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- (71) **Applicant:** INTEL IP CORPORATION [US/US]; 2200 Mission College Boulevard, Santa Clara, California 95054 (US).
- (72) **Inventors:** PHUYAL, Umesh; 20782 NW Longbow Ln, Beaverton, Oregon 97006 (US). HE, Hong; 8F, Raycom Infotech Park A, No. 2, KeXueYuan South Road, HaiDian District, Beijing, 100190 (CN). YIU, Candy; 1750 SW Broadway Drive, Portland, Oregon 97201 (US). ZHANG, Yujian; Room 312, Building 21, CAAS, No. 12 Zhong-

GuanCunNanDaJie, Haidian District, Beijing, 100081 (CN). HEO, Youn Hyoung; 4F, 27-3, Hana Daetoo Securities Bldg, Yeouido-dong, Yeongdeungpo-gu, Seoul, Seoul 07321 (KR).

(74) **Agent:** COOL, Kenneth J.; Alpine Technology Law Group LLC, 9249 S. Broadway, Unit 200-201, Highlands Ranch, Colorado 80129 (US).

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(54) **Title:** UPLINK GRANT SKIPPING INDICATION

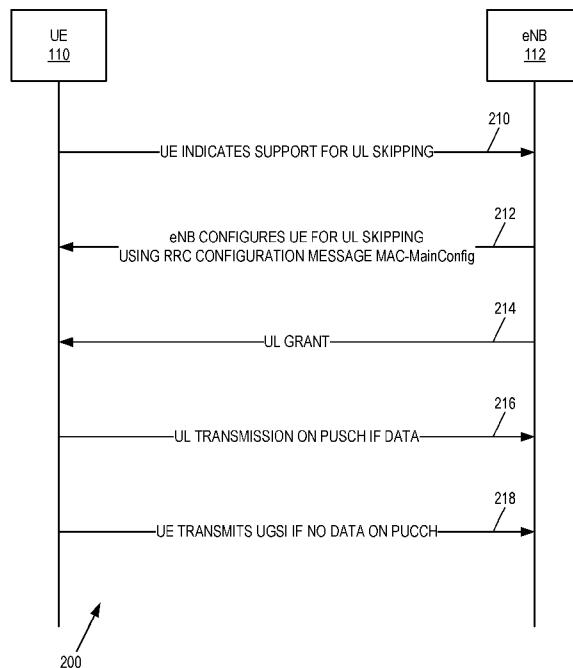


FIG. 2

(57) **Abstract:** Briefly, in accordance with one or more embodiments, an apparatus of an evolved Node B (eNB) or a next generation Node B (gNB), comprises one or more baseband processors to process an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant, and a memory to store the indication for the UE. The one or more baseband processors are to encode a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant.



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UPLINK GRANT SKIPPING INDICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims the benefit of US Provisional Application No. 62/317,207 (P97651Z) filed April 1, 2016. Said Application No. 62/317,207 is hereby incorporated herein by reference in its entirety.

BACKGROUND

Work on latency reductions techniques is ongoing in the Third-Generation Partnership Project (3GPP) standards bodies. Some items being addressed include the reduction of padding for dynamic and semi-persistent scheduling (SPS) based uplink prescheduling to reduce interference and power consumption of user equipment (UE) devices. To achieve such a padding reduction, a UE should be able to ignore or skip an uplink grant such that no uplink transmission may occur on a physical uplink shared channel (PUSCH) in the event the UE has no data to transmit in the uplink buffer. Such behavior is different from the current 3GPP specification wherein a padding protocol data unit (PDU) would be transmitted by the UE in the event the UE has no uplink data to be transmitted.

DESCRIPTION OF THE DRAWING FIGURES

Claimed subject matter is particularly pointed out and distinctly claimed in the concluding portion of the specification. However, such subject matter may be understood by reference to the following detailed description when read with the accompanying drawings in which:

FIG. 1 is a diagram of an uplink grant procedure in which an uplink transmission is lost in accordance with one or more embodiments;

FIG. 2 is a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using a media access control (MAC) Main Configuration information element, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments;

FIG. 3 is a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using a semi-persistent scheduling (SPS) configuration uplink information element, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments;

FIG. 4 is a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using an uplink grant skipping indicator information element in

downlink control information format, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments;

FIG. 5 is a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using an uplink grant skipping indicator information element in semi-persistent scheduling activation/deactivation downlink control information format, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments;

FIG. 6 is a block diagram of an information handling system capable of implementing mobility measurements for beamforming in accordance with one or more embodiments;

FIG. 7 is an isometric view of an information handling system of FIG. 7 that optionally may include a touch screen in accordance with one or more embodiments; and

FIG. 8 is a diagram of example components of a wireless device in accordance with one or more embodiments.

It will be appreciated that for simplicity and/or clarity of illustration, elements illustrated in the figures have not necessarily been drawn to scale. For example, the dimensions of some of the elements may be exaggerated relative to other elements for clarity. Further, if considered appropriate, reference numerals have been repeated among the figures to indicate corresponding and/or analogous elements.

DETAILED DESCRIPTION

In the following detailed description, numerous specific details are set forth to provide a thorough understanding of claimed subject matter. It will, however, be understood by those skilled in the art that claimed subject matter may be practiced without these specific details. In other instances, well-known methods, procedures, components and/or circuits have not been described in detail.

In the following description and/or claims, the terms coupled and/or connected, along with their derivatives, may be used. In particular embodiments, connected may be used to indicate that two or more elements are in direct physical and/or electrical contact with each other. Coupled may mean that two or more elements are in direct physical and/or electrical contact. However, coupled may also mean that two or more elements may not be in direct contact with each other, but yet may still cooperate and/or interact with each other. For example, "coupled" may mean that two or more elements do not contact each other but are indirectly joined together via another element or intermediate elements. Finally, the terms "on," "overlying," and "over" may be used in the following description and claims. "On," "overlying," and "over" may be used to indicate that two or more elements are in direct physical contact with each other. It should be

noted, however, that "over" may also mean that two or more elements are not in direct contact with each other. For example, "over" may mean that one element is above another element but not contact each other and may have another element or elements in between the two elements. Furthermore, the term "and/or" may mean "and", it may mean "or", it may mean "exclusive-or", it may mean "one", it may mean "some, but not all", it may mean "neither", and/or it may mean "both", although the scope of claimed subject matter is not limited in this respect. In the following description and/or claims, the terms "comprise" and "include," along with their derivatives, may be used and are intended as synonyms for each other.

Referring now to FIG. 1, a diagram of an uplink grant procedure in which an uplink transmission is lost in accordance with one or more embodiments will be discussed. As shown in FIG. 1, an evolved Node B (eNB) 112 of a Long Term Evolution (LTE) Third Generation Partnership Project (3GPP) network may allocate an uplink (UL) grant to a user equipment (UE) 110. In one or more embodiments, eNB 112 alternatively may comprise a next generation Node B of a New Radio (NR) Fifth Generation (5G) network, and the scope of the claimed subject matter is not limited in this respect. Transmission 114 may represent an uplink transmission from UE 110 to eNB 112 that was decoded successfully, and eNB 112 may send an acknowledgement (ACK) to UE 110 in response. Transmission 116 may represent an uplink transmission from UE 110 to eNB 112 that was detected by eNB but not decoded successfully, and eNB 112 may then schedule an explicit grant for hybrid automatic repeat request (HARQ) retransmission. Transmission 118 may represent an explicit grant for HARQ retransmission, wherein the configured UL grant 120 is ignored. Transmission 122 may represent an uplink transmission that was lost, and eNB 112 assumes the uplink transmission for that grant was skipped, therefore no explicit grant for HARQ retransmission is scheduled. As a result of the explicit grant being absent, transmission 124 may represent a HARQ retransmission that is ignored by eNB 112, and instead a transmission of new data 126 may be performed in the same slot, or subframe, or transmission time interval (TTI).

Thus, if UE 110 has no data to transmit and UE 110 ultimately ignores the UL grant, eNB 112 may not have any way to differentiate or identify whether the UL grant was skipped or if an UL transmission occurred but physical uplink shared channel (PUSCH) detection has failed. Therefore, it may be unclear to eNB 112 whether the resources corresponding to synchronous HARQ retransmission (non-adaptive) may be dynamically allocated to another UE or otherwise may be left alone for a potential HARQ retransmission. As a result, in absence of some sort of indication that a dynamic UL grant is skipped by UE 100, eNB 112 potentially may not allocate the resources to other UEs and/or for other purposes, resulting in wasted resources.

There may exist cases where adaptive HARQ retransmissions should be supported, for example semi-persistent scheduling (SPS) with short intervals. When UL grant skipping is allowed, eNB 112 may not be aware whether the UL transmission is absent or if the UL transmission has failed. As a result, even if eNB 112 wants to support HARQ retransmissions using explicit signaling, the decision may be erroneous. Specifically, eNB 112 may not send an explicit grant assuming that the UL transmission was skipped when UE 110 in fact performed an UL transmission which got lost and eNB 112 is unable to detect the transmission. In absence of some sort of indication that the UL grant has been skipped, eNB 112 may make wrong decisions related to supporting adaptive retransmissions when the UL transmission is lost but eNB 112 mistakenly assumes the UL transmission is skipped.

After SPS is configured and activated, UE 110 may skip the configured UL grant if there is no UL data to be transmitted. Therefore, for the eNB 112, it is not clear whether the SPS activation/reactivation command is successful or has failed due to the physical downlink control channel (PDCCH) loss. Even though the PDCCH loss rate typically is low, PDCCH loss may create ambiguity. Thus, eNB 112 may not be aware about the success or failure of the SPS activation/reactivation command in the absence of a UL grant skipping indication.

In one or more embodiments described herein, UL grant skipping may be enabled to increase physical uplink shared channel (PUSCH) efficiency, allowing UE 110 to skip an uplink transmission when the UL buffer of UE 110 is empty while ensuring there is no ambiguity. UE 110 may send an UL skipping indication using low-overhead control channels.

In one or more embodiments, eNB 112 may identify whether UE 110 has skipped a transmission for the UL grant or whether the transmission was missed by energy detection of a demodulation reference signal (DMRS) resource such as different DMRS Cyclic Shifts. If eNB 112 does not detect any DMRS resource, eNB 112 may assume the UL grant was skipped. If eNB 112 detects the DMRS sequence corresponding to the scheduled UE 110, but the data is not decodable, then eNB 112 knows that UE 110 indeed transmitted UL data but the UL transmission failed. The embodiments described herein may be useful to mitigate or otherwise address issues that may occur with UL grant signaling by using low signaling overhead while being able to support a large number of UEs 110 simultaneously at a low or very low error probability. It should be noted that the embodiments described herein are not necessarily specific to latency reduction but also may be applicable in general for any communication where UL grant skipping is enabled, and may be applicable to Long Term Evolution (LTE), New Radio (NR) Fifth Generation (5G) or any other technology, and the scope of the claimed subject matter is not limited in this respect.

Referring now to FIG. 2, a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using a media access control (MAC) Main Configuration information element, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments will be discussed. In one or more embodiments, user equipment (UE) 110 may be configured to send an uplink (UL) grant skipping indication (UGSI) to eNB 112. In such embodiments, UE 110 sends a skipping indication signal to eNB 112 by using one high capacity physical channel to inform eNB 112 whether UE 112 is skipping the scheduled physical uplink shared channel (PUSCH) transmission or whether the scheduled PUSCH transmission occurs. According to certain aspects of one or more embodiments, when UE 110 gets an UL grant but there is no UL data to be transmitted, UE 110 skips the UL transmission on the PUSCH. Upon detection of physical downlink control channel (PDCCH) information with an UL grant such as downlink control information (DCI) format 0 or format 4, UE 110 may transmit in the PUSCH in accordance with the received UL grant if there is data available for transmission as per a conventional 3GPP Long Term Evolution (LTE) system. Otherwise, UE 110 may transmit an UL grant skipping indication signal to eNB 112 on a preconfigured resource of one particular physical uplink channel. In one embodiment, UE 110 may transmit a UL Grant Skipping Indication (UGSI) on the PUCCH using PUCCH format 1 to indicate whether UE 110 is skipping this grant in subframe N. Using PUCCH format 1 may minimize additional signaling overhead due to the UGSI transmission.

It is noted that one physical resource block (PRB) may provide up to 36 orthogonal channels while different orthogonal channels may be separated using different orthogonal cover or different cyclic shift of a root constant amplitude zero autocorrelation (CAZAC) sequence. Thus, one PRB may be used to multiplex up to 36 UEs 110 for UGSI transmission, while different UEs 110 may be separated using different orthogonal cover or different cyclic shift of a root constant amplitude zero autocorrelation (CAZAC) sequence. The value of 36 comes from 12 cyclic shift (CS) times three orthogonal cover codes (OCCs). The spectrum efficiency may be increased significantly compared to legacy LTE systems, as the signaling overhead of this approach is 1/36 compared to legacy LTE systems, that is less than 3% compared to not skipping the UL grant in PUSCH in Release 13 LTE system, although the scope of the claimed subject matter is not limited in this respect.

Thus, in accordance with one or more embodiments, a channel index for UGSI transmission may be signaled to UE 110. For such a channel index to be signaled, a channel configuration should be known to UE 110. In one embodiment, the UGSI channel configuration may be broadcast by eNB 112 to UE 110 in a system information block, for example SystemInformationBlock 2 (SIB2), or a specific SIB may be defined. In another embodiment,

the UGSI channel configuration may be predefined in the 3GPP standard and therefore known to the UEs 110. In some embodiments, the channels used for UGSI transmission may be assigned to the UEs 110 in semi-static approach via a UE dedicated radio resource control (RRC) message, or in a dynamic approach via a downlink control information (DCI) format, or a combination of an RRC message and a DCI format.

In the embodiment shown in FIG. 2, for dynamic UL grant skipping, the UGSI resource may be signaled in an RRC configuration message to enable UL skipping for a UE 110. For example, new information elements (IEs) may be added to the *MAC-MainConfig* configuration message. For example, in procedure 200, at operation 201 UE 110 may indicate to eNB 112 that UE 110 is capable of supporting UL grant skipping. At operation 212, eNB 112 configures UE 110 for UL grant skipping using an RRC configuration message *MAC-MainConfig*. At operation 214, eNB 112 may provide an UL grant to UE 110. Once configured for UL skipping, at operation 216 UE 110 may send an UL transmission to eNB 112 on a PUSCH if UE 110 has data to transmit in its buffer, or otherwise at operation 218 UE 110 may transmit the UGSI on PUCCH to eNB 112 if UE 110 has no data to transmit in its buffer. An example of the RRC configuration message *MAC-MainConfig* modified for UL skipping is shown, below with the new IEs and their description indicated via underlining.

<u>MAC-MainConfig</u> ::=	SEQUENCE {
<u>ul-SCH-Config</u>	SEQUENCE {
<u>maxHARQ-Tx</u>	ENUMERATED {
	n1, n2, n3, n4, n5, n6, n7, n8,
	n10, n12, n16, n20, n24, n28,
	spare2, spare1} OPTIONAL, -- Need ON
<u>periodicBSR-Timer</u>	PeriodicBSR-Timer-r12 OPTIONAL,
-- Need ON	
<u>retxBSR-Timer</u>	RetxBSR-Timer-r12,
<u>ttxBundling</u>	BOOLEAN
}	OPTIONAL, -- Need ON
<u>drx-Config</u>	DRX-Config OPTIONAL,
-- Need ON	
<u>timeAlignmentTimerDedicated</u>	TimeAlignmentTimer,
<u>phr-Config</u>	CHOICE {
<u>release</u>	NULL,
<u>setup</u>	SEQUENCE {

periodicPHR-Timer	ENUMERATED {sf10, sf20, sf50, sf100, sf200, sf500, sf1000, infinity},	
prohibitPHR-Timer	ENUMERATED {sf0, sf10, sf20, sf50, sf100, sf200, sf500, sf1000},	
dl-PathlossChange	ENUMERATED {dB1, dB3, dB6, infinity}	
}		
}		OPTIONAL, -- Need ON
...,		
[[sr-ProhibitTimer-r9	INTEGER (0..7)	OPTIONAL
-- Need ON		
]],		
[[mac-MainConfig-v1020	SEQUENCE {	
sCellDeactivationTimer-r10	ENUMERATED {	
	rf2, rf4, rf8, rf16, rf32, rf64, rf128,	
	spare}	OPTIONAL, -- Need OP
extendedBSR-Sizes-r10	ENUMERATED {setup}	OPTIONAL,
-- Need OR		
extendedPHR-r10	ENUMERATED {setup}	OPTIONAL
-- Need OR		
}		OPTIONAL -- Need ON
]],		
[[stag-ToReleaseList-r11	STAG-ToReleaseList-r11	OPTIONAL,
-- Need ON		
stag-ToAddModList-r11	STAG-ToAddModList-r11	OPTIONAL, --
Need ON		
drx-Config-v1130	DRX-Config-v1130	OPTIONAL
-- Need ON		
]],		
[[e-HARQ-Pattern-r12	BOOLEAN	OPTIONAL, --
Need ON		
dualConnectivityPHR	CHOICE {	
release	NULL,	
setup	SEQUENCE {	
phr-ModeOtherCG-r12	ENUMERATED {real, virtual}	
}		

```

    }
    logicalChannelSR-Config-r12 CHOICE {
        release NULL,
        setup SEQUENCE {
            logicalChannelSR-ProhibitTimer-r12 ENUMERATED {sf20, sf40, sf64,
sf128, sf512, sf1024, sf2560, spare1}
        }
    } OPTIONAL -- Need ON
}
|| skipUL-Config-r14 SkipUL-Config-r14 OPTIONAL -- Need ON
||
}

SkipUL-Config-r14 ::= CHOICE {
    release NULL,
    setup SEQUENCE {
        skipUL-r14 BOOLEAN, OPTIONAL, -- Need ON
        skipIndicationEnabled-r14 BOOLEAN, OPTIONAL, -- NEED ON
        skipIndicationChannelConfig-r14
        SkipIndicationChannelConfig-r14 OPTIONAL, -- NEED ON
    }
}

```

SkipUL-Config field descriptions

SkipUL

Indicates whether UL skipping is allowed for the UE as specified in TS 36.321.

skipIndicationEnabled

Indicates whether the UE shall send indication to the eNB when UL is skipped.

This field is applicable only when *SkipUL* is set to true.

skipIndicationChannelConfig

Configuration of the skip indication channel to be used by the UE to indicate UL skipping. This field is applicable only when *skipIndicationEnabled* is set to true.

In an alternative embodiment of the RRC signaling configuration message *MAC-MainConfig*, above, the *skipIndicationEnabled* IE may be optional and not utilized. The presence of the *skipIndicationChannelConfig* IE may indicate that UE 110 should send an

indication to eNB 112 when an UL transmission is skipped, and an absence of the *skipIndicationChannelConfig* IE may indicate that UE 110 does not send any indication when an UL transmission in the PUSCH is skipped.

The resource index used for UGSI transmission also may be signaled. The maximum Index of the UL channel may depend on the amount of resources allocated for UGSI transmission. An example embodiment where one PRB is allocated to indicate the resource index for UGSI is shown below, wherein the resource index may range from 0 to 35.

```
-- ASN1START

SkipIndicationChannelConfig-r14 ::= CHOICE {
    release          NULL,
    setup            SEQUENCE {
        SkipIndicationChannelIndex-r14    INTEGER (0..35)    OPTIONAL
    }
}
-- Need OR
}
}
-- ASN1STOP
```

SkipIndicationChannelConfig field descriptions

SkipIndicationChannelIndex

Indicates the index of skip indication channel as specified in 3GPP Technical Standard (TS) 36.213 to be used when UL skipping is allowed and UE wants to indicate to the network that UL is skipped, as specified in TS 36.321.

Referring now to FIG. 3, a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using a semi-persistent scheduling (SPS) configuration uplink information element, and for a configured UE to indicate of an uplink transmission is skipped in accordance with one or more embodiments will be discussed. For SPS grant skipping, the resource for carrying UGSI may be signaled via RRC signaling along with the SPS configuration. For example in procedure 300, at operation 301 UE 110 may indicate to eNB 112 that UE 110 is capable of supporting UL grant skipping. At operation 312, eNB 112 configures UE 110 for UL grant skipping using an RRC configuration message *SPS-ConfigUL*. At operation 314, eNB 112 may provide an UL grant to UE 110. Once configured for UL skipping, at operation 316 UE 110 may send an UL transmission to eNB 112 on a

PUSCH if UE 110 has data to transmit in its buffer, or otherwise at operation 318 UE 110 may transmit the UGSI on PUCCH to eNB 112 if UE 110 has no data to transmit in its buffer. For this embodiment, new IEs may be added to the *SPS-ConfigUL* Information Element as indicated below via underlining.

-- ASN1START

```
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
    ||_
    || skipIndicationEnabled-r14 BOOLEAN, OPTIONAL, -- NEED ON
```

skipIndicationChannelConfig-r14	SkipIndicationChannelConfig-r14
OPTIONAL, -- NEED ON	
<pre> } } -- ASN1STOP </pre>	

SPS-Config field descriptions

skipIndicationEnabled

Indicates whether the UE shall send indication to the eNB when UL is skipped.

This field is applicable only when UL SPS grant is allowed to be skipped by the UE if no UL data is present in the buffer as specified in TS 36.321.

skipIndicationChannelConfig

Configuration of the skip indication channel to be used by the UE to indicate UL skipping. This field is applicable only when *skipIndicationEnabled* is set to true.

In an alternative embodiment of this RRC signaling configuration message *SPS-ConfigUL*, above, *skipIndicationEnabled* may be optional and not utilized. The presence of the *skipIndicationChannelConfig* IE may indicate that UE 110 may send an indication to eNB 112 when an UL transmission is skipped, and the absence of the *skipIndicationChannelConfig* IE may indicate that UE 110 does not send any indication if the UL transmission in the PUSCH is skipped.

Referring now to FIG. 4, a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using an uplink grant skipping indicator information element in downlink control information format, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments will be discussed. To make the skip indication channel allocation to a UE 110 more dynamic where dynamic grants are implemented, the skip indication channel may be signaled along with an UL grant using the physical downlink control channel (PDCCH). In such embodiments, the downlink control information (DCI) format may be modified to accommodate the skip indication channel allocation. In some embodiments, multiple resources for transmission of the uplink grant skipping indication (UGSI) may be configured by higher layers, for example using radio resource control (RRC) signaling. Then, one UGSI information element (IE) may be added to a current UL grant DCI format to dynamically select one channel from the available resources for

transmission of the UGSI in a flexible manner. Overhead reduction may be achieved by this mechanism by assigning N number of channels to M number of UEs 110, where $N < M$, with an assumption that in most cases that M number of UEs 110 are unlikely to have a physical uplink shared channel (PUSCH) scheduled simultaneously.

Thus, as shown in FIG. 4, procedure 400 may be implemented wherein UE 110 may indicate at operation 410 that is capable of supporting UL grant skipping. At operation 412, eNB 112 may configure UE 110 for UL grant skipping using RRC signaling. At operation 414, eNB 112 sends an UL grant to UE 110 with a UGSI information element (IE) in the DCI format on a physical downlink control channel (PDCCH), wherein eNB 112 is capable to assign N number of channels to M number of UEs 110. At operation 416, UE 110 sends an UL transmission to eNB 112 on a physical uplink shared channel (PUSCH) if UE 110 has data to transmit. Otherwise, if UE 110 has no data to transmit, UE 110 transmits a UGSI to eNB 112 at operation 418 on a physical uplink control channel (PUCCH).

Referring now to FIG. 5, a diagram of a procedure to configure one or more user equipment (UE) devices to utilize uplink grant skipping using an uplink grant skipping indicator information element in semi-persistent scheduling activation/deactivation downlink control information format, and for a configured UE to indicate if an uplink transmission is skipped in accordance with one or more embodiments will be discussed. To make the skip indication channel allocation to a UE 110 more dynamic wherein semi-persistent scheduling is utilized, the skip indication channel may be signaled along with an SPS activation/reactivation command using a physical downlink control channel (PDCCH). The downlink control information (DCI) format may be modified to accommodate the skip indication channel. In some embodiments, multiple resources for UGSI transmission may be configured by higher layers, for example using RRC signaling. Then, one UGSI information element (IE) may be added to a current SPS activation/reactivation DCI format to dynamically select a skip indication channel from the resources available for UGSI transmission in a flexible manner.

Thus, as shown in FIG. 5, procedure 500 may be implemented wherein UE 110 may indicate at operation 510 that is capable of supporting UL grant skipping. At operation 512, eNB 112 may configure UE 110 for UL grant skipping using RRC signaling. At operation 514, eNB 112 sends an UL grant to UE 110 with a UGSI information element (IE) in the SPS activation/deactivation DCI format on a physical downlink control channel (PDCCH). At operation 516, UE 110 sends an UL transmission to eNB 112 on a physical uplink shared channel (PUSCH) if UE 110 has data to transmit. Otherwise, if UE 110 has no data to transmit, UE 110 transmits a UGSI to eNB 112 at operation 518 on a physical uplink control channel (PUCCH).

In one or more embodiments discussed herein, in order for eNB to know if a given UE 110 is capable of signaling the UL grant skip indication (UGSI), a UGSI capability indication may be added in a UE capabilities message or information element which that may be signaled by UE 110 to eNB 112, for example as shown by operation 210 of FIG. 2, operation 310 of FIG. 3, operation 410 of FIG. 4, and/or operation 510 of FIG. 5. For example, the UGSI capability may be added to an Evolved Universal Terrestrial Radio Access (E-UTRA) UE Radio Access Capability Parameters of a *UE-EUTRA-Capability* information element, as shown below via underlining.

-- ASN1START

UE-EUTRA-Capability-v13x0-IEs ::= SEQUENCE {

dc-Parameters-v13x0	DC-Parameters-v13x0	OPTIONAL,
measParameters-v13xy	MeasParameters-v13xy	OPTIONAL,
mac-Parameters-v13x0	MAC-Parameters-v13x0	OPTIONAL,
pdcp-Parameters-v13x0	PDCCP-Parameters-v13x0	OPTIONAL,
phyLayerParameters-v13x0	PhyLayerParameters-v13x0	OPTIONAL,
rf-Parameters-v13x0	RF-Parameters-v13x0	OPTIONAL,
rlc-Parameters-v13x0	RLC-Parameters-v13x0	OPTIONAL,
ue-CategoryDL-v13x0	INTEGER (17)	OPTIONAL,
ue-CategoryUL-v13x0	INTEGER (14)	OPTIONAL,
scptm-Parameters-v13x0	SCPTM-Parameters-v13x0	OPTIONAL,
sl-Parameters-r13	SL-Parameters-r13	OPTIONAL,
supportOfLAA-r13	ENUMERATED {supported}	OPTIONAL,

nonCriticalExtension SEQUENCE {} UE-EUTRA-Capability-v14xy-IEs
OPTIONAL

}

UE-EUTRA-Capability-v14xy-IEs ::= SEQUENCE {

<u>ugsi-Supported-r14</u>	<u>BOOLEAN</u>	<u>OPTIONAL,</u>
---------------------------	----------------	------------------

...

}

-- ASN1STOP

<i>UE-EUTRA-Capability field descriptions</i>	<i>FDD/ TDD diff</i>
<u>ugsi-Supported</u> <u>TRUE indicates UL Grant Skipping Indication is supported.</u>	=

In one or more alternative embodiments, a media access control (MAC) capability parameter for Release 14 of the 3GPP Standard may be created, and UGSI capability may be added there as follows.

-- ASN1START

```

UE-EUTRA-Capability-v14xy-IEs :: SEQUENCE {
    mac-Parameters-r14          MAC-Parameters-r14          OPTIONAL,
    ...
}

```

```

MAC-Parameters-r14 ::= SEQUENCE {
    ugsi-Supported-r14          BOOLEAN,                      OPTIONAL,
    ...
}

```

-- ASN1STOP

Referring now to FIG. 6, a block diagram of an information handling system capable of implementing mobility measurements for beamforming in accordance with one or more embodiments will be discussed. Although information handling system 600 represents one example of several types of computing platforms, information handling system 600 may include more or fewer elements and/or different arrangements of elements than shown in FIG. 6, and the scope of the claimed subject matter is not limited in these respects. In one or more embodiments, information handling system 600 may tangibly embody an apparatus of an evolved Node B (eNB) or a next generation Node B (gNB) for the New Radio (NR) Fifth Generation (5G), comprising one or more baseband processors to process an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant, and a memory to store the indication for the UE, wherein the one or more baseband processors

are to encode a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant. In one or more other embodiments, information handling system may tangibly embody an apparatus of a user equipment (UE), comprising one or more baseband processors to decode a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant, and a memory to store data for the uplink data buffer, wherein the one or more baseband processors are to encode data in the uplink data buffer to the eNB or gNB via a physical uplink shared channel (PUSCH) in response to an UL grant from the eNB or gNB, or to transmit a UGSI to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer. It should be noted that the terms physical uplink shared channel (PUSCH), physical downlink shared channel (PDSCH), physical downlink control channel (PDCCH), and so on, are terms utilized in the Long Term Evolution (LTE) standards of the Third Generation Partnership Project (3GPP) technical standards, and other terms from other standards equally may apply to the embodiments described herein and/or may be equivalents or analogs to the LTE terms, for example New Radio (NR) Fifth Generation (5G) standards, and the scope of the claimed subject is not limited in this respect.

In one or more embodiments, information handling system 600 may include one or more applications processors 610 and one or more baseband processors 612. Applications processor 610 may be utilized as a general-purpose processor to run applications and the various subsystems for information handling system 600. Applications processor 610 may include a single core or alternatively may include multiple processing cores. One or more of the cores may comprise a digital signal processor or digital signal processing (DSP) core. Furthermore, applications processor 610 may include a graphics processor or coprocessor disposed on the same chip, or alternatively a graphics processor coupled to applications processor 610 may comprise a separate, discrete graphics chip. Applications processor 610 may include on board memory such as cache memory, and further may be coupled to external memory devices such as synchronous dynamic random access memory (SDRAM) 614 for storing and/or executing applications during operation, and NAND flash 616 for storing applications and/or data even when information handling system 600 is powered off. In one or more embodiments, instructions to operate or configure the information handling system 600 and/or any of its components or subsystems to operate in a manner as described herein may be stored on an article of manufacture comprising a non-transitory storage medium. In one or more embodiments, the

storage medium may comprise any of the memory devices shown in and described herein, although the scope of the claimed subject matter is not limited in this respect. Baseband processor 612 may control the broadband radio functions for information handling system 600. Baseband processor 612 may store code for controlling such broadband radio functions in a NOR flash 618. Baseband processor 612 controls a wireless wide area network (WWAN) transceiver 620 which is used for modulating and/or demodulating broadband network signals, for example for communicating via a 3GPP LTE or LTE-Advanced network or the like.

In general, WWAN transceiver 620 may operate according to any one or more of the following radio communication technologies and/or standards including but not limited to: a Global System for Mobile Communications (GSM) radio communication technology, a General Packet Radio Service (GPRS) radio communication technology, an Enhanced Data Rates for GSM Evolution (EDGE) radio communication technology, and/or a Third Generation Partnership Project (3GPP) radio communication technology, for example Universal Mobile Telecommunications System (UMTS), Freedom of Multimedia Access (FOMA), 3GPP Long Term Evolution (LTE), 3GPP Long Term Evolution Advanced (LTE Advanced), Code division multiple access 2000 (CDMA2000), Cellular Digital Packet Data (CDPD), Mobitex, Third Generation (3G), Circuit Switched Data (CSD), High-Speed Circuit-Switched Data (HSCSD), Universal Mobile Telecommunications System (Third Generation) (UMTS (3G)), Wideband Code Division Multiple Access (Universal Mobile Telecommunications System) (W-CDMA (UMTS)), High Speed Packet Access (HSPA), High-Speed Downlink Packet Access (HSDPA), High-Speed Uplink Packet Access (HSUPA), High Speed Packet Access Plus (HSPA+), Universal Mobile Telecommunications System-Time-Division Duplex (UMTS-TDD), Time Division-Code Division Multiple Access (TD-CDMA), Time Division-Synchronous Code Division Multiple Access (TD-CDMA), 3rd Generation Partnership Project Release 8 (Pre-4th Generation) (3GPP Rel. 8 (Pre-4G)), 3GPP Rel. 9 (3rd Generation Partnership Project Release 9), 3GPP Rel. 10 (3rd Generation Partnership Project Release 10) , 3GPP Rel. 11 (3rd Generation Partnership Project Release 11), 3GPP Rel. 12 (3rd Generation Partnership Project Release 12), 3GPP Rel. 13 (3rd Generation Partnership Project Release 12), 3GPP Rel. 14 (3rd Generation Partnership Project Release 12), 3GPP LTE Extra, NR (5G), LTE Licensed-Assisted Access (LAA), UMTS Terrestrial Radio Access (UTRA), Evolved UMTS Terrestrial Radio Access (E-UTRA), Long Term Evolution Advanced (4th Generation) (LTE Advanced (4G)), cdmaOne (2G), Code division multiple access 2000 (Third generation) (CDMA2000 (3G)), Evolution-Data Optimized or Evolution-Data Only (EV-DO), Advanced Mobile Phone System (1st Generation) (AMPS (1G)), Total Access Communication System/Extended Total Access Communication System (TACS/ETACS), Digital AMPS (2nd Generation) (D-AMPS (2G)),

Push-to-talk (PTT), Mobile Telephone System (MTS), Improved Mobile Telephone System (IMTS), Advanced Mobile Telephone System (AMTS), OLT (Norwegian for Offentlig Landmobil Telefoni, Public Land Mobile Telephony), MTD (Swedish abbreviation for Mobiltelefonisystem D, or Mobile telephony system D), Public Automated Land Mobile (Autotel/PALM), ARP (Finnish for Autoradiopuhelin, “car radio phone”), NMT (Nordic Mobile Telephony), High capacity version of NTT (Nippon Telegraph and Telephone) (Hicap), Cellular Digital Packet Data (CDPD), Mobitex, DataTAC, Integrated Digital Enhanced Network (iDEN), Personal Digital Cellular (PDC), Circuit Switched Data (CSD), Personal Handy-phone System (PHS), Wideband Integrated Digital Enhanced Network (WiDEN), iBurst, Unlicensed Mobile Access (UMA), also referred to as also referred to as 3GPP Generic Access Network, or GAN standard), Zigbee, Bluetooth®, Wireless Gigabit Alliance (WiGig) standard, millimeter wave (mmWave) standards in general for wireless systems operating at 10-90 GHz and above such as WiGig, IEEE 802.11ad, IEEE 802.11ay, and so on, and/or general telemetry transceivers, and in general any type of RF circuit or RFI sensitive circuit. It should be noted that such standards may evolve over time, and/or new standards may be promulgated, and the scope of the claimed subject matter is not limited in this respect.

The WWAN transceiver 620 couples to one or more power amps 642 respectively coupled to one or more antennas 624 for sending and receiving radio-frequency signals via the WWAN broadband network. The baseband processor 612 also may control a wireless local area network (WLAN) transceiver 626 coupled to one or more suitable antennas 628 and which may be capable of communicating via a Wi-Fi, Bluetooth®, and/or an amplitude modulation (AM) or frequency modulation (FM) radio standard including an IEEE 802.11 a/b/g/n standard or the like. It should be noted that these are merely example implementations for applications processor 610 and baseband processor 612, and the scope of the claimed subject matter is not limited in these respects. For example, any one or more of SDRAM 614, NAND flash 616 and/or NOR flash 618 may comprise other types of memory technology such as magnetic memory, chalcogenide memory, phase change memory, or ovonic memory, and the scope of the claimed subject matter is not limited in this respect.

In one or more embodiments, applications processor 610 may drive a display 630 for displaying various information or data, and may further receive touch input from a user via a touch screen 632 for example via a finger or a stylus. An ambient light sensor 634 may be utilized to detect an amount of ambient light in which information handling system 600 is operating, for example to control a brightness or contrast value for display 630 as a function of the intensity of ambient light detected by ambient light sensor 634. One or more cameras 636 may be utilized to capture images that are processed by applications processor 610 and/or at least

temporarily stored in NAND flash 616. Furthermore, applications processor may couple to a gyroscope 638, accelerometer 640, magnetometer 642, audio coder/decoder (CODEC) 644, and/or global positioning system (GPS) controller 646 coupled to an appropriate GPS antenna 648, for detection of various environmental properties including location, movement, and/or orientation of information handling system 600. Alternatively, controller 646 may comprise a Global Navigation Satellite System (GNSS) controller. Audio CODEC 444 may be coupled to one or more audio ports 650 to provide microphone input and speaker outputs either via internal devices and/or via external devices coupled to information handling system via the audio ports 650, for example via a headphone and microphone jack. In addition, applications processor 610 may couple to one or more input/output (I/O) transceivers 652 to couple to one or more I/O ports 654 such as a universal serial bus (USB) port, a high-definition multimedia interface (HDMI) port, a serial port, and so on. Furthermore, one or more of the I/O transceivers 652 may couple to one or more memory slots 656 for optional removable memory such as secure digital (SD) card or a subscriber identity module (SIM) card, although the scope of the claimed subject matter is not limited in these respects.

Referring now to FIG. 7, an isometric view of an information handling system of FIG. 6 that optionally may include a touch screen in accordance with one or more embodiments will be discussed. FIG. 7 shows an example implementation of information handling system 600 of FIG. 6 tangibly embodied as a cellular telephone, smartphone, or tablet type device or the like. The information handling system 600 may comprise a housing 710 having a display 630 which may include a touch screen 632 for receiving tactile input control and commands via a finger 716 of a user and/or a via stylus 718 to control one or more applications processors 710. The housing 710 may house one or more components of information handling system 600, for example one or more applications processors 610, one or more of SDRAM 614, NAND flash 616, NOR flash 618, baseband processor 612, and/or WWAN transceiver 620. The information handling system 600 further optionally may include a physical actuator area 720 which may comprise a keyboard or buttons for controlling information handling system via one or more buttons or switches. The information handling system 600 may also include a memory port or slot 656 for receiving non-volatile memory such as flash memory, for example in the form of a secure digital (SD) card or a subscriber identity module (SIM) card. Optionally, the information handling system 600 may further include one or more speakers and/or microphones 724 and a connection port 654 for connecting the information handling system 600 to another electronic device, dock, display, battery charger, and so on. In addition, information handling system 600 may include a headphone or speaker jack 728 and one or more cameras 636 on one or more sides of the housing 710. It should be noted that the information handling system 600 of FIG. 7 may include

more or fewer elements than shown, in various arrangements, and the scope of the claimed subject matter is not limited in this respect.

As used herein, the terms "circuit" or "circuitry" may refer to, be part of, or include an Application Specific Integrated Circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group), and/or memory (shared, dedicated, or group) that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable hardware components that provide the described functionality. In some embodiments, the circuitry may be implemented in, or functions associated with the circuitry may be implemented by, one or more software or firmware modules. In some embodiments, circuitry may include logic, at least partially operable in hardware. Embodiments described herein may be implemented into a system using any suitably configured hardware and/or software.

Referring now to FIG. 8, example components of a wireless device such User Equipment (UE) device 800 in accordance with one or more embodiments will be discussed. User equipment (UE) 800 may correspond, for example, UE 110 or alternatively to eNB 112, although the scope of the claimed subject matter is not limited in this respect. In some embodiments, UE device (or eNB device) 600 may include application circuitry 602, baseband circuitry 604, Radio Frequency (RF) circuitry 606, front-end module (FEM) circuitry 608 and one or more antennas 610, coupled together at least as shown and described herein.

Application circuitry 802 may include one or more applications processors. For example, application circuitry 802 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. The one or more processors may include any combination of general-purpose processors and dedicated processors, for example graphics processors, application processors, and so on. The processors may be coupled with and/or may include memory and/or storage and may be configured to execute instructions stored in the memory and/or storage to enable various applications and/or operating systems to run on the system.

Baseband circuitry 804 may include circuitry such as, but not limited to, one or more single-core or multi-core processors. Baseband circuitry 804 may include one or more baseband processors and/or control logic to process baseband signals received from a receive signal path of RF circuitry 806 and to generate baseband signals for a transmit signal path of the RF circuitry 806. Baseband processing circuitry 804 may interface with the application circuitry 802 for generation and processing of the baseband signals and for controlling operations of the RF circuitry 806. For example, in some embodiments, the baseband circuitry 804 may include a second generation (2G) baseband processor 804a, third generation (3G) baseband processor 804b, fourth generation (4G) baseband processor 804c, and/or one or more other baseband processors 804d for other existing generations, generations in development or to be developed in

the future, for example fifth generation (5G), sixth generation (6G), and so on. Baseband circuitry 804, for example one or more of baseband processors 804a through 804d, may handle various radio control functions that enable communication with one or more radio networks via RF circuitry 806. The radio control functions may include, but are not limited to, signal modulation and/or demodulation, encoding and/or decoding, radio frequency shifting, and so on. In some embodiments, modulation and/or demodulation circuitry of baseband circuitry 804 may include Fast-Fourier Transform (FFT), precoding, and/or constellation mapping and/or demapping functionality. In some embodiments, encoding and/or decoding circuitry of baseband circuitry 804 may include convolution, tail-biting convolution, turbo, Viterbi, and/or Low Density Parity Check (LDPC) encoder and/or decoder functionality. Embodiments of modulation and/or demodulation and encoder and/or decoder functionality are not limited to these examples and may include other suitable functionality in other embodiments.

In some embodiments, baseband circuitry 804 may include elements of a protocol stack such as, for example, elements of an evolved universal terrestrial radio access network (EUTRAN) protocol including, for example, physical (PHY), media access control (MAC), radio link control (RLC), packet data convergence protocol (PDCP), and/or radio resource control (RRC) elements. Processor 804e of the baseband circuitry 804 may be configured to run elements of the protocol stack for signaling of the PHY, MAC, RLC, PDCP and/or RRC layers. In some embodiments, the baseband circuitry may include one or more audio digital signal processors (DSP) 804f. The one or more audio DSPs 804f may include elements for compression and/or decompression and/or echo cancellation and may include other suitable processing elements in other embodiments. Components of the baseband circuitry may be suitably combined in a single chip, a single chipset, or disposed on a same circuit board in some embodiments. In some embodiments, some or all of the constituent components of baseband circuitry 804 and application circuitry 802 may be implemented together such as, for example, on a system on a chip (SOC).

In some embodiments, baseband circuitry 804 may provide for communication compatible with one or more radio technologies. For example, in some embodiments, baseband circuitry 804 may support communication with an evolved universal terrestrial radio access network (EUTRAN) and/or other wireless metropolitan area networks (WMAN), a wireless local area network (WLAN), a wireless personal area network (WPAN). Embodiments in which baseband circuitry 804 is configured to support radio communications of more than one wireless protocol may be referred to as multi-mode baseband circuitry.

RF circuitry 806 may enable communication with wireless networks using modulated electromagnetic radiation through a non-solid medium. In various embodiments, RF circuitry 806 may include switches, filters, amplifiers, and so on, to facilitate the communication with the wireless network. RF circuitry 806 may include a receive signal path which may include circuitry to down-convert RF signals received from FEM circuitry 808 and provide baseband signals to baseband circuitry 804. RF circuitry 806 may also include a transmit signal path which may include circuitry to up-convert baseband signals provided by the baseband circuitry 804 and provide RF output signals to FEM circuitry 1008 for transmission.

In some embodiments, RF circuitry 806 may include a receive signal path and a transmit signal path. The receive signal path of RF circuitry 806 may include mixer circuitry 806a, amplifier circuitry 806b and filter circuitry 806c. The transmit signal path of RF circuitry 806 may include filter circuitry 806c and mixer circuitry 806a. RF circuitry 806 may also include synthesizer circuitry 806d for synthesizing a frequency for use by the mixer circuitry 806a of the receive signal path and the transmit signal path. In some embodiments, the mixer circuitry 806a of the receive signal path may be configured to down-convert RF signals received from FEM circuitry 808 based on the synthesized frequency provided by synthesizer circuitry 806d. Amplifier circuitry 806b may be configured to amplify the down-converted signals and the filter circuitry 806c may be a low-pass filter (LPF) or band-pass filter (BPF) configured to remove unwanted signals from the down-converted signals to generate output baseband signals. Output baseband signals may be provided to baseband circuitry 804 for further processing. In some embodiments, the output baseband signals may be zero-frequency baseband signals, although this is not a requirement. In some embodiments, mixer circuitry 806a of the receive signal path may comprise passive mixers, although the scope of the embodiments is not limited in this respect.

In some embodiments, mixer circuitry 806a of the transmit signal path may be configured to up-convert input baseband signals based on the synthesized frequency provided by synthesizer circuitry 806d to generate RF output signals for FEM circuitry 808. The baseband signals may be provided by the baseband circuitry 804 and may be filtered by filter circuitry 806c. Filter circuitry 806c may include a low-pass filter (LPF), although the scope of the embodiments is not limited in this respect.

In some embodiments, mixer circuitry 806a of the receive signal path and the mixer circuitry 806a of the transmit signal path may include two or more mixers and may be arranged for quadrature down conversion and/or up conversion respectively. In some embodiments, mixer circuitry 806a of the receive signal path and the mixer circuitry 806a of the transmit signal path may include two or more mixers and may be arranged for image rejection, for example

Hartley image rejection. In some embodiments, mixer circuitry 806a of the receive signal path and the mixer circuitry 806a may be arranged for direct down conversion and/or direct up conversion, respectively. In some embodiments, mixer circuitry 806a of the receive signal path and mixer circuitry 806a of the transmit signal path may be configured for super-heterodyne operation.

In some embodiments, the output baseband signals and the input baseband signals may be analog baseband signals, although the scope of the embodiments is not limited in this respect. In some alternate embodiments, the output baseband signals and the input baseband signals may be digital baseband signals. In these alternate embodiments, RF circuitry 806 may include analog-to-digital converter (ADC) and digital-to-analog converter (DAC) circuitry, and baseband circuitry 804 may include a digital baseband interface to communicate with RF circuitry 806. In some dual-mode embodiments, separate radio integrated circuit (IC) circuitry may be provided for processing signals for one or more spectra, although the scope of the embodiments is not limited in this respect.

In some embodiments, synthesizer circuitry 806d may be a fractional-N synthesizer or a fractional $N/N+1$ synthesizer, although the scope of the embodiments is not limited in this respect as other types of frequency synthesizers may be suitable. For example, synthesizer circuitry 806d may be a delta-sigma synthesizer, a frequency multiplier, or a synthesizer comprising a phase-locked loop with a frequency divider.

Synthesizer circuitry 806d may be configured to synthesize an output frequency for use by mixer circuitry 806a of RF circuitry 806 based on a frequency input and a divider control input. In some embodiments, synthesizer circuitry 806d may be a fractional $N/N+1$ synthesizer.

In some embodiments, frequency input may be provided by a voltage controlled oscillator (VCO), although that is not a requirement. Divider control input may be provided by either baseband circuitry 804 or applications processor 802 depending on the desired output frequency. In some embodiments, a divider control input (e.g., N) may be determined from a look-up table based on a channel indicated by applications processor 802.

Synthesizer circuitry 806d of RF circuitry 806 may include a divider, a delay-locked loop (DLL), a multiplexer and a phase accumulator. In some embodiments, the divider may be a dual modulus divider (DMD) and the phase accumulator may be a digital phase accumulator (DPA). In some embodiments, the DMD may be configured to divide the input signal by either N or $N+1$, for example based on a carry out, to provide a fractional division ratio. In some example embodiments, the DLL may include a set of cascaded, tunable, delay elements, a phase detector, a charge pump and a D-type flip-flop. In these embodiments, the delay elements may be configured to break a VCO period up into N_d equal packets of phase, where N_d is the number of

delay elements in the delay line. In this way, the DLL provides negative feedback to help ensure that the total delay through the delay line is one VCO cycle.

In some embodiments, synthesizer circuitry 806d may be configured to generate a carrier frequency as the output frequency, while in other embodiments, the output frequency may be a multiple of the carrier frequency, for example twice the carrier frequency, four times the carrier frequency, and so on, and used in conjunction with quadrature generator and divider circuitry to generate multiple signals at the carrier frequency with multiple different phases with respect to each other. In some embodiments, the output frequency may be a local oscillator (LO) frequency (fLO). In some embodiments, RF circuitry 1006 may include an in-phase and quadrature (IQ) and/or polar converter.

FEM circuitry 808 may include a receive signal path which may include circuitry configured to operate on RF signals received from one or more antennas 810, amplify the received signals and provide the amplified versions of the received signals to the RF circuitry 806 for further processing. FEM circuitry 808 may also include a transmit signal path which may include circuitry configured to amplify signals for transmission provided by RF circuitry 806 for transmission by one or more of the one or more antennas 810.

In some embodiments, FEM circuitry 808 may include a transmit/receive (TX/RX) switch to switch between transmit mode and receive mode operation. FEM circuitry 808 may include a receive signal path and a transmit signal path. The receive signal path of FEM circuitry 808 may include a low-noise amplifier (LNA) to amplify received RF signals and to provide the amplified received RF signals as an output, for example to RF circuitry 806. The transmit signal path of FEM circuitry 808 may include a power amplifier (PA) to amplify input RF signals, for example provided by RF circuitry 806, and one or more filters to generate RF signals for subsequent transmission, for example by one or more of antennas 810. In some embodiments, UE device 800 may include additional elements such as, for example, memory and/or storage, display, camera, sensor, and/or input/output (I/O) interface, although the scope of the claimed subject matter is not limited in this respect.

The following are example implementations of the subject matter described herein. It should be noted that any of the examples and the variations thereof described herein may be used in any permutation or combination of any other one or more examples or variations, although the scope of the claimed subject matter is not limited in these respects. In example one, an apparatus of an evolved Node B (eNB) or a next generation Node B (gNB) may comprise one or more baseband processors to process an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant, and a memory to store the indication for the UE, wherein the one or more baseband processors are to encode a configuration message for

the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant. In example two, the apparatus may include the subject matter of example one or any of the examples described herein, further comprising a radio-frequency (RF) transceiver to transmit the configuration message to the UE. In example three, the apparatus may include the subject matter of example one or any of the examples described herein, wherein the configuration message is transmitted to the UE via radio resource control (RRC) configuration signaling or RRC reconfiguration signaling via a media access control (MAC) configuration message *MAC-MainConfig*. In example four, the apparatus may include the subject matter of example one or any of the examples described herein, wherein the configuration message is transmitted to the UE via a semi-persistent scheduling (SPS) message *SPS-ConfigUL*. In example five, the apparatus may include the subject matter of example one or any of the examples described herein, wherein the RF transceiver is to transmit a UL grant to the UE with a UGSI information element (IE) in downlink control information (DCI) format on a physical downlink control channel (PDCCH). In example six, the apparatus may include the subject matter of example one or any of the examples described herein, wherein the RF transceiver is to transmit a UL grant to the UE with a UGSI information element (IE) in a semi-persistent scheduling (SPS) activation/deactivation downlink control information format on a physical downlink control channel (PDCCH). In example seven, the apparatus may include the subject matter of example one or any of the examples described herein, wherein the indication received from UE indicating whether the UE is capable to skip an UL grant comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

In example eight, an apparatus of a user equipment (UE) may comprise one or more baseband processors to decode a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant, and a memory to store data for the uplink data buffer, wherein the one or more baseband processors are to encode data in the uplink data buffer to the eNB or gNB via a physical uplink shared channel (PUSCH) in response to an UL grant from the eNB or gNB, or to transmit a UGSI to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer. In example nine, the apparatus may include the subject matter of example eight or any of the examples described herein, further comprising a radio-frequency (RF) transceiver to transmit the encoded data via the PUSCH or to transmit the UGSI via the PUCCH. In example ten, the

apparatus may include the subject matter of example eight or any of the examples described herein, wherein the RF transceiver is to transmit an indication to the eNB or gNB indicating whether the UE is capable to skip an UL grant, wherein the indication comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*. In example eleven, the apparatus may include the subject matter of example eight or any of the examples described herein, wherein the RF transceiver is to transmit the indication to the eNB or gNB via radio resource control (RRC) signaling. In example twelve, the apparatus may include the subject matter of example eight or any of the examples described herein, wherein the UGSI is to be sent to the eNB or gNB on the PUCCH using PUCCH format 1. In example thirteen, the apparatus may include the subject matter of example eight or any of the examples described herein, wherein the UGSI is to be sent to the eNB or gNB on a predefined channel of the PUCCH. In example fourteen, the apparatus may include the subject matter of example eight or any of the examples described herein, wherein the UGSI is to be sent to the eNB or gNB on a channel signaled to the UE via a system information broadcast (SIB) comprising SIB2 or an SIB for UGSI configuration.

In example fifteen, one or more computer-readable media may have instructions stored thereon that, if executed by an evolved Node B (eNB) or a next generation Node B (gNB), result in processing an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant, and encoding a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant. In example sixteen, the one or more computer-readable media may include the subject matter of example fifteen or any of the examples described herein, wherein the configuration message is encoded to be transmitted to the UE via radio resource control (RRC) configuration signaling or RRC reconfiguration signaling via a media access control (MAC) configuration message *MAC-MainConfig*. In example seventeen, the one or more computer-readable media may include the subject matter of example fifteen or any of the examples described herein, wherein the configuration message is encoded to be transmitted to the UE via a semi-persistent scheduling (SPS) message *SPS-ConfigUL*. In example eighteen, the one or more computer-readable media may include the subject matter of example fifteen or any of the examples described herein, further comprising encoding an UL grant to be transmitted to the UE with a UGSI information element (IE) in downlink control information (DCI) format on a physical downlink control channel (PDCCH). In example nineteen, the one or more computer-readable media may include the subject matter of example fifteen or any of the examples described herein, further comprising encoding an UL grant to be transmitted to the UE with a

UGSI information element (IE) in a semi-persistent scheduling (SPS) activation/deactivation downlink control information format on a physical downlink control channel (PDCCH). In example twenty, the one or more computer-readable media may include the subject matter of example fifteen or any of the examples described herein, wherein the indication received from UE indicating whether the UE is capable to skip an UL grant comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

In example twenty-one, one or more computer-readable media may have instructions stored thereon that, if executed by a user equipment (UE), result in decoding a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant, and encoding data in the uplink data buffer to be transmitted to the eNB via a physical uplink shared channel (PUSCH) response to an UL grant from the eNB or gNB, or encoding a UGSI to be transmitted to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer. In example twenty-two, the one or more computer-readable media may include the subject matter of example twenty-one or any of the examples described herein, further comprising encoding an indication to be transmitted to the eNB indicating whether the UE is capable to skip an UL grant, wherein the indication comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*. In example twenty-three, the one or more computer-readable media may include the subject matter of example twenty-one or any of the examples described herein, wherein the indication is to be transmitted to the eNB or gNB via radio resource control (RRC) signaling. In example twenty-four, the one or more computer-readable media may include the subject matter of example twenty-one or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on the PUCCH using PUCCH format 1. In example twenty-five, the one or more computer-readable media may include the subject matter of example twenty-one or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on a predefined channel of the PUCCH. In example twenty-six, the one or more computer-readable media may include the subject matter of example twenty-one or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on a channel signaled to the UE via a system information broadcast (SIB) comprising SIB2 or an SIB for UGSI configuration.

In example twenty-seven, an apparatus of an evolved Node B (eNB) or a next generation Node B (gNB) may comprise means for processing an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant, and means for encoding

a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant. In example twenty-eight, the apparatus may include the subject matter of example twenty-seven or any of the examples described herein, wherein the configuration message is encoded to be transmitted to the UE via radio resource control (RRC) configuration signaling or RRC reconfiguration signaling via a media access control (MAC) configuration message *MAC-MainConfig*. In example twenty-nine, the apparatus may include the subject matter of example twenty-seven or any of the examples described herein, wherein the configuration message is encoded to be transmitted to the UE via a semi-persistent scheduling (SPS) message *SPS-ConfigUL*. In example thirty, the apparatus may include the subject matter of example twenty-seven or any of the examples described herein, further comprising means for encoding an UL grant to be transmitted to the UE with a UGSI information element (IE) in downlink control information (DCI) format on a physical downlink control channel (PDCCH). In example thirty-one, the apparatus may include the subject matter of example twenty-seven or any of the examples described herein, further comprising means for encoding an UL grant to be transmitted to the UE with a UGSI information element (IE) in a semi-persistent scheduling (SPS) activation/deactivation downlink control information format on a physical downlink control channel (PDCCH). In example thirty-two, the apparatus may include the subject matter of example twenty-seven or any of the examples described herein, wherein the indication received from UE indicating whether the UE is capable to skip an UL grant comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

In example thirty-three, an apparatus of a user equipment (UE), may comprise means for decoding a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant, and means for encoding data in the uplink data buffer to be transmitted to the eNB via a physical uplink shared channel (PUSCH) response to an UL grant from the eNB or gNB, or encoding a UGSI to be transmitted to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer. In example thirty-four, the apparatus may include the subject matter of example twenty-three or any of the examples described herein, further comprising means for encoding an indication to be transmitted to the eNB indicating whether the UE is capable to skip an UL grant, wherein the indication comprises a UE Evolved Universal Terrestrial Radio Access

(E-UTRA) capability information element *UE-EUTRA-Capability*. In example thirty-five, the apparatus may include the subject matter of example twenty-three or any of the examples described herein, wherein the indication is to be transmitted to the eNB or gNB via radio resource control (RRC) signaling. In example thirty-six, the apparatus may include the subject matter of example twenty-three or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on the PUCCH using PUCCH format 1. In example thirty-seven, the apparatus may include the subject matter of example twenty-three or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on a predefined channel of the PUCCH. In example thirty-eight, the apparatus may include the subject matter of example twenty-three or any of the examples described herein, wherein the UGSI is encoded to be sent to the eNB or gNB on a channel signaled to the UE via a system information broadcast (SIB) comprising SIB2 or an SIB for UGSI configuration. In example thirty-nine, machine-readable storage including machine-readable instructions, when executed, to realize an apparatus as described in any preceding example.

Although the claimed subject matter has been described with a certain degree of particularity, it should be recognized that elements thereof may be altered by persons skilled in the art without departing from the spirit and/or scope of claimed subject matter. It is believed that the subject matter pertaining to uplink grant skipping indication and many of its attendant utilities will be understood by the forgoing description, and it will be apparent that various changes may be made in the form, construction and/or arrangement of the components thereof without departing from the scope and/or spirit of the claimed subject matter or without sacrificing all of its material advantages, the form herein before described being merely an explanatory embodiment thereof, and/or further without providing substantial change thereto. It is the intention of the claims to encompass and/or include such changes.

CLAIMS

What is claimed is:

1. An apparatus of an evolved Node B (eNB) or a next generation Node B (gNB), comprising:
 - one or more baseband processors to process an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant; and
 - a memory to store the indication for the UE;wherein the one or more baseband processors are to encode a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant.
2. The apparatus of claim 1, further comprising a radio-frequency (RF) transceiver to transmit the configuration message to the UE.
3. The apparatus of claim 2, wherein the configuration message is transmitted to the UE via radio resource control (RRC) configuration signaling or RRC reconfiguration signaling via a media access control (MAC) configuration message *MAC-MainConfig*.
4. The apparatus of any of claims 2-3, wherein the configuration message is transmitted to the UE via a semi-persistent scheduling (SPS) message *SPS-ConfigUL*.
5. The apparatus of any of claims 2-4, wherein the RF transceiver is to transmit a UL grant to the UE with a UGSI information element (IE) in downlink control information (DCI) format on a physical downlink control channel (PDCCH).
6. The apparatus of any of claims 2-5, wherein the RF transceiver is to transmit a UL grant to the UE with a UGSI information element (IE) in a semi-persistent scheduling (SPS) activation/deactivation downlink control information format on a physical downlink control channel (PDCCH).

7. The apparatus of any of claims 1-6, wherein the indication received from UE indicating whether the UE is capable to skip an UL grant comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

8. An apparatus of a user equipment (UE), comprising:

one or more baseband processors to decode a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant; and

a memory to store data for the uplink data buffer;

wherein the one or more baseband processors are to encode data in the uplink data buffer to the eNB or gNB via a physical uplink shared channel (PUSCH) in response to an UL grant from the eNB or gNB, or to transmit a UGSI to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer.

9. The apparatus of claim 8, further comprising a radio-frequency (RF) transceiver to transmit the encoded data via the PUSCH or to transmit the UGSI via the PUCCH.

10. The apparatus of claim 9, wherein the RF transceiver is to transmit an indication to the eNB or gNB indicating whether the UE is capable to skip an UL grant, wherein the indication comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

11. The apparatus of any of claims 9-10, wherein the RF transceiver is to transmit the indication to the eNB or gNB via radio resource control (RRC) signaling.

12. The apparatus of any of claims 8-11, wherein the UGSI is to be sent to the eNB or gNB on the PUCCH using PUCCH format 1.

13. The apparatus of any of claims 8-12, wherein the UGSI is to be sent to the eNB or gNB on a predefined channel of the PUCCH.

14. The apparatus of any of claims 8-13, wherein the UGSI is to be sent to the eNB or gNB on a channel signaled to the UE via a system information broadcast (SIB) comprising SIB2 or an SIB for UGSI configuration.

15. One or more computer-readable media having instructions stored thereon that, if executed by an evolved Node B (eNB) or a next generation Node B (gNB), result in:

processing an indication received from a user equipment (UE) indicating whether the UE is capable to skip an uplink (UL) grant; and

encoding a configuration message for the UE to skip an UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant.

16. The one or more computer-readable media of claim 15, wherein the configuration message is encoded to be transmitted to the UE via radio resource control (RRC) configuration signaling or RRC reconfiguration signaling via a media access control (MAC) configuration message *MAC-MainConfig*.

17. The one or more computer-readable media of any of claims 15-16, wherein the configuration message is encoded to be transmitted to the UE via a semi-persistent scheduling (SPS) message *SPS-ConfigUL*.

18. The one or more computer-readable media of any of claims 15-17, further comprising encoding an UL grant to be transmitted to the UE with a UGSI information element (IE) in downlink control information (DCI) format on a physical downlink control channel (PDCCH).

19. The one or more computer-readable media of any of claims 15-18, further comprising encoding an UL grant to be transmitted to the UE with a UGSI information element (IE) in a semi-persistent scheduling (SPS) activation/deactivation downlink control information format on a physical downlink control channel (PDCCH).

20. The one or more computer-readable media of any of claims 15-19, wherein the indication received from UE indicating whether the UE is capable to skip an UL grant comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

21. One or more computer-readable media having instructions stored thereon that, if executed by a user equipment (UE), result in:

decoding a configuration message from an evolved Node B (eNB) or a next generation Node B (gNB) to skip an uplink UL grant if an uplink data buffer of the UE is empty, and a channel index of a physical uplink control channel (PUCCH) for the UE to transmit an uplink grant skipping indication (UGSI) if the UE skips an UL grant; and

encoding data in the uplink data buffer to be transmitted to the eNB via a physical uplink shared channel (PUSCH) response to an UL grant from the eNB or gNB, or encoding a UGSI to be transmitted to the eNB or gNB on a channel of the PUCCH corresponding to the channel index if there is no data in the uplink data buffer.

22. The one or more computer-readable media of claim 21, further comprising encoding an indication to be transmitted to the eNB indicating whether the UE is capable to skip an UL grant, wherein the indication comprises a UE Evolved Universal Terrestrial Radio Access (E-UTRA) capability information element *UE-EUTRA-Capability*.

23. The one or more computer-readable media of claim 22, wherein the indication is to be transmitted to the eNB or gNB via radio resource control (RRC) signaling.

24. The one or more computer-readable media of any of claims 21-23, wherein the UGSI is encoded to be sent to the eNB or gNB on the PUCCH using PUCCH format 1.

25. The one or more computer-readable media of any of claims 21-24, wherein the UGSI is encoded to be sent to the eNB or gNB on a predefined channel of the PUCCH.

26. The one or more computer-readable media of any of claims 21-25, wherein the UGSI is encoded to be sent to the eNB or gNB on a channel signaled to the UE via a system information broadcast (SIB) comprising SIB2 or an SIB for UGSI configuration.

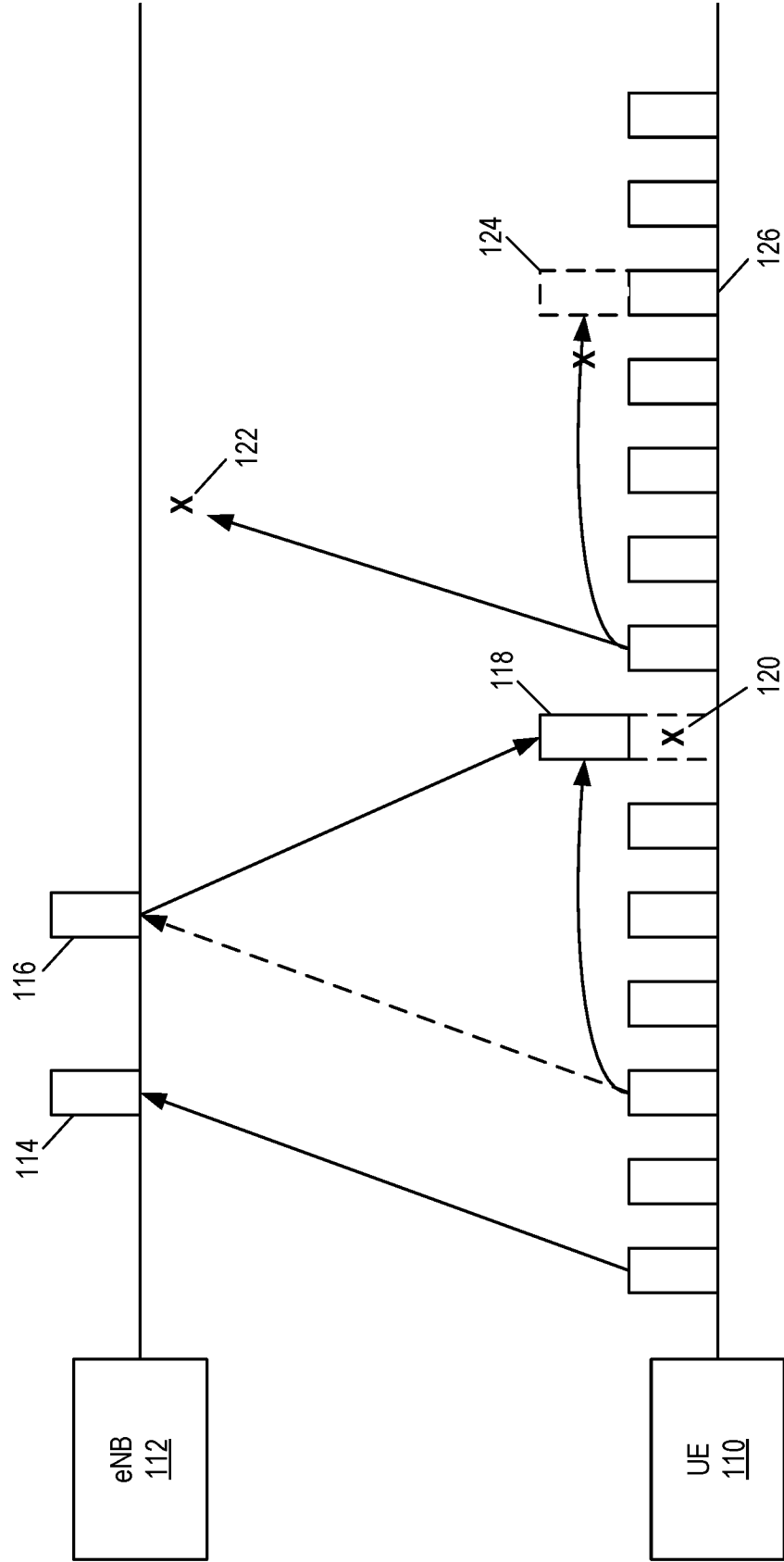


FIG. 1

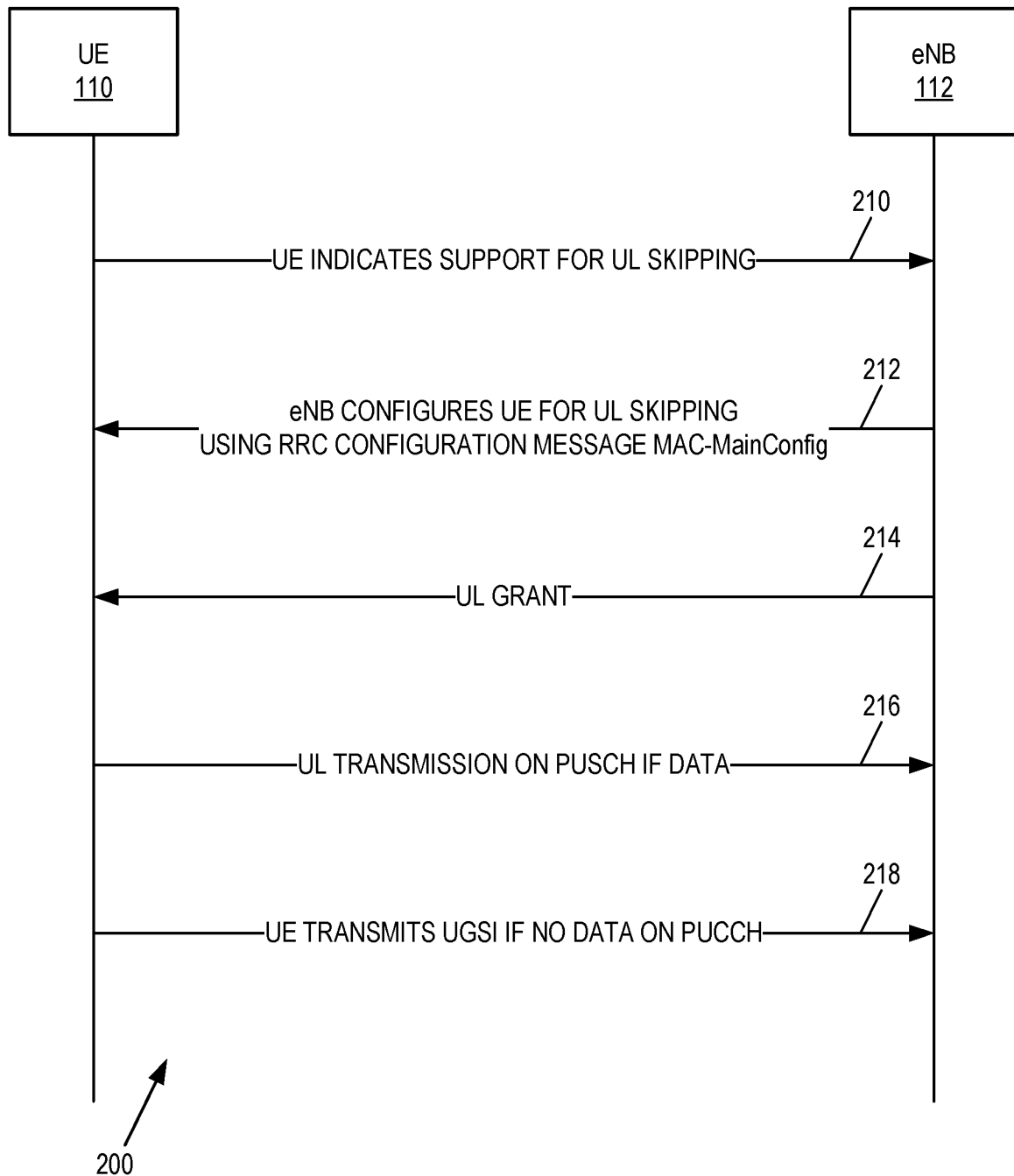


FIG. 2

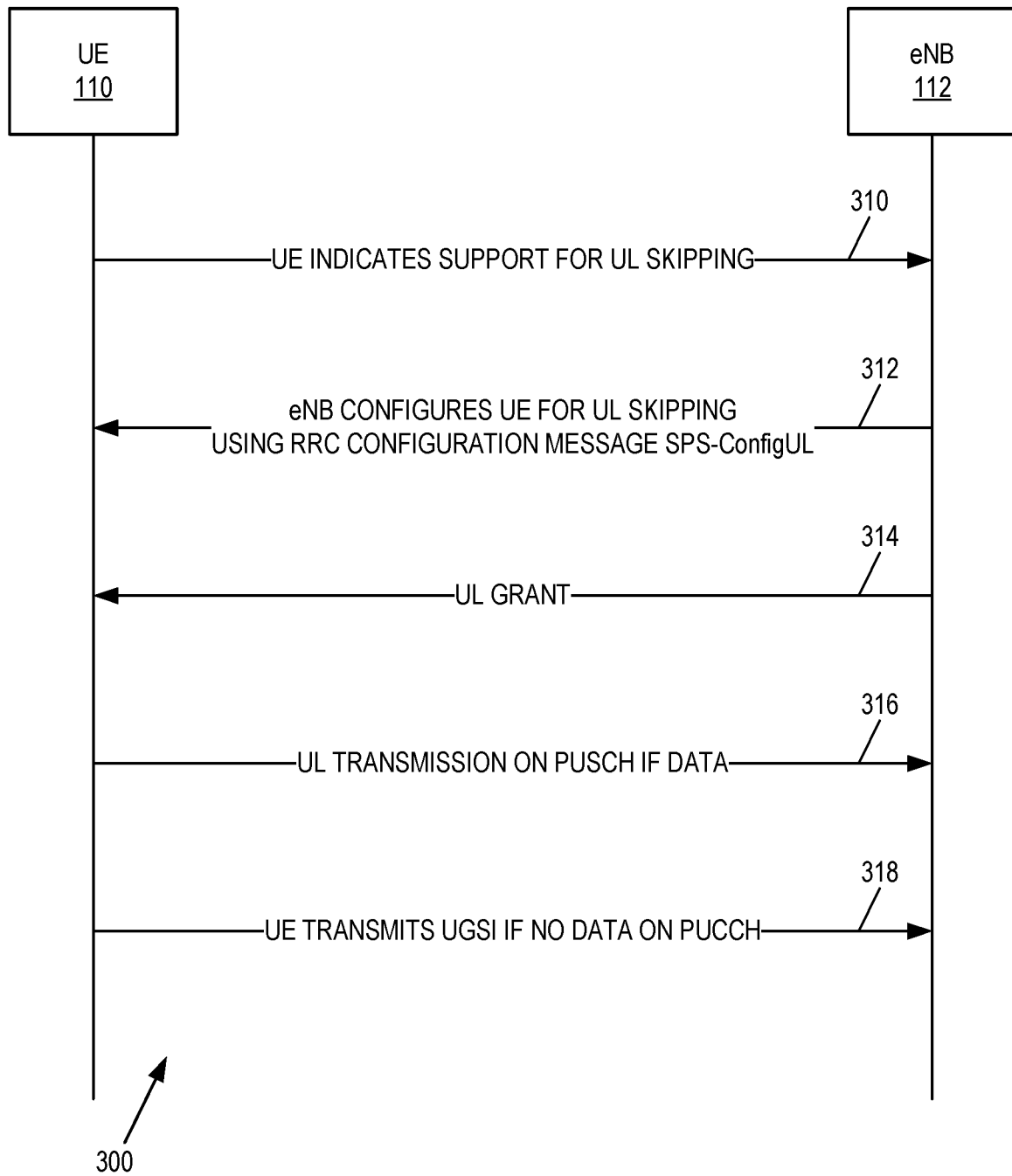


FIG. 3

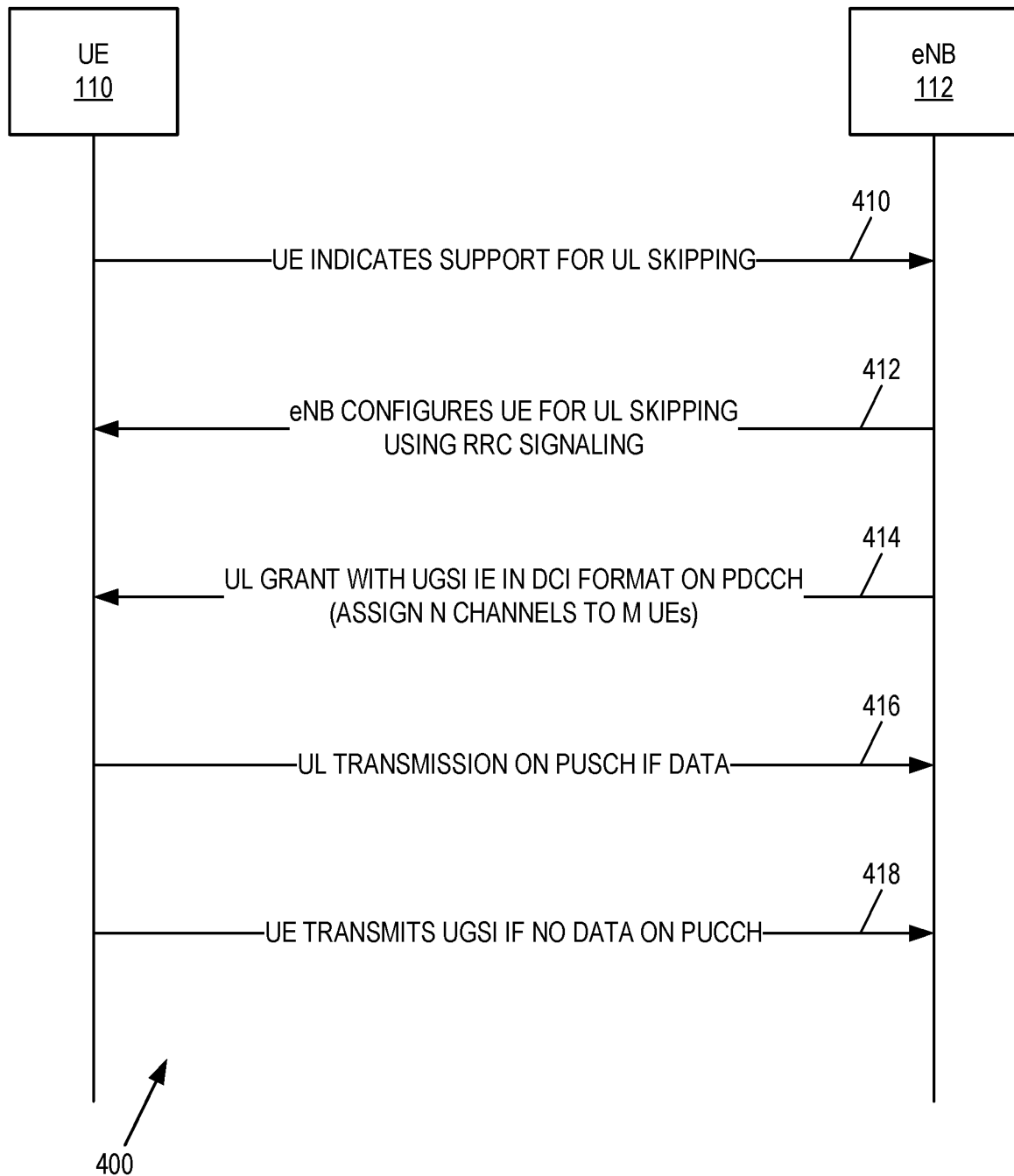


FIG. 4

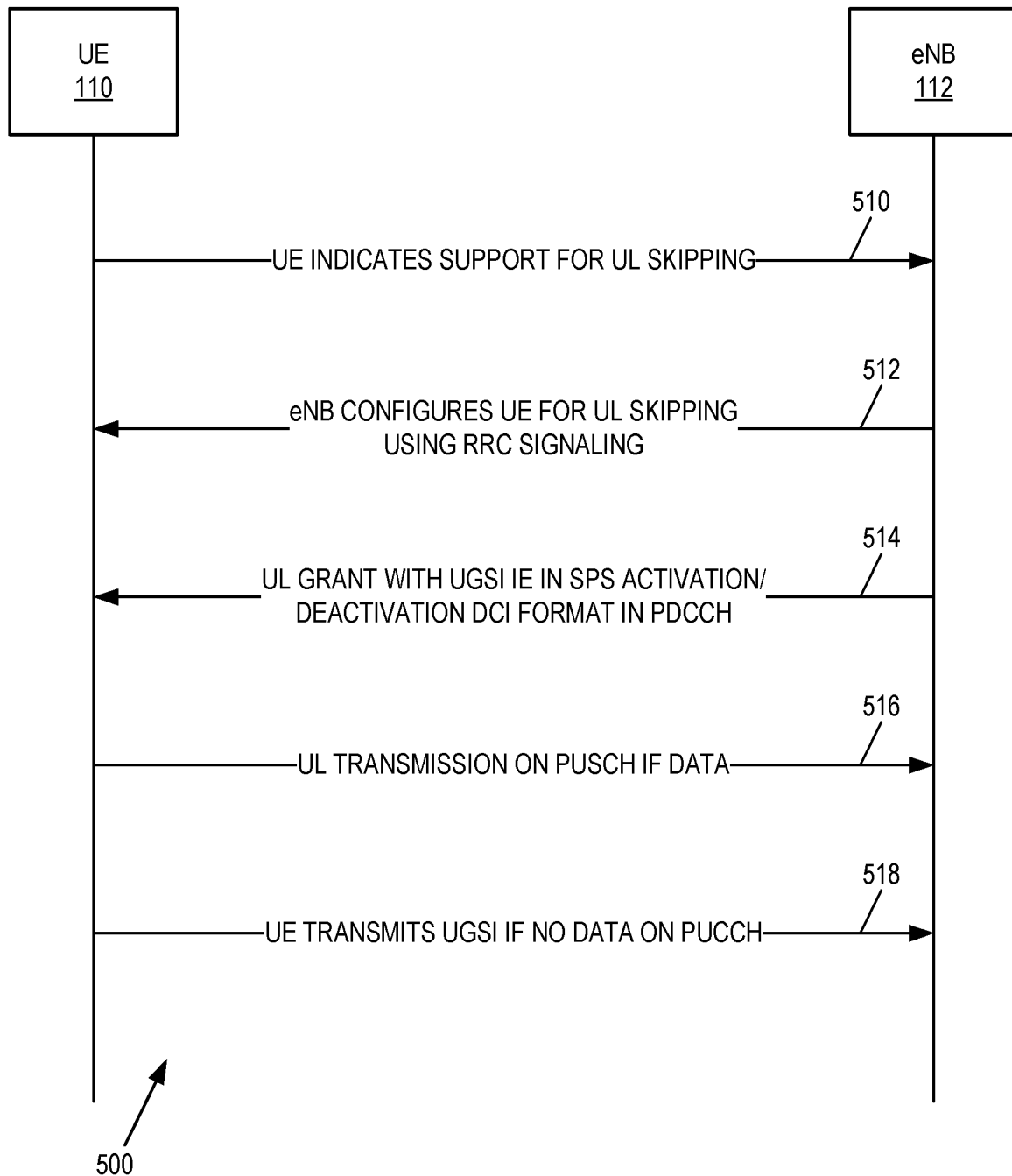


FIG. 5

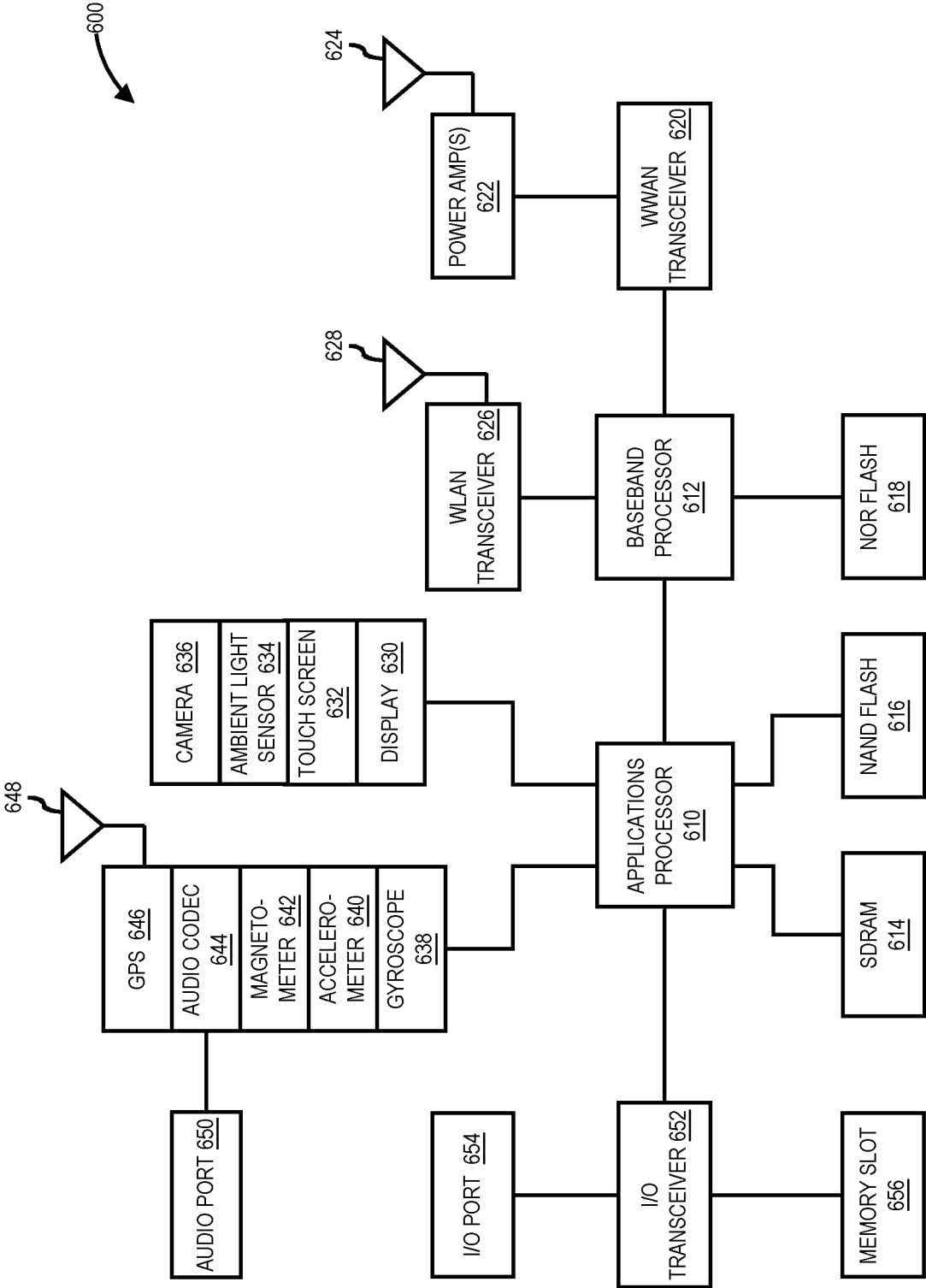


FIG. 6

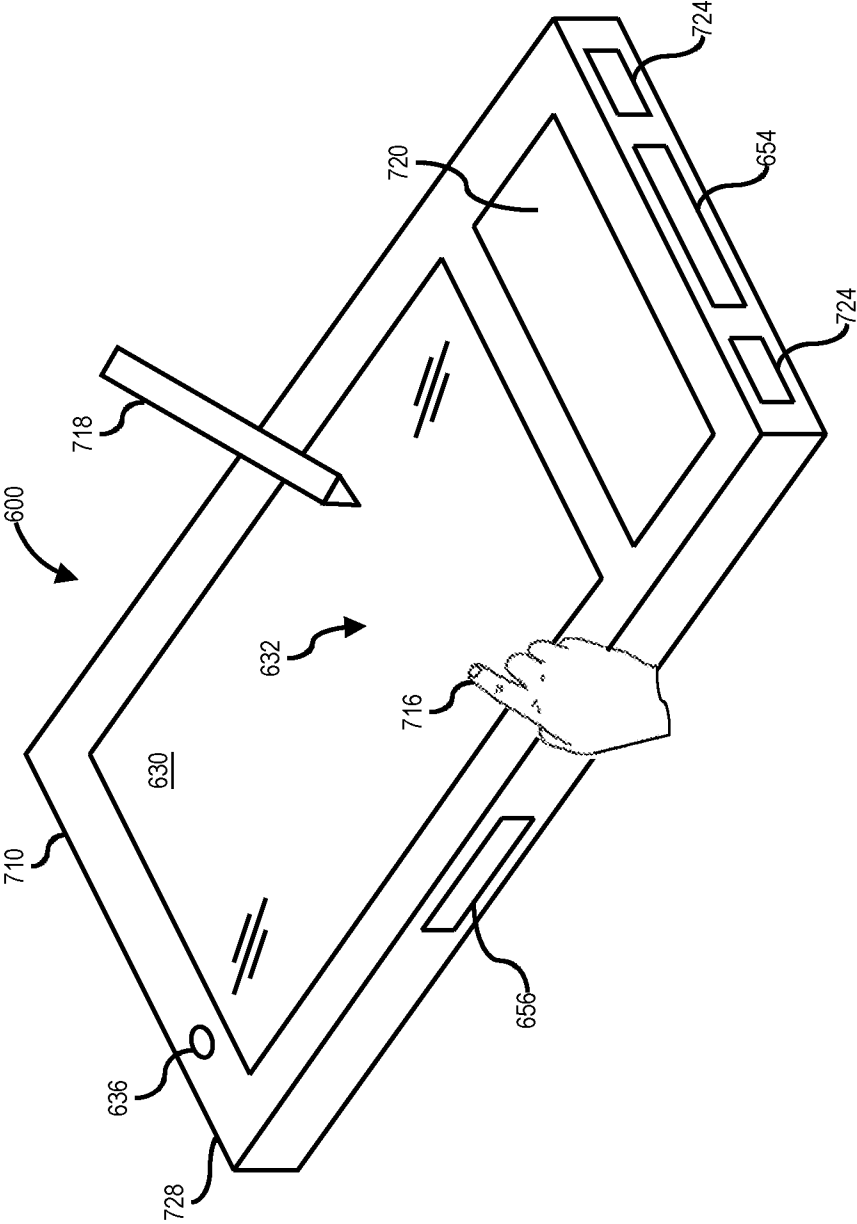


FIG. 7

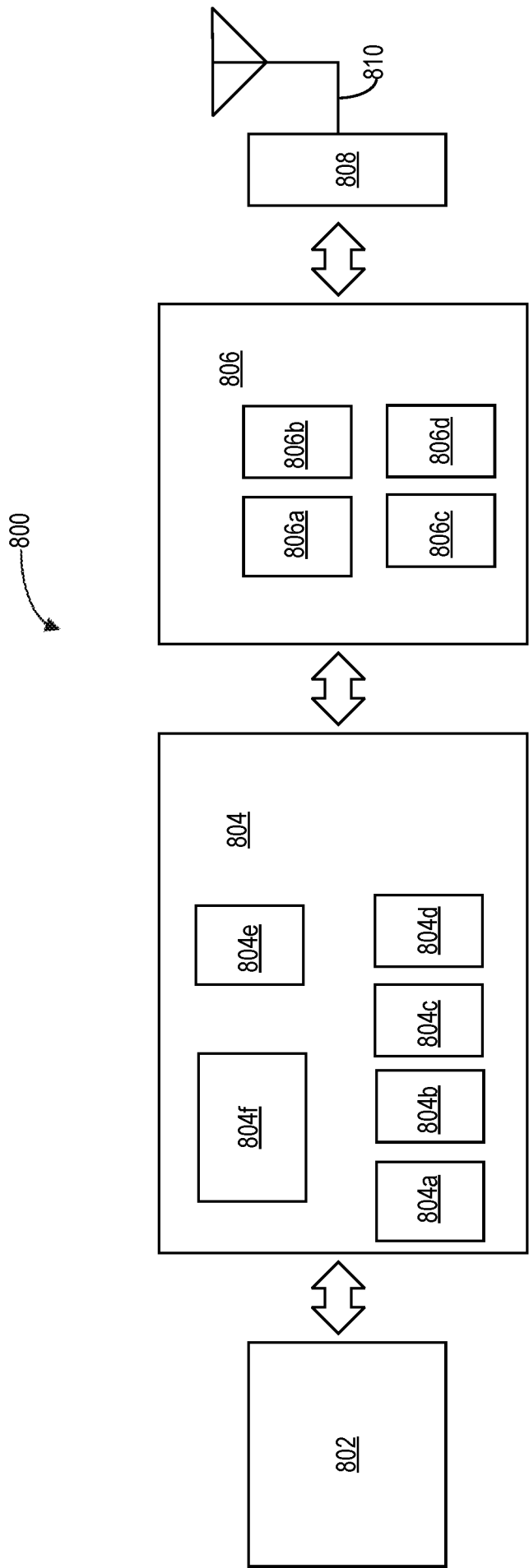


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/019717A. CLASSIFICATION OF SUBJECT MATTER
INV. H04W72/04 H04W72/14
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04W

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	INTEL CORPORATION: "Further aspects of short SPS interval", 3GPP DRAFT; R2-162466 FURTHER ASPECTS OF SHORT SPS INTERVAL, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Dubrovnik, Croatia; 20160411 - 20160415 2 April 2016 (2016-04-02), XP051082423, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_93bis/Docs/[retrieved on 2016-04-02] the whole document ----- -/--	1-26



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 May 2017

Date of mailing of the international search report

06/06/2017

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Manuel, Grégory

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/019717

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	HUAWEI ET AL: "Further analysis on uplink transmission skipping", 3GPP DRAFT; R2-154192 FURTHER ANALYSIS ON UPLINK TRANSMISSION SKIPPING, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; , vol. RAN WG2, no. Malmo, Sweden; 20151005 - 20151009 4 October 2015 (2015-10-04), XP051004775, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-10-04] the whole document -----	1-26
A	SAMSUNG: "Further discussion on Prescheduling", 3GPP DRAFT; R2-154350 FURTHER DISCUSSION ON PRESCHEDULING, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Malmo, Sweden; 20150905 - 20150909 4 October 2015 (2015-10-04), XP051004883, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-10-04] the whole document ----- -/--	1-26

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2017/019717

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	SAMSUNG: "Skipping uplink transmission with no data to transmit", 3GPP DRAFT; R2-153332 SKIP UPLINK TX, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 23 August 2015 (2015-08-23), XP051004073, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-08-23] the whole document -----	1-26
A	SAMSUNG: "Skipping uplink transmission with no data to transmit", 3GPP DRAFT; 36331 CRYYYY (REL-13) R2-153334 SKIP UPLINK, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 23 August 2015 (2015-08-23), XP051003843, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-08-23] the whole document -----	1-26
A	SAMSUNG: "Skipping uplink transmission with no data to transmit", 3GPP DRAFT; 36321 CRYYYY (REL-13) R2-153333 SKIP UPLINK, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Beijing, China; 20150824 - 20150828 23 August 2015 (2015-08-23), XP051003801, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_SYNC/RAN2/Docs/ [retrieved on 2015-08-23] the whole document ----- -/--	1-26

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2017/019717

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CATT: "PDCCH missing issue in skipping UL transmission", 3GPP DRAFT; R2-154121-SKIP UL TRANSMISSION-V1, 3RD GENERATION PARTNERSHIP PROJECT (3GPP), MOBILE COMPETENCE CENTRE ; 650, ROUTE DES LUCIOLES ; F-06921 SOPHIA-ANTIPOLIS CEDEX ; FRANCE , vol. RAN WG2, no. Malmö, Sweden; 20151005 - 20151009 4 October 2015 (2015-10-04), XP051004721, Retrieved from the Internet: URL:http://www.3gpp.org/ftp/Meetings_3GPP_ SYNC/RAN2/Docs/ [retrieved on 2015-10-04] the whole document -----	1-26