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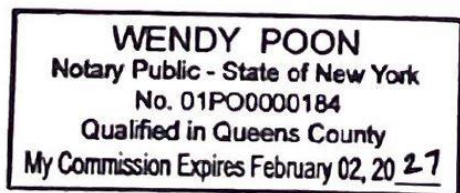


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[Document Name] Specification

[Title of Invention] Wireless station system, wireless terminal, and methods thereof

[Technical field]

[0001]

The present disclosure relates to communications using multiple Radio Access Technologies (RAT) between a wireless station and a wireless terminal.

[Prior Art]

[0002]

The 3rd Generation Partnership Project (3GPP) plans to begin standardization work on 5G in 2016 as 3GPP Release 14, aimed at the introduction of the 2020 transition. 5G is expected to be realized through a combination of continuous enhancement/evolution of LTE and LTE-Advanced and innovative development through the introduction of a new 5G air interface (the new Radio Access Technology (RAT)). The new RAT (New 5G RAT) supports, for example, higher frequency bands than the frequency bands targeted for continuous development of LTE/LTE-Advanced (e.g., 6 GHz or less), such as centimeter bands of 10 GHz or higher and millimeter bands of 30 GHz or higher.

[0003]

The high frequency band can provide high rate communication. However, the coverage of the high frequency band is more local due to its frequency characteristics. Thus, higher frequency bands are used to improve capacity and data rates in specific areas, while broader coverage is provided by existing lower frequency bands. In other words, in order to ensure the stability of New 5G RAT communications in high frequency bands, tight integration or close interworking between low and high frequency bands, i.e., LTE/LTE-Advanced and New 5G RAT, is required. A wireless terminal supporting 5G (5G User Equipment (UE)) uses Carrier Aggregation (CA) or Dual Connectivity (DC) or improved technologies to connect to both low and high frequency bands (i.e., LTE/LTE-Advanced and New 5G cells).

[0004]

Non-Patent Literature 1 discloses the architecture of the user plane and control plane for using both LTE air interface (LTE RAT) and new 5G air interface (New 5G RAT). Some implementations use a common (common) Radio Resource Control (RRC) layer and a common Packet Data Convergence Protocol (PDCP) layer (sublayer). A common PDCP layer connects to the LTE lower layers and the New 5G lower layers and provides transfer services for user and control plane data over these LTE lower and New 5G lower layers to the upper layers. The LTE lower layer includes the Radio Link Control (RLC) layer, Medium Access Control (MAC) layer, and physical layer for LTE-RAT. Similarly, the New 5G lower layer includes an RLC layer, a MAC layer, and a physical layer for New 5G RAT.

[0005]

Non-Patent Literature 1 further describes the simultaneous transmission of the same control plane message in both LTE and New 5G cells (Control Plane Diversity) and switching the path of the control plane connection between the LTE and New 5G cells (Fast Control Plane Switching) assuming that a common PDCP layer and a common RRC layer are located in the LTE base station. By using a common PDCP and a common RRC layer, a UE may connect to a control point (i.e., a common RRC layer) via one of several air interfaces.

[0006]

It should be noted that the term “LTE” used in the present specification includes the development of LTE and LTE-Advanced for 5G to enable close interworking with New 5G RAT, unless otherwise noted. Such developments in LTE and LTE-Advanced are also known as LTE-Advanced Pro, LTE+, or Enhanced LTE (eLTE). The term “5G” or “New 5G” in the present specification is also used expediently to indicate the newly introduced air interface (RAT) for the fifth generation mobile communication system (5G) and associated nodes, cells, and protocol layers, etc. The official name of the new air interface (RAT) and associated nodes, cells, and protocol layers will be determined in the future as the standardization work progresses. For example, LTE RAT may be referred to as Primary RAT (P-RAT, pRAT) or Master RAT, while New 5G RAT may be referred to as Secondary RAT (S-RAT, sRAT).

[Prior Art Literature]

[Patent Literature]

[0007]

[Non-Patent Literature 1] Da Silva, I.; Mildh, G.; Rune, J.; Wallentin, P.; Vikberg, J.; Schl iwa-Bertling, P.; Rui Fan, "Tight Integration of New 5G Air Interface and LTE to Fulfill 5G Requirements," in Vehicular Technology Conference (VTC Spring), 2015 IEEE 81st, pp.1-5, 11-14 May 2015

[Invention Overview]

[Problem to be Solved by the Invention]

[0008]

The inventors examined the 5G radio architecture, which provides close interworking between LTE RAT and New 5G RAT, and found several problems. For example, Non-Patent Literature 1 does not take into account a New 5G cell-specific control plane. Some implementations may require New 5G cell-specific control plane (CP) messages (e.g., temporary UE ID assignment, lower layer configuration, signaling for service quality control, measurement reporting). Some implementations may require 5G cell-specific signaling connections (e.g., RRC connections, Signaling Radio Bearer (SRB)). New 5G cell-specific control plane (CP) message forwarding and 5G cell-specific signaling connections may be more efficient to transmit over New 5G cells rather than LTE cells. For example, one of the key 5G requirements is low latency (5G UEs can expect to be able to communicate at lower latency than LTE cells in New 5G cells.

[0009]

Accordingly, one of the objectives that embodiments disclosed in the present specification seek to achieve is to provide devices, methods, and programs that contribute to effectively transmitting control plane messages via cells of RATs used dependently in a wireless architecture that provides interworking of two different RATs. It should be noted that this purpose is only one of the multiple purposes that multiple embodiments disclosed in the present specification seek to achieve. Other objects or challenges and novel features are clarified from the description in the present specification or from the accompanying drawings.

[Means for solving the problem]

[0010]

In a first aspect, the wireless station system includes one or more wireless stations. The one or more wireless stations are configured to provide one or more first cells according to a first radio access technology and one or more second cells according to a second radio access technology used dependently in addition to the first or more first cells at the same time to a wireless terminal. The one or more wireless stations are configured to transmit or receive from the wireless terminal a control plane message in the one or more second cells when a predetermined condition is met. The control plane message includes a non-access stratum (NAS) message, a radio resource control (RRC) message, or both. The predetermined condition relates to at least one of: (a) the content or type of the control plane message; (b) the type of signaling radio bearer used to transmit the control plane message; (c) the transmission factor of the control plane message; and (d) the type of core network associated with the NAS message.

[0011]

In a second aspect, a method in a wireless station system comprising one or more wireless stations comprises:

- (a) providing one or more first cells according to a first radio access technology and one or more second cells according to a second radio access technology used dependently in addition to the first or more first cells at the same time to a wireless terminal and
- (b) transmitting or receiving from the wireless terminal a control plane message in the one or more second cells when a predetermined condition is met. The control plane message includes a non-access stratum (NAS) message, a radio resource control (RRC) message, or both. The predetermined condition relates to at least one of: (a) the content or type of the control plane message; (b) the type of signaling radio bearer used to transmit the control plane message; (c) the transmission factor of the control plane message; and (d) the type of core network associated with the NAS message.

[0012]

In a third aspect, the wireless terminal includes a memory and at least one processor coupled to the memory. The at least one processor is configured to communicate with a wireless station system comprising one or more wireless stations at the same time in one or more first cells according to a first radio access technology and in one or more second cells according to a second radio access technology used dependently in addition to the first or more first cells. The at least one processor is configured to transmit or receive a control plane message from the wireless station system in the one or more second cells if predetermined conditions are met. The control plane message includes a non-access stratum (NAS) message, a radio resource control (RRC) message, or both. The predetermined condition relates to at least one of: (a) the content or type of the control plane message; (b) the type of signaling radio bearer used to transmit the control plane message; (c) the transmission factor of the control plane message; and (d) the type of core network associated with the NAS message.

[0 0 1 3]

In a fourth aspect, the method at the wireless terminal comprises:

- (a) communicating with a wireless station system comprising one or more wireless stations at the same time in one or more first cells according to a first radio access technology and in one or more second cells according to a second radio access technology used dependently in addition to the first or more first cells; and
- (b) transmitting or receiving from the wireless system a control plane message in the one or more second cells when a predetermined condition is met.

The control plane message includes a non-access stratum (NAS) message, a radio resource control (RRC) message, or both. The predetermined condition relates to at least one of: (a) the content or type of the control plane message; (b) the type of signaling radio bearer used to transmit the control plane message; (c) the transmission factor of the control plane message; and (d) the type of core network associated with the NAS message.

[0014]

In a fifth aspect, the program includes a group of instructions (software code) for causing the computer to perform the method according to the second or fourth aspects described above when loaded into the computer.

[Effects of the invention]

[0015]

According to the above aspects, devices, methods, and programs can be provided that contribute to effectively transmitting control plane messages via cells of dependently used RATs in wireless architectures that provide interworking of two different RATs.

[Brief Description of the Drawings]

[0016]

[FIG. 1] A diagram showing an example configuration of a wireless communication network according to some embodiments.

[Fig. 2] A diagram illustrating an example configuration of a wireless communication network according to some embodiments.

[Fig. 3] A diagram illustrating other configuration examples of wireless communication networks according to some embodiments.

[FIG. 4] A diagram illustrating an example wireless protocol stack according to some embodiments.

[FIG. 5] A diagram illustrating an example wireless protocol stack according to some embodiments.

[FIG. 6] A diagram showing an example layer 2 structure according to some embodiments.

[FIG. 7] A sequence diagram showing an example of operation of a wireless terminal and a base station according to the first embodiment.

[FIG. 8] A sequence diagram showing an example operation of a wireless terminal and a base station according to the first embodiment.

[FIG. 9] A sequence diagram showing an example of operation of a wireless terminal and a base station according to the first embodiment.

[FIG. 10] A flowchart showing an example of operation of an RRC layer according to the first embodiment.

[Fig. 11] A table showing an example key used for generating a lump-sum key for encryption/decryption of each radio bearer in a second embodiment.

[FIG. 12] A block diagram illustrating an example configuration of a wireless terminal according to some embodiments.

[FIG. 13] A block diagram showing an example configuration of a base station according to some embodiments.

[Embodiments of the invention]

[0017]

Hereinafter, specific embodiments will be described in detail with reference to the drawings. In each drawing, the same or corresponding elements are marked with the same symbol, and duplicate explanations are omitted as necessary for clarification of explanation.

[0018]

The embodiments described below can be implemented independently or in combination as appropriate. These multiple embodiments have novel features that differ from each other. Thus, these multiple embodiments contribute to solving different objectives or challenges to each other and to having different effects on each other.

[0019]

The embodiments shown below are primarily directed to a 5G wireless architecture that provides close interworking between LTE RAT and New 5G RAT. However, these embodiments are not limited to 5G wireless architectures, and may be applied to other wireless architectures that provide close interworking of two different RATs.

[0020]

<First embodiment>

FIG. 1 illustrates an example configuration of a wireless communication network according to some embodiments including the present embodiment. In the example of FIG. 1, the wireless communication network includes a wireless terminal (UE) 1 and an integrated base station (integrated eNB) 2. UE 1 is a 5G UE and connects to both one or more LTE cells (e.g., cells 21 and 22) and one or more New 5G cells (e.g., cells 23 and 24) using CA or DC or improved techniques thereof. In the following, one or more LTE cells and one or more New 5G cells used by 5G UE1 are referred to as LTE cell group (CG)) and New 5G CG, respectively. Each cell in LTE CG and New 5G CG is a cell set to 5G UE1 and activated (activated) by

integrated eNB 2. In some implementations, the frequency bands of LTE CG (e.g., cells 21 and 22) (e.g., F1 and F2) are low frequency bands (e.g., lower than 6 GHz) and the frequency bands of New 5G CG (e.g., cells 23 and 24) (e.g., F3 and F4) are high frequency bands (e.g., higher than 6 GHz).

[0021]

Integrated eNB 2 supports 5G and provides multiple cells using multiple component carriers (CCs) with different frequencies and RATs. In the example of FIG. 1, integrated eNB 2 provides LTE cells 21 and 22 and New 5G cells 23 and 24. Integrated eNB 2 communicates with 5GUE1 via both LTE CG (e.g., cells 21 and 22) and New 5G CG (e.g., cells 23 and 24) using CA or DC or improved techniques. In addition, the integrated eNB 2 is connected to a core network, in other words, an integrated Evolved Packet Core (integrated EPC) 41. Integrated EPC 41 provides LTE core network capabilities and 5G new core network capabilities. In some implementations, the integrated eNB 2 may be connected to a 5G specific core network (5G specific EPC 42).

[0022]

As shown in FIG. 2, a remote radio unit 3 may be used to provide at least one of the plurality of cells of the integrated eNB 2 (e.g., New 5G cells 23 and 24). In the configuration of FIG. 2, the integrated eNB2 performs digital signal processing for uplink and downlink signals, and the wireless unit 3 performs analog signal processing for the physical layer. For example, an optical fiber is connected between the integrated eNB2 and the wireless unit 3, on which a digital baseband signal is transferred using the Common Public Radio Interface (CPRI) standard. The configuration of FIG. 2 is called Cloud Radio Access Network (C-RAN). The radio unit 3 is called Remote Radio Head (RRH) or Remote Radio Equipment (RRE). In addition, the integrated eNB2, which handles baseband digital signal processing, is called the Baseband Unit (BBU). In addition, any information (including signals) of Layers 1, 2, or 3 may be transferred using a fronthaul (interface) that is standardized in addition to CPRI (e.g., at 3GPP, Small Cell Forum). For example, a form of fronthaul connection between L1 and L2 or between sublayers in L2 is also referred to as L2 C-RAN. In this case, the integrated eNB 2 in FIG. 2 is also called Digital Unit (DU) and RRH3 is also called Radio Unit (RU).

[0023]

In the configuration example shown in FIGS. 1 and 2, the LTE radio protocol and the New 5G radio protocol are implemented on one node (i.e., integrated eNB 2). Thus, the configuration examples shown in FIGS. 1 and 2 are referred to as co-located deployments (RANs) or co-located RANs. It should be noted that in the case of an L2 C-RAN configuration, a portion of the New 5G wireless protocol may be disposed in the RU. On the other hand, other configuration examples may employ a non co-located arrangement or a non co-located RAN. In non-co-located deployments, LTE radio protocols and New 5G radio protocols are provided by two different nodes (eNBs). These two nodes are located at two different sites, for example, geographically separated.

[0024]

FIG. 3 shows an example of a non collocated arrangement of a wireless communication network according to some embodiments including the present embodiment. In the example of FIG.3, the wireless communication network comprises 5G UE 1, LTE+eNB 5, and 5G specific eNB 6. LTE+eNB5 provides LTE CG (e.g., cells 21 and 22) and 5 G specific eNB 6 provides New 5G CG (e.g., cells 23 and 24). The LTE+eNB 5 is connected to the 5G specific eNB 6 by a communication line, such as an optical fiber link or point-to-point wireless link, and communicates with the 5G specific eNB 6 over the base station-to-base station interface 301 (e.g., developed (enhanced) X2 interface). LTE+eNB 5 and 5G specific eNB 6 work in conjunction with each other (interwork) to enable 5GUE1 to connect to both LTE CG and 5G CG using CA or DC or improved techniques thereof.

[0025]

FIG. 4 shows an example of a wireless protocol stack supported by 5G UE 1 and integrated eNB 2. The wireless protocol stack 400 shown in FIG. 4 includes an integrated (integrated) RRC layer 401 and an integrated PDCP layer (sublayer) 402. The integrated RRC layer 401 and the integrated PDCP layer 402 can also be referred to as a common RRC layer and a common PDCP layer, respectively. The wireless protocol stack 400 further includes an LTE lower layer(s) and a New 5G lower layer(s). The LTE lower layer includes an LTE RLC layer 403, an LTE MAC layer 404, and an LTE PHY layer 405. The New 5G lower layer includes New RLC layer 406, New MAC layer 407, and New PHY layer 408. For integrated eNB2, some of the functions of LTE PHY layer 405 (e.g., analog signal processing) may be provided by RRH for LTE. Similarly, some of the features of the New PHY layer 408 (e.g., analog signal processing) may be provided

by RRH for New 5G. Also, in the case of the L2 C-RAN configuration described above, some of the functions of the New PHY layer, New MAC layer, or New RLC layer (and lower functions) may be provided by the RU for New 5G.

[0026]

The integrated RRC layer 401 is responsible for control plane functions in LTE RAT and New 5G RAT. The main services and functions of the integrated RRC Layer 401 include:

- Sending system information for non-access stratum (NAS) and access stratum (AS);
- Paging,
- Setup, maintenance and release of RRC connections,
- Security functions including key management,
- Setup, maintenance, release of radio bearers,
- Setting the lower layer protocol (i.e., PDCP, RLC, MAC, PHY),
- QoS management,
- UE measurement report and its settings, and
- Forwarding of NAS messages between the UE and the core network.

[0027]

The integrated RRC layer 401 communicates with the integrated PDCP layer 402 to manage radio bearers, control encryption/duplication of user plane (data radio bearer) data, control encryption/duplication of control plane (signaling radio bearer) data (RRC PDUs), and control integrity protection (integrity protection) of control plane (signaling radio bearer) data (RRC PDUs). In addition, the integrated RRC layer 401 controls LTE RLC layer 403, LTE MAC layer 404, and LTE PHY layer 405, as well as New RLC layer 406, New MAC layer 407, and New PHY layer 408.

[0028]

The integrated PDCP layer 402 provides data transfer services for the data radio bearer and signaling radio bearer to the upper layer. The integrated PDCP layer 402 is serviced from LTE RLC layer 403 and New RLC layer 406. That is, the integrated PDCP layer 402 provides a transfer service for PDCP PDUs via LTE RAT from LTE RLC layer 403 and a transfer service for PDCP PDUs via New 5G RAT from New RLC layer 406.

[0029]

It should be noted that the wireless protocol stack 400 using the integrated PDCP layer 402 shown in FIG. 4 can be applied not only to co-located arrangements (FIG. 1 and FIG. 2), but also to non-co-located arrangements (FIG. 3). That is, in a non-co-located arrangement, LTE+ eNB 5 is located at a site 501 and provides an integrated RRC layer 401, an integrated PDCP layer 402, an LTE RLC layer 403, an LTE MAC layer 404, and an LTE PHY layer 405, as shown in FIG. 5. On the other hand, 5G specific eNB 6 is distributed to another site 502 to provide New RLC layer 406, New MAC layer 407, and New PHY layer 408.

[0030]

In some implementations, the 5G specific eNB 6 used in the non-co-located arrangement may have a New RRC layer 511 and a New PDCP layer 512. The 5G specific eNB 6 may also have a control interface or connection (e.g., S1-MME interface, S1-U interface) with the core network (e.g., Integrated EPC 41 or 5G specific EPC 42) for 5G UE 1. In some implementations, New RRC layer 511 may set lower layers 406-408 of New 5G CG (e.g., New 5G cells 23 and 24) and transmit system information (i.e., Master Information Block (MIB) or System Information Blocks (SIBs) or both) via New 5G CG. New RRC layer 511 may configure signaling radio bearers with 5G UE 1, configure lower layers 406-408 of New 5G CG (e.g., New 5G cells 23 and 24) and New PDCP layer 512, and send RRC messages to and receive from 5G UE 1 via New 5G CG. New RRC layer 511 may forward NAS messages between the core network (e.g., Integrated EPC 41 or 5G specific EPC 42) and 5G UE 1. New PDCP layer 512 provides a forwarding service for RRC messages via New 5G lower layers 406-408 to New RRC layer 511.

[0031]

New RRC layer 511 may depend on integrated RRC layer 401 (i.e., dependency relationship) or have equivalent control to integrated RRC layer 401 (i.e., have similar functionality). In the case of the former (dependent relationship), 5G specific eNB 6 (New RRC layer 511) may generate RRC configuration information for the New 5G cell (New 5G CG) in response to instructions or requests for LTE+ eNB5 (Integrated RRC layer 401). 5G specific eNB 6 (New RRC layer 511) may transmit the RRC configuration information to LTE+ eNB5 (Integrated RRC layer 401) and LTE+ eNB 5 may transmit an RRC message (e.g., RRC Connection Reconfiguration message) containing the RRC configuration information to 5G UE 1 in an LTE cell (LTE CG). Alternatively, 5G specific NB 6 (New RRC layer 511) may send an RRC message containing the RRC configuration information to 5G UE 1 in a New 5G cell.

[0032]

5G UE 1 may support the protocol stack shown in FIG. 4 or may support another protocol stack to communicate with the wireless network shown in FIG. 5. For example, 5G UE 1 may have an RRC layer (master RRC layer, primary RRC layer) corresponding to an integrated RRC layer 401 of LTE+ eNB5 and an auxiliary RRC layer (sub RRC layer, secondary RRC layer) corresponding to a New RRC layer 511 of 5G specific eNB 6. For example, the sub RRC layer may transmit or receive (generate or restore) some of the RRC configuration information controlled by the master RRC layer, or both. For example, 5G UE 1 may receive both the RRC setting information for an LTE cell (LTE CG) and the RRC setting information for a New 5G cell (New 5G CG) in an LTE cell or in a New 5G cell. Alternatively, 5G UE 1 may receive the RRC setting information for an LTE cell (LTE CG) in an LTE cell and the RRC setting information for a New 5G cell (New 5G CG) in a New 5G cell.

[0033]

The wireless protocol stack shown in FIG. 4 is an example, and 5G UE 1 and integrated eNB 2 may support other protocol stacks. For example, in FIG. 4, an integrated PDCP layer 402 integrates (collaborates) the LTE lower layer and the New 5G lower layer. Alternatively, an integrated MAC layer may be used that operates to integrate (coordinate) the LTE PHY layer 405 and the New PHY layer 408.

[0034]

FIG. 6 illustrates an example of a layer 2 structure for an uplink according to some embodiments. It should be noted that the layer 2 structure for downlink is similar to FIG. 6 except in some respects, such as the names of transport channels are different. The integrated PDCP layer 602, LTE RLC layer 603, LTE MAC layer 604, New RLC layer 606, and New MAC layer 607 shown in FIG. 6 correspond to the integrated PDCP layer 402, LTE RLC layer 403, LTE MAC layer 404, New RLC layer 406, and New MAC layer 407 shown in FIGS. 4 and 5, respectively.

[0035]

The integrated PDCP layer 602 includes one or more PDCP entities. Each PDCP entity carries data for one radio bearer. Each PDCP entity is associated with a user plane or control plane, depending on whether it carries data from the Data Radio Bearer (DRB) or Signaling Radio Bearer (SRB). In the example of FIG. 6, the integrated PDCP layer 602 includes three PDCP entities 6021, 6022, and 6023 corresponding to three radio bearers #1, #2, and #3, respectively. Each of radio bearers #1, #2, and #3 may be an SRB or a DRB.

[0036]

It should be noted that the data of radio bearer #1 is transmitted from 5G UE 1 to integrated eNB 2 (or LTE+ eNB 5) in LTE CG (e.g., LTE cells 21 and 22) via LTE RAT. Thus, in the following, radio bearer #1 is sometimes referred to as an LTE bearer. Radio Bearer #1 is equivalent to LTE Release 12 DC MCG bearer (MCG bearer).

[0037]

The data for radio bearer #2 is transmitted from 5G UE 1 to integrated eNB 2 (or 5G specific eNB 6) in New 5G CG (e.g., New 5G cells 23 and 24) via New 5G RAT. Thus, radio bearer #2 is sometimes referred to as a New 5G bearer. Here, if data is transmitted in New 5G CG managed by 5 G specific eNB 6, then Radio Bearer #2 is the equivalent of the SCG bearer (SCG bearer) of LTE Release 12 DC. On the other hand, if data is transmitted in a New 5G CG managed by integrated eNB 2, radio bearer #2 may correspond to a bearer on the SCG side of the split bearer (split bearer) of LTE Release 12 DC.

[0038]

Radio Bearer #3 is a bearer equivalent to the split bearer (LTE Release 12 DC). That is, radio bearer #3 is associated with both one logical channel of LTE RAT and one logical channel of New 5G RAT in order to use the resources of LTE CG and New 5G CG together. For user data, the logical channel for LTE RAT is the Dedicated Traffic Channel (DTCH). The logical channel of New 5G RAT is a 5G logical channel for user data corresponding to DTCH. Radio bearer #3 is sometimes referred to as a split bearer or an integrated bearer.

[0039]

In the case of uplink transmission by 5G UE 1, PDCP entity 6021 generates PDCP PDUs from data of radio bearer #1 (LTE bearer) and sends them to LTE RLC entity 6031. In the case of uplink reception by Integrated eNB2 (or LTE+eNB 5), PDCP entity 6021 receives RLC SDUs (PDCP PDUs) from LTE RLC entity 6031 and sends the data of radio bearer #1 to the upper layer.

[0040]

In the case of uplink transmission by 5G UE 1, PDCP entity 6022 generates PDCP PDUs from data of radio bearer #2 (New 5G bearer) and sends them to New RLC entity 6061. In the case of uplink reception by Integrated eNB 2 (or 5G specific eNB 6), PDCP entity 6022 receives RLC SDUs (PDCP PDUs) from New RLC entity 6061 and sends data from radio bearer #2 to the upper layer.

[0041]

In the case of uplink transmission by 5G UE 1, PDCP entity 6023 generates PDCP PDUs from data of radio bearer #3 (integrated bearer) and routes these PDCP PDUs to LTE RLC entity 6032 or New RLC entity 6062. In the case of uplink reception by Integrated eNB 2 (or LTE+ eNB 5 and 5G specific eNB 6), PDCP entity 6023 reorders PDCP PDUs (RLC SDUs) received from LTE RLC entity 6032 and New RLC entity 6062 and sends data from radio bearer #3 to a higher layer.

[0042]

Each RLC entity of LTE RLC layer 603 and New RLC layer 606 is configured by an integrated RRC entity (RRC entity 401 in FIG. 4) to transmit RLC Acknowledged Mode (RLC AM) data or RLC Unacknowledged Mode (RLC UM) data to provide PDCP PDUs transfer services. For uplink transmissions by 5G UE 1, each RLC entity of LTE RLC layer 603 generates RLC PDUs (i.e., logical channel data) from PDCP PDUs (RLC SDUs) and sends them to MAC entity 6041 of LTE MAC layer 604. Similarly, each RLC entity in New RLC layer 606 generates RLC PDUs (that is, logical channel data) from PDCP PDUs (RLC SDUs) and sends them to MAC entity 6071 in New MAC layer 607.

[0043]

In the example of FIG. 6, one MAC entity 6041 is used for two LTE cells (LTE CG) set to one 5G UE 1. For uplink transmissions by 5G UE 1, MAC entity 6041 multiplexes RLC PDUs (MAC SDUs) belonging to two logical channels from two RLC entities 6031 and 6032 into two transport blocks permission time interval (TTI). Here, two transport blocks per TTI are sent to LTE physical layer 405 on two UL transport channels (UL-SCHs) corresponding to two LTE cells 21 and 22.

[0044]

Similarly, one MAC entity 6071 is used for two New 5G cells (New 5G CG) set to one 5G UE 1. For uplink transmissions by 5G UE 1, the MAC entity 6071 multiplexes the RLC PDUs (MAC SDUs) belonging to two logical channels from the two RLC entities 6071 and 6072 into two transport blocks permission time interval (TTI). Here, two transport blocks per TTI are sent to the physical layer 408 for New 5G on two UL transport channels (UL TrCH) corresponding to two New 5G cells 23 and 24.

[0045]

As already described, the layer 2 structure for the downlink is similar to FIG. 6 except in some respects, such as different names of transport channels. For example, in the case of downlink reception by 5G UE 1, PDCP entity 6023 of 5G UE 1 reorders PDCP PDUs (RLC SDUs) received from LTE RLC entity 6032 and New RLC entity 6062 and sends data from radio bearer #3 (integrated bearer) to the upper layer.

[0046]

Next, the operation of sending control plane (CP) messages by 5G UE 1 and integrated eNB2 (or LTE+ eNB5 and 5G specific eNB 6) according to this embodiment is described below. The 5G UE 1 and base station systems are configured so that the transmission of CP messages (i.e., RRC signaling) can be performed in the New 5G cell after the configuration and activation of any of the New 5G cells is complete, that is, after the 5G UE 1 has made the New 5G cell available. The 5G UE 1 and base station system may switch the cell in which the CP message is sent from the LTE cell to the New 5G cell. Further or alternatively, the 5G UE 1 and base station systems may adaptively use the cell in which the CP message is sent between the LTE cell and the New 5G cell. Here, the CP message includes a NAS message, an RRC message, or both. The base station system refers to an integrated eNB 2, or LTE+ eNB 5 and 5G specific eNB 6.

[0047]

More specifically, 5G UE 1 is configured to send or receive CP messages from a base station system in any New 5G cell in a New 5G 5GCG when predetermined conditions are met. Similarly, the base station system is configured to send or receive CP messages from 5G UE 1 in any New 5G cell in the New 5G CG when predetermined conditions are met.

The predetermined conditions for determining whether to send CP messages in LTE CG or New 5G CG relate to at least one of the following:

- (a) the content or type of the CP message;
- (b) the type of signaling radio bearer used to send CP messages;
- (c) the sending factors of the CP message; and
- (d) the type of core network associated with the NAS message.

[0048]

Here, (a) the condition regarding the content or type of the CP message may be, for example, that the content or type of the CP message corresponds (or does not correspond) to a specific content or type. The particular content or type may be at least one of, e.g., a request for terminal measurement or a report of measurement results for a New 5G cell, a request or report of terminal (owned) information held by the terminal, access stratum (AS) security configuration information for a New 5G cell, an activation request for AS security or a response to the activation request, configuration information specific to a New 5G RAT, and control information newly defined by the 3GPP for a New 5G cell.

[0049]

(b) The condition for the type of signaling radio bearer used to transmit CP messages may be that, for example, the type of signaling radio bearer used corresponds to (or does not correspond to) a particular type of signaling radio bearer. The particular signaling radio bearer type may correspond to, for example, a predetermined LTE SRB0, SRB1, or SRB2, or may be a new signaling radio bearer (e.g., SRBx).

[0050]

(c) The condition for the CP message transmission factor may be that, for example, the CP message transmission factor falls under (or does not fall under) a particular transmission factor. The particular transmission factor may be at least one of, for example, a deterioration of radio quality in a New 5G cell, a failure to establish a radio link in an LTE cell or a New 5G cell, and a request or response to reestablishment of a radio link from a failure to establish the radio link.

[0051]

(d) The condition for the type of core network associated with a NAS message may be that the core network used to transmit a NAS message, for example, falls under (or does not fall under) a particular type of core network. The particular core network type may be newly introduced, for example, for New 5G RAT, or it may be a unique core network that is pre-specified to be used for a given service or function.

[0052]

In a first implementation, 5G UE 1 may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message includes a measurement report message (measurement report message) from 5G UE 1 for one or more New 5G 5G cells in the New 5G CG. That is, 5G UE 1 may send an RRC message in any cell in New 5G CG if the RRC message includes reporting measurement results from 5G UE 1 for one or more New 5G cells. The base station system may receive the RRC message in any cell in the New 5G CG. On the other hand, 5G UE 1 may transmit the RRC message in any LTE cell if the RRC message comprises reporting measurement results from 5G UE 1 for one or more LTE cells. Here, the reporting of the measurement results to be transmitted in New 5G CG and the reporting of the measurement results to be transmitted in LTE CG may be distinguished (or specified) by the measurement instructions (e.g., MeasConfig IE) or the criteria defining the trigger conditions for the measurement reporting event (e.g., ReportConfigE UTRA IE). For example, a measurement reporting event targeting a cell of a New 5G CG (e.g., PS Cell, special cell, S Cell) may be specified, and the 5G UE 1 may send a report of a measurement result triggered by the measurement reporting event in any cell of the New 5G CG. The New 5G CG cell-targeted measurement reporting event may be defined as an Inter-RAT measurement for an LTE cell.

[0053]

In a second implementation, 5G UE 1 may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message includes a request message (e.g., UE information request message) of terminal (holding) information about New 5G RAT or a report message (e.g., UE information response message) of terminal (holding) information. That is, 5G UE 1 may send (or receive) an RRC message in any cell within New 5G CG if the RRC message includes reporting (or requesting) terminal (holding) information of 5G UE 1 for New 5G RAT. The base station system may receive (or transmit) the RRC message in any cell in New 5G CG. On the other hand, 5G UE 1 may transmit (or receive) an RRC message in any LTE cell if the RRC message includes a report (or request) of terminal (holding) information of 5G UE 1 for LTE RAT. In addition, 5G UE 1 may determine whether to transmit via New 5G CG or LTE CG depending on the type of terminal (holding) information requested or reported. The type of terminal (held) information may be, for example, at least one of the following or a combination thereof:

- Information about wireless links,
- Information about random access; and
- Information about movement history.

[0054]

Information about radio links may be, for example, information about radio quality degradation (e.g., Radio Link Failure (RLF)) in LTE CG (e.g., PCell) or New 5G CG (e.g., PS Cell, Special Cell) or information about radio link failure (e.g., RRC Connection Establishment Failure: CEF, RRC Connection Re-establishment Failure). For example, information on radio quality degradation in LTE CG may be requested or reported in LTE CG (or New 5G CG). Similarly, information about radio quality degradation in 5G CG may be requested or reported in New 5G CG (or LTE CG). On the other hand, information about the failure to establish a wireless link may always be requested or reported in LTE CG (or New 5G CG). It should be noted that the establishment of a wireless link may include the procedure for changing the settings of the wireless protocol (e.g., RRC, PDCP, RLC, MAC, PHY) by RRC Connection Reconfiguration. 5G UE 1 may also individually retain information about the failure to establish a wireless link in LTE CG and information about the failure to establish a wireless link in New 5G CG.

[0055]

The information about random access (RACH) may be, for example, a flag indicating that the number of preamble transmissions made before the random access was successful and the content of the preamble was detected. For example, information about random access in LTE CG may be requested or reported in LTE CG (or New 5G CG). Similarly, information about random access in New 5G CG may be requested or reported in New 5G CG (or LTE CG). It should be noted that 5G UE 1 may separately retain the number of preamble transmissions in LTE CG and the number of preamble transmissions in New 5G CG.

[0056]

The mobility history report (“mobility history report”) may be, for example, information about the cell (resident cell information list: VisitedCellInfoList) in which 5G UE 1 has stayed (up to the time of the request to report such information). The stay cell information list may include at least any of the identification information (e.g., CGI, PCI, Carrier frequency) of the cells that have stayed and the time (seconds) information (timeSpent) of the time spent in each cell. In addition, 5G UE 1 may record the history of a particular cell (e.g., PSCell, Special cell) of a New 5G cell as information for the New 5G RAT-specific cells (e.g., VisitedCellInfoList-5G, VisitedCellInfoList-SRAT). The list of stay cell information for LTE RAT may then be requested or reported at LTE CG and the list of stay cell information for New 5G RAT may be requested or reported at 5G CG.

[0057]

In a third implementation, the base station system may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message includes access stratum (AS) security configuration information for one or more New 5G cells in the New 5GCG. That is, the base station system may transmit the RRC message in any cell in the New 5G CG if the RRC message comprises AS security configuration information for one or more New 5G cells. 5G UE 1 may receive the RRC message in any cell in New 5G CG. On the other hand, a base station system may transmit an RRC message in any LTE cell if the RRC message contains AS security configuration information for one or more LTE cells. It should be noted that security configuration information may be sent as a NAS message (NAS PDU).

[0058]

In a fourth implementation, the base station system may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message comprises an AS security activation request for one or more New 5G cells in the New 5GCG. That is, the base station system may transmit the RRC message in any cell in the New 5G CG if the RRC message comprises an AS security activation request (Security Mode Comm and: SMC) for one or more New 5G cells. 5G UE 1 may receive the RRC message in any cell in New 5G CG. On the other hand, the base station system may transmit the RRC message in any LTE cell if the RRC message comprises an AS security activation request for one or more LTE cells.

[0059]

In a fifth implementation, 5G UE 1 may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message includes a response to an AS security activation request (Security Mode Complete, Security Mode Failure) for one or more New 5G cells. That is, 5G UE 1 may send an RRC message in any cell in New 5G CG if the RRC message includes a response to an AS security activation request for one or more New 5G cells. The base station system may receive the RRC message in any cell in the New 5G CG. On the other hand, 5G UE 1 may transmit the RRC message in any LTE cell if the RRC message comprises a response to an AS security activation request for one or more LTE cells.

[0060]

In a sixth implementation, the base station system may determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message contains configuration information specific to New 5G RAT (e.g., 5G, SCG configuration for 5G, Secondary RAT (sRAT) configuration). That is, the base station system may transmit the RRC message in any cell in the New 5G CG if the RRC message includes configuration information specific to the New 5G RAT. 5G UE 1 may receive the RRC message in any cell in New 5G CG. On the other hand, the base station system may transmit the RRC message in any LTE cell if the RRC message contains configuration information specific to the LTE RAT. Here, setting information specific to New 5G RAT may be at least one of the following:

- Information on terminal capability,
- Information about the service; and
- Information on the management of 5G CG.

[0061]

Information about terminal capability may, for example, be a terminal response to a request (or inquiry) from a base station system for terminal capability (e.g., UE-EUTRA-CapabilityAddSRAT, UE-EUTRA-Capability-SRAT) for New 5G RAT, or for functions supported in a New 5G cell, which may be a request (e.g., via UE Capability Inquiry message) and a report (e.g., via UE Capability Information message) for New 5G CG. Here, to indicate that it is a request for terminal capability with respect to the New 5G RAT, for example, “sRAT” or “eutra2” may be specified and used as the RAT-Type of the UE-CapabilityRequest IE. It should be noted that at least some of the terminal capabilities associated with the New 5G RAT required to connect to the New 5G cell may be transmitted in the LTE cell.

[0062]

Information about the service may, for example, be control information necessary for the realization of the service provided in New 5G CG (e.g., radio resource configuration, service area information, service availability information, service type/category information), or control information about the content of the service (e.g., content information, Scheduling/planning information). It should be noted that the services described herein may be services that can be provided in LTE or only in 5G. The service may be, for example, Multimedia Broadcast and Multicast Service (MBMS) (MBMS over a Single Frequency Network (MBSFN), single cell point to multipoint (SC-PTM)), Cell Broadcast Service (CBS), Proximity Services (ProSe), Vehicle-to-Everything (V2X) services, or Mobile Edge Computing (MEC).

[0063]

Information about the management of New 5G CG may be, for example, information about changes in specific cells (e.g., PSCell, Special cell) of New 5G CG (e.g., PSCell/Special cell reconfiguration, pSCellToAddMod-rlx). In addition or alternatively, a base station system may send radio resource configuration information (e.g., sCellToAdd ModListSRAT, sCell ToReleaseListSRAT, RadioResourceConfigDedicatedSCell SRAT) for other New 5G cells (e.g., sCellToAdd ModListSRAT, sCell ToReleaseListSRAT, RadioResourceConfigDedicatedSCell SRAT) as information for the management of New 5G CG when additionally setting or releasing other New 5G cells (e.g., 5G SCell) after a particular New 5G cell has been set to 5G UE 1 (e.g., PSCell, Special cell, Special cell is made available). That is, information related to the addition and release of cells in New 5G CG, and the modification of a particular New 5G cell may be transmitted in any cell in New 5G CG.

[0064]

It should be noted that, although the configuration information is specific to New 5G RAT, the basic configuration information required for 5G UE 1 to connect to (or detect) a New 5G cell may be transmitted in an LTE cell. The preference information may be, for example, information about subframe configurations (different from LTE), information about TTI length, information about sampling rates, or information about cell types.

[0065]

In a sixth implementation, the base station system may determine whether to send the RRC message via New 5G CG or LTE CG, depending on whether the RRC message includes control information newly defined by the 3GPP for the New 5G cell. That is, the base station system may transmit the RRC message in any cell in the New 5G CG if the RRC message includes newly defined control information for the New 5G cell. 5G UE 1 may receive the RRC message in any cell in New 5G CG. On the other hand, the base station system may transmit the RRC message in any LTE cell if the RRC message comprises existing control information for the LTE. Here, control information for a New 5G cell may be at least one of the following, or a combination:

- Information about core network selection; and
- Information on the independent operation of New 5G cells.

[0066]

The information about core network selection is, for example, a new type of core network (e.g., 5G specific EPC 42 with the introduction of New 5G RAT. It is also known as 5G Dedicated Core Network (DCN).) Information about it is acceptable. For example, information about core network selection may be identification information (e.g., MME ID, MMEC, GUM MEI, MMEGI, GUTI, TAI, TEID) of core network nodes (e.g., MME ID, MMEC, GUM MEI, MMEGI, GUTI, TAI, TEID) or request (or notification) of switching connections of core network nodes (e.g., Route Command, Reroute Request, Reroute indication, DCN selection information, DCN relocation information). These are required when switching connections from integrated EPC 41 to 5G specific EPC 42 (or vice versa). Further or alternatively, the information about the core network selection may be auxiliary information (assistance information) for selecting a 5G specific EPC (5G DCN) 42. The auxiliary information may be, for example, terminal type (device type), usage type (UE usage type), or expected (recommended) core network information (expected/preferred CN information). It should be noted that information about the core network selection may be sent as a NAS message (NAS PDU).

[0067]

Information about the standalone operation of a New 5G cell may be, for example, configuration information (e.g., Radio resource configuration for 5G /SRAT PCell) necessary to use the New 5G cell as a primary cell (PCell) instead of using the New 5G cell as a secondary cell (SCell) for an LTE cell (PCell), or information that requires or specifies using the New 5G cell as a PCell (e.g., Handover to 5G /SRAT cell, Redirection to 5G /SRAT cell). It should be noted that this information may be transmitted in the newly defined signaling radio bearer (e.g., SRBx). In addition, the information required to set the SRBx may also be transmitted in a New 5G cell or in an LTE cell.

[0068]

In the first to sixth implementations described above, the 5G UE 1 and the base station system determine whether to send the RRC message via New 5G CG or LTE CG depending on whether the RRC message relates to a New 5G RAT or a New 5G cell. Thus, 5G UE 1 and base station systems may exchange RRC messages related to New 5G 5G RAT or New 5G cells via either cell in New 5G CG. This can contribute, for example, to sending RRC messages for New 5G RAT or New 5G cells with low latency.

[0069]

In a seventh implementation, 5G UE 1 may determine whether to send a CP message (i.e., RRC message or NAS message) via New 5G CG or LTE CG depending on whether or not to send the CP message via a specific signaling radio bearer associated with the New 5G RAT. That is, 5G UE 1 may send a CP message in any cell in New 5G CG if it sends the CP message via a particular signaling radio bearer associated with New 5G RAT. The base station system may receive the CP message in any cell in New 5G CG. It should be noted that a particular signaling radio bearer may be an LTE SRB0, SRB1, or SRB2, or may be a new signaling radio bearer (e.g., SRBx). On the other hand, 5G UE 1 may send a CP message in any LTE cell if it sends the CP message via a specific signaling radio bearer associated with the LTE RAT.

[0070]

Similarly, in an eighth implementation, a base station system may determine whether to send a CP message (i.e., RRC message or NAS message) via New 5G CG or LTE CG depending on whether or not to send the CP message via a specific signaling radio bearer associated with a New 5G RAT. That is, a base station system may transmit a CP message in any cell in New 5G CG when transmitting the CP message via a specific signaling radio bearer associated with the New 5G RAT. 5G UE 1 may receive the CP message in any cell in New 5G CG. On the other hand, the base station system may transmit the CP message in any LTE cell when transmitting the CP message via a specific signaling radio bearer associated with the LTE RAT.

[0071]

In the seventh and eighth implementations described above, the 5G UE 1 and the base station system determine whether to send the CP message via New 5G CG or LTE CG depending on whether the signaling radio bearer used to transmit the CP message is a particular bearer or is associated with the New 5G RAT. Thus, 5G UE 1 and base station systems may exchange CP messages related to New 5G 5G RAT or New 5G cells via either cell in New 5G CG. This can contribute, for example, to sending CP messages for New 5G RAT or New 5G cells with low latency.

[0072]

In a ninth implementation, 5G UE 1 may determine whether to send a CP message via New 5G CG or LTE CG depending on whether the sending factor of the CP message (i.e., RRC message or NAS message) is a degradation of radio quality of any New 5G cell. That is, 5G UE 1 may transmit the CP message in any cell in New 5G CG if the CP message is sent due to a deterioration in radio quality of any New 5G cell. The base station system may receive the CP message in any cell in New 5G CG. This can contribute, for example, to sending CP messages for New 5G RAT or New 5G cells with low latency. On the other hand, 5G UE 1 may transmit an RRC message containing the NAS message in any LTE cell if the transmission factor of the CP message is a deterioration of radio quality of any LTE cell.

[0073]

In a tenth implementation, 5G UE 1 may determine whether to send a NAS message via New 5G CG or LTE CG depending on whether the core network associated with the NAS message is a new type of core network (e.g., 5G specific EPC 42) associated with the introduction of New 5G RAT. That is, 5G UE 1 may send an RRC message containing the NAS message in any cell in New 5G CG if the core network associated with the NAS message is a new type of core network associated with the introduction of New 5G RAT. The base station system may receive an RRC message containing the NAS message in any cell in New 5G CG. This can contribute, for example, to sending NAS messages about new types of core networks with New 5G RAT at low latency. On the other hand, 5G UE 1 may send an RRC message containing the NAS message in any LTE cell if the core network associated with the NAS message is another core network (e.g., integrated EPC 41).

[0074]

Similarly, in an eleventh implementation, a base station system may determine whether to send a NAS message via New 5G CG or LTE CG depending on whether the core network associated with the NAS message is a new type of core network (e.g., 5G specific EPC 42) associated with the introduction of New 5G RAT. That is, the base station system may transmit an RRC message containing the NAS message in any cell in New 5G CG if the core network associated with the NAS message is a new type of core network associated with the introduction of New 5G RAT. 5G UE 1 may receive an RRC message containing the NAS message in any cell in New 5G CG. On the other hand, a base station system may send an RRC message containing the NAS message in any LTE cell if the core network associated with the NAS message is another core network (e.g., integrated EPC 41).

[0075]

In the first through eleventh implementations described above, the sending or receiving of an RRC message may occur in a particular cell of LTE CG or New 5G CG. For example, if an RRC message is sent or received in LTE CG, a primary cell (PCell) may be used. Also, if an RRC message is sent or received in New 5G CG, a primary secondary cell (PSCell) may be used. It should be noted that the PCell and PSCell are also referred to as Special Cells (SpCells).

[0076]

In some implementations, LTE+ eNB 5 may send CP messages or information about them sent in a New 5G cell to 5G specific eNB 6. Further or alternatively, 5G specific eNB 6 may send LTE+ eNB5 CP messages or information about them that are transmitted or received (i.e., sent from 5G UE 1) in a New 5G cell. Additionally, 5G specific eNB 6 may send or receive control plane information (CP messages (e.g., NAS messages, S1 Application Protocol (S1AP) messages) to or from nodes (e.g., MME) in the core network (integrated EPC 41 or 5G specific EPC 42).

[0077]

FIG. 7 shows an example of LTE+ eNB5 sending control plane information (CP messages) for a New 5G cell to a 5G specific eNB6. In step 701 A or 701 B, the 5G specific eNB 6 receives an X2 message from the LTE+eNB5 that at least contains control plane information (CP messages) for the New 5G cell. The X2 message may be a DL USER DATA message of the X2 User Plane Protocol (X2-UP) (step 701A) or may be a newly defined DL CONTROL DATA message. The X2 message may be an X2 AP Message Transfer message of X2AP (step 701 B). Alternatively, the X2 message may be a SeNB Modification Request message (e.g., MeNB to SeNB Container) specified for Dual Connectivity, or may be a newly specified X2 message (e.g., SeNB Configuration Request message).

[0078]

Further or alternatively, 5G specific eNB 6 may receive an S1AP message containing control plane information about a New 5G cell from an integrated EPC 41 (e.g., MME 7) or a 5 G specific EPC 42 (step 702). The S1AP message may be an MM E Configuration Transfer message, an MME Direct Information Transfer message, or other S1AP message. At step 703, 5G specific eNB 6 sends an RRC Connection Reconfiguration message containing control plane information (CP message) for a New 5G cell received from LT E+ eNB 5, integrated EPC 41, or 5G specific EPC 42 to 5G UE 1 in a New 5G cell.

[0079]

FIG. 8 shows an example of 5G specific eNB 6 sending control plane information (CP messages) about a New 5G cell to LTE+ eNB 5. In step 801 A or 801 B, the 5G specific eNB 6 sends an X2 message containing at least control plane information (CP messages) for the New 5G cell to the LTE+eNB5. The X2 message may be an X2AP Message Transfer message (step 801A). Alternatively, the X2 message may be a SeNB Modification Required message specified for Dual Connectivity (step 801 B).

[0080]

LTE+eNB5 may initiate a SeNB Modification procedure in response to receiving the X2 message. For example, LTE+ eNB 5 may send a SeNB Modification Request message (RRC Container: SCG-ConfigInfo) to 5G specific eNB6 (step 802). In response to receiving the SeNB Modification Request message, the 5G specific eNB 6 may send a SeNB Modification Request Acknowledge message (RRC Container: including SCG-Config) to the LTE+ eNB5 (step 803). At step 803, 5G specific eNB 6 may transmit control plane information about the 5G cell to LTE+ eNB 5.

[0081]

5G specific eNB 6 may receive an S1AP message containing control plane information about a New 5G cell from an integrated EPC 41 (e.g., MME 7) or a 5G specific EPC 42 (step 804). It should be noted that 5G specific eNB 6 may perform steps 801 A or 801 B in response to receiving control plane information for a 5G cell from integrated EPC 41 or 5G specific EPC 42.

[0082]

At step 805, the 5G specific eNB 6 sends an RRC Connection Reconfiguration message containing control plane information (CP message) for the New 5G cell to the 5G UE 1 in the New 5G cell.

[0083]

FIG. 9 shows another example in which a 5G specific eNB 6 sends control plane information (CP messages) about a New 5G cell to an LTE+ eNB5. At step 901, 5G specific eNB 6 receives control plane information from 5G UE 1 in a 5G cell. At step 902, 5G specific eNB 6 sends an X2 message containing at least a portion of the control plane information received from 5G UE 1 to LTE+ eNB 5. The X2 message may be, for example, an X2AP Message Transfer message or a newly defined X2 message (e.g., SeNB Configuration Update message). It should be noted that 5G specific eNB 6 may generate other control information in response to receiving control plane information from 5G UE 1 and transmit such other control information to LTE+ eNB5 at step 902.

[0084]

Further, the 5G specific eNB 6 may send an S1AP message containing at least a portion of the control plane information received from the 5G UE 1 to the integrated EPC 41 (e.g., MME7) or the 5G specific EPC 42 (step 903). The S1AP message may be, for example, an eNB Configuration Transfer message, an eNB Direct Information Transfer message, or other S1AP message. The 5G specific eNB 6 may generate other control information in response to receiving control plane information from the 5G UE 1 and transmit the other control information to the integrated EPC 41 (e.g., MME 7) or the 5G specific EPC 42 at step 903.

[0085]

FIG. 10 is a flowchart illustrating an example (processing 1000) of a 5G UE 1 and CP message transmission operation by a base station system. In step 1001, the RRC layer (i.e., integrated RRC layer 401 or New RRC layer 511) generates an RRC message. The RRC message may be an RRC message (e.g., UL Information Transfer message, DL Information Transfer message) carrying a NAS message.

[0086]

At step 1002, the RRC layer determines whether to send the RRC message via LTE CG or New 5G CG, depending on (a) the content or type of the RRC message, (b) the type of signaling radio bearer used to transmit the RRC message, (c) the transmission factor of the RRC message, or (d) the type of core network associated with the NAS message contained in the RRC message. As previously described, an RRC layer may send the RRC message via any New 5G cell, for example, if the content or type of the RRC message relates to a New 5G RAT or New 5G cell.

[0087]

In step 1003, the RRC layer sends the message to the PDCP entity corresponding to the cell for RRC message transmission determined in step 1002. This allows the 5G UE 1 and base station systems to control whether RRC messages or NAS messages contained therein are sent via LTE CG or New 5G CG.

[0088]

<Second embodiment>

Examples of wireless communication networks and wireless protocol stacks according to this embodiment are similar to FIGS. 1-6. In this embodiment, the selection of key K_{eNB} for derivation (e.g., K_{UPenc} , K_{RRCin}) is described for derivation of a lump-sum key (e.g., K_{UPenc} , K_{RRCin}) used by each PDCP entity within the PDCP layer (i.e., the integrated PDCP layer 602 or New PDCP layer 512). These temporary keys are used by each PDCP entity, for example, for encryption (ciphering) and decoding (deciphering) of user plane (UP) traffic and RRC traffic. These temporary keys are derived from the key K_{eNB} by 5G UE 1. Similarly, these temporary keys are derived from the key K_{eNB} by integrated eNB2, LTE+ eNB5, or 5G specific eNB6.

[0089]

In some implementations, 5G UE 1 and integrated eNB 2 (or LTE+ eNB 5 and 5G specific eNB 6) may use the first key K_{eNB} for encryption/decryption of data for radio bearer of one bearer type (bearer type) and may use the second key sub- K_{eNB} for encryption/decryption of data for radio bear of another bear type (bearer type). The second key sub- K_{eNB} may be derived from the first key K_{eNB} , similar to the key S- K_{eNB} used for SCG bearers in Dual Connectivity (DC).

[0090]

For example, as shown in FIG. 11, 5G UE 1 and integrated eNB 2 (or LTE+ eNB 5 and 5G specific eNB 6) may use the first key K_{eNB} for encrypting/decrypting data of the LTE bearer (radio bearer #1 in FIG. 6) and the integrated bearer (radio bearer #3 in FIG. 6) and may use the second key sub- K_{eNB} for encrypting/decrypting data of the New 5G bearer (radio bearer #2 in FIG. 6).

[0091]

For example, in a Co-located arrangement (FIG. 1 and FIG. 2), 5G UE 1 and integrated eNB 2 may use the first key K_{eNB} when sending RRC messages on an LTE bearer and the same first key K_{eNB} when sending RRC messages on a New 5G bearer. In contrast, for a non colocated arrangement (FIG. 3), 5G UE 1 and LTE+ eNB5 may use the first key K_{eNB} when sending RRC messages on an LTE bearer, and 5G UE 1 and 5G specific eNB6 may use the second key sub- K_{eNB} when sending RRC messages on a New 5G bearer.

[0092]

Next, the following will describe 5G UE 1, and an example configuration of integrated eNB2, LTE + eNB 5, and 5G specific eNB 6, according to the plurality of embodiments described above. FIG. 12 is a block diagram illustrating an example configuration of 5G UE 1. The LTE transceiver 1201 performs analog RF signal processing for the PHY layer of the LTE RAT to communicate with the integrated eNB2 (or LTE+ eNB 5). Analog RF signal processing performed by the LTE transceiver 1301 includes frequency upconversion, frequency downconversion, and amplification. The LTE transceiver 1201 is coupled with the antenna 1202 and the baseband processor 1205. That is, the LTE transceiver 1201 receives modulation symbol data (or OFDM symbol data) from the baseband processor 1205, generates a transmitted RF signal, and supplies the transmitted RF signal to the antenna 1202. The LTE transceiver 1201 also generates a baseband receive signal based on the received RF signal received by the antenna 1202 and supplies it to the baseband processor 1205.

[0093]

The New 5G transceiver 1203 performs analog RF signal processing for the PHY layer of the New 5G RAT to communicate with the integrated eNB 2 (or 5G specific eNB 6). New 5G transceiver 1203 is coupled with antenna 1204 and baseband processor 1205.

[0094]

The baseband processor 1205 performs digital baseband signal processing (data plane processing) and control plane processing for wireless communication. Digital baseband signal processing includes (a) data compression/restore, (b) data segmentation/concatenation, (c) transmission format (transmission frame) generation/decomposition, (d) transmission path encoding/decryption, (e) modulation (symbol mapping)/demodulation, and (f) OFDM symbol data (baseband OFDM signal) generation by Inverse Fast Fourier Transform (IFFT). Control plane processing, on the other hand, includes Layer 1 (e.g., transmit power control), Layer 2 (e.g., radio resource management, and hybrid automatic repeat request (HARQ) processing), and Layer 3 (e.g., signaling for attach, mobility, and packet communication).

[0095]

For example, for LTE and LTE-Advanced, digital baseband signal processing by the baseband processor 1205 may include signal processing of the Packet Data Convergence Protocol (PDCP) layer, the Radio Link Control (RLC) layer, the MAC layer, and the PHY layer. Control plane processing by the baseband processor 1205 may also include processing of the Non-Access Stratum (NAS) protocol, the RRC protocol, and the MAC CE.

[0096]

The baseband processor 1205 may include a modem processor (e.g., Digital Signal Processor (DSP)) for digital baseband signal processing and a protocol stack processor (e.g., Central Processing Unit (CPU) or Micro Processing Unit (MPU)) for control plane processing. In this case, the protocol stack processor performing control plane processing may be common to the application processor 1206 described below.

[0097]

Application processor 1206 is also referred to as a CPU, MPU, microprocessor, or processor core. The application processor 1206 may include a plurality of processors (multiple processor cores). Application processor 1206 realizes various functions of 5G UE 1 by executing a system software program (Operating System (OS)) read from memory 1208 or memory not shown and various application programs (e.g., communication applications that obtain metering or sensing data).

[0098]

In some implementations, the baseband processor 1205 and the application processor 1206 may be integrated on a single chip, as shown in FIG. 12 with a dashed line (1207). In other words, the baseband processor 1205 and the application processor 1206 may be implemented as one System on Chip (SoC) device 1207. SoC devices are sometimes referred to as system Large Scale Integration (LSI) or chipsets.

[0099]

Memory 1208 is volatile or non-volatile memory or a combination thereof. The memory 1208 may include a plurality of physically independent memory devices. Volatile memory is, for example, Static Random Access Memory (SRAM) or Dynamic RAM (DRAM) or a combination thereof. Nonvolatile memory is a mask Read Only Memory (MROM), an Electronic Erasable Programmable ROM (EEPROM), a flash memory, or a hard disk drive, or any combination thereof. For example, memory 1208 may include a baseband processor 1205, an application processor 1206, and an external memory device accessible from SoC 1207. Memory 1208 may include an internal memory device integrated within baseband processor 1205, application processor 1206, or SoC 1207. Further, the memory 1208 may include memory in a Universal Integrated Circuit Card (UICC).

[0100]

Memory 1208 may store one or more software modules (computer programs) 1209 that include instructions and data for processing by 5G UE 1 described in the embodiments described above. In some implementations, the baseband processor 1205 or the application processor 1206 may be configured to perform the processing of the 5G UE 1 described in the embodiments described above by reading and executing the software module 1209 from the memory 1208.

[0101]

FIG. 13 is a block diagram illustrating an example configuration of an integrated eNB 2 according to an embodiment described above. Referring to FIG. 13, eNB 2 includes an LTE transceiver 1301, a New 5G transceiver 1303, a network interface 1305, a processor 1306, and a memory 1307. The LTE transceiver 1301 performs analog RF signal processing for the PHY layer of the LTE RAT to communicate with the 5G UE 1 via the LTE cell. The LTE transceiver 1301 may include a plurality of transceivers. The LTE transceiver 1301 is coupled with the antenna 1302 and the processor 1306.

[0102]

The New 5G transceiver 1303 performs analog RF signal processing for the PHY layer of the New 5G RAT to communicate with the 5G UE 1 via the New 5G cell. New 5G transceiver 1303 is coupled with antenna 1304 and baseband processor 1306.

[0103]

The network interface 1305 is used to communicate with network nodes (e.g., Mobility Management Entity (MME) and Serving Gateway (S-GW)) within the integrated EPC 41 or 5G specific EPC 42, and other eNBs. The network interface 1305 may include, for example, an IEEE 802.3 series compliant network interface card (NIC).

[0104]

The processor 1306 performs digital baseband signal processing (data plane processing) and control plane processing for wireless communication. For example, for LTE and LTE-Advanced, digital baseband signal processing by processor 1306 may include signal processing of PDCP layer, RLC layer, MAC layer, and PHY layer. Control plane processing by processor 1306 may also include processing of S1 protocol, RRC protocol, and MAC CE.

[0105]

Processor 1306 may include a plurality of processors. For example, processor 1306 may include a modem processor (e.g., DSP) for digital baseband signal processing and a protocol stack processor (e.g., CPU, or MPU) for control plane processing.

[0106]

The memory 1307 is configured by a combination of volatile and non-volatile memory. Volatile memory is, for example, SRAM or DRAM or a combination thereof. Nonvolatile memory is, for example, MROM, PROM, flash memory, or hard disk drive, or a combination thereof. The memory 1307 may include storage disposed away from the processor 1306. In this case, processor 1306 may access memory 1307 via network interface 1305 or an I/O interface not shown.

[0107]

Memory 1307 may store a software module (computer program) 1308 that includes instructions and data for processing by integrated eNB2 described in the embodiments described above. In some implementations, the processor 1306 may be configured to perform the processing of the integrated eNB 2 described in the embodiments described above by reading and executing the software module 1308 from the memory 1307.

[0108]

Each configuration of LTE+ eNB 5 and 5G specific eNB 6 may be similar to the configuration of integrated eNB 2 shown in FIG.13. However, the LTE+ eNB 5 does not need to include a New 5G transceiver 1303, and the 5G specific eNB 6 does not need to include an LTE transceiver 1301.

[0109]

As described with FIGS. 12 and 13, each of the processors having 5G UE 1 and integrated eNB 2, LTE+ eNB 5, and 5G specific eNB 6 according to the above embodiments executes one or more programs including instructions for causing the computer to perform the algorithm described using the drawings. The program can be stored and supplied to a computer using various types of non-transitory computer readable medium (non-transitory computer readable medium). Non-transitory computer-readable media includes various types of entity-based recording media (tangible storage medium). Examples of non-transitory computer-readable media include magnetic recording media (e.g., flexible disks, magnetic tapes, hard disks), optical magnetic recording media (e.g., optical magnetic disks), Compact Disc Read Only Memory (CD-ROM), CD-R, CD-R/W, semiconductor memory (e.g., mask ROM, Programmable ROM (PROM), Erasable PROM (EPROM), flash ROM, Random Access Memory (RAM)). The program may also be supplied to the computer by various types of temporary computer readable medium (transitory computer readable medium). Examples of temporary computer readable media include electrical signals, optical signals, and electromagnetic waves.

The temporary computer-readable medium can supply the program to the computer via a wired communication path, such as a wire and optical fiber, or a wireless communication path.

[0110]

<Other embodiments>

The embodiments described above may each be implemented independently or in combination as appropriate.

[0111]

The protocol stack described in the above embodiments is an example, and other protocol stacks may be employed for interworking LTE RAT and New 5G RAT. In some implementations, existing LTE/LTE-Advanced Carrier Aggregation (CA) or Dual Connectivity (DC) protocol stacks, or modifications thereof as appropriate, may be employed for interworking LTE RAT and New 5G RAT. For example, a co-located arrangement or co-located RAN may use an integrated MAC layer (sublayer) instead of an integrated PDCP layer (sublayer). In this case, the integrated MAC layer may control the LTE PHY layer and the New PHY layer to perform a CA between the LTE cell and the New 5G cell.

[0112]

The base station, base station system, integrated eNB 2, LTE+ eNB 5, 5G specific eNB 6, BBU (or DU), and RRH (or RU) described in the above embodiments may be referred to as a wireless station or radio access network (RAN) node. In other words, the processing and operation performed by the base station, base station system, Integrated eNB 2, LTE+ eNB 5, 5G specific eNB 6, BBU (DU), or RRH (RU) described in the above embodiments may be provided by any one or more wireless stations (RAN nodes).

[0113]

Furthermore, the above-described embodiments are merely examples of the application of technical ideas obtained by the present inventor. That is, the technical ideas are not limited to the above-described embodiments, and of course, various modifications are possible.

[0114]

For example, some or all of the above embodiments may also be described, such as, but not limited to:

[0115]

(Supplementary Note 1)

A wireless terminal comprising: a memory;
and at least one processor coupled to the memory,
the at least one processor configured to communicate with a wireless station system including one or more wireless stations simultaneously in one or more first cells conforming to a first radio access technology
and one or more second cells conforming to a second radio access technology used subordinately in addition to the one or more first cells, and configured to transmit or receive a control plane message to or from the wireless station system in the one or more second cells
if a predetermined condition is satisfied,

the control plane message including a non-access stratum (NAS) message or a radio resource control (RRC) message or both,

the predetermined condition relating to at least one of

(a) a content or type of the control plane message, (b) a type of a signaling radio bearer used to transmit the control plane message, (c) a transmission cause of the control plane message, and (d) a type of a core network associated with the NAS message.

[0116]

(Supplementary Note 2)

The wireless terminal according to Supplementary Note 1,

wherein the predetermined condition relates to a content or type of the control plane message, and the at least one processor is configured to receive or transmit the control plane message in the one or more second cells when the control plane message includes a request to the wireless terminal for terminal measurements on the one or more second cells or a report of measurement results from the wireless terminal on the one or more second cells.

[0117]

(Supplementary Note 3)

The wireless terminal according to Supplementary Note 1,

wherein the predetermined condition relates to a content or type of the control plane message, and the at least one processor is configured to receive or transmit the control plane message in the one or more second cells when the control plane message includes a request to the wireless terminal for terminal information of the wireless terminal related to the second radio access technology or a report of the terminal information from the wireless terminal.

[0118]

(Supplementary Note 4)

The wireless terminal according to Supplementary Note 1,

wherein the predetermined condition relates to a content or a type of the control plane message, and the at least one processor is configured to receive the control plane message in the one or more second cells if the control plane message includes security configuration information of an access stratum (AS) for the one or more second cells.

[0119]

(Supplementary Note 5)

The wireless terminal according to Supplementary Note 1,

wherein the predetermined condition relates to a content or type of the control plane message, and the at least one processor is configured to receive or transmit the control plane message in the one or more second cells

if the control plane message includes a request to the wireless terminal for activation of access stratum (AS) security for the one or more second cells or a response to the request from the wireless terminal.

[0120]

(Supplementary Note 6)

The wireless terminal according to Supplementary Note 1,
wherein the predetermined condition relates to a content or type of the control plane message, and at least one processor is configured to receive the control plane message in the one or more second cells if the control plane message includes configuration information specific to the second radio access technology.

[0121]

(Supplementary Note 7)

The wireless terminal according to Supplementary Note 1,
wherein the predetermined condition relates to a type of a signaling radio bearer used to transmit the control plane message, and the at least one processor is configured to transmit or receive the control plane message in the one or more second cells if the control plane message is transmitted via a specific signaling radio bearer associated with the second radio access technology.

[0122]

(Supplementary Note 8)

The wireless terminal according to Supplementary Note 1,
wherein the predetermined condition relates to a cause of transmission of the control plane message, and the at least one processor is configured to transmit the control plane message in the one or more second cells if the control plane message is transmitted due to deterioration of wireless quality in the one or more second cells.

[0123]

(Supplementary Note 9)

The wireless terminal according to Supplementary Note 1,
wherein the predetermined condition relates to a type of a core network associated with the NAS message, and the at least one processor is configured to receive or transmit the control plane message including the NAS message in the one or more second cells if the core network is a new type of core network associated with the introduction of the second radio access technology.

[Explanation of References]

[0124]

- 1 Wireless terminal (5G UE)
- 2 Base station (integrated eNB)
- 3 RRH
- 5 LTE+ eNB
- 6 5G specific eNB
- 41 Integrated EPC
- 42 5G specific EPC
- 1201 LTE transceiver
- 1203 New 5G transceiver
- 1205 Baseband processor
- 1206 Application processor
- 1208 Memory
- 1301 LTE transceiver
- 1303 New 5G transceiver
- 1306 Processor

[Document Name] Scope of Claims

[Claim 1]

A wireless station system comprising one or more wireless stations,
the one or more wireless stations configured to simultaneously provide one or more first cells conforming to a first radio access technology

and one or more second cells conforming to a second radio access technology used subordinately in addition to the one or more first cells to one wireless terminal,

and configured to transmit or receive control plane messages to or from the wireless terminal in the one or more second cells when a predetermined condition is satisfied,

wherein the control plane messages including non-access stratum (NAS) messages or radio resource control (RRC) messages or both,

and wherein the predetermined condition relating to at least one of

(a) the content or type of the control plane messages, (b) the type of a signaling radio bearer used to transmit the control plane messages, (c) the cause of the transmission of the control plane messages, and (d) the type of a core network associated with the NAS messages.

[Claim 2]

The wireless station system according to Claim 1,

wherein the predetermined condition relates to a content or type of the control plane message,
and the one or more wireless stations are configured to transmit or receive the control plane message in the one or more second cells when the control plane message includes a request to the wireless terminal for terminal measurements on the one or more second cells or a report of measurement results from the wireless terminal on the one or more second cells.

[Claim 3]

The wireless station system according to Claim 1,

wherein the predetermined condition relates to a content or type of the control plane message,
and the one or more wireless stations are configured to transmit or receive the control plane message in the one or more second cells when the control plane message includes a request to the wireless terminal for terminal information of the wireless terminal related to the second radio access technology or a report of the terminal information from the wireless terminal.

[Claim 4]

The wireless station system according to Claim 1,

wherein the predetermined condition relates to a content or a type of the control plane message, and the one or more wireless stations are configured to transmit the control plane message in the one or more second cells if the control plane message includes security configuration information of an access stratum (AS) for the one or more second cells.

[Claim 5]

The wireless station system according to Claim 1,

wherein the predetermined condition relates to a content or type of the control plane message, and the one or more wireless stations are configured to transmit or receive the control plane message in the one or more second cells

if the control plane message includes a request to the wireless terminal for activation of access stratum (AS) security for the one or more second cells or a response to the request from the wireless terminal.

[Claim 6]

The wireless station system according to Claim 1,
wherein the predetermined condition relates to a content or type of the control plane message, and the one or more wireless stations are configured to transmit the control plane message in the one or more second cells if the control plane message includes configuration information specific to the second radio access technology.

[Claim 7]

The wireless station system according to Claim 1,
wherein the predetermined condition relates to a type of a signaling radio bearer used to transmit the control plane message, and the one or more wireless stations are configured to transmit or receive the control plane message in the one or more second cells
if the control plane message is transmitted via a specific signaling radio bearer associated with the second radio access technology.

[Claim 8]

The wireless station system according to Claim 1,
wherein the predetermined condition relates to a cause of transmission of the control plane message, and the one or more wireless stations are configured to receive the control plane message in the one or more second cells
if the control plane message is transmitted due to deterioration of wireless quality in the one or more second cells.

[Claim 9]

The wireless station system according to Claim 1,
wherein the predetermined condition relates to a type of a core network associated with the NAS message, and the one or more wireless stations are configured to transmit or receive the control plane message including the NAS message in the one or more second cells
if the core network is a new type of core network associated with the introduction of the second radio access technology.

[Claim 10]

The wireless station system according to any one of Claims 1 to 9,
wherein the one or more wireless stations are configured to provide a Radio Link Control (RLC) and Medium Access Control (MAC) layer for communicating with the radio terminal according to the first radio access technology, a Radio Link Control (RLC) and Medium Access Control (MAC) layer for communicating with the wireless terminal according to the second radio access technology, a common Packet Data Convergence Protocol (PDCP) layer associated with both of the two RLC layers, and a common RRC layer associated with the common PDCP layer.

[Claim 11]

The wireless station system according to any one of Claims 1 to 9,
wherein the one or more wireless stations include a first wireless station for the first radio access technology
and a second wireless station for the second radio access technology, the second wireless station providing a Radio Link Control (RLC) and Medium Access Control (MAC) layer for communicating with the wireless terminal according to the second radio access technology, and the first wireless station is configured to provide a Radio Link Control (RLC) and Medium Access Control (MAC) layer for communicating with the wireless terminal
according to the first radio access technology, a common Packet Data Convergence Protocol (PDCP) layer associated with both of the two RLC layers, and a common RRC layer associated with the common PDCP layer.

[Claim 12]

The wireless station system according to any one of Claims 1 to 11,
wherein the first radio access technology is a continuing evolution of LTE and LTE-Advanced,
and the second radio access technology is a new 5G radio access technology.

[Claim 13]

A method in a wireless station system including one or more wireless stations,
comprising: simultaneously providing one or more first cells conforming to a first radio access technology
and one or more second cells conforming to a second radio access technology used subordinatedly in addition
to the one or more first cells to one wireless terminal;

and, when a predetermined condition is satisfied, transmitting or receiving a control plane message in the
one or more second cells to the wireless terminal, the control plane message including

a non-access stratum (NAS) message or a radio resource control (RRC) message or both,
the predetermined condition relating to at least one of

(a) the content or type of the control plane message, (b) the type of a signaling radio bearer used to transmit
the control plane message, (c) the transmission cause of the control plane message,
and (d) the type of a core network associated with the NAS message.

[Claim 14]

A wireless terminal comprising: a memory;

and at least one processor coupled to the memory,

the at least one processor configured to communicate with a wireless station system including one or more
wireless stations simultaneously in one or more first cells conforming to a first radio access technology

and one or more second cells conforming to a second radio access technology used subordinatedly in
addition to the one or more first cells, and configured to transmit or receive a control plane message to or
from the wireless station system in the one or more second cells

if a predetermined condition is satisfied,

the control plane message including a non-access stratum (NAS) message or a radio resource control
(RRC) message or both,

the predetermined condition relating to at least one of

(a) a content or type of the control plane message, (b) a type of a signaling radio bearer used to transmit
the control plane message, (c) a transmission cause of the control plane message,

and (d) a type of a core network associated with the NAS message.

[Claim 15]

The wireless terminal according to Claim 14,

wherein the at least one processor is configured to provide a Radio Link Control (RLC) and Medium Access
Control (MAC) layer for communicating with the wireless station system according to the first radio access
technology, a Radio Link Control (RLC) and Medium Access Control (MAC) layer for communicating with
the wireless station system according to the second radio access technology, a common Packet Data
Convergence Protocol (PDCP) layer associated with both of the two RLC layers, and a common RRC layer
associated with the common PDCP layer.

[Claim 16]

The wireless terminal according to Claim 14 or 15,

wherein the first radio access technology is a continuing evolution of LTE and LTE-Advanced,
and the second radio access technology is an emerging 5G radio access technology.

[Claim 17]

A method in a wireless terminal, comprising:

communicating with a wireless station system including one or more wireless stations simultaneously in one or more first cells conforming to a first radio access technology

and one or more second cells conforming to a second radio access technology used subordinatedly in addition to the one or more first cells;

and transmitting or receiving a control plane message to or from the wireless station system in the one or more second cells if a predetermined condition is satisfied,

the control plane message including a non-access stratum (NAS) message or a radio resource control (RRC) message or both,

the predetermined condition relating to at least one of

(a) the content or type of the control plane message, (b) the type of a signaling radio bearer used to transmit the control plane message, (c) the cause of the transmission of the control plane message, and (d) the type of a core network associated with the NAS message.

[Claim 18]

A program for causing a computer to execute a method in a wireless terminal,

the method comprising: communicating with a wireless station system including one or more wireless stations simultaneously in one or more first cells conforming to a first radio access technology and one or more second cells conforming to a second radio access technology used subordinatedly in addition to the one or more first cells;

and transmitting or receiving a control plane message to or from the wireless station system in the one or more second cells if a predetermined condition is satisfied,

the control plane message including a non-access stratum (NAS) message or a radio resource control (RRC) message or both,

the predetermined condition relating to at least one of

(a) the content or type of the control plane message,

(b) the type of a signaling radio bearer used to transmit the control plane message,

(c) a transmission cause of the control plane message, and (d) the type of a core network associated with the NAS message.

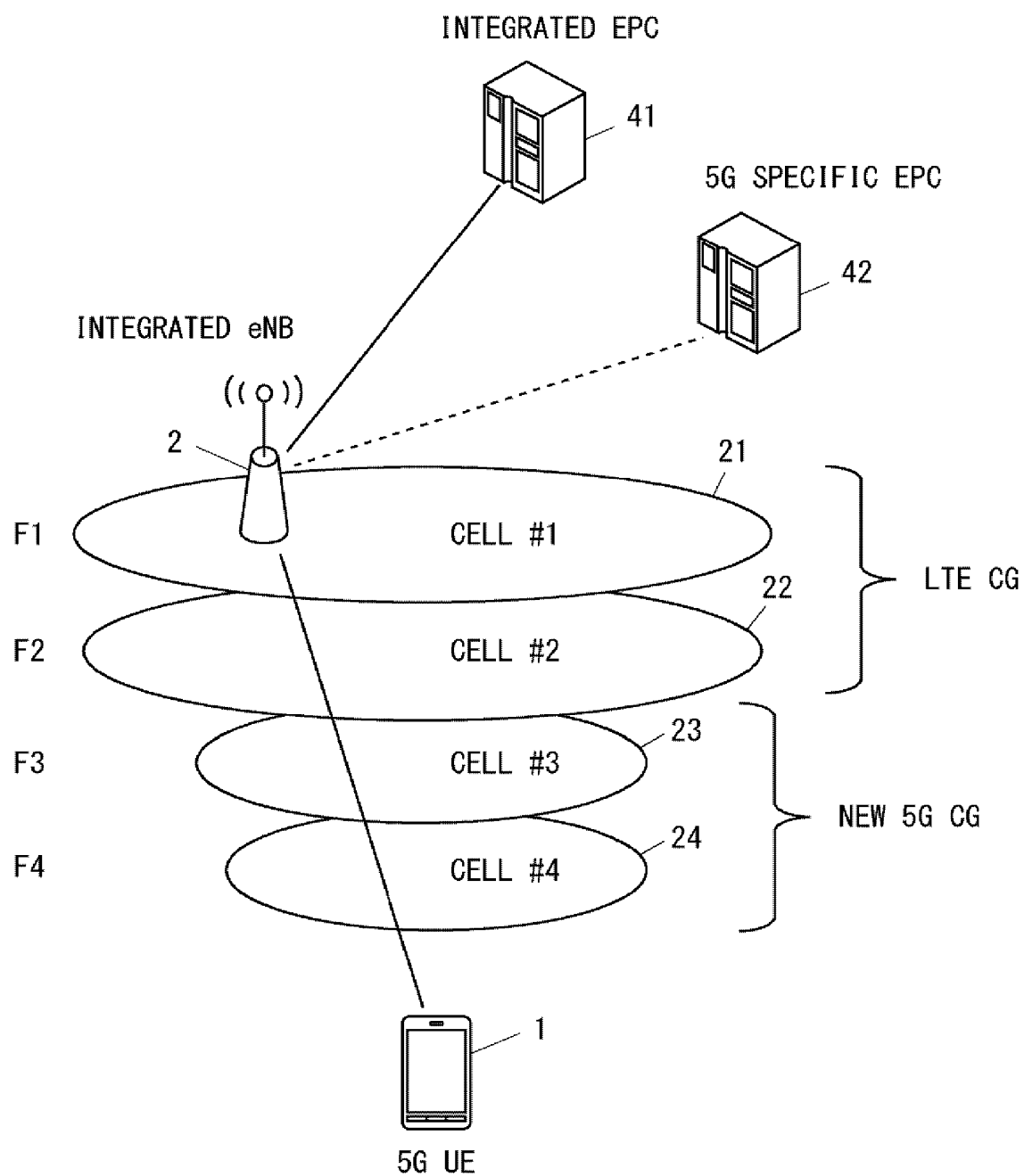
[Document Name] Summary

[Summary]

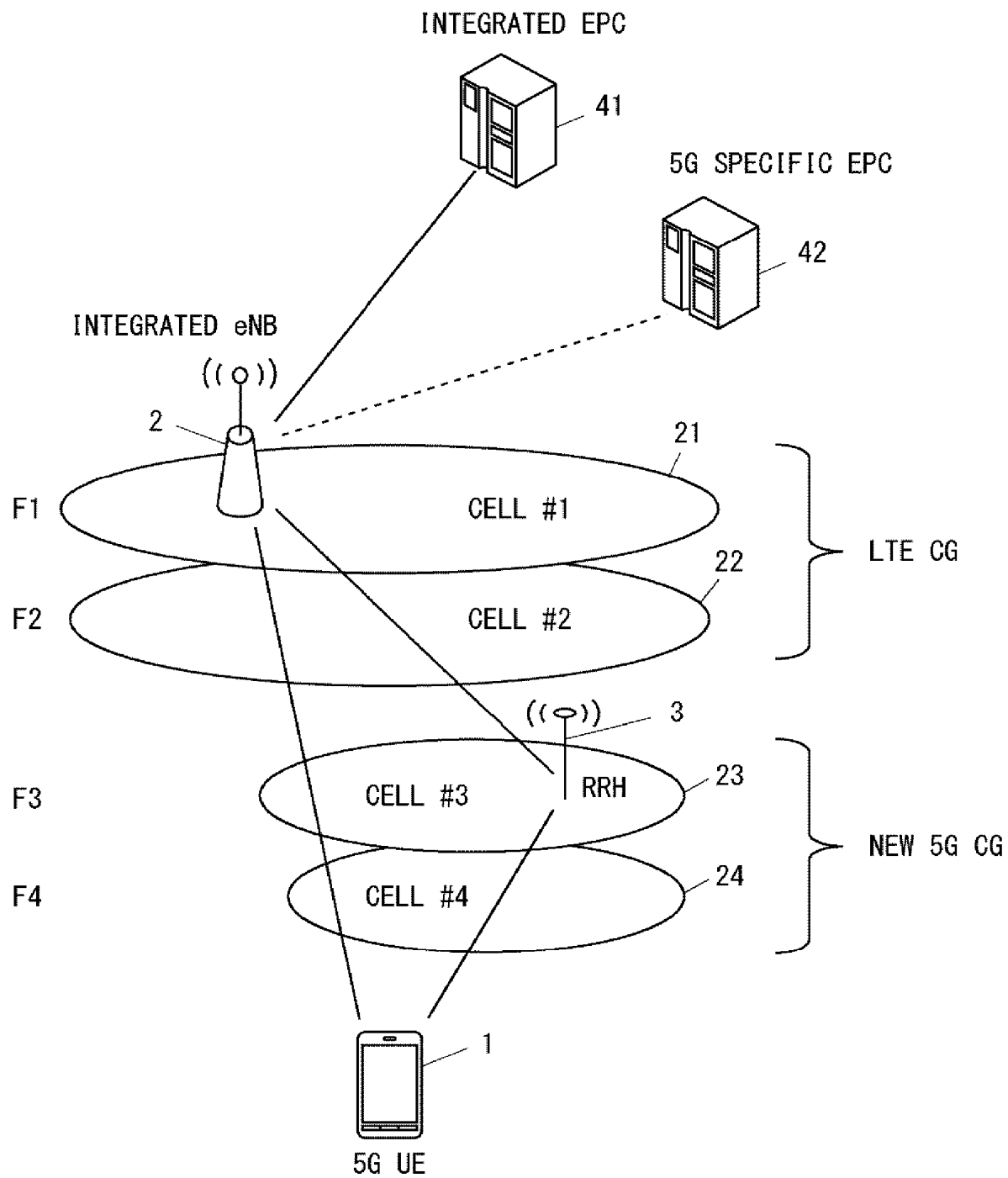
[Problem] In a wireless architecture that provides interworking of two different Radio Access Technology (RATs), it contributes to the effective transmission of control plane (CP) messages.

[Means for solving] Wireless station (2) sends or receives CP messages containing NAS messages and/or RRC messages to and from wireless terminal (1) in second cell (23, 24) when predetermined conditions are met. The second cell (23, 24) uses a different RAT from the first cell and is used dependently in addition to the first cell. The predetermined condition relates to at least one of: (a) the content or type of the CP message; (b) the type of signaling radio bearer used to transmit the CP message; (c) the sending factor of the CP message; and (d) the type of core network associated with the NAS message.

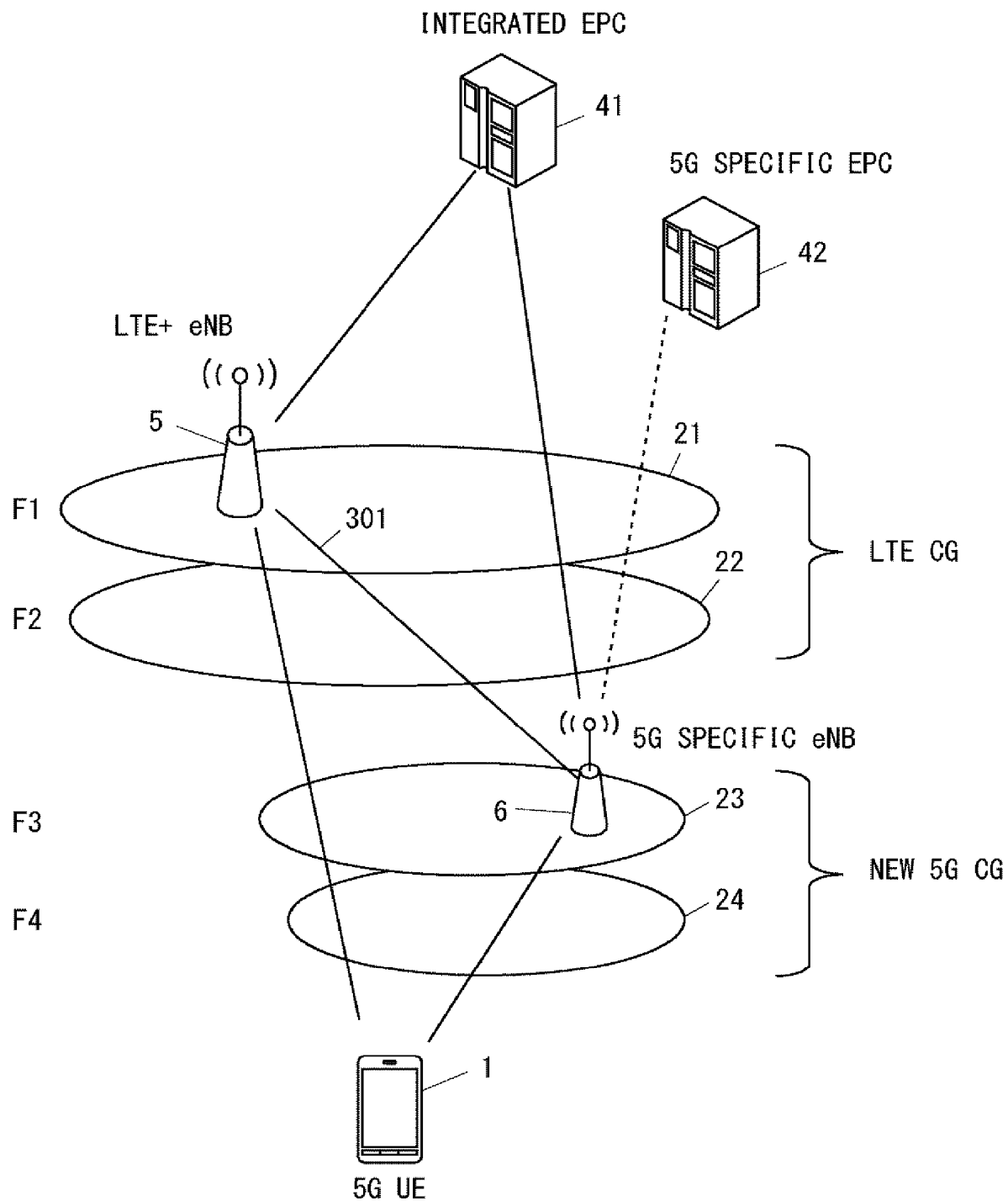
[Selected Drawing] FIG. 10



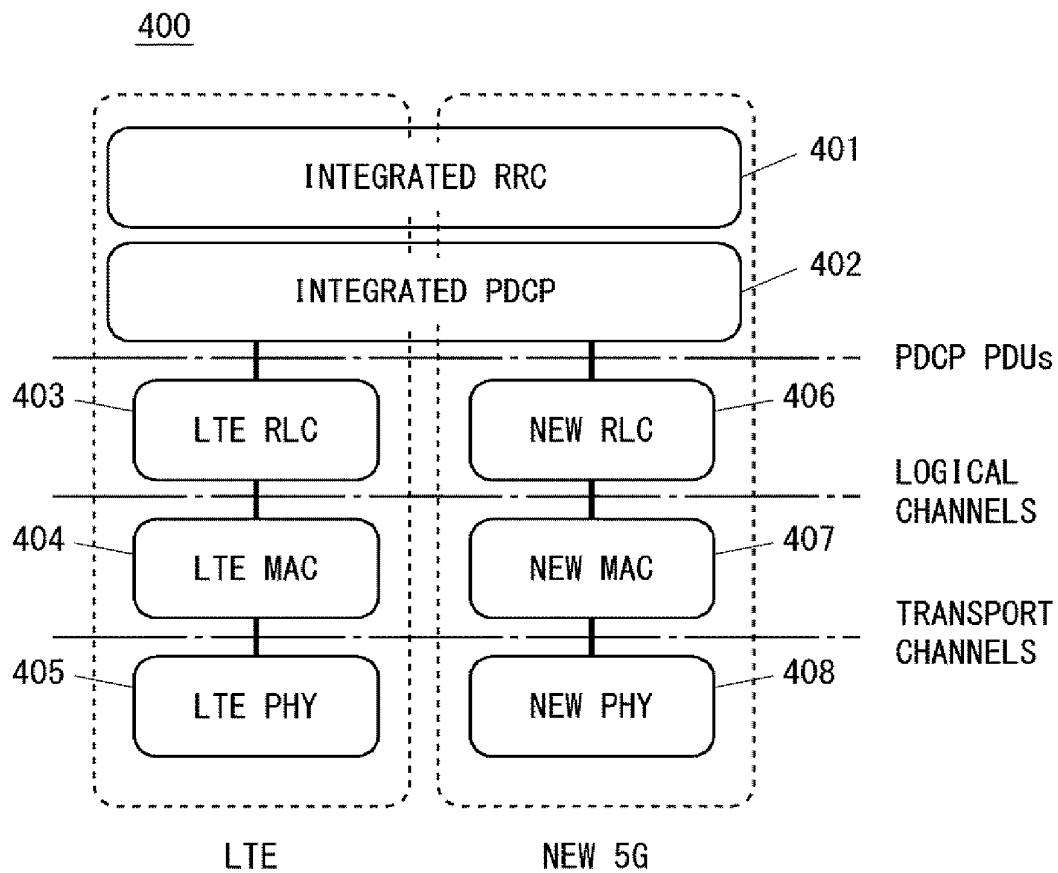
[FIG. 2]



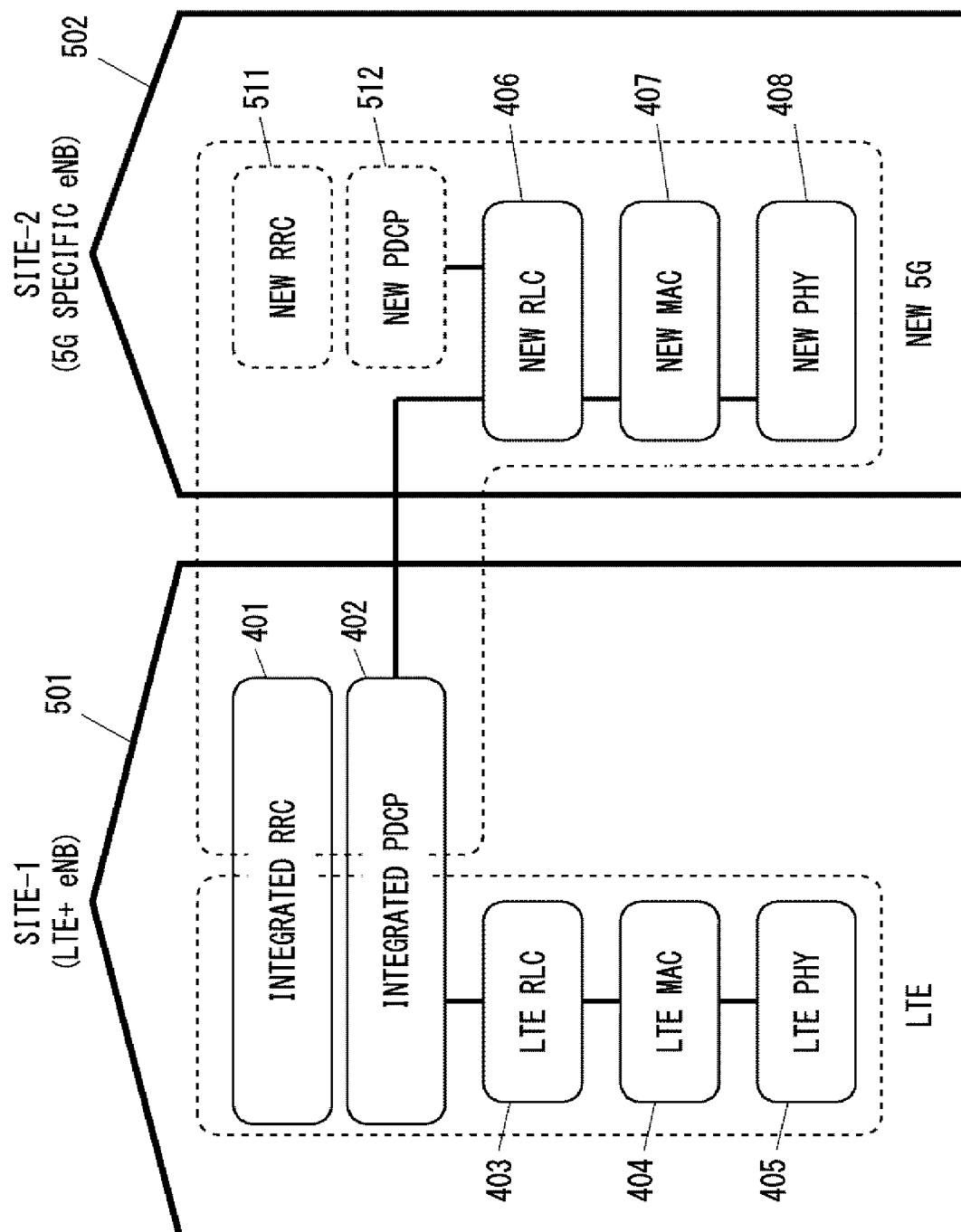
[FIG. 3]



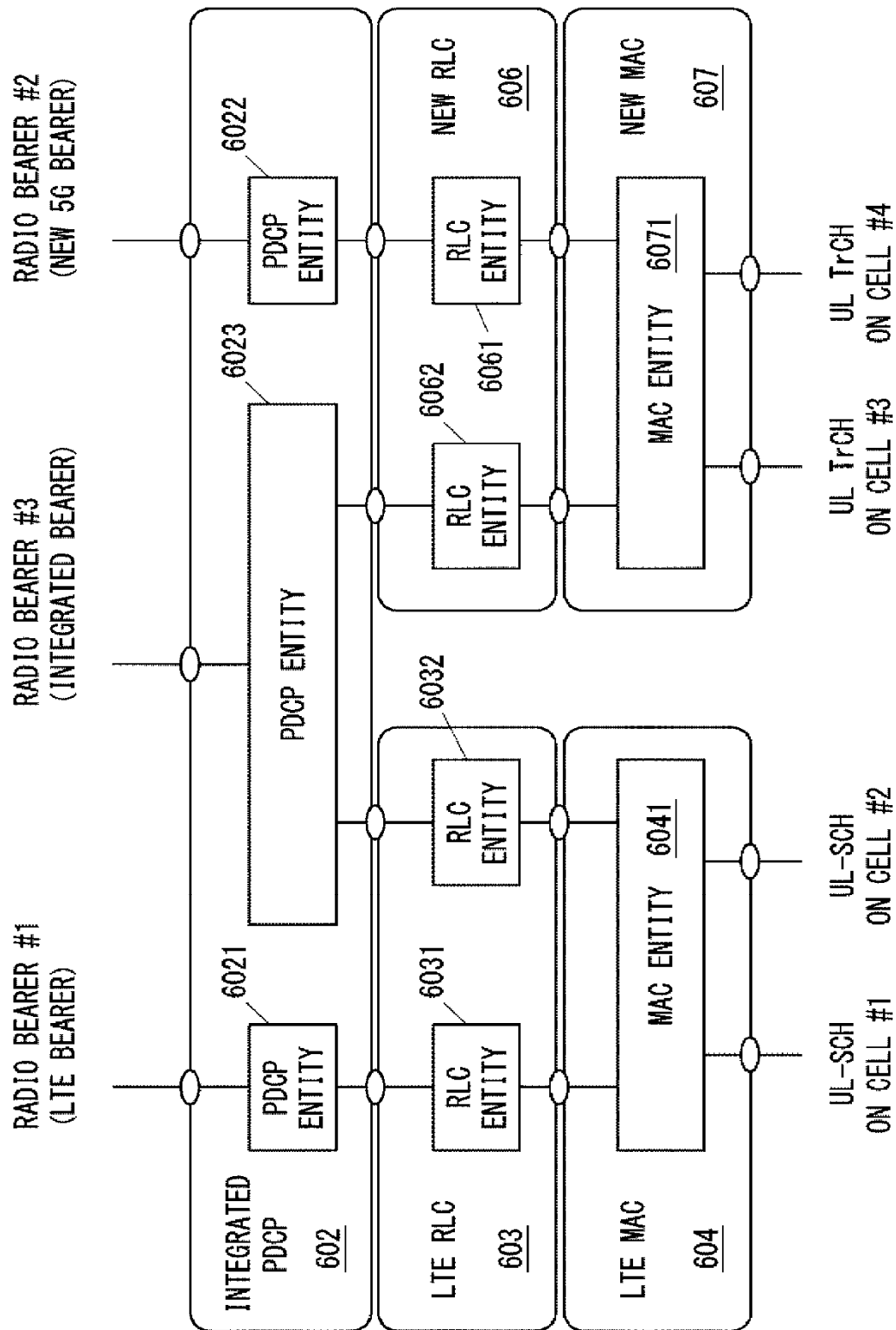
[FIG. 4]



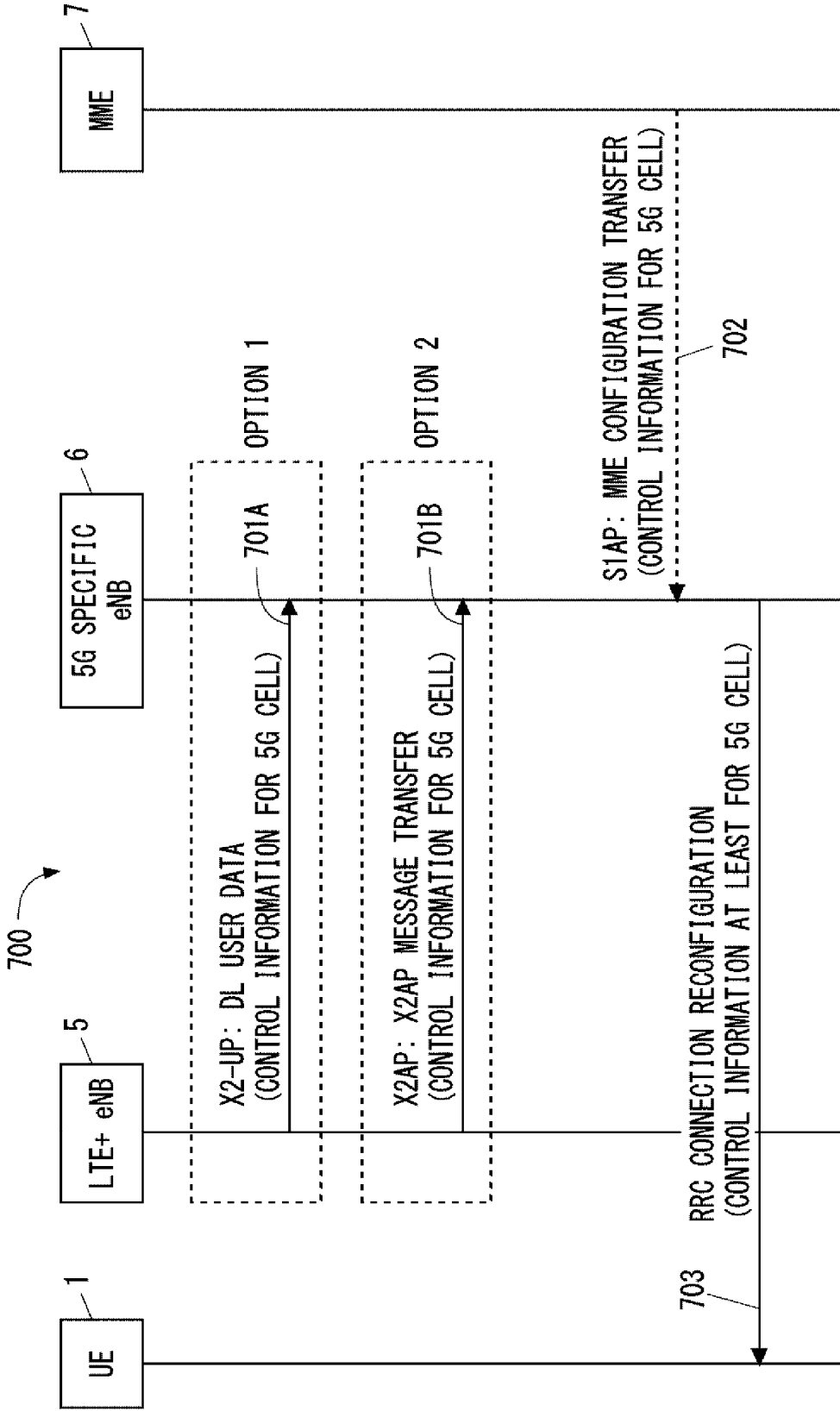
[FIG. 5]



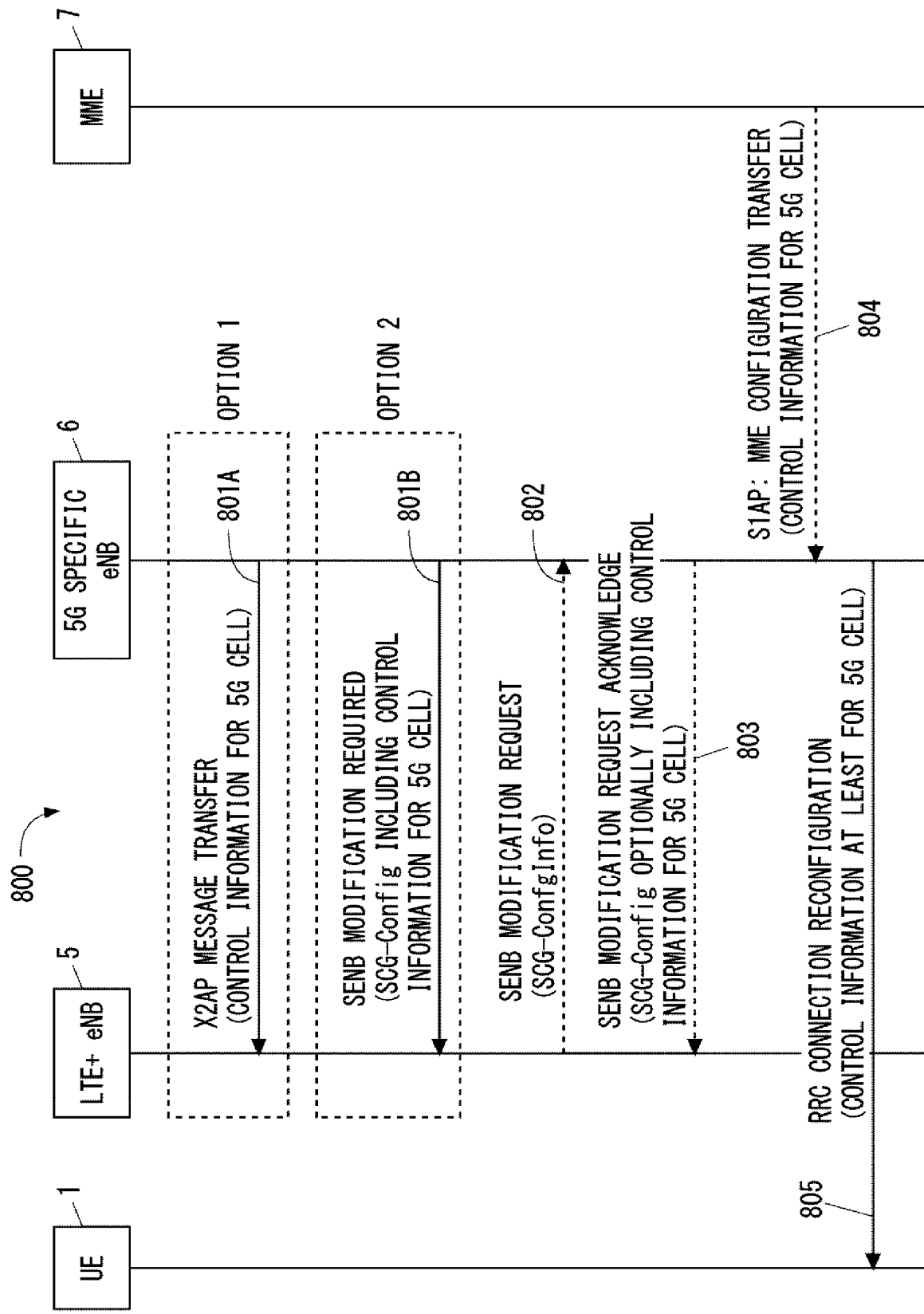
[FIG. 6]



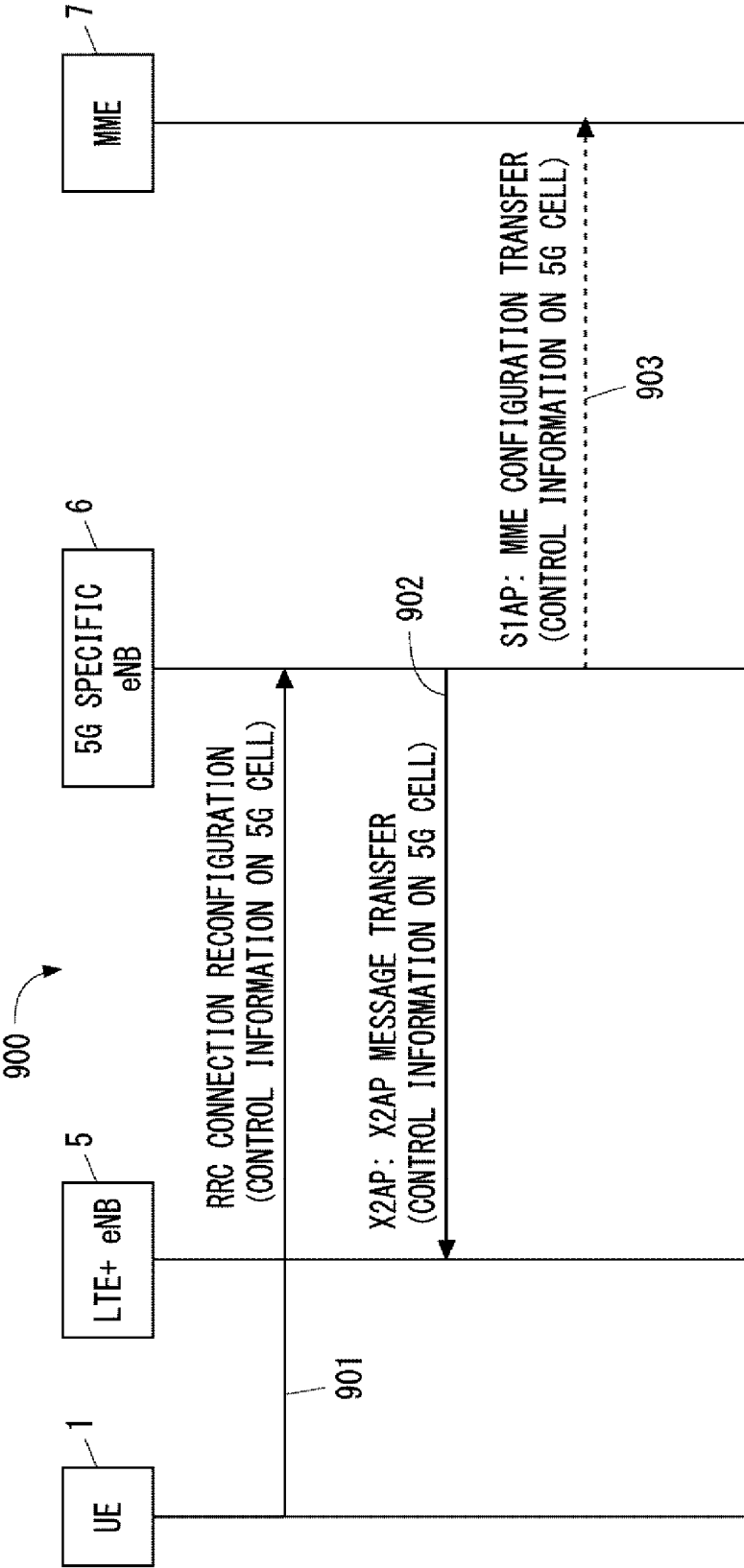
[FIG. 7]



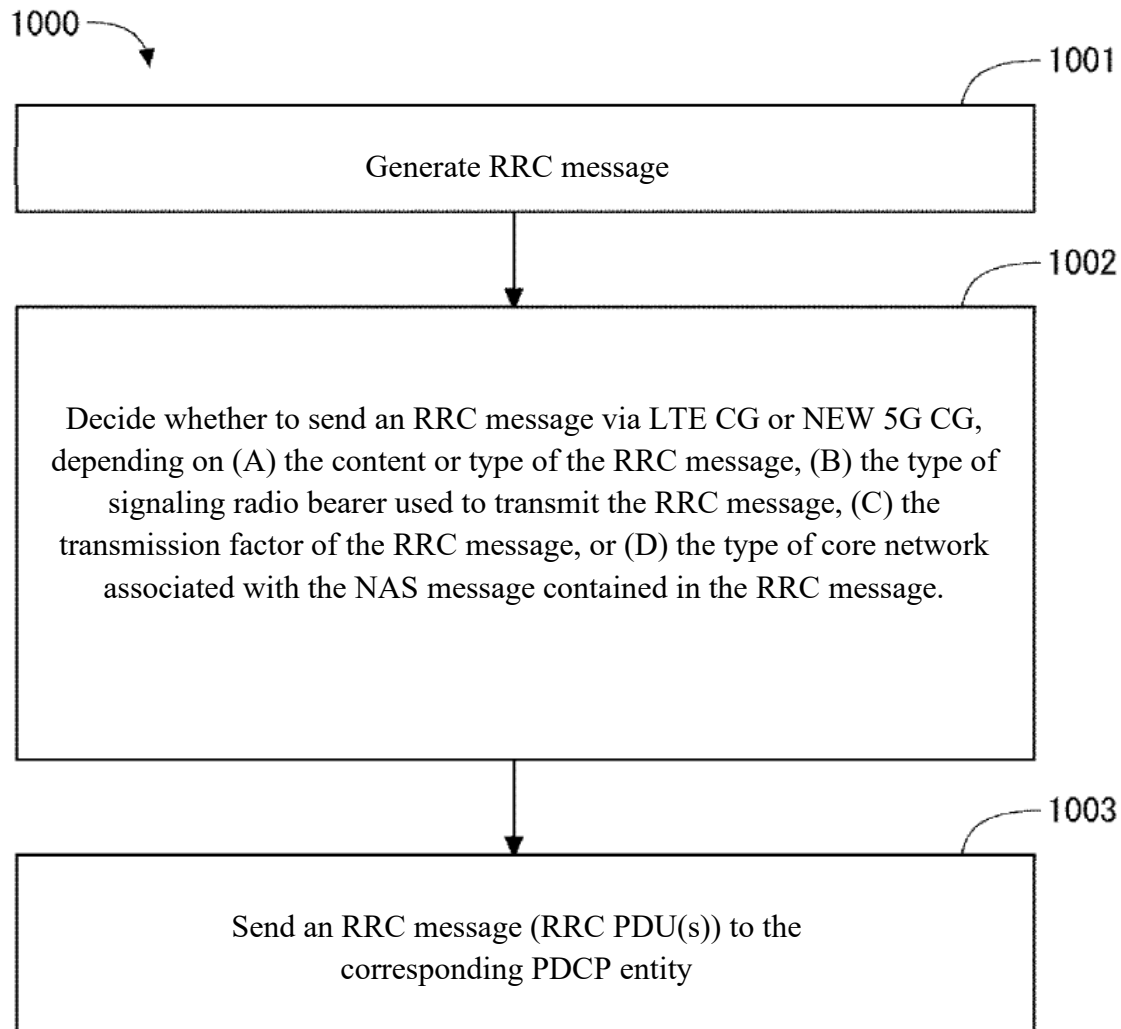
[FIG. 8]



[FIG. 9]



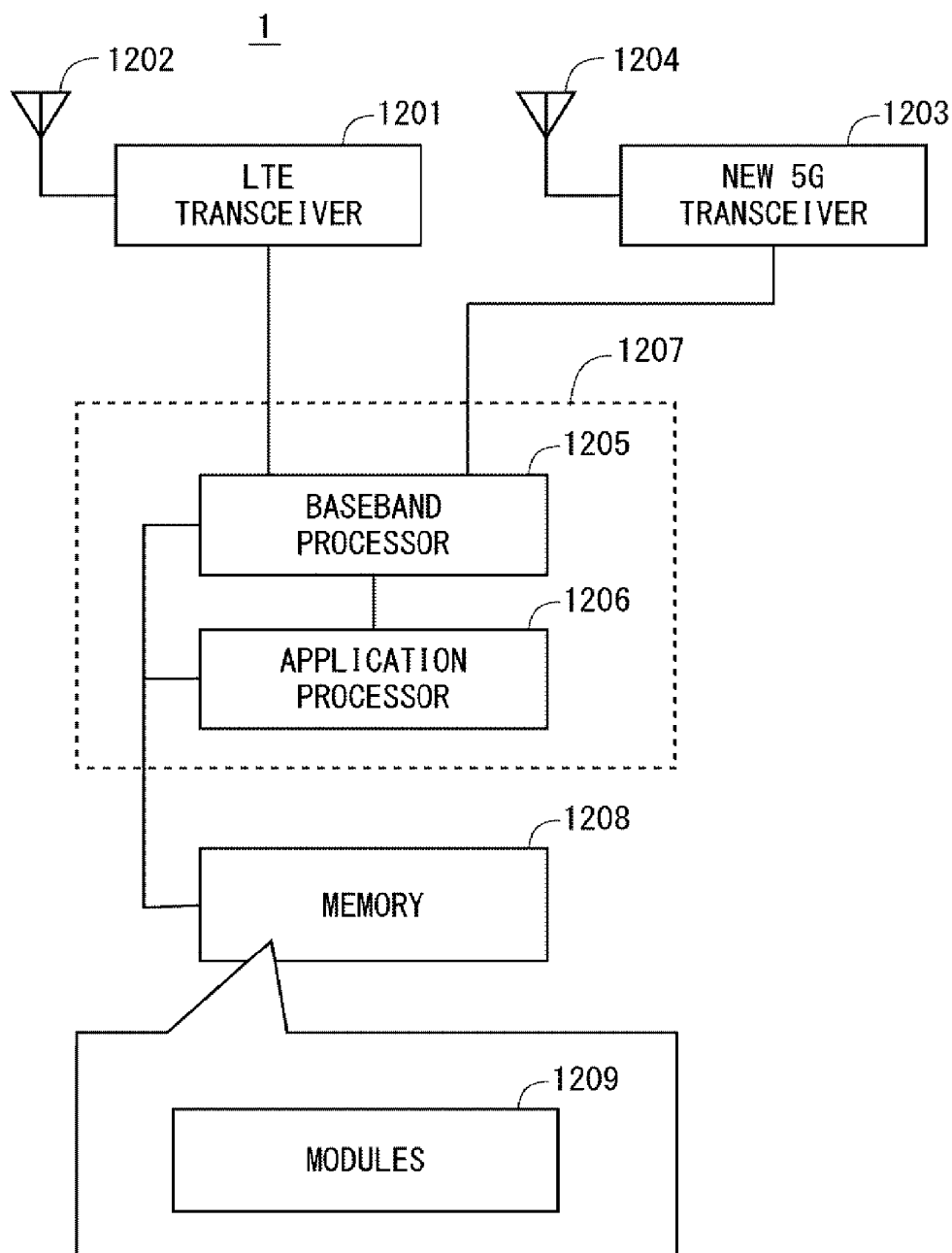
[FIG. 10]



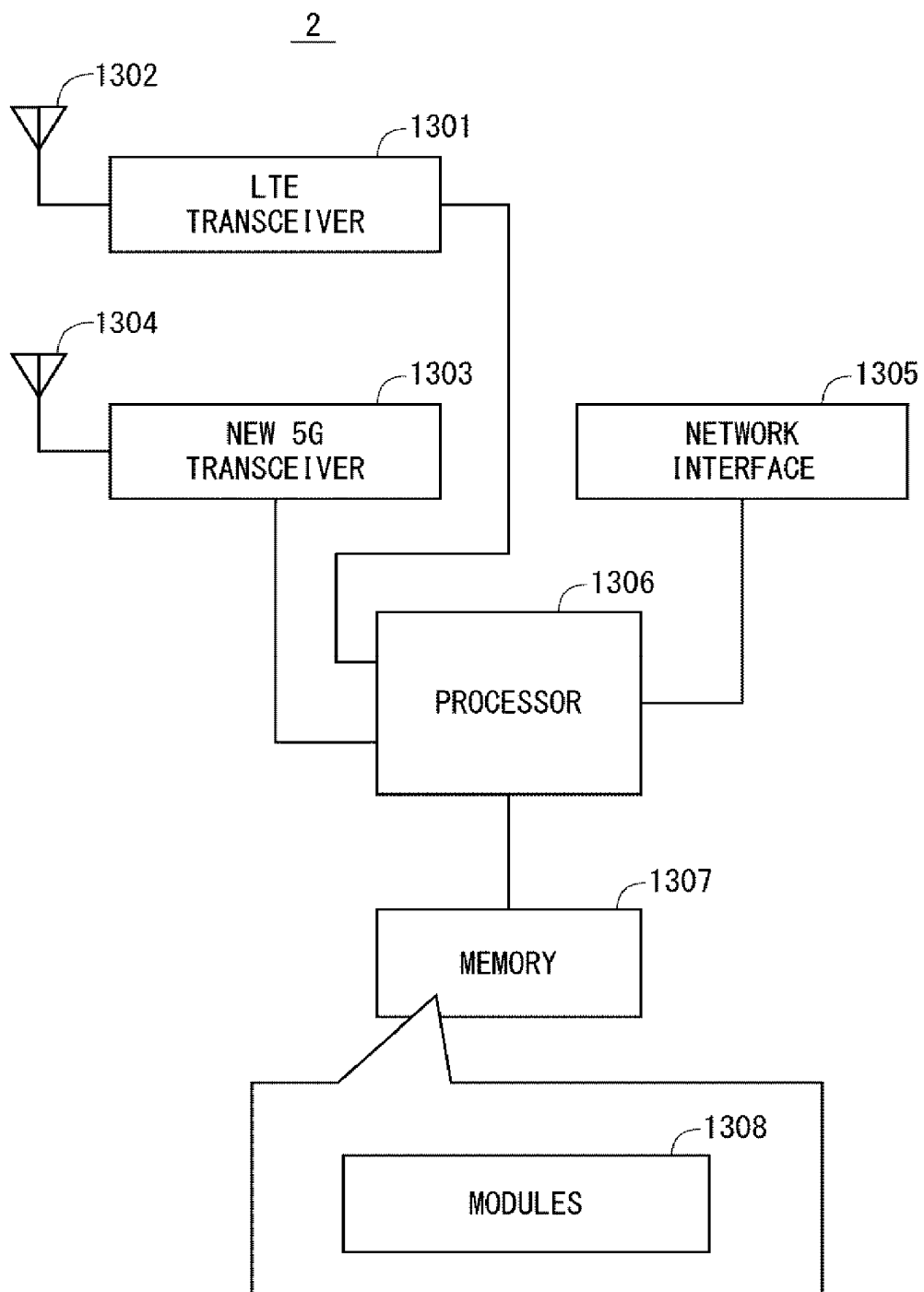
[FIG. 11]

	LTE BEARER	INTEGRATED BEARER	NEW 5G BEARER
KEY FOR DERIVING TEMPORARY KEYS TO CIPHER/DECIPHER UP AND RRC TRAFFIC	K_{eNB}		sub- K_{eNB}

[FIG. 12]



[FIG. 13]



Applicant History

0 0 0 0 0 4 2 3 7

19900829

New registration

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