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UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))		<table border="1" style="width: 100%; border-collapse: collapse;"><tr><td style="width: 50%;">Attorney Docket No.</td><td>1426-113.101</td></tr><tr><td>First Named Inventor</td><td>Ko-Chiang Lin</td></tr><tr><td>Title</td><td>Method and Apparatus for Improving a Transmission Using...</td></tr><tr><td>Express Mail Label No.</td><td></td></tr></table>	Attorney Docket No.	1426-113.101	First Named Inventor	Ko-Chiang Lin	Title	Method and Apparatus for Improving a Transmission Using...	Express Mail Label No.																																																	
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APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.		Commissioner for Patents P.O. Box 1450 Alexandria, VA 22313-1450																																																								
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*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																																																										
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Name (Print/Type) <u>Sang N. Dang</u>		Registration No. (Attorney/Agent) <u>51,186</u>																																																								

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.**

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FEE TRANSMITTAL		Complete if known	
		Application Number	Not Yet Assigned
☐ Applicant asserts small entity status. See 37 CFR 1.27.		Filing Date	Herewith
☐ 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.		First Named Inventor	Ko-Chiang Lin
TOTAL AMOUNT OF PAYMENT (\$)		2,020	
		Practitioner Docket No.	1426-113.101

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)

Application Type	FILING FEES			SEARCH FEES			EXAMINATION FEES			Fees Paid (\$)
	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	U (\$)	S (\$)	M (\$)	
Utility	280	140*	70	600	300	150	720	360	180	1600
Design	180	90	45	120	60	30	460	230	115	
Plant	180	90	45	380	190	95	580	290	145	
Reissue	280	140	70	600	300	150	2,160	1,080	540	
Provisional	260	130	65	0	0	0	0	0	0	

* The \$140 small entity status filing fee for a utility application is further reduced to \$70 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)	80	40	20
Each independent claim over 3 (including Reissues)	420	210	105
Multiple dependent claims	780	390	195

Total Claims	Extra Claims	Fee (\$)	Fee Paid (\$)	Multiple Dependent Claims	Fee (\$)	Fee Paid (\$)
20	-20 or HP =	x	=			

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims	Extra Claims	Fee (\$)	Fee Paid (\$)
4	-3 or HP =	420 x	=

HP = highest number of independent claims paid for, if greater than 3.

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 (\$)
107	- 100 =	7 / 50 =	1 (round up to a whole number) x	=

4. OTHER FEE(S)

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)	51,186	Telephone	(714) 839-3800
Name (Print/Type)	Sang N. Dang	Date	March 31, 2017		

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.

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**METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A
CONFIGURED RESOURCE 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. 62/316,799 filed on April 1, 2016, 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 improving a transmission using a configured resource 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.

SUMMARY

[0005] A method and apparatus are disclosed for improving a transmission using a configured resource in a wireless communication system. In one embodiment, the method includes an uplink grant is available for a UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission. The method further includes the UE transmitting a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI. The method also includes the UE skipping the uplink grant if no physical control information needs to be transmitted in the TTI.

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 1 of 3GPP RP-150310.

[0011] FIG. 6 is a reproduction of Figure 5.2.2-1 of 3GPP TS 36.212 v13.0.0.

[0012] FIG. 7 is a reproduction of Table 5.2.2.6-1 of 3GPP TS 36.212 v13.0.0.

[0013] FIG. 8 is a reproduction of Table 5.2.2.6-2 of 3GPP TS 36.212 v13.0.0.

[0014] FIG. 9 is a reproduction of Table 5.2.2.6-A of 3GPP TS 36.212 v13.0.0.

[0015] FIG. 10 is a reproduction of Table 5.2.2.6-3 of 3GPP TS 36.212 v13.0.0.

[0016] FIG. 11 is a reproduction of Table 5.2.2.6-4 of 3GPP TS 36.212 v13.0.0.

- [0017] FIG. 12 is a reproduction of Table 5.2.2.6-5 of 3GPP TS 36.212 v13.0.0.
- [0018] FIG. 13 is a reproduction of Table 5.2.2.6-6 of 3GPP TS 36.212 v13.0.0.
- [0019] FIG. 14 is a reproduction of Table 5.2.2.6-7 of 3GPP TS 36.212 v13.0.0.
- [0020] FIG. 15 is a reproduction of Table 5.2.2.8-1 of 3GPP TS 36.212 v13.0.0.
- [0021] FIG. 16 is a reproduction of Table 5.2.2.8-2 of 3GPP TS 36.212 v13.0.0.
- [0022] FIG. 17 is a diagram according to one exemplary embodiment.
- [0023] FIG. 18 is a table according to one exemplary embodiment.
- [0024] FIG. 19 is a table according to one exemplary embodiment.
- [0025] FIG. 20 is a table according to one exemplary embodiment.
- [0026] FIG. 21 is a table according to one exemplary embodiment.
- [0027] FIG. 22 is a table according to one exemplary embodiment.
- [0028] FIG. 23 is a flow chart according to one exemplary embodiment.
- [0029] FIG. 24 is a flow chart according to one exemplary embodiment.
- [0030] FIG. 25 is a flow chart according to one exemplary embodiment.
- [0031] FIG. 26 is a flow chart according to one exemplary embodiment.
- [0032] FIG. 27 is a flow chart according to one exemplary embodiment.
- [0033] FIG. 28 is a flow chart according to one exemplary embodiment.
- [0034] FIG. 29 is a flow chart according to one exemplary embodiment.
- [0035] FIG. 30 is a flow chart according to one exemplary embodiment.
- [0036] FIG. 31 is a flow chart according to one exemplary embodiment.

DETAILED DESCRIPTION

[0037] 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.

[0038] 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: RP-150465, “New SI proposal: Study on Latency reduction techniques for LTE”, Ericsson, Huawei; RP-150310, “Study on Latency reduction techniques For LTE”, Ericsson; TS 36.321 v12.5.0, “E-UTRA MAC protocol specification (Release 12)”; TS 36.331 v12.5.0, “E-UTRA RRC protocol specification (Release 12)”; TS 36.213 v12.5.0, “E-UTRA Physical layer procedures (Release 12)”; TR 36.881 V0.6.0, “E-UTRA Study on latency reduction techniques for LTE (Release 13)”; and TS 36.212 V13.0.0, “E-UTRA Multiplexing and channel coding (Release 13)”. The standards and documents listed above are hereby expressly incorporated by reference in their entirety.

[0039] 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 than that used by reverse link 118.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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.

[0044] 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.

[0045] 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.

[0046] 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.

[0047] 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.

[0048] 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, 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.

[0049] 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.

[0050] 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.

[0051] 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.

[0052] 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.

[0053] 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 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.

[0054] 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.

[0055] Packet data latency is one of the important metrics for performance evaluation. Reducing packet data latency improves the system performance. In 3GPP RP-150465, the study item "Study on latency reduction techniques for LTE" generally aims to investigate and standardize some techniques of latency reduction.

[0056] According to 3GPP RP-150465, the objective of the study item is generally to study enhancements to the E-UTRAN radio system in order to significantly reduce the packet data latency over the LTE Uu air interface for an active UE and significantly reduce the packet data transport round trip latency for UEs that have been inactive for a longer period (in connected state). The study area includes resource efficiency, including air interface capacity, battery lifetime, control channel resources, specification impact and technical feasibility. Both FDD (Frequency Division Duplex) and TDD (Time Division Duplex) duplex modes are considered.

[0057] According to 3GPP RP-150465, two following areas should be studies and documented:

1. Fast uplink access solutions - For active UEs and UEs that have been inactive a longer time, but are kept in RRC Connected, the focus should be (i) on reducing user plane latency for the scheduled UL transmission, and (ii) on getting a more resource efficient solution with protocol and signaling enhancements, compared to the pre-scheduling solutions allowed by the standard today, both with and without preserving the current TTI (Transmission Time Interval) length and processing times.
2. TTI shortening and reduced processing times - Assess specification impact and study feasibility and performance of TTI lengths between 0.5ms and one OFDM (Orthogonal Frequency Division Multiplexing) symbol, taking into account impact on reference signals and physical layer control signaling.

[0058] FIG. 5 is a reproduction of Figure 1 of 3GPP RP-150310. FIG. 5 generally illustrates the improvement corresponding to the areas.

[0059] In 3GPP RP-150310, a candidate of fast uplink access solutions was raised:

- Pre-grant → fast uplink access but with limited throughput
Resources can be allocated with (modified) SPS
- Remove the requirement to send padding when no data is in buffer → saves battery resources when inactive
Good throughput per watt statistics
- Switch to dynamic scheduling when entering active phase → optimizing throughput when having lot of data in send buffer

[0060] Detailed result of the study can be found in 3GPP TR 36.881 v0.6.0 as quoted below, which confirmed that it would be beneficial to skip the configured grant if there is no data or regular MAC (Medium Access Control) CE (Control Element) to be sent:

8.1 Semi-Persistent Scheduling

With current Semi-Persistent Scheduling (SPS), the eNodeB may configure SPS periodicity via dedicated RRC signalling. Current minimum SPS periodicity is 10ms. Supporting a SPS periodicity of 1TTI is beneficial as this may reduce the latency of initial UL transmissions. This would allow UL transmission in consecutive subframes.

8.2 UL Grant reception

In current specifications, the UE sends a MAC PDU containing a MAC CE for padding BSR and optionally padding bits in response to an allocated UL dynamic or configured grant even if no data is available for transmission in the UE buffer and no other regular MAC CE is needed to be sent. It is beneficial to allow UEs to skip (most) dynamic and configured uplink grants if no data is available for transmission. With frequent UL grants, allowing skipping UL grants may decrease UL interference and improve UE battery efficiency. The UE will continue to send one or more regular MAC CE(s), if any. The eNB may enable skipping UL grants by RRC dedicated signalling.

8.2.1 Configured SPS activation and deactivation

The SPS resources are UE specific and may be reserved (configured and active) for a longer period in time. As such, it is in some cases considered useful for the eNB to be timely aligned with the UE state on activated or deactivated SPS resource(s), and if UL transmissions might occur in the granted SPS resource allocation instances.

An acknowledgement in response to a PDCCH grant indication activation could for example consist of an UE transmitted new MAC PDU containing zero MAC SDUs on the first SPS granted resource to indicate successful activation when the UE buffer is empty.

If the PDCCH grant indicating activation is not received, and UE has UL data to be transmitted, it is assumed that the UE would initiate a SR procedure if no other action is performed by the eNB.

For Deactivation, the eNB can indicate release of SPS resources on PDCCH. Also in these cases the eNB would in some cases benefit from being timely aligned with the UE state on activate or deactivated SPS resource(s).

Similarly to activation, a single transmission could be used also as deactivation acknowledgement as in instances of skipped transmissions as the absence of a UL transmission cannot be used as an implicit deactivation/release acknowledgement mechanism. Other means may thus be beneficial to specify.

Acknowledgment based Pro's

- 1 With an acknowledgment on the PDCCH grant activating or deactivating the SPS allocation, the eNB may be able to distinguish from cases where the PDCCH is missed by the UE.
- 2 With a higher degree of robustness of the activation/deactivation mechanism, the eNB may not have to repeat unnecessarily the SPS grant.

- 3 A activation and deactivation acknowledgement mechanism may allow for less conservative use of preconfigured SPS resources and may allow decreased PDCCH load as lower aggregation level can be used.
- 4 An acknowledged activation/deactivation of the SPS grant resources may reduce DRX misalignment.

Acknowledgement based Con's

- 1 Unnecessary UE battery consumption in instances of empty UE buffer at activation/deactivation;
- 2 DRX impacted by the additional UL transmission including the HARQ wait time (handling of inactivity timer /short cycle timer)
- 3 Increased uplink interference in instances where the SPS allocation is changed due to e.g. PDCCH activation/deactivation and where the UE buffer is empty.
- 4 New UE behaviour needed for deactivation/release acknowledgment.
- 5 DRX misalignment probability may be increased due to loss of ACK compared to if ACK is received correctly
- 6 SPS resources may be unused for a duration as a result of a missing ACK after successful PDCCH reception.

Acknowledgement free Pro's

- 1 Relies on the legacy behaviour that the UE in the rare cases of PDCCH loss (e.g. 1%) and non-empty buffer may initiate a SR procedure (alt. RACH procedure). The eNB may then re-initialise SPS or allocate a dynamic grant for the UE to compensate the PDCCH loss.
- 2 No additional UL transmissions that may cause interference in instances where the SPS allocation is changed due to e.g. PDCCH activation/deactivation and the UE buffer is empty.
- 3 UE may go earlier to DRX

- 4 UE behaviour simplified and no new behaviour at deactivation is needed.

Acknowledgement free Con's

- 1 Increased PDCCH aggregation level may need to be used which increases the PDCCH resource usage
- 2 SPS resources may be unused until a SR procedure has been initiated by the UE missing the PDCCH
- 3 SPS deactivation on PDCCH may need repetition to have robust SPS resource release
- 4 SPS resources are not released after release indication and are only detected at first periodic grant allocation opportunity after the release signalling time instance.

[0061] In the current 3GPP E-UTRA MAC specification (3GPP TS 36.321 v12.5.0), semi-persistent scheduling operates as follows:

5.10 Semi-Persistent Scheduling

When Semi-Persistent Scheduling is enabled by RRC, the following information is provided [8]:

- Semi-Persistent Scheduling C-RNTI;
- Uplink Semi-Persistent Scheduling interval *semiPersistSchedIntervalUL* and number of empty transmissions before implicit release *implicitReleaseAfter*, if Semi-Persistent Scheduling is enabled for the uplink;
- Whether *twoIntervalsConfig* is enabled or disabled for uplink, only for TDD;
- Downlink Semi-Persistent Scheduling interval *semiPersistSchedIntervalDL* and number of configured HARQ processes for Semi-Persistent Scheduling *numberOfConfSPS-Processes*, if Semi-Persistent Scheduling is enabled for the downlink;

When Semi-Persistent Scheduling for uplink or downlink is disabled by RRC, the corresponding configured grant or configured assignment shall be discarded.

Semi-Persistent Scheduling is supported on the SpCell only.

Semi-Persistent Scheduling is not supported for RN communication with the E-UTRAN in combination with an RN subframe configuration.

NOTE: When eIMTA is configured for the SpCell, if a configured uplink grant or a configured downlink assignment occurs on a subframe that can be reconfigured through eIMTA L1 signalling, then the UE behaviour is left unspecified.

5.10.1 Downlink

After a Semi-Persistent downlink assignment is configured, the MAC entity shall consider sequentially that the N^{th} assignment occurs in the subframe for which:

- $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalDL}] \text{ modulo } 10240.$

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured downlink assignment were (re-)initialised.

5.10.2 Uplink

After a Semi-Persistent Scheduling uplink grant is configured, the MAC entity shall:

- if *twoIntervalsConfig* is enabled by upper layer:
 - set the *Subframe_Offset* according to Table 7.4-1.
- else:
 - set *Subframe_Offset* to 0.
- consider sequentially that the N^{th} grant occurs in the subframe for which:
 - $(10 * \text{SFN} + \text{subframe}) = [(10 * \text{SFN}_{\text{start time}} + \text{subframe}_{\text{start time}}) + N * \text{semiPersistSchedIntervalUL} + \text{Subframe_Offset} * (N \text{ modulo } 2)] \text{ modulo } 10240.$

Where $\text{SFN}_{\text{start time}}$ and $\text{subframe}_{\text{start time}}$ are the SFN and subframe, respectively, at the time the configured uplink grant were (re-)initialised.

The MAC entity shall clear the configured uplink grant immediately after *implicitReleaseAfter* [8] number of consecutive new MAC PDUs each containing zero MAC SDUs have been provided by the Multiplexing and Assembly entity, on the Semi-Persistent Scheduling resource.

NOTE: Retransmissions for Semi-Persistent Scheduling can continue after clearing the configured uplink grant.

[...]

5.4.1 UL Grant reception

In order to transmit on the UL-SCH the MAC entity must have a valid uplink grant (except for non-adaptive HARQ retransmissions) which it may receive dynamically on the PDCCH or in a Random Access Response or which may be configured semi-persistently. To perform requested transmissions, the MAC layer receives HARQ information from lower layers. When the physical layer is configured for uplink spatial multiplexing, the MAC layer can receive up to two grants (one per HARQ process) for the same TTI from lower layers.

If the MAC entity has a C-RNTI, a Semi-Persistent Scheduling C-RNTI, or a Temporary C-RNTI, the MAC entity shall for each TTI and for each Serving Cell belonging to a TAG that has a running *timeAlignmentTimer* and for each grant received for this TTI:

- if an uplink grant for this TTI and this Serving Cell has been received on the PDCCH for the MAC entity's C-RNTI or Temporary C-RNTI; or
- if an uplink grant for this TTI has been received in a Random Access Response:
 - if the uplink grant is for MAC entity's C-RNTI and if the previous uplink grant delivered to the HARQ entity for the same HARQ process was either an uplink grant received for the MAC entity's Semi-Persistent Scheduling C-RNTI or a configured uplink grant:

- consider the NDI to have been toggled for the corresponding HARQ process regardless of the value of the NDI.
- deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if this Serving Cell is the SpCell and if an uplink grant for this TTI has been received for the SpCell on the PDCCH of the SpCell for the MAC entity's Semi-Persistent Scheduling C-RNTI:
 - if the NDI in the received HARQ information is 1:
 - consider the NDI for the corresponding HARQ process not to have been toggled;
 - deliver the uplink grant and the associated HARQ information to the HARQ entity for this TTI.
 - else if the NDI in the received HARQ information is 0:
 - if PDCCH contents indicate SPS release:
 - clear the configured uplink grant (if any).
 - else:
 - store the uplink grant and the associated HARQ information as configured uplink grant;
 - initialise (if not active) or re-initialise (if already active) the configured uplink grant to start in this TTI and to recur according to rules in subclause 5.10.2;
 - consider the NDI bit for the corresponding HARQ process to have been toggled;
 - deliver the configured uplink grant and the associated HARQ information to the HARQ entity for this TTI.
- else, if this Serving Cell is the SpCell and an uplink grant for this TTI has been configured for the SpCell:

- consider the NDI bit for the corresponding HARQ process to have been toggled;
- deliver the configured uplink grant, and the associated HARQ information to the HARQ entity for this TTI.

NOTE: The period of configured uplink grants is expressed in TTIs.

NOTE: If the MAC entity receives both a grant in a Random Access Response and a grant for its C-RNTI or Semi persistent scheduling C-RNTI requiring transmissions on the SpCell in the same UL subframe, the MAC entity may choose to continue with either the grant for its RA-RNTI or the grant for its C-RNTI or Semi persistent scheduling C-RNTI.

NOTE: When a configured uplink grant is indicated during a measurement gap and indicates an UL-SCH transmission during a measurement gap, the MAC entity processes the grant but does not transmit on UL-SCH.

[0062] Details of UL HARQ operation can be found in 3GPP TS 36.321 v12.5.0 as follows:

5.4.2 HARQ operation

5.4.2.1 HARQ entity

There is one HARQ entity at the MAC entity for each Serving Cell with configured uplink, which maintains a number of parallel HARQ processes allowing transmissions to take place continuously while waiting for the HARQ feedback on the successful or unsuccessful reception of previous transmissions.

The number of parallel HARQ processes per HARQ entity is specified in [2], clause 8.

When the physical layer is configured for uplink spatial multiplexing [2], there are two HARQ processes associated with a given TTI. Otherwise there is one HARQ process associated with a given TTI.

At a given TTI, if an uplink grant is indicated for the TTI, the HARQ entity identifies the HARQ process(es) for which a transmission should take place. It also routes the received HARQ feedback (ACK/NACK information), MCS and resource, relayed by the physical layer, to the appropriate HARQ process(es).

When TTI bundling is configured, the parameter TTI_BUNDLE_SIZE provides the number of TTIs of a TTI bundle. TTI bundling operation relies on the HARQ entity for invoking the same HARQ process for each transmission that is part of the same bundle. Within a bundle HARQ retransmissions are non-adaptive and triggered without waiting for feedback from previous transmissions according to TTI_BUNDLE_SIZE. The HARQ feedback of a bundle is only received for the last TTI of the bundle (i.e the TTI corresponding to TTI_BUNDLE_SIZE), regardless of whether a transmission in that TTI takes place or not (e.g. when a measurement gap occurs). A retransmission of a TTI bundle is also a TTI bundle. TTI bundling is not supported when the MAC entity is configured with one or more SCells with configured uplink.

TTI bundling is not supported for RN communication with the E-UTRAN in combination with an RN subframe configuration.

For transmission of Msg3 during Random Access (see subclause 5.1.5) TTI bundling does not apply.

For each TTI, the HARQ entity shall:

- identify the HARQ process(es) associated with this TTI, and for each identified HARQ process:
 - if an uplink grant has been indicated for this process and this TTI:
 - if the received grant was not addressed to a Temporary C-RNTI on PDCCH and if the NDI provided in the associated HARQ information has been toggled compared to the value in the previous transmission of this HARQ process; or
 - if the uplink grant was received on PDCCH for the C-RNTI and the HARQ buffer of the identified process is empty; or

- if the uplink grant was received in a Random Access Response:
 - if there is a MAC PDU in the Msg3 buffer and the uplink grant was received in a Random Access Response:
 - obtain the MAC PDU to transmit from the Msg3 buffer.
 - else:
 - obtain the MAC PDU to transmit from the "Multiplexing and assembly" entity;
 - deliver the MAC PDU and the uplink grant and the HARQ information to the identified HARQ process;
 - instruct the identified HARQ process to trigger a new transmission.
- else:
 - deliver the uplink grant and the HARQ information (redundancy version) to the identified HARQ process;
 - instruct the identified HARQ process to generate an adaptive retransmission.
- else, if the HARQ buffer of this HARQ process is not empty:
 - instruct the identified HARQ process to generate a non-adaptive retransmission.

When determining if NDI has been toggled compared to the value in the previous transmission the MAC entity shall ignore NDI received in all uplink grants on PDCCH for its Temporary C-RNTI.

5.4.2.2 HARQ process

Each HARQ process is associated with a HARQ buffer.

Each HARQ process shall maintain a state variable CURRENT_TX_NB, which indicates the number of transmissions that have taken place for the MAC PDU currently in the buffer, and a state variable HARQ_FEEDBACK, which indicates the HARQ feedback for the MAC PDU currently in the buffer. When the HARQ process is established, CURRENT_TX_NB shall be initialized to 0.

The sequence of redundancy versions is 0, 2, 3, 1. The variable CURRENT_IRV is an index into the sequence of redundancy versions. This variable is up-dated modulo 4.

New transmissions are performed on the resource and with the MCS indicated on PDCCH or Random Access Response. Adaptive retransmissions are performed on the resource and, if provided, with the MCS indicated on PDCCH. Non-adaptive retransmission is performed on the same resource and with the same MCS as was used for the last made transmission attempt.

The MAC entity is configured with a Maximum number of HARQ transmissions and a Maximum number of Msg3 HARQ transmissions by RRC: *maxHARQ-Tx* and *maxHARQ-Msg3Tx* respectively. For transmissions on all HARQ processes and all logical channels except for transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Tx*. For transmission of a MAC PDU stored in the Msg3 buffer, the maximum number of transmissions shall be set to *maxHARQ-Msg3Tx*.

When the HARQ feedback is received for this TB, the HARQ process shall:

- set HARQ_FEEDBACK to the received value.

If the HARQ entity requests a new transmission, the HARQ process shall:

- set CURRENT_TX_NB to 0;
- set CURRENT_IRV to 0;
- store the MAC PDU in the associated HARQ buffer;
- store the uplink grant received from the HARQ entity;
- set HARQ_FEEDBACK to NACK;
- generate a transmission as described below.

If the HARQ entity requests a retransmission, the HARQ process shall:

- increment CURRENT_TX_NB by 1;
- if the HARQ entity requests an adaptive retransmission:
 - store the uplink grant received from the HARQ entity;
 - set CURRENT_IRV to the index corresponding to the redundancy version value provided in the HARQ information;
 - set HARQ_FEEDBACK to NACK;
 - generate a transmission as described below.
- else if the HARQ entity requests a non-adaptive retransmission:
 - if HARQ_FEEDBACK = NACK:
 - generate a transmission as described below.

NOTE: When receiving a HARQ ACK alone, the MAC entity keeps the data in the HARQ buffer.

NOTE: When no UL-SCH transmission can be made due to the occurrence of a measurement gap, no HARQ feedback can be received and a non-adaptive retransmission follows.

To generate a transmission, the HARQ process shall:

- if the MAC PDU was obtained from the Msg3 buffer; or
- if Sidelink Discovery Gaps for Transmission are not configured by upper layers, and there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer in this TTI; or

- if Sidelink Discovery Gaps for Transmission are configured by upper layers, and there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer, and there is no Sidelink Discovery Gap for Transmission in this TTI; or
- if Sidelink Discovery Gaps for Transmission are configured by upper layers, and there is no measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer, and there is a Sidelink Discovery Gap for Transmission, and there is no configured grant for transmission on SL-DCH in this TTI:
 - instruct the physical layer to generate a transmission according to the stored uplink grant with the redundancy version corresponding to the CURRENT_IRV value;
 - increment CURRENT_IRV by 1;
 - if there is a measurement gap or Sidelink Discovery Gap for Reception at the time of the HARQ feedback reception for this transmission and if the MAC PDU was not obtained from the Msg3 buffer:
 - set HARQ_FEEDBACK to ACK at the time of the HARQ feedback reception for this transmission.

After performing above actions, the HARQ process then shall:

- if CURRENT_TX_NB = maximum number of transmissions – 1:
- flush the HARQ buffer;

[0063] In the current 3GPP E-UTRA RRC specification (3GPP TS 36.331 v12.5.0), semi-persistent scheduling is configured as follows:

SPS-Config

The IE *SPS-Config* is used to specify the semi-persistent scheduling configuration.

***SPS-Config* information element**

```
-- ASN1START

SPS-Config ::= SEQUENCE {
    semiPersistSchedC-RNTI          C-RNTI          OPTIONAL,      -- Need OR
    sps-ConfigDL                    SPS-ConfigDL      OPTIONAL,      -- Need ON
    sps-ConfigUL                    SPS-ConfigUL      OPTIONAL,      -- Need ON
}

SPS-ConfigDL ::= CHOICE {
    release                          NULL,
    setup                           SEQUENCE {
        semiPersistSchedIntervalDL  ENUMERATED {
            sf10, sf20, sf32, sf40, sf64, sf80,
            sf128, sf160, sf320, sf640, spare6,
            spare5, spare4, spare3, spare2,
            spare1},
        numberOfConfSPS-Processes   INTEGER (1..8),
        n1PUCCH-AN-PersistentList  N1PUCCH-AN-PersistentList,
        ...,
        [{ twoAntennaPortActivated-r10 CHOICE {
            release                  NULL,
            setup                    SEQUENCE {
                n1PUCCH-AN-PersistentListP1-r10 N1PUCCH-AN-PersistentList
            }
        }
        ]
    }
}
OPTIONAL -- Need ON

}

SPS-ConfigUL ::= CHOICE {
    release                          NULL,
    setup                           SEQUENCE {
        semiPersistSchedIntervalUL  ENUMERATED {
            sf10, sf20, sf32, sf40, sf64, sf80,
            sf128, sf160, sf320, sf640, spare6,
            spare5, spare4, spare3, spare2,
            spare1},
        implicitReleaseAfter        ENUMERATED {e2, e3, e4, e8},
        p0-Persistent               SEQUENCE {

```

```

        p0-NominalPUSCH-Persistent      INTEGER (-126..24),
        p0-UE-PUSCH-Persistent          INTEGER (-8..7)
    } OPTIONAL, -- Need OP
    twoIntervalsConfig                  ENUMERATED {true} OPTIONAL, -- Cond TDD
    ...,
    [ p0-PersistentSubframeSet2-r12 CHOICE {
        release NULL,
        setup SEQUENCE {
            p0-NominalPUSCH-PersistentSubframeSet2-r12 INTEGER (-126..24),
            p0-UE-PUSCH-PersistentSubframeSet2-r12      INTEGER (-8..7)
        }
    } OPTIONAL -- Need ON
}
}
}

N1PUCCH-AN-PersistentList ::= SEQUENCE (SIZE (1..4)) OF INTEGER (0..2047)

-- ASN1STOP
```

<i>SPS-Config</i> field descriptions
<i>implicitReleaseAfter</i> Number of empty transmissions before implicit release, see TS 36.321 [6, 5.10.2]. Value e2 corresponds to 2 transmissions, e3 corresponds to 3 transmissions and so on.
<i>n1PUCCH-AN-PersistentList</i> , <i>n1PUCCH-AN-PersistentListP1</i> List of parameter: $n_{\text{PUCCH}}^{(1,p)}$ for antenna port P0 and for antenna port P1 respectively, see TS 36.213 [23, 10.1]. Field <i>n1-PUCCH-AN-PersistentListP1</i> is applicable only if the <i>twoAntennaPortActivatedPUCCH-Format1a1b</i> in <i>PUCCH-ConfigDedicated-v1020</i> is set to <i>true</i>. Otherwise the field is not configured.
<i>numberOfConfSPS-Processes</i> The number of configured HARQ processes for Semi-Persistent Scheduling, see TS 36.321 [6].
<i>p0-NominalPUSCH-Persistent</i> Parameter: $P_{\text{O_NOMINAL_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dBm step 1. This field is applicable for persistent scheduling, only. If choice setup is used and <i>p0-Persistent</i> is absent, apply the value of <i>p0-NominalPUSCH</i> for <i>p0-NominalPUSCH-Persistent</i>. If uplink power control subframe sets are configured by <i>tpc-SubframeSet</i>, this field applies for uplink power control subframe set 1.
<i>p0-NominalPUSCH-PersistentSubframeSet2</i> Parameter: $P_{\text{O_NOMINAL_PUSCH}}(0)$. See TS 36.213 [23, 5.1.1.1], unit dBm step 1. This field is applicable for persistent scheduling, only. If <i>p0-PersistentSubframeSet2-r12</i> is not configured, apply the value of <i>p0-NominalPUSCH-SubframeSet2-r12</i> for <i>p0-NominalPUSCH-PersistentSubframeSet2</i>. E-UTRAN configures this field only if uplink power control subframe sets are configured by <i>tpc-SubframeSet</i>, in which case this field applies for uplink power control subframe set 2.

SPS-Config field descriptions
<i>p0-UE-PUSCH-Persistent</i> Parameter: $P_{O_UE_PUSCH}(0)$. See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for persistent scheduling, only. If choice setup is used and <i>p0-Persistent</i> is absent, apply the value of <i>p0-UE-PUSCH</i> for <i>p0-UE-PUSCH-Persistent</i>. If uplink power control subframe sets are configured by <i>tpc-SubframeSet</i>, this field applies for uplink power control subframe set 1.
<i>p0-UE-PUSCH-PersistentSubframeSet2</i> Parameter: $P_{O_UE_PUSCH}(0)$. See TS 36.213 [23, 5.1.1.1], unit dB. This field is applicable for persistent scheduling, only. If <i>p0-PersistentSubframeSet2-r12</i> is not configured, apply the value of <i>p0-UE-PUSCH-SubframeSet2</i> for <i>p0-UE-PUSCH-PersistentSubframeSet2</i>. E-UTRAN configures this field only if uplink power control subframe sets are configured by <i>tpc-SubframeSet</i>, in which case this field applies for uplink power control subframe set 2.
<i>semiPersistSchedC-RNTI</i> Semi-persistent Scheduling C-RNTI, see TS 36.321 [6].
<i>semiPersistSchedIntervalDL</i> Semi-persistent scheduling interval in downlink, see TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on. For TDD, the UE shall round this parameter down to the nearest integer (of 10 sub-frames), e.g. sf10 corresponds to 10 sub-frames, sf32 corresponds to 30 sub-frames, sf128 corresponds to 120 sub-frames.
<i>semiPersistSchedIntervalUL</i> Semi-persistent scheduling interval in uplink, see TS 36.321 [6]. Value in number of sub-frames. Value sf10 corresponds to 10 sub-frames, sf20 corresponds to 20 sub-frames and so on. For TDD, the UE shall round this parameter down to the nearest integer (of 10 sub-frames), e.g. sf10 corresponds to 10 sub-frames, sf32 corresponds to 30 sub-frames, sf128 corresponds to 120 sub-frames.

SPS-Config field descriptions	
<i>twoIntervalsConfig</i>	
Trigger of two-intervals-Semi-Persistent Scheduling in uplink. See TS 36.321 [6, 5.10]. If this field is present, two-intervals-SPS is enabled for uplink. Otherwise, two-intervals-SPS is disabled.	

Conditional presence	Explanation
<i>TDD</i>	This field is optional present for TDD, need OR; it is not present for FDD and the UE shall delete any existing value for this field.

[0064] Some UEs are capable of transmitting PUSCH (Physical Uplink Shared Channel) and PUCCH (Physical Uplink Control Channel) simultaneously, and some UEs are not capable of transmitting PUSCH and PUCCH simultaneously. Such capability would be reported to eNB (evolved Node B) so that eNB could decide whether to configure this functionality or not. Even if UE support this feature, eNB may decide not to configure this function if the channel condition of the UE is poor, as to transmit both channel simultaneously is more power consuming. In such case, the UE maximum transmission power may not guarantee proper power level for each channel. UE may decide which channel to transmit UCI (Uplink Control Information) with depending on whether PUSCH and PUCCH simultaneously is configured or not.

[0065] Section 10.1 of 3GPP 36.213 v12.5.0 states:

10.1 UE procedure for determining physical uplink control channel assignment

If the UE is configured for a single serving cell and is not configured for simultaneous PUSCH and PUCCH transmissions, then in subframe n uplink control information (UCI) shall be transmitted

- on PUCCH using format 1/1a/1b/3 or 2/2a/2b if the UE is not transmitting PUSCH

- on PUSCH if the UE is transmitting PUSCH in subframe n unless the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case UCI is not transmitted

If the UE is configured for a single serving cell and simultaneous PUSCH and PUCCH transmission, then in subframe n UCI shall be transmitted

- on PUCCH using format 1/1a/1b/3 if the UCI consists only of HARQ-ACK and/or SR
- on PUCCH using format 2 if the UCI consists only of periodic CSI
- on PUCCH using format 2/2a/2b/3 if the UCI consists of periodic CSI and HARQ-ACK and if the UE is not transmitting PUSCH
- on PUCCH and PUSCH if the UCI consists of HARQ-ACK/HARQ-ACK+SR/positive SR and periodic/aperiodic CSI and if the UE is transmitting PUSCH in subframe n , in which case the HARQ-ACK/HARQ-ACK+SR/positive SR is transmitted on PUCCH using format 1/1a/1b/3 and the periodic/aperiodic CSI transmitted on PUSCH unless the PUSCH transmission corresponds to a Random Access Response Grant or a retransmission of the same transport block as part of the contention based random access procedure, in which case periodic/aperiodic CSI is not transmitted

[0066] For a UE with poor channel condition, such as in cell edge, it is possible to configure HARQ-ACK (Hybrid Automatic Repeat Request Acknowledgement) repetition to improve the HARQ-ACK feedback reliability by repeating the transmission of ACK/NACK (Acknowledgement/Negative Acknowledgement) multiple times. Under such situation, the HARQ-ACK would be transmitted on PUCCH without multiplexed onto other channel, e.g., PUSCH, to enjoy the combining gain of repetition across subframes, as some of the repetitions would occur on the same resource and joint demodulation/channel estimation is possible.

[0067] Section 10.2 of 3GPP 36.213 v12.5.0 states:

10.2 Uplink HARQ-ACK timing

For TDD or for FDD-TDD and primary cell frame structure type 2 or for FDD-TDD and primary cell frame structure type 1, if a UE configured with *EIMTA-MainConfigServCell-r12* for a serving cell, “UL/DL configuration” of the serving cell in subclause 10.2 refers to the UL/DL configuration given by the parameter *eimta-HARQ-ReferenceConfig-r12* for the serving cell unless specified otherwise.

For FDD or for FDD-TDD and primary cell frame structure type 1, the UE shall upon detection of a PDSCH transmission in subframe $n-4$ intended for the UE and for which an HARQ-ACK shall be provided, transmit the HARQ-ACK response in subframe n . If HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission in subframe $n-4$ intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe n corresponding to a PDSCH transmission in subframes $n - N_{\text{ANRep}} - 3, \dots, n - 5$, the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe $n - 4$) on PUCCH in subframes $n, n + 1, \dots, n + N_{\text{ANRep}} - 1$;
- shall not transmit any other signal/channel in subframes $n, n + 1, \dots, n + N_{\text{ANRep}} - 1$; and
- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes $n - 3, \dots, n + N_{\text{ANRep}} - 5$.

<...>

For TDD, if HARQ-ACK repetition is enabled, upon detection of a PDSCH transmission within subframe(s) $n - k$, where $k \in K$ and K is defined in Table 10.1.3.1-1 intended for the UE and for which HARQ-ACK response shall be provided, and if the UE is not repeating the transmission of any HARQ-ACK in subframe n corresponding to a PDSCH transmission in a downlink or special subframe earlier than subframe $n - k$, the UE:

- shall transmit only the HARQ-ACK response (corresponding to the detected PDSCH transmission in subframe $n-k$) on PUCCH in UL subframe n and the next $N_{\text{ANRep}} - 1$ UL subframes denoted as $n_1, \dots, n_{N_{\text{ANRep}} - 1}$;
- shall not transmit any other signal/channel in UL subframe $n, n_1, \dots, n_{N_{\text{ANRep}} - 1}$; and
- shall not transmit any HARQ-ACK response repetitions corresponding to any detected PDSCH transmission in subframes $n_i - k$, where $k \in K_i$, K_i is the set defined in Table 10.1.3.1-1 corresponding to UL subframe n_i , and $1 \leq i \leq N_{\text{ANRep}} - 1$.

[0068] 3GPP TS 36.212 v13.0.0 describes how physical layer process a transport block from MAC layer and how to multiplex uplink control information as follows:

5.2 Uplink transport channels and control information

If the UE is configured with a Master Cell Group (MCG) and Secondary Cell Group (SCG) [6], the procedures described in this clause are applied to the MCG and SCG, respectively. When the procedures are applied to a SCG, the term primary cell refers to the primary SCell (PSCell) of the SCG.

If the UE is configured with a PUCCH SCell [6], the procedures described in this clause are applied to the group of DL cells associated with the primary cell and the group of DL cells associated with the PUCCH SCell, respectively. When the procedures are applied to the group of DL cells associated with the PUCCH SCell, the term primary cell refers to the PUCCH SCell.

If the UE is configured with a LAA SCell, the procedures described in this clause are applied assuming the LAA SCell is an FDD SCell.

5.2.1 Random access channel

The sequence index for the random access channel is received from higher layers and is processed according to [2].

5.2.2 Uplink shared channel

Figure 5.2.2-1 shows the processing structure for the UL-SCH transport channel on one UL cell. Data arrives to the coding unit in the form of a maximum of two transport blocks every transmission time interval (TTI) per UL cell. The following coding steps can be identified for each transport block of an UL cell:

- Add CRC to the transport block
- Code block segmentation and code block CRC attachment
- Channel coding of data and control information
- Rate matching
- Code block concatenation
- Multiplexing of data and control information
- Channel interleaver

The coding steps for one UL-SCH transport block are shown in the figure below. The same general processing applies for each UL-SCH transport block on each UL cell with restrictions as specified in [3].

[Figure 5.2.2-1 of 3GPP TS 36.212 v13.0.0, entitled “Transport block processing for UL-SCH” is reproduced as FIG. 6]

5.2.2.1 Transport block CRC attachment

Error detection is provided on each UL-SCH transport block through a Cyclic Redundancy Check (CRC).

The entire transport block is used to calculate the CRC parity bits. Denote the bits in a transport block delivered to layer 1 by $a_0, a_1, a_2, a_3, \dots, a_{A-1}$, and the parity bits by $p_0, p_1, p_2, p_3, \dots, p_{L-1}$. A is the size of the transport block and L is the number of parity bits. The lowest order information

bit a_0 is mapped to the most significant bit of the transport block as defined in section 6.1.1 of [5].

The parity bits are computed and attached to the UL-SCH transport block according to section 5.1.1 setting L to 24 bits and using the generator polynomial $g_{\text{CRC24A}}(D)$.

5.2.2.2 Code block segmentation and code block CRC attachment

The bits input to the code block segmentation are denoted by $b_0, b_1, b_2, b_3, \dots, b_{B-1}$ where B is the number of bits in the transport block (including CRC).

Code block segmentation and code block CRC attachment are performed according to section 5.1.2.

The bits after code block segmentation are denoted by $c_{r0}, c_{r1}, c_{r2}, c_{r3}, \dots, c_{r(K_r-1)}$, where r is the code block number and K_r is the number of bits for code block number r .

5.2.2.3 Channel coding of UL-SCH

Code blocks are delivered to the channel coding block. The bits in a code block are denoted by $c_{r0}, c_{r1}, c_{r2}, c_{r3}, \dots, c_{r(K_r-1)}$, where r is the code block number, and K_r is the number of bits in code block number r . The total number of code blocks is denoted by C and each code block is individually turbo encoded according to section 5.1.3.2.

After encoding the bits are denoted by $d_{r0}^{(i)}, d_{r1}^{(i)}, d_{r2}^{(i)}, d_{r3}^{(i)}, \dots, d_{r(D_r-1)}^{(i)}$, with $i = 0, 1$, and 2 and where D_r is the number of bits on the i -th coded stream for code block number r , i.e. $D_r = K_r + 4$.

5.2.2.4 Rate matching

Turbo coded blocks are delivered to the rate matching block. They are denoted by $d_{r0}^{(i)}, d_{r1}^{(i)}, d_{r2}^{(i)}, d_{r3}^{(i)}, \dots, d_{r(D_r-1)}^{(i)}$, with $i = 0, 1$, and 2 , and where r is the code block number, i is the coded stream index, and D_r is the number of bits in each coded stream of code block number r . The total number of code blocks is denoted by C and each coded block is individually rate matched according to section 5.1.4.1.

After rate matching, the bits are denoted by $e_{r0}, e_{r1}, e_{r2}, e_{r3}, \dots, e_{r(E_r-1)}$, where r is the coded block number, and where E_r is the number of rate matched bits for code block number r .

5.2.2.5 Code block concatenation

The bits input to the code block concatenation block are denoted by $e_{r0}, e_{r1}, e_{r2}, e_{r3}, \dots, e_{r(E_r-1)}$ for $r = 0, \dots, C-1$ and where E_r is the number of rate matched bits for the r -th code block.

Code block concatenation is performed according to section 5.1.5.

The bits after code block concatenation are denoted by $f_0, f_1, f_2, f_3, \dots, f_{G-1}$, where G is the total number of coded bits for transmission of the given transport block over N_L transmission layers excluding the bits used for control transmission, when control information is multiplexed with the UL-SCH transmission.

5.2.2.6 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication, and CSI-RS resource indication (CRI). Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When control data are transmitted in the PUSCH, the channel coding for HARQ-ACK, rank indication, CRI and channel quality information $o_0, o_1, o_2, \dots, o_{O-1}$ is done independently.

For the cases with TDD primary cell, the number of HARQ-ACK bits is determined as described in section 7.3 of [3].

When the UE transmits HARQ-ACK bits, rank indicator bits or CRI bits, it shall determine the number of coded modulation symbols per layer Q' for HARQ-ACK, rank indicator or CRI bits as follows.

For the case when only one transport block is transmitted in the PUSCH conveying the HARQ-ACK bits, rank indicator bits or CRI bits:

$$Q' = \min \left(\left[\frac{O \cdot M_{sc}^{PUSCH-initial} \cdot N_{symb}^{PUSCH-initial} \cdot \beta_{offset}^{PUSCH}}{\sum_{r=0}^{C-1} K_r} \right], 4 \cdot M_{sc}^{PUSCH} \right)$$

where

- O is the number of HARQ-ACK bits, rank indicator bits or CRI bits, and
- M_{sc}^{PUSCH} is the scheduled bandwidth for PUSCH transmission in the current sub-frame for the transport block, expressed as a number of subcarriers in [2], and
- $N_{symb}^{PUSCH-initial}$ is the number of SC-FDMA symbols per subframe for initial PUSCH transmission for the same transport block, respectively, given by

$$N_{symb}^{PUSCH-initial} = (2 \cdot (N_{symb}^{UL} - 1) - N_{SRS}), \text{ where}$$
 - N_{SRS} is equal to 1
 - if UE configured with one UL cell is configured to send PUSCH and SRS in the same subframe for initial transmission, or
 - if UE transmits PUSCH and SRS in the same subframe in the same serving cell for initial transmission, or
 - if the PUSCH resource allocation for initial transmission even partially overlaps with the cell-specific SRS subframe and bandwidth configuration defined in section 5.5.3 of [2], or
 - if the subframe for initial transmission in the same serving cell is a UE-specific type-1 SRS subframe as defined in Section 8.2 of [3], or
 - if the subframe for initial transmission in the same serving cell is a UE-specific type-0 SRS subframe as defined in section 8.2 of [3] and the UE is configured with multiple TAGs.
 - Otherwise N_{SRS} is equal to 0.

- $M_{sc}^{PUSCH-initial}$, C , and K_r are obtained from the initial PDCCH or EPDCCH for the same transport block. If there is no initial PDCCH or EPDCCH with DCI format 0 for the same transport block, $M_{sc}^{PUSCH-initial}$, C , and K_r shall be determined from:
 - the most recent semi-persistent scheduling assignment PDCCH or EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,
 - the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

For the case when two transport blocks are transmitted in the PUSCH conveying the HARQ-ACK bits, rank indicator bits or CRI bits:

$$Q' = \max \left[\min(Q'_{temp}, 4 \cdot M_{sc}^{PUSCH}), Q'_{min} \right] \text{ with}$$

$$Q'_{temp} = \left\lceil \frac{O \cdot M_{sc}^{PUSCH-initial(1)} \cdot N_{symb}^{PUSCH-initial(1)} \cdot M_{sc}^{PUSCH-initial(2)} \cdot N_{symb}^{PUSCH-initial(2)} \cdot \beta_{offset}^{PUSCH}}{\sum_{r=0}^{C^{(1)}-1} K_r^{(1)} \cdot M_{sc}^{PUSCH-initial(2)} \cdot N_{symb}^{PUSCH-initial(2)} + \sum_{r=0}^{C^{(2)}-1} K_r^{(2)} \cdot M_{sc}^{PUSCH-initial(1)} \cdot N_{symb}^{PUSCH-initial(1)}} \right\rceil$$

where

- O is the number of HARQ-ACK bits, rank indicator bits or CRI bits, and
- $Q'_{min} = O$ if $O \leq 2$, $Q'_{min} = \lceil 2O / Q'_m \rceil$ if $3 \leq O \leq 11$ with $Q'_m = \min(Q_m^1, Q_m^2)$ where $Q_m^x, x = \{1, 2\}$ is the modulation order of transport block “x”, and $Q'_{min} = \lceil 2O_1 / Q'_m \rceil + \lceil 2O_2 / Q'_m \rceil$ if $O > 11$ with $O_1 = \lceil O / 2 \rceil$ and $O_2 = O - \lceil O / 2 \rceil$.
- $M_{sc}^{PUSCH-initial(x)}, x = \{1, 2\}$ are the scheduled bandwidths for PUSCH transmission in the initial sub-frame for the first and second transport block, respectively, expressed as a number of subcarriers in [2], and
- $N_{symb}^{PUSCH-initial(x)}, x = \{1, 2\}$ are the number of SC-FDMA symbols per subframe for initial PUSCH transmission for the first and second transport block given by

$$N_{symb}^{PUSCH-initial(x)} = \left(2 \cdot (N_{symb}^{UL} - 1) - N_{SRS}^{(x)} \right), x = \{1, 2\}, \text{ where}$$

- $N_{SRS}^{(x)}, x = \{1,2\}$ is equal to 1
 - if UE configured with one UL cell is configured to send PUSCH and SRS in the same subframe for initial transmission, or
 - if UE transmits PUSCH and SRS in the same subframe in the same serving cell for initial transmission of transport block “x”, or
 - if the PUSCH resource allocation for initial transmission of transport block “x” even partially overlaps with the cell-specific SRS subframe and bandwidth configuration defined in section 5.5.3 of [2], or
 - if the subframe for initial transmission of transport block “x” in the same serving cell is a UE-specific type-1 SRS subframe as defined in Section 8.2 of [3], or
 - if the subframe for initial transmission of transport block “x” in the same serving cell is a UE-specific type-0 SRS subframe as defined in section 8.2 of [3] and the UE is configured with multiple TAGs.
- Otherwise $N_{SRS}^{(x)}, x = \{1,2\}$ is equal to 0.
- $M_{sc}^{PUSCH-initial(x)}, x = \{1,2\}$, $C^{(x)}, x = \{1,2\}$, and $K_r^{(x)}, x = \{1,2\}$ are obtained from the initial PDCCH or EPDCCH for the corresponding transport block.

For HARQ-ACK, $Q_{ACK} = Q_m \cdot Q'$ and $\beta_{offset}^{PUSCH} = \beta_{offset}^{HARQ-ACK}$, where Q_m is the modulation order of a given transport block. For UEs configured with no more than five DL cells, $\beta_{offset}^{HARQ-ACK}$ shall be determined according to [3] depending on the number of transmission codewords for the corresponding PUSCH. For UEs configured with more than five DL cells, $\beta_{offset}^{HARQ-ACK}$ shall be determined according to [3] depending on the number of transmission codewords for the corresponding PUSCH and the number of HARQ-ACK feedback bits.

For rank indication or CRI, $Q_{RI} = Q_m \cdot Q'$, $Q_{CRI} = Q_m \cdot Q'$ and $\beta_{offset}^{PUSCH} = \beta_{offset}^{RI}$, where Q_m is the modulation order of a given transport block, and β_{offset}^{RI} shall be determined according to [3]

depending on the number of transmission codewords for the corresponding PUSCH, and on the uplink power control subframe set for the corresponding PUSCH when two uplink power control subframe sets are configured by higher layers for the cell.

For HARQ-ACK

Each positive acknowledgement (ACK) is encoded as a binary '1' and each negative acknowledgement (NACK) is encoded as a binary '0'

If HARQ-ACK feedback consists of 1-bit of information, i.e., $[o_0^{ACK}]$, it is first encoded according to Table 5.2.2.6-1.

If HARQ-ACK feedback consists of 2-bits of information, i.e., $[o_0^{ACK} \ o_1^{ACK}]$ with o_0^{ACK} corresponding to HARQ-ACK bit for codeword 0 and o_1^{ACK} corresponding to that for codeword 1, or if HARQ-ACK feedback consists of 2-bits of information as a result of the aggregation of HARQ-ACK bits corresponding to two DL cells with which the UE is configured by higher layers, or if HARQ-ACK feedback consists of 2-bits of information corresponding to two subframes for TDD, it is first encoded according to Table 5.2.2.6-2 where $o_2^{ACK} = (o_0^{ACK} + o_1^{ACK}) \bmod 2$.

[Table 5.2.2.6-1 of 3GPP TS 36.212 v13.0.0, entitled "Encoding of 1-bit HARQ-ACK", is reproduced as FIG. 7]

[Table 5.2.2.6-2 of 3GPP TS 36.212 v13.0.0, entitled "Encoding of 2-bit HARQ-ACK", is reproduced as FIG. 8]

If HARQ-ACK feedback consists of $3 \leq O^{ACK} \leq 11$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, i.e., $o_0^{ACK} \ o_1^{ACK} \dots, o_{O^{ACK}-1}^{ACK}$, then a coded bit sequence

$\tilde{q}_0^{ACK}, \tilde{q}_1^{ACK}, \dots, \tilde{q}_{31}^{ACK}$ is obtained by using the bit sequence $o_0^{ACK}, o_1^{ACK}, \dots, o_{Q_{ACK}-1}^{ACK}$ as the input to the channel coding block described in section 5.2.2.6.4. In turn, the bit sequence $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \dots, q_{Q_{ACK}-1}^{ACK}$ is obtained by the circular repetition of the bit sequence $\tilde{q}_0^{ACK}, \tilde{q}_1^{ACK}, \dots, \tilde{q}_{31}^{ACK}$ so that the total bit sequence length is equal to Q_{ACK} .

If HARQ-ACK feedback consists of $11 < O^{ACK} \leq 22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, i.e., $o_0^{ACK}, o_1^{ACK}, \dots, o_{O^{ACK}-1}^{ACK}$, then the coded bit sequence $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \dots, q_{Q_{ACK}-1}^{ACK}$ is obtained by using the bit sequence $o_0^{ACK}, o_1^{ACK}, \dots, o_{O^{ACK}-1}^{ACK}$ as the input to the channel coding block described in section 5.2.2.6.5.

If HARQ-ACK feedback consists of $O^{ACK} > 22$ bits of information as a result of the aggregation of HARQ-ACK bits corresponding to one or more DL cells with which the UE is configured by higher layers, the coded bit sequence is denoted by $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \dots, q_{Q_{ACK}-1}^{ACK}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to sections 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0^{ACK}, o_1^{ACK}, \dots, o_{O^{ACK}-1}^{ACK}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

The “x” and “y” in Table 5.2.2.6-1 and 5.2.2.6-2 are placeholders for [2] to scramble the HARQ-ACK bits in a way that maximizes the Euclidean distance of the modulation symbols carrying HARQ-ACK information.

For FDD or TDD HARQ-ACK multiplexing or the aggregation of more than one DL cell including at least one cell using FDD and at least one cell using TDD when HARQ-ACK consists of one or two bits of information, the bit sequence $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \dots, q_{Q_{ACK}-1}^{ACK}$ is obtained by concatenation of multiple encoded HARQ-ACK blocks where Q_{ACK} is the total number of coded bits for all the encoded HARQ-ACK blocks. The last concatenation of the encoded HARQ-ACK block may be partial so that the total bit sequence length is equal to Q_{ACK} .

For UEs configured by higher layers with *codebooksizeDetermination-r13* = 0, the bit sequence

$\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$ is determined according to the Downlink Assignment Index (DAI) as in

Table 5.3.3.1.1-2 and as defined in [3]. Otherwise, the bit sequence $\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$ is determined as below.

For FDD when HARQ ACK consists of 2 or more bits of information as a result of the aggregation of more than one DL cell, the bit sequence $\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$ is the result of the concatenation of HARQ-ACK bits for the multiple DL cells according to the following pseudo-code:

Set $c = 0$ – cell index: lower indices correspond to lower RRC indices of corresponding cell

Set $j = 0$ – HARQ-ACK bit index

Set N_{cells}^{DL} to the number of cells configured by higher layers for the UE

while $c < N_{cells}^{DL}$

if transmission mode configured in cell $c \in \{1, 2, 5, 6, 7\}$ – 1 bit HARQ-ACK feedback for this cell

$\tilde{o}_j^{ACK} = \text{HARQ-ACK bit of this cell}$

$j = j + 1$

else

if the UE is not configured with spatial bundling on PUSCH by higher layers

$\tilde{o}_j^{ACK} = \text{HARQ-ACK bit corresponding to the first codeword of this cell}$

$j = j + 1$

$\tilde{o}_j^{ACK} = \text{HARQ-ACK bit corresponding to the second codeword of this cell}$

$j = j + 1$

else

$\tilde{o}_j^{ACK} = \text{binary AND operation of the HARQ-ACK bits corresponding to the first}$

and second codewords of this cell

$j = j + 1$

end if
end if
 $c = c + 1$

end while

For the aggregation of more than one DL cell including a primary cell using FDD and at least one secondary cell using TDD, the bit sequence $\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$ is the result of the concatenation of HARQ-ACK bits for one or multiple DL cells. Define N_{cells}^{DL} as the number of cells configured by higher layers for the UE and B_c^{DL} as the number of subframes for which the UE needs to feed back HARQ-ACK bits in UL subframe n for the c -th serving cell. For a cell using TDD, the subframes are determined by the DL-reference UL/DL configuration if the UE is configured with higher layer parameter *eimta-HARQ-ReferenceConfig*, and determined by the UL/DL configuration otherwise. For a cell using TDD, $B_c^{DL} = 1$ if subframe $n-4$ in the cell is a DL subframe or a special subframe with special subframe configurations 1/2/3/4/6/7/8/9 and normal downlink CP or a special subframe with special subframe configurations 1/2/3/5/6/7 and extended downlink CP, and $B_c^{DL} = 0$ otherwise. For a cell using FDD, $B_c^{DL} = 1$.

The bit sequence $\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$ is performed according to the following pseudo-code:

Set $c = 0$ – cell index: lower indices correspond to lower RRC indices of corresponding cell

Set $j = 0$ – HARQ-ACK bit index

while $c < N_{cells}^{DL}$

if $B_c^{DL} = 1$

if transmission mode configured in cell $c \in \{1, 2, 5, 6, 7\}$ – 1 bit HARQ-ACK feedback

for this cell

$\tilde{o}_j^{ACK} = \text{HARQ-ACK bit of this cell}$

$j = j + 1$

else

if the UE is not configured with spatial bundling on PUSCH by higher layers

```

 $\tilde{o}_j^{ACK}$  = HARQ-ACK bit corresponding to the first codeword of this
cell
 $j = j + 1$ 
 $\tilde{o}_j^{ACK}$  = HARQ-ACK bit corresponding to the second codeword of
this cell
 $j = j + 1$ 
else
 $\tilde{o}_j^{ACK}$  = binary AND operation of the HARQ-ACK bits corresponding
to the first and second codewords of this cell
 $j = j + 1$ 
end if
end if
end if
 $c = c + 1$ 
end while
For the cases with TDD primary cell when HARQ-ACK is for the aggregation of one or more DL
cells and the UE is configured with PUCCH format 3, PUCCH format 4 or PUCCH format 5 [3], the
bit sequence  $\tilde{o}_0^{ACK} \tilde{o}_1^{ACK}, \dots, \tilde{o}_{O^{ACK}-1}^{ACK}$  is the result of the concatenation of HARQ-ACK bits for the
one or more DL cells configured by higher layers and the multiple subframes as defined in [3].
Define  $N_{cells}^{DL}$  as the number of cells configured by higher layers for the UE and  $B_c^{DL}$  as the
number of subframes for which the UE needs to feed back HARQ-ACK bits as defined in Section
7.3 of [3].
The number of HARQ-ACK bits for the UE to convey if it is configured with PUCCH format 3,
PUCCH format 4 or PUCCH format 5 is computed as follows:
Set  $k = 0$  – counter of HARQ-ACK bits
Set  $c=0$  – cell index: lower indices correspond to lower RRC indices of corresponding cell
while  $c < N_{cells}^{DL}$ 

```

```
set  $l = 0$ ;  
while  $l < B_c^{DL}$   
    if transmission mode configured in cell  $c \in \{1,2,5,6,7\}$  -- 1 bit HARQ-ACK feedback for this  
    cell  
         $k = k + 1$   
    else  
         $k = k + 2$   
    end if  
     $l = l + 1$   
end while  
 $c = c + 1$   
end while
```

When PUCCH format 3 is configured, if $k \leq 20$ when TDD is used in all the configured serving cell(s) of the UE, or if $k \leq 21$ when FDD is used in at least one of the configured serving cells with TDD primary cell; or when PUCCH format 4 or PUCCH format 5 is configured and when the UE is not configured with spatial bundling on PUSCH by higher layers, the multiplexing of HARQ-ACK bits is performed according to the following pseudo-code:

Set $c = 0$ – cell index: lower indices correspond to lower RRC indices of corresponding cell

Set $j = 0$ – HARQ-ACK bit index

```
while  $c < N_{cells}^{DL}$   
    set  $l = 0$ ;  
    while  $l < B_c^{DL}$   
        if transmission mode configured in cell  $c \in \{1,2,5,6,7\}$  -- 1 bit HARQ-ACK feedback for this  
        cell  
             $\tilde{o}_j^{ACK} = o_{c,l}^{ACK}$  HARQ-ACK bit of this cell as defined in Section 7.3 of [3]  
             $j = j + 1$   
        else
```

$$[\tilde{o}_j^{ACK}, \tilde{o}_{j+1}^{ACK}] = [o_{c,2l}^{ACK}, o_{c,2l+1}^{ACK}] \text{ HARQ-ACK bits of this cell as defined in}$$

Section 7.3 of [3]

$$j = j + 2$$

end if

$$l = l + 1$$

end while

$$c = c + 1$$

end while

When PUCCH format 3 is configured, if $k > 20$ when TDD is used in all the configured serving cell(s) of the UE, or if $k > 21$ when FDD is used in at least one of the configured serving cells with TDD primary cell, spatial bundling is applied to all subframes in all cells; or when PUCCH format 4 or PUCCH format 5 is configured and when the UE is configured with spatial bundling on PUSCH by higher layers, the multiplexing of HARQ-ACK bits is performed according to the following pseudo-code:

Set $c = 0$ – cell index: lower indices correspond to lower RRC indices of corresponding cell

Set $j = 0$ – HARQ-ACK bit index

while $c < N_{cells}^{DL}$

set $l = 0$;

while $l < B_c^{DL}$

if transmission mode configured in cell $c \in \{1, 2, 5, 6, 7\}$ – 1 bit HARQ-ACK feedback for this cell

$$\tilde{o}_j^{ACK} = o_{c,l}^{ACK} \text{ HARQ-ACK bit of this cell as defined in Section 7.3 of [3]}$$

$$j = j + 1$$

else

$\tilde{o}_j^{ACK} = o_{c,l}^{ACK}$ binary AND operation of the HARQ-ACK bits corresponding to the first and second codewords of this cell as defined in Section 7.3 of [3]

$$j = j + 1$$

end if

$$l = l + 1$$

end while

$$c = c + 1$$

end while

For $o^{ACK} \leq 11$ or $o^{ACK} > 22$, the bit sequence $o_0^{ACK} o_1^{ACK}, \dots, o_{Q_{ACK}-1}^{ACK}$ is obtained by setting

$$o_i^{ACK} = \tilde{o}_i^{ACK}.$$

For $11 < o^{ACK} \leq 22$, the bit sequence $o_0^{ACK} o_1^{ACK}, \dots, o_{Q_{ACK}-1}^{ACK}$ is obtained by setting $o_{i/2}^{ACK} = \tilde{o}_i^{ACK}$ if i is even and $o_{\lceil Q_{ACK}/2 \rceil + (i-1)/2}^{ACK} = \tilde{o}_i^{ACK}$ if i is odd.

For the cases with TDD primary cell when HARQ-ACK is for the aggregation of two DL cells and the UE is configured with PUCCH format 1b with channel selection, the bit sequence $o_0^{ACK} o_1^{ACK}, \dots, o_{Q_{ACK}-1}^{ACK}$ is obtained as described in section 7.3 of [3].

For TDD HARQ-ACK bundling, a bit sequence $\tilde{q}_0^{ACK}, \tilde{q}_1^{ACK}, \tilde{q}_2^{ACK}, \dots, \tilde{q}_{Q_{ACK}-1}^{ACK}$ is obtained by concatenation of multiple encoded HARQ-ACK blocks where Q_{ACK} is the total number of coded bits for all the encoded HARQ-ACK blocks. The last concatenation of the encoded HARQ-ACK block may be partial so that the total bit sequence length is equal to Q_{ACK} . A scrambling

sequence $[w_0^{ACK} w_1^{ACK} w_2^{ACK} w_3^{ACK}]$ is then selected from Table 5.2.2.6-A with index

$i = (N_{\text{bundled}} - 1) \bmod 4$, where N_{bundled} is determined as described in section 7.3 of [3]. The bit

sequence $q_0^{ACK}, q_1^{ACK}, q_2^{ACK}, \dots, q_{Q_{ACK}-1}^{ACK}$ is then generated by setting $m = 1$ if HARQ-ACK consists of

1-bit and $m = 3$ if HARQ-ACK consists of 2-bits and then scrambling $\tilde{q}_0^{ACK}, \tilde{q}_1^{ACK}, \tilde{q}_2^{ACK}, \dots, \tilde{q}_{Q_{ACK}-1}^{ACK}$

as follows

Set i, k to 0

while $i < Q_{ACK}$

if $\tilde{q}_i^{ACK} = y$ // place-holder repetition bit

$$q_i^{ACK} = (\tilde{q}_{i-1}^{ACK} + w_{\lfloor k/m \rfloor}^{ACK}) \bmod 2$$

$$k = (k + 1) \bmod 4m$$

else

if $\tilde{q}_i^{ACK} = x$ // a place-holder bit

$$q_i^{ACK} = \tilde{q}_i^{ACK}$$

else // coded bit

$$q_i^{ACK} = (\tilde{q}_i^{ACK} + w_{\lfloor k/m \rfloor}^{ACK}) \bmod 2$$

$$k = (k + 1) \bmod 4m$$

end if

$$i = i + 1$$

end while

[Table 5.2.2.6-A of 3GPP TS 36.212 v13.0.0, entitled “Scrambling sequence selection for TDD HARQ-ACK bundling”, is reproduced as FIG. 9]

When HARQ-ACK information is to be multiplexed with UL-SCH at a given PUSCH, the HARQ-ACK information is multiplexed in all layers of all transport blocks of that PUSCH, For a given transport block, the vector sequence output of the channel coding for HARQ-ACK information is denoted by $\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \dots, \underline{q}_{Q'_{ACK}-1}^{ACK}$, where $\underline{q}_i^{ACK}$, $i = 0, \dots, Q'_{ACK} - 1$ are column vectors of length $(Q_m \cdot N_L)$ and where $Q'_{ACK} = Q_{ACK} / Q_m$ is obtained as follows:

Set i, k to 0

while $i < Q_{ACK}$

$$\hat{\underline{q}}_k^{ACK} = [q_i^{ACK} \dots q_{i+Q_m-1}^{ACK}] \text{ -- temporary row vector}$$

$$\underline{q}_k^{ACK} = [\hat{\underline{q}}_k^{ACK} \dots \hat{\underline{q}}_k^{ACK}]^T \text{ -- replicating the row vector } \hat{\underline{q}}_k^{ACK} \text{ } N_L \text{ times and transposing into a column vector}$$

$$i = i + Q_m$$

$$k = k + 1$$

end while

where N_L is the number of layers onto which the UL-SCH transport block is mapped.

For rank indication (RI) (RI only, joint report of RI and i1, joint report of CRI and RI, joint report of CRI, RI and i1, joint report of CRI, RI, and PTI, and joint report of RI and PTI) or CRI

- The corresponding bit widths for CRI feedback for PDSCH transmissions are given by Tables 5.2.2.6.1-3A, 5.2.2.6.2-3A, 5.2.2.6.3-3A, 5.2.3.3.1-3D,
- The corresponding bit widths for RI feedback for PDSCH transmissions are given by Tables 5.2.2.6.1-2, 5.2.2.6.2-3, 5.2.2.6.2-3B, 5.2.2.6.3-3, 5.2.2.6.3-3B, 5.2.3.3.1-3, 5.2.3.3.1-3A, 5.2.3.3.1-3B, 5.2.3.3.1-3C, 5.2.3.3.1-3D, 5.2.3.3.2-4, and 5.2.3.3.2-4A, 5.2.3.3.2-4B, 5.2.3.3.2-4C, 5.2.3.3.2-4D which are determined assuming the maximum number of layers as follows:
 - If the *maxLayersMIMO-r10* is configured for the DL cell, the maximum number of layers is determined according to *maxLayersMIMO-r10* for the DL cell
 - Else,
 - If the UE is configured with transmission mode 9, and the *supportedMIMO-CapabilityDL-r10* field is included in the *UE-EUTRA-Capability*, the maximum number of layers is determined according to the minimum of the configured number of CSI-RS ports and the maximum of the reported UE downlink MIMO capabilities for the same band in the corresponding band combination.
 - If the UE is configured with transmission mode 9 and Class B CSI reporting with $K > 1$ and RI and CRI are transmitted in the same reporting instance, and the *supportedMIMO-CapabilityDL-r10* field is included in the *UE-EUTRA-Capability*, the maximum number of layers is determined according to the minimum of the maximum of number of antenna port of the configured CSI-RS resources and the

maximum of the reported UE downlink MIMO capabilities for the same band in the corresponding band combination,.

- If the UE is configured with transmission mode 9, and the *supportedMIMO-CapabilityDL-r10* field is not included in the *UE-EUTRA-Capability*, the maximum number of layers is determined according to the minimum of the configured number of CSI-RS ports and *ue-Category* (without suffix).
- If the UE is configured with transmission mode 9 and Class B CSI reporting with $K > 1$ and RI and CRI are transmitted in the same reporting instance, and the *supportedMIMO-CapabilityDL-r10* field is not included in the *UE-EUTRA-Capability*, the maximum number of layers is determined according to the minimum of the maximum of number of antenna port of the configured CSI-RS resources and *ue-Category* (without suffix).
- If the UE is configured with transmission mode 10, and the *supportedMIMO-CapabilityDL-r10* field is included in the *UE-EUTRA-Capability*, the maximum number of layers for each CSI process is determined according to the minimum of the configured number of CSI-RS ports for that CSI process and the maximum of the reported UE downlink MIMO capabilities for the same band in the corresponding band combination.
- If the UE is configured with transmission mode 10 and Class B CSI reporting with $K > 1$ and RI and CRI are transmitted in the same reporting instance, and the *supportedMIMO-CapabilityDL-r10* field is included in the *UE-EUTRA-Capability*, the maximum number of layers for each CSI process is determined according to the minimum of the maximum of number of antenna port of the configured CSI-RS resources in that CSI process and the maximum of the reported UE downlink MIMO capabilities for the same band in the corresponding band combination.
- If the UE is configured with transmission mode 10, and the *supportedMIMO-CapabilityDL-r10* field is not included in the *UE-EUTRA-Capability*, the maximum

number of layers for each CSI process is determined according to the minimum of the configured number of CSI-RS ports for that CSI process and *ue-Category* (without suffix).

- If the UE is configured with transmission mode 10 and Class B CSI reporting with $K > 1$ and RI and CRI are transmitted in the same reporting instance, and the supportedMIMO-CapabilityDL-r10 field is not included in the UE-EUTRA-Capability, the maximum number of layers for each CSI process is determined according to the minimum of the maximum of number of antenna port of the configured CSI-RS resources in that CSI process and *ue-Category* (without suffix).
- Otherwise the maximum number of layers is determined according to the minimum of the number of PBCH antenna ports and *ue-Category* (without suffix).
- If RI feedback consists of 1-bit of information, i.e., $[o_0^{RI}]$, it is first encoded according to Table 5.2.2.6-3. The $[o_0^{RI}]$ to RI mapping is given by Table 5.2.2.6-5.
- If RI feedback consists of 2-bits of information, i.e., $[o_0^{RI} \ o_1^{RI}]$ with o_0^{RI} corresponding to MSB of 2-bit input and o_1^{RI} corresponding to LSB, it is first encoded according to Table 5.2.2.6-4 where $o_2^{RI} = (o_0^{RI} + o_1^{RI}) \bmod 2$. The $[o_0^{RI} \ o_1^{RI}]$ to RI mapping is given by Table 5.2.2.6-6.

[Table 5.2.2.6-3 of 3GPP TS 36.212 v13.0.0, entitled “Encoding of 1-bit RI”, is reproduced as FIG. 10]

[Table 5.2.2.6-4 of 3GPP TS 36.212 v13.0.0, entitled “Encoding of 2-bit RI”, is reproduced as FIG. 11]

[Table 5.2.2.6-5 of 3GPP TS 36.212 v13.0.0, entitled “ o_0^{RI} to RI mapping”, is reproduced as FIG.

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[Table 5.2.2.6-6 of 3GPP TS 36.212 v13.0.0, entitled " o_0^{RI}, o_1^{RI} to RI mapping", is reproduced as
 FIG. 13]

[Table 5.2.2.6-7 of 3GPP TS 36.212 v13.0.0, entitled " $o_0^{RI}, o_1^{RI}, o_2^{RI}$ to RI mapping", is
 reproduced as FIG. 14]

If RI feedback for a given DL cell consists of 3-bits of information, i.e., $[o_0^{RI} o_1^{RI} o_2^{RI}]$ with o_0^{RI} corresponding to MSB of 3-bit input and o_2^{RI} corresponding to LSB. The $[o_0^{RI} o_1^{RI} o_2^{RI}]$ to RI mapping is given by Table 5.2.2.6-7.

If RI feedback consists of $3 \leq O^{RI} \leq 11$ bits of information, i.e., $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$, then a coded bit sequence $[\tilde{q}_0^{RI} \tilde{q}_1^{RI}, \dots, \tilde{q}_{31}^{RI}]$ is obtained by using the bit sequence $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$ as the input to the channel coding block described in section 5.2.2.6.4.

If RI feedback consists of $11 < O^{RI} \leq 22$ bits of information as a result of the aggregation of RI bits corresponding to multiple DL cells or multiple CSI processes, i.e., $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$, then the coded bit sequence $q_0^{RI}, q_1^{RI}, q_2^{RI}, \dots, q_{Q^{RI}-1}^{RI}$ is obtained by using the bit sequence $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$ as the input to the channel coding block described in section 5.2.2.6.5.

If RI feedback consists of $O^{RI} > 22$ bits of information as a result of the aggregation of RI bits corresponding to multiple DL cells or multiple CSI processes, i.e., $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$, then the coded bit sequence is denoted by $q_0^{RI}, q_1^{RI}, q_2^{RI}, \dots, q_{Q^{RI}-1}^{RI}$. The CRC attachment, channel coding and rate matching of the HARQ-ACK bits are performed according to sections 5.1.1 setting L to 8 bits, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $[o_0^{RI} o_1^{RI}, \dots, o_{O^{RI}-1}^{RI}]$. The output bit sequence of the CRC attachment

operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

The “x” and “y” in Table 5.2.2.6-3 and 5.2.2.6-4 are placeholders for [2] to scramble the RI bits in a way that maximizes the Euclidean distance of the modulation symbols carrying rank information.

For the case where RI feedback for more than one DL cell is to be reported, the RI report for each DL cell is concatenated prior to coding in increasing order of cell index.

For the case where RI feedback for more than one CSI process is to be reported, the RI reports are concatenated prior to coding first in increasing order of CSI process index for each DL cell and then in increasing order of cell index.

For the case where RI feedback consists of one or two bits of information the bit sequence $q_0^{RI}, q_1^{RI}, q_2^{RI}, \dots, q_{Q_{RI}-1}^{RI}$ is obtained by concatenation of multiple encoded RI blocks where Q_{RI} is the total number of coded bits for all the encoded RI blocks. The last concatenation of the encoded RI block may be partial so that the total bit sequence length is equal to Q_{RI} .

For the case where RI feedback consists of $3 \leq O^{RI} \leq 11$ bits of information, the bit sequence $q_0^{RI}, q_1^{RI}, q_2^{RI}, \dots, q_{Q_{RI}-1}^{RI}$ is obtained by the circular repetition of the bit sequence $\tilde{q}_0^{RI}, \tilde{q}_1^{RI}, \dots, \tilde{q}_{31}^{RI}$ so that the total bit sequence length is equal to Q_{RI} .

When rank information is to be multiplexed with UL-SCH at a given PUSCH, the rank information is multiplexed in all layers of all transport blocks of that PUSCH. For a given transport block, the vector sequence output of the channel coding for rank information is denoted by $\underline{q}_0^{RI}, \underline{q}_1^{RI}, \dots, \underline{q}_{Q'_{RI}-1}^{RI}$, where $\underline{q}_i^{RI}$, $i = 0, \dots, Q'_{RI} - 1$ are column vectors of length $(Q_m \cdot N_L)$ and where $Q'_{RI} = Q_{RI} / Q_m$. The vector sequence is obtained as follows:

Set i, j, k to 0

while $i < Q_{RI}$

$\hat{q}_k^{RI} = [q_i^{RI} \dots q_{i+Q_m-1}^{RI}]$ -- temporary row vector

$\underline{q}_k^{RI} = [\hat{q}_k^{RI} \dots \hat{q}_k^{RI}]^T$ -- replicating the row vector $\hat{q}_k^{RI}$ N_L times and transposing into a column

vector

$i = i + Q_m$

$k = k + 1$

end while

where N_L is the number of layers onto which the UL-SCH transport block is mapped.

The same procedures for encoding of RI and RI multiplexing with UL-SCH at a given PUSCH are applied for CRI, using CRI instead of RI in the equations.

For channel quality control information (CQI and/or PMI denoted as CQI/PMI);

When the UE transmits channel quality control information bits, it shall determine the number of modulation coded symbols per layer Q' for channel quality information as

$$Q' = \min \left(\left\lceil \frac{(O + L) \cdot M_{sc}^{PUSCH-initial(x)} \cdot N_{symb}^{PUSCH-initial(x)} \cdot \beta_{offset}^{PUSCH}}{\sum_{r=0}^{C^{(x)}-1} K_r^{(x)}} \right\rceil, M_{sc}^{PUSCH} \cdot N_{symb}^{PUSCH} - \frac{Q_{RI}^{(x)}}{Q_m^{(x)}} \right)$$

where

- O is the number of CQI/PMI bits, and
- L is the number of CRC bits given by $L = \begin{cases} 0 & O \leq 11 \\ 8 & \text{otherwise} \end{cases}$, and
- $Q_{CQI} = Q_m^{(x)} \cdot Q'$ and $\beta_{offset}^{PUSCH} = \beta_{offset}^{CQI}$, where β_{offset}^{CQI} shall be determined according to [3]

depending on the number of transmission codewords for the corresponding PUSCH, and

on the uplink power control subframe set for the corresponding PUSCH when two uplink power control subframe sets are configured by higher layers for the cell.

- If RI or CRI is not transmitted then $Q_{RI}^{(x)} = 0$.

The variable “ x ” in $K_r^{(x)}$ represents the transport block index corresponding to the highest I_{MCS} value indicated by the initial UL grant. In case the two transport blocks have the same I_{MCS} value in the corresponding initial UL grant, “ $x=1$ ”, which corresponds to the first transport block. $M_{sc}^{PUSCH-initial(x)}$, $C^{(x)}$, and $K_r^{(x)}$ are obtained from the initial PDCCH or EPDCCH for the same transport block. If there is no initial PDCCH or EPDCCH with DCI format 0 for the same transport block, $M_{sc}^{PUSCH-initial(x)}$, $C^{(x)}$, and $K_r^{(x)}$ shall be determined from:

- the most recent semi-persistent scheduling assignment PDCCH or EPDCCH, when the initial PUSCH for the same transport block is semi-persistently scheduled, or,
- the random access response grant for the same transport block, when the PUSCH is initiated by the random access response grant.

$N_{symb}^{PUSCH-initial(x)}$ is the number of SC-FDMA symbols per subframe for initial PUSCH transmission for the same transport block.

For UL-SCH data information $G = N_L^{(x)} \cdot (N_{symb}^{PUSCH} \cdot M_{sc}^{PUSCH} \cdot Q_m^{(x)} - Q_{CQI} - Q_{RI}^{(x)})$, where

- $N_L^{(x)}$ is the number of layers the corresponding UL-SCH transport block is mapped onto, and
- M_{sc}^{PUSCH} is the scheduled bandwidth for PUSCH transmission in the current sub-frame for the transport block, and
- N_{symb}^{PUSCH} is the number of SC-FDMA symbols in the current PUSCH transmission sub-frame given by $N_{symb}^{PUSCH} = (2 \cdot (N_{symb}^{UL} - 1) - N_{SRS})$, where
 - N_{SRS} is equal to 1
 - if UE configured with one UL cell is configured to send PUSCH and SRS in the same

- subframe for initial transmission, or
- if UE transmits PUSCH and SRS in the same subframe for the current subframe in the same serving cell, or
- if the PUSCH resource allocation for the current subframe even partially overlaps with the cell-specific SRS subframe and bandwidth configuration defined in section 5.5.3 of [2], or
- if the current subframe in the same serving cell is a UE-specific type-1 SRS subframe as defined in Section 8.2 of [3], or
- if the current subframe in the same serving cell is a UE-specific type-0 SRS subframe as defined in section 8.2 of [3] and the UE is configured with multiple TAGs.
- Otherwise N_{SRS} is equal to 0.

In case of CQI/PMI report for more than one DL cell, $o_0, o_1, o_2, \dots, o_{O-1}$ is the result of concatenating the CQI/PMI report for each DL cell in increasing order of cell index. For the case where CQI/PMI feedback for more than one CSI process is to be reported, $o_0, o_1, o_2, \dots, o_{O-1}$ is the result of concatenating the CQI/PMI reports in increasing order of CSI process index for each DL cell and then in increasing order of cell index.

- If the payload size is less than or equal to 11 bits, the channel coding of the channel quality information is performed according to section 5.2.2.6.4 with input sequence $o_0, o_1, o_2, \dots, o_{O-1}$.
- For payload sizes greater than 11 bits, the CRC attachment, channel coding and rate matching of the channel quality information is performed according to sections 5.1.1, 5.1.3.1 and 5.1.4.2, respectively. The input bit sequence to the CRC attachment operation is $o_0, o_1, o_2, \dots, o_{O-1}$. The output bit sequence of the CRC attachment operation is the input bit sequence to the channel coding operation. The output bit sequence of the channel coding operation is the input bit sequence to the rate matching operation.

The output sequence for the channel coding of channel quality information is denoted by $q_0, q_1, q_2, q_3, \dots, q_{N_L \cdot Q_{CQI} - 1}$, where N_L is the number of layers the corresponding UL-SCH transport block is mapped onto.

[0069] 3GPP TS 36.212 v13.0.0 also states:

5.2.2.7 Data and control multiplexing

The control and data multiplexing is performed such that HARQ-ACK information is present on both slots and is mapped to resources around the demodulation reference signals. In addition, the multiplexing ensures that control and data information are mapped to different modulation symbols.

The inputs to the data and control multiplexing are the coded bits of the control information denoted by $q_0, q_1, q_2, q_3, \dots, q_{N_L \cdot Q_{CQI} - 1}$ and the coded bits of the UL-SCH denoted by

$f_0, f_1, f_2, f_3, \dots, f_{G-1}$. The output of the data and control multiplexing operation is denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, \underline{g}_3, \dots, \underline{g}_{H'-1}$, where $H = (G + N_L \cdot Q_{CQI})$ and $H' = H / (N_L \cdot Q_m)$, and where $\underline{g}_i$, $i = 0, \dots, H' - 1$ are column vectors of length $(Q_m \cdot N_L)$. H is the total number of coded bits allocated for UL-SCH data and CQI/PMI information across the N_L transmission layers of the transport block.

In case where more than one UL-SCH transport block are transmitted in a subframe of an UL cell, the CQI/PMI information is multiplexed with data only on the UL-SCH transport block with highest I_{MCS} value on the initial grant. In case the two transport blocks have the same I_{MCS} value in the corresponding initial UL grant, the CQI/PMI information is multiplexed with data only on the first transport block. For that UL-SCH transport block or in the case of single transport block transmission, and assuming that N_L is the number of layers onto which the UL-SCH transport block is mapped, the control information and the data shall be multiplexed as follows:

Set i, j, k to 0

while $j < N_L \cdot Q_{CQI}$ -- first place the control information

$$\underline{g}_k = [q_j \dots q_{j+N_L \cdot Q_m - 1}]^T$$

$$j = j + N_L \cdot Q_m$$

$$k = k + 1$$

end while

while $i < G$ -- then place the data

$$\underline{g}_k = [f_i \dots f_{i+Q_m \cdot N_L - 1}]^T$$

$$i = i + Q_m \cdot N_L$$

$$k = k + 1$$

end while

5.2.2.8 Channel interleaver

The channel interleaver described in this section in conjunction with the resource element mapping for PUSCH in [2] implements a time-first mapping of modulation symbols onto the transmit waveform while ensuring that the HARQ-ACK and RI information are present on both slots in the subframe. HARQ-ACK information is mapped to resources around the uplink demodulation reference signals while RI information is mapped to resources around those used by HARQ-ACK.

The input to the channel interleaver are denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, \dots, \underline{g}_{H'-1}, \underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, \dots, \underline{q}_{Q_{RI}'-1}^{RI}$ and

$\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, \dots, \underline{q}_{Q_{ACK}'-1}^{ACK}$. In case where more than one UL-SCH transport block are

transmitted in a subframe of an UL cell, the HARQ-ACK and RI information are multiplexed with data on both UL-SCH transport blocks.

The number of modulation symbols per layer in the subframe is given by $H'_{total} = H' + Q_{RI}'$. The output bit sequence from the channel interleaver is derived as follows:

(1) Assign $C_{mux} = N_{\text{symb}}^{\text{PUSCH}}$ to be the number of columns of the matrix. The columns of the matrix are numbered $0, 1, 2, \dots, C_{mux} - 1$ from left to right. $N_{\text{symb}}^{\text{PUSCH}}$ is determined according to section 5.2.2.6.

(2) The number of rows of the matrix is $R_{mux} = (H'_{\text{total}} \cdot Q_m \cdot N_L) / C_{mux}$ and we define

$$R'_{mux} = R_{mux} / (Q_m \cdot N_L).$$

The rows of the rectangular matrix are numbered $0, 1, 2, \dots, R_{mux} - 1$ from top to bottom.

(3) If rank information is transmitted in this subframe, the vector sequence

$\underline{q}_0^{RI}, \underline{q}_1^{RI}, \underline{q}_2^{RI}, \dots, \underline{q}_{Q_{RI}-1}^{RI}$ is written onto the columns indicated by Table 5.2.2.8-1, and by sets of $(Q_m \cdot N_L)$ rows starting from the last row and moving upwards according to the following pseudo-code.

Set i, j to 0.

Set r to $R'_{mux} - 1$

while $i < Q_{RI}$

$$c_{RI} = \text{Column Set}(j)$$

$$\underline{y}_{r \times C_{mux} + c_{RI}} = \underline{q}_i^{RI}$$

$$i = i + 1$$

$$r = R'_{mux} - 1 - \lfloor i/4 \rfloor$$

$$j = (j + 3) \bmod 4$$

end while

Where ColumnSet is given in Table 5.2.2.8-1 and indexed left to right from 0 to 3.

(4) Write the input vector sequence, for $k = 0, 1, \dots, H' - 1$, into the $(R_{mux} \times C_{mux})$ matrix by sets of $(Q_m \cdot N_L)$ rows starting with the vector $\underline{y}_0$ in column 0 and rows 0 to $(Q_m \cdot N_L - 1)$ and skipping the matrix entries that are already occupied:

$$\begin{bmatrix} \underline{y}_0 & \underline{y}_1 & \underline{y}_2 & \cdots & \underline{y}_{C_{mux}-1} \\ \underline{y}_{C_{mux}} & \underline{y}_{C_{mux}+1} & \underline{y}_{C_{mux}+2} & \cdots & \underline{y}_{2C_{mux}-1} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ \underline{y}_{(R'_{mux}-1) \times C_{mux}} & \underline{y}_{(R'_{mux}-1) \times C_{mux}+1} & \underline{y}_{(R'_{mux}-1) \times C_{mux}+2} & \cdots & \underline{y}_{(R'_{mux}-1) \times C_{mux}+C_{mux}-1} \end{bmatrix}$$

The pseudocode is as follows:

Set i, k to 0.

while $k < H'$,

if $\underline{y}_i$ is not assigned to RI symbols

$$\underline{y}_i = \underline{g}_k$$

$$k = k + 1$$

end if

$$i = i + 1$$

end while

(5) If HARQ-ACK information is transmitted in this subframe, the vector sequence

$\underline{q}_0^{ACK}, \underline{q}_1^{ACK}, \underline{q}_2^{ACK}, \dots, \underline{q}_{Q'_{ACK}-1}^{ACK}$ is written onto the columns indicated by Table 5.2.2.8-2, and by

sets of $(Q_m \cdot N_L)$ rows starting from the last row and moving upwards according to the following pseudo-code. Note that this operation overwrites some of the channel interleaver entries obtained in step (4).

Set i, j to 0.

Set r to $R'_{mux} - 1$

while $i < Q'_{ACK}$

$$c_{ACK} = \text{ColumnSet}(j)$$

$$\underline{y}_{r \times C_{mux} + c_{ACK}} = \underline{q}_i^{ACK}$$

$$i = i + 1$$

$$r = R'_{max} - 1 - \lfloor i/4 \rfloor$$

$$j = (j + 3) \bmod 4$$

end while

Where ColumnSet is given in Table 5.2.2.8-2 and indexed left to right from 0 to 3.

- (6) The output of the block interleaver is the bit sequence read out column by column from the $(R_{max} \times C_{max})$ matrix. The bits after channel interleaving are denoted by $h_0, h_1, h_2, \dots, h_{H+N_L \cdot Q_{RI}-1}$, where N_L is the number of layers the corresponding UL-SCH transport block is mapped onto.

[Table 5.2.2.8-1 of 3GPP TS 36.212 v13.0.0, entitled “Column set for Insertion of rank information”, is reproduced as FIG. 15]

[Table 5.2.2.8-2 of 3GPP TS 36.212 v13.0.0, entitled “Column set for Insertion of HARQ-ACK information”, is reproduced as FIG. 16]

The same channel interleaver procedures for RI are applied for CRI, using CRI instead of RI in the equations.

[0070] 3GPP TS 36.212 v13.0.0 also states:

5.2.4 Uplink control information on PUSCH without UL-SCH data

When control data are sent via PUSCH without UL-SCH data, the following coding steps can be identified:

- Channel coding of control information

- Control information mapping
- Channel interleaver

5.2.4.1 Channel coding of control information

Control data arrives at the coding unit in the form of channel quality information (CQI and/or PMI), HARQ-ACK and rank indication. Different coding rates for the control information are achieved by allocating different number of coded symbols for its transmission. When the UE transmits HARQ-ACK bits or rank indicator bits, it shall determine the number of coded symbols Q' for HARQ-ACK or rank indicator as

$$Q' = \min \left(\left\lceil \frac{O \cdot M_{sc}^{PUSCH} \cdot N_{symb}^{PUSCH} \cdot \beta_{offset}^{PUSCH}}{O_{CQI-MIN}} \right\rceil, 4 \cdot M_{sc}^{PUSCH} \right)$$

where O is the number of HARQ-ACK bits as defined in section 5.2.2.6, or rank indicator bits, $O_{CQI-MIN}$ is the number of CQI bits including CRC bits assuming rank equals to 1 for all serving cells for which an aperiodic CSI report is triggered [3], M_{sc}^{PUSCH} is the scheduled bandwidth for PUSCH transmission in the current subframe expressed as a number of subcarriers in [2], and N_{symb}^{PUSCH} is the number of SC-FDMA symbols in the current PUSCH transmission sub-frame given by $N_{symb}^{PUSCH} = \left(2 \cdot (N_{symb}^{UL} - 1) - N_{SRS} \right)$, where N_{SRS} is equal to 1 if UE is configured to send PUSCH and SRS in the same subframe for the current subframe, or if the PUSCH resource allocation for the current subframe even partially overlaps with the cell-specific SRS subframe and bandwidth configuration defined in section 5.5.3 of [2], or if the current subframe is a UE-specific type-1 SRS subframe as defined in Section 8.2 of [3], or if the current subframe is a UE-specific type-0 SRS subframe as defined in section 8.2 of [3] and the UE is configured with multiple TAGs. Otherwise N_{SRS} is equal to 0.

For HARQ-ACK information $Q_{ACK} = Q_m \cdot Q'$ and $\lceil \beta_{offset}^{PUSCH} = \beta_{offset}^{HARQ-ACK} / \beta_{offset}^{CQI} \rceil$. For UEs configured with no more than five DL cells, $\beta_{offset}^{HARQ-ACK}$ shall be determined according to [3]. For UEs configured with more than five DL cells, $\beta_{offset}^{HARQ-ACK}$ shall be determined according to [3] depending on the number of HARQ-ACK feedback bits.

For rank indication or CRI, $Q_{RI} = Q_m \cdot Q'$, $Q_{CRI} = Q_m \cdot Q'$ and $\lceil \beta_{offset}^{PUSCH} = \beta_{offset}^{RI} / \beta_{offset}^{CQI} \rceil$, where β_{offset}^{RI} shall be determined according to [3].

For CQI and/or PMI information $Q_{CQI} = N_{\text{symb}}^{\text{PUSCH}} \cdot M_{\text{sc}}^{\text{PUSCH}} \cdot Q_m - Q_{RI}$.

The channel coding and rate matching of the control data is performed according to section 5.2.2.6. The coded output sequence for channel quality information is denoted by $q_0, q_1, q_2, q_3, \dots, q_{Q_{CQI}-1}$, the coded vector sequence output for HARQ-ACK is denoted by $\underline{q}_0^{\text{ACK}}, \underline{q}_1^{\text{ACK}}, \underline{q}_2^{\text{ACK}}, \dots, \underline{q}_{Q'_{\text{ACK}}-1}^{\text{ACK}}$ and the coded vector sequence output for rank indication or CRI, is denoted by $\underline{q}_0^{\text{RI}}, \underline{q}_1^{\text{RI}}, \underline{q}_2^{\text{RI}}, \dots, \underline{q}_{Q'_{\text{RI}}-1}^{\text{RI}}$.

5.2.4.2 Control information mapping

The input are the coded bits of the channel quality information denoted by $q_0, q_1, q_2, q_3, \dots, q_{Q_{CQI}-1}$. The output is denoted by $\underline{g}_0, \underline{g}_1, \underline{g}_2, \underline{g}_3, \dots, \underline{g}_{H'-1}$, where $H = Q_{CQI}$ and $H' = H / Q_m$, and where $\underline{g}_i$, $i = 0, \dots, H' - 1$ are column vectors of length Q_m . H is the total number of coded bits allocated for CQI/PMI information.

The control information shall be mapped as follows:

Set j, k to 0

while $j < Q_{CQI}$

$$\underline{g}_k = [q_j \dots q_{j+Q_m-1}]^T$$

$$j = j + Q_m$$

$$k = k + 1$$

end while

5.2.4.3 Channel interleaver

The vector sequences $\underline{g}_0, \underline{g}_1, \underline{g}_2, \dots, \underline{g}_{H'-1}$, $\underline{q}_0^{\text{RI}}, \underline{q}_1^{\text{RI}}, \underline{q}_2^{\text{RI}}, \dots, \underline{q}_{Q'_{\text{RI}}-1}^{\text{RI}}$ and $\underline{q}_0^{\text{ACK}}, \underline{q}_1^{\text{ACK}}, \underline{q}_2^{\text{ACK}}, \dots, \underline{q}_{Q'_{\text{ACK}}-1}^{\text{ACK}}$ are channel interleaved according section 5.2.2.8. The bits after channel interleaving are denoted by

$$h_0, h_1, h_2, \dots, h_{H+Q_{\text{RI}}-1}.$$

[0071] Semi-persistent scheduling enables a UE to consider a configured uplink grant occurs periodically after it is initiated. It may be initiated by receiving a network signaling to

initiate SPS (Semi-Persistent Scheduling). No network signaling is needed to allocate the following configured uplink grant after SPS is initiated. Based on 3GPP RP-150310, fast uplink access may be achieved by a specific type of SPS. The specific type of SPS is assumed to be with small size and short interval, for example, less than 10ms.

[0072] Further, the specific type of SPS is assumed to be pre-allocated. An eNB may allocate this kind of SPS resource to a UE without receiving any scheduling request or buffer status information. When the UE has data available for transmission (as discussed in 3GPP TS 36.321 v12.5.0), the UE can use resource configured by the SPS for uplink transmission. Compared with requesting uplink resource via scheduling request (as discussed in 3GPP TS 36.321 v12.5.0), the latency can then be reduced if the interval of the resource configured by the SPS is short enough.

[0073] Figure 2 of 3GPP RP-150310 is reproduced as FIG. 17. In general, FIG. 17 shows how pre-allocated uplink grant (such as allocated by SPS) improves latency reduction compared with scheduling request procedure specified in 3GPP TS 36.321 v12.5.0). The resource configured by the specific type of SPS may be separated from the resource configured by the legacy SPS (with longer interval) or jointly used.

[0074] In addition, it is also mentioned in 3GPP RP-150310 that the requirement of sending padding when there is UL resource but no data is in buffer can be removed. The intention of removing the requirement is to save battery power.

[0075] Based on 3GPP TS 36.213 v12.5.0, when a physical control information (such as channel quality indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and/or HARQ feedback) needs to be transmitted in a TTI, a UE should transmit the physical control information via either PUSCH or PUCCH. Traditionally, if an uplink grant for PUSCH is not available or the UE is allowed to perform transmission on PUCCH and PUSCH simultaneously, the physical control information is transmitted on PUCCH. If HARQ-ACK repetition is not configured, an uplink grant for PUSCH is available, and the UE is not allowed to perform transmission on PUCCH and PUSCH simultaneously (e.g., due to UE capability, UE power limitation, or eNB configuration), the physical control information is transmitted on PUSCH multiplexed with upper layer data (e.g., MAC PDU). If HARQ-ACK repetition is not configured

and an uplink grant for PUSCH is available, the physical control information is transmitted on PUCCH and data is not transmitted, irrespective of whether the UE is allowed to perform transmission on PUCCH and PUSCH simultaneously or not. Note that the UE which is configured with HARQ-ACK repetition is reasonably not allowed to perform transmission on PUCCH and PUSCH simultaneously, given transmitting PUCCH and PUSCH simultaneously require proper channel quality and are usually configured for cell center UEs.

[0076] Three following scenarios are considered:

[0077] Scenario 1 - When a physical control information needs to be transmitted in a TTI, if a UE is unable to perform transmission on PUCCH and PUSCH simultaneously and the UE has data available for transmission, the UE traditionally multiplexes the physical control information with the data and transmits them on PUSCH jointly. However, if an assigned UL resource for PUSCH is small (e.g., a pre-allocated configured uplink resource which is assumed to be small), multiplexing the physical control information into PUSCH may jeopardize the data delivery because coding rate of the data may be worse than normal so that data transmission is likely to fail. In addition, since network (e.g., eNB) may not know whether the UE transmits the physical control information on PUCCH or PUSCH which may depend on whether the UE has data available for transmission or not, complexity of decoding the UE transmission is increased.

[0078] Scenario 2 - When a physical control information needs to be transmitted in a TTI, if a UE has data available for transmission and simultaneous transmission on PUCCH and PUSCH is enabled but the UE is not able to perform both transmissions on a control channel (e.g., PUCCH) and a data channel (e.g., PUSCH) with sufficient power, traditionally the UE prioritizes PUCCH transmission over PUSCH transmission. However, the data on PUSCH may not be transmitted in this TTI, or less power is used on PUSCH so that the PUSCH transmission is likely to fail.

[0079] Scenario 3 - If a UE does not have data available for transmission in a TTI, the UE would skip configured UL grant or dynamic uplink grant in that TTI. Thus, if the UE needs to transmit UCI (Uplink Control Information) in the TTI, UE would transmit the UCI on the PUCCH. However, if there is more than one UCI to be transmitted in one TTI, PUCCH may not be a good candidate to carry the UCI as it has limited capacity and the UE may require to drop

some of the UCI mentioned in the background. Also, the available resource on PUCCH is limited and thus transmit the UCI on PUCCH may not be very robust.

[0080] In general, a configured uplink grant is available periodically after it is initiated. The configured uplink grant is initiated by a network signaling. No network signaling is needed to allocate the following configured uplink grant after it is initiated.

[0081] Unless specified otherwise, a UE may not use a configured uplink grant if no data is available for transmission. Unless specified otherwise, the UE may not transmit padding using the configured uplink grant. The period of the configured uplink grant may be less than a specified value. The specified value may be 10ms or 10 TTIs. The period of the configured uplink grant may be 1ms or 1 TTI. The period of the configured uplink grant may be 2ms or 2 TTIs. The period of the configured uplink grant may be 5ms or 5 TTIs.

[0082] TTI length may be 1ms, 0.5 ms, or several OFDM (or SC-FDMA) symbol(s), e.g., 1, 2, 3, 4, 5, or 6 symbols. Throughout the application, the method may be applied for the case HARQ-ACK repetition is not configured, unless otherwise specified. Furthermore, throughout the application, a UE has data available for transmission may mean the UE has UL data in the buffer. The UE has data available for transmission may mean the UE has regular MAC control element for transmission. Throughout the application, the UE has data available for transmission may mean the UE has UL data in the buffer and regular MAC control element for transmission.

[0083] The configured uplink grant may be pre-allocated. A UE may be allocated the configured uplink grant when no data is available for transmission. The UE may be allocated the configured uplink grant before the UE transmits a scheduling request or a buffer status report.

[0084] To deal with *Scenario 1*, a solution is generally that when a configured uplink grant is available and a physical control information needs to be transmitted in a TTI, if a UE is unable to perform transmission on a control channel and a data channel simultaneously and the UE has data available for transmission, the UE transmits the physical control information on the control channel. Moreover, the UE does not use the configured uplink grant for transmission on the data channel. Examples are listed in FIG. 18 and FIG. 19.

[0085] To deal with *Scenario 1*, a second solution is generally that when a configured uplink grant is available and a physical control information needs to be transmitted in a TTI, the UE would transmit the physical control information on a control channel if HARQ-ACK repetition is not configured and if the UE is unable to perform transmission on the control channel and a data channel simultaneously and the UE has data available for transmission. And if HARQ-ACK repetition is configured and the UE has data available for transmission, the UE would transmit the physical control information on the control channel. Moreover, the UE does not use the configured uplink grant for transmission on the data channel.

[0086] To deal with *Scenario 1*, a third solution is to determine which channel to transmit a physical control information in a TTI according to an uplink grant on a data channel in the TTI. In one embodiment, determining which channel to transmit the physical control information is to determine to transmit the physical control information on the data channel or on a control channel. Furthermore, the determination may be different for different types of UCI, such as HARQ-ACK, CQI/PMI/RI, SR(Scheduling Request).

[0087] In one embodiment, determination is according to a type of the uplink grant. In one example, uplink grant type can be an uplink grant periodically available or an uplink grant for a specific TTI. More specifically, determining based on uplink grant type means to transmit a physical control information on a control channel if the uplink grant is periodically available, and to transmit the physical control information on a data channel if the uplink grant is for the specific TTI.

[0088] In one embodiment, determination is based on the purpose of the uplink grant. An example of purpose is whether the uplink grant is for latency reduction or not. The purpose of the uplink grant may be known according to an indication, a configuration, a periodicity of the uplink grant, or an identifier to address the uplink grant. For the example, if the uplink grant is addressed by one RNTI (Radio Network Temporary Identifier), the UE transmits a physical control information on a control channel. If the uplink grant is addressed by another RNTI, the UE transmits the physical control information on a data channel.

[0089] In one embodiment, determination is based on the available resource of the uplink grant. More specifically, the available resource of an uplink grant is a TTI length of the uplink

grant. Alternatively, the available resource of the uplink grant is a number of PRB (pairs) of the uplink grant. Alternatively, the available resource of the uplink grant is a TTI length of the uplink grant and a number of PRB (pairs) of the uplink grant. In one example, if the available resource of the uplink grant is less than a specific value, the UE transmits the physical control information on a control channel and if the available resource of the uplink grant is more than a specific value, the UE transmits the physical control information on a data channel. More specifically, the specific value is fixed or configured for a UE. Alternatively, the specific value is derived according to payload size or amount of physical control information. Alternatively, the specific value is derived according to a type of the physical control information, e.g. HARQ-ACK/CQI/PMI/RI/SR (Scheduling Request). Alternatively, the specific value is derived according to a MCS (Modulation and Coding Scheme) of the uplink grant. Furthermore, the specific value is set to guarantee the code rate of the physical control information if it is carried on the data channel.

[0090] If a UE behavior can be consistent no matter the UE has data available or not (e.g., a physical control information is transmitted on a control channel as listed in FIG. 19), network decoding can be simplified because network does not need to assume different UE behaviors.

[0091] To deal with *Scenario 2*, a solution is generally that when a configured uplink grant is available and a physical control information needs to be transmitted in a TTI, a UE would transmit the physical control information on a data channel if the UE has data available for transmission and simultaneous transmission on a control channel and the data channel is enabled but the UE is not able to perform both transmissions on the control channel and the data channel with sufficient power. The power-insufficient case may be due to the sum of the computed power for the data channel and the computed power for the control channel exceed the maximum power of the UE.

[0092] More specifically, the UE multiplexes the physical control information with data on the data channel. The UE uses the configured uplink grant to transmit data on the data channel. Moreover, when a configured uplink grant is available and no data is available for transmission, the UE does not use the configured uplink grant for transmission on the data

channel (e.g., transmit padding) if no physical control information needs to be transmitted in a TTI. Examples are listed in FIG. 18 and FIG. 20.

[0093] If a UE transmits a physical control information on a data channel and does not transmit it on a control channel, more power can be used on a data channel transmission and the data channel transmission may be more likely to succeed. On the other hand, if more than one physical control information needs to be transmitted in a TTI, some of the physical control information may be dropped due to the control channel configuration if the UE prioritizes the control channel transmission. Transmitting the physical control information on the data channel allows all physical control information to be transmitted.

[0094] To deal with *Scenario 3*, a solution is generally that a UE determines whether to skip a configured uplink grant or to skip a dynamic grant in a TTI according to whether a physical control information needs to be transmitted in the TTI or not. For example, when a configured uplink grant is available and if the UE does not have data available for transmission, if the physical control information needs to be transmitted in a TTI, the UE transmits the physical control information on a data channel. If no physical control information needs to be transmitted in a TTI, the UE skips the configured uplink grant.

[0095] In one embodiment, the UE skipping the configured uplink grant means that the UE does not perform transmission on a data channel. In another embodiment, the UE transmits a physical control information on the data channel with a transport block comprise padding (or padding MAC control element). More specifically, physical layer in the UE would indicate whether the physical control information needs to be transmitted in the TTI or not to MAC layer, so that MAC layer could decide whether to skip the grant. Alternatively, the UE transmits the physical control information on the data channel without padding (or without padding MAC control element). More specifically, MAC layer may indicate a configured uplink grant or a dynamic grant available for a TTI and indicate there is no data to be transmitted in the TTI so that physical layer in the UE could decide whether to use the grant to transmit the physical control information or to skip the UL grant and decide how to use the grant to transmit the physical control information.

[0096] There are several examples of how a UE transmits a physical control information on a data channel without padding (or without padding MAC control element). In one example, the UE treats all the physical control information as a regular transport block from MAC layer and perform regular encoding, such as CRC (Cyclic Redundancy Check) attachment, interleaving, channel coding, for the all the physical control information. In another example, the UE would perform a data channel transmission like perform a PUSCH transmission without UL-SCH (Uplink Shared Channel) data. More specifically, the UE treats a first type of physical control information (e.g., CQI and/or PMI) as a regular transport block from MAC layer, and performs regular encoding (such as CRC attachment, interleaving, channel coding) for the first type of physical control information. Furthermore, the UE multiplexes a second type of physical control information (e.g., HARQ-ACK and/or RI) on some resource of the data channel.

[0097] In one embodiment, for the above example(s), the UE would indicate a payload size of the physical control information on the data channel. More specifically, indication of the payload size is carried on some specific resource on the data channel. Alternatively, indication of the payload size is done by masking a CRC of the data channel.

[0098] In one embodiment, for the above example(s), the UE would assume a specific payload size to carry the physical control information on the data channel. In another embodiment, the UE would indicate whether the UE have data available for transmission or not on the data channel. More specifically, indication of whether the UE have data available for transmission or not is carried on some specific resource on the data channel. Alternatively, indication of whether the UE have data available for transmission or not is done by masking a CRC of the data channel. In addition, an eNB would assume both hypotheses that the UE have data available for transmission and the UE does not have data available for transmission to perform decoding.

[0099] In the above example, indicating information by masking a CRC of the data channel may mean that after CRC is generated, different sequence is utilized to mask the CRC. To indicate an one-bit information, two sequences may be required. Note that a sequence with all 1 is a special case and may mean no masking is done. In one embodiment, to mask a CRC may mean to perform exclusive or (XOR) operation or some other operation to the CRC with a

sequence. From a receiver perspective, a reverse operation would be performed with different sequences and only one of them would pass the CRC check, so as to realize the indication according to which sequence could be used to pass the CRC check.

[00100] The physical control information may be CQI. The physical control information may be PMI, RI, and/or HARQ feedback. The UE may not be able to transmit the data channel and the control channel simultaneously (e.g., due to UE capability or power restriction). The data channel may be PUSCH. The control channel may be PUCCH.

[00101] FIG. 23 is a flow chart 2300 according to one exemplary embodiment from the perspective of a UE. In step 2305, the UE receives a signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel. In step 2310, the UE prepares a physical control information transmission in a TTI where the configured uplink grant is available. In step 2315, the UE transmits the physical control information on a control channel in the TTI, wherein the UE has data available for transmission, and wherein the UE is not allowed to perform transmission on the control channel and the data channel simultaneously.

[00102] 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 signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a TTI where the configured uplink grant is available, and (iii) to transmit the physical control information on a control channel in the TTI, wherein the UE has data available for transmission, and wherein the UE is not allowed to perform transmission on the control channel and the data channel simultaneously. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00103] FIG. 24 is a flow chart 2400 according to one exemplary embodiment from the perspective of a UE. In step 2405, the UE receives a signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel. In step 2410, the UE prepares a physical control information transmission in a TTI

where the configured uplink grant is available. In step 2415, if HARQ-ACK repetition is not configured, the UE transmits the physical control information on a control channel in the TTI. In step 2420, if HARQ-ACK repetition is configured, the UE transmits the physical control information on the control channel in the TTI, wherein the UE has data available for transmission and wherein the UE is not allowed to perform transmission on the control channel and the data channel simultaneously.

[00104] 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 signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a TTI where the configured uplink grant is available, (iii) to transmit the physical control information on a control channel in the TTI if HARQ-ACK repetition is not configured, and (iv) to transmit the physical control information on the control channel in the TTI if HARQ-ACK repetition is configured, wherein the UE has data available for transmission and wherein the UE is not allowed to perform transmission on the control channel and the data channel simultaneously. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00105] Referring back to the embodiments illustrated in FIGS. 22 and 23, the UE does not use the configured uplink grant for a transmission on the data channel in one embodiment. The UE does not transmit the available data in one embodiment.

[00106] FIG. 25 is a flow chart 2500 according to one exemplary embodiment from the perspective of a UE. In step 2505, the UE receives a signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel. In step 2510, the UE prepares a physical control information transmission in a TTI where the configured uplink grant is available. In step 2515, the UE uses the configured uplink grant to transmit the physical control information on the data channel, wherein the UE has data available for transmission, and wherein simultaneous transmission on a control channel and the

data channel is allowed but the UE is not able to perform both transmissions on the control channel and the data channel with sufficient power.

[00107] In one embodiment, the UE multiplexes the physical control information with data on the data channel. The UE uses the configured uplink grant to transmit the physical control information on the data channel if no data is available for transmission. The UE does not use the configured uplink grant to transmit padding on the data channel if no physical control information needs to be transmitted in a TTI.

[00108] In one embodiment, the physical control information is CQI and/or HARQ feedback. No network signalling is needed to allocate the configured uplink grant after it is initiated. The configured uplink grant could be initiated by a network signalling or could be pre-allocated. The network signalling could be SPS initiation or re-initiation.

[00109] In one embodiment, the UE could receive the signalling before transmitting a scheduling request. The UE could receive the signalling before transmitting a BSR control element. The UE could receive the signalling when no data is available for transmission.

[00110] In one embodiment, the UE does not transmit a MAC PDU with padding only via the configured uplink grant. The padding could include: (i) padding bit(s), (ii) at least one subheader associated with padding bit(s), (iii) a MAC control element corresponding to a Padding BSR, (iv) a subheader associated with a MAC control element corresponding to a Padding BSR, (v) a MAC control element corresponding to a Padding Sidelink BSR, and/or (vi) a subheader associated with a MAC control element corresponding to a Padding Sidelink BSR.

[00111] In one embodiment, periodicity, where the configured uplink grant is available, is shorter than a specified value, such as 10ms. Alternatively, the periodicity could be 1ms, 2ms or 5ms.

[00112] In one embodiment, the signalling could be transmitted on PDCCH. The signalling could be addressed to Semi-Persistent Scheduling C-RNTI. The signalling could be a RRC message.

[00113] In one embodiment, the uplink grant could be on the data channel or on UL-SCH. The data available for transmission could mean that the data belonging to a logical channel, which could utilize the configured uplink grant, is available for transmission.

[00114] In one embodiment, the UE is not allowed to perform transmission on the control channel and the data channel based on network configuration. The control channel could be PUCCH. The data channel could be PUSCH. The UE not being able to perform both transmissions on the control channel and the data channel with sufficient power could mean that the sum of computed power for the data channel and the computed power for the control channel exceeds the maximum power of the UE.

[00115] 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 signalling to configure an uplink grant, wherein the configured uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a TTI where the configured uplink grant is available, and (iii) to use the configured uplink grant to transmit the physical control information on the data channel, wherein the UE has data available for transmission, and wherein simultaneous transmission on a control channel and the data channel is allowed but the UE is not able to perform both transmissions on the control channel and the data channel with sufficient power. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00116] FIG. 26 is a flow chart 2600 according to one exemplary embodiment from the perspective of a UE. In step 2605, the UE receives a first signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel. In step 2610, the UE prepares a physical control information transmission in a TTI. In step 2615, if the configured first uplink grant is available in the TTI, the UE transmits the physical control information on a control channel in the TTI. In step 2620, if a second signalling is received to indicate a second uplink grant for a specific TTI in the TTI, the UE transmits the physical control information on the data channel in the TTI.

[00117] In one embodiment, the UE does not use the configured first uplink grant for a transmission on the data channel if the physical control information is transmitted on the control channel. The UE is not allowed to perform transmission on the control channel and the data channel simultaneously.

[00118] 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 signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a given TTI, (iii) to transmit the physical control information on a control channel in the TTI if the configured first uplink grant is available in the TTI, and (iv) to transmit the physical control information on the data channel in the TTI if a second signalling is received to indicate a second uplink grant for a specific TTI in the TTI. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00119] FIG. 27 is a flow chart 2700 according to one exemplary embodiment from the perspective of a UE. In step 2705, the UE receives a first signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel. In step 2710, the UE prepares a physical control information transmission in a TTI. In step 2715, the UE uses the configured first uplink grant to transmit the physical control information on the data channel if the configured first uplink grant is available in the TTI. In step 2720, the UE transmits the physical control information on a control channel if a second signalling is received to indicate a second uplink grant for a specific TTI in the TTI, wherein simultaneous transmission on the control channel and the data channel is allowed.

[00120] In one embodiment, the UE multiplexes the physical control information with data on the data channel if the physical control information is transmitted on the data channel. The UE uses the configured first uplink grant to transmit the physical control information on the data channel if no data is available for transmission. The UE does not use the configured first uplink grant to transmit padding on the data channel if no physical control information needs to be transmitted in a TTI. The UE uses the second uplink grant to transmit padding on the data

channel if no physical control information needs to be transmitted in the TTI. The UE uses the second uplink grant to transmit data if data is available for transmission.

[00121] In one embodiment, the physical control information could be CQI and/or HARQ feedback. No network signalling is needed to allocate the configured first uplink grant after it is initiated. The configured first uplink grant could be initiated by a network signalling, or could be pre-allocated. The network signalling could be SPS initiation or re-initiation.

[00122] In one embodiment, the UE could receive the signalling before transmitting a scheduling request. The UE could receive the signalling before transmitting a BSR control element. The UE could receive the signalling when no data is available for transmission.

[00123] In one embodiment, the UE does not transmit a MAC PDU with padding only via the configured first uplink grant. The padding could include: (i) padding bit(s), (ii) at least one subheader associated with padding bit(s), (iii) a MAC control element corresponding to a Padding BSR, (iv) a subheader associated with a MAC control element corresponding to a Padding BSR, (v) a MAC control element corresponding to a Padding Sidelink BSR, (vi) a subheader associated with a MAC control element corresponding to a Padding Sidelink BSR.

[00124] In one embodiment, periodicity, where the configured first uplink grant is available, is shorter than a specified value, such as 10 ms. Alternatively, the periodicity could be 1ms, 2ms or 5ms.

[00125] In one embodiment, the first signalling could be transmitted on PDCCH. The first signalling could be addressed to Semi-Persistent Scheduling C-RNTI. The first signalling could be a RRC message.

[00126] In one embodiment, the second signalling could be transmitted on PDCCH. Furthermore, the second signalling could be addressed to C-RNTI.

[00127] In one embodiment, the first uplink grant and the second uplink grant could be on the data channel or on UL-SCH. Furthermore, the data available for transmission means that the data belonging to a logical channel that can utilize the configured first uplink grant is available for transmission. The UE is not allowed to perform transmission on the control channel and the

data channel based on network configuration. The control channel could be PUCCH. The data channel could be PUSCH.

[00128] 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 signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a given TTI, (iii) to use the configured first uplink grant to transmit the physical control information on the data channel if the configured first uplink grant is available in the TTI, and (iv) to transmit the physical control information on a control channel if a second signalling is received to indicate an uplink grant for a specific TTI in the TTI, wherein simultaneous transmission on the control channel and the data channel is allowed. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00129] FIG. 28 is a flow chart 2800 according to one exemplary embodiment from the perspective of a UE. In step 2805, the UE receives a first signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel. In step 2810, the UE prepares a physical control information transmission in a given TTI. In step 2815, if the configured first uplink grant is available in the TTI, the UE transmits the physical control information on a control channel in the TTI. In step 2820, if a second signalling is received to indicate a second uplink grant for a specific TTI in the TTI, the UE transmits the physical control information on the data channel in the TTI.

[00130] 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 signalling to configure a first uplink grant, wherein the configured first uplink grant is periodically available for UL transmission on a data channel, (ii) to prepare a physical control information transmission in a given TTI, (iii) to transmit the physical control information on a control channel in the TTI if the configured first uplink grant is available in the TTI, and (iv) to transmit the physical control information on the data channel in the TTI if a second signalling is received to indicate a second uplink grant for a

specific TTI in the TTI. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00131] FIG. 29 is a flow chart 2900 according to one exemplary embodiment from the perspective of a UE. In step 2905, an uplink grant is available for a TTI for transmission on a data channel. In step 2910, the UE prepares a physical control information transmission in the TTI. In step 2915, the UE determines which channel to transmit the physical control information according to the available resource of the uplink grant. In one embodiment, determining which channel to transmit the physical control information according to the available resource of the uplink grant (shown in step 2915) means that transmitting the physical control information on a control channel in the TTI if the available resource of the uplink grant is less than a specific value, and transmitting the physical control information on the data channel in the TTI if the available resource of the uplink grant is more than a specific value.

[00132] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE wherein an uplink grant is available for a TTI for transmission on a data channel, 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 prepare a physical control information transmission in the TTI, and (ii) to determine which channel to transmit the physical control information according to the available resource of the uplink grant. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00133] Referring back to the embodiments illustrated in FIG. 28 and FIG. 29, in one embodiment, if the available resource of the uplink grant is less than a specific value, the UE transmits the physical control information on a control channel in the TTI. If the available resource of the uplink grant is more than a specific value, the UE transmits the physical control information on the data channel in the TTI.

[00134] In one embodiment, the available resource could be the TTI length of the uplink grant, or the number of PRB (pairs) of the uplink grant. The uplink grant could be received on a downlink control channel for a specific TTI. The uplink grant could be configured to be periodically available for UL transmission.

[00135] In one embodiment, the specific value could be different for different amount/payload size of physical control information. The specific value could be different for different modulation and coding scheme. The specific value could guarantee that the code rate of the physical control information would be above a threshold.

[00136] In one embodiment, the UE does not use the configured uplink grant for a transmission on the data channel if the physical control information is transmitted on a control channel. The UE is not allowed to perform transmission on the control channel and the data channel simultaneously.

[00137] FIG. 30 is a flow chart 3000 according to one exemplary embodiment from the perspective of a UE. In step 3005, an uplink grant is available for the UE in a TTI, wherein the UE does not have data available for transmission. In step 3010, the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not.

[00138] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, wherein an uplink grant is available for the UE in a TTI and the UE does not have data available for transmission, 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 to determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00139] FIG. 31 is a flow chart 3100 according to one exemplary embodiment from the perspective of a UE. In step 3105, an uplink grant is available for the UE in a TTI, wherein the UE does not have data available for transmission. In step 3110, the UE transmits the physical control information on a data channel according to the uplink grant if a physical control information needs to be transmitted in the TTI. In step 3115, the UE skips the uplink grant if no physical control information needs to be transmitted in the TTI.

[00140] Referring back to FIGS. 3 and 4, in one exemplary embodiment of a UE, wherein an uplink grant is available for the UE in a TTI and the UE does not have data available for transmission, 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 transmit a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI, and (ii) to skip the uplink grant if no physical control information needs to be transmitted in the TTI. Furthermore, the CPU 308 can execute the program code 312 to perform all of the above-described actions and steps or others described herein.

[00141] Referring back to the embodiments shown in FIG. 30 and FIG. 31, in one embodiment, skipping the uplink grant means that the UE does not perform transmission on the data channel. The UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

[00142] In one embodiment, the uplink grant could be a configured uplink grant that is periodically available. The uplink grant could be a dynamic grant specific for the TTI.

[00143] In one embodiment, the UE transmits the physical control information on the data channel without padding (or without padding MAC control element). To perform transmission on the data channel, the UE treats all the physical control information as a regular transport block from MAC layer and perform regular encoding for the all the physical control information. The UE would perform the transmission on the data channel like it would perform PUSCH transmission without UL-SCH data.

[00144] In one embodiment, the UE treat a first type of physical control information (such as CQI and/or PMI) as a regular transport block from MAC layer and perform regular encoding (such as CRC attachment, interleaving, and/or channel coding) for the first type of physical control information. The UE multiplexes a second type of physical control information (such as HARQ-ACK and/or RI) on some resources of the data channel. The UE indicates the payload size of physical control information on the data channel. Indication of the payload size is carried on some specific resources of the data channel. The indication of the payload size is done by masking a CRC of the data channel. The UE indicates whether or not the UE has data available for transmission on the data channel. The indication of whether or not the UE has data available for transmission is carried on some specific resources of the data channel. The indication of

whether or not the UE has data available for transmission is done by masking a CRC of the data channel.

[00145] Based on above solutions or embodiments, physical control information could be transmitted more efficiently.

[00146] 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 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.

[00147] 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.

[00148] 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.

[00149] 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 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.

[00150] 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.

[00151] 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 that 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.

[00152] 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 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.

CLAIMS

1. A method of a UE (User Equipment), comprising:
an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;
the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not.
2. The method of claim 1, wherein the uplink grant is a configured uplink grant that is periodically available.
3. The method of claim 1, wherein the uplink grant is a dynamic grant specific for the TTI.
4. The method of claim 1, wherein skipping the uplink grant means the UE does not perform transmission on a data channel.
5. The method of claim 1, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.
6. A User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission 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:
determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not.

7. The UE of claim 6, wherein the uplink grant is a configured uplink grant that is periodically available.

8. The UE of claim 6, wherein the uplink grant is a dynamic grant specific for the TTI.

9. The UE of claim 6, wherein skipping the uplink grant means the UE does not perform transmission on a data channel.

10. The UE of claim 6, wherein the processor is further configured to execute a program code stored in the memory to:

transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

11. A method of a UE (User Equipment), comprising:
an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;
the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and
the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI.

12. The method of claim 11, wherein the uplink grant is a configured uplink grant that is periodically available.

13. The method of claim 11, wherein the uplink grant is a dynamic grant specific for the TTI.

14. The method of claim 11, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.

15. The method of claim 11, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

16. A User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission 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 physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and

skip the uplink grant if the physical control information does not need to be transmitted in the TTI.

17. The UE of claim 16, wherein the uplink grant is a configured uplink grant that is periodically available.

18. The UE of claim 16, wherein the uplink grant is a dynamic grant specific for the TTI.

19. The UE of claim 16, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.

20. The UE of claim 16, wherein the processor is further configured to execute a program code stored in the memory to:

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transmit the physical control information on the data channel with a transport block
comprise a padding or a padding MAC (Medium Access Control) control element.

ABSTRACT

A method and apparatus are disclosed for improving a transmission using a configured resource in a wireless communication system. In one embodiment, the method includes an uplink grant is available for the UE in a TTI, wherein the UE does not have data available for transmission. The method further includes the UE transmitting a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI. The method also includes the UE skipping the uplink grant if the physical control information does not need to be transmitted in the TTI.

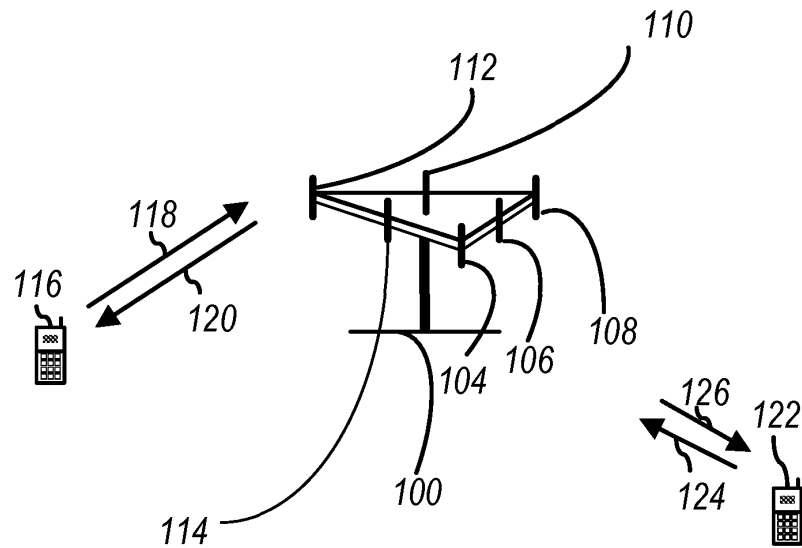


FIG. 1

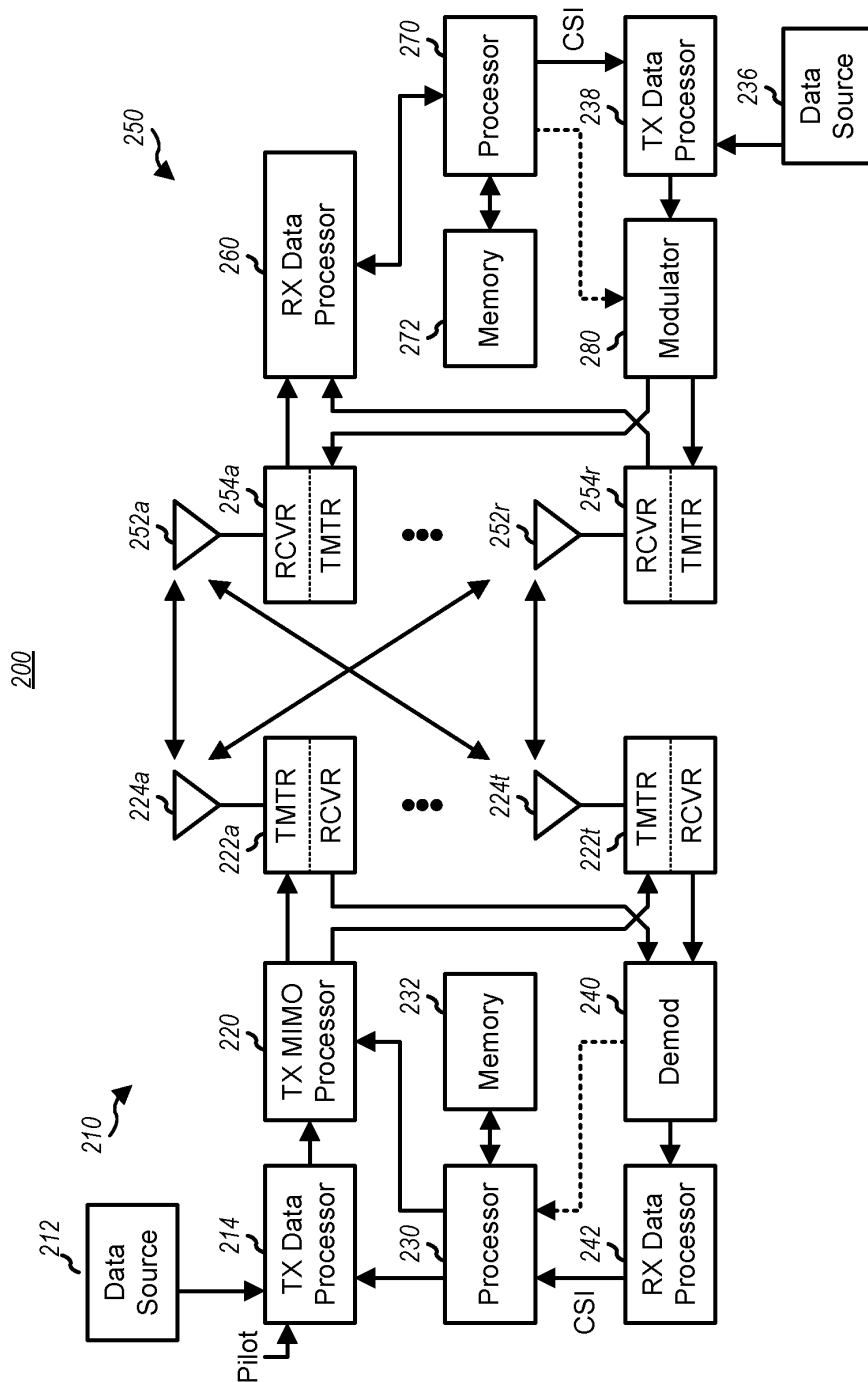
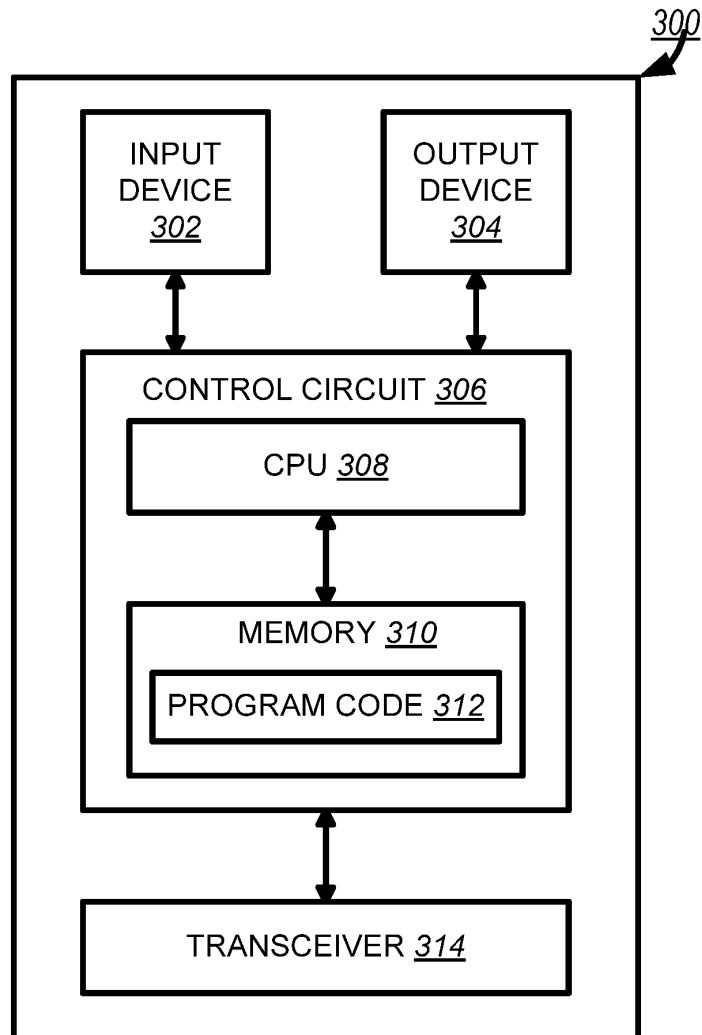
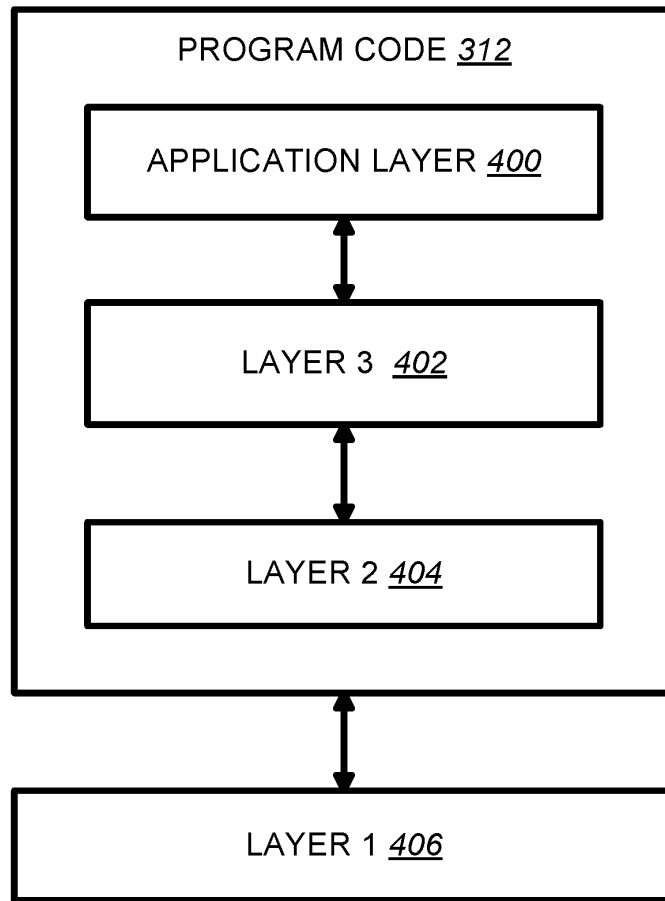


FIG. 2

**FIG. 3**

**FIG. 4**

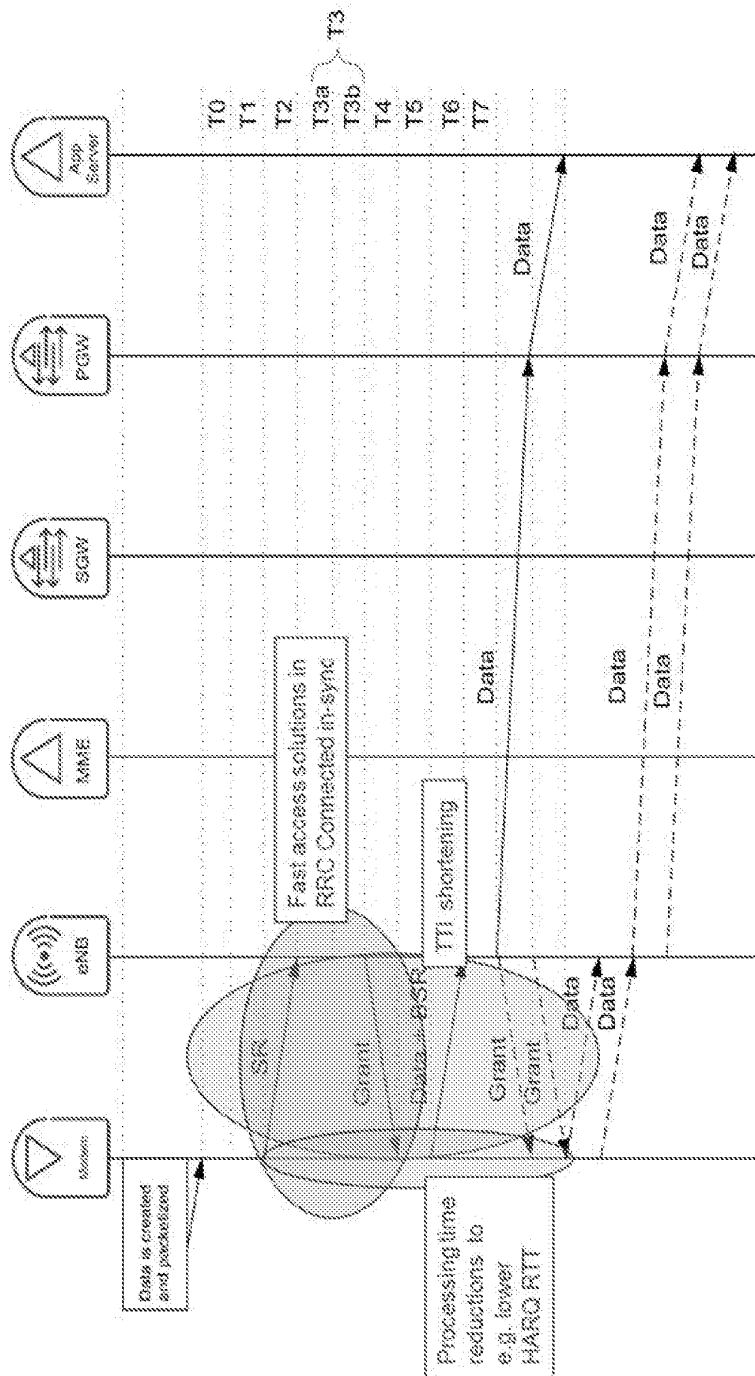


FIG. 5 (PRIOR ART)

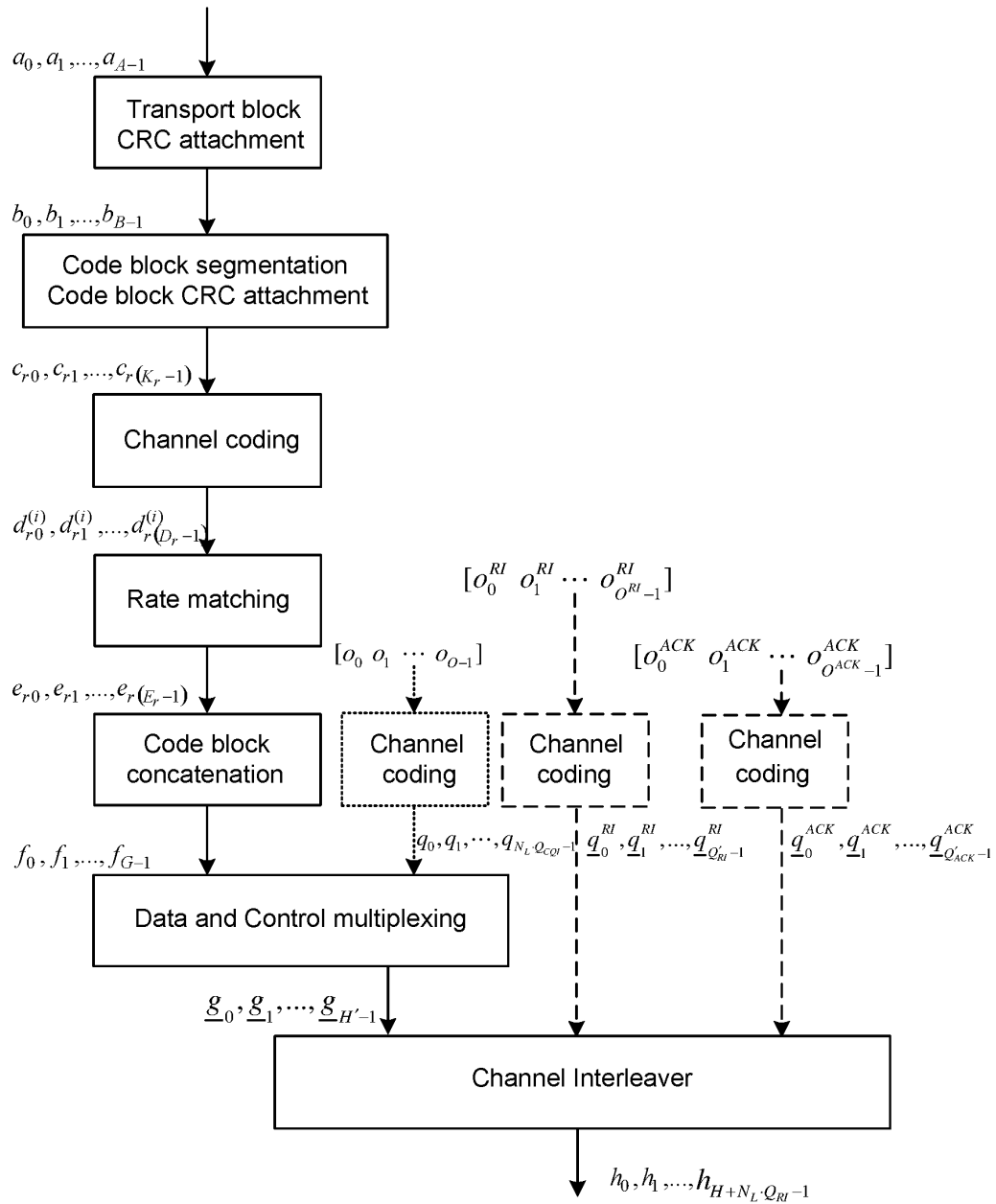


FIG. 6 (PRIOR ART)

Q_m	Encoded HARQ-ACK
2	$[o_0^{ACK} \ y]$
4	$[o_0^{ACK} \ y \ x \ x]$
6	$[o_0^{ACK} \ y \ x \ x \ x \ x]$

FIG. 7 (PRIOR ART)

Q_m	Encoded HARQ-ACK
2	$[o_0^{ACK} \ o_1^{ACK} \ o_2^{ACK} \ o_0^{ACK} \ o_1^{ACK} \ o_2^{ACK}]$
4	$[o_0^{ACK} \ o_1^{ACK} \ x \ x \ o_2^{ACK} \ o_0^{ACK} \ x \ x \ o_1^{ACK} \ o_2^{ACK} \ x \ x]$
6	$[o_0^{ACK} \ o_1^{ACK} \ x \ x \ x \ x \ o_2^{ACK} \ o_0^{ACK} \ x \ x \ x \ x \ o_1^{ACK} \ o_2^{ACK} \ x \ x \ x \ x]$

FIG. 8 (PRIOR ART)

i	$[w_0^{ACK} \ w_1^{ACK} \ w_2^{ACK} \ w_3^{ACK}]$
0	$[1 \ 1 \ 1 \ 1]$
1	$[1 \ 0 \ 1 \ 0]$
2	$[1 \ 1 \ 0 \ 0]$
3	$[1 \ 0 \ 0 \ 1]$

FIG. 9 (PRIOR ART)

Q_m	Encoded RI
2	$[o_0^{RI} \ y]$
4	$[o_0^{RI} \ y \ x \ x]$
6	$[o_0^{RI} \ y \ x \ x \ x \ x]$

FIG. 10 (PRIOR ART)

Q_m	Encoded RI
2	$[o_0^{RI} \ o_1^{RI} \ o_2^{RI} \ o_0^{RI} \ o_1^{RI} \ o_2^{RI}]$
4	$[o_0^{RI} \ o_1^{RI} \ x \ x \ o_2^{RI} \ o_0^{RI} \ x \ x \ o_1^{RI} \ o_2^{RI} \ x \ x]$
6	$[o_0^{RI} \ o_1^{RI} \ x \ x \ x \ x \ o_2^{RI} \ o_0^{RI} \ x \ x \ x \ x \ o_1^{RI} \ o_2^{RI} \ x \ x \ x \ x]$

FIG. 11 (PRIOR ART)

o_0^{RI}	RI
0	1
1	2

FIG. 12 (PRIOR ART)

o_0^{RI}, o_1^{RI}	RI
0, 0	1
0, 1	2
1, 0	3
1, 1	4

FIG. 13 (PRIOR ART)

$o_0^{RI}, o_1^{RI}, o_2^{RI}$	RI
0, 0, 0	1
0, 0, 1	2
0, 1, 0	3
0, 1, 1	4
1, 0, 0	5
1, 0, 1	6
1, 1, 0	7
1, 1, 1	8

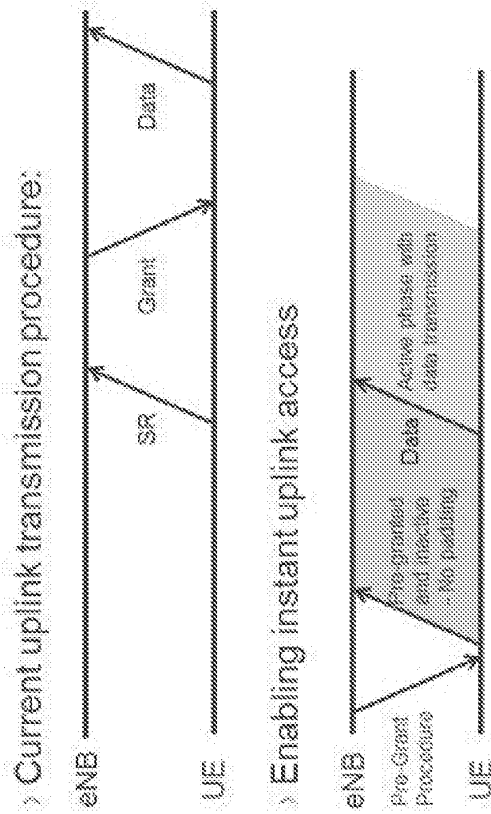
FIG. 14 (PRIOR ART)

CP configuration	Column Set
Normal	{1, 4, 7, 10}
Extended	{0, 3, 5, 8}

FIG. 15 (PRIOR ART)

CP configuration	Column Set
Normal	{2, 3, 8, 9}
Extended	{1, 2, 6, 7}

FIG. 16 (PRIOR ART)



Configured Resource is Available	Scenario 1	Scenario 2
PHY control info needs to be transmitted in a TTI	yes	yes
Data available for Tx	yes	yes
Simultaneous Tx on PUCCH and PUSCH	no	Yes but power is not enough to transmit on both
→ Prior Art	Transmit on PUSCH	Transmit on PUCCH
→ Idea	Transmit on PUCCH	Transmit on PUSCH

FIG. 18

When physical control information needs to be transmitted in a TTI:	Simultaneous transmission on PUCCH and PUSCH is enabled	Simultaneous transmission on PUCCH and PUSCH is disabled
The UE has data	Transmit on PUCCH	Transmit on PUSCH
The UE has no data	Transmit on PUCCH	Transmit on PUCCH

FIG. 19 (PRIOR ART)

When physical control information needs to be transmitted in a TTI :	Simultaneous transmission on PUCCH and PUSCH is enabled	Simultaneous transmission on PUCCH and PUSCH is disabled
The UE has data	Transmit on PUCCH	Transmit on PUCCH
The UE has no data	Transmit on PUCCH	Transmit on PUCCH

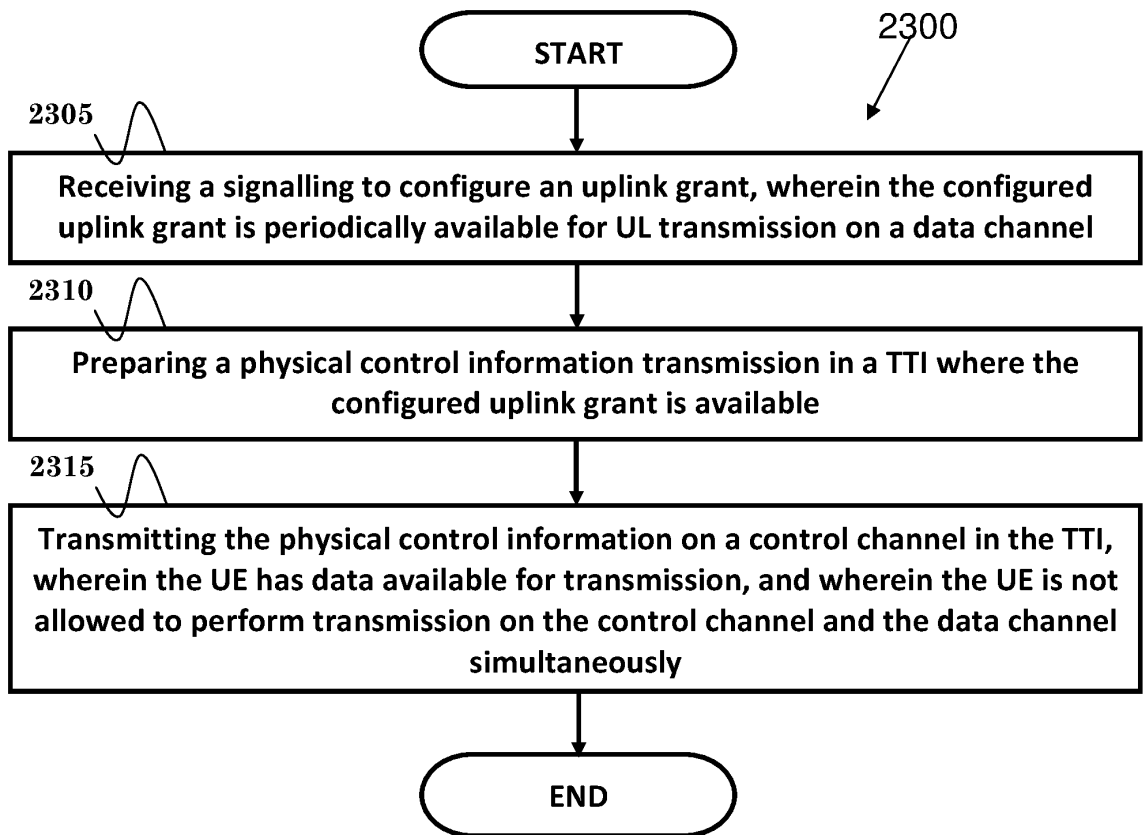
FIG. 20

When physical control information needs to be transmitted in a TTI:	Simultaneous transmission on PUCCH and PUSCH is enabled
The UE has data	Tx power is enough Transmit on PUCCH
The UE has no data	Transmit on PUCCH

FIG. 21 (PRIOR ART)

When physical control information needs to be transmitted in a TTI:	Simultaneous transmission on PUCCH and PUSCH is enabled
The UE has data	Tx power is enough Transmit on PUCCH
The UE has no data	Transmit on PUSCH

FIG. 22

**FIG. 23**

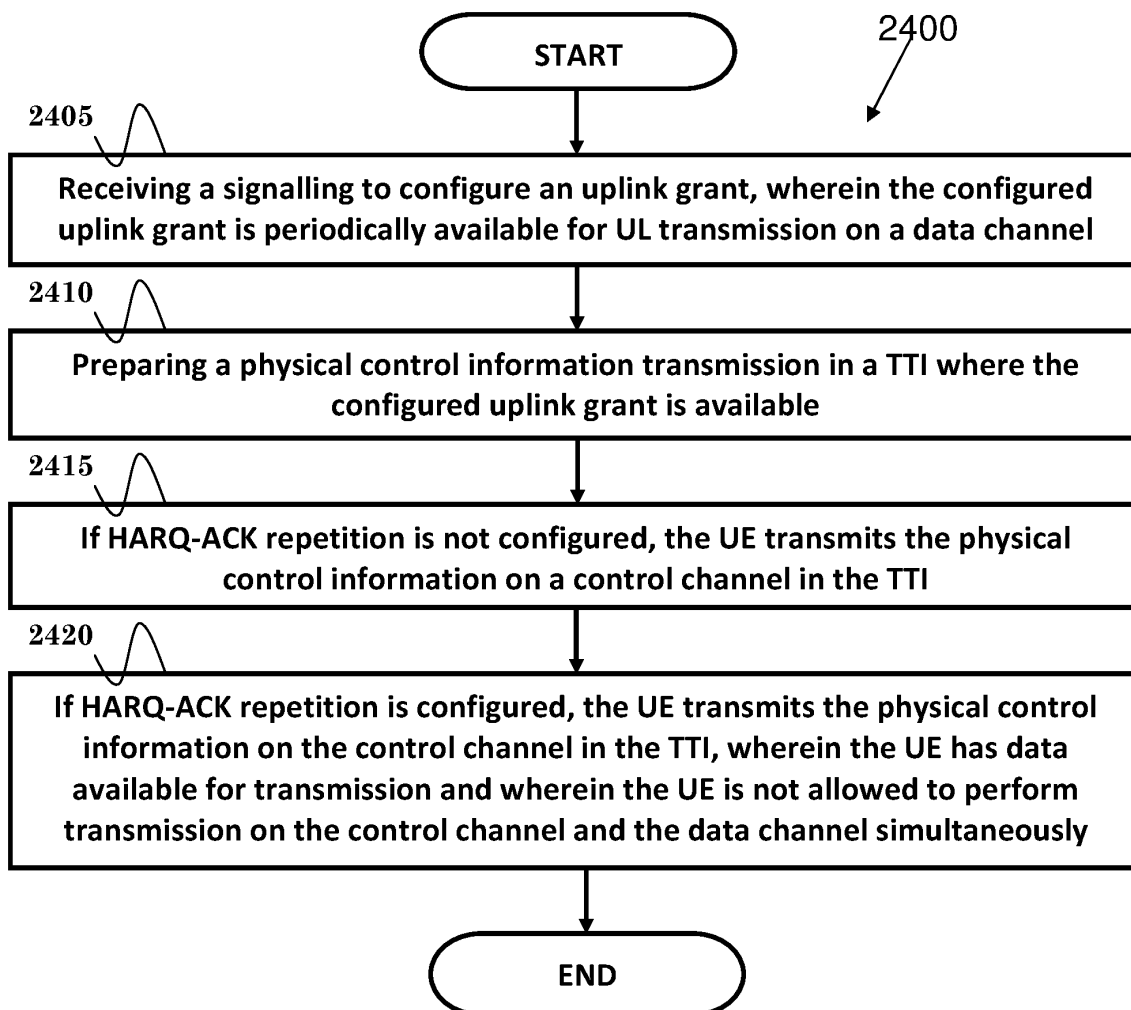


FIG. 24

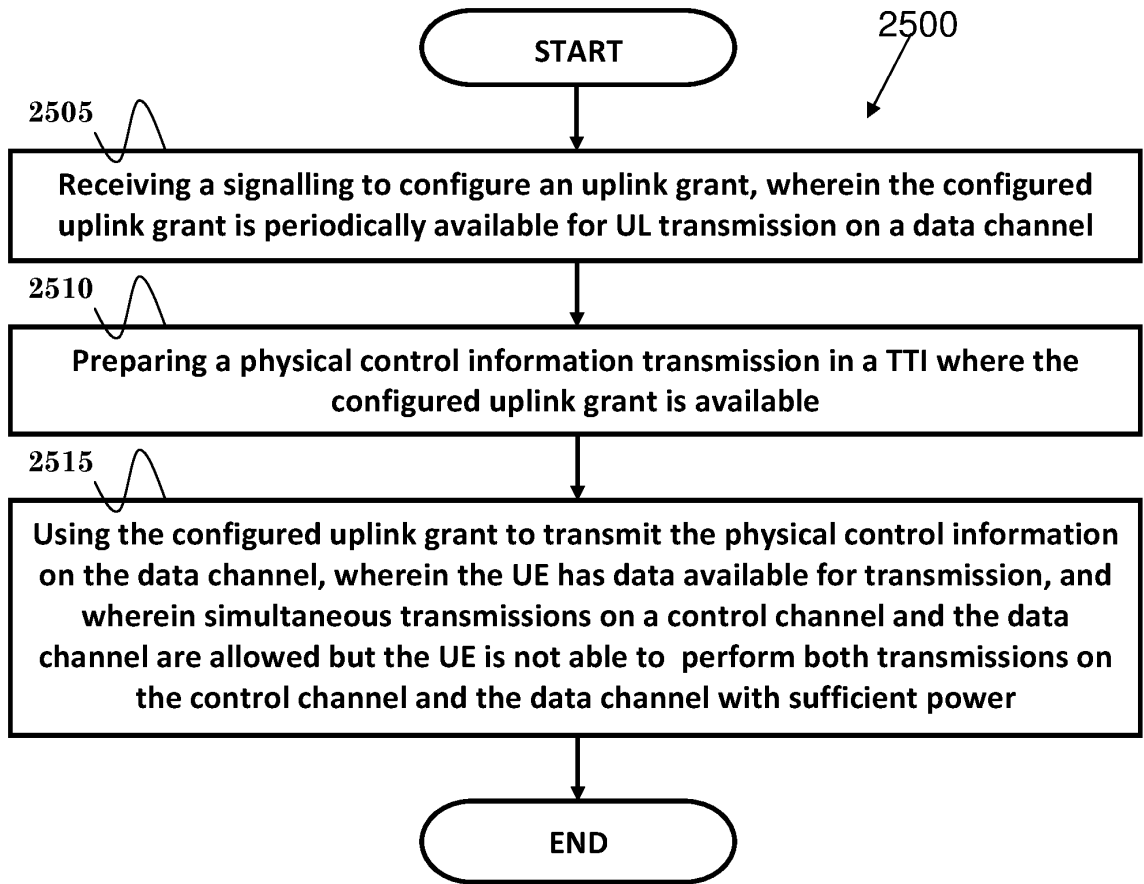


FIG. 25

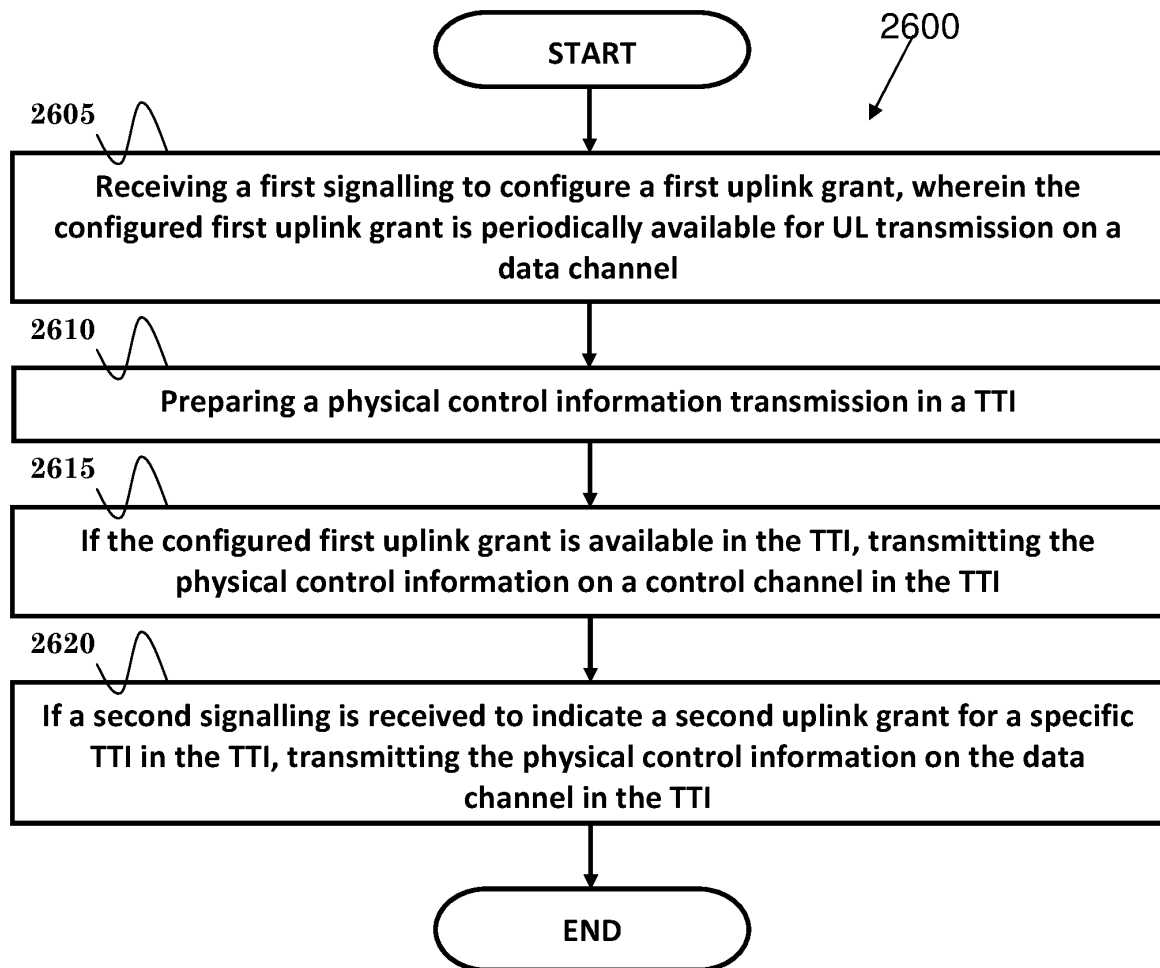


FIG. 26

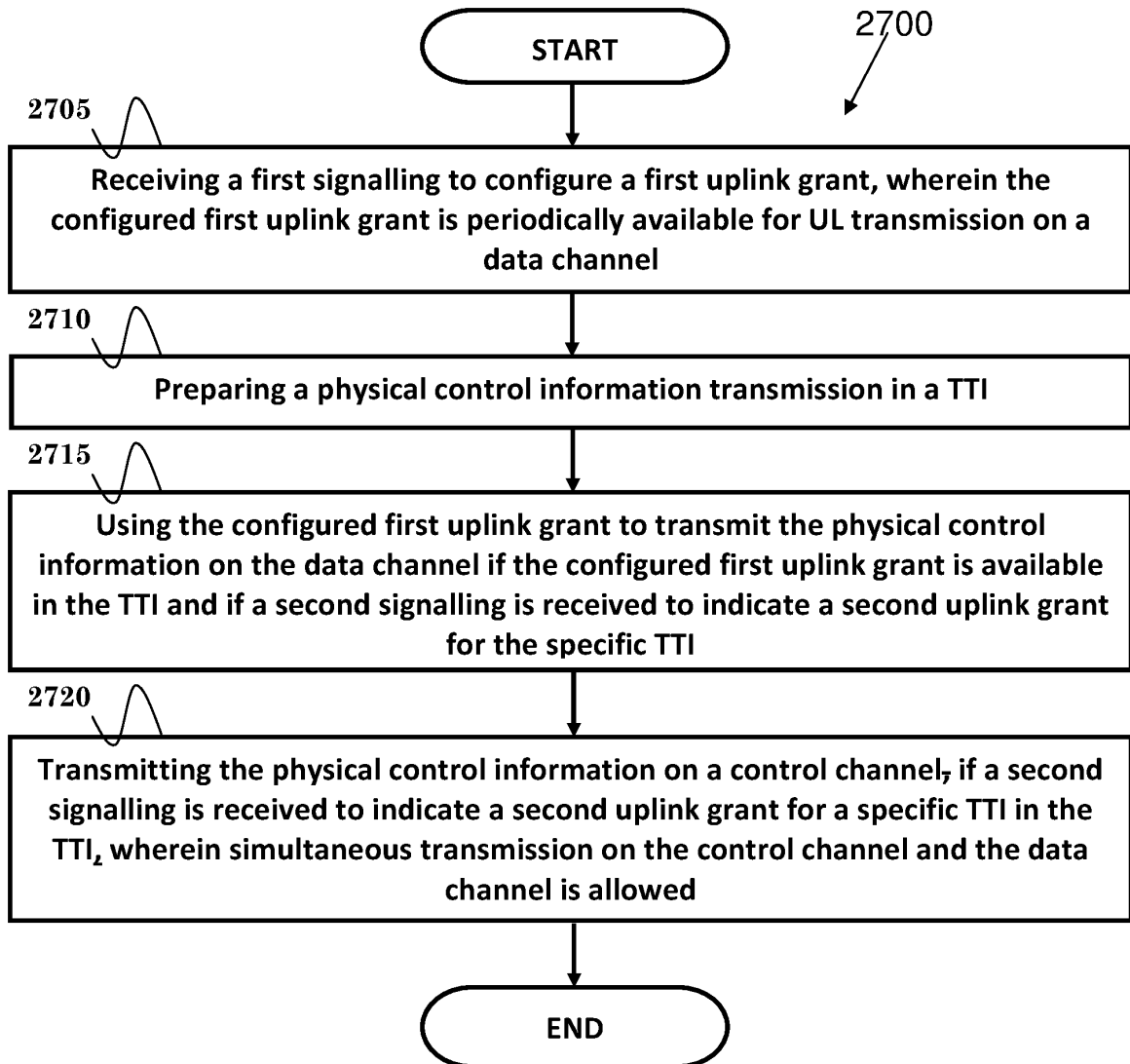


FIG. 27

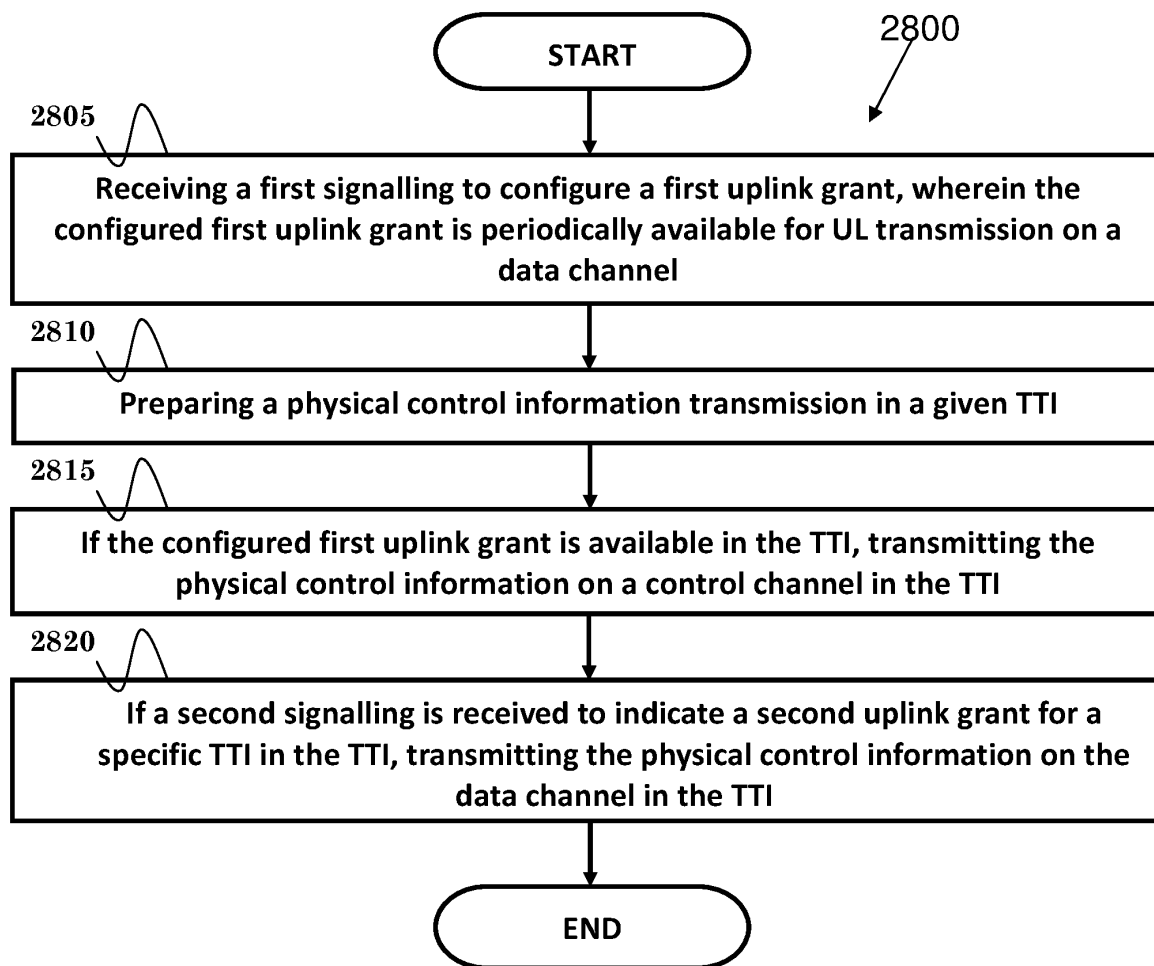
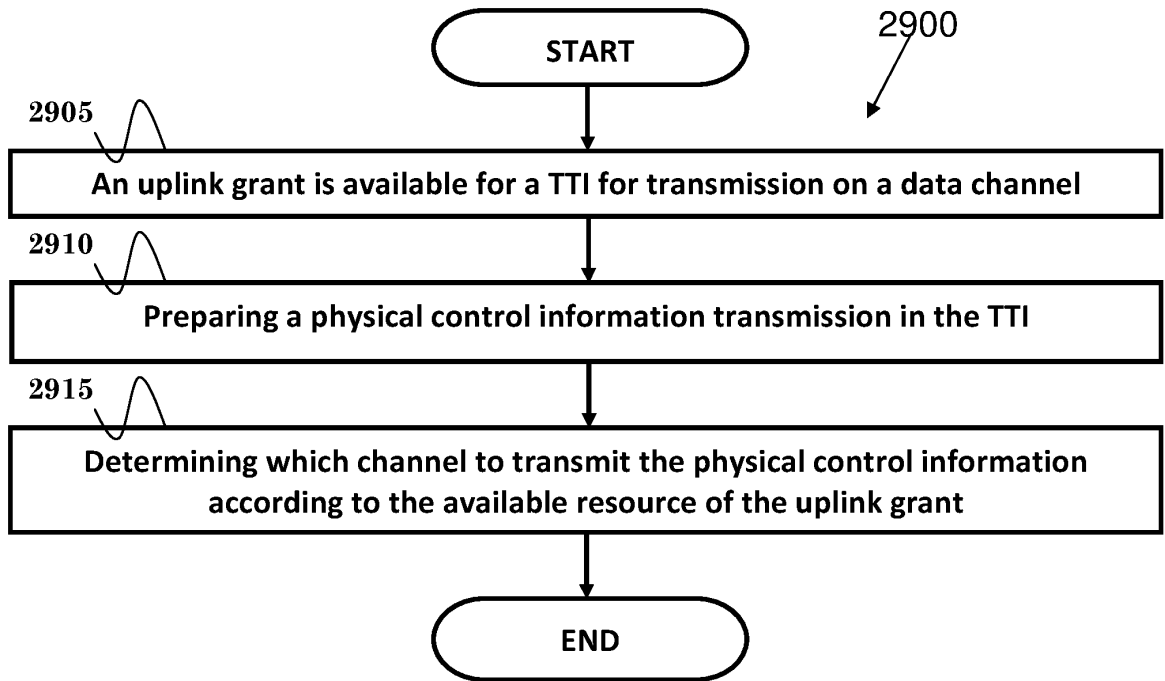
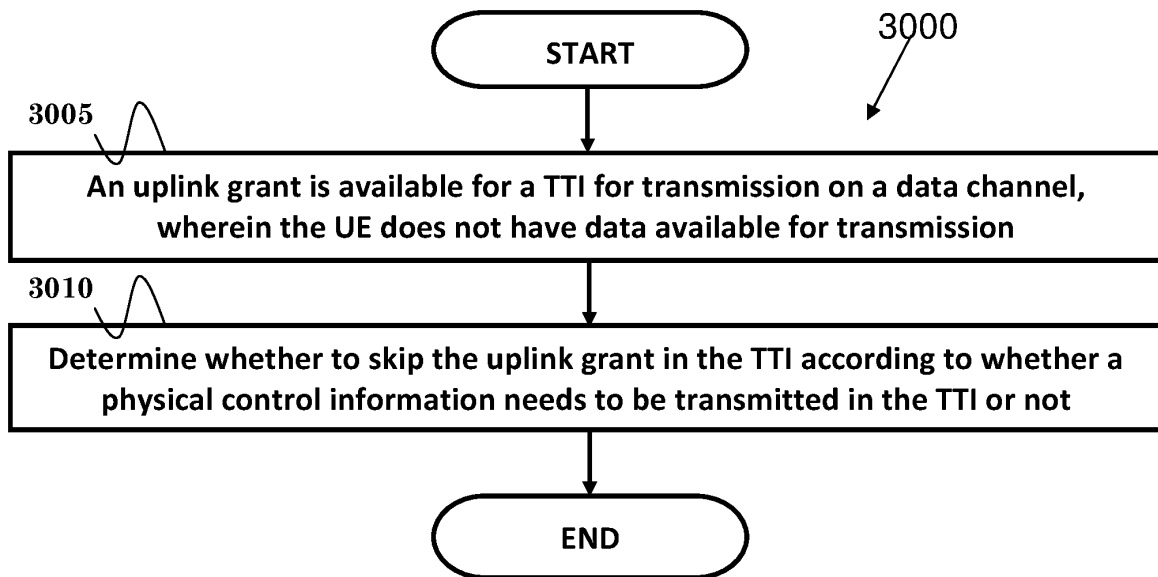
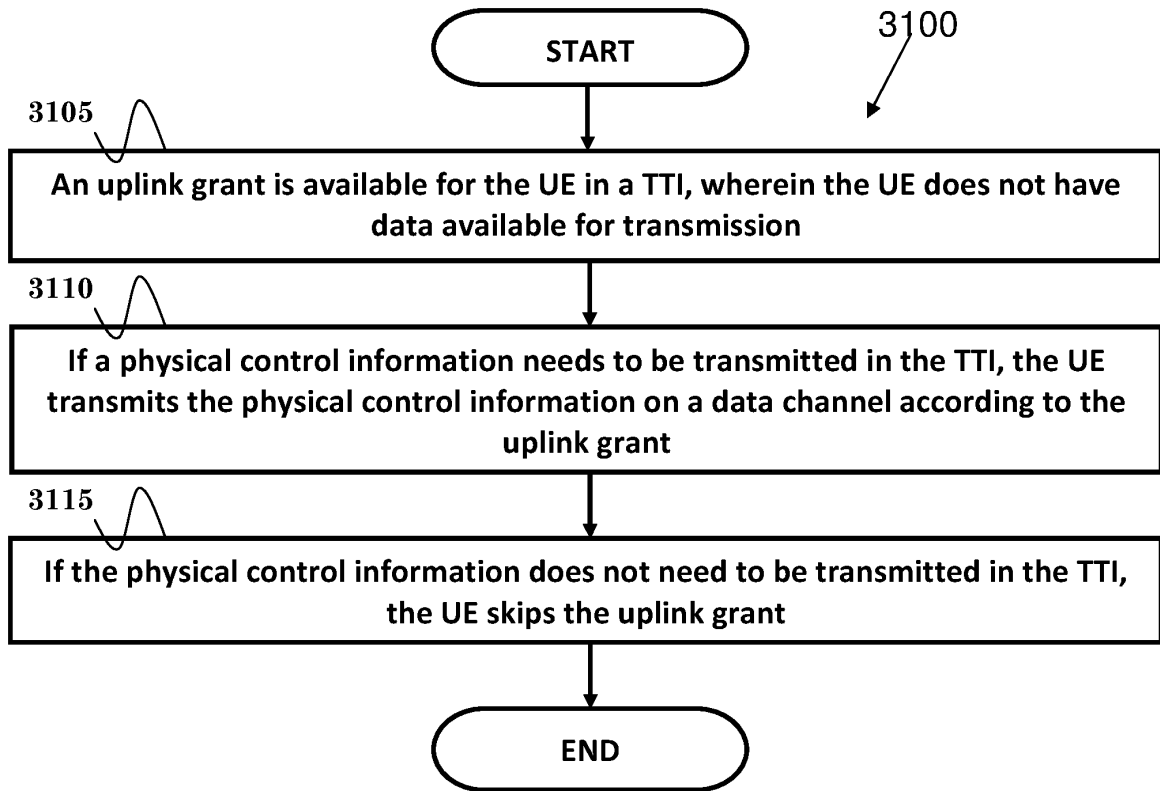


FIG. 28

**FIG. 29**

**FIG. 30**

**FIG. 31**

**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 IMPROVING A TRANSMISSION USING A
CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM**

As the below named inventor, I hereby declare that:

This declaration
is directed to:



The attached application, or



United States application or PCT international application number _____

filed on _____

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

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

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

WARNING:

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

LEGAL NAME OF INVENTOR

Inventor: Lin, Ko-Chiang

Date (Optional): 2017. 3.15.

Signature: Lin, Ko-Chiang

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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**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 IMPROVING A TRANSMISSION USING A
CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM**

As the below named inventor, I hereby declare that:

This declaration
is directed to:



The attached application, or



United States application or PCT international application number _____

filed on _____

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

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

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

WARNING:

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

LEGAL NAME OF INVENTOR

Inventor: Tseng, Li-Chih

Date (Optional): 2017.3.15

Signature: Li-Chih Tseng

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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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 IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to: ☒ The attached application, or
☐ United States application or PCT international application number _____
filed on _____

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

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

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

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LEGAL NAME OF INVENTOR

Inventor: Ou, Meng-Hui Date (Optional): 2017. 7. 15.

Signature: Ou, Meng-Hui

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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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 IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
As the below named inventor, I hereby declare that: This declaration is directed to: ☒ The attached application, or ☐ United States application or PCT international application number _____ filed on _____ The above-identified application was made or authorized to be made by me. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application. I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available. LEGAL NAME OF INVENTOR Inventor: <u>Guo, Yu-Hsuan</u> Date (Optional): <u>2017.3.15</u> Signature: <u>Guo, Yu-Hsuan</u> 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.

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

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	Herewith
First Named Inventor	Ko-Chiang Lin
Title	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
Art Unit	Not Yet Assigned
Examiner Name	Not Yet Assigned
Attorney Docket Number	1426-113.101

SIGNATURE of Applicant or Patent Practitioner

Signature	/Sang N. Dang/	Date (Optional)	March 31, 2017
Name	Sang N. Dang	Registration Number	51,186
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.**

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Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82B (07-13)

Approved for use through 11/30/2014. OMB 0651-0051
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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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

Date (Optional)

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.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ko-Chiang Lin; Li-Chih Tseng; Meng-Hui Ou; Yu-Hsuan Guo
Title: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
Serial No.: TBD Filed: Herewith
Examiner: TBD Group Art Unit: TBD
Attorney Docket No.: 1426-113.101 (1050051-US)

**CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8**

I hereby certify that the enclosed 1 Page Utility Transmittal Sheet; 1 Page Fee
Transmittal; 8 Page Application Data Sheet Web-ADS; 84 Page Specification; 23 Page
Drawings; 4 Page Executed Declaration; and 2 Page Power of Attorney are being transmitted to
the United States Patent and Trademark Office via EFS-Web on March 31, 2017.

Date: March 31, 2017

/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:				
Filing Date:				
Title of Invention:		METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		
First Named Inventor/Applicant Name:		Ko-Chiang Lin		
Filer:		Sang N. Dang/Sandy Kim		
Attorney Docket Number:		1426-113.101		
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	280	280
UTILITY SEARCH FEE	1111	1	600	600
UTILITY EXAMINATION FEE	1311	1	720	720
Pages:				
Claims:				
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	420	420
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				2020

Electronic Acknowledgement Receipt	
EFS ID:	28786644
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	31-MAR-2017
Filing Date:	
Time Stamp:	08:42:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 2020
RAM confirmation Number	033117INTEFSW08434700
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	Application Data Sheet	WebADS.pdf	145530	no	8
			3beeb5a2f5699bac75d0ba3687b479ec8a4e66ae		
Warnings:					
Information:					
2		1426-113-101--Package.pdf	2235649	yes	116
			74ec877e1166e00da5e5115d0c2897ed339cae55		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal of New Application		1	1	
	Fee Worksheet (SB06)		2	2	
	Specification		3	81	
	Claims		82	85	
	Abstract		86	86	
	Drawings-only black and white line drawings		87	109	
	Oath or Declaration filed		110	113	
	Power of Attorney		114	115	
	Miscellaneous Incoming Letter		116	116	
	Warnings:				
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	36552	no	2
			294429c4d1eb18b9f6c4ce7512108da622a5cfa8		

Warnings:	
Information:	
Total Files Size (in bytes):	2417731
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.	

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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
	Ko-Chiang		Lin	
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
	Li-Chih		Tseng	
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 3				
Legal Name				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Meng-Hui		Ou	
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 4**Legal Name**

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yu-Hsuan		Guo	
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

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 Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		

Application Information:

Title of the Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		
Attorney Docket Number	1426-113.101	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	23	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.

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					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		1426-113.101	
		Application Number			
Title of Invention		METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM			
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 this 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 blank.

Prior Application Status		Patented		Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
	Claims benefit of provisiona	62/316799	2016-04-01		
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 ⁱ	Filing Date (YYYY-MM-DD)	Access Code ⁱ (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			

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

This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. ☐ NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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 ¹	TW	Postal Code	
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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.				

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	1426-113.101
		Application Number	
Title of Invention	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		

Signature:

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

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

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

Signature	/Sang N. Dang/			Date (YYYY-MM-DD)	
First Name	Sang N.	Last Name	Dang	Registration Number	51186
Additional Signature may be generated within this form by selecting the Add button.					

SCORE Placeholder Sheet for IFW Content

Application Number: 15475190

Document Date: 03/31/2017

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

- Drawings – Other than Black and White Line Drawings

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

To access the documents in the SCORE database, refer to instructions below.

At the time of document entry (noted above):

- Examiners may access SCORE content via the eDAN interface.
- Other USPTO employees can bookmark the current SCORE URL (<http://Score.uspto.gov/ScoreAccessWeb/>).
- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: September 30, 2013

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/475,190						
APPLICATION AS FILED - PART I												
(Column 1)		(Column 2)		SMALL ENTITY		OR		OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)					
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280					
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	600					
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720					
TOTAL CLAIMS (37 CFR 1.16(i))	20	minus 20 = *				x 80 =	0.00					
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4	minus 3 = *	1			x 420 =	420					
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	2020				
APPLICATION AS AMENDED - PART II												
AMENDMENT A	(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR		OTHER THAN SMALL ENTITY	
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)		
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=		
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=		
	Application Size Fee (37 CFR 1.16(s))											
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
					TOTAL ADD'L FEE			TOTAL ADD'L FEE				
AMENDMENT B	(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR		OTHER THAN SMALL ENTITY	
		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)		
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=		
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=		
	Application Size Fee (37 CFR 1.16(s))											
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
					TOTAL ADD'L FEE			TOTAL ADD'L FEE				
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.												



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/475,190	03/31/2017	2414	2020	1426-113.101	20	4

CONFIRMATION NO. 8621

FILING RECEIPT



CC000000090497592

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

Date Mailed: 04/11/2017

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)

Ko-Chiang Lin, Taipei City, TAIWAN;
Li-Chih Tseng, Taipei City, TAIWAN;
Meng-Hui Ou, Taipei City, TAIWAN;
Yu-Hsuan Guo, Taipei City, TAIWAN;

Applicant(s)

ASUSTeK Computer Inc., Taipei City 112, TAIWAN;

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

Domestic Priority data as claimed by applicant

This appln claims benefit of 62/316,799 04/01/2016

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 04/07/2017

page 1 of 3

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/475,190**

Projected Publication Date: 10/05/2017

Non-Publication Request: No

Early Publication Request: No
Title

METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED
RESOURCE IN A WIRELESS COMMUNICATION SYSTEM

Preliminary Class

370

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

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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

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

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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

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

NOT GRANTED

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Ko-Chiang Lin		
	Art Unit	2464		
	Examiner Name	Ricky Quoc Ngo		
	Attorney Docket Number	1426-113.101		

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	20110205991		2011-08-25	Samsung Electronics Co., Ltd.	

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 ²ⁱ	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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Ko-Chiang Lin	
	Art Unit	2464	
	Examiner Name	Ricky Quoc Ngo	
	Attorney Docket Number	1426-113.101	

1	3GPP TSG-Ran WG2, Meeting #91, Beijing, China, August 24-28, 2015 (R2-153294).	☐
2	European Search Report from corresponding EP Application No. 17164114.5, dated August 25, 2017.	☐

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.

Electronic Acknowledgement Receipt	
EFS ID:	30310300
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	08-SEP-2017
Filing Date:	31-MAR-2017
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1	Information Disclosure Statement (IDS) Form (SB08)	1426-113-101-- IDSasFiled09082017.pdf	54241 aca2b54de94a2d7e117cd9474910a2b3296b23fe	no	2
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PUBLICATION NOTICE



Title:METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM

Publication No.US-2017-0289995-A1

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Lin, Ko-Chiang		
	Art Unit	2464		
	Examiner Name	Ricky Quoc Ngo		
	Attorney Docket Number	1426-113.101		

U.S.PATENTS						
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	1	20150282148		2015-10-01	LE, Kheim	
	2	20150163791		2015-06-11	CHEN, Wei-Yu	
	3	20100142467		2010-06-10	TIIROLA et al.	

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	1	201531135	TW		2015-08-01	Innovative Sonic Corp.		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
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	First Named Inventor	Lin, Ko-Chiang	
	Art Unit	2464	
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	1	Office Action from TIPO in corresponding TW Patent Application No. 106111274, dated December 14, 2017.	☐
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申請實體審查：有 申請專利範圍項數：20 項 圖式數：5 共 37 頁

(54)名稱

在一無線通訊系統中改善裝置間通訊的方法及裝置

METHOD AND APPARATUS FOR IMPROVING DEVICE TO DEVICE (D2D) COMMUNICATION
IN A WIRELESS COMMUNICATION SYSTEM

(57)摘要

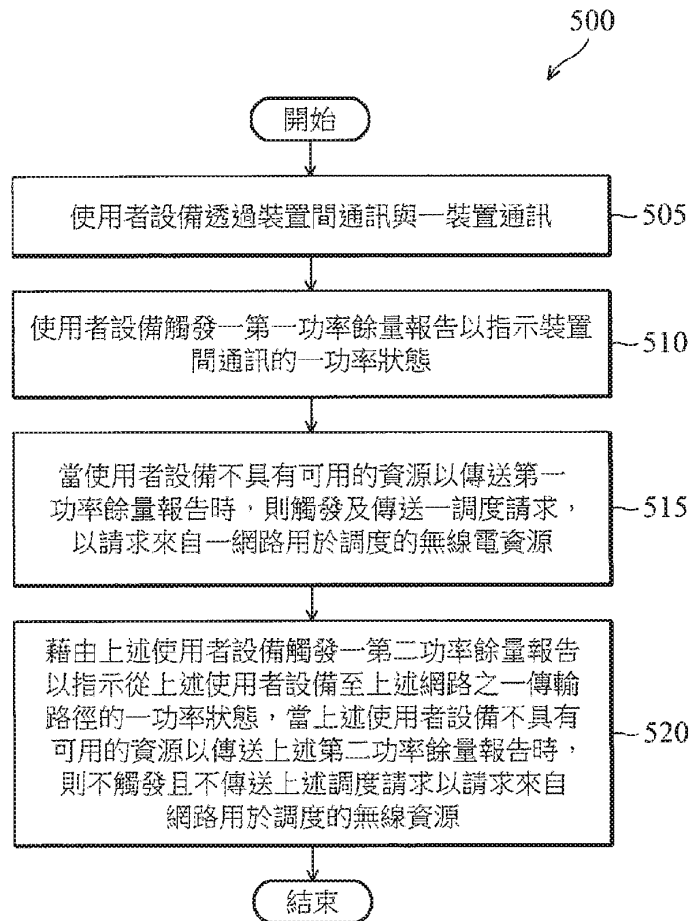
改善裝置間通訊方法及裝置揭露於本文中。方法包括藉由一使用者設備透過裝置間通訊與一裝置通訊。方法還包括藉由使用者設備觸發第一功率餘量報告以指示裝置間通訊的功率狀態。方法更提供當使用者設備不具有可用的資源以傳送上述第一功率餘量報告，則藉由使用者設備觸發及傳送調度請求，以請求來自網路用於調度的無線電資源。方法包括當使用者設備觸發第二功率餘量報告以指示從使用者設備至網路之傳輸路徑的功率狀態，當上述使用者設備不具有可用的資源以傳送第二功率餘量報告時，不觸發且不傳送調度請求以請求來自網路用於調度的無線資源。

Methods and apparatuses for improving device to device (D2D) communication are disclosed herein. One method includes communicating, by a user equipment (UE), with a device via the D2D communication. The method further includes triggering, by the UE, a first power headroom report (PHR) to indicate a power status of the D2D. The method also provides for triggering and transmitting, by the UE, a Scheduling Request (SR) to ask for radio resources from a network for scheduling if the UE has no available resources to transmit the first PHR. The method further includes triggering, by the UE, a second PHR to indicate a power status of a transmission path from the UE to the network and not triggering and transmitting the SR to ask for radio resources from the network for scheduling if the UE has no available resource to transmit the second PHR.

500 . . . 流程圖

505、510、515、

520 . . . 步驟



第 5 圖

201531135**發明摘要**

※ 申請案號：103143212

※ 申請日：103. 12. 11

※IPC 分類：H04W 72/08 (2009.01)

【發明名稱】 在一無線通訊系統中改善裝置間通訊的方法及裝置METHOD AND APPARATUS FOR IMPROVING
DEVICE TO DEVICE (D2D) COMMUNICATION
IN A WIRELESS COMMUNICATION SYSTEM**【中文】**

改善裝置間通訊方法及裝置揭露於本文中。方法包括藉由一使用者設備透過裝置間通訊與一裝置通訊。方法還包括藉由使用者設備觸發第一功率餘量報告以指示裝置間通訊的功率狀態。方法更提供當使用者設備不具有可用的資源以傳送上述第一功率餘量報告，則藉由使用者設備觸發及傳送調度請求，以請求來自網路用於調度的無線電資源。方法包括當使用者設備觸發第二功率餘量報告以指示從使用者設備至網路之傳輸路徑的功率狀態，當上述使用者設備不具有可用的資源以傳送第二功率餘量報告時，不觸發且不傳送調度請求以請求來自網路用於調度的無線資源。

【英文】

Methods and apparatuses for improving device to device (D2D) communication are disclosed herein. One method includes communicating, by a user equipment (UE), with a device via the D2D communication. The method further

includes triggering, by the UE, a first power headroom report (PHR) to indicate a power status of the D2D. The method also provides for triggering and transmitting, by the UE, a Scheduling Request (SR) to ask for radio resources from a network for scheduling if the UE has no available resources to transmit the first PHR. The method further includes triggering, by the UE, a second PHR to indicate a power status of a transmission path from the UE to the network and not triggering and transmitting the SR to ask for radio resources from the network for scheduling if the UE has no available resource to transmit the second PHR.

【代表圖】

【本案指定代表圖】：第(5)圖。

【本代表圖之符號簡單說明】：

500 流程圖；

505、510、515、520 步驟。

【本案若有化學式時，請揭示最能顯示發明特徵的化學式】：

無。

發明專利說明書

【發明名稱】 在一無線通訊系統中改善裝置間通訊的方法及裝置
METHOD AND APPARATUS FOR IMPROVING
DEVICE TO DEVICE (D2D) COMMUNICATION
IN A WIRELESS COMMUNICATION SYSTEM

【技術領域】

【0001】 本發明係有關於無線通訊網路，且特別係有關於在一無線通訊系統中改善裝置間 (Device-to-Device Communications, D2D)通訊的方法及裝置。

【先前技術】

【0002】 隨著在行動通訊裝置上傳輸大量數據的需求迅速增加，傳統行動語音通訊網路進化為藉由網際網路協定 (Internet Protocol, IP)數據封包在網路上傳輸。藉由傳輸網際網路協定(IP)數據封包，可提供行動通訊裝置之使用者IP電話、多媒體、多重廣播以及隨選通訊的服務。

【0003】 進化通用移動通訊系統陸面無線電存取網路 (Evolved Universal Terrestrial Radio Access Network, E-UTRAN)為一種目前正在標準化之網路架構。進化通用移動通訊系統陸面無線電存取網路(E-UTRAN)系統可以提供高速傳輸以實現上述IP電話、多媒體之服務。進化通用移動通訊系統陸面無線電存取網路(E-UTRAN)系統之規格係為第三代通信系統標準組織(3rd Generation Partnership Project, 3GPP)規格組織所制定。為了進化和完善第三代通信系統標準組織(3GPP)之規格，許多在目前第三代通信系統標準組織(3GPP)

規格及骨幹上的改變持續地被提出及考慮。

【發明內容】

【0004】 改善裝置間通訊方法及裝置揭露於本文中。一方法包括藉由一使用者設備透過上述裝置間通訊與一裝置通訊。上述方法還包括藉由上述使用者設備觸發一第一功率餘量報告以指示上述裝置間通訊的一功率狀態。上述方法更提供當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告，則藉由上述使用者設備觸發及傳送一調度請求，以請求來自一網路用於調度的無線電資源。上述方法更包括藉由上述使用者設備觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之傳輸路徑的功率狀態，若是使用者設備不具有可用的資源以傳送上述第二功率餘量報告，則不觸發且不傳送上述調度請求以請求來自網路用於調度的無線資源。

【圖式簡單說明】

【0005】

第1圖係顯示根據本發明一實施例之無線通訊系統之示意圖。

第2圖係顯示根據本發明一實施例之一發送器系統(可視為存取網路)及一接收器系統(可視為存取終端或使用者設備)之方塊圖。

第3圖係以另一方式表示根據本發明一實施例所述之通訊設備之簡化功能方塊圖。

第4圖係根據此發明一實施例中表示第3圖中執行程式碼之簡化功能方塊圖。

第5圖係根據本發明一實施例之流程圖。

【實施方式】

【0006】 本發明在以下所揭露之無線通訊系統、裝置和相關的方法係使用支援一寬頻服務的無線通訊系統中。無線通訊系統廣泛的用以提供在不同類型的傳輸上，像是語音、數據等。這些無線通訊系統根據分碼多重存取(Code Division Multiple Access, CDMA)、分時多重存取(Time Division Multiple Access, TDMA)、正交分頻多重存取(Orthogonal Frequency Division Multiple Access, OFDMA)、3GPP長期演進技術(Long Term Evolution, LTE)無線電存取、3GPP長期演進進階技術(Long Term Evolution Advanced, LTE-A)、3GPP2超行動寬頻(Ultra Mobile Broadband, UMB)、全球互通微波存取(WiMax)或其它調變技術來設計。

【0007】 特別地，以下敘述之範例之無線通訊系統可用以支援一或多種標準，例如由第三代通信系統標準組織(3rd Generation Partnership Project, 3GPP)所制定之標準，在本文中稱為3GPP，其中包括了文件號碼SP-110638“鄰近服務研究提案的工作項目說明”(“WID on Proposal for a study on Proximity-based Services”)；3GPP TS 22.803 v12.2.0“用於鄰近服務的可行性研究”(“Feasibility Study for Proximity Services (ProSe)”)；R2-133486“用於裝置間廣播通訊的存取方案”(“Access schemes for D2D broadcast communications”)；以及TS 36.321 v11.2.0“演進通用陸地無線存取媒體存取控制協定規範”(“E-UTRA MAC protocol

specification”)。上述所列出之標準及文件在此引用並構成本說明書之一部分。

【0008】 第1圖係顯示根據本發明之實施例所述之多重存取無線通訊系統之方塊圖。存取網路(Access Network, AN)100包括複數天線群組，一群組包括天線104和106、一群組包括天線108和110，另一群組包括天線112和114。在第1圖中，每一群天線群組暫以兩個天線圖型為代表，實際上每一群天線群組之天線數量可多可少。存取終端(Access Terminal, AT)116與天線112和114進行通訊，其中天線112和114透過前向鏈路(forward link)120發送資訊給存取終端116，以及透過反向鏈路(reverse link)118接收由存取終端116傳出之資訊。存取終端122與天線106和108進行通訊，其中天線106和108透過前向鏈路126發送資訊至存取終端122，且透過反向鏈路124接收由存取終端122傳出之資訊。在一分頻雙工(Frequency Division Duplexing, FDD)系統，反向鏈路118、124及前向鏈路120、126可使用不同頻率通信。舉例說明，前向鏈路120可用與反向鏈路118不同之頻率。

【0009】 每一群天線群組及 / 或它們設計涵蓋的區塊通常被稱為存取網路的區塊(sector)。在此一實施例中，每一群天線群組係設計為與存取網路100之區塊所涵蓋區域內之存取終端進行通訊。

【0010】 當使用前向鏈路120及126進行通訊時，存取網路100中的傳輸天線可能利用波束形成(beamforming)以分別改善存取終端116及122的前向鏈路信噪比。而且相較於使用單個天

線與涵蓋範圍中所有存取終端進行傳輸之存取網路來說，利用波束形成技術與在其涵蓋範圍中分散之存取終端進行傳輸之存取網路可降低對位於鄰近細胞中之存取終端的干擾。

【0011】 存取網路(Access Network, AN)可以用來與終端設備進行通訊的固定機站或基地台，也可稱作接入點、B節點(Node B)、基地台、進化基地台、進化B節點(eNode B)、或其他專業術語。存取終端(Access Terminal, AT)也可稱作係使用者設備(User Equipment, UE)、無線通訊裝置、終端、存取終端、或其他專業術語。

【0012】 第2圖係顯示一發送器系統210(可視為存取網路)及一接收器系統250(可視為存取終端或使用者設備)應用在多重輸入多重輸出(Multiple-input Multiple-output, MIMO)系統200中之方塊圖。在發送器系統210中，數據源212提供所產生之數據流中的流量數據至發送(TX)數據處理器214。

【0013】 在一實施例中，每一數據流係經由個別之發送天線發送。發送數據處理器214使用特別為此數據流挑選之編碼法將流量數據格式化、編碼、交錯處理並提供編碼後的數據數據。

【0014】 每一編碼後之數據流可利用正交分頻多工技術(Orthogonal frequency-division multiplexing, OFDM)調變來和引導數據(pilot data)作多工處理。一般來說，引導數據係一串利用一些方法做過處理之已知數據模型，引導數據也可用作在接收端估算頻道回應。每一多工處理後之引導數據及編碼後的數據接下來可用選用的調變方法(二元相位偏移調變BPSK、正

交相位偏移調變QPSK、多級相位偏移調變M-PSK、多級正交振幅調變M-QAM)作調變(亦即符元對應, symbol mapped)。每一數據流之數據傳輸率、編碼、及調變係由處理器230所指示。

【0015】 所有數據流產生之調變符號接下來被送到發送多重輸入多重輸出處理器220, 以繼續處理調變符號(例如, 使用正交分頻多工技術(OFDM))。發送多重輸入多重輸出處理器220接下來提供 N_T 調變符號流至 N_T 發送器(TMTR)222a至222t。在某些狀況下, 發射多重輸入多重輸出處理器220會提供波束形成之比重給數據流之符號以及發送符號之天線。

【0016】 每一發送器222a至222t接收並處理各自之符號流及提供一至多個類比訊號, 並調節(放大、過濾、下調)這些類比訊號, 以提供適合以多重輸入多重輸出頻道所發送的調變訊號。接下來, 由發送器222a至222t送出之 N_T 調變後訊號各自傳送至 N_T 天線224a至224t。

【0017】 在接收器系統250端, 傳送過來之調變後訊號在 N_R 天線252a至252r接收後, 每個訊號被傳送到各自的接收器(respective receiver, RCVR) 254a至254r。每一接收器254a至254r將調節(放大、過濾、下調)各自接收之訊號, 將調節後之訊號數位化以提供樣本, 接下來處理樣本以提供相對應之「接收端」符號流。

【0018】 N_R 接收符號流由接收器254a至254r傳送至接收數據處理器260, 接收數據處理器260將由接收器254a至254r傳送之 N_R 接收符號流用特定之接收處理技術處理, 並且提供 N_T 「測得」符號流。接收數據處理器260接下來對每一測得符號流作

解調、去交錯、及解碼之動作以還原數據流中之流量數據。在接收數據處理器260所執行的動作與在發送器系統210內之發送多重輸入多重輸出處理器220及發送數據處理器214所執行的動作互補。

【0019】 處理器270週期性地決定欲使用之預編碼矩陣(於下文討論)。處理器270制定一由矩陣索引(matrix index)及秩值(rank value)所組成之反向鏈路訊息。

【0020】 此反向鏈路訊息可包括各種通訊鏈路及 / 或接收數據流之相關資訊。反向鏈路訊息接下來被送至發射數據處理器238，由數據源236傳送之數據流也被送至此匯集並送往調變器280進行調變，經由接收器254a至254r調節後，再送回發送器系統210。

【0021】 在發送器系統210端，源自接收器系統250之調變後訊號被天線224接收，在收發器222a至222t被調節，在解調器240作解調，再送往接收數據處理器242以提取由接收器系統250端所送出之反向鏈路訊息244。處理器230接下來即可決定欲使用決定波束形成之比重之預編碼矩陣，並處理提取出之訊息。

【0022】 接下來，參閱第3圖，第3圖係以另一方式表示根據本發明一實施例所述之通訊設備之簡化功能方塊圖。在第3圖中，通訊裝置300可用以具體化第1圖中之使用者設備(UE)(或存取終端(AT))116及122，並且此通訊系統以一長期演進技術(LTE)系統，一長期演進進階技術(LTE-A)，或其它與上述兩者近似之系統為佳。通訊裝置300可包括一輸入裝置302、

一輸出裝置304、一控制電路306、一中央處理器(Central Processing Unit, CPU)308、一記憶體310、一程式碼312、一收發器314。控制電路306在記憶體310中透過中央處理器308執行程式碼312，並以此控制在通訊裝置300中所進行之作業。通訊裝置300可利用輸入裝置302(例如鍵盤或數字鍵)接收使用者輸入訊號；也可由輸出裝置304(例如螢幕或喇叭)輸出圖像及聲音。收發器314在此用作接收及發送無線訊號，將接收之訊號送往控制電路306，以及以無線方式輸出控制電路306所產生之訊號。

【0023】 第4圖係根據本發明一實施例中表示第3圖中執行程式碼312之簡化功能方塊圖。此實施例中，執行程式碼312包括一應用層400、一第三層402、一第二層404、並且與第一層406耦接。第三層402一般執行無線電資源控制。第二層404一般執行鏈路控制。第一層406一般負責實體連接。

【0024】 對於LTE或LTE-A系統，第2層部分可包括一無線電連結控制(Radio Link Control, RLC)層及一媒體存取控制(Medium Access Control, MAC)層。第3層部分可以包括一無線電資源控制(Radio Resource Control, RRC)層。

【0025】 3GPP SP-110638提出鄰近服務(proximity-based services, ProSe)的一新研究項目，稱為裝置至裝置(device-to-device, D2D)。如在3GPP SP-110638中所討論，此研究項目的合理性和目標如下：

3. 合理性

鄰近應用和服務代表最近且巨大的社會技術趨勢。這些應用的原理係爲了發現運行在彼此鄰近區域中之裝置中應用程式的例子，且最終達到交換與應用相關的數據。與此同時，鄰近探索及通訊的應用在公共安全團體中得到關注。

目前的3GPP規範僅部分適用於這樣的需求，因爲所有這些傳輸和訊號將必須被路由至網路中，從而影響它們的性能並在網路中增加不必要的負荷。這些目前的限制也阻礙了創造更先進基於鄰近資訊的應用程式。

在此內容中，3GPP技術，有機會成爲使用鄰近探索及裝置間通訊的選擇平台，並促進廣大的未來和更先進的鄰近應用程式。

4. 目標

主要目標是爲了研究各種使用情況，並找出由在鄰近區域中、在連續網路控制下，並在一3GPP網路的覆蓋範圍下的裝置間進行受網路營運商控制的探索及通訊此一模式所需的潛在要求，用於：

1. 商業/社交應用
2. 網路分流
3. 公共安全
4. 整合現有基礎設施服務，以確保包括可到達性和流動性方面使用者經驗的一致性

此外，該研究項目將為以下所列研究其用例和識別潛在需求

5.公共安全，萬一不具有EUTRAN覆蓋區域(受區域監管和營運商策略的限制，並侷限於特定公共安全所指定的頻帶和終端)

使用情況和服務要求將被研究，包括網路運營商控制、身份認證、授權、計費和監管方面的問題。

這項研究並不適用於GERAN或UTRAN。

【0026】 3GPP TR22.803揭露裝置間(Device-to-device)通訊的無線電資源分配，以及裝置間通訊特性，其描述如下：

[PR.29]無論是否具有經由基礎設施建設路徑所傳送的數據，該系統須能在演進通用陸地無線存取鄰近通訊路徑上監測通訊特性(例如，通道狀況、路徑的QoS、傳輸流量等等)。

[...]

[PR.34]無線存取網路應控制與演進通用陸地無線存取鄰近通訊路徑相關的無線電資源。

[...]

[PR.124] 這些使用者設備只要有一個是在演進通用陸地無線存取網路覆蓋範圍中，並使用運營商的頻譜，運營商網路應能連續控制使用者設備間鄰近探索及鄰近通訊之演

進通用陸地無線存取網路資源的使用。

【0027】 在R2-133486中，有兩種模式用於控制裝置間通訊的無線電資源，其引述如下：

目前，有兩種用於裝置間通訊可能的無線電資源分配方案：

- 協調存取：在此種存取方案中，存在一作為一資源分配控制器的群組代表(cluster head)。在網路覆蓋範圍的情況下，群組代表可以是進化B節點或一調度器。而在超出覆蓋範圍的公眾安全情況下，群組代表係為調度器。協調存取類似在使用者設備中當前動態調度被調度以用於每一裝置間傳輸的資源或類似在使用者設備中半靜態(SPS)調度，而半靜態調度是指使用者設備被安排了用於裝置間傳輸的週期性資源。

- 不協調存取：這種存取方案允許使用者設備自動從半靜態配置的資源塊的一池中分配本身資源。由於其為不協調，因此當另一使用者設備可分配本身相同的資源時，分配的資源係在競爭。不協調存取類似在一資源池中前置訊號(Preamble)的隨機選擇。需要某些形式的碰撞處理機制(例如，CSMA/CA或CSMA/CD)以避免/解決/檢測碰撞。

【0028】 3GPP TS 36.321討論在媒體存取控制(MAC)層的

功率餘量報告(power headroom report, PHR)特徵，其引述如下：

5.4.6 功率餘量報告

功率餘量報告過程係用以提供服務進化B節點關於標稱(nominal)使用者設備最大傳輸功率及每一活動服務細胞在上行鏈路共享通道(UL-SCH)估計功率之間差值的資訊，並提供關於標稱使用者設備最大傳輸功率及在主要細胞中用於上行鏈路共享通道(UL-SCH)及實體上行鏈路控制通道(Physical Uplink Control Channel, PUCCH)傳輸估計功率之間差值的資訊。

功率餘量報告的報告週期、延遲和映射定義在[9]的9.1.8子節中。因功率管理(由P-MPR_c[10]所允許)而觸發一功率餘量報告[8]，無線電資源控制(RRC)藉由配置兩個計時器 *periodicPHR-Timer* 和 *prohibitPHR-Timer*，及藉由用在測量下行鏈路路徑衰減中設定變化及所需的功率補償的信號 *DL-PathlossChange* 控制功率餘量報告。

如果以下事件發生，則功率餘量報告(Power Headroom Report, PHR)將被觸發：

- *prohibitPHR-timer* 逾期或已經過期，且當使用者設備具有新傳輸之上行鏈路資源時，因一功率餘量報告的最後傳輸，對至少一作為通道衰減參考的活動服務細胞，路徑衰減已改變超過 *DL-PathlossChange* dB。

- *periodicPHR-timer* 逾期；

- 根據由不被用來禁止此功能之上層[8]功率餘量報告功能的配置或重新配置；
- 具有配置上行鏈路的次要細胞的活動。
- *prohibitPHR-timer*逾期或已經逾期，當使用者設備資源具有用於新傳輸的上鏈路資源，且對於任何具有配置上行鏈路的活化服務細胞在此傳輸時間間隔中以下為真時：
 - 具有分配用於傳輸的上行鏈路資源或具有在此細胞中的實體上行鏈路控制通道傳輸，並且當使用者設備在此細胞中具有分配用於傳輸之上行鏈路資源或實體上行鏈路控制通道傳輸時，從一功率餘量報告的最後傳輸開始，因此細胞功率管理(由 $P\text{-}MPR_c$ [10]所允許)，故所需的功率回退(Power backoff)已改變超過 $DL\text{-}PathlossChange$ dB。

注意：當所需功率回退因功率管理而僅暫時(例如，長達幾十毫秒)減少時，使用者設備應避免觸發一功率餘量報告，並且當一功率餘量報告由其他觸發條件所觸發時，應避免反射在 $P_{CMAX, c}/PH$ 值暫時減少。

如果使用者設備具有在此傳輸時間間隔中用於新傳輸分配之上行鏈路資源時：

- 如果此為從上次媒體存取控制重置開始，用於分配一新傳輸之第一上行鏈路資源時，啟動*periodicPHR-timer*；
- 如果功率餘量報告過程決定至少一功率餘量已被觸發，

而非取消時，以及：

- 由於邏輯通道優先級的因素，如果所分配的上行鏈路資源當 *extendedPHR* 未配置時可容納一功率餘量報告媒體存取控制 (MAC) 控制元件加上其子標頭，或當 *extendedPHR* 已被配置時可容納擴展的功率餘量報告媒體存取控制 (MAC) 控制元件加上其子標頭時：
 - 如果 *extendedPHR* 已被配置時：
 - 對於每一活動的服務細胞配置上行鏈路：
 - 獲得 Type 1 的功率餘量值；
 - 如果使用者設備具有分配至在此服務細胞中對於傳輸時間間隔的上行鏈路資源：
 - 獲得從實體層對應 $P_{CMAX,C}$ 欄位的值；
 - 如果 *simultaneousPUCCH-PUSCH* 被配置時：
 - 獲得用於主要細胞 Type 2 功率餘量的值；
 - 如果使用者設備在此傳輸時間間隔中具有一實體上行鏈路控制通道傳輸時：
 - 獲得從實體層對應 $P_{CMAX,C}$ 欄位的值；
 - 根據由實體層所回報的值指示多路復用及集合程序以產生並傳送一已擴展功率餘量報告媒體存取控制 (MAC) 控制元件，其定義於第 6.1.3.6a 子節中；
 - 啟動或重新啟動 *periodicPHR-timer*；
 - 啟動或重新啟動 *prohibitPHR-timer*；
 - 取消所有已觸發的(複數)功率餘量報告。

【0029】 3GPP TS 36.321 討論調度請求，其引述如下：

5.4.4 調度請求

調度請求(Scheduling Request, SR)用於請求新傳輸的上行鏈路共享通道(UL-SCH)資源。

當一調度請求被觸發時，直到其被取消前應被視為未決定的。當一媒體存取控制協定資料單元(Protocol Data Unit, PDU)被組合且此協定資料單元包括一包含緩衝狀態直到(包括)觸發一緩衝區狀態報告(Buffer Status Report, BSR)的前一事件之緩衝區狀態報告(參見第5.4子節)時，或當(複數)設上行鏈路授予可容納所有用於傳輸未決定的數據時，所有未決定的(複數)調度請求將被取消且 *sr-ProhibitTimer* 應被停止。

如果一調度請求被觸發並且沒有其他調度請求未決定時，使用者設備將SR_COUNTER設為0。

只要一調度請求未決定的，在每一傳輸時間間隔中使用使用者設備將：

- 如果沒有上行鏈路共享通道資源可用於在此傳輸時間間隔中之一傳輸時：
 - 如果使用使用者設備不具有配置在任何傳輸時間間隔中調度請求有效的實體上行鏈路控制通道資源：在主要細胞中啟動一隨機存取程序(參見第5.1子節)並取消所有待決定調度請求；
 - 否則，若使用者設備具有配置在任何傳輸時間間隔中調度請求有效的實體上行鏈路控制通道資源，且若此傳

輸時間間隔不為一測量間隙的一部分並且若 *sr-ProhibitTimer* 未運行時：

- 如果 $SR_COUNTER < dsr-TransMax$ ：
- $SR_COUNTER$ 增加 1；
- 在實體上行鏈路控制通道中指示實體層以傳輸調度請求訊號；
- 啟動 *sr-ProhibitTimer*。
- 否則：
- 通知無線電資源控制(RRC)釋放所有服務細胞之實體上行鏈路控制通道 / SRS；
- 清除所有配置的下行鏈路分配及上行鏈路授予；
- 在主要細胞中啟動一隨機存取程序(詳見第 5.1 子節)並取消所有未決定的調度請求。

【0030】 一般來說，假設協調存取方案被採納用於裝置間通訊，資源分配係由群組代表/進化B節點所控制。因此，使用者設備將需提供一些必要的資訊至群組代表/進化B節點以實現裝置間通訊的資源控制。在一般上行鏈路(Uplink, UL)通訊中，資訊像是緩衝區狀態報告(Buffer Status Report, BSR)及功率餘量報告(power headroom report, PHR)需要被提供給進化B節點以分配資源。

【0031】 如果裝置間通訊的單播只使用有限的功率最大值，則有可能重新使用功率餘量報告作為功率控制功能以滿足要

求並重新利用現有LTE功能。功率餘量報告為提供對於一使用者設備除當前傳輸功率外還有多少剩餘傳輸功率可使用之報告。根據使用者設備的功率餘量報告，網路可決定使用者設備的資源分配是否會改變或不會改變。若關於裝置間通訊的功率餘量報告資訊被提供至網路時，和一般的上行鏈路行為相同，網路可根據裝置間通訊的功率餘量報告重新分配資源到使用者設備的裝置間通訊。此外，功率餘量報告還可提供參考資訊給網路，以決定對裝置間通訊服務而言通訊路徑是否會被改變。然而，為了支援裝置間通訊的功率餘量報告，目前功率餘量報告將需要做出許多修改，這將造就一用於網路的新類型功率餘量報告。此種新類型的功率餘量報告也預計將透過正常上行鏈路傳輸傳送至網路。

【0032】遺憾的是，功率餘量報告不會根據媒體存取控制規範觸發授予請求過程。若使用者設備具有一數據鏈結在裝置間通訊而非於一般的蜂窩通訊，則網路將須提供授權資源給功率餘量報告，以使其可被設計成週期性地觸發。因此，直到來自網路的一授權資源或上行鏈路數據到達前，功率餘量報告將需要持續等待。若沒有經修改的功率餘量報告，網路可能無法重新分配裝置間通訊的資源。在此種情況下，資源可能被浪費或服務質量(Quality of Service, QoS)無法得到保證。

【0033】為了避免資源的浪費或服務質量的維護，各個實施例是針對重新使用功率餘量報告以幫助網路來分配和/或重新分配用於裝置間通訊的資源。更具體地說，如果沒有用於由裝置間通訊所觸發之功率餘量報告的授權資源，功率餘量報告

將觸發一調度請求(Scheduling Request, SR)以請求一上行鏈路授權資源來發送功率餘量報告至網路中。

【0034】 一示範的方法包括藉由一使用者設備(User Equipment, UE)透過裝置間通訊與一裝置通訊。方法更包括藉由上述使用者設備觸發一第一功率餘量報告(power headroom report, PHR)以指示上述裝置間通訊的一功率狀態。方法還提供當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告，則藉由上述使用者設備觸發及傳送一調度請求(Scheduling Request, SR)，以請求來自一網路用於調度的無線電資源。此方法更包括藉由上述使用者設備觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之一傳輸路徑的一功率狀態，當上述使用者設備不具有可用的資源以傳送上述第二功率餘量報告時，則不觸發且不傳送上述調度請求以請求來自網路用於調度的無線資源。在另一示範的實施例中，該方法包括在由上述第一功率餘量報告所觸發之一傳輸時間間隔(Transmission Time Interval, TTI)內觸發上述調度請求。

【0035】 在另一方法中，裝置間通訊為裝置間鄰近服務(proximity-based service, ProSe)直接通訊。在各種方法中，上述第一功率餘量報告係為一新類型的功率餘量報告，其中上述第一功率餘量報告不同於一功率餘量媒體存取控制(MAC)控制元件和一擴展功率餘量控制元件。在一實施例中，第一功率餘量報告包括用於區別上述裝置間通訊及其他裝置間通訊的一指示。而且其它裝置間通訊和上述裝置間通訊比起，有著不同的通訊對象或不同的傳輸目標。在另一實施例中，上述第一

功率餘量報告包括上述裝置間通訊之一身份。在一實施例中，上述功率狀態係為一當前使用功率值及可用於裝置間通訊之一最大功率值之間的一功率差。

【0036】 在另一實施例中，無線電資源係一上行鏈路授權資源(uplink grant)。在一實施例中，上述第一功率餘量報告係一媒體存取控制(MAC)控制元件。而當滿足下列條件其他之一或下列條件之組合時，上述第一功率餘量報告係被觸發。在一實施例中，上述第一功率餘量報告係由上述裝置間通訊所觸發。在另一實施例中，上述第一功率餘量報告係由上述裝置間通訊之路徑衰減變化所觸發。在另一實施例中，上述第一功率餘量報告係由上述裝置間通訊之功率值變化所觸發。在另一實施例中，上述第一功率餘量報告係由用於上述裝置間通訊之一計時器的一逾期所觸發。在另一實施例中，上述第一功率餘量報告係由用於上述裝置間通訊之一通道品質指標(Channel Quality Indicator, CQI)所觸發。

【0037】 在又一實施例中，上述第一功率餘量報告被傳送至一進化B節點(evolved Node B)或一中繼點。在一實施例中，上述第二功率餘量報告係由一週期計時器逾期所觸發。或者，上述第二功率餘量報告係由一大於一臨界值之一下行鏈路通道衰減之變化所觸發。或者，上述第二功率餘量報告係由一功率餘量功能的配置或重新配置所觸發。或者，上述第二功率餘量報告係由一具有已配置上行鏈路的一次要細胞(Scell)的一啟動所觸發。

【0038】 第5圖係描述一用以在一細胞中改變一測量信號

之一示範方法500，其中一使用者設備(User Equipment, UE)係由一第一細胞所服務。在步驟505中，一使用者設備透過裝置間通訊與一裝置通訊。在步驟510中，使用者設備觸發一第一功率餘量報告(power headroom report, PHR)以指示上述裝置間通訊的一功率狀態。在步驟515中，當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告時，則觸發及傳送一調度請求(Scheduling Request, SR)，以請求來自一網路用於調度的無線電資源。在步驟520中，藉由上述使用者設備觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之一傳輸路徑的一功率狀態，當上述使用者設備不具有可用的資源以傳送上述第二功率餘量報告時，則不觸發且不傳送上述調度請求以請求來自網路用於調度的無線資源。

【0039】 回到第3圖及第4圖所示，在一實施例中，此裝置300包括一儲存於記憶體310內之用以改變在一細胞中一測量信號之程式碼312，其中一使用者設備由一第一細胞所服務。在一實施例中，中央處理器308可執行程式碼312以執行(i)透過上述裝置間通訊與一裝置通訊；(ii)觸發一第一功率餘量報告(power headroom report, PHR)以指示上述裝置間通訊的一功率狀態；(iii)當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告時，則觸發及傳送一調度請求(Scheduling Request, SR)，以請求來自一網路用於調度的無線電資源；以及(iv)觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之一傳輸路徑的一功率狀態，當上述使用者設備不具有可用的資源以傳送上述第二功率餘量報告時，則不觸發且不傳

送上述調度請求以請求來自網路用於調度的無線資源。此外，中央處理器308可執行程式碼312以執行上述實施例所述之動作和步驟，或其它在說明書中內容之描述。

【0040】 以上實施例使用多種角度來描述。顯然這裡的教示可以多種方式呈現，而在範例中揭露之任何特定架構或功能僅為一代表性之狀況。根據本文之教示，任何熟知此技藝之人士應理解在本文呈現之內容可獨立利用其他某種型式或綜合多種型式作不同呈現。舉例說明，可遵照前文中提到任何方式利用某種裝置或某種方法實現。一裝置之實施或一種方式之執行可用任何其他架構、或功能性、又或架構及功能性來實現在前文所討論的一種或多種型式上。再舉例說明以上觀點，在某些情況下，併行之頻道可基於脈衝重複頻率所建立。又在某些情況，併行之頻道也可基於脈波位置或偏位所建立。在某些情況，併行之頻道可基於時序跳頻建立。在某一些情況，併行之頻道可基於脈衝重複頻率、脈波位置或偏位、以及時序跳頻建立。

【0041】 熟知此技藝之人士將了解訊息及訊號可用多種不同科技及技巧展現。舉例，在以上描述所有可能引用到之數據、指令、命令、訊息、訊號、位元、符號、以及碼片(chip)可以伏特、電流、電磁波、磁場或磁粒、光場或光粒、或以上任何組合所呈現。

【0042】 熟知此技術之人士更會了解在此描述各種說明性之邏輯區塊、模組、處理器、裝置、電路、以及演算步驟與以上所揭露之各種情況可用的電子硬體(例如用來源編碼或其他

技術設計之數位實施、類比實施、或兩者之組合)、各種形式之程式或與指示作為連結之設計碼(在內文中為方便而稱作「軟體」或「軟體模組」)、或兩者之組合。為清楚說明此硬體及軟體間之可互換性，多種具描述性之元件、方塊、模組、電路及步驟在以上之描述大致上以其功能性為主。不論此功能以硬體或軟體型式呈現，將視加注在整體系統上之特定應用及設計限制而定。熟知此技藝之人士可為每一特定應用將描述之功能以各種不同方法作實現，但此實現之決策不應被解讀為偏離本文所揭露之範圍。

【0043】 此外，多種各種說明性之邏輯區塊、模組、及電路以及在此所揭露之各種情況可實施在積體電路(integrated circuit, IC)、存取終端、存取點；或由積體電路、存取終端、存取點執行。積體電路可由一般用途處理器、數位訊號處理器(Digital Signal Processor, DSP)、特定應用積體電路(application specific integrated circuit, ASIC)、現場可編程閘列(field programmable gate array, FPGA)或其他可編程邏輯裝置、離散閘(discrete gate)或電晶體邏輯(transistor logic)、離散硬體元件、電子元件、光學元件、機械元件、或任何以上之組合之設計以完成在此文內所描述之功能；並可能執行存在於積體電路內、積體電路外、或兩者皆有之執行碼或指令。一般用途處理器可能是微處理器，但也可能是任何常規處理器、控制器、微控制器、或狀態機。處理器可由電腦設備之組合所構成，例如：數位訊號處理器(DSP)及一微電腦之組合、多組微電腦、一組至多組微電腦以及一數位訊號處理器核心、或任何其他類似之配

置。

【0044】 在此所揭露程序之任何具體順序或分層之步驟純爲一舉例之方式。基於設計上之偏好，必須了解到程序上之任何具體順序或分層之步驟可在此文件所揭露的範圍內被重新安排。伴隨之方法申請專利範圍以一示範例順序呈現出各種步驟之元件，也因此不應被本發明說明書所展示之特定順序或階層所限制。

【0045】 本發明之說明書所揭露之方法和演算法之步驟，可以直接透過執行一處理器直接應用在硬體以及軟體模組或兩者之結合上。一軟體模組(包括執行指令和相關數據)和其它數據可儲存在數據記憶體中，像是隨機存取記憶體(Random Access Memory，RAM)、快閃記憶體(flash memory)、唯讀記憶體(Read-Only Memory，ROM)、可抹除可規化唯讀記憶體(EPROM)、電子抹除式可複寫唯讀記憶體(Electrically-Erasable Programmable Read-Only Memory，EEPROM)、暫存器、硬碟、可攜式硬碟、光碟唯讀記憶體(Compact Disc Read-Only Memory，CD-ROM)、數位視頻光碟(Digital Video Disc，DVD)或在此領域習之技術中任何其它電腦可讀取之儲存媒體格式。一儲存媒體可耦接至一機器裝置，舉例來說，像是電腦/處理器(爲了說明之方便，在本說明書以處理器來表示)，上述處理器可透過來讀取資訊(像是程式碼)，以及寫入資訊至儲存媒體。一儲存媒體可整合一處理器。一特殊應用積體電路(ASIC)包括處理器和儲存媒體。一使用者設備則包括一特殊應用積體電路。換句話說，處理器和儲存媒體以不直接連接使用者設備的方式，

包含於使用者設備中。此外，在一些實施例中，任何適合電腦程序之產品包括可讀取之儲存媒體，其中可讀取之儲存媒體包括一或多個所揭露實施例相關之程式碼。而在一些實施例中，電腦程序之產品可以包括封裝材料。

【0046】 雖然本發明已以較佳實施例揭露如上，然其並非用以限定本發明，任何熟習此技藝者，在不脫離本發明之精神和範圍內，當可作些許之更動與潤飾，因此本發明之保護範圍當視後附之申請專利範圍所界定者為準。

【符號說明】

【0047】

- 100 存取網路；
- 104、106、108、110、112、114 天線；
- 116 存取終端；
- 118 反向鏈路；
- 120 前向鏈路；
- 122 存取終端；
- 124 反向鏈路；
- 126 前向鏈路；
- 210 發送器系統；
- 212 數據源；
- 214 發送數據處理器；
- 220 多重輸入多重輸出處理器；
- 222a~222t 發送器；
- 224a~224t 天線；

230 處理器；
232 記憶體；
236 數據源；
238 發送數據處理器；
242 接收數據處理器；
240 解調器；
250 接收器系統；
252a~252r 天線；
254a~254r 接收器；
260 接收數據處理器；
270 處理器；
272 記憶體；
280 調變器；
300 通訊裝置；
302 輸入裝置；
304 輸出裝置；
306 控制電路；
308 中央處理器；
310 記憶體；
312 執行程式碼；
314 收發器；
400 應用層；
402 第三層；
404 第二層；

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406 第一層；

500 流程圖；

505、510、515、520 步驟。

申請專利範圍

1. 一種改善裝置間(Device-to-Device Communications, D2D)通訊的方法，上述方法包括：
藉由一使用者設備(User Equipment, UE)透過上述裝置間通訊與一裝置通訊；
藉由上述使用者設備觸發一第一功率餘量報告(power headroom report, PHR)以指示上述裝置間通訊的一功率狀態；
當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告，則藉由上述使用者設備觸發及傳送一調度請求(Scheduling Request, SR)，以請求來自一網路用於調度的無線電資源；以及
藉由上述使用者設備觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之一傳輸路徑的一功率狀態，當上述使用者設備不具有可用的資源以傳送上述第二功率餘量報告時，則不觸發且不傳送上述調度請求以請求來自網路用於調度的無線資源。
2. 如申請專利範圍第1項所述之改善裝置間通訊的方法，其中上述裝置間通訊為裝置間鄰近服務(proximity-based service, ProSe)直接通訊。
3. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告不同於一功率餘量媒體存取控制(MAC)控制元件和一擴展功率餘量控制元件。
4. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上

述第一功率餘量報告包括用於區別上述裝置間通訊及其他裝置間通訊的一指示。

5. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告包括上述裝置間通訊之一身份。
6. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述功率狀態係為一當前使用功率值及可用於裝置間通訊的一最大功率值之間的一功率差。
7. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述無線資源係一上行鏈路授權資源(uplink grant)。
8. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告係一媒體存取控制(MAC)控制元件。
9. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告係由上述裝置間通訊之路徑衰減變化所觸發。
10. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告係由上述裝置間通訊之功率值變化所觸發。
11. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告係由用於上述裝置間通訊之一計時器的一逾期所觸發。
12. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告係由用於上述裝置間通訊之一通道品質指標(Channel Quality Indicator, CQI)所觸發。
13. 如申請專利範圍第1項所述之改善裝置間通訊方法，其中上

述第一功率餘量報告係由用於上述裝置間通訊所觸發。

14.如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第一功率餘量報告被傳送至一進化B節點(evolved Node B)或一中繼點。

15.如申請專利範圍第1項所述之改善裝置間通訊方法，更包括：

在由上述第一功率餘量報告所觸發之一傳輸時間間隔(Transmission Time Interval, TTI)內觸發上述調度請求。

16.如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第二功率餘量報告係由一週期計時器逾期所觸發。

17.如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第二功率餘量報告係由一大於一臨界值之一下行鏈路通道衰減之變化所觸發。

18.如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第二功率餘量報告係由一功率餘量功能的配置或重新配置所觸發。

19.如申請專利範圍第1項所述之改善裝置間通訊方法，其中上述第二功率餘量報告係由一具有已配置上行鏈路的一次要細胞(Scell)的啟動所觸發。

20.一種改善裝置間(device to device, D2D)通訊的通訊裝置，上述通訊裝置包括：

一控制電路；

一處理器，安裝至上述控制電路中；以及

一記憶體，安裝至上述控制電路中並且耦接至上述處理

器；

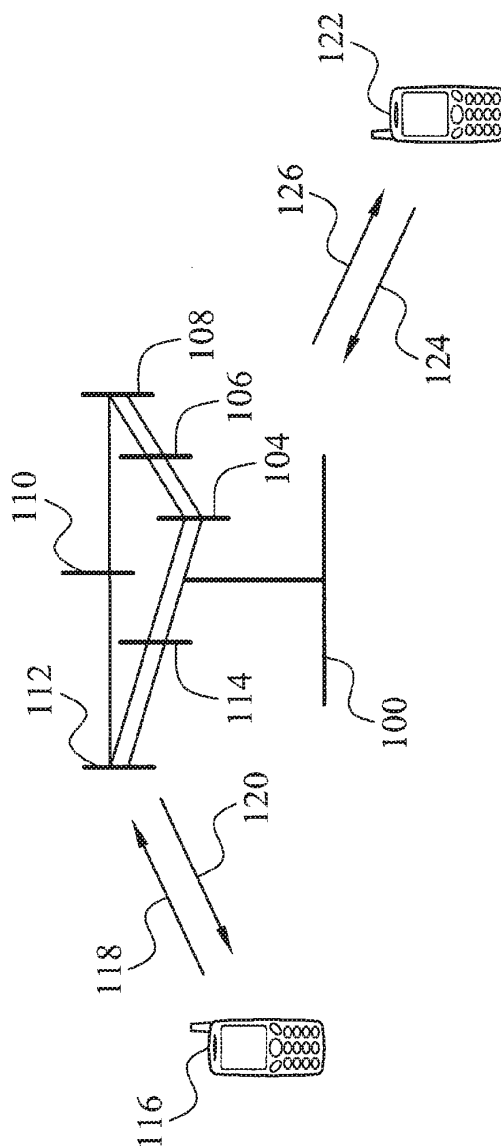
其中上述處理器配置用以執行一儲存於上述記憶體中之程式碼以使一使用者設備(User Equipment, UE)執行：

透過上述裝置間通訊與一裝置通訊；

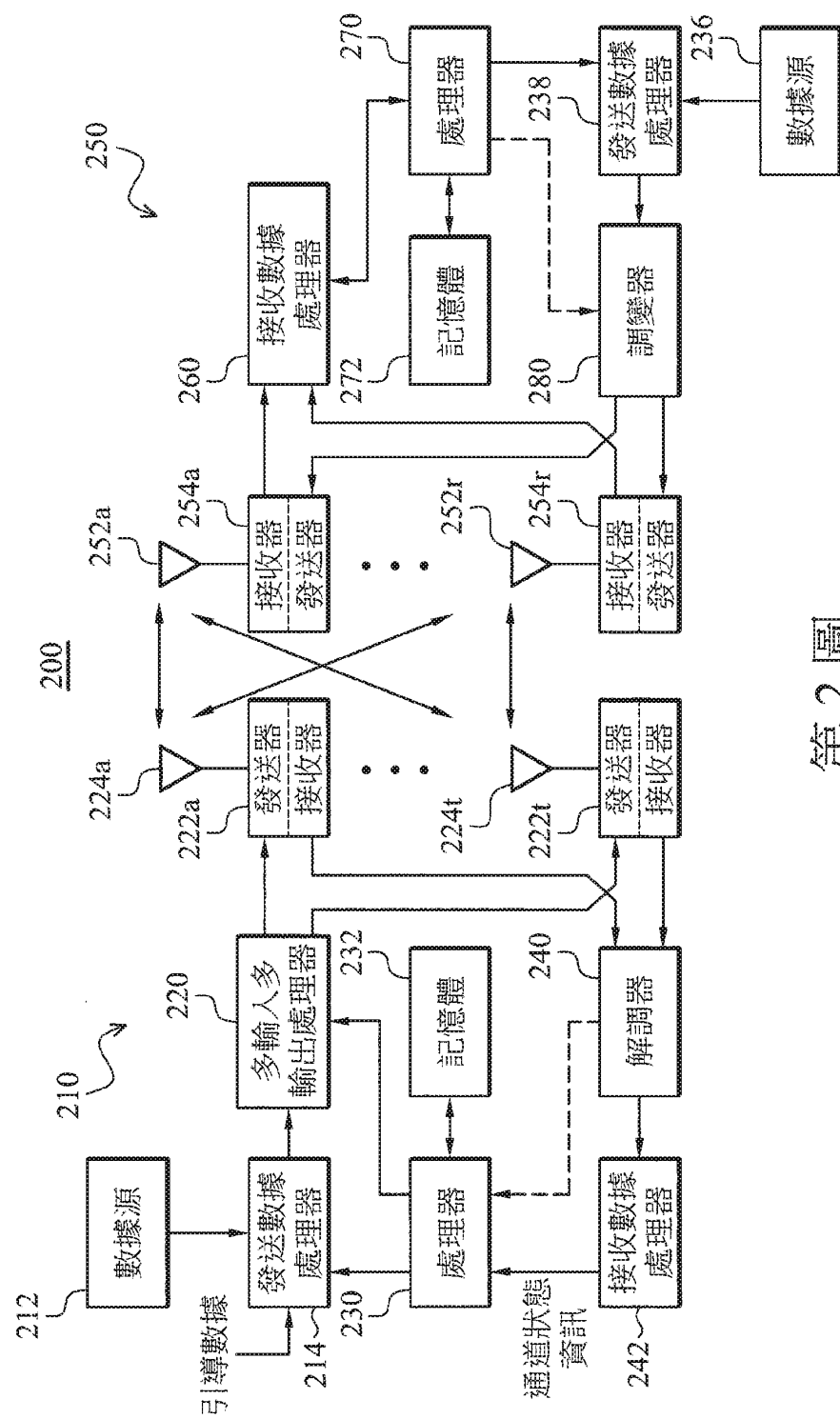
觸發一第一功率餘量報告(power headroom report, PHR)以指示上述裝置間通訊的一功率狀態；

當上述使用者設備不具有可用的資源以傳送上述第一功率餘量報告時，則觸發及傳送一調度請求(Scheduling Request, SR)，以請求來自一網路用於調度的無線電資源；以及
觸發一第二功率餘量報告以指示從上述使用者設備至上述網路之一傳輸路徑的一功率狀態，當上述使用者設備不具有可用的資源以傳送上述第二功率餘量報告時，則不觸發且不傳送上述調度請求以請求來自網路用於調度的無線資源。

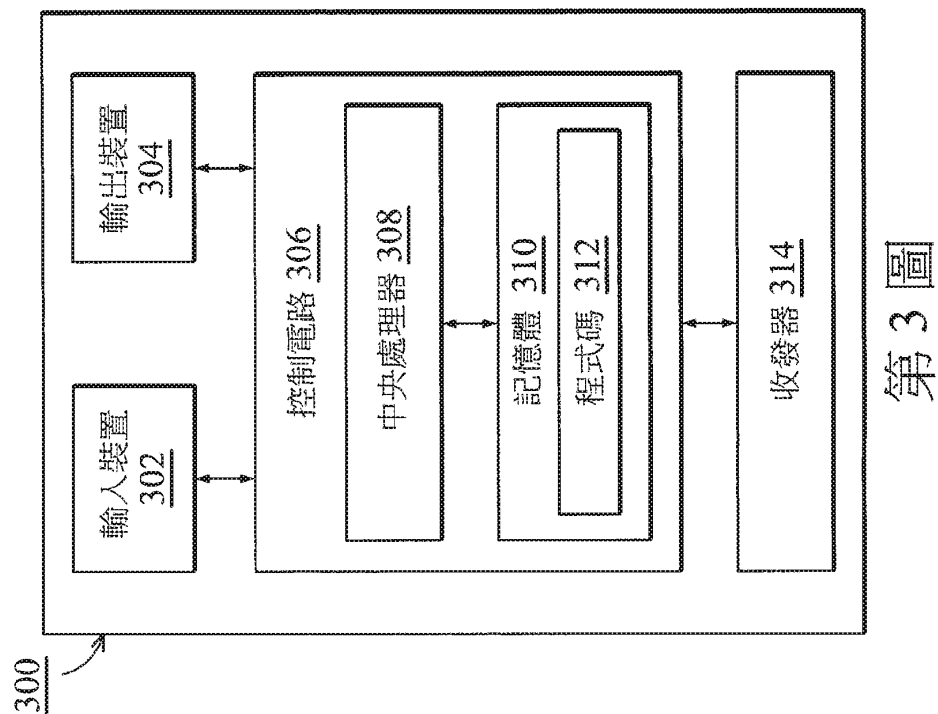
圖式



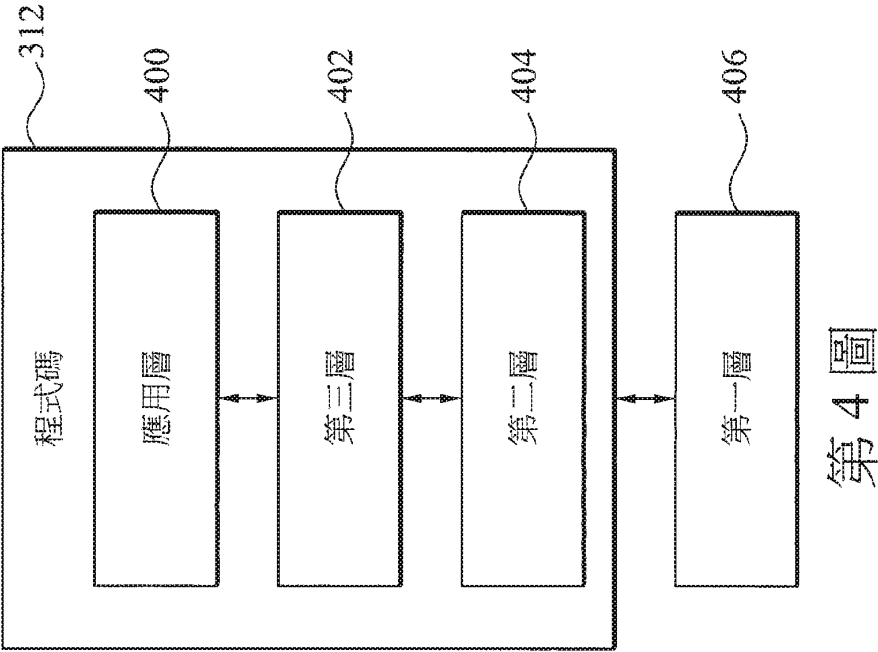
第 1 圖

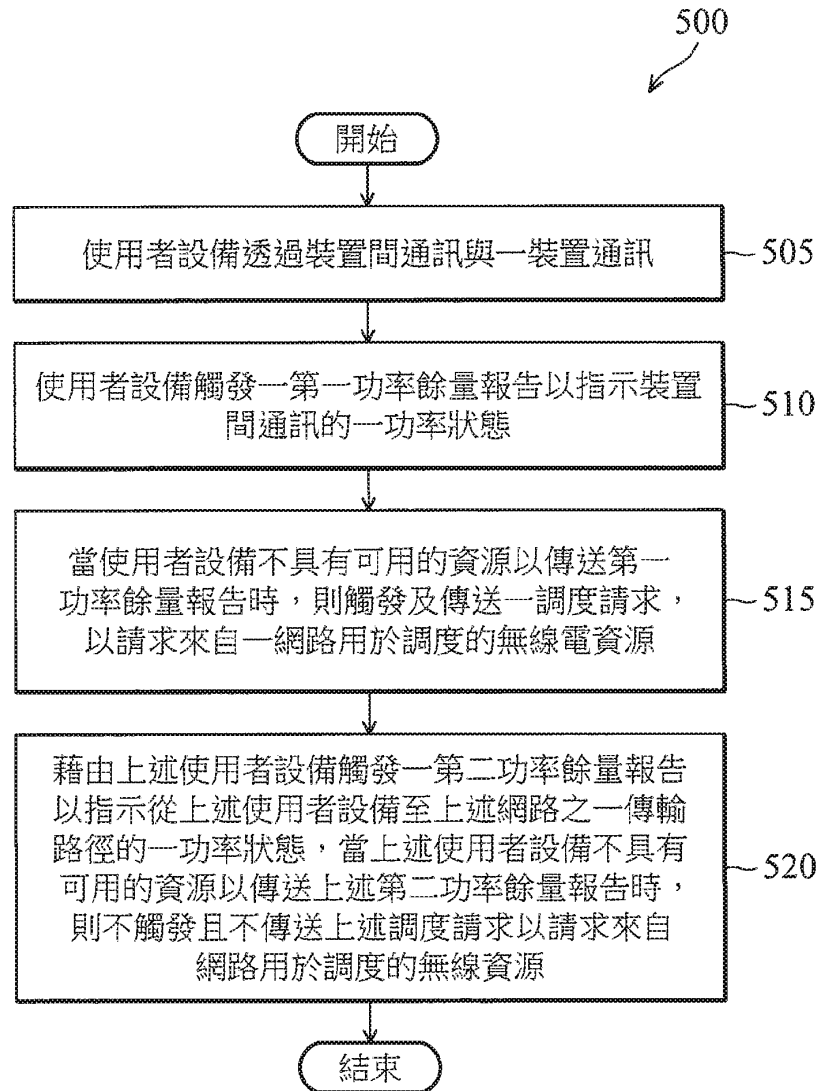


第2圖



第3圖





第 5 圖

Electronic Acknowledgement Receipt	
EFS ID:	31308806
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	21-DEC-2017
Filing Date:	31-MAR-2017
Time Stamp:	16:00:46
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)	1426-113-101-- IDSasFiled12212017v2.pdf	54775 2337ae649f285645a5d2d869a8ed89b00789fcb6	no	2
Warnings:					

Information:					
This is not an USPTO supplied IDS fillable form					
2	Foreign Reference	NPL--TW201531135.pdf	5317958 3acdd07dc808000222879321ee8eea1fda523842	no	39
Warnings:					
Information:					
3	Non Patent Literature	NPL--TWofficeaction.pdf	574585 3d0509476181e8a51322c39875cbb0d14dd026ba	no	6
Warnings:					
Information:					
Total Files Size (in bytes):			5947318		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/475,190	03/31/2017	Ko-Chiang Lin	1426-113.101	8621
106622 7590 06/11/2018 Blue Capital Law Firm, P.C. 650 Town Center Drive, Suite 1530 Costa Mesa, CA 92626			EXAMINER KAMARA, MOHAMED A	
			ART UNIT 2412	PAPER NUMBER
			NOTIFICATION DATE 06/11/2018	DELIVERY MODE 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

Office Action Summary	Application No. 15/475,190	Applicant(s) LIN ET AL.	
	Examiner MOHAMED KAMARA	Art Unit 2412	AIA (First Inventor to File) 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 03/21/2017.
☐ 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) 1-20 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) 1-20 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 03/31/2017 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 09/08/2017 & 12/21/2017.

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

4) ☐ Other: _____.

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

DETAILED ACTION

1. This office action is in response to the application filed on 03/31/2017.
2. Claims 1-20 are currently pending.
3. Claims 1-20 are rejected.

Claim Interpretation

4. Examiner will interpreted the limitation “*UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not*” as follows:

If the UE has physical control information to transmit, the UE will transmit said control information. If on the other hand, the UE does not have physical control information to send, it will skip the uplink grant (i.e. the UE does not perform transmission (as clarified in claim 3)). This interpretation, which is consistent with claim 11, will be used in the rejection that follows.

Claim Rejections - 35 USC § 103

5. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the

statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

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

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102 of this title, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

7. 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.

8. This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date

of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

9. Claim 1-2, 4-7, 9-12, 14-17 and 19-20 are rejected under 35 U.S.C. 103 as being unpatentable over Kyou-Woong Kim et al (US 20110205991 A1) in view of Antti Ratilainen et al (US 20180091269 A1).

For Claim 1, Kim discloses a method of a UE (User Equipment) (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission (Kim teaches, in ¶ 0060, lines 1-3, that the UE apparatus **receives a ULG signal** in block 400 and **determines whether there is uplink user data to be transmitted**);

the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI.

However, Ratilainen discloses that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI (Ratilainen teaches, in ¶ 0093, lines 1-4, that if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission**).

Ratilainen further teaches, in ¶ 0095, that whenever the UE has something to transmit in the downlink cell during an **"IUA granted" subframe**, it can transmit in this subframe (i.e., in **a given TTI**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the Instant Uplink Access (IUA) taught in Ratilainen in order to allow uplink transmission of data without a Status Report.

For Claims 2, 7, 12 & 17, Kim discloses a method of a UE, wherein the uplink grant is a configured uplink grant that is periodically available (Kim teaches, in ¶ 0026, lines 4-6, an uplink scheduling scheme based on **a periodic UpLink Grant (ULG)** signal transmitted from a Base Station).

For Claims 4, 9, 14 & 19, Kim discloses all of the claimed subject matter with the exception that skipping the uplink grant means the UE does not perform transmission on a data channel.

However, Ratilainen discloses that skipping the uplink grant means the UE does not perform transmission on a data channel (Ratilainen teaches, in ¶ 0093, lines 1-4, that if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the Instant Uplink Access (IUA) taught in Ratilainen in order to allow uplink transmission of data without a Status Report.

For Claims 5, 10, 15 & 20, Kim discloses a method of a UE, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element (Kim teaches, in ¶ 0007, lines 2-5 & 11-12, that the UE that has received a ULG signal and has been allocated to the PUSCH **generates a Medium Access Control (MAC) Protocol Data Unit (PDU) padded with zeroes** at a MAC layer ... and is **then transmitted**).

For Claim 6, Kim discloses a User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

a control circuit (Kim teaches, in FIG. 2, **a CONTROLLER 300**);

a processor installed in the control circuit (Kim teaches, in FIG. 2, **a DATA PROCESSOR 304**); and

a memory installed in the control circuit and operatively coupled to the processor; wherein the processor is configured to execute a program code (Kim teaches, in ¶ 0073, lines 1-3, that the foregoing embodiments may be implemented as code that can be written on a memory in a component of a UE apparatus ...**reads the program code** from the **memory by a processor** or a Central Processing Unit (CPU) and **executes it**) stored in the memory to:

determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not (Kim teaches, in ¶ 0062, lines 1-4, that in

the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI.

However, Ratilainen discloses that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI (Ratilainen teaches, in ¶ 0093, lines 1-4, that if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission**).

Ratilainen further teaches, in ¶ 0095, that whenever the UE has something to transmit in the downlink cell during an "**IUA granted**" subframe, it can transmit in this subframe (i.e., in **a given TTI**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the Instant Uplink Access (IUA) taught in Ratilainen in order to allow uplink transmission of data without a Status Report.

For Claim 11, Kim discloses a method of a UE (User Equipment) (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission (Kim teaches, in ¶ 0060, lines 1-3, that the UE apparatus **receives a ULG signal** in block 400 and **determines whether there is uplink user data to be transmitted**);

the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI.

However, Ratilainen discloses that the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI (Ratilainen teaches, in ¶ 0093, lines 1-4, that if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission**).

Ratilainen further teaches, in ¶ 0095, that whenever the UE has something to transmit in the downlink cell during an **"IUA granted" subframe**, it can transmit in this subframe (i.e., in **a given TTI**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the Instant Uplink Access (IUA) taught in Ratilainen in order to allow uplink transmission of data without a Status Report.

For Claim 16, Kim discloses a User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

a control circuit (Kim teaches, in FIG. 2, **a CONTROLLER 300**);

a processor installed in the control circuit (Kim teaches, in FIG. 2, **a DATA PROCESSOR 304**); and

a memory installed in the control circuit and operatively coupled to the processor; wherein the processor is configured to execute a program code (Kim teaches, in ¶ 0073, lines 1-3, that the foregoing embodiments may be implemented as code that can be written on a memory in a component of a UE apparatus ...**reads the program code** from the **memory by a processor** or a Central Processing Unit (CPU) and **executes it**) stored in the memory to:

transmit a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose skipping the uplink grant if the physical control information does not need to be transmitted in the TTI.

However, Ratilainen discloses skipping the uplink grant if the physical control information does not need to be transmitted in the TTI (Ratilainen teaches, in ¶ 0093, lines 1-4, that if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission**).

Ratilainen further teaches, in ¶ 0095, that whenever the UE has something to transmit in the downlink cell during an "**IUA granted**" subframe, it can transmit in this subframe (i.e., in **a given TTI**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the Instant Uplink Access (IUA) taught in Ratilainen in order to allow uplink transmission of data without a Status Report.

10. Claims 3, 8, 13 and 18 are rejected under 35 U.S.C. 103 as being unpatentable over Kyou-Woong Kim et al (US 20110205991 A1) in view of Antti Ratilainen et al (US 20180091269 A1) as applied to claims 1, 6, 11 or 16 above, and further in view of Ying Sun et al (US 20160242176 A1).

For Claims 3, 8, 13 and 18, Kim & Ratilainen disclose all of the claimed subject matter with the exception that skipping the uplink grant means the UE does not perform transmission on a data channel.

However, Sun discloses that that skipping the uplink grant means the UE does not perform transmission on a data channel (Sun teaches, in ¶ 0072, lines 6-12, that In such situation **the eNB** may, in addition to the NACK, also **send a dynamic grant**, overriding the semi-persistent scheduling).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim & Pelletier with the dynamic scheduling taught in Sun so that both the retransmission and semi-persistent transmission may be carried out without cancellation or interruption.

11. Claim 1-2, 4-7, 9-12, 14-17 and 19-20 are also rejected under 35 U.S.C. 103 as being unpatentable over Kyou-Woong Kim et al (US 20110205991 A1) in view of Ghyslain Pelletier et al (US 20170013565 A1).

For Claim 1, Kim discloses a method of a UE (User Equipment) (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission (Kim teaches, in ¶ 0060, lines 1-3, that the UE apparatus **receives a ULG signal** in block 400 and **determines whether there is uplink user data to be transmitted**);

the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI.

However, Pelletier discloses that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI (Pelletier teaches, in ¶

0970, lines 2-4 & 6, that the **WTRU may determine that there is no data available for transmission for a given subframe** for a given CG, such that reception of a grant **would lead to** transmission of padding information or **no transmission at all**).

Pelletier further teaches, in ¶ 0461, lines 2-3, a **grant** to be used for uplink transmission(s) in **a given TTI**.

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the no-transmission taught in Pelletier in order to conserve energy/power.

For Claims 2, 7, 12 & 17, Kim discloses a method of a UE, wherein the uplink grant is a configured uplink grant that is periodically available (Kim teaches, in ¶ 0026, lines 4-6, an uplink scheduling scheme based on **a periodic UpLink Grant (ULG)** signal transmitted from a Base Station).

For Claims 4, 9, 14 & 19, Kim discloses all of the claimed subject matter with the exception that skipping the uplink grant means the UE does not perform transmission on a data channel.

However, Pelletier discloses that that skipping the uplink grant means the UE does not perform transmission on a data channel (Pelletier teaches, in ¶ 0970, lines 2-4 & 6, that the WTRU may determine that there is no data available for transmission for a given subframe for a given CG, such that **reception of a grant would lead to** transmission of padding information or **no transmission at all**).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the no-transmission taught in Pelletier in order to conserve energy/power.

For Claims 5, 10, 15 & 20, Kim discloses a method of a UE, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element (Kim teaches, in ¶ 0007, lines 2-5 & 11-12, that the UE that has received a ULG signal and has been allocated to the PUSCH **generates a Medium Access Control (MAC) Protocol Data Unit (PDU) padded with zeroes** at a MAC layer ... and is **then transmitted**).

For Claim 6, Kim discloses a User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

a control circuit (Kim teaches, in FIG. 2, **a CONTROLLER 300**);

a processor installed in the control circuit (Kim teaches, in FIG. 2, **a DATA PROCESSOR 304**); and

a memory installed in the control circuit and operatively coupled to the processor; wherein the processor is configured to execute a program code (Kim teaches, in ¶ 0073, lines 1-3, that the foregoing embodiments may be implemented as code that can be written on a memory in a component of a UE apparatus ...**reads the program code** from the **memory by a processor** or a Central Processing Unit (CPU) and **executes it**) stored in the memory to:

determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not (Kim teaches, in ¶ 0062, lines 1-4, that in

the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI.

However, Pelletier discloses that the UE determines whether to skip the uplink grant in the TTI when/if control information need **not** be transmitted in the TTI (Pelletier teaches, in ¶ 0970, lines 2-4 & 6, that the **WTRU may determine that there is no data available for transmission for a given subframe** for a given CG, such that reception of **a grant would lead to transmission of padding information or no transmission at all**).

Pelletier further teaches, in ¶ 0461, lines 2-3, a **grant** to be used for uplink transmission(s) in **a given TTI**.

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the no-transmission taught in Pelletier in order to conserve energy/power.

For Claim 11, Kim discloses a method of a UE (User Equipment) (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission (Kim teaches, in ¶ 0060, lines 1-3, that the UE apparatus **receives a ULG signal** in block 400 and **determines whether there is uplink user data to be transmitted**);

the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose that the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI.

However, Pelletier discloses that the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI (Pelletier teaches, in ¶ 0970, lines 2-4 & 6, that the **WTRU may determine that there is no data available for transmission for a given subframe** for a given CG, such that reception of **a grant would lead to** transmission of padding information or **no transmission at all**).

Pelletier further teaches, in ¶ 0461, lines 2-3, a **grant** to be used for uplink transmission(s) in **a given TTI**.

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the no-transmission taught in Pelletier in order to conserve energy/power.

For Claim 16, Kim discloses a User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission (Kim teaches, in ¶ 0011, lines 2-5, **a method and apparatus for** transmitting control information indicating **the absence of user data to be transmitted to a BS at a UE**), comprising:

a control circuit (Kim teaches, in FIG. 2, **a CONTROLLER 300**);

a processor installed in the control circuit (Kim teaches, in FIG. 2, **a DATA PROCESSOR 304**); and

a memory installed in the control circuit and operatively coupled to the processor; wherein the processor is configured to execute a program code (Kim teaches, in ¶ 0073, lines 1-3, that the foregoing embodiments may be implemented as code that can be written on a memory in a component of a UE apparatus ...**reads the program code** from the **memory by a processor** or a Central Processing Unit (CPU) and **executes it**) stored in the memory to:

transmit a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI (Kim teaches, in ¶ 0062, lines 1-4, that in the absence of uplink user data, **the UE apparatus transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**).

Kim fails to expressly disclose skipping the uplink grant if the physical control information does not need to be transmitted in the TTI.

However, Pelletier discloses skipping the uplink grant if the physical control information does not need to be transmitted in the TTI (Pelletier teaches, in ¶ 0970, lines 2-4 & 6, that the **WTRU may determine that there is no data available for transmission for a given subframe** for a given CG, such that reception of **a grant would lead to** transmission of padding information or **no transmission at all**).

Pelletier further teaches, in ¶ 0461, lines 2-3, a **grant** to be used for uplink transmission(s) in **a given TTI**.

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim with the no-transmission taught in Pelletier in order to conserve energy/power.

12. Claims 3, 8, 13 and 18 are rejected under 35 U.S.C. 103 as being unpatentable over Kyou-Woong Kim et al (US 20110205991 A1) in view of Ghyslain Pelletier et al (US 20170013565 A1) as applied to claims 1, 6, 11 or 16 above, and further in view of Ying Sun et al (US 20160242176 A1).

For Claims 3, 8, 13 and 18, Kim & Pelletier disclose all of the claimed subject matter with the exception that skipping the uplink grant means the UE does not perform transmission on a data channel.

However, Sun discloses that that skipping the uplink grant means the UE does not perform transmission on a data channel (Sun teaches, in ¶ 0072, lines 6-12, that In such situation **the eNB** may, in addition to the NACK, also **send a dynamic grant**, overriding the semi-persistent scheduling).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to modify the communication system of Kim & Pelletier with the dynamic scheduling taught in Sun so that both the retransmission and semi-persistent transmission may be carried out without cancellation or interruption.

Conclusion

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MOHAMED KAMARA whose telephone number is (571)270-5629. The examiner can normally be reached on Monday thru. Thursday 10:00 a.m. to 4:00 p.m..

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, CHARLES C. JIANG can be reached on (571)270-7191. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

15. 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.

MOHAMED KAMARA
Primary Examiner
Art Unit 2412

Application/Control Number: 15/475,190
Art Unit: 2412

Page 19

/MOHAMED KAMARA/
Primary Examiner, Art Unit 2412

Notice of References Cited	Application/Control No. 15/475,190		Applicant(s)/Patent Under Reexamination LIN ET AL.	
	Examiner MOHAMED KAMARA		Art Unit 2412	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-2011/0205991 A1	08-2011	Kim; Kyou-Woong	H04W72/0413	370/329
*	B	US-2018/0091269 A1	03-2018	RATILAINEN; Antti	H04L5/0032	1/1
*	C	US-2017/0013565 A1	01-2017	PELLETIER; Ghyslain	H04W52/146	1/1
*	D	US-2016/0242176 A1	08-2016	SUN; Ying	H04W72/0446	1/1
*	E	US-2013/0308610 A1	11-2013	Bergstrom; Andreas	H04W56/00	370/336
*	F	US-2017/0208607 A1	07-2017	QUAN; Wei	H04W72/12	1/1
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

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)
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	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.

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

Notice of References Cited

Part of Paper No. 20180524

Search Notes 	Application/Control No. 15475190	Applicant(s)/Patent Under Reexamination LIN ET AL.
	Examiner MOHAMED KAMARA	Art Unit 2412

CPC- SEARCHED		
Symbol	Date	Examiner
H04W72/0413 OR H04W72/0446 OR H04W72/12 OR H04W72/1278 OR H04W72/14 or H04W52/\$	5/25/2018	M.K

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
Search EAST, CPC & IP.COM	5/25/2018	M.K

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/MOHAMED KAMARA/ Primary Examiner.Art Unit 2412
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Receipt date: 09/08/2017

15/475,190 - GAU: 2412

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)

Approved for use through 07/31/2018, 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		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Ko-Chiang Lin		
	Art Unit	2464		
	Examiner Name	Ricky Quoc Ngo /MOHAMED A KAMARA/		
	Attorney Docket Number	1426-113.101		

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
/M. A. K./	1	20110205991		2011-08-25	Samsung Electronics Co., Ltd.	

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 ²ⁱ	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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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

Receipt date: 09/08/2017

15/475,190 - GAU: 2412

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	First Named Inventor	Ko-Chiang Lin	
	Art Unit	2464	
	Examiner Name	Ricky Quoc Ngo / MOHAMED A. KAMARA /	
Attorney Docket Number		1426-113.101	

/M.A.K./	1	3GPP TSG-Ran WG2, Meeting #91, Beijing, China, August 24-28, 2015 (R2-153294).	☐
/M.A.K./	2	European Search Report from corresponding EP Application No. 17164114.5, dated August 25, 2017.	☐

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EXAMINER SIGNATURE

Examiner Signature	/MOHAMED A KAMARA/	Date Considered	05/25/2018
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*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.

Bibliographic Data

Application No: 15/475,190

Foreign Priority claimed: ☐ Yes ☒ No

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

Verified and Acknowledged: /MOHAMED A KAMARA/

Examiner's Signature

Initials

Title:

METHOD AND APPARATUS FOR IMPROVING A
TRANSMISSION USING A CONFIGURED RESOURCE IN A
WIRELESS COMMUNICATION SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/31/2017	370	2412	1426-113.101
RULE			

APPLICANTS

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Li-Chih Tseng Taipei City, TAIWAN

Meng-Hui Ou Taipei City, TAIWAN

Yu-Hsuan Guo Taipei City, TAIWAN

CONTINUING DATA

This application has PRO of 62316799 04/01/2016

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

04/07/2017

STATE OR COUNTRY

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ADDRESS

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650 Town Center Drive, Suite 1530

Costa Mesa, CA 92626

UNITED STATES

FILING FEE RECEIVED

\$2,020

Receipt date: 12/21/2017

15/475,190 - GAU: 2412

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Doc description: Information Disclosure Statement (IDS) Filed

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	Art Unit	2464		
	Examiner Name	Ricky Quoc Ngo /MOHAMED A KAMARA/		
	Attorney Docket Number	1426-113.101		

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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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/M.A.K/	¹	20150282148		2015-10-01	LE, Kheim	
/M.A.K/	²	20150163791		2015-06-11	CHEN, Wei-Yu	
/M.A.K/	³	20100142467		2010-06-10	TIIROLA et al.	

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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
/M.A.K/		201531135	TW		2015-08-01	Innovative Sonic Corp.		☐

Receipt date: 12/21/2017

15/475,190 - GAU: 2412

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Lin, Ko-Chiang	
	Art Unit	2464	
	Examiner Name	Ricky Quoc Ngo	
Attorney Docket Number		1426-113.101	

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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
/M.A.K/		Office Action from TIPO in corresponding TW Patent Application No. 106111274, dated December 14, 2017.	☐
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EXAMINER SIGNATURE			
Examiner Signature	/MOHAMED A KAMARA/		Date Considered 05/25/2018
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.			
¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.			

<i>Index of Claims</i> 	Application/Control No. 15475190	Applicant(s)/Patent Under Reexamination LIN ET AL.
	Examiner MOHAMED KAMARA	Art Unit 2412

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

☐ Claims renumbered in the same order as presented by applicant			☐ CPA			☐ T.D.			☐ R.1.47		
CLAIM		DATE									
Final	Original	05/25/2018									
	1	✓									
	2	✓									
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	17	✓									
	18	✓									
	19	✓									
	20	✓									

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S2	101565	(H04W72/0413 OR H04W72/0446 OR H04W72/12 OR H04W72/1278 OR H04W72/14 or H04W52/\$).CPC.	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:35
S3	3	S2 and (ignor\$3 or skip\$4 or avoid\$3) near4 (("UL" or uplink) adj3 grant) near4 (available or unavailable or present)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:37
S4	6	S2 and (ignor\$3 or skip\$4 or avoid\$3) with (("UL" or uplink) adj3 grant) with ((data or information) adj3(available or unavailable or present or not\$2available or without))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:38
S5	6	S2 and (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3) with (("UL" or uplink) adj3 grant) with ((data or information) adj3(available or unavailable or present or not\$2available or without))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:39
S6	5	S5 not S3	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:39
S7	1	("TTI" or "transmit time interval") with (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3) with (("UL" or uplink) adj3 grant) with ((data or information) adj3("no" or available or unavailable or present or not\$2available or without))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:44
S8	21	("TTI" or "transmit time interval") with (("UL" or uplink) adj3 grant) with ((data or information) adj3("no" or available or unavailable or present or not\$2available or without))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:44
S9	21	S8 and ((data or information) adj2 ("no" or available or unavailable or present or not\$2available or without))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:45
S10	3	S9 and (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3) near4 ("UL grant" or "uplink grant" or "uplink control channel" or "UCI" or resource)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:48
S11	19	S9 and (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3)	US-PGPUB; USPAT;	ADJ	OFF	2018/05/23 16:50

			EPO; JPO; DERWENT; IBM_TDB			
S12	16	S11 not S10	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:50
S13	505	("TTI" or "transmit time interval") near5 (("UL" or uplink) adj3 grant)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:56
S14	289	S13 and (without or no or unavailable or not\$2available or empty) near3 (data or traffic or information or buffer)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:57
S15	27	S14 and (determin\$3 or detect\$3) near4 (without or no or unavailable or not\$2available or empty) near3 (data or traffic or information or buffer)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:58
S16	27	S15 not S9	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 16:59
S17	303	(receiv\$3 near4 ("UL grant" or "uplink grant" or assignment) near5 ("TTI" or "transmit time interval"))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:12
S18	31	S17 and (determin\$3 or detect\$3 or confirm\$3 or establish\$3 or conclud\$3) near4 (without or no or unavailable or not\$2available or empty or "does not have") near3 (data or traffic or information or buffer)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:14
S19	12	S18 not S15	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:14
S20	196	S17 and (without or no or unavailable or not\$2available or empty or "does not have") near3 (data or traffic or information or buffer)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:39
S21	159	S20 and (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3 or sleep or power\$1down or turn\$1off)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:39
S22	140	S21 not S18	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:40
S23	75	S22 and (without or no or unavailable or	US-PGPUB;	ADJ	OFF	2018/05/23

		not\$2available or empty or "does not have") near3 (data or traffic or information or buffer) near4 (transmit\$4 or transmission or send\$3)	USPAT; EPO; JPO; DERWENT; IBM_TDB			17:40
S24	72	(receiv\$3 near4 ("UL grant" or "uplink grant" or assignment)) near5 (without or no or unavailable or not\$2available or empty or "does not have") near3 (data or traffic or information or buffer) near4 (transmit\$4 or transmission or send\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:57
S25	70	S24 not S23	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 17:58
S26	3	"20110205991"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/23 18:16
S27	175	(grant adj3 (resource or uplink or absolute or assignment)) with ((data or traffic or information or buffer) near4 (without or no or unavailable or not\$2available or empty or absent or absence or "there is no" or "does not have" or "does not exist"))	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 09:51
S28	64	S27 and (skip\$3 or ceas\$3 or stop\$4 or avoid\$3 or suppress\$3 or inhibit\$4 or ignor\$3 or disallow\$3 or disregard\$3) near4 (transmit\$4 or transmission or send\$3 or forward\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 09:53
S29	5	S28 and (grant adj3 (resource or uplink or absolute or assignment)) near4 ("TTI" or "transmit time interval" or sub\$1frame)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 09:54
S30	840	(grant adj3 (resource or uplink or absolute or assignment)) near4 ("TTI" or "transmit time interval" or sub\$1frame)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 09:59
S31	149	S30 and (skip\$3 or ceas\$3 or deactivat\$3 or sleep or "power down" or "turn off" or hibernat\$3 or inactive or suppress\$3 or inhibit\$4 or ignor\$3 or disallow\$3 or disregard\$3) near4 (transmit\$4 or transmission or send\$3 or forward\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 10:00
S32	146	S31 not S28	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 10:00
S33	142	S32 not S27	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 10:01
S34	840	(grant adj3 (resource or uplink or	US-PGPUB;	ADJ	OFF	2018/05/24

EAST Search History

		absolute or assignment)) near4 ("TTI" or "transmit time interval" or sub\$1frame)	USPAT; EPO; JPO; DERWENT; IBM_TDB			11:47
S35	226	S34 and (without or no or unavailable or not\$2available or empty or "does not have") near3 (data or traffic or information or buffer) near4 (transmit\$4 or transmission or send\$3)	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	ADJ	OFF	2018/05/24 11:47

5/ 25/ 2018 9:32:41 AM**C:\ Users\ mkamara\ Documents\ EAST\ Workspaces\ 15475190.w sp**

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Ko-Chiang Lin		
	Art Unit	2412		
	Examiner Name	Mohamed A. Kamara		
	Attorney Docket Number	1426-113.101		

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
	1	20110205991		2011-08-25	Kyou-Woong Kim	

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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ²ⁱ	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		15475190
	Filing Date		2017-03-31
	First Named Inventor	Ko-Chiang Lin	
	Art Unit	2412	
	Examiner Name	Mohamed A. Kamara	
	Attorney Docket Number	1426-113.101	

1	INTEL CORPORATION: "Protocol impact of fast uplink access solution for latency reduction", 3GPP DRAFT; R2-153294 PROTOCOL IMPACT OF FAST UPLINK ACCESS SOLUTION FOR LATENCY REDUCTION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPH vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 , 23 August 2015 (2015-08-23), XPO51004O42, Retrieved from the Internet:	☐
2	Office Action from corresponding TW Application No. 106111274, dated June 27, 2018.	☒

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

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
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*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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ko-Chiang Lin; Li-Chih Tseng; Meng-Hui Ou; Yu-Hsuan Guo
Title: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
Serial No.: 15/475,190 Filed: March 31, 2017
Examiner: Mohamed A. Kamara Group Art Unit: 2412
Attorney Docket No.: 1426-113.101 (1050051-US)

**CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8**

I hereby certify that the enclosed 3 Page Information Disclosure Statement Transmittal;
2 Page Information Disclosure Statement by Applicant with 2 references are being transmitted to
the United States Patent and Trademark Office via EFS-Web on July 2, 2018.

Date: July 2, 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

Electronic Acknowledgement Receipt	
EFS ID:	33068116
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	02-JUL-2018
Filing Date:	31-MAR-2017
Time Stamp:	15:50:43
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		1426-113-101-- IDSasFiled07022018.pdf	148470	yes	6
			b50dff86148f05036b1a115a29abd731933a c7bf		

Multipart Description/PDF files in .zip description					
Document Description			Start	End	
Transmittal Letter			1	3	
Information Disclosure Statement (IDS) Form (SB08)			4	5	
Miscellaneous Incoming Letter			6	6	
Warnings:					
Information:					
2	Non Patent Literature	D2.pdf	1149682	no	3
			ecf38cdf1735c84aee9a7c738bc1475347b39e5e		
Warnings:					
Information:					
3	Non Patent Literature	1050051-TW-2OA.PDF	1825962	no	7
			0a9feb3f5e3478a63b141128df3c38dc5fbb6cd5		
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Information Disclosure Statement Transmittal

Docket Number

1426-113.101

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

In Re Application Of:

Ko-Chiang Lin

Application No.	15/475,190
Filing Date	March 31, 2017
Examiner	Mohamed A. Kamara
Art Unit	2412

Title of Invention

METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A
WIRELESS COMMUNICATION SYSTEM

BASIS FOR FILING (Select 1, 2 or 3 below.)

37 CFR 1.97(b)

- 1) ☐ The Information Disclosure Statement submitted herewith is being filed within three months of the filing of a national application other than a continued prosecution application under 37 CFR 1.53 (d); within three months of the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; before the mailing of a first Office Action on the merits, or before the mailing of a first Office Action after the filing of a request for continued examination under 37 CFR 1.114.

37 CFR 1.97(c)

- 2) ☒ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(b), but before the mailing date of a Final Action under 37 CFR 1.113, a Notice of Allowance under 37 CFR 1.311, or an Action that otherwise closes prosecution in the application, and is accompanied by one of:

- a) ☒ the statement specified in 37 CFR 1.97(e);

OR

- b) ☐ the fee set forth in 37 CFR 1.17(p).

37 CFR 1.97(d)

- 3) ☐ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(c), and on or before payment of the issue fee, and is accompanied by the Statement as specified in 37 CFR 1.97(e) and the fee set forth in 37 CFR 1.17(p).

Information Disclosure Statement Transmittal

Docket Number

1426-113.101

STATEMENT UNDER 37 CFR 1.97(e) ACCOMPANYING INFORMATION DISCLOSURE STATEMENT

The Information Disclosure Statement submitted herewith is submitted under one of the following conditions, which satisfies the requirement under 37 CFR 1.97(e). (Select 4 or 5 below if applicable.)

- 4) ☒ That each item of information contained in the Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the Information Disclosure Statement; or
- 5) ☐ That no item of information contained in the Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the Information Disclosure Statement.

Remarks (Enter Remarks Below or Attach Document Containing Remarks)

Fee set forth in 37 CFR 1.17(p):

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Information Disclosure Statement Transmittal	Docket Number
	1426-113.101

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Country		Postal Code	
Phone Number			
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Select the name of the person who will electronically sign the Transmittal Letter 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	
	/Sang N. Dang/		Date Signed	07/02/2018

Information Disclosure Statement Transmittal

Docket Number

1426-113.101

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

In Re Application Of:

Ko-Chiang Lin

Application No.	15/475,190
Filing Date	March 31, 2017
Examiner	Mohamed A. Kamara
Art Unit	2412

Title of Invention

METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A
WIRELESS COMMUNICATION SYSTEM

BASIS FOR FILING (Select 1, 2 or 3 below.)

37 CFR 1.97(b)

- 1) ☐ The Information Disclosure Statement submitted herewith is being filed within three months of the filing of a national application other than a continued prosecution application under 37 CFR 1.53 (d); within three months of the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; before the mailing of a first Office Action on the merits, or before the mailing of a first Office Action after the filing of a request for continued examination under 37 CFR 1.114.

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OR

- b) ☐ the fee set forth in 37 CFR 1.17(p).

37 CFR 1.97(d)

- 3) ☐ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(c), and on or before payment of the issue fee, and is accompanied by the Statement as specified in 37 CFR 1.97(e) and the fee set forth in 37 CFR 1.17(p).

Information Disclosure Statement Transmittal

Docket Number

1426-113.101

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The Information Disclosure Statement submitted herewith is submitted under one of the following conditions, which satisfies the requirement under 37 CFR 1.97(e). (Select 4 or 5 below if applicable.)

- 4) ☒ That each item of information contained in the Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the Information Disclosure Statement; or
- 5) ☐ That no item of information contained in the Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the Information Disclosure Statement.

Remarks (Enter Remarks Below or Attach Document Containing Remarks)

Fee set forth in 37 CFR 1.17(p):

- ☒ No additional fee is required.
- ☐ A check in the amount of _____ is attached.
- ☐ The Director is hereby authorized to charge and credit Deposit Account No. _____ as described below.
- ☐ Charge the amount of _____
- ☐ Credit any overpayment.
- ☐ Charge any additional fee required.
- ☐ Payment by credit card. Form PTO-2038 is attached.

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.

Information Disclosure Statement Transmittal	Docket Number
	1426-113.101

Correspondence Address			
Customer Number	106622		
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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	
	/Sang N. Dang/		Date Signed	07-25-2018

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Lin, Ko-Chiang		
	Art Unit	2412		
	Examiner Name	Mohamed A. Kamara		
	Attorney Docket Number	1426-113.101		

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
	1	20110205991		2011-08-25	Kyou-Woong Kim	

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 ²ⁱ	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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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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Lin, Ko-Chiang	
	Art Unit	2412	
	Examiner Name	Mohamed A. Kamara	
Attorney Docket Number		1426-113.101	

1	3GPP TR 36.881 V0.6.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Study on latency reduction techniques for LTE, (February 29, 2016), first three pages only.	☐
2	3GPP TSG RAN Meeting #67, RP-150310-Motivation for new proposed SI, (March 9, 2015).	☐
3	Office Action from corresponding KR Application No. 10-2017-0042256, dated July 4, 2018.	☒

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.			

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ko-Chiang Lin; Li-Chih Tseng; Meng-Hui Ou; Yu-Hsuan Guo
Title: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
Serial No.: 15/475,190 Filed: March 31, 2017
Examiner: Mohamed A. Kamara Group Art Unit: 2412
Attorney Docket No.: 1426-113.101 (1050051-US)

**CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8**

I hereby certify that the enclosed 3 Page Information Disclosure Statement Transmittal;
2 Page Information Disclosure Statement by Applicant with 4 references are being transmitted to
the United States Patent and Trademark Office via EFS-Web on July 25, 2018.

Date: July 25, 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

Electronic Acknowledgement Receipt	
EFS ID:	33279767
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	25-JUL-2018
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File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	NPL--3GPPT36-881.pdf	231598	no	4
			c610d9625a504b7f6c28d43e31ea2941f6b e51ca		
Warnings:					

Information:					
2	Non Patent Literature	NPL-RP-150310.pdf	618053 67c06347fa7f105510a29caff77234fcb0ab861c	no	16
Warnings:					
Information:					
3	Non Patent Literature	NPL--KROfficeAction.pdf	1508104 71ce7267658e5604807b1939ba844f96841969d4	no	5
Warnings:					
Information:					
4	Non Patent Literature	NPL--KROfficeActioninEnglish.pdf	47293 124f3b77ce527349f000c061eb3fcd5032a4682	no	5
Warnings:					
Information:					
5	Information Disclosure Statement (IDS) Form (SB08)	1426-113-101--IDSasFiled07252018v2.pdf	153887 7f64ea282deba1849c20649e790e8c88267b4cf1	no	6
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
Total Files Size (in bytes):			2558935		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

Docket No. 1426-113.101 (1050051-US)
Appl. No. 15/475,190
Amdt. Dated September 7, 2018
Reply to Office Action of June 11, 2018

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 15/475,190
Confirmation No. : 8621
Applicants : Ko-Chiang Lin, Li-Chih Tseng, Meng-Hui Ou, and Yu-Hsuan Guo
Filed : March 31, 2017
Title : METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
TC/A.U. : 2412
Examiner : Mohamed A. Kamara
Docket No. : 1426-113.101 (1050051-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 non-final Office Action mailed on June 11, 2018, having a three-month period for filing a response to **September 11, 2018**, please amend the above-identified application as follows:

Claims begin on page 2.

Remarks begin on page 6.

IN THE CLAIMS:

1. (Currently Amended) A method of a UE (User Equipment), comprising:
an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;
the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and
the UE transmits the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.
2. (Original) The method of claim 1, wherein the uplink grant is a configured uplink grant that is periodically available.
3. (Original) The method of claim 1, wherein the uplink grant is a dynamic grant specific for the TTI.
4. (Currently Amended) The method of claim 1, wherein skipping the uplink grant means the UE does not perform transmission on [[a]] the data channel.
5. (Original) The method of claim 1, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.
6. (Currently Amended) A User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission 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:
determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not; and

transmit the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.

7. (Original) The UE of claim 6, wherein the uplink grant is a configured uplink grant that is periodically available.

8. (Original) The UE of claim 6, wherein the uplink grant is a dynamic grant specific for the TTI.

9. (Currently Amended) The UE of claim 6, wherein skipping the uplink grant means the UE does not perform transmission on [[a]] the data channel.

10. (Original) The UE of claim 6, wherein the processor is further configured to execute a program code stored in the memory to:

transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

11. (Original) A method of a UE (User Equipment), comprising:
an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission;
the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and
the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI.

12. (Original) The method of claim 11, wherein the uplink grant is a configured uplink grant that is periodically available.

13. (Original) The method of claim 11, wherein the uplink grant is a dynamic grant specific for the TTI.

14. (Original) The method of claim 11, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.

15. (Original) The method of claim 11, wherein the UE transmits the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

16. (Original) A User Equipment (UE), wherein an uplink grant is available for the UE in a TTI (Transmission Time Interval) and the UE does not have data available for transmission 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 physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI; and

skip the uplink grant if the physical control information does not need to be transmitted in the TTI.

17. (Original) The UE of claim 16, wherein the uplink grant is a configured uplink grant that is periodically available.

18. (Original) The UE of claim 16, wherein the uplink grant is a dynamic grant specific for the TTI.

19. (Original) The UE of claim 16, wherein skipping the uplink grant means the UE does not perform transmission on the data channel.

20. (Original) The UE of claim 16, wherein the processor is further configured to execute a program code stored in the memory to:

transmit the physical control information on the data channel with a transport block comprise a padding or a padding MAC (Medium Access Control) control element.

21. (New) The method of claim 1, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.

22. (New) The UE of claim 6, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.

23. (New) The method of claim 11, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.

24. (New) The UE of claim 16, wherein the physical control information includes at least one of Channel Quality Indicator (CQI), Precoding Matrix Index (PMI), Rank Indicator (RI), and Hybrid Automatic Repeat reQuest (HARQ) feedback.

25. (New) The method of claim 1, wherein the data channel is Physical Uplink Shared Channel (PUSCH).

26. (New) The UE of claim 6, wherein the data channel is Physical Uplink Shared Channel (PUSCH).

27. (New) The method of claim 11, wherein the data channel is Physical Uplink Shared Channel (PUSCH).

28. (New) The UE of claim 16, wherein the data channel is Physical Uplink Shared Channel (PUSCH).

REMARKS

Claims 1-20 are pending in the application.

I. Rejections Based on Kim and Ratilainen

Claims 1-2, 4-7, 9-12, 14-17 and 19-20 stand rejected under 35 U.S.C. § 103 as being unpatentable over Kim (U.S. Patent Publication No. 2011/0205991) in view of Ratilainen (U.S. Patent Publication No. 2018/0091269). *See* Office Action, ¶ 9. Furthermore, claims 3, 8, 13 and 18 stand rejected under 35 U.S.C. § 103 as being anticipated by Kim in view of Ratilainen, and further in view of Sun (U.S. Patent Publication No. 2016/0242176). *See* Office Action, ¶ 10.

Claims 1, 4, 6 and 9 have been amended. New claims 21-28 have been added. No new matter has been added. Applicants respectfully request reconsideration of claims 1-4 and 6-9 as amended and new claims 21-22 and 25-26 as added. Furthermore, Applicants respectfully traverse the rejection of claims 11-20 and respectfully request reconsideration of original claims 11-20 and new claims 23-24 and 27-28 as added.

Claim 1 recites “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission”, “the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not”, and “the UE transmits the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.” Similarly, claim 6 recites “determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not”, and “transmit the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.”

Claim 11 recites “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission”, “the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI”, and “the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI”. Similarly, claim 16 recites “transmit a physical control information on a data channel according to the uplink grant if the

physical control information needs to be transmitted in the TTI” and “skip the uplink grant if the physical control information does not need to be transmitted in the TTI.”

Applicants respectfully submit that the combination of Kim and Ratilainen fails to disclose the noted limitations of claims 1, 6, 11, and 16.

In particular, Paragraphs [0061] - [0062] of Kim teach that in the presence of uplink user data, the UE apparatus generates a general PUSCH signal based on resource allocation information included in the uplink grant (ULG) signal and transmits the general **PUSCH signal** on an uplink to the BS. In the absence of uplink user data, the UE apparatus **transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**. However, to transmit control information **PUCCH** does **not** imply to utilize the ULG.

From Paragraph [004] of Kim, it is clear the ULG signal disclosed in Kim would grant data transmission on a **PUSCH**. In other words, Kim does **not** teach that the UE would utilize ULG when there is no data and there is control information to be transmitted, as recited in claims 1 and 6. Rather, Kim discloses transmitting PUSCH signal on PUSCH and transmitting control information on PUCCH.

The Office Action admits that “Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need not be transmitted in the TTI”. *See e.g.*, Office Action, Page 4. Nevertheless, the Office Action cites to Ratilainen in rejecting the claims. *See e.g.*, Office Action, Page 4. Applicants respectfully disagree.

Paragraphs [0075] - [0079] of Ratilainen teach that a UE performs dual connectivity with **a first network node and a second network node**. The UE receives an IUA grant from the first network node. When the UE have information to be transmitted in the UL to the first network node, the UE determines resources associated with IUA is scheduled for UL transmission by the second network node in a resource associated with the IUA grant or not. When the resources is not scheduled, the UE transmits UL information to the first network node in the resource associated with IUA, and when the resources is scheduled, the second network node refrains from transmitting the UL information to the first network node in the resource associated with IUA.

Furthermore, Paragraph [0010] of Ratilainen teaches that if a UE capable of UL/DL separation has activated the UL/DL separation between two cells, it means that the uplink user application data is transferred via **physical uplink shared channel (PUSCH)** and while the

downlink user application data is transferred via **physical downlink shared channel (PDSCH)**.

More precisely, Paragraphs [0089] - [0094] and FIG.10 of Ratilainen teach that the UE performs dual connectivity with **MeNB and SeNB**. MeNB transmits an IUA grant which is indicate uplink resources shared by MeNB and SeNB to the UE, and MeNB informs SeNB of the IUA grant via UL scheduling coordination information. Therefore, SeNB knows the periodicity and starting subframe related to system frame number (SFN) of the IUA grant.

Paragraphs [0089] – [0093] of Ratilainen state:

[0089] One example of a network side controlled periodic implementation of the solution is depicted in FIG. 10 and described below. This periodic embodiment corresponds to the methods performed by the first and the second network node described above in conjunction with FIGS. 8-9.

[0090] 1. The eNB serving the downlink cell, which is typically the MeNB, configures a UE in UL/DL separation with a periodic IUA grant. The period of the IUA grant should be >1 to allow for uplink transmissions also in the uplink cell. To share uplink resources in the downlink cell among a group of UEs, contention based IUA grant can be used.

[0091] 2. The eNB serving the downlink cell informs the eNB serving the uplink cell, typically the SeNB, of the periodic IUA grant in the downlink cell via UL scheduling coordination information. The report includes the periodicity and starting subframe related to system frame number (SFN) of the IUA grant.

[0092] 3. The eNB serving the uplink cell refrains from scheduling the UE in UL/DL separation in the subframes where the UE has an IUA grant in the downlink cell.

[0093] 4. When UE has an UL transmission to be sent in the downlink cell, it uses the IUA grant to send that transmission in a transmission resource associated with the IUA grant. If no information is waiting to be transmitted in the UL in the downlink cell, the IUA resources are not utilized for transmission.

FIG. 10 (reproduced below with added annotation) of Ratilainen illustrates:

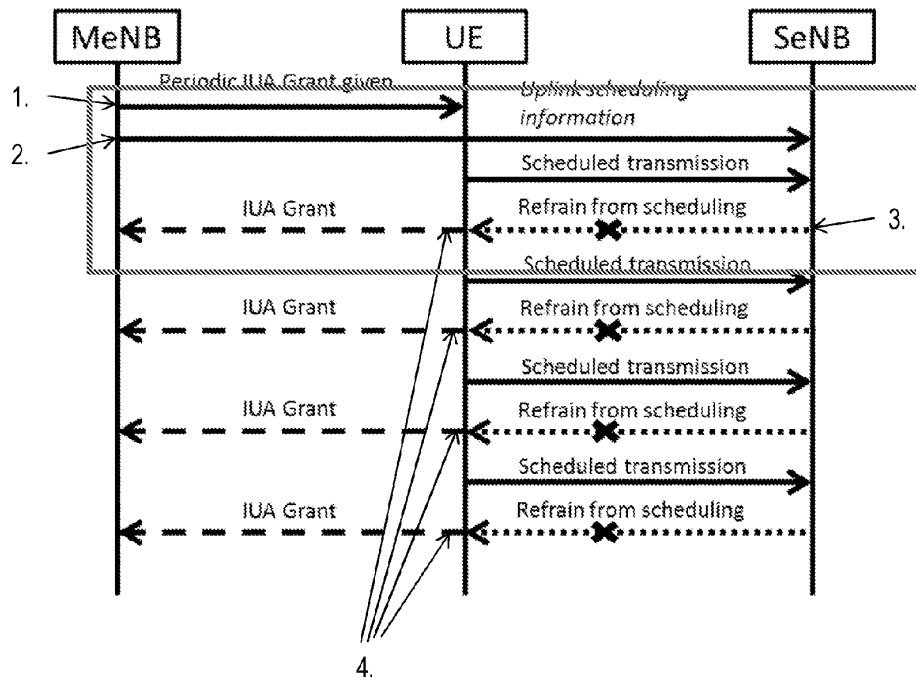


Figure 10

In addition, Paragraph [0085] of Ratilainen states:

[0085] FIG. 9 illustrates a method to be performed by a second network node in a wireless communication system supporting dual connectivity. The method corresponds to the method performed by the first network node described above. The method comprises, when serving a UE also being connected to a first network node: receiving 901 an indication from the first network node of an IUA grant for the UE. The IUA grant is associated with at least a periodicity of a semi-persistent scheduling. The method further comprises refraining 902 from scheduling the UE in UL resources associated with the IUA grant. **That is, the second network node may determine, based on the indication received from the first network node, which resources (IUA resources) that may be used by the UE for UL transmissions to the first network node, and refrain from scheduling the UE for UL transmission in these resources. By performing this method, simultaneous UL transmissions to the first and the second network node may be avoided, and thus also cross interference caused by such simultaneous transmissions.**

See Ratilainen, Paragraph [0085], emphasis added.

As seen, the UE is continuously scheduled for UL transmission by SeNB in all IUA resources on data channel. SeNB refrains scheduling transmission when UE has an UL transmission to be sent in MeNB, the UE uses the IUA grant to send that transmission in a transmission resource associated with the IUA grant on data channel. The motivation of Ratilainen is that by coordinating the UL transmissions between MeNB and SeNB, the UE obviates interference caused by simultaneous or contemporaneous UL transmissions to MeNB and SeNB.

Moreover, the Office Action cites to Paragraph [0093] of Ratilainen and alleges that “if **no information is waiting to be transmitted** in the UL in the downlink cell, **the IUA resources are not utilized for transmission.**” *See e.g.*, Office Action, Page 4. However, Paragraph [0094] of Ratilainen states that “..., UL information, such as RLC or RRC related messages, to be sent in the IUA resources, ...”. Therefore, the “UL information” disclosed in Ratilainen is **not** the physical control information recited in claims 1 and 6. Furthermore, the physical control information, as recited in claims 1, 6, 11, and 16, is further clarified in new claims 21 to 24.

In summary, Applicants respectfully submit that Ratilainen fails to teach that the UE determines whether to skip the uplink grant in the TTI when/if control information need not be transmitted in the TTI”. Accordingly, the combination of Kim and Ratilainen fail to teach “the UE determines whether to skip the uplink grant in the TTI **according to whether a physical control information needs to be transmitted** in the TTI or not.”

For the reasons stated the above, Applicants respectfully submit that claims 1-28 are patentable over any combination of Kim, Ratilainen, and/or Sun.

II. Rejections Based on Kim and Pelletier

Claims 1-2, 4-7, 9-12, 14-17 and 19-20 also stand rejected under 35 U.S.C. § 103 as being unpatentable over Kim in view of Pelletier (U.S. Patent Publication No. 2017/0013565). *See* Office Action, ¶ 11. Furthermore, claims 3, 8, 13 and 18 stand rejected under 35 U.S.C. § 103 as being unpatentable over Kim in view of Pelletier, and further in view of Sun. *See* Office Action, ¶ 12.

Claims 1, 4, 6 and 9 have been amended. New claims 21-28 have been added. No new matter has been added. Applicants respectfully request reconsideration of claims 1-4 and 6-9 as amended and new claims 21-22 and 25-26 as added. Furthermore, Applicants respectfully traverse the rejection of claims 11-20 and respectfully request reconsideration of original claims 11-20 and

new claims 23-24 and 27-28 as added.

Claim 1 recites “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission”, “the UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not”, and “the UE transmits the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.” Similarly, claim 6 recites “determine whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not”, and “transmit the physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI.”

Claim 11 recites “an uplink grant is available for the UE in a TTI (Transmission Time Interval), wherein the UE does not have data available for transmission”, “the UE transmits a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI”, and “the UE skips the uplink grant if the physical control information does not need to be transmitted in the TTI”. Similarly, claim 16 recites “transmit a physical control information on a data channel according to the uplink grant if the physical control information needs to be transmitted in the TTI” and “skip the uplink grant if the physical control information does not need to be transmitted in the TTI.”

Applicants respectfully submit that the combination of Kim and Pelletier fails to disclose the noted limitations of claims 1, 6, 11, and 16.

As discussed in Section I above, Paragraphs [0061] - [0062] of Kim teach that in the presence of uplink user data, the UE apparatus generates a general PUSCH signal based on resource allocation information included in the uplink grant (ULG) signal and transmits the general **PUSCH signal** on an uplink to the BS. In the absence of uplink user data, the UE apparatus **transmits control information** including state information indicating the absence of user data **on a PUCCH to the BS**. However, to transmit control information **PUCCH** does **not** imply to utilize the ULG.

From Paragraph [004] of Kim, it is clear the ULG signal disclosed in Kim would grant data transmission on a **PUSCH**. In other words, Kim does **not** teach that the UE would utilize ULG when there is no data and there is control information to be transmitted, as recited in claims 1 and

6. Rather, Kim discloses transmitting PUSCH signal on PUSCH and transmitting control information on PUCCH.

The Office Action admits that “Kim fails to expressly disclose that the UE determines whether to skip the uplink grant in the TTI when/if control information need not be transmitted in the TTI”. *See e.g.*, Office Action, Page 11. Nevertheless, the Office Action cites to Pelletier in rejecting the claims. *See e.g.*, Office Action, Pages 11-12. Applicants respectfully disagree.

Pelletier addresses prioritization of transmission and power scaling priority. In particular, Paragraph [0461] of Pelletier teaches that there may be more than one grant for a given TTI such that WTRU may select a grant to be used for uplink transmission. Besides, paragraph [0970] of Pelletier teaches when there is no data available for transmission for a given subframe, the WTRU transmits with zero power for PUSCH in the concerned subframe. In summary, Pelletier fails to teach or disclose “that the UE determines whether to skip the uplink grant in the TTI when/if control information need not be transmitted in the TTI”

For the reasons stated the above, Applicants respectfully submit that claims 1-28 are patentable over any combination of Kim, Pelletier, and/or Sun.

II. 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 at an early date is solicited. The Examiner is invited to contact Applicants’ undersigned counsel by telephone at (714) 839-3800 to expedite the prosecution of this case should there be any unresolved matters remaining.

Docket No. 1426-113.101 (1050051-US)
Appl. No. 15/475,190
Amdt. Dated September 7, 2018
Reply to Office Action of June 11, 2018

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: September 7, 2018

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ko-Chiang Lin; Li-Chih Tseng; Meng-Hui Ou; Yu-Hsuan Guo
Title: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
Serial No.: 15/475,190 Filed: March 31, 2017
Examiner: Mohamed A. Kamara Group Art Unit: 2412
Attorney Docket No.: 1426-113.101 (1050051-US)

**CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8**

I hereby certify that the enclosed 2 Page Amendment Transmittal Sheet; and 13 Page
Amendment are being transmitted to the United States Patent and Trademark Office via EFS-
Web on September 7, 2018.

Date: September 7, 2018

/Sandy Kim/
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Electronic Patent Application Fee Transmittal				
Application Number:		15475190		
Filing Date:		31-Mar-2017		
Title of Invention:		METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		
First Named Inventor/Applicant Name:		Ko-Chiang Lin		
Filer:		Sang N. Dang/Sandy Kim		
Attorney Docket Number:		1426-113.101		
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:				
CLAIMS IN EXCESS OF 20	1202	8	100	800
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				800

Electronic Acknowledgement Receipt	
EFS ID:	33660271
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	07-SEP-2018
Filing Date:	31-MAR-2017
Time Stamp:	15:41:11
Application Type:	Utility under 35 USC 111(a)

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Payment Type	CARD
Payment was successfully received in RAM	\$800
RAM confirmation Number	091018INTEFSW15415600
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		1426-113-101-- ROAof06112018asFiled09072018v2.pdf	280234	yes	16
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	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	2	
	Amendment/Req. Reconsideration-After Non-Final Reject		3	3	
	Claims		4	7	
	Applicant Arguments/Remarks Made in an Amendment		8	15	
	Miscellaneous Incoming Letter		16	16	
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30605	no	2
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Warnings:					
Information:					
Total Files Size (in bytes):			310839		

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New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

Amendment Transmittal Letter

Docket Number

1426-113.101

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

Title of Invention

METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM

First Named Inventor	Ko-Chiang Lin
Application No.	15/475,190
Filing Date	March 31, 2017
Examiner	Mohamed A. Kamara
Art Unit	2412

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	28	- 20 =	100	x ☐ =	800
Total Indep. Claims	4	- 4 =	460	x ☐ =	
Multiple Dependent Claims (check if applicable) ☐					
TOTAL					800

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 800

Amendment Transmittal Letter	Docket Number
	1426-113.101

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	
	/Sang N. Dang/		Date Signed	09/07/2018

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875			Application or Docket Number 15/475,190		Filing Date 03/31/2017		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO								
APPLICATION AS FILED - PART I								
		(Column 1)	(Column 2)					
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)		FEE (\$)	
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A			
☐ SEARCH FEE (37 CFR 1.16(k), (j), 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 \$80 =			
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		x \$420 =			
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))								
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL			
APPLICATION AS AMENDED - PART II								
		(Column 1)	(Column 2)		(Column 3)			
AMENDMENT	09/07/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)	ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 28	Minus	** 20	= 8	x \$100 =	800	
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 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	800	
		(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.						SLIE		
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						KIMBERLY D WILLIAMS		
*** 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.

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

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 15/475,190		Filing Date 03/31/2017		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO									
APPLICATION AS FILED – PART I									
(Column 1)		(Column 2)							
FOR	NUMBER FILED	NUMBER EXTRA				RATE (\$)	FEE (\$)		
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A				N/A			
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A				N/A			
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A				N/A			
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =		*			X \$	=		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =		*			X \$	=		
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).								
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									
* If the difference in column 1 is less than zero, enter "0" in column 2.						TOTAL			
APPLICATION AS AMENDED – PART II									
(Column 1)		(Column 2)		(Column 3)					
AMENDMENT	09/07/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 28	Minus	** 20	= 8	x \$100 =		800	
	Independent (37 CFR 1.16(h))	* 4	Minus	***4	= 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		800	
(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 \$			
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X \$			
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.									

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.



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 11/07/2018
Blue Capital Law Firm, P.C.
650 Town Center Drive, Suite 1530
Costa Mesa, CA 92626

EXAMINER

KAMARA, MOHAMED A

ART UNIT

PAPER NUMBER

2412

DATE MAILED: 11/07/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/475,190	03/31/2017	Ko-Chiang Lin	1426-113.101	8621

TITLE OF INVENTION: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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	02/07/2019

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

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

HOW TO REPLY TO THIS NOTICE:

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

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

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

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

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

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

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

PART B - FEE(S) TRANSMITTAL

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

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

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

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

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

106622 7590 11/07/2018
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.
15/475,190	03/31/2017	Ko-Chiang Lin	1426-113.101	8621

TITLE OF INVENTION: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE 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	02/07/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
KAMARA, MOHAMED A	2412	370-329000

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, 1 _____
- (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. 2 _____
- 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

4a. Fees submitted: ☐ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

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

- ☐ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
- ☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

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

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

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/475,190	03/31/2017	Ko-Chiang Lin	1426-113.101	8621
106622	7590	11/07/2018	EXAMINER	
Blue Capital Law Firm, P.C.			KAMARA, MOHAMED A	
650 Town Center Drive, Suite 1530			ART UNIT	
Costa Mesa, CA 92626			PAPER NUMBER	

2412

DATE MAILED: 11/07/2018

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

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

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

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

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

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

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

Privacy Act Statement

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

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

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

Notice of Allowability	Application No. 15/475,190	Applicant(s) Lin et al.
	Examiner MOHAMED A KAMARA	Art Unit 2412
		AIA 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 amendment and remarks filed on 09/07/2018.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

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

3. ☒ The allowed claim(s) is/are 1-28. 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 <u>07/02/2018 & 07/25/2018</u> . 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 _____.
---	--

/MOHAMED A KAMARA/ Primary Examiner, Art Unit 2412	
---	--

Notice of Pre-AIA or AIA Status

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

DETAILED ACTION

1. This office action is in response to the amendment and remarks filed on 09/07/2018.
2. Claims 1-28 are currently pending.
3. Claims 1, 4, 6, 9 are currently amended.
4. Claims 21-28 are newly added.

Allowable Subject Matter

5. Claims 1-28 are allowable.
6. The following is a statement of reasons for the indication of allowable subject matter:
Claims 1-28 are considered allowable since Applicant's argument below is persuasive:

“Applicants respectfully submit that the combination of Kim and Ratilainen fails to disclose the noted limitations of claims 1, 6, 11, and 16.

From Paragraph [004] of Kim, it is clear the ULG signal disclosed in Kim would grant data transmission on a PUSCH. In other words, Kim does not teach that the UE would utilize ULG when there is no data and there is control information to be transmitted, as recited in claims 1 and 6. Rather, Kim discloses transmitting PUSCH signal on PUSCH and transmitting control information on PUCCH.

In summary, Applicants respectfully submit that Ratilainen fails to teach that the UE determines whether to skip the uplink grant in the TTI when/if control information need not be transmitted in the TTI”. Accordingly, the combination of Kim and Ratilainen fail to teach ‘the

UE determines whether to skip the uplink grant in the TTI according to whether a physical control information needs to be transmitted in the TTI or not’.”

7. 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

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MOHAMED A KAMARA whose telephone number is (571)270-5629. The examiner can normally be reached on M-F 9AM-4PM.

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

10. If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, CHARLES C JIANG can be reached on (571) 270-7191. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

11. 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.

/MOHAMED A KAMARA/
Primary Examiner, Art Unit 2412

Issue Classification 	Application/Control No. 15/475,190	Applicant(s)/Patent Under Reexamination Lin et al.
	Examiner MOHAMED A KAMARA	Art Unit 2412

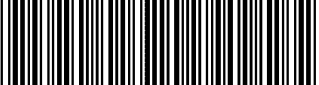
CPC						
Symbol					Type	Version
H04W	/	72	/	0413	F	2013-01-01
H04W	/	72	/	0446	I	2013-01-01
H04W	/	72	/	14	I	2013-01-01
H04W	/	72	/	12	I	2013-01-01
H04W	/	72	/	1278	A	2013-01-01

CPC Combination Sets					
Symbol				Type	Version
	/		/		

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	28	
/MOHAMED A KAMARA/ Primary Examiner, Art Unit 2412	29 October 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	FIG. 23

U.S. Patent and Trademark Office

Part of Paper No.: 20181029

Issue Classification 	Application/Control No. 15/475,190	Applicant(s)/Patent Under Reexamination Lin et al.
	Examiner MOHAMED A KAMARA	Art Unit 2412

INTERNATIONAL CLASSIFICATION			
CLAIMED			
H04W		72	00

NON-CLAIMED			

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	28	
/MOHAMED A KAMARA/ Primary Examiner, Art Unit 2412	29 October 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	FIG. 23

Issue Classification 	Application/Control No. 15/475,190	Applicant(s)/Patent Under Reexamination Lin et al.
	Examiner MOHAMED A KAMARA	Art Unit 2412

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10		19		28								
	2		11		20										
	3		12		21										
	4		13		22										
	5		14		23										
	6		15		24										
	7		16		25										
	8		17		26										
	9		18		27										

NONE	Total Claims Allowed:	
(Assistant Examiner)	(Date)	28
/MOHAMED A KAMARA/ Primary Examiner, Art Unit 2412	29 October 2018	O.G. Print Claim(s)
(Primary Examiner)	(Date)	1
		O.G. Print Figure
		FIG. 23

Search Notes 	Application/Control No. 15/475,190	Applicant(s)/Patent Under Reexamination Lin et al.
	Examiner MOHAMED A KAMARA	Art Unit 2412

CPC - Searched*		
Symbol	Date	Examiner
H04W72/0413 OR H04W72/0446 OR H04W72/12 OR H04W72/1278 OR H04W72/14 or H04W52/\$	5/25/2018	M.K

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
Search EAST, CPC & IP.COM	5/25/2018	M.K
Inventor-names and Assignee-name searches performed	10/29/2018	M.K

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	See Interference Search History Report	10/29/2018	M.K

/MOHAMED KAMARA/ Primary Examiner.Art Unit 2412	
--	--

Bibliographic Data

Application No: 15/475,190

Foreign Priority claimed: ☐ Yes ☒ No

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

Verified and Acknowledged:

/MOHAMED A KAMARA/

Examiner's Signature

Initials

Title:

METHOD AND APPARATUS FOR IMPROVING A
TRANSMISSION USING A CONFIGURED RESOURCE IN A
WIRELESS COMMUNICATION SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
03/31/2017	370	2412	1426-113.101
RULE			

APPLICANTS

ASUSTeK Computer Inc., Taipei City 112, TAIWAN

INVENTORS

Ko-Chiang Lin Taipei City, TAIWAN

Li-Chih Tseng Taipei City, TAIWAN

Meng-Hui Ou Taipei City, TAIWAN

Yu-Hsuan Guo Taipei City, TAIWAN

CONTINUING DATA

This application has PRO of 62316799 04/01/2016

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

04/07/2017

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

\$2,020

Receipt date: 07/02/2018

15/475,190 - GAU: 2412

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Ko-Chiang Lin		
	Art Unit	2412		
	Examiner Name	Mohamed A. Kamara		
	Attorney Docket Number	1426-113.101		

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
/M.A.K/	1	20110205991		2011-08-25	Kyou-Woong Kim	

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 ²ⁱ	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

Receipt date: 07/02/2018

15/475,190 - GAU: 2412

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Ko-Chiang Lin	
	Art Unit	2412	
	Examiner Name	Mohamed A. Kamara	
	Attorney Docket Number	1426-113.101	

/M.A.K./ ¹	INTEL CORPORATION: "Protocol impact of fast uplink access solution for latency reduction", 3GPP DRAFT; R2-153294 PROTOCOL IMPACT OF FAST UPLINK ACCESS SOLUTION FOR LATENCY REDUCTION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPH vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 , 23 August 2015 (2015-08-23), XPO51004O42, Retrieved from the Internet:	☐
/M.A.K./ ²	Office Action from corresponding TW Application No. 106111274, dated June 27, 2018.	☒

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

EXAMINER SIGNATURE

Examiner Signature	/MOHAMED A KAMARA/	Date Considered	10/29/2018
--------------------	--------------------	-----------------	------------

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

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

Information Disclosure Statement Transmittal

Docket Number

1426-113.101

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

In Re Application Of:

Ko-Chiang Lin

Application No.	15/475,190
Filing Date	March 31, 2017
Examiner	Mohamed A. Kamara
Art Unit	2412

Title of Invention

METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A
WIRELESS COMMUNICATION SYSTEM

BASIS FOR FILING (Select 1, 2 or 3 below.)

37 CFR 1.97(b)

- 1) ☐ The Information Disclosure Statement submitted herewith is being filed within three months of the filing of a national application other than a continued prosecution application under 37 CFR 1.53 (d); within three months of the date of entry of the national stage as set forth in 37 CFR 1.491 in an international application; before the mailing of a first Office Action on the merits, or before the mailing of a first Office Action after the filing of a request for continued examination under 37 CFR 1.114.

37 CFR 1.97(c)

- 2) ☒ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(b), but before the mailing date of a Final Action under 37 CFR 1.113, a Notice of Allowance under 37 CFR 1.311, or an Action that otherwise closes prosecution in the application, and is accompanied by one of:

- a) ☒ the statement specified in 37 CFR 1.97(e);

OR

- b) ☐ the fee set forth in 37 CFR 1.17(p).

37 CFR 1.97(d)

- 3) ☐ The Information Disclosure Statement submitted herewith is being filed after the period specified in 37 CFR 1.97(c), and on or before payment of the issue fee, and is accompanied by the Statement as specified in 37 CFR 1.97(e) and the fee set forth in 37 CFR 1.17(p).

**Information Disclosure Statement
Transmittal**

Docket Number

1426-113.101

STATEMENT UNDER 37 CFR 1.97(e) ACCOMPANYING INFORMATION DISCLOSURE STATEMENT

The Information Disclosure Statement submitted herewith is submitted under one of the following conditions, which satisfies the requirement under 37 CFR 1.97(e). (Select 4 or 5 below if applicable.)

- 4) ☒ That each item of information contained in the Information Disclosure Statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the Information Disclosure Statement; or
- 5) ☐ That no item of information contained in the Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the Information Disclosure Statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the Information Disclosure Statement.

Remarks (Enter Remarks Below or Attach Document Containing Remarks)**Fee set forth in 37 CFR 1.17(p):**

- ☒ No additional fee is required.
- ☐ A check in the amount of _____ is attached.
- ☐ The Director is hereby authorized to charge and credit Deposit Account No. _____ as described below.
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- ☐ Credit any overpayment.
- ☐ Charge any additional fee required.
- ☐ Payment by credit card. Form PTO-2038 is attached.

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Information Disclosure Statement Transmittal	Docket Number
	1426-113.101

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

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Certificate of Transmission
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Select the name of the person who will electronically sign the Transmittal Letter 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	
	/Sang N. Dang/		Date Signed	07-25-2018

Receipt date: 07/25/2018

15/475,190 - GAU: 2412

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Lin, Ko-Chiang		
	Art Unit	2412		
	Examiner Name	Mohamed A. Kamara		
	Attorney Docket Number	1426-113.101		

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
/M.A.K./	1	20110205991		2011-08-25	Kyou-Woong Kim	

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 ²ⁱ	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1							☐

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

Receipt date: 07/25/2018

15/475,190 - GAU: 2412

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Lin, Ko-Chiang	
	Art Unit	2412	
	Examiner Name	Mohamed A. Kamara	
Attorney Docket Number		1426-113.101	

/M.A.K/	1	3GPP TR 36.881 V0.6.0, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Study on latency reduction techniques for LTE, (February 29, 2016), first three pages only.	☐
/M.A.K/	2	3GPP TSG RAN Meeting #67, RP-150310-Motivation for new proposed SI, (March 9, 2015).	☐
/M.A.K/	3	Office Action from corresponding KR Application No. 10-2017-0042256, dated July 4, 2018.	☒

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

EXAMINER SIGNATURE

Examiner Signature	/MOHAMED A KAMARA/	Date Considered	10/29/2018
*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.			
¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.			

EAST Search History**EAST Search History (Interference)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	164546	(lin or Tseng or Ou or Guo).in.	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 11:22
L2	1911	("AsusTek" or "Asus" or "ASSUSTeK Computer").as.	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 11:22
L3	412	1 and 2	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 11:23
L4	2143	(transmit\$4 or send\$3) near4 (control adj3 (element or information or signal or packet or frame)) near4 (data adj2 (channel or region))	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 11:24
L5	425	(transmit\$4 or send\$3) near4 (control adj3 (element or information or signal or packet or frame)) near4 (data adj2 (channel or region)).clm.	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 11:25
L6	9	5 and (ignor\$3 or skip\$4 or avoid\$3 or disregard\$3 or dismiss\$3) near5 ("UL grant" or "uplink grant" or "resource grant" or "grant")	US-PGPUB; USPAT	ADJ	OFF	2018/10/29 12:01

10/ 29/ 2018 12:16:58 PM**C:\Users\mkamara\Documents\EAST\Workspaces\15475190.wsp**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Ko-Chiang Lin; Li-Chih Tseng; Meng-Hui Ou; Yu-Hsuan Guo
Title: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION
USING A CONFIGURED RESOURCE IN A WIRELESS
COMMUNICATION SYSTEM
Serial No.: 15/475,190 Filed: March 31, 2017
Examiner: Mohamed A. Kamara Group Art Unit: 2412
Attorney Docket No.: 1426-113.101 (1050051-US)

**CERTIFICATE OF EFS-WEB TRANSMISSION
UNDER 37 CFR § 1.8**

I hereby certify that the enclosed 1 Page Issue Fee Transmittal; and Payment by EFS-
Web are being transmitted to the United States Patent and Trademark Office via EFS-Web on
November 26, 2018.

Date: November 26, 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

Electronic Patent Application Fee Transmittal				
Application Number:		15475190		
Filing Date:		31-Mar-2017		
Title of Invention:		METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM		
First Named Inventor/Applicant Name:		Ko-Chiang Lin		
Filer:		Sang N. Dang/Sandy Kim		
Attorney Docket Number:		1426-113.101		
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:	34391440
Application Number:	15475190
International Application Number:	
Confirmation Number:	8621
Title of Invention:	METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Ko-Chiang Lin
Customer Number:	106622
Filer:	Sang N. Dang/Sandy Kim
Filer Authorized By:	Sang N. Dang
Attorney Docket Number:	1426-113.101
Receipt Date:	26-NOV-2018
Filing Date:	31-MAR-2017
Time Stamp:	14:42:45
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	112718INTEFSW14432600
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		1426-113-101-- IssueFeeAsFiledV2.pdf	185892	yes	2
			8ba271d93296990e9a4cc4d991fa63f51468777d		
	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	30251	no	2
			b5ac69b0db4ff6b5f1ddabf8f83b0c6229de4d8d		
Warnings:					
Information:					
Total Files Size (in bytes):			216143		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

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
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.

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

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

APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
15/475,190	03-31-2017	Ko-Chiang Lin	1426-113.101	8621

TITLE OF INVENTION: METHOD AND APPARATUS FOR IMPROVING A TRANSMISSION USING A CONFIGURED RESOURCE IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEES DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0	\$0	\$1000	02/07/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
KAMARA, MOHAMED A	2412	370-329000

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

ASUSTek Computer Inc.

(B) RESIDENCE: (CITY and STATE or COUNTRY)

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):

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5. Change of 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.

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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 November 26, 2018

Typed or printed name Sang N. Dang

Registration No. 51,186

Receipt date: 07/02/2018

15/475,190 - GAU: 2412

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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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190	
	Filing Date		2017-03-31	
	First Named Inventor	Ko-Chiang Lin		
	Art Unit	2412		
	Examiner Name	Mohamed A. Kamara		
	Attorney Docket Number	1426-113.101		

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
/M.A.K/	1	20110205991		2011-08-25	Kyou-Woong Kim	

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 ²ⁱ	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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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

Receipt date: 07/02/2018

15/475,190 - GAU: 2412

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		15475190
	Filing Date		2017-03-31
	First Named Inventor	Ko-Chiang Lin	
	Art Unit	2412	
	Examiner Name	Mohamed A. Kamara	
Attorney Docket Number		1426-113.101	

/M.A.K./ 1	INTEL CORPORATION: "Protocol impact of fast uplink access solution for latency reduction", 3GPP DRAFT; R2-153294 PROTOCOL IMPACT OF FAST UPLINK ACCESS SOLUTION FOR LATENCY REDUCTION, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPH vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 , 23 August 2015 (2015-08-23), XPO51004O42, Retrieved from the Internet: https://portal.3gpp.org/ngppapp/CreateTdoc.aspx?mode=view&contributionId=651850	☐
/M.A.K./ 2	Office Action from corresponding TW Application No. 106111274, dated June 27, 2018.	☒

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EXAMINER SIGNATURE

Examiner Signature	/MOHAMED A KAMARA/	Date Considered	12/02/2018 ~~10/25/2018~~
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*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

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



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/475,190	01/22/2019	10187878	1426-113.101	8621

106622 7590 01/01/2019

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 11 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

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Li-Chih Tseng, Taipei City, TAIWAN;
Meng-Hui Ou, Taipei City, TAIWAN;
Yu-Hsuan Guo, Taipei City, TAIWAN;

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IR103 (Rev. 10/09)