

CONFLICT MITIGATION IN NEAR-RT RIC

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to apparatuses, methods, and computer readable medium for conflict mitigation in a near real
5 time (Near-RT) radio access network (RAN) intelligent controller (RIC).

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
10 communication devices, such as a base station may support wireless communications for one or multiple user communication devices, which may be otherwise known as user equipment (UE), or other suitable terminology. The wireless communications system may support wireless communications with one or multiple user communication devices by utilizing resources of the wireless communication system (e.g., time resources (e.g., symbols, slots,
15 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
20 generation (6G)).

[0003] An open radio access network (O-RAN) is an open and smart RAN with the following concepts: openness to build a more cost effective and agile RAN through open interfaces, open hardware and open source, and intelligence to meet the requirements for increasing complex, denser and richer networks through deep learning techniques and
25 embedded intelligence in every layer of the RAN architecture. The Near-RT RIC may support multiple functionalities, however how to address conflicting interactions between different xApps is still needed to be studied.

SUMMARY

[0004] The present disclosure relates to methods, apparatuses, processors, and computer
30 readable medium for conflict mitigation in a Near-RT RIC. According to the proposed

solution, the conflict mitigation may be achieved by providing one or more suggestions to an xApp.

[0005] In some implementations, there is provided a first apparatus of a Near-RT RIC. The first apparatus comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the first apparatus to: receive, from a second apparatus, first information for conflict mitigation associated with at least one xApp; determine one or more suggestions for the at least one xApp, the one or more suggestions being used for eliminating conflict among a plurality of xApps comprising the at least one xApp; and transmit, to the second apparatus, second information comprising the one or more suggestions.

[0006] In some implementations, there is provided a Near-RT RIC platform. The Near-RT RIC platform comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the Near-RT RIC platform to: receive, from a specific xApp dedicated to conflict mitigation, a registration request comprising one of: information about at least one E2 service model (E2SM) function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp, information about at least one application programming interface (API) required by the specific xApp, or description information of the specific xApp; and transmit, to the specific xApp, a registration response indicating that a registration of the specific xApp is successful or failed.

[0007] In some implementations, there is provided an xApp of a Near-RT RIC. The xApp comprises at least one memory; and at least one processor coupled with the at least one memory and configured to cause the xApp to: transmit, to a first apparatus, first information for conflict mitigation, the first information comprises information about an E2SM related RAN function that the xApp determines to perform on an E2 node; and receive, from the first apparatus, second information comprising one or suggestions for modifying or cancelling the E2SM related RAN function.

[0008] In some implementations, there is provided a method performed by the first apparatus of a Near-RT RIC. The method comprises: receiving, from a second apparatus, first information for conflict mitigation associated with at least one xApp; determining one or more suggestions for the at least one xApp, the one or more suggestions being used for eliminating conflict among a plurality of xApps comprising the at least one xApp; and transmitting, to the second apparatus, second information comprising the one or more

suggestions.

[0009] In some implementations, there is provided a method performed by the Near-RT RIC platform. The method comprises: receiving, from a specific xApp dedicated to conflict mitigation, a registration request comprising one of: information about at least one E2SM function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp, information about at least one API required by the specific xApp, or description information of the specific xApp; and transmitting, to the specific xApp, a registration response indicating that a registration of the specific xApp is successful or failed.

[0010] In some implementations, there is provided a method performed by the xApp of a Near-RT RIC. The method comprises: transmitting, to a first apparatus, first information for conflict mitigation, the first information comprises information about an E2SM related RAN function that the xApp determines to perform on an E2 node; and receiving, from the first apparatus, second information comprising one or suggestions for modifying or cancelling the E2SM related RAN function.

[0011] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a second apparatus, first information for conflict mitigation associated with at least one xApp; determine one or more suggestions for the at least one xApp, the one or more suggestions being used for eliminating conflict among a plurality of xApps comprising the at least one xApp; and transmit, to the second apparatus, second information comprising the one or more suggestions.

[0012] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: receive, from a specific xApp dedicated to conflict mitigation, a registration request comprising one of: information about at least one E2SM function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp, information about at least one API required by the specific xApp, or description information of the specific xApp; and transmit, to the specific xApp, a registration response indicating that a registration of the specific xApp is successful or failed.

[0013] In some implementations, there is provided a processor for wireless communication. The processor comprises at least one controller coupled with at least one memory and configured to cause the processor to: transmit, to a first apparatus, first information for

conflict mitigation, the first information comprises information about an E2SM related RAN function that the xApp determines to perform on an E2 node; and receive, from the first apparatus, second information comprising one or suggestions for modifying or cancelling the E2SM related RAN function.

5 [0014] In some implementations of the methods and the first apparatus described herein, the first apparatus comprises a specific xApp dedicated to conflict mitigation, and further comprising: transmitting, to a Near-RT RIC platform, a registration request comprising one of: information about at least one E2 service model (E2SM) function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp, information about at
10 least one application programming interface (API) required by the specific xApp, or description information of the specific xApp; and receiving, from the Near-RT RIC platform, a registration response indicating that a registration of the specific xApp is successful or failed.

[0015] In some implementations of the methods and the first apparatus described herein,
15 the first apparatus comprises a Near-RT RIC platform, the second apparatus comprises the at least one xApp or an E2 node, and further comprising: transmitting, to the second apparatus, a measurement request for a measurement report from the E2 node, and wherein the first information is a performance measurement result.

[0016] In some implementations of the methods and the Near-RT RIC platform described
20 herein, further comprising: receiving, from at least one xApp, an E2 control request or an E2 guidance request comprising information about an E2SM related RAN function that the at least one xApp determines to perform on an E2 node; transmitting, to the specific xApp, a conflict mitigation request comprising the information about the E2SM related RAN function that the at least one xApp determines to perform on the E2 node; receiving, from the specific
25 xApp, a conflict mitigation response comprising one or more suggestions for the at least one xApp; and transmitting, to the at least one xApp, an E2 control response or an E2 guidance response comprising the one or more suggestions.

[0017] In some implementations of the methods and the Near-RT RIC platform described herein, further comprising: receiving, from at least one xApp, an API discovery request
30 comprising an identifier of the specific xApp; and transmitting, to the at least one xApp, an API discovery response comprising API information about a specific API dedicated to conflict mitigation.

[0018] In some implementations of the methods and the Near-RT RIC platform described herein, further comprising: receiving, from an E2 node, a performance measurement result associated with the at least one xApp; determining updated suggestions for the at least one xApp based on the performance measurement result; and transmitting, to the at least one
5 xApp, the updated suggestions.

[0019] In some implementations of the methods and the xApp described herein, further comprising: transmitting, to a Near-RT RIC platform, an application programming interface (API) discovery request comprising an identifier of a specific xApp; and receiving, from the Near-RT RIC platform, an API discovery response comprising API information about a
10 specific API dedicated to conflict mitigation .

[0020] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the information about the at least one API comprises one of: at least one name of the at least one API, or at least one version of the at least one API.

[0021] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the description information of the specific xApp comprises one of: a name of the specific xApp, a vendor of the specific xApp, or a purpose of the specific xApp.

[0022] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the registration response comprises one of: an identifier of the specific xApp assigned by the Near-RT RIC platform, or a cause value indicating a failure cause of the registration, wherein the failure cause comprises the at least one E2SM function or the at least one API required by the specific xApp is not supported by the Near-RT RIC platform.

[0023] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the first apparatus comprises a specific xApp dedicated to conflict mitigation, the second apparatus comprises a Near-RT RIC platform or the at least one xApp, wherein the first information is a conflict mitigation request comprising information about an E2SM related RAN function that the at least one xApp determines to
25 perform on an E2 node, and wherein the second information is a conflict mitigation response comprising the one or more suggestions.

[0024] In some implementations of the methods, the first apparatus, the Near-RT RIC

platform, and the xApp described herein, the second apparatus comprises the at least one xApp, and wherein the first information and the second information are transmitted by using a specific API dedicated to conflict mitigation or via the Near-RT RIC platform.

5 [0025] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the measurement request indicates one of a plurality of measurement types, wherein the plurality of measurement types comprise: a first type indicating requesting measurement result for a specific user equipment (UE), a second type indicating requesting measurement result for a plurality of UEs, or a third type indicating requesting measurement result for all UEs.

10 [0026] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the one or more suggestions comprise one of: an indication indicating whether an E2SM related RAN function that the at least one xApp determines to perform results in a conflict with one or more further xApps, one or more identifiers of the one or more further xApps, or one or more recommendations for modifying
15 the E2SM related RAN function.

[0027] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the one or more recommendations comprise: a plurality of guidance instances with different priorities or execution orders.

20 [0028] In some implementations of the methods, the first apparatus, the Near-RT RIC platform, and the xApp described herein, the API information about a specific API dedicated to conflict mitigation comprises one of: name of the specific API, identifier of the specific API assigned by the Near-RT RIC platform, API type of the specific API, description information of the specific API, or API profiles of the specific API.

BRIEF DESCRIPTION OF THE DRAWINGS

25 [0029] FIG. 1 illustrates an example of a wireless communications system in which some embodiments of the present disclosure can be implemented;

[0030] FIG. 2 illustrates a schematic diagram of an example communication network in which some embodiments of the present disclosure can be implemented;

30 [0031] FIG. 3 illustrates a signalling chart illustrating communication process in accordance with some example embodiments of the present disclosure;

[0032] FIG. 4 illustrates a signalling chart illustrating communication process for

determining suggestions in accordance with some example embodiments of the present disclosure;

[0033] FIG. 5 illustrates a signalling chart illustrating communication process for determining suggestions in accordance with some example embodiments of the present disclosure;

[0034] FIG. 6 illustrates an example of a device that is suitable for implementing embodiments of the present disclosure;

[0035] FIG. 7 illustrates an example of a processor that is suitable for implementing some embodiments of the present disclosure;

[0036] FIG. 8 illustrates a flowchart of an example method implemented at a first apparatus in accordance with aspects of the present disclosure;

[0037] FIG. 9 illustrates a flowchart of an example method implemented at a Near-RT RIC platform in accordance with aspects of the present disclosure; and

[0038] FIG. 10 illustrates a flowchart of an example method implemented at an xApp in accordance with aspects of the present disclosure.

[0039] Throughout the drawings, the same or similar reference numerals represent the same or similar element.

DETAILED DESCRIPTION

[0040] 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 can be implemented in various manners other than the ones described below. 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.

[0041] 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.

[0042] 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.

[0043] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of 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, components and/or the like, 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 embodiment” and “an embodiment” are to be read as “at least one embodiment.” The term “another embodiment” is to be read as “at least one other embodiment.” The 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.

[0044] FIG. 1 illustrates an example of a wireless communications system 100 in which some embodiments of the present disclosure can be implemented. The wireless communications system 100 may include one or more network entities 102 (also referred to as network equipment (NE)), one or more 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 a long term evolution (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 a new radio (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.

[0045] The one or more 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, a network element, a radio access network (RAN), 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.

[0046] 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, message, 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.

[0047] 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.

[0048] 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.

[0049] 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 (SL). For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0050] 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, N3, 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
5 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).

10 **[0051]** 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 RAN (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
15 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.

[0052] An RU may also be referred to as a radio head, a smart radio head, a remote radio
20 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
25 virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0053] 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
30 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 adaption 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.

[0054] 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).

[0055] 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.

[0056] 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.

[0057] 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, N3, 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
5 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
10 more network functions of the core network 106).

[0058] 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
15 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
20 104 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.

[0059] 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
25 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
30 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.

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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.

[0064] For the purposes of the present document, some terms and definitions are provided below.

[0065] Non-Real-Time RAN Intelligent Controller: A functionality within service management and orchestration (SMO) that drives the content carried across the A1 interface. It is comprised of the Non-RT RIC Framework and the Non-RT RIC Applications (rApps) whose services are defined below.

[0066] Near-Real-Time RAN Intelligent Controller: An O-RAN network function (NF) that enables near-real-time control and optimization of RAN elements and resources via fine-grained data collection and actions over E2 interface. It may include AI/ML (artificial intelligence / machine learning) workflow including model training, inference and updates.

[0067] E2 Node: A logical node terminating E2 interface. Examples are:

[0068] O-CU-CP: O-RAN Central Unit – Control Plane: a logical node hosting the RRC and the control plane part of the PDCP (packet data convergence protocol) protocol.

[0069] O-CU-UP: O-RAN Central Unit – User Plane: a logical node hosting the user plane part of the PDCP protocol and the SDAP protocol.

[0070] O-DU: O-RAN Distributed Unit: a logical node hosting RLC (radio link control), MAC (medium access protocol) and High-PHY (physical) layers based on a lower layer functional split.

[0071] A1: An interface between the Non-RT RIC in SMO and the Near-RT RIC function O-RAN NF.

[0072] E2: An interface connecting Near-RT RIC and E2 node.

[0073] O1: Interface between SMO framework and O-RAN managed elements, for operation and management, by which FCAPS (fault, configuration, accounting, performance and security) management, PNF (physical network function) software management, File management shall be achieved.

[0074] Y1: An interface over which RAN analytics services are exposed by the Near-RT RIC to be consumed by Y1 consumers.

[0075] Y1 consumers: A role played by entities within or outside of the PLMN trust domain that consumes the Y1 services produced by the Near-RT RIC.

[0076] xApp: An application designed to run on the Near-RT RIC. Such an application is likely to consist of one or more microservices and at the point of on-boarding will identify which data it consumes and which data it provides. The application is independent of the Near-RT RIC and may be provided by any third party. The E2 enables a direct association between the xApp and the RAN functionality.

[0077] FIG. 2 illustrates a schematic diagram of an example communication network 200 in which some embodiments of the present disclosure can be implemented. The network 200 may include a service management and orchestration 210, Y1 consumers 220, a Near-RT RIC 230, and E2 node(s) 240.

[0078] In O-RAN, the radio resource management function is typically located at the Near-RT RIC 230, where the Near-RT RIC 230 is composed of a Near-RT RIC platform 232 and one or more xApps 234-1 through 234-N.

[0079] The Near-RT RIC 230 may support multiple functionalities, as shown in FIG. 2. The functionality of conflict mitigation is about addressing conflicting interactions between different xApps, because an xApp will typically change one or more parameters with the objective of optimizing a specific metric. However, conflict mitigation is not easy to achieve, because it usually requires techniques from artificial intelligence, causal inference, optimization, etc. The gravity of the problem and the gaps in the current specification are quite significant.

[0080] Embodiments of the present disclosure provide a solution for conflict mitigation. In some example embodiments, a specific xApp dedicated to conflict mitigation, such as a specific xApp 250 shown in FIG. 2, is introduced. In the solution, the specific xApp or the

Near-RT RIC platform may determine one or more suggestions for at least one xApp. As such, the conflict among multiple xApps may be eliminated. Principles and implementations of the present disclosure will be described in detail below with reference to the figures.

5 [0081] In the present disclosure, the term “suggestion” may be interchangeably used with one of the following: recommendation, guidance, indication, instruction, suggested information, proposed modification, or the like, the present disclosure does not limit this aspect.

[0082] Reference is further made to FIG. 3, which illustrates a signalling chart illustrating
10 communication process 300 in accordance with some example embodiments of the present disclosure. The process 300 may involve a specific xApp 250, an xApp 234, a Near-RT RIC platform 232, and an E2 node 240 as shown in FIG. 2. It would be appreciated that the process 300 may be applied to other communication scenarios, which will not be described in detail.

15 [0083] The specific xApp 250 may be an xApp dedicated to conflict mitigation, for example, it may be referred to as a dedicated xApp of conflict mitigation.

[0084] In the process 300, the specific xApp 250 transmits a registration request to the Near-RT RIC platform 232 at 310. In some implementations, the specific xApp 250 initiates the xApp registration procedure by sending an xApp Registration (Request) message to the Near-
20 RT RIC platform 232. The message contains a unique *Procedure Transaction ID* IE assigned by the initiating xApp, the optional *xApp Description* IE, and the *Required APIs and Data Types* IE that specifies the APIs and data types needed for normal operation of the xApp.

[0085] In some example embodiments, the registration request from the specific xApp 250 includes information about at least one E2SM function on an E2 node 240 being controlled
25 by the Near-RT RIC platform 232 and required by the specific xApp 250. For example, the at least one E2SM function may describe the function(s) in the E2 node 240 which may be controlled by the Near-RT RIC and the related procedures.

[0086] In some example embodiments, the registration request from the specific xApp 250 includes information about at least one API required by the specific xApp 250. For example,
30 the specific xApp 250 may define the at least one API, so that one or more xApps 234 may access or send data to the specific xApp 250 by using the at least one API.

[0087] In some examples, the information about at least one API may include at least one

name of the at least one API, and/or at least one version of the at least one API. For example, a name of an API may indicate a name of a required Near-RT RIC API, such as E2_Subscription_API, E2_Control_API, E2_Indication_API. For example, a version of an API may indicate a version of a required Near-RT RIC API, such as v1.0.1.

- 5 [0088] In some example embodiments, the registration request from the specific xApp 250 may include description information of the specific xApp 250. In some examples, the description information may include one or more of: a name of the specific xApp 250, a vendor of the specific xApp 250, or a purpose of the specific xApp 250. For example, the description information may provide generic information related to the specific xApp 250.
- 10 For example, a name of the specific xApp 250 may be Conflict_Mitigation_xApp. For example, the purpose of the specific xApp 250 may be Conflict_Mitigation.

[0089] In the process 300, the Near-RT RIC platform 232 transmits a registration response to the specific xApp 250 at 320. In some implementations, the registration response may indicate whether a registration of the specific xApp 250 is successful or failed.

- 15 [0090] In some example embodiments, in case the registration of the specific xApp 250 is successful, the registration response may be a registration success response. In some examples, the registration response (the registration success response) may include an identifier (xApp ID) of the specific xApp 250 assigned by the Near-RT RIC platform 232.

- [0091] For example, at reception of the xApp Registration (Request) message, the Near-RT RIC platform shall: - Check xApp's compatibility with the Near-RT RIC platform, using information in the *Required APIs and Data Types* IE; - Assign an xApp ID and create the profile for the xApp. If the registration request is successfully fulfilled, the Near-RT RIC platform shall send an xApp Registration (Success) message back to the xApp. In the xApp Registration (Success) message, the Near-RT RIC platform shall include the associated
- 20
- 25 *Procedure Transaction ID* IE and the *xApp ID* IE.

- [0092] In some other example embodiments, in case the registration of the specific xApp 250 is failed, the registration response may be a registration failure response. In some examples, the registration response (the registration failure response) may include a cause value which indicate a reason why the registration is failed. For example, the cause value
- 30 may indicate that a failure cause of the registration, e.g., the failure cause includes that the at least one E2SM function or the at least one API required by the specific xApp 250 is not supported by the Near-RT RIC platform 232.

[0093] For example, if the registration request is failed, the Near-RT RIC platform shall send an xApp Registration (Failure) message back to the xApp. In the xApp Registration (Failure) message, the Near-RT RIC platform shall include the cause value.

[0094] According to the registration procedure of 310 and 320, the Near-RT RIC platform 5 232 may be aware of the specific xApp 250 dedicated to conflict mitigation. According to the registration procedure, the specific xApp 250 dedicated to conflict mitigation may provide information of the specific xApp 250 to the Near-RT RIC platform 232, which may be regarded as conflict mitigation related value-added services, in this event, the Near-RT RIC platform 232 may be able to access the related information for conflict mitigation, and 10 thus operations such as conflict detection may be enabled. In addition, the conflict mitigation may be performed by the procedure 330 or 340.

[0095] In a solution of procedure 330, the xApp 234 transmits an E2 control request or an E2 guidance request to the Near-RT RIC platform 232 at 331. In some implementations, the E2 control/guidance request may be implemented by another message, the present 15 disclosure does not limit this aspect.

[0096] In some implementations, the E2 control/guidance request includes information about an E2SM related RAN function that the xApp 234 determines to perform on an E2 node. For example, the E2SM related RAN function may include cell configuration and control, which performs the control and/or configuration of node level and cell level 20 parameters. For example, the E2SM related RAN function may include RAN control, which performs the modification and initiation of RAN control related call processes and messages. For example, the E2SM related RAN function may include network interface, which performs the modification of both incoming and/or outgoing network interface message contents.

[0097] The Near-RT RIC platform 232 transmits a conflict mitigation request to the specific xApp 250 at 332. In some implementations, the conflict mitigation request includes the information about the E2SM related RAN function that the xApp 234 determines to perform on the E2 node. In some examples, the specific xApp 250 may detect the conflict of control, e.g., direct conflict, indirect conflict, or implicit conflict.

[0098] In addition, the specific xApp 250 performs a conflict mitigation to determine one or more suggestions for the xApp 234 at 333. In some implementations, the specific xApp 250 may detect a potential conflict and takes a decision on an optimal mitigation solution.

For example, there may be an artificial intelligence (AI) model deployed at the specific xApp 250, and the AI model may be used for the conflict mitigation. For example, an input of the AI model may include the information about the E2SM related RAN function that the xApp 234 determines to perform on the E2 node, and an output of the AI model may be the one or more suggestions.

[0099] In some implementations, the one or more suggestions may include an indication indicating whether an E2SM related RAN function that the xApp 234 determines to perform results in a conflict with one or more further xApps. In some implementations, the one or more suggestions may include one or more identifiers of the one or more further xApps. For example, the one or more suggestions may indicate whether the E2SM related RAN function initiated by the xApp 234 may result in a conflict with other xApps. If the conflict may happen, the one or more suggestions may further include xApp ID(s) subject to the conflict.

[00100] In some implementations, the one or more suggestions may include one or more recommendations for modifying the E2SM related RAN function. In some examples, the one or more recommendations may include multiple guidance instances with different priorities or execution orders.

[00101] For example, the one or more suggestions may include recommendation(s) on how the E2SM related RAN functions initiated by the xApp 234 should be modified to avoid conflicts. The recommendation may be a guidance instance, or a prior guidance instance list including multiple guidance instances. In some examples, the recommendation may include a list of guidance instances, and the list may include multiple guidance instances which are associated with an execution order in an explicit or implicit manner.

[00102] In one example, the multiple guidance instances in the list are ordered from the first to the last. That is, the first guidance instance in the list should be used with a highest priority to resolve the potential conflicts. In another example, each guidance instance in the list is associated with an execution order. For example, the guidance instance with the execution order 1 in the list should be used with a highest priority to resolve the potential conflicts.

[00103] The specific xApp 250 transmits a conflict mitigation response to the Near-RT RIC platform 232 at 334. In some implementations, the conflict mitigation response includes the one or more suggestions for the xApp 234. In addition, the Near-RT RIC platform 232 transmits an E2 control response or an E2 guidance response to the xApp 234 at 335, where

the E2 control/guidance response includes the one or more suggestions for the xApp 234. For example, the E2 control response may be an E2 control success response or an E2 control reject response which includes the one or more suggestions. For example, the E2 guidance response may be an E2 guidance modification which includes the one or more suggestions.

5 [00104] It is to be noted that in some other example embodiments, the E2 control/guidance response may be implemented as an E2 control reject or an E2 guidance reject. For example, if all the E2SM related RAN function in the E2 control/guidance request are rejected by the specific xApp 250 or the Near-RT RIC platform 232, the E2 control/guidance reject may be transmitted to the xApp 234.

10 [00105] In a solution of procedure 340, the xApp 234 transmits an API discovery request to the Near-RT RIC platform 232 at 341. In some implementations, the API discovery request may include an identifier of the specific xApp 250. For example, in order to discover the Near-RT RIC API dedicated to conflict mitigation which is available at the Near-RT RIC platform 232, the xApp 234 may send the API discovery request at 341.

15 [00106] The Near-RT RIC platform 232 transmits an API discovery response to the xApp 234 at 342. In some implementations, the API discovery response includes API information about a specific API dedicated to conflict mitigation. For example, the API information about the specific API dedicated to conflict mitigation may include one or more of the following: name of the specific API, identifier of the specific API assigned by the Near-RT
20 RIC platform, API type of the specific API, description information of the specific API, or API profiles of the specific API.

[00107] For example, a name of the specific API may be the Near-RT RIC API dedicated to conflict mitigation, e.g., Conflict_Mitigation_API, E2_Conflict_Mitigation_API, etc. For example, an identifier of the specific API may be an API ID (identifier) assigned by the Near-
25 RT RIC platform 232. For example, an API type of the specific API may be a Near-RT RIC API category to which the API belongs, e.g., conflict mitigation. For example, description information of the specific API may include a text description of the Near-RT RIC API dedicated to conflict mitigation. For example, there may be a list of API profiles includes one or more of: an API version indicating a version of the Near-RT RIC API dedicated to
30 conflict mitigation, a protocol used by the Near-RT RIC API dedicated to conflict mitigation, a data format used by the Near-RT RIC API dedicated to conflict mitigation, etc. For example, the protocol may be a stream control transmission protocol. For example, a data

format may be a java script object notation.

[00108] It is to be understood that although API discovery request and API discovery response are used for the xApp to discover the specific API dedicated to conflict mitigation, in some other examples, different messages may be used for discovering the specific API.

5 For example, an API event subscription request message may be used by the xApp 234 to discover the Near-RT RIC API dedicated to conflict mitigation which is available at the Near-RT RIC platform 232.

[00109] Similarly, the Near-RT RIC platform 232 may use other message to send the API information of discovered Near-RT RIC API dedicated to conflict mitigation to the xApp 234.

10 For example, an API event notification message may be used by the Near-RT RIC platform 232 to transmit the API information about the specific API.

[00110] In the procedure 340 shown in FIG. 3, the Near-RT RIC platform 232 responds with the API information about the specific API at 342. However, in some other implementations, the Near-RT RIC platform 232 may reject the API discovery request. For example, if the
15 Near-RT RIC platform 232 doesn't discover the Near-RT RIC API dedicated to conflict mitigation (e.g., a registration of the specific xApp 250 is failed), the Near-RT RIC platform 232 may respond to the xApp 234 with a failure message, e.g., an API discovery failure message or an API event subscription failure message, where the failure message may include a cause value indicating the requested API is not available.

20 [00111] In the present disclosure, for ease of description, it is assumed that the xApp 234 may know the API information about the specific API dedicated to conflict mitigation and is available at the Near-RT RIC platform 232.

[00112] The xApp 234 transmits a conflict mitigation request to the specific xApp 250 using the specific API at 343. In some implementations, the conflict mitigation request includes
25 the information about the E2SM related RAN function that the xApp 234 determines to perform on the E2 node. For example, the E2SM related RAN function may include cell configuration and control, which performs the control and/or configuration of node level and cell level parameters. For example, the E2SM related RAN function may include RAN control, which performs the modification and initiation of RAN control related call processes
30 and messages. For example, the E2SM related RAN function may include network interface, which performs the modification of both incoming and/or outgoing network interface message contents.

[00113] In some examples, the xApp 234 may, prior to initiating an action, send the conflict mitigation request using the Near-RT RIC API dedicated to conflict mitigation. For example, the xApp 234 may send the conflict mitigation request to the specific xApp 250 directly. For example, the xApp 234 may send the conflict mitigation request to the specific xApp 250 via the Near-RT RIC platform 232.

[00114] In addition, the specific xApp 250 performs a conflict mitigation to determine one or more suggestions for the xApp 234 at 344. The operation 344 is similar with the operation 333 discussed above, and thus details will not be repeated herein.

[00115] The specific xApp 250 transmits a conflict mitigation response to the xApp 234 using the specific API at 345. In some implementations, the conflict mitigation response includes one or more suggestions for the xApp 234, and details of the one or more suggestions may refer to those discussed at 333.

[00116] In addition or alternatively, the xApp 234 may modify or update the parameters of the E2SM related RAN function that the xApp 234 determines to perform on an E2 node, based on the one or more suggestions from the Near-RT RIC platform 232 at 335 or from the specific xApp 250 at 345. In some implementations, the xApp 234 may determine an updated E2SM related RAN function, so as to resolve potential conflicts.

[00117] In the process 300, the xApp 234 transmits the updated E2SM related RAN function to the E2 node 240 at 350.

[00118] According to some example embodiments with reference to FIG. 3, a specific xApp dedicated to conflict mitigation is introduced, and the specific xApp may determine one or more suggestions for at least one xApp. For example, one or more suggestions may be provided to the xApp before the xApp initiating an E2SM related RAN function. Therefore, a conflict mitigation is enabled at the Near-RT RIC (e.g., at the specific xApp), and the conflict among multiple xApps may be eliminated or avoided.

[00119] It is to be noted that in some other example embodiments, the conflict mitigation is within the Near-RT RIC platform 232. The specific xApp 250 dedicated to conflict mitigation may be omitted, with reference to FIG. 3, the one or more suggestions may be determined by the Near-RT RIC platform 232, for example, a functionality of conflict mitigation may be used for conflict mitigation. For example, the operations 310, 320, 332, 333 and 334 are omitted. For example, the xApp 234 transmits a conflict mitigation request to the Near-RT RIC platform 232 using the specific API at 343, the Near-RT RIC platform

232 performs a conflict mitigation to determine one or more suggestions for the xApp 234 at 344, and the Near-RT RIC platform 232 transmits a conflict mitigation response to the xApp 234 using the specific API at 345. Therefore, a conflict mitigation is enabled at the Near-RT RIC (e.g., at the Near-RT RIC platform), and the conflict among multiple xApps may be eliminated or avoided.

[00120] FIG. 4 illustrates a signalling chart illustrating communication process 400 for determining suggestions in accordance with some example embodiments of the present disclosure. The process 400 may involve an xApp 234, a Near-RT RIC platform 232, and an E2 node 240 as shown in FIG. 2. It would be appreciated that the process 400 may be applied to other communication scenarios, which will not be described in detail.

[00121] In the process 400, the Near-RT RIC platform 232 transmits an E2 indication to the xApp 234 at 410. In some implementations, the E2 indication may include a first indicator, where the first indicator may indicate to the xApp 234 to initiate a measurement report from the E2 node 240. In some examples, the E2 indication may be included in an E2 message or a measurement request message, the present disclosure does not limit a format of the message.

[00122] In some implementations, the E2 indication may indicate at least one measurement type of multiple measurement types. In some example embodiments, multiple measurement types may be defined for the measurement report, e.g., the multiple measurement types may include a first type, a second type, and a third type. In some examples, the first type may indicate requesting measurement result for a specific UE, i.e. one UE of interest. In some examples, the second type may indicate requesting measurement result for multiple UEs, i.e. multiple UE of interest, such as a UE group in a same cell, or a UE cell served by a same O-DU. In some examples, the third type may indicate requesting measurement result for all UEs, such as all UEs served by the E2 node 240.

[00123] In some implementations, the E2 indication may include an identifier of the E2 node 240, that is, a target E2 node is indicated by the E2 indication.

[00124] In the process 400, the xApp 234 transmits an E2SM key performance measurement (KPM) action to the E2 node 240 at 420. In some implementations, the E2SM KPM action may indicate to the E2 node 240 to perform a measurement.

[00125] In some example embodiments, the E2SM KPM action may include a destination

where the E2 node 240 should send a measurement result to. For example, the destination may be associated with the xApp 234 or the Near-RT RIC platform 232. For example, the destination may include a domain name, an internet protocol (IP) version 4 (IPv4) address, or an IPv6 address.

5 [00126] In some example embodiments, the E2SM KPM action may include a second indicator. For example, the second indicator may indicate whether the measurement result should be provided to the Near-RT RIC platform 232. For example, the second indicator may equal to a first value (such as 1) indicating that the measurement result should be provided to the Near-RT RIC platform 232 directly. For example, a destination of the Near-
10 RT RIC platform 232 is known to the E2 node 240, e.g., the destination may be a name or an address of a database on the Near-RT RIC platform 232.

[00127] In the process 400, the E2 node 240 performs a measurement at 430, e.g. according to the E2SM KPM action. The E2 node 240 may generate or determine a measurement result by performing the measurement. In the present disclosure, the measurement result
15 may also be referred to as a measurement report, a performance measurement result, a performance measurement report, results of performing measurement, or the like.

[00128] In some implementations, the E2 node 240 transmits an E2SM KPM report to the xApp 234 at 440, where the E2SM KPM report may include the measurement result. In some examples, if the E2SM KPM action includes a destination associated with the xApp
20 234, the operation 440 may be performed. Accordingly, the xApp 234 may transmit the measurement result to the Near-RT RIC platform 232 at 450. For example, the xApp 234 decodes the E2SM KPM report to obtain the measurement result, and further transmit the measurement result to the Near-RT RIC platform 232.

[00129] In some other implementations, alternatively, the E2 node 240 transmits the measurement result to the Near-RT RIC platform 232 at 455. In some examples, if the
25 E2SM KPM action includes a destination associated with the Near-RT RIC platform 232, or the E2SM KPM action includes a second indicator indicating that the measurement result should be provided to the Near-RT RIC platform 232, the operation 455 may be performed. In this case, the operations 440 and 450 may be omitted.

30 [00130] In the process 400, the Near-RT RIC platform 232 determines one or more suggestions for the xApp 234 at 460. In some implementations, in case there are already one or more suggestions determined previously, the Near-RT RIC platform 232 may update

one or more suggestions for the xApp 234 at 460. Embodiments of the one or more suggestions may refer to those discussed with reference to operation 333 above.

[00131] In the process 400, the Near-RT RIC platform 232 may transmit the determined or updated one or more suggestions to the xApp 234. As shown in FIG. 4, the Near-RT RIC platform 232 may transmit, at 470, an E2 suggestion indication (or an E2 suggestion modification) message to the xApp 234, which includes the determined (or updated) one or more suggestions for the xApp 234.

[00132] In some implementations, the specific xApp 250 dedicated to conflict mitigation may be omitted, with reference to FIG. 4, the one or more suggestions may be determined by the Near-RT RIC platform 232, for example, a functionality of conflict mitigation may be used for conflict mitigation. According to the process 400, in case the Near-RT RIC platform 232 is not able to independently trigger E2SM related RAN function or decode the E2SM level information, the E2 indication at 410 may be used for triggering a measurement result from the E2 node 240, and thus the conflict detection may be enabled.

[00133] In some other implementations, the specific xApp 250 dedicated to conflict mitigation may be used for conflict mitigation as those discussed with reference to FIG. 3, in addition, the process 300 and the process 400 may be combined, for example, the process 400 may be performed after the process 300, for example, the one or more suggestions may be updated by the Near-RT RIC platform 232 according to a measurement result from the E2 mode 240.

[00134] FIG. 5 illustrates a signalling chart illustrating communication process 500 for determining suggestions in accordance with some example embodiments of the present disclosure. The process 500 may involve an xApp 234, a Near-RT RIC platform 232, and an E2 node 240 as shown in FIG. 2. It would be appreciated that the process 500 may be applied to other communication scenarios, which will not be described in detail.

[00135] In the process 500, the Near-RT RIC platform 232 transmits a measurement request to the E2 node 240 at 510. In some implementations, the measurement request may indicate at least one measurement type of multiple measurement types. In some example embodiments, multiple measurement types may be defined for the measurement report, e.g., the multiple measurement types may include a first type, a second type, and a third type. In some examples, the first type may indicate requesting measurement result for a specific UE, i.e. one UE of interest. In some examples, the second type may indicate requesting

measurement result for multiple UEs, i.e. multiple UE of interest, such as a UE group in a same cell, or a UE cell served by a same O-DU. In some examples, the third type may indicate requesting measurement result for all UEs, such as all UEs served by the E2 node 240.

5 [00136] In the process 500, the E2 node 240 performs a measurement at 520, e.g. according to the measurement request. The E2 node 240 may generate or determine a measurement result by performing the measurement. In addition, the E2 node 240 transmits the measurement result to the Near-RT RIC platform 232 at 530.

[00137] In the process 500, the Near-RT RIC platform 232 determines one or more
10 suggestions for the xApp 234 at 540, and the Near-RT RIC platform 232 may transmit the determined or updated one or more suggestions to the xApp 234. As shown in FIG. 5, the Near-RT RIC platform 232 may transmit, at 550, an E2 suggestion indication (or an E2 suggestion modification) message to the xApp 234, which includes the determined (or updated) one or more suggestions for the xApp 234. It is to be noted that the operations
15 540 and 550 are similar with the operations 460 and 470 with reference to FIG. 4, thus will not be repeated herein.

[00138] In some implementations, the specific xApp 250 dedicated to conflict mitigation may be omitted, with reference to FIG. 5, the one or more suggestions may be determined by the Near-RT RIC platform 232, for example, a functionality of conflict mitigation may be
20 used for conflict mitigation. In some other implementations, the specific xApp 250 dedicated to conflict mitigation may be used for conflict mitigation as those discussed with reference to FIG. 3, in addition, the process 300 and the process 500 may be combined, for example, the process 500 may be performed after the process 300, for example, the one or more suggestions may be updated by the Near-RT RIC platform 232 according to a
25 measurement result from the E2 mode 240.

[00139] FIG. 6 illustrates an example of a device 600 that is suitable for implementing embodiments of the present disclosure. The device 600 may be an example of a Near-RT RIC platform, or an xApp as described herein. The device 600 may support wireless communication with a Near-RT RIC platform 232, an xApp 234, a specific xApp 250
30 dedicated to conflict mitigation, or any combination thereof. The device 600 may include components for bi-directional communications including components for transmitting and receiving communications, such as a processor 602, a memory 604, a transceiver 606, and,

optionally, an I/O controller 608. 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).

[00140] The processor 602, the memory 604, the transceiver 606, 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 602, the memory 604, the transceiver 606, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[00141] In some implementations, the processor 602, the memory 604, the transceiver 606, 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 602 and the memory 604 coupled with the processor 602 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 602, instructions stored in the memory 604).

[00142] For example, the processor 602 may support wireless communication at the device 600 in accordance with examples as disclosed herein. The processor 602 may be configured to operable to support a means for operations discussed above.

[00143] The processor 602 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 602 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 602. The processor 602 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 604) to cause the device 600 to perform various functions of the present disclosure.

[00144] The memory 604 may include random access memory (RAM) and read-only memory (ROM). The memory 604 may store computer-readable, computer-executable

code including instructions that, when executed by the processor 602 cause the device 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. In some implementations, the code may not be directly executable by the processor 602 but may cause
5 a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 604 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.

[00145] The I/O controller 608 may manage input and output signals for the device 600.
10 The I/O controller 608 may also manage peripherals not integrated into the device 600. In some implementations, the I/O controller 608 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 608 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
15 608 may be implemented as part of a processor, such as the processor 602. In some implementations, a user may interact with the device 600 via the I/O controller 608 or via hardware components controlled by the I/O controller 608.

[00146] In some implementations, the device 600 may include a single antenna 610. However, in some other implementations, the device 600 may have more than one antenna
20 610 (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 606 may communicate bi-directionally, via the one or more antennas 610, wired, or wireless links as described herein. For example, the transceiver 606 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver.
25 The transceiver 606 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 610 for transmission, and to demodulate packets received from the one or more antennas 610. The transceiver 606 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[00147] A transmit chain may be configured to generate and transmit signals (e.g., control
30 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 610 for transmitting the amplified signal into the air or wireless medium.

[00148] 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 610 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.

[00149] FIG. 7 illustrates an example of a processor 700 that is suitable for implementing some embodiments of the present disclosure. The processor 700 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 700 may include a controller 702 configured to perform various operations in accordance with examples as described herein. The processor 700 may optionally include at least one memory 704, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 700 may optionally include one or more arithmetic-logic units (ALUs) 706. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[00150] The processor 700 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 700) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory

(PCM), and others).

[00151] The controller 702 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. For example, the controller 702 may operate as a control unit of the processor 700, generating control signals that manage the operation of various components of the processor 700. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[00152] The controller 702 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 704 and determine subsequent instruction(s) to be executed to cause the processor 700 to support various operations in accordance with examples as described herein. The controller 702 may be configured to track memory address of instructions associated with the memory 704. The controller 702 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 702 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 700 to cause the processor 700 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 702 may be configured to manage flow of data within the processor 700. The controller 702 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 700.

[00153] The memory 704 may include one or more caches (e.g., memory local to or included in the processor 700 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 704 may reside within or on a processor chipset (e.g., local to the processor 700). In some other implementations, the memory 704 may reside external to the processor chipset (e.g., remote to the processor 700).

[00154] The memory 704 may store computer-readable, computer-executable code including instructions that, when executed by the processor 700, cause the processor 700 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 702 and/or the processor 700 may be configured to execute computer-readable instructions stored

in the memory 704 to cause the processor 700 to perform various functions. For example, the processor 700 and/or the controller 702 may be coupled with or to the memory 704, the processor 700, the controller 702, and the memory 704 may be configured to perform various functions described herein. In some examples, the processor 700 may include multiple
5 processors and the memory 704 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[00155] The one or more ALUs 706 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or more
10 ALUs 706 may reside within or on a processor chipset (e.g., the processor 700). In some other implementations, the one or more ALUs 706 may reside external to the processor chipset (e.g., the processor 700). One or more ALUs 706 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 706 may receive input operands and an operation code, which
15 determines an operation to be executed. One or more ALUs 706 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation. Additionally, or alternatively, the one or more ALUs 706 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more
20 ALUs 706 to handle conditional operations, comparisons, and bitwise operations.

[00156] The processor 700 may support wireless communication in accordance with examples as disclosed herein. The processor 700 may be configured to or operable to support a means for operations described in some embodiments of the present disclosure.

[00157] FIG. 8 illustrates a flowchart of a method 800 performed by a first apparatus in accordance with aspects of the present disclosure. The operations of the method 800 may
25 be implemented by a device or its components as described herein. For example, the operations of the method 800 may be performed by the Near-RT RIC platform 232 or the specific xApp 250 dedicated to conflict mitigation in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements of the device to
30 perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00158] At 810, the method may include receiving, from a second apparatus, first

information for conflict mitigation associated with at least one xApp. The operations of 810 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 810 may be performed by the Near-RT RIC platform 232 or the specific xApp 250 dedicated to conflict mitigation as described with reference to FIG. 2.

[00159] At 820, the method may include determining one or more suggestions for the at least one xApp, the one or more suggestions being used for eliminating conflict among a plurality of xApps comprising the at least one xApp. The operations of 820 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 820 may be performed by the Near-RT RIC platform 232 or the specific xApp 250 dedicated to conflict mitigation as described with reference to FIG. 2.

[00160] At 830, the method may include transmitting, to the second apparatus, second information comprising the one or more suggestions. The operations of 830 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 830 may be performed by the Near-RT RIC platform 232 or the specific xApp 250 dedicated to conflict mitigation as described with reference to FIG. 2.

[00161] FIG. 9 illustrates a flowchart of a method 900 performed by a Near-RT RIC platform in accordance with aspects of the present disclosure. The operations of the method 900 may be implemented by a device or its components as described herein. For example, the operations of the method 900 may be performed by the Near-RT RIC platform 232 in FIG. 2. 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.

[00162] At 910, the method may include receiving, from a specific xApp dedicated to conflict mitigation, a registration request comprising one of: information about at least one E2SM function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp, information about at least one API required by the specific xApp, or description information of the specific xApp. The operations of 910 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 910 may be performed by the Near-RT RIC platform 232 as described with reference to FIG. 2.

[00163] At 920, the method may include transmitting, to the specific xApp, a registration

response indicating that a registration of the specific xApp is successful or failed. The operations of 920 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 920 may be performed by the Near-RT RIC platform 232 as described with reference to FIG. 2.

5 [00164] FIG. 10 illustrates a flowchart of a method 1000 performed by an xApp in accordance with aspects of the present disclosure. The operations of the method 1000 may be implemented by a device or its components as described herein. For example, the operations of the method 1000 may be performed by the xApp 234 in FIG. 2. In some implementations, the device may execute a set of instructions to control the function elements
10 of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[00165] At 1010, the method may include transmitting, to a first apparatus, first information for conflict mitigation, where the first information comprises information about an E2SM related RAN function that the xApp determines to perform on an E2 node. The operations
15 of 1010 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1010 may be performed by the xApp 234 as described with reference to FIG. 2.

[00166] At 1020, the method may include receiving, from the first apparatus, second information comprising one or suggestions for modifying or cancelling the E2SM related
20 RAN function. The operations of 1020 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 1020 may be performed by the xApp 234 as described with reference to FIG. 2.

[00167] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise
25 modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[00168] 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
30 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).

[00169] The functions described herein may be implemented in hardware, software executed
5 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,
10 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.

[00170] Computer-readable media includes both non-transitory computer storage media and
communication media including any medium that facilitates transfer of a computer program
15 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
20 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.

[00171] 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
25 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).
30 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.

[00172] 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
5 person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A first apparatus of a near real time (Near-RT) radio access network (RAN) intelligent controller (RIC), comprising:

5 at least one memory; and

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

receive, from a second apparatus, first information for conflict mitigation associated with at least one xApp;

10 determine one or more suggestions for the at least one xApp, the one or more suggestions being used for eliminating conflict among a plurality of xApps comprising the at least one xApp; and

transmit, to the second apparatus, second information comprising the one or more suggestions.

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2. The first apparatus of claim 1, wherein the first apparatus comprises a specific xApp dedicated to conflict mitigation, and wherein the first apparatus is further caused to:

transmit, to a Near-RT RIC platform, a registration request comprising one of:

20 information about at least one E2 service model (E2SM) function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp,

information about at least one application programming interface (API) required by the specific xApp, or

description information of the specific xApp; and

25 receive, from the Near-RT RIC platform, a registration response indicating that a registration of the specific xApp is successful or failed.

3. The first apparatus of claim 2, wherein the information about the at least one API comprises one of:

30 at least one name of the at least one API, or

at least one version of the at least one API.

4. The first apparatus of claim 2, wherein the registration response comprises one of:

an identifier of the specific xApp assigned by the Near-RT RIC platform, or
a cause value indicating a failure cause of the registration, wherein the failure cause
comprises the at least one E2SM function or the at least one API required by the specific
xApp is not supported by the Near-RT RIC platform.

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5. The first apparatus of claim 1, wherein the first apparatus comprises a specific
xApp dedicated to conflict mitigation, the second apparatus comprises a Near-RT RIC
platform or the at least one xApp,

wherein the first information is a conflict mitigation request comprising information
10 about an E2SM related RAN function that the at least one xApp determines to perform on an
E2 node, and

wherein the second information is a conflict mitigation response comprising the one
or more suggestions.

15 6. The first apparatus of claim 1, wherein the first apparatus comprises a Near-RT
RIC platform, the second apparatus comprises the at least one xApp or an E2 node, and
wherein the first apparatus is further caused to:

transmit, to the second apparatus, a measurement request for a measurement report
from the E2 node, and

20 wherein the first information is a performance measurement result.

7. The first apparatus of claim 1, wherein the one or more suggestions comprise
one of:

an indication indicating whether an E2SM related RAN function that the at least one
25 xApp determines to perform results in a conflict with one or more further xApps,
one or more identifiers of the one or more further xApps, or
one or more recommendations for modifying the E2SM related RAN function.

8. The first apparatus of claim 7, wherein the one or more recommendations
30 comprise: a plurality of guidance instances with different priorities or execution orders.

9. A near real time (Near-RT) radio access network (RAN) intelligent controller
(RIC) platform, comprising:
at least one memory; and

at least one processor coupled with the at least one memory and configured to cause the Near-RT RIC platform to:

receive, from a specific xApp dedicated to conflict mitigation, a registration request comprising one of:

5 information about at least one E2 service model (E2SM) function on an E2 node being controlled by the Near-RT RIC platform required by the specific xApp,

information about at least one application programming interface (API) required by the specific xApp, or

description information of the specific xApp; and

10 transmit, to the specific xApp, a registration response indicating that a registration of the specific xApp is successful or failed.

10. The Near-RT RIC platform of claim 9, wherein the registration response comprises one of:

15 an identifier of the specific xApp assigned by the Near-RT RIC platform, or

a cause value indicating a failure cause of the registration, wherein the failure cause comprises the at least one E2SM function or the at least one API required by the specific xApp is not supported by the Near-RT RIC platform.

20 11. The Near-RT RIC platform of claim 9, wherein the Near-RT RIC platform is further caused to:

receive, from at least one xApp, an E2 control request or an E2 guidance request comprising information about an E2SM related RAN function that the at least one xApp determines to perform on an E2 node;

25 transmit, to the specific xApp, a conflict mitigation request comprising the information about the E2SM related RAN function that the at least one xApp determines to perform on the E2 node;

receive, from the specific xApp, a conflict mitigation response comprising one or more suggestions for the at least one xApp; and

30 transmit, to the at least one xApp, an E2 control response or an E2 guidance response comprising the one or more suggestions.

12. The Near-RT RIC platform of claim 11, wherein the one or more suggestions comprises one of:

an indication indicating whether an E2SM related RAN function that the at least one xApp determines to perform results in a conflict with one or more further xApps, one or more identifiers of the one or more further xApps, or one or more recommendations for modifying the E2SM related RAN function.

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13. The Near-RT RIC platform of claim 12, wherein the one or more recommendations comprise: a plurality of guidance instances with different priorities or execution orders.

10 14. The Near-RT RIC platform of claim 9, wherein the Near-RT RIC platform is further caused to:

receive, from at least one xApp, an API discovery request comprising an identifier of the specific xApp; and

15 transmit, to the at least one xApp, an API discovery response comprising API information about a specific API dedicated to conflict mitigation.

15 15. The Near-RT RIC platform of claim 14, wherein the API information comprises one of:

name of the specific API,
20 identifier of the specific API assigned by the Near-RT RIC platform,
API type of the specific API,
description information of the specific API, or
API profiles of the specific API.

25 16. The Near-RT RIC platform of claim 9, wherein the Near-RT RIC platform is further caused to:

receive, from an E2 node, a performance measurement result associated with the at least one xApp;

determine updated suggestions for the at least one xApp based on the performance
30 measurement result; and

transmit, to the at least one xApp, the updated suggestions.

17. An xApp of a near real time (Near-RT) radio access network (RAN) intelligent controller (RIC), comprising:

at least one memory; and

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

transmit, to a first apparatus, first information for conflict mitigation, the first
5 information comprises information about an E2 service model (E2SM) related RAN function that the xApp determines to perform on an E2 node; and

receive, from the first apparatus, second information comprising one or suggestions for modifying or cancelling the E2SM related RAN function.

10 18. The xApp of claim 17, wherein the one or more suggestions comprises one of:
an indication indicating whether the E2SM related RAN function results in a conflict with one or more further xApps,
one or more identifiers of the one or more further xApps, or
one or more recommendations for modifying the E2SM related RAN function.

15 19. The xApp of claim 18, wherein the one or more recommendations comprise: a plurality of guidance instances with different priorities or execution orders.

20 20. The xApp of claim 17, wherein the xApp is further caused to:
transmit, to a Near-RT RIC platform, an application programming interface (API) discovery request comprising an identifier of a specific xApp; and
receive, from the Near-RT RIC platform, an API discovery response comprising API information about a specific API dedicated to conflict mitigation.