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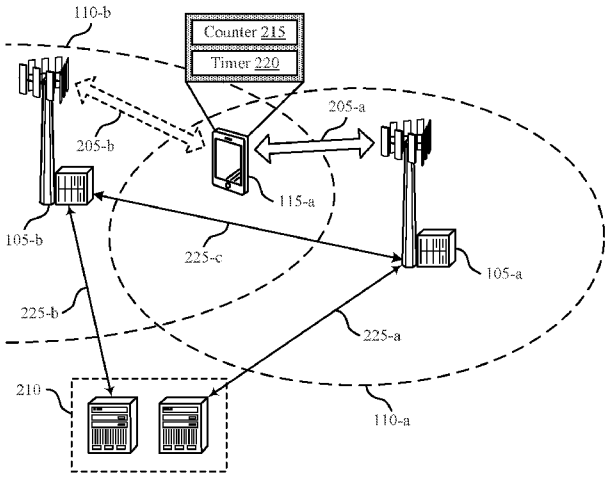



FIG. 2

200

(57) Abstract: Methods, systems, and devices for wireless communications are described. Some systems may support dual connectivity (DC) for different radio access technologies (RATs). For example, a user equipment (UE) supporting New Radio (NR) capabilities may connect to a Long Term Evolution (LTE) cell and may operate in a non-standalone (NSA) mode. A base station supporting the LTE cell may trigger the UE to establish a connection with an NR cell for DC operation. In some cases, however, the network may repeatedly trigger release and re-establishment of such connections (e.g., resulting in significant overhead at the UE). To break out of this looped procedure of NR connection setup and release, the UE may update a counter for each connection release procedure. If the counter satisfies a threshold counter value, the UE may detach from the LTE cell and re-attach with a connection that does not support DC for LTE and NR.

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# RECOVERING FROM PROBLEMATIC NETWORK

## FIELD OF TECHNOLOGY

[0001] The following relates generally to wireless communications and more specifically to recovering from a problematic network.

## BACKGROUND

[0002] Wireless communications systems are widely deployed to provide various types of communication content such as voice, video, packet data, messaging, broadcast, and so on. These systems may be capable of supporting communication with multiple users by sharing the available system resources (e.g., time, frequency, and power). Examples of such multiple-access systems include fourth generation (4G) systems such as Long Term Evolution (LTE) systems, LTE-Advanced (LTE-A) systems, or LTE-A Pro systems, and fifth generation (5G) systems which may be referred to as New Radio (NR) systems. These systems may employ technologies such as code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA), orthogonal frequency division multiple access (OFDMA), or discrete Fourier transform spread orthogonal frequency division multiplexing (DFT-S-OFDM). A wireless multiple-access communications system may include one or more base stations or one or more network access nodes, each simultaneously supporting communication for multiple communication devices, which may be otherwise known as user equipment (UE).

[0003] Some wireless communications systems may support dual connectivity (DC) between different radio access technologies (RATs), such as LTE and NR. For example, when operating in a non-standalone (NSA) mode, a UE may communicate with the network via both an LTE connection (e.g., for control signaling) and an NR connection (e.g., for data signaling). However, in some cases, the network may repeatedly trigger setup and release of an NR connection, causing the UE to enter a looped procedure. Such a looped procedure may adversely impact the UE's data service, cause significant processing overhead at the UE, and cause significant messaging overhead on a channel due to the repeated NR connection setup and release procedures performed.

## SUMMARY

[0004] The described techniques relate to improved methods, systems, devices, and apparatuses that support recovering from a problematic network. Generally, the described techniques provide a mechanism for a user equipment (UE) to break out of a looped procedure triggered in some wireless networks. For example, some wireless networks support dual connectivity (DC) for different radio access technologies (RATs), such as Long Term Evolution (LTE) and New Radio (NR). A UE supporting NR capabilities may connect to an LTE cell and may operate in a non-standalone (NSA) mode. A base station supporting the LTE cell may trigger the UE to establish a connection with an NR cell for DC operation based on the NSA mode of the UE. In some cases, however, the network may repeatedly trigger release and re-establishment of such an NR connection, resulting in significant overhead at the UE, among other problems. A network initiating such a looped procedure of NR connection setup and release may be referred to as a "problematic network." To recover from such a looped procedure, the UE may maintain a counter, a timer, or both. The UE may update the counter for each successive connection release procedure triggered at the UE. If the counter satisfies a threshold counter value (e.g., prior to expiry of the timer), the UE may detach from the LTE cell and may re-attach with a connection that does not support (e.g., restricts) DC for LTE and NR to avoid the previous looped procedure and adverse effects.

[0005] A method for wireless communications is described. The method may include establishing a connection with a cell associated with a first RAT and in an NSA mode of operation, performing a setup procedure for an SCG associated with a second RAT, receiving, from a base station supporting the cell, a configuration message indicating a release of the SCG, updating a counter value based on receiving the configuration message indicating the release of the SCG, and detaching from the cell based on the counter value satisfying a threshold counter value.

[0006] An apparatus for wireless communications is described. The apparatus may include a processor, memory coupled with the processor, and instructions stored in the memory. The instructions may be executable by the processor to cause the apparatus to establish a connection with a cell associated with a first RAT and in an NSA mode of operation, perform a setup procedure for an SCG associated with a second RAT, receive, from a base station supporting the cell, a configuration message indicating a release of the

SCG, update a counter value based on receiving the configuration message indicating the release of the SCG, and detach from the cell based on the counter value satisfying a threshold counter value.

[0007] Another apparatus for wireless communications is described. The apparatus may include means for establishing a connection with a cell associated with a first RAT and in an NSA mode of operation, performing a setup procedure for an SCG associated with a second RAT, receiving, from a base station supporting the cell, a configuration message indicating a release of the SCG, updating a counter value based on receiving the configuration message indicating the release of the SCG, and detaching from the cell based on the counter value satisfying a threshold counter value.

[0008] A non-transitory computer-readable medium storing code for wireless communications is described. The code may include instructions executable by a processor to establish a connection with a cell associated with a first RAT and in an NSA mode of operation, perform a setup procedure for an SCG associated with a second RAT, receive, from a base station supporting the cell, a configuration message indicating a release of the SCG, update a counter value based on receiving the configuration message indicating the release of the SCG, and detach from the cell based on the counter value satisfying a threshold counter value.

[0009] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the connection with the cell may include a first connection supporting DC operation with the second RAT and the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for transmitting, to the base station, an attach request message for a second connection restricting DC operation with the second RAT based on detaching from the cell.

[0010] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for establishing the second connection with the cell associated with the first RAT based on the attach request message, where the second connection restricts DC operation with the second RAT.

[0011] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station, an attach accept message, where the second connection may be established with the cell based on the attach accept message.

[0012] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for communicating information with the cell associated with the first RAT via the second connection.

[0013] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station supporting the cell, a configuration message requesting addition of the SCG, where the setup procedure for the SCG may be performed based on the configuration message requesting addition of the SCG.

[0014] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, updating the counter value may include operations, features, means, or instructions for incrementing the counter value from a first counter value to a second counter value.

[0015] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for comparing the second counter value to the threshold counter value, where the second counter value is less than the threshold counter value, and maintaining the connection with the cell based on the second counter value being less than the threshold counter value.

[0016] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station supporting the cell, a configuration message requesting addition of the SCG, performing an additional setup procedure for the SCG based on the configuration message requesting addition of the SCG, receiving, from the base station supporting the cell, an additional configuration message indicating the release of the SCG, incrementing the counter value from the second counter value to a third counter value, and comparing the third counter value to the threshold counter value, where the connection with the cell may be based on comparing the third counter value to the threshold counter value.

[0017] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station supporting the cell, a radio resource control (RRC) connection release message and detaching from the cell based on the RRC connection release message.

[0018] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the connection with the cell supports DC operation with the second RAT and the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for establishing an additional connection with the cell associated with the first RAT in the NSA mode of operation, the additional connection with the cell supporting DC operation with the second RAT.

[0019] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station supporting the cell, a configuration message indicating a measurement configuration based on establishing the additional connection with the cell and transmitting, to the base station, a measurement report based on the configuration message indicating the measurement configuration.

[0020] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for receiving, from the base station supporting the cell, a configuration message requesting addition of the SCG based on the measurement report, performing an additional setup procedure for the SCG based on the configuration message requesting addition of the SCG, receiving, from the base station supporting the cell, an additional configuration message indicating the release of the SCG, incrementing the counter value from the second counter value to a third counter value, and comparing the third counter value to the threshold counter value, where the connection with the cell may be based on comparing the third counter value to the threshold counter value.

[0021] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for

determining that a timer may be inactive and activating the timer based on receiving the configuration message indicating the release of the SCG.

[0022] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, detaching from the cell may be further based on the timer being activated.

[0023] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for determining an expiry of the timer, resetting the counter value to a counter start value based on the expiry of the timer, resetting the timer to a timer start value based on the expiry of the timer, and deactivating the timer based on the expiry of the timer.

[0024] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for configuring an active duration for the timer, where the expiry of the timer may be determined based on the timer running for at least the active duration.

[0025] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the cell may include a first cell and the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for switching the connection from the first cell to a second cell, resetting the timer to a timer start value based on switching the connection to the second cell, and deactivating the timer based on switching the connection to the second cell.

[0026] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the cell may include a first cell and the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for switching the connection from the first cell to a second cell and resetting the counter value to a counter start value based on switching the connection to the second cell.

[0027] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for

configuring the threshold counter value based on the connection, the cell, a previous connection with the cell, past connection information, or any combination thereof.

[0028] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for transmitting a detach request message to the base station supporting the cell and receiving, from the base station supporting the cell, a detach accept message, where detaching from the cell may be based on receiving the detach accept message.

[0029] Some examples of the method, apparatuses, and non-transitory computer-readable medium described herein may further include operations, features, means, or instructions for transmitting an SCG setup complete message to the base station based on performing the setup procedure for the SCG, where the configuration message indicating the release of the SCG may be received based on the SCG setup complete message.

[0030] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the first RAT may be an LTE technology, a fourth generation (4G) technology, or both, and the second RAT may be an NR technology, a fifth generation (5G) technology, or both.

[0031] In some examples of the method, apparatuses, and non-transitory computer-readable medium described herein, the configuration message indicating the release of the SCG includes an RRC reconfiguration message.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0032] FIGs. 1 and 2 illustrate examples of wireless communications systems in accordance with aspects of the present disclosure.

[0033] FIGs. 3 and 4 illustrate examples of process flows that support recovering from a problematic network by breaking from a looped procedure in accordance with aspects of the present disclosure.

[0034] FIGs. 5 and 6 show block diagrams of devices in accordance with aspects of the present disclosure.

[0035] FIG. 7 shows a block diagram of a communications manager in accordance with aspects of the present disclosure.

[0036] FIG. 8 shows a diagram of a system including a device in accordance with aspects of the present disclosure.

[0037] FIGs. 9 through 13 show flowcharts illustrating methods in accordance with aspects of the present disclosure.

## DETAILED DESCRIPTION

[0038] Some wireless communications systems may support dual connectivity (DC) between different radio access technologies (RATs), such as Long Term Evolution (LTE) and New Radio (NR) (e.g., among other RATs). For example, when operating in a non-standalone (NSA) mode, a user equipment (UE) may communicate with a wireless network via both an LTE connection (e.g., for control signaling) and an NR connection (e.g., for data signaling). In the NSA mode, the UE may connect to an LTE cell and may perform secondary cell group (SCG) setup to additionally connect to an NR cell to support communication of pending data.

[0039] However, in some cases, the network may trigger SCG release at the UE, causing the UE to release the connection to the NR cell. For example, based on the network configuration, a resource overhead involved in SCG setup, or some other aspect of the network, the network may fail to support an NR connection with the UE. Such a network may be referred to as a "problematic network." Because the UE or network may still have data pending for transmission, the network may continue to request the UE to setup an NR connection, resulting in a looped procedure at the UE. For example, the UE may repeatedly setup and release an NR connection with the network based on radio resource control (RRC) reconfiguration messages from the base station supporting the LTE cell. Such a looped procedure may negatively impact the UE's data service and cause significant processing overhead at the UE.

[0040] As described herein, the UE may implement one or more techniques to recover from a looped procedure of NR connection setup and release (e.g., for a problematic network). The UE may maintain a counter associated with NR connection release to track the looped procedure. For example, the UE may update (e.g., increment) the counter each time the network triggers the UE to release an NR connection with an SCG. In some cases, the UE may implement a timer. For example, the UE may activate the timer when a first SCG setup

procedure fails for a specific cell. If the UE determines that the counter value satisfies a threshold counter value (e.g., prior to expiration of the timer), the UE may trigger a detach procedure from the LTE cell. Based on detaching due to the counter value, the UE may perform reattachment to the LTE cell in such a manner to avoid reentering the looped procedure.

**[0041]** For example, the UE may transmit, to the base station, an attach request message that does not support DC operation with NR. Specifically, the attach request message may include a field or a flag indicating that the UE, the requested connection, or both do not support setting up an NR connection for DC operation. Based on the attach request message, the UE may establish a new connection with the network via an LTE cell, where the new connection restricts DC operation with NR. Such a connection may disable NR operation for the UE, causing the network to refrain from transmitting further requests for NR connection setup. As such, the UE may avoid reentering the looped procedure of NR connection setup and release. By recovering from (e.g., breaking out of) the looped procedure, the UE may significantly reduce the processing overhead associated with repeated NR connection setup and release. Additionally or alternatively, the UE and base station may communicate over the new connection (e.g., using an LTE connection for both control and data communications). Falling back to LTE operations in this manner may improve the UE's service, for example data service, compared to operating in a looped procedure of NR connection setup and release that causes adverse effects.

**[0042]** Aspects of the disclosure are initially described in the context of wireless communications systems. Aspects of the disclosure are further illustrated by and described with reference to process flows, apparatus diagrams, system diagrams, and flowcharts that relate to recovering from a problematic network.

**[0043]** **FIG. 1** illustrates an example of a wireless communications system 100 in accordance with aspects of the present disclosure. The wireless communications system 100 may include one or more base stations 105, one or more UEs 115, and a core network 130. In some examples, the wireless communications system 100 may be an LTE network, an LTE-Advanced (LTE-A) network, an LTE-A Pro network, or an NR network. In some examples, the wireless communications system 100 may support enhanced broadband communications,

ultra-reliable (e.g., mission critical) communications, low latency communications, communications with low-cost and low-complexity devices, or any combination thereof.

**[0044]** The base stations 105 may be dispersed throughout a geographic area to form the wireless communications system 100 and may be devices in different forms or having different capabilities. The base stations 105 and the UEs 115 may wirelessly communicate via one or more communication links 125. Each base station 105 may provide a coverage area 110 over which the UEs 115 and the base station 105 may establish one or more communication links 125. The coverage area 110 may be an example of a geographic area over which a base station 105 and a UE 115 may support the communication of signals according to one or more radio access technologies.

**[0045]** The UEs 115 may be dispersed throughout a coverage area 110 of the wireless communications system 100, and each UE 115 may be stationary, or mobile, or both at different times. The UEs 115 may be devices in different forms or having different capabilities. Some example UEs 115 are illustrated in FIG. 1. The UEs 115 described herein may be able to communicate with various types of devices, such as other UEs 115, the base stations 105, or network equipment (e.g., core network nodes, relay devices, integrated access and backhaul (IAB) nodes, or other network equipment), as shown in FIG. 1.

**[0046]** The base stations 105 may communicate with the core network 130, or with one another, or both. For example, the base stations 105 may interface with the core network 130 through one or more backhaul links 120 (e.g., via an S1, N2, N3, or other interface). The base stations 105 may communicate with one another over the backhaul links 120 (e.g., via an X2, Xn, or other interface) either directly (e.g., directly between base stations 105), or indirectly (e.g., via core network 130), or both. In some examples, the backhaul links 120 may be or include one or more wireless links.

**[0047]** One or more of the base stations 105 described herein may include or may be referred to by a person having ordinary skill in the art as a base transceiver station, a radio base station, an access point, a radio transceiver, a NodeB, an eNodeB (eNB), a next-generation NodeB or a giga-NodeB (either of which may be referred to as a gNB), a Home NodeB, a Home eNodeB, or other suitable terminology.

**[0048]** A UE 115 may include or may be referred to as a mobile device, a wireless device, a remote device, a handheld device, or a subscriber device, or some other suitable

terminology, where the "device" may also be referred to as a unit, a station, a terminal, or a client, among other examples. A UE 115 may also include or may be referred to as a personal electronic device such as a cellular phone, a personal digital assistant (PDA), a tablet computer, a laptop computer, or a personal computer. In some examples, a UE 115 may include or be referred to as a wireless local loop (WLL) station, an Internet of Things (IoT) device, an Internet of Everything (IoE) device, or a machine type communications (MTC) device, among other examples, which may be implemented in various objects such as appliances, or vehicles, meters, among other examples.

**[0049]** The UEs 115 described herein may be able to communicate with various types of devices, such as other UEs 115 that may sometimes act as relays as well as the base stations 105 and the network equipment including macro eNBs or gNBs, small cell eNBs or gNBs, or relay base stations, among other examples, as shown in FIG. 1.

**[0050]** The UEs 115 and the base stations 105 may wirelessly communicate with one another via one or more communication links 125 over one or more carriers. The term "carrier" may refer to a set of radio frequency spectrum resources having a defined physical layer structure for supporting the communication links 125. For example, a carrier used for a communication link 125 may include a portion of a radio frequency spectrum band (e.g., a bandwidth part (BWP)) that is operated according to one or more physical layer channels for a given radio access technology (e.g., LTE, LTE-A, LTE-A Pro, NR). Each physical layer channel may carry acquisition signaling (e.g., synchronization signals, system information), control signaling that coordinates operation for the carrier, user data, or other signaling. The wireless communications system 100 may support communication with a UE 115 using carrier aggregation or multi-carrier operation. A UE 115 may be configured with multiple downlink component carriers and one or more uplink component carriers according to a carrier aggregation configuration. Carrier aggregation may be used with both frequency division duplexing (FDD) and time division duplexing (TDD) component carriers.

**[0051]** In some examples (e.g., in a carrier aggregation configuration), a carrier may also have acquisition signaling or control signaling that coordinates operations for other carriers. A carrier may be associated with a frequency channel (e.g., an evolved universal mobile telecommunication system terrestrial radio access (E-UTRA) absolute radio frequency channel number (EARFCN)) and may be positioned according to a channel raster for

discovery by the UEs 115. A carrier may be operated in a standalone mode where initial acquisition and connection may be conducted by the UEs 115 via the carrier, or the carrier may be operated in a non-standalone mode where a connection is anchored using a different carrier (e.g., of the same or a different radio access technology).

**[0052]** The communication links 125 shown in the wireless communications system 100 may include uplink transmissions from a UE 115 to a base station 105, or downlink transmissions from a base station 105 to a UE 115. Carriers may carry downlink or uplink communications (e.g., in an FDD mode) or may be configured to carry downlink and uplink communications (e.g., in a TDD mode).

**[0053]** A carrier may be associated with a particular bandwidth of the radio frequency spectrum, and in some examples the carrier bandwidth may be referred to as a "system bandwidth" of the carrier or the wireless communications system 100. For example, the carrier bandwidth may be one of a number of determined bandwidths for carriers of a particular radio access technology (e.g., 1.4, 3, 5, 10, 15, 20, 40, or 80 megahertz (MHz)). Devices of the wireless communications system 100 (e.g., the base stations 105, the UEs 115, or both) may have hardware configurations that support communications over a particular carrier bandwidth or may be configurable to support communications over one of a set of carrier bandwidths. In some examples, the wireless communications system 100 may include base stations 105 or UEs 115 that support simultaneous communications via carriers associated with multiple carrier bandwidths. In some examples, each served UE 115 may be configured for operating over portions (e.g., a sub-band, a BWP) or all of a carrier bandwidth.

**[0054]** Signal waveforms transmitted over a carrier may be made up of multiple subcarriers (e.g., using multi-carrier modulation (MCM) techniques such as orthogonal frequency division multiplexing (OFDM) or discrete Fourier transform spread OFDM (DFT-S-OFDM)). In a system employing MCM techniques, a resource element may consist of one symbol period (e.g., a duration of one modulation symbol) and one subcarrier, where the symbol period and subcarrier spacing are inversely related. The number of bits carried by each resource element may depend on the modulation scheme (e.g., the order of the modulation scheme, the coding rate of the modulation scheme, or both). Thus, the more resource elements that a UE 115 receives and the higher the order of the modulation scheme, the higher the data rate may be for the UE 115. A wireless communications resource may

refer to a combination of a radio frequency spectrum resource, a time resource, and a spatial resource (e.g., spatial layers or beams), and the use of multiple spatial layers may further increase the data rate or data integrity for communications with a UE 115.

**[0055]** The time intervals for the base stations 105 or the UEs 115 may be expressed in multiples of a basic time unit which may, for example, refer to a sampling period of $T_s = 1/(\Delta f_{max} \cdot N_f)$ seconds, where $\Delta f_{max}$ may represent the maximum supported subcarrier spacing, and $N_f$ may represent the maximum supported discrete Fourier transform (DFT) size. Time intervals of a communications resource may be organized according to radio frames each having a specified duration (e.g., 10 milliseconds (ms)). Each radio frame may be identified by a system frame number (SFN) (e.g., ranging from 0 to 1023).

**[0056]** Each frame may include multiple consecutively numbered subframes or slots, and each subframe or slot may have the same duration. In some examples, a frame may be divided (e.g., in the time domain) into subframes, and each subframe may be further divided into a number of slots. Alternatively, each frame may include a variable number of slots, and the number of slots may depend on subcarrier spacing. Each slot may include a number of symbol periods (e.g., depending on the length of the cyclic prefix prepended to each symbol period). In some wireless communications systems 100, a slot may further be divided into multiple mini-slots containing one or more symbols. Excluding the cyclic prefix, each symbol period may contain one or more (e.g., $N_f$) sampling periods. The duration of a symbol period may depend on the subcarrier spacing or frequency band of operation.

**[0057]** A subframe, a slot, a mini-slot, or a symbol may be the smallest scheduling unit (e.g., in the time domain) of the wireless communications system 100 and may be referred to as a transmission time interval (TTI). In some examples, the TTI duration (e.g., the number of symbol periods in a TTI) may be variable. Additionally or alternatively, the smallest scheduling unit of the wireless communications system 100 may be dynamically selected (e.g., in bursts of shortened TTIs (sTTIs)).

**[0058]** Physical channels may be multiplexed on a carrier according to various techniques. A physical control channel and a physical data channel may be multiplexed on a downlink carrier, for example, using one or more of time division multiplexing (TDM) techniques, frequency division multiplexing (FDM) techniques, or hybrid TDM-FDM techniques. A control region (e.g., a control resource set (CORESET)) for a physical control

channel may be defined by a number of symbol periods and may extend across the system bandwidth or a subset of the system bandwidth of the carrier. One or more control regions (e.g., CORESETs) may be configured for a set of the UEs 115. For example, one or more of the UEs 115 may monitor or search control regions for control information according to one or more search space sets, and each search space set may include one or multiple control channel candidates in one or more aggregation levels arranged in a cascaded manner. An aggregation level for a control channel candidate may refer to a number of control channel resources (e.g., control channel elements (CCEs)) associated with encoded information for a control information format having a given payload size. Search space sets may include common search space sets configured for sending control information to multiple UEs 115 and UE-specific search space sets for sending control information to a specific UE 115.

**[0059]** Each base station 105 may provide communication coverage via one or more cells, for example a macro cell, a small cell, a hot spot, or other types of cells, or any combination thereof. The term "cell" may refer to a logical communication entity used for communication with a base station 105 (e.g., over a carrier) and may be associated with an identifier for distinguishing neighboring cells (e.g., a physical cell identifier (PCID), a virtual cell identifier (VCID), or others). In some examples, a cell may also refer to a geographic coverage area 110 or a portion of a geographic coverage area 110 (e.g., a sector) over which the logical communication entity operates. Such cells may range from smaller areas (e.g., a structure, a subset of structure) to larger areas depending on various factors such as the capabilities of the base station 105. For example, a cell may be or include a building, a subset of a building, or exterior spaces between or overlapping with geographic coverage areas 110, among other examples.

**[0060]** A macro cell generally covers a relatively large geographic area (e.g., several kilometers in radius) and may allow unrestricted access by the UEs 115 with service subscriptions with the network provider supporting the macro cell. A small cell may be associated with a lower-powered base station 105, as compared with a macro cell, and a small cell may operate in the same or different (e.g., licensed, unlicensed) frequency bands as macro cells. Small cells may provide unrestricted access to the UEs 115 with service subscriptions with the network provider or may provide restricted access to the UEs 115 having an association with the small cell (e.g., the UEs 115 in a closed subscriber group (CSG), the UEs 115 associated with users in a home or office). A base station 105 may

support one or multiple cells and may also support communications over the one or more cells using one or multiple component carriers.

**[0061]** In some examples, a carrier may support multiple cells, and different cells may be configured according to different protocol types (e.g., MTC, narrowband IoT (NB-IoT), enhanced mobile broadband (eMBB)) that may provide access for different types of devices.

**[0062]** In some examples, a base station 105 may be movable and therefore provide communication coverage for a moving geographic coverage area 110. In some examples, different geographic coverage areas 110 associated with different technologies may overlap, but the different geographic coverage areas 110 may be supported by the same base station 105. In other examples, the overlapping geographic coverage areas 110 associated with different technologies may be supported by different base stations 105. The wireless communications system 100 may include, for example, a heterogeneous network in which different types of the base stations 105 provide coverage for various geographic coverage areas 110 using the same or different radio access technologies.

**[0063]** The wireless communications system 100 may be configured to support ultra-reliable communications or low-latency communications, or various combinations thereof. For example, the wireless communications system 100 may be configured to support ultra-reliable low-latency communications (URLLC) or mission critical communications. The UEs 115 may be designed to support ultra-reliable, low-latency, or critical functions (e.g., mission critical functions). Ultra-reliable communications may include private communication or group communication and may be supported by one or more mission critical services such as mission critical push-to-talk (MCPTT), mission critical video (MCVideo), or mission critical data (MCData). Support for mission critical functions may include prioritization of services, and mission critical services may be used for public safety or general commercial applications. The terms ultra-reliable, low-latency, mission critical, and ultra-reliable low-latency may be used interchangeably herein.

**[0064]** In some examples, a UE 115 may also be able to communicate directly with other UEs 115 over a device-to-device (D2D) communication link 135 (e.g., using a peer-to-peer (P2P) or D2D protocol). One or more UEs 115 utilizing D2D communications may be within the geographic coverage area 110 of a base station 105. Other UEs 115 in such a group may be outside the geographic coverage area 110 of a base station 105 or be otherwise unable to

receive transmissions from a base station 105. In some examples, groups of the UEs 115 communicating via D2D communications may utilize a one-to-many (1:M) system in which each UE 115 transmits to every other UE 115 in the group. In some examples, a base station 105 facilitates the scheduling of resources for D2D communications. In other cases, D2D communications are carried out between the UEs 115 without the involvement of a base station 105.

**[0065]** The core network 130 may provide user authentication, access authorization, tracking, Internet Protocol (IP) connectivity, and other access, routing, or mobility functions. The core network 130 may be an evolved packet core (EPC) or 5G core (5GC), which may include at least one control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management function (AMF)) and at least one user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a Packet Data Network (PDN) gateway (P-GW), or a user plane function (UPF)). The control plane entity may manage non-access stratum (NAS) functions such as mobility, authentication, and bearer management for the UEs 115 served by the base stations 105 associated with the core network 130. User IP packets may be transferred through the user plane entity, which may provide IP address allocation as well as other functions. The user plane entity may be connected to the network operators IP services 150. The operators IP services 150 may include access to the Internet, Intranet(s), an IP Multimedia Subsystem (IMS), or a Packet-Switched Streaming Service.

**[0066]** Some of the network devices, such as a base station 105, may include subcomponents such as an access network entity 140, which may be an example of an access node controller (ANC). Each access network entity 140 may communicate with the UEs 115 through one or more other access network transmission entities 145, which may be referred to as radio heads, smart radio heads, or transmission/reception points (TRPs). Each access network transmission entity 145 may include one or more antenna panels. In some configurations, various functions of each access network entity 140 or base station 105 may be distributed across various network devices (e.g., radio heads and ANCs) or consolidated into a single network device (e.g., a base station 105).

**[0067]** The wireless communications system 100 may operate using one or more frequency bands, typically in the range of 300 megahertz (MHz) to 300 gigahertz (GHz).

Generally, the region from 300 MHz to 3 GHz is known as the ultra-high frequency (UHF) region or decimeter band because the wavelengths range from approximately one decimeter to one meter in length. The UHF waves may be blocked or redirected by buildings and environmental features, but the waves may penetrate structures sufficiently for a macro cell to provide service to the UEs 115 located indoors. The transmission of UHF waves may be associated with smaller antennas and shorter ranges (e.g., less than 100 kilometers) compared to transmission using the smaller frequencies and longer waves of the high frequency (HF) or very high frequency (VHF) portion of the spectrum below 300 MHz.

**[0068]** The wireless communications system 100 may utilize both licensed and unlicensed radio frequency spectrum bands. For example, the wireless communications system 100 may employ License Assisted Access (LAA), LTE-Unlicensed (LTE-U) radio access technology, or NR technology in an unlicensed band such as the 5 GHz industrial, scientific, and medical (ISM) band. When operating in unlicensed radio frequency spectrum bands, devices such as the base stations 105 and the UEs 115 may employ carrier sensing for collision detection and avoidance. In some examples, operations in unlicensed bands may be based on a carrier aggregation configuration in conjunction with component carriers operating in a licensed band (e.g., LAA). Operations in unlicensed spectrum may include downlink transmissions, uplink transmissions, P2P transmissions, or D2D transmissions, among other examples.

**[0069]** A base station 105 or a UE 115 may be equipped with multiple antennas, which may be used to employ techniques such as transmit diversity, receive diversity, multiple-input multiple-output (MIMO) communications, or beamforming. The antennas of a base station 105 or a UE 115 may be located within one or more antenna arrays or antenna panels, which may support MIMO operations or transmit or receive beamforming. For example, one or more base station antennas or antenna arrays may be co-located at an antenna assembly, such as an antenna tower. In some examples, antennas or antenna arrays associated with a base station 105 may be located in diverse geographic locations. A base station 105 may have an antenna array with a number of rows and columns of antenna ports that the base station 105 may use to support beamforming of communications with a UE 115. Likewise, a UE 115 may have one or more antenna arrays that may support various MIMO or beamforming operations. Additionally or alternatively, an antenna panel may support radio frequency beamforming for a signal transmitted via an antenna port.

[0070] Beamforming, which may also be referred to as spatial filtering, directional transmission, or directional reception, is a signal processing technique that may be used at a transmitting device or a receiving device (e.g., a base station 105, a UE 115) to shape or steer an antenna beam (e.g., a transmit beam, a receive beam) along a spatial path between the transmitting device and the receiving device. Beamforming may be achieved by combining the signals communicated via antenna elements of an antenna array such that some signals propagating at particular orientations with respect to an antenna array experience constructive interference while others experience destructive interference. The adjustment of signals communicated via the antenna elements may include a transmitting device or a receiving device applying amplitude offsets, phase offsets, or both to signals carried via the antenna elements associated with the device. The adjustments associated with each of the antenna elements may be defined by a beamforming weight set associated with a particular orientation (e.g., with respect to the antenna array of the transmitting device or receiving device, or with respect to some other orientation).

[0071] The wireless communications system 100 may be a packet-based network that operates according to a layered protocol stack. In the user plane, communications at the bearer or Packet Data Convergence Protocol (PDCP) layer may be IP-based. A Radio Link Control (RLC) layer may perform packet segmentation and reassembly to communicate over logical channels. A Medium Access Control (MAC) layer may perform priority handling and multiplexing of logical channels into transport channels. The MAC layer may also use error detection techniques, error correction techniques, or both to support retransmissions at the MAC layer to improve link efficiency. In the control plane, the RRC protocol layer may provide establishment, configuration, and maintenance of an RRC connection between a UE 115 and a base station 105 or a core network 130 supporting radio bearers for user plane data. At the physical layer, transport channels may be mapped to physical channels.

[0072] In some examples, the wireless communications system 100 may support DC for different RATs, such as LTE and NR. A UE 115 supporting NR capabilities may connect to an LTE cell (e.g., supported by a base station 105, such as an eNB) and may operate in an NSA mode. The base station 105 supporting the LTE cell may trigger the UE 115 to establish a connection with an NR cell (e.g., supported by another base station 105, such as a gNB) for DC operation based on the NSA mode of the UE. However, in some cases, the network may repeatedly trigger release and re-establishment of such an NR connection, resulting in

significant overhead at the UE 115. To break out of such a looped procedure, the UE 115 may maintain a counter, a timer, or both. The UE 115 may update the counter for each successive connection release procedure triggered at the UE 115 (e.g., by the base station 105 serving the LTE cell). If the counter satisfies a threshold counter value (e.g., prior to expiry of the timer), the UE 115 may detach from the LTE cell and may re-attach with a connection that restricts DC for LTE and NR. This detachment and reattachment procedure based on the counter value may allow the UE 115 to effectively recover from the problematic network and avoid reentering the looped procedure.

**[0073]** **FIG. 2** illustrates an example of a wireless communications system 200 that supports recovering from a problematic network in accordance with aspects of the present disclosure. In some examples, the wireless communications system 200 may implement aspects of a wireless communications system 100. For example, the wireless communications system 200 may include base stations 105-a and 105-b and UE 115-a, which may be examples of base stations 105 and a UE 115 as described with reference to FIG. 1. Base station 105-a may serve geographic coverage area 110-a and base station 105-b may serve geographic coverage area 110-b.

**[0074]** For example, base station 105-a may serve a first cell corresponding to a first RAT (e.g., LTE) and base station 105-b may serve a second cell corresponding to a second RAT (e.g., NR). As such, in some cases, base station 105-a may be an example of an eNB, while base station 105-b may be an example of a gNB. Alternatively, in some examples, a base station 105 may support both the first cell for the first RAT and the second cell for the second RAT. UE 115-a may establish a connection 205-a to the network via an LTE cell (e.g., via base station 105-a supporting an LTE cell). However, in some cases, the UE 115-a may experience issues with setting up a 5G connection 205-b with the network (e.g., due to one or more aspects of a problematic network).

**[0075]** For example, the wireless communications system 200 may support an NSA mode of operation. In the NSA mode, both base stations 105 may be supported by a shared core network 210 (e.g., an EPC or a 5G NSA core). That is, a 5G network may be supported by 4G infrastructure (e.g., eNBs, an EPC). The base stations 105 may communicate with the core network 210, each other, or both via backhaul links 225. The backhaul links 225 may be examples of wired backhaul links, wireless backhaul links, or some combination thereof. For

example, base station 105-a may communicate with the core network 210 via backhaul link 225-a, base station 105-b may communicate with the core network 210 via backhaul link 225-b, and base station 105-a may communicate with base station 105-b either indirectly through the core network 210 or directly via backhaul link 225-c. In some examples, when operating in an NSA mode of operation, UE 115-a may communicate with the LTE cell (e.g., via a connection 205-a) for control plane signaling and may communicate with the 5G cell (e.g., via a connection 205-b) to transmit and receive user plane data.

**[0076]** In some cases, in the NSA mode, UE 115-a may initially connect to the network via the LTE cell. For example, UE 115-a may register on the LTE cell and may establish a connection 205-a (e.g., an RRC connection) to the network via base station 105-a. In such a mode, UE 115-a may indicate that it is NR capable. Based on the indication of NR capability, the network may determine to transition UE 115-a to a DC mode between both LTE and NR. A DC mode supporting NR communications may be referred to as a "DCNR" mode or operation. To transition to DCNR, base station 105-a may trigger UE 115-a to set up a connection, such as an SCG connection, (e.g., connection 205-b) with an NR cell, for example, via base station 105-b. Accordingly, UE 115-a may perform an SCG setup procedure and transmit an SCG setup complete message (e.g., an RRC reconfiguration complete message) to the network via the LTE cell.

**[0077]** In some examples, the network may respond with a message triggering a release of the SCG connection (e.g., connection 205-b). For example, due to a deployment configuration of the wireless communications system 200, the network may determine that the requested SCG connection is not supported by the network (e.g., due to a resource overhead, a network configuration, or one or more other aspects of the network, infrastructure, or both). Based on the received message, UE 115-a may release the SCG connection (e.g., connection 205-b) and may fail to establish an NR connection with the network.

**[0078]** However, UE 115-a may still be NR capable. As such, base station 105-a may again trigger UE 115-a to set up an SCG connection (e.g., connection 205-b) with the NR cell. For example, the network may fail to identify a problem with the SCG connection at request time (e.g., when determining whether to transmit an RRC reconfiguration message indicating an SCG addition), but may reject the connection at accept time (e.g., when

determining whether to transmit an SCG setup confirmation message for the UE 115-a). As such, UE 115-a may enter a looped procedure, repeatedly setting up connection 205-b and releasing the connection 205-b, which may be a 5G connection, based on the network signaling. Such a looped procedure may significantly impact UE data service, increase UE processing overhead, and increase channel overhead (e.g., based on the repeated transmissions of messages for SCG setup and release), among other issues.

**[0079]** To mitigate the negative effects of such a looped procedure, UE 115-a may implement a counter 215, a timer 220, or both to detect and recover from such a looped procedure. For example, if UE 115-a sets up an SCG connection (e.g., connection 205-b) and receives a message requesting the UE 115-a to release the SCG connection, UE 115-a may update the counter 215. By using the counter 215, or another alternative technique, UE 115-a may track a number of times base station 105-a triggers the UE 115-a to release the SCG connection. For example, for each successive SCG release command, UE 115-a may increment the counter 215. If the counter 215 satisfies a threshold counter value (e.g., meets or exceeds a MAX_COUNTER value), UE 115-a may identify that the network is problematic for 5G connections and may determine to break from the looped procedure. In some cases, the threshold counter value may be configurable (e.g., by the UE 115-a, by a base station 105). Alternatively, UE 115-a may count down from a starting counter value and may determine to break from the looped procedure if the counter 215 reaches a threshold value, such as zero.

**[0080]** The counter 215 may be associated with a specific time frame, a specific cell, or both. In some examples, UE 115-a may include a timer 220 to help the UE 115-a identify the problematic network. When UE 115-a receives a first given message or detects a condition, such as receiving an SCG release message for a cell (e.g., the LTE cell anchoring the UE's connection to the network), UE 115-a may activate the timer 220. When activated, the timer 220 may run for a set active duration (e.g., T_Period), which may be pre-configured at the UE 115-a or may be configurable (e.g., by the UE 115-a, by a base station 105). If the counter 215 satisfies the threshold counter value prior to expiration of the timer 220, UE 115-a may identify that the network is problematic for 5G connections. However, if the timer 220 expires—for example, runs for the full timer duration—without the counter 215 satisfying the threshold counter value, UE 115-a may reset the counter 215 and timer 220 to start values and may deactivate the timer 220. As such, based on the counter 215 and the

timer 220, UE 115-a may determine if the network triggers a specific number of events, such as SCG releases (e.g., the threshold counter value) within a specific time period (e.g., the duration of the timer 220). Additionally or alternatively, UE 115-a may track the counter 215 for a specific cell. For example, if UE 115-a switches to a different cell (e.g., UE 115-a switches the connection 205-a to connect with a different LTE cell), UE 115-a may reset the counter 215 and timer 220 to start values and may deactivate the timer 220 until a further triggering event occurs.

**[0081]** If UE 115-a identifies that the network is problematic for one or more connections, such as 5G connections, UE 115-a may determine to break from the looped procedure. For example, UE 115-a may trigger a detach procedure and may detach from the LTE cell. UE 115-a may remove connection 205-a and may perform a reattachment procedure to reconnect with the LTE cell. However, UE 115-a may indicate that DC with NR is not supported in an attach request message to base station 105-a to disable 5G connections. For example, based on identifying the problematic network, UE 115-a may trigger reattachment without DCNR support to break from the looped procedure. UE 115-a may transmit, to base station 105-a, an attach request message restricting DCNR support, and UE 115-a and base station 105-a may reestablish a connection 205-a restricting DCNR. Using connection 205-a, UE 115-a may communicate information, including data (e.g., user plane data), with the network via the LTE cell. Because the connection 205-a restricts DCNR, the network may refrain from triggering SCG setup for an NR connection 205-b, allowing UE 115-a to avoid reentering the looped procedure and to effectively recover from the problematic network.

**[0082]** **FIG. 3** illustrates an example of a process flow 300 that supports recovering from a problematic network in accordance with aspects of the present disclosure. The process flow 300 may include a UE 115-b, which may be an example of a UE 115 as described with reference to FIGs. 1 and 2. UE 115-b may connect to an LTE cell 305, which may be supported by a base station 105 as described with reference to FIGs. 1 and 2. The LTE cell 305 may be a component of a network supporting interworking between LTE (e.g., a first RAT) and NR (e.g., a second RAT). In some cases, the network may support any number of additional or alternative RATs. UE 115-b may be NR capable, may operate in an NSA mode, and may register on the LTE cell 305. The LTE cell 305 may be NSA capable. UE 115-b may implement one or more techniques described herein to identify a problematic network for 5G

connection and recover from the problematic network, for example, by falling back to LTE operation. Alternative examples of the following may be implemented, where some steps are performed in a different order than described or are not performed at all. In some cases, steps may include additional features not mentioned below, or further steps may be added.

**[0083]** UE 115-b may establish an RRC connection with the LTE cell 305. For example, at 320, UE 115-b may transmit an RRC connection request message to the LTE cell 305. The LTE cell 305 may respond with an RRC connection setup message at 322. At 324, UE 115-b may establish the RRC connection with the LTE cell 305 according to the RRC connection setup message and may transmit an RRC connection setup complete message to the LTE cell 305. Using the established RRC connection, UE 115-b may camp on the LTE cell 305 and operate in an NSA mode.

**[0084]** In some examples (e.g., upon setting up the RRC connection), the LTE cell 305 may transmit an RRC reconfiguration message to UE 115-b indicating a measurement configuration at 326. UE 115-b may transmit periodic or aperiodic measurement reports—for example, at 328—to the LTE cell 305 based on the measurement configuration. In some cases, a measurement report may include a UE capability report or some other information indicating that the UE 115-b is NR capable. Based on the UE 115-b being NR capable and operating in an NSA mode, the LTE cell 305 may determine to trigger addition of an SCG supporting NR communications. In some examples, UE 115-b may request an NR connection based on the UE 115-b having data in a buffer to send to the network. For example, UE 115-b may transmit, to the LTE cell 305, a scheduling request (SR) for packet switching (PS) data transfer to NR. In some other examples, the LTE cell 305 may identify data in a buffer to send to UE 115-b and may trigger the NR SCG setup based on the data on the network-side.

**[0085]** At 330, the LTE cell 305 may transmit an RRC reconfiguration message to UE 115-b requesting addition of an SCG. For example, the LTE cell 305 may operate as a master cell group (MCG) and an anchor for communications. As described herein, UE 115-b may initially register to this anchor cell (e.g., the LTE cell 305) via a master node (e.g., a base station 105) and the LTE cell 305 may reconfigure the UE 115-b with one or more SCGs, including an NR cell via a secondary node (e.g., another base station 105). In some cases, the LTE cell 305 may indicate a specific NR cell for SCG connection in the RRC reconfiguration message. UE 115-b may set up a connection with the NR cell based on the RRC

reconfiguration message and may transmit an SCG setup complete message (e.g., an RRC reconfiguration complete message) to the LTE cell 305 at 332. If the network supports UE 115-b operating in a DCNR mode with the LTE cell 305 and the NR cell, the LTE cell 305 may respond with an SCG setup confirmation message at 334 to accept the DC for the UE 115-b between the LTE cell 305 and the NR cell. However, if the network does not support UE 115-b operating in the DCNR mode (e.g., if the network is a problematic network), the network may reject the NR SCG connection. In such cases, the LTE cell 305 may transmit, at 334, an RRC reconfiguration message to UE 115-b indicating release of the SCG. UE 115-b may release (or otherwise not complete connection of) the NR SCG connection set up at 332 based on the RRC reconfiguration message received at 334. Additionally or alternatively, the LTE cell 305 may initially support the DC connection with the NR cell, but may transmit an RRC reconfiguration message to UE 115-b indicating release of the SCG soon after SCG set up (e.g., within a specific time window).

**[0086]** In such cases, to detect a problematic network, UE 115-b may implement a timer, a counter, or both to track a number of SCG releases (e.g., within a specific time span). At 336, UE 115-b may determine whether the RRC reconfiguration message indicating SCG release received at 334 is the first failure on the LTE cell 305 (e.g., for setting up an NR connection in DC operation). If so, UE 115-b may start a timer (e.g., a T_guard) at 338. Otherwise, the timer may be actively running (e.g., based on a previous first failure on the LTE cell 305). At 340, UE 115-b may update the counter based on the RRC reconfiguration message indicating SCG release received at 334. For example, UE 115-b may increment a counter value. At 342, UE 115-b may compare the updated counter value to a threshold counter value (e.g., a maximum counter value). If the updated counter value equals (or is greater than) the threshold counter value before the timer expires (e.g., before the timer runs for a configured active duration), the UE 115-b may trigger a detach operation to break out of a looped procedure. However, if the updated counter value does not satisfy (e.g., is less than) the threshold counter value, UE 115-b may not break from the looped procedure. In some cases, the LTE cell 305 may trigger an RRC connection release at 344. In some other cases, UE 115-b and the LTE cell 305 may maintain the RRC connection. In some examples, at 346, the UE 115-b, the LTE cell 305, or some combination thereof may trigger the procedure 310 to occur again.

[0087] For example, if the LTE cell 305 releases the RRC connection at 344, UE 115-b may retransmit an RRC connection request (e.g., at 320), effectively looping the procedure 310. That is, in such an example, the LTE cell 305 may transmit an RRC reconfiguration with SCG addition for each RRC connection. When the network releases the SCG, the network may additionally release the RRC connection, triggering the UE 115-b to reestablish an RRC connection. The network may reconfigure UE 115-b for measurement reporting and may request SCG addition for this new RRC connection based on the measurement reporting. Alternatively, if UE 115-b and the LTE cell 305 maintain the RRC connection, the LTE cell 305 may retransmit an RRC reconfiguration message requesting addition of an NR SCG (e.g., at 330), effectively looping the procedure 310. That is, in such an example, the network may repeatedly transmit RRC reconfigurations with SCG addition for an RRC connection. In some cases, because UE 115-b or the network may have data pending for transmission, and the SCG is released at 334, the LTE cell 305 may trigger the UE 115-b to set up the SCG again to support data communication with an NR cell. This looped procedure 310 may occur any number of times for the LTE cell 305. For each successive SCG setup and release, UE 115-b may further update the counter at 340 (e.g., incrementing a counter value by one for each SCG release for the LTE cell 305) until the counter satisfies the threshold counter value or the timer expires.

[0088] To break from the looped procedure 310, UE 115-b may transmit a detach request message at 348. For example, based on determining that the updated counter value satisfies the threshold counter value prior to expiry of the timer, UE 115-b may trigger a detach procedure. The LTE cell 305 may receive the detach request at 348 and may transmit a detach accept message at 350. Accordingly, UE 115-b may disconnect from the LTE cell 305 (e.g., remove the RRC connection). UE 115-b may transmit an attach request message to the LTE cell 305 at 352 based on the detach procedure and based on the updated counter value satisfying the threshold counter value. For example, because the updated counter value satisfies the threshold counter value prior to expiry of the timer, UE 115-b may determine that the network is problematic with regard to setting up an NR connection for DCNR operation. Accordingly, UE 115-b may include an indication in the attach request message (e.g., using a bit flag, a bit field) indicating no DCNR support. The LTE cell 305 may respond with an attach accept message at 354 to establish the new RRC connection with UE 115-b. Based on the indication of no DCNR support, the established RRC connection may

restrict DCNR operation (e.g., not support setting up an NR SCG for data communications). For example, UE 115-b may be served by an LTE radio bearer using an LTE-only service for the cell (e.g., and may not be served by an NR radio bearer). As such, the established RRC connection may result in the LTE cell 305 refraining from transmitting any further RRC reconfiguration messages indicating NR SCG addition, allowing the UE 115-b to recover from the looped procedure 310 and communicate with the network over the new connection with the LTE cell 305.

**[0089]** UE 115-b may implement the counter, the timer, or both (e.g., as opposed to breaking from the looped procedure 310 immediately upon the first failure on the cell) to support the LTE cell 305 recovering from the problematic network. For example, in some cases, the LTE cell 305 may identify triggering the SCG addition and the SCG release (e.g., within a threshold time span) and may refrain from triggering a further SCG addition, a further SCG release, or both. In some cases, the network may fall back to LTE operation based on detecting the looped procedure 310. Additionally or alternatively, the network may recover by implementing a tracking area update (TAU) or some other procedure to achieve DCNR support. In some examples, by implementing the counter, the timer, or both, UE 115-b may allow the LTE cell 305 to potentially correct the problem on the network-side. In some such examples, the network may correct the problem without falling back to LTE or without detaching an RRC connection, improving subsequent performance, the latency involved in recovering from the problematic network, or both. However, if the network fails to identify or solve the problem, implementing the counter, the timer, or both may allow UE 115-b to break from the looped procedure 310 transparent to the network.

**[0090]** **FIG. 4** illustrates an example of a process flow 400 that supports recovering from a problematic network in accordance with aspects of the present disclosure. The process flow 400 may implement aspects of a wireless communications system, such as a wireless communications system 100 or 200 as described herein with reference to FIGs. 1 and 2. The process flow 400 may include UE 115-c and base station 105-c, which may be examples of the corresponding devices described with reference to FIGs. 1 through 3. UE 115-c may be NR capable and support operating in an NSA mode. Base station 105-c may support an LTE cell and may be NSA capable. Alternative examples of the following may be implemented, where some steps are performed in a different order than described or are not performed at

all. In some cases, steps may include additional features not mentioned below, or further steps may be added.

**[0091]** In some case, at 405, UE 115-c may configure a threshold counter value. The threshold counter value may correspond to a number of times an SCG connection with an NR cell is set up and released before the UE 115-c stops attempting to set up such a connection (e.g., by triggering a specific detachment and reattachment procedure). In some examples, UE 115-c may configure the threshold counter value based on a current connection (e.g., RRC connection with an LTE cell), a connected cell (e.g., an LTE cell), a previous connection with the cell, past connection information (e.g., for the UE 115-c, the cell, or both), or any combination thereof. Additionally or alternatively, at 410, UE 115-c may configure a timer duration. The timer duration (e.g., an active duration for the timer) may correspond to an amount of time in which the threshold number of SCG releases may occur and trigger falling back to LTE operations. In some cases, the threshold counter value, the timer duration, or both may be pre-configured at UE 115-c or configured by the network. As an example, the threshold counter value may be five and the active duration for the timer may be one minute. Accordingly, if UE 115-c is commanded to release an NR SCG connection five times within a minute, UE 115-c may trigger a detach procedure and fall back to LTE operations (e.g., as opposed to operating in a DC mode for LTE and NR).

**[0092]** At 415, UE 115-c may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. For example, the connection may be an LTE connection with an LTE cell.

**[0093]** At 420, base station 105-c may transmit a configuration message requesting addition of an SCG associated with a second RAT (e.g., NR). The configuration message may be an example of an RRC reconfiguration message. At 425, UE 115-c may perform a setup procedure for the SCG associated with the second RAT (e.g., based on the configuration message requesting addition of the SCG). For example, UE 115-c may set up an NR SCG connection with an NR cell, or may otherwise initiate a process for setting up the NR SCG connection with the NR cell. UE 115-c may transmit an SCG setup complete message to the base station 105-c based on performing the setup procedure for the SCG.

**[0094]** At 430, UE 115-c may receive, from base station 105-c supporting the LTE cell, a configuration message indicating a release of the SCG. The configuration message indicating

the release of the SCG may be an example of an RRC reconfiguration message. In some examples, base station 105-c may transmit the configuration message indicating the release of the SCG based on the SCG setup complete message received from UE 115-c. Based on the configuration message indicating the release of the SCG, UE 115-c may release the SCG set up at 425 (e.g., by releasing the NR SCG connection or refraining from completing a setup procedure for the NR SCG connection).

**[0095]** In some cases, at 435, UE 115-c may activate a timer. UE 115-c may determine that the timer is inactive and may activate the timer based on receiving the configuration message indicating the release of the SCG. For example, this configuration message may correspond to a first failure by UE 115-c to establish an NR SCG connection while camped on the LTE cell. When active, the timer may run for an amount of time corresponding to the active duration of the timer.

**[0096]** In some examples, at 440, UE 115-c may reset the timer and the counter. In some cases, UE 115-c may determine an expiry of the timer (e.g., the timer has run for at least the active duration of the timer) and may reset the timer and the counter based on the expiry of the timer. In some other cases, UE 115-c may switch the connection from the cell (e.g., a first cell) to a second cell (e.g., in a handover procedure or some other procedure), triggering UE 115-c to reset the timer and the counter. Resetting the timer may involve resetting the timer to a timer start value and deactivating the timer. Resetting the counter may involve resetting the counter value to a counter start value (e.g., zero if incrementing the counter to a max counter value when tracking the number of SCG releases).

**[0097]** At 445, UE 115-c may update the counter value based on receiving the configuration message indicating the release of the SCG, based on setting up the NR SCG connection, or based on some combination thereof. By updating the counter value, UE 115-c may keep count of the number of times it sets up and tears down an NR SCG connection. In some examples, updating the counter value may involve incrementing the counter value from a first counter value to a second counter value.

**[0098]** At 450, UE 115-c may compare the counter value to the threshold counter value. If the counter value satisfies the threshold counter value, UE 115-c may detach from the cell at 455 based on the comparing. For example, the counter value may satisfy the threshold counter value if the counter value is greater than or equal to the threshold counter value. In

some cases, UE 115-c may check to ensure that the timer is still running. If the timer has expired, UE 115-c may refrain from detaching from the cell at 455. In some examples, if the counter value fails to satisfy the threshold counter value, UE 115-c may experience a loop procedure at 460. For example, UE 115-c may maintain the connection with the cell based on the updated counter value being less than the threshold counter value and may receive, from base station 105-c supporting the cell, a configuration message requesting addition of the SCG (e.g., looping back to 420). In another example, base station 105-c may transmit an RRC connection release message to UE 115-c, and UE 115-c may detach from the cell based on the RRC connection release message. Such a detachment may trigger UE 115-c to reestablish a connection in NSA mode (e.g., looping back to 415). A loop procedure may increase channel overhead and processing resources at UE 115-c and base station 105-c based on the signaling involved in the looped procedure (e.g., at 415, 420, 425, 430, or some combination thereof). Additionally or alternatively, the looped procedure may increase the latency involved in data communications between UE 115-c and base station 105-c, as the devices may schedule data for transmission over an NR SCG connection that is repeatedly released at 430.

**[0099]** If the counter value satisfies the threshold counter value, UE 115-c may detach from the cell at 455 and reattach to the cell. For example, the initial RRC connection established at 415 may support DC operation with the second RAT (e.g., for LTE and NR DC operation). At 465, UE 115-c may transmit, to base station 105-c, an attach request message for a second connection (e.g., a new RRC connection) restricting DC operation with the second RAT (e.g., restricting DCNR) based on detaching from the cell. In some cases, this reattachment procedure may be triggered further based on detaching from the cell due to the counter value satisfying the threshold counter value. At 470, UE 115-c may establish the second connection with the cell associated with the first RAT (e.g., LTE) based on the attach request message, where the second connection restricts DC operation with the second RAT (e.g., NR). Specifically, UE 115-c may fallback to LTE operation over the second connection, rather than supporting DCNR. In some examples, base station 105-c may transmit, to UE 115-c, an attach accept message to complete the establishment of the second connection. UE 115-c and base station 105-c may communicate information associated with the first RAT (e.g., LTE) via the second connection. For example, UE 115-c may

communicate data, such as user plane data, over the LTE connection, rather than setting up an NR connection for user plane data communications in a DCNR mode.

**[0100]** **FIG. 5** shows a block diagram 500 of a device 505 in accordance with aspects of the present disclosure. The device 505 may be an example of aspects of a UE 115 as described herein. The device 505 may include a receiver 510, a communications manager 515, and a transmitter 520. The device 505 may also include a processor. Each of these components may be in communication with one another (e.g., via one or more buses).

**[0101]** The receiver 510 may receive information such as packets, user data, or control information associated with various information channels (e.g., control channels, data channels). Information may be passed on to other components of the device 505. The receiver 510 may be an example of aspects of the transceiver 820 described with reference to FIG. 8. The receiver 510 may utilize a single antenna or a set of antennas.

**[0102]** The communications manager 515 may establish a connection with a cell associated with a first RAT and in an NSA mode of operation, perform a setup procedure for an SCG associated with a second RAT, and receive, from a base station 105 supporting the cell, a configuration message indicating a release of the SCG. The communications manager 515 may update a counter value based on receiving the configuration message indicating the release of the SCG and may detach from the cell based on the counter value satisfying a threshold counter value. The communications manager 515 may be an example of aspects of the communications manager 810 described herein.

**[0103]** The actions performed by the communications manager 515 as described herein may be implemented to realize one or more potential advantages. For example, detaching from the cell based on the counter value satisfying a threshold counter value may allow the device 505 (e.g., a UE 115) to break out of a looped procedure involving repeatedly setting up and releasing a 5G connection with an SCG. Breaking out of this procedure may reduce processing and channel overhead, as the UE 115 may reduce the number of times that SCG setup and release is performed. Additionally or alternatively, breaking out of this procedure may allow the UE 115 to fall back to LTE operations, supporting data communications over an LTE connection. This fallback procedure may reduce latency, as the UE 115 may transmit or receive, via an LTE connection, data pending in a data buffer that may otherwise be held for a 5G connection (e.g., a connection repeatedly released by the network).

[0104] Based on tracking a counter value and detaching from the cell according to the counter value, a processor of the device 505 (e.g., a processor controlling the receiver 510, the communications manager 515, the transmitter 520) may reduce processing resources used for network connection procedures. For example, by reducing a number of times the device 505 (e.g., a UE 115) sets up and releases an SCG connection in a looped procedure, the device 505 may reduce the processing overhead associated with establishing these connections. Reducing the number of SCG connection procedures may reduce a number of times the processor ramps up processing power and turns on processing units to handle network connection (e.g., 5G network connection) procedures in an NSA mode.

[0105] The communications manager 515, or its sub-components, may be implemented in hardware, code (e.g., software or firmware) executed by a processor, or any combination thereof. If implemented in code executed by a processor, the functions of the communications manager 515, or its sub-components may be executed by a general-purpose processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described in the present disclosure.

[0106] The communications manager 515, or its sub-components, may be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations by one or more physical components. In some examples, the communications manager 515, or its sub-components, may be a separate and distinct component in accordance with various aspects of the present disclosure. In some examples, the communications manager 515, or its sub-components, may be combined with one or more other hardware components, including but not limited to an input/output (I/O) component, a transceiver, a network server, another computing device, one or more other components described in the present disclosure, or a combination thereof in accordance with various aspects of the present disclosure.

[0107] The transmitter 520 may transmit signals generated by other components of the device 505. In some examples, the transmitter 520 may be collocated with a receiver 510 in a transceiver module. For example, the transmitter 520 may be an example of aspects of the

transceiver 820 described with reference to FIG. 8. The transmitter 520 may utilize a single antenna or a set of antennas.

**[0108]** **FIG. 6** shows a block diagram 600 of a device 605 in accordance with aspects of the present disclosure. The device 605 may be an example of aspects of a device 505 or a UE 115 as described herein. The device 605 may include a receiver 610, a communications manager 615, and a transmitter 640. The device 605 may also include a processor. Each of these components may be in communication with one another (e.g., via one or more buses).

**[0109]** The receiver 610 may receive information such as packets, user data, or control information associated with various information channels (e.g., control channels, data channels). Information may be passed on to other components of the device 605. The receiver 610 may be an example of aspects of the transceiver 820 described with reference to FIG. 8. The receiver 610 may utilize a single antenna or a set of antennas.

**[0110]** The communications manager 615 may be an example of aspects of the communications manager 515 as described herein. The communications manager 615 may include a connection component 620, an SCG setup component 625, an SCG release component 630, and a counter component 635. The communications manager 615 may be an example of aspects of the communications manager 810 described herein.

**[0111]** The connection component 620 may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The SCG setup component 625 may perform a setup procedure for an SCG associated with a second RAT. The SCG release component 630 may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG.

**[0112]** The counter component 635 may update a counter value based on receiving the configuration message indicating the release of the SCG. The connection component 620 may detach from the cell based on the counter value satisfying a threshold counter value.

**[0113]** The transmitter 640 may transmit signals generated by other components of the device 605. In some examples, the transmitter 640 may be collocated with a receiver 610 in a transceiver module. For example, the transmitter 640 may be an example of aspects of the transceiver 820 described with reference to FIG. 8. The transmitter 640 may utilize a single antenna or a set of antennas.

[0114] FIG. 7 shows a block diagram 700 of a communications manager 705 in accordance with aspects of the present disclosure. The communications manager 705 may be an example of aspects of a communications manager 515, a communications manager 615, or a communications manager 810 described herein. The communications manager 705 may include a connection component 710, an SCG setup component 715, an SCG release component 720, a counter component 725, a communication component 730, an SCG addition component 735, a measurement component 740, a timer component 745, a timer configuration component 750, a counter configuration component 755, and a detaching component 760. Each of these modules may communicate, directly or indirectly, with one another (e.g., via one or more buses).

[0115] The connection component 710 may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The SCG setup component 715 may perform a setup procedure for an SCG associated with a second RAT. The SCG release component 720 may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG.

[0116] In some examples, the SCG setup component 715 may transmit an SCG setup complete message to the base station based on performing the setup procedure for the SCG, where the configuration message indicating the release of the SCG may be received based on the SCG setup complete message. In some examples, the configuration message indicating the release of the SCG may be an example of an RRC reconfiguration message. In some cases, the first RAT may be an LTE technology, a 4G technology, or both. In some cases, the second RAT may be an NR technology, a 5G technology, or both.

[0117] The counter component 725 may update a counter value based on receiving the configuration message indicating the release of the SCG. The connection component 710 may detach from the cell based on the counter value satisfying a threshold counter value.

[0118] In some examples, the connection with the cell may be an example of a first connection supporting DC operation with the second RAT. In some such examples, the connection component 710 may transmit, to the base station, an attach request message for a second connection restricting DC operation with the second RAT based on detaching from the cell. In some cases, the attach request message may restrict DC operation with the second RAT further based on the counter value satisfying the threshold counter value. In some

examples, the connection component 710 may establish the second connection with the cell associated with the first RAT based on the attach request message, where the second connection restricts DC operation with the second RAT. For example, the connection component 710 may receive, from the base station, an attach accept message, where the second connection may be established with the cell based on the attach accept message. The communication component 730 may communicate information with the cell associated with the first RAT via the second connection. For example, the communication component 730 may communicate data with the network via an LTE connection with an LTE cell.

**[0119]** The SCG addition component 735 may receive, from the base station supporting the cell, a configuration message requesting addition of the SCG, where the setup procedure for the SCG may be performed based on the configuration message requesting addition of the SCG.

**[0120]** In some examples, updating the counter value may involve the counter component 725 incrementing the counter value from a first counter value to a second counter value. In some examples, the counter component 725 may compare the second counter value to the threshold counter value. In some cases, the second counter value is less than the threshold counter value. In some such cases, the connection component 710 may maintain the connection with the cell based on the second counter value being less than the threshold counter value.

**[0121]** In some cases, the communications manager 705 may experience a looped procedure based on maintaining the connection with the cell. For example, the SCG addition component 735 may receive, from the base station supporting the cell, a configuration message requesting addition of the SCG. The SCG setup component 715 may perform an additional setup procedure for the SCG based on the configuration message requesting addition of the SCG, and the SCG release component 720 may receive, from the base station supporting the cell, an additional configuration message indicating the release of the SCG. The counter component 725 may increment the counter value from the second counter value to a third counter value and may compare the third counter value to the threshold counter value, where the connection with the cell is based on comparing the third counter value to the threshold counter value. For example, the connection component 710 may maintain the

connection or detach from the cell based on comparing the third counter value to the threshold counter value.

**[0122]** In some examples (e.g., within the looped procedure), the connection component 710 may receive, from the base station supporting the cell, an RRC connection release message and may detach from the cell based on the RRC connection release message. In some such examples, the connection component 710 may establish an additional connection with the cell associated with the first RAT in the NSA mode of operation, the additional connection with the cell supporting DC operation with the second RAT (e.g., where the first connection with the cell supported DC operation with the second RAT as well). The measurement component 740 may receive, from the base station supporting the cell, a configuration message indicating a measurement configuration based on establishing the additional connection with the cell. In some examples, the measurement component 740 may transmit, to the base station, a measurement report based on the configuration message indicating the measurement configuration. In some examples, the SCG addition component 735 may receive, from the base station supporting the cell, a configuration message requesting addition of the SCG based on the measurement report. The SCG setup component 715 may perform an additional setup procedure for the SCG based on the configuration message requesting addition of the SCG, and the SCG release component 720 may receive, from the base station supporting the cell, an additional configuration message indicating the release of the SCG. The counter component 725 may increment the counter value from the second counter value to a third counter value and may compare the third counter value to the threshold counter value, where the connection with the cell is based on comparing the third counter value to the threshold counter value. For example, the connection component 710 may maintain the connection or detach from the cell based on comparing the third counter value to the threshold counter value.

**[0123]** The timer component 745 may determine that a timer is inactive and may activate the timer based on receiving the configuration message indicating the release of the SCG. In some examples, detaching from the cell may be further based on the timer being activated.

**[0124]** In some examples, the timer component 745 may determine an expiry of the timer. In some such examples, the counter component 725 may reset the counter value to a counter start value based on the expiry of the timer, and the timer component 745 may reset

the timer to a timer start value based on the expiry of the timer. In some cases, the timer component 745 may additionally deactivate the timer based on the expiry of the timer. The timer configuration component 750 may configure an active duration for the timer, where the expiry of the timer is determined based on the timer running for at least the active duration.

**[0125]** In some examples, the cell may be a first cell and the connection component 710 may switch the connection from the first cell to a second cell. In some such examples, the timer component 745 may reset the timer to a timer start value based on switching the connection to the second cell and may deactivate the timer based on switching the connection to the second cell. Additionally or alternatively, in some such examples, the counter component 725 may reset the counter value to a counter start value based on switching the connection to the second cell.

**[0126]** The counter configuration component 755 may configure the threshold counter value based on the connection, the cell, a previous connection with the cell, past connection information, or any combination thereof.

**[0127]** The detaching component 760 may transmit a detach request message to the base station supporting the cell and may receive, from the base station supporting the cell, a detach accept message, where detaching from the cell may be based on receiving the detach accept message.

**[0128]** **FIG. 8** shows a diagram of a system 800 including a device 805 in accordance with aspects of the present disclosure. The device 805 may be an example of or include the components of device 505, device 605, or a UE 115 as described herein. The device 805 may include components for bi-directional voice and data communications including components for transmitting and receiving communications, including a communications manager 810, an I/O controller 815, a transceiver 820, an antenna 825, memory 830, and a processor 840. These components may be in electronic communication via one or more buses (e.g., bus 845).

**[0129]** The communications manager 810 may establish a connection with a cell associated with a first RAT and in an NSA mode of operation, perform a setup procedure for an SCG associated with a second RAT, and receive, from a base station supporting the cell, a configuration message indicating a release of the SCG. The communications manager 810 may update a counter value based on receiving the configuration message indicating the

release of the SCG and detach from the cell based on the counter value satisfying a threshold counter value.

**[0130]** The I/O controller 815 may manage input and output signals for the device 805. The I/O controller 815 may also manage peripherals not integrated into the device 805. In some cases, the I/O controller 815 may represent a physical connection or port to an external peripheral. In some cases, the I/O controller 815 may utilize an operating system such as iOS®, ANDROID®, MS-DOS®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In other cases, the I/O controller 815 may represent or interact with a modem, a keyboard, a mouse, a touchscreen, or a similar device. In some cases, the I/O controller 815 may be implemented as part of a processor. In some cases, a user may interact with the device 805 via the I/O controller 815 or via hardware components controlled by the I/O controller 815.

**[0131]** The transceiver 820 may communicate bi-directionally, via one or more antennas, wired, or wireless links as described above. For example, the transceiver 820 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 820 may also include a modem to modulate the packets and provide the modulated packets to the antennas for transmission, and to demodulate packets received from the antennas.

**[0132]** In some cases, the wireless device may include a single antenna 825. However, in some cases the device may have more than one antenna 825, which may be capable of concurrently transmitting or receiving multiple wireless transmissions.

**[0133]** The memory 830 may include random-access memory (RAM) and read-only memory (ROM). The memory 830 may store computer-readable, computer-executable code 835 including instructions that, when executed, cause the processor to perform various functions described herein. In some cases, the memory 830 may contain, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

**[0134]** The processor 840 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a central processing unit (CPU), a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some cases, the processor 840 may be

configured to operate a memory array using a memory controller. In other cases, a memory controller may be integrated into the processor 840. The processor 840 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 830) to cause the device 805 to perform various functions described herein.

**[0135]** The code 835 may include instructions to implement aspects of the present disclosure, including instructions to support wireless communications. The code 835 may be stored in a non-transitory computer-readable medium such as system memory or other type of memory. In some cases, the code 835 may not be directly executable by the processor 840 but may cause a computer (e.g., when compiled and executed) to perform functions described herein.

**[0136]** **FIG. 9** shows a flowchart illustrating a method 900 in accordance with aspects of the present disclosure. The operations of method 900 may be implemented by a UE 115 or its components as described herein. For example, the operations of method 900 may be performed by a communications manager as described with reference to FIGs. 5 through 8. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the functions described below. Additionally or alternatively, a UE may perform aspects of the functions described below using special-purpose hardware.

**[0137]** At 905, the UE may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The operations of 905 may be performed according to the methods described herein. In some examples, aspects of the operations of 905 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0138]** At 910, the UE may perform a setup procedure for an SCG associated with a second RAT. The operations of 910 may be performed according to the methods described herein. In some examples, aspects of the operations of 910 may be performed by an SCG setup component as described with reference to FIGs. 5 through 8.

**[0139]** At 915, the UE may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG. The operations of 915 may be performed according to the methods described herein. In some examples, aspects of the operations of 915 may be performed by an SCG release component as described with reference to FIGs. 5 through 8.

**[0140]** At 920, the UE may update a counter value based on receiving the configuration message indicating the release of the SCG. The operations of 920 may be performed according to the methods described herein. In some examples, aspects of the operations of 920 may be performed by a counter component as described with reference to FIGs. 5 through 8.

**[0141]** At 925, the UE may detach from the cell based on the counter value satisfying a threshold counter value. The operations of 925 may be performed according to the methods described herein. In some examples, aspects of the operations of 925 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0142]** **FIG. 10** shows a flowchart illustrating a method 1000 in accordance with aspects of the present disclosure. The operations of method 1000 may be implemented by a UE 115 or its components as described herein. For example, the operations of method 1000 may be performed by a communications manager as described with reference to FIGs. 5 through 8. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the functions described below. Additionally or alternatively, a UE may perform aspects of the functions described below using special-purpose hardware.

**[0143]** At 1005, the UE may establish a first connection with an LTE cell (e.g., a cell associated with a first RAT, such as LTE) and in an NSA mode of operation, where the first connection supports DCNR. The operations of 1005 may be performed according to the methods described herein. In some examples, aspects of the operations of 1005 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0144]** At 1010, the UE may perform a setup procedure for an SCG associated with a second RAT, such as NR. The operations of 1010 may be performed according to the methods described herein. In some examples, aspects of the operations of 1010 may be performed by an SCG setup component as described with reference to FIGs. 5 through 8.

**[0145]** At 1015, the UE may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG. The operations of 1015 may be performed according to the methods described herein. In some examples, aspects of the operations of 1015 may be performed by an SCG release component as described with reference to FIGs. 5 through 8.

**[0146]** At 1020, the UE may update a counter value based on receiving the configuration message indicating the release of the SCG. The operations of 1020 may be performed according to the methods described herein. In some examples, aspects of the operations of 1020 may be performed by a counter component as described with reference to FIGs. 5 through 8.

**[0147]** At 1025, the UE may detach from the cell based on the counter value satisfying a threshold counter value. The operations of 1025 may be performed according to the methods described herein. In some examples, aspects of the operations of 1025 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0148]** At 1030, the UE may transmit, to the base station, an attach request message for a second connection restricting DCNR based on detaching from the cell. The operations of 1030 may be performed according to the methods described herein. In some examples, aspects of the operations of 1030 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0149]** At 1035, the UE may establish the second connection with the cell associated with the first RAT based on the attach request message, where the second connection restricts DCNR. The operations of 1035 may be performed according to the methods described herein. In some examples, aspects of the operations of 1035 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0150]** At 1040, the UE may communicate information (e.g., data or other information) with the LTE cell via the second connection. The operations of 1040 may be performed according to the methods described herein. In some examples, aspects of the operations of 1040 may be performed by a communication component as described with reference to FIGs. 5 through 8.

**[0151]** **FIG. 11** shows a flowchart illustrating a method 1100 in accordance with aspects of the present disclosure. The operations of method 1100 may be implemented by a UE 115 or its components as described herein. For example, the operations of method 1100 may be performed by a communications manager as described with reference to FIGs. 5 through 8. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the functions described below. Additionally or alternatively, a UE may perform aspects of the functions described below using special-purpose hardware.

[0152] At 1105, the UE may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The operations of 1105 may be performed according to the methods described herein. In some examples, aspects of the operations of 1105 may be performed by a connection component as described with reference to FIGs. 5 through 8.

[0153] At 1110, the UE may receive, from a base station supporting the cell, a configuration message requesting addition of an SCG associated with a second RAT. The operations of 1110 may be performed according to the methods described herein. In some examples, aspects of the operations of 1110 may be performed by an SCG addition component as described with reference to FIGs. 5 through 8.

[0154] At 1115, the UE may perform a setup procedure for the SCG based on the configuration message requesting addition of the SCG. The operations of 1115 may be performed according to the methods described herein. In some examples, aspects of the operations of 1115 may be performed by an SCG setup component as described with reference to FIGs. 5 through 8.

[0155] At 1120, the UE may receive, from the base station supporting the cell, a configuration message indicating a release of the SCG. The operations of 1120 may be performed according to the methods described herein. In some examples, aspects of the operations of 1120 may be performed by an SCG release component as described with reference to FIGs. 5 through 8.

[0156] At 1125, the UE may update a counter value based on receiving the configuration message indicating the release of the SCG. The operations of 1125 may be performed according to the methods described herein. In some examples, aspects of the operations of 1125 may be performed by a counter component as described with reference to FIGs. 5 through 8.

[0157] At 1130, the UE may detach from the cell based on the counter value satisfying a threshold counter value. The operations of 1130 may be performed according to the methods described herein. In some examples, aspects of the operations of 1130 may be performed by a connection component as described with reference to FIGs. 5 through 8.

[0158] **FIG. 12** shows a flowchart illustrating a method 1200 in accordance with aspects of the present disclosure. The operations of method 1200 may be implemented by a UE 115

or its components as described herein. For example, the operations of method 1200 may be performed by a communications manager as described with reference to FIGs. 5 through 8. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the functions described below. Additionally or alternatively, a UE may perform aspects of the functions described below using special-purpose hardware.

**[0159]** At 1205, the UE may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The operations of 1205 may be performed according to the methods described herein. In some examples, aspects of the operations of 1205 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0160]** At 1210, the UE may perform a setup procedure for an SCG associated with a second RAT. The operations of 1210 may be performed according to the methods described herein. In some examples, aspects of the operations of 1210 may be performed by an SCG setup component as described with reference to FIGs. 5 through 8.

**[0161]** At 1215, the UE may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG. The operations of 1215 may be performed according to the methods described herein. In some examples, aspects of the operations of 1215 may be performed by an SCG release component as described with reference to FIGs. 5 through 8.

**[0162]** At 1220, the UE may increment a counter value from a first counter value to a second counter value. The operations of 1220 may be performed according to the methods described herein. In some examples, aspects of the operations of 1220 may be performed by a counter component as described with reference to FIGs. 5 through 8.

**[0163]** At 1225, the UE may compare the second counter value to a threshold counter value. The operations of 1225 may be performed according to the methods described herein. In some examples, aspects of the operations of 1225 may be performed by a counter component as described with reference to FIGs. 5 through 8.

**[0164]** At 1230, the UE may maintain the connection with the cell based on the second counter value being less than the threshold counter value. The operations of 1230 may be performed according to the methods described herein. In some examples, aspects of the

operations of 1230 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0165]** **FIG. 13** shows a flowchart illustrating a method 1300 in accordance with aspects of the present disclosure. The operations of method 1300 may be implemented by a UE 115 or its components as described herein. For example, the operations of method 1300 may be performed by a communications manager as described with reference to FIGs. 5 through 8. In some examples, a UE may execute a set of instructions to control the functional elements of the UE to perform the functions described below. Additionally or alternatively, a UE may perform aspects of the functions described below using special-purpose hardware.

**[0166]** At 1305, the UE may establish a connection with a cell associated with a first RAT and in an NSA mode of operation. The operations of 1305 may be performed according to the methods described herein. In some examples, aspects of the operations of 1305 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0167]** At 1310, the UE may perform a setup procedure for an SCG associated with a second RAT. The operations of 1310 may be performed according to the methods described herein. In some examples, aspects of the operations of 1310 may be performed by an SCG setup component as described with reference to FIGs. 5 through 8.

**[0168]** At 1315, the UE may receive, from a base station supporting the cell, a configuration message indicating a release of the SCG. The operations of 1315 may be performed according to the methods described herein. In some examples, aspects of the operations of 1315 may be performed by an SCG release component as described with reference to FIGs. 5 through 8.

**[0169]** At 1320, the UE may determine that a timer is inactive. The operations of 1320 may be performed according to the methods described herein. In some examples, aspects of the operations of 1320 may be performed by a timer component as described with reference to FIGs. 5 through 8.

**[0170]** At 1325, the UE may activate the timer based on receiving the configuration message indicating the release of the SCG. The operations of 1325 may be performed according to the methods described herein. In some examples, aspects of the operations of

1325 may be performed by a timer component as described with reference to FIGs. 5 through 8.

**[0171]** At 1330, the UE may update a counter value based on receiving the configuration message indicating the release of the SCG. The operations of 1330 may be performed according to the methods described herein. In some examples, aspects of the operations of 1330 may be performed by a counter component as described with reference to FIGs. 5 through 8.

**[0172]** At 1335, the UE may detach from the cell based on the counter value satisfying a threshold counter value and the timer being active (e.g., the counter value satisfies the threshold counter value prior to expiry of the timer). The operations of 1335 may be performed according to the methods described herein. In some examples, aspects of the operations of 1335 may be performed by a connection component as described with reference to FIGs. 5 through 8.

**[0173]** It should be noted that the methods described herein describe possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

**[0174]** Although aspects of an LTE, LTE-A, LTE-A Pro, or NR system may be described for purposes of example, and LTE, LTE-A, LTE-A Pro, or NR terminology may be used in much of the description, the techniques described herein are applicable beyond LTE, LTE-A, LTE-A Pro, or NR networks. For example, the described techniques may be applicable to various other wireless communications systems such as Ultra Mobile Broadband (UMB), Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM, as well as other systems and radio technologies not explicitly mentioned herein.

**[0175]** Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0176] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[0177] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0178] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special purpose computer. By way of example, and not limitation, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless

technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of computer-readable medium. Disk and disc, as used herein, include CD, laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above are also included within the scope of computer-readable media.

**[0179]** As used herein, including in the claims, "or" as used in a list of items (e.g., a list of items prefaced by a phrase such as "at least one of" or "one or more of") indicates an inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase "based on" shall not be construed as a reference to a closed set of conditions. For example, an example step that is described as "based on condition A" may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase "based on" shall be construed in the same manner as the phrase "based at least in part on."

**[0180]** In the appended figures, similar components or features may have the same reference label. Further, various components of the same type may be distinguished by following the reference label by a dash and a second label that distinguishes among the similar components. If just the first reference label is used in the specification, the description is applicable to any one of the similar components having the same first reference label irrespective of the second reference label, or other subsequent reference label.

**[0181]** The description set forth herein, in connection with the appended drawings, describes example configurations and does not represent all the examples that may be implemented or that are within the scope of the claims. The term "example" used herein means "serving as an example, instance, or illustration," and not "preferred" or "advantageous over other examples." The detailed description includes specific details for the purpose of providing an understanding of the described techniques. These techniques, however, may be practiced without these specific details. In some instances, known structures and devices are shown in block diagram form in order to avoid obscuring the concepts of the described examples.

[0182] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein, but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

# CLAIMS

**What is claimed is:**

1. A method for wireless communications, comprising:

establishing a connection with a cell associated with a first radio access technology and in a non-standalone mode of operation;

performing a setup procedure for a secondary cell group associated with a second radio access technology;

receiving, from a base station supporting the cell, a configuration message indicating a release of the secondary cell group;

updating a counter value based at least in part on receiving the configuration message indicating the release of the secondary cell group; and

detaching from the cell based at least in part on the counter value satisfying a threshold counter value.

2. The method of claim 1, wherein the connection with the cell comprises a first connection supporting dual connectivity operation with the second radio access technology, the method further comprising:

transmitting, to the base station, an attach request message for a second connection restricting dual connectivity operation with the second radio access technology based at least in part on detaching from the cell.

3. The method of claim 2, further comprising:

establishing the second connection with the cell associated with the first radio access technology based at least in part on the attach request message, wherein the second connection restricts dual connectivity operation with the second radio access technology.

4. The method of claim 3, further comprising:

receiving, from the base station, an attach accept message, wherein the second connection is established with the cell based at least in part on the attach accept message.

5. The method of claim 3, further comprising:

communicating information with the cell associated with the first radio access technology via the second connection.

6. The method of claim 1, further comprising:

receiving, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group, wherein the setup procedure for the secondary cell group is performed based at least in part on the configuration message requesting addition of the secondary cell group.

7. The method of claim 1, wherein updating the counter value comprises:

incrementing the counter value from a first counter value to a second counter value.

8. The method of claim 7, further comprising:

comparing the second counter value to the threshold counter value, wherein the second counter value is less than the threshold counter value; and

maintaining the connection with the cell based at least in part on the second counter value being less than the threshold counter value.

9. The method of claim 8, further comprising:

receiving, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group;

performing an additional setup procedure for the secondary cell group based at least in part on the configuration message requesting addition of the secondary cell group;

receiving, from the base station supporting the cell, an additional configuration message indicating the release of the secondary cell group;

incrementing the counter value from the second counter value to a third counter value; and

comparing the third counter value to the threshold counter value, wherein the connection with the cell is based at least in part on comparing the third counter value to the threshold counter value.

10. The method of claim 8, further comprising:

receiving, from the base station supporting the cell, a radio resource control connection release message; and

detaching from the cell based at least in part on the radio resource control connection release message.

11. The method of claim 10, wherein the connection with the cell supports dual connectivity operation with the second radio access technology, the method further comprising:

establishing an additional connection with the cell associated with the first radio access technology in the non-standalone mode of operation, the additional connection with the cell supporting dual connectivity operation with the second radio access technology.

12. The method of claim 11, further comprising:

receiving, from the base station supporting the cell, a configuration message indicating a measurement configuration based at least in part on establishing the additional connection with the cell; and

transmitting, to the base station, a measurement report based at least in part on the configuration message indicating the measurement configuration.

13. The method of claim 12, further comprising:

receiving, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group based at least in part on the measurement report;

performing an additional setup procedure for the secondary cell group based at least in part on the configuration message requesting addition of the secondary cell group;

receiving, from the base station supporting the cell, an additional configuration message indicating the release of the secondary cell group;

incrementing the counter value from the second counter value to a third counter value; and

comparing the third counter value to the threshold counter value, wherein the connection with the cell is based at least in part on comparing the third counter value to the threshold counter value.

14. The method of claim 1, further comprising:

determining that a timer is inactive; and

activating the timer based at least in part on receiving the configuration message indicating the release of the secondary cell group.

15. The method of claim 14, wherein detaching from the cell is further based at least in part on the timer being activated.

16. The method of claim 14, further comprising:

determining an expiry of the timer;

resetting the counter value to a counter start value based at least in part on the expiry of the timer;

resetting the timer to a timer start value based at least in part on the expiry of the timer; and

deactivating the timer based at least in part on the expiry of the timer.

17. The method of claim 16, further comprising:

configuring an active duration for the timer, wherein the expiry of the timer is determined based at least in part on the timer running for at least the active duration.

18. The method of claim 14, wherein the cell comprises a first cell, the method further comprising:

switching the connection from the first cell to a second cell;

resetting the timer to a timer start value based at least in part on switching the connection to the second cell; and

deactivating the timer based at least in part on switching the connection to the second cell.

19. The method of claim 1, wherein the cell comprises a first cell, the method further comprising:

switching the connection from the first cell to a second cell; and

resetting the counter value to a counter start value based at least in part on switching the connection to the second cell.

20. The method of claim 1, further comprising:

configuring the threshold counter value based at least in part on the connection, the cell, a previous connection with the cell, past connection information, or any combination thereof.

21. The method of claim 1, further comprising:

transmitting a detach request message to the base station supporting the cell; and

receiving, from the base station supporting the cell, a detach accept message, wherein detaching from the cell is based at least in part on receiving the detach accept message.

22. The method of claim 1, further comprising:

transmitting a secondary cell group setup complete message to the base station based at least in part on performing the setup procedure for the secondary cell group, wherein the configuration message indicating the release of the secondary cell group is received based at least in part on the secondary cell group setup complete message.

23. The method of claim 1, wherein:

the first radio access technology comprises a long term evolution technology, a fourth generation (4G) technology, or both; and

the second radio access technology comprises a new radio technology, a fifth generation (5G) technology, or both.

24. The method of claim 1, wherein the configuration message indicating the release of the secondary cell group comprises a radio resource control reconfiguration message.

25. An apparatus for wireless communications, comprising:

a processor;

memory coupled with the processor; and

instructions stored in the memory and executable by the processor to cause the apparatus to:

establish a connection with a cell associated with a first radio access technology and in a non-standalone mode of operation;

perform a setup procedure for a secondary cell group associated with a second radio access technology;

receive, from a base station supporting the cell, a configuration message indicating a release of the secondary cell group;

update a counter value based at least in part on receiving the configuration message indicating the release of the secondary cell group; and

detach from the cell based at least in part on the counter value satisfying a threshold counter value.

26. The apparatus of claim 25, wherein the connection with the cell comprises a first connection supporting dual connectivity operation with the second radio access technology, and the instructions are further executable by the processor to cause the apparatus to:

transmit, to the base station, an attach request message for a second connection restricting dual connectivity operation with the second radio access technology based at least in part on detaching from the cell.

27. The apparatus of claim 26, wherein the instructions are further executable by the processor to cause the apparatus to:

establish the second connection with the cell associated with the first radio access technology based at least in part on the attach request message, wherein the second connection restricts dual connectivity operation with the second radio access technology.

28. The apparatus of claim 27, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station, an attach accept message, wherein the second connection is established with the cell based at least in part on the attach accept message.

29. The apparatus of claim 27, wherein the apparatus further comprises a transceiver and the instructions are further executable by the processor to cause the apparatus to:

communicate, via the transceiver, information with the cell associated with the first radio access technology via the second connection.

30. The apparatus of claim 25, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group, wherein the setup procedure for the

secondary cell group is performed based at least in part on the configuration message requesting addition of the secondary cell group.

31. The apparatus of claim 25, wherein the instructions to update the counter value are executable by the processor to cause the apparatus to:

increment the counter value from a first counter value to a second counter value.

32. The apparatus of claim 31, wherein the instructions are further executable by the processor to cause the apparatus to:

compare the second counter value to the threshold counter value, wherein the second counter value is less than the threshold counter value; and

maintain the connection with the cell based at least in part on the second counter value being less than the threshold counter value.

33. The apparatus of claim 32, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group;

perform an additional setup procedure for the secondary cell group based at least in part on the configuration message requesting addition of the secondary cell group;

receive, from the base station supporting the cell, an additional configuration message indicating the release of the secondary cell group;

increment the counter value from the second counter value to a third counter value; and

compare the third counter value to the threshold counter value, wherein the connection with the cell is based at least in part on comparing the third counter value to the threshold counter value.

34. The apparatus of claim 32, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station supporting the cell, a radio resource control connection release message; and

detach from the cell based at least in part on the radio resource control connection release message.

35. The apparatus of claim 34, wherein the connection with the cell supports dual connectivity operation with the second radio access technology, and the instructions are further executable by the processor to cause the apparatus to:

establish an additional connection with the cell associated with the first radio access technology in the non-standalone mode of operation, the additional connection with the cell supporting dual connectivity operation with the second radio access technology.

36. The apparatus of claim 35, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station supporting the cell, a configuration message indicating a measurement configuration based at least in part on establishing the additional connection with the cell; and

transmit, to the base station, a measurement report based at least in part on the configuration message indicating the measurement configuration.

37. The apparatus of claim 36, wherein the instructions are further executable by the processor to cause the apparatus to:

receive, from the base station supporting the cell, a configuration message requesting addition of the secondary cell group based at least in part on the measurement report;

perform an additional setup procedure for the secondary cell group based at least in part on the configuration message requesting addition of the secondary cell group;

receive, from the base station supporting the cell, an additional configuration message indicating the release of the secondary cell group;

increment the counter value from the second counter value to a third counter value; and

compare the third counter value to the threshold counter value, wherein the connection with the cell is based at least in part on comparing the third counter value to the threshold counter value.

38. The apparatus of claim 25, wherein the instructions are further executable by the processor to cause the apparatus to:

determine that a timer is inactive; and

activate the timer based at least in part on receiving the configuration message indicating the release of the secondary cell group.

39. The apparatus of claim 38, wherein detaching from the cell is further based at least in part on the timer being activated.

40. The apparatus of claim 38, wherein the instructions are further executable by the processor to cause the apparatus to:

determine an expiry of the timer;

reset the counter value to a counter start value based at least in part on the expiry of the timer;

reset the timer to a timer start value based at least in part on the expiry of the timer; and

deactivate the timer based at least in part on the expiry of the timer.

41. The apparatus of claim 40, wherein the instructions are further executable by the processor to cause the apparatus to:

configure an active duration for the timer, wherein the expiry of the timer is determined based at least in part on the timer running for at least the active duration.

42. The apparatus of claim 38, wherein the cell comprises a first cell, and the instructions are further executable by the processor to cause the apparatus to:

switch the connection from the first cell to a second cell;

reset the timer to a timer start value based at least in part on switching the connection to the second cell; and

deactivate the timer based at least in part on switching the connection to the second cell.

43. The apparatus of claim 25, wherein the cell comprises a first cell, and the instructions are further executable by the processor to cause the apparatus to:

switch the connection from the first cell to a second cell; and

reset the counter value to a counter start value based at least in part on switching the connection to the second cell.

44. The apparatus of claim 25, wherein the instructions are further executable by the processor to cause the apparatus to:

configure the threshold counter value based at least in part on the connection, the cell, a previous connection with the cell, past connection information, or any combination thereof.

45. The apparatus of claim 25, wherein the apparatus further comprises a transceiver and the instructions are further executable by the processor to cause the apparatus to:

transmit, via the transceiver, a detach request message to the base station supporting the cell; and

receive, from the base station supporting the cell and via the transceiver, a detach accept message, wherein detaching from the cell is based at least in part on receiving the detach accept message.

46. The apparatus of claim 25, wherein the instructions are further executable by the processor to cause the apparatus to:

transmit a secondary cell group setup complete message to the base station based at least in part on performing the setup procedure for the secondary cell group, wherein the configuration message indicating the release of the secondary cell group is received based at least in part on the secondary cell group setup complete message.

47. The apparatus of claim 25, wherein:

the first radio access technology comprises a long term evolution technology, a fourth generation (4G) technology, or both; and

the second radio access technology comprises a new radio technology, a fifth generation (5G) technology, or both.

48. The apparatus of claim 25, wherein:

the apparatus further comprises a transceiver; and

the configuration message indicating the release of the secondary cell group comprises a radio resource control reconfiguration message received via the transceiver.

49. An apparatus for wireless communications, comprising:

means for establishing a connection with a cell associated with a first radio access technology and in a non-standalone mode of operation;

means for performing a setup procedure for a secondary cell group associated with a second radio access technology;

means for receiving, from a base station supporting the cell, a configuration message indicating a release of the secondary cell group;

means for updating a counter value based at least in part on receiving the configuration message indicating the release of the secondary cell group; and

means for detaching from the cell based at least in part on the counter value satisfying a threshold counter value.

50. A non-transitory computer-readable medium storing code for wireless communications, the code comprising instructions executable by a processor to:

establish a connection with a cell associated with a first radio access technology and in a non-standalone mode of operation;

perform a setup procedure for a secondary cell group associated with a second radio access technology;

receive, from a base station supporting the cell, a configuration message indicating a release of the secondary cell group;

update a counter value based at least in part on receiving the configuration message indicating the release of the secondary cell group; and

detach from the cell based at least in part on the counter value satisfying a threshold counter value.

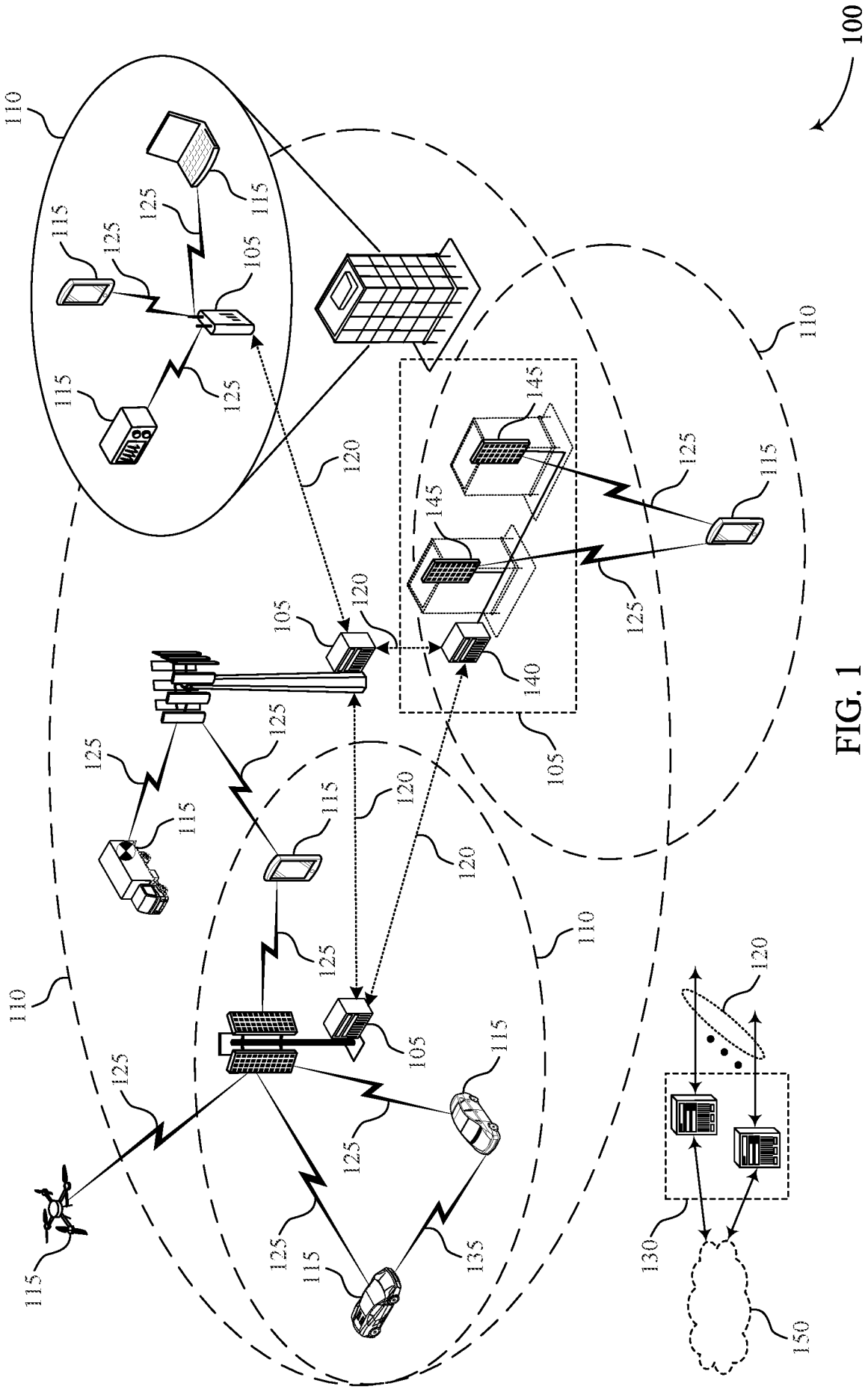



FIG. 1

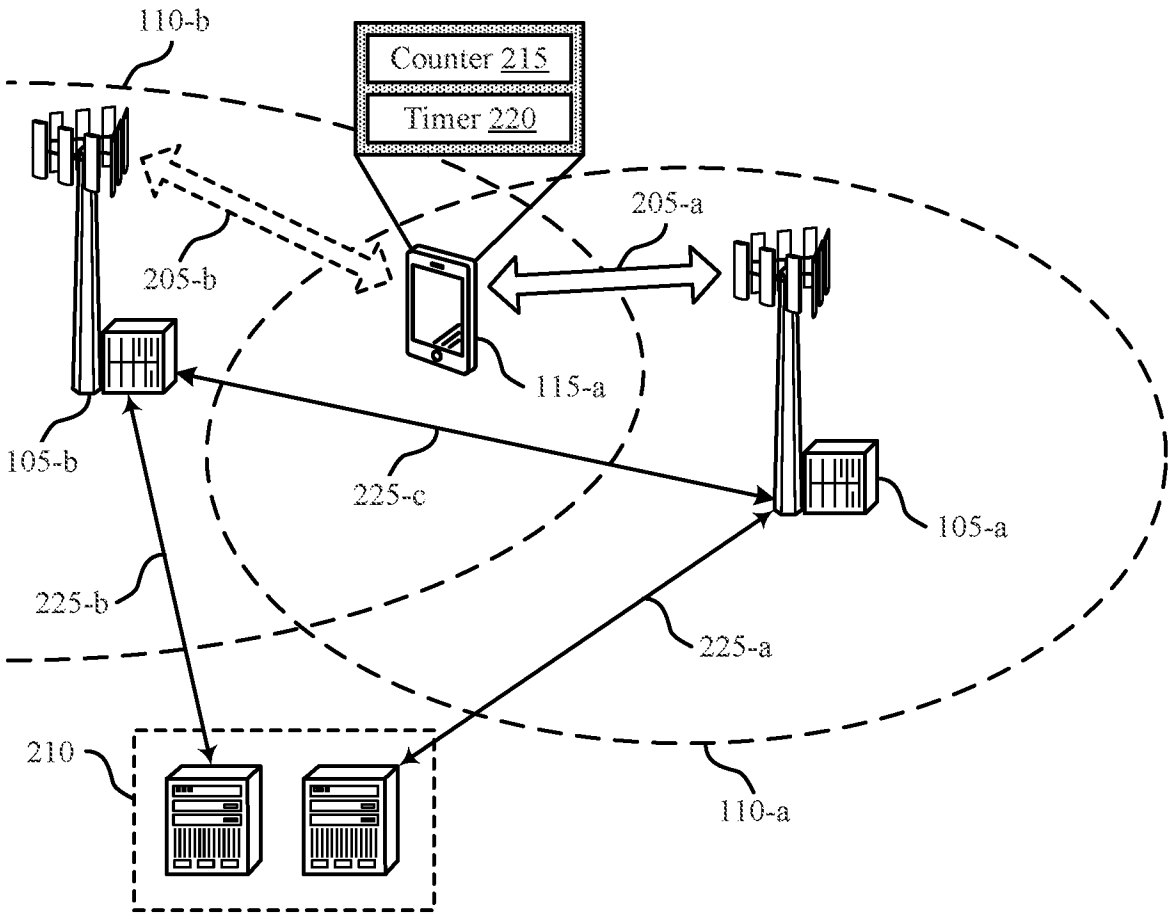

110-b
Counter 215
Timer 220
205-a
205-b
115-a
105-b
225-c
105-a
225-b
225-a
210
110-a
200

FIG. 2

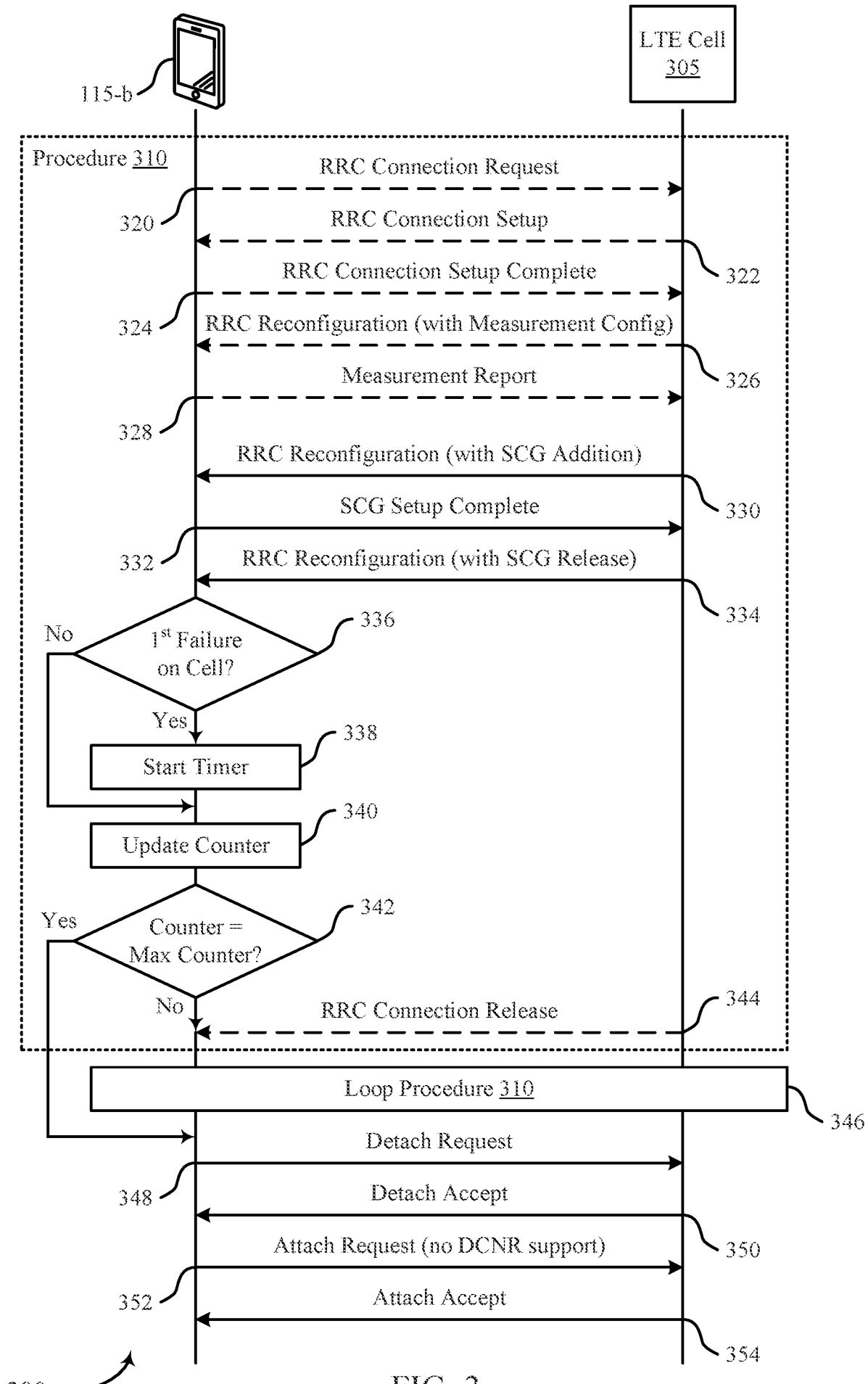

115-b
LTE Cell 305
Procedure 310
RRC Connection Request
320
RRC Connection Setup
322
RRC Connection Setup Complete
324
RRC Reconfiguration (with Measurement Config)
326
Measurement Report
328
RRC Reconfiguration (with SCG Addition)
330
SCG Setup Complete
332
RRC Reconfiguration (with SCG Release)
334
No
1st Failure on Cell?
336
Yes
Start Timer
338
Update Counter
340
Yes
Counter = Max Counter?
342
No
RRC Connection Release
344
Loop Procedure 310
346
Detach Request
348
Detach Accept
Attach Request (no DCNR support)
350
352
Attach Accept
354
300

FIG. 3

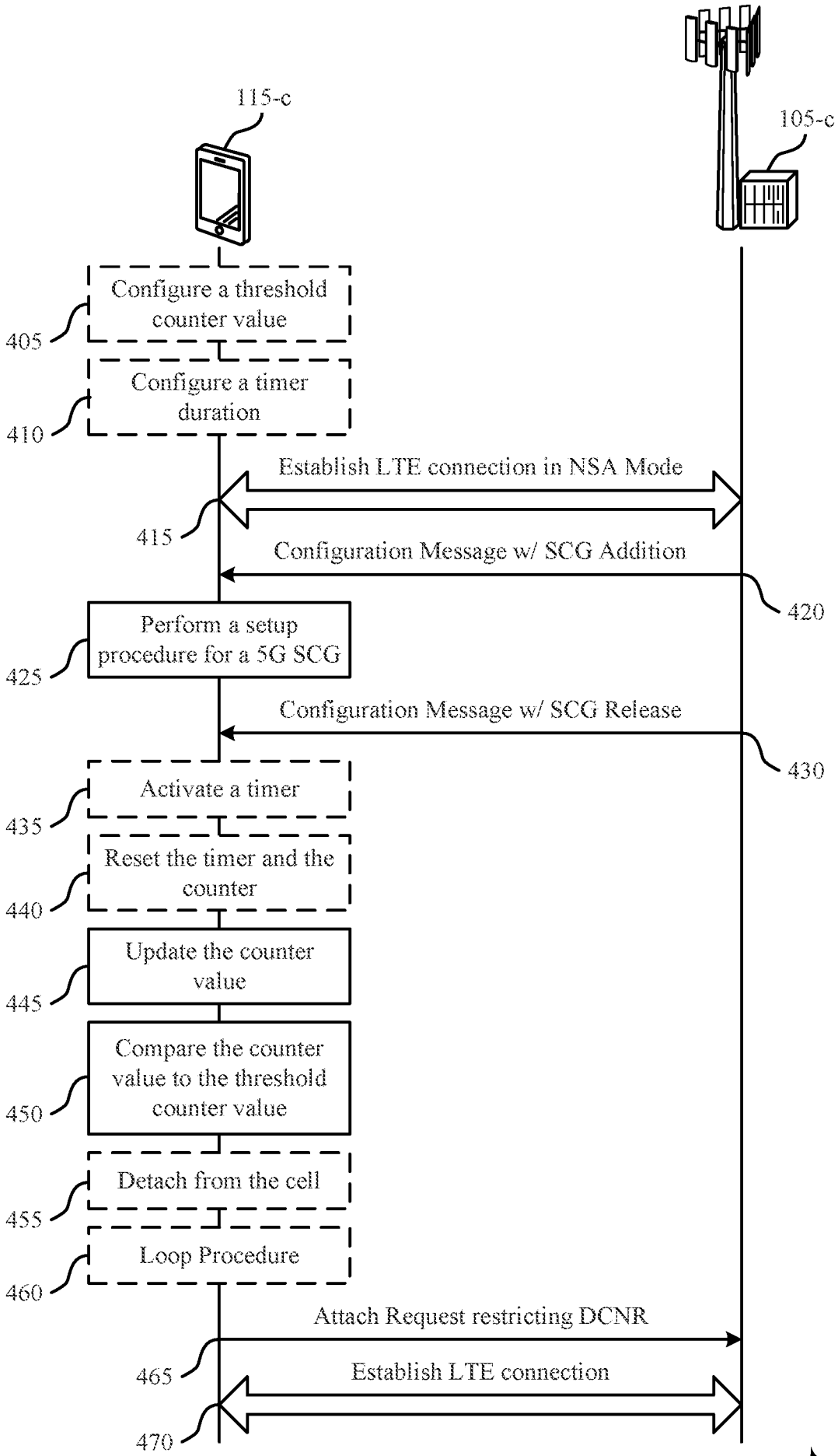

115-c
105-c
Configure a threshold counter value
405
Configure a timer duration
410
Establish LTE connection in NSA Mode
415
Configuration Message w/ SCG Addition
420
Perform a setup procedure for a 5G SCG
425
Configuration Message w/ SCG Release
430
Activate a timer
435
Reset the timer and the counter
440
Update the counter value
445
Compare the counter value to the threshold counter value
450
Detach from the cell
455
Loop Procedure
460
Attach Request restricting DCNR
465
Establish LTE connection
470
400

FIG. 4

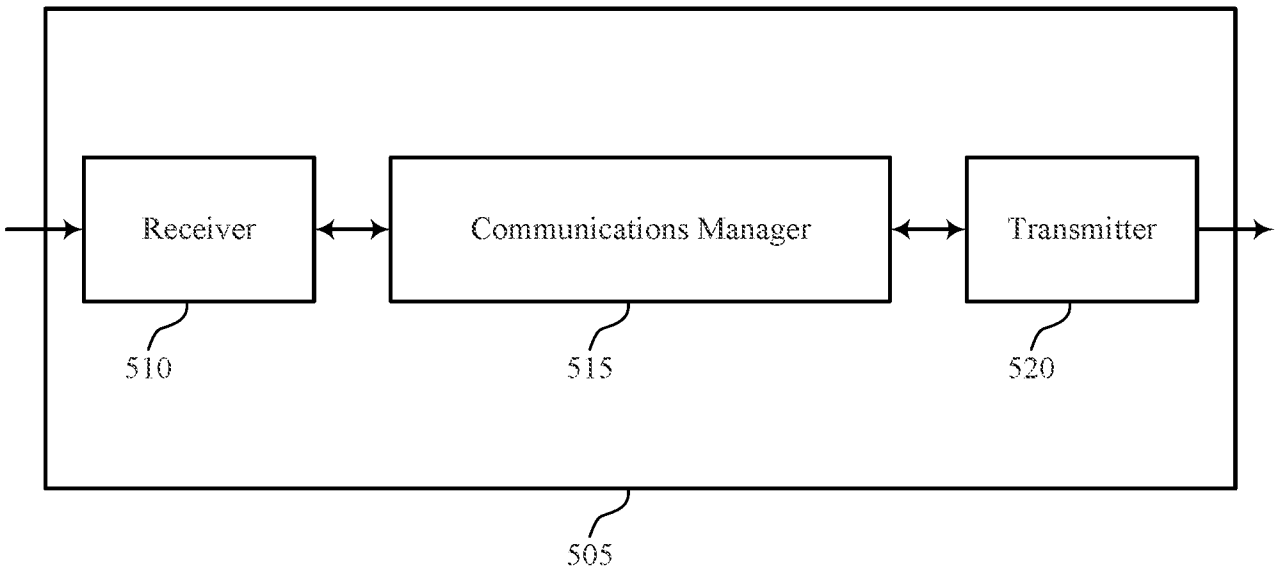

Receiver
Communications Manager
Transmitter
510
515
520
505
500

FIG. 5

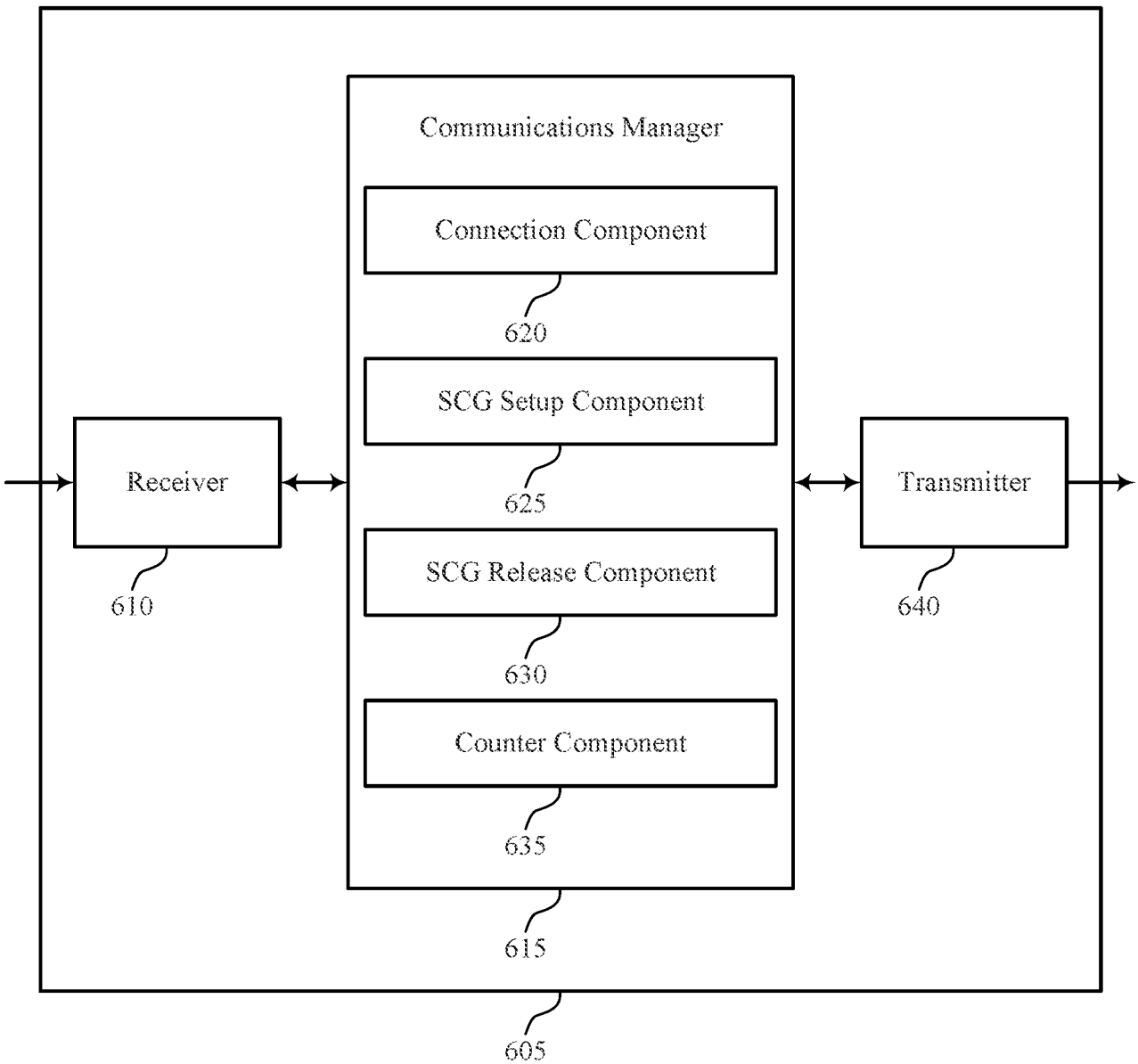

Communications Manager
Connection Component
620
SCG Setup Component
625
Receiver
Transmitter
SCG Release Component
630
610
640
Counter Component
635
615
605
600

FIG. 6

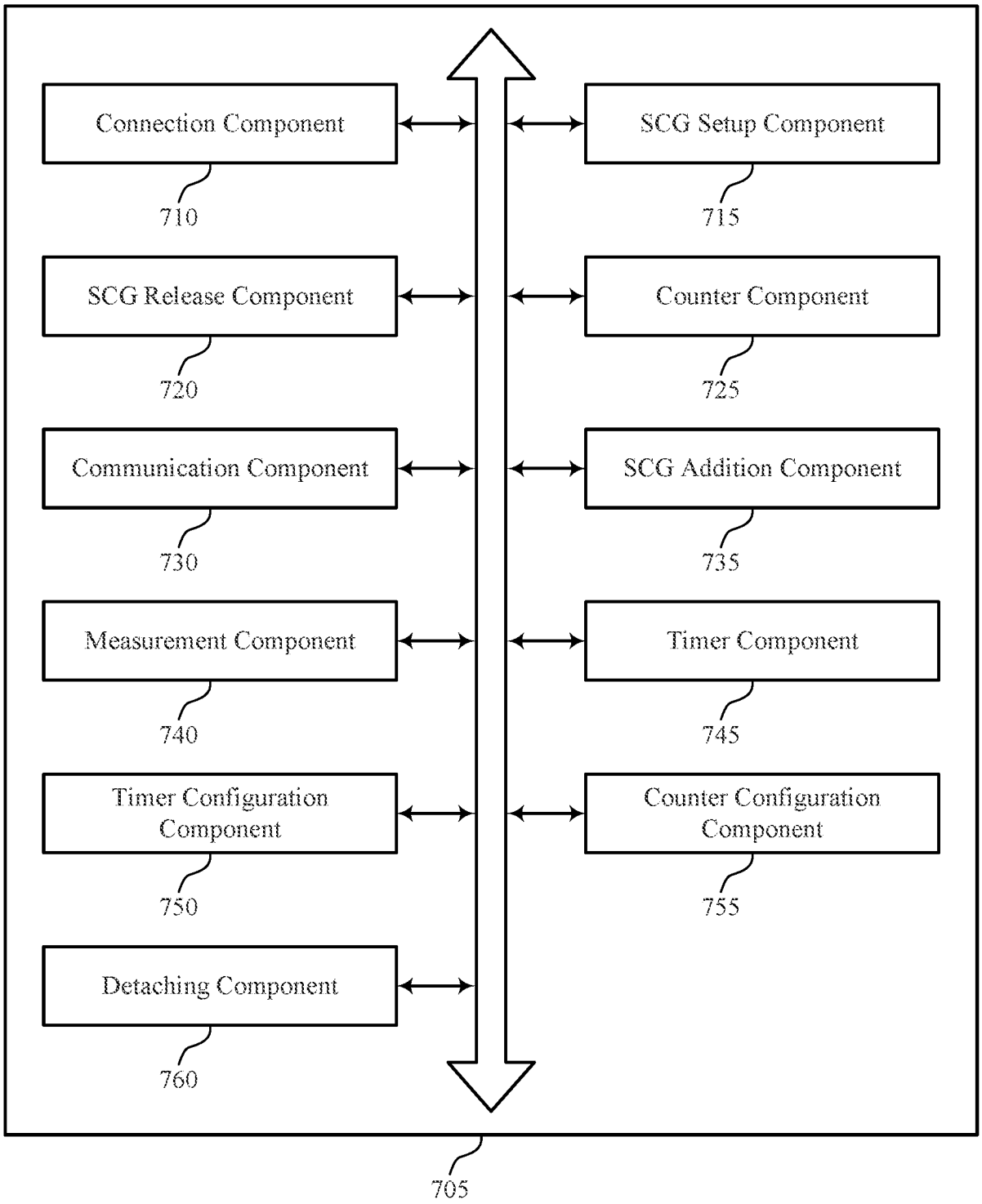

Connection Component
710
SCG Setup Component
715
SCG Release Component
720
Counter Component
725
Communication Component
730
SCG Addition Component
735
Measurement Component
740
Timer Component
745
Timer Configuration Component
750
Counter Configuration Component
755
Detaching Component
760
705
700

FIG. 7

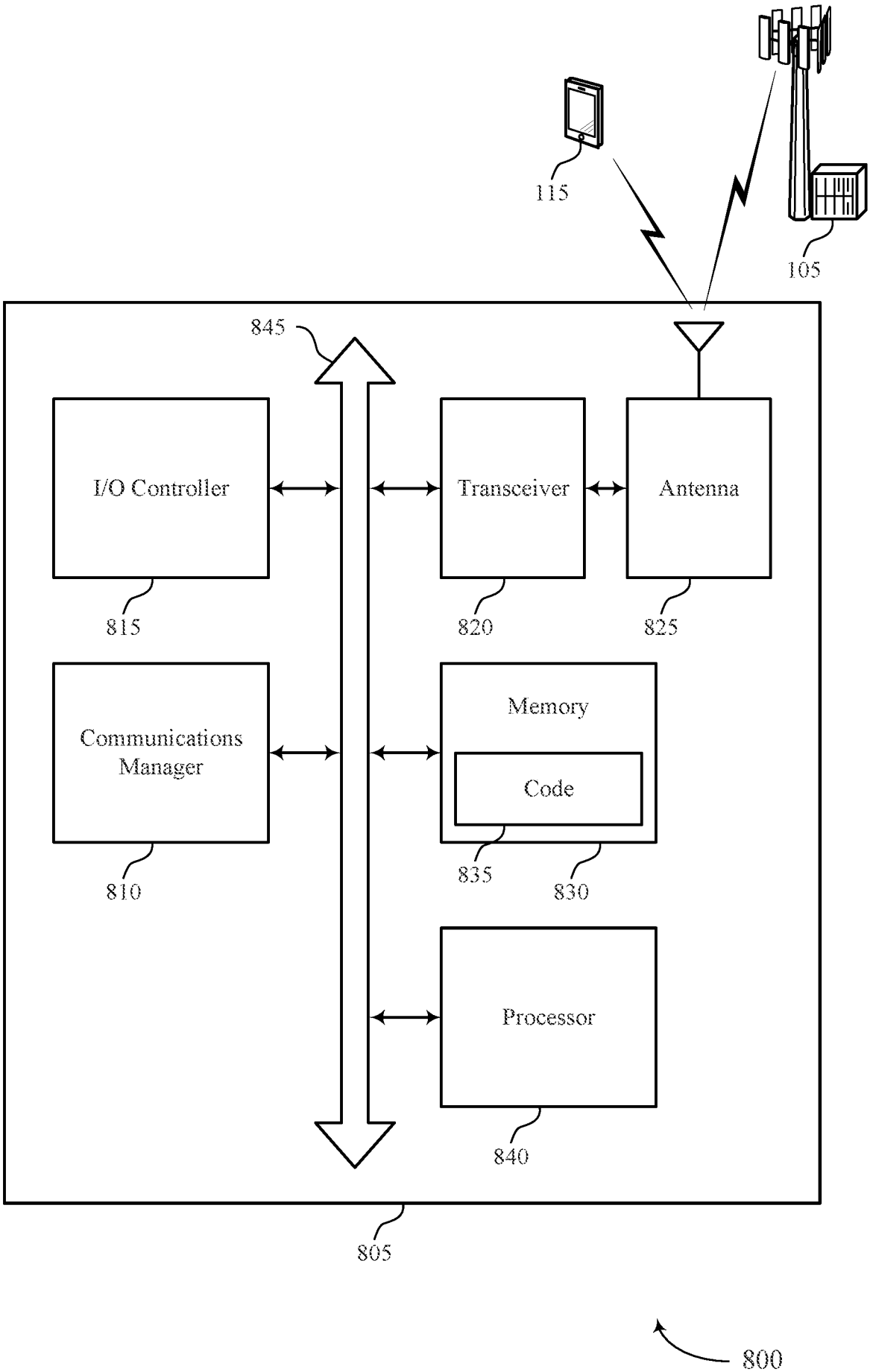

115
105
845
I/O Controller
Transceiver
Antenna
815
820
825
Communications Manager
Memory
Code
810
835
830
Processor
840
805
800

FIG. 8

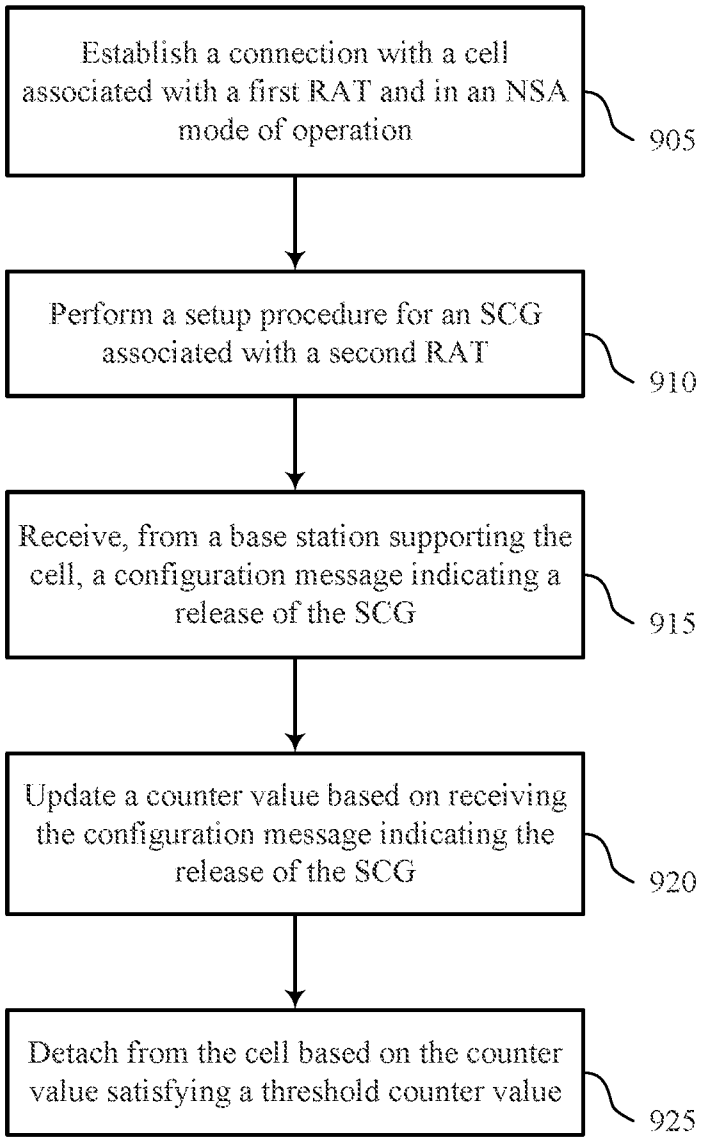

Establish a connection with a cell associated with a first RAT and in an NSA mode of operation
905
Perform a setup procedure for an SCG associated with a second RAT
910
Receive, from a base station supporting the cell, a configuration message indicating a release of the SCG
915
Update a counter value based on receiving the configuration message indicating the release of the SCG
920
Detach from the cell based on the counter value satisfying a threshold counter value
925
900

FIG. 9

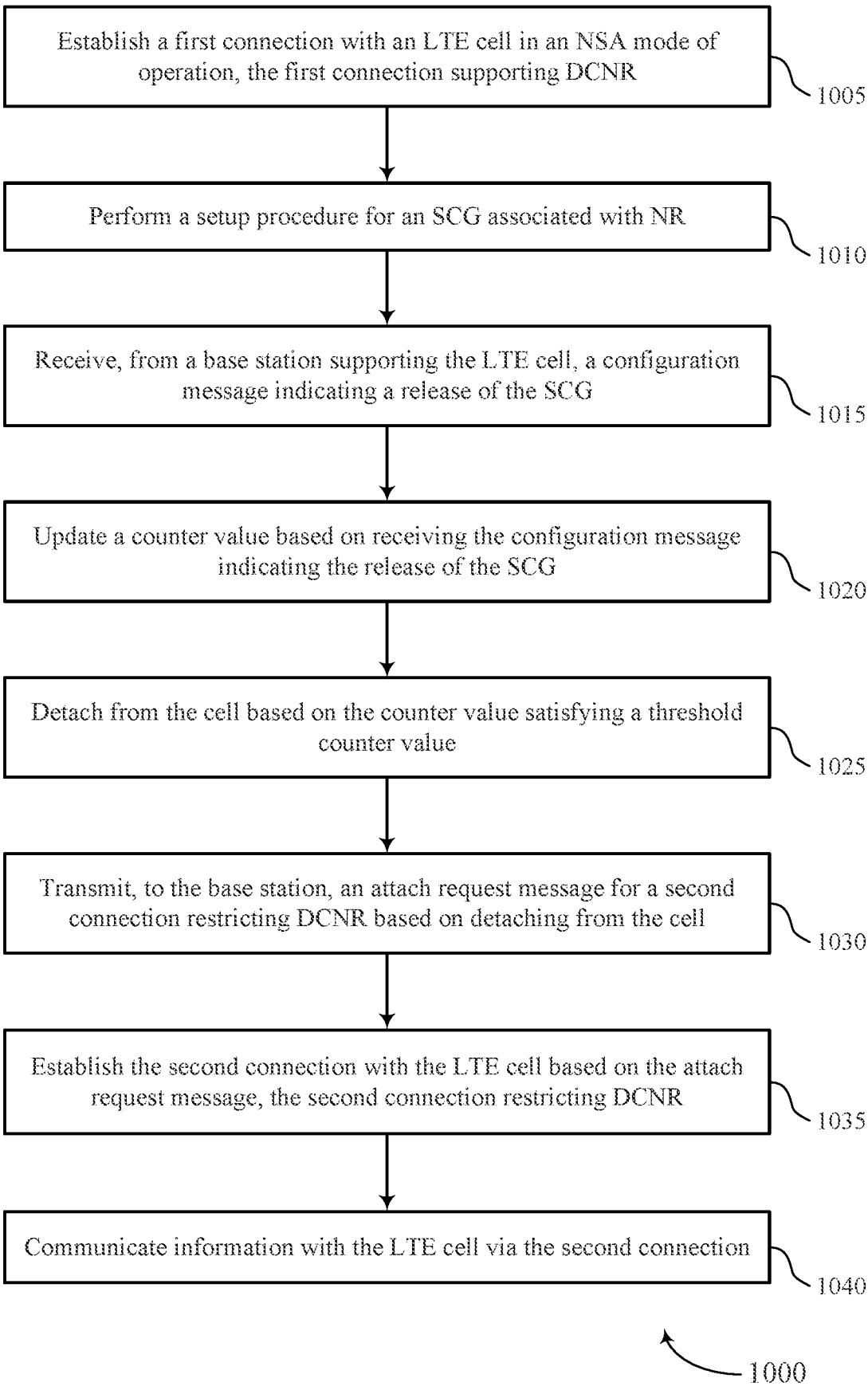

Establish a first connection with an LTE cell in an NSA mode of operation, the first connection supporting DCNR
1005
Perform a setup procedure for an SCG associated with NR
1010
Receive, from a base station supporting the LTE cell, a configuration message indicating a release of the SCG
1015
Update a counter value based on receiving the configuration message indicating the release of the SCG
1020
Detach from the cell based on the counter value satisfying a threshold counter value
1025
Transmit, to the base station, an attach request message for a second connection restricting DCNR based on detaching from the cell
1030
Establish the second connection with the LTE cell based on the attach request message, the second connection restricting DCNR
1035
Communicate information with the LTE cell via the second connection
1040
1000

FIG. 10

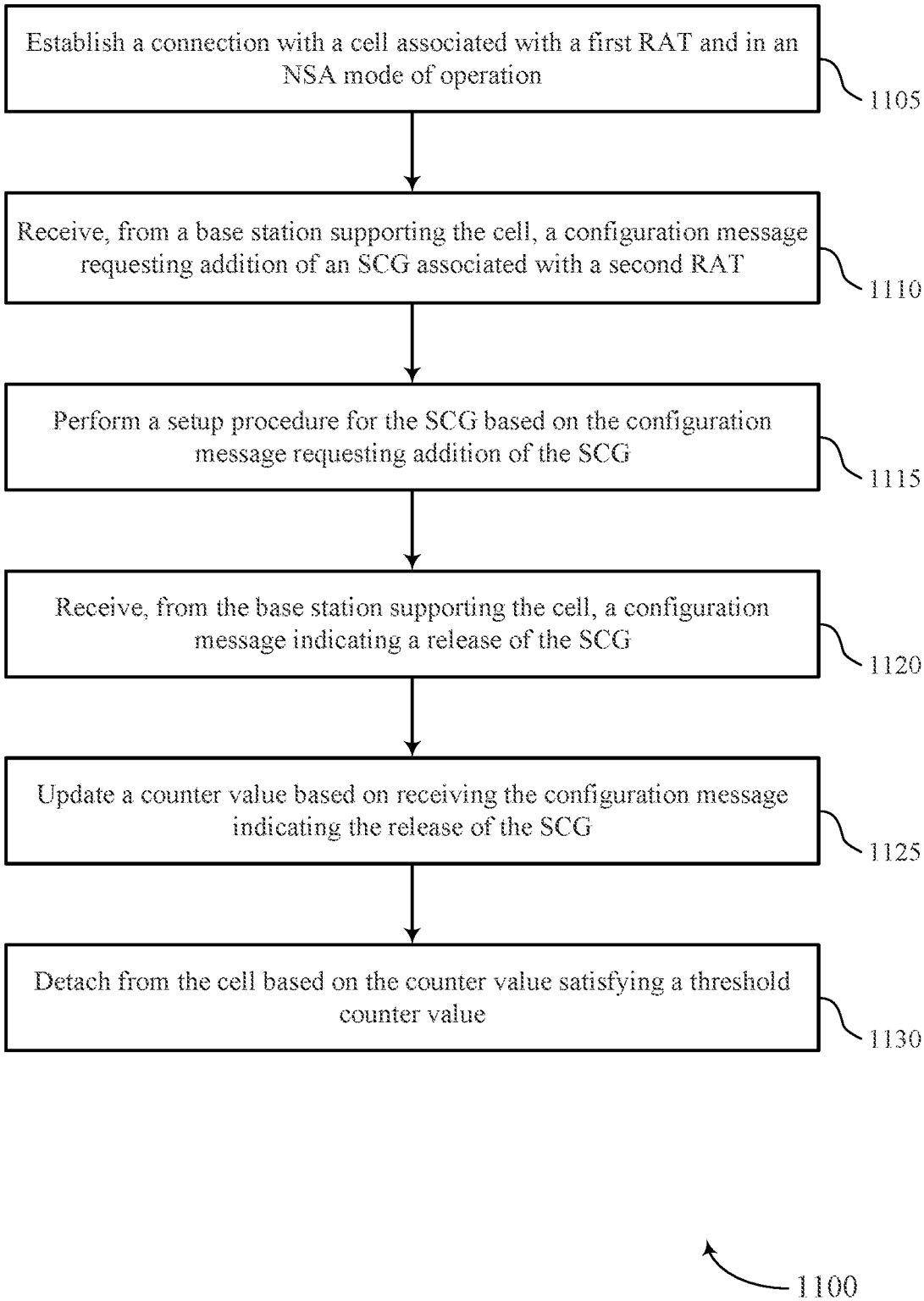

Establish a connection with a cell associated with a first RAT and in an NSA mode of operation
1105
Receive, from a base station supporting the cell, a configuration message requesting addition of an SCG associated with a second RAT
1110
Perform a setup procedure for the SCG based on the configuration message requesting addition of the SCG
1115
Receive, from the base station supporting the cell, a configuration message indicating a release of the SCG
1120
Update a counter value based on receiving the configuration message indicating the release of the SCG
1125
Detach from the cell based on the counter value satisfying a threshold counter value
1130
1100

FIG. 11

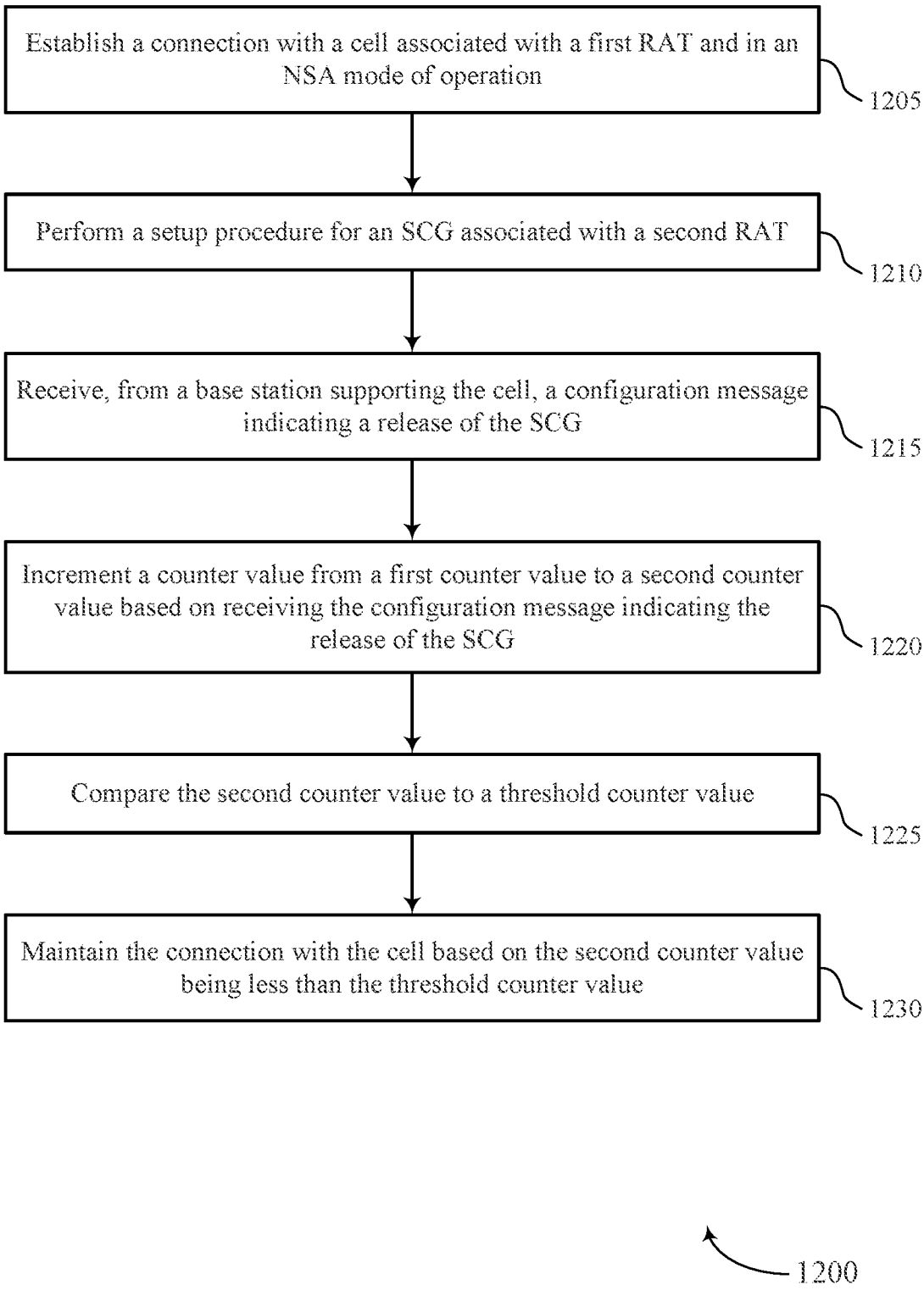

Establish a connection with a cell associated with a first RAT and in an NSA mode of operation
1205
Perform a setup procedure for an SCG associated with a second RAT
1210
Receive, from a base station supporting the cell, a configuration message indicating a release of the SCG
1215
Increment a counter value from a first counter value to a second counter value based on receiving the configuration message indicating the release of the SCG
1220
Compare the second counter value to a threshold counter value
1225
Maintain the connection with the cell based on the second counter value being less than the threshold counter value
1230
1200

FIG. 12

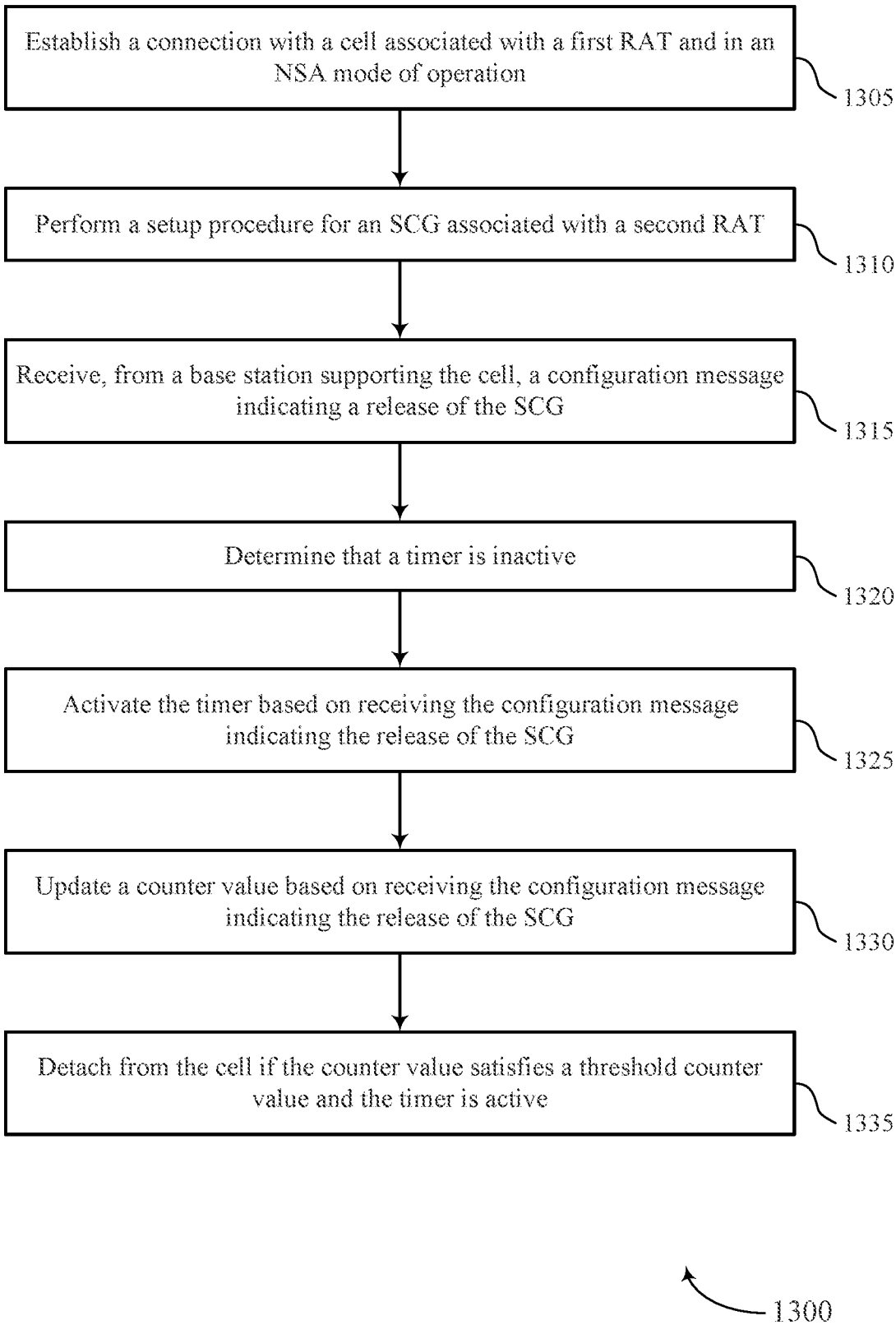

Establish a connection with a cell associated with a first RAT and in an NSA mode of operation
1305
Perform a setup procedure for an SCG associated with a second RAT
1310
Receive, from a base station supporting the cell, a configuration message indicating a release of the SCG
1315
Determine that a timer is inactive
1320
Activate the timer based on receiving the configuration message indicating the release of the SCG
1325
Update a counter value based on receiving the configuration message indicating the release of the SCG
1330
Detach from the cell if the counter value satisfies a threshold counter value and the timer is active
1335
1300

FIG. 13

# INTERNATIONAL SEARCH REPORT

International application No.
**PCT/CN2020/088658**

## A. CLASSIFICATION OF SUBJECT MATTER

H04W 76/18(2018.01)i

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

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04W; H04L

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

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

CNPAT,WPI,EPODOC,CNKI,3GPP: non-standalone, NSA, secondary cell group, SCG, RAT, LTE, NR, dual connection, dual connectivity, DC, release, releases, threshold, detach, number, count, amount, quantity, quantities

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | CN 110557778 A (GUANGDONG OPPO MOBILE TELECOMMUNICATIONS CORP., LTD.) 10 December 2019 (2019-12-10)<br>description, paragraphs [0002]-[0003], [0043]-[0117], figures 1-6 | 1-50 |
| A | CN 107113907 A (NOKIA SOLUTIONS AND NETWORKS OY) 29 August 2017 (2017-08-29)<br>the whole document | 1-50 |
| A | US 2020059985 A1 (NOKIA TECHNOLOGIES OY) 20 February 2020 (2020-02-20)<br>the whole document | 1-50 |
| A | INTERDIGITAL. "Summary of [103#50][NR late drop] - MR-DC configuration in INACTIVE (Interdigital)"<br>*3GPP TSG-RAN WG2 Meeting #103bis R2-1814021,* 12 October 2018 (2018-10-12),<br>the whole document | 1-50 |

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| **14 January 2021** | **27 January 2021** |
| Name and mailing address of the ISA/CN<br>**National Intellectual Property Administration, PRC**<br>**6, Xitucheng Rd., Jimen Bridge, Haidian District, Beijing**<br>**100088**<br>**China**<br>Facsimile No. **(86-10)62019451** | Authorized officer<br>**WANG,Manli**<br>Telephone No. **86-(10)-53961741** |

**INTERNATIONAL SEARCH REPORT**
**Information on patent family members**

International application No.
**PCT/CN2020/088658**

| Patent document cited in search report | | | Publication date (day/month/year) | Patent family member(s) | | | Publication date (day/month/year) |
|---|---|---|---|---|---|---|---|
| CN | 110557778 | A | 10 December 2019 | CN | 110536348 | A | 03 December 2019 |
| | | | | CN | 110536343 | A | 03 December 2019 |
| | | | | CN | 110557777 | A | 10 December 2019 |
| | | | | CN | 110557780 | A | 10 December 2019 |
| | | | | CN | 110536345 | A | 03 December 2019 |
| | | | | CN | 110557779 | A | 10 December 2019 |
| | | | | CN | 110536347 | A | 03 December 2019 |
| | | | | CN | 110505652 | A | 26 November 2019 |
| | | | | CN | 110536342 | A | 03 December 2019 |
| | | | | CN | 110557776 | A | 10 December 2019 |
| | | | | CN | 110536344 | A | 03 December 2019 |
| | | | | CN | 110536346 | A | 03 December 2019 |
| | | | | CN | 110557781 | A | 10 December 2019 |
| | | | | WO | 2020228502 | A1 | 19 November 2020 |
| | | | | WO | 2020228500 | A1 | 19 November 2020 |
| | | | | WO | 2020228497 | A1 | 19 November 2020 |
| | | | | WO | 2020228501 | A1 | 19 November 2020 |
| | | | | WO | 2020228616 | A1 | 19 November 2020 |
| | | | | WO | 2020228613 | A1 | 19 November 2020 |
| | | | | WO | 2020228615 | A1 | 19 November 2020 |
| | | | | WO | 2020228611 | A1 | 19 November 2020 |
| | | | | WO | 2020228831 | A1 | 19 November 2020 |
| | | | | CN | 111954253 | A | 17 November 2020 |
| CN | 107113907 | A | 29 August 2017 | US | 2018295670 | A1 | 11 October 2018 |
| | | | | EP | 3216310 | A1 | 13 September 2017 |
| | | | | WO | 2016071311 | A1 | 12 May 2016 |
| US | 2020059985 | A1 | 20 February 2020 | EP | 3619943 | A1 | 11 March 2020 |
| | | | | WO | 2018203306 | A1 | 08 November 2018 |