exceeding a threshold individually and/or in aggregate, such as for image, music, video, eBook content, email attachments, content/media subscriptions, RSS/news feeds, text/image/video chat, software updates, and/or other content downloads) can be differentially controlled using the various techniques described herein.

[00259] For example, using the DAS for protecting network capacity techniques described herein an adaptive policy control for protecting network capacity can be provided. A network capacity controlled services list can be generated, updated, reported, and/or received by the device and stored on the device (e.g., the list can be based on adapted to the service plan associated with the device). If a monitored network service usage activity is not on the list, then the device can report the monitored network service usage activity to a network element (e.g., for a monitored network service usage activity that also exceeds a certain threshold, based on a network busy state, based on a time based criteria, and/or other criteria/measure). As an example, monitored network service usage activity can be reported if/when the monitored network service usage activity exceeds a data usage threshold (e.g., 50 MB total data usage per day, a socket opening frequency/rate, velocity of data usage at an instant in time, or more complicated thresholds over time, over peak periods, by content and time, by various other parameters/thresholds). As another example, the monitored network service usage activity can be reported based on testing of the network service usage behavior and/or application developer characterization input. The report can include information that identifies the network service usage activity and various network service usage parameters.

[00260] In some embodiments, a notification setting is selected based on a service usage notification policy. In some embodiments, a notification setting includes a user notification setting (e.g., various user notifications settings as described above with respect to FIG. 18).

[00261] In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity (e.g., using a usage threshold filter and/or cascading filter techniques) into one or more of a plurality of classification categories for differential network access control for protecting network capacity. In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity into one or more network capacity controlled services in which the network capacity controlled services include one or more of the following: applications requiring data network access, application software updates, applications requiring network information, applications requiring GPS or physical location, operating system software updates, security software updates, network based backups, email downloads, and a set of activities configured as network capacity controlled service activities based on a service profile and/or user input (e.g., and/or various other types of network service usage activities as described herein and as will now be apparent to one of ordinary skill in the art). For example, network capacity controlled services can include software updates for OS and applications, OS background network accesses, cloud synchronization services, RSS feeds and other background information feeds, browser/application/device behavior reporting, background email downloads, content subscription service updates and downloads (e.g., music/video downloads, news feeds), text/voice/video chat clients, security updates (e.g., antimalware updates), peer to peer networking application updates, inefficient network access sequences during frequent power cycling or power save state cycling, large downloads or other high bandwidth accesses, and greedy application programs that constantly/repeatedly access the network with small transmissions or requests for information. In some embodiments, a network capacity controlled services list is static, adaptive, generated using a service processor, received from a network element (e.g., service controller or service cloud), received from a network element (e.g., service controller or service cloud) and based at least in part on device activity reports received from the service processor, based on criteria set by pre-testing, report of behavior characterization performed by the application developer, and/or based at least in part on user input. In some

embodiments, the network capacity controlled services list includes one or more network service activity background (QoS) classes.

[00262] In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity based on one or more of the following: application or widget (e.g., Outlook, Skype, iTunes, Android email, weather channel weather widget, iCal, Firefox Browser, etc), application type (e.g., user application, system application/utility/function/process, OS application/utility/function/process, email, browser, widget, malware (such as a virus or suspicious process), RSS feed, device synchronization service, download application, network backup/imaging application, voice/video chat, peer to peer content application or other peer to peer application, streaming media feed or broadcast reception/transmission application, network meeting application, chat application or session, and/or any other application or process identification and categorization), OS/system function (e.g., any system application/utility/function/process and/or OS application/utility/function/process, such as a OS update and/or OS error reporting), modem function, network communication function (e.g., network discovery or signaling, EtherType messages, connection flow/stream/session set up or tear down, network authentication or authorization sequences, IP address acquisition, and DNS services), URL and/or domain, destination/source IP address, protocol, traffic type, socket (e.g., IP address, protocol, and/or port), socket address/label/identifier (e.g., port address/port number), content type (e.g., email downloads, email text, video, music, eBooks, widget update streams, and download streams), port (e.g., port number), QoS classification level, time of day, on peak or off peak, network time, network busy state, access network selected, service plan selected, user preferences, device credentials, user credentials, and/or status, modem power cycling or power state changes, modem authentication processes, modem link set up or tear down, modem management communications, modem software or firmware updates, modem power management information, device power state, and modem power state. In some embodiments, classifying the network service usage activity further includes associating the classified network service usage activity with an ID (e.g., an application ID, which can be, for example, a unique number, name, and/or signature). In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity using a plurality of classification parameters, including one or more of the following: application ID, remote IP (e.g., URL, domain, and/or IP address), remote

port, protocol, content type, a filter action class (e.g., network busy state class, QoS class, time of day, network busy state, and/or other criteria/measures), and access network selected. In some embodiments, classifying the network service usage activity further includes using a combination of parameters as discussed above to determine the classification of the network service usage activity.

[00263] In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity as a network capacity controlled service, a non-network capacity controlled service, a blocked or disallowed service, and/or a not yet classified/identified service (e.g., unknown/yet to be determined classification or pending classification). In some embodiments, an application connection, OS connection, and/or other service activity is classified as a network capacity controlled service activity when the device has been inactive (e.g., or in a power save state) for a period of time (e.g., when the user has not interacted with it for a period of time, when it has not displayed user notification policy, and/or a user input has not been received for a period of time, and/or when a power save state is entered). In some embodiments, an application connection, OS connection, and/or other service activity is classified as a network capacity controlled service activity when the monitored network service usage activity exceeds a data usage threshold for more than one application connection, OS connection, and/or other service activity (e.g., aggregated data usage exceeds the data usage threshold); or for a specific application connection. In some embodiments, an application connection, OS connection, and/or other service activity is classified as a network capacity controlled service activity when the monitored network service usage activity exceeds a data usage threshold based on a predetermined list of one or more data usage limits, based on a list received from a network element, usage time limit (e.g., based on a period of time exceeding a usage limit), and/or based on some other usage related criteria/measures. In some embodiments, classifying the network service usage activity further includes classifying the network service usage activity as a network capacity controlled service based on a network peak time, a network busy state, or a network connection to the device falls below a certain performance level (e.g., higher/lower priorities assigned based on various such criteria/other input/factors).

[00264] In some embodiments, one or more of the network capacity controlled services are associated with a different network access policy set for one or more networks and/or one or

more alternative networks. In some embodiments, one or more of the network capacity controlled services are associated with a different notification policy set for one or more networks and/or one or more alternative networks. In some embodiments, the network capacity controlled services list is stored on the device. In some embodiments, the network capacity controlled services list is received/periodically updated from a network element and stored on the device. In some embodiments, the network capacity controlled services list includes network capacity controlled services, non-network capacity controlled services (e.g., foreground services or services based on various possibly dynamic criteria are not classified as network capacity controlled services), and an unclassified set of services (e.g., grey list including one or more network service activities pending classification based on further analysis and/or input, such as from a network element, service provider, and/or user). In some embodiments, the network capacity controlled services list is based on one or more of the following: predefined/predesignated (e.g., network, service plan, pre-test and/or characterized by an application developer) criteria; device assisted/based monitoring (e.g., using a service processor); network based monitoring (e.g., using a DPI gateway); network assisted analysis (e.g., based on device reports of DAS activity analysis). For example, the device can report device monitored network service usage activities (e.g., all monitored network service usage activities or a subset based on configuration, threshold, service plan, network, and/or user input) to the network element. As another example, the network element can update the network capacity controlled services list and send the updated list to the device. As yet another example, the network element can perform a statistical analysis of network service activities across a plurality of devices based on the device based and/or network based network service usage activity monitoring/reporting. In some embodiments, a network service usage activity is determined to be an active application or process (e.g., based on a user interaction with the device and/or network service usage activity, such as a pop-up and/or other criteria/measures).

[00265] In some embodiments, implementing traffic control for network capacity controlled services is provided using various techniques. In some embodiments, the device includes a service processor agent or function to intercept, block, modify, remove or replace UI messages, notifications or other UI communications generated by a network service activity that whose network service usage is being controlled or managed (e.g., using various measurement points as shown in and described with respect to FIGS. 12 and 13). For example, this technique

can be used to provide for an improved user experience (e.g., to prevent an application that is being controlled for protecting network capacity from generating repeated and/or confusing messages/alerts to the user). In some embodiments, a network stack interface of the device is replaced or modified to provide for intercept or discontinuance of network socket interface messages to applications or OS functions or other functions/software.

[00266] In some embodiments, implementing traffic control for network capacity controlled services using DAS techniques is provided using various techniques in which the network service usage activity is unaware of network capacity control (e.g., does not support an API or other interface for implementing network capacity control). For example, network service application messaging interface based techniques can be used to implement traffic control. Example network service application messaging interfaces include the following: network stack API, network communication stream/flow interface, network stack API messages, EtherType messages, ARP messages, and/or other messaging or other or similar techniques as will now be apparent to one of ordinary skill in the art in view of the various embodiments described herein. In some embodiments, network service usage activity control policies or network service activity messages are selected based on the set of traffic control policies or service activity messages that result in reduced or modified user notification by the service activity due to network capacity controlled service policies applied to the network service activity. In some embodiments, network service usage activity control policies or network service activity messages are selected based on the set of traffic control policies or service activity messages that result in reduced disruption of device operation due to network capacity controlled service activity policies applied to the network service activity. In some embodiments, network service usage activity control policies or network service activity messages are selected based on the set of traffic control policies or service activity messages that result in reduced disruption of network service activity operation due to network capacity controlled service activity policies applied to the network service activity. In some embodiments, implementing traffic control for network capacity controlled services is provided by intercepting opens/connects/writes. In some embodiments, implementing traffic control for network capacity controlled services is provided by intercepting stack API level or application messaging layer requests (e.g., socket open/send requests). For example, an intercepted request can be copied (e.g., to memory) and queued (e.g., delayed or throttled) or dropped (e.g.,

blocked). As another example, an intercepted request can be copied into memory and then a portion of the transmission can be retrieved from memory and reinjected (e.g., throttled). As yet another example, intercepting messaging transmissions can be parsed inline and allowed to transmit (e.g., allowed), and the transmission or a portion of the transmission can be copied to memory for classifying the traffic flow. In some embodiments, implementing traffic control for network capacity controlled services is provided by intercepting or controlling or modulating UI notifications. In some embodiments, implementing traffic control for network capacity controlled services is provided by killing or suspending the network service activity. In some embodiments, implementing traffic control for network capacity controlled services is provided by deprioritizing the process(es) associated with the service activity (e.g., CPU scheduling deprioritization).

[00267] In some embodiments, implementing traffic control for network capacity controlled services using DAS techniques for network service usage activities that are unaware of network capacity control is provided by emulating network API messaging (e.g., effectively providing a spoofed or emulated network API). For example, an emulated network API can intercept, modify, block, remove, and/or replace network socket application interface messages and/or EtherType messages (e.g., EWOULDBLOCK, ENETDOWN, ENETUNREACH, EHOSTDOWN, EHOSTUNREACH, EALRADY, EINPROGRESS, ECONNREFUSED, EINPROGRESS, ETIMEDOUT, and/other such messages). As another example, an emulated network API can modify, swap, and/or inject network socket application interface messages (socket(), connect(), read(), write(), close(), and other such messages) that provide for control or management of network service activity service usage behavior. As yet another example, before a connection is allowed to be opened (e.g., before a socket is opened), transmission, or a flow/stream is initiated, it is blocked and a message is sent back to the application (e.g., a reset message in response to a sync request or another message that the application will understand and can interpret to indicate that the network access attempt was not allowed/blocked, that the network is not available, and/or to try again later for the requested network access). As yet another example, the socket can be allowed to open but after some point in time (e.g., based on network service usage, network busy state, time based criteria, and/or some other criteria/measure), the stream is blocked or the socket is terminated. As yet another example, time window based traffic control techniques can be implemented (e.g., during non-peak, not

network busy state times), such as by allowing network access for a period of time, blocking for a period of time, and then repeating to thereby effectively spread the network access out either randomly or deterministically. Using these techniques, an application that is unaware of network capacity control based traffic control can send and receive standard messaging, and the device can implement traffic controls based on the network capacity control policy using messaging that the network service usage activity (e.g., application or OS or software function) can understand and will respond to in a typically predictable manner as would now be apparent to one of ordinary skill in the art.

[00268] In some embodiments, implementing traffic control for network capacity controlled services using DAS techniques is provided using various techniques in which the network service usage activity is aware of network capacity control (e.g., the network service usage activity supports an API or other interface for implementing network capacity control). For example, a network access API as described herein can be used to implement traffic control for network capacity controlled services. In some embodiments, the API facilitates communication of one or more of the following: network access conditions, network busy state or network availability state of one or more networks or alternative networks, one or more network capacity controlled service policies (e.g., the network service can be of a current network access setting, such as allow/block, throttle, queue, scheduled time/time slot, and/or defer, which can be based on, for example, a current network, a current network busy state, a time based criteria, a service plan, a network service classification, and/or other criteria/measures), a network access request from a network service activity, a query/polled request to a network service activity, a network access grant to a network service activity (e.g., including a priority setting and/or network capacity controlled service classification, a scheduled time/time slot, an alternative network, and/or other criteria/measures), a network busy state or a network availability state or a network QoS state.

[00269] In some embodiments, implementing traffic control for network capacity controlled services using network assisted/based techniques is provided using various techniques in which the network service usage activity is unaware of network capacity control (e.g., does not support an API or other interface for implementing network capacity control). In some embodiments, DPI based techniques are used to control network capacity controlled services (e.g., to block or throttle network capacity controlled services at a DPI gateway).

[00270] In some embodiments, implementing traffic control for network capacity controlled services using network assisted/based techniques is provided using various techniques in which the network service usage activity is aware of network capacity control (e.g., does support an API or other interface for implementing network capacity control). In some embodiments, the application/messaging layer (e.g., a network API as described herein) is used to communicate with a network service activity to provide associated network capacity controlled service classifications and/or priorities, network busy state information or network availability of one or more networks or alternative networks, a network access request and response, and/other criteria/measures as similarly described herein.

[00271] In some embodiments, DAS for protecting network capacity includes implementing a service plan for differential charging based on network service usage activities (e.g., including network capacity controlled services). In some embodiments, the service plan includes differential charging for network capacity controlled services. In some embodiments, the service plan includes a cap network service usage for network capacity controlled services. In some embodiments, the service plan includes a notification when the cap is exceeded. In some embodiments, the service plan includes overage charges when the cap is exceeded. In some embodiments, the service plan includes modifying charging based on user input (e.g., user override selection as described herein, in which for example, overage charges are different for network capacity controlled services and/or based on priority levels and/or based on the current access network). In some embodiments, the service plan includes time based criteria restrictions for network capacity controlled services (e.g., time of day restrictions with or without override options). In some embodiments, the service plan includes network busy state based criteria restrictions for network capacity controlled services (e.g., with or without override options). In some embodiments, the service plan provides for network service activity controls to be overridden (e.g., one time, time window, usage amount, or permanent) (e.g., differentially charge for override, differentially cap for override, override with action based UI notification option, and/or override with UI setting). In some embodiments, the service plan includes family plan or multi-user plan (e.g., different network capacity controlled service settings for different users). In some embodiments, the service plan includes multi-device plan (e.g., different network capacity controlled service settings for different devices, such as smart phone v. laptop v. net book v. eBook). In some embodiments, the service plan includes free network capacity

controlled service usage for certain times of day, network busy state(s), and/or other criteria/measures. In some embodiments, the service plan includes network dependent charging for network capacity controlled services. In some embodiments, the service plan includes network preference/prioritization for network capacity controlled services. In some embodiments, the service plan includes arbitration billing to bill a carrier partner or sponsored service partner for the access provided to a destination, application, or other network capacity controlled service. In some embodiments, the service plan includes arbitration billing to bill an application developer for the access provided to a destination, application or other network capacity controlled service.

[00272] In some application scenarios, excess network capacity demand can be caused by modem power state changes on the device. For example, when an application or OS function attempts to connect to the network for any reason when the modem is in a power save state wherein the modem is not connected to the network, it can cause the modem to change power save state, reconnect to the network, and then initiate the application network connection. In some cases, this can also cause the network to re-initiate a modem connection session (e.g., PPP session) which in addition to the network capacity consumed by the basic modem connection also consumes network resources for establishing the PPP session. Accordingly, in some embodiments, network service usage activity control policies are implemented that limit or control the ability of applications, OS functions, and/or other network service usage activities (e.g., network capacity controlled services) from changing the modem power control state or network connection state. In some embodiments, a service usage activity is prevented or limited from awakening the modem, changing the power state of the modem, or causing the modem to connect to the network until a given time window is reached. In some embodiments, the frequency a service usage activity is allowed to awakening the modem, changing the power state of the modem, or causing the modem is limited. In some embodiments, a network service usage activity is prevented from awakening the modem, changing the power state of the modem, or causing the modem until a time delay has passed. In some embodiments, a network service usage activity is prevented from awakening the modem, changing the power state of the modem, or causing the modem until multiple network service usage activities require such changes in modem state, or until network service usage activity is aggregated to increase network capacity and/or network resource utilization efficiency. In some embodiments, limiting the ability of a

network service usage activity to change the power state of a modem includes not allowing the activity to power the modem off, place the modem in sleep mode, or disconnect the modem from the network. In some embodiments, these limitations on network service usage activity to awaken the modem, change the power state of the modem, or cause the modem to connect to a network are set by a central network function (e.g., a service controller or other network element/function) policy communication to the modem. In some embodiments, these power control state policies are updated by the central network function.

[00273] FIG. 24 depicts a diagram of a network capacity protection system 2400 utilizing device-assisted services (DAS). The system 2400 includes wireless devices 2402-1 to 2402-N (referred to collectively as the wireless devices 2402), wireless networks 2404-1 to 2404-N (referred to collectively as the wireless networks 2404), a network traffic analysis engine 2406, a network service usage classification engine 2408, and a differential network access control engine 2410.

[00274] The wireless devices 2402 will at a minimum include a processor, memory (though the memory could be implemented in the processor), a radio, and a radio interface (though the radio interface could be implemented as "part of" the radio). In order to make the wireless devices 2402 useful, they will typically have at least one input device and at least one output device, including input and output interfaces, if applicable.

[00275] The wireless devices 2402 can be implemented as stations. A station, as used herein, may be referred to as a device with a media access control (MAC) address and a physical layer (PHY) interface to the wireless medium that comply with, e.g., the IEEE 802.11 standard. A station can be described as "IEEE 802.11-compliant" when compliance with the IEEE 802.11 standard is intended to be explicit. (I.e, a device acts as described in at least a portion of the IEEE 802.11 standard.) One of ordinary skill in the relevant art would understand what the IEEE 802.11 standard comprises today and that the IEEE 802.11 standard can change over time, and would be expected to apply techniques described in this paper in compliance with future versions of the IEEE 802.11 standard if an applicable change is made. IEEE Std 802.11™-2007 (Revision of IEEE Std 802.11-1999) is incorporated by reference. IEEE 802.11k-2008, IEEE 802.11n-2009, IEEE 802.11p-2010, IEEE 802.11r-2008, IEEE 802.11w-2009, and IEEE 802.11y-2008 are also incorporated by reference.

[00276] In alternative embodiments, one or more of the wireless devices 2402 may comply with some other standard or no standard at all, and may have different interfaces to a wireless or other medium. It should be noted that not all standards refer to wireless devices as "stations," but where the term is used in this paper, it should be understood that an analogous unit will be present on all applicable wireless networks. Thus, use of the term "station" should not be construed as limiting the scope of an embodiment that describes wireless devices as stations to a standard that explicitly uses the term, unless such a limitation is appropriate in the context of the discussion.

[00277] The wireless networks 2404 will typically include an internetworking unit (IWU) that interconnects wireless devices on the relevant one of the wireless networks 2404 with another network, such as a wired LAN. The IWU is sometimes referred to as a wireless access point (WAP). In the IEEE 802.11 standard, a WAP is also defined as a station. Thus, a station can be a non-WAP station or a WAP station. In a cellular network, the WAP is often referred to as a base station.

[00278] The wireless networks 2404 can be implemented using any applicable technology, which can differ by network type or in other ways. The wireless networks 2404 can be of any appropriate size (e.g., metropolitan area network (MAN), personal area network (PAN), etc.). Broadband wireless MANs may or may not be compliant with IEEE 802.16, which is incorporated by reference. Wireless PANs may or may not be compliant with IEEE 802.15, which is incorporated by reference. The wireless networks 2404 can be identifiable by network type (e.g., 2G, 3G, WiFi), service provider, WAP/base station identifier (e.g., WiFi SSID, base station and sector ID), geographic location, or other identification criteria.

[00279] The wireless networks 2404 may or may not be coupled together via an intermediate network. The intermediate network can include practically any type of communications network, such as, by way of example but not limitation, the Internet, a public switched telephone network (PSTN), or an infrastructure network (e.g., private LAN). The term "Internet" as used herein refers to a network of networks which uses certain protocols, such as the TCP/IP protocol, and possibly other protocols such as the hypertext transfer protocol (HTTP) for hypertext markup language (HTML) documents that make up the World Wide Web (the web).

[00280] In the example of FIG. 24, the network traffic analysis engine 2406 is coupled to the wireless device 2402-1. In a specific implementation, the network traffic analysis engine 2406 is implemented on a server and is coupled to the wireless device 2402-1 through the Internet. However, at least a portion of the network traffic analysis engine 2406 can alternatively be implemented on the wireless device 2402-1, with or without a connection to a server that includes another portion (e.g., a server portion) of the network traffic analysis engine 2406.

[00281] As used in this paper, an engine includes a dedicated or shared processor and, typically, firmware or software modules that are executed by the processor. Depending upon implementation-specific or other considerations, an engine can be centralized or its functionality distributed. An engine can include special purpose hardware, firmware, or software embodied in a computer-readable medium for execution by the processor. As used in this paper, a computer-readable medium is intended to include all mediums that are statutory (e.g., in the United States, under 35 U.S.C. 101), and to specifically exclude all mediums that are non-statutory in nature to the extent that the exclusion is necessary for a claim that includes the computer-readable medium to be valid. Known statutory computer-readable mediums include hardware (e.g., registers, random access memory (RAM), non-volatile (NV) storage, to name a few), but may or may not be limited to hardware.

[00282] The network traffic analysis engine 2406 analyzes a subset of traffic between the wireless device 2402-1 and a source or destination. The analyzed traffic may or may not be limited to a network segment, such as between a cellular phone and a base station. The network traffic analysis engine 2406 can analyze traffic for a subset of devices in the wireless network 2404-1 service area. The analyzed traffic may or may not be limited to subscribers.

[00283] In the example of FIG. 24, the network service usage classification engine 2408 is coupled to the network traffic analysis engine 2406. In a specific implementation, the network service usage classification engine 2408 is implemented on a server, which may or may not be the same server on which the network traffic analysis engine 2406 is implemented. However, at least a portion of the network service usage classification engine 2408 can alternatively be implemented on the wireless device 2402-1, with or without a connection to a server that includes another portion (e.g., a server portion) of the network service usage classification engine 2408.

[00284] The network service usage classification engine 2408 can categorize traffic based upon the service class (e.g., conversational, streaming, interactive, background, or some other service class) requested or needed for a service. The categorization facilitates identification of a snapshot of service class use at a given time, and, in some implementations, predictions of future service class use based upon the snapshot (e.g., making an assumption that future service class use is at least somewhat related to service class use of the snapshot), historical data analysis (e.g., service class usage at certain times of day/days of the week), identification of trends, or the use of some other predictive technology.

[00285] In the example of FIG. 24, the differential network access control engine 2410 is coupled to the network service usage classification engine 2408. In a specific implementation, the network access control engine 2410 is implemented on a server, which may or may not be the same server on which the network traffic analysis engine 2406 and/or the network service usage classification engine 2408 are implemented. However, at least a portion of the network access control engine 2410 can alternatively be implemented on the wireless device 2402-1, with or without a connection to a server that includes another portion (e.g., a server portion) of the network access control engine 2410.

[00286] The differential network access control engine 2410 uses the predicted service class use from the network service usage classification engine 2408 to dynamically adjust resources allocated to service classes. For example, the differential network access control engine 2410 can perform a service class availability assessment to determine whether service class capacity for service classes on a channel is sufficient for predicted service usage, and either add resources if service class availability is insufficient for predicted service usage or reduce resources if service class availability is more than sufficient for predicted service usage.

[00287] Alternatively, the differential network access control engine 2410 can instead or in addition control applications on devices such that the applications change service usage levels or delay consumption of wireless resources (e.g., by delaying software updates until more resources become available). In an embodiment, a service usage control policy is implemented on the wireless device 2402-1. This may be necessary in some cases to ensure the wireless device 2402-1 can adjust application settings that are normally fixed, optimize network service usage activation based on network state (e.g., if the network is busy), control over-the-air

software updates, throttle resource-hungry applications, manage network service usage requests from repeated power down modes, keep PPP sessions active, or otherwise facilitate dynamic service class adjustments or other device behavior.

[00288] In a specific implementation, subscribers can be incented to change service classes by, for example, charging more for higher service classes. The differential network access control engine 2410 can send a notification of differential charges for service classes. Alternatively, the charges could be implemented via subscriber account settings or preferences.

[00289] In the example of FIG. 24, in operation, the network traffic analysis engine 2406 analyzes traffic from one or more devices, including the wireless device 2402-1. The network service usage classification engine 2408 predicts the amount of resources needed for service classes, and the differential network access control engine 2410 dynamically allocates resources on an as-needed basis to adjust the service classes that are available to the one or more devices and/or adjusts device behavior for a subset of the one or more devices or instructs a subset of the one or more devices to adjust device behavior such that the device consumes service class-specific resources in accordance with an access control policy appropriate for the resources allocated to the applicable service classes.

[00290] FIG. 25 depicts a diagram an example of a differential access control notification system 2500. In the example of FIG. 25, the system 2500 includes a network service usage analysis engine 2502, a network service usage classification engine 2504, a differential network access control engine 2506, a network service usage control policy datastore 2508, a network service usage notification engine 2510, a user interface 2512, and a service plan update engine 2514.

[00291] In the example of FIG. 25, the network service usage analysis engine 2502 analyzes network service usage activity. The analysis can include an analysis of traffic sent to or from a device, an application running on a device, a request for services, or other analysis that is informative of past, current, or future network service usage. For example, the network service usage activity can include an attempt to download or load an application onto the communications device, an attempt to execute the network service activity or the network service usage activity attempts to access the network, meeting or exceeding a network service usage threshold, satisfying a network service usage pre-condition, an update to a network capacity

controlled service activity classification list, an update to a network capacity controlled services policy, and a network message is sent to the device triggering the notification, to name several by way of example. The analysis can occur on a non-WAP station, a WAP or base station, a server, or partly on one of these devices or some other device.

[00292] In the example of FIG. 25, the network service usage classification engine 2504 is coupled to the network service usage analysis engine 2502. The network service usage classification engine 2504 classifies the analyzed network service usage into one or more service classes. The classification can occur on a non-WAP station, a WAP or base station, a server, or partly on one of these devices or some other device.

[00293] In the example of FIG. 25, the differential network access control engine 2506 is coupled to the network service usage classification engine 2504. The differential network access control engine 2506 determines network access parameters using the service classes associated with the network service usage activity and network service usage control policies stored in the network service usage control policy datastore 2508. The determination can occur on a non-WAP station, a WAP or base station, a server, or partly on one of these devices or some other device. The network service usage control policy datastore 2508 can be implemented on a wireless device, but it is also possible to maintain the datastore remotely relative to the device (e.g., on a server). In a specific implementation, even if the network service usage control policy datastore 2508 is maintained remotely relative to the wireless device, the wireless device will still have a network service usage control policy implemented.

[00294] A datastore can be implemented, for example, as software embodied in a physical computer-readable medium on a general- or specific-purpose machine, in firmware, in hardware, in a combination thereof, or in an applicable known or convenient device or system. Datastores in this paper are intended to include any organization of data, including tables, comma-separated values (CSV) files, traditional databases (e.g., SQL), or other applicable known or convenient organizational formats. Datastore-associated components, such as database interfaces, can be considered "part of" a datastore, part of some other system component, or a combination thereof, though the physical location and other characteristics of datastore-associated components is not critical for an understanding of the techniques described in this paper.

[00295] Datastores can include data structures. As used in this paper, a data structure is associated with a particular way of storing and organizing data in a computer so that it can be used efficiently within a given context. Data structures are generally based on the ability of a computer to fetch and store data at any place in its memory, specified by an address, a bit string that can be itself stored in memory and manipulated by the program. Thus some data structures are based on computing the addresses of data items with arithmetic operations; while other data structures are based on storing addresses of data items within the structure itself. Many data structures use both principles, sometimes combined in non-trivial ways. The implementation of a data structure usually entails writing a set of procedures that create and manipulate instances of that structure.

[00296] In the example of FIG. 25, the network service usage notification engine 2510 is coupled to the differential network access control engine 2506 and the network service usage control policy datastore 2508. The network service usage notification engine 2510 is configured to generate a notification sufficient to indicate relevant access control information. For example, the notification could indicate what network service usage activities are network capacity controlled services, the type of network service policy in effect for one or more network capacity controlled services, that a network service activity belongs to a network capacity controlled services classification, that a service activity that is classified as network capacity controlled services classification can have the classification changed, that if the service class is changed for the network service activity that the associated network service usage charges will change, a service plan upgrade/downgrade offer, and an offer for a service plan that provides discounts and/or incentives for responding to one or more user notifications for protecting network capacity, to name several by way of example.

[00297] The notification may or may not also include a user preference selection. For example, the notification could include a provision to associate a network service usage control policy with the network service usage activity, an over-ride option for selecting the network service usage control policy, a modify option to select the service usage control policy, and a select option to select a new service plan, to name several by way of example. Other examples include network service usage activity information for one or more network capacity controlled services, predicted network service usage activity information for one or more network capacity controlled services, an option for obtaining more information about the network service usage of

the network service usage activity, a message that the network service usage activity may result in network service usage that exceeds a threshold for a service plan associated with the device, an option to review or select an alternative service plan, an acknowledgement request, and an option to submit the acknowledgement request, to name several more by way of example.

[00298] In the example of FIG. 25, the user interface 2512 is coupled to the network service usage notification engine 2510. It may be noted that notifications can be disposed of by consulting user preferences (e.g., when a user indicates that maximum performance or minimum cost should be automatically selected). However, unless subscriber preferences are set as a default, a user is likely to have notifications displayed in the UI 2512. The notification can be in an applicable known or convenient form, such as SMS, email, a popup window, or the like. To the extent a response is permitted, a user can input a response to the notification using an input device (not shown).

[00299] In the example of FIG. 25, the service plan update engine 2514 is coupled to the UI 2512. As was previously mentioned, the UI can be bypassed because of, e.g., user preferences that are determinative of a selection provided in the notification. Regardless of how the selection associated with the notification is made, the service plan update engine 2514 can update a service plan, network service usage control policy, user preferences, or other parameters in accordance with the selection. The service plan update engine 2514 can also update accounting if costs accrue.

[00300] FIG. 26 depicts an example of a computer system 2600 on which techniques described in this paper can be implemented. The computer system 2600 may be a conventional computer system that can be used as a client computer system, such as a wireless client or a workstation, or a server computer system. The computer system 2600 includes a computer 2602, I/O devices 2604, and a display device 2606. The computer 2602 includes a processor 2608, a communications interface 2610, memory 2612, display controller 2614, non-volatile storage 2616, and I/O controller 2618. The computer 2602 may be coupled to or include the I/O devices 2604 and display device 2606.

[00301] The computer 2602 interfaces to external systems through the communications interface 2610, which may include a modem or network interface. It will be appreciated that the communications interface 2610 can be considered to be part of the computer system 2600 or a

part of the computer 2602. The communications interface 2610 can be an analog modem, ISDN modem, cable modem, token ring interface, satellite transmission interface (e.g., "direct PC"), or other interfaces for coupling a computer system to other computer systems.

[00302] The processor 2608 may be, for example, a conventional microprocessor such as an Intel Pentium microprocessor or Motorola power PC microprocessor. The memory 2612 is coupled to the processor 2608 by a bus 2670. The memory 2612 can be Dynamic Random Access Memory (DRAM) and can also include Static RAM (SRAM). The bus 2670 couples the processor 2608 to the memory 2612, also to the non-volatile storage 2616, to the display controller 2614, and to the I/O controller 2618.

[00303] The I/O devices 2604 can include a keyboard, disk drives, printers, a scanner, and other input and output devices, including a mouse or other pointing device. The display controller 2614 may control in the conventional manner a display on the display device 2606, which can be, for example, a cathode ray tube (CRT) or liquid crystal display (LCD). The display controller 2614 and the I/O controller 2618 can be implemented with conventional well known technology.

[00304] The non-volatile storage 2616 is often a magnetic hard disk, an optical disk, or another form of storage for large amounts of data. Some of this data is often written, by a direct memory access process, into memory 2612 during execution of software in the computer 2602. One of skill in the art will immediately recognize that the terms "machine-readable medium" or "computer-readable medium" includes any type of storage device that is accessible by the processor 2608 and also encompasses a carrier wave that encodes a data signal.

[00305] The computer system 2600 is one example of many possible computer systems which have different architectures. For example, personal computers based on an Intel microprocessor often have multiple buses, one of which can be an I/O bus for the peripherals and one that directly connects the processor 2608 and the memory 2612 (often referred to as a memory bus). The buses are connected together through bridge components that perform any necessary translation due to differing bus protocols.

[00306] Network computers are another type of computer system that can be used in conjunction with the teachings provided herein. Network computers do not usually include a hard disk or other mass storage, and the executable programs are loaded from a network

connection into the memory 2612 for execution by the processor 2608. A Web TV system, which is known in the art, is also considered to be a computer system, but it may lack some of the features shown in FIG. 26, such as certain input or output devices. A typical computer system will usually include at least a processor, memory, and a bus coupling the memory to the processor.

[00307] In addition, the computer system 2600 is controlled by operating system software which includes a file management system, such as a disk operating system, which is part of the operating system software. One example of operating system software with its associated file management system software is the family of operating systems known as Windows® from Microsoft Corporation of Redmond, Washington, and their associated file management systems. Another example of operating system software with its associated file management system software is the Linux operating system and its associated file management system. The file management system is typically stored in the non-volatile storage 2616 and causes the processor 2608 to execute the various acts required by the operating system to input and output data and to store data in memory, including storing files on the non-volatile storage 2616.

[00308] FIG. 27 depicts a diagram of an example of a system 2700 for application-specific differential network access control. In the example of FIG. 27, the system 2700 includes a network service consuming application 2702, a network service usage analysis engine 2704, an application behavior datastore 2706, a network service usage classification engine 7708, an application traffic prioritization engine 2710, a network service usage control policy datastore 2712, a differential network access control engine 2714, an application traffic cache 2716, an application traffic override engine 2718, and a network interface 2720. The system 2700 is intended to represent a specific implementation of techniques described previously in this paper for illustrative purposes. The techniques may be applicable to an applicable known or convenient (wired or wireless) device for which there is a motivation to control network service usage.

[00309] In the example of FIG. 27, the network service consuming application 2702 is a application that is implemented on a device. In an expected use, the application is a software application stored at least in part in memory on a wireless device, though kernel-level instructions could be implemented as firmware or even hardware. The application can be

referred to as "running" on the device or as being "executed" by the device in accordance with known uses of those terms. Wireless media are known to have more bandwidth constraints, which is why a wireless device is an expected use, though the technique may be applicable to wired devices in certain situations.

[00310] In the example of FIG. 27, the network service usage analysis engine 2704 is coupled to the network service consuming application 2702. The network service usage analysis engine 2704 analyzes traffic from the network service consuming application 2702 and stores relevant data in the application behavior datastore 2706. The data can include all traffic that is sent by the application, or a subset of the traffic (e.g., that which has a certain QoS classification or priority, that which has high resource consumption due to frequent transmission from the application, that which is sent to a particular destination, etc.) The data can also include traffic that is received for the application. The application behavior datastore 2706 can alternatively or in addition be implemented as a traffic source/destination datastore, which can be valuable if differential access control is based upon the source and/or destination of traffic. The application behavior datastore 2706 includes data structures (e.g., records) representative of data that is organized with implementation-specific granularity. For example, the data structures could be representative of frames (L2), packets (L3), or messages. (It may be noted that the term "packets" is often used to mean collections of data that are not limited to L3.) The desired granularity may depend upon where the network service usage analysis engine 2704 is located. Whether the data structures are changed over time (e.g., to change data associated with a record), replaced as records age, or maintained as historical data is also implementation-specific.

[00311] In the example of FIG. 27, the network service usage classification engine 2708 is coupled to the network service usage analysis engine 2704 and the application behavior datastore 2706. The network service usage classification engine 2708 can categorize the traffic stored in the application behavior datastore 2706 based on, e.g., network type, time of day, connection cost, whether home or roaming, network busy state, QoS, and whether the particular service usage activity is in foreground of user interaction or in the background of user interaction, or other characteristics that are obtained from network service usage analysis or through other means. Classification rules can include, for example, examining if one or more of the following has taken place within a specified period of time: user has interacted with the device, user has interacted with the service usage activity, user has picked up the device, service usage activity UI

content is in the foreground of the device UI, audio or video information is being played by the service usage activity, a certain amount of data has been communicated by the service usage activity, service usage activity is or is not on a foreground or background service list. Rules that define which service usage activities to classify as, e.g., background service usage activities can be user-selected, set by a service provider, or through some other applicable means.

[00312] Advantageously, the network service usage analysis engine 2704 can examine a particular service usage activity and the network service usage classification engine 2708 can determine if the particular service usage activity fits a set of one or more classification rules that define the particular service usage activity as, e.g., a background service usage activity.

[00313] In the example of FIG. 27, the application traffic prioritization engine 2710 uses a policy stored in the network service usage control policy datastore 2712 to determine an appropriate prioritization for traffic to and/or from the network service consuming application 2702. Prioritization can enable the system 2700 to fine-tune the amount of network resources consumed by the network service consuming application 2702, or the rate of network resource consumption. The control policy can require applications to throttle network resource consumption, prohibit the use of network resources by certain applications, etc.

[00314] Advantageously, the application traffic prioritization engine 2710 can determine a particular service usage activity has a particular characteristic, such as being a background service usage activity. This can involve checking whether a condition is satisfied.

[00315] In the example of FIG. 27, the differential network access control engine 2714 is coupled to the application traffic prioritization engine 2710 and the network service usage control policy datastore 2712. The differential network access control engine 2714 causes the network service consuming application 2702 traffic to be queued in the application traffic cache 2716. (If no throttling is required to follow the control policy, of course, the traffic need not be cached anywhere other than is typical, such as in an output buffer.) The application traffic cache 2716 is intended to represent a cache that is implemented on top of an output buffer or other standard caching device, and is used by the differential network access control engine 2714 to facilitate control over "rogue" applications, applications having anomalous behavior, or applications that must otherwise be controlled to conform with the control policy.

[00316] Advantageously, the differential network access control engine can restrict network access of a particular service usage activity when a condition is satisfied, such as when the service usage activity is a background activity.

[00317] In the example of FIG. 27, the application traffic override engine 2718 is coupled to the differential network access control engine 2714 and the application traffic cache 2716. The application traffic override engine 2718 enables a user or device to deviate from the control policy. Such deviation can be prompted by, for example, an incentive offer or a notification of cost.

[00318] In an illustrative example, the device 2700 blocks chatter for an application running in the background that is attempting to report device or user behavior. The application traffic prioritization engine 2710 determines that the chatter has zero priority, such that the network service consuming application 2702 is prevented from consuming any resources. The user can be sent a notification by the application traffic override engine 2718 that their control policy prohibits the application from consuming network resources, but that the user can opt to deviate from the control policy if they are willing to pay for the consumed resources. If the user is willing to pay for the resources, traffic can be sent at a certain rate from the application traffic cache 2716 through the network interface 2720, or perhaps sent without using the application traffic cache 2716.

[00319] As another illustrative example, the device 2700 could identify application traffic as a software update. The differential network access control engine 2714 may determine that software updates can be received at a throttled rate (perhaps even slower than the lowest QoS categorization). The application traffic override engine 2718 can receive an indication from the user, from user preferences, service provider settings, or the like that the updates can ignore the control policy for a particular application (or for all applications).

[00320] Advantageously, the control policy can set up a priority to communicate cached elements, set minimum update frequencies, provide control policy overrides (typically for payment), or the like to fine-tune differential network access control policies. This can enable the system 2700 to encourage certain behavior, such as sending low QoS traffic when it is cheaper (e.g., when the network does not have a busy state, at historically low-use times of day, when on a certain type of network, such as Wi-Fi, as opposed to another, such as cellular, etc.).

[00321] Some portions of the detailed description are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of operations leading to a desired result. The operations are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[00322] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[00323] The present invention, in some embodiments, also relates to apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magnetic or optical cards, any type of disk including floppy disks, optical disks, CD-ROMs, and magnetic-optical disks, or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

[00324] The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with

programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language, and various embodiments may thus be implemented using a variety of programming languages.

[00325] Although the foregoing embodiments have been described in some detail for purposes of clarity of understanding, the invention is not limited to the details provided. There are many alternative ways of implementing the invention. The disclosed embodiments are illustrative and not restrictive.

INCORPORATION BY REFERENCE

[00326] This application incorporates by reference the following U.S. Patent Applications for all purposes: U.S. serial No. 13/134,028, filed May 25, 2011, entitled "Device-Assisted Services for Protecting Network Capacity"; U.S. serial No. 12/380,778 filed March 2, 2009, entitled "Verifiable Device Assisted Service Usage Billing with Integrated Accounting, Mediation Accounting, and Multi-Account"; U.S. serial No. 12/380,780 filed March 2, 2009, entitled "Automated Device Provisioning and Activation"; U.S. serial No. 12/695,019 filed January 27, 2010, entitled "Device Assisted CDR Creation, Aggregation, Mediation and Billing"; U.S. serial No. 12/695,020 filed January 27, 2010, entitled "Adaptive Ambient Services"; U.S. serial No. 12/694,445 filed January 27, 2010, entitled "Security Techniques for Device Assisted Services"; U.S. serial No. 12/694,451 filed January 27, 2010, entitled "Device Group Partitions and Settlement Platform"; U.S. serial No. 12/694,455 filed January 27, 2010, entitled "Device Assisted Services Install"; U.S. serial No. 12/695,021 filed January 27, 2010, entitled "Quality of Service for Device Assisted Services"; U.S. serial No. 12/695,980 filed January 28, 2010, entitled "Enhanced Roaming Services and Converged Carrier Networks with Device Assisted Services and a Proxy"; and U.S. application serial No. 13/134,005, filed May 25, 2011, entitled "System and Method for Wireless Network Offloading".

[00327] This application also incorporates by reference the following U.S. provisional applications: U.S. provisional application serial No. 61/206,354, filed January 28, 2009, entitled "Services Policy Communication System and Method"; U.S. provisional application serial No. 61/206,944, filed February 4, 2009, entitled "Services Policy Communication System and Method"; U.S. provisional application serial No. 61/207,393, filed February 10, 2009, entitled "Services Policy Communication System and Method"; U.S. provisional application serial No. 61/207,739, filed February 13, 2009, entitled "Services Policy Communication System and Method"; U.S. provisional application serial No. 61/270,353, filed July 6, 2009, entitled "Device Assisted CDR Creation, Aggregation, Mediation and Billing"; U.S. provisional application serial No. 61/275,208, filed August 25, 2009, entitled "Adaptive Ambient Services"; U.S. provisional application serial No. 61/237,753, filed August 28, 2009, entitled "Adaptive Ambient Services"; U.S. provisional application serial No. 61/252,151, filed October 15, 2009, entitled "Security Techniques for Device Assisted Services"; U.S. provisional application serial No. 61/252,153,

filed October 15, 2009, entitled "Device Group Partitions and Settlement Platform"; U.S. provisional application serial No. 61/264,120, filed November 24, 2009, entitled "Device Assisted Services Install," and U.S. provisional application serial No. 61/264,126, filed November 24, 2009, entitled "Device Assisted Services Activity Map"; U.S. provisional application serial No. 61/348,022, filed May 25, 2010, entitled "Device Assisted Services for Protecting Network Capacity"; U.S. provisional application serial No. 61/381,159, filed September 9, 2010, entitled "Device Assisted Services for Protecting Network Capacity"; U.S. provisional application serial No. 61/381,162, filed September 9, 2010, entitled "Service Controller Interfaces and Workflows"; U.S. provisional application serial No. 61/384,456, filed September 20, 2010, entitled "Securing Service Processor with Sponsored SIMs"; U.S. provisional application serial No. 61/389,547, filed October 4, 2010, entitled "User Notifications for Device Assisted Services"; U.S. provisional application serial No. 61/385,020, filed September 21, 2010, entitled "Service Usage Reconciliation System Overview"; U.S. provisional application serial No. 61/387,243, filed September 28, 2010, entitled "Enterprise and Consumer Billing Allocation for Wireless Communication Device Service Usage Activities"; U.S. provisional application serial No. 61/387,247, filed September 28, 2010, entitled "Secured Device Data Records"; U.S. provisional application serial No. 61/407,358, filed October 27, 2010, entitled "Service Controller and Service Processor Architecture"; U.S. provisional application serial No. 61/418,507, filed December 1, 2010, entitled "Application Service Provider Interface System"; U.S. provisional application serial No. 61/418,509, filed December 1, 2010, entitled "Service Usage Reporting Reconciliation and Fraud Detection for Device Assisted Services"; U.S. provisional application serial No. 61/420,727, filed December 7, 2010, entitled "Secure Device Data Records"; U.S. provisional application serial No. 61/422,565, filed December 13, 2010, entitled "Service Design Center for Device Assisted Services"; U.S. provisional application serial No. 61/422,572, filed December 13, 2010, entitled "System Interfaces and Workflows for Device Assisted Services"; U.S. provisional application serial No. 61/422,574, filed December 13, 2010, entitled "Security and Fraud Detection for Device Assisted Services"; U.S. provisional application serial No. 61/435,564, filed January 24, 2011, entitled "Framework for Device Assisted Services"; and U.S. provisional application serial No. 61/472,606, filed April 6, 2011, entitled "Managing Service User Discovery and Service Launch Object Placement on a Device."

CLAIMS

We claim:

1. A system, comprising:

a processor of a communications device configured to:

monitor a network service usage activity of the communications device in network communication;

classify the network service usage activity for differential network access control for protecting network capacity; and

associate the network service usage activity with a service usage control policy based on a classification of the network service usage activity to facilitate differential network access control for protecting network capacity; and

a memory coupled to the processor and configured to provide the processor with instructions.

ABSTRACT

Device Assisted Services (DAS) for protecting network capacity is provided. In some embodiments, DAS for protecting network capacity includes monitoring a network service usage activity of the communications device in network communication; classifying the network service usage activity for differential network access control for protecting network capacity; and associating the network service usage activity with a network service usage control policy based on a classification of the network service usage activity to facilitate differential network access control for protecting network capacity.

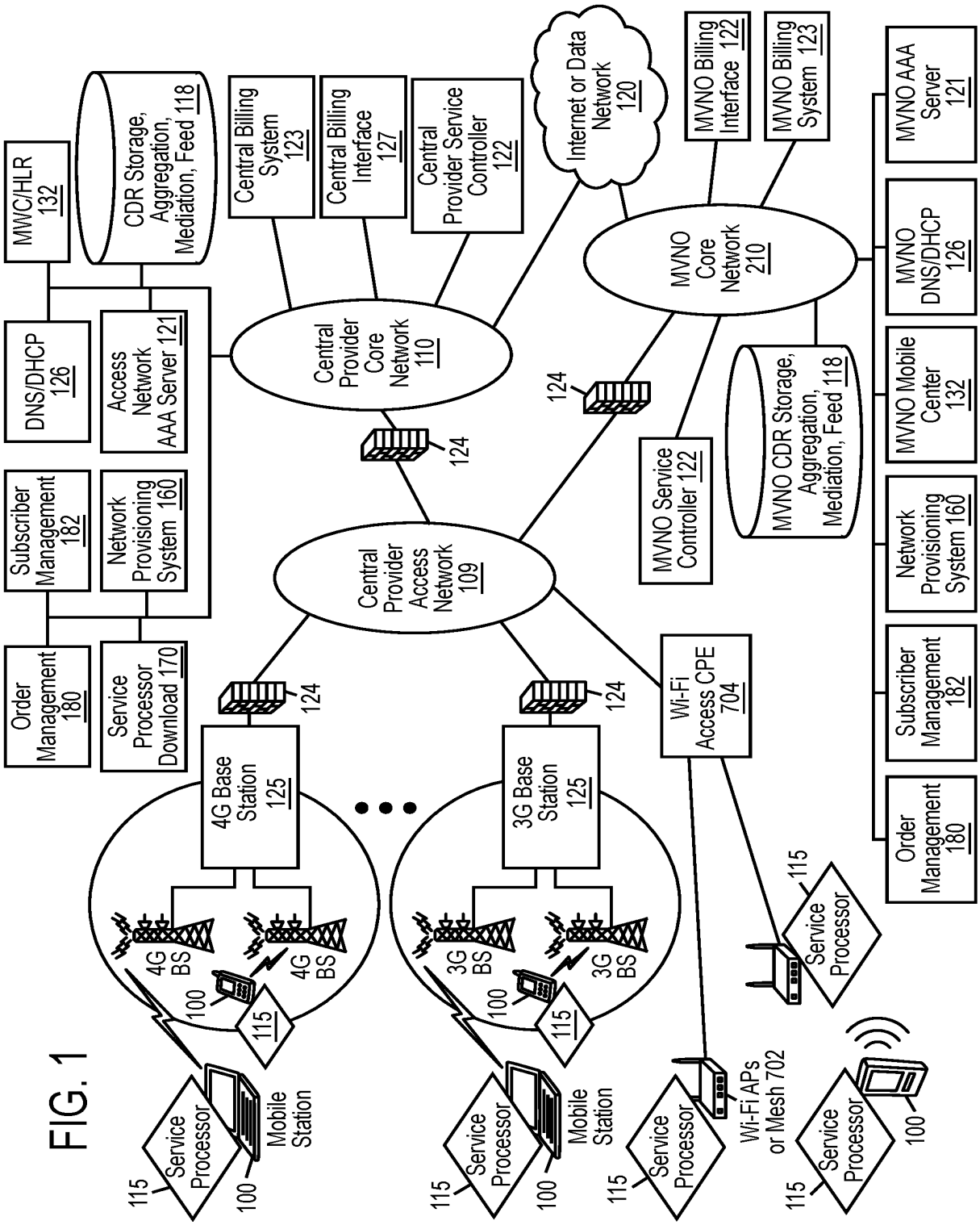

MWC/HLR 132
CDR Storage, Aggregation, Mediation, Feed 118
Central Billing System 123
Central Billing Interface 127
Central Provider Service Controller 122
Internet or Data Network 120
MVNO Billing Interface 122
MVNO Billing System 123
MVNO AAA Server 121
DNS/DHCP 126
Access Network AAA Server 121
Central Provider Core Network 110
MVNO Core Network 210
MVNO DNS/DHCP 126
Subscriber Management 182
Network Provisioning System 160
MVNO Service Controller 122
MVNO CDR Storage, Aggregation, Mediation, Feed 118
MVNO Mobile Center 132
Order Management 180
Service Processor Download 170
Central Provider Access Network 109
Wi-Fi Access CPE 704
4G Base Station 125
3G Base Station 125
4G BS
3G BS
100
115
124
Service Processor
Mobile Station
Wi-Fi APs or Mesh 702

FIG. 1

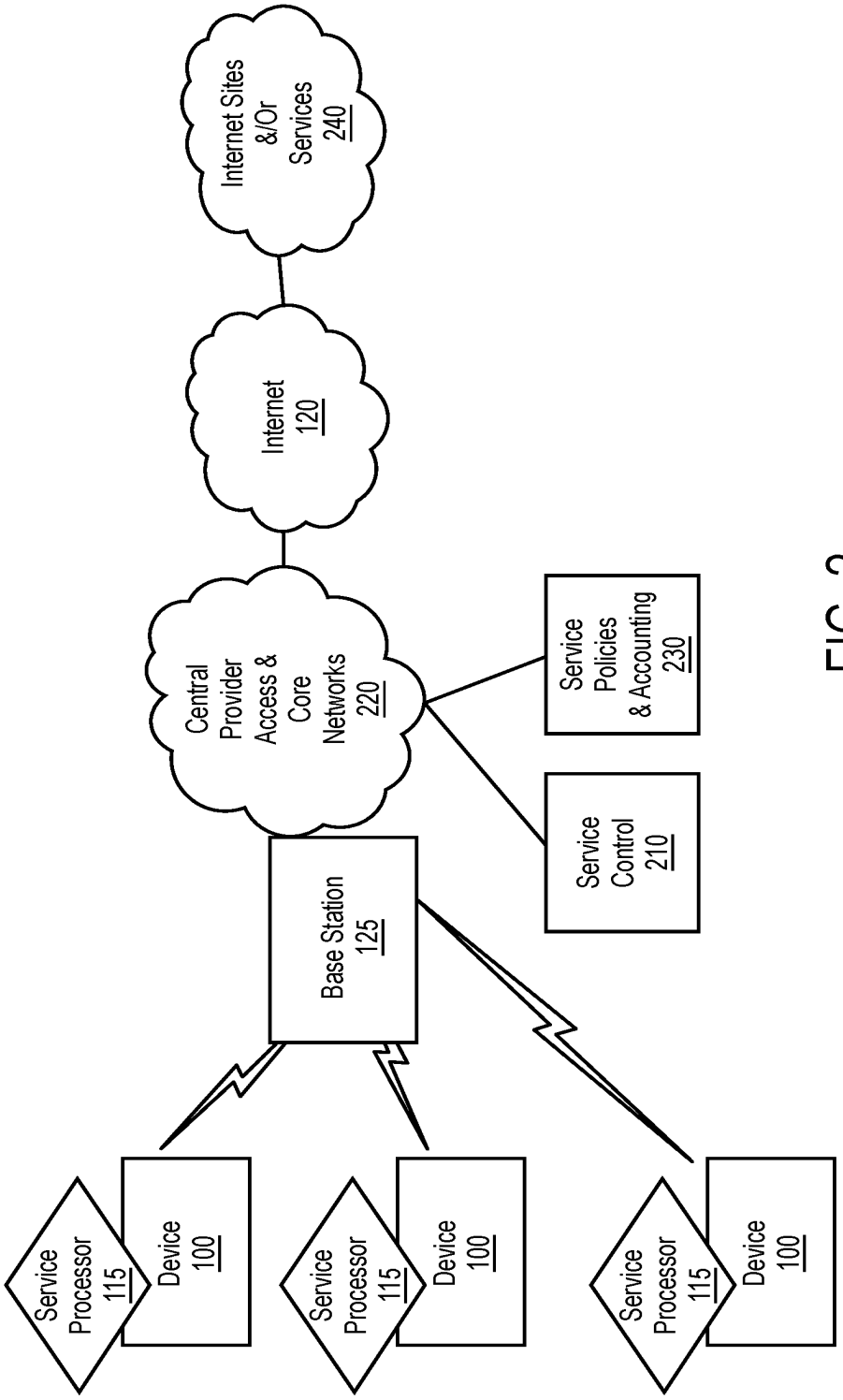

Internet Sites &/Or Services 240
Internet 120
Central Provider Access & Core Networks 220
Service Policies & Accounting 230
Service Control 210
Base Station 125
Service Processor 115
Device 100
Service Processor 115
Device 100
Service Processor 115
Device 100

FIG. 2

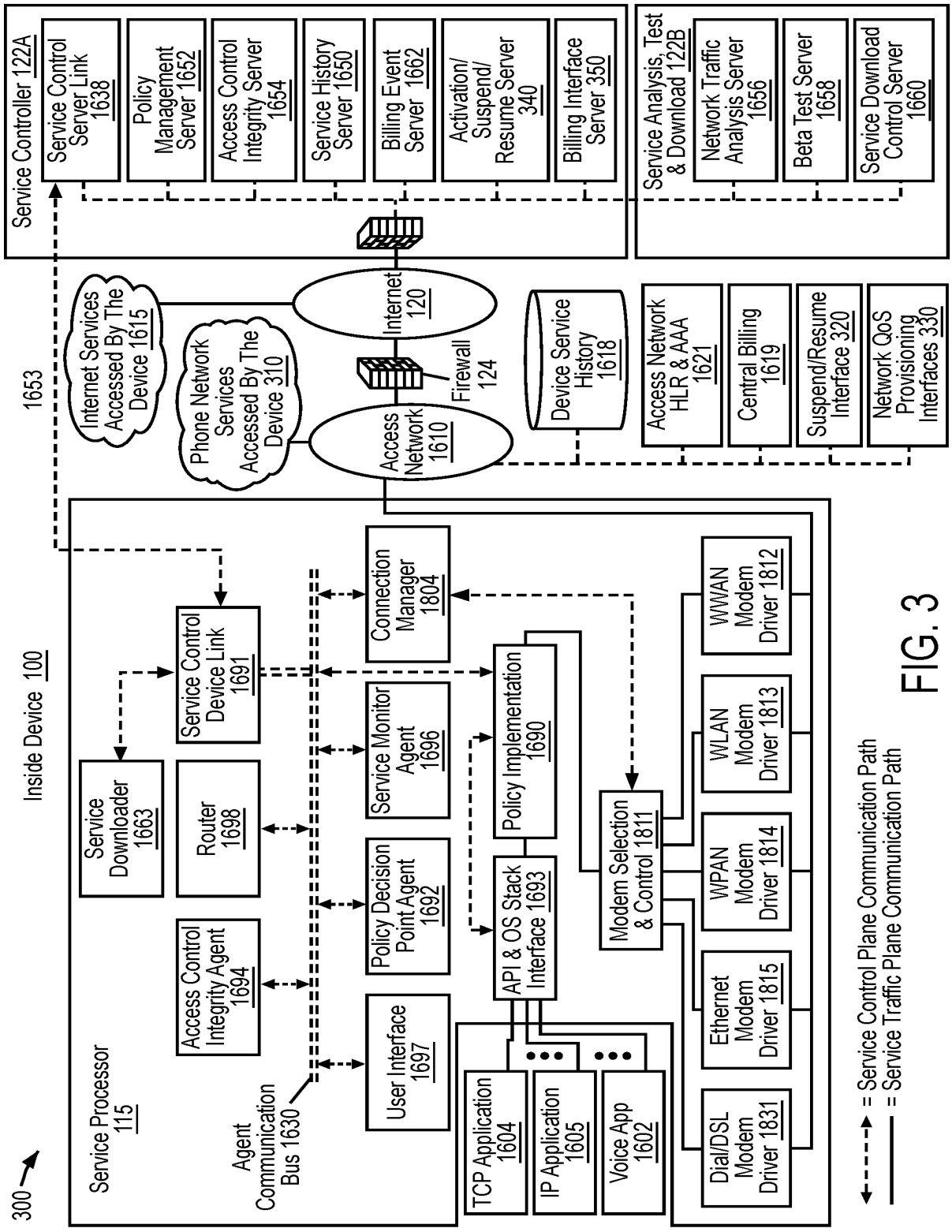

300
Inside Device 100
Service Processor 115
Agent Communication Bus 1630
Service Downloader 1663
Router 1698
Service Control Device Link 1691
Connection Manager 1804
Service Monitor Agent 1696
Policy Implementation 1690
Access Control Integrity Agent 1694
Policy Decision Point Agent 1692
API & OS Stack Interface 1693
Modem Selection & Control 1811
User Interface 1697
TCP Application 1604
IP Application 1605
Voice App 1602
Dial/DSL Modem Driver 1831
Ethernet Modem Driver 1815
WPAN Modem Driver 1814
WLAN Modem Driver 1813
WWAN Modem Driver 1812
1653
Internet Services Accessed By The Device 1615
Phone Network Services Accessed By The Device 310
Access Network 1610
Firewall 124
Internet 120
Device Service History 1618
Service Controller 122A
Service Control Server Link 1638
Policy Management Server 1652
Access Control Integrity Server 1654
Service History Server 1650
Billing Event Server 1662
Activation/ Suspend/ Resume Server 340
Billing Interface Server 350
Service Analysis, Test & Download 122B
Network Traffic Analysis Server 1656
Beta Test Server 1658
Service Download Control Server 1660
Access Network HLR & AAA 1621
Central Billing 1619
Suspend/Resume Interface 320
Network QoS Provisioning Interfaces 330
= Service Control Plane Communication Path
= Service Traffic Plane Communication Path

FIG. 3

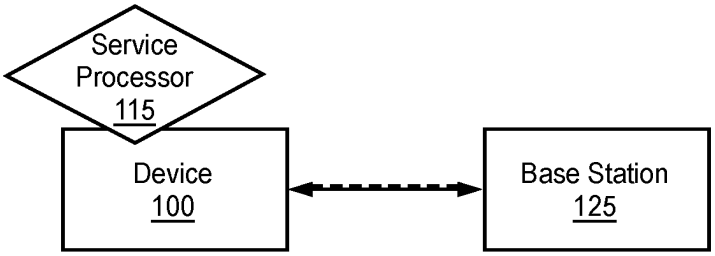


FIG. 4A

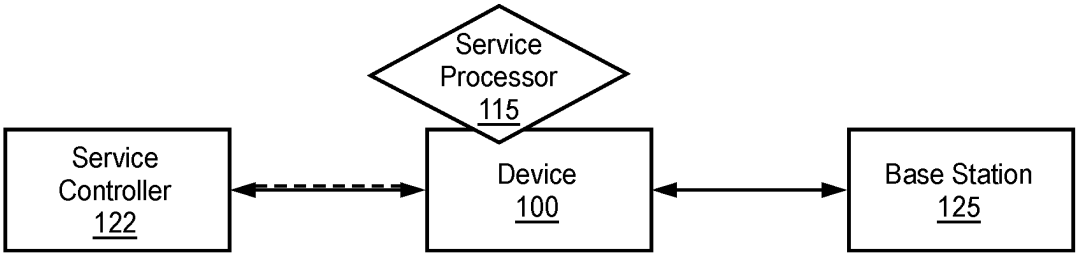


FIG. 4B

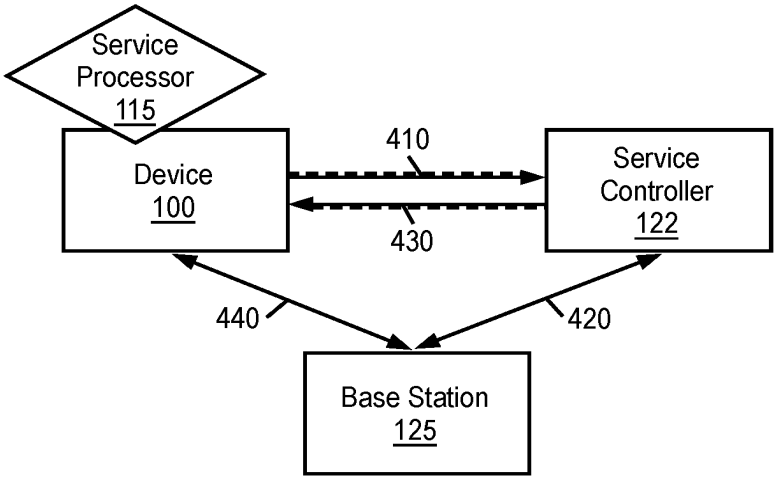


FIG. 4C

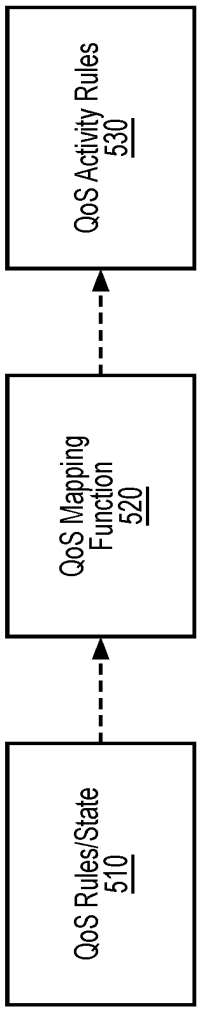

QoS Rules/State
510
QoS Mapping
Function
520
QoS Activity Rules
530

FIG. 5

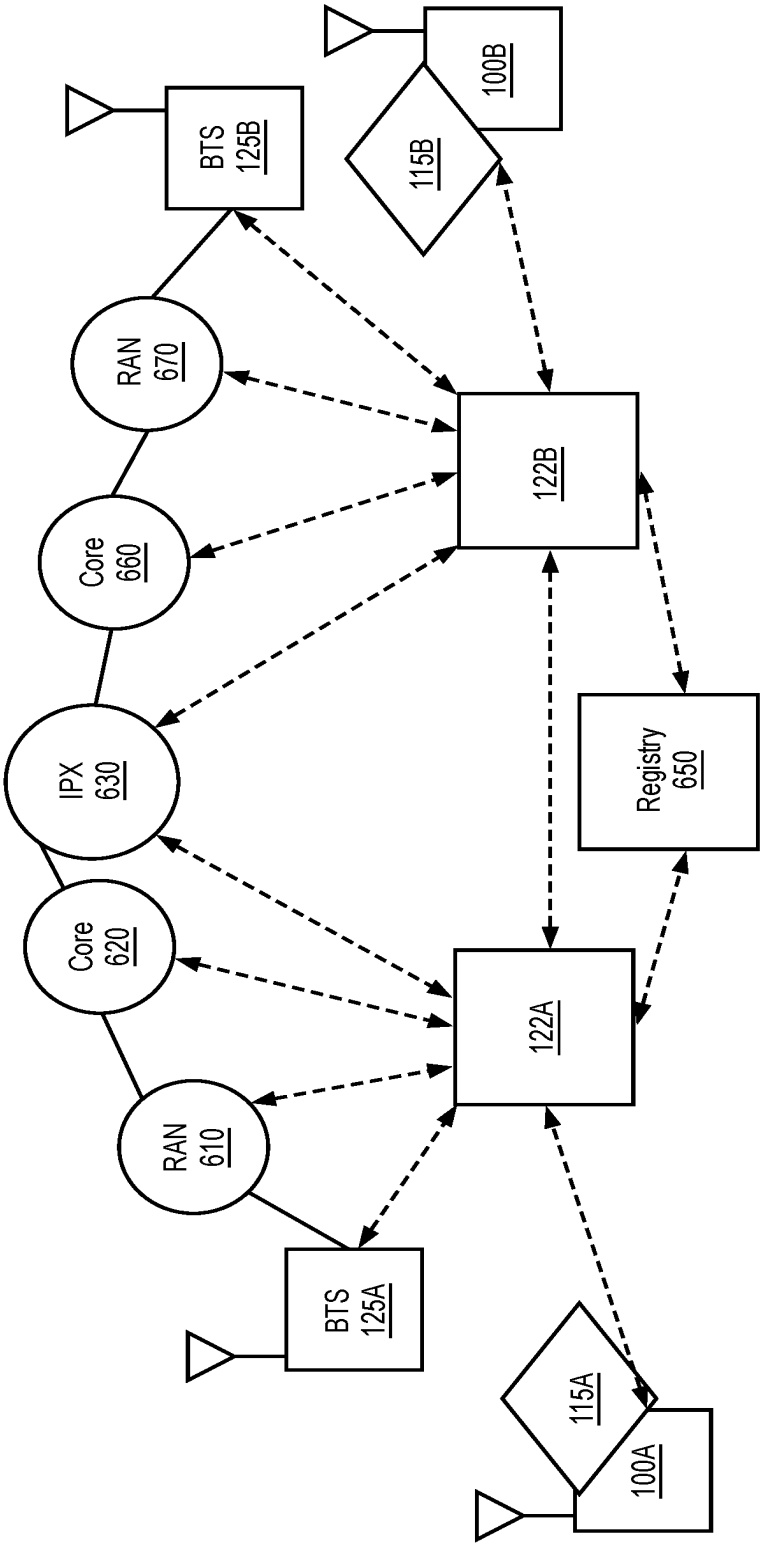

100B
115B
BTS 125B
RAN 670
Core 660
IPX 630
Core 620
RAN 610
BTS 125A
115A
100A
122B
122A
Registry 650

FIG. 6

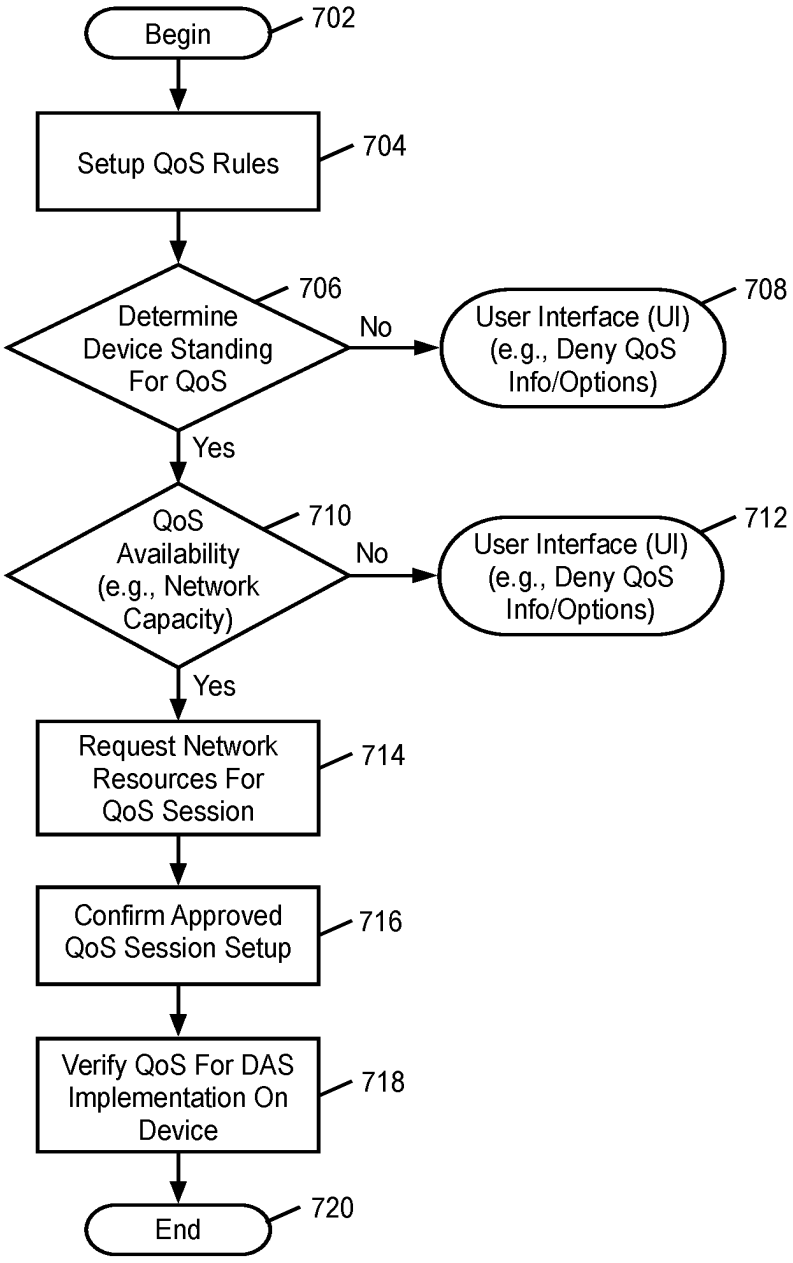

Begin
702
Setup QoS Rules
704
Determine Device Standing For QoS
706
No
User Interface (UI) (e.g., Deny QoS Info/Options)
708
Yes
QoS Availability (e.g., Network Capacity)
710
No
User Interface (UI) (e.g., Deny QoS Info/Options)
712
Yes
Request Network Resources For QoS Session
714
Confirm Approved QoS Session Setup
716
Verify QoS For DAS Implementation On Device
718
End
720

FIG. 7

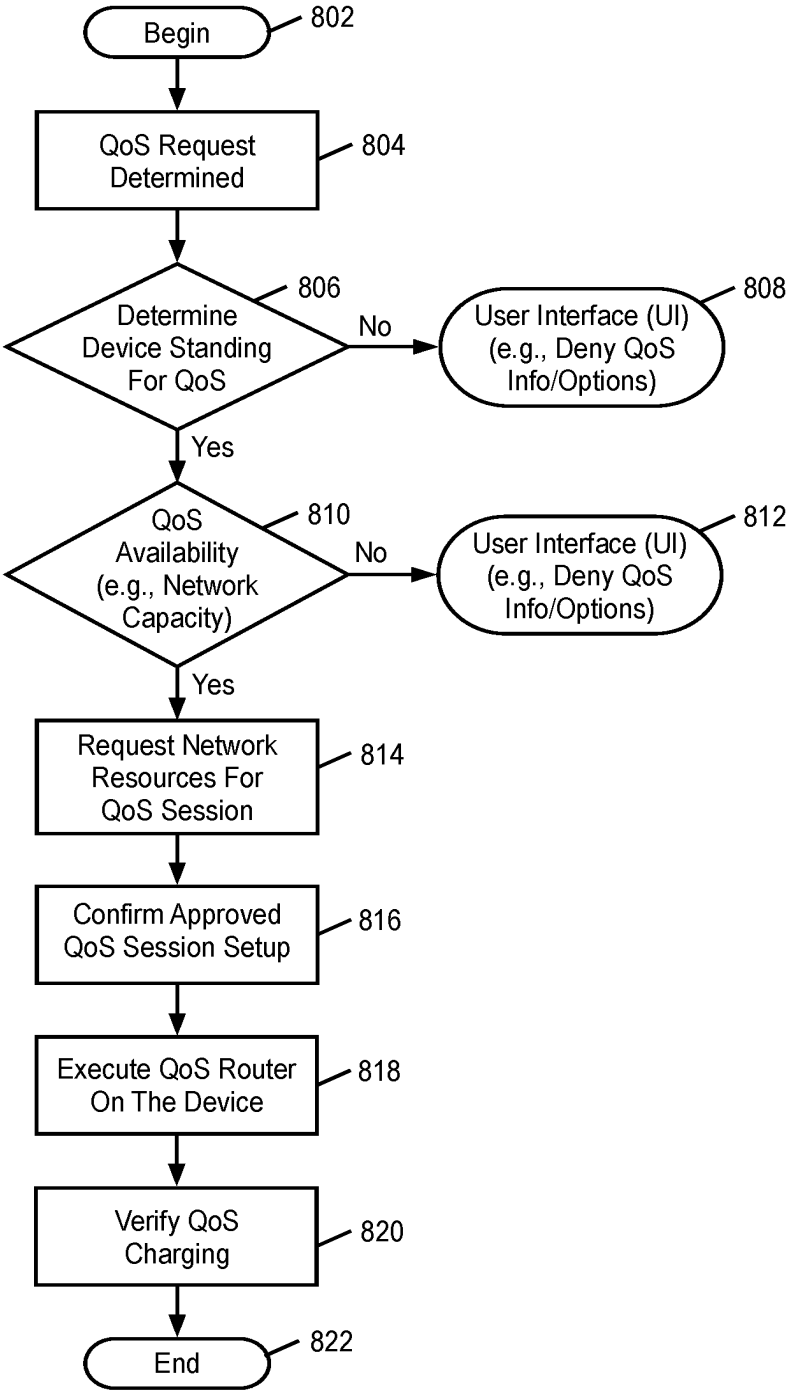

Begin
802
QoS Request Determined
804
Determine Device Standing For QoS
806
No
User Interface (UI) (e.g., Deny QoS Info/Options)
808
Yes
QoS Availability (e.g., Network Capacity)
810
No
User Interface (UI) (e.g., Deny QoS Info/Options)
812
Yes
Request Network Resources For QoS Session
814
Confirm Approved QoS Session Setup
816
Execute QoS Router On The Device
818
Verify QoS Charging
820
End
822

FIG. 8A

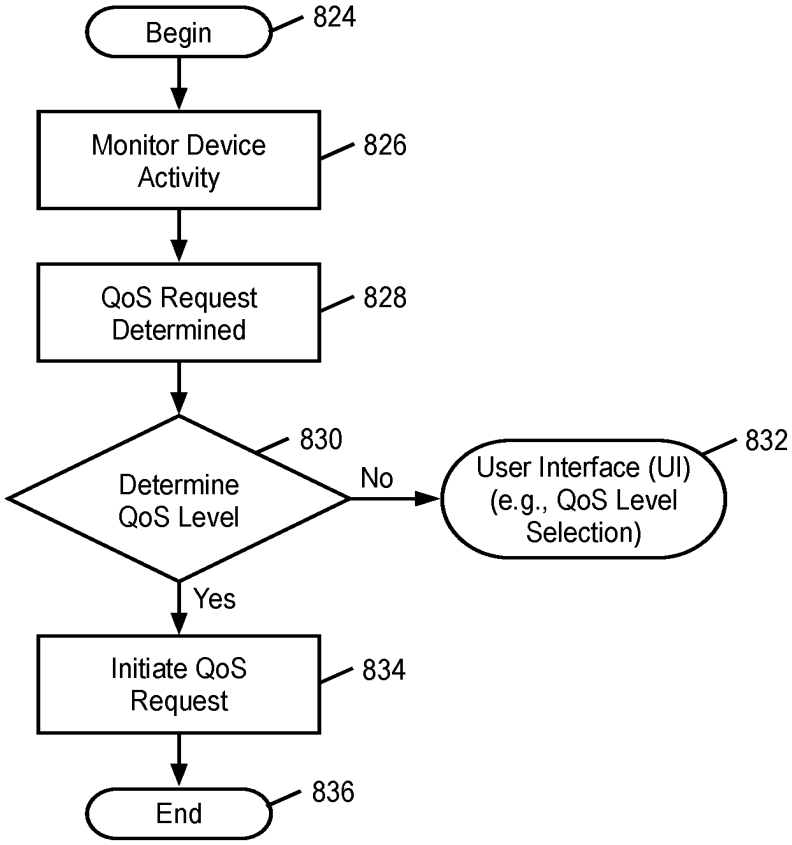

Begin
824
Monitor Device Activity
826
QoS Request Determined
828
Determine QoS Level
830
No
User Interface (UI) (e.g., QoS Level Selection)
832
Yes
Initiate QoS Request
834
End
836

FIG. 8B

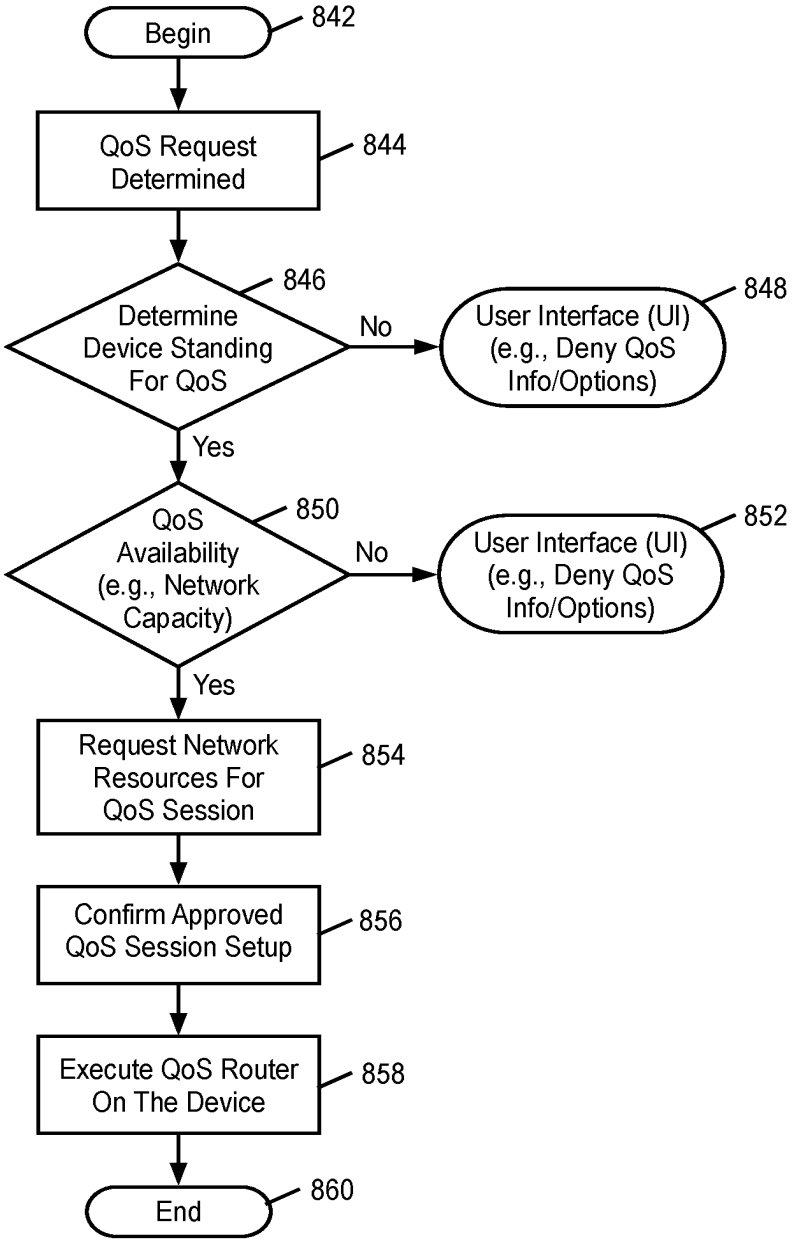

Begin
842
QoS Request Determined
844
Determine Device Standing For QoS
846
No
User Interface (UI) (e.g., Deny QoS Info/Options)
848
Yes
QoS Availability (e.g., Network Capacity)
850
No
User Interface (UI) (e.g., Deny QoS Info/Options)
852
Yes
Request Network Resources For QoS Session
854
Confirm Approved QoS Session Setup
856
Execute QoS Router On The Device
858
End
860

FIG. 8C

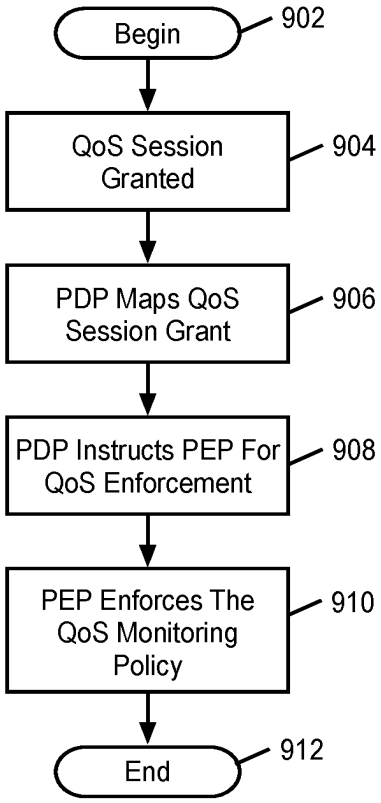

Begin
902
QoS Session Granted
904
PDP Maps QoS Session Grant
906
PDP Instructs PEP For QoS Enforcement
908
PEP Enforces The QoS Monitoring Policy
910
End
912

FIG. 9

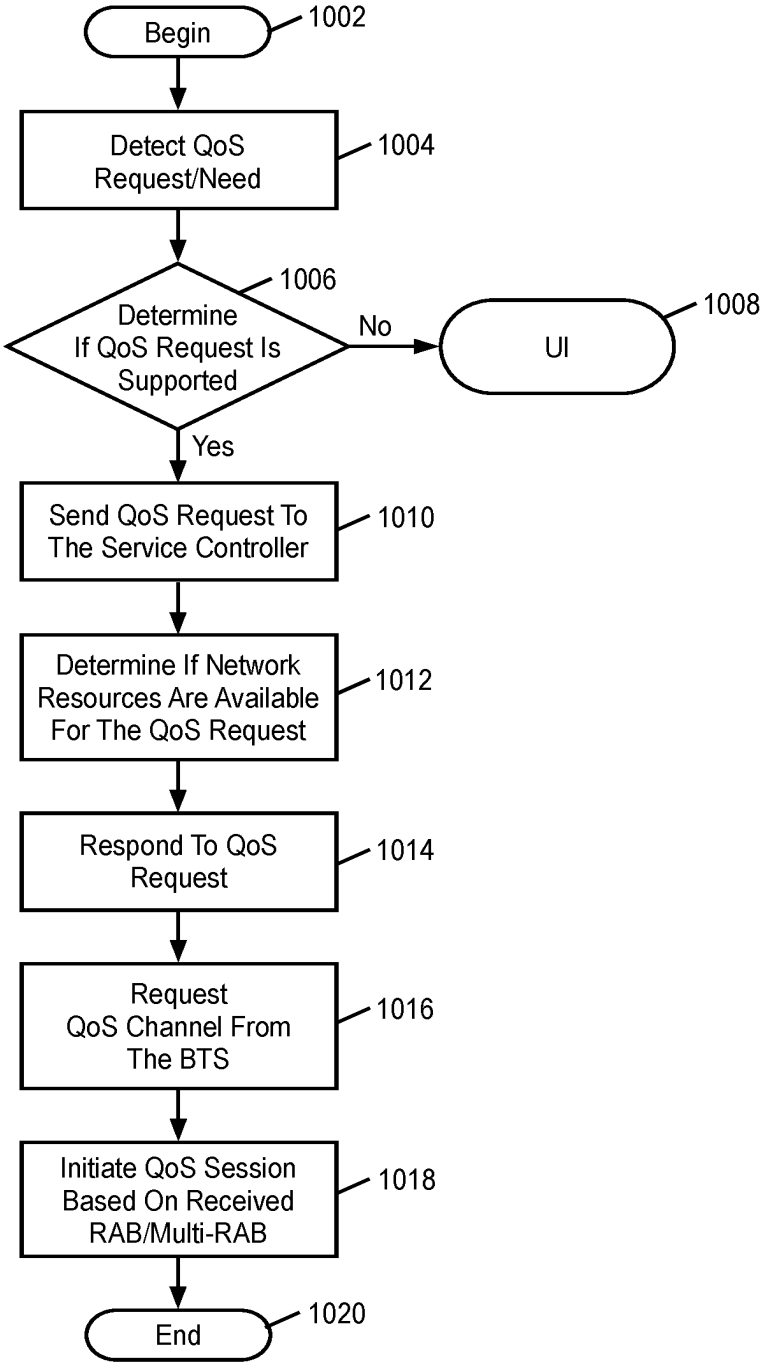

Begin
1002
Detect QoS Request/Need
1004
Determine If QoS Request Is Supported
1006
No
UI
1008
Yes
Send QoS Request To The Service Controller
1010
Determine If Network Resources Are Available For The QoS Request
1012
Respond To QoS Request
1014
Request QoS Channel From The BTS
1016
Initiate QoS Session Based On Received RAB/Multi-RAB
1018
End
1020

FIG. 10

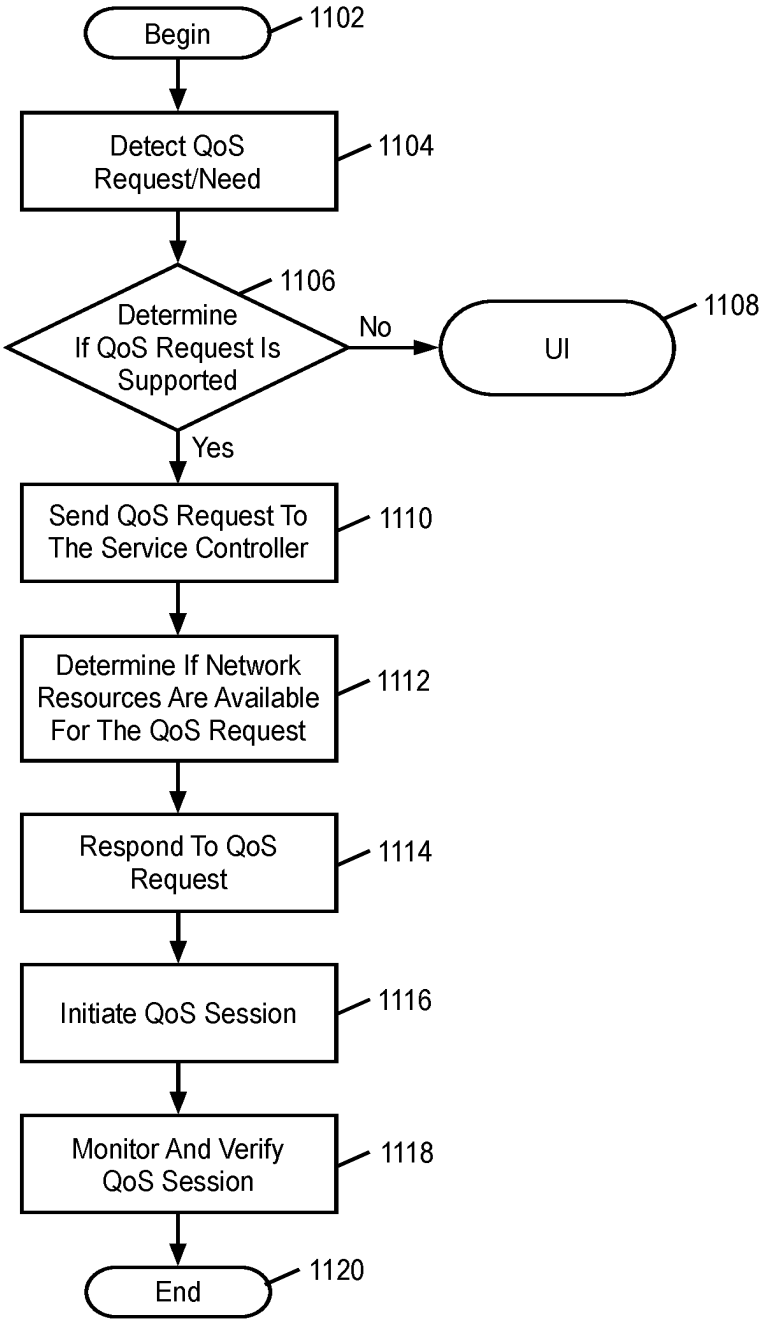

Begin
1102
Detect QoS Request/Need
1104
Determine If QoS Request Is Supported
1106
No
UI
1108
Yes
Send QoS Request To The Service Controller
1110
Determine If Network Resources Are Available For The QoS Request
1112
Respond To QoS Request
1114
Initiate QoS Session
1116
Monitor And Verify QoS Session
1118
End
1120

FIG. 11

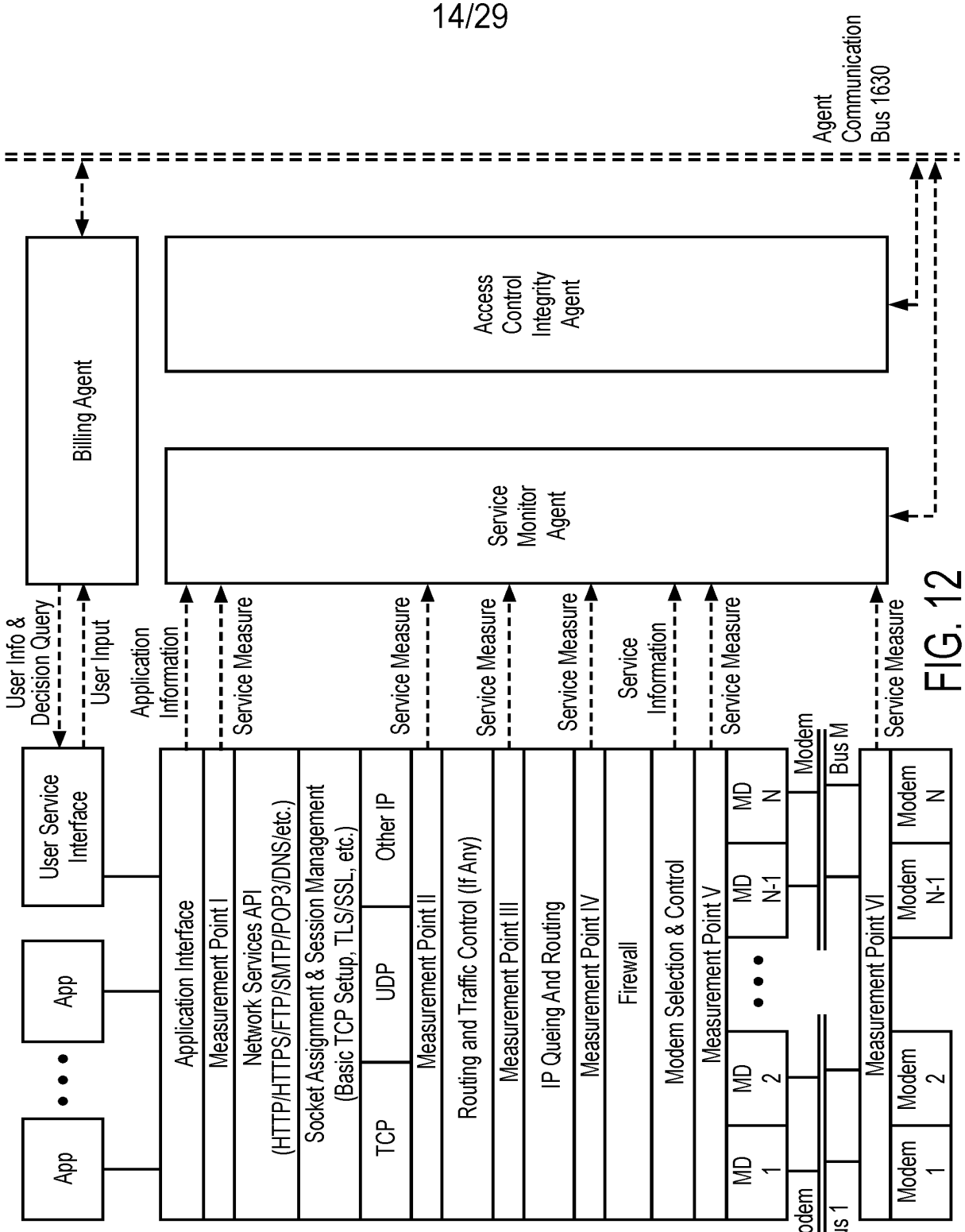

Agent Communication Bus 1630
Billing Agent
Access Control Integrity Agent
Service Monitor Agent
User Info & Decision Query
User Input
Application Information
Service Measure
User Service Interface
App
App
Application Interface
Measurement Point I
Network Services API (HTTP/HTTPS/FTP/SMTP/POP3/DNS/etc.)
Socket Assignment & Session Management (Basic TCP Setup, TLS/SSL, etc.)
TCP
UDP
Other IP
Measurement Point II
Routing and Traffic Control (If Any)
Measurement Point III
IP Queing And Routing
Measurement Point IV
Firewall
Service Information
Modem Selection & Control
Measurement Point V
MD 1
MD 2
MD N-1
MD N
Modem
Bus 1
Bus M
Measurement Point VI
Modem 1
Modem 2
Modem N-1
Modem N

FIG. 12

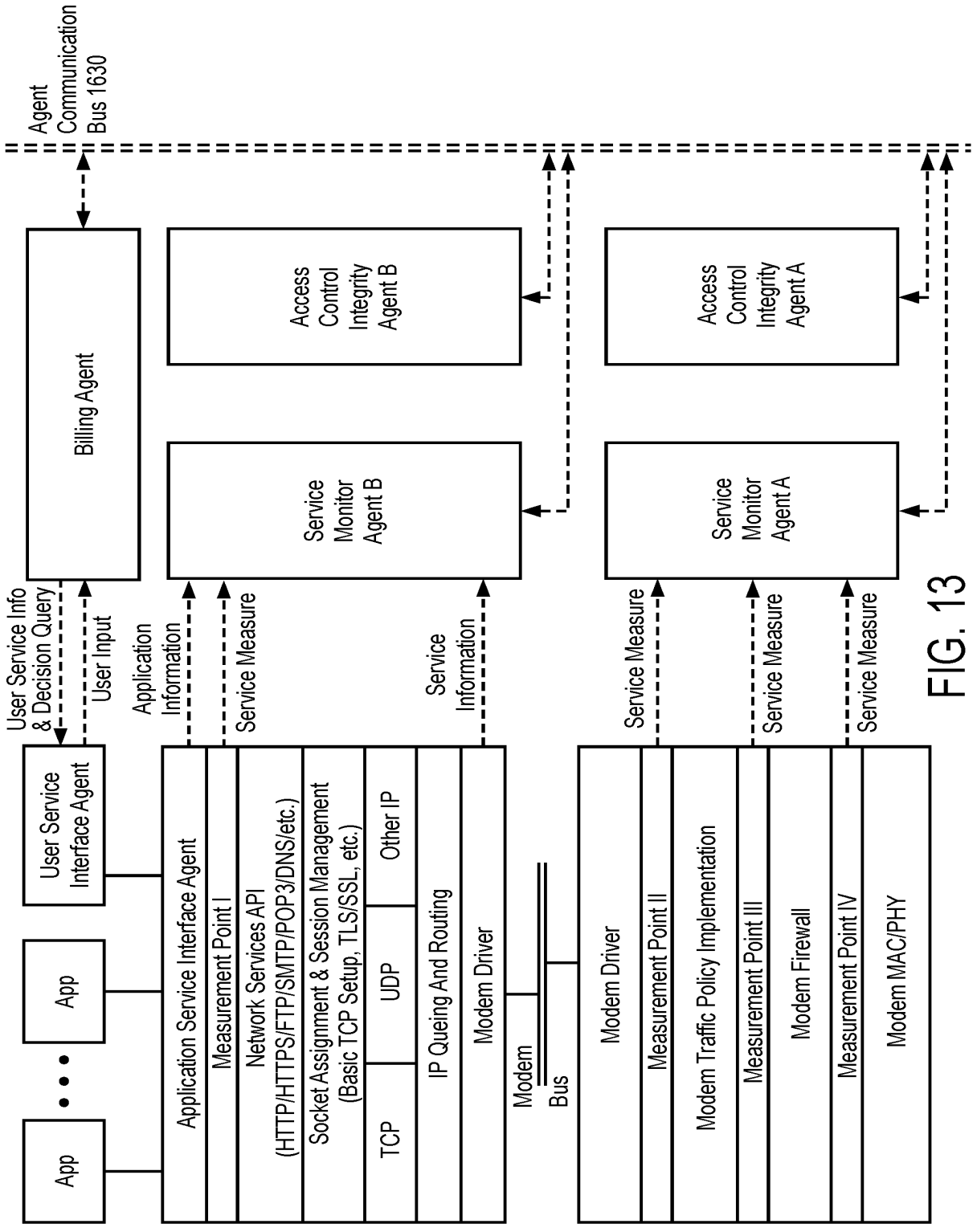

Agent Communication Bus 1630
Billing Agent
Access Control Integrity Agent B
Access Control Integrity Agent A
Service Monitor Agent B
Service Monitor Agent A
User Service Info & Decision Query
User Input
Application Information
Service Measure
Service Information
Service Measure
Service Measure
Service Measure
User Service Interface Agent
App
App
Application Service Interface Agent
Measurement Point I
Network Services API (HTTP/HTTPS/FTP/SMTP/POP3/DNS/etc.)
Socket Assignment & Session Management (Basic TCP Setup, TLS/SSL, etc.)
TCP
UDP
Other IP
IP Queing And Routing
Modem Driver
Modem Bus
Modem Driver
Measurement Point II
Modem Traffic Policy Implementation
Measurement Point III
Modem Firewall
Measurement Point IV
Modem MAC/PHY

FIG. 13

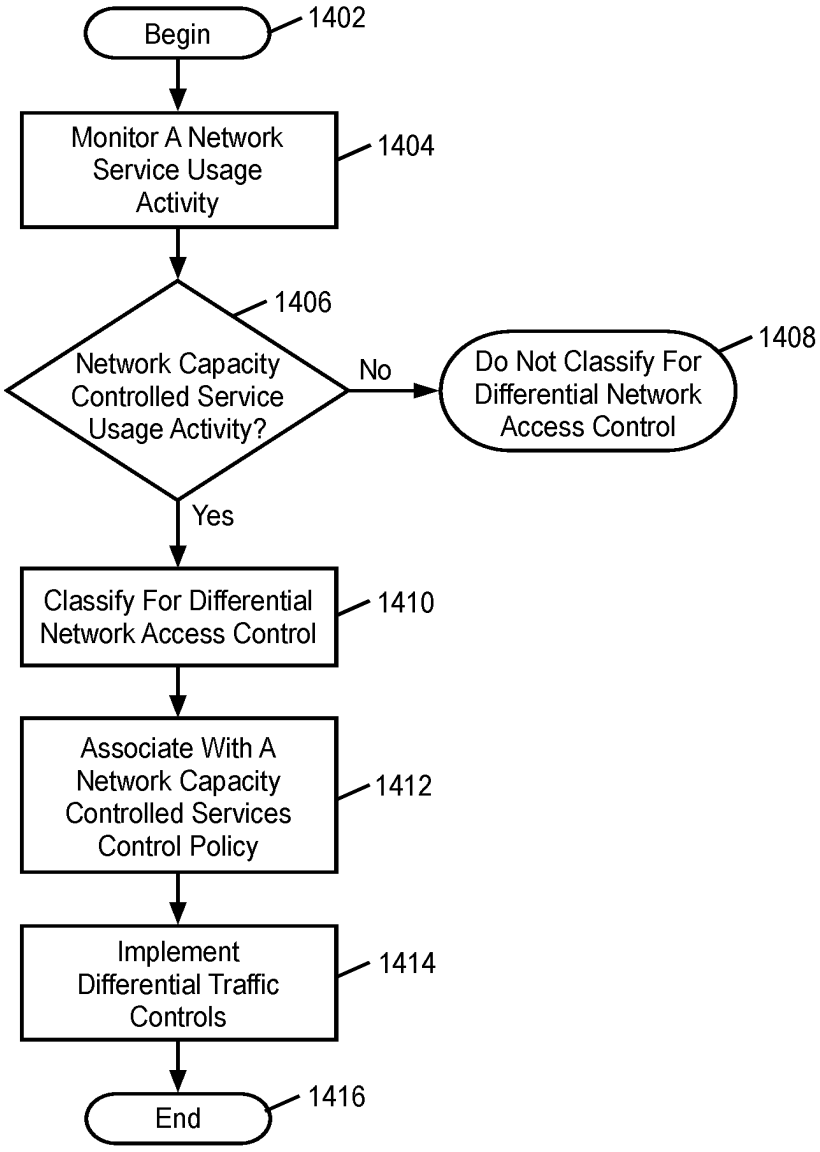

Begin
1402
Monitor A Network Service Usage Activity
1404
Network Capacity Controlled Service Usage Activity?
1406
No
Do Not Classify For Differential Network Access Control
1408
Yes
Classify For Differential Network Access Control
1410
Associate With A Network Capacity Controlled Services Control Policy
1412
Implement Differential Traffic Controls
1414
End
1416

FIG. 14

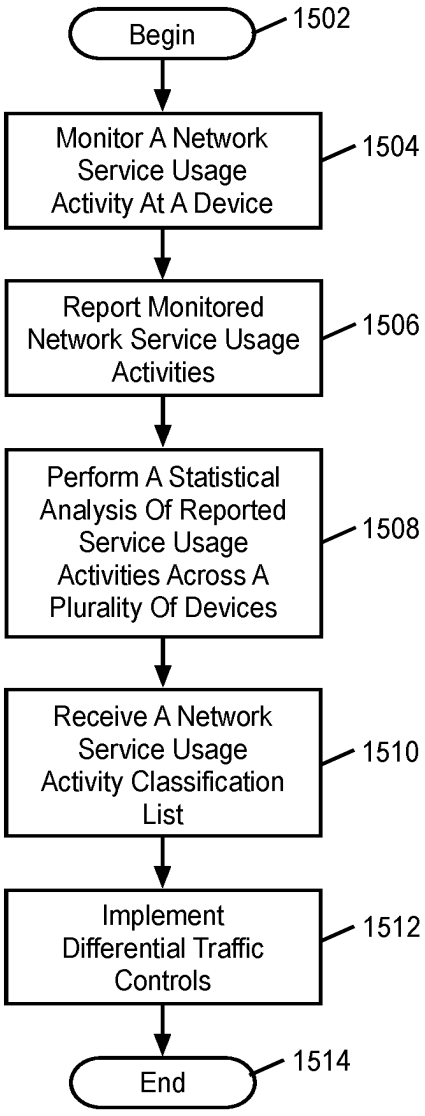

Begin
1502
Monitor A Network Service Usage Activity At A Device
1504
Report Monitored Network Service Usage Activities
1506
Perform A Statistical Analysis Of Reported Service Usage Activities Across A Plurality Of Devices
1508
Receive A Network Service Usage Activity Classification List
1510
Implement Differential Traffic Controls
1512
End
1514

FIG. 15

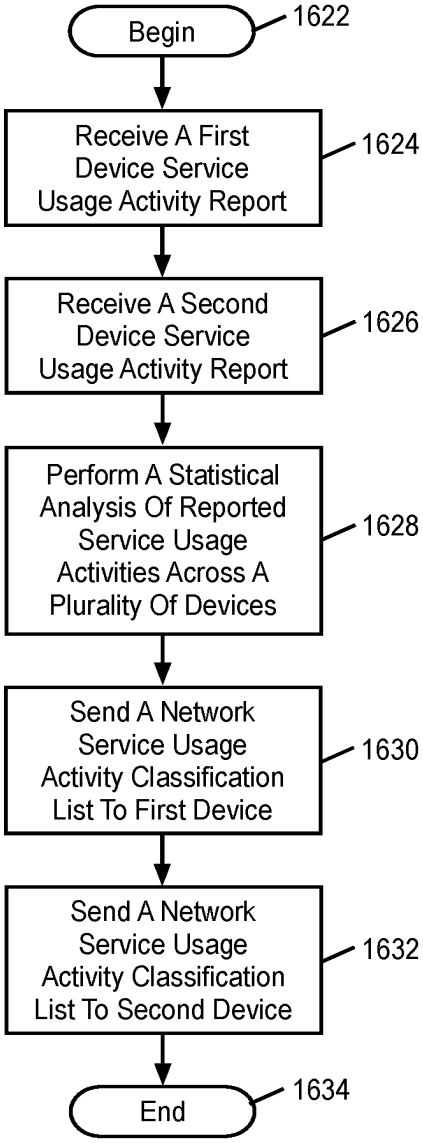

Begin
1622
Receive A First Device Service Usage Activity Report
1624
Receive A Second Device Service Usage Activity Report
1626
Perform A Statistical Analysis Of Reported Service Usage Activities Across A Plurality Of Devices
1628
Send A Network Service Usage Activity Classification List To First Device
1630
Send A Network Service Usage Activity Classification List To Second Device
1632
End
1634

FIG. 16

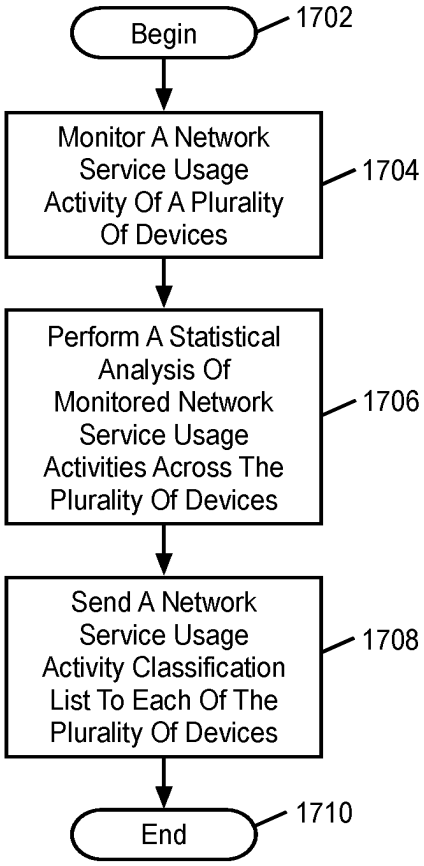

Begin
1702
Monitor A Network Service Usage Activity Of A Plurality Of Devices
1704
Perform A Statistical Analysis Of Monitored Network Service Usage Activities Across The Plurality Of Devices
1706
Send A Network Service Usage Activity Classification List To Each Of The Plurality Of Devices
1708
End
1710

FIG. 17

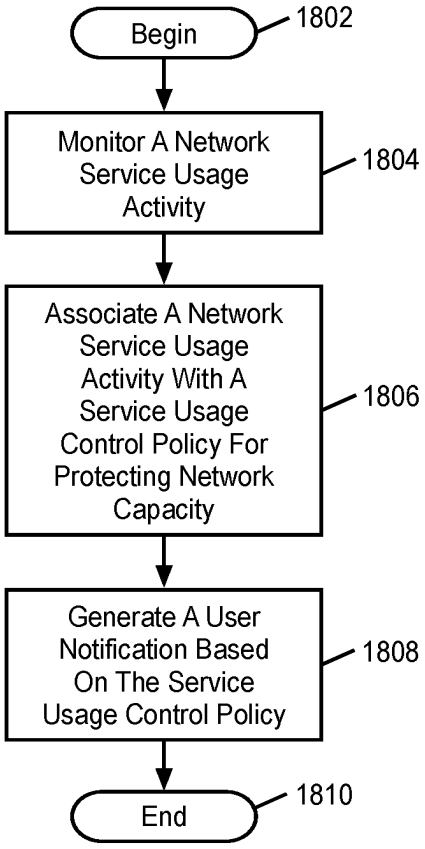

Begin
1802
Monitor A Network Service Usage Activity
1804
Associate A Network Service Usage Activity With A Service Usage Control Policy For Protecting Network Capacity
1806
Generate A User Notification Based On The Service Usage Control Policy
1808
End
1810

FIG. 18

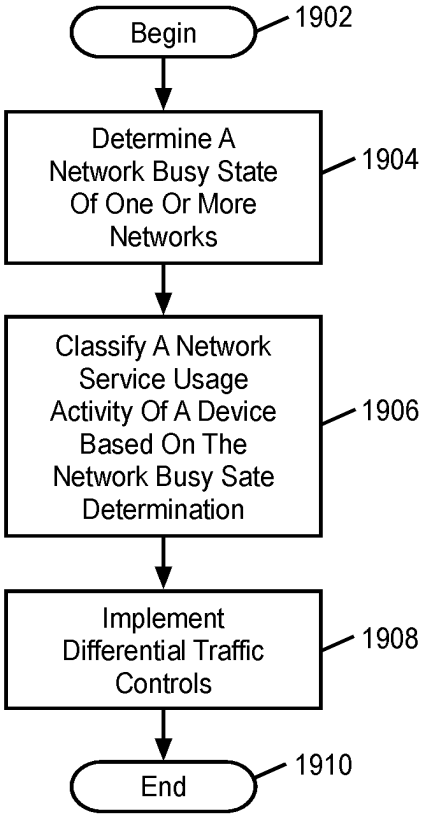

Begin
1902
Determine A Network Busy State Of One Or More Networks
1904
Classify A Network Service Usage Activity Of A Device Based On The Network Busy Sate Determination
1906
Implement Differential Traffic Controls
1908
End
1910

FIG. 19

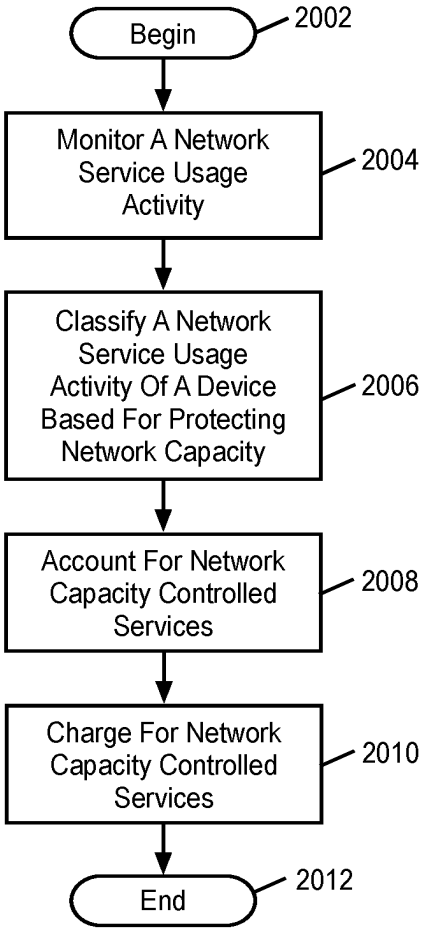

Begin
2002
Monitor A Network Service Usage Activity
2004
Classify A Network Service Usage Activity Of A Device Based For Protecting Network Capacity
2006
Account For Network Capacity Controlled Services
2008
Charge For Network Capacity Controlled Services
2010
End
2012

FIG. 20

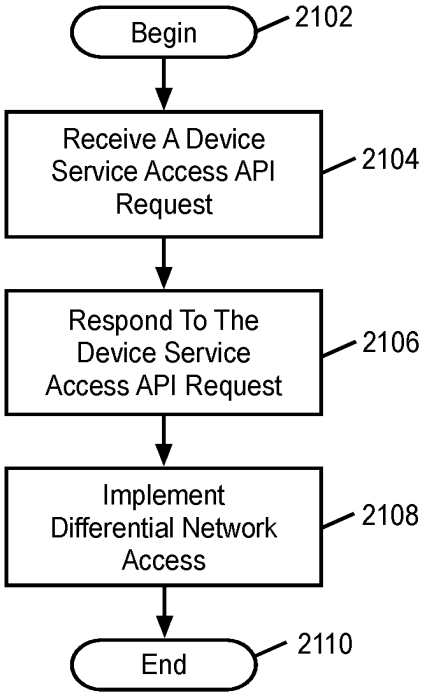

Begin
2102
Receive A Device Service Access API Request
2104
Respond To The Device Service Access API Request
2106
Implement Differential Network Access
2108
End
2110

FIG. 21

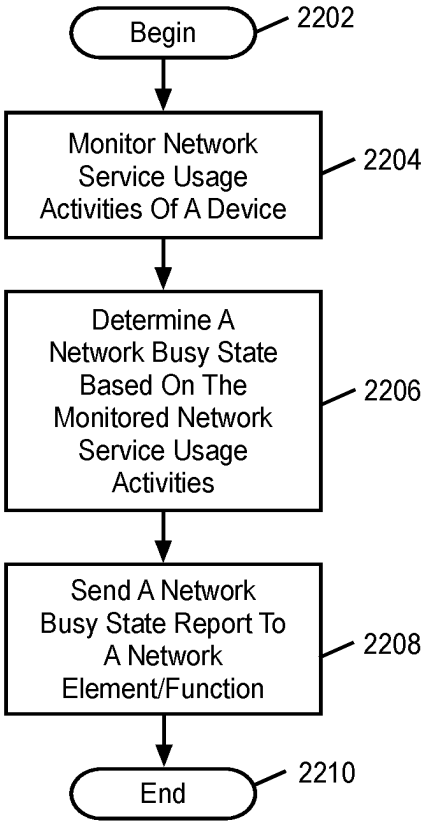

Begin
2202
Monitor Network Service Usage Activities Of A Device
2204
Determine A Network Busy State Based On The Monitored Network Service Usage Activities
2206
Send A Network Busy State Report To A Network Element/Function
2208
End
2210

FIG. 22

653

	NBS 10%	NBS 25%	NBS 50%	NBS 75%	NBS 90%
Outlook	6	5	4	3	2
Skype	7	6	2	1	0
Safari	5	4	3	2	1
Pandora	5	4	3	2	1
FaceBook	4	3	2	1	0
iTunes	7	6	3	1	0
QuickTime	8	6	4	1	0
AV Software	9	7	5	3	1
Online Backup	3	2	1	1	0
OS Update	2	1	0	0	0

FIG. 23

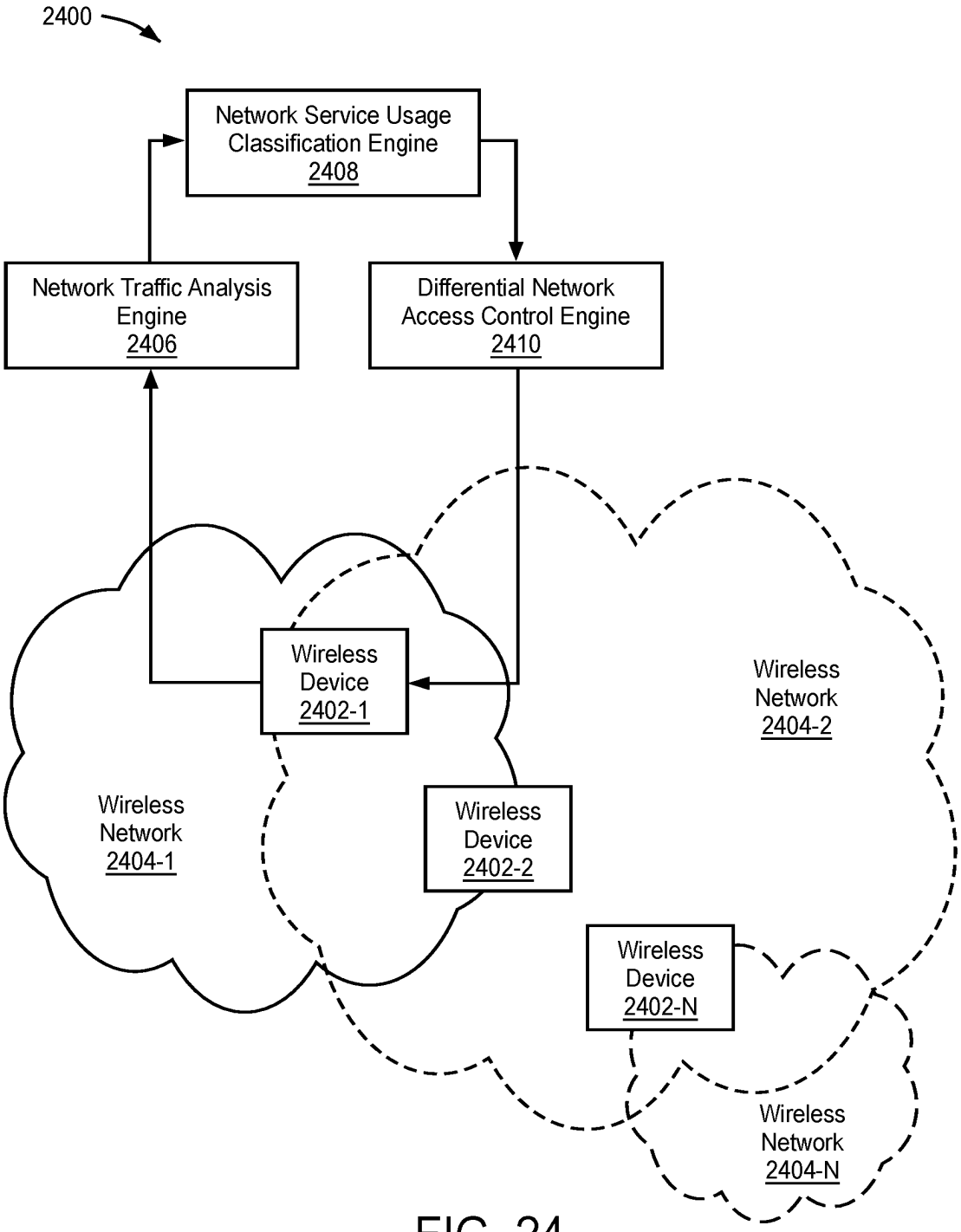

2400
Network Service Usage Classification Engine 2408
Network Traffic Analysis Engine 2406
Differential Network Access Control Engine 2410
Wireless Device 2402-1
Wireless Network 2404-1
Wireless Device 2402-2
Wireless Network 2404-2
Wireless Device 2402-N
Wireless Network 2404-N

FIG. 24

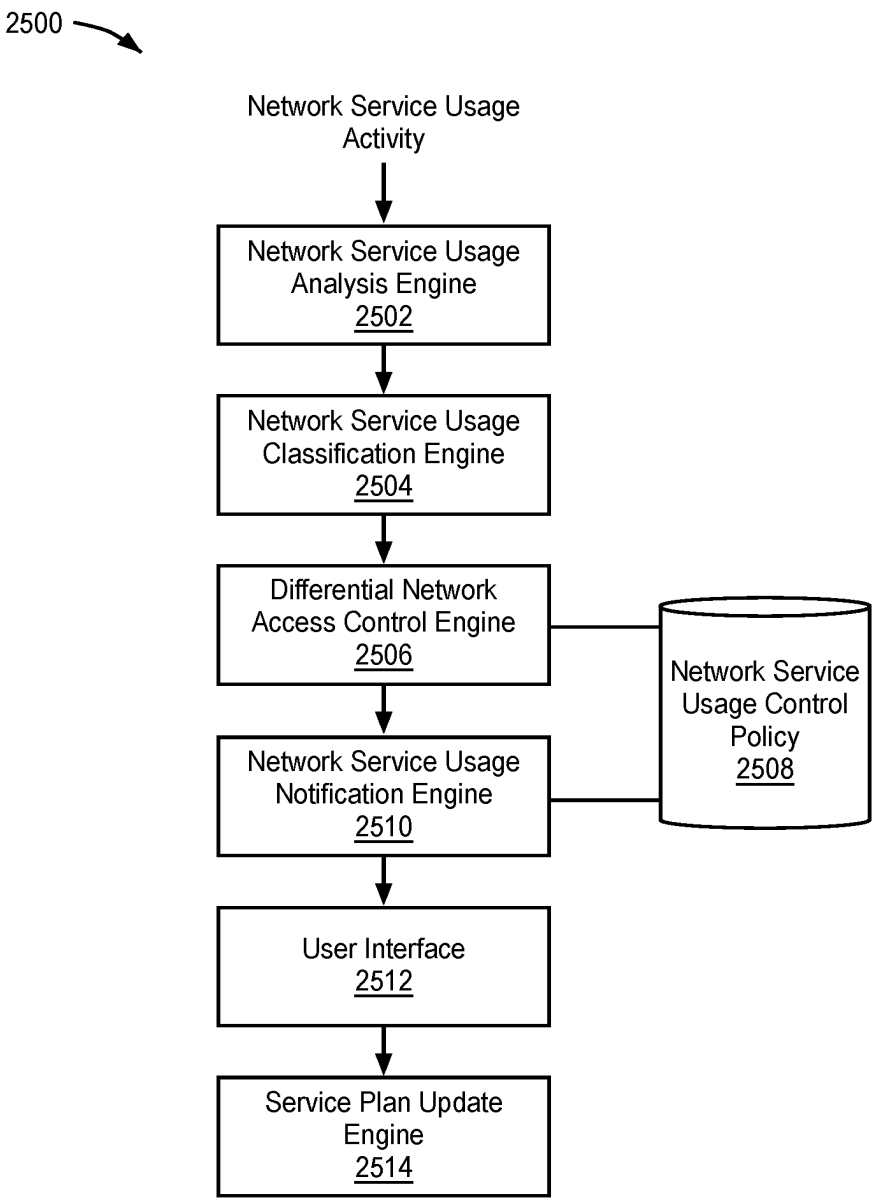

2500
Network Service Usage Activity
Network Service Usage Analysis Engine 2502
Network Service Usage Classification Engine 2504
Differential Network Access Control Engine 2506
Network Service Usage Control Policy 2508
Network Service Usage Notification Engine 2510
User Interface 2512
Service Plan Update Engine 2514

FIG. 25

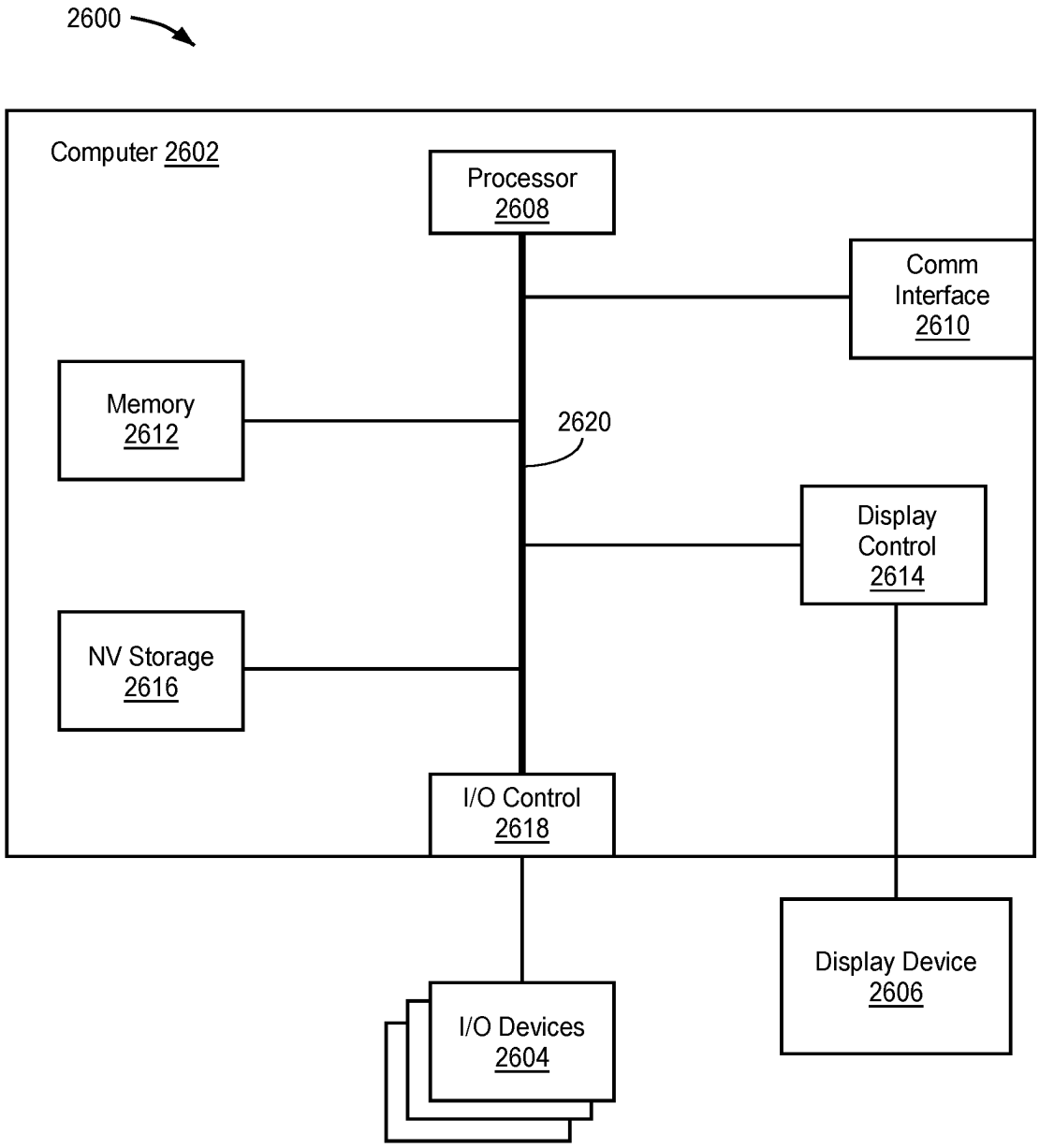

2600
Computer 2602
Processor 2608
Comm Interface 2610
Memory 2612
2620
Display Control 2614
NV Storage 2616
I/O Control 2618
Display Device 2606
I/O Devices 2604

FIG. 26

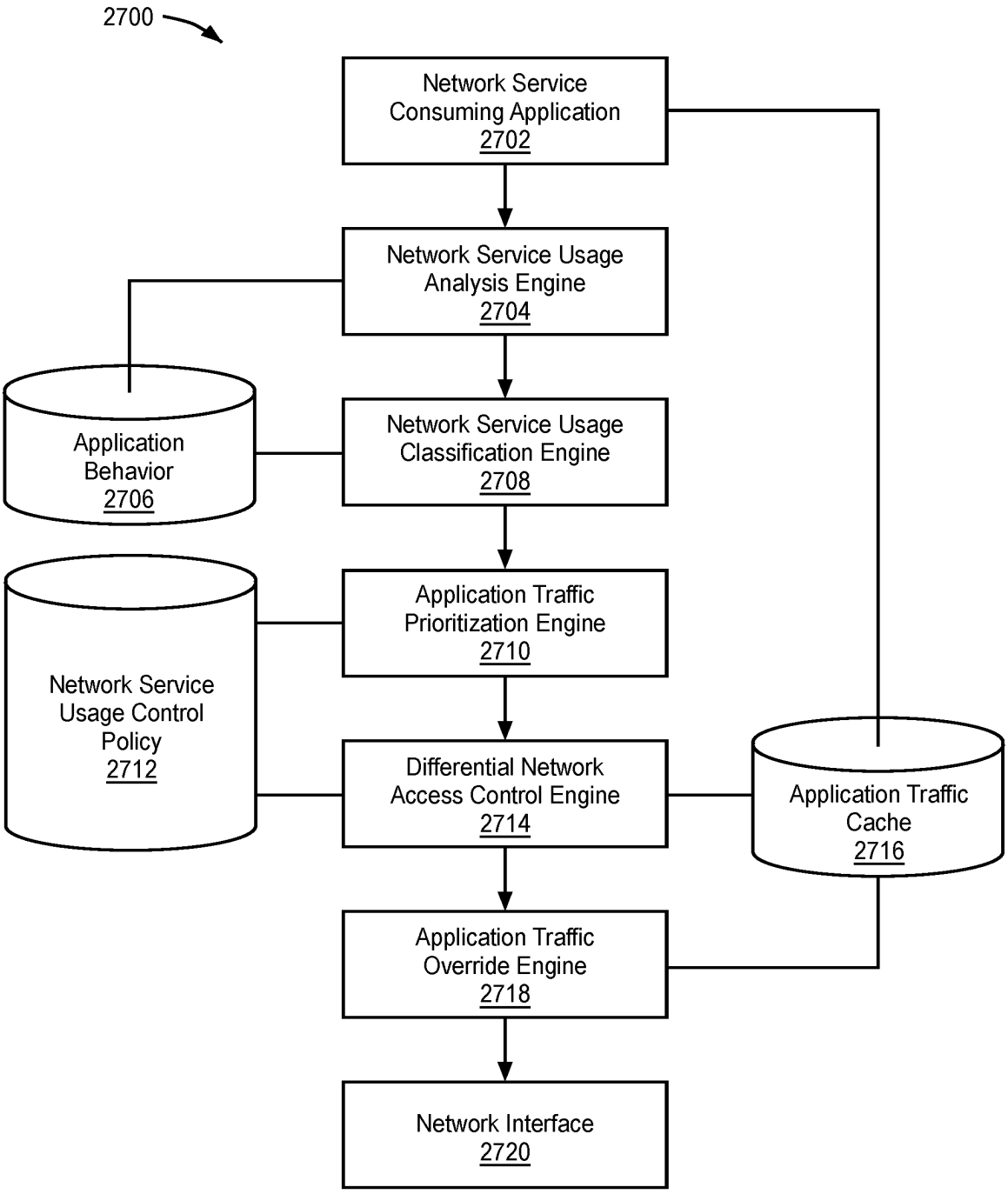

2700
Network Service Consuming Application 2702
Network Service Usage Analysis Engine 2704
Application Behavior 2706
Network Service Usage Classification Engine 2708
Application Traffic Prioritization Engine 2710
Network Service Usage Control Policy 2712
Differential Network Access Control Engine 2714
Application Traffic Cache 2716
Application Traffic Override Engine 2718
Network Interface 2720

FIG. 27

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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	Device-Assisted Services for Protecting Network Capacity (RALEP032C1)

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 _____

filed on _____.

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: Gregory G. Raleigh _____ Date (Optional) :_____

Signature: _____

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

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

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LEGAL NAME OF INVENTOR

Inventor: Alireza Raissinia Date (Optional): 11/13/2013

Signature: _____

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

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LEGAL NAME OF INVENTOR

Inventor: James Lavine Date (Optional): 11/11/13

Signature: _____

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

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

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

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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:

[X] Practitioners associated with Customer Number: 106963

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 assignment 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:

[X] The address associated with Customer Number: 106963

OR

[ ]

Firm or individual name		
Address		
City	State	Zip
Country		
Telephone	Email	

Assignee name and address: Headwater Research LLC
1011 Pruitt Place
Tyler, TX 75703 (USA)

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	Date January 17, 2018
Name James E. Harris	Telephone 903-201-6212
Title CEO	

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 update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 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.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Filer:	James E. Harris/Ann Taylor
Attorney Docket Number:	RALEP032C1C12C2C1

Filed as Small Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	75	75
UTILITY SEARCH FEE	2111	1	330	330
UTILITY EXAMINATION FEE	2311	1	380	380
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2000	2000
Pages:				
UTILITY APPL SIZE FEE PER 50 SHEETS >100	2081	1	200	200
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**3055**

Electronic Acknowledgement Receipt	
EFS ID:	32604989
Application Number:	15977766
International Application Number:	
Confirmation Number:	8228
Title of Invention:	Device-Assisted Services for Protecting Network Capacity
First Named Inventor/Applicant Name:	Gregory G. Raleigh
Customer Number:	106963
Filer:	James E. Harris/Ann Taylor
Filer Authorized By:	James E. Harris
Attorney Docket Number:	RALEP032C1C12C2C1
Receipt Date:	11-MAY-2018
Filing Date:	
Time Stamp:	17:06:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$3055
RAM confirmation Number	051418INTEFSW00003985505876
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1	TrackOne Request	P032C1C12C2C1_TrackOneRequest.pdf	139119 e78a1e0eaaa0639e62b347d09b52419e666762f7	no	2
Warnings:					
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2	Application Data Sheet	P032C1C12C2C1_ADS.pdf	1795176 9e8d0b961fda3301d96d45b4acb3c97e9c4a0b6b	no	14
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3		P032C1C12C2C1_App.pdf	705901 5aabaf7e9fa0b387eae3591d61ba88f4eebd944e	yes	152

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Specification	1	150
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4	Drawings-only black and white line drawings	P032C1C12C2C1_Drawings.PDF	150761 ac7246ee5ca09e393b3f612f53effe5b049e98b2	no	29
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5	Oath or Declaration filed	P032C1C12C2C1_RaleighDecl.pdf	63907 c6a50cad9c7a434f4f78f93ab5a1e92a8474542f	no	1

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6	Oath or Declaration filed	P032C1C12C2C1_RaissiniaDecl.pdf	65020 52dd45edafeb4a71acd6368bc129cf6e798b60ea	no	1
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7	Oath or Declaration filed	P032C1C12C2C1_LavineDecl.pdf	276545 36ee0f95bf0cdc129378ac847054b11d3d11d866	no	2
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8	Power of Attorney	P032C1C12C2C1_POA.pdf	288395 24d2507013acb1dd49b36861e933f27266a9bd95	no	1
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9	Fee Worksheet (SB06)	fee-info.pdf	41868 a16f3e508e178ffcb958c9fd9d7c5c9fce1fa804	no	2
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