MANAGING DOWNLINK CONTROL CHANNEL MONITORING DURING A DOWNLINK CONTROL CHANNEL SKIPPING DURATION

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present Application claims priority to U.S. Patent Application No. 63/551,690 filed February 9, 2024, assigned to the Assignee hereof, and expressly incorporated by reference herein.

TECHNICAL FIELD

[0002] The present disclosure relates to wireless communications, and more specifically to managing (e.g., resuming) downlink control channel (e.g., physical downlink control channel (PDCCH)) monitoring during a skipping duration (e.g., a PDCCH skipping duration).

BACKGROUND

[0003] A wireless communications system may include one or multiple network communication devices, such as base stations, which may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers, or the like)). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0004] Some wireless communication systems may support extended reality (XR) applications, which may include various types of realities including augmented reality (AR), virtual reality (VR), and mixed reality (MR). Virtual reality (VR) may be a rendered version of a delivered visual and audio scene. The rendering may represent visual and audio

sensory stimuli of the real world to an observer or a user. In some cases, VR may require a user to be equipped with a head mounted display (HMD) to replace the user's field of view with a simulated visual component, and the user may be equipped with headphones to provide the user with accompanying audio. Some form of head and motion tracking of the user in VR may be provided to enable the simulated visual and audio components to be updated to ensure that, from the user's perspective, items and sound sources remain consistent with the user's movements.

[0005] AR may be when a user is provided with additional information or artificially generated items, or content overlaid upon a current environment. Such additional information or content may be visual or audible, or both, and the user's observation of the current environment may be direct, with no intermediate sensing, processing and rendering, or indirect, where the user's perception of the environment may be relayed via sensors and may be enhanced or processed. MR may be an advanced form of AR, in which some virtual elements are inserted into a physical scene with an intent to provide an illusion that the elements are part of the real scene. XR may include real-and-virtual combined environments and human-machine interactions generated by computer technology and wearables. It may include representative forms such as AR, MR and VR and the areas interpolated among them. The levels of virtuality range from partially sensory inputs to fully immersive VR. One aspect of XR includes extension of human experiences relating to senses of existence (e.g., represented by VR) and the acquisition of cognition (e.g., represented by AR). In some cases, XR applications can be data intensive and incite high demands on UE. While power can be saved by skipping operations, such as channel monitoring, these skipping operations may cause delays and reduce a quality of the XR applications.

SUMMARY

[0006] An article "a" before an element is unrestricted and understood to refer to "at least one" of those elements or "one or more" of those elements. The terms "a," "at least one," "one or more," and "at least one of one or more" may be interchangeable. As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of" or "one or both of") indicates an

inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on”. Further, as used herein, including in the claims, a “set” may include one or more elements.

[0007] The present disclosure relates to methods, apparatuses, and systems that support resuming PDDCH monitoring during a PDDCH skipping duration. By resuming PDDCH monitoring before the end of the PDDCH skipping duration, a UE can minimize impacts to latency, especially for XR data.

[0008] Some implementations of the method and apparatuses described herein may further include receiving downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration, transmitting at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration, and resuming monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

[0009] In some implementations of the method and apparatuses described herein, a UE determines a presence of uplink data in an uplink buffer of the UE, wherein the at least one PUSCH transmission or monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration is based at least in part on the presence of the uplink data in the uplink buffer of the UE.

[0010] In some implementations of the method and apparatuses described herein, the UE may receive, from a network entity, a downlink feedback indicator (DFI) based at least in part on the at least one PUSCH transmission using the set of one or more configured grant resources. The UE may retransmit the at least one PUSCH transmission, including uplink data, based at least in part on the DFI. In some implementations, the UE may receive

a second uplink grant in response to one or more of a scheduling request (SR) or a buffer status report (BSR). The second uplink grant may include a second set of one or more resources, and retransmitting the at least one PUSCH transmission, including uplink data, may be based at least in part on the DFI and using the second set of one or more resources.

[0011] In some implementations of the method and apparatuses described herein, the at least one PUSCH transmission comprises data including extended reality (XR) data.

[0012] In some implementations of the method and apparatuses described herein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the UE monitors at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a UE-specific search space associated with the UE.

[0013] In some implementations of the method and apparatuses described herein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the UE monitors at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a common search space, wherein the common search space corresponds to a lowest search space index.

[0014] In some implementations of the method and apparatuses described herein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the UE monitors at least one PDCCH occasion for downlink communication from a network entity, and resumes skipping the monitoring of the set of one or more PDCCH occasions for a remainder of the PDCCH skipping duration after the at least one PDCCH occasion.

[0015] In some implementations of the method and apparatuses described herein, the at least one PUSCH transmission comprises an indication of a set of one or more unused transmission occasions, and wherein the indication comprises uplink control information (UCI). The UE may resume skipping the monitoring of the set of one or more PDCCH occasions for downlink slots of the set of one or more configured grant resources which are indicated as being unused by the UCI. In another embodiment, the UE resumes skipping the monitoring of the set of one or more PDCCH occasions in response to receiving at least one PDCCH transmission after a last uplink transmission indicated in the UCI.

[0016] In some implementations of the method and apparatuses described herein, the UE receives, from a network entity, an indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions, and resumes monitoring of the set of one or more PDCCH occasions based at least in part on the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions. In some implementations, the UE receives the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration after the UE resumes monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Figure 1 illustrates an example of a wireless communications system in accordance with aspects of the present disclosure.

[0018] Figure 2 illustrates an example of a PDCCH skipping duration supported by a UE in accordance with aspects of the present disclosure.

[0019] Figure 3 illustrates an example of a PDCCH skipping duration compared to a reduced PDCCH monitoring by search space set group (SSSG) switching in accordance with aspects of the present disclosure.

[0020] Figure 4 illustrates an example of CG PUSCH resources in accordance with aspects of the present disclosure.

[0021] Figure 5A illustrates uplink (UL) PUSCH transmissions during a PDCCH skipping duration in accordance with aspects of the present disclosure.

[0022] Figure 5B illustrates resuming PDCCH monitoring during the skipping duration based on one or more of the UL PUSCH transmissions.

[0023] Figure 6 illustrates an example of a UE 600 in accordance with aspects of the present disclosure.

[0024] Figure 7 illustrates an example of a processor 700 in accordance with aspects of the present disclosure.

[0025] Figure 8 illustrates an example of a network equipment (NE) 800 in accordance with aspects of the present disclosure.

[0026] Figure 9 illustrates a flowchart of a method performed by a UE in accordance with aspects of the present disclosure.

[0027] Figure 10 illustrates a flowchart of a method performed by a NE in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0028] A UE may consume significant power during monitoring for a PDCCH. In some cases, to decrease the power consumption, the UE may be configured (e.g., enabled) to support a PDCCH skipping duration, in which the UE may skip monitoring for the PDCCH. The PDCCH skipping duration may include a set of one or more downlink slots in a time division duplex (TDD) UL/DL configuration. Although, the PDCCH skipping duration may reduce the power consumption for the UE by enabling the UE to skip (e.g., avoid) monitoring for the PDCCH, skipping of the PDCCH may degrade user experience for applications associated with the PDCCH (e.g., XR applications or the like). Additionally, skipping of the PDCCH may result in high latency because the UE may be unreachable during the PDCCH skipping duration.

[0029] For example, when a set of one or more packets arrive during a PDCCH skipping duration, the network (e.g., base station) may buffer the set of one or more packets (e.g., payload of the set of one or more packets). The network may provide for a grant via a downlink control information (DCI) over a configured search space for a PDCCH after the PDCCH skipping duration lapses. The network may transmit the set of one or more packets (e.g., payload of the set of one or more packets) on allocated resources associated with the grant. The buffering and delay of the transmission of the payload leads to a significant buffering delay. While the UE may transmit uplink data during the PDCCH skipping duration, the network may fail to successfully receive the uplink data, and the UE might not

receive a negative acknowledgement (NACK) from the network until after the PDCCH skipping duration. As a result, uplink retransmissions may be delayed.

[0030] Various aspects of the present disclosure relate to enabling a UE to resume (e.g., continue) monitoring for at least one PDCCH during a PDCCH skipping duration. The UE may implicitly resume the monitoring for the at least one PDCCH during the PDCCH skipping duration. In some implementations, the UE may transmit uplink data during the PDCCH skipping duration, and the UE may monitor for at least one PDCCH during a next PDCCH monitoring occasion after the transmitted uplink data. For example, the UE may monitor for at least one PDCCH during the next PDCCH monitoring occasion, which may begin a predetermined time after an uplink slot or uplink frame associated with the transmitted uplink data. The predetermined time may be an amount of time sufficient for the network (e.g., base station) to determine whether the uplink data was successfully received and process a downlink feedback indicator (DFI), which may prompt a retransmission from the UE.

[0031] A configured grant (CG) may be a grant configuration that includes one or more configured uplink grants for a single periodicity. For a PUSCH, a multi-PUSCH CG may be a CG configuration that includes multiple configured uplink grants (e.g., which may be consecutive) within a single periodicity. In some cases, when CG-PUSCH resources are configured for transmission of XR data during a PDCCH skipping duration, the UE may be configured to resume monitoring for at least one PDCCH when the UE is configured for the PDCCH skipping duration at the time when XR data arrives, or when the PDCCH skipping duration starts immediately after the UE transmits the XR data.

[0032] Various aspects of the present disclosure reduce latency and improve reliability of a wireless communication system. By resuming PDCCH monitoring during a PDCCH skipping duration (e.g., after transmitting uplink data), the UE can reduce delays in retransmitting uplink data that might not have been successfully received by the network during the PDCCH skipping duration. As described herein, a NACK may be buffered at the network until the end of the PDCCH skipping duration before transmitting to the UE, and may result in significant delays for retransmission of uplink data. As described herein, the UE may experience power saving as a result of PDCCH skipping durations without causing

unnecessary latency in retransmissions. Some implementations of the present disclosure relate to XR communication, but may be extended to other applications.

[0033] Aspects of the present disclosure are described in the context of a wireless communications system.

[0034] Figure 1 illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more NE 102, one or more UE 104, and a core network (CN) 106. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-Advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a NR network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G, for example, 6G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0035] The one or more NE 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a network function, a network entity, a radio access network (RAN), a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0036] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. For

example, an NE 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, an NE 102 may be moveable, for example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NE 102.

[0037] The one or more UE 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an Internet-of-Things (IoT) device, an Internet-of-Everything (IoE) device, or machine-type communication (MTC) device, among other examples.

[0038] A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0039] An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g., S1, N2, N3, or network interface). In some implementations, the NE 102 may communicate with each other directly. In some other implementations, the NE 102 may communicate with each other indirectly (e.g., via the CN 106). In some implementations, one or more NE 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other

access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0040] The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more NE 102 associated with the CN 106.

[0041] The CN 106 may communicate with a packet data network over one or more backhaul links (e.g., via an S1, N2, N3, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the CN 106 (e.g., one or more network functions of the CN 106).

[0042] In the wireless communications system 100, the NEs 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the NEs 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the NEs 102 and the UEs 104 may support various frame structures

(i.e., multiple frame structures). The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0043] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., μ=0) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., μ=0) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., μ=1) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., μ=2) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., μ=3) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., μ=4) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0044] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0045] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., μ=0, μ=1, μ=2, μ=3, μ=4) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively.# Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a

numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., μ=0) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0046] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR5A or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the NEs 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the NEs 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0047] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., μ=0), which includes 15 kHz subcarrier spacing; a second numerology (e.g., μ=1), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., μ=2), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., μ=3), which includes 120 kHz subcarrier spacing.

[0048] Figure 2 illustrates an example of a skipping duration that is configured at a UE 104 in accordance with aspects of the present disclosure. In a channel monitoring period, the UE continuously monitors occasions of the physical downlink control channel

(PDCCH) and the physical downlink shared channel (PDSCH). When a UE is configured for a skipping duration, the UE saves energy from monitoring the PDCCH and PDSCH channels by skipping the monitoring for the time of the skipping duration, and resumes monitoring the channels after the end of the skipping duration.

[0049] Figure 3 illustrates an example of reduced PDCCH monitoring by PDCCH skipping (a), and an example of reduced PDCCH monitoring by search space set group (SSSG) switching (b). With respect to SSSG implementations, a UE 104 can be provided with a group index for a respective Type3-PDCCH common search space (CSS) set or UE-specific search space (USS) set by *searchSpaceGroupIdList* for PDCCH monitoring on a serving cell, and/or a group index for a respective Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on an active DL BWP of a serving cell.

[0050] If the UE is not provided *searchSpaceGroupIdList* or *searchSpaceGroupIdList-r17* for a search space set, the following procedures that are based on search space set group switching are not applicable for PDCCH monitoring according to the search space set. A UE can be provided a set of durations by *pdcch-SkippingDurationList* for Type3-PDCCH CSS set or USS set for PDCCH monitoring on an active DL BWP of a serving cell. If the UE is not provided *pdcch-SkippingDurationList*, the following procedures related to skipping of PDCCH monitoring are not applicable.

[0051] If a UE is provided *cellGroupsForSwitchList*, indicating one or more groups of serving cells, the following procedures apply to all serving cells within each group; otherwise, the following procedures apply only to a serving cell for which the UE is provided *searchSpaceGroupIdList*. When a UE is provided *searchSpaceGroupIdList* or *searchSpaceGroupIdList-r17*, the UE resets PDCCH monitoring according to search space sets with group index 0, if provided by *searchSpaceGroupIdList* or *searchSpaceGroupIdList-r17*.

[0052] A UE can be provided by *searchSpaceSwitchDelay* or *searchSpaceSwitchDelay-r17* a number of symbols P_{switch} where a minimum value of P_{switch} is provided in the following Table 1 for UE processing capability 1 and UE processing capability 2 and SCS

configuration μ. UE processing capability 1 for SCS configuration μ applies unless the UE indicates support for UE processing capability 2.

Table 1: Minimum value of P_{switch} [symbols]

μ	Minimum P_{switch} value for UE processing capability 1 [symbols]	Minimum P_{switch} value for UE processing capability 2 [symbols]
0	25	10
1	25	12
2	25	22
3	40	-
5	160	-
6	320	-

[0053] A UE can be provided, by *searchSpaceSwitchTimer*, a timer value for a serving cell that the UE is provided *searchSpaceGroupIdList* or, if provided, for a set of serving cells provided by *cellGroupsForSwitchList*. The UE decrements the timer value by one after each slot based on a reference SCS configuration that is the smallest SCS configuration μ among all configured DL BWPs in the serving cell, or in the set of serving cells. The UE maintains the reference SCS configuration during the timer decrement procedure.

[0054] If a UE is provided by *SearchSpaceSwitchTrigger* a location of a search space set group switching flag field in a DCI format 2_0, as described in clause 11.1.1, for a serving cell where the UE has active DL BWP with SCS configuration μ:

- if the UE detects a DCI format 2_0 and a value of the search space set group switching flag field in the DCI format 2_0 is 0, the UE starts monitoring PDCCH according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell;

- at the beginning of the first slot that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format 2_0 when $\mu \in \{0, 1, 2, 3\}$;
- at the beginning of the first slot, of a group of X_s slots, that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format 2_0 when $\mu \in \{5, 6\}$;
- if the UE detects a DCI format 2_0 and a value of the search space set group switching flag field in the DCI format 2_0 is 1, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, for the serving cell;
- at the beginning of the first slot that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format 2_0, when $\mu \in \{0, 1, 2, 3\}$;
- at the beginning of the first slot, of a group of X_s slots, that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format 2_0 when $\mu \in \{5, 6\}$,

and the UE sets the timer value to the value provided by *searchSpaceSwitchTimer*:

- if the UE monitors PDCCH for a serving cell according to search space sets with group index 1, the UE starts monitoring PDCCH for the serving cell according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell;
- at the beginning of the first slot that is at least P_{switch} symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2_0 when $\mu \in \{0, 1, 2, 3\}$;
- at the beginning of the first slot, of a group of X_s slots, that is at least P_{switch} symbols after a slot where the timer expires or after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2_0 when $\mu \in \{5, 6\}$.

[0055] If a UE is provided *searchSpaceGroupIdList* and is not provided *SearchSpaceSwitchTrigger* for a serving cell:

- if the UE detects a DCI format by monitoring PDCCH according to a search space set with group index 0, the UE starts monitoring PDCCH according to search space sets with group index 1, and stops monitoring PDCCH according to search space sets with group index 0, for the serving cell;

- at the beginning of the first slot that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format when $\mu \in \{0, 1, 2, 3\}$;
- at the beginning of the first slot, of a group of X_s slots, that is at least P_{switch} symbols after the last symbol of the PDCCH with the DCI format when $\mu \in \{5, 6\}$;
- the UE sets the timer value to the value provided by *searchSpaceSwitchTimer* if the UE detects a DCI format by monitoring PDCCH in any search space set;
- if the UE monitors PDCCH for a serving cell according to search space sets with group index 1, the UE starts monitoring PDCCH for the serving cell according to search space sets with group index 0, and stops monitoring PDCCH according to search space sets with group index 1, for the serving cell;
- at the beginning of the first slot that is at least P_{switch} symbols after a slot where the timer expires or, if the UE is provided a search space set to monitor PDCCH for detecting a DCI format 2_0, after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2_0 when $\mu \in \{0, 1, 2, 3\}$;
- at the beginning of the first slot, of a group of X_s slots, that is at least P_{switch} symbols after a slot where the timer expires or, if the UE is provided a search space set to monitor PDCCH for detecting a DCI format 2_0, after a last symbol of a remaining channel occupancy duration for the serving cell if indicated by DCI format 2_0 when $\mu \in \{5, 6\}$.

[0056] A UE determines a slot and a symbol in the slot to start or stop PDCCH monitoring according to search space sets for a serving cell that the UE is provided *searchSpaceGroupIdList* or, if *cellGroupsForSwitchList* is provided, for a set of serving cells, based on the largest X_s if the SCS configuration μ among all configured DL BWPs in the set of serving cells equals to 6, otherwise, based on the smallest SCS configuration μ among all configured DL BWPs in the serving cell or in the set of serving cells and, if any, in the serving cell where the UE receives a PDCCH and detects a corresponding DCI format 2_0 triggering the start or stop of PDCCH monitoring according to search space sets.

[0057] A UE can be provided a set of durations by *pdcch-SkippingDurationList* for PDCCH monitoring on an active DL BWP of a serving cell and, if the UE is not provided

searchSpaceGroupIdList-r17 on the active DL BWP of the serving cell, a DCI format 0_1/0_2/0_3 that schedules PUSCH transmission, and a DCI format 1_1/1_2/1_3 that schedules PDSCH reception, can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits.

[0058] If the field has 1 bit and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on the active DL BWP of the serving cell, a '0' value for the bit indicates no skipping in PDCCH monitoring, and a '1' value for the bit indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations.

[0059] If the field has 2 bits and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on the active DL BWP of the serving cell, a '00' value for the bits indicates no skipping in PDCCH monitoring, a '01' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations, a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations, and a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the third value in the set of durations, if any; otherwise, if the set of durations includes two values, a use of the '11' value is reserved.

[0060] A UE can be provided group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on an active DL BWP of a serving cell and, if the UE is not provided *pdcch-SkippingDurationList* for the active DL BWP of the serving cell, a DCI format 0_1/0_2/0_3 that schedules PUSCH transmission, and a DCI format 1_1/1_2/1_3 that schedules PDSCH reception, can include a PDCCH monitoring adaptation field of 1 bit or of 2 bits for the serving cell.

[0061] If the field has 1 bit and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on the active DL BWP of the serving cell, a '0' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, and a '1' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space

sets with other group indexes, if any, and the UE sets the timer value to the one provided by *searchSpaceSwitchTimer-r17*, if provided.

[0062] If the field has 2 bits and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on the active DL BWP of the serving cell, a '00' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, a '01' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, and the UE sets the timer value to the one provided by *searchSpaceSwitchTimer-r17*, if provided, a '10' value for the bit indicates start of PDCCH monitoring according to search space sets with group index 2 and stop of PDCCH monitoring according to search space sets with other group indexes, if any, and the UE sets the timer value to the one provided by *searchSpaceSwitchTimer-r17*, if provided, and a '11' value is reserved.

[0063] A UE can be provided a set of durations by *pdcch-SkippingDurationList* and group indexes for a Type3-PDCCH CSS set or USS set by *searchSpaceGroupIdList-r17* for PDCCH monitoring on an active DL BWP of a serving cell and, a DCI format 0_1/0_2/0_3 that schedules PUSCH transmission, and a DCI format 1_1/1_2/1_3 that schedules PDSCH reception, can include a PDCCH monitoring adaptation field of 2 bits.

[0064] If the set of durations includes one value and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on the active DL BWP of the serving cell, a '00' value for the bits indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, a '01' value for the bits indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, and the UE sets the timer value to the one provided by *searchSpaceSwitchTimer-r17*, if provided, a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the value in the set of durations, and a '11' value is reserved.

[0065] If the set of durations includes two values and for PDCCH monitoring by the UE according to Type3-PDCCH CSS sets or USS sets on active DL BWP of the serving cell, a '00' value for the bits indicates start of PDCCH monitoring according to search space sets with group index 0 and stop of PDCCH monitoring according to search space sets with group index 1, if any, a '01' value for the bits indicates start of PDCCH monitoring according to search space sets with group index 1 and stop of PDCCH monitoring according to search space sets with group index 0, if any, and the UE sets the timer value to the one provided by *searchSpaceSwitchTimer-r17*, if provided, a '10' value for the bits indicates skipping PDCCH monitoring for a duration provided by the first value in the set of durations, and a '11' value for the bits indicates skipping PDCCH monitoring for a duration provided by the second value in the set of durations.

[0066] When the PDCCH monitoring adaptation field indicates to a UE to start PDCCH monitoring according to search space sets with a first group index and stop PDCCH monitoring according to search space sets with a second group index, the UE applies the indication at the beginning of a first slot that is at least P_{switch} symbols after the last symbol of the PDCCH reception providing the DCI format with the PDCCH monitoring adaptation field when $\mu \in \{0, 1, 2, 3\}$, and at the beginning of a first slot, of a slot group of X_s slots, that is at least P_{switch} symbols after the last symbol of the PDCCH reception providing the DCI format with the PDCCH monitoring adaptation field when $\mu \in \{5, 6\}$.

[0067] When the PDCCH monitoring adaptation field indicates to a UE to skip PDCCH monitoring for a duration on the active DL BWP of a serving cell, the UE starts skipping of PDCCH monitoring at the beginning of a first slot that is after the last symbol of the PDCCH reception providing the DCI format with the PDCCH monitoring adaptation field. If the UE transmits a PUCCH providing a positive SR before the UE detects a DCI format providing the PDCCH monitoring adaptation field indicating to the UE to skip PDCCH monitoring for the duration on the active DL BWP of the serving cell, the UE shall monitor PDCCH regardless of PDCCH skipping indication on all serving cells of the corresponding Cell Group when the SR is pending [11, TS 38.321]. If the UE transmits a PUCCH providing a positive SR after the UE detects a DCI format providing the PDCCH monitoring adaptation field indicating to the UE to skip PDCCH monitoring for the

duration on the active DL BWP of the serving cell, the UE resumes PDCCH monitoring starting at the beginning of a first slot that is after a last symbol of the PUCCH transmission in all serving cells of the corresponding Cell Group. When the UE is provided *pdcchMornitoringResumptionAfterNack*, after the UE detects a DCI format providing the PDCCH monitoring adaptation field indicating to the UE to skip PDCCH monitoring for the duration on the active DL BWP of the serving cell, if the UE transmits a PUCCH or a PUSCH providing a NACK value associated with a PDSCH reception that is scheduled by a DCI format in a PDCCH reception on the serving cell, the UE terminates PDCCH skipping, starting from the beginning of a first slot that is after a last symbol of the PUCCH or PUSCH transmission on the serving cell. During the time of *ra-ResponseWindow* or *msgB-ResponseWindow* or the duration where *ra-ContentionResolutionTimer* is running, the UE shall not skip PDCCH monitoring on SpCell. After the UE detects a DCI format providing the PDCCH monitoring adaptation field indicating to the UE to skip PDCCH monitoring for the duration on the active DL BWP of a SpCell, when contention resolution is successful [11, TS 38.321], the UE resumes PDCCH monitoring on the SpCell. After the UE detects a DCI format providing the PDCCH monitoring adaptation field indicating to the UE to skip PDCCH monitoring for the duration on the active DL BWP of a serving cell, when a pending SR is cancelled [11, TS 38.321], the UE resumes PDCCH monitoring in all serving cells of the corresponding Cell Group. If a UE transmits a RACH due to positive SR, the UE does not skip PDCCH monitoring on any serving cell of the corresponding Cell Group during the time of *ra-ResponseWindow* or *msgB-ResponseWindow* or the duration where *ra-ContentionResolutionTimer* is running. If DRX is configured and the DRX group of the serving cell enters outside Active Time, the UE terminates PDCCH skipping for the serving cell.

[0068] If the UE changes to a new active DL bandwidth part (BWP) of the serving cell by the expiration of *bwp-InactivityTimer* or by RRC configuration, the UE resumes PDCCH monitoring according to the search space sets on the new active BWP of the serving cell when UE is in a PDCCH skipping duration, and if the UE is not provided *searchSpaceGroupIdList-r17* on the new active DL BWP monitors PDCCH according to search space sets with group index 0 on the new active BWP of the serving cell, if the UE is provided *searchSpaceGroupIdList-r17*.

[0069] If a UE is provided group indexes for a Type3-PDCCH CSS set or a USS set by *searchSpaceGroupIdList-r17* and a timer value by *searchSpaceSwitchTimer-r17* for PDCCH monitoring an active DL BWP of a serving cell and the timer is running, the UE resets the timer after a slot of the active DL BWP of the serving cell if the UE detects a DCI format in a PDCCH reception in the slot for with CRC scrambled by C-RNTI/CS-RNTI/MCS-C-RNTI/G-RNTI for multicast/G-CS-RNTI. Otherwise, the timer value decrements by one after a slot of the active DL BWP of the serving cell.

[0070] When the timer expires in a first slot, the UE monitors PDCCH on the serving cell according to search space sets with group index 0 starting in a second slot that is not earlier than P_{switch} symbols after the first slot when $\mu \in \{0, 1, 2, 3\}$, is a first slot in a slot group of X_s slots that is not earlier than P_{switch} symbols after the first slot when $\mu \in \{5, 6\}$, and is not earlier than a slot where a PDCCH skipping duration expires, if applicable.

[0071] When a UE receives a first PDCCH in a first slot that provides a DCI format with a PDCCH monitoring adaptation field having a first value indicating skipping PDCCH monitoring, or indicating start of PDCCH monitoring according to a search space sets with a first group index and stop of PDCCH monitoring according to search space sets with a second group index, for an active DL BWP, and a second PDCCH that provides a DCI format with a PDCCH monitoring adaptation field having a second value indicating skipping PDCCH monitoring, or indicating start of PDCCH monitoring according to search space sets with a first group index and stop of PDCCH monitoring according to search space sets with a second group index different than the first group index, for the active DL BWP where the second PDCCH is received, in the first slot if the first value indicates skipping PDCCH monitoring, before a slot that is at least P_{switch} symbols after the first slot if the first value indicates start of PDCCH monitoring according to search space sets with a first group index, the UE does not expect the second value to be different than the first value.

[0072] A UE does not expect to receive in a second slot a PDCCH on an active DL BWP that provides a DCI format indicating skipping PDCCH monitoring, or start of PDCCH monitoring according to search space sets with group index 1 or 2 for the active

DL BWP, if the second slot is not at least P_{switch} symbols after a first slot where the timer expires.

[0073] Figure 4 illustrates an example of CG PUSCH resources that are allocated within a PDCCH skipping duration in a TDD system in accordance with aspects of the present disclosure. CG PUSCH resources may be allocated to a UE 104, and those resources may fall within a PDCCH skipping duration. When CG PUSCH resources fall within a PDCCH skipping duration, a UE can transmit uplink data on those resources. However, in a conventional system, the UE 104 would not receive a PDCCH related to the uplink transmissions in a DL slot since PDCCH monitoring is being skipped.

[0074] Figure 5A illustrates an example of uplink transmissions from a UE 104 during a skipping duration and Figure 5B illustrates corresponding PDCCH occasions in downlink that supports resuming PDCCH monitoring during a skipping duration in a TDD system in accordance with aspects of the present disclosure. When a UE is configured and activated for a PDCCH skipping duration and data arrives in the UE's uplink buffer for transmission using CG resources, the UE may transmit the buffered data during the PDCCH skipping duration or terminate the PDCCH skipping duration. In the example illustrated in Figure 5A, the UE transmits two frames of data, each of which includes uplink control information (UCI). The UE then resumes PDCCH monitoring for a DL time slot to receive PDCCH1 associated with the transmitted CG PUSCH resources, and resumes skipping.

[0075] The uplink transmissions may be transmitted by the UE 104 over physical uplink shared channel (PUSCH) resources which are configured to the UE by a configured grant (CG). Such resources may be referred to as CG-PUSCH resources, which are resources allocated to the UE to transmit data on the PUSCH.

[0076] An example of CG resources are time slots associated with a PUSCH that are available to a UE in which to transmit data to a gNB. The CG may be a type 1 CG which is configured using radio resource control (RRC) signaling, which may be activated and/or deactivated using PDCCH transmissions. Alternatively, the CG may be a type 2 CG which is indicated to the UE by downlink control information (DCI) received from a network equipment 102, e.g. a gNB. The DCI may be received by the UE in a PDCCH occasion before the start of the skipping duration. For a type 2 CG, the UE may transmit data on the

PUSCH, and receive retransmissions in the PDCCH in the configured resources, e.g. the time and frequency resources designated by the CG. In either case, the UE can transmit data on the PUSCH without having to request a scheduling grant from a gNB nor receiving an UL grant. Using CG resource, a gNB periodically pre-allocates the uplink resources with a fixed time-frequency resource size and the number of uplink resources within one periodicity to reduce the scheduling latency for uplink transmission. In addition, with configured grants, the gNB can allocate uplink resources for the initial HARQ transmissions and HARQ retransmissions to UEs.

[0077] In an embodiment, when the UE 104 transmits uplink data during the skipping duration, the UE implicitly resumes monitoring PDCCH occasions subsequent to the uplink transmissions, or terminates the PDCCH skipping duration. In other words, the UE activates an active PDCCH monitoring period, or enables active monitoring of PDCCH occasions after the uplink transmission by monitoring for certain PDCCH occasions or terminating the PDCCH skipping occasion and resuming normal monitoring.

[0078] In the example of figure 5B, the UE monitors PDCCH skipping durations corresponding to the uplink transmissions in Figure 5A after the first uplink frame is transmitted. In this example, the UE resumes PDCCH monitoring after only one uplink frame is transmitted during the skipping duration. In another embodiment, the UE resumes PDCCH monitoring after the last uplink transmission, or prior to a downlink slot that occurs during the skipping duration. In some embodiments, the UE resumes PDCCH monitoring a predetermined time after the uplink frame is transmitted so the gNB can process the uplink frame and provide feedback in the monitored PDCCH occasion.

[0079] Examples of feedback that may be present in the PDCCH occasion are downlink feedback information (DFI) and a retransmission uplink grant. Such indications may be provided in a PDCCH occasion when a gNB is unable to successfully decode data in one or more uplink data frame. Embodiments provide a mechanism for a gNB to provide DFI to a UE that performs configured grant uplink data transmissions. The DFI and/or dynamic uplink grant may be associated with the reception and decoding status of the UL PUSCH transmission in the CG resource.

[0080] According to the DFI, the UE determines whether to re-transmit the uplink data to the base station. The DFI may be part of a downlink control signal, e.g., DCI transmitted via a PDCCH. The DFI may be in the form of a bitmap, e.g. a hybrid automatic repeat request (HARQ) acknowledgment (ACK) bitmap. The DFI may include one or more indication indicating to the UE whether the uplink data was successfully received by the gNB.

[0081] In some embodiments, the UE only resumes PDCCH resources for a limited time after the last uplink data is transmitted. For example, the UE may resume PDCCH skipping after the UE receives a PDCCH with DFI for the last buffered frame that is transmitted by the UE, or after the end of a CG period. In another implementation, a base station can transmit the PDCCH containing DFI after the PDCCH skipping duration is finished when the latency allows. In another implementation, a base station can semi-statically configure the priority of the UL in the CG resources during the PDCCH skipping duration and according to the priority of the UL in the CG resource, the UE may continue the PDCCH skipping duration or may terminate the PDCCH skipping duration. In some examples, the priority may be linked to the latency of packet reception.

[0082] In some embodiments, the CG duration, or CG period, is longer than the time necessary to transmit all uplink frames buffered at the UE, e.g. to accommodate for jitter. That is, there may be a plurality of CG-PUSCH resources within one CG period in consideration of jitter of XR data. In such instances, when the uplink data is transmitted before the end of the CG period, the unused CG-PUSCH resources may be indicated by UCI using unused transmission occasion(s) indicated by uplink control information (UTO-UCI) signaling.

[0083] In an embodiment, the UE may stop PDCCH monitoring DL slots that are within the duration of unused CG PUSCH time occasions indicated by UTO-UCI and resume skipping after receiving the PDCCH following the last uplink frame transmitted by the UE. Accordingly, a UE may use a UTO-UCI indication to terminate the resumed PDCCH monitoring within the skipping duration.

[0084] For dynamic indication of unused CG PUSCH transmission occasions based on a UCI, the indicated unused CG PUSCH transmission occasions, if any, by the UCI in a CG

PUSCH for a CG configuration may be consecutive or non-consecutive CG PUSCH occasions in the time domain in one CG period. The UTO-UCI may provide a bitmap where a bit corresponds to a transmission occasion within a time duration/range. The bit indicates whether the occasion is “unused”. UTO-UCI may be sent in every CG PUSCH that is transmitted in a CG PUSCH configuration, or in only a portion of those occasions. With respect to PHY two-level priority, for a configured grant PUSCH configuration, the UTO-UCI may have the same priority level as the CG PUSCH.

[0085] Existing CG-UCI encoding and multiplexing procedures may be reused for encoding a UTO-UCI in a configured grant PUSCH in absence or presence of other UCIs being multiplexed in the PUSCH. In some embodiments, a UTO-UCI is used instead of CG-UCI in the corresponding procedures for encoding of CG-UCI and/or HARQ-ACK, whichever is present. For determining the beta-offset configured for the UTO-UCI, if UTO-UCI and HARQ-ACK are not jointly encoded, the beta offset for the UTO-UCI is used in the procedures instead of a CG-UCI beta offset. If UTO-UCI and HARQ-ACK are jointly encoded, HARQ-ACK beta offset may be used instead of the CG-UCI beta offset.

[0086] In an embodiment, when a UE 104 transmits UL transmissions in CG PUSCH resources in UL slots before or within PDCCH skipping durations in DL slots, the UE may resume monitoring of the PDCCH in a PDCCH skipping duration as illustrated in Figure 5B to receive an UL dynamic grant implicitly after the transmission of a positive scheduling grant (e.g. a scheduling request (SR)) or a buffer status report (BSR). In some embodiments, the UE may resume the PDCCH monitoring only for a common search space (CSS) or for the UE specific search space (USS) that is assigned to the UE.

[0087] In some implementations, when a UE 104 transmits UL data in a CG PUSCH resource in UL slots before or within a PDCCH skipping duration, the UE may resume PDCCH monitoring after terminating the PDCCH skipping duration to monitor DCI formats configured to monitor only for the USS, to monitor set of DCI formats configured by RRC, or to monitor only UL DCI formats such as DCI format 0_0/0_1 that schedules the uplink PUSCH transmission dynamically.

[0088] A USS is dedicated for each specific UE and informed to a UE via an RRC signaling message, while a CSS is common to a group of UEs. Common search spaces may

be designated by different indices, e.g. 0-3, and may be further differentiated by a letter designation, e.g. 0A. In some embodiments, the UE may resume monitoring PDCCH occasions during the skipping duration by using the lowest group index of search space group indices configured at the UE. For example, when indices 0, 1 and 2 are configured at the UE, the UE may resume monitoring PDCCH occasions using index 0. Lower search space indices may have higher levels of PDCCH monitoring than higher search space indices.

[0089] In one embodiment, after transmitting an UL transmission in a CG PUSCH resource before or during a PDCCH skipping duration, a UE may resume monitoring the PDCCH after terminating the PDCCH skipping duration by switching to the lowest group index of search space group index (SSSG 0). In another embodiment, the UE may resume the monitoring the PDCCH after terminating the PDCCH skipping duration by switching to the previously monitored search space group index within the same C_DRX active time/on duration. In still another embodiment, the UE may resume the monitoring of PDCCH after terminating the PDCCH skipping duration by switching to the RRC configured group index of a search space group index. A UE may be configured according to one or more of these embodiments to resume PDCCH monitoring during a PDCCH skipping duration.

[0090] As noted above, in some embodiments, a UE may terminate the PDCCH skipping duration and resume PDCCH monitoring. In such an embodiment, the UE may resume PDCCH monitoring at the first symbol of the next DL slot following the UL transmission that triggered resuming PDCCH monitoring. Referring to Figure 4, this may be the first DL slot following UL CG PUSCH resources in which the UL transmission occurred.

[0091] A network entity 102, e.g. a gNB, may transmit an UL retransmission grant in UL DCI format to a UE in DL slots within the PDCCH skipping duration, even when the UE is previously configured to skip the PDCCH duration, after receiving and decoding the initial UL PUSCH transmissions in CG-UL resource and BS fails to decode.

[0092] In some embodiments, the UE 104 may receive an explicit PDCCH skipping duration cancellation for the duration of time slots for which PDCCH skipping duration was previously activated. The UE may receive such an explicit cancellation from a gNB

during those DL time slots in which the UE monitors implicitly for PDCCH monitoring after a CG-PUSCH transmission. That is, when a UE implicitly resumes PDCCH monitoring after uplink transmissions during a skipping duration, a gNB may provide an indication to the UE to resume normal channel monitoring, effectively cancelling the remainder of the skipping duration for the UE. A UE may receive an explicit cancellation trigger in DCI in a PDCCH during those 'N' DL time slots in which UE monitors implicitly for PDCCH monitoring after CG-PUSCH transmission. The value of N may be configurable by RRC.

[0093] For explicit PDCCH skipping duration cancelation, a network entity 102 may transmit a PDCCH skipping cancellation indication to the UE in a DL slot within the PDCCH skipping duration, even when the UE is previously configured to skip the PDCCH duration, after receiving and failing to successfully decode a UL PUSCH transmission received from the UE in a CG-UL resource.

[0094] In some embodiments, as noted above, the UE 104 may provide UTO-UCI in one or more uplink frame transmitted during the skipping duration. In an embodiment, if the UE indicates unused CG-PUSCH resources using UTO-UCI in the CG-PUSCH resource in which it transmits data during the skipping duration, the PDCCH monitoring may be skipped for a corresponding number of downlink slots within the CG period until the duration at which the UE indicated the unused CG-PUSCH resource using UTO-UCI. For example, if a UE has more CG resources than the three frames shown in Figure 5A and the UE is able to transmit its buffered data by the third frame, the UE may only monitor the first PDCCH (PDCCH 1 in Figure 5B) and stop monitoring for the remainder of the skipping duration, even when additional PDCCH occasions are within the skipping duration, when UTO-UCI indicates that subsequent CG-PUSCH resources are unused. Using the example of Figure 5B, under these circumstances, the UE would monitor PDCCH1 and then resume skipping so that PDCCH2 is not monitored.

[0095] In various embodiments, if a UE 104 indicates unused CG-PUSCH resources using UTO-UCI in a CG-PUSCH resource after it transmits XR data in a UL CG resource, then PDCCH monitoring may be skipped for a corresponding number of DL slots within that CG period. PDCCH monitoring may be skipped for a corresponding number of DL

slots until a time duration indicating unused CG-PUSCH resources using UTO-UCI, or PDCCH monitoring may be skipped for a corresponding number of DL slots for multiple CG periods configured by RRC. This UE behavior may be configured separately independent to an explicit PDCCH skipping duration indication from a NE 102 using a DCI indication.

[0096] Figure 6 illustrates an example of a UE 600 in accordance with aspects of the present disclosure. The UE 600 may include a processor 602, a memory 604, a controller 606, and a transceiver 608. The processor 602, the memory 604, the controller 606, or the transceiver 608, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0097] The processor 602, the memory 604, the controller 606, or the transceiver 608, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0098] The processor 602 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 602 may be configured to operate the memory 604. In some other implementations, the memory 604 may be integrated into the processor 602. The processor 602 may be configured to execute computer-readable instructions stored in the memory 604 to cause the UE 600 to perform various functions of the present disclosure.

[0099] The memory 604 may include volatile or non-volatile memory. The memory 604 may store computer-readable, computer-executable code including instructions when executed by the processor 602 cause the UE 600 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as the memory 604 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that

facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0100] In some implementations, the processor 602 and the memory 604 coupled with the processor 602 may be configured to cause the UE 600 to perform one or more of the functions described herein (e.g., executing, by the processor 602, instructions stored in the memory 604). For example, the processor 602 may support wireless communication at the UE 600 in accordance with examples as disclosed herein. The UE 600 may be configured to support a means for receiving downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration, transmitting at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration, and resuming monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

[0101] The controller 606 may manage input and output signals for the UE 600. The controller 606 may also manage peripherals not integrated into the UE 600. In some implementations, the controller 606 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 606 may be implemented as part of the processor 602.

[0102] In some implementations, the UE 600 may include at least one transceiver 608. In some other implementations, the UE 600 may have more than one transceiver 608. The transceiver 608 may represent a wireless transceiver. The transceiver 608 may include one or more receiver chains 610, one or more transmitter chains 612, or a combination thereof.

[0103] A receiver chain 610 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 610 may include one or more antennas for receiving the signal over the air or wireless medium. The receiver chain 610 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 610 may include at least one demodulator configured to demodulate the received signal and obtain the

transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 610 may include at least one decoder for decoding and/or processing the demodulated signal to receive the transmitted data.

[0104] A transmitter chain 612 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 612 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 612 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 612 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0105] Figure 7 illustrates an example of a processor 700 in accordance with aspects of the present disclosure. The processor 700 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 700 may include a controller 702 configured to perform various operations in accordance with examples as described herein. The processor 700 may optionally include at least one memory 704, which may be, for example, an L1/L2/L3 cache. Additionally, or alternatively, the processor 700 may optionally include one or more arithmetic-logic units (ALUs) 706. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0106] The processor 700 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 700)) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM),

synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0107] The controller 702 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. For example, the controller 702 may operate as a control unit of the processor 700, generating control signals that manage the operation of various components of the processor 700. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0108] The controller 702 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 704 and determine subsequent instruction(s) to be executed to cause the processor 700 to support various operations in accordance with examples as described herein. The controller 702 may be configured to track memory address of instructions associated with the memory 704. The controller 702 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 702 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 702 may be configured to manage flow of data within the processor 700. The controller 702 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 700.

[0109] The memory 704 may include one or more caches (e.g., memory local to or included in the processor 700) or other memory, such as RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 704 may reside within or on a processor chipset (e.g., local to the processor 700). In some other implementations, the memory 704 may reside external to the processor chipset (e.g., remote to the processor 700).

[0110] The memory 704 may store computer-readable, computer-executable code including instructions that, when executed by the processor 700, cause the processor 700 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 702 and/or the processor 700 may be configured to execute computer-readable instructions stored in the memory 704 to cause the processor 700 to perform various functions. For example, the processor 700 and/or the controller 702 may be coupled with or to the memory 704, the processor 700, the controller 702, and the memory 704 may be configured to perform various functions described herein. In some examples, the processor 700 may include multiple processors and the memory 704 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0111] The one or more ALUs 706 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more ALUs 706 may reside within or on a processor chipset (e.g., the processor 700). In some other implementations, the one or more ALUs 706 may reside external to the processor chipset (e.g., the processor 700). One or more ALUs 706 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 706 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 706 may be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 706 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 706 to handle conditional operations, comparisons, and bitwise operations.

[0112] The processor 700 may support wireless communication in accordance with examples as disclosed herein. The processor 700 may be configured to or operable to support a means for receiving downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH)

occasions during a PDCCH skipping duration, transmitting at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration, and resuming monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

[0113] Figure 8 illustrates an example of a NE 800 in accordance with aspects of the present disclosure. The NE 800 may include a processor 802, a memory 804, a controller 806, and a transceiver 808. The processor 802, the memory 804, the controller 806, or the transceiver 808, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0114] The processor 802, the memory 804, the controller 806, or the transceiver 808, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0115] The processor 802 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 802 may be configured to operate the memory 804. In some other implementations, the memory 804 may be integrated into the processor 802. The processor 802 may be configured to execute computer-readable instructions stored in the memory 804 to cause the NE 800 to perform various functions of the present disclosure.

[0116] The memory 804 may include volatile or non-volatile memory. The memory 804 may store computer-readable, computer-executable code including instructions when executed by the processor 802 cause the NE 800 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as the memory 804 or another type of memory. Computer-readable media includes both non-transitory computer storage media and communication media including any medium that

facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0117] In some implementations, the processor 802 and the memory 804 coupled with the processor 802 may be configured to cause the NE 800 to perform one or more of the functions described herein (e.g., executing, by the processor 802, instructions stored in the memory 804). For example, the processor 802 may support wireless communication at the NE 800 in accordance with examples as disclosed herein. The NE 800 may be configured to support a means for granting UL resources to a UE, transmitting DCI comprising an indication to skip monitoring of a set of one or more PDCCH occasions during a PDCCH skipping duration, receiving at least one PUSCH transmission using a set of one or more CG resources and during the PDCCH skipping duration, and transmit data to the UE using the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

[0118] The controller 806 may manage input and output signals for the NE 800. The controller 806 may also manage peripherals not integrated into the NE 800. In some implementations, the controller 806 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 806 may be implemented as part of the processor 802.

[0119] In some implementations, the NE 800 may include at least one transceiver 808. In some other implementations, the NE 800 may have more than one transceiver 808. The transceiver 808 may represent a wireless transceiver. The transceiver 808 may include one or more receiver chains 810, one or more transmitter chains 812, or a combination thereof.

[0120] A receiver chain 810 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 810 may include one or more antennas for receiving the signal over the air or wireless medium. The receiver chain 810 may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receiver chain 810 may include at least one demodulator configured to demodulate the received signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the

signal. The receiver chain 810 may include at least one decoder for decoding and/or processing the demodulated signal to receive the transmitted data.

[0121] A transmitter chain 812 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 812 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 812 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 812 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0122] Figure 9 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a UE as described herein. In some implementations, the UE may execute a set of instructions to control the function elements of the UE to perform the described functions. Details related to various implementations of the method are provided above in the explanations with respect to Figures 2-5B, and are presented here in limited detail for the sake of brevity.

[0123] At 902, the method may include receiving DCI comprising an indication to skip monitoring of a set of one or more PDCCH occasions during a PDCCH skipping duration. The operations of 902 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 902 may be performed by a UE as described with reference to Figure 6. In particular, the DCI received by the UE may include an indication for a PDCCH skipping duration, and the UE may enter the PDCCH skipping duration based on the indication. The UE may have CG resources which are scheduled during the skipping duration so that the UE may continue to transmit data, e.g. XR data, that arrives at its buffer during the skipping duration using the CG resources.

[0124] At 904, the method may include transmitting at least one PUSCH transmission using a set of one or more CG resources and during the PDCCH skipping duration. The operations of 904 may be performed in accordance with examples as described herein. In

some implementations, aspects of the operations of 904 may be performed by a UE as described with reference to Figure 6.

[0125] In particular, the UE may transmit data which arrives at its buffer before and/or during a skipping duration using the CG PUSCH resources assigned to the UE. The data may comprise XR data. In some instances, the UE transmits at least a portion of the data before the start of the skipping duration, and the skipping duration begins either during or immediately after the resources are transmitted. In such instances, the UE is configured to resume monitoring of the PDCCH during the skipping duration even though some of the associated UL data was transmitted before the start of the skipping duration.

[0126] At 906, the method may include resuming monitoring the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission. The operations of 906 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 906 may be performed a UE as described with reference to Figure 6.

[0127] The resumed PDCCH monitoring by the UE at 906 may be implicit. In particular, the UE may automatically resume monitoring when a skipping duration occurs in the time in which DFI or an uplink grant for a retransmission would be expected to arrive at the UE in a PDCCH. In some embodiments, the UE resumes monitoring for limited downlink resources as described above, e.g. for a CSS or USS as described above. The UE may resume skipping the monitoring of the set of one or more PDCCH occasions for downlink slots of the set of one or more configured grant resources which are indicated as being unused by UCI in one or more of the uplink transmissions.

[0128] In an embodiment, the UE monitors at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a UE-specific search space associated with the UE. In another embodiment, the UE monitors at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a common search space, wherein the common search space corresponds to a lowest search space index.

[0129] In an embodiment, the UE monitors at least one PDCCH occasion for downlink communication from a network entity, and resumes skipping the monitoring of the set of

one or more PDCCH occasions for a remainder of the PDCCH skipping duration after the at least one PDCCH occasion.

[0130] The at least one PUSCH transmission from the UE may include an indication of a set of one or more unused transmission occasions, and the indication may include uplink control information (UCI). In such an embodiment, the UE may resume skipping the monitoring of the set of one or more PDCCH occasions for downlink slots of the set of one or more configured grant resources which are indicated as being unused by the UCI. In another embodiment, the UE resumes skipping the monitoring of the set of one or more PDCCH occasions in response to receiving at least one PDCCH transmission after a last uplink transmission indicated in the UCI.

[0131] In an embodiment, the UE receives, from a network entity, an indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions, and resumes monitoring of the set of one or more PDCCH occasions based at least in part on the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions. In such an embodiment, the UE may receive the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration after the UE resumes monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

[0132] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0133] Figure 10 illustrates a flowchart of a method in accordance with aspects of the present disclosure. The operations of the method may be implemented by a NE as described herein. In some implementations, the NE may execute a set of instructions to control the function elements of the NE to perform the described functions. Details related to various implementations of the method are provided above in the explanations with respect to Figures 2-5B, and are presented here in limited detail for the sake of brevity.

[0134] At 1002, the method may include granting UL PUSCH resources to a UE. The operations of 1002 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1002 may be performed by a NE as described with reference to Figure 8.

[0135] At 1004, the method may include transmitting DCI comprising an indication to skip monitoring of a set of one or more PDCCH occasions during a PDCCH skipping duration to a UE. The operations of 1004 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1004 may be performed by a NE as described with reference to Figure 8. The PDCCH skipping duration may coincide with one or more CG PUSCH resources granted at 1002.

[0136] At 1006, the method may include receiving at least one PUSCH transmission from the UE using a set of one or more CG resources and during the PDCCH skipping duration. The operations of 1006 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1006 may be performed by a NE as described with reference to Figure 8.

[0137] At 1008, the method may include transmitting data to the UE using the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission. The operations of 1008 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1008 may be performed a NE as described with reference to Figure 8. In particular, the data transmitted to the UE may include one or more of DFI or a retransmission grant in response to received UL data, and an explicit indication to terminate the skipping duration and resume normal PDCCH monitoring.

[0138] It should be noted that the method described herein describes a possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0139] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be

applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A user equipment (UE), comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the UE to:

receive downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration;

transmit at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration; and

resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

2. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

determine a presence of uplink data in an uplink buffer of the UE,

wherein the at least one PUSCH transmission or monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration is based at least in part on the presence of the uplink data in the uplink buffer of the UE.

3. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

receive, from a network entity, a downlink feedback indicator (DFI) based at least in part on the at least one PUSCH transmission using the set of one or more configured grant resources.

4. The UE of claim 3, wherein the at least one processor is configured to cause the UE to:

retransmit the at least one PUSCH transmission, including uplink data, based at least in part on the DFI.

5. The UE of claim 4, wherein the at least one processor is configured to cause the UE to:

receive an uplink grant in response to one or more of a scheduling request (SR) or a buffer status report (BSR), wherein the uplink grant comprises a second set of one or more resources,

wherein retransmitting the at least one PUSCH transmission, including uplink data, is based at least in part on the DFI and using the second set of one or more resources.

6. The UE of claim 1, wherein the at least one PUSCH transmission comprises data including extended reality (XR) data.

7. The UE of claim 1, wherein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the at least one processor is configured to cause the UE to:

monitor at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a UE-specific search space associated with the UE.

8. The UE of claim 1, wherein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the at least one processor is configured to cause the UE to:

monitor at least one PDCCH occasion of the set of one or more PDCCH occasions associated with a common search space, wherein the common search space corresponds to a lowest search space index.

9. The UE of claim 1, wherein, to resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration, the at least one processor is configured to cause the UE to:

monitor at least one PDCCH occasion for downlink communication from a network entity, and wherein the at least one processor is further configured to cause the UE to:

resume skipping the monitoring of the set of one or more PDCCH occasions for a remainder of the PDCCH skipping duration after the at least one PDCCH occasion.

10. The UE of claim 1, wherein the at least one PUSCH transmission comprises an indication of a set of one or more unused transmission occasions, and wherein the indication comprises uplink control information (UCI).

11. The UE of claim 10, wherein the at least one processor is further configured to cause the UE to:

resume skipping the monitoring of the set of one or more PDCCH occasions for downlink slots of the set of one or more configured grant resources which are indicated as being unused by the UCI.

12. The UE of claim 10, wherein the at least one processor is configured to cause the UE to:

resume skipping the monitoring of the set of one or more PDCCH occasions in response to receiving at least one PDCCH transmission after a last uplink transmission indicated in the UCI.

13. The UE of claim 1, wherein the at least one processor is configured to cause the UE to:

receive, from a network entity, an indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions; and

resume monitoring of the set of one or more PDCCH occasions based at least in part on the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions.

14. The UE of claim 13, wherein the UE receives the indication to cancel the skipping of the monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration after the UE resumes monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

15. A processor for wireless communication, comprising:

at least one controller coupled with at least one memory and configured to cause the processor to:

receive downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration;

transmit at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration; and

resume monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

16. A method performed by a user equipment (UE), the method comprising:

receiving downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration;

transmitting at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration; and

resuming monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

17. A base station for wireless communication, comprising:

at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the base station to:

transmit downlink control information (DCI) comprising an indication to skip monitoring of a set of one or more physical downlink control channel (PDCCH) occasions during a PDCCH skipping duration to a user equipment (UE); and

receive, from the UE, at least one physical uplink shared channel (PUSCH) transmission using a set of one or more configured grant resources and during the PDCCH skipping duration;

wherein the UE resumes monitoring of the set of one or more PDCCH occasions during the PDCCH skipping duration in response to the at least one PUSCH transmission.

18. The base station of claim 17, wherein the at least one processor is configured to cause the base station to:

transmit a downlink feedback indicator (DFI) based at least in part on the at least one PUSCH transmission using the set of one or more configured grant resources.

19. The base station of claim 18, wherein the at least one processor is configured to cause the base station to:

receive a retransmission of the at least one PUSCH including uplink data, based at least in part on the DFI.

20. The base station of claim 19, wherein the at least one processor is configured to cause the base station to:

transmit an uplink grant to the UE, wherein the uplink grant comprises a second set of one or more resources,

wherein the retransmission of the at least one PUSCH transmission, including uplink data, is based at least in part on the DFI and using the second set of one or more resources.