

ENHANCED RADIO RESOURCE MANAGEMENT

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to a user equipment (UE), a processor, and a method for enhancing radio resource management (RRM).

BACKGROUND

[0002] A wireless communications system may include one or multiple network communication devices, such as base stations, which may be otherwise known as an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. Each network communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as UE, or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers). Additionally, the wireless communications system may support wireless communications across various radio access technologies including third generation (3G) radio access technology, fourth generation (4G) radio access technology, fifth generation (5G) radio access technology, among other suitable radio access technologies beyond 5G (e.g., sixth generation (6G)).

[0003] To ensure that a UE in RRC_IDLE or RRC_INACTIVE is camping on the best cell, the UE may need to perform mobility measurement. The mobility measurement may involve RRM measurement for mobility. In the wireless communications system, RRM is utilized for managing channel interference, radio resources, other radio transmission characteristics, etc. However, how to improve performance of a device in the wireless communications system (e.g. the UE) with the RRM is still desired.

SUMMARY

[0004] The present disclosure relates to a UE, a processor, and a method that enhance radio resource management. With the solution of embodiments of the present disclosure, the enhanced RRM for mobility may be achieved.

[0005] Some implementations of a UE described herein may include at least one memory; and at least one processor coupled with the at least one memory and configured to cause the UE to: determine whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a low power-wake up signal (LP-WUS) configured for the UE is satisfied; and perform, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to a low power-wake up receiver (LP-WUR).

[0006] In some implementations, the first trigger condition includes one of the following: in the case that the UE is in low mobility or stationary, a difference between a cell selection reception level value (Srxlev) for the serving cell and an Srxlev reference for the serving cell is less than a first threshold during a time window; in the case that the UE is in low mobility or stationary, a difference between a cell selection quality value (Squal) for the serving cell and an Squal reference for the serving cell is less than a second threshold during the time window; in the case that the UE is not at an edge of the serving cell, the Srxlev is greater than the first threshold during the time window; in the case that the UE is not at the edge of the serving cell, the Squal for the serving cell is greater than the second threshold during the time window; or any combination of thereof.

[0007] In some implementations, the second trigger condition includes at least one of the following: the UE is in coverage of the LP-WUS during a time window; or a reference signal measurement obtained by the LP-WUR reaches a third threshold during the time window.

[0008] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the UE is located within the coverage of the LP-WUS, performing the relaxed RRM measurement for the serving cell and a neighboring cell on the MR.

[0009] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the UE is located within the coverage of the LP-WUS, performing the RRM measurement offloading for at least the serving cell from the MR to the LP-WUR.

[0010] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the

UE is located within the coverage of the LP-WUS, relaxing a portion of a RRM measurement for at least one of a neighboring cell or the serving cell on the MR; and offloading another portion of the RRM measurement to the LP-WUR.

[0011] In some implementations, the at least one of the relaxed RRM measurement or the RRM measurement offloading is performed in a case of satisfying the first trigger condition on the MR.

[0012] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the reference signal measurement obtained by the LP-WUR reaches the third threshold, performing the RRM measurement offloading for only the serving cell.

[0013] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the reference signal measurement obtained by the LP-WUR reaches the third threshold, performing the RRM measurement offloading for both the serving cell and a neighboring cell.

[0014] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that a neighboring cell measurement relaxation condition on the MR and the second trigger condition are satisfied, performing the RRM measurement offloading for a neighboring cell.

[0015] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the first trigger condition is satisfied, performing the relaxed RRM measurement for the serving cell.

[0016] In some implementations, the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by: in the case that the first and second trigger conditions are satisfied, performing the RRM measurement offloading for the serving cell.

[0017] In some implementations, the UE is further caused to: stop the relaxed RRM measurement or the RRM measurement offloading based on a third trigger condition.

[0018] In some implementations, the third trigger condition includes at least one of the following: the UE moves out of a coverage of the LP-WUS; a target reference signal measured from the serving cell by the LP-WUR satisfies a fourth threshold during a time window; the UE stops an operation related to the LP-WUS; the LP-WUR detects a wake-up signal for the MR; the UE is to perform uplink data transmission; a low mobility or stationary condition of the UE is not satisfied for the relaxed RRM measurement or the RRM measurement offloading; or a not-at-cell-edge condition of the UE is not satisfied for the relaxed RRM measurement or the RRM measurement offloading.

[0019] In some implementations, the UE is further caused to: stop the relaxed RRM measurement at expiration of a first time period during which the relaxed RRM measurement on the MR is performed for the serving cell.

[0020] In some implementations, the UE is further caused to: stop the RRM measurement offloading at expiration of a second time period during which the RRM measurement offloaded to the LP-WUR is performed for the serving cell or both the serving cell and a neighboring cell.

[0021] In some implementations, the UE is caused to relax a portion of the RRM measurement on the MR and offload another portion of the RRM measurement to the LP-WUR by: in case of continuous monitoring, performing the offloaded RRM measurement on the LP-WUR during the time period that the relaxed RRM measurement on the MR is performed.

[0022] In some implementations, the UE is caused to relax a portion of the RRM measurement on the MR and offload another portion of the RRM measurement to the LP-WUR by: in case of duty-cycle monitoring, performing the offloaded RRM measurement on the LP-WUR during a LP-WUS monitoring cycle while relaxing the portion of the RRM measurement on the MR during the LP-WUS monitoring cycle.

[0023] In some implementations, the UE is further caused to: perform a relaxed RRM measurement for a neighboring cell after a relaxed RRM measurement is performed for the serving cell by a number of times.

[0024] Some implementations of a method described herein may include: determining whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a LP-WUS configured for the UE is satisfied; and

performing, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to a LP-WUR.

[0025] Some implementations of a processor described herein may include at least one memory and a controller coupled with the at least one memory and configured to cause the controller to: determine whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a LP-WUS configured for the UE is satisfied; and perform, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to a LP-WUR.

[0026] It is to be understood that the summary section is not intended to identify key or essential features of embodiments of the present disclosure, nor is it intended to be used to limit the scope of the present disclosure. Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] Fig. 1 illustrates an example of a wireless communications system that enhances RRM in accordance with aspects of the present disclosure.

[0028] Fig. 2 illustrates a schematic diagram of an example of RRM under different trigger conditions.

[0029] Fig. 3 illustrates a schematic diagram of another example of RRM under different trigger conditions.

[0030] Fig. 4 illustrate a schematic diagram of yet another example of RRM under different trigger conditions.

[0031] Fig. 5 illustrates an example of a device that enhances RRM in accordance with some aspects of the present disclosure.

[0032] Fig. 6 illustrates an example of a processor that enhances RRM in accordance with aspects of the present disclosure.

[0033] Fig. 7 illustrate a flowchart of a method that enhances RRM in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0034] Principles of the present disclosure will now be described with reference to some 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. The disclosure described herein may be implemented in various manners other than the ones described below.

[0035] 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.

[0036] References in the present disclosure to “one embodiment,” “an example embodiment,” “an embodiment,” “some embodiments,” and the like indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0037] It shall be understood that although the terms “first” and “second” or the like may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms. In some examples, values, procedures, or apparatuses 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.

[0038] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. 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. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/ or combinations thereof. For example, 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 “based at least in part on.” The term “one implementation” and “an implementation” are to be read as “at least one implementation.” The term “another implementation” is to be read as “at least one other implementation.” The use of an expression such as “A and/or B” can mean either “only A” or “only B” or “both A and B.” Other definitions, explicit and implicit, may be included below.

[0039] Aspects of the present disclosure are described in the context of a wireless communications system.

[0040] Fig. 1 illustrates an example of a wireless communications system 100 that enhances RRM in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more terminal devices or UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as an LTE network or an LTE-advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a 5G network, such as an NR network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including institute of electrical and electronics engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0041] The network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station (BS), a network element, a radio access network (RAN) node, a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0042] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0043] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an internet-of-things (IoT) device, an internet-of-everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE

104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0044] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in Fig. 1. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102, other UEs 104, or network equipment (e.g., the core network 106, the packet data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in Fig. 1. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100.

[0045] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0046] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0047] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open radio access network (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a central unit (CU), a distributed unit (DU), a radio unit (RU), a RAN intelligent controller (RIC) (e.g., a near-real time RIC (Near-RT RIC), a non-real time RIC (Non-RT RIC)), a service management and orchestration (SMO) system, or any combination thereof.

[0048] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0049] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., radio resource control (RRC), service data adaptation protocol (SDAP), packet data convergence protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU.

[0050] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of

the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0051] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-c, F1-u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0052] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a packet data network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0053] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the

application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0054] In the wireless communications system 100, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0055] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15 kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., $\mu=0$) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., $\mu=1$) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., $\mu=2$) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., $\mu=3$) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., $\mu=4$) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

[0056] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some

implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0057] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0058] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0059] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., $\mu=0$), which includes 15 kHz subcarrier spacing; a second numerology (e.g., $\mu=1$), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., $\mu=3$), which includes 120 kHz subcarrier spacing.

[0060] The RRM measurement may include serving cell measurements and neighbour cell measurements, which can be intra-frequency or inter-frequency (including inter-RAT) measurements. For a UE operating with an LP-WUR (also can be referred as LR), using a main radio (MR) for mobility measurements has significant impacts on UE energy saving, since the UE needs to start up the MR for measurements frequently especially for serving cell measurements that must be performed every second or every Inactive/Idle Discontinuous Reception (I-DRX) cycle in FR1, which removes a large part of UE power saving gains from an LP-WUS/WUR.

[0061] In order to achieve the UE power saving gains by the LP-WUS/WUR, the RRM measurements on a serving cell and neighboring cells via the MR may be relaxed or stopped when the UE is using the LP-WUS or when the MR is in ultra-deep sleep. In 3rd Generation Partnership Project (3GPP) Release-16/17, power saving and RedCap Work Item, RRM measurement relaxation on the neighboring cell is introduced. But here, further relaxation or even no measurement by the MR could be considered, and serving cell or neighboring cell measurements may be offloaded to the LR. The RRM measurement relaxation on the serving cell and neighboring cells should be premised on the feasibility or support of RRM measurements on the LR.

[0062] Specifically, the RRM measurement relaxation or offloading can be classified into the following cases based on different serving cell/neighboring cells measurement behaviors for the MR and LR.

	Serving cell measurement		Neighboring cell measurement	
	MR	LR	MR	LR
Legacy case	Yes	No	Yes	No
Relaxation Case	Relax	No	Relax	No

Offloading Case1	No	Yes	No	Yes
Offloading Case2	No	Yes	Yes	No
Exceptional Case	No	No	No	No

[0063] It is to be understood that the above serving cell/neighboring cell measurements in different cases can be combined into any RRM strategy. For example, in an implementation of combining relaxation and offloading cases, the serving cell measurement on the MR is relaxed, and the neighboring cell measurement is offloaded to the LR. In another implementation of combining relaxation and offloading cases, the serving cell measurement on the MR is relaxed, and the neighboring cell measurement is still performed on the MR. More details and other implementations will be further explained below.

[0064] Reference is now made to Figs. 2-4, which illustrates schematic diagrams of various examples of RRM under different trigger conditions, respectively. The trigger conditions for the RRM measurement relaxation on the MR or RRM measurement offloading from the MR to the LR (e.g. first trigger condition or second trigger condition) are provided herein. The trigger conditions for the RRM measurement relaxation or offloading can take both UE state and LP WUS/WUR conditions into account. The schematic diagrams in Figs. 2-4 may involve the UE 104 in the wireless communications system 100. More details about the enhanced RRM will be further described with reference to the UE 104.

[0065] In the implementations described herein, regarding the MR, the Tx/Rx module operates for NR signals/channels apart from signals/channels related to low-power wake-up, and regarding the LR, the Rx module operates for receiving/processing signals/channels related to low-power wake-up.

[0066] With the configuration for the enhanced RRM, the UE104 determines whether at least one of a trigger condition related to status of the UE 104 or a trigger condition related to the LP-WUS/WUR configured for the UE 104 is satisfied. In some implementations, the trigger condition related to status of the UE 104 (condition 1-1) may refer to low mobility or stationary criteria. Specifically, regarding the condition 1-1, if the UE 104 is in low mobility or stationary, a difference between a cell selection reception level value (S_{rxlev}) for the serving cell and an S_{rxlev} reference for the serving cell is less

than a threshold (i.e. first threshold) during a time window. In other words, low mobility or stationary criteria on the MR RRM measurement are fulfilled, i.e., $(S_{rxlevRef-mr} - S_{rxlev-mr}) < S_{SearchThresholdP-mr}$. The $S_{rxlev-mr}$ is a cell selection reception level value of the serving cell (dB) performed by the MR. The $S_{rxlevRef-mr}$ is a reference S_{rxlev} value of the serving cell (dB) performed by the MR. After selecting or reselecting a new cell, or if $(S_{rxlev-mr} - S_{rxlevRef-mr}) > 0$, or if the relaxed measurement criterion has not been met for $T_{SearchDeltaP-mr}$, the UE 104 shall set the value of $S_{rxlevRef}$ to the current S_{rxlev} value of the serving cell. The $S_{SearchThresholdP-mr}$ is the S_{rxlev} threshold (in dB) for relaxation on the MR serving cell measurement. The threshold of S_{rxlev} for low mobility and the threshold of S_{rxlev} for stationary criteria are (pre)-configured independently by the network.

[0067] Additionally or alternatively, regarding the condition 1-1, if the UE 104 is in low mobility or stationary, a difference between a cell selection quality value (S_{qual}) for the serving cell and an S_{qual} reference for the serving cell is less than a threshold (i.e. second threshold) during the time window, i.e., $S_{qualRef-mr} - S_{qual-mr} < S_{SearchThresholdQ-mr}$, if $S_{SearchThresholdQ-mr}$ is configured. The $S_{qual-mr}$ is a cell selection quality value of the serving cell (dB) performed by the MR. The $S_{qualRef-mr}$ is a reference $S_{qual-mr}$ value of the serving cell (dB) performed by the MR. The $S_{SearchThresholdQ-mr}$ is the S_{qual} threshold (in dB) for relaxation on the MR serving cell measurement. The threshold of S_{qual} for low mobility and the threshold of S_{qual} for stationary criteria are (pre)-configured independently by the network.

[0068] In some implementations, the trigger condition related to status of the UE 104 (condition 1-2) may refer to not-at-cell edge criteria. Specifically, regarding the condition 1-2, if the UE 104 is not at an edge of the serving cell, the S_{rxlev} is greater than the first threshold during the time window, i.e., $S_{rxlev-mr} > S_{SearchThresholdP-mr}$.

[0069] Additionally or alternatively, regarding condition 1-2, if the UE 104 is not at the edge of the serving cell, the S_{qual} for the serving cell is greater than the second threshold during the time window, i.e., $S_{qual-mr} > S_{SearchThresholdQ-mr}$, if $S_{SearchThresholdQ-mr}$ is configured.

[0070] In some implementations, there exists a condition 1-3 for triggering. Regarding the condition 1-3, both the low mobility or stationary criterial and not-at-cell

edge criteria on the MR measurement are fulfilled, i.e., the above condition 1-1 and condition 1-2 are fulfilled simultaneously.

[0071] It should be understood that the above low mobility criterial, stationary criterial, and not-at-cell-edge criterial defined for the trigger conditions related to UE state, i.e., first trigger conditions can be equated with or can be (pre-)configured independently with the low mobility criterial, stationary criterial, and not-at-cell-edge criterial defined for neighboring cell measurement relaxation conditions. Specifically, the thresholds for the above low mobility or stationary criterial and not at-cell-edge criterial of UE 104 are configured dependently or independently with the thresholds of low mobility or stationary criterial and not at-cell-edge criterial defined for neighboring cell measurement relaxation conditions, and the specific values can be (pre-)configured with the same values or different values.

[0072] In some implementations, the trigger condition related to the LP-WUS/WUR (conditions 2-1 and 2-2) may refer to the signal conditions of the LP-WUS. Regarding the conditions 2-1, the UE 104 is in the coverage of the LP-WUS during a time window. The UE 104 may determine the condition 2-1 based on the measured reference signal receiving power (RSRP) or reference signal receiving quality (RSRQ) of a reference signal from the serving cell on the LR, e.g., compared to an entry RSRP or RSRQ threshold in system information during a specified time window, for example, when the measured RSRP value or RSRQ value of a reference signal from the serving cell on the LR is higher than the (pre-)configured entry RSRP or RSRQ threshold during a time window, the UE 104 is considered to be within the coverage of LP-WUS. Regarding the conditions 2-2, a reference signal measurement value obtained by the LP-WUR reaches a threshold during the time window. For example, the measured RSRP or RSRQ of a reference signal from the serving cell on the LR satisfies a specific threshold during a time window. It should be understood that the threshold in condition 2-2 may be higher than the threshold in condition 2-1 used to define the LP-WUS coverage. The reference signal to measure for the LR can be e.g., a primary synchronization signal (PSS)/secondary synchronization signal (SSS)/physical broadcast channel (PBCH) demodulation reference signal (DMRS), LP WUS waveform sequence, low power-synchronization signal (LP-SS), etc.

[0073] Then, if the UE 104 determines that at least one of both the trigger conditions is satisfied, the UE 104 performs a relaxed RRM measurement for at least the serving cell on the MR, or RRM measurement offloading from the MR to the LP-WUR, or both.

[0074] By taking the conditions of both UE state and LP WUS/WUR into consideration, in the case of both conditions are configured, the UE 104 may determine to relax the serving cell measurement on the MR, or perform the RRM measurement offloading from the MR to the LR, e.g., offload the serving cell measurement only or offload both the serving cell and neighboring cell measurement when at least one of the UE state conditions (conditions 1-1, 1-2, and 1-3) and at least one of the LP WUS/WUR conditions (conditions 2-1 and 2-2) defined above are satisfied simultaneously, or when either one of the UE state conditions or one of the LP WUS/WUR conditions defined above are satisfied.

[0075] For example, when both the conditions 1-1 and 2-1 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When both the conditions 1-2 and 2-1 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When both the conditions 1-3 and 2-1 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When both the conditions 1-1 and 2-2 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When both the conditions 1-2 and 2-2 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When both the conditions 1-3 and 2-2 are fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When any of the conditions 1-1, 1-2, and 1-3 is fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein. When any of the conditions 2-1 and 2-2 is fulfilled during a specified time window, the UE 104 may perform the relaxed RRM measurement and/or the RRM measurement offloading described herein.

[0076] In addition to the MR serving cell measurement relaxation, legacy RRM relaxation conditions for the neighboring cell may still be applied. Since the neighboring cell measurement is triggered by the serving cell measurement results, if the serving cell measurement on the MR is relaxed, e.g., by X times, the neighboring cell measurement may also be relaxed. In other words, the UE may perform the relaxed RRM measurement for the neighboring cell after the relaxed RRM measurement is performed for the serving cell by a number of times.

[0077] Additionally, according to the above configured conditions, the UE 104 may have different statuses based on the different criterion as shown in Figs. 2 and 3, considering the different alternatives on UE measurement behaviors. In some examples, when the trigger conditions are satisfied, the specific measurement behaviors on relaxation or offloading depend on UE implementation. In other examples, the specific measurement behaviors of UE to be performed with different trigger conditions are (pre-)configured by the network.

[0078] For example, in the alternative 1, the MR may perform the RRM relaxation on the serving cell measurement, and the LR does not perform the RRM measurement. In the alternative 2: the MR may perform the neighboring cell measurement only and offload the serving cell measurement to the LR, and the LR performs the serving cell measurement. In the alternative 3: the MR does not perform the RRM measurements and may offload the RRM measurements to the LR, and the LR performs both the serving cell and neighboring cell measurements.

[0079] As shown in Fig. 2, the trigger conditions related to UE state are fulfilled outside the LP WUS coverage. In some implementations of Fig. 2, when the UE 104 (e.g., UE1) is in the coverage but does not satisfy the trigger conditions related to UE state, the MR may perform the serving cell and neighboring cell measurements as legacy. When the UE 104 (e.g., UE2) satisfies the trigger condition(s) related to UE state and is located outside the LP WUS coverage, the MR may perform the neighboring cell measurement relaxation as legacy.

[0080] In some implementations of Fig. 2, when the UE 104 (e.g., UE3) is located within the LP-WUS coverage, the MR may perform at least one of the serving cell measurement relaxation and neighboring cell measurement relaxation, and/or the RRM measurement offloading from the MR to the LR. As an implementation, if the UE 104 is

located within the coverage of the LP-WUS, the UE 104 may perform the relaxed RRM measurement for the serving cell and the neighboring cell on the MR. As another implementation, if the UE 104 is located within the coverage of the LP-WUS, the UE 104 may perform the RRM measurement offloading for at least one of the serving cell or neighboring cell from the MR to the LP-WUR.

[0081] As yet another implementation, if the UE 104 is located within the coverage of the LP-WUS, the UE 104 may offload the partial RRM measurement for at least one of the serving cell or neighboring cell to the LP-WUR. For example, if the UE 104 is located within the coverage of the LP-WUS, the UE 104 may relax a portion of the RRM measurement for at least one of the neighboring cell or serving cell on the MR, and may offload another portion of the RRM measurement to the LP-WUR.

[0082] As still yet another implementation, if the UE 104 is located within the coverage of the LP-WUS, the UE 104 may offload the entire RRM measurement for at least one of the serving cell or neighboring cell(s) to the LP-WUR.

[0083] In some implementations of Fig. 2, when the UE 104 (e.g., UE4) is located within the LP-WUS coverage with good quality, the MR may offload the serving cell measurement only or offload both the serving cell and neighboring cell measurements to the LR. As an implementation, if the reference signal measurement value i.e., RSRP or RSRQ obtained by the LP-WUR reaches the threshold (condition 2-2), the UE 104 may perform the RRM measurement offloading for only the serving cell. As another implementation, if the reference signal measurement value i.e., RSRP or RSRQ obtained by the LP-WUR reaches the threshold (condition 2-2), the UE 104 may perform the RRM measurement offloading for both the serving cell and neighboring cell.

[0084] As shown in Fig. 3, the trigger condition(s) related to UE state is within the LP WUS coverage. In some implementations of Fig. 3, when the UE 104 (e.g., UE1) is within the cell coverage but outside the LP-WUS coverage, the MR may perform the serving cell and neighboring cell measurements as legacy. When the UE 104 (e.g., UE2) is within the LP WUS coverage but does not satisfy the trigger condition(s) related to UE state, the MR may perform the serving cell and neighboring cell measurements as legacy.

[0085] In some implementations of Fig. 3, when the UE 104 (e.g., UE3) is within the LP-WUS coverage and satisfies at least one of the trigger conditions related to UE state, the MR may perform at least one of the serving cell measurement relaxation and

neighboring cell measurement relaxation, and/or the RRM measurement from the MR to the LR. As an implementation, if the UE 104 is located within the coverage of the LP-WUS and satisfies the trigger condition(s) related to UE state on the MR, the UE 104 may perform the relaxed RRM measurement for the serving cell and neighboring cell on the MR.

[0086] As another implementation, if the UE 104 is located within the coverage of the LP-WUS and satisfies at least one of the trigger conditions related to UE state on the MR, the UE 104 may perform the RRM measurement offloading for at least one of the serving cell or neighboring cell(s) from the MR to the LP-WUR.

[0087] As yet another implementation, if the UE 104 is located within the coverage of the LP-WUS and satisfies at least one of the trigger conditions related to UE state on the MR, the UE 104 may offload the partial RRM measurement for at least one of the serving cell or neighboring cell(s) to the LP-WUR. For example, if the UE 104 is located within the coverage of the LP-WUS and satisfies the trigger condition(s) related to UE state on the MR, the UE 104 may relax a portion of the RRM measurement for at least one of the neighboring cell or the serving cell on the MR, and may offload another portion of the RRM measurement to the LP-WUR.

[0088] As still yet another implementation, if the UE 104 is located within the coverage of the LP-WUS and satisfies the trigger condition(s) related to UE state on the MR, the UE 104 may offload the entire RRM measurement for at least one of the serving cell or neighboring cell to the LP-WUR.

[0089] In some implementations of Fig. 3, when the UE 104 (e.g., UE4) is located within the LP-WUS coverage with good quality, the MR may offload the serving cell measurement only or offload both the serving cell and neighboring cell measurements to the LR. As an implementation, if the reference signal measurement value i.e., RSRP or RSRQ obtained by the LP-WUR reaches the threshold (condition 2-2), the UE 104 may perform the RRM measurement offloading for only the serving cell. As another implementation, if the reference signal measurement value i.e., RSRP or RSRQ obtained by the LP-WUR reaches the threshold (condition 2-2), the UE 104 may perform the RRM measurement offloading for both the serving cell and neighboring cell(s).

[0090] In some implementations, the UE 104 may determine whether to perform the MR serving cell measurement relaxation based on UE state conditions firstly, e.g.,

whether the UE 104 satisfies the conditions 1-1, 1-2, or 1-3 defined above or not. If at least one of UE state conditions is satisfied, the UE 104 may determine to perform the MR serving cell measurement relaxation, and determine whether to offload the serving cell measurement or neighboring cell measurements to the LR, depending on the measurement quality of LR. More details in these implementations will be described with reference to Fig. 4.

[0091] As shown in Fig. 4, in addition to the cell coverage, there may be two condition converges for cell measurement relaxation, i.e., a condition coverage defined by the MR neighboring cell measurement relaxation condition(s), and a condition coverage defined by the MR serving cell measurement relaxation condition(s). The condition coverage defined by the MR neighboring cell measurement relaxation condition(s) is equal to or more lenient than the condition coverage defined by the MR serving cell measurement relaxation condition(s).

[0092] In some implementations of Fig. 4, when the UE 104 (e.g., UE1) does not satisfy at least one of neighboring cell measurement relaxation conditions defined as legacy, the UE 104 may perform the RRM measurements as legacy.

[0093] In some implementations of Fig. 4, when the UE 104 (e.g., UE2) does satisfy the legacy neighboring cell measurement relaxation condition(s), the MR may perform the neighboring cell measurement relaxation, and then the UE 104 (e.g., UE2) may determine whether at least one of LP WUS/WUR conditions, i.e., conditions 2-1 or 2-2, is satisfied. If the at least one of LP WUS/WUR conditions is satisfied, the MR may offload the neighboring cell measurement to the LR. As an implementation, if the neighboring cell measurement relaxation condition(s) on the MR and the trigger condition(s) related to the LP WUS/WUR are satisfied, the UE 104 may perform the RRM measurement offloading for the neighboring cell.

[0094] In some implementations of Fig. 4, when the UE 104 (e.g., UE3) does satisfy the MR serving cell measurement relaxation condition(s), the MR may perform the serving cell measurement relaxation. The MR serving cell measurement relaxation condition(s) may refer to the UE state conditions defined above, i.e., at least one of conditions 1-1, 1-2 or 1-3 is satisfied. It is to be understood that for the MR serving cell measurement relaxation and neighboring cell measurement relaxation conditions related to UE state, i.e., low mobility or stationary criterion or not-at-cell edge criterion, the

thresholds are (pre-)configured by the NW dependently or independently, with the same or different values. Then, the UE 104 may further determine whether at least one of LP WUS/WUR conditions, i.e., conditions 2-1 or 2-2, is satisfied. If the at least one of LP WUS/WUR conditions is satisfied, the MR may offload the serving cell measurement to the LR.

[0095] As an implementation, if the trigger condition(s) related to the status of UE 104 is satisfied, the UE 104 may perform the relaxed RRM measurement for the serving cell. As another implementation, if the trigger condition(s) related to the status of UE 104 and the trigger condition(s) related to LP WUS/WUR are satisfied, the UE 104 may perform the RRM measurement offloading for the serving cell.

[0096] In some implementations, a fallback mechanism for the RRM relaxation or RRM measurement offloading from the MR to the LR is provided. For example, the UE 104 may perform the MR measurement relaxation or measurement offloading with necessary condition(s) as defined for power saving purpose. However, considering the relaxed measurement or LR measurement may still have loss on accuracy to some extent, the fallback mechanism needs to be considered to make the UE 104 stop the RRM measurement relaxation or offloading and fallback to the legacy measurement mechanism so as to guarantee mobility performances.

[0097] When at least one of the following conditions are satisfied, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement, i.e., the MR may fallback to perform the serving cell measurement or to perform both the serving cell and neighboring cell measurements. In other words, the UE 104 may stop the relaxed RRM measurement or the RRM measurement offloading from the MR to the LR based on certain trigger condition(s).

[0098] As some implementations, the trigger condition for fallback mechanism may refer to the condition that a reference signal measurement value of the serving cell measured by the LP-WUR satisfies certain threshold during a time window. In these implementations, when the measured RSRP or RSRQ value of the reference signal from the serving cell by the LR does satisfy an exit RSRP threshold during a specified time window, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement. The reference signal to measure for the LR can be e.g., PSS/SSS/PBCH DMRS, LP WUS waveform sequence, LP-SS, etc. The LR

may stop to perform the serving cell measurement only, or stop to perform both the serving cell and neighboring cell measurements based on different exit thresholds here. As an example, when the LR measurement result(s) does satisfy a first exist threshold during a time window, the LR may stop to perform the serving cell measurement. As another example, when the LR measurement result(s) does satisfy a second exist threshold during a time window, e.g., when the UE 104 moves out of the LP WUS coverage, LR may stop to perform both the serving cell and neighboring cell measurements.

[0099] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that the UE 104 stops an operation related to the LP-WUS. In this implementation, when the UE 104 stops the LP-WUS operation, e.g., the UE 104 turns off its LP WUR, or the UE 104 stops the LP-WUS monitoring, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement.

[0100] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that the LP-WUR detects a wake-up signal for the MR. In this implementation, when the LR detects the wake-up indication for the MR, i.e., when the LR detects the wake-up signal and then the MR wakes up, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement.

[0101] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that the UE 104 is to perform uplink data transmission. In this implementation, when the UE 104 has UL data transmission, i.e., UL data arrival, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement.

[0102] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that a low mobility or stationary criterion of the UE 104 is not satisfied for the relaxed RRM measurement or the RRM measurement offloading. In this implementation, when the UE 104 determines that the stationary condition is not satisfied by the relaxed measurement results of serving cell on the MR or by the offloaded measurement results of serving cell on the LR, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement.

[0103] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that a not-at-cell-edge criterion of the UE 104 is not satisfied

for the relaxed RRM measurement or the RRM measurement offloading. In this implementation, when the UE 104 determines that the not-at-cell-edge condition(s) is not satisfied by the relaxed measurement results of serving cell on the MR or by the offloaded measurement results of serving cell on the LR, the UE 104 may stop the RRM measurement relaxation or offloading and fallback to the legacy RRM measurement.

[0104] Additionally or alternatively, the trigger condition for fallback mechanism may refer to the condition that cell (re)selection is triggered based on the relaxed measurement(s).

[0105] In the case that the MR performs RRM measurement relaxation on the serving cell, the UE 104 may determine the above fallback conditions on low mobility or stationary criterion, and not-at-cell-edge criterion are not fulfilled by detecting the relaxed measurement results, i.e., the RSRQ or RSRP value of serving cell on the MR. In the case that the serving cell measurement is offloaded from the MR to the LR, the UE 104 may determine the above fallback conditions on low mobility or stationary criterion, and not-at-cell-edge criterion are not fulfilled by detecting the offloaded measurement results, i.e., the RSRQ or RSRP value of serving cell on the LR. Specifically, additional offset can be (pre-)configured to the LR measurement results on the serving cell or neighboring cells to compensate potential loss of accuracy of the LR measurement.

[0106] In some implementations, to ensure the mobility performances, a period may be (pre-)configured for the UE 104 to perform the RRM measurement relaxation on the MR or the RRM measurement offloading from the MR to the LR. Specifically, for the relaxation case, the MR may be triggered to perform the RRM measurement relaxation on the serving cell during a (pre-)configured first time period, and the UE 104 may stop the relaxation and fallback to the legacy RRM measurement(s) when the first time period expires, until the defined trigger conditions is satisfied. As an implementation, the UE 104 may stop the relaxed RRM measurement at expiration of the first time period during which the relaxed RRM measurement on the MR is performed for the serving cell.

[0107] More specifically, for the offloading case, the LR may be triggered to perform the offloaded measurement (the serving cell measurement or the serving cell and neighboring cell measurements) during a (pre-)configured second time period, and the UE 104 may fall back to the MR measurement when the second time period expires, until the defined trigger conditions is satisfied. As an implementation, the UE 104 may stop the

RRM measurement offloading at expiration of the second time period during which the RRM measurement offloaded to the LP-WUR is performed for the serving cell or both the serving cell and neighboring cell.

[0108] In some implementations, as mentioned above, the LR may perform the relaxed measurement(s) when the MR relaxation is triggered. When the LP WUS/WUR is (pre-)configured, the UE 104 may work on different modes, i.e., continuous monitoring or duty-cycle monitoring, since anyway the LR needs to monitor the LP-WUS with configured cycles. When the MR is relaxed with certain conditions, the LR may perform the relaxed measurement(s) during a MR relaxation time duration so as to ensure better mobility performances. The relaxed measurement may include both the serving cell and neighboring cell measurements.

[0109] For continuous monitoring, i.e., the LP-WUR is ON all the time, the MR may perform RRM relaxation on at least one of the serving cell and neighboring cell(s) when the defined trigger condition(s) is satisfied, and the LR may perform the corresponding relaxed measurement(s) during the MR relaxation time. In other words, in case of continuous monitoring, the UE 104 may perform the offloaded relaxed RRM measurement on the LP-WUR during the time period that the relaxed RRM measurement on the MR is performed.

[0110] For duty-cycle monitoring, i.e., the LP-WUR switches between ON/OFF states, the UE 104 may perform at least one of the serving cell measurement and neighboring cell measurement by the LR during the LR monitoring cycle, while stopping the MR measurement on at least one of the serving cell and neighboring cell during the cycle. In other words, in case of duty-cycle monitoring, the UE 104 may perform the offloaded relaxed RRM measurement on the LP-WUR during a LP-WUS monitoring cycle while stopping the RRM measurement on the MR during the LP-WUS monitoring cycle.

[0111] With the trigger conditions described above, the RRM relaxation on the MR for the serving cell measurement can be supported, and the RRM measurement(s) can be offloaded from the MR to the LP-WUR when certain trigger condition(s) is satisfied. Both the serving cell and neighboring cell measurements may be considered. The trigger conditions for the UE MR to perform the serving cell measurement relaxation or offloading can take both UE state and LP WUS/WUR conditions into account. In addition,

the fallback mechanism for the RRM relaxation or RRM measurement offloaded from the MR to the LR is provided to guarantee the mobility performances. Further, the partial offloading implementations with corresponding UE behaviors are provided for the better RRM.

[0112] Fig. 5 illustrates an example of a device 500 that enhances RRM in accordance with aspects of the present disclosure. The device 500 may be an example of a UE 104 as described herein. The device 500 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 500 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 502, a memory 504, a transceiver 506, and, optionally, an I/O controller 508. These components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0113] The processor 502, the memory 504, the transceiver 506, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 502, the memory 504, the transceiver 506, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0114] In some implementations, the processor 502, the memory 504, the transceiver 506, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 502 and the memory 504 coupled with the processor 502 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 502, instructions stored in the memory 504).

[0115] For example, the processor 502 may support wireless communication at the device 500 in accordance with examples as disclosed herein. The processor 502 may be configured to operable to support a means for determining whether at least one of a first

trigger condition related to status of the UE or a second trigger condition related to a LP-WUS configured for the UE is satisfied; and a means for performing, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to an LP-WUR.

[0116] The processor 502 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 502 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 502. The processor 502 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 504) to cause the device 500 to perform various functions of the present disclosure.

[0117] The memory 504 may include random access memory (RAM) and read-only memory (ROM). The memory 504 may store computer-readable, computer-executable code including instructions that, when executed by the processor 502 cause the device 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 502 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 504 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0118] The I/O controller 508 may manage input and output signals for the device 500. The I/O controller 508 may also manage peripherals not integrated into the device 500. In some implementations, the I/O controller 508 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 508 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 508 may be implemented as part of a processor, such as the processor 506. In some implementations, a user may interact with the device 500

via the I/O controller 508 or via hardware components controlled by the I/O controller 508.

[0119] In some implementations, the device 500 may include a single antenna 510. However, in some other implementations, the device 500 may have more than one antenna 510 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 506 may communicate bi-directionally, via the one or more antennas 510, wired, or wireless links as described herein. For example, the transceiver 506 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 506 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 510 for transmission, and to demodulate packets received from the one or more antennas 510. The transceiver 506 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0120] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 510 for transmitting the amplified signal into the air or wireless medium.

[0121] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 510 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain

may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0122] Fig. 6 illustrates an example of a processor 600 that enhances RRM in accordance with aspects of the present disclosure. The processor 600 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 600 may include a controller 602 configured to perform various operations in accordance with examples as described herein. The processor 600 may optionally include at least one memory 604, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 600 may optionally include one or more arithmetic-logic units (ALUs) 606. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0123] The processor 600 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 600) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0124] The controller 602 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 600 to cause the processor 600 to support various operations in accordance with examples as described herein. For example, the controller 602 may operate as a control unit of the processor 600, generating control signals that manage the operation of various components of the processor 600. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0125] The controller 602 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 604 and determine subsequent instruction(s) to be executed to cause the processor 600 to support various operations in accordance with examples as described herein. The controller 602 may be configured to track memory address of instructions associated with the memory 604. The controller 602 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 602 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 600 to cause the processor 600 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 602 may be configured to manage flow of data within the processor 600. The controller 602 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 600.

[0126] The memory 604 may include one or more caches (e.g., memory local to or included in the processor 600 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 604 may reside within or on a processor chipset (e.g., local to the processor 600). In some other implementations, the memory 604 may reside external to the processor chipset (e.g., remote to the processor 600).

[0127] The memory 604 may store computer-readable, computer-executable code including instructions that, when executed by the processor 600, cause the processor 600 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 602 and/or the processor 600 may be configured to execute computer-readable instructions stored in the memory 604 to cause the processor 600 to perform various functions. For example, the processor 600 and/or the controller 602 may be coupled with or to the memory 604, the processor 600, the controller 602, and the memory 604 may be configured to perform various functions described herein. In some examples, the processor 600 may include multiple processors and the memory 604 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0128] The one or more ALUs 606 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 606 may reside within or on a processor chipset (e.g., the processor 600). In some other implementations, the one or more ALUs 606 may reside external to the processor chipset (e.g., the processor 600). One or more ALUs 606 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 606 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 606 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 606 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 606 to handle conditional operations, comparisons, and bitwise operations.

[0129] The processor 600 may support wireless communication in accordance with examples as disclosed herein. The processor 600 may be configured to operable to support a means for determining whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a LP-WUS configured for the UE is satisfied; and a means for performing, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to an LP-WUR.

[0130] Fig. 7 illustrates a flowchart of a method 700 that enhances RRM in accordance with aspects of the present disclosure. The operations of the method 700 may be implemented by a device or its components as described herein. For example, the operations of the method 700 may be performed by the UE 104 as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0131] At 710, the method may include determining whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to an LP-WUS configured for the UE is satisfied. The operations of 710 may be performed in

accordance with examples as described herein. In some implementations, aspects of the operations of 710 may be performed by a device as described with reference to Fig. 1.

[0132] At 720, the method may include performing, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed RRM measurement for at least a serving cell on an MR or (ii) RRM measurement offloading from the MR to an LP-WUR. The operations of 720 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 720 may be performed by a device as described with reference to Fig. 1.

[0133] It shall be noted that implementations of the present disclosure which have been described with reference to Figs. 1 to 4 are also applicable to the device 500, the processor 600 and the method 700.

[0134] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0135] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[0136] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using

software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0137] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[0138] As used herein, including in the claims, an article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based on” shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

[0139] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the

disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

WHAT IS CLAIMED IS:

1. A user equipment (UE), comprising:
 - at least one memory; and
 - at least one processor coupled with the at least one memory and configured to cause the UE to:
 - determine whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a low power-wake up signal (LP-WUS) configured for the UE is satisfied; and
 - perform, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed radio resource management (RRM) measurement for at least a serving cell on a main radio (MR) or (ii) RRM measurement offloading from the MR to a low power-wake up receiver (LP-WUR).
2. The UE of claim 1, wherein the first trigger condition includes one of the following:
 - in the case that the UE is in low mobility or stationary, a difference between a cell selection reception level value (Srxlev) for the serving cell and an Srxlev reference for the serving cell is less than a first threshold during a time window;
 - in the case that the UE is in low mobility or stationary, a difference between a cell selection quality value (Squal) for the serving cell and an Squal reference for the serving cell is less than a second threshold during the time window;
 - in the case that the UE is not at an edge of the serving cell, the Srxlev is greater than the first threshold during the time window;
 - in the case that the UE is not at the edge of the serving cell, the Squal for the serving cell is greater than the second threshold during the time window; or
 - any combination of thereof.
3. The UE of claim 1 or 2, wherein the second trigger condition includes at least one of the following:
 - the UE is in coverage of the LP-WUS during a time window; or
 - a reference signal measurement obtained by the LP-WUR reaches a third threshold during the time window.

4. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the UE is located within the coverage of the LP-WUS, performing the relaxed RRM measurement for the serving cell and a neighboring cell on the MR.

5. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the UE is located within the coverage of the LP-WUS, performing the RRM measurement offloading for at least the serving cell from the MR to the LP-WUR.

6. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the UE is located within the coverage of the LP-WUS, relaxing a portion of a RRM measurement for at least one of a neighboring cell or the serving cell on the MR; and

offloading another portion of the RRM measurement to the LP-WUR.

7. The UE of any of claims 4-6, wherein the at least one of the relaxed RRM measurement or the RRM measurement offloading is performed in a case of satisfying the first trigger condition on the MR.

8. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the reference signal measurement obtained by the LP-WUR reaches the third threshold, performing the RRM measurement offloading for only the serving cell.

9. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the reference signal measurement obtained by the LP-WUR reaches the third threshold, performing the RRM measurement offloading for both the serving cell and a neighboring cell.

10. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that a neighboring cell measurement relaxation condition on the MR and the second trigger condition are satisfied, performing the RRM measurement offloading for a neighboring cell.

11. The UE of claim 2, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the first trigger condition is satisfied, performing the relaxed RRM measurement for the serving cell.

12. The UE of claim 3, wherein the UE is caused to perform at least one of the relaxed RRM measurement or the RRM measurement offloading by:

in the case that the first and second trigger conditions are satisfied, performing the RRM measurement offloading for the serving cell.

13. The UE of claim 1, wherein the UE is further caused to:

stop the relaxed RRM measurement or the RRM measurement offloading based on a third trigger condition.

14. The UE of claim 13, wherein the third trigger condition includes at least one of the following:

the UE moves out of a coverage of the LP-WUS;

a target reference signal measured from the serving cell by the LP-WUR satisfies a fourth threshold during a time window;

the UE stops an operation related to the LP-WUS;

the LP-WUR detects a wake-up signal for the MR;

the UE is to perform uplink data transmission;

a low mobility or stationary condition of the UE is not satisfied for the relaxed RRM measurement or the RRM measurement offloading; or

a not-at-cell-edge condition of the UE is not satisfied for the relaxed RRM measurement or the RRM measurement offloading.

15. The UE of claim 1, wherein the UE is further caused to:

stop the relaxed RRM measurement at expiration of a first time period during which the relaxed RRM measurement on the MR is performed for the serving cell.

16. The UE of claim 1, wherein the UE is further caused to:

stop the RRM measurement offloading at expiration of a second time period during which the RRM measurement offloaded to the LP-WUR is performed for the serving cell or both the serving cell and a neighboring cell.

17. The UE of claim 6, wherein the UE is caused to relax a portion of the RRM measurement on the MR and offload another portion of the RRM measurement to the LP-WUR by:

in case of continuous monitoring, performing the offloaded RRM measurement on the LP-WUR during the time period that the relaxed RRM measurement on the MR is performed.

18. The UE of claim 6, wherein the UE is caused to relax a portion of the RRM measurement on the MR and offload another portion of the RRM measurement to the LP-WUR by:

in case of duty-cycle monitoring, performing the offloaded RRM measurement on the LP-WUR during a LP-WUS monitoring cycle while relaxing the portion of the RRM measurement on the MR during the LP-WUS monitoring cycle.

19. A processor for wireless communication, comprising:

at least one memory; and

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

determine whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a low power-wake up signal (LP-WUS) configured for the UE is satisfied; and

perform, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed radio resource management (RRM) measurement for at least a serving cell on a main radio (MR) or (ii) RRM measurement offloading from the MR to a low power-wake up receiver (LP-WUR).

20. A method performed by a user equipment, the method comprising:
- determining whether at least one of a first trigger condition related to status of the UE or a second trigger condition related to a low power-wake up signal (LP-WUS) configured for the UE is satisfied; and
 - performing, based on determining that at least one of the first trigger condition or the second trigger condition is satisfied, at least one of (i) a relaxed radio resource management (RRM) measurement for at least a serving cell on a main radio (MR) or (ii) RRM measurement offloading from the MR to a low power-wake up receiver (LP-WUR).