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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	10/06/2020	10798754	1426-221.101	7229

106622 7590 09/16/2020

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

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):

Li-Te Pan, Taipei City, TAIWAN;
ASUSTek Computer Inc., Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;

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.

Petitioners' Exhibit 1002, p. 1
AT&T et al v. Asustek Technology
IPR2024-00997

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 09/03/2020

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER
PHAN, TRI H

ART UNIT	PAPER NUMBER
2471	

NOTIFICATION DATE	DELIVERY MODE
09/03/2020	ELECTRONIC

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

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

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

docketing@bluecapitallaw.com

Petitioners' Exhibit 1002, p. 2
AT&T et al v. Asustek Technology
IPR2024-00997

Response to Rule 312 Communication	Application No. 16/043,818	Applicant(s)
	Examiner	Art Unit

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

1. ☒ The amendment filed on *28 August 2020* under 37 CFR 1.312 has been considered, and has been:

a) ☒ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.
Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/ Kimberly Payne /

Kimberly Payne

Publishing Division

Office of Data Management

Petitioners' Exhibit 1002, p. 3
AT&T et al v. Asustek Technology
IPR2024-00997

Electronic Acknowledgement Receipt

EFS ID:	40416958
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	28-AUG-2020
Filing Date:	24-JUL-2018
Time Stamp:	16:52:24
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		1426-221-101--ResposetoNTFCAP08282020.pdf	80256 5cee99d2448eac3efdcb5989c45a8feffdb4e470	yes	5

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	5	5
	Amendment after Notice of Allowance (Rule 312)	1	4
Warnings:			
Information:			
	Total Files Size (in bytes):	80256	

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

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	16/043,818	Filed: July 24, 2018
Examiner:	Tri H. Phan	Group Art Unit: 2471
Attorney Docket No.:	1426-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 4 Page Response to Notice to File Corrected Application Papers is being transmitted to the United States Patent and Trademark Office via EFS-Web on August 28, 2020.

Date: August 28, 2020 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	16/043,818
Confirmation No.	:	7229
Applicants	:	Li-Te Pan and Richard Lee-Chee Kuo
Filed	:	July 24, 2018
Title	:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	:	2471
Examiner	:	Tri H. Phan
Docket No.	:	1426-221.101 (1060196-US)
Customer No.	:	106622

RESPONSE TO NOTICE TO FILE CORRECTED APPLICATION PAPERS

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

Dear Sir:

In response to the Notice to File Corrected Application Papers of the above-identified non-provisional patent application mailed on July 16, 2020, please amend the above-identified application as follows:

Amendments to the Specification begin on page 2
Remarks begin on page 3.

Petitioners' Exhibit 1002, p. 7
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE SPECIFICATION:

On page 7 of the specification, please amend the last line to:

The QoS architecture in NG-RAN is depicted ~~in the Figure 13-1~~ [in the Figure 12-1 of 3GPP TS 38.300 v0.4.1, which is reproduced as FIG. 5] and described in the following:

On page 10 of the specification, please amend line 4 from bottom of page to:

procedures discussed above. Details of this are as shown in Figure X.2-1 and Figure X.3-1 [of 3GPP TS 38.300 v0.4.1].

On page 13 of the specification, please amend line 17 to:

AN resources is illustrated in Figure 5.7.1-1 [of 3GPP TS 23.501 v1.0.0, which is reproduced as FIG. 7].

On page 13 of the specification, please amend line 18 to:

[Figure 5.7.1-1 of 3GPP TS 23.501 v1.0.0, entitled "The principle for classification and User Plane marking for QoS Flows and mapping to AN Resources", is reproduced as FIG. 7]

Petitioners' Exhibit 1002, p. 8
AT&T et al v. Asustek Technology
IPR2024-00997

REMARKS

The amendments to the specification have been made to show designation to drawings as described in the brief description. The amendments to the specification are in compliance with USPTO Rules. No new matter has been added.

In particular, the Notice to File Corrected Application Papers requests corrections to the following references to the figures:

1. Reference to Figure 13-1 on the last line of Page 7;
2. Reference to Figure X.2-1 and Figure X.3-1 on line 4 of Page 10; and
3. Reference to Figure 5.7.1-1 on line 17 of Page 13.

Applicants respectfully submit that the references to the figures listed above are in sections where verbiage from 3GPP standards are quoted and copied. Nevertheless, Applicants inserted additional text to point out that the figures are available in a 3GPP standard. Furthermore, in the case of the reference to Figure 13-1 on Page 7, the 3GPP standard (namely, 3GPP TS 38.300 v0.4.1) refers to an incorrect figure number. Therefore, Applicants insert text to correct the figure number (namely, Figure 12-1). In addition, Figure 12-1 of 3GPP TS 38.300 v0.4.1 and Figure 5.7.1-1 of 3GPP TS 23.501 v1.0.0 are reproduced respectively as FIG. 5 and FIG. 7 of the present application. Therefore, Applicants insert text to indicate that Figure 12-1 of 3GPP TS 38.300 v0.4.1 is reproduces as FIG. 5, and that Figure 5.7.1-1 of 3GPP TS 23.501 v1.0.0 is reproduced as FIG. 7.

The pending claims have all been indicated as allowable in the Notice of Allowance of May 7, 2020.

Applicant respectfully requests entry of the amendment to specification prior to publication of the patent.

Petitioners' Exhibit 1002, p. 9
AT&T et al v. Asustek Technology
IPR2024-00997

Should the Examiner wish to speak with Applicants' attorney, the Examiner is invited to contact the undersigned at the telephone number identified below.

Respectfully submitted,
Sang N. Dang
BLUE CAPITAL LAW FIRM, P.C.

Dated: August 28, 2020

/Sang N. Dang/
Reg. No. 51,186
Tel.: (714) 839-3800

Petitioners' Exhibit 1002, p. 10
AT&T et al v. Asustek Technology
IPR2024-00997

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 07/16/2020
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
PHAN, TRI H	

ART UNIT	PAPER NUMBER
2471	

NOTIFICATION DATE	DELIVERY MODE
07/16/2020	ELECTRONIC

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

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

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

docketing@bluecapitallaw.com

Petitioners' Exhibit 1002, p. 11
AT&T et al v. Asustek Technology
IPR2024-00997

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

Application No. : 16043818
Applicant : Pan
Filing Date : 07/24/2018
Date Mailed : 07/16/2020

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Notice of Allowance Mailed

This application has been accorded an Allowance Date and is being prepared for issuance. The application, however, is incomplete for the reasons below.

Applicant is given two (2) months from the mail date of this Notice within which to respond. This time period for reply is extendable under 37 CFR 1.136(a) for only TWO additional MONTHS.

The informalities requiring correction are indicated in the attachment(s). If the informality pertains to the abstract, specification (including claims) or drawings, the informality must be corrected with an amendment in compliance with 37 CFR 1.121 (or, if the application is a reissue application, 37 CFR 1.173). Such an amendment may be filed after payment of the issue fee if limited to correction of informalities noted herein. See Waiver of 37 CFR 1.312 for Documents Required by the Office of Patent Publication, 1280 Off. Gaz. Patent Office 918 (March 23, 2004). In addition, if the informality is not corrected until after payment of the issue fee, for purposes of 35 U.S.C. 154(b)(1)(iv), "all outstanding requirements" will be considered to have been satisfied when the informality has been corrected. A failure to respond within the above-identified time period will result in the application being ABANDONED.

See attachment(s).

A copy of this notice MUST be returned with the reply. Please address response to "Mail Stop Issue Fee, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450".

/Quang Nguyen/
Publication Branch
Office of Data Management
(571) 272-4200

Application No. 16043818

IDENTIFICATION OF SPECIFICATION/DRAWING INCONSISTENCIES

☐ On Page of the specification there is a brief description of FIG. , but the drawings filed do not include a drawing with that designation. Applicant must respond either by supplying the omitted drawing or by amending the specification to remove all references to that drawing.

☐ The drawings filed include FIG. , but the specification's brief description of the drawings does not describe a drawing with that designation. Applicant must respond either by amending the specification to add a brief description of that drawing or by correcting the drawings to remove the drawing in question.

☐ In the utility application, drawings are present in the application and are referred to in the detailed description of the invention, but the specification does not contain a brief description of the several views as required by 37 CFR 1.74 and 37 CFR 1.77(b)(9).

☐ The design application does not contain a description of the figure or figures of the drawing as required by 37 CFR 1.153(a) and 37 CFR 1.154(b)(4).

☐ In the plant application, the specification does not contain a brief description of the drawing as required by 37 CFR 1.163(c)(8).

☒ Page 7, 10, 13 of the specification refers to FIG. See Comment below, but no drawing with that designation is described in the brief description of the drawings and no drawing with that designation is present in the application. Applicant must respond either by amending the specification to remove all references to that drawing, or by supplying that drawing and amending the specification to add a brief description of it.

☐ In the reissue application, FIG. , is labeled as "New" but is not described in the reissue specification's brief description of the drawings. Applicant must respond by amending the reissue specification's brief description of the drawings to add a brief description of the new drawing.

☐ OTHER:

☒ COMMENTS:
- Page 7, last line, referes to FIG. 13-1.
- Page 10, line 4 from bottom of page, referes to FIG. X.2-1 and X.3-1.
- Page 13, line 17, referes to FIG. 5.7.1-1.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	16/043,818	Filed: July 24, 2018
Examiner:	Tri H. Phan	Group Art Unit: 2471
Attorney Docket No.:	1426-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 1 Page Issue Fee Transmittal; and Electronic payment via EFS are being transmitted to the United States Patent and Trademark Office via EFS-Web on June 30, 2020.

Date: June 30, 2020 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Electronic Patent Application Fee Transmittal

Application Number:	16043818
Filing Date:	24-Jul-2018
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-221.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

Electronic Acknowledgement Receipt

EFS ID:	39876128
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	30-JUN-2020
Filing Date:	24-JUL-2018
Time Stamp:	17:08:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	E20206TH09015029
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		1426-221-101--IssueFeeasFiled06302020.pdf	174568 8da86fc639c568cfca284a8fdc19ed8693898148	yes	2

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Issue Fee Payment (PTO-85B)	1	1
	Miscellaneous Incoming Letter	2	2

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30419 d654316f8d289f7528cca9a3153f3ad522c1ed1f	no	2

Warnings:

Information:

Total Files Size (in bytes):	204987

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PART B – FEE(S) TRANSMITTAL

Complete and send this form, together with the 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, VA 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)

106622
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

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

Certificate of Mailing or Transmission

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

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

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

TITLE OF INVENTION: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0	$0	$1000	08/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAN, TRI H.	2471	370-23000

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. Blue Capital Law Firm, P.C.
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)
ASUSTek Computer Inc.	Taipei City, Taiwan

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 of Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29. NOTE: Absent a valid Certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

☐ Applicant asserting small entity status. See 37 CFR 1.27. NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status. NOTE: Checking this box will be taken as 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 /Sang N. Dang/ Date June 30, 2020

Typed or printed name Sang N. Dang Registration No. 51186

Petitioners' Exhibit 1002, p. 19
AT&T et al v. Asustek Technology
IPR2024-00997

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 06/30/2020

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
PHAN, TRI H	

ART UNIT	PAPER NUMBER
2471	

NOTIFICATION DATE	DELIVERY MODE
06/30/2020	ELECTRONIC

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docketing@bluecapitallaw.com

Petitioners' Exhibit 1002, p. 20
AT&T et al v. Asustek Technology
IPR2024-00997

Response to Rule 312 Communication	Application No.	Applicant(s)	
	16/043,818	Pan et al.	
	Examiner	Art Unit	AIA (FITF) Status
	TRI H PHAN	2471	Yes

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

1. ☑ The amendment filed on 22 June 2020 under 37 CFR 1.312 has been considered, and has been:

a) ☑ entered.

b) ☐ entered as directed to matters of form not affecting the scope of the invention.

c) ☐ disapproved because the amendment was filed after the payment of the issue fee.

Any amendment filed after the date the issue fee is paid must be accompanied by a petition under 37 CFR 1.313(c)(1) and the required fee to withdraw the application from issue.

d) ☐ disapproved. See explanation below.

e) ☐ entered in part. See explanation below.

/TRI H PHAN/
Primary Examiner, Art Unit 2471

Petitioners' Exhibit 1002, p. 21
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	16/043,818
Confirmation No.	:	7229
Applicants	:	Li-Te Pan and Richard Lee-Chee Kuo
Filed	:	July 24, 2018
Title	:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	:	2471
Examiner	:	Tri H. Phan
Docket No.	:	1426-221.101 (1060196-US)
Customer No.	:	106622

AMENDMENT UNDER 37 CFR 1.312

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

Dear Sir:

Please amend the above-identified application as follows:

Claims begin on page 2.

Remarks begin on page 4.

OK to enter.
TP
06/24/2020

Petitioners' Exhibit 1002, p. 22
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	16/043,818
Confirmation No.	:	7229
Applicants	:	Li-Te Pan and Richard Lee-Chee Kuo
Filed	:	July 24, 2018
Title	:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	:	2471
Examiner	:	Tri H. Phan
Docket No.	:	1426-221.101 (1060196-US)
Customer No.	:	106622

AMENDMENT UNDER 37 CFR 1.312

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

Dear Sir:

Please amend the above-identified application as follows:

Claims begin on page 2.

Remarks begin on page 4.

Petitioners' Exhibit 1002, p. 23
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE CLAIMS:

1. (Currently Amended) A method of a network node, comprising:

transmitting a first RRC (Radio Resource Control) message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Protocol Data Unit) ~~(Packet Data Unit)~~ session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establishing the default DRB with a presence of the QFI field in uplink; and

receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

2. (Previously Presented) The method of claim 1, wherein the network node is not allowed to transmit a second RRC_message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

3. (Original) The method of claim 1, wherein a header in the SDAP PDU includes at least the QFI field.

4. (Original) The method of claim 1, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

5. (Original) The method of claim 1, wherein the network node is a base station (or gNB).

6. (Currently Amended) A network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

Petitioners' Exhibit 1002, p. 24
AT&T et al v. Asustek Technology
IPR2024-00997

transmit a first RRC (Radio Resource Control) message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Protocol Data Unit) ~~(Packet Data Unit)~~ session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establish the default DRB with a presence of the QFI field in uplink; and

receive a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

7. (Previously Presented) The network node of claim 6, wherein the network node is not allowed to transmit a second RRC message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

8. (Original) The network node of claim 6, wherein a header in the SDAP PDU includes at least the QFI field.

9. (Original) The network node of claim 6, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

10. (Original) The network node of claim 6, wherein the network node is a base station (or gNB).

Petitioners' Exhibit 1002, p. 25
AT&T et al v. Asustek Technology
IPR2024-00997

REMARKS

Claims 1-10 are pending in the above-referenced application.

The pending claims have all been indicated as allowable in the Notice of Allowance of May 7, 2020.

Previously allowed claims 1 and 6 have been amended to correct grammatical errors. No new matter has been added. Applicant respectfully requests entry of the amendment to claims 1 and 6 prior to publication of the patent.

Should the Examiner wish to speak with Applicant's attorney, she is invited to contact the undersigned at the telephone number identified below.

Respectfully submitted,
Sang N. Dang
BLUE CAPITAL LAW FIRM, P.C.

Dated: June 22, 2020

/Sang N. Dang/
Reg. No. 51,186
Tel.: (714) 839-3800

Petitioners' Exhibit 1002, p. 26
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	16/043,818	Filed: July 24, 2018
Examiner:	Tri H. Phan	Group Art Unit: 2471
Attorney Docket No.:	1426-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Amendment Transmittal Sheet and 4 Page Amendment Under 37 CFR 1.312 are being transmitted to the United States Patent and Trademark Office via EFS-Web on June 22, 2020.

Date: June 22, 2020 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Electronic Acknowledgement Receipt

EFS ID:	39790123
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	22-JUN-2020
Filing Date:	24-JUL-2018
Time Stamp:	16:07:40
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		1426-221-101--312Amendment asFiledv2.pdf	130761 4712486d608d4819b09be4508164888303 12e27d	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal Letter	1	2
	Amendment after Notice of Allowance (Rule 312)	3	3
	Claims	4	5
	Applicant Arguments/Remarks Made in an Amendment	6	6
	Miscellaneous Incoming Letter	7	7
Warnings:			
Information:			
	Total Files Size (in bytes):	130761	

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.

Amendment Transmittal Letter

Docket Number
1426-221.101

Address To
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Title of Invention

METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Li-Te Pan
Application No.	16/043,818
Filing Date	July 24, 2018
Examiner	Tri H. Phan
Art Unit	2471

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated and is transmitted as shown below.

☐ **Applicant claims Small Entity Status.** See 37 CFR 1.27.

Fee Calculation

Claims as Amended

For	#Filed	#Previously Paid For	#Extra	Rate	Fee
Total Claims	10	- 20 =		x ☐ =	
Total Indep. Claims	2	- 3 =		x =	
Multiple Dependent Claims (check if applicable) ☐					
				TOTAL	0

Method of Payment

☐ Deposit Account ☐ Credit Card ☐ Check ☐ Money Order ☐ Other: _____

Deposit Account Number

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge the fee(s) set forth above
☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
☐ Charge fee(s) indicated above, **except for the filing fee**
☐ Credit any overpayments

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

Amount Grand Total 0

Petitioners' Exhibit 1002, p. 30
AT&T et al v. Asustek Technology
IPR2024-00997

Amendment Transmittal Letter

Docket Number
1426-221.101

Correspondence Address

Customer Number	106622		
-OR-			
Name			
Address			
City		State	
Country		Postal Code	
Phone Number			
E-mail Address			

Certificate of Mailing by Express Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing)

(Typed or Printed Name of Person Mailing Correspondence)

(Signature of Person Mailing Correspondence)

("Express Mail" Mailing Label Number)

Certificate of Mailing by First Class Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing) *(Name of Person Mailing Correspondence)*

(Signature of Person Mailing Correspondence)

Certificate of Transmission

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) authorization are being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

(Date of Transmission) *(Name of Person Transmitting Correspondence)*

(Signature of Person Transmitting Correspondence)

Signature Instructions

Select the name of the person who will electronically sign the Amendment from the drop-down box below.

If a practitioner is not present in the drop-down list, you must close this form and select 'Add Practitioner...' in the Form Manager's Utility menu.

Verify that the signatory information is correct and press the 'eSign' button to electronically sign the submission. If you prefer to sign the form manually, simply do not click the 'eSign' button; just print and manually sign.

Signatory Drop-Down Box Sang N. Dang

Name	Sang N. Dang	Registration Number	51,186
Signatory Capacity	Attorney for Applicant(s)	E-mail Address	sdang@bluecapitallaw.com
eSign	/Sang N. Dang/	Date Signed	06-22-2020

Petitioners' Exhibit 1002, p. 31
AT&T et al v. Asustek Technology
IPR2024-00997

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

106622 7590 05/07/2020
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER
PHAN, TRI H

ART UNIT	PAPER NUMBER
2471	

DATE MAILED: 05/07/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

TITLE OF INVENTION: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	08/07/2020

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.

Petitioners' Exhibit 1002, p. 32
AT&T et al v. Asustek Technology
IPR2024-00997

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)

106622 7590 05/07/2020
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

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

Certificate of Mailing or Transmission

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

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

TITLE OF INVENTION: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	08/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAN, TRI H	2471	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. _____

Petitioners' Exhibit 1002, p. 33
AT&T et al v. Asustek Technology
IPR2024-00997

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 05/07/2020

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
PHAN, TRI H	

ART UNIT	PAPER NUMBER
2471	

DATE MAILED: 05/07/2020

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

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

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

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

Petitioners' Exhibit 1002, p. 34
AT&T et al v. Asustek Technology
IPR2024-00997

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

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

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

Privacy Act Statement

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

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

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

Notice of Allowability	Application No. 16/043,818	Applicant(s) Pan et al.	
	Examiner TRI H PHAN	Art Unit 2471	AIA (FITF) Status Yes

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

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

1. ☑ This communication is responsive to the RCE filed on 04/14/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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

3. ☑ The allowed claim(s) is/are 1-10 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

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

   Certified copies:

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

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

   * Certified copies not received: _____ .

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

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

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

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

Attachment(s)

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

/TRI H PHAN/
Primary Examiner, Art Unit 2471

Petitioners' Exhibit 1002, p. 36
AT&T et al v. Asustek Technology
IPR2024-00997

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Response to Communication(s)

2. This office action is in response to the RCE filed on April 14, 2020. Claims 1-10 are now pending in the application.

Information Disclosure Statement

3. The information disclosure statement filed 04/15/2020 complies with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609. It has been considered and placed in the application file.

Response to Amendment/Arguments

4. Applicant's amendment/arguments filed on 04/14/2020 are acknowledged.

With respect to the rejections of claims 1-10 under 35 U.S.C. 103(a), the applicant's amendment/arguments (see REMARKS, pages 4-9) have been fully considered and are persuasive. Accordingly, the previous office action sent on 01/29/2020 has been withdrawn.

Allowable Subject Matter

5. Claims 1-10 are allowed. The following is a statement of reasons for the indication of allowable subject matter:

The Applicants' amendment/arguments in the outstanding response filed 04/14/20 have been fully appreciated and considered. The prior art of record, considered individually or in combination, fails to fairly show or suggest the claimed network node (claim 6) and method (claim 1), comprising, among other limitations, the novel and unobvious limitations as "*transmitting a first Radio Resource Control 'RRC' message with a Data Radio Bearer 'DRB' configuration to a User Equipment 'UE' for establishing a default DRB for a Packet Data Unit 'PDU' session, wherein the DRB configuration includes a QoS Flow Id 'QFI' configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB; ... via the default DRB from the UE.*" structurally and functionally interconnected with other limitations in a manner as recited in dependent claims 2-5 and 7-10.

6. References U.S. 10,492,096; U.S. 2019/0357093; U.S. 2020/0037197; U.S. 2020/0084003; U.S. 2020/0100136 and U.S. 2020/0128430 are cited because they are put pertinent to improve the serving QoS flow in wireless telecommunication networks. However, none of references teaches as recited in claimed invention.

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

Conclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tri H. Phan, whose telephone number is (571) 272-3074. The examiner can normally be reached on M-F (8:00Am-4:30PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chi H. Pham can be reached on (571) 272-3179.

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.

/TRI H PHAN/
Primary Examiner, Art Unit 2471

May 1, 2020

Notice of References Cited	Application/Control No. 16/043,818	Applicant(s)/Patent Under Reexamination Pan et al.	
	Examiner TRI H PHAN	Art Unit 2471	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-10492096-B2	11-2019	Lee; Hyungho	H04L47/2408	1/1
*	B	US-20190357093-A1	11-2019	Xu; Jian	H04W36/0058	1/1
*	C	US-20200037197-A1	01-2020	CHO; Heejeong	H04W80/08	1/1
*	D	US-20200084003-A1	03-2020	Sun; Junshuai	H04W28/065	1/1
*	E	US-20200100136-A1	03-2020	CHANG; NINGJUAN	H04W28/0252	1/1
*	F	US-20200128430-A1	04-2020	YI; Seungjune	H04W28/0268	1/1
	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.

Petitioners' Exhibit 1002, p. 40
AT&T et al v. Asustek Technology
IPR2024-00997

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	Art Unit
	TRI H PHAN	2471

CPC - Searched*		
Symbol	**Date**	**Examiner**
H04W28/00,02,0268,10,12,16,24; H04W76/00,10,11; H04L12/24; H04L41/50,5003,5006,5009,5019; H04L47/2425	09/03/2019	TP
H04W28/00,02,0268,10,12,16,24; H04W76/00,10,11; H04L12/24; H04L41/50,5003,5006,5009,5019; H04L47/2425 (up[dated search printout).	05/01/2020	TP

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 (USPT,JPO,EPO,FPRS,DWPI) - see text search printout.	09/03/2019	TP
Inventorship search.	05/01/2020	TP
EAST (updated search history printout).	05/01/2020	TP

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	Interference search history printout).	05/01/2020	TP

/TRI H PHAN/ Primary Examiner, Art Unit 2471	

Petitioners' Exhibit 1002, p. 41
AT&T et al v. Asustek Technology
IPR2024-00997

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	**Art Unit**
	TRI H PHAN	2471

CPC						
Symbol					**Type**	**Version**
H04W	/	76	/	10	F	2018-02-01
H04L	/	41	/	5019	I	2013-01-01
H04W	/	76	/	00	I	2013-01-01
H04W	/	28	/	12	I	2013-01-01
H04W	/	28	/	0268	I	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	10	
/TRI H PHAN/ Primary Examiner, Art Unit 2471	01 May 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	12

U.S. Patent and Trademark Office — Part of Paper No.: 20200501

Petitioners' Exhibit 1002, p. 42
AT&T et al v. Asustek Technology
IPR2024-00997

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	**Art Unit**
	TRI H PHAN	2471

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04W	/	76	/	10
H04L	/	12	/	24

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	10	
/TRI H PHAN/ Primary Examiner, Art Unit 2471	01 May 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	12

U.S. Patent and Trademark Office — Part of Paper No.: 20200501

Petitioners' Exhibit 1002, p. 43
AT&T et al v. Asustek Technology
IPR2024-00997

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	**Art Unit**
	TRI H PHAN	2471

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

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10												
	2														
	3														
	4														
	5														
	6														
	7														
	8														
	9														

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	10	
/TRI H PHAN/ Primary Examiner, Art Unit 2471	01 May 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	12

U.S. Patent and Trademark Office — Part of Paper No.: 20200501

Petitioners' Exhibit 1002, p. 44
AT&T et al v. Asustek Technology
IPR2024-00997

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	Art Unit
	TRI H PHAN	2471

✓	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	09/03/2019	01/23/2020	05/01/2020						
1	1	✓	✓	=						
2	2	✓	✓	=						
3	3	✓	✓	=						
4	4	✓	✓	=						
5	5	✓	✓	=						
6	6	✓	✓	=						
7	7	✓	✓	=						
8	8	✓	✓	=						
9	9	✓	✓	=						
10	10	✓	✓	=						

Petitioners' Exhibit 1002, p. 45
AT&T et al v. Asustek Technology
IPR2024-00997

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

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
Attorney Docket Number	1426-221.101

U.S.PATENTS

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

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

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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

FOREIGN PATENT DOCUMENTS

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

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

NON-PATENT LITERATURE DOCUMENTS

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

Petitioners' Exhibit 1002, p. 46
AT&T et al v. Asustek Technology
IPR2024-00997

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.H.P/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16043818
	Filing Date	2018-07-24
	First Named Inventor	PAN, LI-TE
	Art Unit	2471
	Examiner Name	Tri H. Phan
	Attorney Docket Number	1426-221.101

	1	SDAP Header Format, Convida Wireless, 3GPP TSG-RAN WG2 NR Ad Hoc, R2-1707351, 2017, June 27-29, 2017.	☐
	2	Office Action from SIPO in corresponding CN Application No. 201810820169, dated March 3, 2020.	☐

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

EXAMINER SIGNATURE

Examiner Signature	/TRI H PHAN/	Date Considered	04/30/2020

*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.

Petitioners' Exhibit 1002, p. 47
AT&T et al v. Asustek Technology
IPR2024-00997

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.H.P/

Bibliographic Data

Application No: 16/043,818

Foreign Priority claimed: ○ Yes ◉ No

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

Verified and Acknowledged: /TRI H PHAN/ (Examiner's Signature) | (Initials)

Title: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/24/2018	370	2471	1426-221.101
RULE			

APPLICANTS

ASUSTek Computer Inc., Taipei City, TAIWAN

INVENTORS

Li-Te Pan Taipei City, TAIWAN

Richard Lee-Chee Kuo Taipei City, TAIWAN

CONTINUING DATA

This application has PRO of 62536163 07/24/2017

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

08/07/2018

STATE OR COUNTRY

TAIWAN

ADDRESS

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626
UNITED STATES

FILING FEE RECEIVED

$1,720

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S32	1	((RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:11
S33	2	((RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:15
S34	10	((DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:18
S35	7	((default adj2 (DRB! (Data adj Radio adj Bearer))) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:22
S36	23	((DRB! (Data adj Radio adj Bearer)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:23
S37	3	((DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (QoS! (quality adj "of" adj service)) and (Flow adj2 Id)).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:26
S38	16	((DRB! (Data adj Radio adj Bearer)) and (QoS! (quality adj "of" adj service)) and (Flow adj2 Id)).clm.	US-PGPUB; USPAT	OR	OFF	2020/05/01 14:27

5/1/2020 2:29:22 PM
C:\Users\tphan4\Documents\EAST\Workspaces\16-043818.wsp

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S17	332	(RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 10:20
S18	191	(RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and ((SDAP! (Service adj Data adj Adaptation adj Protocol)) same (PDU! (Packet adj Data adj Unit)) same (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 10:21
S19	6861	(ASUSTek.asn. or "ASUSTek Computer".asn. or (Pan.in. near2 Li-Te.in.) or (Kuo.in. near2 Richard.in. near2 Lee-Chee.in.))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 14:44
S20	2	S19 and ((RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 14:45
S21	142771	((H04W28/00 OR H04W28/02 OR H04W28/0268 OR H04W28/10 OR H04W28/12 OR H04W28/16 OR H04W28/24 OR H04W76/00 OR H04W76/10 OR H04W76/11 OR H04L12/24 OR H04L41/50 OR H04L41/5003 OR H04L41/5006 OR H04L41/5009 OR H04L41/5019 OR H04L47/2425).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 14:46

S22	86	S21 and ((RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/04/30 14:46
S23	332	((RRC! (Radio adj resource adj control)) and (DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:23
S24	2	S23 and (ASUSTek.asn. or "ASUSTek Computer".asn. or (Pan.in. near2 Li-Te.in.) or (Kuo.in. near2 Richard.in. near2 Lee-Chee.in.))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:24
S25	2	S23 and @ad<="20170724"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:25
S26	33	S23 and @Prad<="20170724"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:26
S27	86	S23 and (H04W28/00 OR H04W28/02 OR H04W28/0268 OR H04W28/10 OR H04W28/12 OR H04W28/16 OR H04W28/24 OR H04W76/00 OR H04W76/10 OR H04W76/11 OR H04L12/24 OR H04L41/50 OR H04L41/5003 OR H04L41/5006 OR H04L41/5009 OR H04L41/5019 OR H04L47/2425).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:30

S28	301	((RRC! (Radio adj resource adj control)) and ((DRB! (Data adj Radio adj Bearer)) same configur$5) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and (QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 13:42
S29	36	((RRC! (Radio adj resource adj control)) and ((DRB! (Data adj Radio adj Bearer)) same configur$5) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and (PDU! (Packet adj Data adj Unit)) and ((QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))) with value))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 14:05
S30	47	S23 and ((QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))) same value)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 14:07
S31	53	((DRB! (Data adj Radio adj Bearer)) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and ((QFI! ((QoS! (quality adj "of" adj service)) near3 (Flow adj2 Id))) same value))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/05/01 14:09

5/1/2020 2:29:11 PM
C:\Users\tphan4\Documents\EAST\Workspaces\16-043818.wsp

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
Attorney Docket Number	1426-221.101

U.S.PATENTS

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

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U.S.PATENT APPLICATION PUBLICATIONS

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16043818
	Filing Date	2018-07-24
	First Named Inventor	PAN, LI-TE
	Art Unit	2471
	Examiner Name	Tri H. Phan
	Attorney Docket Number	1426-221.101

	1	SDAP Header Format, Convida Wireless, 3GPP TSG-RAN WG2 NR Ad Hoc, R2-1707351, 2017, June 27-29, 2017.	☐
	2	Office Action from SIPO in corresponding CN Application No. 201810820169, dated March 3, 2020.	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

Petitioners' Exhibit 1002, p. 54
AT&T et al v. Asustek Technology
IPR2024-00997

Electronic Acknowledgement Receipt

EFS ID:	39170799
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	15-APR-2020
Filing Date:	24-JUL-2018
Time Stamp:	18:06:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-221-101--IDSasFiled04152020.pdf	53507 1a8ddc0584d2715098f595f0522d406d44ef49e1	no	2

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Non Patent Literature	NPL-R2-1707351.pdf	532382 9a7cc9abe5e5401c2359b4a005712c5d83296479	no	6
Warnings:					
Information:					
3	Non Patent Literature	NPL--CNOfficeAction.pdf	626049 7c58c4567e19a15f48b5fd10cb5b635d0b72a08a	no	6
Warnings:					
Information:					
			Total Files Size (in bytes):	1211938	

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

PTO/SB/06 (09-11)
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/043,818	Filing Date 07/24/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	10 minus 20 =	* 0		x $100 =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	* 0		x $460 =	0
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ 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	0

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	04/14/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 10	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/PEGGY S YARBOROUGH/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

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

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16/043,818	Filing Date	2018-07-24	Docket Number (if applicable)	1426-221.101	Art Unit	2471
First Named Inventor	Li-Te Pan			Examiner Name	Tri H. Phan		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☐ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

☐ Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/Sang N. Dang/	Date (YYYY-MM-DD)	2020-04-14
Name	Sang N. Dang	Registration Number	51186

This collection of information is required by 37 CFR 1.114. 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.

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

Amendment Transmittal Letter

Docket Number
1426-221.101

Address To
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Title of Invention

METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Li-Te Pan
Application No.	16/043,818
Filing Date	July 24, 2018
Examiner	Tri H. Phan
Art Unit	2471

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated and is transmitted as shown below.

☐ **Applicant claims Small Entity Status.** See 37 CFR 1.27.

Fee Calculation

Claims as Amended

For	#Filed	#Previously Paid For	#Extra	Rate	Fee
Total Claims	10	- 20 =		x ☐ =	
Total Indep. Claims	2	- 3 =		x =	
Multiple Dependent Claims (check if applicable) ☐					
				TOTAL	0

Method of Payment

☐ Deposit Account ☐ Credit Card ☐ Check ☐ Money Order ☐ Other: _____

Deposit Account Number

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge the fee(s) set forth above
☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
☐ Charge fee(s) indicated above, **except for the filing fee**
☐ Credit any overpayments

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

Amount Grand Total 0

Petitioners' Exhibit 1002, p. 60
AT&T et al v. Asustek Technology
IPR2024-00997

Amendment Transmittal Letter

Docket Number
1426-221.101

Correspondence Address

Customer Number	106622		
-OR-			
Name			
Address			
City		State	
Country		Postal Code	
Phone Number			
E-mail Address			

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(Signature of Person Mailing Correspondence)

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(Date of Mailing) *(Name of Person Mailing Correspondence)*

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I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) authorization are being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

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Signature Instructions

Select the name of the person who will electronically sign the Amendment from the drop-down box below.

If a practitioner is not present in the drop-down list, you must close this form and select 'Add Practitioner...' in the Form Manager's Utility menu.

Verify that the signatory information is correct and press the 'eSign' button to electronically sign the submission. If you prefer to sign the form manually, simply do not click the 'eSign' button; just print and manually sign.

Signatory Drop-Down Box Sang N. Dang

Name	Sang N. Dang			Registration Number	51,186
Signatory Capacity	Attorney for Applicant(s)		E-mail Address	sdang@bluecapitallaw.com	
eSign	/Sang N. Dang/			Date Signed	04/14/2020

Petitioners' Exhibit 1002, p. 61
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	: 16/043,818
Confirmation No.	: 7229
Applicants	: Li-Te Pan and Richard Lee-Chee Kuo
Filed	: July 24, 2018
Title	: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	: 2471
Examiner	: Tri H. Phan
Docket No.	: 1426-221.101 (1060196-US)
Customer No.	: 106622

AMENDMENT TO FINAL OFFICE ACTION

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

Dear Sir:

In response to the final Office Action mailed on January 29, 2020, having a three-month period for responding to **April 29, 2020**, Applicants respectfully submit the following amendments and remarks along with a RCE:

Claims begin on page 2.

Remarks begin on page 4.

Petitioners' Exhibit 1002, p. 62
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE CLAIMS:

1. (Currently Amended) A method of a network node, comprising:

transmitting a first RRC (Radio Resource Control) message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establishing the default DRB with a presence of the QFI field in uplink; and

receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

2. (Currently Amended) The method of claim 1, wherein the network node is not allowed to transmit a second RRC message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

3. (Original) The method of claim 1, wherein a header in the SDAP PDU includes at least the QFI field.

4. (Original) The method of claim 1, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

5. (Original) The method of claim 1, wherein the network node is a base station (or gNB).

6. (Currently Amended) A network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

Petitioners' Exhibit 1002, p. 63
AT&T et al v. Asustek Technology
IPR2024-00997

transmit a first RRC (Radio Resource Control) message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establish the default DRB with a presence of the QFI field in uplink; and

receive a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

7. (Currently Amended) The network node of claim 6, wherein the network node is not allowed to transmit a second RRC message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

8. (Original) The network node of claim 6, wherein a header in the SDAP PDU includes at least the QFI field.

9. (Original) The network node of claim 6, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

10. (Original) The network node of claim 6, wherein the network node is a base station (or gNB).

Petitioners' Exhibit 1002, p. 64
AT&T et al v. Asustek Technology
IPR2024-00997

REMARKS

Claims 1-10 are pending. Claims 1-10 stand rejected under 35 U.S.C. § 103 as being unpatentable over Convida Wireless ("SDAP Header Format", 3GPP TSG-RAN WG2 #99 TDOC R2-1708324, 20 June 2017) in view of Cho (U.S. Patent Publication No. 2019/0150023). *See* Office Action, ¶ 3.

Claims 1, 2, 6, and 7 have been amended based on at least Paragraph [0062] of the present application. No new matter has been added. Applicants respectfully request reconsideration of the claims as amended.

Claims 1 and 6 recite "transmitting [or transmit] a first RRC (Radio Resource Control) message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB", "establishing [or establish] the default DRB with a presence of the QFI field in uplink", and "receiving [or receive] a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE." Applicants respectfully submit that the combination of Convida Wireless and Cho fails to disclose the noted limitations.

In response to Applicants' arguments set forth in the Response filed on November 18, 2019, the Examiner states:

> In response to applicant's argument that Convida Wireless relates only to processes occurring **after the corresponding DRB(s) is established/initiated**. In other words, Convida Wireless do not refer to the specific claimed process, namely **transmitting a DRB configuration including a QFI configuration for establishing a default DRB** to the UE and establishing the default DRB as recited in the claims.
>
> The examiner respectfully disagrees with the arguments. Convida Wireless does disclose, for example see figs. 1-4 in Section4: Appendix, for downlink 'DL' SDAP header and uplink 'UL' SDAP header with flow id field; and wherein, in section 1, Introduction: ... for each DRB, the UE monitors the QoS flow ID(s) of the downlink packets, e.g. "*transmitting a DRB configuration including a QFI*

Petitioners' Exhibit 1002, p. 65
AT&T et al v. Asustek Technology
IPR2024-00997

> *configuration*", as disclosed in figs. 1 and 3 for DL SDAP header with flow id field, and applies the same mapping in the uplink; that is, for a DRB, the UE maps the uplink packets belonging to the QoS flows(s) corresponding to the QoS flow ID(s) and PDU Session observed in the downlink packets for that DRB, e.g. "*for establishing the DRB*", ...

See Office Action, Page 8, emphasis and italics original.

Applicants respectfully disagree. In particular, Convida Wireless refers to 3GPP TS 38.300, NR; NR and NG-RAN Overall Description, Stage 2, V0.4.1. Section 4.4 of 3GPP TS 38.300 provides a description of User Plane Protocol Stack and Control Plane Protocol Stack in Figure 4.4.1-1 entitled "User Plane Protocol Stack" and Figure 4.4.2-1 entitled "Control Plane Protocol Stack" as follows:

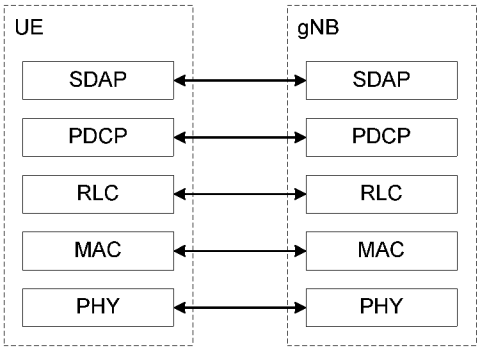


Figure 4.4.1-1: User Plane Protocol Stack

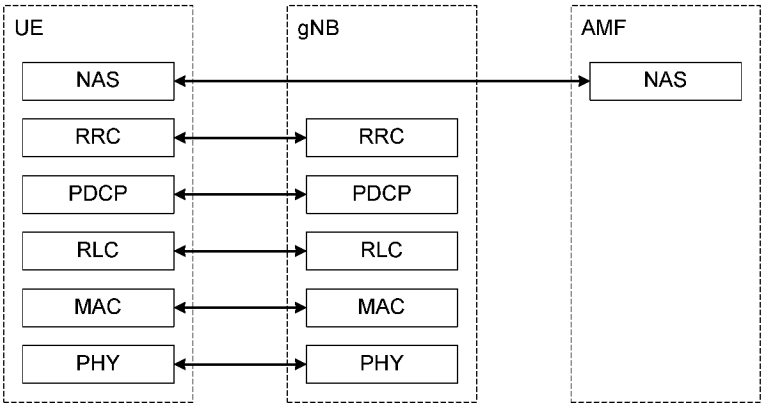


Figure 4.4.2-1: Control Plane Protocol Stack

Petitioners' Exhibit 1002, p. 66
AT&T et al v. Asustek Technology
IPR2024-00997

In addition, Section 6.1 of 3GPP TS 38.300 states that "Radio bearers are categorized into two groups: data radio bearers (DRB) for user plane data and signalling radio bearers (SRB) for control plane data."

It is clear from the above two figures that SDAP is in **User Plane Protocol Stack**, while RRC is in **Control Plane Protocol Stack**. And, the SDAP packet (i.e. the SDAP PDU disclosed in Cho) is transmitted via DRB, while RRC message is transmitted via SRB. Thus, SDAP and RRC are different protocol layers and use different radio bearers for transmission. Basically, the SDAP header is included in a SDAP packet (or SDAP PDU). Thus, the statement "for each DRB, the UE monitors the QoS flow ID(s) of the downlink (SDAP) packets" in Convida Wireless does **not** correspond to the concept that the UE receives a first RRC message which includes a QFI configuration as recited in amended claims 1 and 6 of the present application.

In addition, the following two statements in Section 1 of Convida Wireless define AS-level mapping and Reflective mapping:

- AS-level mapping in the UE and in the NG-RAN associate UL and DL QoS Flows with DRBs.
- Reflective mapping: for each DRB, the UE monitors the QoS flow ID(s) of the downlink packets and applies the same mapping in the uplink; that is, for a DRB, the UE maps the uplink packets belonging to the QoS flows(s) corresponding to the QoS flow ID(s) and PDU Session observed in the downlink packets for that DRB. To enable this reflective mapping, the NG-RAN marks downlink packets over Uu with QoS flow ID.

AS-level mapping defines a mapping between UL/DL QoS flows and DRBs and Reflective mapping means the AS-level mapping in uplink direction on a DRB follows the AS-level mapping in downlink direction for the DRB. In other words, the UE will map a QoS flow with QoS flow ID1 to a DRB for uplink transmission if the UE receives a QoS flow with QoS flow ID1 from this DRB in downlink direction (i.e. from the network). That is how the flow id field in the SDAP header is used by the UE.

In contrast, the QFI configuration recited in amended claims 1 and 6 of the present application is used to indicate **whether** a QFI field is present **or not** in uplink for the default DRB. Therefore, it is clear the usage of the flow id field in the SDAP header disclosed in

Petitioners' Exhibit 1002, p. 67
AT&T et al v. Asustek Technology
IPR2024-00997

Convida Wireless is different and distinguishable from the usage of the QFI configuration disclosed in amended claims 1 and 6 of the present application.

Furthermore, the statement "for each DRB, the UE monitors the QoS flow ID(s) of the downlink (SDAP) packets" (disclosed in Convida Wireless) implies that the concerned DRB should have been established by the UE so that the UE can monitors the QoS flow ID(s) of the downlink (SDAP) packets received on the DRB. In contrast, the first RRC message with a DRB configuration is transmitted for the UE to establish the default DRB according to the amended claims 1 and 6 of the present application. Therefore, the UE has **not** established the default DRB yet before the first RRC message is received. The two concepts are different and distinguishable.

The Examiner also states:

Furthermore, applicant asserts that "There are three main differences between Cho and the claimed invention as recited in the claims of the present application".

The first difference is *Cho discloses that two indications in the DL SDAP header are used to determine whether QFI field is present in 'downlink', while the QFI configuration recited in the claims is used to determine whether QFI field is present in 'uplink'*. The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication or the AS-level reflective QoS activation indication is set to '1' indicating the QFI field is present (or where one indication may be set to value '0' indicating the QFI field is not present), the DL SDAP PDU further includes a QoS flow ID 'QFI', e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915; and wherein, as disclosed in page 7, para 129; pages 7-8, para 153, Cho discloses for the UL QoS flow ID=13 to a UL DRB, e.g. "the QFI configuration is used to determine whether QFI field is present in 'uplink'".

The second difference is *Cho discloses using 'two indications f to determine whether QFI field is present in SDAP headeror not, while 'one QFI configuration' is used and recited in the claims*. The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication **or** the AS-level reflective QoS activation indication is set to '1', the DL SDAP PDU further includes a QoS flow ID CQFI, e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915.

Petitioners' Exhibit 1002, p. 68
AT&T et al v. Asustek Technology
IPR2024-00997

> The third difference is Cho discloses these two indications may he set to values indicating the QFI field is not present, while the claims specify that the QFI configuration is always 'set to a value' indicating the QFI field is present in 'uplink' for the default DRB. The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication or the AS-level reflective QoS activation indication is set to '1' (or where one indication may be set to value '0' indicating the QFI field is not present), the DL SDAP PDU further includes a QoS flow ID 'CQFI', e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915; and wherein, as disclosed in page 7, para 129; pages 7-8, para 153, Cho discloses for the UL QoS flow ID=13 to a UL DRB, e.g. "the QFI configuration is always 'set to a value' indicating the QFI field is present in 'uplink' for the DRB".

See Office Action, Pages 9-10, emphasis original.

Applicants respectfully disagree. According its Abstract, Cho discloses a method for performing reflective QoS, which comprises receiving a DL SDAP PDU via a DRB from a network and the DL SDAP PDU includes a first indicator indicating whether to perform AS mapping rule update for uplink. The concept is basically same as what disclosed in Convida Wireless. Therefore, most of the arguments against Convida Wireless are also applicable to Cho.

Firstly, the first indicator is included in a DL SDAP PDU, while a RRC message is used to include a QFI configuration as recited in amended claims 1 and 6 of the present application.

Secondly, the first indicator included in a DL SDAP PDU is used to indicate **whether** to perform AS mapping rule update for uplink (the AS-level mapping defines a mapping between UL/DL QoS flows and DRBs as explained above) according to the Abstract (or Paragraph [0108]) of Cho, while the QFI configuration disclosed in amended claims 1 and 6 of the present application is used to indicate **whether** a QFI field is present **or not** in uplink for the default DRB. Therefore, usage of the first indicator included in a DL SDAP PDU is different from that of the QFI configuration.

Furthermore, since the UE needs to receive a DL SDAP PDU via a DRB from a network to determine whether to perform AS mapping rule update for uplink direction, this implies that the concerned DRB should have been established so that the UE can receive the DL SDAP PDU via the DRB. In contrast, the default DRB is established after the first RRC message is received

Petitioners' Exhibit 1002, p. 69
AT&T et al v. Asustek Technology
IPR2024-00997

by the UE (or transmitted by the network node) according to the amended claims 1 and 6 of the present application.

Besides, although the first indicator indicating whether to perform AS mapping rule update for uplink, Cho does **not** that disclose the first indicator is **always** set to a value indicating the AS mapping rule is updated for uplink on a DRB, while amended claims 1 and 6 of the present application discloses the QFI configuration is **always** set to a value indicating the QFI field is present in uplink for the default DRB.

Furthermore, claims 2 and 7 recite "the network node is not allowed to transmit a second RRC message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field." Applicants respectfully submit that the combination of Convida Wireless and Cho fails to disclose the noted limitations of claims 2 and 7.

For the reasons stated above, Applicants respectfully submit that claims 1-10 are patentable over any combination of Convida and/or Cho.

In view of the foregoing it is respectfully submitted that the pending claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims is solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made.

Respectfully submitted,

Sang N. Dang

BLUE CAPITAL LAW FIRM, P.C.

Dated: April 14, 2020

/Sang N. Dang/

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Petitioners' Exhibit 1002, p. 70
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	16/043,818	Filed: July 24, 2018
Examiner:	Tri H. Phan	Group Art Unit: 2471
Attorney Docket No.:	1291-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Request for Continued Examination; 2 Page Amendment Transmittal Sheet and 9 Page Amendment are being transmitted to the United States Patent and Trademark Office via EFS-Web on April 14, 2020.

Date: April 14, 2020 /Sandy Kim/
Sandy Kim

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Electronic Patent Application Fee Transmittal

Application Number:	16043818
Filing Date:	24-Jul-2018
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-221.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**1300**

Electronic Acknowledgement Receipt

EFS ID:	39158081
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	14-APR-2020
Filing Date:	24-JUL-2018
Time Stamp:	17:35:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1300
RAM confirmation Number	E20204DH35444615
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		1426-221-101--RFOAof01292020asFiled04142020.pdf	291177 08b0c90385bdf520147a243dfe30de7dab16231e	yes	14

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Request for Continued Examination (RCE)	1	2
Transmittal Letter	3	4
Amendment Submitted/Entered with Filing of CPA/RCE	5	5
Claims	6	7
Applicant Arguments/Remarks Made in an Amendment	8	13
Miscellaneous Incoming Letter	14	14

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30319 592a49786fe670efdf57ebbe9d909b5c3adb87ce	no	2

Warnings:

Information:

Total Files Size (in bytes):	321496

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/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
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/043,818	Filing Date 07/24/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	04/14/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 10	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/DORIS M KING/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

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

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 01/29/2020

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
PHAN, TRI H	

ART UNIT	PAPER NUMBER
2471	

NOTIFICATION DATE	DELIVERY MODE
01/29/2020	ELECTRONIC

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

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

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

docketing@bluecapitallaw.com

Petitioners' Exhibit 1002, p. 78
AT&T et al v. Asustek Technology
IPR2024-00997

Office Action Summary	Application No. 16/043,818	Applicant(s) Pan et al.	
	Examiner TRI H PHAN	Art Unit 2471	AIA (FITF) Status Yes

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

Period for Reply

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

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

Status

1)☑ Responsive to communication(s) filed on 11/18/2019.

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

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

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

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

Disposition of Claims*

5) ☐ Claim(s) _____ is/are pending in the application.

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

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-10 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 07/24/2018 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: _____.

Petitioners' Exhibit 1002, p. 79
AT&T et al v. Asustek Technology
IPR2024-00997

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Response to Communication(s)

2. This office action is in response to the Arguments filed on November 18, 2019. Claims 1-10 are now pending in the application.

Claim Rejections - 35 USC § 103

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

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

The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1,148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Note: Document U.S. 2019/0150023 has been published on 05/16/2019 and claims priority to U.S. provisional application 62/453,467, filed February 1, 2017 (entirely in English and thereby antedating this application).

3. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Convida Wireless** ("SDAP Header Format", 3GPP TSG-RAN WG2 #99 TDOC R2-1708324, 29 June 2017, cited by the applicants; hereinafter **'Convida Wireless')** in view of **Cho et al.** (U.S. 2019/0150023; hereinafter **'Cho').**

- In regard to claim 1**, Convida Wireless** discloses the method of a network node, comprising

transmitting a first message with a Data Radio Bearer 'DRB' configuration to a UE (User Equipment) for establishing a default DRB for a Packet Data Unit 'PDU' session (*for example see Chapter 1, Introduction: "In the downlink, the NG-RAN maps QoS Flows to DRBs based on NG-U markings, QoS Flow ID, and the associated QoS profiles... To enable this reflective mapping, NG-RAN marks downlink packets over Uu with QoS flow ID"*), wherein the DRB configuration includes a QoS Flow Id 'QFE configuration; establishing the default DRB with a presence of the QFI field in uplink (*for example see Chapter 1, Introduction: "Reflective mapping: for each DRB, the UE monitors the QoS flaw IDs of the downlink packets and applies the same mapping in the uplink ... To enable this reflective mapping, the NG-RAN marks downlink packets over Uu with QoS flow ID"; Chapter 2: "..for UE supporting NAS reflective QoS function, and if NAS reflective QoS function is enabled by the 5GC for some traffic flows, the UE shall create a derived QoS rule for the uplink traffic based, on the received downlink traffic. The UE shall use the derived. QoS rules to determine mapping between uplink traffic and QoS flow. The derived QoS rule includes packet filter, QoS flow identifier QFI and rule precedence value ..."*); and

receiving a Service Data Adaptation Protocol 'SDAP' PDU with the QFI field via the

default DRB from the UE (*for example see Chapter 2, "... As per RAN2 previous agreement now reflected in 38.300, in the uplink, the UE marks uplink packets over Uu with the QFI for the purposes of marking forwarded packets to the CN. So in the UL the SDAP header should at least include the QFI... "*).

Though, **Convida Wireless** does disclose for NAS-RQI indicator and AS-RQI indicator (*for example see figs. 1, 3: DL SDAP header*) to indicate whether the UE shall create (or update) the QoS Flow to DRB mapping as specified in Chapter 3, Proposals 2-3; figs. 2, 4: UL SDAP header; but does not explicitly disclose for wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. However, such limitation lacks thereof from **Convida Wireless** reference is well known and disclosed by **Cho.**

In an analogous art, **Cho** discloses for system/device and method for performing reflective quality of service 'QoS' in wireless communication system (*for example see Abstract; figs. 7, 9: page 1, para 2*); wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig, 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig, 9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claim 6, the combination of **Cho** and **Convida Wireless** also discloses for network node (e.g. NG-eNB, NG-RAN) having limitations mirrored method steps of claim 1, respectively. Thus, they are rejected for the same rationales applied to claim 1 discussed above, as additionally disclosed in NG-RAN in figs. 7, 20; page 3, para 54; and in the respective portions of the specification.

- In regard to claims 2 and 7, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no **presence** of the QFI field (*for example see Cho: page 6, para 113; steps S907, 911 in fig. 9*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig. 9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claims 3 and 8, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims **1** and **6** discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein a header in the SDAP PDU includes at least the QFI field (*for example see Convida Wireless: Chapter 2, As per RAN1 previous agreement now reflected in 38.300, in the uplink, the UE marks uplink packets over Uu with the QFI for the purposes of marking forwarded packets to the CN. So in the UL the SDAP header should at least include the QFI... "; Cho: see fig. 11*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 infig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- In regard to claims 4 and 9, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node transmits an Internet Protocol 'IP' packet included in the SDAP PDU to a core network (*for example see Cho: fig. 6; page 4, paras 67-68*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6. paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step $913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claims 5 and 10, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node is a base station or gNB (*for example see Cho: figs. 2A, 4A-B; page 3, para 54*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6. paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step 5913 in.fig.9; page 4, para 65: page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

Response to Arguments

4. Applicant's arguments, in REMARKS, pages 4-7, of the outstanding response, pertaining the rejection of claims 1-10 under 35 U.S.C. § 103(a) as being unpatentable over **Convida Wireless** in view of **Cho**, have been fully considered but they are not persuasive. Applicants' arguments will be addressed herein below in the order in which they appear in the response filed 11/18/2019.

In response to applicant's argument that Convida Wireless relates only to processes occurring **after the corresponding DRB(s) is established/initiated.** In other words, Convida Wireless do not refer to the specific claimed process, namely **transmitting a DRB configuration including a QFI configuration for establishing a default DRB to the UE and establishing the default DRB** as recited in the claims. The examiner respectfully disagrees with the arguments. Convida Wireless does disclose, for example see figs. 1-4 in Section4: Appendix, for downlink 'DL' SDAP header and uplink 'UL' SDAP header with flow id field; and wherein, in section 1, Introduction: ... for each DRB, the UE monitors the QoS flow ID(s) of the downlink packets, e.g. "*transmitting a DRB configuration including a QFI configuration*" , as disclosed in figs. 1 and 3 for DL SDAP header with flow id field, and applies the same mapping in the uplink; that is, for a DRB, the UE maps the uplink packets belonging to the QoS flows(s) corresponding to the QoS flow ID(s) and PDU Session observed in the downlink packets for that DRB, e.g. "*for establishing the DRB*", ... This contribution discusses the header format of the Service Data Adaptation Protocol (SDAP) which is being designed by RAN2 to provide mapping between a QoS flow and a data radio bearer and Marking QoS flow ID (QFI) in both

DL and UL packets, e.g. "*to configure a QFI field in uplink for the default DRB*", as disclosed in figs. 2 and 4 for UL SDAP header with flow id field.

Furthermore, applicant asserts that "There are three main differences between Cho and the claimed invention as recited in the claims of the present application".

The first difference is *Cho discloses that two indications in the DL SDAP header are used to determine whether QFI field is present in 'downlink', while the QFI configuration recited in the claims is used to determine whether QFI field is present in 'uplink'*. The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication or the AS-level reflective QoS activation indication is set to '1' indicating the QFI field is present (or where one indication may be set to value '0' indicating the QFI field is not present), the DL SDAP PDU further includes a QoS flow ID 'QFI', e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915; and wherein, as disclosed in page 7, para 129; pages 7-8, para 153, Cho discloses for the UL QoS flow ID=13 to a UL DRB, e.g. "the QFI configuration is used to determine whether QFI field is present in 'uplink'"

The second difference is *Cho discloses using 'two indications' to determine whether QFI field is present in SDAP header or not, while 'one QFI configuration' is used and recited in the claims*. The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication or the AS-level reflective QoS activation indication is set to '1', the DL SDAP PDU further includes a QoS flow ID 'QFI', e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915.

The third difference is *Cho discloses these two indications may be set to values indicating the QFI field is not present, while the claims specify that the QFI configuration is always 'set to a value' indicating the QFI field is present in 'uplink' for the default DRB.* The examiner respectfully disagrees with the arguments. Cho does disclose, for example see fig. 9, wherein at least one of the NAS-level reflective QoS activation indication or the AS-level reflective QoS activation indication is set to '1' (or where one indication may be set to value '0' indicating the QFI field is not present), the DL SDAP PDU further includes a QoS flow ID 'QFI', e.g. left (AS) or right (NAS) situation appears, in which Cho implies only 'one QFI configuration' is used with steps S913-915; and wherein, as disclosed in page 7, para 129; pages 7-8, para 153, Cho discloses for the UL QoS flow ID=13 to a UL DRB, e.g. "the QFI configuration is always 'set to a value' indicating the QFI field is present in 'uplink' for the DRB".

Claims 2-5 and 7-10 are rejected as in Part 3 above of this Office action and by virtue of their dependence from claims 1 and 6.

Therefore, the examiner concludes that the combination of Cho and Convida Wireless teaches the arguable features.

Conclusion

5. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period

will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tri H. Phan, whose telephone number is (571) 272-3074. The examiner can normally be reached on M-F (8:00Am-4:30PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chi H. Pham can be reached on (571) 272-3179.

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.

/TRI H PHAN/
Primary Examiner, Art Unit 2471

January 23, 2020

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	Art Unit
	TRI H PHAN	2471

✓	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	09/03/2019	01/23/2020							
	1	✓	✓							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							

Petitioners' Exhibit 1002, p. 90
AT&T et al v. Asustek Technology
IPR2024-00997

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 16/043,818	Filing Date 07/24/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	11/18/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 10	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	HSLIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/TRACIE V HARGROVE/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

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

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	: 16/043,818
Confirmation No.	: 7229
Applicants	: Li-Te Pan and Richard Lee-Chee Kuo
Filed	: July 24, 2018
Title	: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
TC/A.U.	: 2471
Examiner	: Tri H. Phan
Docket No.	: 1426-221.101 (1060196-US)
Customer No.	: 106622

AMENDMENT TO OFFICE ACTION

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

Dear Sir:

In response to the Office Action mailed on September 6, 2019, having a three-month period for responding to **December 6, 2019**, Applicants respectfully submit the following amendments and remarks:

Claims begin on page 2.

Remarks begin on page 4.

Petitioners' Exhibit 1002, p. 92
AT&T et al v. Asustek Technology
IPR2024-00997

Amendment Transmittal Letter

Docket Number
1426-221.101

Address To
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Title of Invention

METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Li-Te Pan
Application No.	16/043,818
Filing Date	July 24, 2018
Examiner	Tri H. Phan
Art Unit	2471

Transmitted herewith is an amendment in the above-identified application.

The fee has been calculated and is transmitted as shown below.

☐ **Applicant claims Small Entity Status.** See 37 CFR 1.27.

Fee Calculation

Claims as Amended

For	#Filed	#Previously Paid For	#Extra	Rate	Fee
Total Claims	10	- 20 =		x ☐ =	
Total Indep. Claims	2	- 3 =		x =	
Multiple Dependent Claims (check if applicable) ☐					
				TOTAL	0

Method of Payment

☐ Deposit Account ☐ Credit Card ☐ Check ☐ Money Order ☐ Other: _____

Deposit Account Number

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

☐ Charge the fee(s) set forth above
☐ Charge any additional fee(s) or underpayments of fee(s) under 37 CFR 1.16 and 1.17
☐ Charge fee(s) indicated above, **except for the filing fee**
☐ Credit any overpayments

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

Amount Grand Total 0

Petitioners' Exhibit 1002, p. 93
AT&T et al v. Asustek Technology
IPR2024-00997

Amendment Transmittal Letter

Docket Number
1426-221.101

Correspondence Address

Customer Number	106622		
-OR-			
Name			
Address			
City		State	
Country		Postal Code	
Phone Number			
E-mail Address			

Certificate of Mailing by Express Mail

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing)

(Typed or Printed Name of Person Mailing Correspondence)

(Signature of Person Mailing Correspondence)

("Express Mail" Mailing Label Number)

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I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) are being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450 on the date indicated below:

(Date of Mailing) *(Name of Person Mailing Correspondence)*

(Signature of Person Mailing Correspondence)

Certificate of Transmission

I hereby certify that this Amendment, accompanying documents, and fee (if appropriate) authorization are being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

(Date of Transmission) *(Name of Person Transmitting Correspondence)*

(Signature of Person Transmitting Correspondence)

Signature Instructions

Select the name of the person who will electronically sign the Amendment from the drop-down box below.

If a practitioner is not present in the drop-down list, you must close this form and select 'Add Practitioner...' in the Form Manager's Utility menu.

Verify that the signatory information is correct and press the 'eSign' button to electronically sign the submission. If you prefer to sign the form manually, simply do not click the 'eSign' button; just print and manually sign.

Signatory Drop-Down Box Sang N. Dang

Name	Sang N. Dang	Registration Number	51,186
Signatory Capacity	Attorney for Applicant(s)	E-mail Address	sdang@bluecapitallaw.com
eSign	/Sang N. Dang/	Date Signed	11-18-2019

Petitioners' Exhibit 1002, p. 94
AT&T et al v. Asustek Technology
IPR2024-00997

Electronic Acknowledgement Receipt

EFS ID:	37780631
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	18-NOV-2019
Filing Date:	24-JUL-2018
Time Stamp:	14:52:33
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		1426-221-101--ROAof09062019asFiled11182019.pdf	281306 3fd40f9d93e141b14f22a51dc4c78c19e5386026	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	10	10
	Applicant Arguments/Remarks Made in an Amendment	6	9
	Claims	4	5
	Amendment/Req. Reconsideration-After Non-Final Reject	3	3
	Transmittal Letter	1	2

Warnings:	
Information:	
Total Files Size (in bytes):	281306

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

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	16/043,818	Filed: July 24, 2018
Examiner:	Tri H. Phan	Group Art Unit: 2471
Attorney Docket No.:	1291-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 2 Page Amendment Transmittal Sheet and 7 Page Amendment are being transmitted to the United States Patent and Trademark Office via EFS-Web on November 18, 2019.

Date: November 18, 2019 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

REMARKS

Claims 1-10 are pending.

I. Claim Objections

Claims 1 and 6 are objected to due to use of the claim term "network node." Applicants respectfully submit that as discussed in Paragraph [0085] of the present application, gNB is an example of an access network (i.e. network node). Under the circumstances, Applicants respectfully submit that the present specification supports the use of the claim term "network node" in claims 1 and 6.

II. Rejection under 35 U.S.C. § 103

Claims 1-10 stand rejected under 35 U.S.C. § 103 as being unpatentable over Convida Wireless ("SDAP Header Format", 3GPP TSG-RAN WG2 #99 TDOC R2-1708324, 20 June 2017) in view of Cho (U.S. Patent Publication No. 2019/0150023). *See* Office Action, ¶ 6. Applicants respectfully traverse the rejection and respectfully requests reconsideration of the claims.

As discussed in Paragraphs [0062] – [0065] of the present application, to make sure the gNB can identify a new QoS flow initiated by a UE during an ongoing PDU session, the default DRB of the PDU session should be initiated **with presence of QFI in uplink**. The UE may initiate the default DRB when receiving a DRB configuration (e.g. included in a RRC message) from the gNB. The DRB configuration may include a QFI configuration indicating presence of QFI for the default DRB. With the QFI in a SDAP PDU transmitted on the default DRB in uplink, the gNB is able to identify the new UL QoS flow so that the gNB can transmit the IP packet included in the SDAP PDU to the core network (e.g. UPF) via correct handling (e.g. a tunnel corresponding to the new UL QoS flow) and then the IP packet can pass the corresponding packet filter.

Consistent with the specification, claims 1 and 6 recite "transmitting [or transmit] a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB

Petitioners' Exhibit 1002, p. 98
AT&T et al v. Asustek Technology
IPR2024-00997

configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB" and "establishing [or establish] the default DRB with a presence of the QFI field in uplink". Applicants respectfully submit that the combination of Convida Wireless and Cho fails to disclose the noted limitations.

First, Chapter 1 of Convida Wireless discloses the reflective packet mapping, and Chapter 2 of Convida Wireless discloses the NAS reflective QoS function. However, these chapters of Convida Wireless relate only to processes occurring **after the corresponding DRB(s) is established/initiated**. In other words, Chapters 1 and 2 of Convida Wireless do not refer to the specific claimed process of **establishing a DRB**, namely **transmitting a DRB configuration including a QFI configuration for establishing a default DRB to the UE and establishing the default DRB** as recited in the claims.

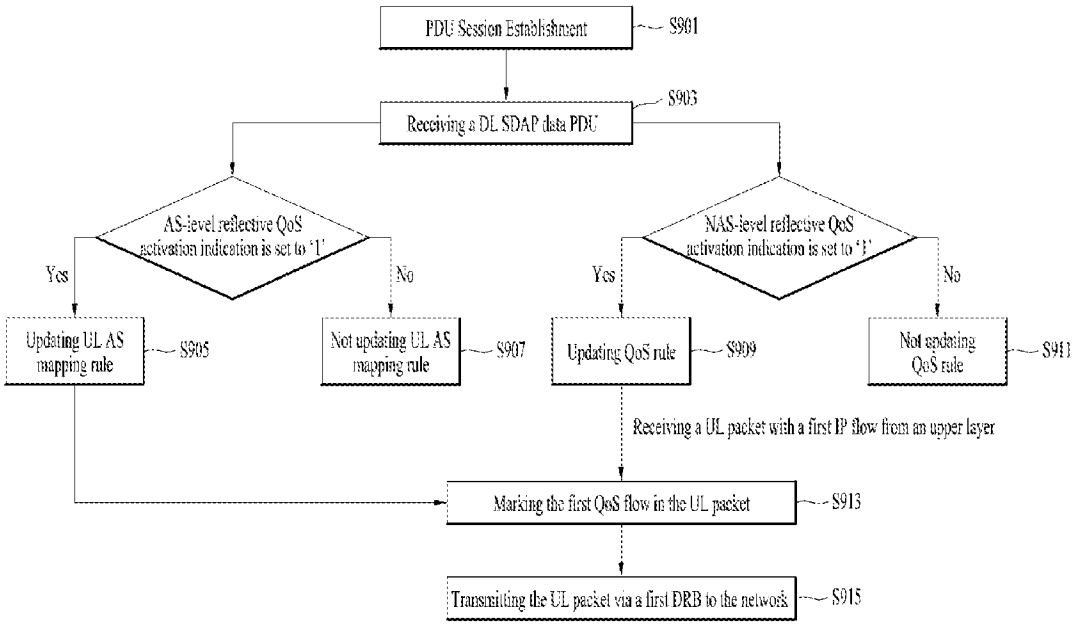
Furthermore, Convida Wireless does **not** teach **how to configure a QFI field in uplink for the default DRB**. In contrast, the claims specify that the DRB configuration includes a QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB, which is however not disclosed in D1.

Second, the Office Action admits that Convida Wireless "does not explicitly disclose for wherein the QFI configuration is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB." *See* Office Action, Pages 5-6. Nevertheless, the Office Action cites to Cho in rejecting the claims. *See* Office Action, Page 6.

Applicants respectfully disagree. In particular, Paragraphs [0109] – [0113] of Cho discuss the flow chart shown in FIG. 9 (reproduced below) of Cho.

Petitioners' Exhibit 1002, p. 99
AT&T et al v. Asustek Technology
IPR2024-00997

FIG. 9



As discussed in Paragraphs [0109] – [0113] of Cho, during the PDU Session Establishment, the UE receives QoS rule(s) related to the PDU session from 5GC, and receives AS mapping rule(s) and DRB configuration information for the PDU session from NG-RAN. The AS-mapping rule(s) is a UL QoS flow to DRB mapping rule configured to the UE. The UE saves the received QoS rule(s) and AS-mapping rule(s), and establishes DRB such as default DRB and/or Dedicated DRB (non-default DRB). The default DRB is established by NG-RAN at PDU Session Establishment. If the first packet of the flow is UL packet, if no mapping rule is configured in the UE, the packet is sent through default DRB to the network.

Paragraph [0117] of Cho discloses that QoS flow ID (QFI) can be present for DL SDAP header only when it is necessary depending on the values of two reflective QoS activation indications in the DL SDAP header. If both NAS - level Reflective QoS activation indication and AS - level Reflective QoS activation indication are "0", the DL SDAP header may not include the QoS flow ID. Otherwise, the DL SDAP header includes the QoS flow ID according to Paragraph [0109] of Cho.

Petitioners' Exhibit 1002, p. 100
AT&T et al v. Asustek Technology
IPR2024-00997

There are three main differences between Cho and the claimed invention as recited in the claims of the present application. The first difference is Cho discloses that two indications in the DL SDAP header are used to determine whether QFI field is present in downlink, while the QFI configuration recited in the claims is used to determine whether QFI field is present in uplink. The second difference is Cho discloses using two indications to determine whether QFI field is present in SDAP header or not, while one QFI configuration is used and recited in the claims. The third difference is Cho discloses these two indications may be set to values indicating the QFI field is not present, while the claims specify that the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. It is clear that Cho fails to teach to use a QFI configuration and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB.

For the reasons stated the above, Applicants respectfully submit that claims 1-10 are patentable over any combination of Convida Wireless and/or Cho.

CONCLUSION

In view of the foregoing it is respectfully submitted that the pending claims are in condition for allowance. Reconsideration of the rejections is requested. Allowance of the claims is solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made.

Respectfully submitted,

Sang N. Dang

BLUE CAPITAL LAW FIRM, P.C.

Dated: November 18, 2019

/Sang N. Dang/

Reg. No. 51,186
Tel.: (714) 839-3800

Petitioners' Exhibit 1002, p. 101
AT&T et al v. Asustek Technology
IPR2024-00997

IN THE CLAIMS:

1. (Original) A method of a network node, comprising:

transmitting a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establishing the default DRB with a presence of the QFI field in uplink; and

receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

2. (Original) The method of claim 1, wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

3. (Original) The method of claim 1, wherein a header in the SDAP PDU includes at least the QFI field.

4. (Original) The method of claim 1, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

5. (Original) The method of claim 1, wherein the network node is a base station (or gNB).

6. (Original) A network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

transmit a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein

Petitioners' Exhibit 1002, p. 102
AT&T et al v. Asustek Technology
IPR2024-00997

the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establish the default DRB with a presence of the QFI field in uplink; and

receive a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

7. (Original) The network node of claim 6, wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

8. (Original) The network node of claim 6, wherein a header in the SDAP PDU includes at least the QFI field.

9. (Original) The network node of claim 6, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

10. (Original) The network node of claim 6, wherein the network node is a base station (or gNB).

Petitioners' Exhibit 1002, p. 103
AT&T et al v. Asustek Technology
IPR2024-00997

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/043,818	07/24/2018	Li-Te Pan	1426-221.101	7229

106622 7590 09/06/2019

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER	
PHAN, TRI H	

ART UNIT	PAPER NUMBER
2471	

NOTIFICATION DATE	DELIVERY MODE
09/06/2019	ELECTRONIC

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

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

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

docketing@bluecapitallaw.com

Petitioners' Exhibit 1002, p. 104
AT&T et al v. Asustek Technology
IPR2024-00997

Office Action Summary	Application No. 16/043,818	Applicant(s) Pan et al.	
	Examiner TRI H PHAN	Art Unit 2471	AIA (FITF) Status Yes

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

Period for Reply

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

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

Status

1)☑ Responsive to communication(s) filed on 24 July 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) 1-10 is/are pending in the application.

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

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-10 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 07/24/2018 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: _____.

Petitioners' Exhibit 1002, p. 105
AT&T et al v. Asustek Technology
IPR2024-00997

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

Response to Communication(s)

2. This office action is in response to the Application filed on July 24, 2018. Claims 1-10 are presented in the application for examination.

Information Disclosure Statement

3. The information disclosure statements filed 07/24/18 and 07/25/18 comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609. It has been considered and placed in the application file.

Specification

4. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Objections

5. Claims 1 and 6 are objected to because of the following informalities:

Regarding claim 1, the claim attempt to define "*A method of a network node ... transmitting a first message with a Data Radio Bearer ... to a User Equipment ... receiving a Service Data Adaptation Protocol ... from the UE*". From this wording it is not possible to unambiguously derive which "network node" performs this method.

However, when looking into the application's specification, specifically at paras. 74-75, it appears that the method is indeed performed by a 'gNB' also referred to as next generation Node B.

It appears that the feature of Claim 1 mentioned above is indeed broader than allowed by the application's description as filed, since no other embodiment providing any alternative to the interpretation of this feature has been found in the application's description as filed. Furthermore, the features as extracted from the application's description as discussed above appear Indeed to be essential features to the alleged invention, and as such they should be included in the independent Claim 1.

The same objections and observation apply to independent Claim 6.

The Applicant is respectfully reminded that the subject-matter for which protection is sought is defined solely by the claims, the description and the figures being meant merely to aid in the interpretation. Therefore, the claims should be dear per se, and as mentioned above, they should include all the features essential to the definition of the invention.

In the case of amending the claimed invention, Applicant is respectfully requested to indicate the portion(s) of the specification which dictate(s) the structure relied on for proper interpretation and also to verify and ascertain the metes and bounds of the claimed invention.

Thus, for the purpose of examination, the claims will be interpreted in the broadest sense as below.

Claim Rejections - 35 USC § 103

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

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

The factual inquiries set forth in Graham v. John Deere Co., 383 U.S. 1,148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under pre-AIA 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or non-obviousness.

Note: Document U.S. 2019/0150023 has been published on 05/16/2019 and claims priority to U.S. provisional application 62/453,467, filed February 1, 2017 (entirely in English and thereby antedating this application).

6. Claims 1-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Convida Wireless** ("SDAP Header Format", 3GPP TSG-RAN WG2 #99 TDOC R2-1708324, 29 June 2017, cited by the applicants; hereinafter '**Convida Wireless**') in view of **Cho et al.** (U.S. 2019/0150023; hereinafter '**Cho**').

- In regard to claim 1, **Convida Wireless** discloses the method of a network node, comprising

transmitting a first message with a Data Radio Bearer 'DRB' configuration to a UE (User Equipment) for establishing a default DRB for a Packet Data Unit 'PDU' session (*for example see Chapter 1, Introduction: "In the downlink, the NG-RAN maps QoS Flows to DRBs based on NG-U markings, QoS Flow ID, and the associated QoS profiles... To enable this reflective mapping, NG-RAN marks downlink packets over Uu with QoS flow ID"*), wherein the DRB configuration includes a QoS Flow Id 'QFI' configuration; establishing the default DRB with a presence of the QFI field in uplink (*for example see Chapter 1, Introduction: "Reflective mapping: for each DRB, the UE monitors the QoS flow IDs of the downlink packets and applies the same mapping in the uplink ... To enable this reflective mapping, the NG-RAN marks downlink packets over Uu with QoS flow ID"; Chapter 2: "... for UE supporting NAS reflective QoS function, and if NAS reflective QoS function is enabled by the 5GC for some traffic flows, the UE shall create a derived QoS rule for the uplink traffic based on the received downlink traffic. The UE shall use the derived QoS rules to determine mapping between uplink traffic and QoS flow. The derived QoS rule includes packet filter, QoS flow identifier QFI and rule precedence value ..."*); and

receiving a Service Data Adaptation Protocol 'SDAP' PDU with the QFI field via the default DRB from the UE (*for example see Chapter 2, "... As per RAN2 previous agreement now reflected in 38.300, in the uplink, the UE marks uplink packets over Uu with the QFI for the purposes of marking forwarded packets to the CN. So in the UL the SDAP header should at least include the QFI ..."*).

Though, **Convida Wireless** does disclose for NAS-RQI indicator and AS-RQI indicator to indicate whether the UE shall create (or update) the QoS Flow to DRB mapping as specified in Chapter 3, Proposals 2-3; but does not explicitly disclose for wherein the QFI configuration

used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. However, such limitation lacks thereof from **Convida Wireless** reference is well known and disclosed by **Cho**.

In an analogous art, **Cho** discloses for system/device and method for performing reflective quality of service 'QoS' in wireless communication system (*for example see Abstract; figs. 7, 9; page 1, para 2*); wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claim 6, the combination of **Cho** and **Convida Wireless** also discloses for network node (e.g. NG-eNB, NG-RAN) having limitations mirrored method steps of claim 1, respectively. Thus, they are rejected for the same rationales applied to claim 1 discussed above, as additionally disclosed in NG-RAN in figs. 7, 20; page 3, para 54; and in the respective portions of the specification.

- In regard to claims 2 and 7, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field (*for example see Cho: page 6, para 113; steps S907, 911 in fig. 9*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claims 3 and 8, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein a header in the SDAP PDU includes at least the QFI field (*for example see Convida Wireless: Chapter 2, "... As per RAN2 previous agreement now reflected in 38.300, in the uplink, the UE marks uplink packets over Uu with the QFI for the purposes of marking forwarded packets to the CN. So in the UL the SDAP header should at least include the QFI ..."; Cho: see fig. 11*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- In regard to claims 4 and 9, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node transmits an Internet Protocol 'IP' packet included in the SDAP PDU to a core network (*for example see Cho: fig. 6; page 4, paras 67-68*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s

system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

- Regarding claims 5 and 10, in addition to features in base claims 1 and 6 (see rationales pertaining the rejection of base claims 1 and 6 discussed above), the combination of **Cho** and **Convida Wireless** further discloses for wherein the network node is a base station or gNB (*for example see Cho: figs. 2A, 4A-B; page 3, para 54*).

Convida Wireless lacks what **Cho** discloses wherein the QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB (*for example see fig. 11; page 6, paras 109, 113, 117*); and where the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB (*for example see figs. 7, step S913 in fig.9; page 4, para 65; page 6, paras 109-111; page 7, paras 126-129*).

Thus, it would have been obvious to those skilled in the art at the time of the invention was made to incorporate **Cho**'s AS-level and NAS-level indication into **Convida Wireless**'s system with a motivation on performing reflective QoS as specified in Cho: page 1, paras 2 and 13.

7. **Examiner's Note:** In the case of **amending the claimed invention**, Applicant is respectfully requested to indicate the portion(s) or passage(s) as originally filed of the specification, which dictate(s) the structure relied on for proper interpretation on which these amendments, including the amended dependent claims in the corresponding embodiment, are based; and also to verify and ascertain the metes and bounds of the claimed invention.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Kim et al. (U.S. 2018/0146398), **Pan; Li-Te** (U.S. 2019/0028920) and **Pan et al.** (U.S. 2019/0029057) are all cited to show system/devices and methods for improving for QoS flow servicing in wireless telecommunication networks, which are considered pertinent to the claimed invention.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tri H. Phan, whose telephone number is (571) 272-3074. The examiner can normally be reached on M-F (8:00Am-4:30PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Chi H. Pham can be reached on (571) 272-3179.

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.

/TRI H PHAN/
Primary Examiner, Art Unit 2471

September 3, 2019

Notice of References Cited	Application/Control No. 16/043,818	Applicant(s)/Patent Under Reexamination Pan et al.	
	Examiner TRI H PHAN	Art Unit 2471	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-20180146398-A1	05-2018	KIM; Donggun	H04W72/0406	1/1
*	B	US-20190028920-A1	01-2019	Pan; Li-Te	H04W28/0268	1/1
*	C	US-20190029057-A1	01-2019	Pan; Li-Te	H04W28/12	1/1
*	D	US-20190150023-A1	05-2019	CHO; Heejeong	H04W28/02	1/1
	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.

Petitioners' Exhibit 1002, p. 115
AT&T et al v. Asustek Technology
IPR2024-00997

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	Art Unit
	TRI H PHAN	2471

CPC - Searched*		
Symbol	Date	Examiner
H04W28/00,02,0268,10,12,16,24; H04W76/00,10,11; H04L12/24; H04L41/50,5003,5006,5009,5019; H04L47/2425	09/03/2019	TP

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 (USPT,JPO,EPO,FPRS,DWPI) - see text search printout.	09/03/2019	TP
Inventorship search.	09/03/2019	TP

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

/TRI H PHAN/ Primary Examiner, Art Unit 2471	

Petitioners' Exhibit 1002, p. 116
AT&T et al v. Asustek Technology
IPR2024-00997

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/043,818	Pan et al.
	Examiner	Art Unit
	TRI H PHAN	2471

✓	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	09/03/2019								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								

Petitioners' Exhibit 1002, p. 117
AT&T et al v. Asustek Technology
IPR2024-00997

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S5	6631	(ASUSTek.asn. or "ASUSTek Computer".asn. or (Pan.in. near2 Li-Te.in.) or (Kuo.in. near2 Richard.in. near2 Lee-Chee.in.))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:25
S6	6	S5 and (QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and (SDAP! (Service adj Data adj Adaptation adj Protocol))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:31
S7	5	S5 and (QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and ((DRB! (Data adj Radio adj Bearer)) with configurat$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:40
S8	77	(QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and ((DRB! (Data adj Radio adj Bearer)) with configurat$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:41
S9	118897	((H04W28/00 OR H04W28/02 OR H04W28/0268 OR H04W28/10 OR H04W28/12 OR H04W28/16 OR H04W28/24 OR H04W76/00 OR H04W76/10 OR H04W76/11 OR H04L12/24 OR H04L41/50 OR H04L41/5003 OR H04L41/5006 OR H04L41/5009 OR H04L41/5019 OR H04L47/2425).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:49
S10	28	S9 and (QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and ((DRB! (Data adj Radio adj Bearer)) with configurat$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:49
S11	39	S9 and (QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and (SDAP! (Service adj Data adj Adaptation adj Protocol))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 12:50

S12	4	(SDAP! with (Header near2 Format$4)) and (H04W28/00 OR H04W28/02 OR H04W28/0268 OR H04W28/10 OR H04W28/12 OR H04W28/16 OR H04W28/24 OR H04W76/00 OR H04W76/10 OR H04W76/11 OR H04L12/24 OR H04L41/50 OR H04L41/5003 OR H04L41/5006 OR H04L41/5009 OR H04L41/5019 OR H04L47/2425).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 15:56
S13	5	(SDAP! with (Header near2 Format$4))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 16:28
S14	15	(QFI! ((QoS! (quality adj "of" adj service)) near2 (Flow adj2 Id))) and (SDAP! (Service adj Data adj Adaptation adj Protocol)) and ((DRB! (Data adj Radio adj Bearer)) with configurat$3) and (header with format$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/02 16:48

9/3/2019 6:55:55 AM
C:\Users\tphan4\Documents\EAST\Workspaces\16-043818.wsp

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

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
Attorney Docket Number	1426-221.101

U.S.PATENTS

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

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U.S.PATENT APPLICATION PUBLICATIONS

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

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2018031081	WO		2018-02-15	PARRON, Jerome et al.		☐
	2							☐
	3							☐

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.H.P./

Petitioners' Exhibit 1002, p. 120
AT&T et al v. Asustek Technology
IPR2024-00997

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
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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]
	1		☐

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Examiner Signature	/TRI H PHAN/	Date Considered	08/31/2019

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Petitioners' Exhibit 1002, p. 121
AT&T et al v. Asustek Technology
IPR2024-00997

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

PTO/SB/08a (03-15)
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Application Number	16/043,818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
Attorney Docket Number	1426-221.101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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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	2018026169	WO		2018-02-18	Youngbin Chang		☐
	2	107637123	CN		2018-01-26	JIANG XIAOWEI		☐
	3							☐

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Petitioners' Exhibit 1002, p. 122
AT&T et al v. Asustek Technology
IPR2024-00997

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16/043,818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2471
Examiner Name	Tri H. Phan
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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Examiner Signature	/TRI H PHAN/	Date Considered	08/31/2019

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[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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Petitioners' Exhibit 1002, p. 123
AT&T et al v. Asustek Technology
IPR2024-00997

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

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
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Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2464 2471
Examiner Name	Ricky Quoc Nog Tri H. Phan
Attorney Docket Number	1426-221.101

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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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]
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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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Petitioners' Exhibit 1002, p. 124
AT&T et al v. Asustek Technology
IPR2024-00997

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	2464 2471
Examiner Name	Ricky Quoc Nog Tri H. Phan
Attorney Docket Number	1426-221.101

	1	CONVIDA WIRELESS: "SDAP Header Format", 3GPP DRAFT; R2-1707351 (SDAP HEADER FORMAT), 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE, vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301839, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	2	ZTE: "Discussion on the SDAP PDU format", 3GPP DRAFT; R2-1704649 DISCUSSION ON THE SDAP PDU FORMAT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650 , ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE vol. RAN WG2, no. Hangzhou, China; 20170515 - 20170519 14 May 2017 (2017-05-14), XP051275194, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	3	ZTE: "Discussion on reflective QoS", 3GPP DRAFT;R2-1706668 DISCUSSION ON REFELECTIVE QOS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F06921 SOPHIA-ANTIPOLIS CEDEX, FRANCE, vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301168, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	4	"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description Stage 2 (Release 15) " 3GPP DRAFT; R2-1706540 38300-050, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650 ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE 17 June 2017 (2017-06-17), XP051307045, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/tsg_ran/	☒
	5	HUAWEI ET AL: "SDAP Header Format", 3GPP DRAFT; R2-1706782 SDAP HEADER FORMAT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301281, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	6	European Search Report from corresponding EP Application No. 18185097.5, dated December 6, 2018	☐

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EXAMINER SIGNATURE

Examiner Signature	/TRI H PHAN/	Date Considered	08/31/2019

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Petitioners' Exhibit 1002, p. 125
AT&T et al v. Asustek Technology
IPR2024-00997

Bibliographic Data

Application No: 16/043,818

Foreign Priority claimed: ○ Yes ◉ No

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

Verified and Acknowledged: /TRI H PHAN/ (Examiner's Signature) | (Initials)

Title: METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/24/2018	370	2471	1426-221.101
RULE			

APPLICANTS

ASUSTek Computer Inc., Taipei City, TAIWAN

INVENTORS

Li-Te Pan Taipei City, TAIWAN

Richard Lee-Chee Kuo Taipei City, TAIWAN

CONTINUING DATA

This application has PRO of 62536163 07/24/2017

FOREIGN APPLICATIONS

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08/07/2018

STATE OR COUNTRY

TAIWAN

ADDRESS

Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626
UNITED STATES

FILING FEE RECEIVED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/043,818	07/24/2018	Li-Te Pan	1426-221.101

CONFIRMATION NO. 7229

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

PUBLICATION NOTICE

OC00000105310078

Title:METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

Publication No.US-2019-0029057-A1
Publication Date:01/24/2019

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

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

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

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AT&T et al v. Asustek Technology
IPR2024-00997

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Application Number	16043818
Filing Date	2018-07-24
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Art Unit	2464
Examiner Name	Ricky Quoc Nog
Attorney Docket Number	1426-221.101

U.S.PATENTS

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	Art Unit	2464
	Examiner Name	Ricky Quoc Nog
	Attorney Docket Number	1426-221.101

	1	CONVIDA WIRELESS: "SDAP Header Format", 3GPP DRAFT; R2-1707351 (SDAP HEADER FORMAT), 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE, vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301839, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	2	ZTE: "Discussion on the SDAP PDU format", 3GPP DRAFT; R2-1704649 DISCUSSION ON THE SDAP PDU FORMAT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650 , ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE vol. RAN WG2, no. Hangzhou, China; 20170515 - 20170519 14 May 2017 (2017-05-14), XP051275194, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	3	ZTE: "Discussion on reflective QoS", 3GPP DRAFT;R2-1706668 DISCUSSION ON REFELECTIVE QOS, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F06921 SOPHIA-ANTIPOLIS CEDEX, FRANCE, vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301168, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	4	"3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description Stage 2 (Release 15) " 3GPP DRAFT; R2-1706540 38300-050, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650 ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE 17 June 2017 (2017-06-17), XP051307045, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/tsg_ran/	☒
	5	HUAWEI ET AL: "SDAP Header Format", 3GPP DRAFT; R2-1706782 SDAP HEADER FORMAT, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE; 650, ROUTE DES LUCIOLES; F-06921 SOPHIA-ANTIPOLIS CEDEX; FRANCE vol. RAN WG2, no. Quingdao, China; 20170627 - 20170629 26 June 2017 (2017-06-26), XP051301281, Retrieved from the Internet: URL: http://www.3gpp.org/ftp/	☒
	6	European Search Report from corresponding EP Application No. 18185097.5, dated December 6, 2018	☐

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Electronic Acknowledgement Receipt

EFS ID:	34686533
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	24-DEC-2018
Filing Date:	24-JUL-2018
Time Stamp:	15:48:07
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-221-101--IDSasFiled12242018.pdf	55746 8296ea9d19d2ebea50f87c0ceeb1213a95572464	no	2

Warnings:

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2	Non Patent Literature	NPL-R2-1707351.pdf	1185798 1557ccd2a29adde3f5a2361aeeac96eef9c01c4d	no	5
Warnings:					
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3	Non Patent Literature	NPL-R2-1704649.pdf	1090566 533884c656782adaa6eef432e4f32dd5d5d5db4bc9	no	5
Warnings:					
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4	Non Patent Literature	NPL-R2-1706668.pdf	1004265 e073412a586ac5bb4b6a2e47bdc79f73b9e2803b	no	4
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5	Non Patent Literature	NPL-R2-1706540.pdf	9188672 8e20762697aaaff31489aabb9523d658bf0322b4	no	55
Warnings:					
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6	Non Patent Literature	NPL--R2-1706782.pdf	1059028 8acadbc7e129035f63c6c81ad8c2d92a1b4502ba	no	5
Warnings:					
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7	Non Patent Literature	NPL--EPSearchReport.pdf	2664102 88b80aa5095151da73d6688f5111aeebc919485d	no	12
Warnings:					
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National Stage of an International Application under 35 U.S.C. 371

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

New International Application Filed with the USPTO as a Receiving Office

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/043,818

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	10 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

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

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

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/043,818	07/24/2018		1720	1426-221.101	10	2

CONFIRMATION NO. 7229

106622
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

FILING RECEIPT

OC000000101337811

Date Mailed: 08/09/2018

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)

Li-Te Pan, Taipei City, TAIWAN;
Richard Lee-Chee Kuo, Taipei City, TAIWAN;

Applicant(s)

ASUSTek Computer Inc., Taipei City, TAIWAN;

Power of Attorney: The patent practitioners associated with Customer Number 106622

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/536,163 07/24/2017

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.

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/043,818**

Petitioners' Exhibit 1002, p. 134
AT&T et al v. Asustek Technology
IPR2024-00997

Projected Publication Date: 01/24/2019

Non-Publication Request: No

Early Publication Request: No
Title

METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

Preliminary Class

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

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IPR2024-00997

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	
Examiner Name	
Attorney Docket Number	1426-221.101

U.S.PATENTS

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

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	1	2018031081	WO		2018-02-15	PARRON, Jerome et al.		☐
	2							☐
	3							☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16043818
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
15 February 2018 (15.02.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/031081 A1

(51) International Patent Classification:
H04W 28/02 (2009.01) *H04W 76/02* (2009.01)
H04W 28/12 (2009.01) *H04L 12/851* (2013.01)

(21) International Application Number:
PCT/US2017/026857

(22) International Filing Date:
10 April 2017 (10.04.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/372,138 08 August 2016 (08.08.2016) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(54) Title: SYSTEMS AND METHODS FOR PACKET DATA CONVERGENCE PROTOCOL SEQUENCING

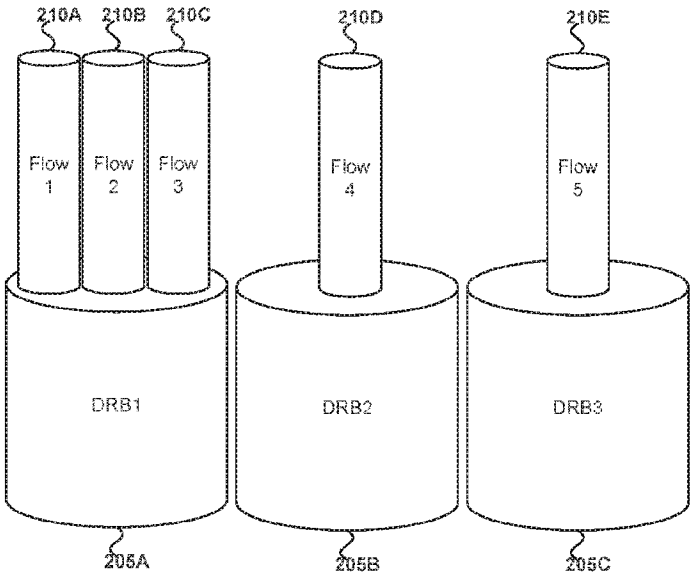


Fig. 2

(57) Abstract: Methods, systems, and storage media for improving packet data convergence protocol (PDCP) sequencing in wireless communications networks are described. In embodiments, a computer device may determine that a data radio bearer (DRB) is to be classified into individual flows of a plurality of flows; and may instantiate a plurality of PDCP entities where individual PDCP entities of the plurality of PDCP entities process corresponding flows of the plurality of flows. The computer device may classify received packets of the DRB into the corresponding flows; and provide, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows. Other embodiments may be described and/or claimed.

WO 2018/031081 A1

[Continued on next page]

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AT&T et al v. Asustek Technology
IPR2024-00997

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Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

Published:

— *with international search report (Art. 21(3))*

SYSTEMS AND METHODS FOR PACKET DATA CONVERGENCE PROTOCOL SEQUENCING

RELATED APPLICATIONS

The present application claims priority under 35 U.S.C. § 119 to U.S. Provisional Application No. 62/372,138 filed on August 8, 2016, which is hereby incorporated by reference in its entirety.

FIELD

Various embodiments of the present application generally relate to the field of wireless communications, and in particular, to improving packet data convergence protocol (PDCP) sequencing in wireless communications networks.

BACKGROUND

Protocol stacks used in most cellular communications networks, such as Long Term Evolution (LTE), LTE-Advanced (LTE-A), Next Generation Cellular Network (5G NR, etc.), and the like, may include a packet data convergence protocol (PDCP) layer. The PDCP layer may provide services to a radio resource control (RRC) layer and user plane upper layers at a user equipment (UE) or an evolved Node B (eNB) or a general Node B (gNB). The PDCP layer may perform various functions including ordering incoming packets according to each packet's sequence number (SN), and in-sequence delivery of those packets to other layers. Many cellular communications networks also use radio bearers (for example, data radio bearers (DRBs), sidelink radio bearers (SLRBs), and signalling radio bearers (SRB)) to route data flows to and from a UE. When a radio bearer is established, a PDCP entity may be created to order packets flowing through the radio bearer. According to current cellular communications standards, each radio bearer is associated with one PDCP entity.

However, the packets that flow through a particular radio bearer (for example, a DRB) may belong to more than one data flow. Additionally, according to current cellular communications standards, the PDCP layer does not differentiate between the different flows traveling through a DRB. This may result in packet processing delays because packets of a flow in a DRB may have to wait for other packets of another flow to be processed due to the SN order of the other packets. Additionally, because the PDCP layer is required to provide in-sequence delivery of packets to other layers, if a packet is missing, then processing of all other packets, including packets belonging to different flows, may be delayed while packet re-transmission procedures take place.

Petitioners' Exhibit 1002, p. 141
AT&T et al v. Asustek Technology
IPR2024-00997

Once solution to these shortcomings may include setting up an individual DRB for an individual data flow. However, these solutions require more signaling to establish additional DRBs, which may increase overhead costs associated with increased network resource consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments will be readily understood by the following detailed description in conjunction with the accompanying drawings. To facilitate this description, like reference numerals designate like structural elements. Embodiments are illustrated by way of example and not by way of limitation in the figures of the accompanying drawings.

FIG. 1 illustrates a cellular communications network in accordance with various example embodiments;

FIG. 2 illustrates a logical representation of various embodiments discussed herein;

FIG. 3 illustrates an example protocol stack, in accordance with various embodiments;

FIG. 4 illustrates example packet data convergence protocol (PDCP) protocol data units (PDUs), in accordance with various embodiments;

FIG. 5 illustrates example components of an electronic device for wireless communication, in accordance with various example embodiments; and

FIG. 6 illustrates an example process that may be performed by an electronic device to perform various embodiments discussed herein.

DETAILED DESCRIPTION

Embodiments discussed herein relate to improving packet data convergence protocol (PDCP) sequencing in wireless communications networks. Embodiments provide a flow-based quality of service (QoS) framework that may be employed in wireless communication networks. In embodiments, a core network (CN) (or a network element therein) may perform flow level QoS control and enforcement procedures. In embodiments, the CN (or a network element therein) may transfer per-Flow QoS information to a Radio Access Network (RAN), and the QoS control may be performed in the RAN on a per-flow basis or may implement traditional radio bearer (RB) concepts. In other embodiments, the RAN itself or a user equipment (UE) may perform the flow level QoS control and enforcement procedures.

In embodiments, the flow-based QoS framework may be implemented by a computer device, such as a UE and/or a base station (for example, an evolved nodeB

Petitioners' Exhibit 1002, p. 142
AT&T et al v. Asustek Technology
IPR2024-00997

(eNB), a next generation nodeB (gNB), and the like). In such embodiments, the computer device may instantiate a plurality of PDCP entities to process a corresponding plurality of flows of a data radio bearer (DRB). As used herein, the terms "instantiate", "instantiation", and the like may refer to the creation of an instance, and an "instance" may refer to a concrete occurrence of an object, which may occur, for example, during execution of program code. The computer device may also classify traffic of the DRB into individual flows of the plurality of flows and provide the traffic of the individual flows to a corresponding PDCP entity. In embodiments, the classification of the individual flows may be based on a flow classification rule (also referred to as a "flow classification configuration"). In such embodiments, the flow classification rule may be generated by a network element (for example, an eNB/gNB or a CN element) and signaled to the UE, generated by the UE and signaled to the network element, or independently generated by each of the UE and the network element without requiring over-the-air (OTA) signaling of the flow classification rule.

Embodiments also provide various PDCP enhancements to allow the PDCP instances to identify a flow to which a packet may belong. In embodiments, each packet may include a new flow identifier field in a header portion of a PDCP packet or protocol data unit (PDU), portions of existing fields of a PDCP packet/ PDU, or the PDCP payload (for example, the beginning or the end of the packet/PDU) may be used for flow identification. Other embodiments may be described and/or claimed.

The following detailed description refers to the accompanying drawings. The same reference numbers may be used in different drawings to identify the same or similar elements. In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular structures, architectures, interfaces, techniques, etc., in order to provide a thorough understanding of the various aspects of the claimed invention. However, it will be apparent to those skilled in the art having the benefit of the present disclosure that the various aspects of the invention claimed may be practiced in other examples that depart from these specific details. In certain instances, descriptions of well-known devices, circuits, and methods are omitted so as not to obscure the description of the present invention with unnecessary detail.

Various aspects of the illustrative embodiments will be described using terms commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. However, it will be apparent to those skilled in the art that alternate embodiments may be practiced with only some of the described aspects. For

Petitioners' Exhibit 1002, p. 143
AT&T et al v. Asustek Technology
IPR2024-00997

purposes of explanation, specific numbers, materials, and configurations are set forth in order to provide a thorough understanding of the illustrative embodiments. However, it will be apparent to one skilled in the art that alternate embodiments may be practiced without the specific details. In other instances, well-known features are omitted or simplified in order not to obscure the illustrative embodiments.

Further, various operations will be described as multiple discrete operations, in turn, in a manner that is most helpful in understanding the illustrative embodiments; however, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation.

The phrase "in various embodiments," "in some embodiments," and the like are used repeatedly. The phrase generally does not refer to the same embodiments; however, it may. The terms "comprising," "having," and "including" are synonymous, unless the context dictates otherwise. The phrase "A and/or B" means (A), (B), or (A and B). The phrases "A/B" and "A or B" mean (A), (B), or (A and B), similar to the phrase "A and/or B." For the purposes of the present disclosure, the phrase "at least one of A and B" means (A), (B), or (A and B). The description may use the phrases "in an embodiment," "in embodiments," "in some embodiments," and/or "in various embodiments," which may each refer to one or more of the same or different embodiments. Furthermore, the terms "comprising," "including," "having," and the like, as used with respect to embodiments of the present disclosure, are synonymous.

Example embodiments may be described as a process depicted as a flowchart, a flow diagram, a data flow diagram, a structure diagram, or a block diagram. Although a flowchart may describe the operations as a sequential process, many of the operations may be performed in parallel, concurrently, or simultaneously. In addition, the order of the operations may be re-arranged. A process may be terminated when its operations are completed, but may also have additional steps not included in the figure(s). A process may correspond to a method, a function, a procedure, a subroutine, a subprogram, and the like. When a process corresponds to a function, its termination may correspond to a return of the function to the calling function and/or the main function.

As used herein, the term "circuitry" refers to, is part of, or includes hardware components such as an Application Specific Integrated Circuit (ASIC), an electronic circuit, a logic circuit, a processor (shared, dedicated, or group) and/or memory (shared, dedicated, or group) that are configured to provide the described functionality. In some

Petitioners' Exhibit 1002, p. 144
AT&T et al v. Asustek Technology
IPR2024-00997

embodiments, the circuitry may execute one or more software or firmware programs to provide at least some of the described functionality. Example embodiments may be described in the general context of computer-executable instructions, such as program code, software modules, and/or functional processes, being executed by one or more of the aforementioned circuitry. The program code, software modules, and/or functional processes may include routines, programs, objects, components, data structures, etc., that perform particular tasks or implement particular data types. The program code, software modules, and/or functional processes discussed herein may be implemented using existing hardware in existing communication networks. For example, program code, software modules, and/or functional processes discussed herein may be implemented using existing hardware at existing network elements or control nodes.

As used herein, the term "processor circuitry" refers to, is part of, or includes circuitry capable of sequentially and automatically carrying out a sequence of arithmetic or logical operations; recording, storing, and/or transferring digital data. The term "processor circuitry" may refer to one or more application processors, one or more baseband processors, a physical central processing unit (CPU), a single-core processor, a dual-core processor, a triple-core processor, a quad-core processor, and/or any other device capable of executing or otherwise operating computer-executable instructions, such as program code, software modules, and/or functional processes. As used herein, the term "interface circuitry" refers to, is part of, or includes circuitry providing for the exchange of information between two or more components or devices. The term "interface circuitry" may refer to one or more hardware interfaces (for example, buses, input/output (I/O) interfaces, peripheral component interfaces, and the like).

As used herein, the term "user equipment" may be considered synonymous to, and may hereafter be occasionally referred to, as a client, mobile, mobile device, mobile terminal, user terminal, mobile unit, mobile station, mobile user, UE, subscriber, user, remote station, access agent, user agent, receiver, etc., and may describe a remote user of network resources in a communications network. Furthermore, the term "user equipment" may include any type of wireless/wired device such as consumer electronics devices, cellular phones, smartphones, tablet personal computers, wearable computing devices, personal digital assistants (PDAs), desktop computers, and laptop computers, for example.

As used herein, the term "network element" may be considered synonymous to and/or referred to as a networked computer, networking hardware, network equipment, router, switch, hub, bridge, radio network controller, radio access network device,

Petitioners' Exhibit 1002, p. 145
AT&T et al v. Asustek Technology
IPR2024-00997

gateway, server, and/or any other like device. The term "network element" may describe a physical computing device of a wired or wireless communication network and be configured to host a virtual machine. Furthermore, the term "network element" may describe equipment that provides radio baseband functions for data and/or voice connectivity between a network and one or more users. The term "network element" may be considered synonymous to and/or referred to as a "base station." As used herein, the term "base station" may be considered synonymous to and/or referred to as a node B, an enhanced or evolved node B (eNB), base transceiver station (BTS), access point (AP), etc., and may describe equipment that provides the radio baseband functions for data and/or voice connectivity between a network and one or more users.

It should also be noted that the term "channel" as used herein may refer to any transmission medium, either tangible or intangible, which is used to communicate data or a data stream. Additionally, the term "channel" may be synonymous with and/or equivalent to "communications channel," "data communications channel," "transmission channel," "data transmission channel," "access channel," "data access channel," "link," "data link," "carrier," "radiofrequency carrier," and/or any other like term denoting a pathway or medium through which data is communicated.

FIG. 1 illustrates an example of a cellular communications network 100 (also referred to as "network 100" and the like), according to various embodiments. Network 100 includes UEs 105, two base stations (BSs) 110 (BS 110-1 and BS 110-2 are collectively referred to as "BS 110" or "BSs 110"), and to cells 115 (cell 115-1 and cell 115-2 are collectively referred to as "cell 115" or "cells 115"). The following description is provided for an example network 100 that operates in conjunction with the Long Term Evolution (LTE) standard as provided by 3rd Generation Partnership Project (3GPP) technical specifications (TS). However, the example embodiments are not limited in this regard and the described embodiments may apply to other networks that benefit from the principles described herein, such as new radio access technologies (NR) and the like. In addition, the following description provided for functionality of the UE 105 and/or downlink (DL) transmissions may be equally applicable to network-side (e.g., BS 110, CN 140, etc.) functionality and/or uplink (UL) transmissions unless stated otherwise.

Referring to FIG. 1, UE 105 may be a physical hardware device capable of running one or more applications and capable of accessing network services via one or more radio links 120 (radio link 120-1 and radio link 120-2 are collectively referred to as "radio links 120" or "links 120") with corresponding BSs 110. A link 120 may allow the UE 105 to

Petitioners' Exhibit 1002, p. 146
AT&T et al v. Asustek Technology
IPR2024-00997

transmit and receive data from a BS 110 that provides the link 120. To transmit/receive data to/from one or more BSs 110, UE 105 may include a transmitter/receiver (or alternatively, a transceiver), memory, one or more processors, and/or other like components that enable UE 105 to operate in accordance with one or more wireless communications protocols and/or one or more cellular phone communications protocols. In various embodiments, UE 105 may have multiple antenna elements that enable the UE 105 to maintain multiple links 120 to transmit/receive data to/from multiple BSs 110. For example, as shown in FIG. 1, UE 105 may connect with BS 110-1 via link 120-1 and simultaneously connect with BS 110-2 via link 120-2. Furthermore, UE 105 may be capable of measuring various cell-related criteria, such as channel conditions and signal quality (for example, reference signal received power (RSRP), reference signal received quality (RSRQ), and the like), and provide a measurement report including this information to a BS 110. Examples of UE 105 may include a wireless phone or smartphone, a laptop personal computer (PC), a tablet PC, a wearable computing device, an autonomous sensor or other like machine type communication (MTC) device, and/or any other physical device capable of recording, storing, and/or transferring digital data to/from BS 110 and/or any other like network element.

The BSs 110 are hardware computing devices configured to provide wireless communication services to mobile devices (for example, UE 105) within a coverage area or cell 115 associated with a BS 110 (for example, cell 115-1 associated with BS 110-1). In embodiments where the cellular communications network 100 is an LTE or LTE-A system, the BSs 110 may be referred to as evolved nodeBs (eNBs) 110 and the like. In embodiments where the cellular communications network 100 is an NR system, the BSs 110 may be referred to as next generation nodeBs (gNBs) 110, transmission reception points (TRPs) 110, and the like. In some embodiments, at least one of the BSs 110 may be a WiFi access point (AP), such as a router, switch, hub, gateway device, or other like network element that provides connection to a Wireless Local Area Network (WLAN) in accordance with an Institute of Electrical and Electronics Engineers (IEEE) 802.11 protocol.

A cell 115 providing services to UE 105 may also be referred to as a "serving cell," "cell coverage area," and the like. As discussed previously, BSs 110 may provide wireless communication services to UE 105 via links 120. The links 120 between the BSs 110 and the UE 105 may include one or more DL (or forward) channels for transmitting information from BS 110 to UE 105. Although not shown by FIG. 1, links 120 may also

Petitioners' Exhibit 1002, p. 147
AT&T et al v. Asustek Technology
IPR2024-00997

include one or more UL (or reverse) channels for transmitting information from UE 105 to a BS 110. The channels may include the physical downlink shared channel (PDSCH), physical downlink control channel (PDCCH), physical hybrid automatic repeat request (HARQ) indicator channel (PHICH), physical control format indicator channel (PCFICH), physical broadcast channel (PBCH), physical uplink shared channel (PUSCH), physical uplink control channel (PUCCH), physical random access channel (PRACH), and/or any other like communications channels or links used to transmit/receive data.

The BSs 110 include a transmitter/receiver (or alternatively, a transceiver) connected to one or more antennas, one or more memory devices, one or more processors, and/or other like components. The one or more transmitters/receivers may be configured to transmit/receive data signals to/from one or more UEs 105 within its cell 115 via one or more links that may be associated with a transmitter and a receiver. In embodiments where network 100 employs the LTE or LTE-A standard, one or both BSs 110 may employ Evolved Universal Terrestrial Radio Access (E-UTRA) protocols, for example, using orthogonal frequency-division multiple access (OFDMA) for scheduling and transmitting DL communications and single carrier frequency-division multiple access (SC-FDMA) for scheduling and receiving UL communications from UE 105. When one of the BSs 110 acts as a WiFi AP, that BS 110 may use direct-sequence spread spectrum (DSSS) signaling, OFDM signaling, etc., according to the particular version of the IEEE 802.11 protocol being. Different protocols may be used in embodiments where network 100 employs other cellular communications standard.

Furthermore, BSs 110 may be capable of communicating with one another over a backhaul connection 125 and may communicate with one or more servers 135 within a core network (CN) 140 over another backhaul connection 130. In embodiments where network 100 employs the LTE/LTE-A and/or NR standards, backhaul connection 125 may include a wired connection employing an X2 interface, which defines an interface for communicating data packets directly between BSs 110. In embodiments where one BS 110 is an eNB or gNB and the other BS 110 is a WiFi AP, the backhaul connection may include a wired or wireless connection employing an Xw interface. Furthermore, in such embodiments the backhaul connection 130 may include a wired connection employing an S1 interface, which defines a protocol for the forwarding of packets indirectly between BSs 110 by way of one or more mobility management entities (MMEs), one or more Serving Gateways (SGWs), and/or other like core network elements. In embodiments, various HO-related messages may be communicated directly between the BSs 110 over

Petitioners' Exhibit 1002, p. 148
AT&T et al v. Asustek Technology
IPR2024-00997

the X2 interface (for example, during an X2-HO operation or an Intra-MME HO, or to forward packets to a secondary eNB (SeNB) in DC mode) or between the BSs 110 and CN elements over the S1 interface (for example, during an S1-HO operation or an Inter-MME HO, or to receive user-plane data from the CN 140).

In many deployment scenarios, an end-to-end bearer may be established between the UE 105 and a device 150. The device 150 may be a UE that is the same or similar to UE 105, a desktop PC, server, or some other electronic device. As discussed previously, a bearer may be a tunnel or pipeline connecting two or more points (e.g., UE 105 and device 150) through which a data flow may travel. Bearers that carry user plane traffic may be referred to as data radio bearers (DRBs), and bearers that carry control plane traffic may be referred to as signaling radio bearers (SRBs).

In embodiments, DRBs may be established according to normal procedures, for example, during an Evolved Packet System (EPS) Session Establishment procedure between the UE 105, a BS 110, and/or one or more elements within the CN 140 (for example, a mobility management entity (MME)). The EPS Session Establishment procedure may include initial attachment procedures, connection re-establishment procedure, among other procedures. During the DRB establishment procedure, the BS 110 may signal a Radio Resource Control (RRC) message (for example, an RRC Connection Setup message, an RRC Connection Reconfiguration message, an RRC Connection Re-establishment message, and the like) to the UE 105 to setup the radio bearer. The RRC message may include all the necessary configuration parameters to establish the radio interface and a radio bearer, such as radio bearer QoS parameters, a session management request, an EPS radio bearer identifier (ID) and/or DRB ID, and other like configuration parameters. In various embodiments, the RRC message may be enhanced to notify the UE 105 that flow-based PDCP functionality is configured. For example, in some embodiments, the UE 105 may signal a first RRC message (for example, a UECapabilityInformation message) to a BS 110 to indicate that the UE 105 supports flow-based PDCP functionality. In response, the BS 110 may activate or configure the UE 105 with flow-based PDCP functionality by signaling a second RRC message (for example, an RRC Connection Reconfiguration message) to the UE 105 that may include a new element/field in an information element (IE) (for example, a new element/field in the PDCP-Config), which may be used to indicate that flow-based PDCP should be used for a particular radio bearer.

Petitioners' Exhibit 1002, p. 149
AT&T et al v. Asustek Technology
IPR2024-00997

In other embodiments, a Non-Access Stratum (NAS) message may be enhanced to notify the UE 105 that flow-based PDCP is configured. NAS signaling may be used in scenarios where filter rules used to identify individual flows are provided at the NAS level. This may be done in a similar manner as configuring traffic flow template (TFT) filters at the NAS layer. In embodiments, the NAS layer/entity may be in charge of flow detection, setting flow identifiers for individual flows (for example, in PDCP service data units (SDUs)), and mapping individual flows to DRBs. In such embodiments, the access stratum (AS) layer may be responsible for creating new PDCP entities for individual flows. In such embodiments, the UE 105 may indicate that the UE 105 supports flow-based PDCP functionality using, for example, a UE Network Capability IE of an Attach Request message or Tracking Area Update message (or equivalent messages for NG implementations). In response, a network element (for example, an MME) may activate or configure the UE 105 with flow-based PDCP functionality when activating an EPS bearer using, for example, an "activate default EPS bearer context request" message or an "activate dedicated EPS bearer context request" message, which may be a NAS message encapsulated in an RRC message (for example, an RRC Connection Reconfiguration message, and the like).

Regardless of how flow-based PDCP procedures are configured, when a DRB is established, a PDCP instance may be created to perform various PDCP functions (for example, aggregate, (re-)order, cipher/decipher, etc.) for packets of an individual flow according to their corresponding flow IDS and/or sequence numbers (SNs) as discussed herein.

In embodiments, the network 100 may implement one or more multi-cell aggregation technologies, such as Dual-Connectivity (DC), LTE-WLAN Aggregation (LWA), and/or LTE-NR aggregation. In such embodiments, split bearers may be used to provide higher throughput by combining the resources available at multiple cells 115. Additionally, split bearers may be used to convey packets with different QoS requirements over separate links 120.

In DC mode, DL transmissions may be conveyed to the UE 105 according to the following example: user plane data from the CN 140 may be first transferred to the BS 110-1 operating as a master eNB (MeNB) or primary cell (PCell) 115-1. At the BS 110-1, the DRB may be split so that some data packets are transmitted to the UE 105 via the PCell 115-1, while other data packets are transmitted to the UE 105 by BS 110-2 operating as the secondary eNB (SeNB) or a secondary cell (SCell) 115-2. The other data packets to

Petitioners' Exhibit 1002, p. 150
AT&T et al v. Asustek Technology
IPR2024-00997

be transmitted by BS 110-2 may be transferred over the backhaul connection 125 from BS 110-1 to BS 110-2. In some cases, the data packets transmitted by the BS 110-1 and the BS 110-2 may belong to the same flow. In various embodiments, packets belonging to an individual flow may be transmitted over a specified link 120 (for example, link 120-1), while other packets may be transmitted over a different link 120 (for example, link 120-2). Typically, all the packets received by the UE 105, from either BS 110-1 or BS 110-2 may be aggregated, cipher/deciphered, and re-ordered at a PDCP layer of the UE 105. In embodiments, all the packets received by the UE 105, from either BS 110-1 or BS 110-2 may be classified as belonging to individual flows, and the classified packets may be provided to corresponding PDCP entities to be aggregated, cipher/deciphered, and re-ordered. For example, embodiments provide that packets of a first flow may be received from BS 110-1 over link 120-1 and provided to a first PDCP entity for processing, while packets of a second flow may be received from BS 110-2 over link 120-2 and provided to a second PDCP entity for processing. This may reduce the need for aggregation of an individual flow, which may reduce the end-to-end and delay for that flow.

In the UL direction, the UE 105 may transmit some packets to BS 110-1 acting as the MeNB and other packets to BS 110-2 acting as the SeNB. Typically, the other data packets received by BS 110-2 may be transferred over the backhaul connection 125 from BS 110-2 to BS 110-1, where the PDCP entity at BS 110-1 may aggregate, decipher, and re-order the packets for upper layer entities. In embodiments, all the packets received by the BS 110-1, from either the UE 105 or BS 110-2 may be classified as belonging to individual flows, and the classified packets may be provided to corresponding PDCP entities to be aggregated, cipher/deciphered, and re-ordered. Similar to the DL direction, packets of a first flow may be received from UE 105 over link 120-1 and provided to a first PDCP entity for processing, while packets of a second flow may be received from BS 110-2 over backhaul link 125 and provided to a second PDCP entity for processing.

In LTE-NR aggregation mode, UL and DL transmissions may be communicated to/from the UE 105 in a similar manner as in DC mode except that one BS 110 (for example BS 110-1) may be an "LTE eNB" that only provides connectivity to an EPC CN 140 or may be an "eLTE eNB", which is an eNB that supports connectivity to both EPC and NG CNs 140, and another BS (for example, BS 110-2) may be a gNB that supports connectivity to a NG CN 140, for example. Additionally, either BS 110 may act as a master node or a secondary node. One difference between LTE-NR aggregation and DC mode is that user-plane traffic may be routed to an EPC CN 140 when an LTE eNB is

Petitioners' Exhibit 1002, p. 151
AT&T et al v. Asustek Technology
IPR2024-00997

acting as the master node, or user-plane traffic may be routed to an NG CN 140 when a gNB or eLTE eNB acts as the master node.

In LWA mode, DL transmissions may be conveyed to the UE 105 in a similar manner as in DC mode except that the BS 110-2 may act as a WiFi AP, for example. In such embodiments, the BS 110-1 may perform scheduling for PDCP packets at its PDCP layer, and may transmit some packets over an LTE (or NR) interface (for example, the "Uu interface") and other packets may be provided to the BS 110-2 for transmission over a WiFi interface. The BS 110-1 may transmit these packets to the BS 110-2 after encapsulating the packets in LWA Adaptation Protocol (LWAAP) packets/units/frames, which carry the bearer identity. Typically, all of the packets received over the LTE and WiFi interfaces may be aggregated and re-ordered at a PDCP layer of the UE 105. In embodiments, packets received by the UE 105 may be processed in a similar manner as discussed with regard to the DC mode, such as classifying packets as belonging to individual flows, and providing the classified packets to corresponding PDCP entities to be aggregated, cipher/deciphered, and re-ordered. Additionally, packets received by the UE 105 from BS 110-1 may be classified as belonging to a first individual flow and provided to a corresponding first PDCP entity to be aggregated, cipher/deciphered, and re-ordered, while packets received by the UE 105 from BS 110-2 may be classified as belonging to a second individual flow and provided to a corresponding second PDCP entity to be aggregated, cipher/deciphered, and re-ordered.

In the UL direction, the UE 105 may transmit some packets to LTE (or NR) BS 110-1 and other packets to the WiFi AP BS 110-2. Typically, the other data packets received by the BS 110-2 may be transferred over a backhaul connection 125 (for example, the Xw interface) from BS 110-2 to BS 110-1, where the PDCP entity at BS 110-1 may aggregate and re-order the packets for upper layer entities. In embodiments, all the packets received by the BS 110-1, from either the UE 105 or BS 110-2 may be classified as belonging to individual flows, and the classified packets may be provided to corresponding PDCP entities to be aggregated, cipher/deciphered, and re-ordered. Similar to the DL direction, packets of a first flow may be received from UE 105 over link 120-1 and provided to a first PDCP entity for processing, while packets of a second flow may be received from BS 110-2 over backhaul link 125 and provided to a second PDCP entity for processing.

Regardless of whether or not multi-cell aggregation technologies are implemented, in conventional systems re-ordering and aggregation operations may be accomplished at

Petitioners' Exhibit 1002, p. 152
AT&T et al v. Asustek Technology
IPR2024-00997

the PDCP layer of a receiver entity using PDCP SNs, and PDCP SNs may be managed on a per-bearer basis. The re-ordering may be required to ensure that all received packets are delivered in sequence to upper layers, and in DC or LWA systems, the re-ordering operations of the PDCP entity may be required even if individual links have different available bandwidths and/or latency. Since data flows from different applications with different latency constraints may be transmitted in the same DRB, in conventional systems, data packets of a first flow may be pending in a re-ordering queue waiting for the reception of data packets of a second flow, which may arrive over another link 120 in DC or LWA systems. This may lead to increased latency or delay for processing packets of the first flow.

According to various embodiments, multiple flows may be assigned to a single DRB and individual PDCP instances may be generated to aggregate, cipher/decipher, and re-order packets of individual flows of a same DRB. In some embodiments, lower layer entities (for example, radio link control (RLC) entities and media access control (MAC) entities) may support individual queues for individual flows of a same DRB. Additionally, the PDCP instances at the UE 105 and/or BSs 110 may aggregate, cipher/decipher, and re-order packets of individual flows based on flow ID and/or an SN included in obtained PDCP packets. Examples of such embodiments are shown and described with regard to FIGS. 2-6.

According to various embodiments, once a DRB is established, a default PDCP entity may be created/generated to process all packets of the DRB. After the default PDCP entity is created, a flow classification rule (also referred to as a "flow classification configuration" and the like) may be activated. The flow classification rule may indicate various parameters for identifying and/or labeling packets belonging to an individual flow and various parameters for processing packets of an individual flow. For example, the flow classification rule may indicate a tag, QoS ID, or flow ID that belongs to an individual flow; a location of a tag/QoS ID/flow ID in individual received packets; a location of a tag/QoS ID/flow ID to be inserted into individual packets for transmission; the size (in bits or bytes) of the tag/QoS ID/flow ID; a destination for the packets once processed, a link over which the packets of the flow will be received or should be sent (for example, in DC or LWA implementations), and/or other like parameters. In some embodiments, the flow classification rule may be provided by upper layers. Additionally, a flow classification rule may map traffic from different protocol data unit (PDU) sessions to different DRBs. In embodiments, an IP flow may be mapped to a QoS flow or class and

Petitioners' Exhibit 1002, p. 153
AT&T et al v. Asustek Technology
IPR2024-00997

a DRB. For example, in some embodiments mapping of IP flows may include a two-step procedure for DL and UL transmissions, in which a NAS entity may be responsible for mapping an IP flow to a QoS flow/class, and access stratum (AS) entity may be responsible for the mapping the QoS flow/class to an individual DRB. In another embodiment, a NAS entity may be responsible for flow identification and creation/addition of the flow ID, and the AS entity may be responsible for creation of a new PDCP entity to manage the identified flow when that flow is reported to the AS entity by the NAS entity.

In embodiments, a flow classification rule may be activated and/or configured at the NAS layer and/or AS layer. In one example, a flow classification rule may be activated when a flow ID is obtained by the PDCP layer from a NAS layer, where receipt of the flow ID may cause PDCP entity creation by the BS 110 and/or the UE 105. In another example, a flow classification rule may be activated when a new flow is detected by an AS entity, where the detection may cause PDCP entity creation by the BS 110 and/or the UE 105. In alternative embodiments, a flow classification rule may be activated in advance (for example, at DRB setup), which may cause creation of a new PDCP entity even when there are no packets of an individual flow to transfer to the newly created PDCP entity. In such embodiments, the new PDPC entity may be created according to instructions/commands in the activated flow classification rule.

Once the flow classification rule is activated, the BS(s) 110 and UE 105 may create a new flow-specific PDCP entity, which may be used to process an individual flow. In some embodiments, the individual flow may be indicated by the flow classification rule. In such embodiments, all other packets of the DRB may still be processed by the default PDCP entity. After activation of the flow classification rule, another flow classification rule may be activated, which may cause the BS(s) 110 and UE 105 to create another flow-specific PDCP entity to process another individual flow indicated by the other flow classification rule. In such embodiments, all other packets of the DRB that are not included in both individual flows may still be processed by the default PDCP entity. There may be multiple flow-specific PDCP entities per DRB, which together with the default PDCP entity may be associated to the same RLC entity of the DRB. As a result, all traffic of the same DRB may be processed by the lower layer entities (for example, RLC and MAC entities) as belonging to the same bearer.

Using flow classification rules in this way may provide resource utilization efficiencies. For example, the flow classification rules may allow offloading of PDCP

Petitioners' Exhibit 1002, p. 154
AT&T et al v. Asustek Technology
IPR2024-00997

functionality to multiple processors or processor-cores, such as operating a first PDCP entity by a first processor, a second PDCP entity for a second processor, and so forth. In some embodiments, the individual PDCP entities may be operated by a corresponding virtual machine. With conventional bearer-based PDCP procedures, data received on multiple links must be aggregated and processed in the same PDCP entity, which may lead to reduced performance when applications for different flows run on different processors or when individual links operate on different processors. This is because all the data must be aggregated at the same PDCP entity. Additionally, in data aggregation implementations, the flow classification rules may indicate an individual link 120 over which an individual flow may be transmitted. This may reduce computational burdens on a cellular modem of the UE 105 by, for example, allowing a WiFi modem of the UE 105 to operate a PDCP entity for a flow that is received over a WiFi link.

In various embodiments, the flow classification rule may be internally configured at the UE 105, or may be configured by a BS 110. Where a BS 110 configures the traffic classification rule, the BS 110 may use a traffic flow template (TFT) to map a flow to individual packets, and may communicate the flow classification rule to the UE 105 using AS or NAS signaling. In alternative embodiments, the UE 105 may determine the flow classification rule, for example, based on a local application programming interface (API) for various applications, and may communicate the flow classification rule to a BS 110 using AS (for example, RRC signaling) or NAS signaling. According to various embodiments, there may be three ways to activate flow classification rules.

In first embodiments, flow classification rules may be activated by the UE 105. In such embodiments, the UE 105 may determine how to map a flow for both DL and UL transmissions, and may send the DL flow classification rule to the BS 110 and/or a CN 140 element (for example, an MME, PGW, etc.).

In second embodiments, flow classification rules may be activated by the BS 110 or a CN 140 element (for example, an MME, PGW, etc.). In such embodiments, the BS 110 or a CN 140 element may determine how to map a flow for both DL and UL, and may send the UL flow classification rule to the UE 105. In embodiments where the CN 140 element (for example, an MME, PGW, etc.) determines the flow classification rule, the CN 140 element may send the DL flow classification rule to BS 110, which may in turn provide the flow classification rule to the UE 105.

In third embodiments, flow classification rules may be activated by the UE 105 and the BS 110 or CN 140 element independently. In such embodiments, the UE 105 may

Petitioners' Exhibit 1002, p. 155
AT&T et al v. Asustek Technology
IPR2024-00997

determine how to map a flow for UL transmissions, and the BS 110 or CN 140 element may determine how to map a flow for DL transmissions. In such embodiments, the flow classification rules may not be signaled OTA. In embodiments where the CN 140 element (for example, an MME, PGW, etc.) determines the flow classification rule, the CN 140 element may provide the DL flow classification rule to the BS 110.

In various embodiments, when a flow classification rule is activated, a sending/transmitting entity may identify or classify a new flow to be transmitted. In embodiments, Internet Protocol (IP) tuples or subset/combinations of IP tuples may be used to identify or classify a flow. The tuples may include a source IP address, a source port, a destination IP address, and a destination port. In some embodiments, a flow may be identified based on a range of ports, a range of IP addresses, and/or a combination of various port ranges and/or various IP address ranges. In some embodiments, the sending/transmitting entity may map all tuples having the QoS requirements or the same QCI to the same flow. Additionally or alternatively, when a flow classification rule is activated, a sending/transmitting entity may identify or classify a new flow to be transmitted according to one or more QoS characteristics. The QoS characteristics/requirements may comprise a QoS class ID (QCI), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level. Additionally or alternatively, when a flow classification rule is activated, a sending/transmitting entity may identify or classify a new flow to be transmitted based on a tag or identification field of a header portion of received packets or an API of the system/application from which the packets are obtained. These embodiments may be applicable when the packets are received/obtained from upper layers, such as a transmission control protocol (TCP)/IP layer/entity and/or an application layer/entity.

In embodiments where link aggregation mechanisms are used (for example DC or LWA), the UE 105 and/or BSs 110 may select a link 120 over which to obtain or send individual flows. The link 120 selection or routing selection can be either determined by the UE 105 itself or configured by the BS 110 or a CN element. The link selection may be based on QoS requirements/characteristics (discussed previously) for an individual flow and a channel quality of a particular link 120. For example, when the UE 105 operates an application with real-time or near real-time latency requirements, the UE 105 or a BS 110 may select a link 120 that has less latency and jitter than other links 120 for communicating packets for that application rather than sending packets of an individual flow over both links 120. This is because, in some cases, high throughput may be less of a

Petitioners' Exhibit 1002, p. 156
AT&T et al v. Asustek Technology
IPR2024-00997

concern for applications with real-time or near real-time latency requirements when compared to applications with relatively high latency and jitter tolerance. For applications with less stringent latency and/or QoS requirements, throughput may be more important, and in such cases, the UE 105 or BS 110 may send packets for an individual flow over both links 120 in a similar manner as convention link aggregation procedures.

Although not shown by FIG. 1, each BS 110 may be part of a radio access network (RAN) or associated with a radio access technology (RAT). In embodiments where communications network 100 employs the LTE standard, the RAN may be referred to as an evolved universal terrestrial radio access network (E-UTRAN). In embodiments where communications network 100 employs NR standards, the RAN may be referred to as an NR RAN, a next generation RAN (gRAN), and the like. RANs and their typical functionality are generally well-known, and thus, a further detailed description of the typical functionality of RAN is omitted.

The network 100 may include CN 140, which may include one or more hardware devices, such as the one or more servers 135. The CN 140 may be an EPC CN or a next generation (NG) CN. These servers may provide various telecommunications services to the UEs 105. In embodiments where network 100 employs the LTE standards, the one or more servers 135 of the CN 140 may comprise components of the System Architecture Evolution (SAE) with an Evolved Packet Core (EPC) as described by 3GPP technical specifications. In such embodiments, the one or more servers 135 of the CN 140 may include components such as one or more MMEs and/or Serving General Packet Radio Service Support Nodes (SGSNs) (which may be referred to as an "SGSN/MME"), a serving gateway (SGW), packet data network (PDN) gateway (PGW), home subscriber server (HSS), access network discovery and selection function (ANDSF), evolved packet data gateway (ePDG), an MTC interworking function (IWF), and/or other like components as are known. In embodiments where network 100 employs NR standards, the one or more servers 135 of the CN 140 may comprise the same components as an EPC core, enhanced versions of those elements, and/or additional or different elements not yet defined. The various elements of the CN 140 may route phone calls from UE 105 to other mobile phones or landline phones, or provide the UE 105 with a connection to the internet 145 for communication with one or more other computer devices, such as device 150. Because the components of the SAE core network and their functionality are generally well-known, a further detailed description of the SAE core network is omitted. The aforementioned

Petitioners' Exhibit 1002, p. 157
AT&T et al v. Asustek Technology
IPR2024-00997

functions may be provided by the same physical hardware device or by separate components and/or devices.

FIG. 2 illustrates a logical representation of various embodiments discussed herein. FIG. 2 shows three DRBs including DRB1 205A ("first DRB") with three flows 210 (flow1 210A, flow2 210B, and flow3 210C). Additionally, arrangement 200 includes DRB2 205B ("second DRB") and DRB3 205C ("third DRB") each have a corresponding flow 210 (flow4 210D of DRB2 210B and flow5 210E of DRB3 210C). Although FIG. 2 only shows a single DRB with three flows, in various embodiments more than one DRB may have a plurality of flows, and each DRB may include any number of flows.

FIG. 3 illustrates an example protocol stack 300, in accordance with various embodiments. The protocol stack 300 may correspond to the DRBs 205 and flows 210 shown by FIG. 2. As shown by FIG. 3, each of PDCP entities 310A-E in the protocol stack 300 correspond with the flows 210A-E of FIG. 2, respectively. For example, PDCP entity 310A in FIG. 3 may correspond to flow1 210A of DRB1 205A in FIG. 2, PDCP entity 310B in FIG. 3 may correspond to flow2 210B of DRB1 205A in FIG. 2, PDCP entity 310C in FIG. 3 may correspond to flow3 210C of DRB1 205A in FIG. 2, PDCP entity 310D in FIG. 3 may correspond to flow4 210D of DRB2 210B in FIG. 2, and PDCP entity 310E in FIG. 3 may correspond to flow5 210E of DRB3 210C in FIG. 2. Additionally, the protocol stack includes a default PDCP entity 310Z for each of the DRBs 205. The default PDCP entities 310Z may perform the various PDCP functions for received packets that do not belong to either of the flow-based PDCP entities 310A-E. Further, each DRB 205 may have a corresponding RLC entity 305, for example, RLC entity 305A in FIG. 3 may correspond with DRB 205A in FIG. 2, RLC entity 305B in FIG. 3 may correspond with DRB 205B in FIG. 2, and RLC entity 305C in FIG. 3 may correspond with DRB 205C in FIG. 2. Furthermore, all of the DRBs 210 may correspond with the MAC entity 315.

The UE 105 and BSs 110-1 and 110-2 may each include a separate protocol stack 300. Each protocol stack 300 may be used as a control plane protocol stack for establishing radio-specific functionality, or may be used as a user plane protocol stack for establishing data-specific functionality including communicating data between the UE 105 and the BS 110 over an air interface, such as the LTE-Uu interface.

The main functions of the PDCP layers/entities 310 may include header compression and decompression of IP data flows using the Robust Header Compression (ROHC) protocol; transfer of data (user plane or control plane); maintenance of PDCP SNs; in-sequence delivery of upper layer protocol data units (PDUs) at re-establishment of

Petitioners' Exhibit 1002, p. 158
AT&T et al v. Asustek Technology
IPR2024-00997

lower layers; duplicate elimination of lower layer service data units (SDUs) at re-establishment of lower layers for radio bearers mapped on the RLC layer; ciphering and deciphering of user plane data and control plane data; integrity protection and integrity verification of control plane data; integrity protection and integrity verification of user plane data for relay nodes (RNs); timer based discard; duplicate discarding; and or split bearers, routing and reordering. According to various embodiments, the PDCP functions may be performed on a per-flow basis as discussed herein. For example, a plurality of PDCP entities, 310 may be instantiated, where individual PDCP entities 310 of the plurality of PDCP entities 310 may process corresponding flows 210 of a plurality of flows 210 and the instantiated PDCP entities 310 may perform any of the aforementioned functions and/or functions specified by 3GPP technical specification (TS) 36.323 V14.1.0 (2016-12) and/or other like TSs.

The main functions of the RLC layers/entities 305 may include transfer of upper layer PDUs; error correction through automatic repeat request (ARQ); concatenation, segmentation and reassembly of RLC SDUs; re-segmentation of RLC data PDUs; reordering of RLC data PDUs; duplicate detection; RLC SDU discard; RLC re-establishment; and protocol error detection. In some embodiments, the RLC entities 305 may each have a single queue for all PDUs of individual flows obtain from corresponding PDCP entities 310. This queue may be a first-in first-out (FIFO) queue where all PDCP entities 310 connected to the same RLC entity 305 may place PDUs in the same queue following the FIFO concept. In other embodiments, the RLC layers/entities 305 may include individual queues for PDUs of individual flows obtained from corresponding PDCP entities 310. For example, the DRB1 RLC entity 305A may include a "default queue" or buffer to store RLC SDUs including PDCP PDUs obtained from the default PDCP entity 310Z, a first queue or buffer to store RLC SDUs including PDCP PDUs obtained from the flow1 PDCP entity 310A, a second queue or buffer to store RLC SDUs including PDCP PDUs obtained from the flow2 PDCP entity 310B, and a third queue or buffer to store RLC SDUs including PDCP PDUs obtained from the flow3 PDCP entity 310C. In some embodiments, the individual queues may be prioritized according to the data delivered to or contained in the individual queues. For example, PDUs of individual flows may be marked with a "priority" or "QoS" indication, and the RLC entity 305 may select data from an individual queue associated with a highest priority flow for transmission before individual queues associated with lower priority flows.

Petitioners' Exhibit 1002, p. 159
AT&T et al v. Asustek Technology
IPR2024-00997

The main functions of the MAC layer/entity 315 may include mapping between logical channels and transport channels; multiplexing of MAC SDUs from one or different logical channels onto transport blocks (TB) to be delivered to the physical layer on transport channels; demultiplexing of MAC SDUs from one or different logical channels from transport blocks (TB) delivered from the physical layer on transport channels; scheduling information reporting; error correction through Hybrid Automatic Repeat Request (HARQ); priority handling between UEs by means of dynamic scheduling; priority handling between logical channels of one MAC entity; Logical Channel prioritization; transport format selection; radio resource selection for sidelink connections. In embodiments, the MAC entity 315 may include individual queues for PDUs of individual flows obtain from a corresponding PDCP entity 310. For example, the MAC entity 315 may include a "default queue" or buffer to store MAC SDUs including PDCP PDUs obtained from the default PDCP entity 310Z, a first queue or buffer to store MAC SDUs including PDCP PDUs obtained from the flow1 PDCP entity 310A, a second queue or buffer to store MAC SDUs including PDCP PDUs obtained from the flow2 PDCP entity 310B, and a third queue or buffer to store MAC SDUs including PDCP PDUs obtained from the flow3 PDCP entity 310C.

Although not shown by FIG. 3, the protocol stack 300 may also include an RRC entity above the PDCP entities 310. The main functions of the RRC entity may include RRC connection control; Inter-RAT mobility including security activation and transfer of RRC context information; measurement configuration and reporting; transfer of dedicated NAS information and non-LTE dedicated information; transfer of UE radio access capability information; support for E-UTRAN sharing (multiple PLMN identities); generic protocol error handling; support of self-configuration and self-optimization; and support of measurement logging and reporting for network performance optimization. The broadcast of system information may include NAS common information; cell (re-)selection parameters, neighboring cell information and information, and common channel configuration information. RRC connection control may include establishment, modification, and release of RRC connections; initial security activation such as initial configuration of AS integrity protection (SRBs) and AS ciphering (for SRBs and DRBs); establishment, modification, and release of resource blocks (RBs) carrying user data (for example, DRBs); radio configuration control; RN-specific radio configuration control for the radio interface; cell management; QoS control; and recovery from radio link failures (RLFs). In addition to the these functions, in various embodiments the RRC layer may be

Petitioners' Exhibit 1002, p. 160
AT&T et al v. Asustek Technology
IPR2024-00997

responsible for configuring the UE 105 and/or the BS 110 for flow-based PDCP aggregation, which may include configuring flow-based PDCP aggregation for a particular DRB 205.

Although not shown by FIG. 3, the protocol stack 300 may also include a NAS layer/entity above the RRC layer/entity. The NAS layer/entity may be the highest stratum of the control plane between UE 105 and an MME at the radio interface. The main functions of the NAS layer may include mobility support for the UE 105; and support of session management procedures to establish and maintain IP connectivity between the UE 105 and a packet data network gateway (PDN GW) within the CN 140. The NAS layer may also provide NAS security services for the NAS protocols, which may include integrity protection and ciphering of NAS signalling messages. In addition to the these functions, in various embodiments the NAS layer may be responsible for configuring the UE 105 and/or the BS 110 for flow-based PDCP aggregation, which may include configuring flow-based PDCP aggregation for a particular DRB 205.

Although not shown by FIG. 3, the protocol stack 300 may also include a Physical layer (PHY) entity below the MAC entity 315. The main functions of the PHY layer may include carrying information from the MAC transport channels over the air interface. The PHY layer may also take care of the link adaptation (AMC), power control, cell search (for initial synchronization and handover purposes) and other measurements (inside the LTE and/or NR systems and between systems) for the RRC layer.

Although not shown by FIG. 3, in embodiments where LWA may be used, the protocol stack 300 may also include an LWAAP entity and a WLAN entity. The LWAAP entity may receive/deliver LWAAP SDUs from/to upper layers (for example, a corresponding PDCP entity 310), and may send/receive LWAAP PDUs to/from its peer LWAAP entity via the WLAN entity. At the BS 110, when an LWAAP entity receives an LWAAP SDU from upper layers, it constructs the corresponding LWAAP PDU and delivers it to lower layers. At the UE 105, when an LWAAP entity receives an LWAAP PDU from lower layers, it reassembles the corresponding LWAAP SDU and delivers it to upper layers. When receiving an LWAAP data PDU from lower layers (for example, downlink data), the LWAAP entity in the UE 105 may identify the upper layer entity to which the LWAAP SDU is destined based on the DRB ID included in the LWAAP header; reassemble the LWAAP SDU from the LWAAP data PDU by removing the LWAAP header from the LWAAP data PDU; and deliver the reassembled LWAAP SDU

Petitioners' Exhibit 1002, p. 161
AT&T et al v. Asustek Technology
IPR2024-00997

to the upper layer entity identified by the DRB ID. The WLAN entity may include its own MAC and PHY entities that operate in accordance with WiFi protocols.

Some of the functions listed above may be applicable to both the UE 105 and the BS 110, while some of the functions may only be applicable to only the UE 105 or the BS 110. Further, although FIG. 3 shows a single protocol stack 300, in various embodiments, the UE 105 and/or BSs 110 may generate or create multiple protocol stacks 300 for communicating with one another, wherein each protocol stack 300 may include a corresponding RRC, PDCP, RLC, MAC, PHY, LWAAP, and/or WLAN entities.

In a first example, the UE 105 may generate a first protocol stack 300 with first RRC, first PDCP, first RLC, first MAC, and first PHY entities for communicating with BSs 110 associated with a master cell group (MCG) including one or more MeNBs, and may generate a second protocol stack 300 with second RRC, second PDCP, second RLC, second MAC, and second PHY entities for communicating with BSs 110 associated with a secondary cell group (SCG) including one or more SeNBs. Such embodiments may be applicable to the UE 105 and/or BSs 110 operating in DC mode where one or more BSs 110 may operate as the MeNBs and the one or more other BSs 110 may operate as a SeNBs.

In a second example, the UE 105 and/or BSs 110 may generate a first protocol stack 300 with first RRC, first PDCP, first RLC, first MAC, and first PHY entities for communicating in an LTE network and may generate a second protocol stack 300 with second RRC, second PDCP, second RLC, second MAC, and second PHY entities for communicating in an NR network. Such embodiments may be applicable to the UE 105 and/or BSs 110 operating in DC mode where the LTE BS 110 may operate as an MeNB and the NR BS 110 may operate as a secondary gNB (SgNB), or where the LTE BS 110 may operate as an SeNB and the NR BS 110 may operate as a master gNB (MgNB).

In a third example the UE 105 and/or BSs 110 may generate a first protocol stack 300 with first RRC, first PDCP, first RLC, first MAC, and first PHY entities for communicating in an LTE network or an NR network and may generate a second protocol stack 300 with second RRC, second PDCP, second RLC, LWAAP, and WLAN entities for communicating in a WiFi network. Such embodiments may be applicable to the UE 105 and/or BSs 110 operating in LWA mode where the LTE or NR BS 110 may operate as a PCell and the WiFi BS 110 may operate as SCell.

FIG. 4 illustrates an example PDCP PDU 400A and an example PDCP PDU 400B, in accordance with various embodiments. The PDCP PDUs 400A-B may be a bit string

Petitioners' Exhibit 1002, p. 162
AT&T et al v. Asustek Technology
IPR2024-00997

that is byte aligned (for example, in multiples of 8 bits) in length. For each of the PDCP PDUs 400A-B and for each field discussed infra, the left most bit may be the first and most significant bit (MSB) and the right most bit may be the last and least significant bit (LSB), unless otherwise mentioned. Additionally, the bits of each field may be ordered and/or populated from MSB to LSB. Furthermore, the fields may include integers that are encoded according to standard binary encoding for unsigned integers.

PDU 400A may include a flow ID field 405, PDCP SN fields 410A-B, a data field 415, reserved (R) fields 420A-B, and a D/C field 425. The data field 415 may have a variable length and may include one or more uncompressed PDCP SDUs for user plane data or control plane data; or one or more compressed PDCP SDUs for user plane data only. The data field 415 may be a payload portion of the PDU 400A and may be referred to as a "data payload 415", "PDU payload 415", and the like. The other fields depicted by FIG. 4 may be part of a header portion of the PDU 400A. Each of the R fields 420A-B may be set to 0 and ignored by the receiver entity. The D/C field 425 may be a single bit having a value of 1 to indicate that the PDCP PDU 400A is a data PDU and a value of 0 to indicate that the PDCP PDCU 400A is a control PDU.

The PDCP SN fields 410A-B may carry an SN. An SN for an SRB may be 5 bits in length, and an SN for DRBs may be 7, 12, 15, 16, or 18 bits in length depending on the configuration by higher layers. The size of the PDCP SN fields 410A-B may be based on an indicated SN size in a PDCP configuration message. For example, the SN size may be indicated by the pdcp-SN-Size field of the PDCP-Config IE in an RRC message. When the SN is 7 bits in length, the SN may be populated in the PDCP SN field 410A and the PDCP SN field 410B may be used by the data field 415, for example. When data for a new flow 210 is received by the receiver entity, the receiver entity may create a new flow-specific PDCP entity 310 for the new flow 210, and may start a re-ordering operation for the new flow 210. If the PDCP entity 310 for the flow 210 already exists, normal re-ordering operations may be performed. As the sequence numbering is based on individual flow 210, the data received for the flow 210 may be re-ordered immediately and delivered to an appropriate application. In this way, received data for one flow 210 is not delayed due to missing data from another flow 210.

To support flow-specific PDCP sequence numbering, the PDCP PDU 400A may include the flow ID field 405 as shown in FIG. 4. The flow ID may be used route packets to a flow-based PDCP entity at the receiver entity for separate and/or parallel processing (for example, in-order delivery). In other embodiments, the flow ID field 405 may be

Petitioners' Exhibit 1002, p. 163
AT&T et al v. Asustek Technology
IPR2024-00997

included in a payload portion of the PDCP PDU 400A (not shown by FIG. 4). In another embodiment, the flow ID may be part of another protocol layer, which may be received by the PDCP in the payload portion of the PDCP PDU 400A (not shown by FIG. 4). The other protocol layer may be an existing layer (for example, an RRC layer or RLC 305), or may be a new protocol layer introduced on top or below the PDCP layer. Each flow-specific PDCP entity 310 may maintain its own PDCP SN, as well as a split bearer and/or link selection decision in the case of DC or LWA implementations. The flow ID may be used by the receiver entity to identify an individual flow. For example, and with reference to FIG. 2, the flow ID field 405 for flow1 210A in DRB1 205A may have a decimal value of 1 (or a binary value of 00001), the flow ID field 405 for flow2 210B in DRB1 205A may have a decimal value of 2 (or a binary value of 00010), and so forth.

Referring to PDU 400B, the PDU 400B may include the same or similar fields as previously discussed with regard to PDU 400A, except that the PDU 400B does not include a separate flow ID field 405. Instead, the MSB 406A and/or the LSB 406B bits of the existing SN fields 410A-B may be used to indicate the flow ID and the remaining bits may be used to indicate the SN. Although FIG. 4 shows that a single MSB 406A and a single LSB 406B may be used, in other embodiments, any number of MSBs 406A and/or LSBs 406B may be used to convey the flow ID.

In various embodiments, the sending/transmitter entity may mark or otherwise insert a flow ID into the flow ID field 405 of PDU 400A or the SN fields 410A-B of PDU 400B. Additionally, the receiver entity may extract or read the flow ID from the flow ID field 405 of PDU 400A or the SN fields 410A-B of PDU 400B.

As an example, in the DL direction, a BS 110 may obtain data packets (for example, IP packets) from a CN element in the CN 140. The data packets may be included in tunneled packets (for example, General Packet Radio System (GPRS) Tunneling Protocol User Plane (GTP-U) packets). The BS 110 may extract or read a tag or other like identifier from a header portion of the tunneled packets and/or the data packets. The tag or other like identifier may be an IP tuple, QoS characteristic/requirement, etc. discussed infra. In embodiments, the BS 110 may translate this tag or other like identifier into a flow ID, or may re-use the tag or other like identifier as the flow ID. The BS 110 may map the data packets to a DRB using a DRB ID, and may map the data packets to a flow-based PDCP entity (when activated) or a default PDCP entity (when no flow-based PDCP entity is activated) using the flow ID. The BS 110 may then route the data packets to the corresponding PDCP entity based on the flow ID. Once the data packets are obtained by

Petitioners' Exhibit 1002, p. 164
AT&T et al v. Asustek Technology
IPR2024-00997

the corresponding PDCP entity, the corresponding PDCP entity may process individual data packets to produce individual PDCP PDUs 400A or 400B. Processing the individual data packets may include inserting the flow ID into the flow ID field 405 or the SN field 410A-B. After receipt of the DL transmission by the UE 105, the PDCP PDUs 400A-B may be obtained by a PDCP layer from a lower layer entity (for example, an RLC entity 305) of the UE 105. The PDCP layer of the UE 105 may then identify the flow ID from the flow ID field 405 of PDU 400A or the SN fields 410A-B of PDU 400B to determine a corresponding flow-based PDCP entity to process the packets.

In another example, in the UL direction, the UE 105 may receive data packets (for example, IP packets) from a higher layer entity (for example, a TCP/IP entity). The UE 105 may extract or read a tag or other like identifier (for example, IP tuples, QoS information, etc.) from a header portion of the data packets. In embodiments, the UE 105 may translate this tag or other like identifier into a flow ID, or may re-use the tag or other like identifier as the flow ID. The UE 105 may map the data packets to a DRB using a DRB ID, and may map the data packets to a flow-based PDCP entity (when activated) or a default PDCP entity (when no flow-based PDCP entity is activated) using the flow ID. The UE 105 may then route the data packets to the corresponding PDCP entity based on the flow ID. Once the data packets are obtained by the corresponding PDCP entity, the corresponding PDCP entity may process individual data packets to produce individual PDCP PDUs 400A or 400B. Processing the individual data packets may include inserting the flow ID into the flow ID field 405 or the SN field 410A-B. After receipt of the UL transmission by the BS 110, the PDCP PDUs 400A-B may be obtained by a PDCP layer from a lower layer entity (for example, an RLC entity 305) of the BS 110. The PDCP layer of the BS 110 may then identify the flow ID from the flow ID field 405 of PDU 400A or the SN fields 410A-B of PDU 400B to determine a corresponding flow-based PDCP entity to process the packets. In embodiments, the BS 110 may encapsulate the packets in a tunneling protocol packet (for example, a GTP-U packet) and send the tunneling protocol packet to a CN element in the CN 140.

In some embodiments, the flow ID may be based on IP tuples, QoS characteristics/requirements, and/or other like flow parameters indicated by the data packets and/or tunneled packets discussed previously. Since space in the SN fields 410A-B or flow ID field 405 may be limited (for example, as shown by FIG. 4, the flow ID field 405 may be 5 bits in length), in some embodiments an algorithm may be used to generate a flow ID using one or more IP tuples, QoS characteristics, QCI values, etc. as inputs to

Petitioners' Exhibit 1002, p. 165
AT&T et al v. Asustek Technology
IPR2024-00997

the algorithm. Additionally or alternatively, in embodiments individual bits in the flow ID field 405 may indicate the IP tuples, QoS characteristics/requirements, etc. Additionally, in some embodiments a special value (for example, "0") may be reserved for the default PDCP entity 310Z of a DRB 205. In embodiments where the flow ID is based on a QoS characteristic or QCI value, the flow ID may be referred to as a "QoS flow ID" and the like.

In embodiments, packets for DL transmission over the Uu interface may be marked in band with a flow ID or QoS flow ID for the purposes of reflective QoS. In embodiments, packets for UL transmission over the Uu interface may be marked in band with a flow ID or QoS flow ID for the purposes of marking packets to be forwarded to the CN 140. In embodiments, the sender/transmitter entity may increment the value in the flow ID field 405 to indicate that the receiver entity should classify and process another flow. Since space in the SN fields 410A-B or flow ID field 405 may be limited, in the event that the sending/transmitter entity runs out of space in the SN fields 410A-B or flow ID field 405, a newly identified flow may be classified to be processed by the default PDCP entity 310Z (as "unclassified") or by an existing flow-specific PDCP that shares the similar QoS characteristics or QCI.

In some embodiments, the use of PDU 400A or PDU 400B may be configured semi-statically by higher layers. For example, a configuration message in an RRC message may indicate whether the flow ID field 405 should be used or not for an individual PDCP entity. This may be used in deployment scenarios where the PDCP PDU may not need to carry flow ID in certain situations, such as when a UE 105 and/or BS 110 is capable of connecting to both a EPC CN 140 and a NG CN 140, or for bearers that are used for signalling setup procedures (for example, SRBs and certain guaranteed bit-rate (GBR) bearers). In an alternative embodiment, where the PDU 400A is used, the flow ID field 405 may be set to a known value when flow IDs should not be used.

In other embodiments, rather than switching between PDU 400A and PDU 400B, the use of flow-based PDCP functionality may be dynamically configured by higher layers. In such embodiments, when flow-based PDCP functionality is configured then PDU 400A or PDU 400B may be used, and when flow-based PDCP functionality is not configured then conventional PDCP PDUs may be used. In one example, dynamic configuration may be used according to a type of CN 140 that the UE 105 is connected with, such as using convention PDUs when connected with an EPC CN or using the PDUs of the example embodiments when connected with an NG CN. In another example, the

Petitioners' Exhibit 1002, p. 166
AT&T et al v. Asustek Technology
IPR2024-00997

dynamic configuration may be used on a DRB basis where the particular PDCP functionality to be used may be based the type of traffic carried in a DRB, such as using convention PDUs when the DRB includes a GBR bearer and using PDU 400A or PDU 400B when the DRB includes non-GBR bearers.

FIG. 5 illustrates, for one embodiment, example components of an electronic device 500. In various embodiments, the electronic device 500 may implemented in or by UE 105 and/or a BS 110 as described previously with regard to FIG. 1. In some embodiments, the electronic device 500 may include application circuitry 502, communication circuitry 503 including WLAN circuitry 512 and baseband circuitry 504, radio frequency (RF) circuitry 506, front-end module (FEM) circuitry 508 and one or more antennas 510, coupled together at least as shown. In embodiments where the electronic device 500 is implemented in or by a BS 110, the electronic device 500 may also include network interface circuitry (not shown) for communicating over a wired interface (for example, an X2 interface, an S1 interface, and the like).

The application circuitry 502 may include one or more application processors. For example, the application circuitry 502 may include circuitry such as, but not limited to, one or more single-core or multi-core processors 502a. The processor(s) 502a may include any combination of general-purpose processors and dedicated processors (e.g., graphics processors, application processors, etc.). The processors may be coupled with and/or may include memory/storage 502b (also referred to as "memory 502b" or "computer-readable medium 502b") and may be configured to execute instructions stored in the memory/storage 502b to enable various applications and/or operating systems to run on the system.

The baseband circuitry 504 (also be referred to a "processor circuitry 504" and the like) may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The baseband circuitry 504 may include one or more baseband processors and/or control logic to process baseband signals received from a receive signal path of the RF circuitry 506 and to generate baseband signals for a transmit signal path of the RF circuitry 506. Baseband circuity 504 may interface with the application circuitry 502 for generation and processing of the baseband signals and for controlling operations of the RF circuitry 506. For example, in some embodiments, the baseband circuitry 504 may include a second generation (2G) baseband processor 504a, third generation (3G) baseband processor 504b, fourth generation (4G) baseband processor 504c, and/or other baseband processor(s) 504d for other existing generations, generations in development or to be

Petitioners' Exhibit 1002, p. 167
AT&T et al v. Asustek Technology
IPR2024-00997

developed in the future (e.g., fifth generation (5G), 6G, etc.). The baseband circuitry 504 (e.g., one or more of baseband processors 504a-d) may handle various radio control functions that enable communication with one or more radio networks via the RF circuitry 506. The radio control functions may include, but are not limited to, signal modulation/demodulation, encoding/decoding, radio frequency shifting, and the like. In some embodiments, modulation/demodulation circuitry of the baseband circuitry 504 may include Fast-Fourier Transform (FFT), precoding, and/or constellation mapping/demapping functionality. In some embodiments, encoding/decoding circuitry of the baseband circuitry 504 may include convolution, tail-biting convolution, turbo, Viterbi, and/or Low Density Parity Check (LDPC) encoder/decoder functionality. Embodiments of modulation/demodulation and encoder/decoder functionality are not limited to these examples and may include other suitable functionality in other embodiments.

In some embodiments, the baseband circuitry 504 may include elements of a protocol stack such as, for example, elements of an evolved universal terrestrial radio access network (E-UTRAN) protocol including, for example, PHY, MAC, RLC, PDCP, and/or RRC elements. A central processing unit (CPU) 504e of the baseband circuitry 504 may be configured to run elements of the protocol stack for signaling of the PHY, MAC, RLC, PDCP and/or RRC layers. In some embodiments, the baseband circuitry may include one or more audio digital signal processor(s) (DSP) 504f. The audio DSP(s) 504f may include elements for compression/decompression and echo cancellation and may include other suitable processing elements in other embodiments. The baseband circuitry 504 may further include memory/storage 504g (also referred to as "memory 504g" or "computer-readable medium 504g"). The memory/storage 504g may be used to load and store data and/or instructions for operations performed by the processors of the baseband circuitry 504. Memory/storage for one embodiment may include any combination of suitable volatile memory and/or non-volatile memory. The memory/storage 504g may include any combination of various levels of memory/storage including, but not limited to, read-only memory (ROM) having embedded software instructions (e.g., firmware), random access memory (e.g., dynamic random access memory (DRAM)), cache, buffers, etc. The memory/storage 504g may be shared among the various processors or dedicated to particular processors. Components of the baseband circuitry 504 may be suitably combined in a single chip, a single chipset, or disposed on a same circuit board in some embodiments. In some embodiments, some or all of the

Petitioners' Exhibit 1002, p. 168
AT&T et al v. Asustek Technology
IPR2024-00997

constituent components of the baseband circuitry 504 and the application circuitry 502 may be implemented together, such as, for example, on a system on a chip (SoC).

In some embodiments, the baseband circuitry 504 may be used for communicating over cellular networks and the WLAN circuitry 512 may be used for communicating over WLAN networks. The WLAN circuitry 512 may include processor circuitry 512a and CRM 512b. The processor circuitry 512a may be similar to process circuitry described with respect to other components and CRM 512b may be similar to CRM described with respect to other components.

In some embodiments, the baseband circuitry 504 may provide for communication compatible with one or more radio technologies. For example, in some embodiments, the baseband circuitry 504 may support communication with an E-UTRAN and/or other wireless metropolitan area networks (WMAN), a wireless local area network (WLAN), a wireless personal area network (WPAN). Embodiments in which the baseband circuitry 504 is configured to support radio communications of more than one wireless protocol may be referred to as multi-mode baseband circuitry.

RF circuitry 506 may enable communication with wireless networks using modulated electromagnetic radiation through a non-solid medium. In various embodiments, the RF circuitry 506 may include switches, filters, amplifiers, etc., to facilitate the communication with the wireless network. RF circuitry 506 may include a receive signal path that may include circuitry to down-convert RF signals received from the FEM circuitry 508 and provide baseband signals to the baseband circuitry 504. RF circuitry 506 may also include a transmit signal path that may include circuitry to up-convert baseband signals provided by the baseband circuitry 504 and provide RF output signals to the FEM circuitry 508 for transmission.

In some embodiments, the RF circuitry 506 may include a receive signal path and a transmit signal path. The receive signal path of the RF circuitry 506 may include mixer circuitry 506a, amplifier circuitry 506b and filter circuitry 506c. The transmit signal path of the RF circuitry 506 may include filter circuitry 506c and mixer circuitry 506a. RF circuitry 506 may also include synthesizer circuitry 506d for synthesizing a frequency for use by the mixer circuitry 506a of the receive signal path and the transmit signal path. In some embodiments, the mixer circuitry 506a of the receive signal path may be configured to down-convert RF signals received from the FEM circuitry 508 based on the synthesized frequency provided by synthesizer circuitry 506d. The amplifier circuitry 506b may be configured to amplify the down-converted signals and the filter circuitry 506c may be a

Petitioners' Exhibit 1002, p. 169
AT&T et al v. Asustek Technology
IPR2024-00997

low-pass filter (LPF) or band-pass filter (BPF) configured to remove unwanted signals from the down-converted signals to generate output baseband signals. Output baseband signals may be provided to the baseband circuitry 504 for further processing. In some embodiments, the output baseband signals may be zero-frequency baseband signals, although this is not a requirement. In some embodiments, mixer circuitry 506a of the receive signal path may comprise passive mixers, although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 506a of the transmit signal path may be configured to up-convert input baseband signals based on the synthesized frequency provided by the synthesizer circuitry 506d to generate RF output signals for the FEM circuitry 508. The baseband signals may be provided by the baseband circuitry 504 and may be filtered by filter circuitry 506c. The filter circuitry 506c may include a low-pass filter (LPF), although the scope of the embodiments is not limited in this respect.

In some embodiments, the mixer circuitry 506a of the receive signal path and the mixer circuitry 506a of the transmit signal path may include two or more mixers and may be arranged for quadrature downconversion and/or upconversion, respectively. In some embodiments, the mixer circuitry 506a of the receive signal path and the mixer circuitry 506a of the transmit signal path may include two or more mixers and may be arranged for image rejection (e.g., Hartley image rejection). In some embodiments, the mixer circuitry 506a of the receive signal path and the mixer circuitry 506a of the transmit signal path may be arranged for direct downconversion and/or direct upconversion, respectively. In some embodiments, the mixer circuitry 506a of the receive signal path and the mixer circuitry 506a of the transmit signal path may be configured for super-heterodyne operation.

In some embodiments, the output baseband signals and the input baseband signals may be analog baseband signals, although the scope of the embodiments is not limited in this respect. In some alternate embodiments, the output baseband signals and the input baseband signals may be digital baseband signals. In these alternate embodiments, the RF circuitry 506 may include analog-to-digital converter (ADC) and digital-to-analog converter (DAC) circuitry and the baseband circuitry 504 may include a digital baseband interface to communicate with the RF circuitry 506.

In some dual-mode embodiments, a separate radio IC circuitry may be provided for processing signals for each spectrum, although the scope of the embodiments is not limited in this respect.

Petitioners' Exhibit 1002, p. 170
AT&T et al v. Asustek Technology
IPR2024-00997

In some embodiments, the synthesizer circuitry 506d may be a fractional-N synthesizer or a fractional N/N+1 synthesizer, although the scope of the embodiments is not limited in this respect, as other types of frequency synthesizers may be suitable. For example, synthesizer circuitry 506d may be a delta-sigma synthesizer, a frequency multiplier, or a synthesizer comprising a phase-locked loop with a frequency divider. The synthesizer circuitry 506d may be configured to synthesize an output frequency for use by the mixer circuitry 506a of the RF circuitry 506 based on a frequency input and a divider control input. In some embodiments, the synthesizer circuitry 506d may be a fractional N/N+1 synthesizer.

In some embodiments, frequency input may be provided by a voltage controlled oscillator (VCO), although that is not a requirement. Divider control input may be provided by either the baseband circuitry 504 or the application circuitry 502 depending on the desired output frequency. In some embodiments, a divider control input (e.g., N) may be determined from a look-up table based on a channel indicated by the application circuitry 502.

Synthesizer circuitry 506d of the RF circuitry 506 may include a divider, a delay-locked loop (DLL), a multiplexer and a phase accumulator. In some embodiments, the divider may be a dual modulus divider (DMD) and the phase accumulator may be a digital phase accumulator (DPA). In some embodiments, the DMD may be configured to divide the input signal by either N or N+1 (e.g., based on a carry out) to provide a fractional division ratio. In some example embodiments, the DLL may include a set of cascaded, tunable, delay elements, a phase detector, a charge pump and a D-type flip-flop. In these embodiments, the delay elements may be configured to break a VCO period up into Nd equal packets of phase, where Nd is the number of delay elements in the delay line. In this way, the DLL provides negative feedback to help ensure that the total delay through the delay line is one VCO cycle.

In some embodiments, synthesizer circuitry 506d may be configured to generate a carrier frequency as the output frequency, while in other embodiments, the output frequency may be a multiple of the carrier frequency (e.g., twice the carrier frequency, four times the carrier frequency) and used in conjunction with quadrature generator and divider circuitry to generate multiple signals at the carrier frequency with multiple different phases with respect to each other. In some embodiments, the output frequency may be a LO frequency (fLO). In some embodiments, the RF circuitry 506 may include an IQ/polar converter.

Petitioners' Exhibit 1002, p. 171
AT&T et al v. Asustek Technology
IPR2024-00997

FEM circuitry 508 may include a receive signal path that may include circuitry configured to operate on RF signals received from one or more antennas 510, amplify the received signals and provide the amplified versions of the received signals to the RF circuitry 506 for further processing. FEM circuitry 508 may also include a transmit signal path that may include circuitry configured to amplify signals for transmission provided by the RF circuitry 506 for transmission by one or more of the one or more antennas 510. In some embodiments, the FEM circuitry 508 may include a TX/RX switch to switch between transmit mode and receive mode operation. The FEM circuitry 508 may include a receive signal path and a transmit signal path. The receive signal path of the FEM circuitry may include a low-noise amplifier (LNA) to amplify received RF signals and provide the amplified received RF signals as an output (e.g., to the RF circuitry 506). The transmit signal path of the FEM circuitry 508 may include a power amplifier (PA) to amplify input RF signals (e.g., provided by RF circuitry 506), and one or more filters to generate RF signals for subsequent transmission (e.g., by one or more of the one or more antennas 510).

In some embodiments, the electronic device 500 may include additional elements such as, for example, memory/storage, display, camera, sensor, and/or interface circuitry (for example, input/output (I/O) interfaces or buses) (not shown). In embodiments where the electronic device is implemented in or by a BS 110, the electronic device may include network interface circuitry. The network interface circuitry may be one or more computer hardware components that connect electronic device 500 to one or more network elements, such as one or more servers within the CN 140 or another BS 110, via a wired connection. To this end, the network interface circuitry may include one or more dedicated processors and/or FPGAs to communicate using one or more wired communications protocol. The wired communications protocols may include a serial communications protocol (e.g., the Universal Serial Bus (USB), FireWire, Serial Digital Interface (SDI), and/or other like serial communications protocols), a parallel communications protocol (e.g., IEEE 1284, Computer Automated Measurement And Control (CAMAC), and/or other like parallel communications protocols), and/or a network communications protocol (e.g., Ethernet, token ring, Fiber Distributed Data Interface (FDDI), and/or other like network communications protocols). The network interface circuitry may also include one or more virtual network interfaces configured to operate with one or more applications.

In some embodiments, the processor circuitry of the electronic device 500 (for example, baseband circuitry 504 and/or processor circuitry 512a) may be to determine that

Petitioners' Exhibit 1002, p. 172
AT&T et al v. Asustek Technology
IPR2024-00997

a DRB is to be classified into individual flows of a plurality of flows; instantiate a plurality of PDCP entities, individual PDCP entities of the plurality of PDCP entities to process corresponding flows of the plurality of flows; classify received packets of the DRB into the corresponding flows; and provide, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows.

In some embodiments, the processor circuitry of the electronic device 500 (for example, baseband circuitry 504 and/or processor circuitry 512a) may determine that a data radio bearer ("DRB") has been established; create a first PDCP entity upon establishment of the DRB. The first PDCP entity may process all packets of the DRB. The processor circuitry of the electronic device 500 may detect activation of a flow classification rule. The flow classification rule may indicate that the DRB is to be classified into individual flows of a plurality of flows. The processor circuitry of the electronic device 500 may create a second PDCP entity to process packets of a flow of the plurality of flows corresponding to the second PDCP entity based on the flow classification rule. Upon creation of the second PDCP entity, the first PDCP entity may cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB. The processor circuitry of the electronic device 500 may classify received packets of the DRB as belonging to the flow corresponding to the second PDCP entity; and may provide, to the second PDCP entity, the classified packets belonging to the flow corresponding to the second PDCP entity.

In some embodiments, the electronic device 500 may be a UE 105 that is to perform the operations/procedures discussed previously. The PDCP entities may be created by components in the baseband circuitry 504, application circuitry 502, or WLAN circuitry 512. In some embodiments, the UE 105 may identify the flow classification rule based on an internal configuration of the UE 105; AS signaling; NAS signaling; or through an application program interface to the application circuitry 502.

In some embodiments, the electronic device 500 may be an eNB/gNB 110 that is to configure a UE 105 with a flow classification rule associated with a first flow; and transmit a plurality of flows of a DRB to the UE 105. The plurality of flows may include the first flow. In some embodiments, the baseband circuitry 504 of the eNB/gNB 110 may configure the UE 105 by transmitting RRC signaling to the UE 105 to configure the UE 105 with the flow classification rule. In some embodiments, the baseband circuitry 504 of the eNB/gNB 110 may transmit the first flow using a first header compression and PDCP

Petitioners' Exhibit 1002, p. 173
AT&T et al v. Asustek Technology
IPR2024-00997

encryption process and transmit a second flow of the plurality of flows using a second header compression and PDCP encryption process.

Furthermore, the electronic device 500 may be configured to perform the processes described herein (or parts thereof), such as process 600 described with respect to FIG. 6.

FIG. 6 illustrates an example flow-based PDCP process 600, in accordance with various embodiments. In embodiments, a computer device (for example, electronic device 500 discussed with regard to FIG. 5, which may be implemented in or by the UE 105 or the BS 110 discussed with regard to FIGS. 1-4) may include one or more non-transitory computer-readable media having instructions, stored thereon, that when executed by the computer device, cause the computer device to perform process 600. For illustrative purposes, the operations of process 600 are described as being performed by various elements of a computer device as described with respect to FIGS. 1-5. However, it should be noted that other similar devices/entities may operate process 600. While particular examples and orders of operations are illustrated in FIG. 6, in various embodiments, these operations may be re-ordered, broken into additional operations, combined, and/or omitted altogether. In some embodiments, the operations illustrated in one of FIG. 6 may be combined with operations described with regard to other example embodiments and/or one or more operations described with regard to the non-limiting examples provided herein.

Referring to FIG. 6, at operation 605, processor circuitry of the computer device may identify a PDCP configuration. In embodiments where the computer device is the UE 105, the RF circuitry 506 may receive RF signaling from a BS 110, and the RF circuitry 506 may pass data representative of the RF signaling (for example, a configuration message) to processor circuitry of the UE 105 via interface circuitry of the UE 105. In such embodiments, the RF signaling may include an RRC signaling message or NAS signaling message.

In embodiments where the computer device is the BS 110, network interface circuitry (NIC) of the BS 110 may receive a configuration message from a CN element within the CN 140 (for example, an MME, PGW, etc.), and the NIC may pass the configuration message to processor circuitry of the BS 110. In such embodiments, the configuration message may be included in a NAS signaling message, an S1-AP message, or some other like message. In other embodiments where the computer device is the BS 110, the processor circuitry of the BS 110 may generate the configuration message based on information obtained from a CN element, and the NIC may pass the configuration

Petitioners' Exhibit 1002, p. 174
AT&T et al v. Asustek Technology
IPR2024-00997

message to processor circuitry of the BS 110, which may be obtained from an S1-AP message.

At operation 610, the processor circuitry of the computer device may determine that a DRB is to be classified into individual flows. In embodiments, the PDCP configuration obtained at operation 605 may identify one or more DRBs (for example, using DRB IDs) and may indicate whether any of the identified DRBs are configured for flow-based PDCP functionality. As an example, and with reference to FIG. 2, the PDCP configuration may indicate that DRB1 205A is to be classified into individual flows. In some embodiments, the PDCP configuration may indicate whether any PDCP PDUs should be sent via a secondary cell group (SCG), a master cell group (MCG), or split between the SCG and MCG in the UL or DL direction. This configuration may be used by a default PDCP entity 310Z to perform various PDCP functions. In addition, the PDCP configuration may include a routing rule for an individual flow, where the routing rule may indicate whether PDCP PDUs should be sent via the SCG over a dedicated link 120, the MCG over a dedicated link 120, or split between the SCG and MCG in the UL or DL direction.

At operation 615, the processor circuitry of the computer device may create a default PDCP entity 310Z, and at operation 620 the processor circuitry of the computer device may operate the default PDCP entity 310Z to process all received packets associated with the identified DRB. In various embodiments, to perform operations 615-620, the processor circuitry may generate a new protocol stack 300 including a new PDCP entity 310Z, a new RLC entity 305, and a new MAC entity 315. In other embodiments, the processor circuitry may maintain and continue operating an already existing protocol stack 300.

At operation 625, the processor circuitry of the computer device may detect activation of a flow classification rule. As an example, and with reference to FIG. 2, the flow classification rule may indicate that flow1 210A of DRB1 205A should be classified as an individual flow. The flow classification rule may indicate various parameters for identifying and/or labeling packets belonging to an individual flow, and various parameters for processing packets of an individual flow as discussed previously.

In embodiments where the computer device is the UE 105, the flow classification rule(s) may be activated by the UE 105. This may be referred to as "local activation" of the flow classification rules. In such embodiments, the processor circuitry of the UE 105 may generate a DL flow classification rule indicating how to map packets of flow1 210A

Petitioners' Exhibit 1002, p. 175
AT&T et al v. Asustek Technology
IPR2024-00997

for DL packets and may generate a UL flow classification rule indicating how to map packets of flow1 210A for UL packets. Additionally, the communication circuitry of the UE 105 may control transmission of the DL flow classification rule to the BS 110 and/or a CN 140 element (for example, an MME, PGW, etc.) using, for example, higher layer signaling.

In embodiments where the computer device is the BS 110, the flow classification rule(s) may be activated by the BS 110. This may be referred to as "network-based activation" of the flow classification rules. In such embodiments, the processor circuitry of the BS 110 may generate a DL flow classification rule indicating how to map packets of flow1 210A for DL packets and may generate a UL flow classification rule indicating how to map packets of flow1 210A for UL packets. Additionally, the communication circuitry of the BS 110 may control transmission of the DL flow classification rule to the UE 105 using higher layer signaling (for example, RRC or NAS signaling) or using explicit signaling of a PDCP control packet that indicates the flow UL and/or DL classification rules to the UE 105. In some embodiments the NIC of the BS 110 may send the DL and/or UL flow classification rules to a CN 140 element (for example, an MME, PGW, etc.) and/or another BS 110 using backhaul links 125, 130. In embodiments where the CN 140 element (for example, an MME, PGW, etc.) determines the flow classification rule, the computer device is a CN 140 element (for example, an MME, PGW, etc.), processor circuitry of the CN element may generate and send the UL and DL flow classification rules to the BS 110, which may in turn provide the DL flow classification rule to the UE 105.

In other embodiments, the UL and DL flow classification rules may be activated by the UE 105 and the BS 110 or CN 140 element independently. This may be referred to as "independent activation" of the flow classification rules since each device may locally activate their own flow activation rules independent of one another. In such embodiments, the processor circuitry of the UE 105 may determine how to map packets of flow1 210A for UL transmissions, and the BS 110 or CN 140 element may determine how to map packets of flow1 210A for DL transmissions. In such embodiments, the flow classification rules may not be signaled OTA. In embodiments where the CN 140 element determines the flow classification rules, the CN 140 element may provide the DL flow classification rule to the BS 110.

Referring back to FIG. 6, at operation 630, the processor circuitry of the computer device may generate or create a flowX PDCP entity, where X is a number that is

Petitioners' Exhibit 1002, p. 176
AT&T et al v. Asustek Technology
IPR2024-00997

representative of a flow ID. In an example, X may be equal to 1 when the flow classification rule indicates that flow1 210A of DRB1 205A is to be classified as an individual flow. In this example, at operation 630, the processor circuitry may generate the flow1 PDCP entity 310A as shown by FIG. 3.

At operation 635 the processor circuitry of the computer device may classify received packets of the DRB (for example, DRB1 205A of FIG. 2) as belonging to flowX (for example, flow1 210A of FIG. 2) or other flows. At operation 640, the processor circuitry of the computer device may provide classified packets belonging to flowX (for example, flow1 210A of FIG. 2) to the flowX PDCP entity (for example, flow1 PDCP entity 310A of FIG. 3). At operation 645, the processor circuitry of the computer device may operate the to the flowX PDCP entity (for example, flow1 PDCP entity 310A of FIG. 3) to process packets of flowX (for example, packets of flow1 210A of FIG. 2) and may operate the default PDCP entity 310Z to process all other received packets that do not belong to flowX.

At operation 650, the processor circuitry of the computer device may determine whether another flow classification rule has been activated. Operation 650 may be performed in a same or similar manner as discussed previously with regard to operation 625. If at operation 650 the processor circuitry determines that another flow classification rule has been activated, then the processor circuitry may proceed back to perform operations 630-645 as discussed previously for another identified flow (for example, flow2 210B of FIG. 2). If at operation 650 the processor circuitry determines that another flow classification rule has not been activated, then the processor circuitry may proceed to operation 655 to determine whether any more packet for flowX have been received or should be received.

If at operation 655 the processor circuitry determines that more packet for flowX have been received or should be received, then the processor circuitry may proceed back to perform operations 645-650 as discussed previously. If at operation 655 the processor circuitry determines that no more packet for flowX have been received or that packets for flowX will not be received, then the processor circuitry may proceed to operation 660 to terminate or pause the flowX PDCP entity. In embodiments, to perform operation 660, the processor circuitry may determine whether the EPS session, which resulted in the DRB being established, has ended. In embodiments, operation 660 may be based on expiration of a timer, or based on receipt of an indication from higher level layers. After completion of operation 660, process 600 may end or repeat as necessary.

Petitioners' Exhibit 1002, p. 177
AT&T et al v. Asustek Technology
IPR2024-00997

Some non-limiting examples are provided below.

Example 1 may include one or more computer-readable media including instructions, which when executed by one or more processors, causes a computer device to: determine that a data radio bearer ("DRB") is to be classified into individual flows of a plurality of flows; instantiate a plurality of packet data convergence protocol ("PDCP") entities, individual PDCP entities of the plurality of PDCP entities to process corresponding flows of the plurality of flows; classify obtained packets of the DRB into the corresponding flows; and provide, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows.

Example 2 may include the computer-readable media of example 1 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the computer device, in response to execution of the instructions, is to: identify the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples, a combination of two or more IP tuples, one or more Quality of Service ("QoS") characteristics, or a flow identifier ("ID") marking in the classified packets.

Example 3 may include the computer-readable media of example 2 and/or some other examples herein, wherein: when identification of the obtained packets is according to one or more IP tuples or a combination of two or more IP tuples, the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type, when identification of the obtained packets is according to one or more QoS characteristics, the QoS characteristics comprise a QoS class ID ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level, and when identification of the obtained packets is according to the flow ID marking, wherein the flow ID is a value in a header portion of the obtained packets.

Example 4 may include the computer-readable media of examples 1-3 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the computer device, in response to execution of the instructions, is to: determine, based on a flow ID within individual packets of the obtained packets, an individual PDCP entity of the plurality of PDCP entities to which the obtained packets belong.

Example 5 may include the computer-readable media of example 4 and/or some other examples herein, wherein, to identify a flow ID within individual packets of the obtained packets, the computer device, in response to execution of the instructions, is to: extract a first flow ID from one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the obtained

Petitioners' Exhibit 1002, p. 178
AT&T et al v. Asustek Technology
IPR2024-00997

packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, a value in a flow ID field in a header portion of the PDCP PDU of the first packet, or a value in a flow ID field in a payload portion of the PDCP PDU of the first packet.

Example 6 may include the computer-readable media of example 1 and/or some other examples herein, wherein the computer device, in response to execution of the instructions, is to: operate the individual PDCP entities to insert a flow ID into the obtained packets when the flow ID is not present within individual packets of the obtained packets.

Example 7 may include the computer-readable media of any one of examples 1-6 and/or some other examples herein, wherein, to instantiate the plurality of PDCP entities, the computer device, in response to execution of the instructions, is to: create a first PDCP entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; detect activation of a flow classification rule; and create a second PDCP entity to process packets of a flow corresponding to the second PDCP entity based on the flow classification rule, wherein upon activation of the flow classification rule, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB.

Example 8 may include the computer-readable media of example 7 and/or some other examples herein, wherein the computer device, in response to execution of the instructions, is further to: upon establishment of the DRB, implement the first PDCP entity to cipher or decipher all packets of the DRB using a bearer ID of the DRB or the identified flow ID; and upon creation of the second PDCP entity, implement the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer ID of the DRB or a flow ID of the flow corresponding to the second PDCP entity.

Example 9 may include one or more computer-readable media including instructions, which when executed by one or more processors, causes a computer device to: determine that a data radio bearer ("DRB") has been established; create a first packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; detect activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; create a second PDCP entity to process packets of a flow of the plurality of flows corresponding to the second PDCP entity based on the flow classification rule, wherein upon creation of the second PDCP entity, the first PDCP entity is to cease processing the packets of the flow corresponding to

Petitioners' Exhibit 1002, p. 179
AT&T et al v. Asustek Technology
IPR2024-00997

the second PDCP entity and continue processing all other packets of the DRB; classify obtained packets of the DRB as belonging to the flow corresponding to the second PDCP entity; and provide, to the second PDCP entity, the classified packets belonging to the flow corresponding to the second PDCP entity.

Example 10 may include the computer-readable media of example 9 and/or some other examples herein, wherein, to detect activation of a flow classification rule, the computer device, in response to execution of the instructions, is to: identify the flow classification rule based on an internal configuration of the computer device, information included in access stratum signaling, information included in non-access stratum ("NAS") signaling, or information obtained from an application of the computer device via an application programing interface.

Example 11 may include the computer-readable media of examples 9-10 and/or some other examples herein, wherein, to detect activation of the flow classification rule, the computer device, in response to execution of the instructions, is to: detect a local activation of the flow classification rule, wherein, to detect the local activation of the flow classification rule, the computer device, in response to execution of the instructions, is to: determine a downlink ("DL") flow classification rule to map a downlink flow; determine an uplink ("UL") flow classification rule to map an uplink flow; and control transmission of the DL flow classification rule or the UL flow classification rule to another computer device.

Example 12 may include the computer-readable media of examples 9-10 and/or some other examples herein, wherein, to detect activation of the flow classification rule, the computer device, in response to execution of the instructions, is to: identify an indication of the flow classification rule based on an obtained message, wherein, to identify the indication of the flow classification rule, the computer device, in response to execution of the instructions, is to: control receipt of one or more signals, wherein the one or more signals comprise radio resource control ("RRC") signaling or NAS signaling; and identify a DL flow classification rule to map a DL flow or a UL flow classification rule to map a UL flow.

Example 13 may include the computer-readable media of examples 9-10 and/or some other examples herein, wherein the computer device, in response to execution of the instructions, is to: select one or more links for each of the corresponding flows based on a routing rule associated with each of the corresponding flows; and control transmission of a

Petitioners' Exhibit 1002, p. 180
AT&T et al v. Asustek Technology
IPR2024-00997

message to indicate the selected one or more links and a flow identifier for each of the corresponding flows, wherein the message is an RRC message or a NAS message.

Example 14 may include the computer-readable media of example 13, wherein the routing rule is based on a QoS characteristic.

Example 15 may include the computer-readable media of examples 9-10 and/or some other examples herein, wherein the computer device, in response to execution of the instructions, is to: determine a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received; obtain packets of the first flow from first communication circuitry used to communicate over the first link; and obtain packets of the second flow from second communication circuitry used to communicate over the second link, wherein the first link is different than the second link.

Example 16 may include an apparatus to be implemented by base station ("BS"), the apparatus comprising: communication circuitry to: transmit a configuration message to establish a data radio bearer ("DRB"), and transmit and receive packets of the DRB after the DRB is established; and processor circuitry coupled with the communication circuitry, the processor circuitry to: instantiate one or more of packet data convergence protocol ("PDCP") entities in response to establishment of the DRB, wherein individual PDCP entities of the one or more of PDCP entities are to process corresponding flows of the one or more of flows; classify obtained packets of the DRB into the one or more flows; provide, to the individual PDCP entities of the one or more of PDCP entities, the classified packets of the corresponding flows; and operate the individual PDCP entities to re-order the classified packets according to information included in the classified packets.

Example 17 may include the apparatus of example 16 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor circuitry is to: identify the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples or a combination of two or more IP tuples, wherein the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type; determine a flow identifier ("ID") for the obtained packets; and insert the flow ID into one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Petitioners' Exhibit 1002, p. 181
AT&T et al v. Asustek Technology
IPR2024-00997

Example 18 may include the apparatus of example 16 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor circuitry is to:

identify the obtained packets of the corresponding flows according to one or more Quality of Service ("QoS") characteristics, wherein the QoS characteristics comprise a QoS class identifier ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level; determine a flow ID for the obtained packets; and insert the flow ID into one of one or more most significant bits of an SN field of a PDCP PDU of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Example 19 may include the apparatus of example 16 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor circuitry is to:

identify a flow ID within individual packets of the obtained packets.

Example 20 may include the apparatus of examples 16-19 and/or some other examples herein, wherein, to instantiate the plurality of PDCP entities, the processor circuitry is to: create a default PDCP entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; detect activation of a flow classification rule; and create a first flow PDCP entity to process packets of a first flow based on the flow classification rule, wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB.

Example 21 may include the apparatus of example 20 and/or some other examples herein, wherein the processor circuitry is to: upon establishment of the DRB, implement the first PDCP entity to cipher or decipher all packets of the DRB using a bearer identifier of the DRB or the identified flow identifier; and upon creation of the second PDCP entity, implement the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer identifier of the DRB or a flow identifier of the flow corresponding to the second PDCP entity.

Example 22 may include an apparatus to be implemented in a user equipment ("UE"), the apparatus comprising: communication circuitry to receive a configuration message to establish a data radio bearer ("DRB"), and receive packets of the DRB after the DRB is established; and processor circuitry coupled with the communication circuitry, the processor circuitry to: determine, based on information in the configuration message, that the DRB is to be classified into individual flows of a one or more of flows; create a

Petitioners' Exhibit 1002, p. 182
AT&T et al v. Asustek Technology
IPR2024-00997

default packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; detect activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; create a first flow PDCP entity to process packets of a first flow of the plurality of flows based on the flow classification rule, wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB; classify obtained packets of the DRB as belonging to the first flow or belonging to other flows of the plurality of flows; and provide the classified packets belonging to the first flow to the first flow PDCP entity and the classified packets belonging to the other flows to the default PDCP entity.

Example 23 may include the apparatus of example 22 and/or some other examples herein, wherein, to detect activation of the flow classification rule, the processor circuitry is to: detect a local activation of the flow classification rule, and wherein, to detect the local activation of the flow classification rule, the processor circuitry is to: determine a downlink ("DL") flow classification rule to map a downlink flow; or determine an uplink ("UL") flow classification rule to map an uplink flow.

Example 24 may include the apparatus of example 22 and/or some other examples herein, wherein the flow classification rule is a first flow classification rule that corresponds with the first flow, and wherein the processor circuitry is to: detect activation of a second flow classification rule corresponding to a second flow of the plurality of flows; create a second flow PDCP entity to process packets of the second flow based on the second flow classification rule, wherein upon creation of the second flow PDCP entity, the default PDCP entity is to cease processing the packets of the second flow and continue processing all other packets of the DRB that do not belong to the first flow or the second flow; classify packets of the DRB received after creation of the second flow PDCP entity as belonging to the first flow, belonging to the second flow, or belonging to the other flows of the plurality of flows; provide the classified packets belonging to the first flow to the first flow PDCP entity; provide the classified packets belonging to the second flow to the second flow PDCP entity; and provide the classified packets belonging to the other flows to the default PDCP entity.

Example 25 may include the apparatus of examples 22-24 and/or some other examples herein, wherein the communication circuitry comprises first communication circuitry and second communication circuitry, and the processor circuitry is to: identify a

Petitioners' Exhibit 1002, p. 183
AT&T et al v. Asustek Technology
IPR2024-00997

first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received, wherein the first link is provided by a first BS and the second link is provided by a second BS, and wherein the identification is based on an indication in the configuration message or an indication in a received RRC message or a received NAS message; obtain packets of the first flow from the first communication circuitry used to communicate with the first BS over the first link; and obtain packets of the second flow from second communication circuitry used to communicate with the second BS over the second link, wherein the first flow is a different flow than the second flow, and the first link is different than the second link, wherein the first communication circuitry is cellular modem circuitry and the second communication circuitry is wireless local area network modem circuitry.

Example 26 may include an apparatus comprising: means for determining that a data radio bearer ("DRB") is to be classified into individual flows of a plurality of flows; means for instantiating a plurality of packet data convergence protocol ("PDCP") entities, individual PDCP entities of the plurality of PDCP entities to process corresponding flows of the plurality of flows; means for classifying obtained packets of the DRB into the corresponding flows; and means for providing, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows.

Example 27 may include the apparatus of example 26 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the apparatus comprises: means for identifying the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples, a combination of two or more IP tuples, one or more Quality of Service ("QoS") characteristics, or a flow identifier ("ID") marking in the classified packets.

Example 28 may include the apparatus of example 27 and/or some other examples herein, wherein: when identification of the obtained packets is according to one or more IP tuples or a combination of two or more IP tuples, the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type, when identification of the obtained packets is according to one or more QoS characteristics, the QoS characteristics comprise a QoS class ID ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level, and when identification of the obtained packets is according to the flow ID marking, wherein the flow ID is a value in a header portion of the obtained packets.

Petitioners' Exhibit 1002, p. 184
AT&T et al v. Asustek Technology
IPR2024-00997

Example 29 may include the apparatus of examples 26-28 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the apparatus comprises: means for determining, based on a flow ID within individual packets of the obtained packets, an individual PDCP entity of the plurality of PDCP entities to which the obtained packets belong.

Example 30 may include the apparatus of example 29 and/or some other examples herein, wherein, to identify a flow ID within individual packets of the obtained packets, the apparatus comprises: means for extracting a first flow ID from one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the obtained packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, a value in a flow ID field in a header portion of the PDCP PDU of the first packet, or a value in a flow ID field in a payload portion of the PDCP PDU of the first packet.

Example 31 may include the apparatus of example 26 and/or some other examples herein, further comprising: means for operating the individual PDCP entities to insert a flow ID into the obtained packets when the flow ID is not present within individual packets of the obtained packets.

Example 32 may include the apparatus of examples 26-31 and/or some other examples herein, wherein, to instantiate the plurality of PDCP entities, the apparatus comprises: means for creating a first PDCP entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; means for detecting activation of a flow classification rule; and means for creating a second PDCP entity to process packets of a flow corresponding to the second PDCP entity based on the flow classification rule, wherein upon activation of the flow classification rule, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB.

Example 33 may include the apparatus of example 32 and/or some other examples herein, further comprising: means for implementing, upon establishment of the DRB, the first PDCP entity to cipher or decipher all packets of the DRB using a bearer ID of the DRB or the identified flow ID; and means for implement, upon creation of the second PDCP entity, the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer ID of the DRB or a flow ID of the flow corresponding to the second PDCP entity.

Petitioners' Exhibit 1002, p. 185
AT&T et al v. Asustek Technology
IPR2024-00997

Example 34 may include an apparatus comprising: means for determining that a data radio bearer ("DRB") has been established; create a first packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; means for detecting activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; means for creating a second PDCP entity to process packets of a flow of the plurality of flows corresponding to the second PDCP entity based on the flow classification rule, wherein upon creation of the second PDCP entity, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB; means for classifying obtained packets of the DRB as belonging to the flow corresponding to the second PDCP entity; and means for providing, to the second PDCP entity, the classified packets belonging to the flow corresponding to the second PDCP entity.

Example 35 may include the apparatus of example 34 and/or some other examples herein, wherein, to detect activation of a flow classification rule, the apparatus comprises: means for identifying the flow classification rule based on an internal configuration of the computer device, information included in access stratum signaling, information included in non-access stratum ("NAS") signaling, or information obtained from an application of the computer device via an application programing interface.

Example 36 may include the apparatus of examples 34-35 and/or some other examples herein, wherein, to detect activation of the flow classification rule, the apparatus comprises: means for detecting a local activation of the flow classification rule; means for determining a downlink ("DL") flow classification rule to map a downlink flow; means for determining an uplink ("UL") flow classification rule to map an uplink flow; and means for transmitting the DL flow classification rule or the UL flow classification rule to another computer device.

Example 37 may include the apparatus of examples 34-35 and/or some other examples herein, wherein, to detect activation of the flow classification rule, the apparatus comprises: means for identifying an indication of the flow classification rule based on an obtained message; means for receiving of one or more signals, wherein the one or more signals comprise radio resource control ("RRC") signaling or NAS signaling; and means for identifying a DL flow classification rule to map a DL flow or a UL flow classification rule to map a UL flow.

Petitioners' Exhibit 1002, p. 186
AT&T et al v. Asustek Technology
IPR2024-00997

Example 38 may include the apparatus of examples 34-35 and/or some other examples herein, wherein the apparatus comprises: means for selecting one or more links for each of the corresponding flows based on a routing rule associated with each of the corresponding flows; and means for transmitting a message to indicate the selected one or more links and a flow identifier for each of the corresponding flows, wherein the message is an RRC message or a NAS message.

Example 39 may include the apparatus of example 38 and/or some other examples herein, wherein the routing rule is based on a QoS characteristic.

Example 40 may include the apparatus of examples 34-35 and/or some other examples herein, further comprising: means for determining a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received; means for obtaining packets of the first flow from first communication circuitry used to communicate over the first link; and means for obtaining packets of the second flow from second communication circuitry used to communicate over the second link, wherein the first link is different than the second link.

Example 41 may include an apparatus to be implemented by base station ("BS"), the apparatus comprising: communication means for transmitting a configuration message to establish a data radio bearer ("DRB"), and transmitting and receive packets of the DRB after the DRB is established; and processor means for: instantiating one or more of packet data convergence protocol ("PDCP") entities in response to establishment of the DRB, wherein individual PDCP entities of the one or more of PDCP entities are to process corresponding flows of the one or more of flows; classifying obtained packets of the DRB into the one or more flows; providing, to the individual PDCP entities of the one or more of PDCP entities, the classified packets of the corresponding flows; and operating the individual PDCP entities to re-order the classified packets according to information included in the classified packets.

Example 42 may include the apparatus of example 41 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor means is for: identifying the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples or a combination of two or more IP tuples, wherein the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type; determining a flow identifier ("ID") for the obtained packets; and inserting the flow ID into one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the

Petitioners' Exhibit 1002, p. 187
AT&T et al v. Asustek Technology
IPR2024-00997

received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Example 43 may include the apparatus of example 41 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor means is for: identifying the obtained packets of the corresponding flows according to one or more Quality of Service ("QoS") characteristics, wherein the QoS characteristics comprise a QoS class identifier ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level; determining a flow ID for the obtained packets; and inserting the flow ID into one of one or more most significant bits of an SN field of a PDCP PDU of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Example 44 may include the apparatus of example 41 and/or some other examples herein, wherein, to classify the obtained packets of the DRB, the processor means is for: identifying a flow ID within individual packets of the obtained packets.

Example 45 may include the apparatus of examples 41-44 and/or some other examples herein, wherein, to instantiate the plurality of PDCP entities, the processor means is for: creating a default PDCP entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; detecting activation of a flow classification rule; and creating a first flow PDCP entity to process packets of a first flow based on the flow classification rule, and wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB.

Example 46 may include the apparatus of example 45 and/or some other examples herein, wherein the processor means is for: implementing, upon establishment of the DRB, the first PDCP entity to cipher or decipher all packets of the DRB using a bearer identifier of the DRB or the identified flow identifier; and implementing, upon creation of the second PDCP entity, the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer identifier of the DRB or a flow identifier of the flow corresponding to the second PDCP entity.

Example 47 may include an apparatus to be implemented in a user equipment ("UE"), the apparatus comprising: means for receiving a configuration message to establish a data radio bearer ("DRB"); means for determining, based on information in the

Petitioners' Exhibit 1002, p. 188
AT&T et al v. Asustek Technology
IPR2024-00997

configuration message, that the DRB is to be classified into individual flows of a one or more of flows; means for creating a default packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; means for receiving packets of the DRB after the DRB is established; means for detecting activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; means for creating a first flow PDCP entity to process packets of a first flow of the plurality of flows based on the flow classification rule, wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB; means for classifying obtained packets of the DRB as belonging to the first flow or belonging to other flows of the plurality of flows; and means for providing the classified packets belonging to the first flow to the first flow PDCP entity and the classified packets belonging to the other flows to the default PDCP entity.

Example 48 may include the apparatus of example 47 and/or some other examples herein, wherein the means for detecting the activation of the flow classification rule is for: detecting a local activation of the flow classification rule, and wherein, to detect the local activation of the flow classification rule, the processor circuitry is to: determining a downlink ("DL") flow classification rule to map a downlink flow; or determining an uplink ("UL") flow classification rule to map an uplink flow.

Example 49 may include the apparatus of example 47 and/or some other examples herein, wherein the flow classification rule is a first flow classification rule that corresponds with the first flow, and wherein the apparatus comprises: means for detecting activation of a second flow classification rule corresponding to a second flow of the plurality of flows; means for creating a second flow PDCP entity to process packets of the second flow based on the second flow classification rule, wherein upon creation of the second flow PDCP entity, the default PDCP entity is to cease processing the packets of the second flow and continue processing all other packets of the DRB that do not belong to the first flow or the second flow; means for classifying packets of the DRB received after creation of the second flow PDCP entity as belonging to the first flow, belonging to the second flow, or belonging to the other flows of the plurality of flows; means for providing the classified packets belonging to the first flow to the first flow PDCP entity; means for providing the classified packets belonging to the second flow to the second flow PDCP

Petitioners' Exhibit 1002, p. 189
AT&T et al v. Asustek Technology
IPR2024-00997

entity; and means for providing the classified packets belonging to the other flows to the default PDCP entity.

Example 50 may include the apparatus of examples 47-49 and/or some other examples herein, further comprising: means for identifying a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received, wherein the first link is provided by a first BS and the second link is provided by a second BS, and wherein the identification is based on an indication in the configuration message or an indication in a received RRC message or a received NAS message; means for obtaining packets of the first flow from the first communication circuitry used to communicate with the first BS over the first link; and means for obtaining packets of the second flow from second communication circuitry used to communicate with the second BS over the second link, wherein the first flow is a different flow than the second flow, and the first link is different than the second link.

Example 51 may include a method comprising: determining that a data radio bearer ("DRB") is to be classified into individual flows of a plurality of flows; instantiating a plurality of packet data convergence protocol ("PDCP") entities, individual PDCP entities of the plurality of PDCP entities to process corresponding flows of the plurality of flows; classifying obtained packets of the DRB into the corresponding flows; and providing, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows.

Example 52 may include the method of example 51 and/or some other examples herein, wherein classifying the obtained packets of the DRB comprises: identifying the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples, a combination of two or more IP tuples, one or more Quality of Service ("QoS") characteristics, or a flow identifier ("ID") marking in the classified packets.

Example 53 may include the method of example 52 and/or some other examples herein, wherein: when identification of the obtained packets is according to one or more IP tuples or a combination of two or more IP tuples, the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type, when identification of the obtained packets is according to one or more QoS characteristics, the QoS characteristics comprise a QoS class ID ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level, and when identification of the obtained packets is according to the flow ID marking, wherein the flow ID is a value in a header portion of the obtained packets.

Petitioners' Exhibit 1002, p. 190
AT&T et al v. Asustek Technology
IPR2024-00997

Example 54 may include the method of examples 51-53 and/or some other examples herein, wherein classifying the obtained packets of the DRB comprises: determining, based on a flow ID within individual packets of the obtained packets, an individual PDCP entity of the plurality of PDCP entities to which the obtained packets belong.

Example 55 may include the method of example 54 and/or some other examples herein, wherein identifying a flow ID within individual packets of the obtained packets comprises: extracting a first flow ID from one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the obtained packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, a value in a flow ID field in a header portion of the PDCP PDU of the first packet, or a value in a flow ID field in a payload portion of the PDCP PDU of the first packet.

Example 56 may include the method of example 51 and/or some other examples herein, further comprising: operating the individual PDCP entities to insert a flow ID into the obtained packets when the flow ID is not present within individual packets of the obtained packets.

Example 57 may include the method of examples 51-56 and/or some other examples herein, wherein instantiating the plurality of PDCP entities comprises: creating a first PDCP entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; detecting activation of a flow classification rule; and creating a second PDCP entity to process packets of a flow corresponding to the second PDCP entity based on the flow classification rule, and wherein upon activation of the flow classification rule, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB.

Example 58 may include the method of example 57 and/or some other examples herein, further comprising: implementing, upon establishment of the DRB, the first PDCP entity to cipher or decipher all packets of the DRB using a bearer ID of the DRB or the identified flow ID; and implement, upon creation of the second PDCP entity, the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer ID of the DRB or a flow ID of the flow corresponding to the second PDCP entity.

Petitioners' Exhibit 1002, p. 191
AT&T et al v. Asustek Technology
IPR2024-00997

Example 59 may include a method comprising: determining that a data radio bearer ("DRB") has been established; create a first packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB; detecting activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; creating a second PDCP entity to process packets of a flow of the plurality of flows corresponding to the second PDCP entity based on the flow classification rule, wherein upon creation of the second PDCP entity, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB; classifying obtained packets of the DRB as belonging to the flow corresponding to the second PDCP entity; and providing, to the second PDCP entity, the classified packets belonging to the flow corresponding to the second PDCP entity.

Example 60 may include the method of example 59 and/or some other examples herein, wherein detecting activation of a flow classification rule comprises: means for identifying the flow classification rule based on an internal configuration of the computer device, information included in access stratum signaling, information included in non-access stratum ("NAS") signaling, or information obtained from an application of the computer device via an application programing interface.

Example 61 may include the method of examples 59-60 and/or some other examples herein, wherein detecting activation of a flow classification rule comprises: detecting a local activation of the flow classification rule, wherein detecting the local activation of the flow classification rule comprises: determining a downlink ("DL") flow classification rule to map a downlink flow; determining an uplink ("UL") flow classification rule to map an uplink flow; and transmitting the DL flow classification rule or the UL flow classification rule to another computer device.

Example 62 may include the method of examples 59-60 and/or some other examples herein, wherein detecting activation of a flow classification rule comprises: identifying an indication of the flow classification rule based on an obtained message, wherein identifying the indication of the flow classification rule comprises: receiving of one or more signals, wherein the one or more signals comprise radio resource control ("RRC") signaling or NAS signaling; and identifying a DL flow classification rule to map a DL flow or a UL flow classification rule to map a UL flow.

Petitioners' Exhibit 1002, p. 192
AT&T et al v. Asustek Technology
IPR2024-00997

Example 63 may include the method of examples 59-60 and/or some other examples herein, further comprising: selecting one or more links for each of the corresponding flows based on a routing rule associated with each of the corresponding flows; and transmitting a message to indicate the selected one or more links and a flow identifier for each of the corresponding flows, wherein the message is an RRC message or a NAS message.

Example 64 may include the method of example 63 and/or some other examples herein, wherein the routing rule is based on a QoS characteristic.

Example 65 may include the method of examples 59-60 and/or some other examples herein, further comprising: determining a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received; obtaining packets of the first flow from first communication circuitry used to communicate over the first link; and obtaining packets of the second flow from second communication circuitry used to communicate over the second link, wherein the first link is different than the second link.

Example 66 may include a method to be performed by base station ("BS"), the method comprising: transmitting a configuration message to establish a data radio bearer ("DRB"), instantiating one or more of packet data convergence protocol ("PDCP") entities in response to establishment of the DRB, wherein individual PDCP entities of the one or more of PDCP entities are to process corresponding flows of the one or more of flows; obtaining packets of the DRB after the DRB is established; classifying the obtained packets of the DRB into the one or more flows; providing, to the individual PDCP entities of the one or more of PDCP entities, the classified packets of the corresponding flows; and operating the individual PDCP entities to re-order the classified packets according to information included in the classified packets; and transmitting the re-ordered packets of the DRB to a destination device.

Example 67 may include the method of example 66 and/or some other examples herein, wherein classifying the obtained packets of the DRB comprises: identifying the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples or a combination of two or more IP tuples, wherein the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type; determining a flow identifier ("ID") for the obtained packets; and inserting the flow ID into one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the received packets, one or more

Petitioners' Exhibit 1002, p. 193
AT&T et al v. Asustek Technology
IPR2024-00997

least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Example 68 may include the method of example 66 and/or some other examples herein, wherein classifying the obtained packets of the DRB comprises: identifying the obtained packets of the corresponding flows according to one or more Quality of Service ("QoS") characteristics, wherein the QoS characteristics comprise a QoS class identifier ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level; determining a flow ID for the obtained packets; and inserting the flow ID into one of one or more most significant bits of an SN field of a PDCP PDU of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

Example 69 may include the method of example 66 and/or some other examples herein, wherein classifying the obtained packets of the DRB comprises: identifying a flow ID within individual packets of the obtained packets.

Example 70 may include the method of examples 66-69 and/or some other examples herein, wherein instantiating the plurality of PDCP entities comprises: creating a default PDCP entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; detecting activation of a flow classification rule; and creating a first flow PDCP entity to process packets of a first flow based on the flow classification rule, and wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB.

Example 71 may include the method of example 70 and/or some other examples herein, further comprising: implementing, upon establishment of the DRB, the first PDCP entity to cipher or decipher all packets of the DRB using a bearer identifier of the DRB or the identified flow identifier; and implementing, upon creation of the second PDCP entity, the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer identifier of the DRB or a flow identifier of the flow corresponding to the second PDCP entity.

Example 72 may include a method to be performed by user equipment ("UE"), the method comprising: receiving a configuration message to establish a data radio bearer ("DRB"); determining, based on information in the configuration message, that the DRB is to be classified into individual flows of a one or more of flows; creating a default packet

Petitioners' Exhibit 1002, p. 194
AT&T et al v. Asustek Technology
IPR2024-00997

data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB; receiving packets of the DRB after the DRB is established; detecting activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows; creating a first flow PDCP entity to process packets of a first flow of the plurality of flows based on the flow classification rule, wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB; classifying obtained packets of the DRB as belonging to the first flow or belonging to other flows of the plurality of flows; and providing the classified packets belonging to the first flow to the first flow PDCP entity and the classified packets belonging to the other flows to the default PDCP entity.

Example 73 may include the method of example 72 and/or some other examples herein, wherein detecting the activation of the flow classification rule comprises: detecting a local activation of the flow classification rule, and wherein, to detect the local activation of the flow classification rule, the processor circuitry is to: determining a downlink ("DL") flow classification rule to map a downlink flow; or determining an uplink ("UL") flow classification rule to map an uplink flow.

Example 74 may include the method of example 72 and/or some other examples herein, wherein the flow classification rule is a first flow classification rule that corresponds with the first flow, and wherein the method comprises: detecting activation of a second flow classification rule corresponding to a second flow of the plurality of flows; creating a second flow PDCP entity to process packets of the second flow based on the second flow classification rule, wherein upon creation of the second flow PDCP entity, the default PDCP entity is to cease processing the packets of the second flow and continue processing all other packets of the DRB that do not belong to the first flow or the second flow; classifying packets of the DRB received after creation of the second flow PDCP entity as belonging to the first flow, belonging to the second flow, or belonging to the other flows of the plurality of flows; providing the classified packets belonging to the first flow to the first flow PDCP entity; providing the classified packets belonging to the second flow to the second flow PDCP entity; and providing the classified packets belonging to the other flows to the default PDCP entity.

Example 75 may include the method of examples 72-74 and/or some other examples herein, further comprising: identifying a first link over which a first flow of the

Petitioners' Exhibit 1002, p. 195
AT&T et al v. Asustek Technology
IPR2024-00997

plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received, wherein the first link is provided by a first BS and the second link is provided by a second BS, and wherein the identification is based on an indication in the configuration message or an indication in a received RRC message or a received NAS message; obtaining packets of the first flow from the first communication circuitry used to communicate with the first BS over the first link; and obtaining packets of the second flow from second communication circuitry used to communicate with the second BS over the second link, wherein the first flow is a different flow than the second flow, and the first link is different than the second link.

The foregoing description of the above Examples provides illustration and description for the example embodiments disclosed herein, but the above Examples are not intended to be exhaustive or to limit the scope of the invention to the precise form disclosed. Modifications and variations are possible in light of the above teachings and/or may be acquired from practice of various implementations of the invention.

Petitioners' Exhibit 1002, p. 196
AT&T et al v. Asustek Technology
IPR2024-00997

Claims

1. One or more computer-readable media including instructions, which when executed by one or more processors, causes a computer device to:

determine that a data radio bearer ("DRB") is to be classified into individual flows of a plurality of flows;

instantiate a plurality of packet data convergence protocol ("PDCP") entities, individual PDCP entities of the plurality of PDCP entities to process corresponding flows of the plurality of flows;

classify obtained packets of the DRB into the corresponding flows; and

provide, to the individual PDCP entities of the plurality of PDCP entities, the classified packets of the corresponding flows.

2. The one or more computer-readable media of claim 1, wherein, to classify the obtained packets of the DRB, the computer device, in response to execution of the instructions, is to:

identify the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples, a combination of two or more IP tuples, one or more Quality of Service ("QoS") characteristics, or a flow identifier ("ID") marking in the classified packets.

3. The one or more computer-readable media of claim 2, wherein:

when identification of the obtained packets is according to one or more IP tuples or a combination of two or more IP tuples, the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type,

when identification of the obtained packets is according to one or more QoS characteristics, the QoS characteristics comprise a QoS class ID ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level, and

when identification of the obtained packets is according to the flow ID marking, wherein the flow ID is a value in a header portion of the obtained packets.

4. The one or more computer-readable media of claim 1 or 3, wherein, to classify the obtained packets of the DRB, the computer device, in response to execution of the instructions, is to:

Petitioners' Exhibit 1002, p. 197
AT&T et al v. Asustek Technology
IPR2024-00997

determine, based on a flow ID within individual packets of the obtained packets, an individual PDCP entity of the plurality of PDCP entities to which the obtained packets belong.

5. The one or more computer-readable media of claim 4, wherein, to identify a flow ID within individual packets of the obtained packets, the computer device, in response to execution of the instructions, is to:

extract a first flow ID from one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the obtained packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, a value in a flow ID field in a header portion of the PDCP PDU of the first packet, or a value in a flow ID field in a payload portion of the PDCP PDU of the first packet.

6. The one or more computer-readable media of claim 1, wherein the computer device, in response to execution of the instructions, is to:

operate the individual PDCP entities to insert a flow ID into the obtained packets when the flow ID is not present within individual packets of the obtained packets.

7. The one or more computer-readable media of any one of claims 1-6, wherein, to instantiate the plurality of PDCP entities, the computer device, in response to execution of the instructions, is to:

create a first PDCP entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB;

detect activation of a flow classification rule; and

create a second PDCP entity to process packets of a flow corresponding to the second PDCP entity based on the flow classification rule,

wherein upon activation of the flow classification rule, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB.

8. The one or more computer-readable media of claim 7, wherein the computer device, in response to execution of the instructions, is further to:

Petitioners' Exhibit 1002, p. 198
AT&T et al v. Asustek Technology
IPR2024-00997

upon establishment of the DRB, implement the first PDCP entity to cipher or decipher all packets of the DRB using a bearer ID of the DRB or the identified flow ID; and

upon creation of the second PDCP entity, implement the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer ID of the DRB or a flow ID of the flow corresponding to the second PDCP entity.

9. One or more computer-readable media including instructions, which when executed by one or more processors, causes a computer device to:

determine that a data radio bearer ("DRB") has been established;

create a first packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the first PDCP entity is to process all packets of the DRB;

detect activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows;

create a second PDCP entity to process packets of a flow of the plurality of flows corresponding to the second PDCP entity based on the flow classification rule, wherein upon creation of the second PDCP entity, the first PDCP entity is to cease processing the packets of the flow corresponding to the second PDCP entity and continue processing all other packets of the DRB;

classify obtained packets of the DRB as belonging to the flow corresponding to the second PDCP entity; and

provide, to the second PDCP entity, the classified packets belonging to the flow corresponding to the second PDCP entity.

10. The one or more computer-readable media of claim 9, wherein, to detect activation of a flow classification rule, the computer device, in response to execution of the instructions, is to:

identify the flow classification rule based on an internal configuration of the computer device, information included in access stratum signaling, information included in non-access stratum ("NAS") signaling, or information obtained from an application of the computer device via an application programing interface.

Petitioners' Exhibit 1002, p. 199
AT&T et al v. Asustek Technology
IPR2024-00997

11. The one or more computer-readable media of claim 9 or 10, wherein, to detect activation of the flow classification rule, the computer device, in response to execution of the instructions, is to:

detect a local activation of the flow classification rule, wherein, to detect the local activation of the flow classification rule, the computer device, in response to execution of the instructions, is to:

determine a downlink ("DL") flow classification rule to map a downlink flow;

determine an uplink ("UL") flow classification rule to map an uplink flow; and

control transmission of the DL flow classification rule or the UL flow classification rule to another computer device.

12. The one or more computer-readable media of claim 9 or 10, wherein, to detect activation of the flow classification rule, the computer device, in response to execution of the instructions, is to:

identify an indication of the flow classification rule based on an obtained message, wherein, to identify the indication of the flow classification rule, the computer device, in response to execution of the instructions, is to:

control receipt of one or more signals, wherein the one or more signals comprise radio resource control ("RRC") signaling or NAS signaling; and

identify a DL flow classification rule to map a DL flow or a UL flow classification rule to map a UL flow.

13. The one or more computer-readable media of claim 9 or 10, wherein the computer device, in response to execution of the instructions, is to:

select one or more links for each of the corresponding flows based on a routing rule associated with each of the corresponding flows; and

control transmission of a message to indicate the selected one or more links and a flow identifier for each of the corresponding flows, wherein the message is an RRC message or a NAS message.

14. The one or more computer-readable media of claim 13, wherein the routing rule is based on a QoS characteristic.

Petitioners' Exhibit 1002, p. 200
AT&T et al v. Asustek Technology
IPR2024-00997

15. The one or more computer-readable media of claim 9 or 10, wherein the computer device, in response to execution of the instructions, is to:

determine a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received;

obtain packets of the first flow from first communication circuitry used to communicate over the first link; and

obtain packets of the second flow from second communication circuitry used to communicate over the second link, wherein the first link is different than the second link.

16. An apparatus to be implemented by base station ("BS"), the apparatus comprising:

communication circuitry to:

transmit a configuration message to establish a data radio bearer ("DRB"), and

transmit and receive packets of the DRB after the DRB is established; and

processor circuitry coupled with the communication circuitry, the processor circuitry to:

instantiate one or more of packet data convergence protocol ("PDCP") entities in response to establishment of the DRB, wherein individual PDCP entities of the one or more of PDCP entities are to process corresponding flows of the one or more of flows;

classify obtained packets of the DRB into the one or more flows;

provide, to the individual PDCP entities of the one or more of PDCP entities, the classified packets of the corresponding flows; and

operate the individual PDCP entities to re-order the classified packets according to information included in the classified packets.

17. The apparatus of claim 16, wherein, to classify the obtained packets of the DRB, the processor circuitry is to:

identify the obtained packets of the corresponding flows according to one or more internet protocol ("IP") tuples or a combination of two or more IP tuples, wherein the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type;

determine a flow identifier ("ID") for the obtained packets; and

Petitioners' Exhibit 1002, p. 201
AT&T et al v. Asustek Technology
IPR2024-00997

insert the flow ID into one of one or more most significant bits of a sequence number ("SN") field of a PDCP protocol data unit ("PDU") of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

18. The apparatus of claim 16, wherein, to classify the obtained packets of the DRB, the processor circuitry is to:

identify the obtained packets of the corresponding flows according to one or more Quality of Service ("QoS") characteristics, wherein the QoS characteristics comprise a QoS class identifier ("QCI"), a bit rate, a delivery order, a reliability indication, a delay characteristic, and a priority level;

determine a flow ID for the obtained packets; and

insert the flow ID into one of one or more most significant bits of an SN field of a PDCP PDU of a first packet of the received packets, one or more least significant bits of the SN field of the PDCP PDU of the first packet, or a value in a flow identifier field of the PDCP PDU or a PDCP body of the first packet.

19. The apparatus of claim 16, wherein, to classify the obtained packets of the DRB, the processor circuitry is to:

identify a flow ID within individual packets of the obtained packets.

20. The apparatus of any one of claims 16-19, wherein, to instantiate the plurality of PDCP entities, the processor circuitry is to:

create a default PDCP entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB;

detect activation of a flow classification rule; and

create a first flow PDCP entity to process packets of a first flow based on the flow classification rule,

wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB.

21. The apparatus of claim 20, wherein the processor circuitry is to:

Petitioners' Exhibit 1002, p. 202
AT&T et al v. Asustek Technology
IPR2024-00997

upon establishment of the DRB, implement the first PDCP entity to cipher or decipher all packets of the DRB using a bearer identifier of the DRB or the identified flow identifier; and

upon creation of the second PDCP entity, implement the second PDCP entity to cipher or decipher the flow corresponding to the second PDCP entity using at least the bearer identifier of the DRB or a flow identifier of the flow corresponding to the second PDCP entity.

22. An apparatus to be implemented in a user equipment ("UE"), the apparatus comprising:

communication circuitry to receive a configuration message to establish a data radio bearer ("DRB"), and receive packets of the DRB after the DRB is established; and

processor circuitry coupled with the communication circuitry, the processor circuitry to:

determine, based on information in the configuration message, that the DRB is to be classified into individual flows of a one or more of flows;

create a default packet data convergence protocol ("PDCP") entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB;

detect activation of a flow classification rule, wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows;

create a first flow PDCP entity to process packets of a first flow of the plurality of flows based on the flow classification rule, wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue processing all other packets of the DRB;

classify obtained packets of the DRB as belonging to the first flow or belonging to other flows of the plurality of flows; and

provide the classified packets belonging to the first flow to the first flow PDCP entity and the classified packets belonging to the other flows to the default PDCP entity.

23. The apparatus of claim 22, wherein, to detect activation of the flow classification rule, the processor circuitry is to:

Petitioners' Exhibit 1002, p. 203
AT&T et al v. Asustek Technology
IPR2024-00997

detect a local activation of the flow classification rule, and wherein, to detect the local activation of the flow classification rule, the processor circuitry is to:

determine a downlink ("DL") flow classification rule to map a downlink flow; or

determine an uplink ("UL") flow classification rule to map an uplink flow.

24. The apparatus of claim 22, wherein the flow classification rule is a first flow classification rule that corresponds with the first flow, and wherein the processor circuitry is to:

detect activation of a second flow classification rule corresponding to a second flow of the plurality of flows;

create a second flow PDCP entity to process packets of the second flow based on the second flow classification rule, wherein upon creation of the second flow PDCP entity, the default PDCP entity is to cease processing the packets of the second flow and continue processing all other packets of the DRB that do not belong to the first flow or the second flow;

classify packets of the DRB received after creation of the second flow PDCP entity as belonging to the first flow, belonging to the second flow, or belonging to the other flows of the plurality of flows;

provide the classified packets belonging to the first flow to the first flow PDCP entity;

provide the classified packets belonging to the second flow to the second flow PDCP entity; and

provide the classified packets belonging to the other flows to the default PDCP entity.

25. The apparatus of any one of claims 22-24, wherein the communication circuitry comprises first communication circuitry and second communication circuitry, and the processor circuitry is to:

identify a first link over which a first flow of the plurality of flows is to be received and a second link over which a second flow of the plurality of flows is to be received, wherein the first link is provided by a first BS and the second link is provided by a second BS, and wherein the identification is based on an indication in the configuration message or an indication in a received RRC message or a received NAS message;

Petitioners' Exhibit 1002, p. 204
AT&T et al v. Asustek Technology
IPR2024-00997

obtain packets of the first flow from the first communication circuitry used to communicate with the first BS over the first link; and

obtain packets of the second flow from second communication circuitry used to communicate with the second BS over the second link, wherein the first flow is a different flow than the second flow, and the first link is different than the second link.

Petitioners' Exhibit 1002, p. 205
AT&T et al v. Asustek Technology
IPR2024-00997

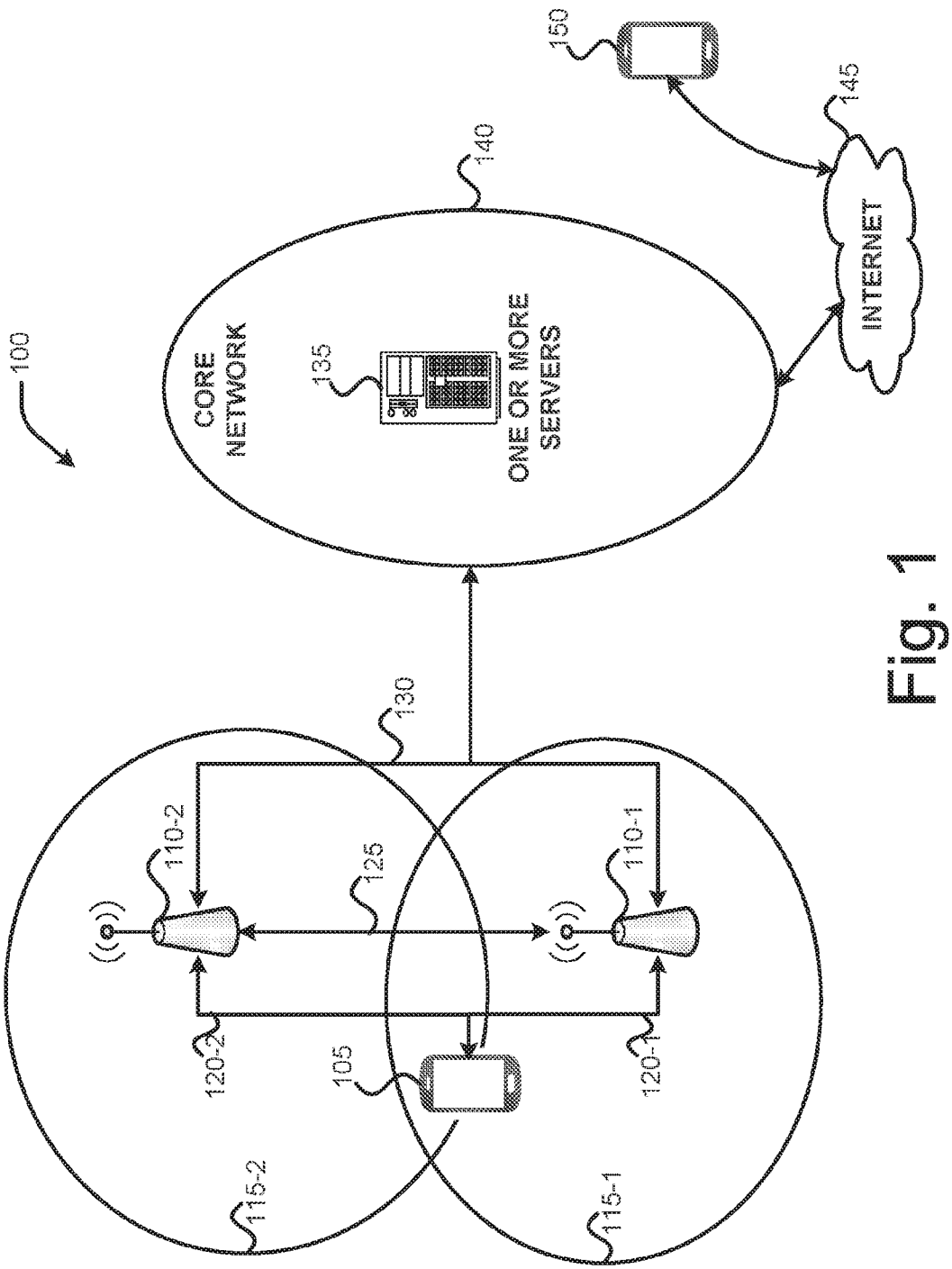

100
CORE NETWORK
135
ONE OR MORE SERVERS
140
150
145
INTERNET
130
110-2
125
110-1
120-2
105
120-1
115-2
115-1

Fig. 1

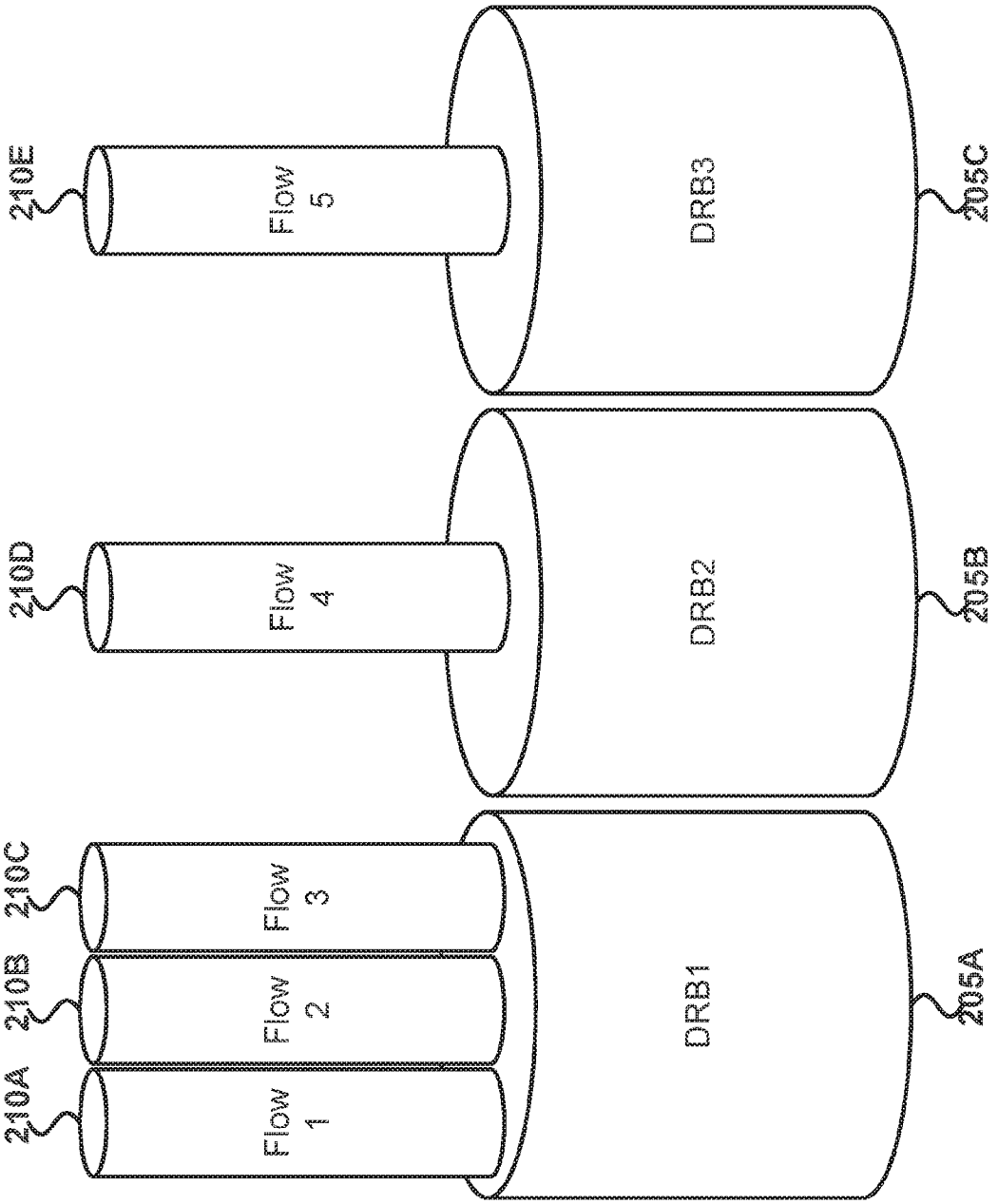

210E
Flow 5
DRB3
205C
210D
Flow 4
DRB2
205B
210C
Flow 3
210B
Flow 2
210A
Flow 1
DRB1
205A

Fig. 2

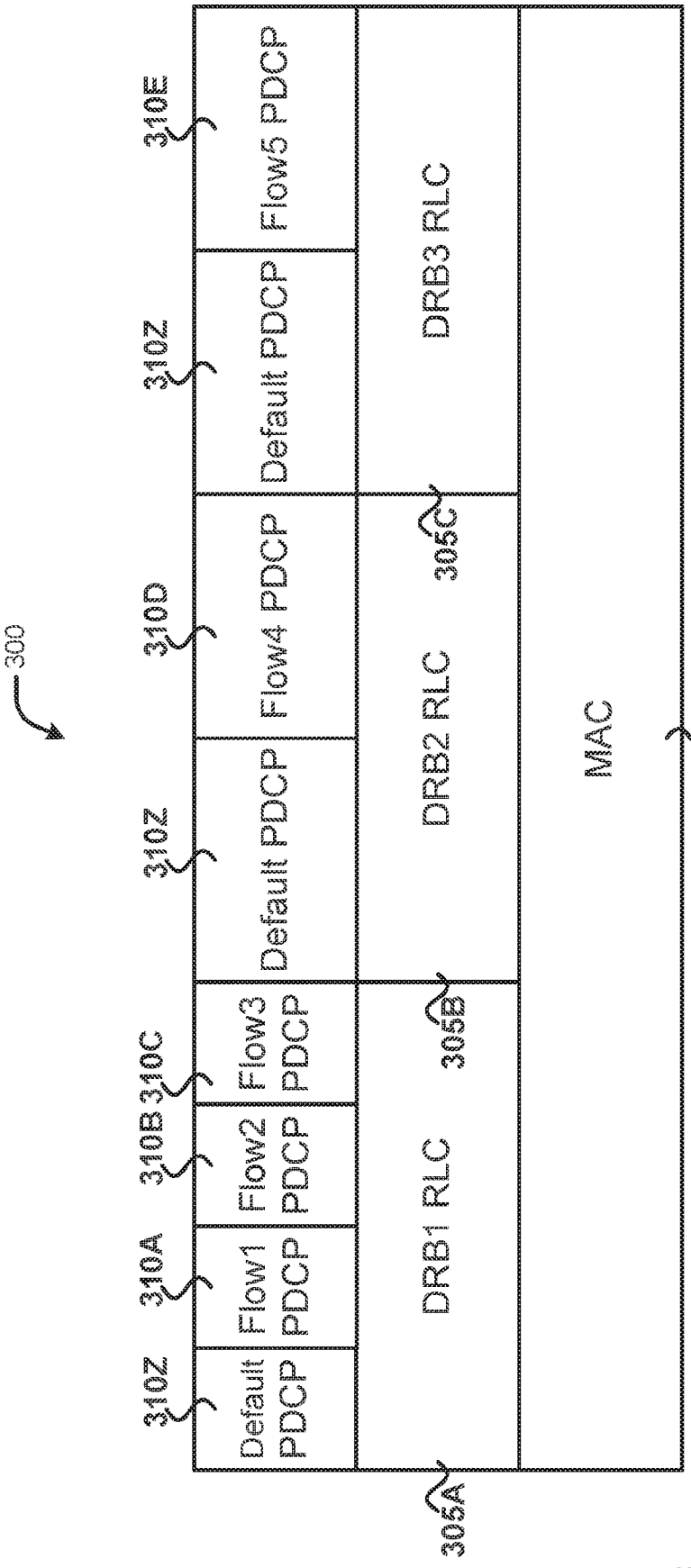

300
310Z
Default PDCP
310A
Flow1 PDCP
310B
Flow2 PDCP
310C
Flow3 PDCP
310Z
Default PDCP
310D
Flow4 PDCP
310Z
Default PDCP
310E
Flow5 PDCP
DRB1 RLC
305A
DRB2 RLC
305B
DRB3 RLC
305C
MAC
315

Fig. 3

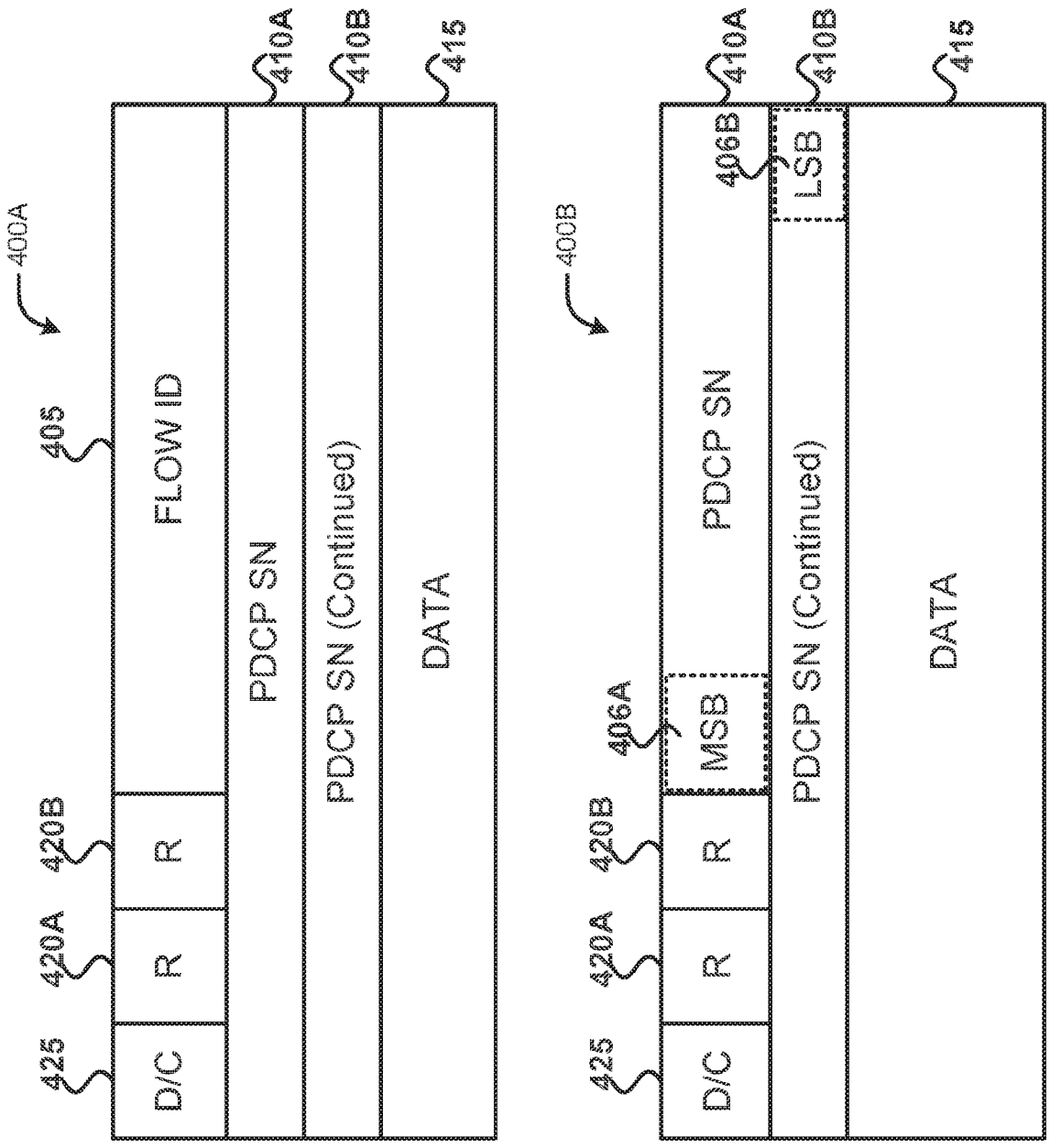

400A
405
FLOW ID
PDCP SN
PDCP SN (Continued)
DATA
410A
410B
415
420B
R
420A
R
425
D/C
400B
406B
LSB
406A
MSB

Fig. 4

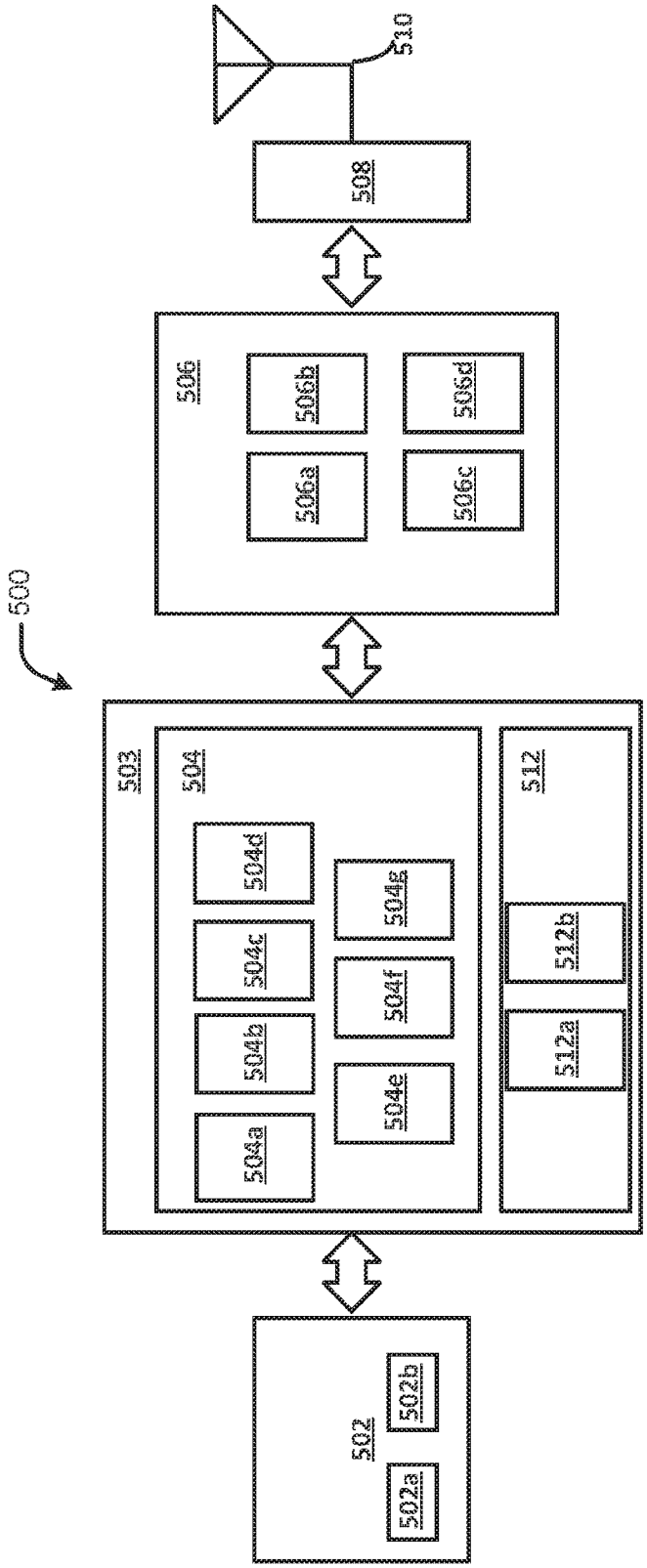

500
502
502a
502b
503
504
504a
504b
504c
504d
504e
504e
504f
506
506a
506b
506c
506d
508
510
512
512a
512b

Fig. 5

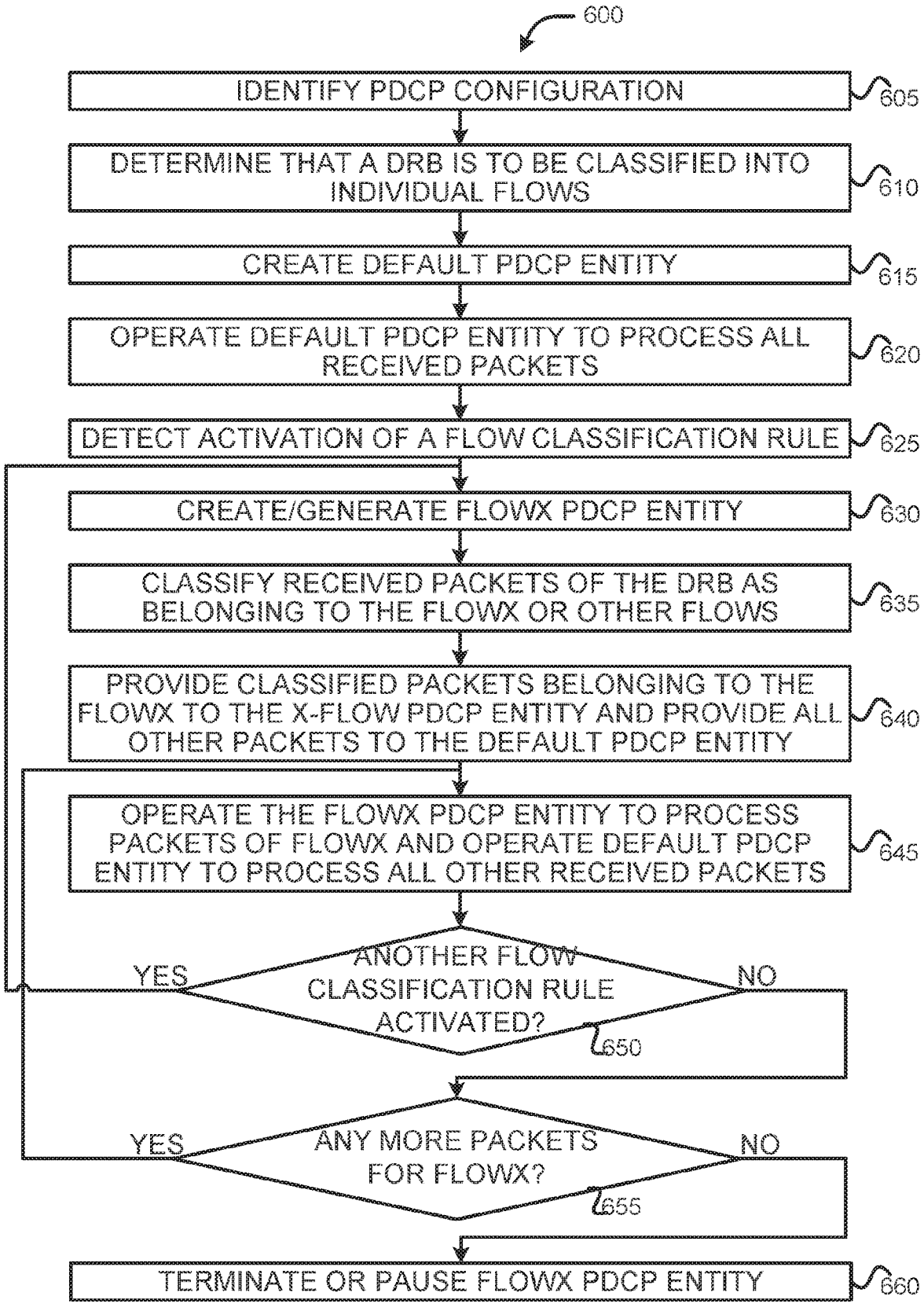


Fig.6

Petitioners' Exhibit 1002, p. 211
AT&T et al v. Asustek Technology
IPR2024-00997

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/026857

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W28/02
ADD. H04W28/12 H04W76/02 H04L12/851

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W H04L

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, COMPENDEX, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/112084 A1 (ERICSSON TELEFON AB L M [SE]; ERIKSSON ANN-CHRISTINE [SE]; STJERNHOLM) 1 August 2013 (2013-08-01) page 5, line 7 - line 26 page 7, line 17 - line 28 page 8, line 26 - line 30 page 11, line 9 - line 28 page 14, line 27 - line 29 page 15, line 5 - line 34 page 16, line 25 - line 28 page 17, line 15 - line 25 figures 1-3,5-6	1-6,16, 18,19
A	US 2014/341031 A1 (MUTIKAINEN JARI [FI]) 20 November 2014 (2014-11-20) paragraph [0018] - paragraph [0024] figure 2	1-8, 16-21

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 July 2017	12/09/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Ruscitto, Alfredo

2

Form PCT/ISA/210 (second sheet) (April 2005)

Petitioners' Exhibit 1002, p. 212
AT&T et al. v. Asustek Technology
IPR2024-00997

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	"3 Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification (Release 13)", 3GPP STANDARD; 3GPP TS 36.323, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE, vol. RAN WG2, no. V13.2.1, 11 July 2016 (2016-07-11), pages 1-39, XP051123667, paragraph 4.2 Figure 4.2.1.1 Figure 4.2.2.1 -----	1-8, 16-21
X,P	MEDIATEK INC ET AL: "Remaining issues with reflective QoS for NR", 3GPP DRAFT; R2-1700552 REMAINING ISSUES WITH REFLECTIVE QOS FOR NR, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRA , vol. RAN WG2, no. Spokane, USA; 20170117 - 20170119 17 January 2017 (2017-01-17), XP051211124, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2017-01-17] paragraph 1 paragraph 2.1 paragraph 2.2 -----	1,16
X,P	INTEL CORPORATION: "Supporting Next Gen QoS in NR", 3GPP DRAFT; R2-169070-QOS-V5, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Reno, USA; 20161114 - 20161118 18 November 2016 (2016-11-18), XP051193505, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_96/Docs/ [retrieved on 2016-11-18] paragraph 2.2.2 paragraph 2.3 -----	1,16

Petitioners' Exhibit 1002, p. 213
AT&T et al. v. Asustek Technology
IPR2024-00997

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2017/026857

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

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

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

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

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

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

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

see additional sheet

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

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

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

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

1-8, 16-21

Remark on Protest

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

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

☐ No protest accompanied the payment of additional search fees.

Petitioners' Exhibit 1002, p. 214
AT&T et al v. Asustek Technology
IPR2024-00997

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-8, 16-21

(F1) an apparatus to be implemented by base station, BS, the apparatus comprising communication circuitry to (F2) transmit a configuration message to establish a data radio bearer, DRB, and (F3) transmit and receive packets of the DRB after the DRB is established and (F4) processor circuitry coupled with the communication circuitry, the processor circuitry to instantiate one or more of packet data convergence protocol, PDCP, entities in response to establishment of the DRB, wherein individual PDCP entities of the one or more of PDCP entities are to process corresponding flows of the one or more of flows (F5) classify obtained packets of the DRB into the one or more flows (F6) provide, to the individual PDCP entities of the one or more of PDCP entities, the classified packets of the corresponding flows and (F7) operate the individual PDCP entities to re-order the classified packets according to information included in the classified packets (F8) wherein, to classify the obtained packets of the DRB, the processor circuitry is to identify the obtained packets of the corresponding flows according to one or more internet protocol, IP, tuples or a combination of two or more IP tuples, wherein the IP tuples comprise a source IP address, a source port, a destination IP address, a destination port, and a protocol type according to the subject-matter of independent claim 16 and the first part of dependent claim 17.

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2. claims: 9-15, 22-25

(F9) an apparatus to be implemented in a user equipment, UE, the apparatus comprising communication circuitry to (F10) receive a configuration message to establish a data radio bearer, DRB, and (F11) receive packets of the DRB after the DRB is established and (F12) processor circuitry coupled with the communication circuitry, the processor circuitry to determine, based on information in the configuration message, that the DRB is to be classified into individual flows of a one or more of flows (F13) create a default packet data convergence protocol, PDCP, entity upon establishment of the DRB, wherein the default PDCP entity is to process all packets of the DRB (F14) detect activation of a flow classification rule (F15) wherein the flow classification rule is to indicate that the DRB is to be classified into individual flows of a plurality of flows (F16) create a first flow PDCP entity to process packets of a first flow of the plurality of flows based on the flow classification rule (F17) wherein upon creation of the first flow PDCP entity, the default PDCP entity is to cease processing the packets of the first flow and continue

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

processing all other packets of the DRB (F18) classify obtained packets of the DRB as belonging to the first flow or belonging to other flows of the plurality of flows and (F19) provide the classified packets belonging to the first flow to the first flow PDCP entity and the classified packets belonging to the other flows to the default PDCP entity according to the subject-matter of independent claim 22.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2017/026857

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2013112084 A1	01-08-2013	EP 2815616 A1	24-12-2014
		US 2015098332 A1	09-04-2015
		WO 2013112084 A1	01-08-2013
US 2014341031 A1	20-11-2014	NONE	

Petitioners' Exhibit 1002, p. 217
AT&T et al v. Asustek Technology
IPR2024-00997

Electronic Acknowledgement Receipt

EFS ID:	33280071
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	25-JUL-2018
Filing Date:	
Time Stamp:	14:39:54
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	1426-221-101--IDSasFiled07252018.pdf	53610 a491399f169f881394dd29a8a16fbf2dbd50e8b0	no	2

Warnings:

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	WO2018-031081b2.pdf	10306379 b8dee280bf518db3a7bde050ba7a6f087bff025c	no	79
Warnings:					
Information:					
		Total Files Size (in bytes):	10359989		

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.

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

PTO/AIA/82A (07-13)
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

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

Application Number	Not Yet Assigned
Filing Date	July 24, 2018
First Named Inventor	Li-Te Pan
Title	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	1426-221.101

SIGNATURE of Applicant or Patent Practitioner

Signature	/Sang N. Dang/	Date (Optional)	July 24, 2018
Name	Sang N. Dang	Registration Number	51186
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

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

☐ *Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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

PTO/AIA/82B (07-13)
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POWER OF ATTORNEY BY APPLICANT

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

Application Number	Filing Date

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

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 106622

OR

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

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

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

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

☐ Inventor or Joint Inventor (title not required below)

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

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

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

SIGNATURE of Applicant for Patent

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

Signature	MING-HSIU HSU	Date (Optional)	Aug. 26, 2015
Name	MING-HSIU HSU		
Title	Director of ASUSTek Computer Inc.		

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

☐ Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Li-Te Pan and Richard Lee-Chee Kuo	
Title:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	
Serial No.:	TBD	Filed: Herewith
Examiner:	TBD	Group Art Unit: TBD
Attorney Docket No.:	1291-221.101 (1060196-US)	

CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8

I hereby certify that the enclosed 1 Page Utility Transmittal; 1 Page Fee Transmittal; 8 Page Application Data Sheet; 56 Page Specification; 12 Page Drawings; 2 Page executed Declaration; 2 Page Information Disclosure Statement by Applicant with 2 references; and 2 Page Power of Attorney are being transmitted to the United States Patent and Trademark Office via EFS-Web on July 24, 2018.

Date: July 24, 2018 /Sandy Kim/
Sandy Kim

Mailing Address:

BLUE CAPITAL LAW FIRM, P.C. (Customer No.: 106622)
650 Town Center Drive, Suite 1530
Costa Mesa, California 92626
Tel: 714-839-3800
Fax: 714-795-2995

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Li-Te		Pan	

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

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Richard	Lee-Chee	Kuo	

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

City	Taipei City	Country of Residence i	TW

Mailing Address of Inventor:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	State/Province	OT
Postal Code		Country i	TW

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

Petitioners' Exhibit 1002, p. 223
AT&T et al v. Asustek Technology
IPR2024-00997

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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	106622		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM		
Attorney Docket Number	1426-221.101	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	**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.

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	106622		

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	Remove
Registration Number					

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

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)
	Claims benefit of provisional	62536163	2017-07-24

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

Foreign Priority Information:

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

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

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

Petitioners' Exhibit 1002, p. 225
AT&T et al v. Asustek Technology
IPR2024-00997

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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.

Petitioners' Exhibit 1002, p. 226
AT&T et al v. Asustek Technology
IPR2024-00997

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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.

Petitioners' Exhibit 1002, p. 227
AT&T et al v. Asustek Technology
IPR2024-00997

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

Applicant Information:

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

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:	

If the Applicant is an Organization check here. ☒

Organization Name	ASUSTek Computer Inc.

Mailing Address Information For Applicant:

Address 1	No. 15, Lite Rd., Peitou District		
Address 2			
City	Taipei City 112	**State/Province**	OT
Country[i]	TW	Postal Code	
Phone Number		Fax Number	
Email Address			

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

PTO/AIA/14 (08-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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

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

Mailing Address Information For Assignee including Non-Applicant Assignee:

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

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

PTO/AIA/14 (08-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	1426-221.101
	Application Number	
Title of Invention	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM	

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
08 February 2018 (08.02.2018)

WIPO | PCT

(10) International Publication Number
WO 2018/026169 A1

(51) International Patent Classification:
H04W 28/02 (2009.01) *H04W 28/06* (2009.01)

(21) International Application Number:
PCT/KR2017/008293

(22) International Filing Date:
01 August 2017 (01.08.2017)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
201641026242 01 August 2016 (01.08.2016) IN
201641026242 28 July 2017 (28.07.2017) IN

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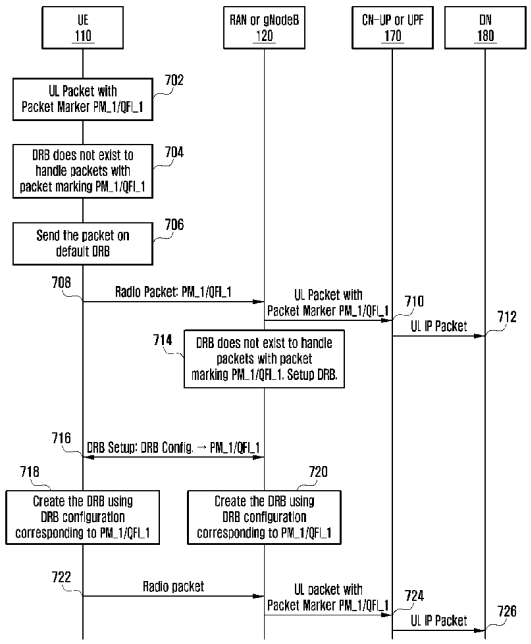
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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

(54) Title: METHOD AND APPARATUS FOR MANAGING DATA COMMUNICATION IN WIRELESS COMMUNICATION NETWORK



(57) Abstract: The present disclosure relates to a communication method and system for converging a 5th-Generation (5G) communication system for supporting higher data rates beyond a 4th-Generation (4G) system with a technology for Internet of Things (IoT). The present disclosure may be applied to intelligent services based on the 5G communication technology and the IoT-related technology, such as smart home, smart building, smart city, smart car, connected car, health care, digital education, smart retail, security and safety services. Embodiments herein disclose a UE for managing a data communication in a wireless communication network. The UE includes a DRB management unit configured to determine a DRB for transmitting a packet based on QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. The DRB management unit performs one of mapping the packet to an established non-default DRB if the list of one or more QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and mapping the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet.

WO 2018/026169 A1

[Continued on next page]

Petitioners' Exhibit 1002, p. 231
AT&T et al v. Asustek Technology
IPR2024-00997

Published:
— *with international search report (Art. 21(3))*

Description

Title of Invention: METHOD AND APPARATUS FOR MANAGING DATA COMMUNICATION IN WIRELESS COMMUNICATION NETWORK

Technical Field

[1] The present disclosure relates to a wireless communication system. More particularly related to a method and apparatus for managing data communication in a next generation communication system such as 5G wireless communication system.

Background Art

[2] To meet the demand for wireless data traffic having increased since deployment of 4G communication systems, efforts have been made to develop an improved 5G or pre-5G communication system. Therefore, the 5G or pre-5G communication system is also called a 'Beyond 4G Network' or a 'Post LTE System'. The 5G communication system is considered to be implemented in higher frequency (mmWave) bands, e.g., 60GHz bands, so as to accomplish higher data rates. To decrease propagation loss of the radio waves and increase the transmission distance, the beamforming, massive multiple-input multiple-output (MIMO), Full Dimensional MIMO (FD-MIMO), array antenna, an analog beam forming, large scale antenna techniques are discussed in 5G communication systems. In addition, in 5G communication systems, development for system network improvement is under way based on advanced small cells, cloud Radio Access Networks (RANs), ultra-dense networks, device-to-device (D2D) communication, wireless backhaul, moving network, cooperative communication, Coordinated Multi-Points (CoMP), reception-end interference cancellation and the like. In the 5G system, Hybrid FSK and QAM Modulation (FQAM) and sliding window superposition coding (SWSC) as an advanced coding modulation (ACM), and filter bank multi carrier (FBMC), non-orthogonal multiple access(NOMA), and sparse code multiple access (SCMA) as an advanced access technology have been developed.

[3] The Internet, which is a human centered connectivity network where humans generate and consume information, is now evolving to the Internet of Things (IoT) where distributed entities, such as things, exchange and process information without human intervention. The Internet of Everything (IoE), which is a combination of the IoT technology and the Big Data processing technology through connection with a cloud server, has emerged. As technology elements, such as "sensing technology", "wired/wireless communication and network infrastructure", "service interface technology", and "Security technology" have been demanded for IoT implementation, a sensor network, a Machine-to-Machine (M2M) communication, Machine Type Com-

munication (MTC), and so forth have been recently researched. Such an IoT environment may provide intelligent Internet technology services that create a new value to human life by collecting and analyzing data generated among connected things. IoT may be applied to a variety of fields including smart home, smart building, smart city, smart car or connected cars, smart grid, health care, smart appliances and advanced medical services through convergence and combination between existing Information Technology (IT) and various industrial applications.

[4] In line with this, various attempts have been made to apply 5G communication systems to IoT networks. For example, technologies such as a sensor network, Machine Type Communication (MTC), and Machine-to-Machine (M2M) communication may be implemented by beamforming, MIMO, and array antennas. Application of a cloud Radio Access Network (RAN) as the above-described Big Data processing technology may also be considered to be as an example of convergence between the 5G technology and the IoT technology.

[5] Several broadband wireless technologies have been developed to meet the growing number of broadband subscribers and to provide more and better applications and services. The second generation wireless communication system has been developed to provide voice services while ensuring the mobility of users. The third generation wireless communication system supports not only a voice service but also data service. In recent years, the fourth wireless communication system has been developed to provide high-speed data service. However, currently, the fourth generation wireless communication system suffers from lack of resources to meet the growing demand for high speed data services. So fifth generation wireless communication system is being developed to meet the growing demand for high speed data services, support ultra-reliability and low latency applications and support a massive machine type communication.

[6] In an existing system, a bearer service architecture to support QoS is shown in the FIG. 1. An Evolved Packet Service (EPS) bearer is established between a user equipment (UE) 110 and a Public Data Network (PDN) gateway for the transportation of an application packet (or an internet protocol (IP) packet). The EPS bearer is a bearer corresponding to an IP packet flow (or a service data flow) with a defined QoS between the UE 110 and the PDN gateway. The EPS bearer may be bidirectional or unidirectional. Multiple EPS bearers can be established for the UE 110 in order to provide different QoS streams or connectivity to different PDNs. In an example, a user might be engaged in a voice call (i.e., VoIP call) while at the same time performing web browsing or File Transfer Protocol (FTP) download. A VoIP EPS bearer would provide the necessary QoS for the voice call, while a best-effort EPS bearer would be suitable for the web browsing or the FTP session.

[7] One EPS bearer and EUTRA Radio Access Bearer (E-RAB) is established when the UE 110 connects to the PDN, and that remains established throughout the lifetime of the PDN connection to provide the UE 110 with always-on IP connectivity to that PDN. This bearer is referred to as the default EPS bearer. Any additional EPS bearer/ E-RAB that is established to the same PDN is referred to as a dedicated bearer. The initial bearer level QoS parameter values of the default bearer are assigned by the network, based on a subscription data. The decision to establish or modify the dedicated bearer can only be taken by the EPC, and the bearer level QoS parameter values are always assigned by the EPC.

[8] The EPS bearer/E-RAB is the level of granularity for bearer level QoS control in the network. That is, service data flows (SDFs) mapped to the same EPS bearer receive the same bearer level packet forwarding treatment (e.g. scheduling policy, queue management policy, rate shaping policy, RLC configuration, etc.).

[9] The EPS bearer/E-RAB is referred to as a Guaranteed Bit Rate (GBR) bearer if the dedicated network resources related to a GBR value that is associated with the EPS bearer/E-RAB are permanently allocated (e.g. by an admission control function in the eNodeB) at the bearer establishment/modification. Otherwise, the EPS bearer/E-RAB is referred to as a Non-GBR bearer. The dedicated bearer can either be the GBR or the Non-GBR bearer while a default bearer shall be a Non-GBR bearer.

[10] Applications/IP flows or SDFs are mapped to the EPS bearer based on a packet classification rule or a Traffic Flow Template (TFT) i.e. source IP address, destination IP address and port number of the IP flow or the SDF. An UL TFT in the UE 110 binds the SDF to an EPS bearer in an uplink (UL) direction. Multiple SDFs can be multiplexed onto the same EPS bearer by including multiple uplink packet filters in the UL TFT. A DL TFT in the PDN GW 140 binds the SDF to the EPS bearer in a downlink (DL) direction. Multiple SDFs can be multiplexed onto the same EPS bearer by including multiple downlink packet filters in the DL TFT. An E-RAB transports the packets of the EPS bearer between the UE 110 and the EPC. When the E-RAB exists, there is a one-to-one mapping between the E-RAB and the EPS bearer. A data radio bearer transports the packets of the EPS bearer between the UE 110 and the one or more eNB(s) 120. When a data radio bearer exists, there is a one-to-one mapping between the data radio bearer and the EPS bearer/E-RAB.

[11] Further, a S1 bearer transports the packets of an E-RAB between the eNodeB 120 and a serving GW 130. A S5/S8 bearer transports the packets of the EPS bearer between the serving GW 130 and the PDN GW 140. The UE 110 stores the mapping between an uplink packet filter and a data radio bearer to create the binding between the SDF and the data radio bearer in the uplink. The PDN GW 140 stores a mapping between a downlink packet filter and the S5/S8a bearer to create the binding between

the SDF and the S5/S8a bearer in the downlink. Further, the eNB 120 stores a one-to-one mapping between the data radio bearer and the S1 bearer to create the binding between the data radio bearer and the S1 bearer in both the uplink and downlink. Further, the serving GW 130 stores the one-to-one mapping between the S1 bearer and the S5/S8a bearer to create the binding between the S1 bearer and the S5/S8a bearer in both the uplink and downlink.

[12] The data radio bearer and the S5/S8 bearer corresponding to each EPS bearer is established when the UE 110 enters the RRC connected state from an IDLE state. A new data radio bearer can be setup during the connected state if a new EPS bearer is established. An existing data radio bearer is released during connected state if a corresponding EPS bearer is released. All data radio bearers are released when RRC connection is released. The EPS bearer ID, a PDCP configuration, the RLC configuration and a logical channel configuration are provided by the eNB 120 in the RRC connection reconfiguration message when the DRB is established. The EPS bearers configuration provided by a NAS signaling included an EPS bearer ID, QoS info and TFT.

Disclosure of Invention

Technical Problem

[13] In the existing bearer concept, the SDFs with same characteristic are mapped to same bearer. An Over-the-air (OTA) services are mapped to same best effort EPS bearer. If the SDFs of difference services are mixed together in the same bearer then service "starvation or blockage", i.e. a large chunk of data in the buffer delays packets belonging to a different service or delays in TCP connection establishment process when the TCP connection request/response packets get to end of the queue. In the next generation communication design it is proposed to remove EPS bearer to reduce signaling overhead and to provide more QoS granularity. The OTA services can be treated differently if operator desires to do so. The flow based QoS framework is being developed. In a flow based QoS framework, the PDU session is established between the UE 110 and the data network. The PDU session may carry multiple flows requiring QoS differentiation. The QoS differentiation between several flows multiplexed on the same PDU session is provided by means of QoS marking applied to each packet. In the flow based QoS framework, existing methods of establishing the data radio bearers and mapping packets to the data radio bearers cannot be used as the EPS bearer is not established between the UE 110 and the PDN. In the flow based QoS framework, there is needed a robust method and apparatus for establishing the data radio bearer and mapping the packets of the PDU session to the data radio bearer in the DL and the UL.

[14] Thus, it is desired to address the above mentioned disadvantages or other

shortcomings or at least provide a useful alternative.

Solution to Problem

[15] Embodiments herein disclose a method for managing a data communication in a wireless communication network. The method includes receiving, by a gNodeB, a plurality of packets of at least one QoS flow from a network entity. A QoS flow identifier (QFI) associated with the at least one QoS flow is received in a header of each packet. Further, the method includes mapping, by the gNodeB, each received packet of the at least one QoS flow to a DRB. The at least one QoS flow is mapped to the DRB based on the QFI associated with the at least one QoS flow.

[16] In an embodiment, the plurality of packets of the at least one QoS flow is received, by the gNodeB, from the network entity by receiving the packet on at least one PDU tunnel between the gNodeB and the network entity. The PDU tunnel is separate for receiving the plurality of packets of the at least one QoS flow of each PDU session.

[17] In an embodiment, each received packet from the network entity of the at least one QoS flow is mapped, by the gNodeB, to the DRB by mapping the received packet to an already established DRB if the list of at least one QoS flow identifiers associated with the established DRB includes the QoS flow identifier of the received packet and the established DRB is associated with the PDU session of the received packet.

[18] In an embodiment, each received packet from the network entity of the QoS flow is mapped, by the gNodeB, to the DRB by establishing a new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet, transmit a signaling message including the DRB configuration of new DRB to a User Equipment (UE), wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to newly established DRB.

[19] In an embodiment, each received packet from the network entity of the QoS flow is mapped to the DRB by updating configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow of the received packet, where the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB, transmitting the signaling message including the DRB configuration of the updated DRB to the UE, where the DRB configuration includes the at least one of the PDU session identifier and a list of at least one of QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to the updated DRB.

[20] In an embodiment, the QoS flow is mapped to only one DRB.

[21] In an embodiment, the DRB is mapped to the at least one QoS flow of same PDU

session.

[22] In an embodiment, each of the DRB defines a packet forwarding treatment on a radio interface to data exchange between the UE and the gNodeB in the wireless communication network.

[23] In an embodiment, the plurality of packets of the at least one QoS flow is received, by the gNodeB (i.e., target gNodeB), from another gNodeB (i.e., source gNodeB). The QoS flow identifier associated with each packet is also received by the gNodeB from another gNB.

[24] In an embodiment, the plurality of packets of the at least one QoS flow is received, by the gNodeB (i.e., target gNodeB), from another gNodeB (i.e., source gNodeB). The QoS flow identifier and the PDU session identifier of PDU session associated with each packet is also received by the gNodeB from another gNodeB.

[25] Embodiments herein disclose a method for managing a data communication in a wireless communication network. The method includes determining, by a UE, a DRB for transmitting a packet based on a QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. Further, the method includes performing by the UE one of: mapping the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and mapping the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. Further, the method includes transmitting the packet over the mapped DRB.

[26] In an embodiment, the UE receives mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB in a signaling message.

[27] In an embodiment, the UE receives the PDU session identifier and a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in the signaling message.

[28] In an embodiment, the UE receives a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in the signaling message.

[29] In an embodiment, the UE receives from the gNodeB the default DRB configuration associated with the PDU session in the signaling message.

[30] In an embodiment, the UE receives from the gNodeB configuration of a default DRB associated with the PDU session in a signaling message after the establishment of RRC connection.

[31] In an embodiment, the UE includes at least one of the QoS flow identifier and the PDU session identifier in a packet header of the packet transmitted on the default

DRB.

[32] In an embodiment, on receiving a packet on default DRB, the gNodeB establishes a new DRB for the QoS flow identifier and the PDU session identifier received in the packet header of the packet received on the default DRB. Further, the gNodeB transmits a signaling message including the DRB configuration of new DRB, where the DRB configuration includes one or more of a PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB.

[33] In an embodiment, on receiving a packet on default DRB, the gNodeB establishes a new DRB for the QoS flow identifier received in the packet header of the packet received on the default DRB. Further, the gNodeB transmits a signaling message including the DRB configuration of new DRB, where the DRB configuration includes a list of one or more QoS flow identifiers of the QoS flows associated with the DRB.

[34] In an embodiment, on receiving a packet on default DRB, the gNodeB updates an already established DRB corresponding to the PDU session identifier received in the packet header of packet received on the default DRB. The QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB. Further, the gNodeB transmits a signaling message including the DRB configuration of the updated DRB, where the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS Flows associated with DRB.

[35] In an embodiment, on receiving a packet on default DRB, the gNodeB updates an already established DRB. The QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB. Further, the gNodeB transmits a signaling message including the DRB configuration of the updated DRB, where the DRB configuration includes a list of one or more QoS flow identifiers of the QoS Flows associated with DRB.

[36] Embodiments herein disclose an apparatus for managing a data communication in a wireless communication network. The apparatus includes a processor and a memory to store DRB configurations. A DRB management unit is coupled to the memory and the processor. The DRB management unit is configured to receive a plurality of packets of at least one QoS flow from a network entity. A QoS flow identifier associated with the at least one QoS flow is received in a header of each packet. The DRB management unit is configured to receive a plurality of packets of the at least one QoS flow from another gNodeB (i.e., source gNodeB). At least one of QoS flow identifier and PDU session identifier of the PDU session associated with each packet is also received. Further, the DRB management unit is configured to map each received packet of the at least one QoS flow to the DRB. The at least one QoS flow is mapped to the DRB based on the ID associated with the at least one QoS flow and a QoS parameter.

[37] Embodiments herein disclose a UE for managing a data communication in a wireless communication network. The UE includes a processor and a memory to store a DRB configuration received from a gNodeB in the wireless communication network. A DRB management unit is coupled to the memory and the processor. The DRB management unit is configured to determine a DRB for transmitting a packet based on a QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. Further, the UE is configured to perform one of: map the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and map the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. Further, the UE is configured to transmit the packet over the mapped DRB.

[38] These and other aspects of the embodiments herein will be better appreciated and understood when considered in conjunction with the following description and the accompanying drawings. It should be understood, however, that the following descriptions, while indicating preferred embodiments and numerous specific details thereof, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the embodiments herein without departing from the spirit thereof, and the embodiments herein include all such modifications.

Advantageous Effects of Invention

[39] The principal object of the embodiments herein is to provide a method and apparatus for managing a data communication in a next generation wireless communication system.

[40] Another object of the embodiments herein is to receive, by a gNodeB, a plurality of packets of one or more QoS flows from a network entity.

[41] Another object of the embodiments herein is to map, by the gNodeB, each received packet of one or more QoS flows to a DRB.

[42] Another object of the embodiments herein is to determine, by the UE, the DRB for transmitting the packet based on the QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session.

[43] Another object of the embodiments herein is to receive the mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB in a signaling message.

[44] Another object of the embodiments herein is to map, by the UE, the packet to an es-

tablished non-default DRB if the list of one or more QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet.

[45] Another object of the embodiments herein is to map, by the UE, the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet.

[46] Another object of the embodiments herein is to transmit, by the UE, the packet over the mapped DRB.

Brief Description of Drawings

[47] This method is illustrated in the accompanying drawings, throughout which like reference letters indicate corresponding parts in the various figures. The embodiments herein will be better understood from the following description with reference to the drawings, in which:

[48] FIG. 1 illustrates an EPS bearer service architecture, according to a prior art;

[49] FIG. 2 is an overview of a system for managing a data communication in a wireless communication network, according to an embodiment as disclosed herein;

[50] FIG. 3 illustrates various components of a gNodeB, according to an embodiment as disclosed herein;

[51] FIG. 4 illustrates various components of a UE, according to an embodiment as disclosed herein;

[52] FIG. 5 is a flow diagram illustrating a method for managing, by the gNodeB, a data communication in the wireless communication network, according to an embodiment as disclosed herein;

[53] FIG. 6 is a flow diagram illustrating a method for managing, by the UE, the data communication in the wireless communication network, according to an embodiment as disclosed herein;

[54] FIG. 7 is a sequence diagram illustrating various operations performed for establishing a data radio bearer and mapping packets to the DRBs in an uplink (UL), according to an embodiment as disclosed herein;

[55] FIG. 8 is a sequence diagram illustrating various operations for establishing the data radio bearer and mapping packets of QoS flows to DRBs, according to an embodiment as disclosed herein;

[56] FIG. 9 is a sequence diagram illustrating various operations performed for establishing the data radio bearer in the UL, where the PM/QFI and PDU session identifier is included in a BSR, according to an embodiment as disclosed herein;

[57] FIG. 10 is a sequence diagram illustrating various operations performed for es-

tablishing one or more DRBs, according to an embodiment as disclosed herein;

[58] FIG. 11 is a sequence diagram illustrating various operations performed for establishing one or more DRBs in a DL, according to an embodiment as disclosed herein;

[59] FIG. 12 is a sequence diagram illustrating various operations performed for establishing one or more DRBs in the UL, according to an embodiment as disclosed herein;

[60] FIG. 13 is a sequence diagram illustrating various operations performed for the DRB setup in the DL, according to an embodiment as disclosed herein; and

[61] FIG. 14 is a sequence diagram illustrating various operations performed for establishing the data radio bearer in the DL, according to an embodiment as disclosed herein.

Mode for the Invention

[62] The embodiments herein and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments that are illustrated in the accompanying drawings and detailed in the following description. Descriptions of well-known components and processing techniques are omitted so as to not unnecessarily obscure the embodiments herein. Also, the various embodiments described herein are not necessarily mutually exclusive, as some embodiments can be combined with one or more other embodiments to form new embodiments. The term "or" as used herein, refers to a non-exclusive or, unless otherwise indicated. The examples used herein are intended merely to facilitate an understanding of ways in which the embodiments herein can be practiced and to further enable those skilled in the art to practice the embodiments herein. Accordingly, the examples should not be construed as limiting the scope of the embodiments herein.

[63] As is traditional in the field, embodiments may be described and illustrated in terms of blocks which carry out a described function or functions. These blocks, which may be referred to herein as managers, units or modules or the like, are physically implemented by analog and/or digital circuits such as logic gates, integrated circuits, microprocessors, microcontrollers, memory circuits, passive electronic components, active electronic components, optical components, hardwired circuits and the like, and may optionally be driven by firmware and software. The circuits may, for example, be embodied in one or more semiconductor chips, or on substrate supports such as printed circuit boards and the like. The circuits constituting a block may be implemented by dedicated hardware, or by a processor (e.g., one or more programmed microprocessors and associated circuitry), or by a combination of dedicated hardware to perform some functions of the block and a processor to perform other functions of the block. Each

block of the embodiments may be physically separated into two or more interacting and discrete blocks without departing from the scope of the disclosure. Likewise, the blocks of the embodiments may be physically combined into more complex blocks without departing from the scope of the disclosure.

[64] The term "first" and "second" herein are used merely for labeling purpose and can be used interchangeably without departing from the scope of the embodiments. It is to be noted that terms, QoS packet markings or QoS markings or QoS ID or packet marking or QoS descriptor is used interchangeably throughout the description. It is to be noted that the QoS packet marking or the QoS marking or the QoS ID or packet marking or the flow descriptor or the QoS descriptor identifies a set of QoS parameters. The proposed method have described the invention using the packet marking (PM), however it is equally applicable for QoS packet marking or QoS marking or QoS ID or packet marking or flow descriptor.

[65] Accordingly embodiments herein disclose a UE for managing a data communication in a wireless communication network. The UE includes a processor and a memory to store a DRB configuration received from a gNodeB in the wireless communication network. A DRB management unit is coupled to the memory and the processor. Further, the DRB management unit is configured to determine a DRB for transmitting the packet based on the QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. The DRB management unit is configured to perform one of mapping the packet to an established non-default DRB if the list of one or more QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and mapping the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. Further, the DRB management unit is configured to transmit the packet over the mapped DRB.

[66] The proposed method can be used to reduce the signaling overhead and to provide more QoS granularity by eliminating the EPS bearer concept in the next generation wireless communication system (e.g., 5G wireless communication system or the like).

[67] Unlike the conventional methods and the conventional systems, the RAN provides the mapping between the DRBs and the QoS flows. Multiple QoS flows can be mapped to same DRB. In UL, the UE maps the QoS flows to the DRBs based on mapping received from the RAN. Further, the UE receives packet in the UL from a higher layer. The UE receives the PM associated with packet along with the packet. Further, the UE maps the packet to a default DRB if the DRB does not exist for PM associated with the DRB. Further, the UE also adds the packet marking in a header of the

packet sent on default DRB. Further, the UE adding packet marking in the packet header of packet is transmitted to the gNB. The gNB adding packet marking in the packet header of packet is transmitted to a CN

[68] In the uplink, the UE marks uplink packets over a Uu interface with the QoS flow identifier for the purposes of marking forwarded packets to the CN as described in the 3GPP standard TR 38.804 and the 3GPP standard TS 38.300.

[69] Referring now to the drawings, and more particularly to FIGS. 2 through 14, there are shown preferred embodiments.

[70] FIG. 2 is an overview of a system for managing a data communication in a wireless communication network, according to an embodiment as disclosed herein. In an embodiment, the system includes a UE 110, a gNodeB 120, a network entity 160. The UE 110 may also include or be referred to by those skilled in the art as a mobile station, a subscriber station, a mobile unit, a subscriber unit, a wireless unit, a remote unit, a mobile device, a wireless device, a wireless communications device, a remote device, a mobile subscriber station, an access terminal, a mobile terminal, a wireless terminal, a remote terminal, a handset, a user agent, a mobile client, a client, or some other suitable terminology.

[71] The UE 110 can be, for example, but not limited to a cellular phone, a smart phone, a Personal Digital Assistant (PDA), a wireless modem, a wireless communication device, a handheld device, a tablet computer, a laptop computer, a wireless local loop (WLL) station, a Universal Serial Bus (USB) dongle, a wireless router, etc.

[72] The gNodeB (GNB) 120 may also include or be referred to by those skilled in the art as a 5G eNB, a base station, a base transceiver station, a radio base station, an access point, a radio transceiver, an eNB or some other suitable terminology.

[73] The next generation communication system supports a PDU Connectivity Service i.e. a service that provides exchange of PDUs between the UE 110 and a data network (DN) (not shown). The PDU connectivity service is supported via PDU sessions that are established upon request from the UE 110. The PDU session is an association between the UE 110 and the DN that provides a PDU connectivity service. Each PDU session supports a single PDU session type i.e. supports the exchange of a single type (e.g. IPv4, IPv6, Ethernet, etc.,) of the PDU requested by the UE 110 at the establishment of the PDU session. The PDU sessions are established (upon UE 110 request), modified (upon UE 110 and network request) and released (upon UE 110 and network request) using a Non Access Stratum (NAS) session management signaling exchanged between the UE 110 and a Session Management Function (SMF) in a core network (CN) (not shown). In the next generation communication system, for data communication, the UE 110 may establish one or more PDU sessions, to the same DN or to different DNs. Each PDU session is identified by a PDU session identifier.

[74] In case of non-roaming, packets of the PDU session in the uplink (UL) direction traverses from the UE 110 to a RAN (or gNodeB) 120 over a radio interface, the RAN (or gNodeB) 120 to a User Plane Function (UPF) over a N3 interface and from the UPF to the DN over a N6 interface. In case of roaming, the packets of PDU session in the UL traverses from the UE 110 to the RAN (or gNodeB) 120 over the radio interface, the RAN (or gNodeB) 120 to the UPF in a visiting PLMN over the N3 interface, the UPF in the visiting PLMN to the UPF in a home PLMN over a N9 interface and from the UPF in the home PLMN to the DN over a N6 interface. In case of non-roaming, the packets of PDU session in a downlink (DL) traverses from the DN to the UPF over the N6 interface, the UPF to the RAN (or gNodeB) 120 over a N3 interface, the RAN (or gNodeB) 120 to the UE 110. In case of roaming, the packets of the PDU session in the DL traverses from the DN to the UPF in a Home PLMN over the N6 interface, the UPF in the home PLMN to the visiting PLMN over a N9 interface, the UPF in the visiting PLMN to the RAN (or gNodeB) 120 over the N3 interface, the RAN (or gNodeB) 120 to the UE 110.

[75] Further, the packets of the PDU session may require different QoS treatment. The QoS flow is the finest granularity of the QoS differentiation in the PDU session. The packets of the PDU session which require same QoS treatment constitute the QoS flow. There can be several QoS flows per PDU session. A QoS flow identifier (ID) (or QoS Marking or QoS ID or QoS descriptor or packet marking) is used to identify the QoS flow. The QoS Flow ID is unique within the PDU session. A user plane traffic with the same QoS Flow ID within the PDU session receives the same traffic forwarding treatment (e.g. scheduling, admission control etc.). Each QoS flow is mapped to a set of QoS parameters (e.g. Allocation and Retention Priority, guaranteed bit rate, maximum bit rate, etc.). The QoS flow identifier is included in each packet of the PDU session exchanged between the RAN (or gNodeB) 120 and the UPF. Marking of packet (i.e. associating the packet transmitted on a N3 interface to the QoS flow identifier) is done by the UPF in the DL. Marking of the packet (i.e. associating the packet transmitted on the N3 interface to the QoS flow identifier) is done by the RAN (or gNodeB) 120 in the UL. For each PDU session, the single tunnel is established between the UPF and the RAN (or gNodeB) 120 for exchanging the packets associated with different QoS flows of the PDU session.

[76] For exchanging the packets of a PDU session, the data radio bearers (DRBs) need to be established between the UE 110 and the RAN (or gNodeB) 120. Various methods to establish the DRBs and mapping packets of QoS flows to DRBs are discussed further.

[77] In an embodiment, the RAN (or gNodeB) 120 is configured to receive a plurality of packets of at least one QoS flow from a network entity 160 (i.e., a UPF in a core network or a UP entity in the core network). The QoS flow ID (QFI) associated with

the at least one QoS flow is received in the header of each packet. Further, the RAN (or gNodeB) 120 is configured to map each received packet of the at least one QoS flow to the DRB. The at least one QoS flow is mapped to the DRB based on the QFI associated with the at least one QoS flow.

[78] In an embodiment, the plurality of packets of the at least one QoS flow is received, by the gNodeB 120, from the network entity 160 by receiving the packet on at least one PDU tunnel between the gNodeB 120 and the network entity 160. The PDU tunnel is separate for receiving the plurality of packets of the at least one QoS flow of each PDU session.

[79] In an embodiment, each received packet, from the network entity 160, of the at least one QoS flow is mapped, by the gNodeB 120, to the DRB by mapping the received packet to an already established DRB if the list of at least one QoS flow identifiers associated with the established DRB includes the QoS flow identifier of the received packet and the established DRB is associated with the PDU session of the received packet.

[80] In an embodiment, each received packet, from the network entity 160, of the QoS flow is mapped, by the gNodeB 120, to the DRB by establishing a new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet, transmitting a signaling message including the DRB configuration of new DRB to the UE 110, wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to newly established DRB.

[81] In an embodiment, each received packet, from the network entity 160, of the QoS flow is mapped to the DRB by updating configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow of the received packet, where the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB, transmitting the signaling message including the DRB configuration of the updated DRB to the UE 110, where the DRB configuration includes the at least one of the PDU session identifier and a list of at least one of QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to the updated DRB.

[82] In an embodiment, the QoS flow is mapped to only one DRB.

[83] In an embodiment, the DRB is mapped to the at least one QoS flow of same PDU session.

[84] In an embodiment, each of the DRB defines a packet forwarding treatment on a radio interface to data exchange between the UE 110 and the gNodeB 120 in the wireless communication network.

[85] In an embodiment, the RAN (or gNodeB) 120 is configured to receive the plurality of packets of the at least one QoS flow from another gNodeB. The at least one of QFI and the PDU session identifier of the PDU session associated with each packet is also received by the RAN (or gNodeB) 120 from another gNodeB. Further, the RAN (or gNodeB) 120 is configured to map each received packet of the at least one QoS flow to the DRB. The at least one QoS flow is mapped to the DRB based on the QFI associated with the at least one QoS flow. Further, the UE 110 is configured to determine the DRB for transmitting the packet based on the QoS flow identifier and the PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. Further, the UE is configured to perform one of: map the packet to the established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and map the packet to the default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. Further, the UE 110 is configured to transmit the packet over the mapped DRB.

[86] In an embodiment, the UE 110 receives mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB 120 in a signaling message.

[87] In an embodiment, the UE 110 receives the PDU session identifier and a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB 120 in the signaling message.

[88] In an embodiment, the UE 110 receives the list of at least one of QoS flow identifiers associated with each DRB from the gNodeB 120 in the signaling message.

[89] In an embodiment, the UE 110 receives, from the gNodeB 120, the default DRB configuration associated with the PDU session in the signaling message.

[90] In an embodiment, the UE 110 receives from the gNodeB 120 configuration of the default DRB associated with the PDU session in the signaling message after the establishment of the RRC connection.

[91] In an embodiment, on receiving the packet on default DRB, the gNodeB 120 is further configured to establish a new DRB for the QoS flow identifier and the PDU session identifier received in the packet header of the packet received on the default DRB. Further, the UE 110 is configured to transmit the signaling message including the DRB configuration of new DRB, where the DRB configuration includes one or more of a PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB.

[92] In an embodiment, on receiving the packet on the default DRB, the gNodeB 120 is configured to establish a new DRB for the QoS flow identifier received in the packet

header of the packet received on the default DRB. Further, the gNodeB 120 is configured to transmit the signaling message including the DRB configuration of new DRB. The DRB configuration includes the list of one or more QoS flow identifiers of the QoS flows associated with the DRB.

[93] In an embodiment, on receiving the packet on the default DRB, the gNodeB 120 is further configured to update an already established DRB corresponding to the PDU session identifier received in the packet header of packet received on the default DRB. The QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB. Further, the gNodeB 120 is configured to transmit the signaling message including the DRB configuration of the updated DRB, where the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS Flows associated with DRB.

[94] In an embodiment, on receiving the packet on the default DRB, the gNodeB 120 is configured to update the already established DRB. The QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB. Further, the gNodeB 120 is configured to transmit the signaling message including the DRB configuration of the updated DRB. The DRB configuration includes the list of one or more QoS flow identifiers of the QoS flows associated with DRB.

[95] The FIG. 2 shows the limited overview of the system but, it is to be understood that other embodiments are not limited thereto. Further, the system can include any number of hardware or software components communicating with each other. Further, the labels are only used for illustrative purpose and not limiting the scope of the invention. For example, the component can be, but not limited to, a process running in the controller or processor, an object, an executable process, a thread of execution, a program, or a computer.

[96] FIG. 3 illustrates various components of the gNodeB 120, according to an embodiment as disclosed herein. In an embodiment, the gNodeB 120 includes a DRB management unit 121, a communication unit 122, a memory 123 and a processor 124. The processor 124 is in communication with the DRB management unit 121, the communication unit 122, and the memory 123. The DRB management unit 121 is coupled to the memory 123 and the processor 124. In an embodiment, the DRB management unit 121 is configured to receive the plurality of packets of at least one QoS flow from the network entity 160. (The various procedures for receiving the plurality of packets of at least one QoS flow from the network entity 160 is explained in the FIGS. 7 to 14). After receiving the plurality of packets of at least one QoS flow from the network entity 160, the DRB management unit 121 is configured to map each received packet of the at least one QoS flow to the DRB. (The various procedures for mapping each

received packet of the at least one QoS flow to the DRB is explained in the FIGS. 7 to 14). In an embodiment, the DRB management unit 121 is configured to establish the DRBs and provide the DRBs to the QoS flows mapping information to the UE 110 based on the information received from the network entity 160 and/or the UE 110. (The various procedures for establishing the DRBs and provide the DRBs to the QoS flows mapping information to the UE 110 is explained in the FIGS. 7 to 14).

[97] The communication unit 122 is configured to communicate with internal units of the gNodeB 120. Further, the communication unit 122 is configured to communicate with external units of the system.

[98] In an embodiment, the memory 123 is configured to store the DRB configurations. The memory 123 may include non-volatile storage elements. Examples of such non-volatile storage elements may include magnetic hard discs, optical discs, floppy discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable (EEPROM) memories. In addition, the memory 123 may, in some examples, be considered a non-transitory storage medium. The term "non-transitory" may indicate that the storage medium is not embodied in a carrier wave or a propagated signal. However, the term "non-transitory" should not be interpreted that the memory 123 is non-movable. In some examples, the memory 123 can be configured to store larger amounts of information than the memory. In certain examples, a non-transitory storage medium may store data that can, over time, change (e.g., in Random Access Memory (RAM) or cache).

[99] Although the FIG. 3 shows the hardware components of the gNodeB 120 but it is to be understood that other embodiments are not limited thereon. In other embodiments, the gNodeB 120 may include less or more number of components. Further, the labels or names of the components are used only for illustrative purpose and does not limit the scope of the invention. One or more components can be combined together to perform same or substantially similar function to manage the data communication in the wireless communication network.

[100] FIG. 4 illustrates various components of the UE 110, according to an embodiment as disclosed herein. In an embodiment, the UE 110 includes a DRB management unit 111, a communication unit 112, a memory 113 and a processor 114. The processor 114 is in communication with the DRB management unit 111, the communication unit 112, and the memory 113.

[101] In an embodiment, the DRB management unit 111 is coupled to the memory 113 and the processor 114. Further, the DRB management unit 111 is configured to determine the DRB for transmitting the packet based on the QoS flow identifier and the PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. Further, the DRB management unit 111 is

configured to perform one of: map the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and map the packet to the default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. Further, the DRB management unit 111 is configured to transmit the packet over the mapped DRB.

[102] Further, the communication unit 112 is configured to communicate with internal units of the UE 110. Further, the communication unit 112 is configured to communicate with external units of the system.

[103] In an embodiment, the memory 113 may include non-volatile storage elements. Examples of such non-volatile storage elements may include magnetic hard discs, optical discs, floppy discs, flash memories, or forms of electrically programmable memories (EPROM) or electrically erasable and programmable (EEPROM) memories. In addition, the memory 113 may, in some examples, be considered a non-transitory storage medium. The term "non-transitory" may indicate that the storage medium is not embodied in a carrier wave or a propagated signal. However, the term "non-transitory" should not be interpreted that the memory 113 is non-movable. In some examples, the memory 113 can be configured to store larger amounts of information than the memory. In certain examples, a non-transitory storage medium may store data that can, over time, change (e.g., in Random Access Memory (RAM) or cache).

[104] Although the FIG. 4 shows the hardware components of the UE 110 but it is to be understood that other embodiments are not limited thereon. In other embodiments, the UE 110 may include less or more number of components. Further, the labels or names of the components are used only for illustrative purpose and does not limit the scope of the invention. One or more components can be combined together to perform same or substantially similar function to manage the data communication in the wireless communication network.

[105] FIG. 5 is a flow diagram 500 illustrating a method for managing, by the gNodeB 120, the data communication in the wireless communication network, according to an embodiment as disclosed herein. The operations of the 502 and 504 are performed by the DRB management unit 121.

[106] At 502, the method includes receiving the plurality of packets of at least one QoS flow from the network entity 160. The identifier associated with the at least one QoS flow is included in the header of each packet by the network entity 160. The plurality of packets of at least one QoS flow of the at least one PDU session are received from the network entity 160 over at least one tunnel established between the gNodeB 120 and the network entity 160. The tunnel established between the gNodeB 120 and the

network entity 160 is per PDU session. In an embodiment, the plurality of packets of the at least one QoS flow is received from another gNodeB. The at least one of QFI and the PDU session identifier of the PDU session associated with each packet is also received from another gNodeB. At 504, the method includes mapping each received packet of the at least one QoS flow of the PDU session to the DRB. The at least one QoS flow of the PDU session is mapped to the DRB based on the ID associated with the at least one QoS flow.

[107] The received packet of the at least one QoS flow is mapped to the already established DRB if the list of at least one QoS flow identifiers associated with the established DRB including the QoS flow identifier of the received packet and the established DRB is associated with the PDU session of the received packet.

[108] The received packet of the at least one QoS flow is mapped to the DRB by establishing the new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet, transmitting the signaling message including the DRB configuration of new DRB to the UE 110, wherein the DRB configuration includes one or more of the PDU session identifier and the list of one or more QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to newly established DRB.

[109] The received packet of the at least one QoS flow is mapped to the DRB by updating configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow of the received packet, where the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB, transmitting the signaling message including the DRB configuration of the updated DRB to the UE 110, where the DRB configuration includes the at least one of the PDU session identifier and the list of at least one of QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to the updated DRB.

[110] Each QoS flow is mapped to only one DRB. Each DRB is mapped to the at least one QoS flow of same PDU session.

[111] In an embodiment, mapping each received packet of the at least one QoS flow of the PDU session to the DRB includes establishing a new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet, transmitting the signaling message including the DRB configuration of new DRB to the UE 110, wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to newly established DRB.

[112] In an embodiment, mapping each received packet of the at least one QoS flow of the

PDU session to the DRB includes updating configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow of the received packet wherein the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB, transmitting the signaling message including the DRB configuration of the updated DRB to the UE 110 where the DRB configuration includes the at least one of the PDU session identifier and the list of at least one of QoS flow identifiers of the QoS flows associated with the DRB, and mapping the received packet to the updated DRB.

[113] FIG. 6 is a flow diagram 600 illustrating a method for managing, by the UE 110, the data communication in the wireless communication network, according to an embodiment as disclosed herein. The operations of the 602, 604a, 604b and 606 are performed by the DRB management unit 111.

[114] At 602, the method includes determining the DRB for transmitting the packet based on the QoS flow identifier and the PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session. At 604a, the method includes mapping the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet. At 604b, the method includes mapping the packet to the default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet. At 606, the method includes transmitting the packet over the mapped DRB.

[115] In an embodiment, the UE 110 receives mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB 120 in the signaling message (e.g., RRC signaling message).

[116] In an embodiment, the UE 110 receives the PDU session identifier and the list of at least one of QoS flow identifiers associated with each DRB from the gNodeB 120 in the signaling message.

[117] In an embodiment, the UE 110 receives the list of at least one of QoS flow identifiers associated with each DRB from the gNodeB 120 in the signaling message.

[118] In an embodiment, the UE 110 receives the default DRB configuration associated with the PDU session in the RRC signaling message.

[119] In an embodiment, the UE 110 includes at least one of the QoS flow identifier and the PDU session identifier in the packet header of the packet transmitted on the default DRB.

[120] The various actions, acts, blocks, steps, or the like in the flow diagrams 500 and 600 may be performed in the order presented, in a different order or simultaneously.

Further, in some embodiments, some of the actions, acts, blocks, steps, or the like may be omitted, added, modified, skipped, or the like without departing from the scope of the invention.

[121] FIG. 7 is a sequence diagram illustrating various operations performed for establishing the DRBs and mapping the UL packets to the DRBs, according to an embodiment as disclosed herein.

[122] In an embodiment, the QoS parameters associated with the QoS flow are provided to the RAN (or gNodeB) 120 as the QoS profile when the PDU session is established or the new QoS flow is established or the radio connection is established. The QoS parameters may also be pre-configured in the RAN 120. In the RAN 120, the DRB defines the packet treatment on the radio interface (i.e., Uu interface). The DRB serves packets with the same packet forwarding treatment. The separate DRBs may be established for the QoS flows requiring different packet forwarding treatment. The RAN (or gNodeB) 120 knows the mapping between each QoS Flow and associated QoS parameters (or QoS profile) and accordingly decides the radio configuration for corresponding DRB. In the DL, the RAN (or gNodeB) 120 maps QoS flows to the DRBs based on the packet marking (i.e. QoS Flow ID) and the associated QoS profiles. For the UL, the RAN (or gNodeB) 120 provides the QoS flow to the DRB mapping in the RRC signaling message. This mapping information is used by UE 110 to map the packet to be transmitted to one of the established DRBs. One DRB can be mapped to multiple QoS flows. For each DRB configured, the RAN (or gNodeB) 120 provides the list of one or more QoS Flow Identifiers (QFIs) and PDU session identifier. In a system in which only one PDU session can be established for each UE 110, the RAN (or gNodeB) 120 may not provide the PDU session identifier for each configured DRB. The QoS parameters (e.g. packet error rate, latency, data rate, etc.) which are related to the radio level QoS can be same for multiple QoS flows and hence multiple QoS flows of same PDU session can be mapped to same DRB. The QoS flow of the PDU session is not mapped to more than one DRB. The QoS flow of one PDU session and another QoS flow of another PDU session may have same QoS Flow ID but these are mapped to different DRBs. In other words, the QoS flows of different PDU sessions are not mapped to same DRB. If the QoS flows of different PDU sessions are mapped to same DRB, then on receiving the packet from the UE 110 on this DRB, the gNodeB 120 cannot identify the PDU session associated with this packet and hence it will not be able to identify the tunnel on which this packet should be sent to the UPF 170. Note that, the tunnel between gNodeB 120 and UPF 170 is different for each PDU session.

[123] In the proposed method, the RAN (or gNodeB) 120 first establishes one or more DRBs and provides the configuration of each established DRB to the UE 110 in the

RRC signaling message after the RRC connection is established between the UE 110 and the RAN (or gNodeB) 120. Each established DRB is either a default DRB associated with the PDU session or a non-default DRB associated with the PDU session. One default DRB is established for each PDU session. Multiple non-default DRBs can be associated with the PDU session. For each non-default DRB, the list of one or more QoS flow identifiers is provided by the gNodeB 120. In the DRB configuration included in the RRC signaling, the RAN (or gNodeB) 120 may indicate whether it is the default DRB or not.

[124] In the UL, the access stratum (i.e. AS) in the UE 110 receives (702) the packet to be transmitted and associated PM/QFI and the PDU session identifier from the higher layer (e.g. NAS layer or application layer in the UE 110). In a system in which only one PDU session can be established for each UE 110, the access stratum (i.e. AS) in the UE 110 receives the packet to be transmitted and associated PM/QFI from the higher layer (e.g. NAS layer or application layer in the UE 110).

[125] In the proposed method, the UE 110 checks (704) if the DRB is already established at least for the QoS flow (identified by PM/QFI) and the PDU session associated with received packet or not. If yes, then the UE 110 maps the packet to that DRB and transmits the packet over the mapped DRB. If not, then the UE 110 maps the packet to the default DRB of the PDU session associated with the packet and transmits (706) the packet using the default DRB of the PDU session associated with the packet.

[126] Further, the UE 110 sends (708) the packet over the radio along with associated PM/QFI (i.e. PM_1/QFI_1) to the RAN (or gNodeB) 120.

[127] The PM/QFI is included in the packet sent on the default DRB. The PM/QFI can be included in the packet header (e.g. it can be included in header of the Service Data Adaptation Protocol (SDAP)).

[128] The RAN (or gNodeB) 120 sends (710) the UL packet with the packet marker PM_1/QFI_1 to the UPF 170. The UPF 170 sends (712) the UL IP packet to the DN 180. Further, the 110 RAN (or gNodeB) 120 determines (714) to establish the DRB setup if the DRB does not exist to handle packets with the packet marking PM_1/QFI_1.

[129] On receiving the packet on the default DRB with the PM/QFI, the RAN (or gNodeB) 120 may add the QoS flow identified by the PM/QFI to existing (i.e. already established) DRB or add a new DRB for this QoS flow identified by the PM/QFI. The RAN (or gNodeB) 120 sends (716) the updated DRB configuration to the UE 110. If new DRB is added then the UE 110 creates (718) the new DRB corresponding to new configuration and PM/QFI included in the DRB configuration message. In response, the UE 110 may send the DRB configuration complete message. After receiving the DRB configuration complete message the RAN (or gNodeB) 120 creates (720) the

DRB using the DRB configuration if new DRB configuration is added for the PM/QFI.

[130] On receiving the packet from the UE 110 on the DRB, the RAN (or gNodeB) 120 identifies the PM/QFI and PDU session identifier of the received packet based on mapping between the DRB to the PM/QFI and the PDU session identifier. The RAN (or gNodeB) 120 indicates (710 or 724) the PM/QFI of the packet to UPF 170 by adding PM/QFI in the header while transmitting the packet to UPF 170. The packet is transmitted to UPF 170 on the tunnel associated with the PDU session of the packet. The UPF 170 sends (726) the UL IP packet to the DN 180.

[131] In an embodiment, the packets on the default DRB may be transmitted on first come first basis or can be prioritize based on the QoS marking.

[132] In an embodiment, the PM/QFI and the PDU session identifier may be included in the BSR. This is shown in the FIG. 9. On receiving the PM/QFI and the PDU session identifier in the BSR, if there does not exist the DRB for this PM/QFI and PDU session identifier then the RAN (or gNodeB) 120 initiates DRB setup. The RAN (or gNodeB) 120 may map the PM/QFI to existing DRB or add the new DRB for this PM/QFI and PDU session identifier. The RAN (or gNodeB) 120 sends the updated DRB configuration to the UE 110. If new DRB is added, the UE 110 creates the new DRB corresponding to new configuration and PM/QFI included in the DRB configuration message. In response, the UE 110 may send DRB configuration complete message. After receiving the DRB configuration complete message, the RAN (or gNodeB) 120 creates the DRB using the DRB configuration if new DRB configuration is added for the PM/QFI.

[133] In one embodiment of the proposed method, instead of sending the packet on the default DRB, the UE 110 can create the new DRB and configure it using the default configuration. The default configuration can be pre-defined or provided by the RAN (or gNodeB) 120 in the RRC message. Further, the UE 110 uses an unused LCID for this new DRB. The PM/QFI and optionally PDU session identifier can included in packet transmitted over this new DRB. On receiving the packet for the LCID and/or PM/QFI and/or PDU session identifier for which there is no associated DRB, the RAN (or gNodeB) 120 may map the PM/QFI to existing DRB or add the new DRB for this PM/QFI. Further, the RAN (or gNodeB) 120 sends the updated DRB configuration to the UE 110. If new DRB is added, the UE 110 updates/creates the new DRB corresponding to new configuration and PM/QFI included in the DRB configuration message. In response, the UE 110 may send DRB configuration complete message. After receiving the DRB configuration complete message, the RAN (or gNodeB) 120 creates the DRB using the DRB configuration if new DRB configuration is added for the PM/QFI.

[134] As shown in the FIG. 8, the PDU session and the DRBs (including the default DRB)

are established (802) among the UE 110, the gNodeB 120, an UP entity 190 and a CP entity 200. The UE AS receives (804) the packet with a new QFI from UE NAS. Further, the UE 110 uses (806) the QFI of the packet to map it to the DRB. If there is no mapping of the QFI to the DRB in the AS mapping table for this PDU session, then the packet is assigned to the default DRB for this PDU session.

[135] Further, the UE 110 sends (808) the packet on the default DRB. The UE 110 includes the QFI in the SDAP header if SDAP has been configured for this DRB. SDAP entity is created for each PDU session.

[136] Further, the gNodeB 120 sends (810) the UL packets over NG-U and includes the corresponding QFI.

[137] Further, the gNodeB 120 optionally sets up (812) the DRB for new QoS flow. The user pane data is exchanged (814) between the UE 110 and the gNodeB 120 over radio interface and QFI may be included in the packet header. The user pane data is exchanged (814) between the gNodeB 120 and the UP entity 190 over the PDU tunnel and the QFI is included in the packet header.

[138] As shown in the FIG. 9, the UE 110 receives (902) the UL packet with packet marker PM_1/QFI_1 for the PDU session. Further, the UE 110 determines (904) that the DRB does not exist to handle packets with packet marking PM_1/QFI_1. Further, the UE 110 sends (906) the packet on the default DRB.

[139] Further, the UE 110 sends (908) the BSR: PM_1/QFI_1 to the RAN (or gNodeB) 120. Further, the RAN (or gNodeB) 120 determines that the DRB does not exist to handle packets with the packet marking PM_1/QFI_1 then the RAN (or gNodeB) 120 setups (910) the DRB. The DRB Setup includes (912) DRB Config -> PM_1/QFI_1. Further, the UE 110 creates (914) the DRB using the DRB configuration corresponding to PM_1/QFI_1 and the RAN (or gNodeB) 120 creates (916) the DRB using DRB configuration corresponding to PM_1/QFI_1. The UE 110 sends (918) the radio packet to the RAN (or gNodeB) 120. The RAN (or gNodeB) 120 sends (920) the UL packet with packet marker PM_1/QFI_1 to the UPF 170. Further, the UPF 170 sends (922) the UL IP packet to the DN 180.

[140] FIG. 10 is a sequence diagram illustrating various operations performed for establishing one or more DRBs and mapping the packets of QoS flows to DRBs, according to an embodiment as disclosed herein.

[141] In an embodiment, the RAN (or gNodeB) 120 obtains the list of authorized QoS flows (identified by packet markings i.e. PM or QoS marking or QoS ID or QoS rule or flow descriptor or QoS descriptor or QoS Flow ID (QFI)) for the UE 110. The RAN (or gNodeB) 120 may obtain the authorized list of PMs/QFIs for the UE 110 from the CP function in the CN after the RAN 120 receives the RRC connection request from the UE 110. Alternately, the UE 110 may send authorized the list of PMs/QFIs to the

RAN (or gNodeB) 120. Further, the UE 110 may be pre-configured with the list of authorized PMs/QFIs or the UE 110 may obtain the list of authorized PMs/QFIs from the CP function in the CN.

[142] The QoS parameters of the QoS flow are also provided to the RAN (or gNodeB) 120 as the QoS profile when the PDU session is established or the new QoS flow is established or when the radio connection is established. The QoS parameters may also be pre-configured in the RAN. In the RAN 120, the DRB defines the packet treatment on the radio interface (i.e., Uu). The DRB serves the packets with the same packet forwarding treatment. Separate DRBs may be established for the QoS flows requiring different packet forwarding treatment. The RAN (or gNodeB) 120 knows the mapping between each QoS Flow and associated QoS parameters (or QoS profile) and accordingly decides the radio configuration for corresponding data radio bearer. In the downlink, the RAN (or gNodeB) 120 maps the QoS flows to the DRBs based on the packet marking (i.e. QoS Flow ID) and the associated QoS profiles. For the uplink, the RAN (or gNodeB) provides QoS flow to the DRB mapping in the RRC signaling message. One DRB can be mapped to multiple QoS flows. For each DRB configured, the RAN (or gNodeB) 120 provides the list of one or more QFIs and PDU session identifier. In a system in which only one PDU session can be established for each UE 110, the RAN (or gNodeB) 120 may not provide the PDU session identifier for each configured DRB. The QoS parameters (e.g. packet error rate, latency, data rate, etc.) which are related to the radio level QoS can be same for multiple QoS flows and hence multiple QoS flows of same PDU session can be mapped to same DRB. The QoS flow of the PDU session is not mapped to more than one DRB. The QoS flow of one PDU session and another QoS flow of another PDU session may have same QoS flow identifier but these are mapped to different DRBs.

[143] In other words, the QoS flows of different PDU sessions are not mapped to same DRB. If the QoS flows of different PDU sessions are mapped to same DRB, then on receiving the packet from the UE 110 on the DRB, the gNB 120 cannot identify the PDU session associated with this packet and hence it will not be able to identify the tunnel on which this packet should be sent to the UPF. Note that, the tunnel is different for each PDU session.

[144] In an embodiment, the RAN (or gNodeB) 120 provides one or more DRB configurations to the UE 110 in the RRC signaling message (e.g. RRC connection reconfiguration message). The DRB configuration includes L2 configuration similar to the DRB configuration in the existing system. For example, it may include Service Data Adaptation Protocol (SDAP) configuration, Packet Data Convergence Protocol (PDCP) configuration, Radio Link Control (RLC) configuration, MAC configurations, etc. Each DRB configuration is mapped to one or more PM/QFIs. For each DRB

configured, the RAN (or gNodeB) 120 provides the list of one or more QFIs and PDU session identifier. The RAN (or gNodeB) 120 also indicates whether the DRB corresponding to each DRB configuration is an UL DRB or DL DRB or bidirectional DRB. The UE 110 and the RAN (or gNodeB) 120 create one DRB for each DRB configuration irrespective of whether one or more QoS flows are mapped to same DRB configuration. The created DRB is associated with one or more QoS flows listed in the DRB configuration. The DRB handles the packets of one or more PM/QFIs associated with the DRB.

[145] In embodiment, the RAN (or gNodeB) 120 provides one or more DRB configurations to the UE 110 in the RRC signaling message (e.g. RRC connection reconfiguration message). Each DRB configuration is mapped to one or more PM/QFIs. The RAN (or gNodeB) 120 also indicates whether the DRB corresponding to each data DRB configuration is the UL DRB or the DL DRB or the bidirectional DRB. The UE 110 and the RAN (or gNodeB) 120 creates one DRB for each DRB configuration. However, if the DRB configuration is mapped to multiple PM/QFIs then the UE 110 creates separate data DRB for each PM/QFI using the same DRB configuration. So basically in this embodiment mapping of one DRB configuration to multiple PM/QFIs means that the DRB for these PM/QFIs have same configuration but the packets of these PM/QFIs are mapped to different DRB and hence different queues. The created DRB is associated with one PM/QFI. The DRB handles the packets of QoS flow (identified by PM/QFI) associated with the DRB.

[146] In the UL, an Access Stratum (i.e. AS) layer in the UE 110 receives the packet to be transmitted and associated PM/QFI and the PDU session identifier (needed only when multiple PDU sessions are established for the UE 110) from the higher layer (e.g. NAS layer or application layer). Based on a) PM/QFI and optionally PDU session id of the packet and b) mapping between the DRB to the PMs/QFIs and optionally the PDU session identifier, the UE 110 maps the packet to appropriate DRB. On receiving the packet from the UE 110 on the DRB, the RAN (or gNodeB) 120 identifies the PM/QFI and optionally the PDU session identifier of the received packet based on mapping between the DRB to the PM/QFI and optionally the PDU session identifier. The RAN (or gNodeB) 120 indicates the PM/QFI of the packet to the UPF 170 by adding PM/QFI in the header while transmitting the packet to UPF 170. The packet is transmitted to the UPF 170 on the tunnel associated with the PDU session of the packet.

[147] Further, the RAN (or gNodeB) 120 may provide updated DRB configurations to the UE 110 in the RRC signaling message whenever the PM/QFIs authorized for the UE changes (or new QoS flow is added or existing QoS flow is released).

[148] In one embodiment, the DRB configurations can be provided by the RAN (or gNodeB) 120. The mapping between the PM/QFIs, the PDU session identifier and the

DRB configurations can be provided to the UE 110 by the CP function in the CN.

[149] In one embodiment, in addition to PM/QFI, a priority may also be associated with the packet. Within same DRB, the packets can be treated differently for different priority. The packets can be transmitted in order of priority. The packet queue of the DRB can be managed as priority queue. Alternately, multiple queues can be maintained for packets with different priority.

[150] As shown in the FIG. 10, the list of authorized QoS flows and associated QoS parameters are provided (1002) between the gNodeB 120 and the CN-CP entity. Further, the DRB Config setup including the list of one or more DRBs; for each DRB list of one or more QoS Flows (QFIs) and PDU Session ID is provided (1004) between the UE 110 and the gNodeB 120. Further, the UE 110 creates (1006) the DRBs based on the received DRB configurations. The gNodeB 120 creates (1008) the DRBs based on sent DRB configurations. For each DRB, the UE 110 stores (1010) the list of associated QoS flow(s) and the optionally the PDU Session ID. Further, the gNB 120 maps (1012) the received DL packet to DRB based on the QFI of received packet. Further, the UE 110 maps (1014) the UL packet to the DRB using a) QFI and optionally PDU session id of UL packet and b) DRB to QoS Flow(s) and optionally PDU session identifier mapping.

[151] FIG. 11 is a sequence diagram illustrating various operations performed for establishing one or more DRBs in the DL, and FIG. 12 is a sequence diagram illustrating various operations performed for establishing one or more DRBs in the UL, according to an embodiment as disclosed herein.

[152] In an embodiment, the RAN (or gNodeB) 120 provides mapping between one or more DRBs and the QoS flows (identified by the QoS flow identifier /PM) to the UE 110 in the RRC signaling message (e.g. RRC connection reconfiguration message). The DRB configuration includes the L2 configuration similar to the DRB configuration in the existing system is provided for each DRB. For example, it may include the SDAP configuration, the PDCP configuration, the RLC configuration, the MAC configurations, etc. Each DRB is mapped to one or more PM/QFIs. For each DRB configured, the RAN (or gNB) 120 provides the list of one or more QFIs and optionally PDU session identifier. The QoS flows of same PDU session can be mapped to same DRB. The QoS flow of the PDU session is not mapped to more than one DRB. The QoS flow of one PDU session and another QoS flow of another PDU session may have same QoS Flow ID but these are mapped to different DRBs. In other words, the QoS flows of different PDU sessions are not mapped to same DRB.

[153] Further, if QoS flows of different PDU sessions are mapped to same DRB, then on receiving the packet from UE 110 on the DRB, the gNB 120 cannot identify the PDU session associated with this packet and hence it will not be able to identify the tunnel

on which this packet should be sent to the UPF 170. Note that, the tunnel is different for each PDU session. The RAN 120 also indicates whether each DRB is an UL DRB or DL DRB or bidirectional DRB. The logical channel ID may or may not be present in the DRB configuration. However, the LCG ID is included. In one embodiment, in case LCID is included, for the DL only DRB, the PM/QFI and PDU session id may not be included.

[154] The PM/QFIs, for which DRB configuration is provided, can be the QFIs/PMs for which UE 110 is authorized. The RAN (or gNodeB) 120 may obtain the PM/QFIs when the RAN 120 receives the RRC connection request from the UE 110. The RAN (or gNodeB) 120 may obtain the PM/QFIs from the CP function in the CN. Alternately, the UE 110 may send the PM/QFIs to the RAN (or gNodeB) 120. Further, the UE 110 may be pre-configured with the authorized QFIs/PMs or the UE 110 may obtain the PM/QFIs from the CP function in the CN.

[155] The QoS parameters of the QoS flow are also provided to the RAN (or gNodeB) 120 as the QoS profile when the PDU session is established or the new QoS flow is established or when the radio connection is established. The QoS parameters may also be pre-configured in the RAN 120. The RAN (or gNodeB) 120 knows the mapping between each QFI/PM and associated QoS parameters and accordingly decides the radio configuration for corresponding DRB. The QoS parameters (e.g. packet error rate, latency, data rate, etc.) which are related to the radio level QoS can be same for two QFIs/PMs and hence multiple QFIs/PMs can be mapped to same DRB.

[156] In the proposed method, the DRB is established as shown in FIG. 11 for the DL and as shown in the FIG. 12 for the UL.

[157] DL DRB creation: In the proposed method, the RAN (or gNodeB) 120 receives the packet in the DL from the UP function in the CN. The RAN (or gNodeB) 120 receives the PM/QFI associated with the packet along with the packet marking. The RAN (or gNodeB) 120 checks if the DRB is already established for the PM/QFI associated with received packet or not.

[158] If not then, in an embodiment, the RAN (or gNodeB) 120 may create the DRB using the DRB configuration corresponding to the PM/QFI and the PDU session and adds the packet in the DRB queue. Further, the RAN (or gNodeB) 120 sends the packet to the UE 110 and may include the PM/QFI and optionally PDU session id in the packet header.

[159] If not then, in an embodiment, the RAN (or gNodeB) 120 may add the QoS flow corresponding to the PM/QFI of received packet to one of the existing DRB. Further, the RAN (or gNodeB) 120 updates the DRB configuration to the QoS flows mapping. Further, the RAN (or gNodeB) 120 sends the RRC signaling message to the UE 110 with updated DRB configurations to the QoS flows mapping. Further, the RAN (or

gNodeB) 120 adds the packet in the queue of DRB to which the QoS flow of receive packet is mapped.

[160] If yes, the RAN (or gNodeB) 120 adds the packet in the DRB queue.

[161] On receiving the packet in the DL, the UE 110 obtains the LCID and determines if there exists the DRB corresponding to the LCID. If yes, the UE 110 maps the packet to that DRB. If not, then there are two approaches:

[162] Approach 1 (as shown in the FIG. 11): The UE 110 obtains the PM/QFI and optionally PDU session identifier for the received packet. Further, the UE 110 creates the DRB using the DRB configuration corresponding to PM/QFI and optionally PDU session id and adds the packet in this DRB queue. The LCID of the logical channel associated with this new DRB is the LCID of the received packet.

[163] Approach 2: Alternately, the UE 110 creates the DRB using the DRB configuration corresponding to the LCID and adds the packet in the DRB queue. Note that, the DRB configuration configured for each PM/QFI may have LCID. So, based on the LCID, the UE 110 can identify the DRB configuration to be used for creating the DRB. The LCID of the logical channel associated with this new DRB is the LCID of the received packet.

[164] In an embodiment, the UE 110 may decide to follow approach 1 or approach 2 depending on whether the LCID is included in the DRB configuration or not. The RAN (or gNodeB) 120 may include the PM/QFI and optionally PDU session id in the packet header depending on whether the LCID is included in the DRB configuration or not.

[165] UL DRB Creation: In the UL, the access stratum layer in UE receives the packet to be transmitted and associated the PM PM/QFI and optionally PDU session identifier from the higher layer (e.g. NAS layer or application layer). Further, the UE 110 checks if the DRB is already established for the PM/QFI and optionally the PDU session identifier associated with received packet or not.

[166] If not, the UE 110 creates the DRB using the DRB configuration corresponding to the PM/QFI and optionally the PDU session identifier and adds the packet in the DRB queue. If the LCID is not included in the DRB configuration, the UE 110 itself assigns an unused LCID for the DRB. Further, the UE 110 sends the packet to the RAN (or gNodeB) 120 and may include the PM/QFI and the PDU Session ID in the packet header. If the LCID is included in the DRB configuration, the UE 110 may not include the PM/QFI and PDU session identifier in the packet header.

[167] If yes, the UE 110 adds the packet in that the DRB queue.

[168] In an embodiment, on receiving the packet from the UE 110, the RAN (or gNodeB) 120 checks if the DRB is already established for the PM/QFI and the PDU session id associated with received packet or not. If not, the RAN (or gNodeB) 120 creates the

DRB using the DRB configuration corresponding to the PM/QFI and the PDU session identifier and adds the packet in this DRB queue. If yes, the RAN (or gNodeB) 120 adds the packet in the DRB queue.

[169] In an embodiment, on receiving the packet in the UL, the RAN (or gNodeB) 120 obtains the LCID and determines if there exists the DRB corresponding to this LCID. If yes, the RAN (or gNodeB) 120 maps the packet to that DRB. If not, then there are two approaches:

[170] Approach 1: The RAN (or gNodeB) 120 obtains the PM/QFI and PDU session identifier for the received packet. Further, the RAN (or gNodeB) 120 creates the DRB using the DRB configuration corresponding to the PM/QFI and optionally the PDU session identifier and adds the packet in the DRB queue. The LCID of the logical channel associated with the new DRB is the LCID of the received packet.

[171] Approach 2: Alternately, the RAN (or gNodeB) 120 creates the DRB using the DRB configuration corresponding to the LCID and adds the packet in the DRB queue. Note that, the DRB configuration configured for each PM/QFI and optionally PDU session identifier may have the LCID. So, based on the LCID, the RAN (or gNodeB) 120 can identify the DRB configuration to be used for creating the DRB. The LCID of the logical channel associated with the new DRB is the LCID of the received packet.

[172] In an embodiment, the RAN (or gNodeB) 120 decides to follow approach 1 or approach 2 depending on whether the LCID is included in the DRB configuration or not. The UE 110 may include the PM/QFI and the optionally PDU session identifier in the packet header depending on whether the LCID is included in the DRB configuration or not.

[173] Further, the RAN (or gNodeB) sends the packet to the UPF 170 and may include the PM/QFI in the packet header. The packet is transmitted to the UPF 170 on the tunnel associated with the PDU session of the packet.

[174] In an embodiment, the PM/QFI and optionally the PDU session identifier may be included in the BSR. On receiving the PM/QFI and optionally PDU session identifier in the BSR, if there does not exist the DRB for the PM/QFI and optionally the PDU session identifier, then the RAN (or gNodeB) 120 creates the DRB. In this case, the UE 110 does not include the PM/QFI in the UL packet. Alternately, the LCID may be included in the BSR. On receiving the LCID in the BSR, if there does not exist the DRB for this LCID then the RAN (or gNodeB) 120 creates the DRB. In this case, the UE 110 does not need to include the PM/QFI and optionally the PDU session identifier in the UL packet. Note that, the DRB configuration configured for each PM/QFI and PDU session identifier may have the LCID. So that, based on LCID, the RAN (or gNodeB) 120 can identify the DRB configuration to be used for creating the DRB. The LCID of the logical channel associated with this new DRB is the LCID of the received

packet.

[175] As shown in the FIG. 11, the DN 180 sends (1102) the DL IP packet to the UPF 170. The DRB configuration Setup: List of Mapping between PM/QFI(s) and DRB configuration is established (1104) between the UE 110 and the RAN 120. The UPF sends (1106) the DL packet along with Packet Marker PM_1 or QFI_1 to the RAN 120. Further, the RAN determines (1108) that the DRB does not exist to handle packets with packet marking PM_1/QFI_1. The RAN creates (1110) the DRB using the DRB configuration corresponding to PM_1/QFI_1. The RAN 120 sends (1112) the radio packet along with Packet Marker PM_1/QFI_1. The UE 110 determines (1114) that the DRB does not exist to handle the received radio packet. The UE 110 creates (1116) the DRB using DRB configuration corresponding to PM_1/QFI_1

[176] As shown in the FIG. 12, the DRB Config Setup: List of Mapping between PM/QFI(s) and DRB configuration is established (1202) between the UE 110 and the RAN 120. Further, the UE 110 receives (1204) the UL packet with the Packet Marker PM_1/QFI_1. Further, the UE 110 determines (1206) that the DRB does not exist to handle packets with packet marking PM_1/QFI_1. Further, the UE 110 creates (1208) the DRB using DRB configuration corresponding to PM_1/QFI_1. Further, the UE 110 sends (1210) the radio packet along with Packet Marker PM_1/QFI_1 to the RAN 120. Further, the RAN 120 determines (1212) that the DRB does not exist to handle the received radio packet. Further, the RAN 120 creates (1214) the DRB using DRB configuration corresponding to PM_1/QFI_1. Further, the RAN 120 sends (1216) the UL packet along with the Packet marker PM_1/QFI_1 to the UPF 170. The UPF 170 sends (1218) the UL IP packet to the DN 140.

[177] FIG. 13 is a sequence diagram illustrating various operations performed for the DRB establishment in the DL, according to an embodiment as disclosed herein.

[178] The QoS parameters of the QoS flow are also provided to the RAN (or gNodeB) 120 as the QoS profile when the PDU session is established or the new QoS flow is established or when the radio connection is established. Further, the QoS parameters may also be pre-configured in the RAN 120. In the RAN 120, the DRB defines the packet treatment on the radio interface (Uu). The DRB serves packets with the same packet forwarding treatment. The separate DRBs may be established for the QoS flows requiring different packet forwarding treatment. The RAN (or gNodeB) 120 knows the mapping between each QoS flow and associated QoS parameters (or QoS profile) and accordingly decides the radio configuration for corresponding data radio bearer. In the downlink, the RAN (or gNodeB) 120 maps the QoS flows to the DRBs based on the packet marking (i.e. QoS Flow ID) and the associated QoS profiles. For the uplink, the RAN (or gNodeB) 120 provides the QoS flow to the DRB mapping in the RRC signaling message. One DRB can be mapped to multiple QoS flows. For each DRB

configured, the RAN (or gNodeB) 120 provides the list of one or more QFIs and PDU session identifier. The QoS parameters (e.g. packet error rate, latency, data rate, etc.) which are related to radio level QoS can be same for multiple QoS flows and hence multiple QoS flows of same PDU session can be mapped to same DRB. The QoS flow of the PDU session is not mapped to more than one DRB. The QoS flow of one PDU session and another QoS flow of another PDU session may have same QoS Flow ID but these are mapped to different DRBs. In other words, the QoS flows of different PDU sessions are not mapped to same DRB.

[179] If the QoS flows of different PDU sessions are mapped to same DRB, then on receiving the packet from the UE 110 on the DRB, the gNodeB 120 cannot identify the PDU session associated with this packet and hence it will not be able to identify the tunnel on which this packet should be sent to the UPF. Note that the tunnel is different for each PDU session.

[180] In the proposed method, the DN 180 sends (1302) the DL IP packet to the UPF 170. The RAN (or gNodeB) 120 receives (1304) the packet in the DL from the UP function in the CN. Further, the RAN (or gNodeB) 120 receives the PM/QFI associated with the packet along with the packet marking. The RAN (or gNodeB) 120 checks (1306) if the DRB is already established for the PM/QFI and optionally the PDU session associated with received packet or not. If not, the RAN (or gNodeB) 120 initiates (1308) the DRB setup. It sends DRB configuration message including the DRB configuration and its mapping to one or more PM/QFIs and optionally PDU session identifier. The RAN (or gNodeB) 120 knows the mapping between each PM/QFI and associated QoS parameters and accordingly decides the radio configuration for corresponding DRB. The QoS parameters which are related to radio level QoS can be same for two PM/QFIs and hence multiple PM/QFIs can be mapped to same DRB, so that the RAN (or gNodeB) 120 may add the PM/QFI of received packet to the list of PM/QFIs for an existing DRB or add a new DRB and provide new DRB configuration for the PM/QFI of the received packet. If new DRB is added, the UE 110 creates (1310) the new DRB corresponding to new configuration and PM/QFI included in the DRB configuration message.

[181] In response, the UE 110 may send DRB configuration complete message. After receiving the DRB configuration complete message, the RAN (or gNodeB) 120 creates (1312) the DRB using the DRB configuration corresponding to PM/QFI of received packet if new DRB configuration is added for this PM/QFI and adds the packet in this DRB queue. If the PM/QFI of received packet is added to existing DRB then the packet is mapped (1312) to that DRB queue.

[182] FIG. 14 is a sequence diagram illustrating various operations performed for DRB establishment in the DL, according to an embodiment as disclosed herein. In an em-

bodiment, in the UL, the access stratum layer receives (1402) the packet to be transmitted and associated PM/QFI and optionally the PDU session identifier from the higher layer (e.g. NAS layer or application layer). Further, the UE 110 checks (1404) if the DRB is already established for the PM/QFI and optionally the PDU session identifier associated with received packet or not. If not, the UE initiates (1406) the DRB setup. It sends DRB configuration request message including the PM/QFI and optionally the PDU session identifier of the received packet. On receiving the DRB configuration request message with PM/QFI and PDU session identifier, the RAN (or gNodeB) 120 decides (1408) the radio configuration for corresponding DRB. The RAN (or gNodeB) 120 knows the mapping between each PM/QFI and associated QoS parameters and accordingly decides the radio configuration. The QoS parameters which are related to the radio level QoS can be same for two PM/QFIs and hence multiple PM. Further, the QFIs can be mapped to same DRB, so that the RAN (or gNodeB) 120 may add the PM/QFI received in the DRB configuration request message to list of PM/QFIs for an existing DRB or add the new DRB and provide new DRB configuration for the PM/QFI and PDU session id of received packet. Further, the RAN (or gNodeB) 120 sends the DRB configuration message to the UE 110.

[183] If new DRB is added then the UE 110 creates (1410) the new DRB corresponding to new configuration and the PM/QFI included in the DRB configuration message. In response, the UE 110 may send DRB configuration complete message. After receiving the DRB configuration complete message, the RAN (or gNodeB) 120 creates (1412) the DRB using the DRB configuration if new DRB configuration is added for the PM/QFI.

[184] Further, the UE 110 sends the radio packet to the RAN (or gNodeB) 120. Further, the RAN 120 sends the (1416) the UL packet along with the packet marker PM_1/QFI_1 to the UPF 170. The UPF 170 sends (1418) the UL IP packet to the DN 140.

[185] In an embodiment, each DRB is associated with the PDCP entity, multiple RLC entities and logical channels. In the proposed method, the packets with different PM/QFI or packets of different flows are processed by same PDCP entity. The PDCP PDUs associated with different PM/QFI or different flows are processed by different RLC entity. The RLC PDUs of each RLC entity is processed or mapped to different logical channel.

[186] Further, the RAN (or gNodeB) 120 may provide one or more DRB configurations. Each DRB configuration is associated with one or more PM/QFIs or flows. There is one PDCP configuration per DRB. There can be multiple RLC configurations per DRB. Each RLC configuration is mapped to one or more PM/QFIs or flows. Further, the UE 110 creates RLC entity and logical channel for each RLC configuration. There can be multiple logical channel configurations per DRB. Number of logical channel

configurations is equal to number of RLC configurations. That is, there is one to one mapping between logical channel and RLC entity.

[187] The advantage of this approach is that functions like ROHC; securities which are same for each flow can be applied using one PDCP entity. RLC/logical channel functions are flow specific and hence applied independently.

[188] In an embodiment, the RAN (or gNodeB) 120 may provide one or more DRB configurations. Each DRB configuration is associated with one or more PM/QFIs or flows. There is one PDCP configuration per DRB. There is one RLC configuration per DRB. The logical channel configuration can be different for different PM/QFI or flows. This means that each DRB is mapped to multiple logical channels. The RLC PDUs of different flows/PM/QFIs are mapped to different logical channels. The advantage of this approach is that functions like ROHC; securities, ARQ which are same for each flow can be applied using one PDCP/RLC entity. The logical channel functions are flow specific and hence applied independently.

[189] In an embodiment, the UE 110 may handover from one RAN (or gNodeB) also referred as source gNodeB to another RAN (or gNodeB) also referred as target gNodeB due to mobility. In this case to avoid any loss of packets, the source gNodeB may transmit to target gNodeB, one or more packets received by it from the network entity 160. The packets which are either not yet transmitted by the source gNodeB to the UE 110 or the packets which are transmitted but not yet acknowledged by the UE 110 are transmitted the source gNodeB to the target gNodeB. In order to enable the target gNodeB to map these packets to appropriate DRBs the source gNodeB provides to the target gNodeB, the QFI and optionally the PDU session identifier of the PDU session associated with each packet. The target gNodeB can then map these packets of each PDU session to the DRBs based on the QFI using the methods explained earlier wherein the gNodeB 120 maps the packets received from the network entity 160 to DRBs based on the QFI.

[190] The embodiments disclosed herein can be implemented using at least one software program running on at least one hardware device and performing network management functions to control the elements.

[191] The foregoing description of the specific embodiments will so fully reveal the general nature of the embodiments herein that others can, by applying current knowledge, readily modify and/or adapt for various applications such specific embodiments without departing from the generic concept, and, therefore, such adaptations and modifications should and are intended to be comprehended within the meaning and range of equivalents of the disclosed embodiments. It is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation. Therefore, while the embodiments herein have been described in terms of

preferred embodiments, those skilled in the art will recognize that the embodiments herein can be practiced with modification within the spirit and scope of the embodiments as described herein.

Claims

[Claim 1] A method for managing a data communication in a wireless communication network, comprising:
receiving, by a gNodeB, a plurality of packets of at least one QoS flow from a network entity, wherein an identifier (ID) associated with the at least one QoS flow is included in a header of each packet; and
mapping, by the gNodeB, each received packet of the at least one QoS flow to a Data Radio Bearer (DRB) wherein the at least one QoS flow is mapped to the DRB based on the ID associated with the at least one QoS flow.

[Claim 2] The method of claim 1, wherein receiving by a gNodeB the plurality of packets of the at least one QoS flow from the network entity comprising receiving the packet on at least one PDU tunnel between the gNodeB and the network entity, wherein the PDU tunnel is separate for receiving the plurality of packets of the at least one QoS flow of each PDU session, and
wherein mapping by the gNodeB each received packet of the at least one QoS flow to the DRB comprising mapping the received packet to an already established DRB if the list of at least one QoS flow identifiers associated with the established DRB includes the QoS flow identifier of the received packet and the established DRB is associated with the PDU session of the received packet.

[Claim 3] The method of claim 1, wherein mapping by the gNodeB each received packet of the at least one QoS flow to the DRB comprises:
establishing a new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet;
transmitting a signaling message including the DRB configuration of new DRB to a User Equipment (UE), wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB; and
mapping the received packet to newly established DRB.

[Claim 4] The method of claim 1, wherein mapping by the gNodeB each received packet of the at least one QoS flow to the DRB comprises:
updating configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow

of the received packet wherein the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB;
transmitting a signaling message including the DRB configuration of the updated DRB to the User Equipment (UE) wherein the DRB configuration includes the at least one of the PDU session identifier and a list of at least one of QoS flow identifiers of the QoS flows associated with the DRB; and
mapping the received packet to the updated DRB,
wherein the QoS flow is mapped to only one DRB,
wherein the DRB is mapped to the at least one QoS flow of same PDU session, and
wherein each of the DRB defines a packet forwarding treatment on a radio interface to data exchange between the UE and the gNodeB in the wireless communication network.

[Claim 5] A method for managing a data communication in a wireless communication network, comprising:
determining, by a User Equipment (UE), a Data Radio Bearer (DRB) for transmitting a packet based on a QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session;
performing by the UE one of:
mapping the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet;
mapping the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet; and
transmitting the packet over the mapped DRB.

[Claim 6] The method of claim 5, wherein the UE receives mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB in a signaling message,
wherein the UE receives the PDU session identifier and a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in a signaling message, and
wherein the UE receives a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in a signaling message.

[Claim 7] The method of claim 5, wherein the method further comprises:

establishing by the gNodeB a new DRB for the QoS flow identifier and the PDU session identifier received in the packet header of the packet received on the default DRB;
transmitting by the gNodeB the signaling message including the DRB configuration of new DRB to the UE, wherein the DRB configuration includes one or more of a PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB;
updating by the gNodeB an already established DRB corresponding to the PDU session identifier received in the packet header of packet received on the default DRB, wherein the QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB; and
transmitting by the gNodeB a signaling message including the DRB configuration of the updated DRB to the UE, wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS Flows associated with DRB,
wherein the UE receives the default DRB configuration associated with the PDU session in a RRC signaling message, and
wherein the UE transmits the at least one of the QoS flow identifier and the PDU session identifier in a packet header of the packet on the default DRB.

[Claim 8] The method of claim 5, wherein the method further comprises:
establishing by the gNodeB a new DRB for the QoS flow identifier received in the packet header of the packet received on the default DRB;
transmitting by the gNodeB the signaling message including the DRB configuration of new DRB to the UE;
updating by the gNodeB an already established DRB, wherein the QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB; and
transmitting by the gNodeB a signaling message including the DRB configuration of the updated DRB to the UE, wherein the DRB configuration includes a list of one or more QoS flow identifiers of the QoS Flows associated with DRB,
wherein the DRB configuration includes a list of one or more QoS flow identifiers of the QoS flows associated with the DRB.

[Claim 9] An apparatus for managing a data communication in a wireless com-

munication network, comprising:
a memory to store DRB configurations;
a processor; and
a DRB management unit, coupled to the memory and the processor configured to:
receive a plurality of packets of at least one QoS flow from a network entity, wherein an identifier (ID) associated with the at least one QoS flow is included in a header of each packet; and
map each received packet of the at least one QoS flow to a Data Radio Bearer (DRB) wherein the at least one QoS flow is mapped to the DRB based on the ID associated with the at least one QoS flow and an QoS parameter.

[Claim 10] The apparatus of claim 9, wherein receive the plurality of packets of the at least one QoS flow from the network entity comprises receive the packet on at least one PDU tunnel between the gNodeB and the network entity, wherein the PDU tunnel is separate for receiving the plurality of packets of the at least one QoS flow of each PDU session, and
wherein map each received packet of the at least one QoS flow to the DRB comprises map the received packet to an already established DRB if the list of at least one QoS flow identifiers associated with the established DRB includes the QoS flow identifier of the received packet and the established DRB is associated with the PDU session of the received packet.

[Claim 11] The apparatus of claim 9, wherein map each received packet of the at least one QoS flow to the DRB comprises:
establish a new DRB if none of the established DRBs is associated with the PDU session and the QoS flow of the received packet;
transmit a signaling message including the DRB configuration of new DRB to a User Equipment (UE), wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB;
map the received packet to newly established DRB;
update configuration of an already established DRB associated with the PDU session of the received packet if none of the established DRBs for the PDU session of received packet is associated with the QoS flow of the received packet wherein the QoS flow identifier of the received packet is added to the list of QoS flow identifiers of the updated DRB;

transmit a signaling message including the DRB configuration of the updated DRB to the User Equipment (UE) wherein the DRB configuration includes the at least one of the PDU session identifier and a list of at least one of QoS flow identifiers of the QoS flows associated with the DRB; and

map the received packet to the updated DRB,

wherein the QoS flow is mapped to only one DRB,

wherein the DRB is mapped to the at least one QoS flow of same PDU session, and

wherein each of the DRB defines a packet forwarding treatment on a radio interface to data exchange between the UE and the gNodeB in the wireless communication network.

[Claim 12] A user equipment (UE) for managing a data communication in a wireless communication network, comprising:

a memory to store a DRB configuration received from an gNodeB in the wireless communication network;

a processor; and

a DRB management unit, coupled to the memory and the processor configured to:

determine a Data Radio Bearer (DRB) for transmitting a packet based on a QoS flow identifier and a PDU session associated with the packet and mapping of the QoS flow identifiers to the DRBs for each established PDU session;

perform one of:

mapping the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet, and

mapping the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS flow identifier of the packet; and

transmit the packet over the mapped DRB.

[Claim 13] The UE of claim 12, wherein the UE receives mapping of the QoS flow identifiers to the DRBs for each established PDU session from the gNodeB in a signaling message,

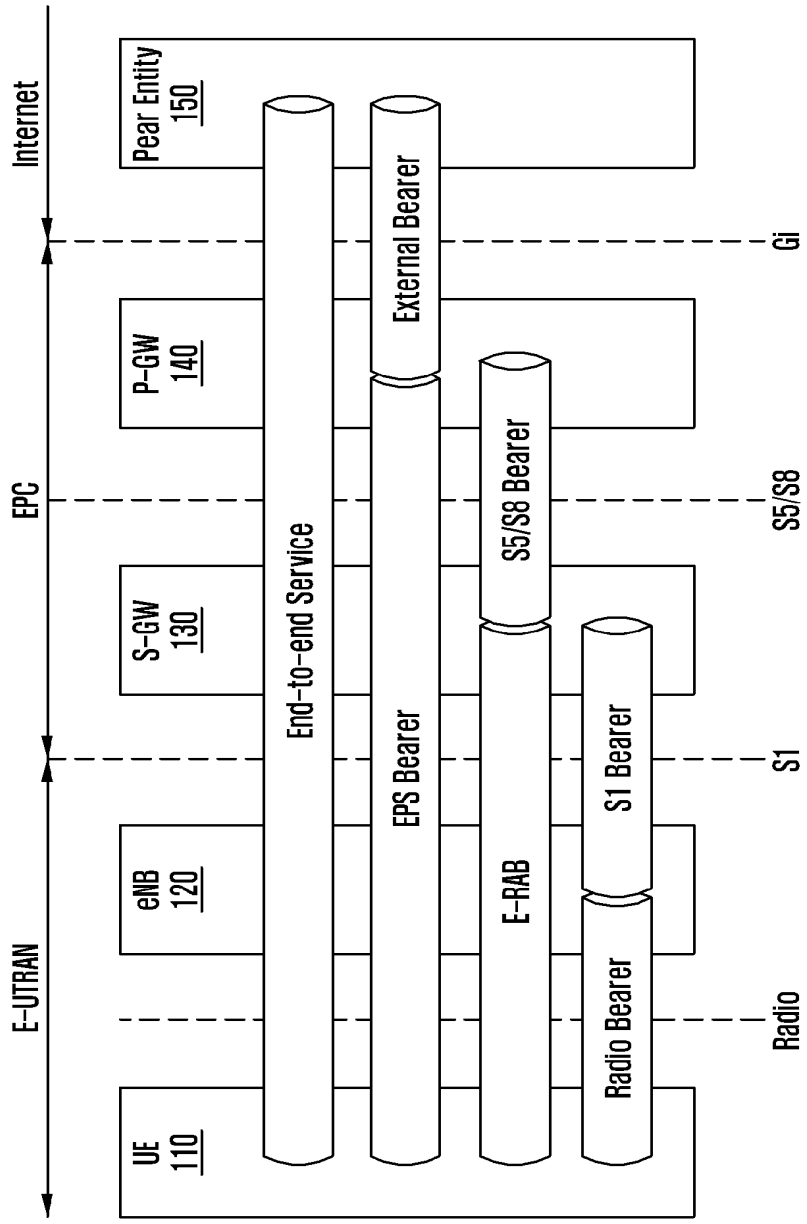
wherein the UE receives the PDU session identifier and a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in the RRC signaling message, and

wherein the UE receives a list of at least one of QoS flow identifiers associated with each DRB from the gNodeB in a signaling message.

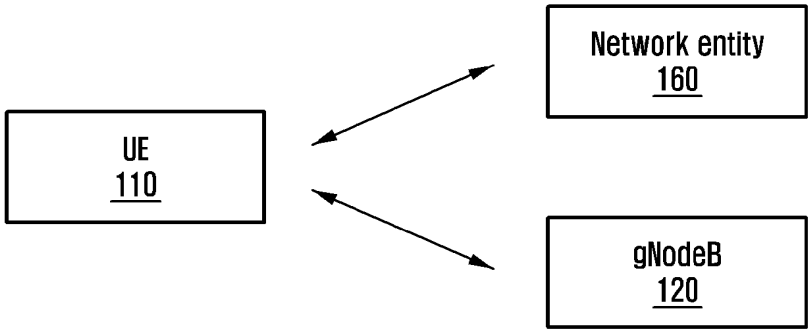
[Claim 14] The UE of claim 12, wherein the UE is further configured to:
establish a new DRB for the QoS flow identifier and the PDU session identifier received in the packet header of the packet received on the default DRB; and
transmit the signaling message including the DRB configuration of new DRB, wherein the DRB configuration includes one or more of a PDU session identifier and a list of one or more QoS flow identifiers of the QoS flows associated with the DRB,
wherein the UE receives the default DRB configuration associated with the PDU session in a RRC signaling message, and
wherein the UE transmits at least one of the QoS flow identifier and the PDU session identifier in a packet header of the packet on the default DRB.

[Claim 15] The UE of claim 14, wherein the UE is further configured to:
establish a new DRB for the QoS flow identifier received in the packet header of the packet received on the default DRB;
transmit the signaling message including the DRB configuration of new DRB, wherein the DRB configuration includes a list of one or more QoS flow identifiers of the QoS flows associated with the DRB;
update an already established DRB corresponding to the PDU session identifier received in the packet header of packet received on the default DRB, wherein the QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB;
transmit a signaling message including the DRB configuration of the updated DRB, wherein the DRB configuration includes one or more of the PDU session identifier and a list of one or more QoS flow identifiers of the QoS Flows associated with DRB;
update an already established DRB, wherein the QoS flow identifier of the packet received on the default DRB is added to the list of the QoS flow identifiers of the updated DRB; and
transmit a signaling message including the DRB configuration of the updated DRB, wherein the DRB configuration includes a list of one or more QoS flow identifiers of the QoS Flows associated with DRB.

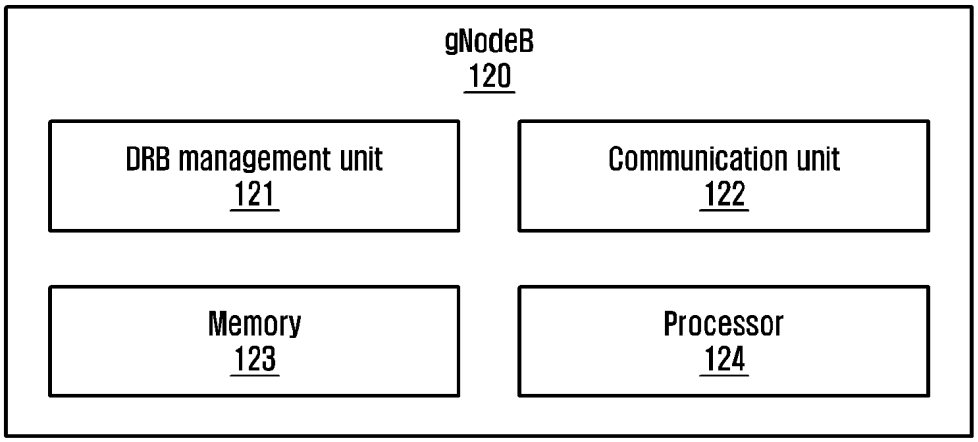
[Fig. 1]


Internet
Pear Entity 150
External Bearer
Gi
P-GW 140
EPC
S5/S8 Bearer
S5/S8
S-GW 130
End-to-end Service
EPS Bearer
E-RAB
S1 Bearer
S1
eNB 120
E-UTRAN
Radio Bearer
Radio
UE 110

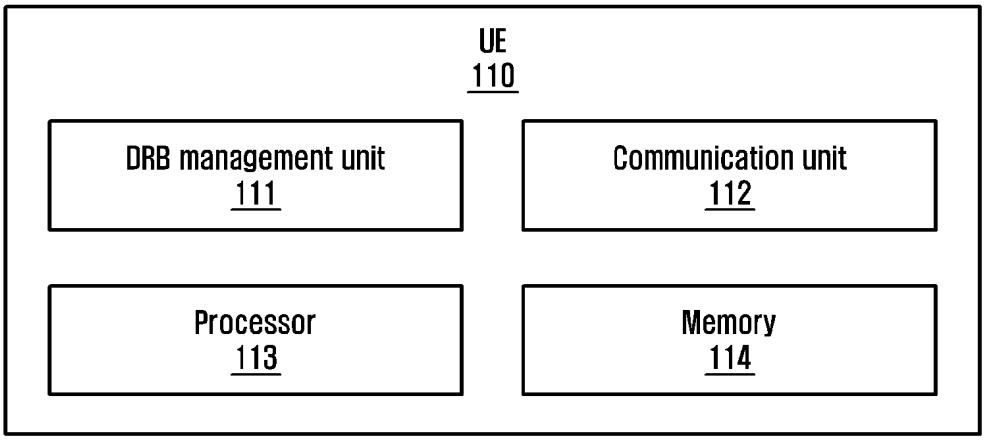
[Fig. 2]


Network entity 160
UE 110
gNodeB 120

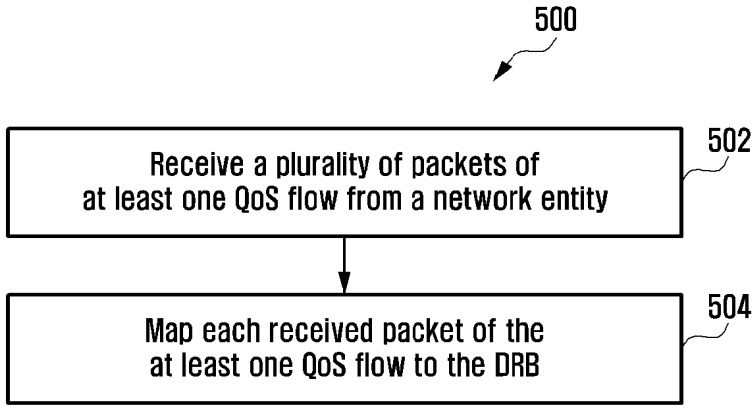
[Fig. 3]



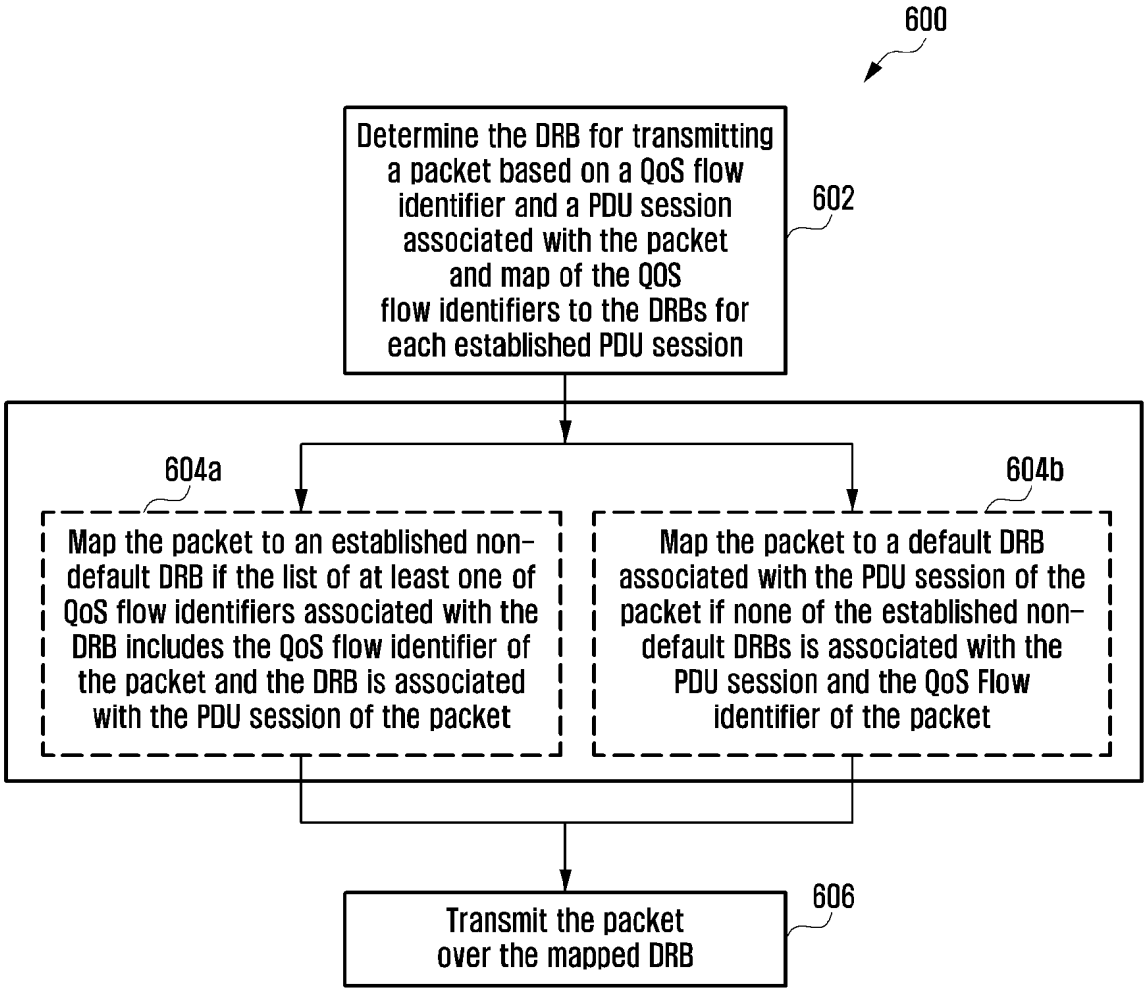
[Fig. 4]



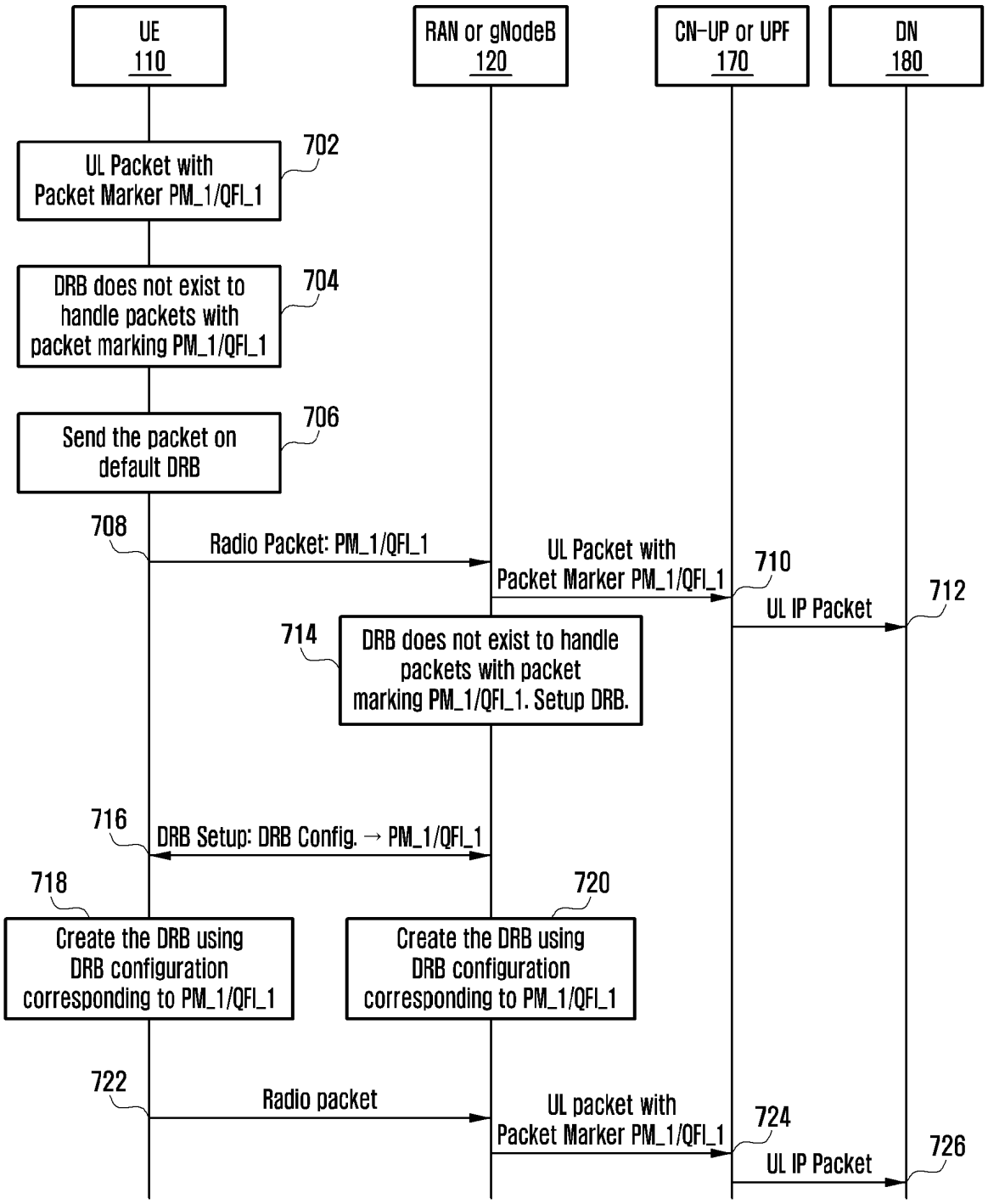
[Fig. 5]



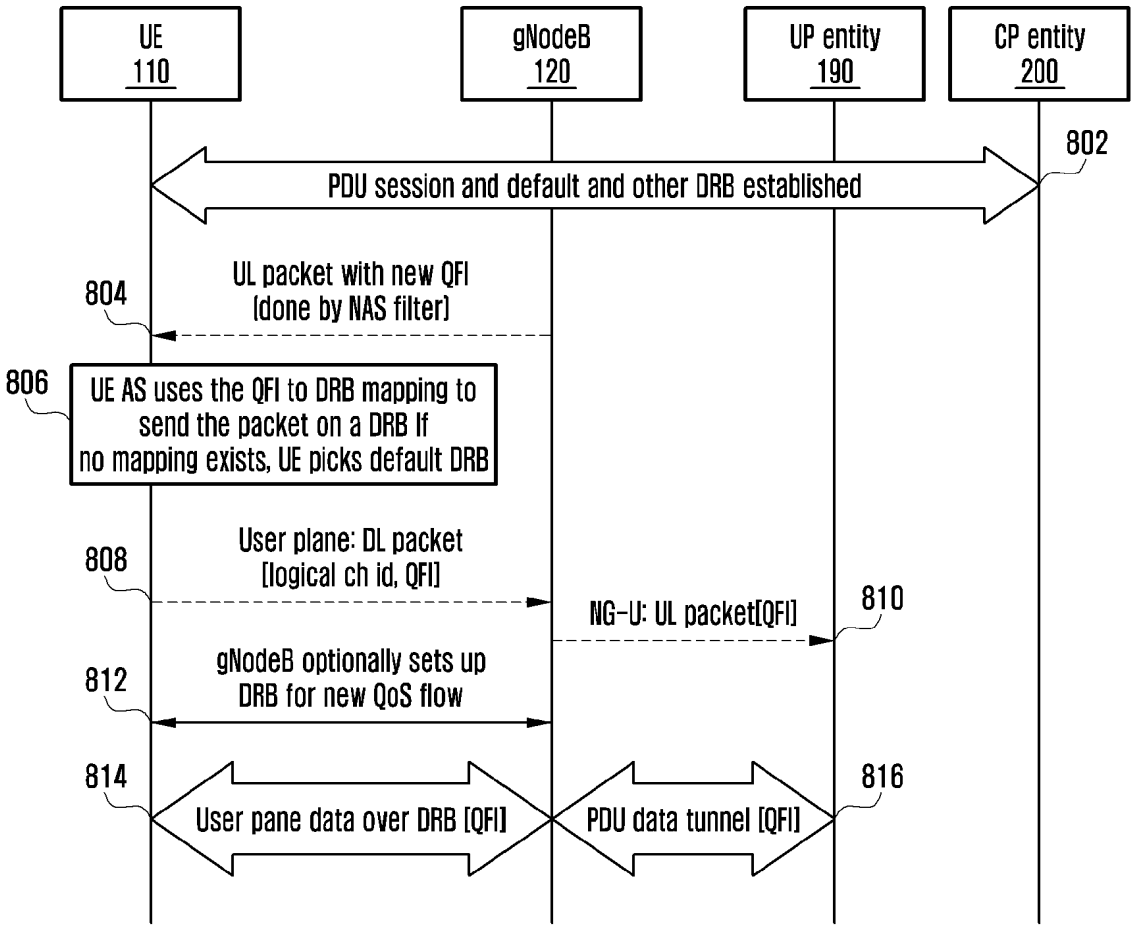
[Fig. 6]


600
Determine the DRB for transmitting a packet based on a QoS flow identifier and a PDU session associated with the packet and map of the QOS flow identifiers to the DRBs for each established PDU session
602
604a
Map the packet to an established non-default DRB if the list of at least one of QoS flow identifiers associated with the DRB includes the QoS flow identifier of the packet and the DRB is associated with the PDU session of the packet
604b
Map the packet to a default DRB associated with the PDU session of the packet if none of the established non-default DRBs is associated with the PDU session and the QoS Flow identifier of the packet
Transmit the packet over the mapped DRB
606

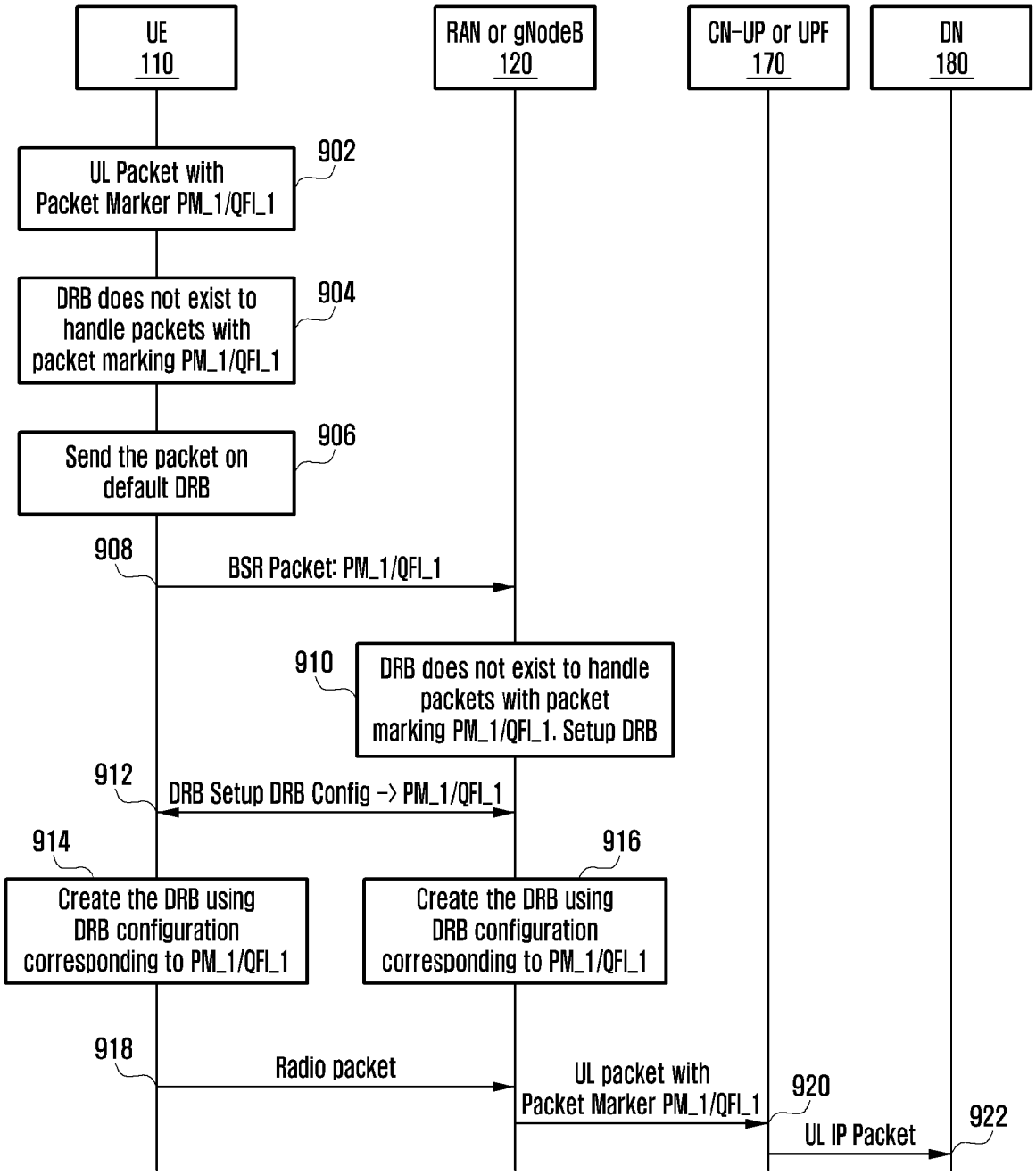
[Fig. 7]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
UL Packet with
Packet Marker PM_1/QFI_1
702
DRB does not exist to
handle packets with
packet marking PM_1/QFI_1
704
Send the packet on
default DRB
706
708
Radio Packet: PM_1/QFI_1
UL Packet with
Packet Marker PM_1/QFI_1
710
UL IP Packet
712
714
DRB does not exist to handle
packets with packet
marking PM_1/QFI_1. Setup DRB.
716
DRB Setup: DRB Config. → PM_1/QFI_1
718
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
720
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
722
Radio packet
UL packet with
Packet Marker PM_1/QFI_1
724
UL IP Packet
726

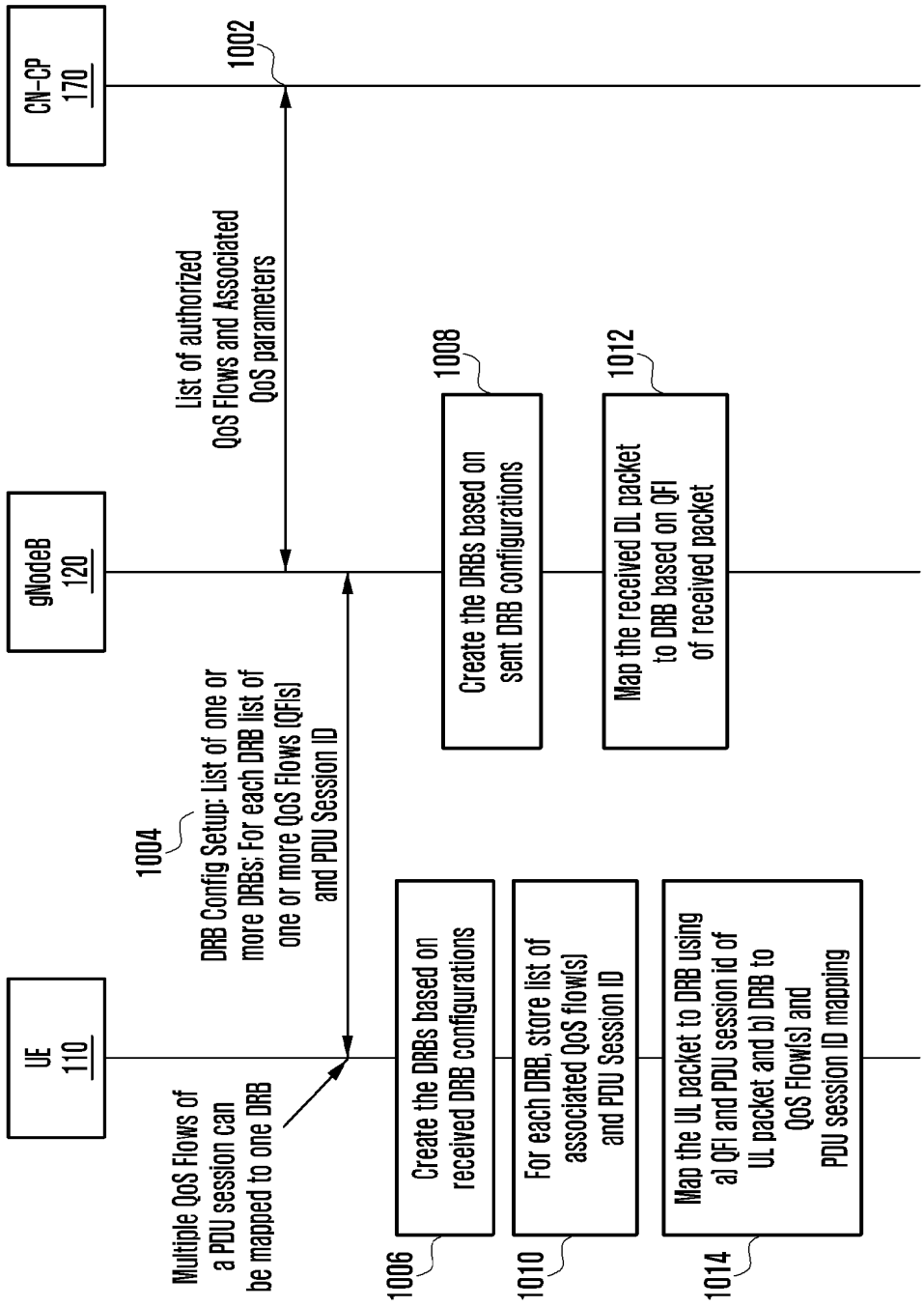
[Fig. 8]


UE
110
gNodeB
120
UP entity
190
CP entity
200
802
PDU session and default and other DRB established
804
UL packet with new QFI
(done by NAS filter)
806
UE AS uses the QFI to DRB mapping to
send the packet on a DRB If
no mapping exists, UE picks default DRB
808
User plane: DL packet
[logical ch id, QFI]
NG-U: UL packet[QFI]
810
812
gNodeB optionally sets up
DRB for new QoS flow
814
User pane data over DRB [QFI]
PDU data tunnel [QFI]
816

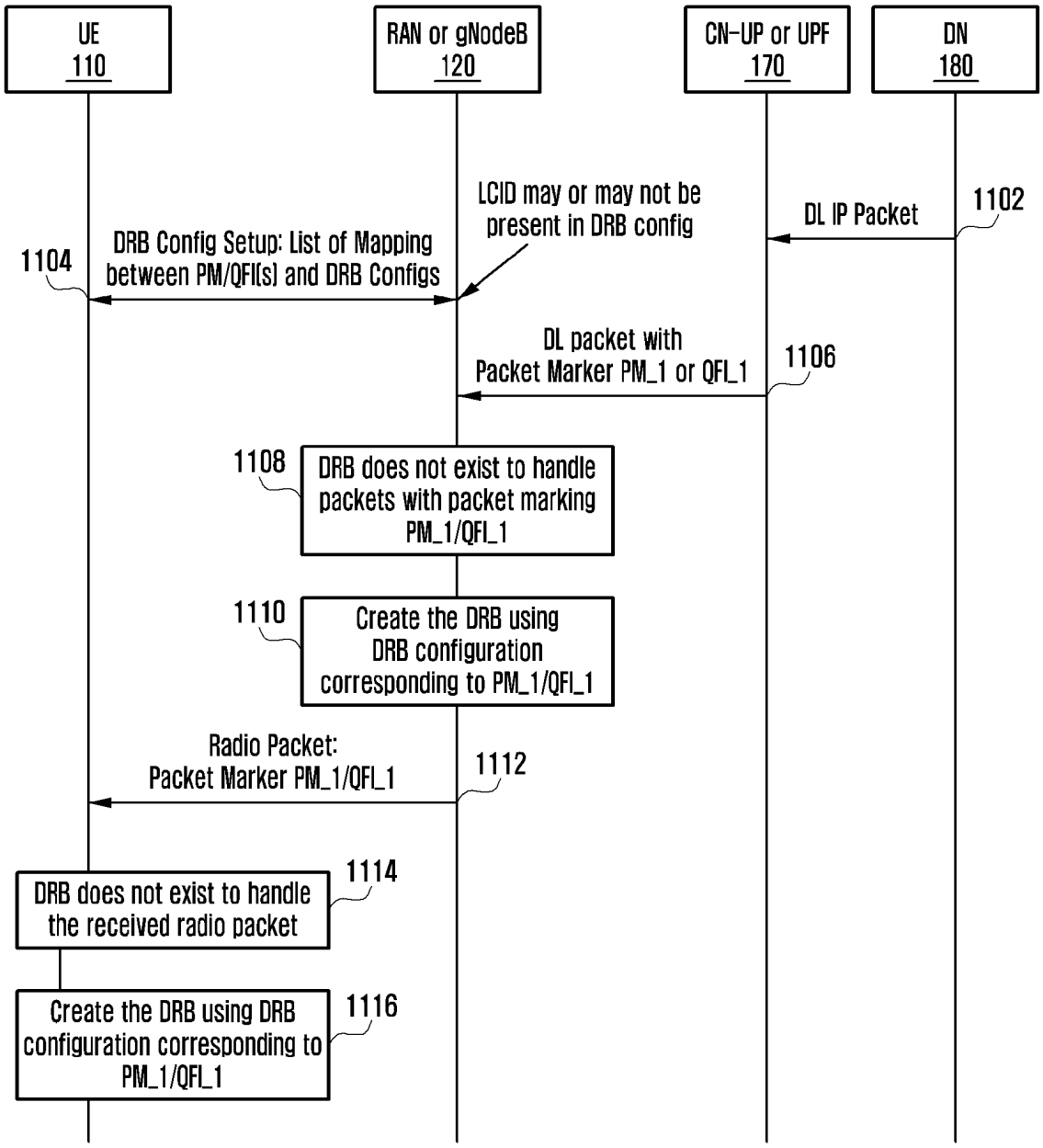
[Fig. 9]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
902
UL Packet with
Packet Marker PM_1/QFI_1
904
DRB does not exist to
handle packets with
packet marking PM_1/QFI_1
906
Send the packet on
default DRB
908
BSR Packet: PM_1/QFI_1
910
DRB does not exist to handle
packets with packet
marking PM_1/QFI_1. Setup DRB
912
DRB Setup DRB Config -> PM_1/QFI_1
914
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
916
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
918
Radio packet
UL packet with
Packet Marker PM_1/QFI_1
920
UL IP Packet
922

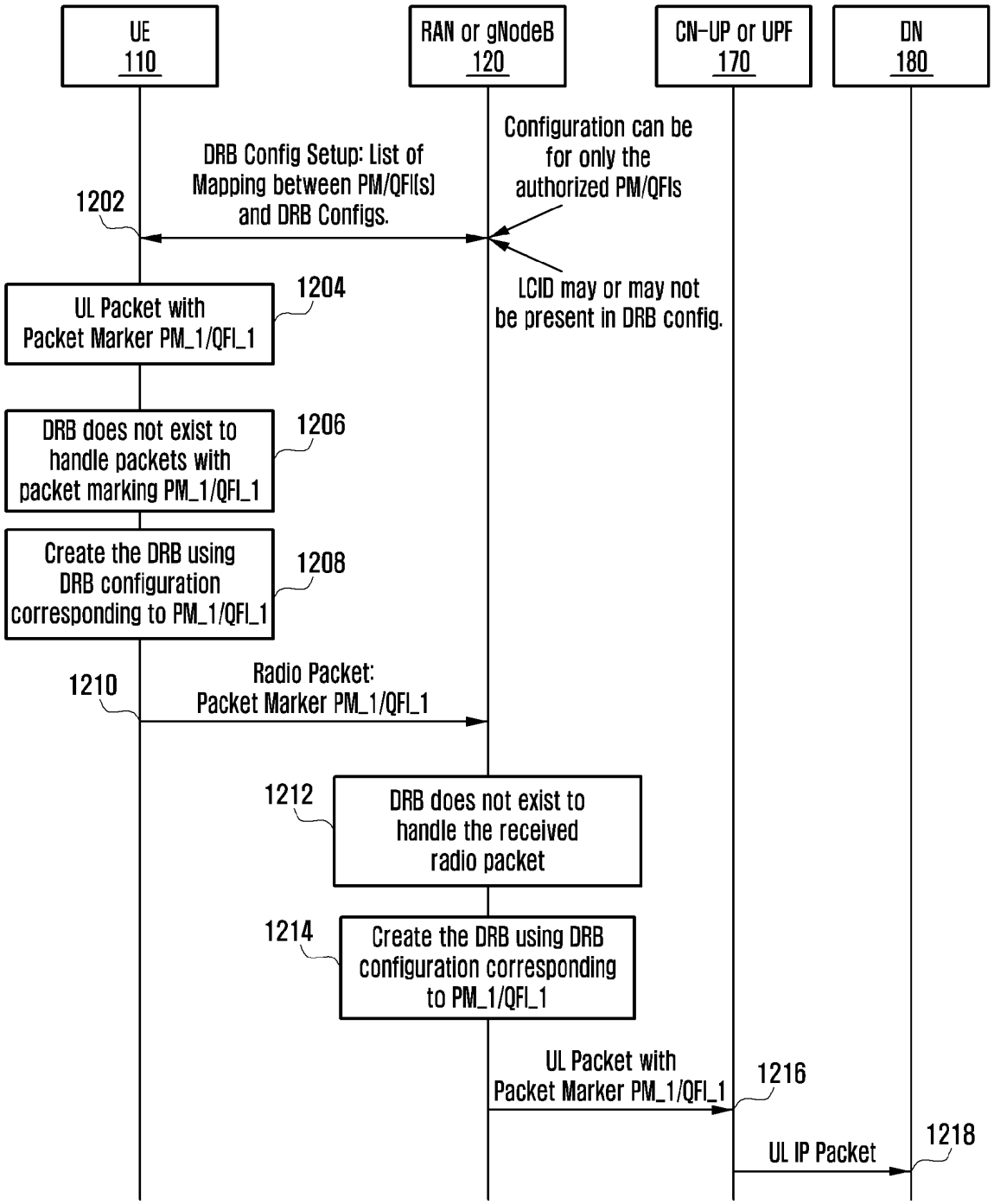
[Fig. 10]


CN-CP 170
gNodeB 120
UE 110
1002
List of authorized QoS Flows and Associated QoS parameters
1004
DRB Config Setup: List of one or more DRBs; For each DRB list of one or more QoS Flows (QFIs) and PDU Session ID
1006
Create the DRBs based on received DRB configurations
1008
Create the DRBs based on sent DRB configurations
1010
For each DRB, store list of associated QoS flow(s) and PDU Session ID
1012
Map the received DL packet to DRB based on QFI of received packet
1014
Map the UL packet to DRB using a) QFI and PDU session id of UL packet and b) DRB to QoS Flow(s) and PDU session ID mapping
Multiple QoS Flows of a PDU session can be mapped to one DRB

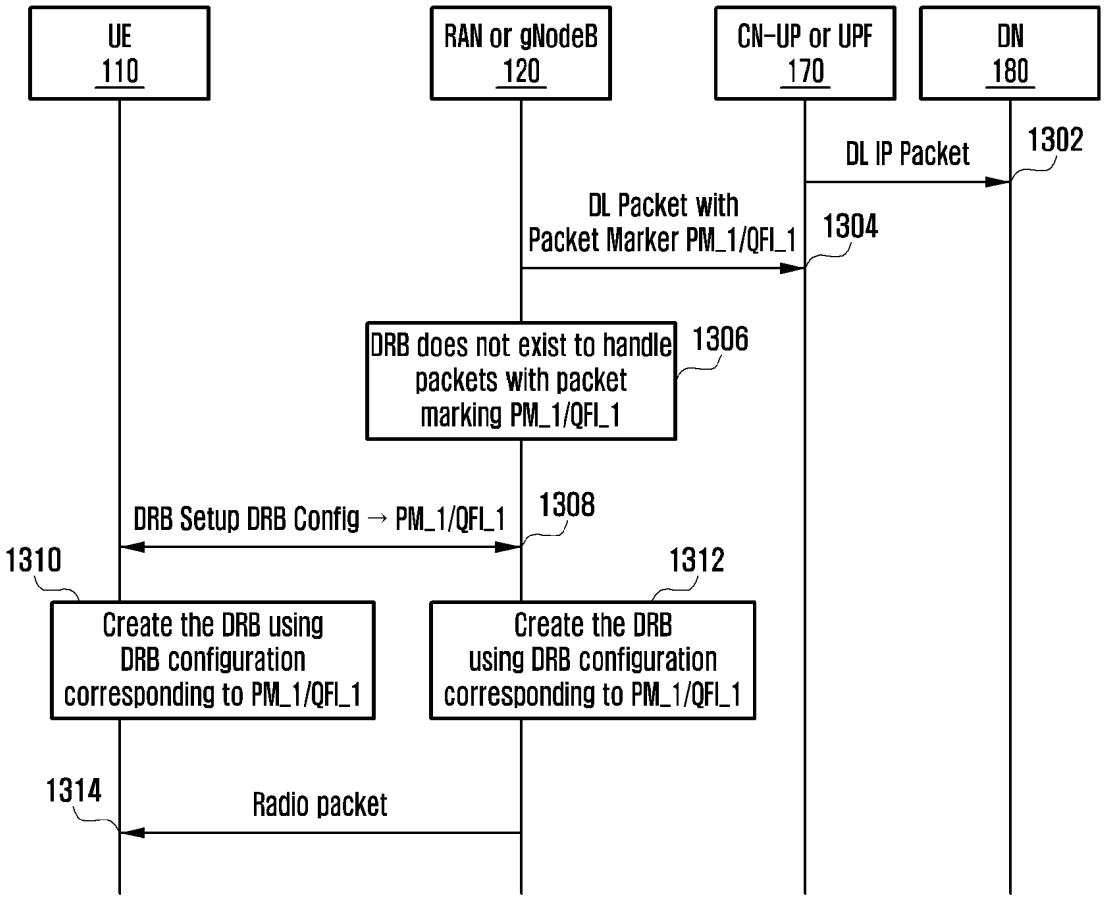
[Fig. 11]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
LCID may or may not be present in DRB config
DL IP Packet
1102
1104
DRB Config Setup: List of Mapping between PM/QFI(s) and DRB Configs
DL packet with Packet Marker PM_1 or QFI_1
1106
1108
DRB does not exist to handle packets with packet marking PM_1/QFI_1
1110
Create the DRB using DRB configuration corresponding to PM_1/QFI_1
Radio Packet: Packet Marker PM_1/QFI_1
1112
1114
DRB does not exist to handle the received radio packet
1116
Create the DRB using DRB configuration corresponding to PM_1/QFI_1

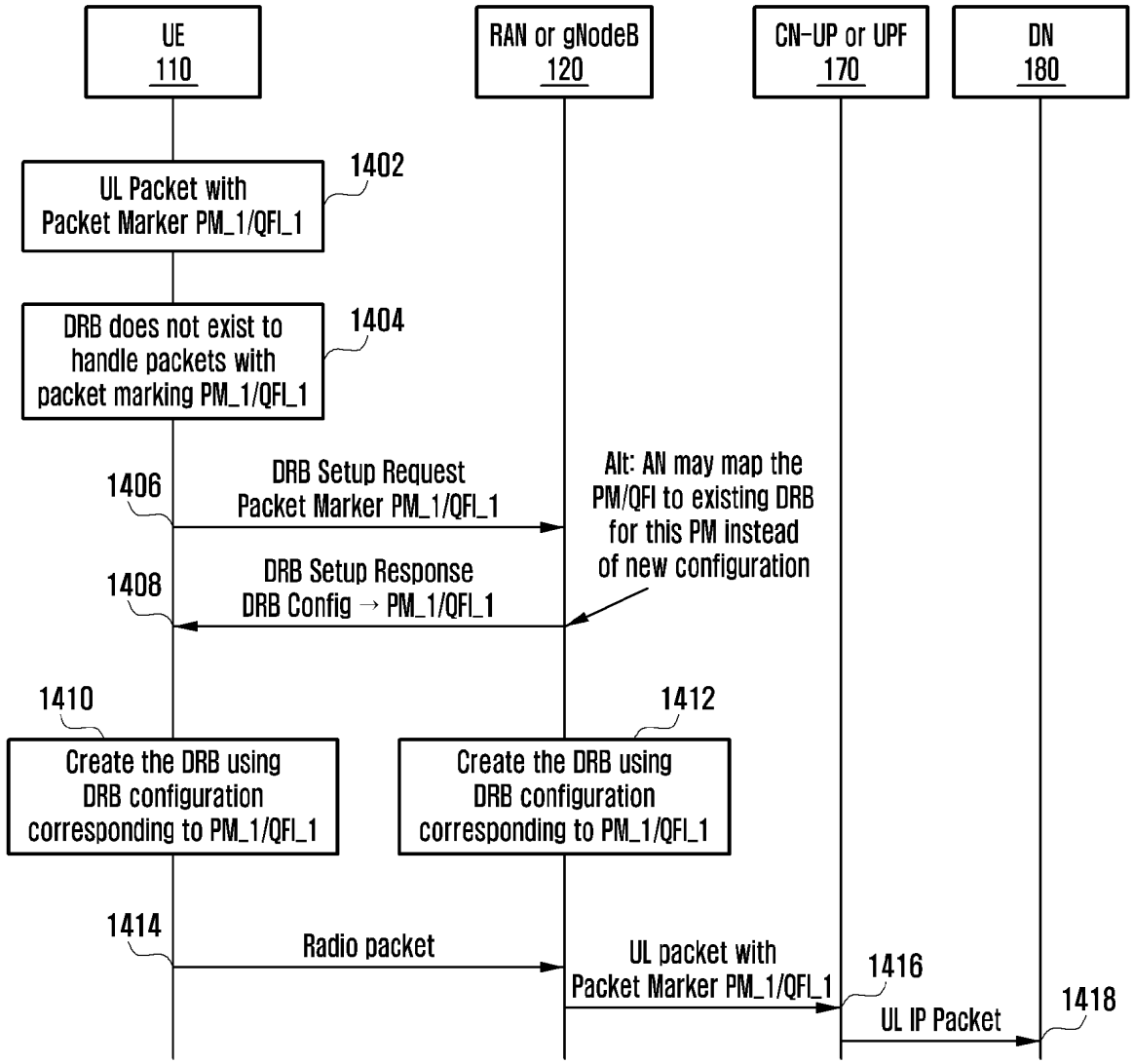
[Fig. 12]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
DRB Config Setup: List of Mapping between PM/QFI(s) and DRB Configs.
1202
Configuration can be for only the authorized PM/QFIs
LCID may or may not be present in DRB config.
UL Packet with Packet Marker PM_1/QFI_1
1204
DRB does not exist to handle packets with packet marking PM_1/QFI_1
1206
Create the DRB using DRB configuration corresponding to PM_1/QFI_1
1208
1210
Radio Packet: Packet Marker PM_1/QFI_1
1212
DRB does not exist to handle the received radio packet
1214
Create the DRB using DRB configuration corresponding to PM_1/QFI_1
UL Packet with Packet Marker PM_1/QFI_1
1216
UL IP Packet
1218

[Fig. 13]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
DL IP Packet
1302
DL Packet with
Packet Marker PM_1/QFI_1
1304
DRB does not exist to handle
packets with packet
marking PM_1/QFI_1
1306
DRB Setup DRB Config → PM_1/QFI_1
1308
1310
1312
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
Create the DRB
using DRB configuration
corresponding to PM_1/QFI_1
1314
Radio packet

[Fig. 14]


UE
110
RAN or gNodeB
120
CN-UP or UPF
170
DN
180
1402
UL Packet with
Packet Marker PM_1/QFI_1
1404
DRB does not exist to
handle packets with
packet marking PM_1/QFI_1
1406
DRB Setup Request
Packet Marker PM_1/QFI_1
Alt: AN may map the
PM/QFI to existing DRB
for this PM instead
of new configuration
1408
DRB Setup Response
DRB Config → PM_1/QFI_1
1410
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
1412
Create the DRB using
DRB configuration
corresponding to PM_1/QFI_1
1414
Radio packet
UL packet with
Packet Marker PM_1/QFI_1
1416
UL IP Packet
1418

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2017/008293

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/02(2009.01)i, H04W 28/06(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W 28/02; H04W 76/02; H04W 36/14; H04W 36/00; H04W 28/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: QoS, mapping, DRB (data radio bearer), flow, and ID

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	QUALCOMM INCORPORATED et al., `Principles for QoS in the RAN`, R2-164119, 3GPP TSG RAN WG2 Meeting #94, Nanjing, China, 14 May 2016 (http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/) See sections 2, 3.	1,9
A		2-8,10-15
Y	INTERDIGITAL COMMUNICATIONS, `Radio Bearers and Per-Flow QoS for New Radio Access`, R2-164089, 3GPP TSG RAN WG2 Meeting #94, Nanjing, China, 14 May 2016 (http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/) See section 2.	1,9
A	SAMSUNG, `NR user plane architecture for supporting multiple services`, R2-163740, 3GPP TSG RAN WG2 Meeting #94, Nanjing, China, 13 May 2016 (http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_94/Docs/) See section 3.	1-15
A	US 2015-0264738 A1 (LG ELECTRONICS INC.) 17 September 2015 See paragraphs [0117], [0123]-[0125], [0234]-[0240]; and claims 1-6.	1-15
A	WO 2009-063434 A1 (NOKIA SIEMENS NETWORKS OY) 22 May 2009 See paragraph [0038]; and claims 1-6.	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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

Date of the actual completion of the international search	Date of mailing of the international search report
10 November 2017 (10.11.2017)	**10 November 2017 (10.11.2017)**

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Petitioners' Exhibit 1002, p. 285
AT&T et al v. Asustek Technology
IPR2024-00997

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2017/008293

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		EP 2919505 A1	16/09/2015
		JP 06082817 B2	15/02/2017
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		US 8514809 B2	20/08/2013

Petitioners' Exhibit 1002, p. 286
AT&T et al v. Asustek Technology
IPR2024-00997

(19)中华人民共和国国家知识产权局

(12)发明专利申请

(10)申请公布号 CN 107637123 A
(43)申请公布日 2018.01.26

(21)申请号 201780000408.0

(22)申请日 2017.06.05

(66)本国优先权数据
PCT/CN2017/082241 2017.04.27 CN

(85)PCT国际申请进入国家阶段日
2017.06.09

(86)PCT国际申请的申请数据
PCT/CN2017/087203 2017.06.05

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(51)Int.Cl.
H04W 28/06(2009.01)
H04W 28/24(2009.01)

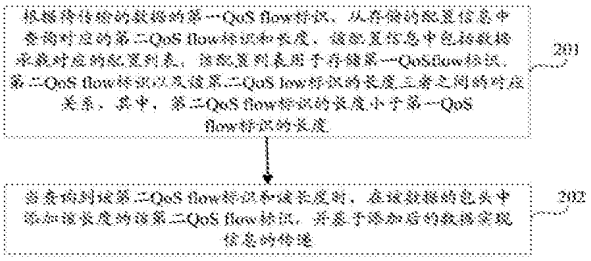
权利要求书2页 说明书13页 附图4页

(54)发明名称

信息传递方法、装置及计算机可读存储介质

(57)摘要

本公开实施例提供了一种信息传递方法及装置，涉及通信技术领域，所述方法包括：根据待传输的数据的第一QoS flow标识，从配置信息中查询对应的第二QoS flow标识和长度，配置信息中包括数据承载对应的配置列表，该配置列表用于存储第一QoS flow标识、第二QoS flow标识以及该第二QoS flow标识的长度三者之间的对应关系，当查询到第二QoS flow标识和长度时，在该数据的包头中添加长度的第二QoS flow标识。由于第二QoS flow标识的长度小于第一QoS flow标识的长度，因此，可以节省开销，且由于还指示了第二QoS flow标识的长度，因此，增加了信息配置及传递的灵活性。



CN 107637123 A

Petitioners' Exhibit 1002, p. 287
AT&T et al v. Asustek Technology
IPR2024-00997

1.一种信息传递方法,其特征在于,所述方法包括:

根据待传输的数据的第一服务质量流QoS flow标识,从存储的配置信息中查询对应的第二QoS flow标识和长度,所述配置信息中包括数据承载对应的配置列表,所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系,其中,第二QoS flow标识的长度小于第一QoS flow标识的长度;

当查询到所述第二QoS flow标识和所述长度时,在所述数据的包头中添加所述长度的所述第二QoS flow标识,并基于添加后的数据实现信息的传递。

2.如权利要求1所述的方法,其特征在于,所述配置信息中还包括第一指示信息,所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow,所述指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

3.如权利要求1所述的方法,其特征在于,所述数据的包头中还包括第二指示信息,所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识,以及是否包括所述第二QoS flow标识。

4.如权利要求1所述的方法,其特征在于,所述数据的包头中还包括第三指示信息,所述第三指示信息用于指示所述数据的包头中指定字段的长度,所述指定字段用于携带所述第一QoS flow标识或第二QoS flow标识。

5.如权利要求1所述的方法,其特征在于,当所述数据的包头中包括所述第二QoS flow标识时,所述数据的包头中还包括第四指示信息,所述第四指示信息用于指示所述第二QoS flow标识的长度。

6.如权利要求1-5任一所述的方法,其特征在于,所述根据待传输的数据的第一QoS flow标识,从存储的配置信息中查询对应的第二QoS flow标识和长度之前,还包括:

接收并存储无线接入设备发送的所述配置信息。

7.一种信息传递装置,其特征在于,所述装置包括:

查询模块,用于根据待传输的数据的第一服务质量流QoS flow标识,从存储的配置信息中查询对应的第二QoS flow标识和长度,所述配置信息中包括数据承载对应的配置列表,所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系,其中,第二QoS flow标识的长度小于第一QoS flow标识的长度;

添加模块,用于当所述查询模块查询到所述第二QoS flow标识和所述长度时,在所述数据的包头中添加所述长度的所述第二QoS flow标识,并基于添加后的数据实现信息的传递。

8.如权利要求7所述的装置,其特征在于,所述配置信息中还包括第一指示信息,所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow,所述指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

9.如权利要求7所述的装置,其特征在于,所述数据的包头中还包括第二指示信息,所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识,以及是否包括所述第二QoS flow标识。

10.如权利要求7所述的装置,其特征在于,所述数据的包头中还包括第三指示信息,所述第三指示信息用于指示所述数据的包头中指定字段的内容的长度,所述指定字段用于携

Petitioners' Exhibit 1002, p. 288
AT&T et al v. Asustek Technology
IPR2024-00997

带所述第一QoS flow标识或第二QoS flow标识。

11.如权利要求7所述的装置，其特征在于，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

12.如权利要求7-11任一所述的装置，其特征在于，所述装置还包括：

接收存储模块，用于接收并存储无线接入设备发送的所述配置信息。

13.一种信息传递装置，其特征在于，所述装置包括：

处理器；

用于存储处理器可执行指令的存储器；

其中，所述处理器被配置为：

根据待传输的数据的第一服务质量流QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

14.一种计算机可读存储介质，所述计算机可读存储介质上存储有指令，其特征在于，所述指令被处理器执行时实现以下步骤：

根据待传输的数据的第一服务质量流QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

Petitioners' Exhibit 1002, p. 289
AT&T et al v. Asustek Technology
IPR2024-00997

信息传递方法、装置及计算机可读存储介质

[0001] 本申请要求于2017年04月27日提交中国专利局、申请号为PCT/CN2017/082241、发明名称为“信息传递方法、装置及计算机可读存储介质”的中国专利申请的优先权，其全部内容通过引用结合在本申请中。

技术领域

[0002] 本公开涉及通信技术领域，特别涉及一种信息传递方法、装置及计算机可读存储介质。

背景技术

[0003] 随着通信技术的快速发展，5G(Fifth Generation，第五代)系统应运而生。5G系统中主要包括有AS(Access Stratum，接入层)和NAS(Non Access Stratum，非接入层)，目前，在5G系统的AS中新引入了一个层，当前一般称之为SDAP(Service Data Adaptation Protocol，服务数据包适应协议)层。该SDAP层可以用于进行QoS(Quality of Service，服务质量)flow(流)与数据承载之间的映射，以及针对不同QoS flow在传输的数据的包头中添加不同的QoS flow标识，用于标识传输的数据的QoS flow。

[0004] 其中，不同的QoS flow是基于不同QoS参数对IP(Internet Protocol，网络协议)flow进行映射处理后得到的。在业务传输过程中，一种业务中可能包括多种QoS flow，不同的QoS flow可能会映射到不同的数据承载上。为了成功实现数据传输，无论是上行数据还是下行数据，一般都需要通过SDAP层根据待传输数据的QoS flow，在包头中添加对应的QoS flow标识，并对该QoS flow标识进行传递。如，为了使得无线接入设备(如，基站)在接收到数据时，可以确定在与核心网之间的多个传输通道中选择哪个传输通道来传输该数据，UE(User Equipment，用户设备)需要根据该数据的QoS flow在传输的数据中添加对应的QoS flow标识，以将该QoS flow标识传递给无线接入设备。

发明内容

[0005] 为了克服相关技术中存在的问题，本公开实施例提供了一种信息传递方法、装置及计算机可读存储介质。所述技术方案如下：

[0006] 第一方面，提供了一种信息传递方法，所述方法包括：

[0007] 根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

[0008] 当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0009] 可选地，所述配置信息中还包括第一指示信息，所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow，所述指定QoS flow包

Petitioners' Exhibit 1002, p. 290
AT&T et al v. Asustek Technology
IPR2024-00997

括指定上行QoS flow和/或指定下行QoS flow。

[0010] 可选地，所述数据的包头中还包括第二指示信息，所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识，以及是否包括所述第二QoS flow标识。

[0011] 可选地，所述数据的包头中还包括第三指示信息，所述第三指示信息用于指示所述数据的包头中指定字段的内容的长度，所述指定字段用于携带所述第一QoS flow标识或第二QoS flow标识。

[0012] 可选地，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

[0013] 可选地，所述根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度之前，还包括：

[0014] 接收并存储无线接入设备发送的所述配置信息。

[0015] 第二方面，提供了一种信息传递装置，所述装置包括：

[0016] 查询模块，用于根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

[0017] 添加模块，用于当所述查询模块查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0018] 可选地，所述配置信息中还包括第一指示信息，所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow，所述指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

[0019] 可选地，所述数据的包头中还包括第二指示信息，所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识，以及是否包括所述第二QoS flow标识。

[0020] 可选地，所述数据的包头中还包括第三指示信息，所述第三指示信息用于指示所述数据的包头中指定字段的内容的长度，所述指定字段用于携带所述第一QoS flow标识或第二QoS flow标识。

[0021] 可选地，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

[0022] 可选地，所述装置还包括：

[0023] 接收存储模块，用于接收并存储无线接入设备发送的所述配置信息。

[0024] 第三方面，提供了一种信息传递装置，所述装置包括：

[0025] 处理器；

[0026] 用于存储处理器可执行指令的存储器；

[0027] 其中，所述处理器被配置为：

[0028] 根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

Petitioners' Exhibit 1002, p. 291
AT&T et al v. Asustek Technology
IPR2024-00997

[0029] 当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0030] 第四方面，提供了一种计算机可读存储介质，所述计算机可读存储介质上存储有指令，所述指令被处理器执行时实现以下步骤：

[0031] 根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，所述配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

[0032] 当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0033] 本公开实施例提供的技术方案的有益效果是：

[0034] 本公开实施例中，在进行数据传输时，根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和该第二QoS flow标识的长度。当查询到该第二QoS flow标识和该长度时，说明可以通过第二QoS flow标识来代替该第一QoS flow标识，因此，在该数据的包头中添加上述长度的第二QoS flow标识。由于该第二QoS flow标识长度小于该第一QoS flow标识，因此，基于添加了该第二QoS flow标识的数据实现信息的传递可以节省开销，并且，该配置信息中还指示了该第二QoS flow标识的长度，如此，增加了对该第二QoS flow标识进行配置的灵活性，从而增加了信息传输的灵活性。

附图说明

[0035] 此处的附图被并入说明书中并构成本说明书的一部分，示出了符合本公开的实施例，并与说明书一起用于解释本公开的原理。

[0036] 图1A是根据一示例性实施例示出的一种实施环境的示意图。

[0037] 图1B是根据一示例性实施例示出的一种5G系统的层次结构示意图。

[0038] 图2是根据一示例性实施例示出的一种信息传递方法的流程图。

[0039] 图3是根据一示例性实施例示出的一种信息传递方法的流程图。

[0040] 图4A是根据一示例性实施例示出的一种信息传递装置的结构示意图。

[0041] 图4B是根据另一示例性实施例示出的一种信息传递装置的结构示意图。

[0042] 图5是根据一示例性实施例示出的一种信息传递装置500的框图。

具体实施方式

[0043] 这里将详细地对示例性实施例进行说明，其示例表示在附图中。下面的描述涉及附图时，除非另有表示，不同附图中的相同数字表示相同或相似的要素。以下示例性实施例中所描述的实施方式并不代表与本公开相一致的所有实施方式。相反，它们仅是与如所附权利要求书中所详述的、本公开的一些方面相一致的装置和方法的例子。

[0044] 在对本公开实施例进行详细介绍之前，先对本公开实施例中涉及的名词进行简单介绍：

[0045] PDU(Protocol Data Unit，协议数据单元)session：一个PDU session对应于一种业务。在5G系统中，每一个PDU session均会对应有一个SDAP逻辑实体，一个PDU session包

Petitioners' Exhibit 1002, p. 292
AT&T et al v. Asustek Technology
IPR2024-00997

括多个QoS flow，不同的QoS flow可以映射到不同的数据承载上。一般情况下，不同PDU session的QoS flow不能映射到同一个数据承载上。需要说明的是，为了便于描述，针对PDU session，本公开实施例一般还以业务的形式来描述PDU session。

[0046] QoS flow：不同的QoS flow是对IP flow基于不同QoS进行映射后得到。在数据传输过程中，UE或无线接入设备可能会根据实际需求，将不同的IP flow映射成不同的QoS flow，并且，需要采用不同的数据承载来传输不同的QoS flow，也即是，不同QoS flow一般需要映射到不同的数据承载上。当然，这里需要说明的是，在一种可能的实现方式中，几个不同的QoS flow可能也会映射到同一个数据承载上，即同一数据承载也可以传输多个不同的QoS flow。

[0047] 接下来，对本公开实施例涉及的应用场景进行介绍：

[0048] 请参考图1A，图1A是根据一示例性实施例示出的一种应用场景的示意图。该应用场景中主要包括有UE 110和无线接入设备120。该UE 110可以通过移动通信网络与该无线接入设备120之间进行连接。

[0049] 其中，该无线接入设备120主要用于向该UE 110发送配置信息，以便于UE 110根据该配置信息，确定如何实现数据传输，以及如何在数据传输过程中实现传递信息。其中，该无线接入设备120可以为诸如基站等之类的设备，本公开实施例对此不做限定。

[0050] 其中，该UE 110主要用于接收无线接入设备120发送的配置信息，并根据该配置信息，如何实现数据传输，以及如何在数据传输过程中实现传递信息。

[0051] 需要说明的是，上述UE 110与该无线接入设备120之间进行信息传递以及数据传输的实现过程请详见如下图3实施例。

[0052] 进一步地，上述无线接入设备120本身也需要向UE 110传输数据，该无线接入设备120也可以根据自身配置的该配置信息，确定如何实现数据传输，以及如何在数据传输过程中实现传递信息，其实现过程与UE 110的实现过程相同。

[0053] 进一步地，该应用场景中还可以包括核心网设备130，该核心网设备130也可以通过移动通信网络与该无线接入设备120之间进行连接。另外，该核心网设备130与该无线接入设备之间可能包括一个或者多个传输通道，用于传输数据。也即是，该无线接入设备120在接收到UE 110发送的数据后，可以通过一个传输通道或者多个中的某个传输通道，将该数据递交给上层的核心网设备，以实现数据的进一步传递。

[0054] 为了便于理解，接下来对5G系统的层次间关系进行简单介绍，请参考图1B，该图1B是根据一示例性实施例示出的一种5G系统的层次结构示意图。5G系统中主要包括AS层和NAS层，其中，新引入的SDAP层即属于AS层，该SDAP层的上层即为NAS层。

[0055] 在5G系统中，上述UE 110和无线接入设备120中均包括上述结构。以UE110侧为例，在发送数据的过程中，数据由NAS层递交该SDAP层，并由该NAS层指示该数据的QoS flow的信息，例如，该信息可以为第一QoS flow标识等。之后，由该SDAP层根据该QoS flow，在数据的包头中添加第一QoS flow标识或第二QoS flow标识。SDAP层对数据进行添加信息处理后，递交给PDCP(Packet Data Convergence Protocol，数据包汇聚协议)层，再经过RLC(Radio Link Control，无线链路控制)层、MAC(Media Sccess Control，媒体接入控制)层进行各自层的处理后，最后通过数据承载发送给无线接入设备。

[0056] 在数据接收的过程中，该UE 110接收到数据时，数据由MAC层经过RLC层、PDCP层进

Petitioners' Exhibit 1002, p. 293
AT&T et al v. Asustek Technology
IPR2024-00997

行各自层的处理后传输至SDAP层，再由该SDAP层进行去包头处理后递交给SDAP层的上层，即递交给NAS层。

[0057] 需要说明的是，在上述对数据进行处理的过程中，针对每一层来说，该层接收的上一次传输的数据可以称为SDU(Service Data Unit，服务数据单元)，经过该层处理后的数据可以称为PDU，也即是，该SDU和PDU是一个相对的概念。例如，对于SDAP层来说，从PDCP接收的数据可以称为SDAP SDU，经过处理后传递给NAS层的数据可以称为SDAP PDU。

[0058] 图2是根据一示例性实施例示出的一种信息传递方法的流程图。该信息传递方法可以包括以下几个步骤：

[0059] 在步骤201中，根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，该配置信息中包括数据承载对应的配置列表，该配置列表用于存储第一QoS flow标识、第二QoS flow标识以及该第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度。

[0060] 在步骤202中，当查询到该第二QoS flow标识和该长度时，在该数据的包头中添加该长度的该第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0061] 在本公开实施例中，在进行数据传输时，根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和该第二QoS flow标识的长度。当查询到该第二QoS flow标识和该长度时，说明可以通过第二QoS flow标识来代替该第一QoS flow标识，因此，在该数据的包头中添加上述长度的第二QoS flow标识。由于该第二QoS flow标识长度小于该第一QoS flow标识，因此，基于添加了该第二QoS flow标识的数据实现信息的传递可以节省开销，并且，该配置信息中还指示了该第二QoS flow标识的长度，如此，增加了对该第二QoS flow标识进行配置的灵活性，从而增加了信息传输的灵活性。

[0062] 可选地，所述配置信息中还包括第一指示信息，所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow，该指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

[0063] 可选地，所述数据的包头中还包括第二指示信息，所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识，以及是否包括所述第二QoS flow标识。

[0064] 可选地，所述数据的包头中还包括第三指示信息，所述第三指示信息用于指示所述数据的包头中指定字段的内容的长度，所述指定字段用于携带所述第一QoS flow标识或第二QoS flow标识。

[0065] 可选地，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

[0066] 可选地，所述根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度之前，还包括：

[0067] 接收并存储无线接入设备发送的所述配置信息。

[0068] 上述所有可选技术方案，均可按照任意结合形成本公开的可选实施例，本公开实施例对此不再一一赘述。

[0069] 图3是根据另一示例性实施例示出的一种信息传递方法的流程图。这里以多方交互实现该信息传递方法为例进行举例说明，该信息传递方法可以包括如下几个实现步骤：

[0070] 在步骤301中，无线接入设备向UE发送配置信息，UE接收该无线接入设备发送的配

Petitioners' Exhibit 1002, p. 294
AT&T et al v. Asustek Technology
IPR2024-00997

置信息。

[0071] 在实际应用场景中，针对上行数据来说，UE一般需要在传输的数据中增加QoS flow标识，以便于无线接入设备在接收到数据时，可以确定需要通过哪个传输通道将该数据传递给上层。其中，如前文所述，该传输通道是指无线接入设备与核心网设备之间的传输通道，例如，该传输通道可以为CN(Core Network，核心网)QoS传输通道。

[0072] 为了便于UE在传输数据时可以根据待传输的数据的QoS flow，确定需要添加哪个QoS flow标识，无线接入设备可以预先向UE发送配置信息，以通过该配置信息来指示UE针对不同的QoS flow如何添加QoS flow标识。在具体实现中，该无线接入设备可以通过RRC(Radio Resource Control，无线资源控制)重配置消息携带该配置信息。

[0073] 当然，这里仅是以该无线接入设备通过RRC重配置消息携带该配置信息为例进行说明，在另一实施例中，该无线接入设备还可以通过其它消息携带该配置信息，本公开实施例对此不做限定。

[0074] 其中，该配置信息中包括数据承载对应的配置列表，该配置列表用于存储第一QoS flow标识、第二QoS flow标识以及该第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度。

[0075] 需要说明的是，在实际实现中，该配置信息中可能包括一个数据承载对应的配置列表，也可能包括多个数据承载对应的配置列表，本公开实施例对此不做限定。

[0076] 其中，该数据承载可以为DRB(Data Radio Bearer，数据承载)。

[0077] 其中，第一QoS flow标识可以用于唯一标识一个QoS flow，如，该第一QoS flow标识可以称为QoS flow ID。相比于第二QoS flow标识，该第一QoS flow标识可以说是QoS flow的完整标识。一般情况下，为了保证每个UE的每个PDU session唯一，该第一QoS flow标识可能会采用8个比特或者大于8个比特的数值来表示。

[0078] 其中，该第二QoS flow标识也可以用于唯一标识一个QoS flow。该第二QoS flow标识与第一QoS flow标识一一对应，与第一QoS flow标识不同的是，该第二QoS flow标识的长度小于第一QoS flow标识的长度。例如，该第二QoS flow标识可以为2比特的数据，进一步地，该数据可以为一个2比特的编号，如，该2比特的编号可以为“10”等。

[0079] 实际上，可以认为该第二QoS flow标识是对应的第一QoS flow标识的另一种表示方式，也就是说，在本公开实施例中，该第二QoS flow标识和对应的第一QoS flow标识用于标识一种QoS flow。

[0080] 由于第一QoS flow标识会采用较长的比特数来表示，如此，导致开销较大，为此，在本公开实施例中，可以采用长度较小的第二QoS flow标识来代替第一QoS flow标识，以节省开销问题。

[0081] 在实际实现中，如果第二QoS flow标识的长度固定不变，则当QoS flow较多时，容易导致无法使用第二QoS flow标识进行表示。针对该种情况，可能需要对该数据承载上的第二QoS flow标识进行重新配置，如此以来，如果之前配置的长度的数据还未传输完，则该数据承载上传输的数据的包头中可能包括多种长度的第二QoS flow标识。

[0082] 或者，在某数据承载上有一些新增的QoS flow，无线接入设备还没有配置对应的第二QoS flow标识，此时，只能先在传输的数据中添加第一QoS flow标识，待配置了对应的第二QoS flow标识后，再利用对应的第二QoS flow标识来代替该第一QoS flow标识。然而，

Petitioners' Exhibit 1002, p. 295
AT&T et al v. Asustek Technology
IPR2024-00997

如此可能导致该数据承载上传输的数据的包头中可能包括第一QoS flow标识，也可能包括第二QoS flow标识，即可能存在包括第一QoS flow标识的数据与包括第二QoS flow标识的数据共存的情况。

[0083] 针对上述两种情况，在实际实现中，无线接入设备一般均会预先指示需要传递的第二QoS flow标识的长度，也即是，该配置列表中存储的是第一QoS flow标识、第二QoS flow标识以及该第二QoS flow标识三者之间的对应关系。例如，请参考表1，该表1是示例性地示出了某个数据承载DRB1的配置列表：

[0084] 表1

[0085]

DRB1	第一 QoS flow 标识	第二 QoS flow 标识	长度（bit）
	QoS flow ID1	QoS flow short ID1	2
	QoS flow ID2	QoS flow short ID2	2
	……	……	……
	QoS flow IDn	QoS flow short IDn	2

[0086] 需要说明的是，上述仅是配置列表以表1的形式存在为例进行说明，在另一实施例中，数据承载的配置列表还可以为其它形式，本公开实施例对此不做限定。

[0087] 另外，还需要说明的是，在实际实现中，针对每个UE，每个第二QoS flow标识的长度可以相同，或者，针对每个UE对应的数据承载，每个第二QoS flow标识的长度可以相同，本公开实施例对此不做限定。

[0088] 在步骤302中，UE根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度。

[0089] 在实际实现中，当需要进行数据传输时，UE的NAS层将待传输的数据的第一QoS flow标识传递给SDAP层，SDAP层在接收该第一QoS flow标识后，确定该第一QoS flow标识对应的数据承载，并从该配置信息中选择该数据承载的配置列表。之后，该UE的SDAP层根据该第一QoS flow标识，从选择的该配置列表中查询是否存在对应的第二QoS flow标识和长度。

[0090] 在步骤303中，当UE查询到该第二QoS flow标识和该长度时，在该数据的包头中添加该长度的该第二QoS flow标识。

[0091] 在具体实现中，该UE的SDAP层查询该第二QoS flow标识和该长度时，说明可以利用该第二QoS flow标识来代替该第一QoS flow标识，也即是，在该数据的包头中添加该长度的该第二QoS flow标识。由于该第二QoS flow标识的长度小于该第一QoS flow标识的长度，因此，可以节省数据传输的开销。

[0092] 需要说明的是，这里仅是以该UE查询到该第二QoS flow标识和该长度为例进行说明，在另一实施例中，如果该UE未查询到该第二QoS flow标识和该长度，说明可能是第一QoS flow标识可能是新增的，无线接入设备尚未给该第一QoS flow标识分配对应的第二QoS flow标识。在该种情况下，UE的SDAP层可以在该数据的包头中添加该第一QoS flow标识。

[0093] 进一步地，该数据的包头中还包括第二指示信息，该第二指示信息用于指示该数

Petitioners' Exhibit 1002, p. 296
AT&T et al v. Asustek Technology
IPR2024-00997

据的包头中是否包括该第一QoS flow标识，以及是否包括该第二QoS flow标识。

[0094] 也即是，该第二指示信息可以指示该数据的包头中是否包括该第一QoS flow标识和该第二QoS flow标识，如果包括，则包括的是该第一QoS flow标识，还是该第二QoS flow标识。

[0095] 进一步地，为了便于接收端的无线接入设备能够准确、快速确定所携带的QoS flow标识，所传输的数据的包头中需要指示QoS flow标识的长度。其中，该QoS flow标识可以为第一QoS flow标识，也可以为第二QoS flow标识。

[0096] 也即是，该数据的包头中还包括第三指示信息，该第三指示信息用于指示该数据的包头中指定字段的内容的长度，该指定字段用于携带该第一QoS flow标识或第二QoS flow标识。

[0097] 进一步地，当该数据的包头中包括该第二QoS flow标识时，该数据的包头中还包括第四指示信息，该第四指示信息用于指示该第二QoS flow标识的长度。

[0098] 在实际实现中，由于一般UE和无线接入设备之间一般都会预先协商好第一QoS flow标识的长度，因此，在数据传输过程中，在该数据的包头中可以不指示该第一QoS flow标识的长度。而当该数据的包头中包括第二QoS flow标识时，由于该第二QoS flow标识是灵活动态配置的，因此，需要在该数据的包头中添加第四指示信息，以通过第四指示信息来指示该第二QoS flow标识的长度。如此，可以达到节省开销的效果。

[0099] 在步骤304中，UE将添加后的数据发送给该无线接入设备，以基于添加后的数据实现信息的传递。

[0100] 在具体实现中，UE将该数据通过对应的数据承载发送给该无线接入设备，如此，即通过该数据，将该第二QoS flow标识发送无线接入设备。

[0101] 在步骤305中，无线接入设备解析该数据，并确定该数据的第一QoS flow标识。

[0102] 无线接入设备接收到该UE发送的数据后，对该数据进行解析。在一种可能的实现方式中，如果该数据中包括上述第二指示信息，且该第二指示信息用于指示该数据的包头中包括第二QoS flow标识，则该无线接入设备解析该数据的包头中包括的该第二QoS flow标识的长度，并根据该长度，从该数据的包头中解析出对应的第二QoS flow标识。

[0103] 例如，若该长度为2比特，则该无线接入设备从该数据的包头中解析出长度为2比特的第二QoS flow标识。

[0104] 进一步地，该无线接入设备解析得到该第二QoS flow标识后，可以根据该第二QoS flow标识，从存储的配置信息中，确定对应的第一QoS flow标识。在具体实现中，该配置信息中可能包括多个配置列表，由于该无线接入设备可以感知该数据是由哪个数据承载传输过来的，因此，该无线接入设备可以从存储的配置信息包括的多个配置列表中，获取该数据承载对应的配置列表，并从该配置列表中存储的第一QoS flow标识、第二QoS flow标识以及QoS flow标识三者之间的对应关系中，确定该第二QoS flow标识对应的第一QoS flow标识。

[0105] 例如，请参考表1，如果无线接入设备是从数据承载DRB1中接收到该数据，且该第二QoS flow标识为QoS flow short ID2，则该无线接入设备根据该配置列表1可以确定该第一QoS flow标识为QoS flow ID2。

[0106] 进一步地，该无线接入设备确定该第一QoS flow标识后，可以从预先配置的第一

Petitioners' Exhibit 1002, p. 297
AT&T et al v. Asustek Technology
IPR2024-00997

QoS flow标识与传输通道之间的对应关系中，确定该第一QoS flow标识对应的传输通道，并通过确定的该传输通道，将该数据递交给上层的核心网设备。

[0107] 进一步地，该配置信息中还包括第一指示信息，该第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定服务质量QoS flow，该指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

[0108] 在实际应用场景中，一些QoS flow不需要传递第一QoS flow标识和/或第二QoS flow标识，例如，如果数据承载中只映射有一个QoS flow，则即使在数据传输过程中，不传递第一QoS flow标识和/或第二QoS flow标识，无线接入设备根据传输该数据的无线数据承载，也可以获知该数据的QoS flow。

[0109] 另外，该指定QoS flow可以为上行数据，也可以为下行数据，还可以是上行数据和下行数据。也即是，无线接入设备一般会指示UE，哪些上行QoS flow不需要传递第一QoS flow标识和/或第二QoS flow标识，或者，哪些下行QoS flow不需要传递第一QoS flow标识和/或第二QoS flow标识，再或者，哪些上行QoS flow和下行QoS flow不需要传递第一QoS flow标识和/或第二QoS flow标识。

[0110] 在本公开实施例中，在进行数据传输时，根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和该第二QoS flow标识的长度。当查询到该第二QoS flow标识和该长度时，说明可以通过第二QoS flow标识来代替该第一QoS flow标识，因此，在该数据的包头中添加上述长度的第二QoS flow标识。由于该第二QoS flow标识长度小于该第一QoS flow标识，因此，基于添加了该第二QoS flow标识的数据实现信息的传递可以节省开销，并且，该配置信息中还指示了该第二QoS flow标识的长度，如此，增加了对该第二QoS flow标识进行配置的灵活性，从而增加了信息传输的灵活性。

[0111] 需要说明的是，上述仅是以UE在传输数据时根据待传输的数据的第一QoS flow标识，查询第二QoS flow标识，并当查询到该第二QoS flow标识时，在该数据的包头中添加该第二QoS flow标识为例进行说明。对于无线接入设备来说，该无线接入设备在向UE传输数据时，也可以按照上述实现方式来传递信息。

[0112] 一般针对下行数据来说，如果QoS flow未配置有指定参数，则无线接入设备不会在传输的数据的包头中添加第一QoS flow标识或第二QoS flow标识，其中，该指定用于指示该QoS flow对应的上行数据与下行数据均映射到相同的数据承载上，例如，该指定参数可以为reflective QoS。

[0113] 但是，如果某QoS flow配置有对应的指定参数，例如，该指定参数为reflective QoS，则无线接入设备一般会在下行数据中增加QoS flow标识，以便于UE确定哪些QoS flow采用与下行数据相同的数据承载，以及采用的是哪个数据承载，从而实现数据的传输。

[0114] 在具体实现中，该无线接入设备也可以根据第一QoS flow标识，查询是否存在对应的第二QoS flow标识。当查询到存在对应的第二QoS flow标识时，在传输的数据的包头中添加该第二QoS flow标识，以通过该数据向该UE传递信息，本公开实施例不对无线接入设备发送数据以及通过数据传递信息的实现过程进行详细介绍，具体请参见上述UE发送数据以及通过数据传递信息的实现过程。

[0115] 需要说明的是，在实际实现中，如果某数据承载上映射的多个QoS flow均配置有上述指定参数，如，均配置有reflective QoS，则在数据传输过程中，无线接入设备也可以

Petitioners' Exhibit 1002, p. 298
AT&T et al v. Asustek Technology
IPR2024-00997

对该多个QoS flow中的随机一个QoS flow不配置对应的第一QoS flow标识或第二QoS flow标识，只对该多个QoS flow中的其它QoS flow配置对应的第一QoS flow标识或第二QoS flow标识即可。也即是，在实际实现中，无线接入设备下发的数据即使配置有对应的reflective QoS，但该数据的包头中也可能未携带第一QoS flow标识或第二QoS flow标识。

[0116] 图4A是根据一示例性实施例示出的一种信息传递装置的结构示意图，该信息传递装置包括：

[0117] 查询模块410，用于根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，该配置信息中包括数据承载对应的配置列表，该配置列表用于存储第一QoS flow标识、第二QoS flow标识以及该第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

[0118] 添加模块420，用于当该查询模块410查询到该第二QoS flow标识和该长度时，在该数据的包头中添加该长度的该第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0119] 可选地，该配置信息中还包括第一指示信息，该第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定QoS flow，该指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

[0120] 可选地，该数据的包头中还包括第二指示信息，该第二指示信息用于指示该数据的包头中是否包括该第一QoS flow标识，以及是否包括该第二QoS flow标识。

[0121] 可选地，该数据的包头中还包括第三指示信息，该第三指示信息用于指示该数据的包头中指定字段的内容的长度，该指定字段用于携带该第一QoS flow标识或第二QoS flow标识。

[0122] 可选地，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

[0123] 可选地，请参考图4B，该装置还包括：

[0124] 接收存储模块430，用于接收并存储无线接入设备发送的该配置信息。

[0125] 在本公开实施例中，在进行数据传输时，根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和该第二QoS flow标识的长度。当查询到该第二QoS flow标识和该长度时，说明可以通过第二QoS flow标识来代替该第一QoS flow标识，因此，在该数据的包头中添加上述长度的第二QoS flow标识。由于该第二QoS flow标识长度小于该第一QoS flow标识，因此，基于添加了该第二QoS flow标识的数据实现信息的传递可以节省开销，并且，该配置信息中还指示了该第二QoS flow标识的长度，如此，增加了对该第二QoS flow标识进行配置的灵活性，从而增加了信息传输的灵活性。

[0126] 关于上述实施例中的装置，其中各个模块执行操作的具体方式已经在有关该方法的实施例中进行了详细描述，此处将不做详细阐述说明。

[0127] 图5是根据一示例性实施例示出的一种信息传递装置500的框图。例如，装置500可以是移动电话，计算机，数字广播终端，消息收发设备，游戏控制台，平板设备，医疗设备，健身设备，个人数字助理等。

[0128] 参照图5，装置500可以包括以下一个或多个组件：处理组件502，存储器504，电源

Petitioners' Exhibit 1002, p. 299
AT&T et al v. Asustek Technology
IPR2024-00997

组件506，多媒体组件508，音频组件510，输入/输出(I/O)的接口512，传感器组件514，以及通信组件516。

[0129] 处理组件502通常控制装置500的整体操作，诸如与显示，电话呼叫，数据通信，相机操作和记录操作相关联的操作。处理组件502可以包括一个或多个处理器520来执行指令，以完成上述的方法的全部或部分步骤。此外，处理组件502可以包括一个或多个模块，便于处理组件502和其他组件之间的交互。例如，处理组件502可以包括多媒体模块，以方便多媒体组件508和处理组件502之间的交互。

[0130] 存储器504被配置为存储各种类型的数据以支持在装置500的操作。这些数据的示例包括用于在装置500上操作的任何应用程序或方法的指令，联系人数据，电话簿数据，消息，图片，视频等。存储器504可以由任何类型的易失性或非易失性存储设备或者它们的组合实现，如静态随机存取存储器(SRAM)，电可擦除可编程只读存储器(EEPROM)，可擦除可编程只读存储器(EPROM)，可编程只读存储器(PROM)，只读存储器(ROM)，磁存储器，快闪存储器，磁盘或光盘。

[0131] 电源组件506为装置500的各种组件提供电源。电源组件506可以包括电源管理系统，一个或多个电源，及其他与为装置500生成、管理和分配电源相关联的组件。

[0132] 多媒体组件508包括在所述装置500和用户之间的提供一个输出接口的屏幕。在一些实施例中，屏幕可以包括液晶显示器(LCD)和触摸面板(TP)。如果屏幕包括触摸面板，屏幕可以被实现为触摸屏，以接收来自用户的输入信号。触摸面板包括一个或多个触摸传感器以感测触摸、滑动和触摸面板上的手势。所述触摸传感器可以不仅感测触摸或滑动动作的边界，而且还检测与所述触摸或滑动操作相关的持续时间和压力。在一些实施例中，多媒体组件508包括一个前置摄像头和/或后置摄像头。当装置500处于操作模式，如拍摄模式或视频模式时，前置摄像头和/或后置摄像头可以接收外部的多媒体数据。每个前置摄像头和后置摄像头可以是一个固定的光学透镜系统或具有焦距和光学变焦能力。

[0133] 音频组件510被配置为输出和/或输入音频信号。例如，音频组件510包括一个麦克风(MIC)，当装置500处于操作模式，如呼叫模式、记录模式和语音识别模式时，麦克风被配置为接收外部音频信号。所接收的音频信号可以被进一步存储在存储器504或经由通信组件516发送。在一些实施例中，音频组件510还包括一个扬声器，用于输出音频信号。

[0134] I/O接口512为处理组件502和外围接口模块之间提供接口，上述外围接口模块可以是键盘，点击轮，按钮等。这些按钮可包括但不限于：主页按钮、音量按钮、启动按钮和锁定按钮。

[0135] 传感器组件514包括一个或多个传感器，用于为装置500提供各个方面的状态评估。例如，传感器组件514可以检测到装置500的打开/关闭状态，组件的相对定位，例如所述组件为装置500的显示器和小键盘，传感器组件514还可以检测装置500或装置500一个组件的位置改变，用户与装置500接触的存在或不存在，装置500方位或加速/减速和装置500的温度变化。传感器组件514可以包括接近传感器，被配置用来在没有任何的物理接触时检测附近物体的存在。传感器组件514还可以包括光传感器，如CMOS或CCD图像传感器，用于在成像应用中使用。在一些实施例中，该传感器组件514还可以包括加速度传感器，陀螺仪传感器，磁传感器，压力传感器或温度传感器。

[0136] 通信组件516被配置为便于装置500和其他设备之间有线或无线方式的通信。装置

Petitioners' Exhibit 1002, p. 300
AT&T et al v. Asustek Technology
IPR2024-00997

500可以接入基于通信标准的无线网络，如WiFi，2G或3G，或它们的组合。在一个示例性实施例中，通信组件516经由广播信道接收来自外部广播管理系统的广播信号或广播相关信息。在一个示例性实施例中，所述通信组件516还包括近场通信(NFC)模块，以促进短程通信。例如，在NFC模块可基于射频识别(RFID)技术，红外数据协会(IrDA)技术，超宽带(UWB)技术，蓝牙(BT)技术和其他技术来实现。

[0137] 在示例性实施例中，装置500可以被一个或多个应用专用集成电路(ASIC)、数字信号处理器(DSP)、数字信号处理设备(DSPD)、可编程逻辑器件(PLD)、现场可编程门阵列(FPGA)、控制器、微控制器、微处理器或其他电子元件实现，用于执行上述图2或图3实施例所述的信息传递方法。

[0138] 在示例性实施例中，还提供了一种包括指令的非临时性计算机可读存储介质，例如包括指令的存储器504，上述指令可由装置500的处理器520执行以完成上述方法。例如，所述非临时性计算机可读存储介质可以是ROM、随机存取存储器(RAM)、CD-ROM、磁带、软盘和光数据存储设备等。

[0139] 一种非临时性计算机可读存储介质，当所述存储介质中的指令由移动终端的处理器执行时，使得移动终端能够执行一种信息传递方法，所述方法包括：

[0140] 根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度，所述配置信息中包括数据承载对应的配置列表，该配置列表用于存储第一QoS flow标识、第二QoS flow标识以及所述第二QoS flow标识的长度三者之间的对应关系，其中，第二QoS flow标识的长度小于第一QoS flow标识的长度；

[0141] 当查询到所述第二QoS flow标识和所述长度时，在所述数据的包头中添加所述长度的所述第二QoS flow标识，并基于添加后的数据实现信息的传递。

[0142] 可选地，所述配置信息中还包括第一指示信息，所述第一指示信息用于指示不需要传递第一QoS flow标识和/或第二QoS flow标识的指定服务质量QoS flow，该指定QoS flow包括指定上行QoS flow和/或指定下行QoS flow。

[0143] 可选地，所述数据的包头中还包括第二指示信息，所述第二指示信息用于指示所述数据的包头中是否包括所述第一QoS flow标识，以及是否包括所述第二QoS flow标识。

[0144] 可选地，该数据的包头中还包括第三指示信息，该第三指示信息用于指示该数据的包头中指定字段的内容的长度，该指定字段用于携带该第一QoS flow标识或第二QoS flow标识。

[0145] 可选地，当所述数据的包头中包括所述第二QoS flow标识时，所述数据的包头中还包括第四指示信息，所述第四指示信息用于指示所述第二QoS flow标识的长度。

[0146] 可选地，所述根据待传输的数据的第一QoS flow标识，从存储的配置信息中查询对应的第二QoS flow标识和长度之前，还包括：

[0147] 接收并存储无线接入设备发送的所述配置信息。

[0148] 本领域技术人员在考虑说明书及实践这里公开的发明后，将容易想到本公开的其它实施方案。本申请旨在涵盖本公开的任何变型、用途或者适应性变化，这些变型、用途或者适应性变化遵循本公开的一般性原理并包括本公开未公开的本技术领域中的公知常识或惯用技术手段。说明书和实施例仅被视为示例性的，本公开的真正范围和精神由下面的权利要求指出。

Petitioners' Exhibit 1002, p. 301
AT&T et al v. Asustek Technology
IPR2024-00997

[0149] 应当理解的是，本公开并不局限于上面已经描述并在附图中示出的精确结构，并且可以在不脱离其范围进行各种修改和改变。本公开的范围仅由所附的权利要求来限制。

Petitioners' Exhibit 1002, p. 302
AT&T et al v. Asustek Technology
IPR2024-00997

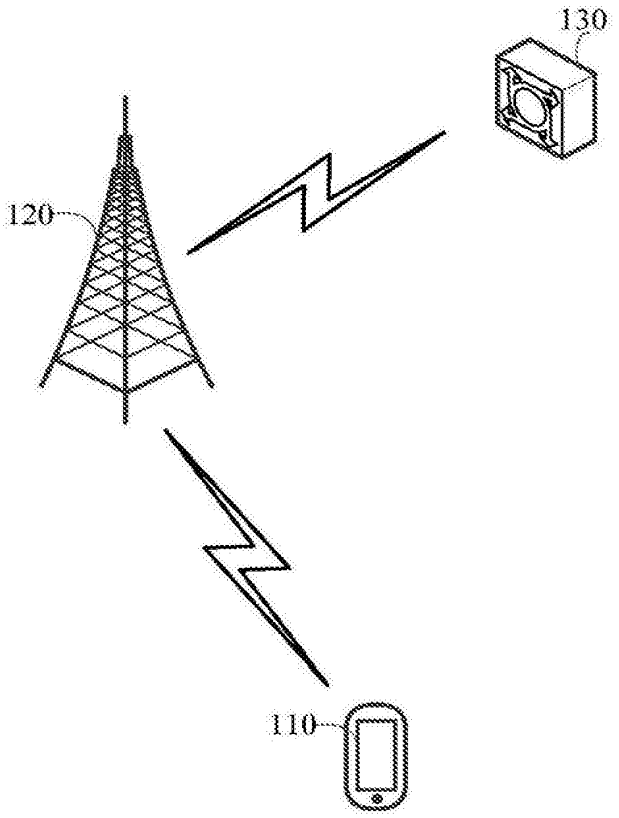


图1A

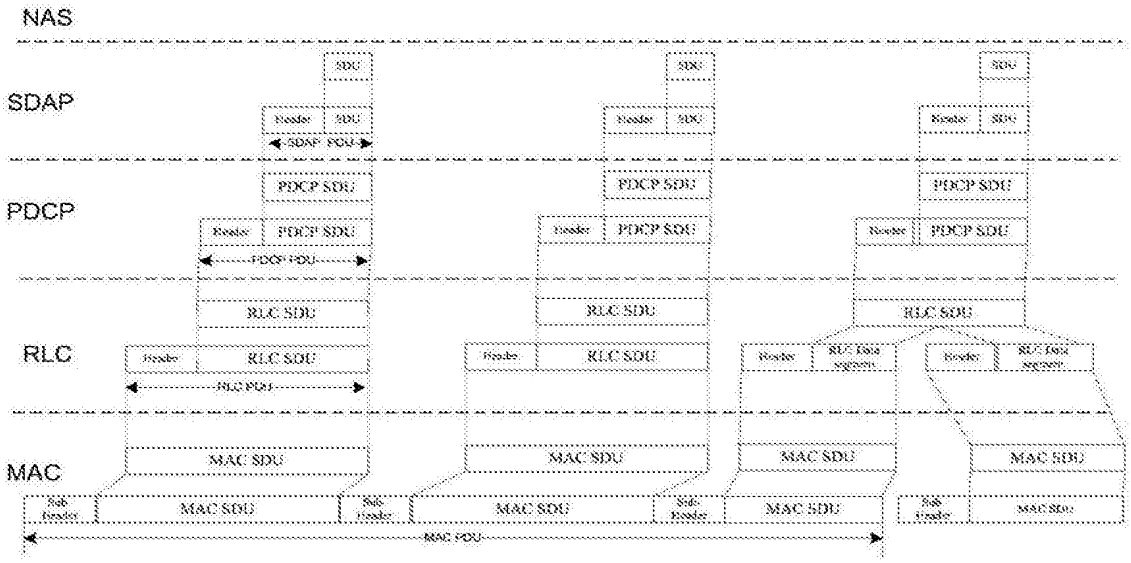


图1B

Petitioners' Exhibit 1002, p. 303
AT&T et al v. Asustek Technology
IPR2024-00997

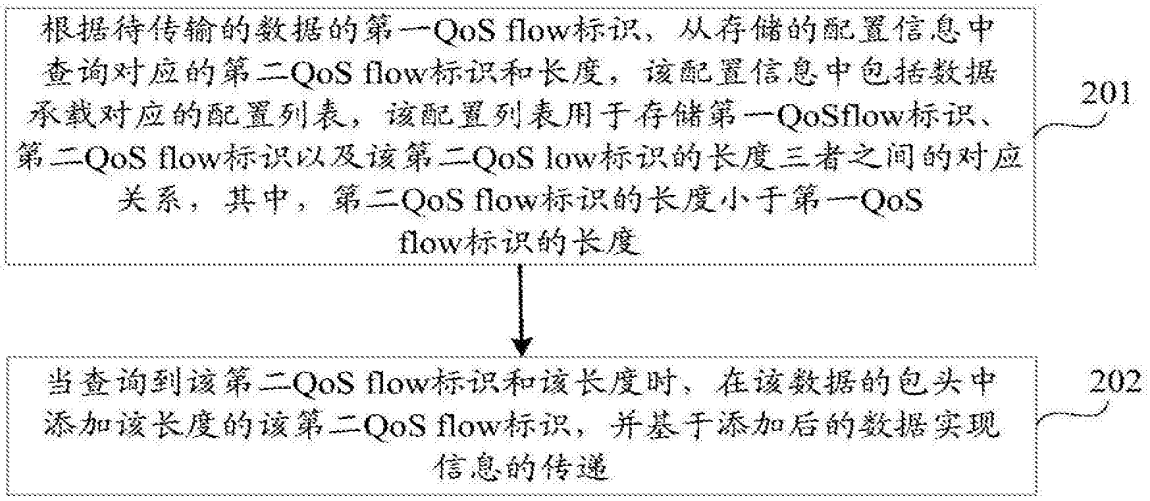


图2

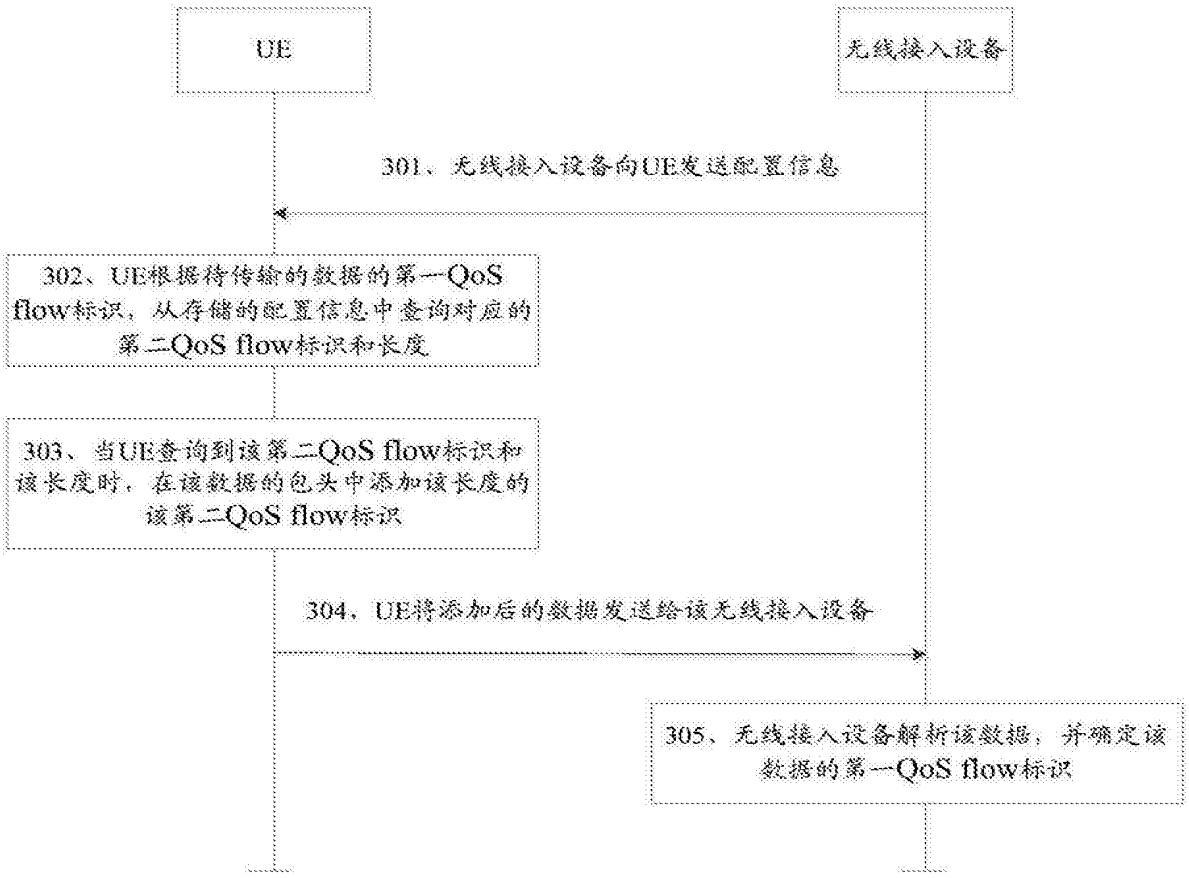


图3

Petitioners' Exhibit 1002, p. 304
AT&T et al v. Asustek Technology
IPR2024-00997

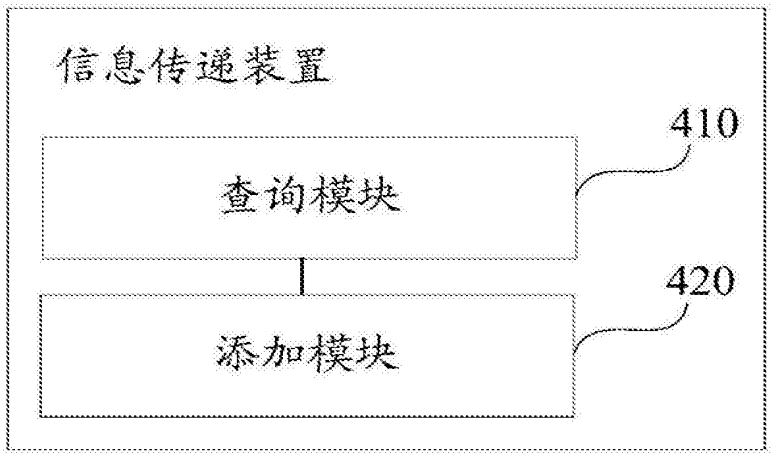


图4A

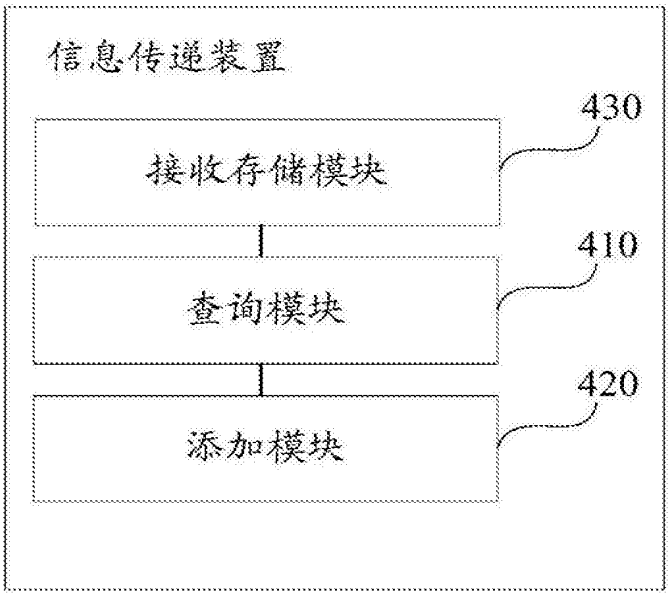


图4B

Petitioners' Exhibit 1002, p. 305
AT&T et al v. Asustek Technology
IPR2024-00997

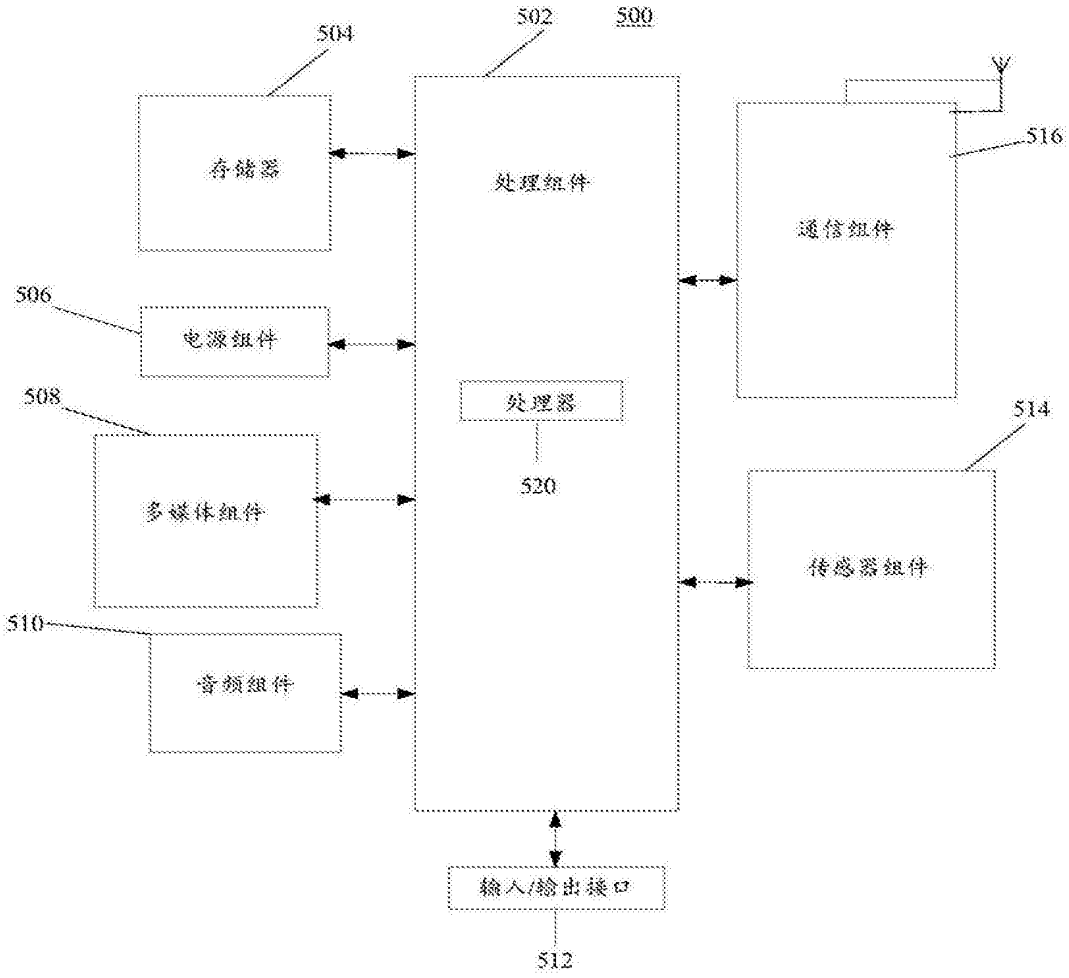


图5

Petitioners' Exhibit 1002, p. 306
AT&T et al v. Asustek Technology
IPR2024-00997

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Filer:	Sang N. Dang/Sandy Kim
Attorney Docket Number:	1426-221.101

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1720**

Electronic Acknowledgement Receipt

EFS ID:	33266520
Application Number:	16043818
International Application Number:	
Confirmation Number:	7229
Title of Invention:	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Li-Te Pan
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-221.101
Receipt Date:	24-JUL-2018
Filing Date:	
Time Stamp:	15:29:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1720
RAM confirmation Number	072518INTEFSW15304300
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		1426-221-101--PackageAsFiled.pdf	1695895 2ee2ba165b5ca05396b800f8f30b8ae98de0fa92	yes	77

Multipart Description/PDF files in .zip description

Document Description	Start	End
Transmittal of New Application	1	1
Fee Worksheet (SB06)	2	2
Specification	3	55
Claims	56	57
Abstract	58	58
Drawings-only black and white line drawings	59	70
Oath or Declaration filed	71	72
Information Disclosure Statement (IDS) Form (SB08)	73	74
Power of Attorney	75	76
Miscellaneous Incoming Letter	77	77

Warnings:

Information:

2	Application Data Sheet	WebADS.pdf	126335 0bcc2b496b4d79d8f457f37c15cafa6aee302c2d	no	8

Warnings:

Information:

3	Foreign Reference	WO2018026169A1.pdf	2820495 ce43cfabc2dd7dbb14c4430eb59c5454d851cfa5	no	56
Warnings:					
Information:					
4	Foreign Reference	CN107637123A.pdf	1400485 e2639e3bd44a4ef01938d964ae020702415d8ba6	no	20
Warnings:					
Information:					
5	Fee Worksheet (SB06)	fee-info.pdf	34830 50abba350956ed142aeea84ebdf7e99ae6303c28	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	6078040	

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/SB/08a (03-15)
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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	
Filing Date	2018-07-24
First Named Inventor	PAN, LI-TE
Art Unit	
Examiner Name	
Attorney Docket Number	1426-221.101

U.S.PATENTS

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

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

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] 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	2018026169	WO		2018-02-18	Youngbin Chang		☐
	2	107637123	CN		2018-01-26	JIANG XIAOWEI		☐
	3							☐

Petitioners' Exhibit 1002, p. 312
AT&T et al v. Asustek Technology
IPR2024-00997

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	2018-07-24
	First Named Inventor	PAN, LI-TE
	Art Unit	
	Examiner Name	
	Attorney Docket Number	1426-221.101

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

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

Petitioners' Exhibit 1002, p. 313
AT&T et al v. Asustek Technology
IPR2024-00997

PTO/AIA/15 (10-17)
Approved for use through 11/30/2020. OMB 0651-0032
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	1426-221.101
First Named Inventor	Li-Te Pan
Title	Method and Apparatus For Serving Quality of Service (QOS)...
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

1. [✓] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✓] **Specification** [*Total Pages* 56] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✓] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 12]
6. **Inventor's Oath or Declaration** [*Total Pages* 2] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [✓] Newly executed (original or copy)
   b. [ ] A copy from a prior application (37 CFR 1.63(d))
7. [✓] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✓] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [✓] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [✓] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [✓] **Other:** 2 foreign references

Note*: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✓] The address associated with Customer Number: 106622 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Sang N. Dang/	Date	July 24, 2018
Name (Print/Type)	Sang N. Dang	Registration No. (Attorney/Agent)	51,186

This collection of information is required by 37 CFR 1.53(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/SB/17 (01-18)
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FEE TRANSMITTAL

Complete if known	
Application Number	Not Yet Assigned
Filing Date	July 24, 2018
First Named Inventor	Li-Te Pan
Examiner Name	Not Yet Assigned
Art Unit	Not Yet Assigned
Practitioner Docket No.	1426-221.101

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

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

TOTAL AMOUNT OF PAYMENT ($) 1720

METHOD OF PAYMENT (check all that apply)

☐ Check ☒ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☐ Deposit Account Deposit Account Number: _____ Deposit Account Name: _____

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

☐ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 ☐ Credit any overpayment of fee(s)

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

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	Fees Paid ($)
Utility	300	150*	75	660	330	165	760	380	190	1720
Design	200	100	50	160	80	40	600	300	150	
Plant	200	100	50	420	210	105	620	310	155	
Reissue	300	150	75	660	330	165	2,200	1,100	550	
Provisional	280	140	70	0	0	0	0	0	0	

* The $150 small entity status filing fee for a utility application is further reduced to $75 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee ($)	Small Entity Fee ($)	Micro Entity Fee ($)
Each claim over 20 (including Reissues)	100	50	25
Each independent claim over 3 (including Reissues)	460	230	115
Multiple dependent claims	820	410	205

Total Claims		Extra Claims		Fee ($)		Fee Paid ($)
10	-20 or HP =	_____	x	_____	=	_____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		Extra Claims		Fee ($)		Fee Paid ($)
2	-3 or HP =	_____	x	_____	=	_____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	
Fee ($)	Fee Paid ($)
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		Extra Sheets		Number of each additional 50 or fraction thereof		Fee ($)		Fee Paid ($)
68	- 100 =	_____	/ 50 =	_____ (round up to a whole number)	x	_____	=	_____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English specification, $130 fee (no small or micro entity discount)	_____
Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity)	_____
Other (e.g., late filing surcharge): _____	_____

SUBMITTED BY

Signature	/Sang N. Dang/	Registration No. (Attorney/Agent) 51186	Telephone (714) 839-3800
Name (Print/Type)	Sang N. Dang		Date July 24, 2018

This collection of information is required by 37 CFR 1.136. 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, 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.

METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present Application claims the benefit of U.S. Provisional Patent Application Serial No. 62/536,163 filed on July 24, 2017, the entire disclosure of which is incorporated herein in their entirety by reference.

FIELD

[0002] This disclosure generally relates to wireless communication networks, and more particularly, to a method and apparatus for serving QOS flow in a wireless communication system.

BACKGROUND

[0003] With the rapid rise in demand for communication of large amounts of data to and from mobile communication devices, traditional mobile voice communication networks are evolving into networks that communicate with Internet Protocol (IP) data packets. Such IP data packet communication can provide users of mobile communication devices with voice over IP, multimedia, multicast and on-demand communication services.

[0004] An exemplary network structure is an Evolved Universal Terrestrial Radio Access Network (E-UTRAN). The E-UTRAN system can provide high data throughput in order to realize the above-noted voice over IP and multimedia services. A new radio technology for the next generation (e.g., 5G) is currently being discussed by the 3GPP standards organization. Accordingly, changes to the current body of 3GPP standard are currently being submitted and considered to evolve and finalize the 3GPP standard.

Petitioners' Exhibit 1002, p. 316
AT&T et al v. Asustek Technology
IPR2024-00997

SUMMARY

[0005] A method and apparatus are disclosed from the perspective of a network node. In one embodiment, the method includes the network node transmitting a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. The method further includes the network node establishing the default DRB with a presence of the QFI field in uplink. The method also includes the network node receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 shows a diagram of a wireless communication system according to one exemplary embodiment.

[0007] FIG. 2 is a block diagram of a transmitter system (also known as access network) and a receiver system (also known as user equipment or UE) according to one exemplary embodiment.

[0008] FIG. 3 is a functional block diagram of a communication system according to one exemplary embodiment.

[0009] FIG. 4 is a functional block diagram of the program code of FIG. 3 according to one exemplary embodiment.

[0010] FIG. 5 is a reproduction of Figure 12-1 of 3GPP TS 38.300 v0.4.1.

[0011] FIG. 6 is a reproduction of Figure A.6-1 of 3GPP TS 38.300 v0.4.1.

[0012] FIG. 7 is a reproduction of Figure 5.7.1-1 of TS 23.501 v1.0.0.

[0013] FIG. 8 is reproduction of Figure 1 of 3GPP R2-1707159.

[0014] FIG. 9 is reproduction of Figure 2 of 3GPP R2-1707159.

[0015] FIG. 10 is reproduction of Figure 3 of 3GPP R2-1707159.

Petitioners' Exhibit 1002, p. 317
AT&T et al v. Asustek Technology
IPR2024-00997

[0016] FIG. 11 is reproduction of Figure 4 of 3GPP R2-1707159.

[0017] FIG. 12 is a flow chart according to one exemplary embodiment.

[0018] FIG. 13 is a flow chart according to one exemplary embodiment.

[0019] FIG. 14 is a flow chart according to one exemplary embodiment.

DETAILED DESCRIPTION

[0020] The exemplary wireless communication systems and devices described below employ a wireless communication system, supporting a broadcast service. Wireless communication systems are widely deployed to provide various types of communication such as voice, data, and so on. These systems may be based on code division multiple access (CDMA), time division multiple access (TDMA), orthogonal frequency division multiple access (OFDMA), 3GPP LTE (Long Term Evolution) wireless access, 3GPP LTE-A or LTE-Advanced (Long Term Evolution Advanced), 3GPP2 UMB (Ultra Mobile Broadband), WiMax, or some other modulation techniques.

[0021] In particular, the exemplary wireless communication systems devices described below may be designed to support one or more standards such as the standard offered by a consortium named "3rd Generation Partnership Project" referred to herein as 3GPP, including: TS 38.300 v0.4.1, "NR; NR and NG-RAN Overall Description; Stage 2"; TS 23.501 v1.0.0, "System Architecture for the 5G System; Stage 2"; R2-1707159, "SDAP Header Format", Ericsson; R2-1707160, "Reflective QoS and Presence of Flow-ID", Ericsson; R2-1707161, "QoS Flow Remapping Within the Same Cell and in Handover", Ericsson; S2-170065, "Discussion on Reflective QoS activation using C-plane and U-plane", Huawei and HiSilicon; 3GPP RAN2#98 meeting chairman's note; 3GPP RAN2 NR Ad Hoc#2 meeting chairman's note; TS 38.323 v0.0.5, "NR; Packet Data Convergence Protocol (PDCP) specification"; 3GPP email discussion [NR-AH2#08][NR UP] Running TS 37.324 attachment "Draft 37324-010-v1.doc"; R2-1705780, "QoS flow ID in AS Reflective QoS", CMCC; R2-1704648, "Discussion on reflective QoS", ZTE; R2-1704649, "Discussion on the SDAP PDU format", ZTE; TS 23.401 v14.0.0, "General Packet Radio Service (GPRS) enhancements for Evolved Universal Terrestrial

Petitioners' Exhibit 1002, p. 318
AT&T et al v. Asustek Technology
IPR2024-00997

Radio Access Network (E-UTRAN) access". The standards and documents listed above are hereby expressly incorporated by reference in their entirety.

[0022] FIG. 1 shows a multiple access wireless communication system according to one embodiment of the invention. An access network 100 (AN) includes multiple antenna groups, one including 104 and 106, another including 108 and 110, and an additional including 112 and 114. In FIG. 1, only two antennas are shown for each antenna group, however, more or fewer antennas may be utilized for each antenna group. Access terminal 116 (AT) is in communication with antennas 112 and 114, where antennas 112 and 114 transmit information to access terminal 116 over forward link 120 and receive information from access terminal 116 over reverse link 118. Access terminal (AT) 122 is in communication with antennas 106 and 108, where antennas 106 and 108 transmit information to access terminal (AT) 122 over forward link 126 and receive information from access terminal (AT) 122 over reverse link 124. In a FDD system, communication links 118, 120, 124 and 126 may use different frequency for communication. For example, forward link 120 may use a different frequency then that used by reverse link 118.

[0023] Each group of antennas and/or the area in which they are designed to communicate is often referred to as a sector of the access network. In the embodiment, antenna groups each are designed to communicate to access terminals in a sector of the areas covered by access network 100.

[0024] In communication over forward links 120 and 126, the transmitting antennas of access network 100 may utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 116 and 122. Also, an access network using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access network transmitting through a single antenna to all its access terminals.

[0025] An access network (AN) may be a fixed station or base station used for communicating with the terminals and may also be referred to as an access point, a Node B, a base station, an enhanced base station, an evolved Node B (eNB), or some other terminology. An access terminal (AT) may also be called user equipment (UE), a wireless communication device, terminal, access terminal or some other terminology.

Petitioners' Exhibit 1002, p. 319
AT&T et al v. Asustek Technology
IPR2024-00997

[0026] FIG. 2 is a simplified block diagram of an embodiment of a transmitter system 210 (also known as the access network) and a receiver system 250 (also known as access terminal (AT) or user equipment (UE)) in a MIMO system 200. At the transmitter system 210, traffic data for a number of data streams is provided from a data source 212 to a transmit (TX) data processor 214.

[0027] In one embodiment, each data stream is transmitted over a respective transmit antenna. TX data processor 214 formats, codes, and interleaves the traffic data for each data stream based on a particular coding scheme selected for that data stream to provide coded data.

[0028] The coded data for each data stream may be multiplexed with pilot data using OFDM techniques. The pilot data is typically a known data pattern that is processed in a known manner and may be used at the receiver system to estimate the channel response. The multiplexed pilot and coded data for each data stream is then modulated (i.e., symbol mapped) based on a particular modulation scheme (e.g., BPSK, QPSK, M-PSK, or M-QAM) selected for that data stream to provide modulation symbols. The data rate, coding, and modulation for each data stream may be determined by instructions performed by processor 230.

[0029] The modulation symbols for all data streams are then provided to a TX MIMO processor 220, which may further process the modulation symbols (e.g., for OFDM). TX MIMO processor 220 then provides N_T modulation symbol streams to N_T transmitters (TMTR) 222a through 222t. In certain embodiments, TX MIMO processor 220 applies beamforming weights to the symbols of the data streams and to the antenna from which the symbol is being transmitted.

[0030] Each transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals, and further conditions (e.g., amplifies, filters, and upconverts) the analog signals to provide a modulated signal suitable for transmission over the MIMO channel. N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.

[0031] At receiver system 250, the transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r. Each receiver 254 conditions (e.g., filters,

Petitioners' Exhibit 1002, p. 320
AT&T et al v. Asustek Technology
IPR2024-00997

amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding "received" symbol stream.

[0032] An RX data processor 260 then receives and processes the N_R received symbol streams from N_R receivers 254 based on a particular receiver processing technique to provide N_T "detected" symbol streams. The RX data processor 260 then demodulates, deinterleaves, and decodes each detected symbol stream to recover the traffic data for the data stream. The processing by RX data processor 260 is complementary to that performed by TX MIMO processor 220 and TX data processor 214 at transmitter system 210.

[0033] A processor 270 periodically determines which pre-coding matrix to use (discussed below). Processor 270 formulates a reverse link message comprising a matrix index portion and a rank value portion.

[0034] The reverse link message may comprise various types of information regarding the communication link and/or the received data stream. The reverse link message is then processed by a TX data processor 238, which also receives traffic data for a number of data streams from a data source 236, modulated by a modulator 280, conditioned by transmitters 254a through 254r, and transmitted back to transmitter system 210.

[0035] At transmitter system 210, the modulated signals from receiver system 250 are received by antennas 224, conditioned by receivers 222, demodulated by a demodulator 240, and processed by a RX data processor 242 to extract the reserve link message transmitted by the receiver system 250. Processor 230 then determines which pre-coding matrix to use for determining the beamforming weights then processes the extracted message.

[0036] Turning to FIG. 3, this figure shows an alternative simplified functional block diagram of a communication device according to one embodiment of the invention. As shown in FIG. 3, the communication device 300 in a wireless communication system can be utilized for realizing the UEs (or ATs) 116 and 122 in FIG. 1 or the base station (or AN) 100 in FIG. 1, and the wireless communications system is preferably the LTE system. The communication device 300 may include an input device 302, an output device 304, a control circuit 306, a central processing unit (CPU) 308, a memory 310, a program code 312, and a transceiver 314. The

Petitioners' Exhibit 1002, p. 321
AT&T et al v. Asustek Technology
IPR2024-00997

control circuit 306 executes the program code 312 in the memory 310 through the CPU 308, thereby controlling an operation of the communications device 300. The communications device 300 can receive signals input by a user through the input device 302, such as a keyboard or keypad, and can output images and sounds through the output device 304, such as a monitor or speakers. The transceiver 314 is used to receive and transmit wireless signals, delivering received signals to the control circuit 306, and outputting signals generated by the control circuit 306 wirelessly. The communication device 300 in a wireless communication system can also be utilized for realizing the AN 100 in FIG. 1.

[0037] FIG. 4 is a simplified block diagram of the program code 312 shown in FIG. 3 in accordance with one embodiment of the invention. In this embodiment, the program code 312 includes an application layer 400, a Layer 3 portion 402, and a Layer 2 portion 404, and is coupled to a Layer 1 portion 406. The Layer 3 portion 402 generally performs radio resource control. The Layer 2 portion 404 generally performs link control. The Layer 1 portion 406 generally performs physical connections.

[0038] 3GPP TS38.300 described SDAP (Service Data Adaptation Protocol) layer and QoS as follows:

6.5 SDAP Sublayer

The main services and functions of SDAP include:

- Mapping between a QoS flow and a data radio bearer;
- Marking QoS flow ID (QFI) in both DL and UL packets.

A single protocol entity of SDAP is configured for each individual PDU session, except for DC where two entities can be configured (one for MCG and another one for SCG - see subclause 12).

[...]

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12 QoS

The QoS architecture in NG-RAN is depicted in the Figure 13-1 and described in the following:

Petitioners' Exhibit 1002, p. 322
AT&T et al v. Asustek Technology
IPR2024-00997

- For each UE, 5GC establishes one or more PDU Sessions.
- For each UE, the NG-RAN establishes one or more Data Radio Bearers (DRB) per PDU Session. The NG-NG-RAN maps packets belonging to different PDU sessions to different DRBs. Hence, the NG-RAN establishes at least one default DRB for each PDU Session indicated by 5GC upon PDU Session establishment.
- NAS level packet filters in the UE and in the 5GC associate UL and DL packets with QoS Flows.
- AS-level mapping in the UE and in the NG-RAN associate UL and DL QoS Flows with DRBs.

[Figure 12-1 of 3GPP TS 38.300 v0.4.1, entitled "QoS architecture", is reproduced as FIG. 5]

NG-RAN and 5GC ensure quality of service (e.g. reliability and target delay) by mapping packets to appropriate QoS Flows and DRBs. Hence there is a 2-step mapping of IP-flows to QoS flows (NAS) and from QoS flows to DRBs (Access Stratum).

In NG-RAN, the data radio bearer (DRB) defines the packet treatment on the radio interface (Uu). A DRB serves packets with the same packet forwarding treatment. Separate DRBs may be established for QoS flows requiring different packet forwarding treatment. In the downlink, the NG-RAN maps QoS Flows to DRBs based on NG-U marking (QoS Flow ID) and the associated QoS profiles. In the uplink, the UE marks uplink packets over Uu with the QFI for the purposes of marking forwarded packets to the CN.

In the uplink, the NG-RAN may control the mapping of QoS Flows to DRB in two different ways:

- Reflective mapping: for each DRB, the UE monitors the QFI(s) of the downlink packets and applies the same mapping in the uplink; that is, for a DRB, the UE maps the uplink packets belonging to the QoS flows(s) corresponding to the QFI(s) and PDU Session observed in the downlink packets for that DRB. To enable this reflective mapping, the NG-RAN marks downlink packets over Uu with QFI.

Petitioners' Exhibit 1002, p. 323
AT&T et al v. Asustek Technology
IPR2024-00997

It is FFS whether the marking with a QFI can be semi-statically configured (to not include the QOS flow ID when not needed).

- Explicit Configuration: besides the reflective mapping, the NG-RAN may configure by RRC an uplink "QoS Flow to DRB mapping".

The precedence of the RRC configured mapping and reflective QoS is FFS (can reflective QoS update and thereby override an RRC configured mapping? Or does a configured QoS Flow ID to DRB mapping always take precedence over a reflective mapping?)

If an incoming UL packet matches neither an RRC configured nor a reflective "QoS Flow ID to DRB mapping", the UE shall map that packet to the default DRB of the PDU session.

Within each PDU session, is up to NG-RAN how to map multiple QoS flows to a DRB. The NG-RAN may map a GBR flow and a non-GBR flow, or more than one GBR flow to the same DRB, but mechanisms to optimise these cases are not within the scope of standardization. The timing of establishing non-default DRB(s) between NG-RAN and UE for QoS flow configured during establishing a PDU session can be different from the time when the PDU session is established. It is up to NG-RAN when non-default DRBs are established.

In DC, the QoS flows belonging to the same PDU session can be mapped to different bearer types (see subclause 4.5.2) and as a result there can be two different SDAP entities configured for the same PDU session: one for MCG and another one for SCG (for instance when one MCG bearer and one SCG bearer are used for two different QoS flows).

The support for PDU session mapped to different bearers is pending conclusions in SA2 and RAN3.

[…]

Annex A (informative):

QoS Handling in RAN

When and if to include the QFI in full or in shortened form and RQI in SDAP is FFS.

Petitioners' Exhibit 1002, p. 324
AT&T et al v. Asustek Technology
IPR2024-00997

All message names and parameters are FFS.

These reflect current status and may need to be updated based on further decisions.

[...]

A.6 UE Initiated UL QoS Flow

The following figure shows an example message flow when the UE AS receives an UL packet for a new QoS flow for which a QFI for DRB does not exist.

[Figure A.6-1 of 3GPP TS 38.300 v0.4.1, entitled "UL packet with a new QoS flow for which a mapping does not exist in UE", is reproduced as FIG. 6]

0. PDU session and DRBs (including a default DRB) have been already established.
1. UE AS receives a packet with a new QFI from UE NAS.
2. UE uses the QFI of the packet to map it to a DRB. If there is no mapping of the QFI to a DRB in the AS mapping table for this PDU session, then the packet is assigned to the default DRB.
3. UE sends the packet on the default DRB. The UE includes the QFI in the SDAP header if SDAP has been configured for this DRB.
4. gNB sends UL packets over NG-U and includes the corresponding QFI.
5. If gNB wants to use a new DRB for this QoS flow, it sets up a DRB. It can also choose to move the QoS flow to an existing DRB using RRC signalling or AS reflective mapping procedures discussed above. Details of this are as shown in Figure X.2-1 and Figure X.3-1.
6. UL packets received in UE AS with the QFI are sent over the DRB decided by the QFI to DRB mapping table. If configured in step 5, UL data packets include a QoS marking (same as or corresponding to QFI) in the SDAP header.

Petitioners' Exhibit 1002, p. 325
AT&T et al v. Asustek Technology
IPR2024-00997

[0039] 3GPP TS 23.501 specified QoS model for NR (New RAT/Radio) as follows:

5.7 QoS model

5.7.1 General Overview

The 5G QoS model supports a QoS flow based framework. The 5G QoS model supports both QoS flows that require guaranteed flow bit rate and QoS flows that do not require guaranteed flow bit rate. The 5G QoS model also supports reflective QoS (see clause 5.7.5).

The QoS flow is the finest granularity of QoS differentiation in the PDU session. A QoS Flow ID (QFI) is used to identify a QoS flow in the 5G system. User Plane traffic with the same QFI within a PDU session receives the same traffic forwarding treatment (e.g. scheduling, admission threshold). The QFI is carried in an encapsulation header on N3 (and N9) i.e. without any changes to the e2e packet header. It can be applied to PDUs with different types of payload, i.e. IP packets, unstructured PDUs and Ethernet frames. The QFI shall be unique within a PDU session.

NOTE 1: Policing of User Plane traffic (e.g. MFBR enforcement) is not regarded as QoS differentiation and is done by UPFs on an SDF level granularity.

Each QoS flow (GBR and Non-GBR) is associated with the following QoS parameters (parameter details are described in clause 5.7.2):

- 5G QoS Indicator (5QI).
- Allocation and Retention Priority (ARP).

Each GBR QoS flow is in addition associated with the following QoS parameters (details are described in clause 5.7.2):

- Guaranteed Flow Bit Rate (GFBR) - UL and DL;
- Maximum Flow Bit Rate (MFBR) - UL and DL;
- Notification control.

Each Non-GBR QoS flow may in addition be associated with the following QoS parameter

(details are described in clause 5.7.2):

- Reflective QoS Attribute (RQA).

Two ways to control QoS flows are supported:

1) For non-GBR QoS flows with standardized 5QIs, the 5QI value is used as QFI as defined in clause 5.7.4 and a default ARP is used. In this case no additional N2 signalling is required at the time traffic for the corresponding QoS flows start; or

2) For GBR and non-GBR QoS flows, all the necessary QoS Parameters corresponding to a QFI are sent as QoS profile to (R)AN, UPF either at PDU Session establishment or QoS flow establishment/modification.

Editor's note: Whether beyond the standardized 5QIs, also pre-configured 5QI values can be further used as QFI values is FFS.

The QoS parameters of a QoS flow are provided to the (R)AN as a QoS profile over N2 at PDU Session or at QoS flow establishment and when NG-RAN is used at every time the User Plane is activated. QoS parameters may also be pre-configured in the (R)AN for non-GBR QoS flows (i.e. without the need to be signalled over N2).

The UE performs the classification and marking of UL User plane traffic, i.e. the association of uplink traffic to QoS flows, based on QoS rules. These rules may be explicitly signaled over N1 (at PDU Session establishment or QoS flow establishment), pre-configured in the UE or implicitly derived by UE from reflective QoS. A QoS rule contains a QoS rule identifier, the QFI of the QoS flow, one or more packet filters and a precedence value. There can be more than one QoS rule associated with the same QFI (i.e. with the same QoS flow).

A default QoS rule is required for every PDU session. The default QoS rule is the only QoS rule of a PDU session that may contain no packet filter (in this case, the highest precedence value (i.e. lowest priority) has to be used). If the default QoS rule does not contain a packet filter, the default QoS rule defines the treatment of packets that do not match any other QoS rule in a PDU session.

Petitioners' Exhibit 1002, p. 327
AT&T et al v. Asustek Technology
IPR2024-00997

Editor's note: It is FFS whether there, in addition, is a need for pre-authorized QoS rules be provided to the UE.

The SMF allocates the QFI for every QoS flow and derives its QoS parameters from the information provided by the PCF. When applicable, the SMF provides the QFI together with the QoS profile containing the QoS parameters of a QoS flow to the (R)AN. The SMF provides the SDF template (i.e. the set of packet filters associated with the SDF received from the PCF) together with the SDF precedence and the corresponding QFI to the UPF enabling classification and marking of User Plane traffic. When applicable, the SMF generates the QoS rule(s) for the PDU Session by allocating QoS rule identifiers, adding the QFI of the QoS flow, setting the packet filter(s) to the UL part of the SDF template and setting the QoS rule precedence to the SDF precedence. The QoS rules are then provided to the UE enabling classification and marking of UL User Plane traffic.

Editor's note: Some applications, e.g. IMS, require also the DL part of the SDF template in the QoS rule. Whether the DL of the SDF template has to be sent for every QoS rule is FFS.

The principle for classification and marking of User Plane traffic and mapping of QoS Flows to AN resources is illustrated in Figure 5.7.1-1.

[Figure 5.7.1-1 of TS 23.501 v1.0.0, entitled "The principle for classification and User Plane marking for QoS Flows and mapping to AN Resources", is reproduced s FIG. 7]

In DL incoming data packets are classified based on SDF templates according to their SDF precedence (without initiating additional N4 signalling).. The CN conveys the classification of the User Plane traffic belonging to a QoS flow through an N3 (and N9) User Plane marking using a QFI. The AN binds QoS flows to AN resources (i.e. Data Radio Bearers in case of in case of 3GPP RAN). There is no strict 1:1 relation between QoS flows and AN resources. It is up to the AN to establish the necessary AN resources to map the QoS flows to DRBs so that the UE

**Petitioners' Exhibit 1002, p. 328
AT&T et al v. Asustek Technology
IPR2024-00997**

receives the QFI (and reflective QoS (see clause 5.7.5) may be applied).

In UL, the UE evaluates UL packets against the packet filters in the QoS rules based on the precedence value of QoS rules in increasing order until a matching QoS rule (i.e. whose packet filter matches the UL packet) is found. The UE uses the QFI in the corresponding matching QoS rule to bind the UL packet to a QoS Flow. The UE then binds QoS flows to AN resources.

If no match is found and the default QoS rule contains one or more uplink packet filters, the UE shall discard the uplink data packet.

The following characteristics apply for processing of Downlink traffic:

- UPF maps User Plane traffic to QoS flows based on the SDF templates
- UPF performs Session-AMBR enforcement and also performs PDU counting for support of charging.
- UPF transmits the PDUs of the PDU session in a single tunnel between 5GC and (R)AN, the UPF includes the QFI in the encapsulation header. In addition, UPF may include an indication for reflective QoS activation in the encapsulation header.
- UPF performs transport level packet marking in downlink, e.g. setting the DiffServ Code point in outer IP header. Transport level packet marking may be based on the 5QI and ARP of the associated QoS flow.
- (R)AN maps PDUs from QoS flows to access-specific resources based on the QFIand the associated 5G QoS characteristics and parameters, also taking into account the N3 tunnel associated with the downlink packet.

NOTE 2: Packet filters are not used for binding of QoS flows onto access-specific resources in (R)AN.

- If reflective QoS applies, the UE creates a new derived QoS rule. The packet filter in the derived QoS rule is derived from the (i.e. the header of the) DL packet, and the QFI of the derived QoS rule is is set according to the QFI of the DL packet.

Petitioners' Exhibit 1002, p. 329
AT&T et al v. Asustek Technology
IPR2024-00997

Following characteristics apply for processing of uplink traffic:

- UE uses the stored QoS rules to determine mapping between UL User Plane traffic and QoS flows. UE transmits the UL PDUs using the corresponding access specific resource for the QoS flow based on the mapping provided by RAN.
- (R)AN transmits the PDUs over N3 tunnel towards UPF. When passing an UL packet from (R)AN to CN, the (R)AN determines the QFI value, which is included in the encapsulation header of the UL PDU, and selects the N3 tunnel.
- (R)AN performs transport level packet marking in the uplink, transport level packet marking may be based on the 5QI and ARP of the associated QoS Flow.
- UPF verifies whether QFIs in the UL PDUs are aligned with the QoS Rules provided to the UE or implicitly derived by the UE (e.g. in case of reflective QoS).
- UPF performs Session-AMBR enforcement and counting of packets for charging.

For UL Classifier PDU sessions, UL and DL Session-AMBR shall be enforced in the UPF that supports the UL Classifier functionality. In addition, the DL Session-AMBR shall be enforced separately in every UPF that terminates the N6 interface (i.e. without requiring interaction between the UPFs) (see clause 5.6.4).

For multi-homed PDU sessions, UL and DL Session-AMBR shall be enforced in the UPF that supports the Branching Point functionality. In addition, the DL Session-AMBR shall be enforced separately in every UPF that terminates the N6 interface (i.e. without requiring interaction between the UPFs) (see clause 5.6.4).

NOTE 3: The DL Session-AMBR is enforced in every UPF terminating the N6 interface to reduce unnecessary transport of traffic which may be discarded by the UPF performing the UL Classifier/Branching Point functionality due to the amount of the downlink traffic for the PDU session exceeding the DL Session-AMBR.

The (R)AN shall enforce Max BitRate (UE-AMBR) limit in UL and DL per UE for non-GBR QoS flows. The UE shall perform UL rate limitation on PDU Session basis for non-GBR traffic using

Petitioners' Exhibit 1002, p. 330
AT&T et al v. Asustek Technology
IPR2024-00997

Session-AMBR, if the UE receives a session-AMBR.

Rate limit enforcement per PDU session applies for flows that do not require guaranteed flow bit rate. MBR per SDF is mandatory for GBR QoS flows but optional for non-GBR QoS flows. The MBR is enforced in the UPF.

The QoS control for Unstructured PDUs is performed at the PDU session level. When a PDU session is set up for transferring unstructured PDUs, SMF provides the QFI which will be applied to any packet of the PDU session to the UPF and UE.

Editor's note: Whether and how the QoS flow level QoS control is supported for unstructured PDUs is FFS.

[0040] 3GPP R2-1707159 discussed SDAP Header Format as follows:

2.1 Transparent mode for SDAP

As agreed in the last meeting there are cases when the SDAP header is not needed (e.g. when operating in LTE+DC mode towards EPC or when the network does not intend to use any reflective mapping). When the network does not configure the SDAP header one could model this in a way that the SDAP layer is absent. However, this makes the protocol look different depending on an RRC configuration. Hence, a cleaner solution is to model the absence of the SDAP header as “SDAP transparent mode” as done already in several other 3GPP protocols. In this way, SDAP can always be drawn on top of PDCP. Also a PDCP SDU is always an SDAP PDU.

Proposal 1 When RRC de-configures the SDAP header, this is modelled as SDAP transparent mode.

2.2 SDAP Header format

In RAN2 97-bis meeting, decision was made to include Flow ID in SDAP header and to have the header byte aligned. Yet, the question of Flow Id length remains open. Possible sizes of flow ID are from 7 bits up to 16 bits when SDAP header is assumed to be one or two bytes and Maximum defined QFI value in QFI table defined by SA is 79 [1]. Flow ID value range with 7-bits should be already sufficient as it allows 128 flows to exist in one PDU session. Having larger Flow

Petitioners' Exhibit 1002, p. 331
AT&T et al v. Asustek Technology
IPR2024-00997

ID range requires UE to allocate more resources for Flow to DRB mapping.

Table 1: 3GPP TS23.501 System Architecture for 5G System, Stage2, V0.4.0 (2017-04)

5.7.5.4.2 Reflective QoS Activation via User Plane When the 5GC determines to activate reflective QoS via U-plane, the SMF shall include a QoS rule including an indication to the UPF via N4 interface to activate User Plane with user plane reflective. When the UPF receives a DL packet matching the QoS rule that contains an indication to activate reflective QoS, the UPF shall include the RQI in the encapsulation header on N3 reference point. **The UE creates a UE derived QoS rule when the UE receives a DL packet with a RQI.** *(Reflective QoS Indication).*

Based on the input from SA2 that UEs shall be told whether a DL packet requires an update of the NAS level SDF-to-Flow mapping. We propose that there is one-bit indication in the DL header. When the bit is set to 1, the UE indicates to NAS that it shall determine and possibly update the SDF-to-Flow mapping based on the Flow-ID present in the SDAP header [2].

Proposal 2 The DL SDAP header includes 1-bit NAS-RQI indication that indicates whether the UE shall create (or update) a UE derived QoS rule.

Similarly, to NAS RQI, there could be AS RQI bit indication in SDAP header indicating whether the UE shall create or update a QoS Flow to DRB mapping. Having both, NAS and AS RQI indication would require the SDAP header to be 2-bytes assuming that a 6-bit flow id length is not sufficient.

Figure 1 shows the header when both, AS and NAS RQI exists in the header. Length of the Flow ID is between 7 and 16.

Petitioners' Exhibit 1002, p. 332
AT&T et al v. Asustek Technology
IPR2024-00997

[Figure 1 of 3GPP R2-1707159, entitled "DL SDAP header with 8-bit Flow ID, NAS-RQI, AS-RQI and 6-bit Reserved field", is reproduced as FIG. 8]

Observation 1 In DL, when NAS-RQI and AS-RQI fields are present and Flow ID is greater than 7-bits, SDAP header grows to 2 bytes

Having NAS-RQI and AS-RQI allows gNB transmitter to omit the AS Flow ID in downlink header when neither the NAS RQI bit nor the AS RQI bit is set. This would allow reducing the header size to one octet in all DL packets that should not trigger any filter-update. But of course, it would also result in a variable SDAP header size. Such header is presented in the figure 1.

[Figure 2 of 3GPP R2-1707159, entitled "DL SDAP header with 1-bit NAS-RQI, 1-bit AS-RQI and Flow ID omitted (AS RQI = 0)", is reproduced as FIG. 9]

The header length variation in the SDAP header and adds complexity when e.g. ROHC needs to identify the starting point of the IP packet in the PDCP layer.

Considering that updating the Flow-ID to DRB mapping is significantly easier than the update of the NAS filters, we don't think that such an explicit indication should be added. Without that indication a header length of one byte provides space for a 7-bit Flow ID length.

From DRB to Flow ID mapping perspective in UE, it is not desirable to have longer Flow ID range than required as UE is required to maintain Flow to DRB mapping table. The range of 128 Flow IDs is sufficient for the use cases that currently exists [1].

The resulting downlink SDAP header is depicted in Figure 3.

[Figure 3 of 3GPP R2-1707159, entitled "DL SDAP header with 7-bit Flow ID and NAS-RQI", is

**Petitioners' Exhibit 1002, p. 333
AT&T et al v. Asustek Technology
IPR2024-00997**

reproduced as FIG. 10]

Proposal 3 The DL and UL SDAP header contains a 7-bit Flow ID

For UL, Flow ID provides information to the gNB from which gNB is able to observe the QoS marking carried in the NG3 UL header. The NAS-RQI is not required. Hence the resulting UL header has one spare bit (R) for later use as shown in Figure 4.

[Figure 4 of 3GPP R2-1707159, entitled "UL SDAP header when 7-bit Flow ID is used", is reproduced as FIG. 11]

Proposal 4 The UL SDAP header has one spare bit (R) for later use.

In previous meeting, some companies proposed to have control PDU for SDAP layer. Information carried by the control PDU would be related to the state of NAS and AS usage. This information can carried with the methods proposed above. Furthermore, RRC signalling covers QoS features, which would make control element information redundant. Since SDAP layer is used currently only with QoS and it is currently tightly coupled with the PDCP entity, control PDU would add complexity that may not be justified with the benefits. Additionally, dynamic SDAP header introduces complexity to the ROHC implementation as the position of the IP packet needs to be known by ROCH. Alternatively having SDAP header at the end would avoid the ROCH problems but introduce coupling of SDAP header with PDCP SDU length information. Parsing from the end with dynamic headers would create complexity to the receiver parser as the receiver would need to predict the length of the SDAP header or have it indicated otherwise.

Proposal 5 Control headers are not introduced in SDAP layer.

Proposal 6 SDAP header is placed at the beginning of the PDU.

**Petitioners' Exhibit 1002, p. 334
AT&T et al v. Asustek Technology
IPR2024-00997**

[0041] 3GPP R2-1707160 discussed reflective QoS and presence of Flow-ID as follows:

Presence of SDAP header and QoS Flow ID

To enable reflective QoS, the RAN marks downlink packets over Uu with a QoS flow ID. The UE marks uplink packets over Uu with the QoS flow ID for the purposes of marking forwarded packets to the CN.

RAN2-97bis agreed that …

DL packets over Uu are not marked with "Flow ID" at least for cases where UL AS reflective mapping and NAS reflective QoS is not configured for DRB.

AS layer header include the UL "Flow ID" depending on network configuration

RAN2-98 discussed the topic again and concluded the following:

1. The QoS flow ID is presence once the AS reflective QoS is active. FFS whether it is always present.

2. gNB should be informed when NAS layer reflective QoS is activated (e.g. can be used). It is FFS how we handle NAS reflective QoS and dependent on how/when it will be provided.

3. RAN2 will support a mode in which SDAP header is not present and is configured per DRB. If configured, FFS how the different fields are handled.

Dynamic presence of QoS Flow ID

Bullet 3 above implies that the eNB configures by RRC for each DRB whether or not the UE shall include the SDAP header in uplink PDCP SDUs and whether the SDAP header is present in DL PDCP SDUs. According to bullet 1, it should be discussed further whether the "QoS flow ID", once SDAP is configured, "*is always present*" or whether it may be present only dynamically. To achieve the latter the SDAP header would need to indicate with one bit the presence of the "QoS Flow ID" . Since such an indication would consume one bit itself it would not allow reducing the size of the SDAP header below one octet. Hence, we consider it more efficient to aim for an SDAP header that has a fixed size of one byte (if configured to be present by RRC).

Petitioners' Exhibit 1002, p. 335
AT&T et al v. Asustek Technology
IPR2024-00997

Proposal 1 **If the SDAP is configured for a DRB by means of RRC, the "QoS Flow ID" is present in UL and DL packets on that DRB (*not* dynamically enabled/disabled).**

Re-configuring presence of SDAP header

Since UE and network must be aware at any point in time which PDCP SDUs contain an SDAP header, the presence of this header should only be changed by a synchronized reconfiguration, i.e., RRCConnectionReconfiguration including mobilityControlInfo. One should note that this still requires that the PDCP receiver entity informs the SDAP entity for each delivered PDCP PDU whether the SDAP header is present. If one would like to avoid that, RAN2 should restrict the configuration of SDAP header to full configuration (fullConfig). However, we consider it acceptable to allow enabling/disabling the SDAP header during a handover.

Proposal 2 **The eNB may change the presence of the SDAP header only by means of a handover, i.e., a synchronized reconfiguration.**

Due to the decision to make SDAP a separate protocol above PDCP, the RoHC compressor and decompressor (which are specified to be part of PDCP) must now peek into the SDAP PDU and work with the SDAP SDU (the IP packet). While this is not a nice design, we believe that with the two proposals above both the UE and the network have all information that is necessary to perform RoHC.

Observation 1 **Based on the RRC configuration RoHC compressor and decompressor entities in UE and network side can determine the position of the IP packet inside each PDCP PDU, i.e., whether an SDAP header is present or not.**

Conclusion

Based on the discussion in section 2 we propose the following:

Proposal 1 **If the SDAP is configured for a DRB by means of RRC, the "QoS Flow ID" is present in UL and DL packets on that DRB (*not* dynamically**

Petitioners' Exhibit 1002, p. 336
AT&T et al v. Asustek Technology
IPR2024-00997

enabled/disabled).

Proposal 2 **The eNB may change the presence of the SDAP header only by means of a handover, i.e., a synchronized reconfiguration.**

References

R2-1707159. SDAP Header Format. Ericsson, RAN2-98-AH, Qingdao, P.R. of China, 27th – 29th June 2017

R2-1707161. QoS Flow Remapping Within the Same Cell and in Handover. Ericsson, RAN2-98-AH, Qingdao, P.R. of China, 27th – 29th June 2017

Annex: QoS-related agreements in previous meetings

RAN2-95 discussed the basic principles of the NR QoS framework and reached the following agreements:

Agreements
1 For DL for a non-GBR flow, the eNB sees an indication over NG-u and based on the indication the eNB maps the packet to a DRB of an appropriate QoS. RAN2 understanding of SA2 agreements is that eNB has a QoS profile associated with the indication. FFS whether there is a requirement for every different QoS indication to be mapped to a different radio bearer.

Petitioners' Exhibit 1002, p. 337
AT&T et al v. Asustek Technology
IPR2024-00997

2 Functionality is required to differentiate flows from different PDN-connections over the radio interface (e.g. by using separate DRBs or by an explicit indication in a header)

3 For DL, the eNB establishes DRBs for the UE taking the QoS profiles in to account.

FFS how the DRB is established in the first packet is an UL packet.

At RAN2-95bis some further agreements were achieved and the first of the FFSs above was resolved:

Agreements

1: RAN determines the mapping relationship between QoS flow (as determine by the UE in UL or marked by the CN in DL) and DRB for UL and DL.

1a RAN can map multiple QoS flows to a DRB.

2 Specification will not forbid a GBR flow and non-GBR flow to be mapped to the same DRB, but we will not introduce mechanisms to optimise this case.

3 Specification will not forbid more than one GBR flow to be mapped to the same DRB, but we will not introduce mechanisms to optimise this case.

FFS: Whether traffic from different PDU sessions can be mapped to one DRB or not.

Agreements

Petitioners' Exhibit 1002, p. 338
AT&T et al v. Asustek Technology
IPR2024-00997

1 Default DRB is established by eNB at PDU session establishment (or an existing DRB may be used if mapping of more than one session to a DRB is allowed)

2. If the first packet of the flow is UL packet, if no mapping rule is configured in the UE, the packet is sent through default DRB to the network.

FFS How and when the network can remap the flow to more appropriate DRB.

FFS the first packet is handled in the case that pre-authorised QoS is configured

FFS whether the pre-authorised QoS applies to RAN or only to the UE.

FFS whether there is a single level of mapping from UL TFT (5 tuple) to DRB, or whether there is a 2 level mapping from UL TFT to QoS flow and then from QoS flow to DRB.

RAN2#96:

Agreement

1: Traffic from different PDU sessions are mapped to different DRBs

2: In DL we have a 2-step mapping of IP flows, in which NAS is responsible for the IPflow->QOSflow mapping, and AS is responsible for the QOSflow->DRB mapping (confirmation of SA2 agreement status).

3: In UL we have a 2-step mapping of IP flows, in which NAS is responsible for the IPflow->QOSflow mapping, and AS is responsible for the QOSflow->DRB mapping.

4 DL packets over Uu are marked in band with QOS-flow-id for the purposes of reflective QoS

Petitioners' Exhibit 1002, p. 339
AT&T et al v. Asustek Technology
IPR2024-00997

5 UL packets over Uu are marked in band with QOS-flow-id for the purposes of marking forwarded packets to the CN.

FFS for bullets 4 and 5 whether it can be semi-statically configured to not include the QOS flow ID in some cases.

FFS for bullets 4 and 5 whether it might be possible to use a shorter id over the radio compared to that received from the CN. This is a stage 3 issue.

Agreements

1 For reflective QoS, the UE determines QoS Flow ID to DRB mapping in the uplink based on the downlink packets received within a DRB and applies those filters for mapping uplink Flows to DRBs.

2 The UE "continuously" monitors the QoS Flow ID in downlink PDCP packets and updates the reflective QoS Flow ID to DRB mapping in the uplink accordingly.

3 RRC can configure an uplink mapping

FFS The precedence of the RRC configured mapping and reflective QoS (e.g. can reflective QoS update an RRC configured mapping)

Working assumption:

If an incoming UL packet does not match a QoS Flow ID to DRB mapping (neither a configured nor a determined via reflective QoS), the UE shall map that packet to the default DRB of the PDU session.

=> FFS whether the QoS field is added by PDCP or a new protocol layer above PDCP.

Petitioners' Exhibit 1002, p. 340
AT&T et al v. Asustek Technology
IPR2024-00997

RAN2 Ad-Hoc January 2017:

Agreements

1: A new user plane AS protocol layer (e.g. PDAP) above PDCP should be introduced to accommodate all the functions introduced in AS for the new QoS framework, including:

- QOS flow->DRB routing;
- QoS-flow-id marking in DL packets;
- QoS-flow-id marking in UL packets;

2 The new protocol layer is applicable for all cases connecting to the 5G-CN

3: Single protocol entity is configured for each individual PDU session.

RAN2-97 Athens:

1 RAN2 to confirm that the timing of non-default DRB establishment (RAN to UE) for QoS Flow configured during PDU Session Establishment could be done NOT at the same time as PDU Session Establishment. (up to eNB implementation)

2 Working assumption from RAN2#96 is confirmed. i.e. First UL packet that doesn't have a mapping to a DRB, is mapped to a default DRB.

1 “Lossless HO”, that is, lossless, in sequence without duplication to upper layers,

Petitioners' Exhibit 1002, p. 341
AT&T et al v. Asustek Technology
IPR2024-00997

should be supported in specification for intra-NR.

FFS whether we support QoS flow remapping at handover and, if supported, whether the handover is lossless for this case.

RAN2-97bis Spokane (April 2017)

Agreements

1 NR/NR DC should support that different QoS flows of the same PDU session can be mapped to MgNB and SgNB.

2 In the case of NR/NR DC where different QoS flows of the same PDU session are mapped to MgNB and SgNB then there is one SDAP entity in the MgNB and one in SgNB for that PDU session.

RAN2 understand that support of this behaviour is still under discussion on SA2

Agreements:

- New AS layer PDU is PDCP SDU
- AS layer header is byte-aligned
- DL packets over Uu are not marked with "Flow ID" at least for cases where UL AS reflective mapping and NAS reflective QoS is not configured for DRB.
- AS layer header include the UL "Flow ID" depending on network configuration

[0042] 3GPP R2-1707161 discussed QoS flow remapping within the same Cell and in handover as follows:

Petitioners' Exhibit 1002, p. 342
AT&T et al v. Asustek Technology
IPR2024-00997

2.1 Updating QoS-Flow to DRB filters

At RAN2-96 it was discussed how the network can change a mapping of UL flows to DRBs and RAN2 agreed that "*The UE "continuously" monitors the QoS Flow ID in downlink PDCP packets and updates the reflective QoS Flow ID to DRB mapping in the uplink accordingly*".

The word "continuously" was put in quotation marks since companies wanted to study whether really each and every DL packet needs to be analysed.

We believe that this is the simplest way to allow the eNB to update the mapping by redirecting the packets of a DL flow onto a different DRB. For example, if the UE observes initially a downlink packet with Flow ID X on DRB 1, it creates an "Flow-to-DRB" filter that maps uplink packets with Flow ID X to DRB 1. But if the UE later observes a downlink packet with Flow ID X on DRB 2, it should change the filter for Flow X so that also the UL packets are mapped to DRB 2.

In the meantime, SA2 agreed however that the CN should indicate dynamically in the N3 (user plane) packet header that the UE shall use this packet's headers to create or update the NAS level reflective QoS mapping:

Table 1: 3GPP TS23.501 System Architecture for 5G System, Stage2, V0.3.1 (2017-03)

5.7.5.4.2 Reflective QoS Activation via User Plane *When the 5GC determines to activate reflective QoS via U-plane, the SMF shall include a QoS rule including an indication to the UPF to activate User Plane with user plane reflective. When the UPF receives a DL packet matching the QoS rule that contains an indication to activate reflective QoS, the UPF shall include the RQI in the encapsulation header on N3 reference point. The UE creates a UE derived QoS rule when the UE receives a DL packet with a RQI (Reflective QoS Indication).*

Based on the input from SA2 that UEs shall be told whether a DL packet requires an update of the NAS level SDF-to-Flow mapping, we suggest copying that indication into the SDAP header.

Petitioners' Exhibit 1002, p. 343
AT&T et al v. Asustek Technology
IPR2024-00997

Proposal 5 **If the NAS-RQI bit in a DL SDAP header is set to 1, the UE indicates to NAS that it shall determine and possibly update the SDF-to-Flow mapping based on the Flow-ID present in the SDAP header.**

So far RAN2 assumed that the UE shall update the AS-level Flow-to-DRB mapping based on all received DL packets containing a Flow-ID. One could consider changing this so that the UE updates also the AS-level mapping only if explicitly told to do so. To achieve this, the SDAP header would however need to comprise a second bit which indicates separately but in a similar way whether the UE shall update the Flow-to-DRB mapping using the Flow-ID in the packet header. Obviously this would only leave 6 bit for the Flow ID and hence likely lead to 2 octet SDAP headers if 6 bit is considered too small. More discussion on the possible header formats can be found in 0. In that paper we conclude that the Flow-ID in the SDAP header should 7 bit.

Proposal 6 **The Flow ID length for DL and UL in SDAP header is 7-bits.**

Proposal 7 **Since the NAS-RQI bit is only needed in DL SDAP headers, the UL SDAP header has one spare bit (R).**

2.2 Packet reordering upon re-mapping QoS Flow to another DRB

Some companies observed in the last meeting that the re-mapping of a QoS Flow to a different DRB may cause out-of-sequence packet delivery. This may happen when initial packets of the flow ended up in a low priority DRB and subsequent packets are mapped to a high priority DRB due to an updated Flow-to-DRB mapping. We agree with this observation but believe that the network can avoid this when performing the re-mapping at an occasion where the queues are empty. It may however not always be possible to ensure this for the uplink direction. But at least for initial re-mapping from a default DRB to another DRB, it is likely that higher layers are still in the initial handshaking phase (e.g. TCP SYN/SYN-ACK, TLS security setup, HTTP GET) and hence there will typically be very few packets in flight that could overtake each other.

Observation 2 **When the NW re-maps a flow to a different DRB during the initial transaction phase of the flow, packet re-ordering is unlikely due to few packets being in flight.**

Petitioners' Exhibit 1002, p. 344
AT&T et al v. Asustek Technology
IPR2024-00997

Observation 3 **When the NW re-maps a flow to a different DRB it can minimize the risk of re-ordering by postponing it to occasions when buffers are empty or at least small.**

It was also mentioned that packet re-ordering upon Flow re-mapping could be avoided by means of an additional re-ordering function per QoS Flow (above PDCP). However, in accordance with the observations above, we don't see a need for such (complex) functionality on the UE side.

If RAN2 believes the risk of packet re-ordering upon QoS-Flow remapping (in uplink direction) is unacceptably large, we suggest seeking for a relatively simple solution such as the following: Upon detecting a remapping of a flow to a different DRB (reflectively or explicitly) the PDCP transmitter copies all the not-yet-RLC-ACKed PDCP PDUs to the target DRB's PDCP entity. This may result in some duplicates but those don't matter for higher layers. Since we anyway assume that there will usually be only few packets in flight during the initial phase of a file transfer, the inefficiency due to the (few) duplicates would be negligible for the initial reflective QoS remapping described above. Of course, the approach would also avoid re-ordering on IP level if the network re-maps a flow during handover.

Moving (instead of copying) the data to another DRB would avoid the overhead but would require re-processing already pre-processed the PDCP PDUs of the source DRB.

Proposal 8 **Additional UE functionality for avoiding possible out-of-order delivery when re-mapping a QoS-Flow to a different DRB (by explicit signalling or by update reflective QoS mapping) should not be introduced.**

Proposal 9 **If Proposal 8 is not agreeable (i.e., if RAN2 believes that re-ordering due to QoS flow re-mapping shall be avoided), the PDCP transmitter shall copy all the not-yet-RLC-ACKed PDCP PDUs to the target DRB's PDCP entity.**

2.3 Precedence order of reflective and configured mapping

RAN2-96 did not yet agree on "*The precedence of the RRC configured mapping and reflective*

Petitioners' Exhibit 1002, p. 345
AT&T et al v. Asustek Technology
IPR2024-00997

QoS". There are basically three options:

1) An RRC configured mapping overrides any reflective mapping for that flow.

2) A newly derived reflective mapping overrides a mapping configured previously by RRC.

3) The UE applies always the most recent mapping, i.e., either provided by RRC or derived by reflective QoS

We think that the second option would introduce an undesirable dependency between the RRC configuration and the user plane. For example, the RRC configuration (AS-Config) would not represent the mapping that the UE applies. This would be undesirable in case of mobility since the UE would not behave as expected by the target node. It would also remove the possibility to override a previous reflective QoS mapping by a dedicated configuration.

The third option suffers from possible race conditions since it may not be fully predictable whether the UE received a DL data packet or the RRCConnectionReconfiguration first. Also, just as the second option, ambiguities exist upon mobility.

Generally, we think that RRC signalling should always have precedence over L2 and L1 control signalling. It would ensure a clean split and avoid any ambiguity. Also during mobility this principle ensures that the target eNB is aware of all configured UL QoS mappings applied by the UE. Besides that, it would also allow the eNB to map a DL QoS flow onto a different DRB than the UL QoS flow with the same ID.

Proposal 10 If the eNB configures the UE with an "uplink QoS Flow to DRB filter", it overrides any reflective mapping for this QoS flow.

2.4 Maintaining QoS mapping during handover

In the context of inter-cell mobility, it should be discussed whether the UE maintains the reflective UL QoS filters. As mentioned above, the target eNB does not know the UE's reflective QoS filters from the AS-Config. One could consider that the source eNB provides the reflective UL QoS mappings to the target eNB (e.g. in AS-Context). Alternatively, the target node can change the QoS mapping and send the new mapping to the UE in the HO command

**Petitioners' Exhibit 1002, p. 346
AT&T et al v. Asustek Technology
IPR2024-00997**

(RRCConnectionReconfiguration). But we consider this being unnecessarily complex and it would also introduce risk of state mismatch. It appears simpler that the UE maintains a reflective UL QoS mapping as long as the DRB with which it is associated exists, i.e., also during normal RRC mobility. The UE releases the reflective UL QoS mapping when the eNB releases the DRB with which the mapping is associated.

Proposal 11 The UE maintains a reflective UL QoS mapping as long as the DRB with which it is associated exists, i.e., also during normal RRC mobility and upon bearer-type change. The UE releases the reflective UL QoS mapping when the eNB releases the DRB with which the mapping is associated.

[0043] RAN2#98 Chairman's note captured the following agreements made for related QoS:

Agreements
1: From RAN2 perspective the existing QoS parameters, and in particular the concept of QCI/5QI to abstract QoS requirements between CN and RAN should be maintained in NR/NGC.
2 RAN2 sees a benefit in providing a "averaging window" as new QoS parameter via N2. The RAN may use in this parameter in its scheduling decision e.g. to enforce MBR and GRB.
3: No additional parameters are recommendation to SA2.
4 RAN2 to ask SA2 to clarify the use and corresponding actions from CN related to the notification control to CN, if the QoS targets cannot be fulfilled in RAN

Agreements of SDAP headers

**Petitioners' Exhibit 1002, p. 347
AT&T et al v. Asustek Technology
IPR2024-00997**

1. The QoS flow ID is presence once the AS reflective QoS is active. FFS whether it is always present.
2. gNB should be informed when NAS layer reflective QoS is activated (e.g. can be used). It is FFS how we handle NAS reflective QoS and dependent on how/when it will be provided.
3. RAN2 will support a mode in which SDAP header is not present and is configured per DRB. If configured, FFS how the different fields are handled.

[0044] RAN2 NR Ad Hoc #2 Chairman's note captured the following agreements made for related QoS:

Agreements

1 At SN addition and at new PDU session establishment then MN makes the decision which QoS flows are moved SN

FFS Whether the SN can reject the movement of a QoS flow.

2 Irrespective of which node makes the decision of where a QoS flow is mapped (to MN or SN) then RAN2 will aim that the RRC signalling is the same.

Agreements

1: The MN makes the decision to move ongoing/existing QoS flows to the SN (this agreement does not imply whether the QoS flow is moved by moving a single flow or by moving a whole bearer)

FFS Whether MN or SN takes the decision for flows being moved from SN to MN

2: The SN can reject the addition of a QoS flow, and inform the MN.

Petitioners' Exhibit 1002, p. 348
AT&T et al v. Asustek Technology
IPR2024-00997

3: The DRB level offloading (i.e. offloading all QoS flows of a DRB) is supported between the MN and SN.

FFS: The QoS flow level offloading between the MN and SN, and if supported then whether lossless handover can be supported.

4: The lossless handover user plane procedure could be reused for DRB level offloading, if mapping is maintained in the target node.

FFS: If the case where mapping is not maintained can support lossless handover

5: The SN is responsible for the DRB management (e.g., setup, modify, release) of SCG/SCG-split bearers, and the QoS flow -> DRB mapping at the SN

Agreements:

1. There is a need to tell the UE that it has to update the mapping rule. For the AS reflective QoS it is up to the RAN to decide when to update the mapping rules. FFS on the details of the header format.
2. It is up to the RAN to decide when and which mechanism, explicit RRC re-configuration and/or AS reflective QoS, should be used to provide mapping information to the UE.
3. A UE follows the latest QoS flow to DRB mapping information regardless of the fact whether it was explicit RRC or AS reflective QoS.
4. Whether a SDAP header is present or not is configured by RRC per DRB
5. The gNB indicates to UE using RRC signaling the default DRB for a PDU session.
6. RAN decides and configures the default DRB for a PDU session.

Petitioners' Exhibit 1002, p. 349
AT&T et al v. Asustek Technology
IPR2024-00997

[0045] Draft 3GPP TS 37.324 specified SDAP data transfer procedure and QoS flow to DRB (Data Radio Bearer) mapping as follows:

5.2 SDAP data transfer procedures

5.2.1 UL data transfer procedures

At reception of an SDAP SDU from upper layer for a QoS flow,

- if there is no stored QoS flow to DRB mapping rule for the QoS flow:
  - the SDAP entity shall map the SDAP SDU to the default bearer;
- else:
  - the SDAP entity shall map the SDAP SDU to the DRB according to the stored QoS flow to DRB mapping rule;
- if the DRB to which this SDAP SDU is mapped is configured by upper layer [3] with the presence of SDAP header,
  - the SDAP entity shall construct the SDAP PDU as specified in the subclause 6.2.2.2;
- else:
  - the SDAP entity shall construct the SDAP PDU as specified in the subclause 6.2.2.1;
- the SDAP entity shall deliver the SDAP PDU to the lower layers.

5.2.2 DL data transfer procedures

At reception of an SDAP PDU from lower layers,

- if the DRB from which this SDAP PDU is received is configured by upper layer [3] with the presence of SDAP header, the SDAP entity shall:
  - perform reflective QoS flow to DRB mapping as specified in the subclause 5.3.2;
  - retrieves the SDAP SDU from the SDAP PDU as specified in the subclause 6.2.2.2;

Petitioners' Exhibit 1002, p. 350
AT&T et al v. Asustek Technology
IPR2024-00997

- else:

  -retrieve the SDAP SDU from the SDAP PDU as specified in the subclause 6.2.2.1;

- deliver the retrieved SDAP SDU to the upper layer.

5.3 QoS flow to DRB mapping procedure

5.3.1 QoS flow to DRB mapping configuration

When upper layer [3] configures a UL QoS flow to DRB mapping rule for an SDAP entity:

- the SDAP entity shall store the UL QoS flow to DRB mapping rule.

5.3.2 Reflective QoS flow to DRB mapping

For each received DL packet of the QoS flow, the UE shall check the SDAP header for reflective QoS to DRB mapping, as follows:

- if reflective QoS flow to DRB mapping is enacted:

the SDAP entity shall store the QoS flow to DRB mapping of the DL packet as the QoS flow to DRB mapping rule for the UL packets of the QoS flow.

[0046] 3GPP R2-1704648 proposed to use a SDAP control PDU (Packet Data Unit) to configure QoS flow to DRB mapping as follows:

2.1 Reflective notification on Uu

Per achievement captured in [1] (Annex A for reference), the RAN may control the uplink mapping of QoS Flow-DRB either via reflective mapping or explicit configuration. And the reflective mapping is accomplished via marking DL packets over Uu with QFI (Called as reflective mapping via SDAP data PDU hereafter).

Whether to support QoS flow-DRB remapping was raised up during SI with no final decision. The issue is analyzed in our companion contribution [2] and we propose that the QoS flow-DRB remapping for non-handover case (i.e. intra-cell remapping) should be allowed. Then according

Petitioners' Exhibit 1002, p. 351
AT&T et al v. Asustek Technology
IPR2024-00997

to the achievement indicated above, the RAN can control the uplink QoS flow-DRB remapping via explicit configuration or reflective mapping via SDAP data PDU. However, take the following remapping case listed in [2] for an instance:

– If an incoming UL packet does not match a"QoS Flow ID to DRB mapping", the UE shall map the packet to the default DRB of the PDU session. When the gNB receives the packet, it may decide to remap the UL QoS flow to another appropriate DRB.

If the gNB controls the remapping via explicit configuration, additional RRC signalling overhead and extra delay will be introduced. While if the gNB controls the remapping via SDAP data PDU, it should be noted that for UL mainly traffic, maybe there's no DL data arrival right at that time. Then the control of the remapping may be delayed until the first DL packet arrival. The unpredictable delay may have negative impact on the user experience. The analysis above is also true for the other three remapping cases listed in [2].

To tackle the issue, one possible approach is to introduce a SDAP Control PDU for uplink reflective mapping (Called as SDAP Control PDU for reflective mapping hereafter). For example, if to map a QoS flow to a DRB via the SDAP control PDU, the QFI of the QoS flow should be include in the SDAP control PDU and the SDAP control PDU is delivered via the DRB to which the QoS flow is expected to be mapped to.

– The SDAP control PDU for reflective mapping can be introduced in addition to the reflective mapping via SDAP data PDU: When the gNB decides to control the uplink mapping/remapping of QoS Flow-DRB via reflective mapping, if there's no DL data available right at that time, control via SDAP control PDU, or else control via SDAP data PDU; or,

– The SDAP control PDU for reflective mapping can be introduced instead of the reflective mapping via SDAP data PDU: Whenever the gNB decides to control the uplink mapping/remapping of QoS Flow-DRB via reflective mapping, control via SDAP control PDU.

During the study in SI, majority of the companies propose to decouple the NAS reflective QoS and AS reflective mapping. The target can be achieved with the introduction of SDAP control

Petitioners' Exhibit 1002, p. 352
AT&T et al v. Asustek Technology
IPR2024-00997

PDU replace reflective mapping via SDAP data PDU. And if it is agreed to introduce the SDAP control PDU for reflective mapping, the SDAP control PDU format can be found in our companion contribution [6].

Observation1. If with the introduction of SDAP control PDU to replace reflective mapping via SDAP data PDU, the target of decouple the NAS reflective QoS and AS reflective mapping can be achieved.

With the above analyse, we propose:

Proposal1. To introduce SDAP control PDU for reflective mapping.

Proposal2. The SDAP control PDU can be introduced either to replace or in addition to the reflective mapping via SDAP data PDU.

At RAN2#97bis [3], it's agreed that:

- *DL packets over Uu are not marked with "Flow ID" at least for cases where UL AS reflective mapping and NAS reflective QoS is not configured for DRB.*

Then the question is when should the DL packets over Uu are marked with "Flow ID"?

According to the achievement in SA2 [4] (Annex B for reference), if the NAS reflective QoS is used, the UE needs to rely on the DL packets to derive the QoS rules. The derived QoS rule includes Packet Filter, QFI, precedence value. Among the derived QoS rules, the Packet Filter and QFI can be derived only from the DL packets. So obviously, the QFI should also be included in DL packets for the purpose of NAS reflective QoS.

Observation2. DL packets over Uu should be marked with QFI for the purpose of NAS reflective QoS.

The NAS reflective QoS is to create a QoS rule for an uplink QoS flow in the UE. And per achievement in [1], the timing of establishing non-default DRB(s) and how to map QoS flows to DRBs is up to RAN decision. At the time to create a QoS rule for an uplink QoS flow via NAS reflective QoS, it's the most probably that there will be upcoming uplink packets for this specific QoS flow. If the QoS flow is not mapped to any DRB at that time, the AS reflective mapping may

Petitioners' Exhibit 1002, p. 353
AT&T et al v. Asustek Technology
IPR2024-00997

be used at the same time to map this specific uplink QoS flow to an established DRB. In this case, if keeping using SDAP data PDU for the purpose of AS reflective mapping, QFI should be included in DL packets for both the purpose of NAS reflective QoS and AS reflective mapping.

Observation3. NAS reflective QoS and AS reflective mapping may take place simultaneously over the Uu.

Observation4. If keep using the SDAP data PDU for the purpose of AS reflective QoS, DL packets over Uu should be marked with QFI for the purpose of NAS reflective QoS and/or AS reflective mapping.

With the introduction of QFI in DL packets for the purpose of reflective, whether the UE should "continuously" monitor the QFI in DL packets or not is left open at the end of SI phase. Considering the high data volume in NR, concerns arise that high processing overhead as well as complexity will be introduced if the UE is required to continuously monitor QoS flow ID in each DL packet [5]. Besides, as analyzed above, if keep using the SDAP data PDU for the purpose of AS reflective QoS, the QFI should be included in the DL packets for the purpose of NAS reflective QoS and AS reflective mapping. Then if with only QFI in the DL packets, the UE receives a DL packet with QFI can't discriminate whether it is for NAS reflective QoS or AS reflective mapping, thus should perform both type of reflective checking anytime. In this way, unnecessary processing overhead will be introduced.

To tackle the issues above, indicators should be introduced in the DL packets to inform UE whether the QFI is included in the DL packets or not and whether it is for NAS reflective QoS and/or AS reflective mapping. The UE needs to do reflective checking only if it is indicated that the QFI is included. And the UE performs NAS reflective checking and/or AS reflective checking according to the instruction of the indicators. The detail of the inclusion of the indicators in the SDAP header will be discussed in our companion contribution [6].

Proposal 3. If keep using the SDAP data PDU for the purpose of AS reflective QoS, indicators should be introduced in the DL packets to inform whether QFI is included or not and whether it is for NAS reflective QoS and/or AS reflective mapping.

**Petitioners' Exhibit 1002, p. 354
AT&T et al v. Asustek Technology
IPR2024-00997**

For the AS reflective mapping, the QoS flow-DRB mapping is determined by the gNB itself, it is up to gNB to determine when to make use of the AS reflective mapping. So the gNB knows well when the AS reflective mapping is required and generates the SDAP control PDU or SDAP data PDU for reflective mapping accordingly.

While for NAS reflective QoS, per achievement in SA2 [4], the reflective QoS can be activated via either User Plane or Control Plane via the Reflective QoS Indication (RQI). If activated via User Plane, the RQI will be included in the encapsulation header of the DL packets on N3 reference point. With the receiving of RQI, the gNB knows NAS reflective QoS is required and includes QFI in the DL packets accordingly. If activated via Control Plane, the RQI is only indicated to the UE via N1 reference point [4]. The gNB has no idea of when to include the QFI in the DL packets. So SA2 should be informed that for the case of reflective QoS activated via Control Plane, the RQI should also be informed to the gNB, e.g. via N2 signalling.

Proposal 4. To inform SA2 that the RQI should be informed to the gNB also in case the reflective QoS is activated via Control Plane.

2.2 Precedence of the RRC configured mapping and reflective mapping

The precedence of the RRC configured mapping and AS reflective mapping is still left open now [1]. During the discussion in SI, solution for the issue is discussed but without any considering on the occurring of the issue itself, that is, in which scenarios the issue will take place. The reasonable assumption is that once the QoS flow-DRB mapping is decided in the gNB, it will be kept in use only if QoS flow-DRB remapping is needed. In other words, the issue of the precedence of RRC configured and reflective mapping should only be considered if QoS flow-DRB remapping is allowed.

Proposal 5. The issue of the precedence of RRC configured and reflective mapping should only be considered if QoS flow-DRB remapping is allowed.

The gNB decides the QoS flow-DRB mapping according to the QoS profiles per QoS flow, taking the radio condition in RAN (e.g. radio link quality, load condition etc) into consideration. Neither the QoS profiles nor the radio conditions in RAN will change frequently. So it can be

Petitioners' Exhibit 1002, p. 355
AT&T et al v. Asustek Technology
IPR2024-00997

precluded that another QoS flow-DRB remapping will take place right after the preceding one. In other words, practically, the gNB will initiate a new remapping only after the completion of the previous remapping. And the gNB knows the most updated QoS flow-DRB mapping in UE clearly. Given the above, we propose that the UE should always apply the most recent mapping, i.e., either explicit provided by RRC or derived by reflective mapping.

Proposal 6. The UE should always apply the most recent mapping, i.e., either explicit provided by RRC or derived by reflective mapping.

2.3 QoS flow-DRB mapping handle during handover

According to the agreement at RAN2#97bis, "Lossless HO" can be accomplished if the target uses the same DRB configuration and QoS flow-DRB mapping as the source. So for the purpose of "Lossless HO", all of the QoS flow-DRB mapping information in the source should be forwarded to the target. And the UE should maintain all of the QoS flow-DRB mapping acquired from the source (including both the mapping configured via RRC signaling and the reflective mapping) during handover and update according to the target decision correspondingly.

Proposal 7. Forward all of the QoS flow-DRB mapping information from the source to the target.

Proposal 8. The UE should maintain all of the QoS flow-DRB mapping acquired from the source during handover and update according to the target decision correspondingly.

[0047] According to 3GPP TS 23.501, QoS flow is generally the finest granularity of QoS differentiation in PDU session. The PDU session provides association between a UE and a data network that provides a PDU connectivity service.

[0048] According to 3GPP TS 38.300, a new AS (Access Stratum) layer, called SDAP (Service Data Adaptation Protocol), is specified to provide functions e.g. mapping between a QoS flow and a data radio bearer (DRB) and marking QoS flow ID (QFI) in both DL packets and UL packets. In addition, each SDAP entity is associated with one PDU session. There is at least one DRB (e.g. default DRB) for each PDU session. Each SDAP PDU may contain at least a IP

Petitioners' Exhibit 1002, p. 356
AT&T et al v. Asustek Technology
IPR2024-00997

packet. Each SDAP PDU may contain a SDAP header (if configured for UL and/or DL). The SDAP header may indicate at least a QFI used to identify a QoS flow for which the IP packet comes from the QoS flow. A SDAP PDU could be a PDCP SDU. In addition, the network may control the mapping of QoS flow(s) to DRB in RRC explicit mapping or reflective mapping.

[0049] In general, it is assumed that each QoS flow may be configured to use a DRB via RRC (Radio Resource Control) explicit mapping or reflective mapping. If a DRB (e.g. default DRB or non-default/dedicated DRB) serves only one UL QoS flow, the network may not configure the DRB with presence of SDAP header for UL, which reduces signaling overhead and saves radio resources.

[0050] FIG. 6, which is a reproduction of Figure A.6-1 of 3GPP TS 38.300 v0.4.1, illustrates a scenario of UE initiated UL QoS flow. The UE initiates a new UL QoS flow (the second UL QoS flow) e.g. based on pre-configured QoS parameters. If there is no mapping of the QFI to a DRB in the AS mapping table for this PDU session, the second UL QoS flow will be mapped to a default DRB of the PDU session. In case there is already an ongoing UL QoS flow (the first UL QoS flow) mapped to this default DRB and the default DRB is not configured with presence of SDAP header for UL currently, the gNB would not be aware of the second UL QoS flow when receiving UL SDAP PDUs corresponding to the second UL QoS flow from the UE. In this situation, the target QoS of the second UL QoS flow would not be satisfied because gNB would not set up a new DRB for the second QoS flow or map the second QoS flow to an existing DRB according to QoS parameters of the second QoS flow. Besides, the IP packets included in those SDAP PDUs of the second UL QoS flow would not be distinguished by the core network (e.g. UPF) because the packet filter corresponds to the first UL QoS flow. As a result, the IP packets would be discarded, which causes data missing and resources waste.

[0051] Several solutions described below could be considered.

[0052] *Alternative 1: UE indicates preference/need for presence of SDAP header*

[0053] Since the UE knows if a DRB is to serve multiple UL QoS flows, the UE understands if the presence of SDAP header on the DRB is needed. In case the second UL QoS flow is initiated by the UE, the UE knows that the default DRB currently configured with no presence of SDAP header will serve the existed first UL QoS flow and the second UL QoS flow.

Petitioners' Exhibit 1002, p. 357
AT&T et al v. Asustek Technology
IPR2024-00997

At this time, the UE could transmit a first indication to the gNB to indicate that the presence of SDAP header on the default DRB is needed. Based on the first indication, the gNB reconfigures the default DRB with presence of SDAP header. In case the second UL QoS flow is released by the UE, the UE could transmit a second indication to the gNB to indicate that the presence of SDAP header on the default DRB is not needed. Based on the second indication, the gNB reconfigures the default DRB with no presence of SDAP header. The first indication and/or the second indication could be sent via e.g. physical signaling, MAC control element, PDCP (Packet Data Convergence Protocol) signaling, RRC signaling or a SDAP signaling (e.g. SDAP control PDU). The first indication and the second indication could also indicate the preference/need of presence of SDAP header on a non-default DRB (e.g. a second DRB).

[0054] *Alternative 2: UE provides information about establishment or release of a UE initiated QoS flow*

[0055] In case the UE initiates the second UL QoS flow, the UE could transmit a first assistance information to the gNB to inform that the second UL QoS flow is initiated by the UE. The UE could determine to transmit the first assistance information if it knows that the default DRB currently configured with no presence of SDAP header will serve the existed first UL QoS flow and the second UL QoS flow. In addition, the UE could determine to not transmit the first assistance information if it knows that the default DRB currently configured with presence of SDAP header. Based on the first assistance information, the gNB reconfigures the default DRB with presence of SDAP header.

[0056] In case the UE releases the second UL QoS flow, the UE could transmit a second assistance information to the gNB to inform that the second UL QoS flow is released by the UE. The UE could determine to transmit the second assistance information if it knows that the default DRB currently configured with presence of SDAP header will serve only the first UL QoS flow. In addition, the UE could determine to not transmit the second assistance information if it knows that the default DRB currently configured with presence of SDAP header is still serving multiple UL QoS flows (e.g. the first UL QoS flow and a third UL QoS flow). Based on the second assistance information, the gNB reconfigures the default DRB with no presence of SDAP header.

Petitioners' Exhibit 1002, p. 358
AT&T et al v. Asustek Technology
IPR2024-00997

[0057] In the first assistance information, QoS information/rule or parameters of the second UL QoS flow could be included. In the second assistance information, an identity of the second UL QoS flow (e.g. QFI) or an index of the QoS information/rule or parameters (reported in the first assistance information) could be included. The first assistance information and/or the second assistance information could be sent via, for example, physical signaling, MAC control element, PDCP signaling, RRC signaling or a SDAP signaling.

[0058] Based on the first assistance information indicating establishment of the second UL QoS flow, the gNB may (indicate the UE to) establish a second DRB on the UE and configure the UE to use the second DRB to serve the second UL QoS flow. Based on the second assistance information indicating release of the second UL QoS flow, the gNB may (indicate the UE to) release the second DRB used to serve the second UL QoS flow on the UE.

[0059] Since the second UL QoS flow is initiated by the UE, the UE itself may release the second UL QoS flow when the second UL QoS flow is not needed. In case the default DRB becomes to serve only the first UL QoS flow, the gNB may change the default DRB from a presence of SDAP header to no presence of SDAP header (based on e.g. above alternatives). As a result, the presence of SDAP header on the default DRB would change again and again.

[0060] In general, 3GPP R2-1707160 proposes to change the presence of the SDAP header by means of a handover. In the handover, the UE shall reset MAC layer, re-establish PDCP layer and RLC layer for all RBs that are established according to the legacy LTE system, as discussed in the 3GPP email discussion [NR-AH2#08][NR UP] Running TS 37.324 attachment "Draft 37324-010-v1.doc". As a result, all buffers in MAC layer and RLC layer are flushed. Therefore, using a handover procedure to change the presence of the SDAP header on the default DRB seems to be overkill because all the PDUs stored in the buffers may need to be retransmitted, which wastes lots of radio resources.

[0061] *Alternative 3: the default DRB is initiated with presence of QFI in uplink*

[0062] To make sure the gNB can identify a new QoS flow initiated by a UE during an ongoing PDU session, the default DRB of the PDU session should be initiated with presence of QFI in uplink. The UE may initiate the default DRB when receiving a DRB configuration (e.g. included in a RRC message) from the gNB. The DRB configuration may include a QFI

Petitioners' Exhibit 1002, p. 359
AT&T et al v. Asustek Technology
IPR2024-00997

configuration indicating presence of QFI for the default DRB. It is also feasible for the gNB not to include the QFI configuration and the UE just applies presence of QFI for the default DRB. Accordingly, the gNB should also initiate the default DRB for receiving SDAP PDU(s) from the UE.

[0063] With the QFI in a SDAP PDU transmitted on the default DRB in uplink, the gNB is able to identify the new UL QoS flow so that the gNB can transmit the IP packet included in the SDAP PDU to the core network (e.g. UPF) via correct handling (e.g. a tunnel corresponding to the new UL QoS flow) and then the IP packet can pass the corresponding packet filter.

[0064] More specifically, the QFI is included in a SDAP header of a SDAP PDU transmitted via the default DRB from the UE to the gNB. The SDAP header contains at least the QFI field. If the SDAP header contains only the QFI field, the concept could be replaced as the default DRB is initiated with presence of SDAP header in uplink.

[0065] In principle, the gNB would not reconfigure no presence of QFI for the default DRB if the gNB cannot make sure no further new QoS flows will be initiated by the UE. In this situation, QFI for the default DRB is always present. Otherwise (i.e. no further new QoS flows will be initiated by the UE), the gNB may reconfigure no presence of SDAP header for the default DRB in case only one QoS flow is mapped to the default DRB.

[0066] By this way, the above introduced alternatives (e.g. Alternative 1 and Alternative 2) seem not needed in terms of protocol efforts and signaling overhead.

[0067] In addition, the core network (e.g. UPF) could initiate a third UL QoS flow associated with the PDU session on the UE. The core network (e.g. SMF) provides QoS parameters of the third UL QoS flow to the gNB. Based on the QoS parameters of the third UL QoS flow, the gNB may establish a dedicated DRB on the UE and configure the UE to use the dedicated DRB to serve the third UL QoS flow. 3GPP R2-1704648 mentions that majority of the companies propose to decouple the NAS reflective QoS and AS reflective mapping. Thus, the gNB may configure the UE to serve the third UL QoS flow using reflective mapping.

[0068] Since it is possible that no DL QoS flow corresponds to the third UL QoS flow (i.e. no DL SDAP PDU uses a QFI associated with the third UL QoS flow), the UE cannot create

Petitioners' Exhibit 1002, p. 360
AT&T et al v. Asustek Technology
IPR2024-00997

the reflective mapping rule for the third UL QoS flow so as to use the default DRB to serve the third UL QoS flow. In this situation, the default DRB cannot satisfy the QoS of the third UL QoS flow.

[0069] In general, 3GPP R2-1704648 proposes to use SDAP control PDU to assist the UE creating the reflective mapping rule. This solution seems feasible, but causes complexities and signaling overhead. For example, the gNB cannot know whether the UE receives a SDAP control PDU indicating the third UL QoS flow (e.g. the corresponding QFI included in the SDAP control PDU) on the dedicated DRB so that the gNB would transmit the SDAP control PDU several times till the UE transmits UL SDAP PDUs of the third UL QoS flow on the dedicated DRB.

[0070] Other solutions described below could be used instead.

[0071] *Alternative 4: QoS profile provided to gNB indicates traffic direction (e.g. only UL, only DL or bidirectional)*

[0072] When a QoS flow is initiated by the core network (e.g. SMF), the core network provides a QoS profile related to the QoS flow to the gNB. In general, the QoS profile does not consider traffic directions e.g. UL or DL if NR follows LTE concept (as discussed in 3GPP TS 23.401) that EUTRAN core network (e.g. MME) initiates an EPS (Evolved Packet System) bearer and EUTRAN base station (e.g. eNB) configures the association between the EPS bearer and a DRB. If a LTE UE has UL traffic belonging to the EPS bearer, it uses the DRB for transmission of the UL traffic. If DL traffic belonging to the EPS bearer arrives on the EUTRAN base station, the EUTRAN base station use the DRB to transmit the DL traffic to the LTE UE. In order words, in LTE, mapping of EPS bearer to DRB for UL does not depend on mapping of EPS bearer to DRB for DL. In NR, mapping of QoS flow to DRB for UL may depend on mapping of QoS flow to DRB for DL. If the mapping of QoS flow to DRB for DL is not available, the reflective mapping rule should not be used.

[0073] Therefore, the QoS profile should include information about traffic direction on each QoS flow so that the gNB can know whether mapping of the QoS flow to DRB for DL is available or not. For example, the QoS profile/parameters related to the third UL QoS flow indicates a QFI and traffic in (only) UL direction. By this way, the gNB configures the UE to use

Petitioners' Exhibit 1002, p. 361
AT&T et al v. Asustek Technology
IPR2024-00997

the dedicated DRB to serve the third UL QoS flow via RRC explicit mapping. If the QoS profile/parameters related to the third UL QoS flow indicates a QFI and traffic in both UL and DL direction, the gNB may configure the UE to use the dedicated DRB to serve the third UL QoS flow via reflective mapping.

[0074] *Alternative 5: a QoS flow not to be served by default DRB uses RRC explicit mapping*

[0075] In general, Alternative 4 is feasible, but would cause protocol efforts on definition of traffic direction. Another solution could be that the gNB should use RRC explicit way to configure a QoS flow with the mapping of the QoS flow to a DRB if the DRB is a dedicated DRB i.e. the DRB is not a default DRB.

[0076] Since the gNB uses RRC signaling to establish a dedicated DRB to serve the third UL QoS flow, the RRC signaling can include information about the mapping of the third UL QoS flow to the dedicated DRB because the information does not cause significant signaling overhead.

[0077] If the gNB configures the QoS flow with reflective mapping and Alternative 3 is used, the gNB will be aware of the third UL QoS flow using the default DRB. And then the gNB transmits a RRC signaling indicating the mapping of the third UL QoS flow to the dedicated DRB to the UE.

[0078] Anyway, the RRC explicit way will be used for the mapping of the third UL QoS flow to the dedicated DRB. Therefore, this alternative seems simplest in terms of protocol efforts.

[0079] FIG. 12 is a flow chart 1200 according to one exemplary embodiment of a network node. In step 1205, the network node transmits a first message with a DRB configuration to a UE for establishing a default DRB for a PDU session, wherein the DRB configuration includes a QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. In one embodiment, the network node may

Petitioners' Exhibit 1002, p. 362
AT&T et al v. Asustek Technology
IPR2024-00997

not be allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

[0080] In step 1210, the network node establishes the default DRB with a presence of the QFI field in uplink. In one embodiment, a header in the SDAP PDU could include at least the QFI field.

[0081] In step 1215, the network node receives a SDAP PDU with the QFI field via the default DRB from the UE.

[0082] In one embodiment, the network node could transmit an IP (Internet Protocol) packet included in the SDAP PDU to a core network. Furthermore, the network node could be a base station. Furthermore, the base station could be a gNB.

[0083] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a network node, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the network node (i) to transmit a first message with a DRB configuration to a UE for establishing a default DRB for a PDU session, wherein the DRB configuration includes a QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB, (ii) to establish the default DRB with a presence of the QFI field in uplink, and (iii) to receive a SDAP PDU with the QFI field via the default DRB from the UE. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0084] FIG. 13 is a flow chart 1300 according to one exemplary embodiment of a UE. In step 1305, the UE receives a first message with a DRB configuration from a network node, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session and includes no information of QFI configuration for the default DRB in uplink. In one embodiment, wherein the UE may not receive a second message from the network node for changing the QFI configuration for the default DRB to no presence of QFI (i.e. QFI for the default DRB is always present).

Petitioners' Exhibit 1002, p. 363
AT&T et al v. Asustek Technology
IPR2024-00997

[0085] In step 1310, the UE initiates the default DRB with a presence of QFI in uplink. In step 1315, the UE transmits a SDAP PDU with a QFI via the default DRB to the network node. In one embodiment, a header in the SDAP PDU could include at least a field of QFI. Furthermore, an IP packet could be included in the SDAP PDU for transmitting to a core network. The core network could a UPF (User Plane Function) or a SMF (Session Management Function), as discussed in 3GPP TS 23.501. The network node could be a base station (e.g. gNB).

[0086] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the UE (i) to receive a first message with a DRB configuration from a network node, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session and includes no information of QFI configuration for the default DRB in uplink, (ii) to initiate the default DRB with a presence of QFI in uplink, and (iii) to transmits a SDAP PDU with a QFI via the default DRB to the network node. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0087] FIG. 14 is a flow chart 1400 according to one exemplary embodiment of a network node. In step 1405, the network transmits a first message with a DRB configuration to a UE, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session, and the DRB configuration includes information of a QFI configuration for the default DRB in uplink or includes no information of QFI configuration for the default DRB in uplink.

[0088] In one embodiment, the network node may not transmit a second message to the UE for changing the QFI configuration for the default DRB to no presence of QFI (i.e. QFI for the default DRB is always present). In addition, the network node may not set the QFI configuration for the default DRB in uplink to no presence of QFI in uplink.

[0089] In step 1410, the network node initiates the default DRB with a presence of QFI in uplink.

Petitioners' Exhibit 1002, p. 364
AT&T et al v. Asustek Technology
IPR2024-00997

[0090] In step 1415, the network node receives a SDAP PDU with a QFI via the default DRB from the UE. In one embodiment, a header in the SDAP PDU could include at least a field of QFI.

[0091] In one embodiment, the network node could transmit an IP packet included in the SDAP PDU to a core network. The network node could be a base station (e.g. gNB). The core network could be a UPF or a SMF, as discussed in 3GPP TS 23.501.

[0092] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a network node, the device 300 includes a program code 312 stored in the memory 310. The CPU 308 could execute program code 312 to enable the network node (i) to transmit a first message with a DRB configuration to a UE, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session, and the DRB configuration includes information of a QFI configuration for the default DRB in uplink or includes no information of QFI configuration for the default DRB in uplink, (ii) to initiate the default DRB with a presence of QFI in uplink, and (iii) to receives a SDAP PDU with a QFI via the default DRB from the UE. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[0093] Various aspects of the disclosure have been described above. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative. Based on the teachings herein one skilled in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. As an example of some of the above concepts, in some aspects concurrent channels may be established based on pulse repetition frequencies. In some aspects concurrent channels may be established based on pulse position or offsets. In some aspects concurrent channels may be established

Petitioners' Exhibit 1002, p. 365
AT&T et al v. Asustek Technology
IPR2024-00997

based on time hopping sequences. In some aspects concurrent channels may be established based on pulse repetition frequencies, pulse positions or offsets, and time hopping sequences.

[0094] Those of skill in the art would understand that information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0095] Those of skill would further appreciate that the various illustrative logical blocks, modules, processors, means, circuits, and algorithm steps described in connection with the aspects disclosed herein may be implemented as electronic hardware (e.g., a digital implementation, an analog implementation, or a combination of the two, which may be designed using source coding or some other technique), various forms of program or design code incorporating instructions (which may be referred to herein, for convenience, as "software" or a "software module"), or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0096] In addition, the various illustrative logical blocks, modules, and circuits described in connection with the aspects disclosed herein may be implemented within or performed by an integrated circuit ("IC"), an access terminal, or an access point. The IC may comprise a general purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, electrical components, optical components, mechanical components, or any combination thereof designed to perform the functions described herein, and may execute codes or instructions that reside within the IC, outside of the IC, or both. A general purpose processor may be a microprocessor, but in the

Petitioners' Exhibit 1002, p. 366
AT&T et al v. Asustek Technology
IPR2024-00997

alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0097] It is understood that any specific order or hierarchy of steps in any disclosed process is an example of a sample approach. Based upon design preferences, it is understood that the specific order or hierarchy of steps in the processes may be rearranged while remaining within the scope of the present disclosure. The accompanying method claims present elements of the various steps in a sample order, and are not meant to be limited to the specific order or hierarchy presented.

[0098] The steps of a method or algorithm described in connection with the aspects disclosed herein may be embodied directly in hardware, in a software module executed by a processor, or in a combination of the two. A software module (e.g., including executable instructions and related data) and other data may reside in a data memory such as RAM memory, flash memory, ROM memory, EPROM memory, EEPROM memory, registers, a hard disk, a removable disk, a CD-ROM, or any other form of computer-readable storage medium known in the art. A sample storage medium may be coupled to a machine such as, for example, a computer/processor (which may be referred to herein, for convenience, as a "processor") such the processor can read information (e.g., code) from and write information to the storage medium. A sample storage medium may be integral to the processor. The processor and the storage medium may reside in an ASIC. The ASIC may reside in user equipment. In the alternative, the processor and the storage medium may reside as discrete components in user equipment. Moreover, in some aspects any suitable computer-program product may comprise a computer-readable medium comprising codes relating to one or more of the aspects of the disclosure. In some aspects a computer program product may comprise packaging materials.

[0099] While the invention has been described in connection with various aspects, it will be understood that the invention is capable of further modifications. This application is intended to cover any variations, uses or adaptation of the invention following, in general, the principles

Petitioners' Exhibit 1002, p. 367
AT&T et al v. Asustek Technology
IPR2024-00997

of the invention, and including such departures from the present disclosure as come within the known and customary practice within the art to which the invention pertains.

Petitioners' Exhibit 1002, p. 368
AT&T et al v. Asustek Technology
IPR2024-00997

CLAIMS

1. A method of a network node, comprising:

transmitting a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establishing the default DRB with a presence of the QFI field in uplink; and

receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

2. The method of claim 1, wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

3. The method of claim 1, wherein a header in the SDAP PDU includes at least the QFI field.

4. The method of claim 1, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

5. The method of claim 1, wherein the network node is a base station (or gNB).

6. A network node, comprising:

a control circuit;

a processor installed in the control circuit; and

a memory installed in the control circuit and operatively coupled to the processor;

wherein the processor is configured to execute a program code stored in the memory to:

transmit a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein

Petitioners' Exhibit 1002, p. 369
AT&T et al v. Asustek Technology
IPR2024-00997

the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB;

establish the default DRB with a presence of the QFI field in uplink; and

receive a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

7. The network node of claim 6, wherein the network node is not allowed to transmit a second message to the UE for reconfiguring the QFI configuration for the default DRB to no presence of the QFI field.

8. The network node of claim 6, wherein a header in the SDAP PDU includes at least the QFI field.

9. The network node of claim 6, wherein the network node transmits an IP (Internet Protocol) packet included in the SDAP PDU to a core network.

10. The network node of claim 6, wherein the network node is a base station (or gNB).

Petitioners' Exhibit 1002, p. 370
AT&T et al v. Asustek Technology
IPR2024-00997

ABSTRACT

A method and apparatus are disclosed from the perspective of a network node. In one embodiment, the method includes the network node transmitting a first message with a DRB (Data Radio Bearer) configuration to a UE (User Equipment) for establishing a default DRB for a PDU (Packet Data Unit) session, wherein the DRB configuration includes a QFI (QoS Flow Id) configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB. The method further includes the network node establishing the default DRB with a presence of the QFI field in uplink. The method also includes the network node receiving a SDAP (Service Data Adaptation Protocol) PDU with the QFI field via the default DRB from the UE.

Petitioners' Exhibit 1002, p. 371
AT&T et al v. Asustek Technology
IPR2024-00997

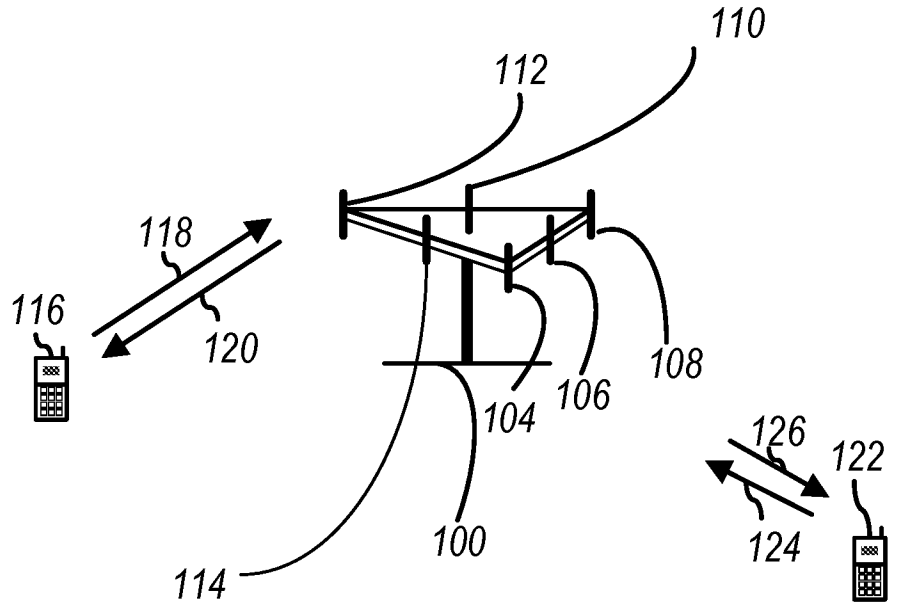


FIG. 1

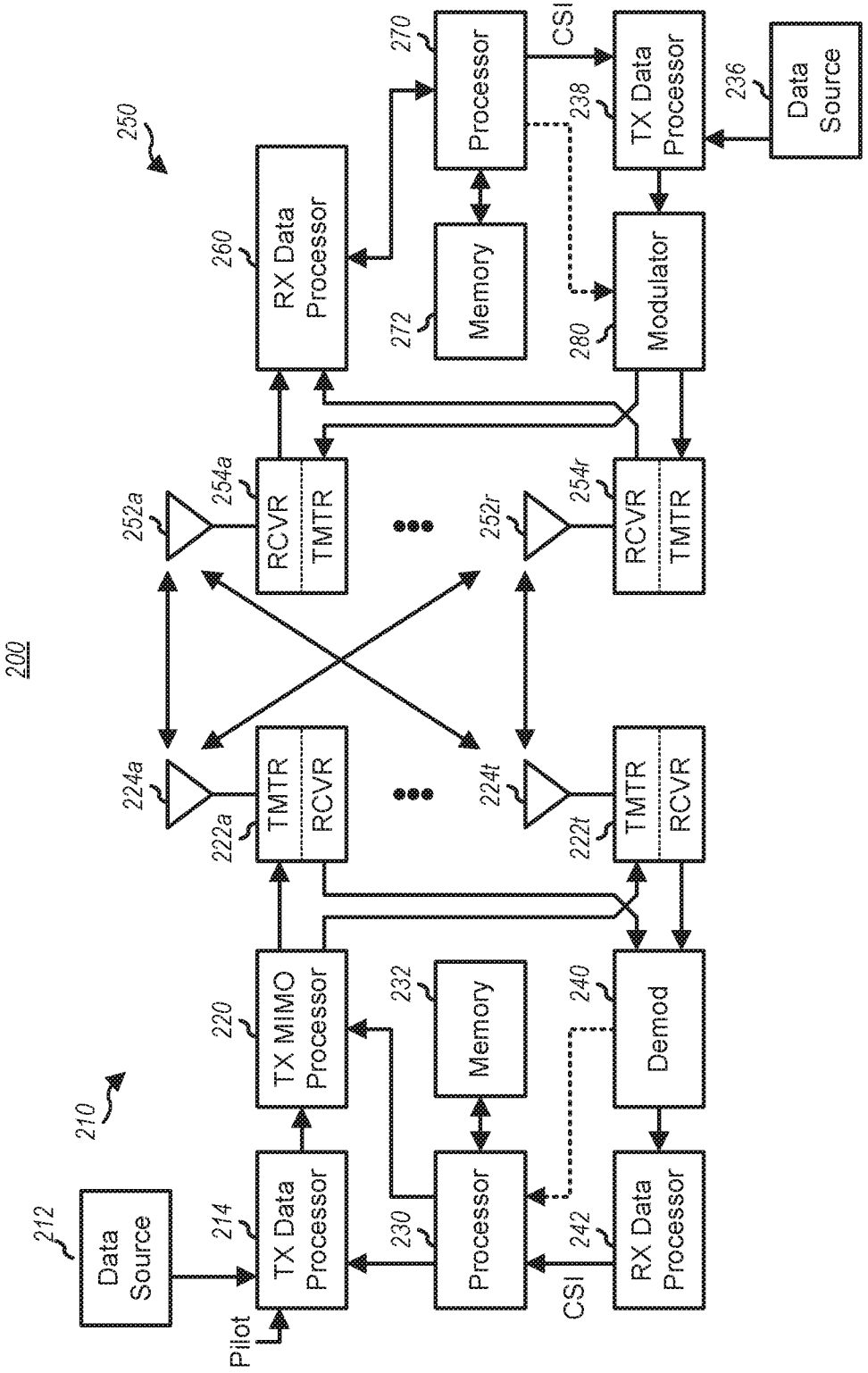

200
210
212
Data Source
214
TX Data Processor
Pilot
220
TX MIMO Processor
222a
TMTR
RCVR
224a
224t
222t
230
Processor
232
Memory
240
Demod
242
RX Data Processor
CSI
250
252a
254a
RCVR
TMTR
252r
254r
260
RX Data Processor
270
Processor
272
Memory
280
Modulator
238
CSI
TX Data Processor
236
Data Source

FIG. 2

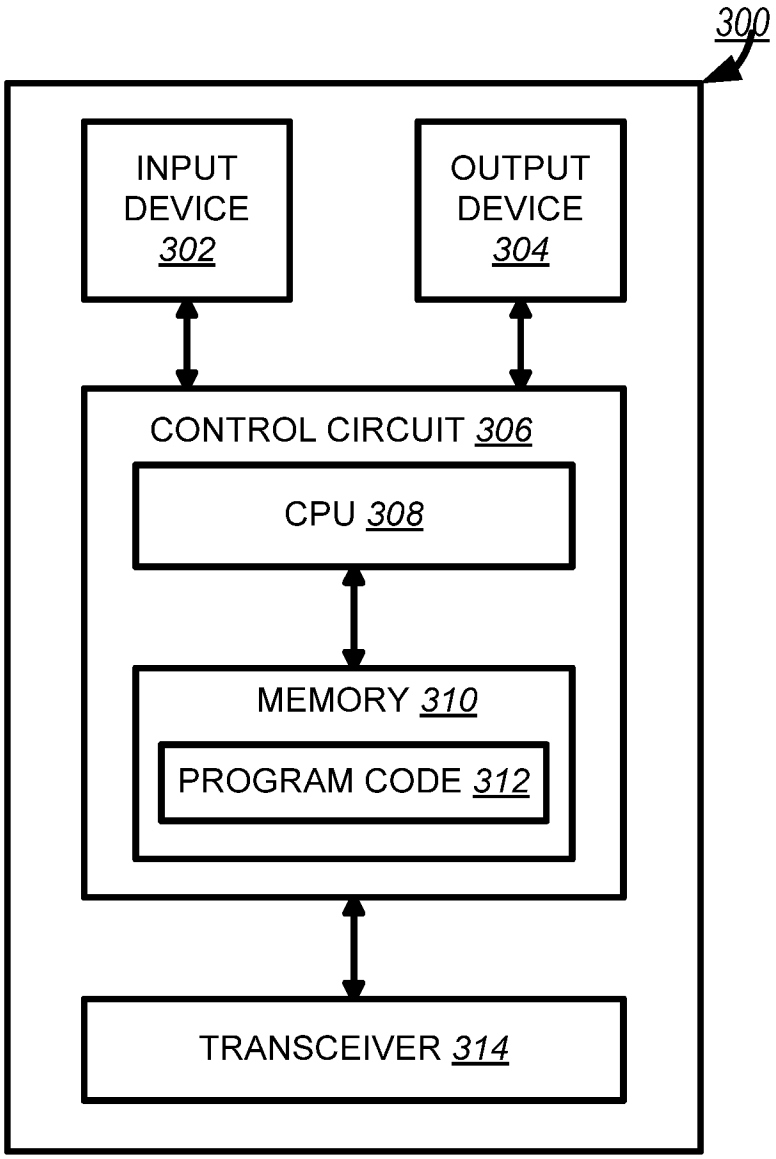

300
INPUT DEVICE 302
OUTPUT DEVICE 304
CONTROL CIRCUIT 306
CPU 308
MEMORY 310
PROGRAM CODE 312
TRANSCEIVER 314

FIG. 3

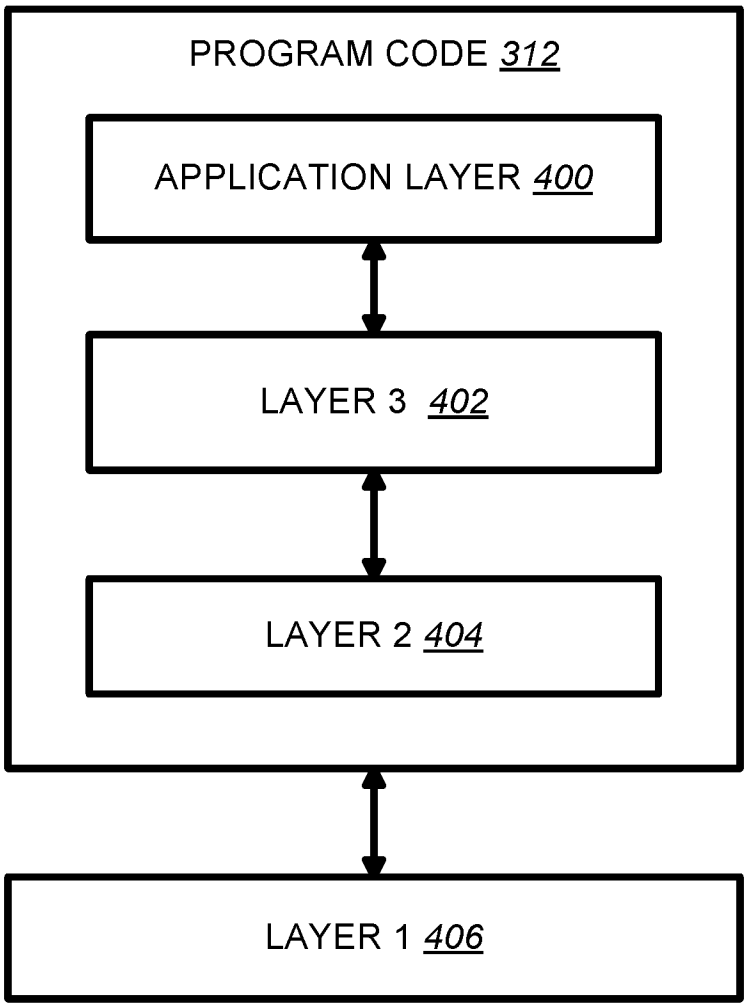

PROGRAM CODE 312
APPLICATION LAYER 400
LAYER 3 402
LAYER 2 404
LAYER 1 406

FIG. 4

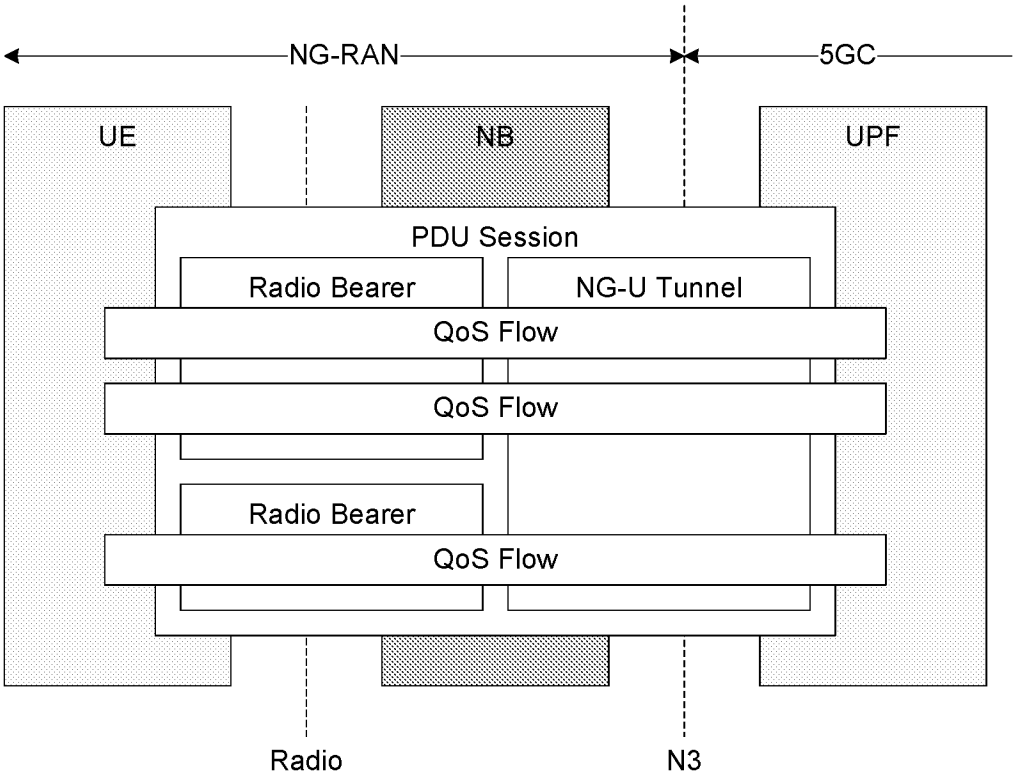


FIG. 5 (PRIOR ART)

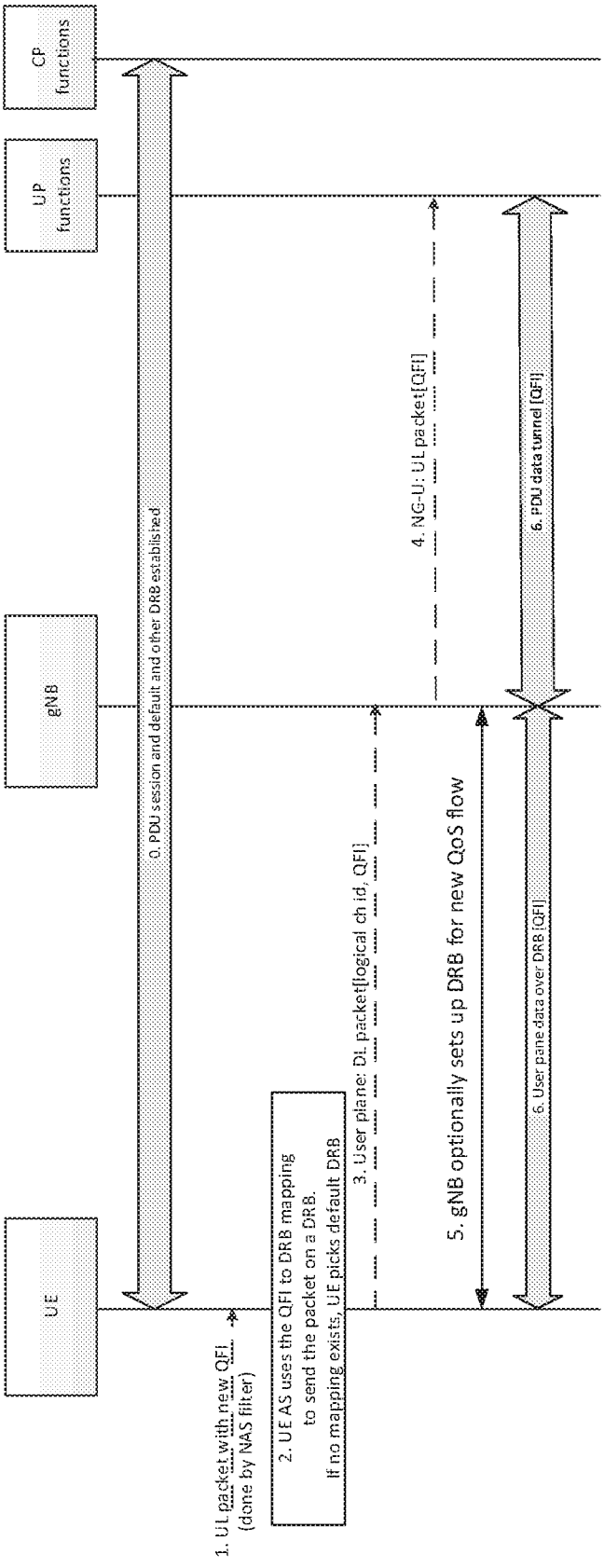


FIG. 6 (PRIOR ART)

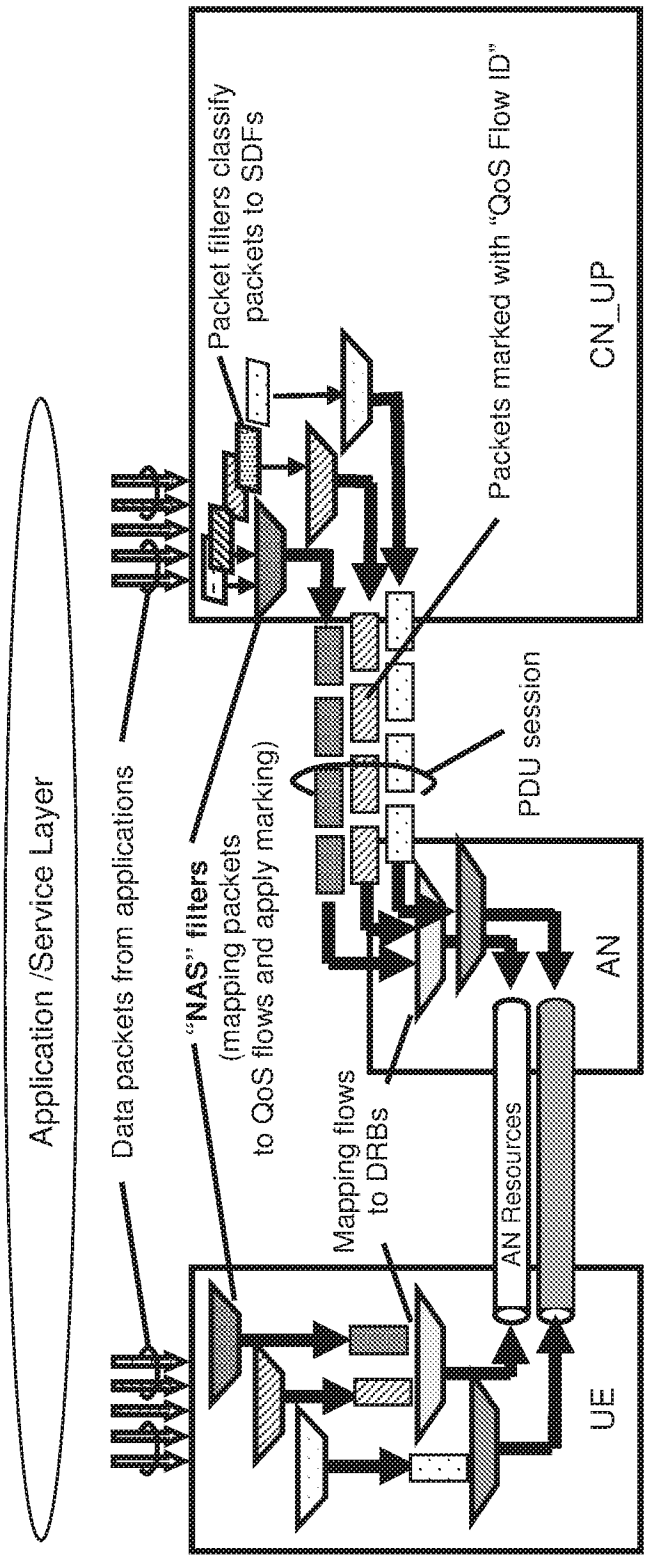


FIG. 7 (PRIOR ART)

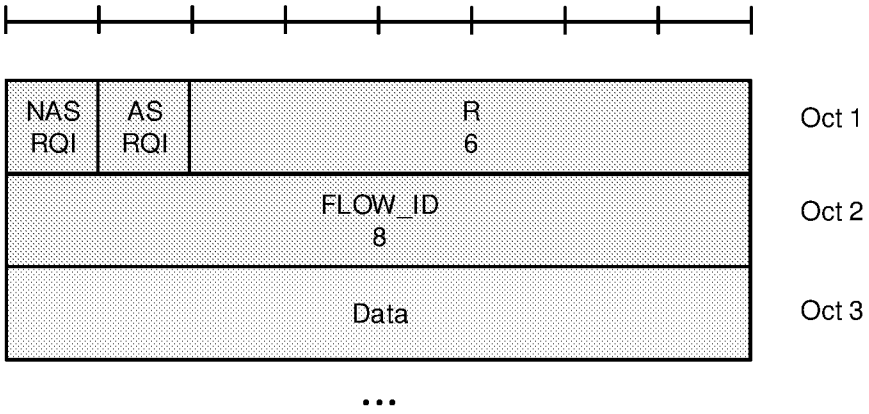


FIG. 8 (PRIOR ART)

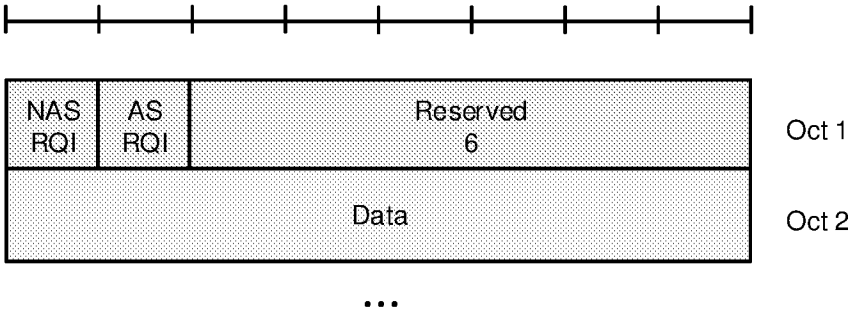


FIG. 9 (PRIOR ART)

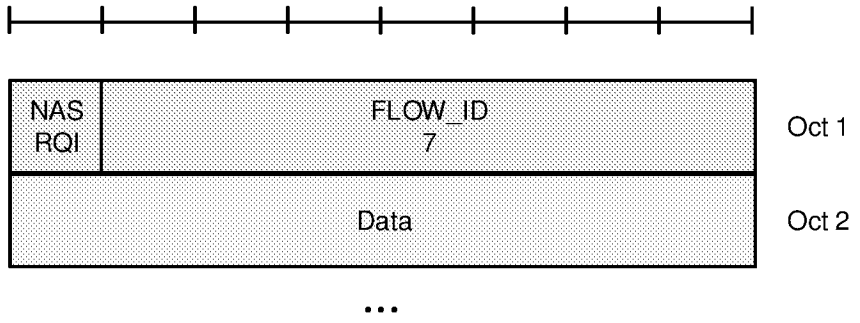


FIG. 10 (PRIOR ART)

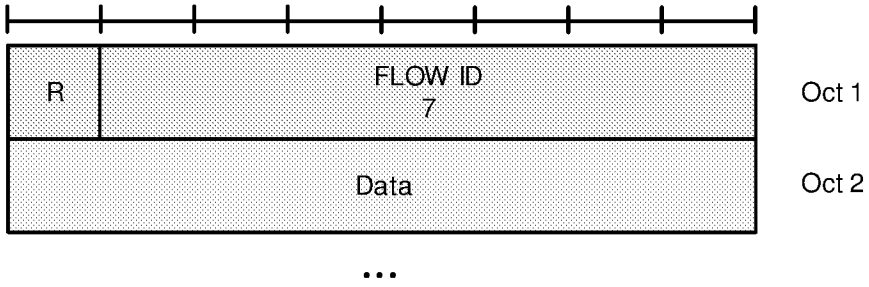


FIG. 11 (PRIOR ART)

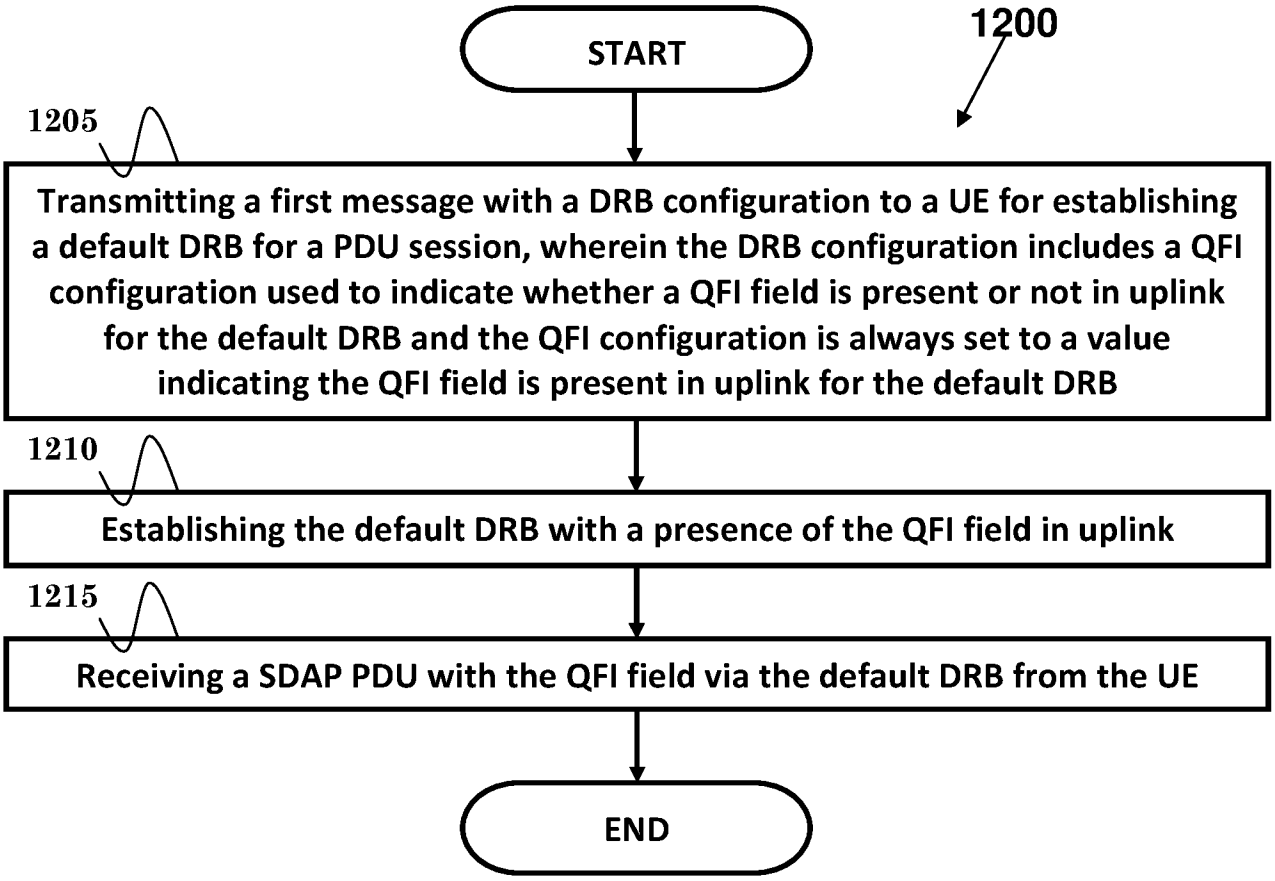

START
1200
1205
Transmitting a first message with a DRB configuration to a UE for establishing a default DRB for a PDU session, wherein the DRB configuration includes a QFI configuration used to indicate whether a QFI field is present or not in uplink for the default DRB and the QFI configuration is always set to a value indicating the QFI field is present in uplink for the default DRB
1210
Establishing the default DRB with a presence of the QFI field in uplink
1215
Receiving a SDAP PDU with the QFI field via the default DRB from the UE
END

FIG. 12

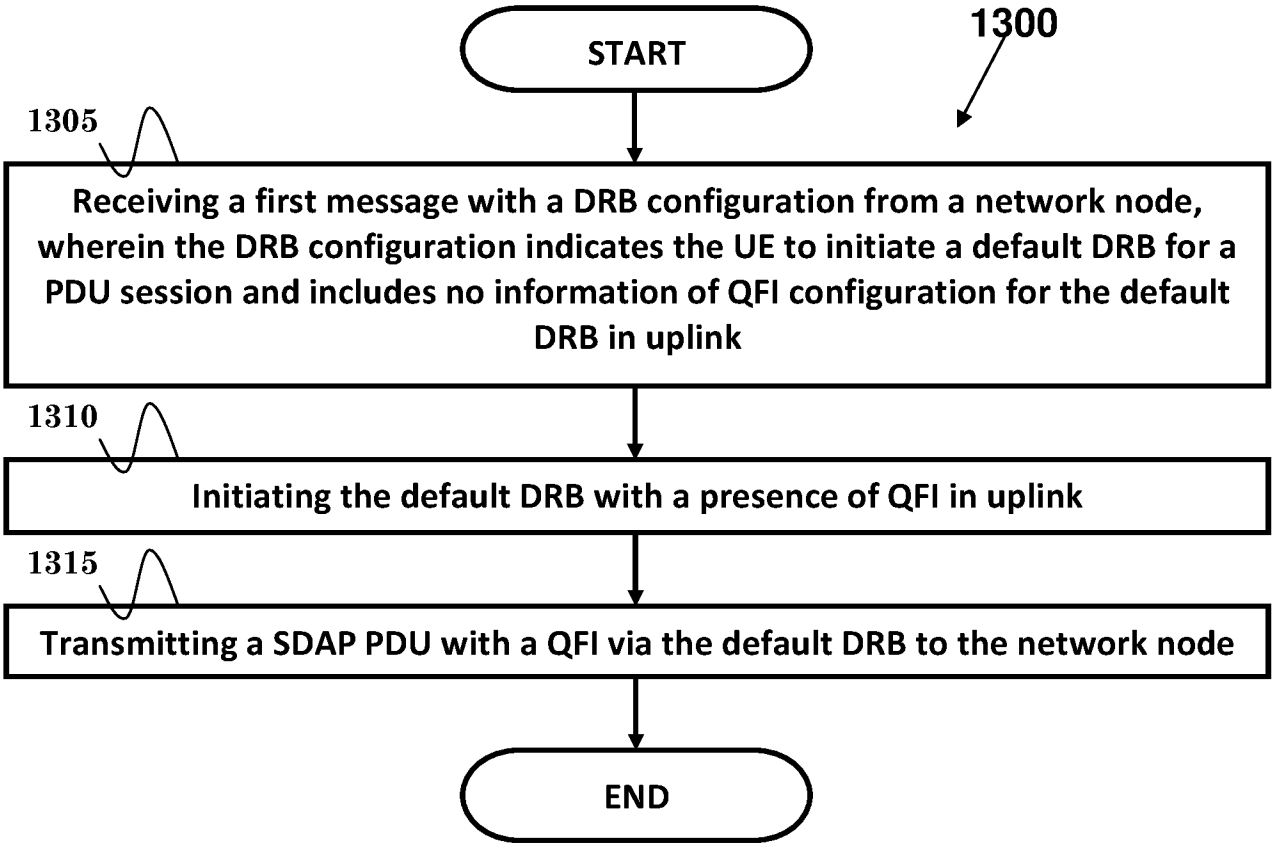

START
1300
1305
Receiving a first message with a DRB configuration from a network node, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session and includes no information of QFI configuration for the default DRB in uplink
1310
Initiating the default DRB with a presence of QFI in uplink
1315
Transmitting a SDAP PDU with a QFI via the default DRB to the network node
END

FIG. 13

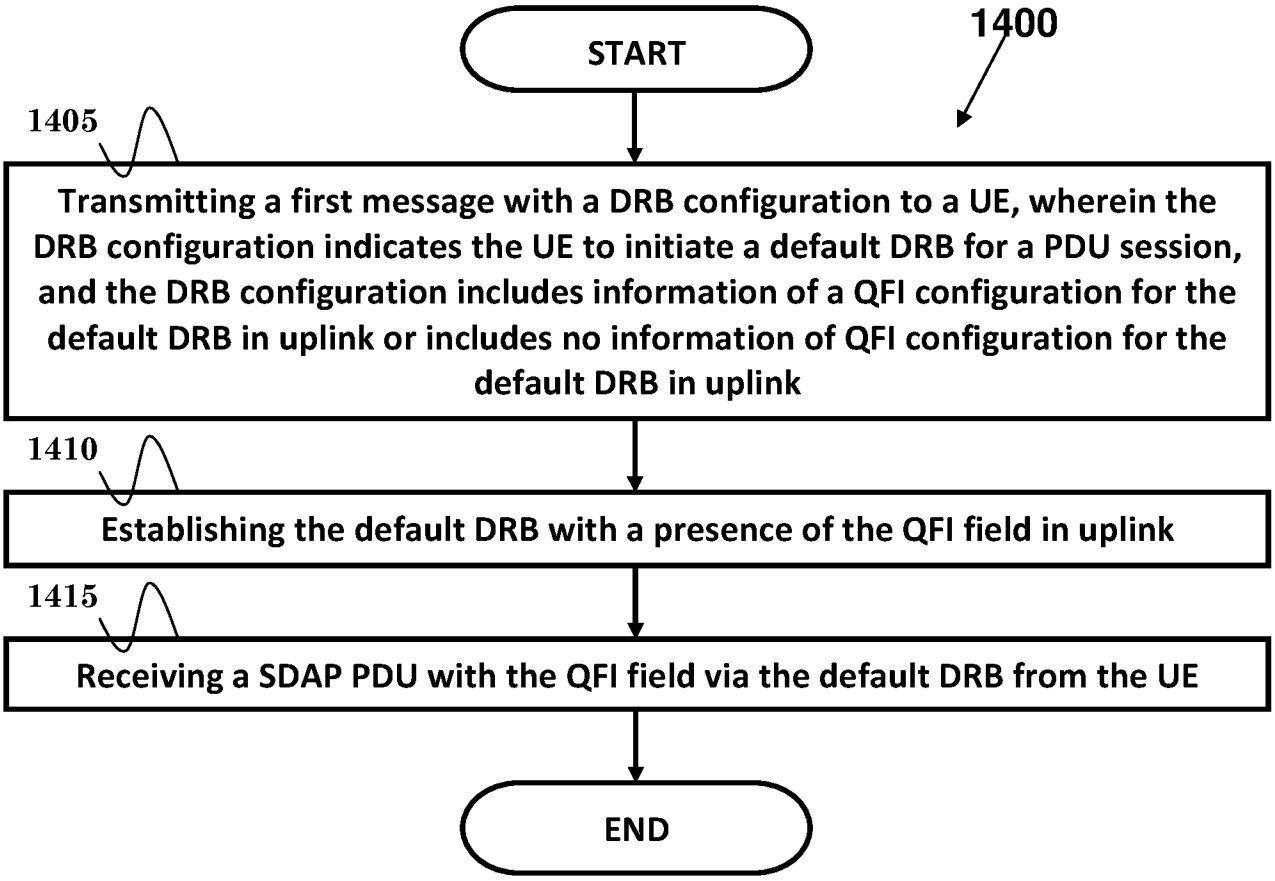

1400
START
1405
Transmitting a first message with a DRB configuration to a UE, wherein the DRB configuration indicates the UE to initiate a default DRB for a PDU session, and the DRB configuration includes information of a QFI configuration for the default DRB in uplink or includes no information of QFI configuration for the default DRB in uplink
1410
Establishing the default DRB with a presence of the QFI field in uplink
1415
Receiving a SDAP PDU with the QFI field via the default DRB from the UE
END

FIG. 14

PTO/AIA/01 (06-12)
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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	METHOD AND APPARATUS FOR SERVING QUALITY OF SERVICE (QOS) FLOW IN A WIRELESS COMMUNICATION SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [x] 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.

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LEGAL NAME OF INVENTOR

Inventor: Pan, Li-Te Date (Optional): 2018.7.17

Signature: Pan, Li-Te

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

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LEGAL NAME OF INVENTOR

Inventor: Richard Lee-Chee Kuo Date (Optional): July 17, 2018

Signature: Richard Lee-chee Kuo

Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/SB/AIA01 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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