

NETWORK ENERGY SAVING TECHNIQUES USING A RACH PROCEDURE

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more
5 specifically to network energy saving techniques using a random access procedure
(RACH procedure).

BACKGROUND

[0002] A wireless communications system may include one or multiple network
communication devices, which may be known as a network equipment (NE), supporting
10 wireless communications for one or multiple user communication devices, which may be
otherwise known as user equipment (UE), or other suitable terminology. The wireless
communications system may support wireless communications with one or multiple user
communication devices by utilizing resources of the wireless communication system
(e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency
15 resources (e.g., subcarriers, carriers, or the like)). Additionally, the wireless
communications system may support wireless communications across various radio
access technologies (RATs) including third generation (3G) radio access technology,
fourth generation (4G) radio access technology, fifth generation (5G) radio access
technology, among other suitable radio access technologies beyond 5G (e.g., 5G-
20 Advanced (5G-A), sixth generation (6G)).

SUMMARY

[0003] An article “a” before an element is unrestricted and understood to refer to “at
least one” of those elements or “one or more” of those elements. The terms “a,” “at least
one,” “one or more,” and “at least one of one or more” may be interchangeable. As used
25 herein, including in the claims, “or” as used in a list of items (e.g., a list of items prefaced
by a phrase such as “at least one of” or “one or more of” or “one or both of”) indicates an
inclusive list such that, for example, a list of at least one of A, B, or C means A or B or C
or AB or AC or BC or ABC (i.e., A and B and C). Also, as used herein, the phrase “based
on” shall not be construed as a reference to a closed set of conditions. For example, an

example step that is described as “based on condition A” may be based on both a condition A and a condition B without departing from the scope of the present disclosure. In other words, as used herein, the phrase “based on” shall be construed in the same manner as the phrase “based at least in part on. Further, as used herein, including in the claims, a “set” may include one or more elements.

5 [0004] A UE for wireless communication is described. The UE may be configured to, capable of, or operable to receive, from a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; transmit a first random-access message that indicates a request for the first system information block of the second cell; monitor for the first system information block of the second cell based at least in part on a transmission the first random-access message; and evaluate cell reselection based at least in part on a reception of the first system information block.

10 [0005] A processor for wireless communication is described. The processor may be configured to, capable of, or operable to receive, from a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; transmit a first random-access message that indicates a request for the first system information block of the second cell; monitor for the first system information block of the second cell based at least in part on a transmission the first random-access message; and evaluate cell reselection based at least in part on a reception of the first system information block.

15 [0006] A method performed or performable by a UE for wireless communication is described. The method may include receiving, from a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; transmitting a first random-access message that indicates a request for the first system information block of the second cell; monitoring for the first system information block of the second cell based at least in part on a transmission the first random-access message; and evaluating cell reselection based at least in part on a reception of the first system information block.

20 [0007] A base station for wireless communication is described. The base station may be configured to, capable of, or operable to transmit, in a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; receive, from a UE, a first random-access message that indicates a request for the

first system information block of a second cell; transmit a second random-access message in response to the first random-access message; and transmit the first system information block of the second cell.

[0008] A processor for wireless communication is described. The processor may be
5 configured to, capable of, or operable to transmit, in a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; receive, from a UE, a first random-access message that indicates a request for the first system information block of a second cell; transmit a second random-access message in response to the first random-access message; and transmit the first system information
10 block of the second cell.

[0009] A method performed or performable by a base station for wireless communication is described. The method may include transmitting, in a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; receiving, from a UE, a first random-access message that
15 indicates a request for the first system information block of a second cell; transmitting a second random-access message in response to the first random-access message; and transmitting the first system information block of the second cell.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Figure 1 illustrates an example of a wireless communications system in
20 accordance with aspects of the present disclosure.

[0011] Figure 2 illustrates an example of a protocol stack showing different protocol layers in the UE and network, in accordance with aspects of the present disclosure.

[0012] Figure 3A illustrates an example of a contention-based random access (CBRA) procedure with 4-step random access (RA) type, in accordance with aspects of
25 the present disclosure.

[0013] Figure 3B illustrates an example of a CBRA procedure with 2-step RA type, in accordance with aspects of the present disclosure.

[0014] Figure 3C illustrates an example of a contention-free random access (CFRA) procedure with 4-step RA type, in accordance with aspects of the present disclosure.

[0015] Figure 3D illustrates an example of a CFRA procedure with 2-step RA type, in accordance with aspects of the present disclosure.

[0016] Figure 3E illustrates an example of a fallback procedure for CBRA with 2-step RA type, in accordance with aspects of the present disclosure.

5 [0017] Figure 4 illustrates an example of a procedure for RACH-based delivery of SIB1 from an anchor cell, in accordance with aspects of the present disclosure.

[0018] Figure 5 illustrates an example of a procedure for RACH-based delivery of SIB1 from a non-anchor cell, in accordance with aspects of the present disclosure.

10 [0019] Figure 6 illustrates an example of a procedure for paging-based acquisition of SIB1 from an anchor cell, in accordance with aspects of the present disclosure.

[0020] Figure 7 illustrates an example of a procedure for paging-based acquisition of SIB1 from a non-anchor cell, in accordance with aspects of the present disclosure.

[0021] Figure 8 illustrates another example of a procedure for paging-based acquisition of SIB1, in accordance with aspects of the present disclosure.

15 [0022] Figure 9 illustrates an example of a UE, in accordance with aspects of the present disclosure.

[0023] Figure 10 illustrates an example of a processor, in accordance with aspects of the present disclosure.

20 [0024] Figure 11 illustrates an example of a NE, in accordance with aspects of the present disclosure.

[0025] Figure 12 illustrates a flowchart of a method performed by a UE, in accordance with aspects of the present disclosure.

[0026] Figure 13 illustrates a flowchart of a method performed by a RAN entity, in accordance with aspects of the present disclosure.

25 DETAILED DESCRIPTION

[0027] Generally, the present disclosure describes systems, methods, and apparatuses for cell measurement of network energy saving cells. In certain embodiments, the methods may be performed using computer-executable code embedded on a computer-

readable medium. In certain embodiments, an apparatus or system may include a computer-readable medium containing computer-readable code which, when executed by a processor, causes the apparatus or system to perform at least a portion of the below described solutions.

5 **[0028]** Emissions and energy consumption from different elements of a telecommunication system are adversely contributing to the climate. Synchronization signal and physical broadcast channel (SS/PBCH) transmissions are necessary for initial access of a radio access network, yet cause significant network energy consumption. Moreover, these SS/PBCH transmissions are wasted energy when no UE is attempting to
10 access the cell.

[0029] Additionally, the operating expenses to run a telecommunication services are huge. In telecommunications, a number of industry-specific factors rooted in countering rising network costs have further shaped efficiency efforts. A continued rise in mobile data traffic, estimated at 6.4 gigabytes (GB) per user per month in 2019 and forecast to
15 grow threefold on a per-user basis over the next five years. Combined with the rising costs of spectrum, capital investment and ongoing RAN maintenance/upgrades, energy-saving measures in network operations are necessary rather than nice to have.

[0030] 5G new radio (NR) offers a significant energy-efficiency improvement per gigabyte over previous generations of mobility. However, new 5G use cases and the
20 adoption of mm Wave will require more sites and antennas. This leads to the prospect of a more efficient network that could paradoxically result in higher emissions without active intervention.

[0031] A study on network energy saving in NR justifies the need for energy saving. Network energy saving is of great importance for environmental sustainability, to reduce
25 environmental impact (greenhouse gas emissions), and for operational cost savings. As 5G is becoming pervasive across industries and geographical areas, handling more advanced services and applications requiring very high data rates (e.g., extended reality (XR) services and applications), networks are being denser, use more antennas, larger bandwidths, and more frequency bands. The environmental impact of 5G needs to stay
30 under control, and novel solutions to improve network energy savings need to be developed.

[0032] Energy consumption has become a key part of the operators' operating expenses. By some reports, the energy cost on mobile networks accounts for approximately 23% of the total operator cost. Most of the energy consumption comes from the radio access network and in particular from the active antenna unit (AAU), with data centers and fiber transport accounting for a smaller share. The power consumption of a radio access can be split into two parts: the dynamic part which is only consumed when data transmission/reception is ongoing, and the static part which is consumed all the time to maintain the necessary operation of the radio access devices, even when the data transmission/reception is not on-going.

10 [0033] Although a UE power consumption model was already defined by the 3rd generation partnership project (3GPP), there was a need to study and develop a network energy consumption model especially for the base station, key performance indicators (KPIs), an evaluation methodology and to identify and study network energy savings techniques in targeted deployment scenarios. The study investigated how to achieve more efficient operation dynamically and/or semi-statically and finer granularity adaptation of transmissions and/or receptions in one or more of network energy saving techniques in time, frequency, spatial, and power domains, with potential support/feedback from UE, potential UE assistance information, and information exchange/coordination over network interfaces.

20 [0034] The 3GPP study not only evaluated the potential network energy consumption gains, but also assessed and balanced the impact on network and user performance, e.g., by looking at KPIs such as spectral efficiency, capacity, user perceived throughput (UPT), latency, UE power consumption, complexity, handover performance, call drop rate, initial access performance, service level agreement (SLA) assurance related KPIs, etc.

[0035] A network expends substantial energy in transmitting synchronization signal block (SSBs), physical broadcast channel (PBCH) (i.e., containing the master information block (MIB) and system information block type 1 (SIB1). In the legacy 5G network, the system information blocks (SIBs) apart from SIB1 can already be provided on demand.

30 [0036] To solve the problems with network energy consumption discussed herein, the present disclosure describes how energy can be saved with respect to SSBs and SIB1. One straightforward option is to provide these as well on an as-need basis, i.e.,

transmitted on an on-demand basis. Another other option is to not provide SSBs and SIB1 in energy-saving cells, and instead use an anchor cell as a proxy transmitter (e.g., for time-frequency synchronization, SIB1) for these energy-saving cells.

5 [0037] Because a network serves RRC idle/ inactive UEs as well as RRC connected UEs, and the service requirements and UE activity in these RRC states are very different from each other, the energy saving techniques for the network should also deal with these separately.

10 [0038] To further solve the problems with network energy consumption discussed herein, the present disclosure discloses UE and network methods enabling network energy saving for RRC idle UEs and RRC inactive UEs.

15 [0039] In various embodiments, the aspects of the present disclosure optimize the energy savings in the network by informing a UE exactly when to start to look for a non-anchor cell, and not before that e.g., not until there is another “good enough” cell to camp on. Further some embodiments reveal efficient ways in which the UE may request the SSB/ SIB1 of a non-anchor cell and these embodiments also disclose an optimized way of provisioning the requested information/ SSB to the UE.

20 [0040] One simple technique for SSB acquisition would be to use the timing of an anchor cell as proxy for downlink (DL) timing of a non-anchor cell not transmitting SSBs. As is obvious, this is sub-optimal since this cannot be applicable for all cell sizes and does not provide frequency synchronization to the for the non-anchor cell.

25 [0041] Similarly, for SIB1 provisioning, a simple technique for SIB1 acquisition would be for the anchor cell to broadcast the SIB1 of the non-anchor cell. However, an anchor cell providing SIB1 of the non-anchor cell does not really provide the overall energy saving as the same number of bits are being broadcasted anyways, unless some optimizations are applied. The disclosed solutions overcome these shortcomings.

30 [0042] In one solution, the UE uses a PRACH transmission as a SIB1 request for the SIB1 of a non-anchor cell. The request can be sent to an anchor cell, or to the non-anchor cell if the SSB transmission is ON. The PRACH resources for SIB1 request can be (pre)configured, e.g., by the anchor cell, or may be already known to the UE, e.g., by way of specification. If it is the anchor cell to which the SIB1 request is being made, either the used PRACH resources signal to the network that the UE is requesting SIB1

information of a neighbor cell, or a Msg3 can be used to signal for which cell (physical cell identity (PCID) and/ or frequency) the SIB1 is being requested. Alternatively, a MsgA can be used to signal for which cell (PCID and/ or frequency) the SIB1 is being requested.

- 5 **[0043]** As another solution, the SIB1 of the non-anchor cell is included in MsgB by the network. For efficient SIB1 delivery via MsgB, the provided SIB1 information may be a subset of “regularly” broadcasted SIB1.

- 10 **[0044]** In a first aspect of the present disclosure, SIB1 information may be a subset of “regularly” broadcasted SIB1, some limited broad categories can be specified or configured. UE signals one of these based on: A) UE's RRC state (e.g., RRC_Idle, RRC_Inactive); and/or B) a UE type (e.g., a reduced capacity (REDCAP) UE, a non-terrestrial network (NTN) UE, etc.).

[0045] In a second aspect of the present disclosure, the MsgB contains the SIB1, or a portion of the SIB1 that is relevant for the UE based on MsgA contents.

- 15 **[0046]** In a third aspect of the present disclosure, MsgB is transmitted by the same cell as receiving MsgA including SIB1 request. Alternatively, MsgA is sent to anchor cell, but MsgB is transmitted by non-anchor itself, e.g., in accordance with the anchor-to-non-anchor communications disclosed below.

- 20 **[0047]** In a fourth aspect of the present disclosure, the *ra-ResponseWindow* may be started after a configurable and/or specified time after the transmission of MsgA.

[0048] In a fifth aspect of the present disclosure, for signaling enhancement, only part of regular SIB1 information of the non-anchor cell is included in MsgB – for remaining not included SIB1 information, the values provided (i.e., broadcasted regularly) by the anchor cell is used.

- 25 **[0049]** In a sixth aspect of the present disclosure, the anchor cell may provide required PBCH for a neighbor cell, providing the UE with parameters (e.g., CORESET#0 configuration) for monitoring SIB1 of the neighbor cell i.e., for receiving physical downlink control channel (PDCCH) for scheduling physical downlink shared channel (PDSCH) that carries the SIB1.

[0050] In a seventh aspect of the present disclosure, the RACH message 1 (Msg1) transmission leads directly to attempts for receiving SIB1 from non-anchor cell in broadcast manner.

5 [0051] In an eighth aspect of the present disclosure, alternatively, after Msg1 transmission, the UE may wait for an acknowledgement (ACK) message (e.g., RACH message 2 (Msg2)) before attempting to receive SIB1 from non-anchor cell in broadcast manner. If SIB1 is not received until a certain time, then the UE retransmits the SIB1 request. The UE considers the cell as barred (for, e.g., 300 seconds) if the SIB1 is not received after a configured number of trials.

10 [0052] In a ninth aspect of the present disclosure, paging can be used by the network to: A) signal that SIB1 is now being broadcasted; or B) provide SIB1 information (or a portion thereof) either i) directly in paging DCI, or ii) using PDSCH (instead of paging message) to provide SIB1; or C) to provide information necessary to receive SIB1.

15 [0053] In a tenth aspect of the present disclosure, the SIB1 request for a non-anchor cell can be made to either the non-anchor cell or to the anchor cell.

[0054] In an eleventh aspect of the present disclosure, the paging configuration can be obtained from the anchor cell (i.e., for both cases of the tenth aspect), or pre-configured.

20 [0055] In a twelfth aspect of the present disclosure, if the UE includes its paging identity with the SIB1 request, then the network may send the SIB1 related paging only on this UE's paging occasions; otherwise, the default identity UE_ID = 0 can be used for the SIB1-related paging.

25 [0056] In a thirteenth aspect of the present disclosure, to indicate that SIB1 from non-anchor cell is "now" being broadcasted, SIB1 paging can be transmitted on PDCCH using P-RNTI with or without associated paging message using short message field in DCI format 1_0. This can be done directly by the anchor cell in one implementation, or by non-anchor cell upon it receiving SIB1 request of the UE from the anchor cell.

30 [0057] In a fourteenth aspect of the present disclosure, the non-anchor cell can reuse the paging P-RNTI, whereas the anchor cell might use a new paging RNTI e.g., P-RNTI-2, if the 'systemInfoModification' bit should be used, for this purpose. In one implementation, the network reuses bit 1, to indicate the 'systemInfoModification'. Alternatively, the network uses one of the not used bits (5-8) to indicate the

'systemInfoModification'. In another implementation, the network uses reserved field in the short message indicator (bit field '00') in the paging DCI to indicate the *'systemInfoModification'*.

5 [0058] In a fifteenth aspect of the present disclosure, RRC inactive UEs may use a small data transmission (SDT) procedure to acquire SIB1.

[0059] In a sixteenth aspect of the present disclosure, an SDT procedure can be initiated on the anchor cell (indicating for which cell the SIB1 request is being made) or on the non-anchor cell. In accordance with the above aspects, a new resume cause value is used for the SIB1 request, or a LCID is reserved for the SIB1 request, or a new RRC
10 CCCH message for SIB1 request. Additionally, access stratum (AS) security may not be applied for SIB1 request. Upon receiving SIB1 request, the network can schedule DL data to the UE containing the requested SIB1 in an ongoing SDT session.

[0060] In a seventeenth aspect of the present disclosure, information for SIB1 acquisition is broadcasted in SIB1 of anchor as a separate information element (IE). In
15 one implementation, this IE is a Boolean flag indicating presence of at least one overlaying/ neighboring non-anchor cell. In another implementation, this Boolean flag (i.e., Yes/ No) can also indicate if the non-anchor cell is broadcasting SIB1 "now". Alternatively, IE contains detailed Msg1/ 2 configuration.

[0061] In an eighteenth aspect of the present disclosure, only limited information is
20 included in SIB1 of anchor and rest in new SIB used for this purpose.

[0062] In a nineteenth aspect of the present disclosure, the triggers to look for non-anchor cell include: A) No suitable cell; B) No cell satisfying S criterion; C) Explicit signaling to camp on a non-anchor cell; D) A new threshold is broadcasted by the anchor to conditionally trigger UE to select a non-anchor cell; and/or E) Random persistence
25 check.

[0063] In a twentieth aspect of the present disclosure, only UEs with certain access identities may request SIB1.

[0064] In a twenty-first aspect of the present disclosure, if the SSB transmission is off and there is no anchor cell available, then the UE will use a global navigation satellite
30 system (GNSS)-based fixed timeslot to make an uplink (UL) transmission using a pre-configured physical random access channel (PRACH) configuration.

[0065] Aspects of the present disclosure are described in the context of a wireless communications system.

[0066] Figure 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 NE 102, one or more UE 104, and a core network (CN) 106. The wireless communications system 100 may support various radio access technologies. In some implementations, the wireless communications system 100 may be a 4G network, such as a long-term evolution (LTE) network or an LTE-advanced (LTE-A) network. In some other implementations, the wireless communications system 100 may be a NR network, such as a 5G network, a 5G-Advanced (5G-A) network, or a 5G ultrawideband (5G-UWB) network. In other implementations, the wireless communications system 100 may be a combination of a 4G network and a 5G network, or other suitable radio access technology including Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20. The wireless communications system 100 may support radio access technologies beyond 5G, for example, 6G. Additionally, the wireless communications system 100 may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0067] The one or more NE 102 may be dispersed throughout a geographic region to form the wireless communications system 100. One or more of the NE 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a network function, a network entity, a radio access network (RAN), a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or other suitable terminology. An NE 102 and a UE 104 may communicate via a communication link, which may be a wireless or wired connection. For example, an NE 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0068] An NE 102 may provide a geographic coverage area for which the NE 102 may support services for one or more UEs 104 within the geographic coverage area. For example, an NE 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, an NE 102 may be

moveable, for example, a satellite associated with a non-terrestrial network (NTN). In some implementations, different geographic coverage areas associated with the same or different radio access technologies may overlap, but the different geographic coverage areas may be associated with different NE 102.

5 **[0069]** The one or more UE 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a remote unit, a mobile device, a wireless device, a remote device, a subscriber device, a transmitter device, a receiver device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client,
10 among other examples. Additionally, or alternatively, the UE 104 may be referred to as an internet-of-things (IoT) device, an internet-of-everything (IoE) device, or machine-type communication (MTC) device, among other examples.

15 **[0070]** A UE 104 may be able to support wireless communication directly with other UEs 104 over a communication link. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D)
communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

20 **[0071]** An NE 102 may support communications with the CN 106, or with another NE 102, or both. For example, an NE 102 may interface with other NE 102 or the CN 106 through one or more backhaul links (e.g., S1, N2, N2, or network interface). In some implementations, the NE 102 may communicate with each other directly. In some other implementations, the NE 102 may communicate with each other or indirectly (e.g., via
25 the CN 106). In some implementations, one or more NE 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

30 **[0072]** The CN 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The CN 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity

that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a packet data network (PDN) gateway (P-GW), or a user plane function (UPF)). In some
5 implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more NE 102 associated with the CN 106.

[0073] The CN 106 may communicate with a packet data network over one or more
10 backhaul links (e.g., via an S1, N2, N2, or another network interface). The packet data network may include an application server. In some implementations, one or more UEs 104 may communicate with the application server. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or a PDN connection, or the like) with the CN 106 via an NE 102. The CN 106 may route traffic (e.g., control information, data, and the
15 like) between the UE 104 and the application server using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the CN 106 (e.g., one or more network functions of the CN 106).

[0074] In the wireless communications system 100, the NEs 102 and the UEs 104
20 may use resources of the wireless communications system 100 (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g., subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the NEs 102 and the UEs 104 may support different resource structures. For example, the NEs 102 and the UEs 104 may support different frame structures. In
25 some implementations, such as in 4G, the NEs 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the NEs 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The NEs 102 and the UEs 104 may support various frame structures based on one or more numerologies.

30 [0075] One or more numerologies may be supported in the wireless communications system 100, and a numerology may include a subcarrier spacing and a cyclic prefix. A first numerology (e.g., $\mu=0$) may be associated with a first subcarrier spacing (e.g., 15

kHz) and a normal cyclic prefix. In some implementations, the first numerology (e.g., $\mu=0$) associated with the first subcarrier spacing (e.g., 15 kHz) may utilize one slot per subframe. A second numerology (e.g., $\mu=1$) may be associated with a second subcarrier spacing (e.g., 30 kHz) and a normal cyclic prefix. A third numerology (e.g., $\mu=2$) may be associated with a third subcarrier spacing (e.g., 60 kHz) and a normal cyclic prefix or an extended cyclic prefix. A fourth numerology (e.g., $\mu=3$) may be associated with a fourth subcarrier spacing (e.g., 120 kHz) and a normal cyclic prefix. A fifth numerology (e.g., $\mu=4$) may be associated with a fifth subcarrier spacing (e.g., 240 kHz) and a normal cyclic prefix.

10 [0076] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In 15 some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0077] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 20 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., orthogonal frequency domain multiplexing (OFDM) symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 25 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a 30 numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$)

associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots.

[0078] In the wireless communications system 100, an electromagnetic (EM) spectrum may be split, based on frequency or wavelength, into various classes, frequency bands, frequency channels, etc. By way of example, the wireless communications system 100 may support one or multiple operating frequency bands, such as frequency range designations frequency range #1 (FR1) (e.g., 410 MHz – 7.125 GHz), frequency range #2 (FR2) (e.g., 24.25 GHz – 52.6 GHz), frequency range #3 (FR3) (e.g., 7.125 GHz – 24.25 GHz), frequency range #4 (FR4) (e.g., 52.6 GHz – 114.25 GHz), frequency range #4a (FR4a) or frequency range #4-1 (FR4-1) (e.g., 52.6 GHz – 71 GHz), and frequency range #5 (FR5) (e.g., 114.25 GHz – 300 GHz). In some implementations, the NEs 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the NEs 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the NEs 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0079] FR1 may be associated with one or multiple numerologies (e.g., at least three numerologies). For example, FR1 may be associated with a first numerology (e.g., $\mu=0$), which includes 15 kHz subcarrier spacing; a second numerology (e.g., $\mu=1$), which includes 30 kHz subcarrier spacing; and a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing. FR2 may be associated with one or multiple numerologies (e.g., at least 2 numerologies). For example, FR2 may be associated with a third numerology (e.g., $\mu=2$), which includes 60 kHz subcarrier spacing; and a fourth numerology (e.g., $\mu=3$), which includes 120 kHz subcarrier spacing.

[0080] Wireless communication in unlicensed spectrum (also referred to as “shared spectrum”) in contrast to licensed spectrum offer some obvious cost advantages allowing communication to obviate overlaying operator’s licensed spectrum and rather use license free spectrum according to local regulation in specific geographies. From the 3GPP technology perspective, the unlicensed operation can be on the Uu interface (referred to as NR-U) or also on sidelink interface (e.g., SL-U).

[0081] For initial access, a UE 104 detects a candidate cell and performs downlink (DL) synchronization. For example, the gNB (e.g., an embodiment of the NE 102) may transmit a synchronization signal and broadcast channel (SS/PBCH) transmission, referred to as a synchronization signal block (SSB). The synchronization signal is a predefined data sequence known to the UE 104 (or derivable using information already stored at the UE 104) and is in a predefined location in time relative to frame/subframe boundaries, etc. The UE 104 searches for the SSB and uses the SSB to obtain DL timing information (e.g., symbol timing) for the DL synchronization. The UE 104 may also decode system information (SI) based on the SSB. Note that with beam-based communication, each DL beam may be associated with a respective SSB.

[0082] After performing DL synchronization and acquiring essential system information, such as the master information block (MIB) and the system information block type 1 (SIB1), the UE 104 performs uplink (UL) synchronization and resource request by performing a random access procedure, referred to as “RACH procedure” by selecting and transmitting a preamble on the physical random access channel (PRACH). The PRACH preamble is transmitted during a RACH occasion, i.e., a predetermined set of time-frequency resources that are available for the reception of the PRACH preamble. Note that with beam-based communication, the UE 104 may select a certain DL beam and transmit the PRACH preamble on a corresponding UL beam. In such embodiments, there may be a mapping between SSB and RACH occasion, allowing the network to determine which beam the UE 104 has selected.

[0083] To complete the RACH procedure, after transmitting the PRACH preamble (also referred to as “Msg1”), the UE 104 monitors for a random-access response (RAR) message (also referred to as “Msg2”). The gNB transmits UL timing adjustment information in the RAR and may also schedule an UL resource, referred to as an initial uplink grant.

[0084] In 3GPP NR, the gNB may transmit the maximum 64 SSBs and the maximum 64 corresponding copies of physical downlink control channel (PDCCH) and/or physical downlink shared channel (PDSCH) for delivery of SIB1 in high frequency bands (e.g., 28 GHz). This may cause significant network energy consumption even for a very low traffic load condition. According to 3GPP technical report (TR) 38.864 (v18.1.0), for network energy savings, on-demand SSB and/or SIB1 (SSB/SIB1) transmissions and a cell

without SSB/SIB1 transmission were considered. When a cell does not transmit SSB/SIB1, for a UE to access the cell, the UE should obtain SI of the cell from other associated carriers/cells and synchronize from other associated carriers/cells. When a cell is in a long period of cell inactivity, a UE served by the cell can trigger SSB/SIB1 transmissions by sending a request to the cell.

[0085] Figure 2 illustrates an example of a protocol stack 200, in accordance with aspects of the present disclosure. While Figure 2 shows a UE 206, a RAN node 208, and a 5G core network (5GC) 210 (e.g., comprising at least an AMF), these are representative of a set of UEs 104 interacting with an NE 102 (e.g., base station) and a CN 106. As depicted, the protocol stack 200 comprises a user plane protocol stack 202 and a control plane protocol stack 204. The user plane protocol stack 202 includes a physical (PHY) layer 212, a medium access control (MAC) sublayer 214, a radio link control (RLC) sublayer 216, a packet data convergence protocol (PDCP) sublayer 218, and a service data adaptation protocol (SDAP) layer 220. The control plane protocol stack 204 includes a PHY layer 212, a MAC sublayer 214, a RLC sublayer 216, and a PDCP sublayer 218. The control plane protocol stack 204 also includes a radio resource control (RRC) layer 222 and a non-access stratum (NAS) layer 224.

[0086] The access stratum (AS) layer 226 (also referred to as “AS protocol stack”) for the user plane protocol stack 202 consists of at least SDAP, PDCP, RLC and MAC sublayers, and the physical layer. The AS layer 228 for the control plane protocol stack 204 consists of at least RRC, PDCP, RLC and MAC sublayers, and the physical layer. The layer-1 (L1) includes the PHY layer 212. The layer-2 (L2) is split into the SDAP layer 220, PDCP sublayer 218, RLC sublayer 216, and MAC sublayer 214. The layer-3 (L3) includes the RRC layer 222 and the NAS layer 224 for the control plane and includes, e.g., an internet protocol (IP) layer and/or PDU layer (not depicted) for the user plane. L1 and L2 are referred to as “lower layers,” while L3 and above (e.g., transport layer, application layer) are referred to as “higher layers” or “upper layers.”

[0087] The PHY layer 212 offers transport channels to the MAC sublayer 214. The PHY layer 212 may perform a beam failure detection procedure using energy detection thresholds, as described herein. In certain embodiments, the PHY layer 212 may send an indication of beam failure to a MAC entity at the MAC sublayer 214. The MAC sublayer 214 offers logical channels to the RLC sublayer 216. The RLC sublayer 216 offers RLC

channels to the PDCP sublayer 218. The PDCP sublayer 218 offers radio bearers to the SDAP sublayer 220 and/or RRC layer 222. The SDAP sublayer 220 offers quality-of-service (QoS) flows to the core network (e.g., 5GC). The RRC layer 222 provides for the addition, modification, and release of carrier aggregation and/or dual connectivity. The
5 RRC layer 222 also manages the establishment, configuration, maintenance, and release of signaling radio bearers (SRBs) and data radio bearers (DRBs).

[0088] The NAS layer 224 is between the UE 206 and an AMF in the 5GC 210. NAS messages are passed transparently through the RAN. The NAS layer 224 is used to manage the establishment of communication sessions and for maintaining continuous
10 communications with the UE 206 as it moves between different cells of the RAN. In contrast, the AS layers 226 and 228 are between the UE 206 and the RAN (i.e., RAN node 208) and carry information over the wireless portion of the network. While not depicted in Figure 2, the IP layer exists above the NAS layer 224, a transport layer exists above the IP layer, and an application layer exists above the transport layer.

15 [0089] The MAC sublayer 214 is the lowest sublayer in the L2 architecture of the NR protocol stack. Its connection to the PHY layer 212 below is through transport channels, and the connection to the RLC sublayer 216 above is through logical channels. The MAC sublayer 214 therefore performs multiplexing and demultiplexing between logical channels and transport channels: the MAC sublayer 214 in the transmitting side constructs MAC
20 PDUs (also known as transport blocks (TBs)) from MAC service data units (SDUs) received through logical channels, and the MAC sublayer 214 in the receiving side recovers MAC SDUs from MAC PDUs received through transport channels.

[0090] The MAC sublayer 214 provides a data transfer service for the RLC sublayer 216 through logical channels, which are either control logical channels which carry control
25 data (e.g., RRC signaling) or traffic logical channels which carry user plane data. On the other hand, the data from the MAC sublayer 214 is exchanged with the PHY layer 212 through transport channels, which are classified as UL or downlink (DL). Data is multiplexed into transport channels depending on how it is transmitted over the air.

[0091] The PHY layer 212 is responsible for the actual transmission of data and control
30 information via the air interface, i.e., the PHY layer 212 carries all information from the MAC transport channels over the air interface on the transmission side. Some of the important functions performed by the PHY layer 212 include coding and modulation, link

adaptation (e.g., adaptive modulation and coding (AMC)), power control, cell search and random access (for initial synchronization and handover purposes) and other measurements (inside the 3GPP system (i.e., NR and/or LTE system) and between systems) for the RRC layer 222. The PHY layer 212 performs transmissions based on transmission parameters, such as the modulation scheme, the coding rate (i.e., the modulation and coding scheme (MCS)), the number of physical resource blocks (PRBs), etc.

[0092] In some implementations, the protocol stack 200 may be an NR protocol stack used in a 5G NR system. Note that an LTE protocol stack comprises similar structure to the protocol stack 200, with the differences that the LTE protocol stack lacks the SDAP sublayer 220 in the AS layer 226, that an EPC replaces the 5GC 210, and that the NAS layer 224 is between the UE 206 and an MME in the EPC. Also note that the present disclosure distinguishes between a protocol layer (such as the aforementioned PHY layer 212, MAC sublayer 214, RLC sublayer 216, PDCP sublayer 218, SDAP layer 220, RRC layer 222 and NAS layer 224) and a transmission layer in multiple-input multiple-output (MIMO) communication (also referred to as a “MIMO layer” or a “data stream”).

[0093] It should be noted that throughout the disclosure, the terms “symbol” and “slot” are terms used to refer to a time unit with a particular duration. For example, symbol could be a fraction/percentage of an OFDM symbol length associated with a particular subcarrier spacing (SCS). As another example, a slot may refer to a predetermined set of symbols and can be a fraction/portion of a radio frame. In the following, an UL transmission can be comprised of multiple transmissions and may contain a physical uplink shared channel (PUSCH) transmission, a physical uplink control channel (PUCCH) transmission, PRACH transmission, a scheduling request (SR), and/or an UL reference signal (RS) such as sounding reference signal (SRS).

[0094] Regarding RRC states, 3GPP defines three different RRC states/modes for 5G NR: RRC_IDLE, RRC_INACTIVE, and RRC_CONNECTED. Initially, i.e., upon powering up, the UE is in an idle mode corresponding to the RRC_IDLE state. Before performing data transfer (including placing calls), the UE must establish a connection with the network which is done using initial access via RRC connection establishment procedure. Once RRC connection is established, the UE is in the RRC_CONNECTED state. The RRC connection may be suspended due to inactivity, wherein the UE transitions

to the RRC_INACTIVE state. Via the RRC release procedure, the RRC connection is released and the UE transitions to the RRC_IDLE state.

[0095] Regarding random access, two types of RACH procedure are supported in a 3GPP wireless communication network: A) a 4-step RA type initiated by the sending of a RACH message 1 (Msg1) and 2-step RA type with RACH message A (MsgA). Both types of RACH procedure support contention-based random access (CBRA) and contention-free random access (CFRA).

[0096] The UE selects the RA type at the initiation of the RACH procedure, e.g., based on network configuration. In one example, when CFRA resources are not configured, an RSRP threshold is used by the UE to select between 2-step RA type and 4-step RA type. In another example, when CFRA resources for 4-step RA type are configured, the UE performs random access with 4-step RA type. In another example, when CFRA resources for 2-step RA type are configured, the UE performs random access with 2-step RA type.

[0097] Note that the network does not configure CFRA resources for 4-step and 2-step RA types at the same time for a bandwidth part (BWP). Additionally, the CFRA with 2-step RA type is only supported for handover.

[0098] The Msg1 of the 4-step RA type consists of a preamble transmitted on a physical random access channel (PRACH). After the Msg1 transmission, the UE monitors for (i.e., attempts to receive and decode) a response from the network within a configured window. For CFRA, a dedicated preamble for Msg1 transmission is assigned by the network and upon receiving a random access response (RAR) from the network, the UE ends the random access procedure. For CBRA, upon reception of the RAR, the UE sends a RACH message 3 (Msg3) using a UL grant scheduled in the RAR and monitors for contention resolution. If contention resolution is not successful after Msg3 (re)transmission(s), then the UE goes back to Msg1 transmission.

[0099] The MsgA of the 2-step RA type includes a preamble on the PRACH and a payload on a physical uplink shared channel (PUSCH). After the MsgA transmission, the UE monitors for (i.e., attempts to receive and decode) a response from the network within a configured window. For CFRA, a dedicated preamble and PUSCH resource are configured for MsgA transmission and upon receiving the network response, the UE ends

the random access procedure. For CBRA, if contention resolution is successful upon receiving the network response, then the UE ends the random access procedure; however, if a fallback indication is received in a RACH message B (MsgB), the UE performs Msg3 transmission using the UL grant scheduled in the fallback indication and monitors for contention resolution. If contention resolution is not successful after Msg3 (re)transmission(s), the UE goes back to MsgA transmission.

[0100] If the random access procedure with 2-step RA type is not completed after a number of MsgA transmissions, the UE can be configured to switch to CBRA with 4-step RA type.

10 [0101] Figures 3A-3E depict signaling flow for RACH procedures of different RA types supporting CBRA and CFRA.

[0102] **Figure 3A** illustrates a first RACH procedure 300 for CBRA with the 4-step RA type, in accordance with aspects of the present disclosure. The UE 206 initiates the RACH procedure 300 by transmitting to the RAN node 208 (e.g., a gNB or other base station) a Msg1 that contains a random access (e.g., PRACH) preamble (see signaling 302). After receiving the Msg1, the RAN node 208 transmits a RACH message 2 (Msg2) containing a RAR message (see signaling 304).

15 [0103] Based on the contents of the RAR, the UE 206 prepares and transmits a Msg3 that contains a scheduled transmission (see signaling 306). As the RACH procedure 300 is a contention-based procedure, there is a possibility that more than one UE transmitted the same random access preamble. Therefore, the RAN node 208 transmits a RACH message 4 (Msg4) that contains a contention resolution message (see signaling 308).

20 [0104] **Figure 3B** illustrates a second RACH procedure 310 for CBRA with the 2-step RA type, in accordance with aspects of the present disclosure. The UE 206 initiates the RACH procedure 310 by transmitting to the RAN node 208 (e.g., a gNB or other base station) a MsgA that contains a random access (e.g., PRACH) preamble (see signaling 312) and a PUSCH payload (see signaling 314). As the RACH procedure 310 is a contention-based procedure, there is a possibility that more than one UE transmitted the same random access preamble. Therefore, after receiving the MsgA, the RAN node 208 transmits a MsgB that contains a contention resolution message (see signaling 316).

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[0105] **Figure 3C** illustrates a third RACH procedure 320 for CFRA with the 4-step RA type, in accordance with aspects of the present disclosure. To support CFRA, the RAN node 208 (e.g., a gNB or other base station) transmits a random access preamble (RA preamble) assignment to the UE 206 (see signaling 322). At a later time, the UE 206
5 initiates the RACH procedure 320 by transmitting, to the RAN node 208, a Msg1 that contains the assigned RA preamble (see signaling 324). After receiving the Msg1, the RAN node 208 transmits a Msg2 containing a RAR message (see signaling 326). While not depicted in Figure 3C, the UE 206 may then prepare and transmit a Msg3 (or other scheduled transmission) based on the RAR message. Note that because the RA preamble
10 is assigned to the UE 206, there is no need for contention resolution for CFRA.

[0106] **Figure 3D** illustrates a fourth RACH procedure 330 for CFRA with the 2-step RA type, in accordance with aspects of the present disclosure. To support CFRA, the RAN node 208 (e.g., a gNB or other base station) transmits a RA preamble assignment to the UE 206 (see signaling 332). At a later time, the UE 206 initiates the RACH
15 procedure 330 by transmitting, to the RAN node 208, a MsgA that contains the assigned RA preamble (see signaling 334) and a PUSCH payload (see signaling 336). After receiving the MsgA, the RAN node 208 transmits a MsgB containing a RAR message (see signaling 338). While not depicted in Figure 3D, the UE 206 may then prepare and transmit a scheduled transmission based on the RAR message. Note that because the RA
20 preamble is assigned to the UE 206, there is no need for contention resolution for CFRA.

[0107] **Figure 3E** illustrates a fifth RACH procedure 340 with fallback for CBRA with the 2-step RA type, in accordance with aspects of the present disclosure. The UE 206 initiates the RACH procedure 310 by transmitting, to the RAN node 208 (e.g., a gNB or other base station), a MsgA that contains a random access (e.g., PRACH) preamble
25 (see signaling 342) and a PUSCH payload (see signaling 344). However, in the RACH procedure 340, the RAN node 208 transmits, to the UE 206, a MsgB that contains a fallback indication (see signaling 346).

[0108] Consequently, based on the contents of the MsgB, the UE 206 switches to a 4-step RA type and transmits a Msg3 that contains a scheduled transmission (see signaling
30 348). As the RACH procedure 340 is a contention-based procedure, there is a possibility that more than one UE transmitted the same random access preamble. Therefore, the

RAN node 208 transmits a RACH message 4 (Msg4) that contains a contention resolution message (see signaling 350).

[0109] According to aspects of a first solution, when an energy-saving, non-anchor cell is not broadcasting SIB1, a UE may use a PRACH transmission as a SIB1 request. In one embodiment, the SIB1 request (PRACH transmission) may be transmitted to an anchor cell. In another embodiment, if the SSB transmission of the non-anchor cell is 'ON,' then the UE may transmit the SIB1 request (PRACH transmission) to the non-anchor cell. In one example, the UE may be provided with a validity area list comprising a list of frequencies and optionally, for each frequency, a list of cells within which the UE can send a SIB1 request.

[0110] In some embodiments, the PRACH resources for the SIB1 request can be preconfigured or configured (e.g., by the anchor cell). Alternatively, the PRACH resources for the SIB1 request may be known to the UE by way of specification or provisioning by the network (e.g., for home PLMN). Similarly, the configuration to receive a Msg2 (e.g., *ra-Response Window*, the common control resource set (CORESET), etc.) and information included in the *Downlink Config Common SIB* (including frequency information DL and initial DL BWP, etc.) can be preconfigured, configured (e.g., by the anchor cell), known by specification, or provisioned by the network.

[0111] If it is the anchor cell to which the SIB1 request is being made, either the used PRACH resources signal to the network that the UE is requesting SIB1 information of a neighbor cell or Msg3 can be used to signal for which cell the SIB1 is being requested (e.g., indicated using a physical cell identity (PCID) and/or frequency). Alternatively, MsgA can be used instead of Msg1/Msg3 to request SIB1 for a particular cell, in accordance with the above aspects.

[0112] As one implementation, a RRC idle UE only uses Msg1 to request the SIB1. However, if the requesting UE is RRC inactive UE, it may use MsgA to be able to include its resume ID, e.g., in case the requesting UE has a valid UL timing alignment, thus making possible the use of the small data transmission (SDT) feature.

[0113] Furthermore, for DL RSRP of configured number of highest ranked SSBs measurement, the anchor cell measurement can be used if the SSB in the non-anchor cell is not being transmitted regularly. Here, the use of Msg1 or MsgA may be also

configurable by the anchor cell. If the UE has no access to (or coverage of) an anchor cell, then a default behavior can be used, whereby the UE always uses Msg1 (or MsgA). In such embodiments, the default behavior may be specified/ pre-configured.

[0114] For the case where only Msg1 can be used, in some implementations, an indication may be included that signals whether the requesting UE is an RRC idle UE or an RRC inactive UE. This information helps a serving cell decide which SIB1 information should be provided to the requesting UE. For example, the network may not provide to a RRC idle UE SIB1 information that is only applicable to RRC inactive UEs (e.g., use full resume ID, some of the *ue-Timers and Constants* parameters applicable only to RRC inactive UEs, *sdt-Config Common*, etc.). Similarly, the network will provide only relevant information to a RRC inactive UE.

[0115] For the case where only Msg1 can be used, in some implementations, a PRACH resource partitioning can be used to distinguish RRC idle UEs from RRC inactive UEs. For example, certain PRACH preamble and/or time-frequency resources may be indicated/assigned for use by RRC idle, while different PRACH preamble and/or time-frequency resources may be indicated/assigned for use by RRC inactive UEs.

[0116] For the case where MsgA needs to be used, in some implementations, an RRC inactive UE will include its resume ID (e.g., an inactive radio network temporary identifier (I-RNTI)). In such implementations, a RRC idle UE (which lacks a resume ID/I-RNTI) can include a dummy/special I-RNTI, e.g., where all bits are set to '1' (alternatively, set to '0').

[0117] In some embodiments, the resources for PRACH transmission may be provided to the UE by the anchor cell. As an alternative – and especially if UE cannot access an anchor cell, but cell search reveals an energy-saving non-anchor cell (i.e., a cell not broadcasting SIB1 regularly) – the UE may use a default configuration (e.g., pre-configured and/or specified) for PRACH transmission and Msg2 reception. This can be for example PRACH preamble(s) (e.g., UL reference signal) reserved for this use, along with time-frequency resources – such that combination of used preamble and time-frequency resource reveals to the network the best downlink beam (SSB) for the UE.

[0118] The actual PRACH (also PUSCH in case of MsgA) transmission to demand SIB1 can be done on the non-anchor cell (i.e., the cell not providing SIB1) if the cell is

transmitting SSB/ PBCH. Otherwise, the PRACH (also PUSCH in case of MsgA) transmission is done on the anchor cell.

[0119] If the one or more non-anchor cell(s) are transmitting SSBs, the UE will after an initial measurement select one or more of such non-anchor cells based on radio quality fulfillment (e.g., based on a new radio threshold comparison or even the cell selection criterion *S* (described below) can be reused for this purpose) to request SIB1 for. In this case, it will include PCIDs of each of these non-anchor cells in MsgA/ Msg3 used for SIB1 request.

[0120] In a different implementation, the UE makes this SIB1 request for one cell only at a time, starting with the best radio candidate. If, after receiving SIB1, the requesting UE cannot select this as a suitable cell, then the UE can go on to request SIB1 for the next candidate (e.g., in radio quality order).

[0121] According to aspects of a second solution, the network includes SIB1 information in a MsgB transmission. To improve the resource efficiency of the SIB1 delivery via MsgB, the provided SIB1 information may be a subset of “regularly” broadcasted SIB1. For example, the subset of SIB1 information that is transmitted in the MsgB may include one or more of: cell selection information, cell access related information, *si-Scheduling* information, serving *Cell Config Common*, *ims-Emergency Support*, eCall over IMS-Support, and some of the *ue-Timers and Constants*, barring information.

[0122] As an enhancement, the distribution of SIB1 information may be based on the actual needs of the requesting UE – which ultimately may depend on the requesting UE’s RRC state, its UE type (e.g., a REDCAP UE, NTN UE, etc.). To this end, some limited broad categories can be specified or configured, indicating which category UE chooses and signals in Msg1/ MsgA. This limited categorization may assist the network in determining which subset of the “regular” SIB1 information needs to be provided to the requesting UE in the MsgB PDSCH part. The MsgB in this case contains a MAC subheader and MAC SDU for common control channel (CCCH), containing required SIB1 information. In some embodiments, the MsgB is transmitted by the same cell as receiving MsgA including SIB1 request.

[0123] In some embodiments, the UE transmits the MsgA to an anchor cell. Here, upon reception of the SIB1 request for a particular neighbor, the anchor cell informs the non-anchor cell neighbor about SIB1 request (via F1 DU-CU interface, or over Xn). The information sent by the anchor cell may include the MsgB-RNTI, the start and length of the *ra-ResponseWindow*, the DL beam to be used for MsgB transmission (or alternatively the UL beam used by the UE for MsgA transmission), and the MsgA contents (e.g., RRC state of the UE, SIB1 category selected, UE type, etc.).

[0124] Upon receiving this information, the non-anchor cell may attempt to include the necessary SIB1 information in MsgB and transmit it to the UE within *ra-ResponseWindow*. As one enhancement, in this case the *ra-ResponseWindow* may be started after a configurable/ specified time after the transmission of MsgA, rather than starting it immediately.

[0125] **Figure 4** illustrates an exemplary procedure 400 for SIB1 delivery, in accordance with aspects of the present disclosure. The procedure 400 involves a UE 402 (e.g., an embodiment of the UE 104 and/or UE 206), an anchor cell 404 (e.g., implemented by a NE 102 and/or RAN node 208), and a non-anchor cell 406 (e.g., implemented by a NE 102 and/or RAN node 208). In the depicted embodiment, an anchor cell provides SIB1 of non-anchor using MsgB.

[0126] In step 1, the anchor cell 404 determines an SSB/ SIB1 request configuration associated with the non-anchor cell 406 (see block 408).

[0127] In step 2, the UE 402 transmits a MsgA to the anchor cell 404, where the MsgA includes an SSB/ SIB1 request (see signaling 410).

[0128] In step conditional 3, if SSB was not previously transmitted "regularly" in the non-anchor cell 406 (e.g., where the non-anchor cell 406 has an irregular SSB transmission pattern), then the anchor cell 404 transmits an SSB request to the non-anchor cell 406 (see signaling 412). Here, the anchor cell 404 requests the non-anchor cell 406 to transmit SSB/ PBCH.

[0129] In step conditional 4, if SSB was not previously transmitted "regularly" in the non-anchor cell 406, then the non-anchor cell 406 initiates SSB/ PBCH transmission (see signaling 414).

[0130] In step 5, the anchor cell 404 transmits a MsgB to the UE 402, where the MsgB includes the SIB1 of the non-anchor cell 406 (see signaling 416). In various embodiments, the UE 402 receiving the MsgB comprising the SIB1 of non-anchor cell 406 may assume the SSB transmissions of the non-anchor cell 406 are present/transmitted from after the last slot of MsgB reception (plus processing time).

[0131] As one enhancement to the above procedure, only part of regular SIB1 information of the non-anchor cell 406 is provided (e.g., included) in the MsgB. In such embodiments, the remaining SIB1 not included in the MsgB may be determined from the values provided (i.e., broadcasted regularly) by the anchor cell 404.

10 [0132] According to aspects of a third solution, a UE may use an Msg1-based SIB1 request, wherein the requesting UE monitors for SIB1 transmission in the non-anchor cell after transmitting the Msg1. In various embodiments, the requesting UE attempts to acquire the SIB1 in the non-anchor cell based on legacy principles, i.e., the master information block (MIB) transmitted on PBCH provides the UE with parameters (e.g., CORESET#0
15 configuration) for monitoring of a PDCCH for scheduling the PDSCH that carries the SIB1.

[0133] In some embodiments, the PBCH transmission may also indicate that there is no associated SIB1, in which case the UE may be pointed to another frequency on which to search for an SSB that is associated with a SIB1, as well as a frequency range where the UE may assume no SSB associated with SIB1 is present. In certain embodiments, the
20 indicated frequency range may be confined within a contiguous spectrum allocation of the same operator in which SSB is detected.

[0134] In some embodiments, if the SIB1 is not broadcast by the non-anchor cell within a defined time period (e.g., the next 20 ms), then the UE re-transmits the SIB1 request. In certain embodiments, SIB1 is transmitted on the DL-SCH (transport channel) with a
25 periodicity of 160 ms and variable transmission repetition periodicity within 160 ms. Note that the default transmission repetition periodicity of SIB1 is 20 ms, but the actual transmission repetition periodicity is up to network implementation.

[0135] In some embodiments, the requesting UE makes the SIB1 request to the non-anchor cell. In other embodiments, the requesting UE makes the SIB1 request to the
30 anchor cell, in which case the anchor cell needs to relay relevant information to the non-anchor cell. Consequently, upon reception of the SIB1 request for a particular neighbor,

the anchor cell informs the non-anchor neighbor cell (e.g., via F1 DU-CU interface, or over Xn) about the SIB1 request, including the RA-RNTI, the start and length of the *ra-ResponseWindow*, the DL beam to be used for Msg2 transmission (or alternatively the UL beam used by the UE for Msg1 transmission), the Msg1 contents, e.g., RRC state of the UE, SIB1 category selected, UE type, etc. based on the reserved PRACH resources, used by the UE for Msg1 transmission. The *ra-ResponseWindow* may be started after a configurable/specified time after the transmission of Msg1, rather than starting it immediately.

[0136] Figure 5 illustrates an exemplary procedure 500 for SIB1 delivery, in accordance with aspects of the present disclosure. The procedure 500 involves a UE 502 (e.g., an embodiment of the UE 104 and/or UE 206), an anchor cell 504 (e.g., implemented by a NE 102 and/or RAN node 208), and a non-anchor cell 506 (e.g., implemented by a NE 102 and/or RAN node 208). In the depicted embodiment, the non-anchor cell 504 broadcasts SIB1 after receiving a request from the UE 502 via the anchor cell 504.

[0137] In step 1, the anchor cell 504 determines an SSB/SIB1 request configuration associated with the non-anchor cell 506 (see block 508).

[0138] In step 2, the UE 502 transmits an SSB/SIB1 request to the anchor cell 504 (see signaling 510). In certain embodiments, the SIB1 request may be contained in a RACH message, such as Msg1.

[0139] In step 3, the anchor cell 504 informs the non-anchor cell 506 about the SSB/SIB1 request (see signaling 512). In one embodiment, the anchor cell 504 forwards the SSB/SIB1 request received in step 2. In another embodiment, the anchor cell 504 transmits a second (independent) SSB/SIB1 request message based on the SSB/SIB1 request received in step 2.

[0140] In step 4, the non-anchor cell 506 transmits SSB and/or SIB1 to the UE 502 (see signaling 514).

[0141] In various embodiments, the UE 502 receiving the MsgB comprising the SIB1 of non-anchor cell 506 may assume the SSB transmissions of the non-anchor cell 506 are present/transmitted from after the last slot of MsgB reception (plus processing time).

[0142] As one enhancement only part of regular SIB1 information of the non-anchor cell 506 is provided (e.g., included) in the MsgB. In such embodiments, the remaining SIB1 not included in the MsgB may be determined from the values provided (i.e., broadcasted regularly) by the anchor cell 504.

5 [0143] In one variation to the above procedure, the SSB/SIB1 request transmitted by the UE 502 contains multiple physical cell identities (PCIDs). In this case, the anchor cell 504 alerts each requested non-anchor cell 506 to start broadcasting SIB1. After transmission of SIB1 request, the UE 502 starts to acquire SIB1 broadcast transmissions.

[0144] In one embodiment, the UE 502 may start to acquire SIB1 first from the best
10 radio quality cell (e.g., based on SSB measurements) and try to camp on the best radio quality cell as a suitable cell. However, if the best radio quality cell is unsuitable to camp on, then the UE 502 may then attempt to acquire SIB1 of a next cell (i.e., in order of radio quality). Additionally, if the UE 502 fails to acquire SIB1 for one of the already requested cells, then the UE 503 may re-request the SIB1 for that cell only. Further, if the
15 UE 502 continues to fail to acquire SIB1 for one of the already requested cells (i.e., after a certain number of attempts or for a time period), then the UE 502 may consider that cell as barred (e.g., for 300 seconds).

[0145] According to aspects of a fourth solution, when Msg1 is used for SIB1 request, the Msg2 may contain only a MAC subheader with random access preamble ID (RAPID), i.e., an acknowledgment (ACK) of the system information (SI) request. Note
20 that the fourth solution is presented as an alternative to the above solutions where the Msg2 also contains a RAR payload UL grant. Because the Msg1 is used for SIB1 request, the UL grant is not needed. In various embodiments, the UE waits to receive an ACK for Msg1 reception at the network before retransmitting the SIB1 request. As noted
25 above, the ACK may be a Msg2 containing only the preamble ID included in Msg1.

[0146] In this case upon receiving the ACK, the UE does not re-transmit the SIB1 request but instead attempts to acquire the SIB1 based on legacy principles, i.e., the MIB transmitted on PBCH provides the UE with parameters (e.g., CORESET#0 configuration) for monitoring of a PDCCH for scheduling the PDSCH that carries the SIB1.

30 [0147] In some embodiments, the PBCH transmission may also indicate that there is no associated SIB1, in which case the UE may be pointed to another frequency on which

to search for an SSB that is associated with a SIB1, as well as a frequency range where the UE may assume no SSB associated with SIB1 is present. In certain embodiments, the indicated frequency range is confined within a contiguous spectrum allocation of the same operator in which SSB is detected.

- 5 **[0148]** In some embodiments, the network transmits SIB1 on the DL-SCH with a periodicity of 160 ms and variable transmission repetition periodicity within 160 ms. In certain embodiments, the default transmission repetition periodicity of SIB1 is 20 ms but the actual transmission repetition periodicity is up to network implementation.

- 10 **[0149]** To reiterate, after Msg1 transmission, the UE waits for an ACK (Msg2) before attempting to receive the SIB1 from non-anchor cell in broadcast manner. If the SIB1 is not received after a certain time, then the UE retransmits the SIB1 request. Additionally, the UE considers the cell as barred (for example for 300 seconds) if the SIB1 is not received after a configured number of attempts.

- 15 **[0150]** Referring again to Figure 5, in one variation the SSB/SIB1 request transmitted by the UE 502 includes multiple PCIDs. In this case, anchor cell 504 alerts each requested non-anchor cell 506 to start broadcasting SIB1. Additionally, the anchor cell 504 transmits, to the UE 502, an ACK for SSB/SIB1 request. After receiving the ACK, the UE 502 starts to acquire SIB1 broadcast transmissions.

- 20 **[0151]** In one embodiment, the UE 502 may start to acquire SIB1 first from the best radio quality cell (e.g., based on SSB measurements) and try to camp on the best radio quality cell as a suitable cell. However, if the best radio quality cell is unsuitable to camp on, then the UE 502 may then attempt to acquire SIB1 of a next cell (i.e., in order of radio quality). Additionally, if the UE 502 fails to acquire SIB1 for one of the already requested cells, then the UE 503 may re-request the SIB1 for that cell only. Further, if the
25 UE 502 continues to fail to acquire SIB1 for one of the already requested cells (i.e., after a certain number of attempts or for a time period), then the UE 502 may consider that cell as barred.

- 30 **[0152]** In various embodiments, an anchor cell 504 may provide the required PBCH for a neighboring non-anchor cell 506, thereby providing the UE with parameters (e.g., CORESET#0 configuration) for monitoring of PDCCH for scheduling PDSCH that carries the SIB1. In this case, the non-anchor cell 506 need not broadcast the MIB

regularly, and the MIB may be provided to the UE in response to the SIB1 request. In such embodiments, the signaling 508 may be considered a MIB/ SIB1 request.

[0153] According to aspects of a fifth solution, upon receiving the SIB1 request, the network may use paging to indicate that the SIB1 is now being broadcasted, to provide (part of) SIB1 information directly, and/or to provide information necessary to receive SIB1. In various embodiments, the SIB1 request may be based on Msg1 and/or Msg3, as described above. In other embodiments, the SIB1 request may be based on MsgA, as described above.

[0154] In some embodiments, the SIB1 request for a non-anchor cell can be made to the non-anchor cell itself. In other embodiments, the SIB1 request for a non-anchor cell may be made to the anchor cell, which may then forward the request to non-anchor cell via backhaul, as described above. In some embodiments, the SIB1 paging may be transmitted by the anchor cell. In other embodiments, the SIB1 paging may be transmitted by the non-anchor cell.

[0155] Figure 6 illustrates an exemplary procedure 600 for SIB1 acquisition, in accordance with aspects of the present disclosure. The procedure 600 involves a UE 602 (e.g., an embodiment of the UE 104 and/or UE 206), an anchor cell 604 (e.g., implemented by a NE 102 and/or RAN node 208), and a non-anchor cell 606 (e.g., implemented by a NE 102 and/or RAN node 208). In the depicted embodiment, the UE 602 transmits a RACH message (e.g., MsgA) to the anchor cell 604, and the anchor cell 604 pages the UE 602 for the acquisition of SIB1 of the non-anchor cell 606.

[0156] In step 1, the anchor cell 604 determines a paging configuration associated with the anchor cell 604 and a SIB1 request configuration associated with the non-anchor cell 606 (see block 608). The anchor cell 604 broadcasts this configuration information, and the UE 602 receives the broadcast (see signaling 610).

[0157] In step 2, the UE 602 transmits an MsgA to the anchor cell 604, where the MsgA includes an SSB/ SIB1 request (see signaling 612).

[0158] In conditional step 3, if SSB was not previously transmitted "regularly" in the non-anchor cell 606, then the anchor cell 604 transmits an SSB request to the non-anchor cell 606 (see signaling 614). Here, the anchor cell 604 requests the non-anchor cell 606 to transmit SSB/ PBCH.

[0159] In conditional step 4, if SSB was not previously transmitted "regularly" in the non-anchor cell 606 (e.g., if the non-anchor cell 606 has an irregular SSB transmission pattern), then the non-anchor cell 606 initiates SSB transmission (see signaling 616).

[0160] In step 5, the anchor cell 604 transmits a paging message to the UE 602, where
5 the paging message is for SIB1 acquisition (see signaling 618). In certain embodiments, the paging message from the anchor cell uses a special/new paging radio network temporary identifier (P-RNTI), as discussed in further detail below. In various embodiments, the UE 602 receiving the paging message for SIB1 acquisition may assume the SSB transmissions of the non-anchor cell are present/transmitted, e.g., from after the
10 last slot of the paging message reception (plus processing time).

[0161] In step 6, the non-anchor cell 606 transmits the SIB1 (see signaling 620).

[0162] **Figure 7** illustrates an exemplary procedure 700 for SIB1 acquisition, in accordance with aspects of the present disclosure. The procedure 700 involves a UE 702 (e.g., an embodiment of the UE 104 and/or UE 206), an anchor cell 704 (e.g.,
15 implemented by a NE 102 and/or RAN node 208), and a non-anchor cell 706 (e.g., implemented by a NE 102 and/or RAN node 208). In the depicted embodiment, the UE 702 transmits a RACH message (e.g., MsgA) to the non-anchor cell 706, and the non-anchor cell 706 pages the UE 702 for the acquisition of SIB1 of the non-anchor cell 706.

[0163] In step 1, the non-anchor cell 706 transmits SSB and/or MIB, and the UE 702
20 receives the transmission (see signaling 708).

[0164] In step 2, the anchor cell 704 determines a paging configuration associated with the anchor cell 704 and a SIB1 request configuration associated with the non-anchor cell 706 (see block 710). The anchor cell 704 broadcasts this configuration information, and the UE 702 receives the broadcast (see signaling 712).

25 [0165] In step 3, the UE 702 transmits a MsgA to the non-anchor cell 706, where the MsgA includes an SSB/ SIB1 request (see signaling 714).

[0166] In step 4, the non-anchor cell 706 transmits a paging message to the UE 702, where the paging message is for SIB1 acquisition (see signaling 716).

[0167] In step 5, the non-anchor cell 706 transmits the SIB1 (see signaling 718).

[0168] Figure 8 illustrates an exemplary procedure 800 for SIB1 acquisition, in accordance with aspects of the present disclosure. The procedure 800 involves a UE 802 (e.g., an embodiment of the UE 104 and/or UE 206), an anchor cell 804 (e.g., implemented by a NE 102 and/or RAN node 208), and a non-anchor cell 806 (e.g., implemented by a NE 102 and/or RAN node 208). In the depicted embodiment, the UE 802 transmits a RACH message (e.g., MsgA) to the anchor cell 804, and the non-anchor cell 806 pages the UE 802 for the acquisition of SIB1 of the non-anchor cell 806.

[0169] In step 1, the non-anchor cell 806 transmits SSB and/or MIB, and the UE 802 receives the transmission (see signaling 808).

10 [0170] In step 2, the anchor cell 804 determines a paging configuration associated with the anchor cell 804 and a SIB1 request configuration associated with the non-anchor cell 806 (see block 810). The anchor cell 804 broadcasts this configuration information, and the UE 802 receives the broadcast (see signaling 812).

[0171] In step 3, the UE 802 transmits a MsgA to the anchor cell 804, where the
15 MsgA includes an SSB/ SIB1 request (see signaling 814).

[0172] In step 4, the anchor cell 804 informs the non-anchor cell 806 about the SSB/SIB1 request (see signaling 816). In one embodiment, the anchor cell 804 forwards the SSB/SIB1 request received in step 3. In another embodiment, the anchor cell 804 transmits a second (independent) SSB/SIB1 request message based on the SSB/SIB1 request received in step 3.
20

[0173] In conditional step 5, if SSB/MIB was not previously transmitted "regularly" in the non-anchor cell (e.g., if the non-anchor cell 806 has an irregular SSB transmission pattern), then the non-anchor cell 806 initiates SSB/MIB transmission (see signaling 818).

[0174] In step 6, the non-anchor cell 806 transmits a paging message to the UE 802,
25 where the paging message is for SIB1 acquisition (see signaling 820).

[0175] In step 7, the non-anchor cell 806 transmits the SIB1 (see signaling 822).

[0176] In some embodiments, the configuration information for transmitting SIB1 request of a non-anchor cell and receiving SIB1 paging directly from non-anchor cell (e.g., RNTI, search space and CORESET configuration to receive paging DCI, and configuration for calculating paging occasions (*PCCH-Config*, e.g., as defined in 3GPP
30

technical specification (TS 38.331)) may be provided by the anchor cell (or may be pre-configured/ specified). In certain embodiments, the configuration information for receiving SIB1 paging may be same as the one used to receive paging in anchor cell, or some delta (where on difference between the two configuration is signaled) configuration on top. If the SIB1 paging is to be received in the anchor cell, most of the legacy paging configuration can be reused, except for a new RNTI in some examples, as explained further.

[0177] If UE includes its paging identity with the SIB1 request, then the network may send the SIB1 related paging only on this UE's paging occasions. The paging identity of the UE comprises the UE_ID and if the UE operates in eDRX, then the paging identity further comprises the 5G-S-TMSI, modulo 4096. Otherwise, (i.e., of the UE does not operate in eDRX) the paging identity comprises 5G-S-TMSI, modulo 1024. If the UE has no 5G-S-TMSI, for instance when the UE has not yet registered onto the network, then the UE uses a default identity, e.g., UE_ID = 0.

[0178] Alternatively, for the purpose of SIB1-related paging, the default identity UE_ID = 0 can be used irrespective of the UE-specific 5G-S-TMSI value (if any). This alternative also allows other UEs interested in receiving SIB1 to check if SIB1 is transmitted using the paging-based techniques described herein, without first needing to transmit SIB1 request.

[0179] According to a first set of embodiments of the fifth solution, to indicate that SIB1 from non-anchor cell is "now" being broadcasted, a SIB1 paging message may be transmitted on PDCCH using P-RNTI with or without an associated paging message using short message field in DCI format 1_0. The non-anchor cell can reuse the paging P-RNTI, whereas the anchor cell might use a new paging RNTI e.g., P-RNTI-2 for this purpose. Table 1 describes the legacy short message (8-bits) used by paging DCI.

Table 1

Bit	Short Message
1	<i>systemInfoModification</i> If set to 1: indication of a broadcast control channel (BCCH) modification other than SIB6, SIB7 and SIB8.
2	<i>etwsAndCmasIndication</i> If set to 1: indication of an ETWS primary notification and/or an ETWS secondary notification and/or a CMAS notification.
3	<i>stopPagingMonitoring</i> This bit can be used for only operation with shared spectrum channel access and if <i>nrofPDCCH-MonitoringOccasionPerSSB-InPO</i> is present. If set to 1: indication that the UE may stop monitoring PDCCH occasion(s) for paging in this paging occasion (PO), e.g., as specified in 3GPP TS 38.304, clause 7.1.
4	<i>systemInfoModification-eDRX</i> If set to 1: indication of a BCCH modification other than SIB6, SIB7 and SIB8. This indication applies only to UEs using eDRX cycle longer than the BCCH modification period.
5 – 8	Not used in this release of the specification, and shall be ignored by UE if received.

[0180] In some embodiments, the non-anchor cell may reuse bit 1 (i.e., the ‘*systemInfoModification*’ bit as shown in Table 1) to indicate that SIB1 from non-anchor cell is “now” being broadcasted; therefore, to a UE that sent a SIB1 request, if set to ‘1’, the bit 1 of the short message field means that the SIB1 is being broadcasted now. In other embodiments, the non-anchor cell may use one of bits 5-8 to signal to the UE that the SIB1 is being broadcast by the non-anchor cell.

[0181] Similarly, the anchor cell may also use one of the bits from bits 5-8) to directly page the UEs in its cell seeking SIB1 of a particular neighbor (non-anchor) cell. In such a case, the UEs served by the anchor cell, not seeking SIB1 of a neighbor cell, do not take any action. Alternatively, when using a SIB1-related paging identity (denoted “P-RNTI-2”), even the anchor cell can reuse bit 1, the ‘*systemInfoModification*’ towards the same purpose, without affecting the UEs served by the anchor cell.

[0182] To elaborate further this example implementation, the paging DCI is sent by the anchor cell and the P-RNTI used for non-anchor cell SIB transmission indication may be different than the SIB1-related paging identity (i.e., P-RNTI-2) used by the anchor cell for paging its own served UEs. The paging DCI contents – including the short message – may be repurposed for indicating SIB1 and SI that is being broadcast (or will be broadcast, e.g., from the next modification period (calculated based on the anchor cell

parameters)) by the non-anchor/neighbor cell and other parameters (e.g., SSB subcarrier spacing, frequency information, physical cell identity, or indication of one or more parameter sets configured for non-anchor cells on the anchor-cell) associated with the non-anchor cell.

5 **[0183]** In another implementation of this example, the paging DCI is sent by the anchor cell and the reserved field in the short message indicator (bit field ‘00’) in the paging DCI is used to page UEs in its cell seeking SIB1 of a particular non-anchor/neighbor cell that SIB1 is being/will be broadcasted by the non-anchor cell.

10 **[0184]** In another example, a field in the short message indicator (e.g., reserved bit field ‘00’) in the paging DCI is used to indicate the short message comprises SI information for non-anchor cell. Here, the 8-bit short message content may be repurposed for indicating SIB1 and SI that is being/will be broadcasted by the non-anchor cell and other parameters (e.g., SSB subcarrier spacing, frequency information, physical cell identity, or indication of one or more parameter sets configured for non-anchor cells on the anchor-cell) associated with the non-anchor cell. Table 2 describes the legacy
15 short message indicator field (2-bits) in paging DCI.

Table 2

Bit field	Short Message Indicator
00	Reserved
01	Only scheduling information for paging, and TRS availability indication if <i>trs-ResourceSetConfig</i> is configured, are present in the DCI
10	Only short message, and TRS availability indication if <i>trs-ResourceSetConfig</i> is configured, are present in the DCI
11	Both scheduling information for paging, TRS availability indication if <i>trs-ResourceSetConfig</i> is configured and short message are present in the DCI

20 **[0185]** As indicated above, the reserved field in the short message indicator (bit field ‘00’) in the paging DCI may be used to indicate the short message comprises SI information for non-anchor cell.

25 **[0186]** In one variation, the SIB request in MsgA, comprises multiple PCIDs. In this case, the anchor cell alerts each requested non-anchor cell to start broadcasting SIB1. After transmission of the SIB1 request, the UE waits to receive the paging. Once received, the UE may start to acquire SIB1 first from the best radio quality cell (e.g., based on SSB measurements) and try to camp on the best radio quality cell as a suitable

cell. However, if this does not work, then the requesting UE goes on to acquire SIB1 of the next cell (i.e., in order of radio quality). Additionally, if the requesting UE fails to acquire SIB1 for one of the already requested cell, then the UE can re-request the SIB1 for that cell only. Further, if the requesting UE continues to fail to acquire SIB1 for one
5 of the already requested cell a certain number of times or for a time period, the UE may consider that cell as barred (e.g., for 300 seconds).

[0187] Further, the network may extend the paging message and the extension created thus can be used to transmit SIB1 (or a relevant part of it) of the non-anchor cell to the UE. Various techniques for paging extension are described in U.S. patent application
10 publication 2023/0300794 A1, by inventors Prateek Basu Mallick, Ravi Kuchibhotla, Joachim Loehr, Genadi Velez, and Hyung-Nam Choi, which publication is herein incorporated by reference. Some examples of paging message extensions are provided below:

[0188] According to a second set of embodiments of the fifth solution, the paging
15 DCI (i.e., in the DCI format 1_0 with cyclic redundancy check (CRC) scrambled by P-RNTI) is reused/ repurposed. For example, in the DCI format 1_0, at least 6 bits are available already as “reserved bits”. In addition to this, when the “Short Messages” is not included, an additional 8 bits become available. Even when “Short Messages” is actually included, the remaining bits of the short messages (e.g., from subclause 6.5 of 3GPP TS
20 38.331) may be used for this purpose.

[0189] Accordingly, currently the legacy DCI format 1_0 has a minimum of 6 bits and maximum 14 bits available for SIB1-related information in the paging DCI. In addition, if the actual RRC paging message in PDSCH need not be transmitted, then the IEs “Frequency domain resource assignment” and “Time domain resource assignment”
25 are also not required. Therefore, some of these bits (e.g., ‘N’ bits) may be used to transmit SIB1 (or a relevant part of it) of the non-anchor cell to the UE.

[0190] Alternatively, some of these available bits may be coded in a variety of ways to carry up to 2^N rows of information – where each row indicates some combination of SIB1 IEs. Here, the SIB1 IEs for each possible combination need to be specified, stored
30 or pre-configured to the UE, e.g., as a table with indexes. In an example, when there are 100 such combinations defined, one of these is signaled to the UE using 7 bits (i.e., out of the previously mentioned ‘N’ bits). Upon receiving the short message, the UE looks at

the stored table and then uses the SIB1 parameters corresponding to the index entry pointed to by the 7 bits.

[0191] When a valid DCI with P-RNTI is detected, certain fields are present in the corresponding DCI, as described in Table 3:

5

Table 3: Fields in paging DCI

Field	Bits	Comment
Short messages indicator	1	0 = short message ([8] bits + padding to meet the DCI size) 1 = paging message scheduled (following fields)
In case of short message service		
Short message	[8]	
Reserved bits		To meet overall DCI size
In case of paging message		
Frequency domain resource assignment	$\lceil \log_2 (N_{RB}^{DL,BWP} (N_{RB}^{DL,BWP} + 1) / 2) \rceil$	
Time domain resource assignment	4	May be applicable to a default table for paging or to an additional default table, or the value may be in a SIB1 signaled table.
VRB-to-PRB mapping	1	
Modulation and coding scheme	5	Same MCS table as for “normal” transmission without 256QAM
TB scaling	2	To scale TB size
Reserved bits	(fixed value)	To meet overall DCI size

[0192] According to another variation of the second set of embodiments of the fifth solution, in combination with one of the techniques revealed, the PDSCH resources assigned in the paging DCI can be used to actually signal (part of) SIB1 content of the non-
10 anchor cell.

[0193] According to a third set of embodiments of the fifth solution, the short message field in DCI format 1_0 may indicate the necessary information from MIB (only

the information required to acquire SIB1 of the non-anchor cell) in the paging DCI. This information will contain one or more of: 1) *subCarrierSpacingCommon*, 2) *dmrs-TypeA-Position*, 3) *ssb-SubcarrierOffset*, and 4) *pdccch-ConfigSIB1* from MIB of non-anchor cell.

[0194] Note that various aspects of the above paging implementations may be applied to both the anchor and non-anchor cell, transmitting the paging to the UE. For example, the paging message (in its various forms, e.g., short message based methods, RRC paging message etc.) can be directly sent by the anchor cell upon receiving the request of a UE for the SIB1 of a non-anchor cell.

[0195] According to aspects of a sixth solution, a UE in the RRC inactive state may use the small data transmission (SDT) procedure to acquire the SIB1. The SDT procedure allows data and/or signaling transmission while the UE remains in the RRC_INACTIVE state (i.e., supports data/signaling transmission without transitioning to RRC_CONNECTED state). In various embodiments, the SDT procedure is considered enabled for SIB1 request. In some embodiments, certain SDT constraints, such as amount of UL data and DL RSRP, may be ignored for the SIB1 request; alternatively, new SIB1-request-specific thresholds may be used.

[0196] The SDT procedure is initiated with either a transmission over RACH (configured via system information) or over Type 1 configured grant (CG) resources, e.g., configured via dedicated signaling in the *RRCRelease* message). Here, the SDT resources may be configured on initial BWP for both RACH and CG. In various embodiments, the RACH and CG resources for SDT may be configured on either (or both) of supplemental uplink (SUL) and normal (i.e., non-supplemental) uplink (NUL) carriers.

[0197] In some embodiments, the CG resources for SDT are valid only within the primary cell (PCell) of the UE when the *RRCRelease* message with suspend indication is received. CG resources are associated with one or multiple SSB(s). For RACH, the network can configure 2-step and/or 4-step RA resources for SDT. When both 2-step and 4-step RA resources for SDT are configured, the UE selects the RA type accordingly.

[0198] In some embodiments, CFRA may also be supported for SDT-based SIB1 request over RACH. In certain embodiments, the SIB1 request can include a resume ID in MsgA or in Msg3, e.g., resume request (or *RRCResumeRequest1* if the full resume ID can be included by way of anchor cell configuration or specification) contains a new

resume cause value for SIB1 request, or a LCID is reserved for the SIB1 request – the reserved LCID is included by MAC carrying the resume request. Alternatively, a new RRC CCCH message for SIB1 request can be used.

5 [0199] In certain embodiments, AS security may not be applied for an SDT-based SIB1 request. In certain embodiments, upon receiving the SDT-based SIB1 request, the network may schedule DL data to the UE containing the requested SIB1 in an ongoing SDT session.

10 [0200] In some embodiments, the SDT procedure can be initiated on anchor cell (indicating for which cell the SIB1 request is being made) or on non-anchor cell. If the UE has valid CG resources for either of these cells, then the UE may decide to send an SDT-based SIB1 request to that cell. In certain embodiments, a UE configuration may indicate a preference for SDT-based SIB1 request, when supported.

15 [0201] According to aspects of a seventh solution, once any of the techniques revealed previously is used to request and receive SIB1 of a non-anchor cell, the non-anchor cell does not keep transmitting SIB1 continuously according to legacy behavior. Instead, to support network energy savings, the non-anchor cell will provide SIB1 a certain number of times (e.g., in the complete modification period) and then stops transmitting SIB1. Thereafter, a new UE, entering in the next modification period, will have to send SIB1 request.

20 [0202] In some embodiments, the UEs that already acquired SIB1 need not constantly monitor SIB1 broadcast to ensure that they have a valid version of essential system information (e.g., contained in MIB and SIB1). Instead, the UEs that already acquired SIB1 continue to monitor paging channel and, in absence of a *systemInfoModification*, they will continue to assume that these have a valid version of the SIB1.

25 [0203] Accordingly, the network is then obliged to: a) page the UEs (include *systemInfoModification* or include another available bit in paging DCI for this purpose, repurpose bits in DCI as revealed previously); and b) broadcast SIB1 when content should change. This avoids the current idle/ inactive UEs having to re-request SIB1. In an example, the broadcasting of SIB1 can still be based on at least one UE requesting the
30 SIB1.

[0204] Thus, from the perspective of a UE that already acquired SIB1 of a non-anchor cell, the UE first attempts to receive SIB1 broadcast, e.g., after receiving paging DCI (including *systemInfoModification*). If the SIB1 is not broadcast, then a SIB1 request is made.

5 [0205] According to aspects of an eighth solution, to optimize broadcast signaling, information for acquisition of SIB1 for an energy-saving, non-anchor cell is broadcasted in the SIB1 of an anchor cell, i.e., as a separate IE, or a list of such IE – one for each non-anchor cell. In some embodiments, the SIB1-Request configuration (e.g., PRACH configuration or another reference signal configuration) may also be signaled by the
10 anchor cell for each of the non-anchor cells.

[0206] In the simplest form, this IE may be a Boolean flag indicating the presence (i.e., Yes/ No) of at least one overlaying/ neighboring non-anchor cell, i.e., a cell that is not broadcasting SIB1 regularly. In a variation, this Boolean flag (or a second such flag in the IE) can also indicate if a corresponding non-anchor cell (with a certain PCID) is
15 broadcasting SIB1 “now”. In such a case the SIB1 broadcast must continue until the end of the current modification period (as calculated based on the anchor cell parameters).

[0207] Further, the IE may include one or more of: frequency information, PCID, SSB subcarrier spacing, tracking area code (TAC), public land mobile network (PLMN) ID of the non-anchor cell, and a configuration to receive Msg2 (e.g., *ra-Response*
20 *Window*, the common control resource set (CORESET), etc.) and information included in *Downlink Config Common SIB* (including frequency information DL and initial DL BWP, etc.).

[0208] Because SIB1 transmission poses a very high signaling load, the SIB1 is broadcasted every 20 ms or so, in an improvement of the above embodiment, only limited
25 information for SIB1 of the non-anchor cell(s) is included in the SIB1 of the anchor cell, and the remaining information for SIB1 of the non-anchor cell(s) is included in a new SIB used for this purpose. Here, the new SIB may be configured as provided on an on-demand basis.

[0209] In such embodiments, the anchor cell’s SIB1 indicates a Boolean presence of
30 at least one overlaying/ neighboring non-anchor cell and may also indicate that the remaining information may be broadcasted in a new SIB. As an optimization, instead of

broadcasting the Boolean flag indicating the presence (i.e., Yes/ No) of at least one overlaying/ neighboring non-anchor cell, the presence of scheduling information of the new SIB implicitly indicates to a UE that there is at least one overlaying/ neighboring non-anchor cell nearby.

- 5 [0210] According to aspects of a ninth solution, one or more triggers are disclosed, which may be used by a UE to determine whether it should start to look for a non-anchor cell/ carrier. A UE can determine that it should start to look for a non-anchor when there is no suitable cell available according to 3GPP TS 38.304; or alternatively when no detected cell fulfills the cell selection criterion S (e.g., as described in clause 5.2.3.2 of
10 3GPP TS 38.304).

[0211] The cell selection criterion S is fulfilled when: $S_{\text{rxlev}} > 0$ AND $S_{\text{qual}} > 0$, where:

$$S_{\text{rxlev}} = Q_{\text{rxlevmeas}} - (Q_{\text{rxlevmin}} + Q_{\text{rxlevminoffset}}) - P_{\text{compensation}} - Q_{\text{offsettemp}}$$

$$S_{\text{qual}} = Q_{\text{qualmeas}} - (Q_{\text{qualmin}} + Q_{\text{qualminoffset}}) - Q_{\text{offsettemp}}$$

- [0212] The signaled values $Q_{\text{rxlevminoffset}}$ and $Q_{\text{qualminoffset}}$ are only applied when a cell is evaluated for cell selection as a result of a periodic search for a higher priority PLMN while camped normally in a visited PLMN (VPLMN) (see 3GPP TS 23.122). During this
15 periodic search for higher priority PLMN, the UE may check the S criteria of a cell using parameter values stored from a different cell of this higher priority PLMN.

[0213] The terms of the above equations are defined in Table 4, below:

Table 4

Name	Description
Srxlev	Cell selection RX level value (dB)
Squal	Cell selection quality value (dB)
Qoffset _{temp}	Offset temporarily applied to a cell as specified in 3GPP TS 38.331 (dB)
Q _{rxlev} meas	Measured cell RX level value (RSRP)
Q _{qual} meas	Measured cell quality value (RSRQ)
Q _{rxlev} min	Minimum required RX level in the cell (dBm). If the UE supports SUL frequency for this cell, Q_{rxlev}min is obtained from <i>q-RxLevMinSUL</i>, if present, in <i>SIB1</i>, <i>SIB2</i> and <i>SIB4</i>, additionally, if Q_{rxlev}minoffsetcellSUL is present in <i>SIB3</i> and <i>SIB4</i> for the concerned cell, this cell specific offset is added to the corresponding Q_{rxlev}min to achieve the required minimum RX level in the concerned cell; else Q_{rxlev}min is obtained from <i>q-RxLevMin</i> in <i>SIB1</i>, <i>SIB2</i> and <i>SIB4</i>, additionally, if Q_{rxlev}minoffsetcell is present in <i>SIB3</i> and <i>SIB4</i> for the concerned cell, this cell specific offset is added to the corresponding Q_{rxlev}min to achieve the required minimum RX level in the concerned cell.
Q _{qual} min	Minimum required quality level in the cell (dB). Additionally, if Q _{qual} minoffsetcell is signaled for the concerned cell, this cell specific offset is added to achieve the required minimum quality level in the concerned cell.
Q _{rxlev} minoffset	Offset to the signaled Q _{rxlev} min taken into account in the Srxlev evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN, as specified in 3GPP TS 23.122.
Q _{qual} minoffset	Offset to the signaled Q _{qual} min taken into account in the Squal evaluation as a result of a periodic search for a higher priority PLMN while camped normally in a VPLMN, as specified in 3GPP TS 23.122.

$P_{\text{compensation}}$	For FR1, if the UE supports the <i>additionalPmax</i> in the <i>NR-NS-PmaxList</i>, if present, in <i>SIB1</i>, <i>SIB2</i> and <i>SIB4</i>: $\max(P_{\text{EMAX1}} - P_{\text{PowerClass}}, 0) - (\min(P_{\text{EMAX2}}, P_{\text{PowerClass}}) - \min(P_{\text{EMAX1}}, P_{\text{PowerClass}})) \text{ (dB)};$ else: $\max(P_{\text{EMAX1}} - P_{\text{PowerClass}}, 0) \text{ (dB)}$ For FR2, $P_{\text{compensation}}$ is set to 0. For IAB-MT, $P_{\text{compensation}}$ is set to 0.
P_{EMAX1} , P_{EMAX2}	Maximum TX power level of a UE may use when transmitting on the uplink in the cell (dBm) defined as P_{EMAX} in 3GPP TS 38.101. If UE supports SUL frequency for this cell, P_{EMAX1} and P_{EMAX2} are obtained from the <i>p-Max</i> for SUL in <i>SIB1</i> and <i>NR-NS-PmaxList</i> for SUL respectively in <i>SIB1</i>, <i>SIB2</i> and <i>SIB4</i> as specified in 3GPP TS 38.331, else P_{EMAX1} and P_{EMAX2} are obtained from the <i>p-Max</i> and <i>NR-NS-PmaxList</i> respectively in <i>SIB1</i>, <i>SIB2</i> and <i>SIB4</i> for normal UL as specified in 3GPP TS 38.331.
$P_{\text{PowerClass}}$	Maximum RF output power of the UE (dBm) according to the UE power class as defined in 3GPP TS 38.101-1.

[0214] According to aspects of a tenth solution, a UE can determine that it should start to look for a non-anchor when an anchor cell includes at least one of the following information: explicit signaling to camp on a non-anchor cell; a new cell selection threshold; and/or a random persistence check.

- 5 [0215] Regarding the explicit signaling to camp on a non-anchor cell, in this case, the UE must attempt to receive *SIB1* of the indicated non-anchor cell and see if the same cell (once *SIB1* is received) satisfies the cell selection criterion *S* and, optionally, turns out to be a suitable cell. Only failing this, is the UE allowed to remain camped on the anchor cell.
- 10 [0216] Regarding the new cell selection threshold, the anchor cell may broadcast a new threshold to conditionally trigger UE to select a non-anchor cell. Accordingly, the UE attempts *SIB1* acquisition of a non-anchor cell when the radio quality of the anchor cell (or the best detected cell) is below the new threshold. Alternatively, the UE attempts *SIB1* acquisition of a non-anchor cell when the radio quality is between two thresholds,
- 15 i.e., $\text{new-threshold1} < \text{radio quality of anchor} < \text{new-threshold2}$. In various embodiments, the radio quality is measured in *RSRP/RSRQ*.

[0217] Regarding the random persistence check, a decimal value $0.0 < p < 1.0$ is broadcast. The UE shall request *SIB1* of a non-anchor cell (and thereby attempt to camp

on it) when a randomly drawn fraction has a value smaller than (alternatively, larger than) the broadcasted persistent value 'p'.

[0218] According to aspects of an eleventh solution, a UE may use access control to request SIB1. In the simplest form, no access control to request for SIB1 is necessary, i.e., any UE can request it. In a variation of this, only UEs with certain access identities are permitted to transmit a request for SIB1. These access identities may be specified or configured by the anchor cell or may be used pre-configured.

[0219] According to aspects of a twelfth solution, different network scenarios and UE behavior for each scenario are described. In a first scenario, the SSB transmission of the non-anchor cell is 'ON', and the UE cannot find an anchor cell. As in this case SSB/PBCH transmission is 'ON,' the UE can use a pre-configured PRACH configuration to demand SIB1. The UE shall do this based on the indication in the master information block (MIB) on PBCH indicating that SIB1 is not broadcast.

[0220] The MIB provides the UE with parameters (e.g., CORESET#0 configuration) for monitoring of PDCCH for scheduling PDSCH that carries the SIB1. The PBCH may also indicate that there is no associated SIB1. In this case the MIB may not point to another frequency from where the UE would otherwise search for an SSB that is associated with a SIB1. Instead, the UE performs the SIB1 request in accordance with one or more aspects of the present disclosure.

[0221] In a second scenario, the SSB transmission on non-anchor cell is 'ON,' and the UE finds an anchor cell. In this case, the UE can receive/ determine SIB1 content of a non-anchor cell from an anchor cell, e.g., in accordance with one or more aspects of the present disclosure.

[0222] As another implementation of the second scenario, the PRACH configuration for on-demand SIB1 can be obtained from the anchor cell. Upon receiving the PRACH based SIB1 request, the network can turn on the SIB1 transmission of non-anchor cell. If the request is made to the non-anchor cell, then the non-anchor cell itself can provide SIB1. However, if the request is made via the anchor cell, then network communication on the backhaul (Xn, F1 and/ or X2 interface) can ensure that the non-anchor cell is informed about the request and the non-anchor cell itself can provide SIB1. After transmitting for some time, the network may stop the transmission of SIB1 based on

network implementation, such as idle mode load (or even RRC connected load as a proxy) of neighboring/ anchor cells and start again based on UE(s) request to anchor for a non-anchor cell's SIB1.

5 [0223] In a third scenario, the SSB transmission on non-anchor cell is 'OFF,' and UE finds an anchor cell. In this case, if the SSB transmission is off, then the UE should request the anchor cell to turn both SSB/ SIB-1 of a non-anchor cell 'ON'.

[0224] In a fourth scenario, the SSB transmission on non-anchor cell is 'OFF,' and UE cannot find an anchor cell. In this case, if the SSB transmission is off and there is no anchor cell available, then the UE will use GNSS based fixed timeslot to make an UL
10 transmission using pre-configured PRACH configuration. As an example, PRACH opportunities every 10 seconds can be used starting from global positioning system (GPS) initial time (GPST).

[0225] The PRACH configuration itself can use default/ (pre)configured/ specified values for preamble (e.g., reference signal) and frequency resources. A limited number of
15 power ramping are made. Here, the network transmits both SSB/ SIB-1 upon receiving RACH preamble from 'N' UEs.

[0226] Note that various aspects of the above solutions may be combined. For example, one or more solutions may be implemented together in a UE and/or network. Therefore, the above numbering of solutions is for organization of similar concepts and
20 the aspects described therein are assumed to be implementable jointly, unless explicitly described otherwise.

[0227] **Figure 9** illustrates an example of a UE 900 in accordance with aspects of the present disclosure. The UE 900 may include a processor 902, a memory 904, a controller 906, and a transceiver 908. The processor 902, the memory 904, the controller 906, or the
25 transceiver 908, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

[0228] The processor 902, the memory 904, the controller 906, or the transceiver 908,
30 or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an

application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure.

[0229] The processor 902 may include an intelligent hardware device (e.g., a general-
5 purpose processor, a DSP, a central processing unit (CPU), an ASIC, a field
programmable gate array (FPGA), or any combination thereof). In some implementations,
the processor 902 may be configured to operate the memory 904. In some other
implementations, the memory 904 may be integrated into the processor 902. The
processor 902 may be configured to execute computer-readable instructions stored in the
10 memory 904 to cause the UE 900 to perform various functions of the present disclosure.

[0230] The memory 904 may include volatile or non-volatile memory. The memory
904 may store computer-readable, computer-executable code including instructions that,
when executed by the processor 902, cause the UE 900 to perform various functions
described herein. The code may be stored in a non-transitory computer-readable medium
15 such the memory 904 or another type of memory. 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.

20 [0231] In some implementations, the processor 902 and the memory 904 coupled with
the processor 902 may be configured to cause the UE 900 to perform various functions
(e.g., operations, signaling) described herein (e.g., executing, by the processor 902,
instructions stored in the memory 904). In some implementations, the processor 902 may
include multiple processors and the memory 904 may include multiple memories. One or
25 more of the multiple processors may be coupled with one or more of the multiple
memories, which may be individually or collectively, configured to perform various
functions (e.g., operations, signaling) of the UE 900 as disclosed herein.

[0232] The processor 902 coupled with the memory 904 may be configured to,
capable of, or operable to cause the UE 900 to receive, from a first cell, broadcast
30 signaling comprising a configuration for requesting a first system information block (i.e.,
SIB1) of the second cell; transmit a first random-access message (i.e., Msg1) that
indicates a request for the SIB1 of the second cell; monitor for the SIB1 of the second cell

based at least in part on a reception of a second random-access message (Msg2); and perform cell selection based at least in part on a reception of the SIB1.

[0233] In some implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to transmit the Msg1 to the first cell. In other implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to transmit the Msg1 to the second cell.

[0234] In some implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to perform cell reselection to the second cell based at least in part on a positive evaluation of one or more cell reselection criteria.

[0235] In some implementations, to receive the broadcast signaling, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to receive a new SIB comprising the configuration for requesting a respective SIB1 for one or more neighboring cells. In some implementations, the broadcast signaling further comprises at least one condition for the UE to camp on a second cell, and wherein the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to: A) determine, based on the at least one condition, whether to attempt camping on the second cell; and B) transmit the Msg1 in response to a determination to attempt camping on the second cell. In certain implementations, the determination to attempt camping on the second cell is based at least in part on a received radio quality of a best cell available to the UE 900 on a frequency associated with the second cell.

[0236] In some implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to transmit a MsgA that indicates the request for the SIB1. In certain implementations, the MsgA comprises a cell identity of the second cell, a UE RRC state, and a UE type.

[0237] In certain implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to receive a MsgB from the first cell in response to the MsgA, wherein the MsgB comprises at least a portion of the SIB1 of the second cell. In other implementations, the UE 900 is configured to

receive a MsgB from the second cell in response to the MsgA, wherein the MsgB comprises at least a portion of the SIB1 of the second cell.

[0238] In certain implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a CFRA procedure based at least in part on an evaluation of the first cell. In other implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a CBRA procedure based at least in part on an evaluation of the first cell.

[0239] In certain implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a two-step RACH procedure based at least in part on an evaluation of the first cell, where the two-step RACH procedure comprises the transmission of the MsgA and the reception of a MsgB.

[0240] In certain implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a CFRA procedure based at least in part on an evaluation of the first cell. In certain implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a CBRA procedure based at least in part on an evaluation of the first cell.

[0241] In some implementations, the processor 902 coupled with the memory 904 may be configured to, capable of, or operable to cause the UE 900 to determine to perform a four-step RACH procedure based at least in part on an evaluation of the first cell, and wherein the four-step RACH procedure comprises the transmission of the Msg1, a reception of a Msg2, a transmission of a Msg3, and a reception of a Msg4. In certain embodiments, the Msg3 may comprise a cell identity of the second cell, a UE RRC state, and a UE type.

[0242] The controller 906 may manage input and output signals for the UE 900. The controller 906 may also manage peripherals not integrated into the UE 900. In some implementations, the controller 906 may utilize an operating system (OS) such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 906 may be implemented as part of the processor 902.

[0243] In some implementations, the UE 900 may include at least one transceiver 908. In some other implementations, the UE 900 may have more than one transceiver 908. The transceiver 908 may represent a wireless transceiver. The transceiver 908 may include one or more receiver chains 910, one or more transmitter chains 912, or a
5 combination thereof.

[0244] A receiver chain 910 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 910 may include one or more antennas for receiving the signal over the air or wireless medium. The receiver chain 910 may include at least one amplifier (e.g., a low-noise
10 amplifier (LNA)) configured to amplify the received signal. The receiver chain 910 may include at least one demodulator configured to demodulate the received signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 910 may include at least one decoder for decoding/
processing the demodulated signal to receive the transmitted data.

[0245] A transmitter chain 912 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 912 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for
15 transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or
20 quadrature amplitude modulation (QAM). The transmitter chain 912 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain
912 may also include one or more antennas for transmitting the amplified signal into the
25 air or wireless medium.

[0246] **Figure 10** illustrates an example of a processor 1000 in accordance with aspects of the present disclosure. The processor 1000 may be an example of a processor configured to perform various operations in accordance with examples as described
herein. The processor 1000 may include a controller 1002 configured to perform various
30 operations in accordance with examples as described herein. The processor 1000 may optionally include at least one memory 1004, which may be, for example, an L1/L2/L3 cache. Additionally, or alternatively, the processor 1000 may optionally include one or

more arithmetic-logic units (ALUs) 1006. One or more of these components may be in electronic communication or otherwise coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces (e.g., buses).

[0247] The processor 1000 may be a processor chipset and include a protocol stack (e.g., a software stack) executed by the processor chipset to perform various operations (e.g., receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) in accordance with examples as described herein. The processor chipset may include one or more cores, one or more caches (e.g., memory local to or included in the processor chipset (e.g., the processor 1000) or other memory (e.g., random access memory (RAM), read-only memory (ROM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), static RAM (SRAM), ferroelectric RAM (FeRAM), magnetic RAM (MRAM), resistive RAM (RRAM), flash memory, phase change memory (PCM), and others).

[0248] The controller 1002 may be configured to manage and coordinate various operations (e.g., signaling, receiving, obtaining, retrieving, transmitting, outputting, forwarding, storing, determining, identifying, accessing, writing, reading) of the processor 1000 to cause the processor 1000 to support various operations in accordance with examples as described herein. For example, the controller 1002 may operate as a control unit of the processor 1000, generating control signals that manage the operation of various components of the processor 1000. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0249] The controller 1002 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 1004 and determine subsequent instruction(s) to be executed to cause the processor 1000 to support various operations in accordance with examples as described herein. The controller 1002 may be configured to track memory address of instructions associated with the memory 1004. The controller 1002 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 1002 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 1000 to cause the processor 1000 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 1002 may

be configured to manage flow of data within the processor 1000. The controller 1002 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 1000.

5 [0250] The memory 1004 may include one or more caches (e.g., memory local to or included in the processor 1000 or other memory, such as RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementations, the memory 1004 may reside within or on a processor chipset (e.g., local to the processor 1000). In some other implementations, the memory 1004 may reside external to the processor chipset (e.g., remote to the processor 1000).

10 [0251] The memory 1004 may store computer-readable, computer-executable code including instructions that, when executed by the processor 1000, cause the processor 1000 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 1002 and/or the processor 1000 may be configured to execute computer-
15 readable instructions stored in the memory 1004 to cause the processor 1000 to perform various functions. For example, the processor 1000 and/or the controller 1002 may be coupled with or to the memory 1004, the processor 1000, the controller 1002, and the memory 1004 may be configured to perform various functions described herein. In some examples, the processor 1000 may include multiple processors and the memory 1004 may
20 include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0252] The one or more ALUs 1006 may be configured to support various operations in accordance with examples as described herein. In some implementations, the one or
25 more ALUs 1006 may reside within or on a processor chipset (e.g., the processor 1000). In some other implementations, the one or more ALUs 1006 may reside external to the processor chipset (e.g., the processor 1000). One or more ALUs 1006 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 1006 may receive input operands and an operation code,
30 which determines an operation to be executed. One or more ALUs 1006 be configured with a variety of logical and arithmetic circuits, including adders, subtractors, shifters, and logic gates, to process and manipulate the data according to the operation.

Additionally, or alternatively, the one or more ALUs 1006 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 1006 to handle conditional operations, comparisons, and bitwise operations.

5 **[0253]** In some implementations, the processor 1000 may support various functions (e.g., operations, signaling) of a UE, in accordance with examples as disclosed herein. For example, the controller 1002 coupled with the memory 1004 may be configured to, capable of, or operable to cause the processor 1000 to receive, from a first cell, broadcast signaling comprising a configuration for requesting a first system information block of
10 the second cell; transmit a first random-access message that indicates a request for the first system information block of the second cell; monitor for the first system information block of the second cell based at least in part on a transmission the first random-access message; and perform cell selection based at least in part on a reception of the first system information block. Additionally, the controller 1002 coupled with the memory 1004 may
15 be configured to, capable of, or operable to cause the processor 1000 to perform one or more functions (e.g., operations, signaling) of the UE as described herein.

[0254] Additionally, or alternatively, in some other implementations, the processor 1000 may support various functions (e.g., operations, signaling) of a NE (e.g., base station), in accordance with examples as disclosed herein. For example, the controller
20 1002 coupled with the memory 1004 may be configured to, capable of, or operable to cause the processor 1000 to transmit, in a first cell, broadcast signaling comprising a configuration for requesting a first system information block of the second cell; receive, from a UE, a first random-access message (i.e., Msg1) that indicates a request for the first system information block of a second cell; transmit a second random-access message
25 (i.e., Msg2) in response to the Msg1; and transmit the first system information block of the second cell. Additionally, the controller 1002 coupled with the memory 1004 may be configured to, capable of, or operable to cause the processor 1000 to perform one or more functions (e.g., operations, signaling) of the NE as described herein.

[0255] **Figure 11** illustrates an example of a NE 1100 in accordance with aspects of
30 the present disclosure. The NE 1100 may include a processor 1102, a memory 1104, a controller 1106, and a transceiver 1108. The processor 1102, the memory 1104, the controller 1106, or the transceiver 1108, or various combinations thereof or various

components thereof may be examples of means for performing various aspects of the present disclosure as described herein. These components may be coupled (e.g., operatively, communicatively, functionally, electronically, electrically) via one or more interfaces.

5 **[0256]** The processor 1102, the memory 1104, the controller 1106, or the transceiver 1108, or various combinations or components thereof may be implemented in hardware (e.g., circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), or other programmable logic device, or any combination thereof configured as or otherwise supporting a means for performing
10 the functions described in the present disclosure.

[0257] The processor 1102 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, an ASIC, an FPGA, or any combination thereof). In some implementations, the processor 1102 may be configured to operate the memory 1104. In some other implementations, the memory 1104 may be integrated into
15 the processor 1102. The processor 1102 may be configured to execute computer-readable instructions stored in the memory 1104 to cause the NE 1100 to perform various functions of the present disclosure.

[0258] The memory 1104 may include volatile or non-volatile memory. The memory 1104 may store computer-readable, computer-executable code including instructions
20 when executed by the processor 1102 cause the NE 1100 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such the memory 1104 or another type of memory. 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-
25 transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer.

[0259] In some implementations, the processor 1102 and the memory 1104 coupled with the processor 1102 may be configured to cause the NE 1100 to perform various functions (e.g., operations, signaling) described herein (e.g., executing, by the processor
30 1102, instructions stored in the memory 1104). In some implementations, the processor 1102 may include multiple processors and the memory 1104 may include multiple memories. One or more of the multiple processors may be coupled with one or more of

the multiple memories, which may be individually or collectively, configured to perform various functions (e.g., operations, signaling) of the NE 1100 as disclosed herein.

[0260] The processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit, in a first cell, broadcast signaling comprising a configuration for requesting a first system information block (i.e., SIB1) of the second cell; receive, from a UE, a first random-access message (i.e., Msg1) that indicates a request for the SIB1 of a second cell; transmit a second random-access message (Msg2) in response to the Msg1; and transmit the SIB1 of the second cell.

[0261] In some implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit a second random-access message (i.e., Msg2) in response to the Msg1; and to transmit the SIB1 in response to transmitting the RACH Msg2.

[0262] In some implementations, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to receive a third random-access message (i.e., Msg3) in response to the Msg2, the Msg3 comprising a cell identity of the second cell, a UE RRC state, and a UE type.

[0263] In some implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to receive the Msg1 via the first cell. In other implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to receive the Msg1 via the second cell.

[0264] In some implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit a new SIB comprising the configuration for requesting the SIB1. In certain implementations, the broadcast signaling further comprises at least one condition for the UE to camp on a second cell.

[0265] In some implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit the SIB1 of the second cell in response to transmitting the Msg2.

[0266] In some implementations, to transmit the broadcast signaling, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to initiate SS/PBCH transmission in the second cell in response to the Msg1.

5 [0267] In some implementations, to receive the request for the SIB1, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to receive a MsgA via the first cell. In certain implementations, the RACH MsgA comprises a cell identity of the second cell, a UE RRC state, and a UE type. In other implementations, to receive the request for the SIB1, the processor 1102 coupled
10 with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to receive a Msg1.

[0268] In certain implementations, the processor 1102 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit a MsgB from the first cell in response to the MsgA. In other implementations, the processor 1102
15 coupled with the memory 1104 may be configured to, capable of, or operable to cause the NE 1100 to transmit a MsgB from the second cell in response to the MsgA. In various implementations, the MsgB comprises at least a portion of the SIB1 of the second cell.

[0269] The controller 1106 may manage input and output signals for the NE 1100. The controller 1106 may also manage peripherals not integrated into the NE 1100. In
20 some implementations, the controller 1106 may utilize an operating system such as iOS®, ANDROID®, WINDOWS®, or other operating systems. In some implementations, the controller 1106 may be implemented as part of the processor 1102.

[0270] In some implementations, the NE 1100 may include at least one transceiver 1108. In some other implementations, the NE 1100 may have more than one transceiver
25 1108. The transceiver 1108 may represent a wireless transceiver. The transceiver 1108 may include one or more receiver chains 1110, one or more transmitter chains 1112, or a combination thereof.

[0271] A receiver chain 1110 may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receiver chain 1110
30 may include one or more antennas for receiving the signal over the air or wireless medium. The receiver chain 1110 may include at least one amplifier (e.g., a low-noise

amplifier (LNA)) configured to amplify the received signal. The receiver chain 1110 may include at least one demodulator configured to demodulate the received signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receiver chain 1110 may include at least one decoder for decoding/

5 processing the demodulated signal to receive the transmitted data.

[0272] A transmitter chain 1112 may be configured to generate and transmit signals (e.g., control information, data, packets). The transmitter chain 1112 may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmitter chain 1112 may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmitter chain 15 1112 may also include one or more antennas for transmitting the amplified signal into the air or wireless medium.

[0273] **Figure 12** depicts one embodiment of a method 1200 in accordance with aspects of the present disclosure. In various embodiments, the operations of the method 1200 may be implemented by a UE as described herein. In some implementations, the UE 20 may execute a set of instructions to control the function elements of the UE to perform the described functions.

[0274] At step 1202, the method 1200 may include receiving, from a first cell, broadcast signaling comprising a configuration for requesting a SIB1 of the second cell. The operations of step 1202 may be performed in accordance with examples as described 25 herein. In some implementations, aspects of the operation of step 1202 may be performed by a UE, as described with reference to Figure 9.

[0275] At step 1204, the method 1200 may include transmitting a Msg1 that indicates a request for the SIB1 of the second cell. The operations of step 1204 may be performed in accordance with examples as described herein. In some implementations, aspects of the operation of step 1204 may be performed by a UE, as described with reference to Figure 9. 30

[0276] At step 1206, the method 1200 may include monitoring for the SIB1 of the second cell based at least in part on a reception of a second random-access message (Msg2). The operations of step 1206 may be performed in accordance with examples as described herein. In some implementations, aspects of the operation of step 1206 may be performed by a UE, as described with reference to Figure 9.

[0277] At step 1208, the method 1200 may include evaluating cell reselection based at least in part on a reception of the SIB1. The operations of step 1208 may be performed in accordance with examples as described herein. In some implementations, aspects of the operation of step 1208 may be performed by a UE, as described with reference to Figure 9.

[0278] It should be noted that the method 1200 described herein describes one possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0279] It should be noted that the method 1200 described herein describes one possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0280] **Figure 13** depicts one embodiment of a method 1300 in accordance with aspects of the present disclosure. The operations of the method 1300 may be implemented by a RAN as described herein. In some implementations, the RAN may execute a set of instructions to control the function elements of the RAN to perform the described functions.

[0281] At step 1302, the method 1300 may include transmitting, in a first cell, broadcast signaling comprising a configuration for requesting a SIB1 of the second cell. The operations of step 1302 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 1302 may be performed by a NE, as described with reference to Figure 11.

[0282] At step 1304, the method 1300 may include receiving, from a UE, a Msg1 that indicates a request for the SIB1 of a second cell. The operations of step 1304 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 1304 may be performed by a NE, as described with reference to Figure 11.

[0283] At step 1306, the method 1300 may include transmitting a Msg2 in response to the Msg1; and. The operations of step 1306 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of step 1306 may be performed by a NE, as described with reference to Figure 11.

- 5 [0284] At step 1308, the method 1300 may include transmitting the SIB1 of the second cell. The operations of step 1308 may be performed in accordance with examples as described herein. In some implementations, aspects of the operation of step 1308 may be performed by a NE, as described with reference to Figure 11.

[0285] It should be noted that the method 1300 described herein describes one
10 possible implementation, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible.

[0286] 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
15 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 user equipment (UE) for wireless communication, comprising:
at least one memory; and
5 at least one processor coupled with the at least one memory and configured to cause the UE to:
receive, from a first cell, broadcast signaling comprising a configuration
for requesting a first system information block (SIB1) of the
second cell;
10 transmit a first random-access message (Msg1) that indicates a request for
the SIB1 of the second cell;
monitor for the SIB1 of the second cell based at least in part on a reception
of a second random-access message (Msg2); and
evaluate cell reselection based at least in part on a reception of the SIB1.
- 15 2. The UE of claim 1, wherein the at least one processor is configured to cause the
UE to transmit the Msg1 to the first cell.
3. The UE of claim 1, wherein the at least one processor is configured to cause the
UE to transmit the Msg1 to the second cell.
4. The UE of claim 1, wherein the at least one processor is configured to cause the
20 UE to perform cell reselection to the second cell based at least in part on a positive
evaluation of one or more cell reselection criteria.
5. The UE of claim 1, wherein to receive the broadcast signaling, the at least one
processor is configured to cause the UE to receive a new system information
block (SIB) comprising the configuration for requesting a respective SIB1 for one
25 or more neighboring cells.
6. The UE of claim 1, wherein the broadcast signaling further comprises at least one
condition for the UE to camp on a second cell, and wherein the at least one
processor is configured to cause the UE to:

determine, based on the at least one condition, whether to attempt camping on the second cell; and
transmit the Msg1 in response to a determination to attempt camping on the second cell.

- 5 7. The UE of claim 6, wherein the determination to attempt camping on the second cell is based at least in part on a received radio quality of a best cell available to the UE on a frequency associated with the second cell.
8. The UE of claim 1, wherein the at least one processor is configured to cause the UE to determine to perform a contention-based RACH procedure based at least in part on an evaluation of the first cell.
- 10 9. A processor for wireless communication, comprising:
at least one controller coupled with at least one memory and configured to cause the processor to:
receive, from a first cell, broadcast signaling comprising a configuration for requesting a first system information block (SIB1) of the second cell;
15 transmit a first random-access message (Msg1) that indicates a request for the SIB1 of the second cell;
monitor for the SIB1 of the second cell based at least in part on a reception of a second random-access message (Msg2); and
20 evaluate cell reselection based at least in part on a reception of the SIB1.
10. The processor of claim 9, wherein the at least one controller is configured to cause the processor to transmit the Msg1 to the first cell.
11. The processor of claim 9, wherein the at least one controller is configured to cause the processor to transmit the Msg1 to the second cell.
- 25 12. The processor of claim 9, wherein to receive the broadcast signaling, the at least one controller is configured to cause the processor to receive a new system information block (SIB) comprising the configuration for requesting a respective SIB1 for one or more neighboring cells.

13. A base station for wireless communication, comprising:
at least one memory; and
at least one processor coupled with the at least one memory and configured
to cause the base station to:
- 5 transmit, in a first cell, broadcast signaling comprising a configuration for
requesting a first system information block (SIB1) of the second
cell;
receive, from a user equipment (UE), a first random-access message
(Msg1) that indicates a request for the SIB1 of a second cell;
- 10 transmit a second random-access message (Msg2) in response to the Msg1;
and
transmit the SIB1 of the second cell.
14. The base station of claim 13, wherein the at least one processor is configured to
cause the base station to receive the Msg1 via the first cell.
- 15 15. The base station of claim 13, wherein the at least one processor is configured to
cause the base station to receive the Msg1 via the second cell.
16. The base station of claim 13, wherein to transmit the broadcast signaling, the at
least one processor is configured to cause the base station to transmit a new
system information block (SIB) comprising the configuration for requesting the
20 SIB1.
17. The base station of claim 13, wherein the at least one processor is configured to
cause the base station to transmit the SIB1 of the second cell in response to
transmitting the Msg2.
18. The base station of claim 13, wherein the broadcast signaling further comprises at
25 least one condition for the UE to camp on a second cell.
19. The base station of claim 13, wherein the at least one processor is configured to
cause the base station to initiate synchronization signal and physical broadcast
channel block (SS/PBCH) transmission in the second cell in response to the Msg1.
20. A method performed by a base station for wireless communication, comprising:

transmitting, in a first cell, broadcast signaling comprising a configuration
for requesting a first system information block (SIB1) of the
second cell;
receiving, from a user equipment (UE), a first random-access message
5 (Msg1) that indicates a request for the SIB1 of a second cell;
transmitting a second random-access message (Msg2) in response to the
Msg1; and
transmitting the SIB1 of the second cell.