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(71) Applicant: **NEC CORPORATION** [JP/JP]; 7-1, Shiba 5-Chome, Minato-Ku, Tokyo 108-8001 (JP).

(72) Inventor; and

(71) Applicant *(for SC only)*: **WANG, Gang** [CN/CN]; 6F, Building D2,Liangmaqiao Diplomatic Office Building, No.19 Dongfangdonglu, Chaoyang District, Beijing 100600 (CN).

(74) Agent: **SHIHUI PARTNERS**; 42/F, Tower C, Beijing Yintai Centre, No.2 Jianguomenwai Avenue, Chaoyang District, Beijing 100022 (CN).

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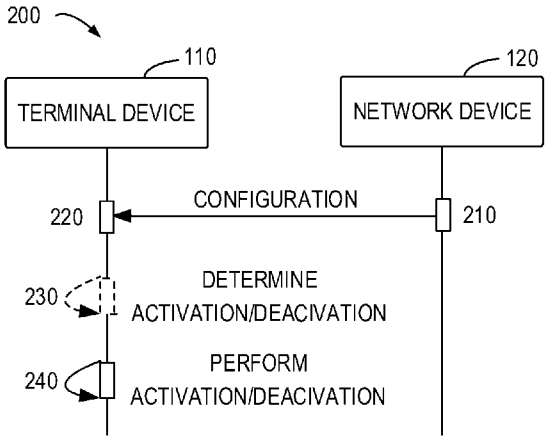

FIG. 2

(57) Abstract: Embodiments of the present disclosure provide a solution for measurement gap activation and deactivation. In the solution, a terminal device receives, from a network device, a configuration of a measurement gap for performing a measurement. The terminal device performs an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device. In this way, the measurement gap can be activated or deactivated.

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DEVICES AND METHODS FOR COMMUNICATION

FIELDS

[0001] Example embodiments of the present disclosure generally relate to the field of communication techniques and in particular, to devices and methods for measurement gap (MG) activation and deactivation.

BACKGROUND

[0002] In new radio (NR), a measurement gap may be configured in a terminal device for performing inter-frequency measurements for frequency range one (FR1)/frequency range two (FR2) an intra-frequency measurement for FR2. With the measurement gap(s), the terminal device may perform neighbour cell measurements of synchronization signal or physical broadcast channel (PBCH) blocks (SSBs) over the SSB based radio resource management (RRM) measurement timing configuration (SMTC), for example, for handover (HO) purposes.

[0003] If configured with MG, the terminal device is not expected to perform any transmissions or receptions of other signals or channels. As such, the MGs may have an impact on scheduling and data transmissions.

SUMMARY

[0004] In general, embodiments of the present disclosure provide a solution for measurement gap activation and deactivation.

[0005] In a first aspect, there is provided a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, a configuration of a measurement gap for performing a measurement; and perform an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device.

[0006] In a second aspect, there is provided a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, a configuration

of at least one measurement gap for performing a measurement; receive, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and perform the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication.

[0007] In a third aspect, there is provided a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, a configuration of a measurement gap for performing a measurement; and transmit, to the terminal device, indication information associated with a data transmission or a data reception of the terminal device, wherein an activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information.

[0008] In a fourth aspect, there is provided a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, a configuration of at least one measurement gap for performing a measurement; and transmit, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX).

[0009] In a fifth aspect, there is provided a communication method performed by a terminal device. The method comprises: receiving, from a network device, a configuration of a measurement gap for performing a measurement; and performing an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device.

[0010] In a sixth aspect, there is provided a communication method performed by a terminal device. The method comprises: receiving, from a network device, a configuration of at least one measurement gap for performing a measurement; receiving, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and performing the activation or the deactivation of the

at least one measurement gap or at least one measurement gap occasion based on the indication.

[0011] In a seventh aspect, there is provided a communication method performed by a network device. The method comprises: transmitting, to a terminal device, a configuration of a measurement gap for performing a measurement; and transmitting, to the terminal device, indication information associated with a data transmission or a data reception of the terminal device, wherein an activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information.

[0012] In an eighth aspect, there is provided a communication method performed by a network device. The method comprises: transmitting, to a terminal device, a configuration of at least one measurement gap for performing a measurement; and transmitting, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX).

[0013] In a ninth aspect, there is provided a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to carry out the method according to the fifth, sixth, seventh, or eighth aspect.

[0014] Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Through the more detailed description of some example embodiments of the present disclosure in the accompanying drawings, the above and other objects, features and advantages of the present disclosure will become more apparent, wherein:

[0016] FIG. 1 illustrates an example communication environment in which example embodiments of the present disclosure can be implemented;

[0017] FIG. 2 illustrates a signaling flow of measurement gap activation and deactivation in accordance with some embodiments of the present disclosure;

[0018] FIG. 3A to FIG. 3C illustrate examples of determination of the activation or

deactivation of the measurement gap in accordance with some embodiments of the present disclosure, respectively;

[0019] FIG. 4A to FIG. 4C illustrate examples of determination of the activation or deactivation of the measurement gap in accordance with some embodiments of the present disclosure, respectively;

[0020] FIG. 5A illustrates an example showing long DRX cycles;

[0021] FIG. 5B illustrates an example showing short DRX cycles;

[0022] FIG. 6 illustrates a process for determining the activation or deactivation of measurement gap in accordance with some embodiments of the present disclosure;

[0023] FIG. 7 illustrates another process for determining the activation or deactivation of measurement gap in accordance with some embodiments of the present disclosure;

[0024] FIG. 8 illustrates a signaling flow of activation or deactivation of measurement gap in accordance with some embodiments of the present disclosure;

[0025] FIG. 9 illustrates a flowchart of a method implemented at a terminal device according to some example embodiments of the present disclosure;

[0026] FIG. 10 illustrates a flowchart of a method implemented at a terminal device according to some example embodiments of the present disclosure;

[0027] FIG. 11 illustrates a flowchart of a method implemented at a network device according to some example embodiments of the present disclosure;

[0028] FIG. 12 illustrates a flowchart of a method implemented at a network device according to some example embodiments of the present disclosure;

[0029] FIG. 13 illustrates a simplified block diagram of an apparatus that is suitable for implementing example embodiments of the present disclosure.

[0030] Throughout the drawings, the same or similar reference numerals represent the same or similar element.

DETAILED DESCRIPTION

[0031] Principle of the present disclosure will now be described with reference to some example embodiments. It is to be understood that these embodiments are described only

for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure. Embodiments described herein can be implemented in various manners other than the ones described below.

[0032] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0033] As used herein, the term 'terminal device' refers to any device having wireless or wired communication capabilities. Examples of the terminal device include, but not limited to, user equipment (UE), personal computers, desktops, mobile phones, cellular phones, smart phones, personal digital assistants (PDAs), portable computers, tablets, wearable devices, internet of things (IoT) devices, Ultra-reliable and Low Latency Communications (URLLC) devices, Internet of Everything (IoE) devices, machine type communication (MTC) devices, devices on vehicle for V2X communication where X means pedestrian, vehicle, or infrastructure/network, devices for Integrated Access and Backhaul (IAB), Space borne vehicles or Air borne vehicles in Non-terrestrial networks (NTN) including Satellites and High Altitude Platforms (HAPs) encompassing Unmanned Aircraft Systems (UAS), eXtended Reality (XR) devices including different types of realities such as Augmented Reality (AR), Mixed Reality (MR) and Virtual Reality (VR), the unmanned aerial vehicle (UAV) commonly known as a drone which is an aircraft without any human pilot, devices on high speed train (HST), or image capture devices such as digital cameras, sensors, gaming devices, music storage and playback appliances, or Internet appliances enabling wireless or wired Internet access and browsing and the like. The 'terminal device' can further has 'multicast/broadcast' feature, to support public safety and mission critical, V2X applications, transparent IPv4/IPv6 multicast delivery, IPTV, smart TV, radio services, software delivery over wireless, group communications and IoT applications. It may also incorporate one or multiple Subscriber Identity Module (SIM) as known as Multi-SIM. The term "terminal device" can be used interchangeably with a UE, a mobile station, a subscriber station, a mobile terminal, a user terminal or a wireless device.

[0034] The term "network device" refers to a device which is capable of providing or hosting a cell or coverage where terminal devices can communicate. Examples of a network device include, but not limited to, a Node B (NodeB or NB), an evolved NodeB

(eNodeB or eNB), a next generation NodeB (gNB), a transmission reception point (TRP), a remote radio unit (RRU), a radio head (RH), a remote radio head (RRH), an IAB node, a low power node such as a femto node, a pico node, a reconfigurable intelligent surface (RIS), and the like.

[0035] The terminal device or the network device may have Artificial intelligence (AI) or Machine learning capability. It generally includes a model which has been trained from numerous collected data for a specific function, and can be used to predict some information.

[0036] The terminal or the network device may work on several frequency ranges, e.g., FR1 (e.g., 450 MHz to 6000 MHz), FR2 (e.g., 24.25GHz to 52.6GHz), frequency band larger than 100 GHz as well as Tera Hertz (THz). It can further work on licensed/unlicensed/shared spectrum. The terminal device may have more than one connection with the network devices under Multi-Radio Dual Connectivity (MR-DC) application scenario. The terminal device or the network device can work on full duplex, flexible duplex and cross division duplex modes.

[0037] The embodiments of the present disclosure may be performed in test equipment, e.g., signal generator, signal analyzer, spectrum analyzer, network analyzer, test terminal device, test network device, channel emulator. In some embodiments, the terminal device may be connected with a first network device and a second network device. One of the first network device and the second network device may be a master node and the other one may be a secondary node. The first network device and the second network device may use different radio access technologies (RATs). In some embodiments, the first network device may be a first RAT device and the second network device may be a second RAT device. In some embodiments, the first RAT device is eNB and the second RAT device is gNB. Information related with different RATs may be transmitted to the terminal device from at least one of the first network device or the second network device. In some embodiments, first information may be transmitted to the terminal device from the first network device and second information may be transmitted to the terminal device from the second network device directly or via the first network device. In some embodiments, information related with configuration for the terminal device configured by the second network device may be transmitted from the second network device via the first network device. Information related with reconfiguration for the terminal device configured by the second network device may be transmitted to the terminal device from the second network device directly or via the first network device.

[0038] As used herein, the singular forms 'a', 'an' and 'the' are intended to include the plural forms as well, unless the context clearly indicates otherwise. The term 'includes' and its variants are to be read as open terms that mean 'includes, but is not limited to.' The term 'based on' is to be read as 'at least in part based on.' The term 'one embodiment' and 'an embodiment' are to be read as 'at least one embodiment.' The term 'another embodiment' is to be read as 'at least one other embodiment.' The terms 'first,' 'second,' and the like may refer to different or same objects. Other definitions, explicit and implicit, may be included below.

[0039] In some examples, values, procedures, or apparatus are referred to as 'best,' 'lowest,' 'highest,' 'minimum,' 'maximum,' or the like. It will be appreciated that such descriptions are intended to indicate that a selection among many used functional alternatives can be made, and such selections need not be better, smaller, higher, or otherwise preferable to other selections.

[0040] As used herein, the term "resource," "transmission resource," "uplink resource," or "downlink resource" may refer to any resource for performing a communication, such as a resource in time domain, a resource in frequency domain, a resource in space domain, a resource in code domain, or any other resource enabling a communication, and the like. In the following, unless explicitly stated, a resource in both frequency domain and time domain will be used as an example of a transmission resource for describing some example embodiments of the present disclosure. It is noted that example embodiments of the present disclosure are equally applicable to other resources in other domains.

[0041] As used herein, the term "data transmission" may include but not limited to a transmission of a signaling radio bearer (SRB), a transmission of a data radio bearer (DRB), a transmission of channel state information (CSI), a transmission of sounding reference signal (SRS), physical uplink shared channel (PUSCH) transmission, physical uplink control channel (PUCCH) transmission, physical downlink shared channel (PDSCH) transmission, physical downlink control channel (PDCCH) transmission, or any other suitable data transmission.

[0042] As used herein, in some embodiments, the term "measurement gap" may refer to "measurement gap configuration", "measurement gap occasion", or "measurement gap length".

[0043] As used herein, the term "deactivation of measurement gap" or "deactivating the measurement gap" or "the terminal device 110 or UE considering of the deactivation of the measurement gap" may refer to that the data transmission prioritizes over the

measurement gap, or the data transmission may be performed during the measurement gap, or the measurement may not be performed during the measurement gap, or handling of the measurement gap may not be performed during the measurement gap.

[0044] As used herein, in some embodiments, the term "DRX on duration time" may be replaced by DRX active time.

[0045] Principles and implementations of the present disclosure will be described in detail below with reference to the figures.

[0046] FIG. 1 illustrates a schematic diagram of an example communication environment 100 in which example embodiments of the present disclosure can be implemented. In the communication environment 100, a plurality of communication devices, including a terminal device 110 and a network device 120, can communicate with each other.

[0047] In the example of FIG. 1, the terminal device 110 may be a UE and the network device 120 may be a base station serving the UE. The serving area of the network device 120 may be called a cell.

[0048] It is to be understood that the number of devices and their connections shown in FIG. 1 are only for the purpose of illustration without suggesting any limitation. The communication environment 100 may include any suitable number of devices configured to implementing example embodiments of the present disclosure. Although not shown, it would be appreciated that one or more additional devices may be located in the cell, and one or more additional cells may be deployed in the communication environment 100. It is noted that although illustrated as a network device, the network device 120 may be another device than a network device. Although illustrated as a terminal device, the terminal device 110 may be other device than a terminal device.

[0049] In the following, for the purpose of illustration, some example embodiments are described with the terminal device 110 operating as a UE and the network device 120 operating as a base station. However, in some example embodiments, operations described in connection with a terminal device may be implemented at a network device or other device, and operations described in connection with a network device may be implemented at a terminal device or other device.

[0050] In some example embodiments, if the terminal device 110 is a terminal device and the network device 120 is a network device, a link from the network device 120 to the terminal device 110 is referred to as a downlink (DL), while a link from the terminal device 110 to the

network device 120 is referred to as an uplink (UL). In DL, the network device 120 is a transmitting (TX) device (or a transmitter) and the terminal device 110 is a receiving (RX) device (or a receiver). In UL, the terminal device 110 is a TX device (or a transmitter) and the network device 120 is a RX device (or a receiver).

[0051] The communications in the communication environment 100 may conform to any suitable standards including, but not limited to, Global System for Mobile Communications (GSM), Long Term Evolution (LTE), LTE-Evolution, LTE-Advanced (LTE-A), New Radio (NR), Wideband Code Division Multiple Access (WCDMA), Code Division Multiple Access (CDMA), GSM EDGE Radio Access Network (GERAN), Machine Type Communication (MTC) and the like. The embodiments of the present disclosure may be performed according to any generation communication protocols either currently known or to be developed in the future. Examples of the communication protocols include, but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G) communication protocols, 5.5G, 5G-Advanced networks, or the sixth generation (6G) networks.

[0052] As discussed above, if configured with MG, the terminal device is not expected to perform any transmissions or receptions of other signals or channels. As such, MGs may have an impact on scheduling and data transmissions, especially for transmitting or receiving protocol data unit (PDU) or PDU sets with tight packet delay budget (PDB) or PDU set delay budget (PSDB). Enhancements for reducing the impact to capacity and impact to individual terminal devices with respect to scheduling restrictions for measurements with MGs are needed. For FR2, capacity loss due to SSB measurements range from 5% to greater than 50%. An individual UE may be non-schedulable for 25% of the time.

[0053] In some mechanisms, extended reality (XR) enhancement is discussed and XR-specific capacity improvements which includes the buffer status report (BSR) enhancements, discard operation and configured grant enhancements are discussed. During release (Rel) – 18 work item (WI), MG enhancements were deprioritized due to lack of time.

[0054] In some mechanisms, for handling of measurement gaps, during an activated measurement gap, the medium access control (MAC) entity may, on the serving cell(s) in the corresponding frequency range of the measurement gap configured by *measGapConfig*

as specified in technical specification (TS) 38.331, not perform the transmission of hybrid automatic repeat request (HARQ) feedback, scheduling request (SR) and channel state information (CSI); not report sounding reference signal (SRS); not transmit on uplink shared channel (UL-SCH) except for Msg3 or the MSGA payload; if the *ra-ResponseWindow* or the *ra-ContentionResolutionTimer* or the *msgB-ResponseWindow* is running: monitor the PDCCH; otherwise: not monitor the PDCCH; and not receive on downlink shared channel (DL-SCH).

[0055] Configuring MG for measurements may have a major impact on scheduling of data in multi-modal flows, since data transmissions are expected to be done more frequently than in single flow case. In an approach, it may be beneficial if MG may be dynamically (de)activated during transmissions of XR data. Alternatively, a mechanism to relax some scheduling restrictions such that data/signaling may be prioritized over measurements may be considered. Based on the discussion on the potential scope for XR-specific MG enhancements, it is proposed to study and specify the MG enhancements to minimize scheduling restrictions and the impact on XR data transmissions/receptions.

[0056] Delaying data transmissions until after the MG duration may result in not meeting the quality of service (QoS) requirements and unnecessary PDU discarding. For example, for an MG length of 6ms, the remaining time for scheduling a PDU set with PSDB of 10ms may be only 4ms (e.g., if the PDU set arrives at the start of a MG), or example for an MG length of 6ms, the remaining time of a PDU set with only 4ms at the start of a MG, which resulting the PDU discarding.

[0057] The impact of MG may be more severe on XR multi-modal flows, where the scheduling and transmissions are expected to be done more frequently than in the case of single flow traffic considered in Rel-18. Although the gNB may configure short MG durations when the UE is expected to be scheduled with XR traffic, it may be challenging to balance the trade-off between having accurate measurements and timely transmissions of data in multi-modal flows.

[0058] In order to solve at least part of the above problems or other potential problems, a solution on measurement gap activation and deactivation is proposed. In the solution, a measurement gap is configured for a terminal device receives by a network device. For example, the terminal device receives a configuration of the measurement gap from the network device. The terminal device performs an activation or a deactivation of the

measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device. In this way, the terminal device can determine and perform the activation or the deactivation of the configured measurement gap.

[0059] FIG. 2 illustrates a signaling flow 200 of measurement gap activation and deactivation in accordance with some embodiments of the present disclosure. For the purposes of discussion, the signaling flow 200 will be discussed with reference to FIG. 1, for example, by using the terminal device 110 and the network device 120.

[0060] In operation, the network device 120 transmits (210), to the terminal device 110, a configuration of a measurement gap for performing a measurement. The terminal device 110 receives (220) the configuration. For example, the configuration may be via radio resource control (RRC) signaling, medium access control control element (MAC CE) or any other suitable message or signaling.

[0061] The terminal device 110 performs (240) an activation or a deactivation of the measurement gap based on the configuration and further information. For example, the terminal device 110 may determine (230) the activation or the deactivation of the measurement gap based on the further information, and perform (240) the activation or the deactivation based on the determining. The further information is associated with at least one of: a type of data to be transmitted or received by the terminal device 110, a remaining time of a data transmission of the terminal device 110, or indication information associated with a data transmission or a data reception of the terminal device 110. For example, the type of data to be transmitted or received may indicate whether the data is delay-critical data. As used herein, the activation and deactivation of the measurement gap may be referred to as measurement gap scheduling restrictions relax.

[0062] In an example embodiment, the terminal device 110 performs (240) the activation or deactivation of the measurement gap based on the configuration and delay-critical data to be transmitted or received by the terminal device 110.

[0063] In some embodiments, if the delay-critical data exists during the measurement gap, the terminal device 110 may determine (230) the deactivation of the measurement gap. The delay-critical data may associate with at least one of: a logical channel group

(LCG), a data radio bearer (DRB) or a logical channel (LCH). The terminal device 110 may perform (240) the deactivation of the measurement gap. In some embodiments, the terminal device 110 may transmit or receive the delay-critical data regardless of the measurement gap.

[0064] As used herein, the terminal device 110 determining (230) the activation or deactivation of the measurement gap may represent that the terminal device 110 determines (230) to perform (240) the activation or deactivation of the measurement gap.

[0065] In some embodiments, if at least one of an uplink grant or a downlink assignment is available for the data transmission or the data reception of the terminal device 110, the terminal device 110 may perform (240) the deactivation of the measurement gap. In some embodiments, if at least one of an uplink grant or a downlink assignment is available for the transmission or reception of data including the delay-critical data of the terminal device 110 during the measurement gap, the terminal device 110 may perform (240) the deactivation of the measurement gap.

[0066] As used herein, if a delay of buffered data exceeds a configured time threshold, or the remaining delay budget of buffered data is less than a configured time threshold, or the remaining time of packet data convergence protocol (PDCP) discard timer is less than a configured time threshold, then the buffered data is considered as delay-critical data. Other ways to distinguish delay-critical data and non-delay-critical data is not excluded.

[0067] As used herein, the term "data burst" may refer to a set of multiple PDUs generated and sent by the application in a short period of time, as defined in TS 23.501.

[0068] As used herein, the term "PDU set" may refer to one or more PDUs carrying the payload of one unit of information generated at the application level (e.g., frame(s) or video slice(s) for XR Services), as defined in TS 23.501.

[0069] As used herein, the term "PDU set delay budget (PSDB)" may refer to upper bound for the duration between the reception time of the first PDU (at the user plane function (UPF) for DL, at the UE for UL) and the time when all PDUs of a PDU set have been successfully received (at the UE in DL, at the UPF in UL). A QoS flow is associated with only one PSDB, and when available, it applies to both DL and UL and supersedes the PDB of the QoS flow. The PSDB may be as defined in TS 23.501.

[0070] If *pdu-SetDiscard* is not configured, a PDCP service data unit (SDU) for which

the remaining time till *discardTimer* expiry is less than the *remainingTimeThreshold* may be referred to as "Delay-critical PDCP SDU". If *pdu-SetDiscard* is configured, a PDCP SDU belonging to a PDU Set of which at least one PDCP SDU has the remaining time till *discardTimer* expiry less than the *remainingTimeThreshold* may be referred to as "Delay-critical PDCP SDU".

[0071] As used herein, the term "delay-critical radio link control (RLC) SDU" may refer to RLC SDU corresponding to a PDCP PDU indicated as delay-critical by PDCP, for example, as defined in TS 38.323.

[0072] As used herein, the term "delay-critical PDU Set" may refer to the PDU Set to which the delay-critical PDCP SDU belongs.

[0073] The delay-critical data (also referred to as delay-critical information) may at least include the delay-critical RLC SDUs, or the delay-critical PDCP SDUs. It is to be understood that any suitable data may also be regarded as the delay-critical data. Scope of the present disclosure is not limited here.

[0074] In some embodiments, the terminal device 110 may determine that the delay-critical data exists based on that the remaining time of the data transmission of the terminal device 110 is less than or equal to a time threshold. The time threshold may be predefined or configured. In some embodiments, for uplink, the terminal device 110 may determine (230) whether there is delay-critical data based on the remaining time, for example, a smallest remaining value of the PDCP discardTimers of all SDUs buffered for the LCG is below remainingTimeThreshold, consider there is the delay-critical data for the LCG.

[0075] Alternatively, or in addition, in some embodiments, the terminal device 110 may determine that the delay-critical data exists based on that the indication information from the network device 120 indicating an existence of the delay-critical data to be received during the measurement gap. For downlink, the network device 120 may indicate the downlink delay-critical data to the terminal device 110. For example, the indication information may be via MAC CE or downlink control information (DCI).

[0076] Upon receiving the indication information indicating the existence of the delay-critical data, the terminal device 110 may consider the MG is deactivated in DRX on duration time. That is, the terminal device 110 may skip or not perform the measurement during the MG in DRX on duration time. If the received indication information indicates

that there is no delay-critical DL data or on indication information is received, the terminal device 110 may consider the MG as activated in DRX on duration time. That is, the terminal device 110 may perform the measurement during the MG in DRX on duration time. The delay-critical information such as DL delay-critical information may be provided by core network (CN) or application function (AF). As used herein, in some embodiments, the term "DRX on duration time" may be replaced by DRX active time.

[0077] In some embodiments, if there is delay-critical data for any LCG or DRB or LCH exists, the terminal device 110 may transmit the delay-critical data regardless of the MG during the discontinuous reception (DRX) on duration time. Alternatively, or in addition, the terminal device 110 may prioritize transmission of the delay-critical data in DRX on time over MG. The delay-critical data such as XR data or XR delay-critical data.

[0078] If there is delay-critical data during the measurement gap occasion, the terminal device 110 may consider this measurement gap occasion as deactivated. Otherwise, there is no delay-critical data, the terminal device 110 performs the measurement during the MG occasion in DRX on duration time. For example, if there is no delay-critical data during the measurement gap occasion, the terminal device 110 may consider this measurement gap occasion as activated.

[0079] In this way, the scheduling restrictions can be relaxed based on the delay-critical data. The data such as XR data may be scheduled or transmitted during the measurement gap, which can minimize the impact of the measurement gap on scheduling restrictions. The delayed data exceeding the delay budget can be avoided.

[0080] In another example embodiment, the terminal device 110 performs (240) the activation or deactivation of the measurement gap based on the configuration and a remaining time of a data transmission of the terminal device 10. For example, the configuration of the measurement gap may indicate the time length of the measurement gap. The time length of the measurement gap can be called measurement gap length. The time length of the measurement gap used to perform measurement by the terminal device 110. In some embodiments, a time length of the measurement gap can regard as a measurement gap occasion. The terminal device 110 may determine (230) the activation or the deactivation of the measurement gap based on the time length of the measurement gap and the remaining time of the data transmission. The terminal device 110 may perform (240) the activation or the deactivation of the measurement gap based on the

determining.

[0081] In some embodiments, the terminal device 110 may determine (230) the deactivation of the measurement gap based on a first condition that the remaining time of the data transmission is less than or equal to a sum of the time length of the measurement gap and a first value. As used herein, the term "first value" may also be referred to as a "first threshold". That is, the first condition may be that a difference between the remaining time of the data transmission and the time length of the measurement gap is less than or equal to the first threshold. The first value can be zero or greater than zero.

[0082] For example, the remaining time of the data transmission may be a remaining value of a PDCP timer corresponding to a PDCP SDU of the terminal device 110. For another example, the remaining time of the data transmission may be a smallest remaining value of PDCP timers corresponding a plurality of PDCP SDUs of the terminal device 110.

[0083] In some embodiments, if the smallest remaining value of the PDCP discardTimers of all SDUs buffered for the LCG is below or equal to the measurement gap length plus a delta (such as the first value), the terminal device 110 may transmit the XR data regardless of the MG during the DRX on duration time.

[0084] In some embodiments, the terminal device 110 may determine (230) the activation or the deactivation of the measurement gap further based on a remaining on duration time of DRX. The remaining on duration time of DRX may refer to the time length until the DRX on duration timer expires or the remaining time of the DRX on duration timer.

[0085] In an example embodiment, the terminal device 110 may determine (230) the deactivation of the measurement gap based on a second condition that a sum of the time length of the measurement gap and a second value is greater than or equal to the remaining on duration time of DRX. The second value may be zero or other suitable value. For example, if the measurement gap length is greater than or equal to the remaining DRX on duration time, the terminal device 110 may determine (230) the deactivation of the measurement gap.

[0086] In another example embodiment, the terminal device 110 may determine (230) the deactivation of the measurement gap based on a third condition that the remaining on

duration time of DRX is less than or equal to the remaining time of the data transmission, and the remaining time of the data transmission is less than or equal to a time duration from a current time to a next DRX on duration. For example, if the remaining DRX on duration time is below or equal to the smallest remaining value of the PDCP discardTimers of all SDUs buffered for the LCG, and the smallest remaining value of the PDCP discardTimers below to the time duration from the current time to the next DRX on duration, the terminal device 110 may determine (230) the deactivation of the measurement gap.

[0087] Alternatively, or in addition, in some embodiments, if the remaining DRX on duration time is above the remaining time of the data transmission, and if the remaining time of the data transmission is above the measurement gap length plus a delta (such as, the first value, which may be greater than or equal to 0), the terminal device 110 may determine (230) the activation of the measurement gap. That is, the terminal device 110 may perform the measurement during the measurement gap. In other words, the terminal device 110 may consider the measurement gap is activated for example in the DRX on duration time. For example, if the remaining DRX on duration time is above the smallest remaining value of the PDCP discardTimers of all SDUs buffered for the LCG, and if the smallest remaining value of the PDCP discardTimers of all SDUs buffered for the LCG is above the measurement gap length plus a delta, the terminal device 110 may determine (230) the activation of the measurement gap. .

[0088] FIG. 3A to FIG. 3C illustrate examples of determination of the activation or deactivation of the measurement gap, respectively. As shown in FIG. 3A, the time length 310 of the measurement gap is less than the remaining time 320 of the data transmission, and the remaining time 320 of the data transmission is less than the remaining on duration time 330 of DRX. In such case, the terminal device 110 may determine (230) that the measurement gap is activated. That is, the terminal device 110 may perform the measurement on the measurement gap in the remaining on duration time 330 of DRX.

[0089] In the example of FIG. 3B, the remaining time 360 of the data transmission is less than the time length 340 of the measurement gap in the remaining on duration time 350 of DRX. In such case, the terminal device 110 may determine (230) the deactivation of the measurement gap.

[0090] In the example of FIG. 3C, the remaining on duration time 380 of DRX is less

than the remaining time 390 of data transmission, and the remaining time 390 of data transmission is less than a time duration from the current time to the next DRX on duration, and/or the measurement gap length is greater or equal to the remaining on duration time. In such case, the terminal device 110 may determine the deactivation of the measurement gap such as the measurement gap with a time length 370.

[0091] Several embodiments regarding the determining and performing of the activation or deactivation of the measurement gap based on the time length of the measurement gap and the remaining time of the data transmission have been described.

[0092] In this way, the scheduling restrictions can be relaxed based on the remaining time of data, the measurement gap duration and remaining time of DRX on duration. The XR data may be scheduled or transmitted during the measurement gap, which can minimize the impact of the measurement gap on scheduling restrictions. The delayed data exceeding the delay budget can be avoided.

[0093] Referring back to FIG. 2, in some embodiments, the terminal device 110 may determine (230) the activation or the deactivation of the measurement gap further based on the grant resource.

[0094] In some embodiments, the terminal device 110 may determine (230) the deactivation of the measurement gap based on a fourth condition that the remaining time of the data transmission is greater than a sum of the time length of the measurement gap and a third value, and an ending point of the remaining time of the data transmission is earlier than the next available grant resource after the measurement gap. Alternatively, the fourth condition may be that the remaining time of the data transmission is greater than a sum of the time length of the measurement gap and a third value, and the remaining time of the data transmission is less than or equal to zero before the next available grant resource. The next available grant resource may be a nearest available resource after the measurement gap. The third value may be predefined or configured. For example, the third value may be equal to zero or greater than zero.

[0095] By way of example, if the smallest remaining value of the PDCP discardTimers of all SUDs is above the measurement gap length plus a delta (such as the third value, which is greater than or equal to 0), and the smallest remaining value of the PDCP discardTimers of all SDUs is below the time duration from current time to next available uplink grant, the terminal device 110 may determine (230) and perform (240) the

deactivation of the measurement gap. By another way of example, if the smallest remaining value of the PDCP discardTimers of all SDUs is below or equal to the measurement gap length plus a delta the terminal device 110 may determine (230) and perform (240) the deactivation of the measurement gap.

[0096] In some embodiments, if the remaining time of the data transmission is above the measurement gap length plus a delta (such as the third value which is greater than or equal to 0), and the remaining time of the data transmission is above the time duration from current time to next available uplink grant, the terminal device 110 may determine (230) an activation of the measurement gap. The next available grant resource may be a nearest available resource after the measurement gap. For example, if the smallest remaining value of the PDCP discardTimers of all SDUs is above the measurement gap length plus a delta, and the smallest remaining value of the PDCP discardTimers of all SDUs is above the time duration from current time to next available uplink grant, the terminal device 110 may determine (230) an activation of the measurement gap. That is, the terminal device 110 may perform the measurement during the measurement gap. In other words, the terminal device 110 considers the measurement gap as activated.

[0097] FIG. 4A to FIG. 4C illustrate examples of determination of the activation or deactivation of the measurement gap, respectively. As shown in FIG. 4A, the time length 410 of the measurement gap is less than the remaining time 430 of the data transmission, and the remaining time 430 of the data transmission is above the time duration 420 from the current time to next available uplink grant. In such case, the terminal device 110 may determine (230) that the measurement gap is activated. That is, the terminal device 110 may perform the measurement during the measurement gap. For example, the terminal device 110 may perform the measurement during the measurement gap in the remaining on duration time of DRX.

[0098] In the example of FIG. 4B, the time length 440 of the measurement gap is less than the remaining time 460 of the data transmission, and the remaining time 460 of the data transmission is above the time duration 450 from the current time to next available uplink grant. In such case, the terminal device 110 may determine (230) that the measurement gap is activated. That is, the terminal device 110 may perform the measurement during the measurement gap. For example, the terminal device 110 may perform the measurement during the measurement gap in the remaining on duration time of DRX.

[0099] In the example of FIG. 4C, the time length 470 of the measurement gap is less than the remaining time 490 of the data transmission, and the remaining time 490 of the data transmission is less than the time duration 480 from the current time to next available uplink grant. In such case, the terminal device 110 may determine (230) the deactivation of the measurement gap.

[0100] Several embodiments have been described with respect to the DRX on duration time. FIG. 5A illustrates an example diagram 500 showing long DRX cycles. As illustrated, for the long DRX cycles, the DRX on duration time may be shown as the drx-onDurationTimer 510 in the long DRX cycle.

[0101] FIG. 5B illustrates an example diagram 550 showing short DRX cycles inside the long DRX cycle. As shown, the DRX on duration time may be the drx-onDurationTimer 560 in a short DRX cycle.

[0102] In some embodiments, RRC controls DRX operation by configuring the following parameters: *drx-onDurationTimer*: the duration at the beginning of a DRX cycle; *drx-SlotOffset*: the delay before starting the *drx-onDurationTimer*; *drx-InactivityTimer*: the duration after the PDCCH occasion in which a PDCCH indicates a new UL, DL or SL transmission for the MAC entity; *drx-LongCycleStartOffset*: the Long DRX cycle and *drx-StartOffset* which defines the subframe where the Long and Short DRX cycle starts; *drx-ShortCycle* (optional): the Short DRX cycle; *drx-ShortCycleTimer* (optional): the duration the UE shall follow the Short DRX cycle; or the like.

[0103] In some embodiments, when DRX is configured, the Active Time for Serving Cells in a DRX group includes the time while:

- *drx-onDurationTimer* or *drx-InactivityTimer* configured for the DRX group is running; or
- drx-RetransmissionTimerDL, drx-RetransmissionTimerUL or drx-RetransmissionTimerSL is running on any Serving Cell in the DRX group; or
- *ra-ContentionResolutionTimer* (as described in clause 5.1.5) or *msgB-ResponseWindow* (as described in clause 5.1.4a) is running; or
- a Scheduling Request is sent on PUCCH and is pending (as described in clause 5.4.4 or 5.22.1.5). If this Serving Cell is part of a non-terrestrial network, the Active Time is started after the Scheduling Request transmission that is performed when the

SR_COUNTER is 0 for all the SR configurations with pending SR(s) plus the UE-gNB RTT; or

- a PDCCH indicating a new transmission addressed to the C-RNTI of the MAC entity has not been received after successful reception of a Random Access Response for the Random Access Preamble not selected by the MAC entity among the contention-based Random Access Preamble (as described in clauses 5.1.4 and 5.1.4a).

[0104] Several embodiments regarding determining and/or performing the activation or deactivation of the measurement gap based on the time length of the measurement gap, the remaining time of the data transmission and optional the remaining on duration time of DRX or optional the grant resource have been described. In these embodiments, the measurement gap may represent a single measurement gap occasion. That is, these embodiments may be applied for per MG occasion behavior or per MG occasion scheduling restrictions relax.

[0105] Still referring to FIG. 2, in a further example embodiment, the terminal device 110 performs (240) the activation or deactivation of the measurement gap based on the configuration and indication information associated with a data transmission or a data reception of the terminal device 110. For example, the indication information is received from the network device 120.

[0106] In some embodiments, the indication information from the network device 120 indicates an existence of delay-critical data to be received by the terminal device 110 during the measurement gap. If the indication information indicates the existence of delay-critical data, the terminal device 110 may determine (230) the deactivation of the measurement gap.

[0107] Alternatively, or in addition, in some embodiments, the indication information from the network device 120 indicates configuration information associated with the data transmission of the terminal device during the measurement gap. The configuration information is used to configure the priority of the data transmission and the measurement gap. In some embodiments, the configuration information comprises at least one of the PDU set importance (PSI) information, logical channel group information, logical channel information, or radio bearer information. PSI is used to identifies the relative importance of a PDU Set compared to other PDU Sets within a QoS Flow. For example, lower values or indexes shall indicate a higher importance PDU Set with the highest importance PDU

Set indicated by 0 and the lowest importance PDU Set indicated by 15. By way of example, the configuration information comprises at least one of: a threshold of PSI such as a threshold value of PSI, a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or a set of data radio bearers, a data transmission by the data radio bearer belonging to the set of data radio bearers having priority higher than that of the measurement gap. In some embodiments, the value of PSI may refer to the index of PSI.

[0108] In example embodiments, if a value of PSI of buffered data of the terminal device is less than the threshold value of PSI, the terminal device 110 may perform (240) the deactivation of the measurement gap. That is, if the PSI of the buffered data of the terminal device is higher important than the threshold of PSI, the terminal device 110 may perform (240) the deactivation of the measurement gap. If the buffered data belonging to the set of logical channel groups or the set of logical channels, the terminal device 110 may perform (240) the deactivation of the measurement gap. If the buffered data belonging to the set of data radio bearers, the terminal device 110 may perform (240) the deactivation of the measurement gap. The terminal device 110 may perform the data transmission of the buffered data during the deactivated measurement gap, or the terminal device 110 may perform the data transmission of the buffered data during the deactivated measurement gap if there is uplink grant or DL assignment resources.

[0109] In some embodiments, the configuration information may be referred to as scheduling restrictions relax related criteria. That is, the network may configure the scheduling restrictions relax related criteria such as by RRC signaling. The configured criteria may include PSI related information used for scheduling restrictions relax. For example, the network device 120 configures the PSI threshold. If the PDU or PDU set importance of the data is below the configured PSI threshold, the terminal device 110 may prioritize the data transmission over the measurement gap or the terminal device 110 may consider the measurement gap as deactivated. In some embodiments, the data refers to XR data.

[0110] The configured criteria may include LCH or LCG related information used for scheduling restrictions relax. For example, the network device 120 configures the LCH or LCG list, which is containing at least one LCID or LCG ID. The list indicates which

LCH or LCG transmission takes priority over measurement gap. If there is data mapped to the LCH or LCG configured by LCH or LCG list, the terminal device 110 may prioritize the data transmission over the measurement gap or the terminal device 110 may consider the measurement gap as deactivated. In some embodiments, the data refers to XR data.

[0111] The configured criteria may include radio bearer related information used for scheduling restrictions relax. For example, the network device 120 configures the priority radio bearer (RB) list, which is containing at least one RB identity. The RB can be DRB or SRB. The list indicates which RB transmission takes priority over measurement gap. If there is data mapped to the RB configured by RB list, the terminal device 110 may prioritize the data transmission over the measurement gap or the terminal device 110 may consider the measurement gap as deactivated. In some embodiments, the data refers to XR data.

[0112] In this way, the measurement gap can be activated or deactivated based on the configured criteria (such as the configuration information). Alternatively, the data transmission such as data (including XR data) transmission can be prioritized based on the configured criteria.

[0113] In some embodiments, during a hybrid automatic repeat request (HARQ) process, if there is no activated measurement gap at a time of a transmission, the terminal device 110 may indicate, to a physical layer, a transmission based on a stored uplink grant. By way of example, an example of HARQ process may be shown as Table 1 below.

Table 1 HARQ process

To generate a transmission for a TB, the HARQ process shall:
1>if the MAC PDU was obtained from the Msg3 buffer; or
1>if the MAC PDU was obtained from the MSGA buffer; or
1>if there is no activated measurement gap at the time of the transmission and, in case of retransmission, the retransmission does not collide with a transmission for a MAC PDU obtained from the Msg3 buffer or the MSGA buffer:
2>if there are neither NR sidelink transmission nor transmission of V2X sidelink communication at the time of the transmission; or
2>if the transmission of the MAC PDU is prioritized over sidelink

transmission or can be simultaneously performed with sidelink transmission:

3>instruct the physical layer to generate a transmission according to the stored uplink grant.

[0114] In some embodiments, the network device 120 may transmit, to the terminal device 110, an indication for enabling a deactivation of a measurement gap. The terminal device 110 may receive the indication. That is, the scheduling restrictions relax mechanism or measurement activation/deactivation mechanism may be enabled or disabled by the network device 120. For example, a field in a message may indicate whether the terminal device 110 may apply or enable scheduling restrictions relax related handling.

[0115] In some embodiments, if the terminal device 110 determines (230) the deactivation of the measurement gap, the terminal device 110 may transmit or receive data during the measurement gap. The terminal device 110 may skip the measurement during the deactivated measurement gap. Optionally, if the terminal device 110 considers that the measurement gap as deactivated, that is, the terminal device 110 skip the measurement on this measurement gap, the terminal device 110 may indicate is to the network device 120. For example, the terminal device 110 may transmit, to the network device 120, information indicating of the deactivation of the measurement gap. The network device 120 may receive the information.

[0116] In some embodiments, if the number of consecutive deactivated measurement gaps is greater than or equal to a threshold number, the terminal device 110 may perform (240) the activation of the measurement gap. For example, the threshold number may be configured by the network device 120, or predefined.

[0117] In some embodiments, the terminal device 110 may count the consecutive deactivated or skipped measurement occasions. The network may configure the maximum number (such as the threshold number) of the consecutive measurement gap occasions that may be skipped or deactivated for the terminal device 110. The variable such as COUNTER of the terminal device 110 may be used for the scheduling restrictions relax procedure. The COUNTER may represent the counter for consecutive measurement gap deactivation times which is initially set to 0. The COUNTER may be per serving cell.

[0118] In some embodiments, if there is delay-critical data or if any of the conditions for deactivating the measurement gap described above is satisfied during the measurement gap, or if there is delay-critical data or if any of the conditions for deactivating the measurement gap described above is satisfied during the measurement gap, the terminal device 110 may increment the COUNTER by 1. If the COUNTER is great than the configured threshold, the terminal device 110 considers this measurement gap as activated. Otherwise, the terminal device 110 considers the measurement gap as deactivated. In addition, the terminal device 110 may reset the COUNTER to 0 once the terminal device 110 perform the measurement during the measurement gap or the terminal device 110 reset the COUNTER to 0 if the measurement gap is activated. Such trade-off between the measurement gap and the scheduling restrictions may be referred to as centric relax scheduling. With such trade-off, the XR data may be scheduled or transmitted during the measurement gap, which can minimize the impact of the measurement gap on scheduling restrictions. The delayed data exceeding the delay budget can be avoided.

[0119] FIG. 6 illustrates an example process 600 for determining the activation or deactivation of the measurement gap. The process 600 may be implemented by the terminal device 110. At block 610, the terminal device 110 may determine whether there is delay-critical data or whether a condition for deactivation of a measurement gap is satisfied. The condition used in block 610 may be condition one, condition two, condition three, or condition four for deactivating the measurement gap described above, or any other suitable condition for deactivation of the measurement gap. If there is delay-critical data or if a condition for deactivation of the measurement gap is satisfied, at block 620, the terminal device 110 may determine a deactivation of the measurement gap. Otherwise, if there is no delay-critical data or if no condition is satisfied or if any condition for activating the measurement gap described above is satisfied, at block 630, the terminal device 110 may determine an activation of the measurement gap.

[0120] FIG. 7 illustrates an example process 700 for determining the activation or deactivation of the measurement gap. The process 700 may be implemented by the terminal device 110. At block 710, the terminal device 110 may determine whether there is delay-critical data or whether a condition for deactivating the measurement gap is satisfied. The condition used in block 710 may be condition one, condition two, condition three, or condition four for deactivating the measurement gap described above, or any other suitable condition for the measurement gap. If there is delay-critical data or if a

condition for deactivation of the measurement gap is satisfied, at block 720, the terminal device 110 may increment a counter by one. The counter may be set to be zero before the process 700. If the counter is not initiated, the terminal device 110 may first initiate the zero to be zero and increment the counter by one at block 720.

[0121] At block 730, the terminal device 110 may determine whether the counter is greater than a threshold. If the counter is not greater than the threshold, at block 740, the terminal device 110 may determine a deactivation of the measurement gap. If the counter is greater than the threshold, at block 750, the terminal device 110 may determine an activation of the measurement gap. At block 760, the terminal device 110 may set the counter to be zero.

[0122] If there is no delay-critical data or if no condition for deactivating the measurement gap is satisfied or if a condition for activating the measurement gap is satisfied, at block 750, the terminal device 110 may determine an activation of the measurement gap. At block 760, the terminal device 110 may set the counter to be zero.

[0123] In some embodiments, the terminal device 110 may transmit, to the network device 120, capability information of the terminal device, the capability information indicating at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a PSI, a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0124] In this way, the capabilities for scheduling restrictions relax may be reported by the terminal device for example via RRC signaling, such as via UECapabilityInformation. A capability may indicate whether the terminal device 110 supports scheduling restrictions relax, e.g., priority the XR transmission if there is XR delay-critical data during the MG on DRX on duration time. A capability may indicate whether the terminal device 110 supports measurement gap activation/deactivation handling. A capability may indicate whether the terminal device 110 supports semi-Persistent MG. A capability may indicate whether the terminal device 110 supports PSI-based or RB-based or LCH-based or LGG-based scheduling restrictions relax. A capability may indicate whether the terminal device 110 supports scheduling restrictions for UL and/or DL.

[0125] In order to solve at least part of the above problems or other potential problems, another solution on measurement gap activation and deactivation is proposed. In the solution, the network device transmits a configuration of at least one measurement gap to the terminal device 110. The network device further transmits an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion. The terminal device performs an activation or a deactivation of the at least one measurement gap or the at least one measurement gap occasion based on the indication. In this way, the measurement gap can be activated or deactivated.

[0126] FIG. 8 illustrates a signaling flow 800 of measurement gap activation and deactivation in accordance with some embodiments of the present disclosure. For the purposes of discussion, the signaling flow 800 will be discussed with reference to FIG. 1, for example, by using the terminal device 110 and the network device 120.

[0127] In operation, the network device 120 transmits (810), to the terminal device 110, a configuration of at least one measurement gap for performing a measurement. The terminal device 110 receives (820) the configuration.

[0128] The network device 120 transmits (830), to the terminal device 110, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion. The terminal device 110 receives (840) the indication. For example, the indication may be for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of DRX (also referred to as DRX on duration time). Bay way of example, the activation or the deactivation may be indicated by DCI, MAC CE, or any other suitable message or signaling.

[0129] The terminal device 110 performs (850) the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication.

[0130] In an embodiment, the at least one measurement gap or the at least one measurement gap occasion includes a single measurement gap or a single measurement gap occasion. For example, the network device 120 may indicate whether the next or the latest measurement gap is deactivated or the network device 120 may indicate whether the next or the latest measurement gap is deactivated during the DRX on duration time.

[0131] In another embodiment, the at least one measurement gap or the at least one

measurement gap occasion includes a plurality of measurement gaps or a plurality of measurement gap occasions. For example, the indication may indicate whether the measurement gap is activated or deactivated. If the network indicates that the measurement gap is deactivated, the terminal device 110 may not perform the handling of the measurement gap until the network indicates that the measurement gap is activated.

[0132] In a further embodiment, the at least one measurement gap or the at least one measurement gap occasion includes a number of consecutive measurement gaps or a number of consecutive measurement gap occasions. For example, the indication may indicate n consecutive measurement gap occasions activation or deactivation status, n being an integer greater than or equal to 1. For example, two bits may indicate the status of 4 consecutive measurement gap occasions, or two bits may indicate one of the 4 consecutive measurement gap occasion status.

[0133] In some embodiments, the at least one measurement gap includes at least one measurement gap configuration.

[0134] In some embodiments, the network device 120 may determine whether to activate or deactivate the measurement gap configuration or measurement gap occasion. That is, it may be up to network implementation to decide whether to activate or deactivate the measurement gap configuration or measurement gap occasion. In addition, the network may determine whether to activate or deactivate the measurement gap configuration or measurement gap occasion based on the buffer status report (BSR), the delay status report (DSR) or the DL traffic flow.

[0135] In some embodiments, the indication further indicates location information of the at least one measurement gap or the at least one measurement gap occasion. The location information may be time domain information, and/or frequency domain information. For example, the location information of a certain MG occasion such as a first MG occasion may include a starting location in time domain such as a starting frame, a starting subframe or a starting symbol of the MG occasion.

[0136] In some embodiments, the activation or deactivation may be indicated by DCI. By way of example, a single bit in the DCI may indicate the activation or deactivation status of the measurement gap(s). For example, the single bit may indicate the deactivation of all measurement gaps or all measurement gap occasions. The terminal device 110 may not perform the handling of the measurement gap until the network

indicates that the measurement gap is activated. That is, the terminal device 110 may not consider that the measurement gap is activated until the network indicates that the measurement gap is activated.

[0137] Alternatively, a bit in the DCI may indicate the activation or deactivation of a single measurement gap or a single measurement gap occasion. For example, one bit set to 1 may indicate the deactivation, and set to 0 may indicate the activation. For another example, a value of 0 of the bit may indicate the deactivation, and a value of 1 may indicate the activation. In a further embodiment, a plurality of bits such as a plurality of consecutive bits in the DCI may indicate the activation or deactivation of a plurality of consecutive measurement gaps or a plurality of consecutive measurement gap occasions. For example, two bits may indicate the activation or deactivation status of 4 consecutive measurement gap occasions, or two bits may indicate one of the 4 consecutive measurement gap occasion status. For another example, three bits may indicate the status of 8 consecutive measurement gap occasions. It is to be understood that the number of bits and the value of bits here are only for purpose of illustration, without suggesting any limitation. Scope of the present disclosure is not limited here.

[0138] In some embodiments, the activation or deactivation may be indicated by MAC CE such as measurement gap activation/deactivation command MAC CE. The MAC CE may indicate whether the MG is activated or deactivated. Alternatively, the MAC CE may indicate whether the MG is activated or deactivated during the DRX on duration time. The MAC CE may be identified by a MAC subheader with a first LCID for the activation or deactivation of a measurement gap or a measurement gap occasion. The first LCID may be a new LCID or eLCID or the reserved LCID or reserved eLCID. For example, the measurement gap activation/deactivation Command MAC CE may be identified by a MAC subheader with new LCID or eLCID. In some embodiments, if the network indicates that the MG or measurement gap occasion is deactivated, the terminal device 110 may not perform the handling of the measurement gap or measurement gap occasion. In some embodiments, if the network indicates that the MG is deactivated, the terminal device 110 may not perform the handling of the measurement gap until the network indicate that the MG is activated.

[0139] The MAC CE may include at least one of the following:

- A/D: this field indicates the activation or deactivation of the Measurement Gap. For

example, the field is set to 1 to indicate activation, otherwise set to 0 indicates deactivation. The length of the field is 1 bit;

- R: Reserved bit, set to 0.
- MGi: this field indicates the activation or deactivation of the Measurement Gap for the measurement gap i. The MGi field set to 1 indicates that the measurement gap i is activated.
- MG ID: this field indicates the identifier for the measurement gap. For example, the length of the field is 4 bits.

[0140] In some embodiments, the measurement gap refers to measurement gap configuration. In some embodiment, MGi or MGID with index 0 indicate the GapConfig without suffix. In some embodiments, the measurement gap refers to measurement gap length.

[0141] Table 2 illustrates example values of one-octet eLCID for DL-SCH.

Table 2

Codepoint	Index	LCID values
0 to x-1	64 to y-1	Reserved
x	y	Measurement Gap activation/deactivation Command MAC CE
…	…	…
255	319	Timing Delta

[0142] In some embodiments, the measurement gap activation/deactivation command and the corresponding operations of the terminal device 110 such as UE may be configure as Table 3 below.

Table 3

Measurement Gap activation/deactivation Command

If the UE is configured with measurement gap(s), the network may send DL MAC CE for Measurement Gap Activation/Deactivation Command to the UE. For the activated measurement gap, the UE shall follow the specified UE behaviour of Handling of measurement gaps.

Upon the reception of the MAC CE for Measurement Gap Activation/Deactivation Command, the MAC entity shall:

1> if the Measurement Gap Activation/Deactivation Command MAC CE indicates the deactivation of a measurement gap:

2> deactivate the measurement gap.

1> else if the Measurement Gap Activation/Deactivation Command MAC CE indicates the activation of a measurement gap:

2> activate the measurement gap and perform the procedure of handling of measurement gaps.

[0143] In some embodiments, the indication may indicate whether to activate or deactivate MG occasions or n consecutive MG occasions. By way of example, the measurement gap activation/deactivation Command MAC CE at least include one of the following:

- the information related to the location (e.g., time/frequent domain) of MG occasion. E.g., the time/frequent/location information of the first MG occasion indicated by the Measurement Gap activation/deactivation Command MAC CE;
- the activation or deactivation status information related to measurement gap occasion, at least include one of the following:
  - MGi: this field indicates the activation or deactivation status of the Measurement Gap occasion i. The MGi field set to 1 indicates that the measurement gap occasion i is activated.
  - MGO ID: this field indicates the identifier for the measurement gap occasion. For example， the length of the field is 4 bits;

- A/D: this field indicates the activation or deactivation status of the Measurement Gap occasion. For example, the field is set to 1 to indicate activation, otherwise 0 indicates deactivation. The length of the field is 1 bit;

- R: Reserved bit, set to 0.

[0144] In some embodiments, the MG activation or deactivation states for each MG occasion may be updated by activation/deactivation command MAC CE. It may be up to NW implementation to decide whether to activate or deactivate the MG configuration or MG occasion. In addition, the network device 120 may determine whether to activate or deactivate the MG based on the BSR or DSR or DL traffic flow.

[0145] In some embodiments, the indication indicates the deactivation of the at least one measurement gap or the at least one measurement gap occasion. The terminal device 110 may transmit or receive data during the at least one measurement gap or the at least one measurement gap occasion. Alternatively, or in addition, the terminal device 110 may skip the measurement during the deactivated at least one measurement gap or the at least one deactivated measurement gap occasion.

[0146] In some embodiments, the measurement gap activation/deactivation command and the corresponding operations of the terminal device 110 such as UE may be configured as Table 4 below.

Table 4

Measurement Gap activation/deactivation Command
If the UE is configured with measurement gap(s), the network may send DL MAC CE for Measurement Gap Activation/Deactivation Command to the UE. For the activated measurement gap occasion(s), the UE shall follow the specified UE behaviour of Handling of measurement gaps. Upon the reception of the MAC CE for Measurement Gap Activation/Deactivation Command, the MAC entity shall: 1> if the Measurement Gap Activation/Deactivation Command MAC CE indicates the deactivation of a measurement gap occasion(s): 2> deactivate the measurement gap occasion(s).

1> else if the Measurement Gap Activation/Deactivation Command MAC CE indicates the activation of a measurement gap: 2> activate the measurement gap occasion(s) and perform the procedure of handling of measurement gap.

[0147] Table 5 to Table 7 show some examples of the MG activation or deactivation command MAC CE. The MG activation or deactivation command MAC CE may consists of a single or multiple octet.

Table 5

R	R	R	R	R	R	R	A/D

[0148] In some embodiments, if the field "A/D" in Table 5 indicates the deactivation, the deactivation here may be considered as "deactivation of all measurement gaps" or "deactivation of a single measurement gap configuration", or "deactivation of a single measurement gap occasion", or "deactivation of a single measurement gap length". If it indicates of the deactivation of all measurement gaps or the single measurement gap configuration, the terminal device 110 may consider the measurement gap(s) as deactivated until the network indicates to activate the measurement gap.

Table 6

R	R	R	R	R	R	R	MG_0
MG_8	MG_7	MG_6	MG_5	MG_4	MG_3	MG_2	MG_1

[0149] In some embodiments, the field "MG_i" (i being an integer greater than or equal to 0) in Table 6 may indicate the activation or deactivation status of the ith measurement gap configuration or the ith measurement gap. For example, if MG_i indicates of the deactivation, such indication may be considered as "deactivation of the ith measurement gap configuration" or "deactivation of the ith measurement gap occasion". In some embodiments, the MG activation or deactivation states for MG configuration i or MG occasion i may be updated by activation or deactivation command MAC CE.

Table 7

R	R	R	A/D	MGID

[0150] In some embodiments, the field "MGID" in Table 7 may indicate the identifier of the measurement gap. The field "A/D" in Table 7 may indicate the activation or deactivation of the measurement gap identified by the field "MGID".

[0151] In some embodiments, during an HARQ process, if there is no activated measurement gap at a time of a transmission, the terminal device 110 may indicate, to a physical layer, a transmission based on a stored uplink grant. By way of example, an example of HARQ process may be shown as Table 1 above.

[0152] In some embodiments, the terminal device 110 may transmit, to the network device 120, capability information of the terminal device 110. By way of example, the capability information may indicate at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a PSI, a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0153] Several embodiments regarding activation or deactivation of measurement gap based on network indication have been described. In this way, the measurement gap can be activated or deactivated by DCI or MAC CE during the transmission of XR data. The XR data can be scheduled or transmitted during the measurement gap. The impact of measurement gap on scheduling restrictions can be minimized. The delayed data exceeding the delay budget can be avoided.

[0154] It is to be understood the example contents, parameters, fields, tables, values and conditions described above are only for the purpose of illustration, without suggesting any limitation. Those example contents, parameters, fields, tables, values and conditions may be adapted or changed in any proper way.

[0155] It is to be understood that the above-described example embodiments are only for the purpose of illustration without suggesting any limitations. The present disclosure is not limited in this regard. Any embodiment(s) herein may be applied separately, or in

any suitable combination. With these embodiments, the XR can be enhanced.

[0156] FIG. 9 illustrates a flowchart of a communication method 900 implemented at a terminal device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 900 will be described from the perspective of the terminal device 110 in FIG. 1.

[0157] At block 910, the terminal device 110 receives, from a network device, a configuration of a measurement gap for performing a measurement.

[0158] At block 920, the terminal device 110 performs an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device.

[0159] In some example embodiments, in accordance with a determination that the delay-critical data associated with at least one of: a logical channel group, a data radio bearer or a logical channel exists during the measurement gap, the terminal device 110 may perform the deactivation of the measurement gap; and/or transmit or receive the delay-critical data during the measurement gap.

[0160] In some example embodiments, in accordance with a determination that at least one of an uplink grant or a downlink assignment is available for the data transmission or the data reception of the terminal device, the terminal device 110 may perform the deactivation of the measurement gap.

[0161] In some example embodiments, the terminal device 110 may determine that the delay-critical data exists based on at least one of: that the remaining time of the data transmission of the terminal device is less than or equal to a time threshold, or the indication information indicating an existence of the delay-critical data to be received during the measurement gap.

[0162] In some example embodiments, the configuration of the measurement gap indicates a time length of the measurement gap, and the terminal device 110 may determine the activation or the deactivation of the measurement gap based on the time length of the measurement gap and the remaining time of the data transmission; perform

the activation or the deactivation of the measurement gap based on the determining.

[0163] In some example embodiments, the terminal device 110 may determine the deactivation of the measurement gap based on a first condition that the remaining time of the data transmission is less than or equal to a sum of the time length of the measurement gap and a first value.

[0164] In some example embodiments, the terminal device 110 may determine the activation or the deactivation of the measurement gap further based on a remaining on duration time of discontinuous reception (DRX).

[0165] In some example embodiments, the terminal device 110 may determine the deactivation of the measurement gap based on at least one of: a second condition that a sum of the time length of the measurement gap and a second value is greater than or equal to the remaining on duration time of DRX, or a third condition that the remaining on duration time of DRX is less than or equal to the remaining time of the data transmission, and the remaining time of the data transmission is less than or equal to a time duration from a current time to a next DRX on duration.

[0166] In some example embodiments, the terminal device 110 may determine the activation or the deactivation of the measurement gap further based on a grant resource.

[0167] In some example embodiments, the terminal device 110 may determine the deactivation of the measurement gap based on a fourth condition that the remaining time of the data transmission is greater than a sum of the time length of the measurement gap and a third value, and an ending point of the remaining time of the data transmission is earlier than the next available grant resource after the measurement gap.

[0168] In some example embodiments, the remaining time of the data transmission comprises one of: a remaining value of a packed data convergence protocol (PDCP) timer corresponding to a PDCP service data unit (SDU) of the terminal device, or a smallest remaining value of PDCP timers corresponding a plurality of PDCP SDUs of the terminal device 110.

[0169] In some example embodiments, the terminal device 110 in accordance with a determination that the number of consecutive deactivated measurement gaps is greater than or equal to a threshold number, the terminal device 110 may perform an activation of the measurement gap.

[0170] In some example embodiments, the threshold number is configured by the network device, or predefined.

[0171] In some example embodiments, the indication information from the network device indicates at least one of: an existence of delay-critical data to be received by the terminal device during the measurement gap, or configuration information associated with the data transmission of the terminal device during the measurement gap.

[0172] In some example embodiments, the configuration information comprises at least one of: a threshold of protocol data unit (PDU) set importance (PSI), a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or a set of data radio bearers, a data transmission by the data radio bearer belonging to the set of data radio bearers having priority higher than that of the measurement gap.

[0173] In some example embodiments, the terminal device 110 may perform the deactivation of the measurement gap based on at least one of: a PSI of buffered data of the terminal device being less than the threshold of PSI, the buffered data belonging to the set of logical channel groups or the set of logical channels, or the buffered data belonging to the set of data radio bearers; and/or preform the data transmission of the buffered data during the measurement gap.

[0174] In some example embodiments, during a hybrid automatic repeat request (HARQ) process, in accordance with a determination that there is no activated measurement gap at a time of a transmission, the terminal device 110 may indicate, to a physical layer, a transmission based on a stored uplink grant.

[0175] In some example embodiments, the terminal device 110 may receive, from the network device, an indication for enabling a deactivation of a measurement gap.

[0176] In some example embodiments, in accordance with a determination of the deactivation of the measurement gap, the terminal device 110 may perform at least one of: transmitting or receiving data during the measurement gap; skipping the measurement during the deactivated measurement gap; or transmitting, to the network device, information indicating of the deactivation of the measurement gap.

[0177] FIG. 10 illustrates a flowchart of a communication method 1000 implemented at a terminal device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 1000 will be described from the perspective of the terminal device 110 in FIG. 1.

[0178] At block 1010, the terminal device 110 receives, from a network device, a configuration of at least one measurement gap for performing a measurement.

[0179] At block 1020, the terminal device 110 receives, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX).

[0180] At block 1030, the terminal device 110 performs the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication.

[0181] In some example embodiments, the at least one measurement gap or the at least one measurement gap occasion comprises one of: a single measurement gap or a single measurement gap occasion, a plurality of measurement gaps or a plurality of measurement gap occasions, or a number of consecutive measurement gaps or a number of consecutive measurement gap occasions.

[0182] In some example embodiments, the activation or the deactivation is indicated by at least one of: downlink control information (DCI) or a medium access control (MAC) control element (CE).

[0183] In some example embodiments, the MAC CE is identified with a first logical channel identity (LCID) for the activation or deactivation of a measurement gap or a measurement gap occasion.

[0184] In some example embodiments, the indication further indicates location information of the at least one measurement gap or the at least one measurement gap occasion.

[0185] In some example embodiments, the indication indicates the deactivation of the at least one measurement gap or the at least one measurement gap occasion, and the terminal device 110 may perform at least one of: transmitting or receiving data during the at least one measurement gap or the at least one measurement gap occasion; or skipping

the measurement during the deactivated at least one measurement gap or the at least one deactivated measurement gap occasion.

[0186] In some example embodiments, the terminal device 110 may transmit, to the network device, capability information of the terminal device, the capability information indicating at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a protocol data unit (PDU) set importance (PSI), a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0187] FIG. 11 illustrates a flowchart of a communication method 1100 implemented at a network device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 1100 will be described from the perspective of the network device 120 in FIG. 1.

[0188] At block 1110, the network device 120 transmits, to a terminal device, a configuration of a measurement gap for performing a measurement.

[0189] At block 1120, the network device 120 transmits, to the terminal device, indication information associated with a data transmission or a data reception of the terminal device. An activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information.

[0190] In some example embodiments, the indication indicates at least one of: an existence of delay-critical data to be received by the terminal device during the measurement gap, or configuration information associated with the data transmission of the terminal device during the measurement gap.

[0191] In some example embodiments, the configuration information comprises at least one of: a threshold of protocol data unit (PDU) set importance (PSI), a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or a set of data radio bearers, a data transmission by the data radio

bearer belonging to the set of data radio bearers having priority higher than that of the measurement gap.

[0192] In some example embodiments, the network device 120 may transmit, to the terminal device, a further configuration of a threshold number for consecutive deactivated measurement gaps.

[0193] In some example embodiments, the network device 120 may transmit, to the terminal device, an indication for enabling a deactivation of a measurement gap.

[0194] In some example embodiments, the network device 120 may receive, from the terminal device, information indicating of the deactivation of the measurement gap.

[0195] FIG. 12 illustrates a flowchart of a communication method 1200 implemented at a network device in accordance with some embodiments of the present disclosure. For the purpose of discussion, the method 1200 will be described from the perspective of the network device 120 in FIG. 1.

[0196] At block 1210, the network device 120 transmits, to a terminal device, a configuration of at least one measurement gap for performing a measurement.

[0197] At block 1220, the network device 120 transmits, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX).

[0198] In some example embodiments, the at least one measurement gap comprises one of: a single measurement gap or a single measurement gap occasion, a plurality of measurement gaps or a plurality of measurement gap occasions, or a number of consecutive measurement gaps or a number of consecutive measurement gap occasions.

[0199] In some example embodiments, the activation or the deactivation is indicated by at least one of: downlink control information (DCI) or a medium access control (MAC) control element (CE).

[0200] In some example embodiments, the MAC CE is identified with a first logical channel identity (LCID) for the activation or deactivation of a measurement gap or a measurement gap occasion.

[0201] In some example embodiments, the indication further indicates location

information of the at least one measurement gap or the at least one measurement gap occasion.

[0202] In some example embodiments, the network device 120 may receive, from the terminal device, capability information of the terminal device, the capability information indicating at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a protocol data unit (PDU) set importance (PSI), a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0203] FIG. 13 is a simplified block diagram of a device 1300 that is suitable for implementing embodiments of the present disclosure. The device 1300 can be considered as a further example implementation of any of the devices as shown in FIG. 1. Accordingly, the device 1300 can be implemented at or as at least a part of the terminal device 110 or the network device 120.

[0204] As shown, the device 1300 includes a processor 1310, a memory 1320 coupled to the processor 1310, a suitable transceiver 1340 coupled to the processor 1310, and a communication interface coupled to the transceiver 1340. The memory 1320 stores at least a part of a program 1330. The transceiver 1340 may be for bidirectional communications or a unidirectional communication based on requirements. The transceiver 1340 may include at least one of a transmitter 1342 and a receiver 1344. The transmitter 1342 and the receiver 1344 may be functional modules or physical entities. The transceiver 1340 has at least one antenna to facilitate communication, though in practice an Access Node mentioned in this application may have several ones. The communication interface may represent any interface that is necessary for communication with other network elements, such as X2/Xn interface for bidirectional communications between eNBs/gNBs, S1/NG interface for communication between a Mobility Management Entity (MME)/Access and Mobility Management Function (AMF)/SGW/UPF and the eNB/gNB, Un interface for communication between the eNB/gNB and a relay node (RN), or Uu interface for communication between the eNB/gNB and a terminal device.

[0205] The program 1330 is assumed to include program instructions that, when

executed by the associated processor 1310, enable the device 1300 to operate in accordance with the embodiments of the present disclosure, as discussed herein with reference to FIGS. 1 to 12. The embodiments herein may be implemented by computer software executable by the processor 1310 of the device 1300, or by hardware, or by a combination of software and hardware. The processor 1310 may be configured to implement various embodiments of the present disclosure. Furthermore, a combination of the processor 1310 and memory 1320 may form processing means 1350 adapted to implement various embodiments of the present disclosure.

[0206] The memory 1320 may be of any type suitable to the local technical network and may be implemented using any suitable data storage technology, such as a non-transitory computer readable storage medium, semiconductor based memory devices, magnetic memory devices and systems, optical memory devices and systems, fixed memory and removable memory, as non-limiting examples. While only one memory 1320 is shown in the device 1300, there may be several physically distinct memory modules in the device 1300. The processor 1310 may be of any type suitable to the local technical network, and may include one or more of general purpose computers, special purpose computers, microprocessors, digital signal processors (DSPs) and processors based on multicore processor architecture, as non-limiting examples. The device 1300 may have multiple processors, such as an application specific integrated circuit chip that is slaved in time to a clock which synchronizes the main processor.

[0207] According to embodiments of the present disclosure, a terminal device comprising a circuitry is provided. The circuitry is configured to: receive, from a network device, a configuration of a measurement gap for performing a measurement; and perform an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device. According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the terminal device as discussed above.

[0208] According to embodiments of the present disclosure, a terminal device comprising a circuitry is provided. The circuitry is configured to: receive, from a network device, a configuration of at least one measurement gap for performing a measurement;

receive, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and perform the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication. According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the terminal device as discussed above.

[0209] According to embodiments of the present disclosure, a network device comprising a circuitry is provided. The circuitry is configured to: transmit, to a terminal device, a configuration of a measurement gap for performing a measurement; and transmit, to the terminal device, indication information associated with a data transmission or a data reception of the terminal device, wherein an activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information. According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the network device as discussed above.

[0210] According to embodiments of the present disclosure, a network device comprising a circuitry is provided. The circuitry is configured to: transmit, to a terminal device, a configuration of at least one measurement gap for performing a measurement; and transmit, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX). According to embodiments of the present disclosure, the circuitry may be configured to perform any method implemented by the network device as discussed above.

[0211] The term "circuitry" used herein may refer to hardware circuits and/or combinations of hardware circuits and software. For example, the circuitry may be a combination of analog and/or digital hardware circuits with software/firmware. As a further example, the circuitry may be any portions of hardware processors with software including digital signal processor(s), software, and memory(ies) that work together to cause an apparatus, such as a terminal device or a network device, to perform various functions. In a still further example, the circuitry may be hardware circuits and or processors, such as a microprocessor or a portion of a microprocessor, that requires software/firmware for operation, but the software may not be present when it is not needed

for operation. As used herein, the term circuitry also covers an implementation of merely a hardware circuit or processor(s) or a portion of a hardware circuit or processor(s) and its (or their) accompanying software and/or firmware.

[0212] According to embodiments of the present disclosure, a terminal apparatus is provided. The terminal apparatus comprises means for receiving, from a network device, a configuration of a measurement gap for performing a measurement; and means for performing an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device. In some embodiments, the first apparatus may comprise means for performing the respective operations of the method 900. In some example embodiments, the first apparatus may further comprise means for performing other operations in some example embodiments of the method 900. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[0213] According to embodiments of the present disclosure, a terminal apparatus is provided. The terminal apparatus comprises means for receiving, from a network device, a configuration of at least one measurement gap for performing a measurement; means for receiving, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and means for performing the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication. In some embodiments, the second apparatus may comprise means for performing the respective operations of the method 1000. In some example embodiments, the second apparatus may further comprise means for performing other operations in some example embodiments of the method 1000. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[0214] According to embodiments of the present disclosure, a network apparatus is provided. The network apparatus comprises means for transmitting, to a terminal device, a configuration of a measurement gap for performing a measurement; and means for transmitting, to the terminal device, indication information associated with a data

transmission or a data reception of the terminal device, means for wherein an activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information. In some embodiments, the third apparatus may comprise means for performing the respective operations of the method 1100. In some example embodiments, the third apparatus may further comprise means for performing other operations in some example embodiments of the method 1100. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[0215] According to embodiments of the present disclosure, a network apparatus is provided. The network apparatus comprises means for transmitting, to a terminal device, a configuration of at least one measurement gap for performing a measurement; and means for transmitting, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX). In some embodiments, the fourth apparatus may comprise means for performing the respective operations of the method 1200. In some example embodiments, the fourth apparatus may further comprise means for performing other operations in some example embodiments of the method 1200. The means may be implemented in any suitable form. For example, the means may be implemented in a circuitry or software module.

[0216] In summary, embodiments of the present disclosure provide the following aspects.

[0217] In an aspect, it is proposed a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, a configuration of a measurement gap for performing a measurement; and perform an activation or a deactivation of the measurement gap based on the configuration and at least one of: delay-critical data to be transmitted or received by the terminal device, a remaining time of a data transmission of the terminal device, or indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device.

[0218] In some embodiments, the processor is further configured to cause the terminal device to: in accordance with a determination that the delay-critical data associated with at least one of: a logical channel group, a data radio bearer or a logical channel exists

during the measurement gap, perform the deactivation of the measurement gap; and/or transmit or receive the delay-critical data during the measurement gap.

[0219] In some embodiments, the processor is further configured to cause the terminal device to: in accordance with a determination that at least one of an uplink grant or a downlink assignment is available for the data transmission or the data reception of the terminal device, perform the deactivation of the measurement gap.

[0220] In some embodiments, the processor is further configured to cause the terminal device to: determine that the delay-critical data exists based on at least one of: that the remaining time of the data transmission of the terminal device is less than or equal to a time threshold, or the indication information indicating an existence of the delay-critical data to be received during the measurement gap.

[0221] In some embodiments, the configuration of the measurement gap indicates a time length of the measurement gap, and the processor is further configured to cause the terminal device to: determine the activation or the deactivation of the measurement gap based on the time length of the measurement gap and the remaining time of the data transmission; perform the activation or the deactivation of the measurement gap based on the determining.

[0222] In some embodiments, the processor is further configured to cause the terminal device to: determine the deactivation of the measurement gap based on a first condition that the remaining time of the data transmission is less than or equal to a sum of the time length of the measurement gap and a first value.

[0223] In some embodiments, the processor is further configured to cause the terminal device to: determine the activation or the deactivation of the measurement gap further based on a remaining on duration time of discontinuous reception (DRX).

[0224] In some embodiments, the processor is further configured to cause the terminal device to: determine the deactivation of the measurement gap based on at least one of: a second condition that a sum of the time length of the measurement gap and a second value is greater than or equal to the remaining on duration time of DRX, or a third condition that the remaining on duration time of DRX is less than or equal to the remaining time of the data transmission, and the remaining time of the data transmission is less than or equal to a time duration from a current time to a next DRX on duration.

[0225] In some embodiments, the processor is further configured to cause the terminal device to: determine the activation or the deactivation of the measurement gap further based on a grant resource.

[0226] In some embodiments, the processor is further configured to cause the terminal device to: determine the deactivation of the measurement gap based on a fourth condition that the remaining time of the data transmission is greater than a sum of the time length of the measurement gap and a third value, and an ending point of the remaining time of the data transmission is earlier than the next available grant resource after the measurement gap.

[0227] In some embodiments, the remaining time of the data transmission comprises one of: a remaining value of a packed data convergence protocol (PDCP) timer corresponding to a PDCP service data unit (SDU) of the terminal device, or a smallest remaining value of PDCP timers corresponding a plurality of PDCP SDUs of the terminal device.

[0228] In some embodiments, the processor is further configured to cause the terminal device to: in accordance with a determination that the number of consecutive deactivated measurement gaps is greater than or equal to a threshold number, perform an activation of the measurement gap.

[0229] In some embodiments, the threshold number is configured by the network device, or predefined.

[0230] In some embodiments, the indication information from the network device indicates at least one of: an existence of delay-critical data to be received by the terminal device during the measurement gap, or configuration information associated with the data transmission of the terminal device during the measurement gap.

[0231] In some embodiments, the configuration information comprises at least one of: a threshold of protocol data unit (PDU) set importance (PSI), a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or a set of data radio bearers, a data transmission by the data radio bearer belonging to the set of data radio bearers having priority higher than that of the

measurement gap.

[0232] In some embodiments, the processor is further configured to cause the terminal device to: perform the deactivation of the measurement gap based on at least one of: a PSI of buffered data of the terminal device being less than the threshold of PSI, the buffered data belonging to the set of logical channel groups or the set of logical channels, or the buffered data belonging to the set of data radio bearers; and/or preform the data transmission of the buffered data during the measurement gap.

[0233] In some embodiments, the processor is further configured to cause the terminal device to: during a hybrid automatic repeat request (HARQ) process, in accordance with a determination that there is no activated measurement gap at a time of a transmission, indicate, to a physical layer, a transmission based on a stored uplink grant.

[0234] In some embodiments, the processor is further configured to cause the terminal device to: receive, from the network device, an indication for enabling a deactivation of a measurement gap.

[0235] In some embodiments, the processor is further configured to cause the terminal device to: in accordance with a determination of the deactivation of the measurement gap, perform at least one of: transmitting or receiving data during the measurement gap; skipping the measurement during the deactivated measurement gap; or transmitting, to the network device, information indicating of the deactivation of the measurement gap.

[0236] In an aspect, it is proposed a terminal device comprising: a processor configured to cause the terminal device to: receive, from a network device, a configuration of at least one measurement gap for performing a measurement; receive, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and perform the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication.

[0237] In some embodiments, the at least one measurement gap or the at least one measurement gap occasion comprises one of: a single measurement gap or a single measurement gap occasion, a plurality of measurement gaps or a plurality of measurement gap occasions, or a number of consecutive measurement gaps or a number of consecutive measurement gap occasions.

[0238] In some embodiments, the activation or the deactivation is indicated by at least one of: downlink control information (DCI) or a medium access control (MAC) control element (CE).

[0239] In some embodiments, the MAC CE is identified with a first logical channel identity (LCID) for the activation or deactivation of a measurement gap or a measurement gap occasion.

[0240] In some embodiments, the indication further indicates location information of the at least one measurement gap or the at least one measurement gap occasion.

[0241] In some embodiments, the indication indicates the deactivation of the at least one measurement gap or the at least one measurement gap occasion, and the processor is further configured to cause the terminal device to perform at least one of: transmitting or receiving data during the at least one measurement gap or the at least one measurement gap occasion; or skipping the measurement during the deactivated at least one measurement gap or the at least one deactivated measurement gap occasion.

[0242] In some embodiments, the processor is further configured to cause the terminal device to: transmit, to the network device, capability information of the terminal device, the capability information indicating at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a protocol data unit (PDU) set importance (PSI), a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0243] In an aspect, it is proposed a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, a configuration of a measurement gap for performing a measurement; and transmit, to the terminal device, indication information associated with a data transmission or a data reception of the terminal device, wherein an activation or a deactivation of the measurement gap is performed by the terminal device based on the configuration and the indication information.

[0244] In some embodiments, the indication indicates at least one of: an existence of

delay-critical data to be received by the terminal device during the measurement gap, or configuration information associated with the data transmission of the terminal device during the measurement gap.

[0245] In some embodiments, the configuration information comprises at least one of: a threshold of protocol data unit (PDU) set importance (PSI), a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or a set of data radio bearers, a data transmission by the data radio bearer belonging to the set of data radio bearers having priority higher than that of the measurement gap.

[0246] In some embodiments, the processor is further configured to cause the network device to: transmit, to the terminal device, a further configuration of a threshold number for consecutive deactivated measurement gaps.

[0247] In some embodiments, the processor is further configured to cause the network device to: transmit, to the terminal device, an indication for enabling a deactivation of a measurement gap.

[0248] In some embodiments, the processor is further configured to cause the network device to: receive, from the terminal device, information indicating of the deactivation of the measurement gap.

[0249] In an aspect, it is proposed a network device comprising: a processor configured to cause the network device to: transmit, to a terminal device, a configuration of at least one measurement gap for performing a measurement; and transmit, to the terminal device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX).

[0250] In some embodiments, the at least one measurement gap comprises one of: a single measurement gap or a single measurement gap occasion, a plurality of measurement gaps or a plurality of measurement gap occasions, or a number of consecutive measurement gaps or a number of consecutive measurement gap occasions.

[0251] In some embodiments, the activation or the deactivation is indicated by at least

one of: downlink control information (DCI) or a medium access control (MAC) control element (CE).

[0252] In some embodiments, the MAC CE is identified with a first logical channel identity (LCID) for the activation or deactivation of a measurement gap or a measurement gap occasion.

[0253] In some embodiments, the indication further indicates location information of the at least one measurement gap or the at least one measurement gap occasion.

[0254] In some embodiments, the processor is further configured to cause the network device to: receive, from the terminal device, capability information of the terminal device, the capability information indicating at least one of: a support for a deactivation of a measurement gap, a support for prioritizing a data transmission over a measurement gap, a support for a semi-persistent measurement gap, a support for deactivating a measurement gap based on configuration information associated with at least one of: a protocol data unit (PDU) set importance (PSI), a logical channel group or a logical channel, or a data radio bearer for a data transmission, or a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

[0255] In an aspect, a terminal device comprises: at least one processor; and at least one memory coupled to the at least one processor and storing instructions thereon, the instructions, when executed by the at least one processor, causing the device to perform the method implemented by the terminal device discussed above.

[0256] In an aspect, a network device comprises: at least one processor; and at least one memory coupled to the at least one processor and storing instructions thereon, the instructions, when executed by the at least one processor, causing the device to perform the method implemented by the network device discussed above.

[0257] In an aspect, a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the terminal device discussed above.

[0258] In an aspect, a computer readable medium having instructions stored thereon, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the network device discussed above.

[0259] In an aspect, a computer program comprising instructions, the instructions, when

executed on at least one processor, causing the at least one processor to perform the method implemented by the terminal device discussed above.

[0260] In an aspect, a computer program comprising instructions, the instructions, when executed on at least one processor, causing the at least one processor to perform the method implemented by the network device discussed above.

[0261] Generally, various embodiments of the present disclosure may be implemented in hardware or special purpose circuits, software, logic or any combination thereof. Some aspects may be implemented in hardware, while other aspects may be implemented in firmware or software which may be executed by a controller, microprocessor or other computing device. While various aspects of embodiments of the present disclosure are illustrated and described as block diagrams, flowcharts, or using some other pictorial representation, it will be appreciated that the blocks, apparatus, systems, techniques or methods described herein may be implemented in, as non-limiting examples, hardware, software, firmware, special purpose circuits or logic, general purpose hardware or controller or other computing devices, or some combination thereof.

[0262] The present disclosure also provides at least one computer program product tangibly stored on a non-transitory computer readable storage medium. The computer program product includes computer-executable instructions, such as those included in program modules, being executed in a device on a target real or virtual processor, to carry out the process or method as described above with reference to FIGS. 1 to 13. Generally, program modules include routines, programs, libraries, objects, classes, components, data structures, or the like that perform particular tasks or implement particular abstract data types. The functionality of the program modules may be combined or split between program modules as desired in various embodiments. Machine-executable instructions for program modules may be executed within a local or distributed device. In a distributed device, program modules may be located in both local and remote storage media.

[0263] Program code for carrying out methods of the present disclosure may be written in any combination of one or more programming languages. These program codes may be provided to a processor or controller of a general purpose computer, special purpose computer, or other programmable data processing apparatus, such that the program codes, when executed by the processor or controller, cause the functions/operations specified in the flowcharts and/or block diagrams to be implemented. The program code may execute

entirely on a machine, partly on the machine, as a stand-alone software package, partly on the machine and partly on a remote machine or entirely on the remote machine or server.

[0264] The above program code may be embodied on a machine readable medium, which may be any tangible medium that may contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device. The machine readable medium may be a machine readable signal medium or a machine readable storage medium. A machine readable medium may include but not limited to an electronic, magnetic, optical, electromagnetic, infrared, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. More specific examples of the machine readable storage medium would include an electrical connection having one or more wires, a portable computer diskette, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), an optical fiber, a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, or any suitable combination of the foregoing.

[0265] Further, while operations are depicted in a particular order, this should not be understood as requiring that such operations be performed in the particular order shown or in sequential order, or that all illustrated operations be performed, to achieve desirable results. In certain circumstances, multitasking and parallel processing may be advantageous. Likewise, while several specific implementation details are contained in the above discussions, these should not be construed as limitations on the scope of the present disclosure, but rather as descriptions of features that may be specific to particular embodiments. Certain features that are described in the context of separate embodiments may also be implemented in combination in a single embodiment. Conversely, various features that are described in the context of a single embodiment may also be implemented in multiple embodiments separately or in any suitable sub-combination.

[0266] Although the present disclosure has been described in language specific to structural features and/or methodological acts, it is to be understood that the present disclosure defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

CLAIMS

1. A terminal device comprising:

a processor configured to cause the terminal device to:

receive, from a network device, a configuration of a measurement gap for performing a measurement; and

perform an activation or a deactivation of the measurement gap based on the configuration and at least one of:

delay-critical data to be transmitted or received by the terminal device,

a remaining time of a data transmission of the terminal device, or

indication information associated with a data transmission or a data reception of the terminal device, the indication information being received from the network device.

2. The terminal device of claim 1, wherein the processor is further configured to cause the terminal device to:

in accordance with a determination that the delay-critical data associated with at least one of: a logical channel group, a data radio bearer or a logical channel exists during the measurement gap,

perform the deactivation of the measurement gap; and/or

transmit or receive the delay-critical data during the measurement gap.

3. The terminal device of claim 2, wherein the processor is further configured to cause the terminal device to:

in accordance with a determination that at least one of an uplink grant or a downlink assignment is available for the data transmission or the data reception of the terminal device, perform the deactivation of the measurement gap.

4. The terminal device of claim 2, wherein the processor is further configured to cause the terminal device to:

determine that the delay-critical data exists based on at least one of:

that the remaining time of the data transmission of the terminal device is less than or equal to a time threshold, or

the indication information indicating an existence of the delay-critical data to be

received during the measurement gap.

5. The terminal device of any of claims 1-4, wherein the configuration of the measurement gap indicates a time length of the measurement gap, and the processor is further configured to cause the terminal device to:

determine the activation or the deactivation of the measurement gap based on the time length of the measurement gap and the remaining time of the data transmission;

perform the activation or the deactivation of the measurement gap based on the determining.

6. The terminal device of claim 5, wherein the processor is further configured to cause the terminal device to:

determine the activation or the deactivation of the measurement gap further based on a grant resource.

7. The terminal device of claim 5 or 6, wherein the processor is further configured to cause the terminal device to:

determine the deactivation of the measurement gap based on a fourth condition that the remaining time of the data transmission is greater than a sum of the time length of the measurement gap and a third value, and an ending point of the remaining time of the data transmission is earlier than the next available grant resource after the measurement gap.

8. The terminal device of any of claims 1-7, wherein the indication information from the network device indicates at least one of:

an existence of delay-critical data to be received by the terminal device during the measurement gap, or

configuration information associated with the data transmission of the terminal device during the measurement gap.

9. The terminal device of claim 8, wherein the configuration information comprises at least one of:

a threshold of protocol data unit (PDU) set importance (PSI),

a set of logical channel groups or a set of logical channels, a data transmission via the logical channel belonging to the set of logical channel groups or a data transmission via the

logical channel belonging to the set of logical channels having priority higher than that of the measurement gap, or

a set of data radio bearers, a data transmission by the data radio bearer belonging to the set of data radio bearers having priority higher than that of the measurement gap.

10. The terminal device of claim 9, wherein the processor is further configured to cause the terminal device to:

perform the deactivation of the measurement gap based on at least one of:

a PSI of buffered data of the terminal device being less than the threshold of PSI,

the buffered data belonging to the set of logical channel groups or the set of logical channels, or

the buffered data belonging to the set of data radio bearers; and/or

preform the data transmission of the buffered data during the measurement gap.

11. The terminal device of any of claims 1-10, wherein the processor is further configured to cause the terminal device to: during a hybrid automatic repeat request (HARQ) process,

in accordance with a determination that there is no activated measurement gap at a time of a transmission, indicate, to a physical layer, a transmission based on a stored uplink grant.

12. The terminal device of any of claims 1-11, wherein the processor is further configured to cause the terminal device to:

receive, from the network device, an indication for enabling a deactivation of a measurement gap.

13. The terminal device of any of claims 1-12, wherein the processor is further configured to cause the terminal device to:

in accordance with a determination of the deactivation of the measurement gap, perform at least one of:

transmitting or receiving data during the measurement gap;

skipping the measurement during the deactivated measurement gap; or

transmitting, to the network device, information indicating of the deactivation of the measurement gap.

14. A terminal device comprising:

a processor configured to cause the terminal device to:

receive, from a network device, a configuration of at least one measurement gap for performing a measurement;

receive, from the network device, an indication for an activation or a deactivation of the at least one measurement gap or at least one measurement gap occasion during an on duration time of discontinuous reception (DRX); and

perform the activation or the deactivation of the at least one measurement gap or at least one measurement gap occasion based on the indication.

15. The terminal device of claim 14, wherein the at least one measurement gap or the at least one measurement gap occasion comprises one of:

a single measurement gap or a single measurement gap occasion,

a plurality of measurement gaps or a plurality of measurement gap occasions, or

a number of consecutive measurement gaps or a number of consecutive measurement gap occasions.

16. The terminal device of claim 14 or claim 15, wherein the activation or the deactivation is indicated by at least one of: downlink control information (DCI) or a medium access control (MAC) control element (CE).

17. The terminal device of claim 16, wherein the MAC CE is identified with a first logical channel identity (LCID) for the activation or deactivation of a measurement gap or a measurement gap occasion.

18. The terminal device of any of claims 14-17, wherein the indication further indicates location information of the at least one measurement gap or the at least one measurement gap occasion.

19. The terminal device of any of claims 14-18, wherein the indication indicates the deactivation of the at least one measurement gap or the at least one measurement gap occasion, and the processor is further configured to cause the terminal device to perform at least one of:

transmitting or receiving data during the at least one measurement gap or the at least one measurement gap occasion; or

skipping the measurement during the deactivated at least one measurement gap or the at least one deactivated measurement gap occasion.

20. The terminal device of any of claims 1-19, wherein the processor is further configured to cause the terminal device to:

transmit, to the network device, capability information of the terminal device, the capability information indicating at least one of:

a support for a deactivation of a measurement gap,

a support for prioritizing a data transmission over a measurement gap,

a support for a semi-persistent measurement gap,

a support for deactivating a measurement gap based on configuration information associated with at least one of: a protocol data unit (PDU) set importance (PSI), a logical channel group or a logical channel, or a data radio bearer for a data transmission, or

a support for deactivating a measurement gap for at least one of: an uplink transmission, or a downlink reception.

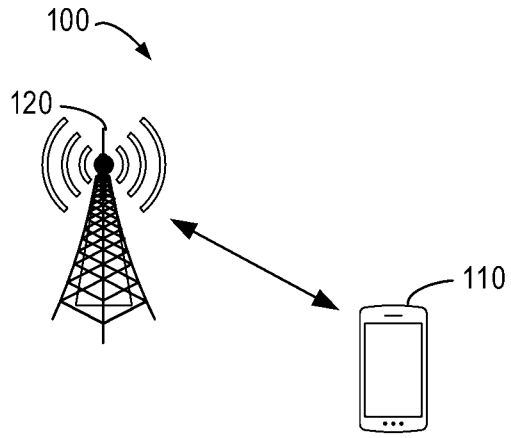
100
120
110

FIG. 1

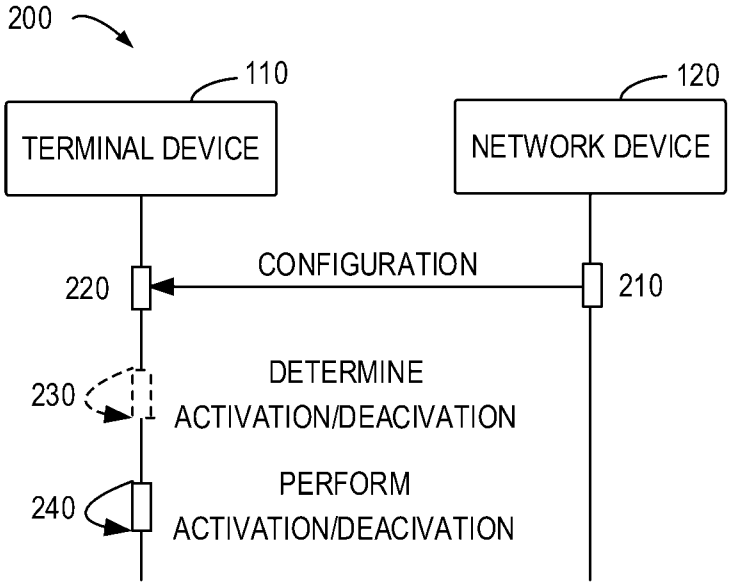
200
110
TERMINAL DEVICE
120
NETWORK DEVICE
CONFIGURATION
220
210
230
DETERMINE
ACTIVATION/DEACIVATION
240
PERFORM
ACTIVATION/DEACIVATION

FIG. 2

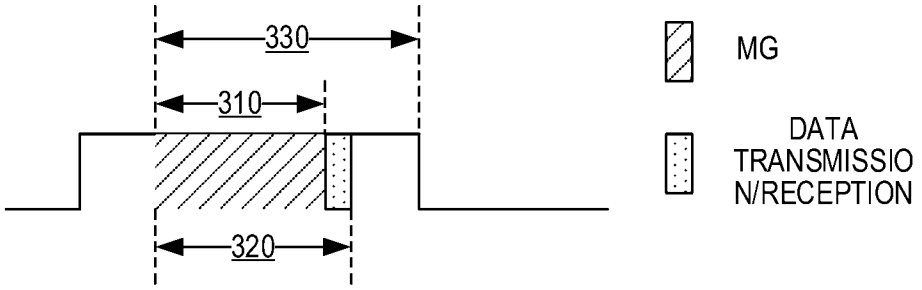

FIG. 3A

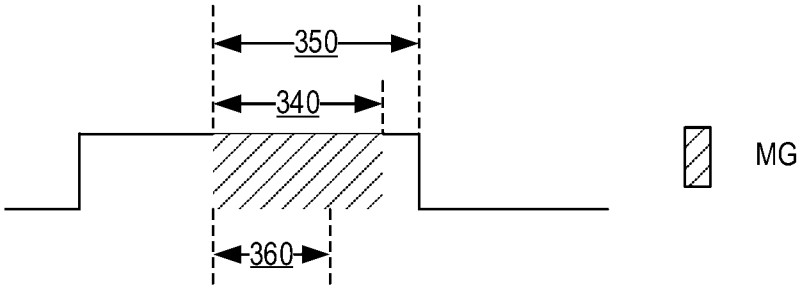

FIG. 3B

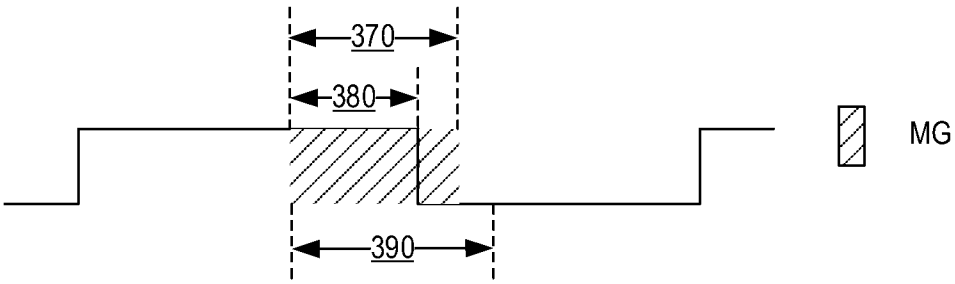

FIG. 3C

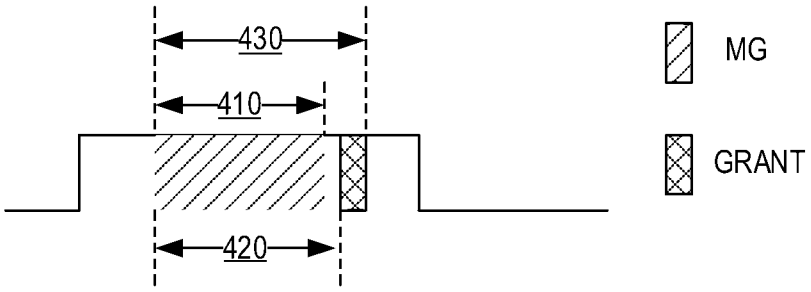

FIG. 4A

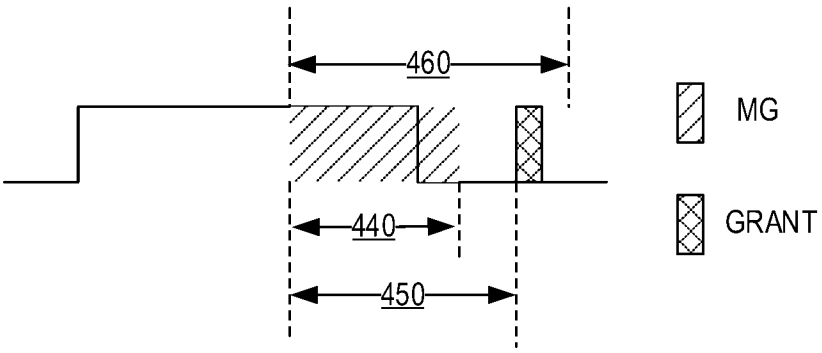

FIG. 4B

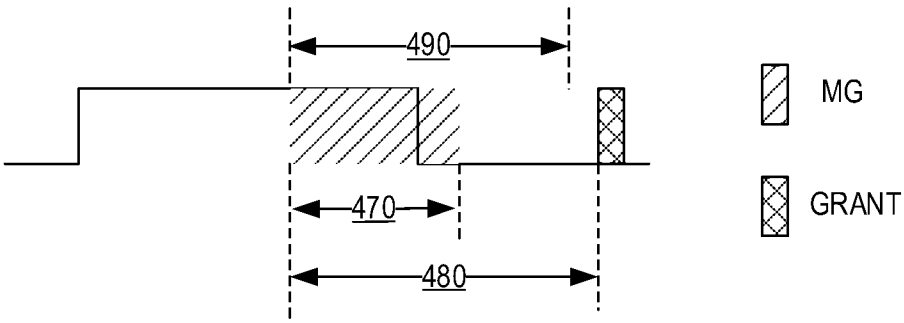

FIG. 4C

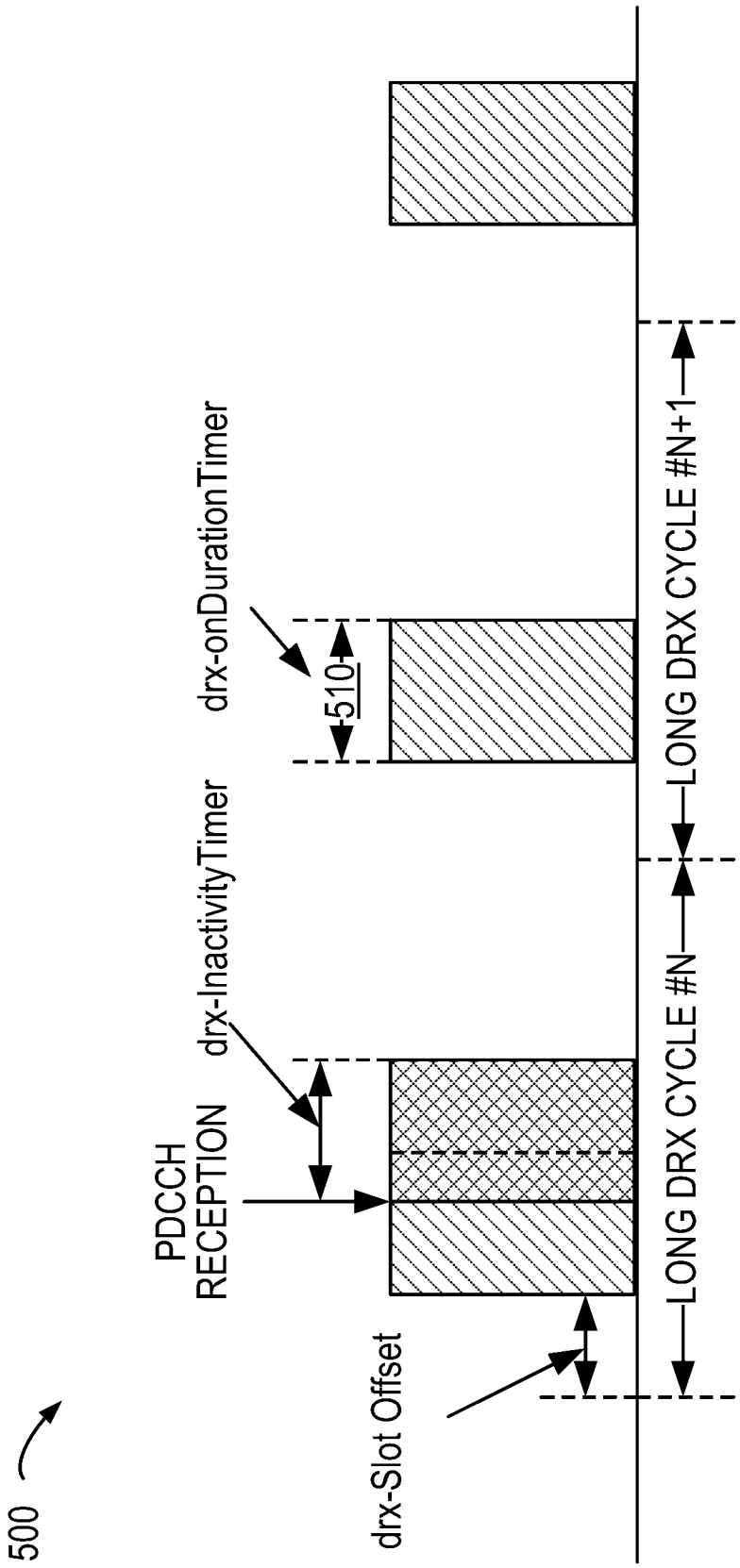
500
drx-Slot Offset
PDCCH RECEPTION
drx-InactivityTimer
drx-onDurationTimer
510
LONG DRX CYCLE #N
LONG DRX CYCLE #N+1

FIG. 5A

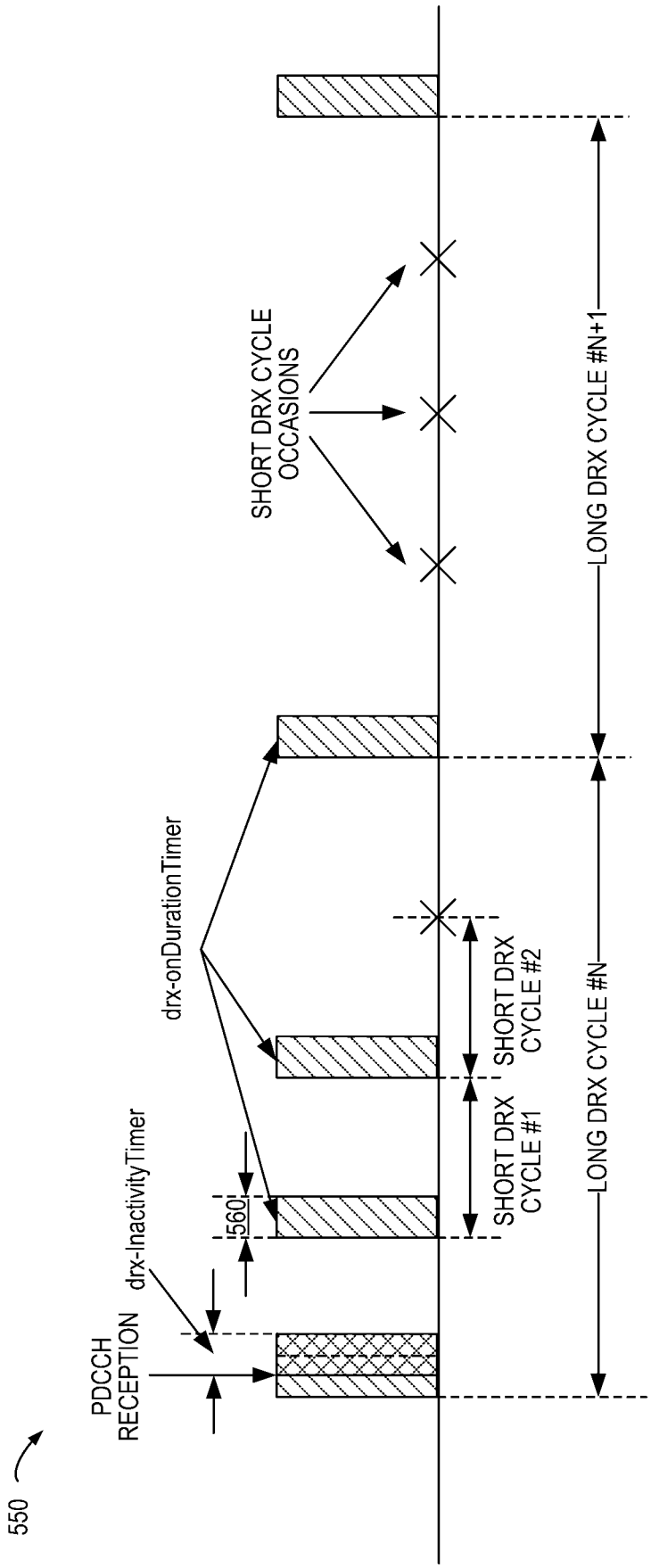
550
PDCCH RECEPTION
drx-InactivityTimer
560
drx-onDurationTimer
SHORT DRX CYCLE #1
SHORT DRX CYCLE #2
LONG DRX CYCLE #N
LONG DRX CYCLE #N+1
SHORT DRX CYCLE OCCASIONS

FIG. 5B

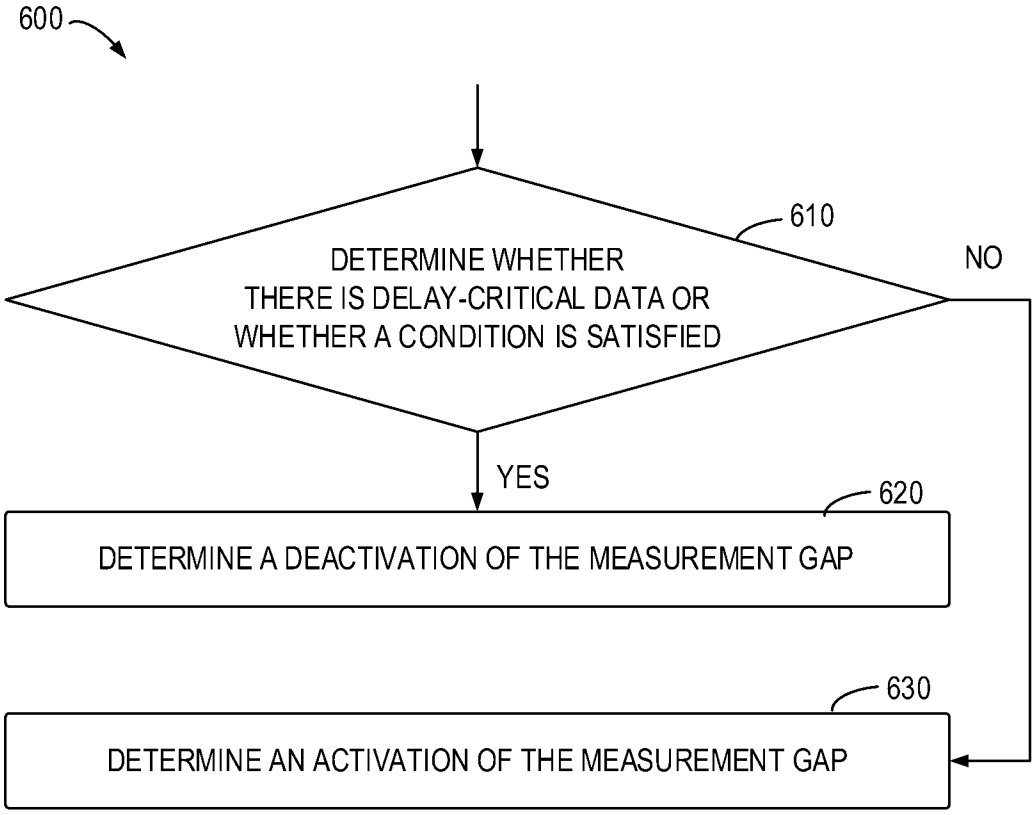
600
610
DETERMINE WHETHER
THERE IS DELAY-CRITICAL DATA OR
WHETHER A CONDITION IS SATISFIED
NO
YES
620
DETERMINE A DEACTIVATION OF THE MEASUREMENT GAP
630
DETERMINE AN ACTIVATION OF THE MEASUREMENT GAP

FIG. 6

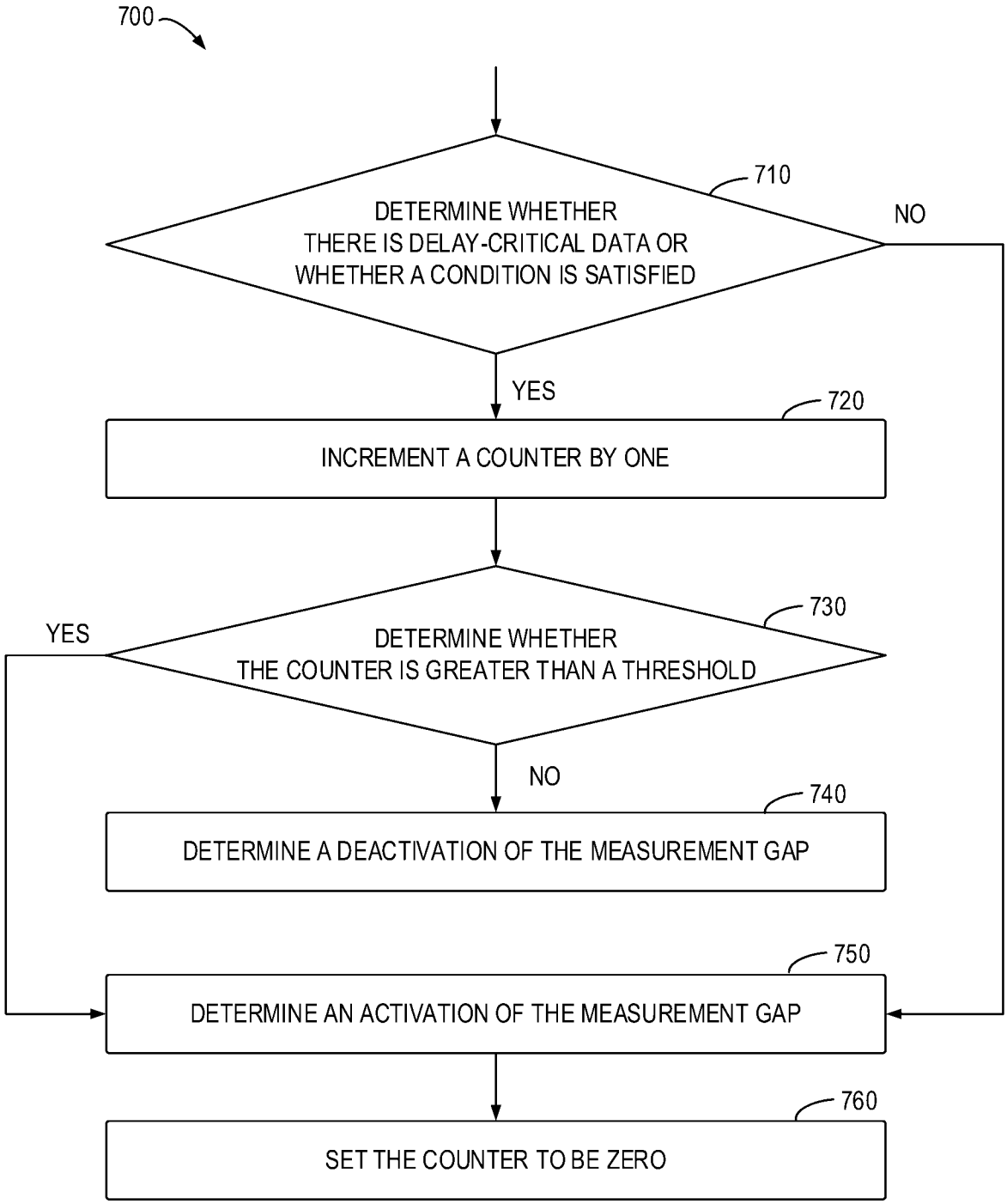
700
710
DETERMINE WHETHER
THERE IS DELAY-CRITICAL DATA OR
WHETHER A CONDITION IS SATISFIED
NO
YES
720
INCREMENT A COUNTER BY ONE
730
YES
DETERMINE WHETHER
THE COUNTER IS GREATER THAN A THRESHOLD
NO
740
DETERMINE A DEACTIVATION OF THE MEASUREMENT GAP
750
DETERMINE AN ACTIVATION OF THE MEASUREMENT GAP
760
SET THE COUNTER TO BE ZERO

FIG. 7

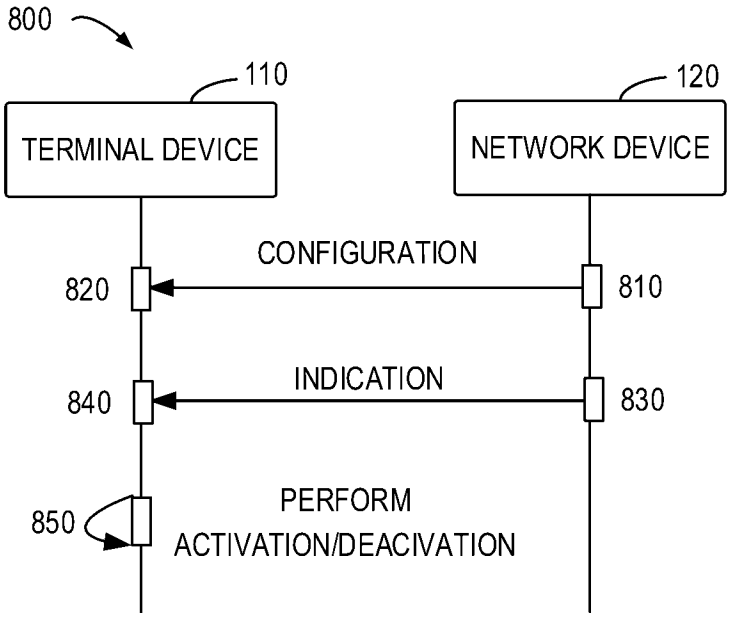
800
110
120
TERMINAL DEVICE
NETWORK DEVICE
CONFIGURATION
820
810
INDICATION
840
830
850
PERFORM
ACTIVATION/DEACIVATION

FIG. 8

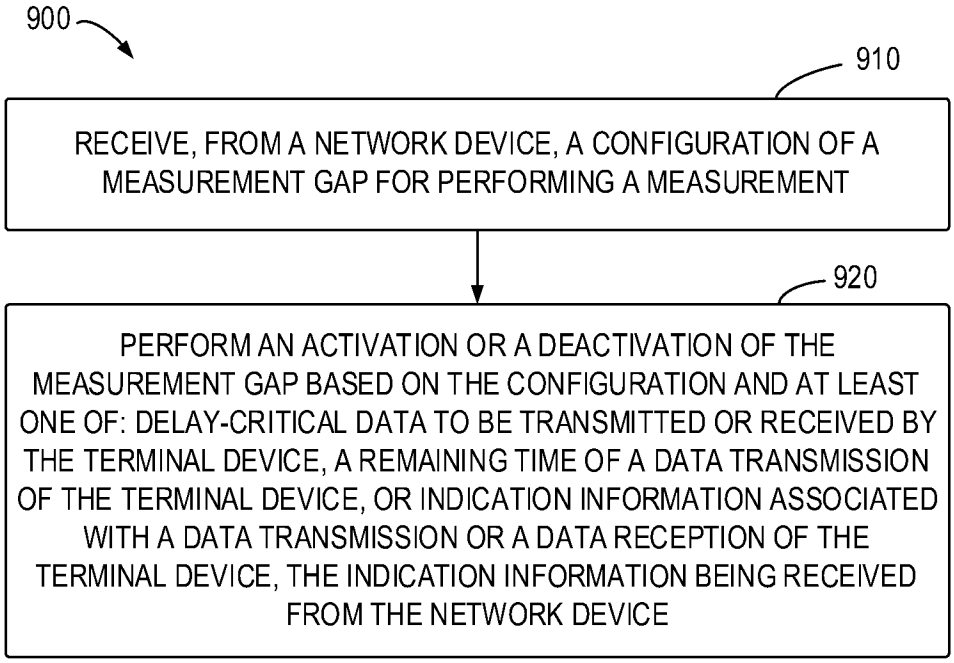
900
910
RECEIVE, FROM A NETWORK DEVICE, A CONFIGURATION OF A MEASUREMENT GAP FOR PERFORMING A MEASUREMENT
920
PERFORM AN ACTIVATION OR A DEACTIVATION OF THE MEASUREMENT GAP BASED ON THE CONFIGURATION AND AT LEAST ONE OF: DELAY-CRITICAL DATA TO BE TRANSMITTED OR RECEIVED BY THE TERMINAL DEVICE, A REMAINING TIME OF A DATA TRANSMISSION OF THE TERMINAL DEVICE, OR INDICATION INFORMATION ASSOCIATED WITH A DATA TRANSMISSION OR A DATA RECEPTION OF THE TERMINAL DEVICE, THE INDICATION INFORMATION BEING RECEIVED FROM THE NETWORK DEVICE

FIG. 9

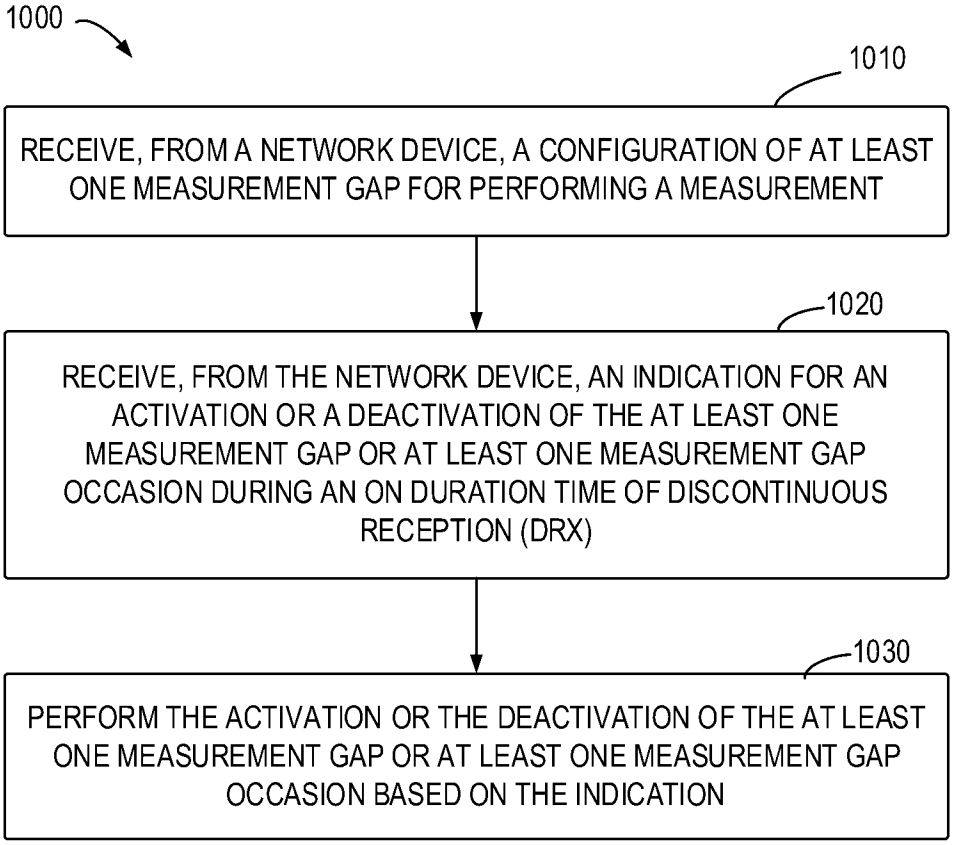
1000
1010
RECEIVE, FROM A NETWORK DEVICE, A CONFIGURATION OF AT LEAST ONE MEASUREMENT GAP FOR PERFORMING A MEASUREMENT
1020
RECEIVE, FROM THE NETWORK DEVICE, AN INDICATION FOR AN ACTIVATION OR A DEACTIVATION OF THE AT LEAST ONE MEASUREMENT GAP OR AT LEAST ONE MEASUREMENT GAP OCCASION DURING AN ON DURATION TIME OF DISCONTINUOUS RECEPTION (DRX)
1030
PERFORM THE ACTIVATION OR THE DEACTIVATION OF THE AT LEAST ONE MEASUREMENT GAP OR AT LEAST ONE MEASUREMENT GAP OCCASION BASED ON THE INDICATION

FIG. 10

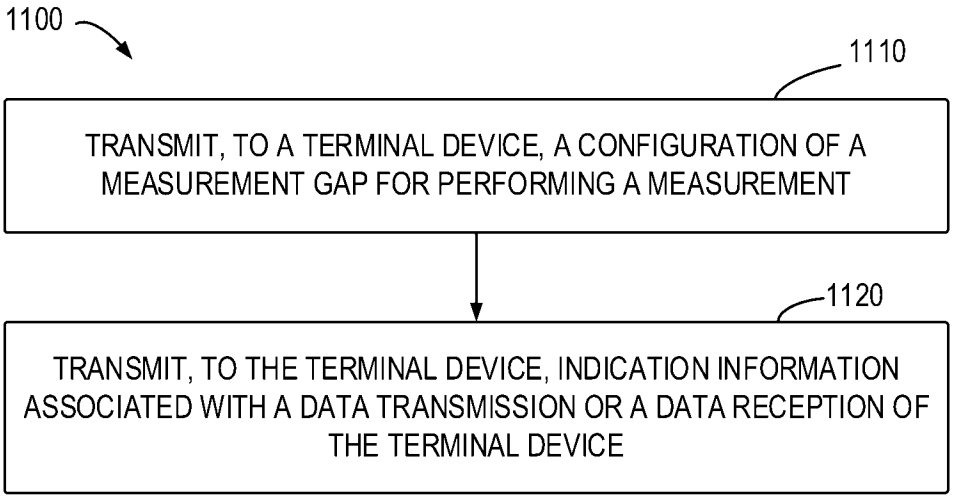
1100
1110
TRANSMIT, TO A TERMINAL DEVICE, A CONFIGURATION OF A MEASUREMENT GAP FOR PERFORMING A MEASUREMENT
1120
TRANSMIT, TO THE TERMINAL DEVICE, INDICATION INFORMATION ASSOCIATED WITH A DATA TRANSMISSION OR A DATA RECEPTION OF THE TERMINAL DEVICE

FIG. 11

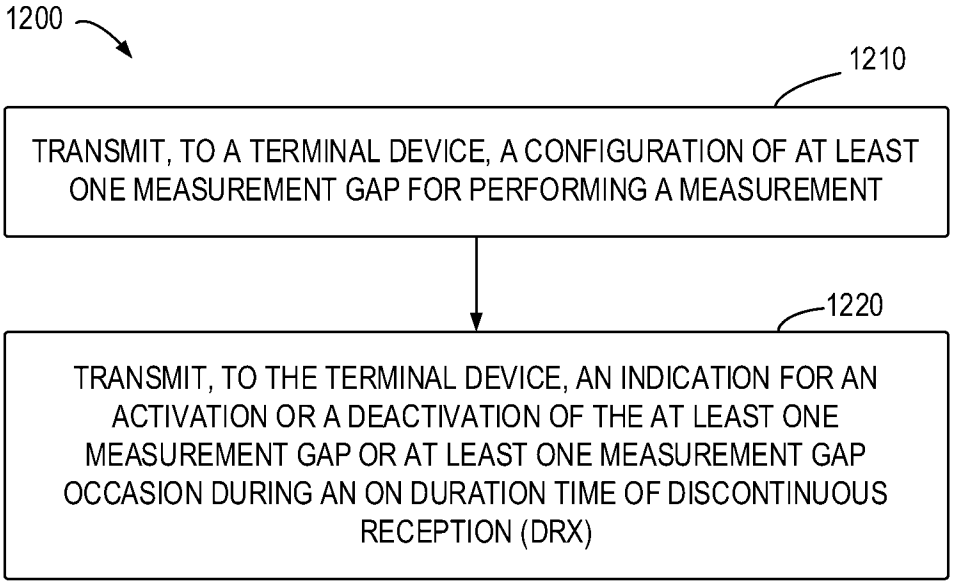
1200
1210
TRANSMIT, TO A TERMINAL DEVICE, A CONFIGURATION OF AT LEAST ONE MEASUREMENT GAP FOR PERFORMING A MEASUREMENT
1220
TRANSMIT, TO THE TERMINAL DEVICE, AN INDICATION FOR AN ACTIVATION OR A DEACTIVATION OF THE AT LEAST ONE MEASUREMENT GAP OR AT LEAST ONE MEASUREMENT GAP OCCASION DURING AN ON DURATION TIME OF DISCONTINUOUS RECEPTION (DRX)

FIG. 12

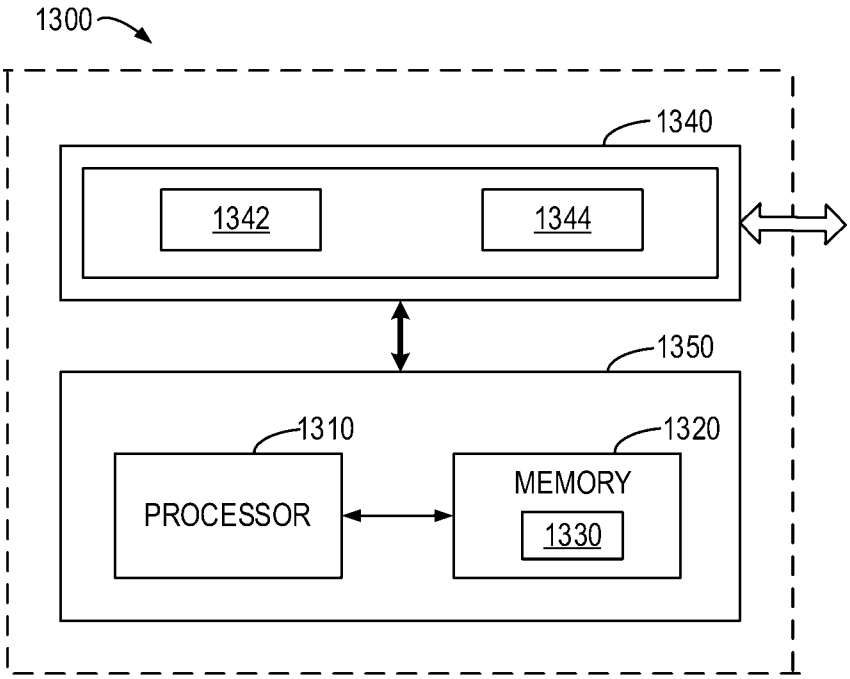

FIG. 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2023/141202

A. CLASSIFICATION OF SUBJECT MATTER

H04W 24/02(2009.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:H04W H04L

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

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

CJFD,CNTXT,ENTXTC,VEN,CNABS:measurement gap,measurement interval,+activat+,release,collision

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 111757509 A (TELECOMMUNICATIONS TECHNOLOGY RESEARCH INSTITUTE CO., LTD.) 09 October 2020 (2020-10-09) see claims 1 and 2, description, paragraphs [0173]-[0462], figures 1-13	1-20
X	CN 115843458 A (BEIJING XIAOMI MOBILE SOFTWARE CO., LTD.) 24 March 2023 (2023-03-24) see description, paragraphs [0074]-[0166], figures 1-6	1-20
A	US 2019090151 A1 (INTEL IP CORP.) 21 March 2019 (2019-03-21) see the whole document	1-20
A	US 2023345286 A1 (HUAWEI TECH CO., LTD.) 26 October 2023 (2023-10-26) see the whole document	1-20

☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

* Special categories of cited documents:
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 September 2024	**12 September 2024**

Name and mailing address of the ISA/CN	Authorized officer
CHINA NATIONAL INTELLECTUAL PROPERTY ADMINISTRATION **6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing 100088, China**	**XU,Qian** Telephone No. **(+86) 010-62411433**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2023/141202

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN 111757509 A	09 October 2020	None	
CN 115843458 A	24 March 2023	None	
US 2019090151 A1	21 March 2019	US 10743206 B2	11 August 2020
US 2023345286 A1	26 October 2023	WO 2022143965 A1	07 July 2022
		CA 3203892 A1	07 July 2022
		EP 4258727 A1	11 October 2023
		EP 4258727 A4	05 June 2024