

DOWNLINK SIGNAL DETERMINATION

TECHNICAL FIELD

[0001] The present disclosure relates to wireless communications, and more specifically to base stations, apparatuses and methods for determining a downlink (DL) signal.

BACKGROUND

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

[0003] The synchronization signal block (SSB) is comprised of the primary and secondary synchronization signals (PSS and SSS) as well as the broadcast channel (BCH), which includes the master information block (MIB). The PSS enables frame synchronization and, along with the SSS, determination of the physical cell ID. The system information block 1 (SIB1) carries the most critical information required for the UE to access the cell e.g., random access parameters. SIB1 includes information regarding the availability and scheduling of other SIBs e.g. mapping of SIBs to SI message, periodicity, SI-window size, etc.

SUMMARY

[0004] Various aspects of the present disclosure relate to base stations, apparatuses and methods for determining a downlink (DL) signal. In a first aspect, a first network comprises a processor; and a transceiver coupled to the processor, wherein the processor is configured to device determine a DL signal of a cell; and transmit information associated with the DL signal to a second network device. By implementing the embodiments of the present disclosure, a solution of determining a DL signal to support on-demand SSB and/or SIB1 can be provided, and the determination of the SSB and/or SIB1 transmission for an on-demand SSB and/or SIB1 SCell and interaction information between centralized unit (CU) and distributed unit (DU) nodes can be provided.

[0005] In some implementations of the method and apparatuses described herein, the DL signal may comprise an on-demand SSB or on-demand SIB.

[0006] In some implementations of the method and apparatuses described herein, transmitting the information associated with the DL signal may comprise transmitting, via the transceiver and to the second network device, a signaling for transmitting the DL signal; or transmitting, via the transceiver and to the second network device, a signaling for stopping the DL signal.

[0007] In some implementations of the method and apparatuses described herein, the information associated with the DL signal for transmitting the DL signal may comprise one or more of the following: a starting point of the DL signal; a starting time of the DL signal; a period of the DL signal; an offset of the DL signal; a transmission occasion of the DL signal; a transmission pattern of the DL signal; one or more secondary cells (SCells) which transmit the DL signal; or a difference configuration between the configuration for determining the DL signal and a previous configuration for determining the DL signal.

[0008] In some implementations of the method and apparatuses described herein, wherein the information associated with the DL signal for stopping the DL signal may comprise one or more of the following: a stopping point of the DL signal; a stopping time of the DL signal; or one or more SCells which stop the DL signal.

[0009] In some implementations of the method and apparatuses described herein, the information associated with the DL signal for transmitting the DL signal may further comprise a set of SSB configurations, and the second network device selects a configuration from the set of SSB configurations; and the information associated with the

DL signal for stopping the DL signal may further comprise a set of SSB configurations, and the second network device selects one or more configurations from the set of SSB configurations.

[0010] In some implementations of the method and apparatuses described herein, a first node of the first network device may determine a configuration for determining the DL signal. The first network device may transmit, via the transceiver and to a second node of the first network device, a configuration for determining the DL signal.

[0011] In some implementations of the method and apparatuses described herein, a first node of the first network device may transmit, via the transceiver and to a second node of the second network device, a configuration for determining the DL signal.

[0012] In some implementations of the method and apparatuses described herein, a second node of the first network device may transmit, via the transceiver and to a second node of the second network device, the configuration for determining the DL signal.

[0013] In some implementations of the method and apparatuses described herein, a first node of the first network device may receive, via the transceiver and from the second network device, a request for the DL signal.

[0014] In some implementations of the method and apparatuses described herein, a first node of the first network device may receive, via the transceiver and from the second network device, information of the request for the DL signal.

[0015] In some implementations of the method and apparatuses described herein, a first node of the first network device may transmit, via the transceiver and to a second node of the first network device, a signaling for transmitting the DL signal; or the first network device may transmit, via the transceiver and to the second node of the first network device, a signaling for stopping the DL signal.

[0016] In some implementations of the method and apparatuses described herein, the signaling for transmitting the DL signal may be transmitted via an Xn signaling or an information element (IE) via an Xn interface; or the signaling for stopping the DL signal may be transmitted via an Xn signaling or an information element (IE) via an Xn interface.

[0017] In some implementations of the method and apparatuses described herein, a second node of the first network device may receive, via the transceiver and from a first node of the first network device, a configuration for determining the DL signal.

[0018] In some implementations of the method and apparatuses described herein, a second node of the first network device may transmit, via the transceiver and to a second node of the second network device, a configuration for determining the DL signal.

[0019] In some implementations of the method and apparatuses described herein, a second node of the first network device may receive, via the transceiver and from a second node of the second network device, information of a request for the DL signal.

[0020] In some implementations of the method and apparatuses described herein, a second node of the first network device may transmit, via the transceiver and to a first node of the first network device, a signaling for transmitting the DL signal; or the first network device may transmit, via the transceiver and to the first node of the first network device, a signaling for stopping the DL signal.

[0021] In a second aspect of the solution, a second network comprises a processor; and a transceiver coupled to the processor, wherein the processor is configured to determine a DL signal of a cell; and transmit information associated with the DL signal to a first network device. By implementing the embodiments of the present disclosure, a solution of determining a DL signal to support on-demand SSB and/or SIB1 can be provided, and the determination of the SSB and/or SIB1 transmission for an on-demand SSB and/or SIB1 SCell and interaction information between centralized unit (CU) and distributed unit (DU) nodes can be provided.

[0022] In some implementations of the method and apparatuses described herein, the second network device may determine one of the following actions: transmitting the DL signal stopping the DL signal; or updating the DL signal. The second network device may transmit, via the transceiver and to the first network device, information for the determined action.

[0023] In some implementations of the method and apparatuses described herein, a first network node of the second network device may determine a configuration for determining the DL signal.

[0024] In some implementations of the method and apparatuses described herein, a first network node of the second network device may transmit, via the transceiver and to a first node of the first network device, a configuration for determining the DL signal.

[0025] In some implementations of the method and apparatuses described herein, a first network node of the second network device may determine one of the following actions: transmitting the DL signal; stopping the DL signal; or updating the DL signal. The second network device may transmit, via the transceiver and to a first node of the first network device, information for the determined action.

[0026] In some implementations of the method and apparatuses described herein, a second node of the second network device may determine one of the following actions: transmitting the DL signal, stopping the DL signal; or updating the DL signal; and the second node of the second network device may further transmit, via the transceiver, information for the determined action to a second node of the first network device.

[0027] In some implementations of the method and apparatuses described herein, the second network device may receive, from a user equipment (UE), a request for the DL signal, wherein the request for the DL signal indicates an identifier (ID) of the UE. The request for the DL signal may indicate one or more SCells that the UE expects for the DL signal, or the request for the DL signal may indicate one or more SCells that the UE expects for stopping the DL signal.

[0028] In some implementations of the method and apparatuses described herein, the second network device may receive the request for the DL signal via a radio resource control (RRC) signaling; and receive, via the transceiver and from the first network device, the request for the DL signal forwarded by the first network device.

[0029] In a third aspect of the solution, a processor for wireless communication may comprise: at least one memory; and a controller coupled with the at least one memory and configured to cause the controller to: determine a downlink (DL) signal of a cell; and transmit, to a second network device, information associated with the DL signal.

[0030] In a fourth aspect of the solution, a processor for wireless communication may comprise: at least one memory; and a controller coupled with the at least one memory and configured to cause the controller to: determine a downlink (DL) signal of a cell; and transmit, to a first network device, information associated with the DL signal.

[0031] In a fifth aspect of the solution, a method performed by a first network device described herein may include determining a downlink (DL) signal of a cell; and transmitting, to a second network device, information associated with the DL signal.

[0032] In a sixth aspect of the solution, a method performed by a second network device described herein may include determining a downlink (DL) signal of a cell; and transmitting, to a first network device, information associated with the DL signal.

[0033] It is to be understood that the summary section is not intended to identify key or essential features of embodiments of the present disclosure, nor is it intended to be used to limit the scope of the present disclosure. Other features of the present disclosure will become easily comprehensible through the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] FIG. 1A illustrates an example of a wireless communications system that supports a solution for determining a DL signal in accordance with aspects of the present disclosure.

[0035] FIG. 1B illustrates an overall architecture of new generation radio access network (NG-RAN).

[0036] FIG. 2 illustrates an example signalling procedure for determining a DL signal in accordance with aspects of the present disclosure.

[0037] FIG. 3 illustrates another example signalling procedure for determining a DL signal in accordance with aspects of the present disclosure.

[0038] FIG. 4 illustrates an example of device for determining a DL signal in accordance with aspects of the present disclosure.

[0039] FIG. 5 illustrates an example of processor for determining a DL signal in accordance with aspects of the present disclosure.

[0040] FIGS. 6-7 illustrate flowcharts of methods for determining a DL signal in accordance with aspects of the present disclosure.

DETAILED DESCRIPTION

[0041] Principles of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure.

The disclosure described herein may be implemented in various manners other than the ones described below.

[0042] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

[0043] References in the present disclosure to “one embodiment,” “an example embodiment,” “an embodiment,” “some embodiments,” and the like indicate that the embodiment(s) described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment(s). Further, when a particular feature, structure, or characteristic is described in connection with an embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0044] It shall be understood that although the terms “first” and “second” or the like may be used herein to describe various elements, these elements should not be limited by these terms. These terms are used to distinguish one element from another element. For example, a first element could also be termed as a second element, and similarly, a second element could also be termed as a first element, without departing from the scope of embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

[0045] The terminology used herein is for the purpose of describing particular embodiments and is not intended to be limiting of example embodiments. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/or combinations thereof.

[0046] As used herein, the term “communication network” refers to a network following any suitable communication standards, such as, 5G NR, long term evolution (LTE), LTE-advanced (LTE-A), wideband code division multiple access (WCDMA),

high-speed packet access (HSPA), narrow band internet of things (NB-IoT), and so on. Further, the communications between a terminal device and a network device in the communication network may be performed according to any suitable generation communication protocols, including but not limited to, the first generation (1G), the second generation (2G), 2.5G, 2.75G, the third generation (3G), the fourth generation (4G), 4.5G, the fifth generation (5G) communication protocols, and/or any other protocols either currently known or to be developed in the future. Embodiments of the present disclosure may be applied in various communication systems. Given the rapid development in communications, there will also be future type communication technologies and systems in which the present disclosure may be embodied. It should not be seen as limiting the scope of the present disclosure to only the aforementioned systems.

[0047] As used herein, the term “network device” generally refers to a node in a communication network via which a terminal device can access the communication network and receive services therefrom. The network device may refer to a base station (BS) or an access point (AP), for example, a node B (NodeB or NB), a radio access network (RAN) node, an evolved NodeB (eNodeB or eNB), a NR NB (also referred to as a gNB), a remote radio unit (RRU), a radio header (RH), an infrastructure device for a V2X (vehicle-to-everything) communication, a transmission and reception point (TRP), a reception point (RP), a remote radio head (RRH), a relay, an integrated access and backhaul (IAB) node, a low power node such as a femto BS, a pico BS, and so forth, depending on the applied terminology and technology.

[0048] As used herein, the term “terminal device” generally refers to any end device that may be capable of wireless communications. By way of example rather than a limitation, a terminal device may also be referred to as a communication device, a user equipment (UE), an end user device, a subscriber station (SS), an unmanned aerial vehicle (UAV), a portable subscriber station, a mobile station (MS), or an access terminal (AT). The terminal device may include, but is not limited to, a mobile phone, a cellular phone, a smart phone, a voice over IP (VoIP) phone, a wireless local loop phone, a tablet, a wearable terminal device, a personal digital assistant (PDA), a portable computer, a desktop computer, an image capture terminal device such as a digital camera, a gaming terminal device, a music storage and playback appliance, a vehicle-mounted wireless terminal device, a wireless endpoint, a mobile station, laptop-embedded equipment (LEE), laptop-mounted equipment (LME), a USB dongle, a smart device, wireless customer-

premises equipment (CPE), an internet of things (IoT) device, a watch or other wearable, a head-mounted display (HMD), a vehicle, a drone, a medical device (for example, a remote surgery device), an industrial device (for example, a robot and/or other wireless devices operating in an industrial and/or an automated processing chain contexts), a consumer electronics device, a device operating on commercial and/or industrial wireless networks, and the like. In the following description, the terms: “terminal device,” “communication device,” “terminal,” “user equipment” and “UE,” may be used interchangeably.

[0049] Aspects of the present disclosure are described in the context of a wireless communications system.

[0050] FIG. 1A illustrates an example of a wireless communications system 100A that supports a solution for determining a DL signal in accordance with aspects of the present disclosure. The wireless communications system 100A may include one or more network entities 102 (also referred to as network equipment (NE), or a base station (BS) 102), one or more UEs 104, a core network 106, and a packet data network 108. The wireless communications system 100A may support various radio access technologies. In some implementations, the wireless communications system 100A may be a 4G network, such as an LTE network or an LTE-advanced (LTE-A) network. In some other implementations, the wireless communications system 100A may be a 5G network, such as an NR network. In other implementations, the wireless communications system 100A 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 100A may support radio access technologies beyond 5G. Additionally, the wireless communications system 100A may support technologies, such as time division multiple access (TDMA), frequency division multiple access (FDMA), or code division multiple access (CDMA), etc.

[0051] The one or more network entities 102 may be dispersed throughout a geographic region to form the wireless communications system 100A. One or more of the network entities 102 described herein may be or include or may be referred to as a network node, a base station, a network element, a radio access network (RAN), a base transceiver station, an access point, a NodeB, an eNodeB (eNB), a next-generation NodeB (gNB), or

other suitable terminology. A network entity 102 and a UE 104 may communicate via a communication link 110, which may be a wireless or wired connection. For example, a network entity 102 and a UE 104 may perform wireless communication (e.g., receive signaling, transmit signaling) over a Uu interface.

[0052] A network entity 102 may provide a geographic coverage area 112 for which the network entity 102 may support services (e.g., voice, video, packet data, messaging, broadcast, etc.) for one or more UEs 104 within the geographic coverage area 112. For example, a network entity 102 and a UE 104 may support wireless communication of signals related to services (e.g., voice, video, packet data, messaging, broadcast, etc.) according to one or multiple radio access technologies. In some implementations, a network entity 102 may be moveable, for example, a satellite associated with a non-terrestrial network. In some implementations, different geographic coverage areas 112 associated with the same or different radio access technologies may overlap, but the different geographic coverage areas 112 may be associated with different network entities 102. Information and signals described herein may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0053] The one or more UEs 104 may be dispersed throughout a geographic region of the wireless communications system 100. A UE 104 may include or may be referred to as a mobile device, a wireless device, a remote device, a remote unit, a handheld device, or a subscriber device, or some other suitable terminology. In some implementations, the UE 104 may be referred to as a unit, a station, a terminal, or a client, among other examples. Additionally, or alternatively, the UE 104 may be referred to as an internet-of-things (IoT) device, an internet-of-everything (IoE) device, or machine-type communication (MTC) device, among other examples. In some implementations, a UE 104 may be stationary in the wireless communications system 100. In some other implementations, a UE 104 may be mobile in the wireless communications system 100.

[0054] The one or more UEs 104 may be devices in different forms or having different capabilities. Some examples of UEs 104 are illustrated in FIG. 1A. A UE 104 may be capable of communicating with various types of devices, such as the network entities 102,

other UEs 104, or network equipment (e.g., the core network 106, the packet data network 108, a relay device, an integrated access and backhaul (IAB) node, or another network equipment), as shown in FIG. 1A. Additionally, or alternatively, a UE 104 may support communication with other network entities 102 or UEs 104, which may act as relays in the wireless communications system 100A.

[0055] A UE 104 may also be able to support wireless communication directly with other UEs 104 over a communication link 114. For example, a UE 104 may support wireless communication directly with another UE 104 over a device-to-device (D2D) communication link. In some implementations, such as vehicle-to-vehicle (V2V) deployments, vehicle-to-everything (V2X) deployments, or cellular-V2X deployments, the communication link 114 may be referred to as a sidelink. For example, a UE 104 may support wireless communication directly with another UE 104 over a PC5 interface.

[0056] A network entity 102 may support communications with the core network 106, or with another network entity 102, or both. For example, a network entity 102 may interface with the core network 106 through one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The network entities 102 may communicate with each other over the backhaul links 116 (e.g., via an X2, Xn, or another network interface). In some implementations, the network entities 102 may communicate with each other directly (e.g., between the network entities 102). In some other implementations, the network entities 102 may communicate with each other or indirectly (e.g., via the core network 106). In some implementations, one or more network entities 102 may include subcomponents, such as an access network entity, which may be an example of an access node controller (ANC). An ANC may communicate with the one or more UEs 104 through one or more other access network transmission entities, which may be referred to as a radio heads, smart radio heads, or transmission-reception points (TRPs).

[0057] In some implementations, a network entity 102 may be configured in a disaggregated architecture, which may be configured to utilize a protocol stack physically or logically distributed among two or more network entities 102, such as an integrated access backhaul (IAB) network, an open radio access network (O-RAN) (e.g., a network configuration sponsored by the O-RAN Alliance), or a virtualized RAN (vRAN) (e.g., a cloud RAN (C-RAN)). For example, a network entity 102 may include one or more of a

CU, a DU, a radio unit (RU), a RAN intelligent controller (RIC) (e.g., a near-real time RIC (Near-RT RIC), a non-real time RIC (Non-RT RIC)), a service management and orchestration (SMO) system, or any combination thereof.

[0058] An RU may also be referred to as a radio head, a smart radio head, a remote radio head (RRH), a remote radio unit (RRU), or a transmission reception point (TRP). One or more components of the network entities 102 in a disaggregated RAN architecture may be co-located, or one or more components of the network entities 102 may be located in distributed locations (e.g., separate physical locations). In some implementations, one or more network entities 102 of a disaggregated RAN architecture may be implemented as virtual units (e.g., a virtual CU (VCU), a virtual DU (VDU), a virtual RU (VRU)).

[0059] Split of functionality between a CU, a DU, and an RU may be flexible and may support different functionalities depending upon which functions (e.g., network layer functions, protocol layer functions, baseband functions, radio frequency functions, and any combinations thereof) are performed at a CU, a DU, or an RU. For example, a functional split of a protocol stack may be employed between a CU and a DU such that the CU may support one or more layers of the protocol stack and the DU may support one or more different layers of the protocol stack. In some implementations, the CU may host upper protocol layer (e.g., a layer 3 (L3), a layer 2 (L2)) functionality and signaling (e.g., radio resource control (RRC), service data adaptation protocol (SDAP), packet data convergence protocol (PDCP)). The CU may be connected to one or more DUs or RUs, and the one or more DUs or RUs may host lower protocol layers, such as a layer 1 (L1) (e.g., physical (PHY) layer) or an L2 (e.g., radio link control (RLC) layer, medium access control (MAC) layer) functionality and signaling, and may each be at least partially controlled by the CU 160.

[0060] Additionally, or alternatively, a functional split of the protocol stack may be employed between a DU and an RU such that the DU may support one or more layers of the protocol stack and the RU may support one or more different layers of the protocol stack. The DU may support one or multiple different cells (e.g., via one or more RUs). In some implementations, a functional split between a CU and a DU, or between a DU and an RU may be within a protocol layer (e.g., some functions for a protocol layer may be performed by one of a CU, a DU, or an RU, while other functions of the protocol layer are performed by a different one of the CU, the DU, or the RU).

[0061] A CU may be functionally split further into CU control plane (CU-CP) and CU user plane (CU-UP) functions. A CU may be connected to one or more DUs via a midhaul communication link (e.g., F1, F1-c, F1-u), and a DU may be connected to one or more RUs via a fronthaul communication link (e.g., open fronthaul (FH) interface). In some implementations, a midhaul communication link or a fronthaul communication link may be implemented in accordance with an interface (e.g., a channel) between layers of a protocol stack supported by respective network entities 102 that are in communication via such communication links.

[0062] The core network 106 may support user authentication, access authorization, tracking, connectivity, and other access, routing, or mobility functions. The core network 106 may be an evolved packet core (EPC), or a 5G core (5GC), which may include a control plane entity that manages access and mobility (e.g., a mobility management entity (MME), an access and mobility management functions (AMF)) and a user plane entity that routes packets or interconnects to external networks (e.g., a serving gateway (S-GW), a packet data network (PDN) gateway (P-GW), or a user plane function (UPF)). In some implementations, the control plane entity may manage non-access stratum (NAS) functions, such as mobility, authentication, and bearer management (e.g., data bearers, signal bearers, etc.) for the one or more UEs 104 served by the one or more network entities 102 associated with the core network 106.

[0063] The core network 106 may communicate with the packet data network 108 over one or more backhaul links 116 (e.g., via an S1, N2, N2, or another network interface). The packet data network 108 may include an application server 118. In some implementations, one or more UEs 104 may communicate with the application server 118. A UE 104 may establish a session (e.g., a protocol data unit (PDU) session, or the like) with the core network 106 via a network entity 102. The core network 106 may route traffic (e.g., control information, data, and the like) between the UE 104 and the application server 118 using the established session (e.g., the established PDU session). The PDU session may be an example of a logical connection between the UE 104 and the core network 106 (e.g., one or more network functions of the core network 106).

[0064] In the wireless communications system 100A, the network entities 102 and the UEs 104 may use resources of the wireless communications system 100A (e.g., time resources (e.g., symbols, slots, subframes, frames, or the like) or frequency resources (e.g.,

subcarriers, carriers)) to perform various operations (e.g., wireless communications). In some implementations, the network entities 102 and the UEs 104 may support different resource structures. For example, the network entities 102 and the UEs 104 may support different frame structures. In some implementations, such as in 4G, the network entities 102 and the UEs 104 may support a single frame structure. In some other implementations, such as in 5G and among other suitable radio access technologies, the network entities 102 and the UEs 104 may support various frame structures (i.e., multiple frame structures). The network entities 102 and the UEs 104 may support various frame structures based on one or more numerologies.

[0065] One or more numerologies may be supported in the wireless communications system 100A, 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.

[0066] A time interval of a resource (e.g., a communication resource) may be organized according to frames (also referred to as radio frames). Each frame may have a duration, for example, a 10 millisecond (ms) duration. In some implementations, each frame may include multiple subframes. For example, each frame may include 10 subframes, and each subframe may have a duration, for example, a 1 ms duration. In some implementations, each frame may have the same duration. In some implementations, each subframe of a frame may have the same duration.

[0067] Additionally or alternatively, a time interval of a resource (e.g., a communication resource) may be organized according to slots. For example, a subframe may include a number (e.g., quantity) of slots. The number of slots in each subframe may also depend on the one or more numerologies supported in the wireless communications

system 100. For instance, the first, second, third, fourth, and fifth numerologies (i.e., $\mu=0$, $\mu=1$, $\mu=2$, $\mu=3$, $\mu=4$) associated with respective subcarrier spacings of 15 kHz, 30 kHz, 60 kHz, 120 kHz, and 240 kHz may utilize a single slot per subframe, two slots per subframe, four slots per subframe, eight slots per subframe, and 16 slots per subframe, respectively. Each slot may include a number (e.g., quantity) of symbols (e.g., OFDM symbols). In some implementations, the number (e.g., quantity) of slots for a subframe may depend on a numerology. For a normal cyclic prefix, a slot may include 14 symbols. For an extended cyclic prefix (e.g., applicable for 60 kHz subcarrier spacing), a slot may include 12 symbols. The relationship between the number of symbols per slot, the number of slots per subframe, and the number of slots per frame for a normal cyclic prefix and an extended cyclic prefix may depend on a numerology. It should be understood that reference to a first numerology (e.g., $\mu=0$) associated with a first subcarrier spacing (e.g., 15 kHz) may be used interchangeably between subframes and slots. In this disclosure, a time unit could be one or multiple frame, subframe, slot, symbol.

[0068] In the wireless communications system 100A, 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 100A may support one or multiple operating frequency bands, such as frequency range designations FR1 (410 MHz – 7.125 GHz), FR2 (24.25 GHz – 52.6 GHz), FR3 (7.125 GHz – 24.25 GHz), FR4 (52.6 GHz – 114.25 GHz), FR4a or FR4-1 (52.6 GHz – 71 GHz), and FR5 (114.25 GHz – 300 GHz). In some implementations, the network entities 102 and the UEs 104 may perform wireless communications over one or more of the operating frequency bands. In some implementations, FR1 may be used by the network entities 102 and the UEs 104, among other equipment or devices for cellular communications traffic (e.g., control information, data). In some implementations, FR2 may be used by the network entities 102 and the UEs 104, among other equipment or devices for short-range, high data rate capabilities.

[0069] 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.

[0070] FIG. 1B illustrates an overall architecture of NG-RAN 100B. The NG-RAN comprise a set of gNBs (for example, gNB 120 and gNB 122) connected to the 5GC through the NG interface. gNBs can be interconnected through the Xn interface. A gNB may comprise a gNB-CU (such as CU 124) and one or more gNB-DU(s) (such as DUs 126 and 128). A gNB-CU and a gNB-DU is connected via F1 interface. One gNB-DU is connected to only one gNB-CU. In case of network sharing with multiple cell ID broadcast, each Cell Identity associated with a subset of PLMNs corresponds to a gNB-DU and the gNB-CU it is connected to, i.e. the corresponding gNB-DUs share the same physical layer cell resources. For resiliency, a gNB-DU may be connected to multiple gNB-CUs by appropriate implementation. NG, Xn and F1 are logical interfaces.

[0071] For NG-RAN, the NG and Xn-C interfaces for a gNB consisting of a gNB-CU and gNB-DUs, terminate in the gNB-CU. For EN-DC, the S1-U and X2-C interfaces for a gNB consisting of a gNB-CU and gNB-DUs, terminate in the gNB-CU. The gNB-CU and connected gNB-DUs are only visible to other gNBs and the 5GC as a gNB.

[0072] Current specification supports synchronization signal block (SSB) and/or system information block 1(SIB1)-less operation for intra-band carrier aggregation (CA), where UE retrieves system information from and can perform synchronization based on another intra-band cell that transmits SSB and SIB1. Current specification supports SSB periodicity configuration up to 160 msec. For technique A-5-1 for non-CA, the UE may obtain system information from other associated carriers and/or cells and synchronize from other associated carriers and/or cells and/or synchronize from signal(s) transmitted on the cell. Technique A-5-2 also supports on-demand SSB and/or SIB1 transmissions and enable longer periods of cell inactivity to achieve network energy saving. SSB and/or SIB1 transmission at the serving cell can be triggered on-demand, e.g. by the UE.

[0073] One of the objectives for Rel-19 network energy savings (NES) is that specifying procedures and signaling method(s) to support on-demand SSB SCell operation for UEs in connected mode configured with CA, for both intra- and/or inter-band CA. However, When the UE request the on-demand SSB, which node (CU or DU) shall decide the transmission of the SSB is not discussed yet.

[0074] By implementing the embodiments of the present disclosure, a solution of determining a DL signal to support on-demand SSB and/or SIB1 can be provided, and the determination of the SSB and/or SIB1 transmission for an on-demand SSB and/or SIB1 SCell and interaction information between centralized unit (CU) and distributed unit (DU) nodes can be provided. In some embodiments, it is provided that the procedure to complete the on-demand SSB transmission between CU and DU nodes, and the procedure to complete the on-demand SSB transmission in DC cases.

[0075] FIG. 2 illustrates an example signalling procedure 200 for determining a DL signal in accordance with aspects of the present disclosure. The first network device (such as a CU, an MN-CU or an SN-CU) 202 determines (206) a DL signal of a cell. The first network device 202 transmits (208) information associated with the DL signal (212) to the second network device (such as a DU, an MN-DU or an SN-DU) 204. The second network device 204 receives (210) the DL signal 212 from the first network device 202.

[0076] In some example embodiments, the first network device 202 (also referred to as the CU thereafter) may configure a UE with enabling the trigger request for on-demand SSB. In some example embodiments, CU may configure the UE with disabling the trigger request for on-demand SSB. In some example embodiments, CU may configure the UE with the trigger of the activation of the SCell. In some example embodiments, CU may configure the UE with enabling the trigger of the deactivation of the SCell. In some example embodiments, CU may configure the UE with enabling the activation of the SCell. In some example embodiments, CU may configure the UE with enabling deactivation of the SCell.

[0077] In some example embodiments, CU may indicate the enabling configuration to the second network device 204 (also referred to as the DU thereafter). In some example embodiments, CU may indicate the disabling configuration to DU. In some example embodiments, DU may receive the request for on-demand SSB from the UE. In some example embodiments, the request may indicate the SCell(s) that the UE expects for the SSB transmission. In some example embodiments, the request may indicate the SCell(s) that the UE expects for stopping the SSB transmission. The request for transmission and stopping of the SSB transmission can be indicated simultaneously.

[0078] In some example embodiments, DU may indicate the request information to CU. In some example embodiments, the indication may include the UE ID. In some

example embodiments, if the request is transmitted via a RRC message, the DU may forward the received request from UE to CU. In some example embodiments, if the request is transmitted via a MAC CE, the DU may decode the request from UE. Then, the DU may transmit the F1 request message to CU.

[0079] In some example embodiments, DU may receive the signalling for transmission of SSB from CU. In some example embodiments, DU may receive the signalling for stopping transmission of SSB from CU. In some example embodiments, the signalling for transmission may include at least one of the following: a starting point and/or time, the period and/or offset of the DL signal, the transmission occasion of the DL signal, the transmission pattern of the DL signal, the SCell(s) that transmit(s) the DL signal, the delta configuration comparing with the previous configuration. In some example embodiments, the signalling may include more than one set of SSB configuration. In some example embodiments, DU may select one set of SSB configuration to transmit to UE or DU may be configured by CU to select one set of SSB configuration to transmit to UE.

[0080] In some example embodiments, the signalling for stopping transmission may include at least one of the following: a stopping point and/or time, or the SCell(s) that stop(s) transmission of the DL signal. In some example embodiments, the signalling may indicate to stop more than one set of SSB transmission. In some example embodiments, DU may select one or more set of SSB transmission to be stopped or DU may be configured by CU to select one or more set of SSB transmission to be stopped.

[0081] In some example embodiments, CU reconfigures the measurement to the UE. In some example embodiments, DU may transmit SSB to UE based on the CU signalling. In some example embodiments, DU may stop SSB transmission to UE based on the CU signalling.

[0082] In some example embodiments, for a dual connectivity case, a first node of the first network device (also referred to as an MN-CU thereafter) may determine the transmission of the SSB. In some example embodiments, MN-CU may configure the UE with enabling the trigger of request for on-demand SSB. In some example embodiments, MN-CU may configure the UE with disabling the trigger request for on-demand SSB. In some example embodiments, MN-CU may configure the UE with the trigger of the activation of the SCell. In some example embodiments, MN-CU may configure the UE

with enabling the trigger of the deactivation of the SCell. In some example embodiments, MN-CU may configure the UE with enabling the activation of the SCell. In some example embodiments, MN-CU may configure the UE with enabling deactivation of the SCell.

[0083] In some example embodiments, MN-CU may indicate the enabling and/or disabling configuration to a first node of the second network device (also referred to as an MN-DU thereafter) and/or to a second node of the first network device (also referred to as an SN-CU thereafter). In some example embodiments, MN-CU may indicate the configuration to a second node of the second network device (also referred to as an SN-DU) via SN-CU. In some example embodiments, MN-DU may receive the request for on-demand SSB of MCG SCell(s) from the UE. In some example embodiments, MN-DU may indicate the request information to MN-CU.

[0084] In some example embodiments, MN-DU may receive the request for on-demand SSB of SCG SCell(s) from the UE. In some example embodiments, MN-DU may indicate the request information to MN-CU. In some example embodiments, MN-CU may send signalling for transmission of SSB to SN-CU. In some example embodiments, SN-DU receives the signalling for transmission of SSB from SN-CU. In some example embodiments, SN-DU may receive the signalling for stopping transmission of SSB from SN-CU. In some example embodiments, Xn signalling or a new IE via Xn interface may be needed to transmit the signalling for transmission and/or stopping transmission of SCG-SCell SSB between MN-CU and SN-CU. In some example embodiments, MN-CU may reconfigure the measurement to the UE. In some example embodiments, SN-DU may transmit and/or stop SSB to UE based on the MN-CU signalling.

[0085] In some example embodiments, SN-DU may receive the request for on-demand SSB of SCG SCell(s) from the UE. In some example embodiments, SN-DU may indicate the request information to SN-CU. In some example embodiments, SN-CU may send the request information to MN-CU. In some example embodiments, the request information may be sent via Xn interface with a new Xn signalling or a new IE. In some example embodiments, MN-CU may send signalling for transmission of SSB to SN-CU. In some example embodiments, SN-DU may receive the signalling for transmission of SSB from SN-CU. In some example embodiments, SN-DU may receive the signalling for stopping transmission of SSB from SN-CU. In some example embodiments, Xn signalling or a new IE via Xn interface may be needed to transmit the signaling for

transmission and/or stopping transmission of SCG-SCell SSB between MN-CU and SN-CU. In some example embodiments, MN-CU may reconfigure the measurement to the UE. In some example embodiments, SN-DU may transmit and/or stop SSB to UE based on the MN-CU signalling.

[0086] In some example embodiments, for a dual connectivity case, SN-CU may determine the transmission of the SSB. In some example embodiments, MN-CU or SN-CU may configure the UE with enabling or disabling the trigger request for on-demand SSB. In some example embodiments, MN-CU or SN-CU may configure the UE with the trigger of the activation or deactivation of the SCell. In some example embodiments, MN-CU or SN-CU may configure the UE with the activation or deactivation the SCell.

[0087] In some example embodiments, MN-CU may indicate the enabling and/or disabling configuration to MN-DU and/or to SN-CU. In some example embodiments, SN-CU may indicate the configuration to SN-DU. In some example embodiments, SN-CU may indicate the enabling and/or disabling configuration to SN-DU. In some example embodiments, SN-DU may receive the request for on-demand SSB of SCG SCell(s) from the UE. In some example embodiments, SN-DU may indicate the request information to SN-CU.

[0088] In some example embodiments, SN-DU may receive the request for on-demand SSB of MCG SCell(s) from the UE. In some example embodiments, SN-DU may indicate the request information to SN-CU. In some example embodiments, SN-CU may send a signalling for transmission of SSB to MN-CU. In some example embodiments, MN-DU may receive the signalling for transmission of SSB from MN-CU. In some example embodiments, MN-DU may receive the signalling for stopping transmission of SSB from MN-CU. In some example embodiments, Xn signalling or a new IE via Xn interface may be needed to transmit the signaling for transmission and/or stopping transmission of MCG-SCell SSB between MN-CU and SN-CU. In some example embodiments, MN-CU may reconfigure the measurement to the UE. In some example embodiments, MN-DU may transmit and/or stop SSB to UE based on the MN-CU signalling.

[0089] FIG. 3 illustrates an example signalling procedure 300 for determining a DL signal in accordance with aspects of the present disclosure. The second network device (such as a DU, an MN-DU or an SN-DU) 304 determines (306) a DL signal of a cell. The

second network device 304 transmits (310) information associated with the DL signal (312) to the first network device (such as a CU, an MN-CU or an SN-CU) 302. The first network device 302 receives (308) the DL signal 312 from the second network device 304.

[0090] In some example embodiments, DU may configure the UE with enabling or disabling the trigger request for on-demand SSB. In some example embodiments, DU may configure the UE with the trigger of the activation or deactivation of the SCell. In some example embodiments, DU may configure the UE with enabling the activation or deactivation of the SCell.

[0091] In some example embodiments, DU may indicate the enabling and/or disabling configuration to CU. In some example embodiments, DU may receive the request for on-demand SSB from the UE, e.g., via MAC CE or WUS (wake-up-signal) or a specific sequence. In some example embodiments, the request may indicate the SCell(s) that the UE expects for the SSB transmission. In some example embodiments, the request may indicate the SCell(s) that the UE expects for stopping the SSB transmission.

[0092] In some example embodiments, DU may determine to transmit and/or update the transmission of SSB or stop the transmission of SSB. In some example embodiments, DU may indicate the transmission and/or update and/or stopping of SSB to CU. In some example embodiments, the signaling for transmission may include at least one of the following: a starting point and/or time, the period and/or offset of the DL signal, the transmission occasion of the DL signal, the transmission pattern of the DL signal, the SCell(s) that transmit(s) the DL signal, the delta configuration comparing with the previous configuration.

[0093] In some example embodiments, the signalling for stopping transmission may include at least one of the stopping point and/or time, the SCell(s) that stop(s) transmission of the DL signal. In some example embodiments, CU may reconfigure the measurement to the UE. In some example embodiments, DU may transmit SSB or updates the transmission of SSB to the UE.

[0094] In some example embodiments, for a dual connectivity case, MN-DU may determine the transmission of the SSB. In some example embodiments, MN-DU may configure the UE with enabling or disabling the trigger request for on-demand SSB. In some example embodiments, MN-DU may configure the UE with the trigger of the

activation or deactivation of the SCell. In some example embodiments, MN-DU may configure the UE with enabling the trigger of the activation or deactivation of the SCell. In some example embodiments, MN-DU may configure the UE with enabling the activation or deactivation of the SCell.

[0095] In some example embodiments, MN-DU may indicate the enabling and/or disabling configuration to MN-CU. In some example embodiments, MN-DU may receive the request for on-demand SSB of MCG SCell(s) from the UE. In some example embodiments, MN-DU may receive the request for on-demand SSB of SCG SCell(s) from the UE. In some example embodiments, MN-DU may determine to transmit and/or update the transmission of SSB or stop the transmission of SSB. In some example embodiments, MN-DU may indicate the transmission and/or update and/or stopping of SSB to MN-CU. In some example embodiments, MN-DU may transmit SSB or updates the transmission of SSB to the UE. In some example embodiments, MN-CU may reconfigure the measurement to the UE.

[0096] In some example embodiments, for a dual connectivity case, SN-DU may determine the transmission of the SSB. In some example embodiments, SN-DU may receive the request for on-demand SSB of SCG SCell(s) from the UE. In some example embodiments, SN-DU may determine to transmit and/or update the transmission of SSB or stop the transmission of SSB. In some example embodiments, SN-DU may indicate the transmission and/or update and/or stopping of SSB to SN-CU.

[0097] By implementing the embodiments of the present disclosure, a solution of determining a DL signal to support on-demand SSB and/or SIB1 can be provided, and the determination of the SSB and/or SIB1 transmission for an on-demand SSB and/or SIB1 SCell and interaction information between centralized unit (CU) and distributed unit (DU) nodes can be provided. In some embodiments, it is provided that the procedure to complete the on-demand SSB transmission between CU and DU nodes, and the procedure to complete the on-demand SSB transmission in DC cases.

[0098] FIG. 4 illustrates an example of device 400 for determining a DL signal in accordance with aspects of the present disclosure. The device 400 may be an example of a CU of a network entity 102 and/or a DU of a network entity 102 as described herein. The device 400 may support wireless communication with one or more network entities 102, UEs 104, or any combination thereof. The device 400 may include components for

bi-directional communications including components for transmitting and receiving communications, such as a processor 402, a memory 404, a transceiver 406, and, optionally, an I/O controller 408. 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).

[0099] The processor 402, the memory 404, the transceiver 406, or various combinations thereof or various components thereof may be examples of means for performing various aspects of the present disclosure as described herein. For example, the processor 402, the memory 404, the transceiver 406, or various combinations or components thereof may support a method for performing one or more of the operations described herein.

[0100] In some implementations, the processor 402, the memory 404, the transceiver 406, or various combinations or components thereof may be implemented in hardware (e.g., in communications management circuitry). The hardware may include a processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field-programmable gate array (FPGA) or other programmable logic device, a discrete gate or transistor logic, discrete hardware components, or any combination thereof configured as or otherwise supporting a means for performing the functions described in the present disclosure. In some implementations, the processor 402 and the memory 404 coupled with the processor 402 may be configured to perform one or more of the functions described herein (e.g., executing, by the processor 402, instructions stored in the memory 404).

[0101] For example, the processor 402 may support wireless communication at the device 400 in accordance with examples as disclosed herein. The processor 402 may be configured to operable to support means for determining a DL signal. For example, the processor 402 may be configured to operable to support means for determining, at a first network device, a DL signal of a cell. The processor 402 may be configured to operable to support means for transmitting, to a second network device, information associated with the DL signal. The processor 402 may be configured to operable to support means for performing other steps as discussed with reference to FIG. 2.

[0102] For another example, the processor 402 may be configured to operable to support means for determining, at a second network device, a DL signal of a cell. The processor 402 may be configured to operable to support means for transmitting, to a first

network device, information associated with the DL signal. The processor 402 may be configured to operate to support means for performing other steps as discussed with reference to FIG. 3.

[0103] The processor 402 may include an intelligent hardware device (e.g., a general-purpose processor, a DSP, a CPU, a microcontroller, an ASIC, an FPGA, a programmable logic device, a discrete gate or transistor logic component, a discrete hardware component, or any combination thereof). In some implementations, the processor 402 may be configured to operate a memory array using a memory controller. In some other implementations, a memory controller may be integrated into the processor 402. The processor 402 may be configured to execute computer-readable instructions stored in a memory (e.g., the memory 404) to cause the device 400 to perform various functions of the present disclosure.

[0104] The memory 404 may include random access memory (RAM) and read-only memory (ROM). The memory 404 may store computer-readable, computer-executable code including instructions that, when executed by the processor 402 cause the device 400 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. In some implementations, the code may not be directly executable by the processor 402 but may cause a computer (e.g., when compiled and executed) to perform functions described herein. In some implementations, the memory 404 may include, among other things, a basic I/O system (BIOS) which may control basic hardware or software operation such as the interaction with peripheral components or devices.

[0105] The I/O controller 408 may manage input and output signals for the device 400. The I/O controller 408 may also manage peripherals not integrated into the device 402. In some implementations, the I/O controller 408 may represent a physical connection or port to an external peripheral. In some implementations, the I/O controller 408 may utilize an operating system such as iOS®, ANDROID®, MS-WINDOWS®, OS/2®, UNIX®, LINUX®, or another known operating system. In some implementations, the I/O controller 408 may be implemented as part of a processor, such as the processor 406. In some implementations, a user may interact with the device 400 via the I/O controller 408 or via hardware components controlled by the I/O controller 408.

[0106] In some implementations, the device 400 may include a single antenna 410. However, in some other implementations, the device 400 may have more than one antenna 410 (i.e., multiple antennas), including multiple antenna panels or antenna arrays, which may be capable of concurrently transmitting or receiving multiple wireless transmissions. The transceiver 406 may communicate bi-directionally, via the one or more antennas 410, wired, or wireless links as described herein. For example, the transceiver 406 may represent a wireless transceiver and may communicate bi-directionally with another wireless transceiver. The transceiver 406 may also include a modem to modulate the packets, to provide the modulated packets to one or more antennas 410 for transmission, and to demodulate packets received from the one or more antennas 410. The transceiver 406 may include one or more transmit chains, one or more receive chains, or a combination thereof.

[0107] A transmit chain may be configured to generate and transmit signals (e.g., control information, data, packets). The transmit chain may include at least one modulator for modulating data onto a carrier signal, preparing the signal for transmission over a wireless medium. The at least one modulator may be configured to support one or more techniques such as amplitude modulation (AM), frequency modulation (FM), or digital modulation schemes like phase-shift keying (PSK) or quadrature amplitude modulation (QAM). The transmit chain may also include at least one power amplifier configured to amplify the modulated signal to an appropriate power level suitable for transmission over the wireless medium. The transmit chain may also include one or more antennas 1010 for transmitting the amplified signal into the air or wireless medium.

[0108] A receive chain may be configured to receive signals (e.g., control information, data, packets) over a wireless medium. For example, the receive chain may include one or more antennas 410 for receive the signal over the air or wireless medium. The receive chain may include at least one amplifier (e.g., a low-noise amplifier (LNA)) configured to amplify the received signal. The receive chain may include at least one demodulator configured to demodulate the receive signal and obtain the transmitted data by reversing the modulation technique applied during transmission of the signal. The receive chain may include at least one decoder for decoding the processing the demodulated signal to receive the transmitted data.

[0109] FIG. 5 illustrates an example of a processor 500 that supports the solution for determining a DL signal in accordance with aspects of the present disclosure. The

processor 500 may be an example of a processor configured to perform various operations in accordance with examples as described herein. The processor 500 may include a controller 502 configured to perform various operations in accordance with examples as described herein. The processor 500 may optionally include at least one memory 504, such as L1/L2/L3 cache. Additionally, or alternatively, the processor 500 may optionally include one or more arithmetic-logic units (ALUs) 500. 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).

[0110] The processor 500 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 500) 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).

[0111] The controller 502 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 500 to cause the processor 500 to support various operations of a base station in accordance with examples as described herein. For example, the controller 502 may operate as a control unit of the processor 500, generating control signals that manage the operation of various components of the processor 500. These control signals include enabling or disabling functional units, selecting data paths, initiating memory access, and coordinating timing of operations.

[0112] The controller 502 may be configured to fetch (e.g., obtain, retrieve, receive) instructions from the memory 504 and determine subsequent instruction(s) to be executed to cause the processor 500 to support various operations in accordance with examples as described herein. The controller 502 may be configured to track memory address of

instructions associated with the memory 504. The controller 502 may be configured to decode instructions to determine the operation to be performed and the operands involved. For example, the controller 502 may be configured to interpret the instruction and determine control signals to be output to other components of the processor 500 to cause the processor 500 to support various operations in accordance with examples as described herein. Additionally, or alternatively, the controller 502 may be configured to manage flow of data within the processor 500. The controller 502 may be configured to control transfer of data between registers, arithmetic logic units (ALUs), and other functional units of the processor 500.

[0113] The memory 504 may include one or more caches (e.g., memory local to or included in the processor 500 or other memory, such RAM, ROM, DRAM, SDRAM, SRAM, MRAM, flash memory, etc. In some implementation, the memory 504 may reside within or on a processor chipset (e.g., local to the processor 500). In some other implementations, the memory 504 may reside external to the processor chipset (e.g., remote to the processor 500).

[0114] The memory 504 may store computer-readable, computer-executable code including instructions that, when executed by the processor 500, cause the processor 500 to perform various functions described herein. The code may be stored in a non-transitory computer-readable medium such as system memory or another type of memory. The controller 502 and/or the processor 500 may be configured to execute computer-readable instructions stored in the memory 504 to cause the processor 500 to perform various functions. For example, the processor 500 and/or the controller 502 may be coupled with or to the memory 504, and the processor 500, the controller 502, and the memory 504 may be configured to perform various functions described herein. In some examples, the processor 500 may include multiple processors and the memory 504 may include multiple memories. One or more of the multiple processors may be coupled with one or more of the multiple memories, which may, individually or collectively, be configured to perform various functions herein.

[0115] The one or more ALUs 500 may be configured to support various operations in accordance with examples as described herein. In some implementation, the one or more ALUs 500 may reside within or on a processor chipset (e.g., the processor 500). In some other implementations, the one or more ALUs 500 may reside external to the

processor chipset (e.g., the processor 500). One or more ALUs 500 may perform one or more computations such as addition, subtraction, multiplication, and division on data. For example, one or more ALUs 500 may receive input operands and an operation code, which determines an operation to be executed. One or more ALUs 500 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 500 may support logical operations such as AND, OR, exclusive-OR (XOR), not-OR (NOR), and not-AND (NAND), enabling the one or more ALUs 500 to handle conditional operations, comparisons, and bitwise operations.

[0116] The processor 500 may support wireless communication in accordance with examples as disclosed herein. The processor 500 may be configured to or operable to support means for determining a DL signal. For example, the processor 500 may be configured to operable to support means for determining, at a first network device, a DL signal of a cell. The processor 500 may be configured to operable to support means for transmitting, to a second network device, information associated with the DL signal. The processor 500 may be configured to operable to support means for performing other steps as discussed with reference to FIG. 2.

[0117] For another example, the processor 500 may be configured to operable to support means for determining, at a second network device, a DL signal of a cell. The processor 500 may be configured to operable to support means for transmitting, to a first network device, information associated with the DL signal. The processor 500 may be configured to operable to support means for performing other steps as discussed with reference to FIG. 3.

[0118] FIG. 6 illustrates a flowchart of a method 600 that supports a solution for determining a DL signal in accordance with aspects of the present disclosure. The operations of the method 600 may be implemented by a device or its components as described herein. For example, the operations of the method 600 may be performed by a first network device as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0119] At 605, the method may include determining a DL signal of a cell. The operations of 605 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 605 may be performed by a device as described with reference to FIG. 1A.

[0120] At 610, the method may include transmitting information associated with the DL signal to a second network device. The operations of 610 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 610 may be performed by a device as described with reference to FIG. 1A.

[0121] FIG. 7 illustrates a flowchart of a method 700 that supports a solution for determining a DL signal in accordance with aspects of the present disclosure. The operations of the method 700 may be implemented by a device or its components as described herein. For example, the operations of the method 700 may be performed by a second network device as described herein. In some implementations, the device may execute a set of instructions to control the function elements of the device to perform the described functions. Additionally, or alternatively, the device may perform aspects of the described functions using special-purpose hardware.

[0122] At 705, the method may include determining a DL signal of a cell. The operations of 705 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 705 may be performed by a device as described with reference to FIG. 1A.

[0123] At 710, the method may include transmitting information associated with the DL signal to a first network device. The operations of 710 may be performed in accordance with examples as described herein. In some implementations, aspects of the operations of 710 may be performed by a device as described with reference to FIG. 1A.

[0124] It should be noted that the methods described herein describes possible implementations, and that the operations and the steps may be rearranged or otherwise modified and that other implementations are possible. Further, aspects from two or more of the methods may be combined.

[0125] The various illustrative blocks and components described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, a CPU, an FPGA or other programmable logic device, discrete gate or

transistor logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices (e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration).

[0126] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described herein may be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations.

[0127] Computer-readable media includes both non-transitory computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A non-transitory storage medium may be any available medium that may be accessed by a general-purpose or special-purpose computer. By way of example, non-transitory computer-readable media may include RAM, ROM, electrically erasable programmable ROM (EEPROM), flash memory, compact disk (CD) ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other non-transitory medium that may be used to carry or store desired program code means in the form of instructions or data structures and that may be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor.

[0128] As used herein, including in the claims, an article “a” before an element is unrestricted and understood to refer to “at least one” of those elements or “one or more” of those elements. The terms “a,” “at least one,” “one or more,” and “at least one of one or more” may be interchangeable. As used herein, including in the claims, “or” as used

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

[0129] The description herein is provided to enable a person having ordinary skill in the art to make or use the disclosure. Various modifications to the disclosure will be apparent to a person having ordinary skill in the art, and the generic principles defined herein may be applied to other variations without departing from the scope of the disclosure. Thus, the disclosure is not limited to the examples and designs described herein but is to be accorded the broadest scope consistent with the principles and novel features disclosed herein.

CLAIMS

What is claimed is:

1. A first network device comprising:
a processor; and
a transceiver coupled to the processor,
wherein the processor is configured to:
determine a downlink (DL) signal of a cell; and
transmit, via the transceiver and to a second network device, information
associated with the DL signal.
2. The first network device of claim 1, wherein the DL signal comprises an on-demand synchronization signal block (SSB) or on-demand system information block (SIB).
3. The first network device of claim 1, wherein transmitting the information associated with the DL signal comprises:
transmitting, via the transceiver and to the second network device, a signaling for transmitting the DL signal; or
transmitting, via the transceiver and to the second network device, a signaling for stopping the DL signal.
4. The first network device of claim 3, wherein the information associated with the DL signal for transmitting the DL signal comprises one or more of the following:
a starting point of the DL signal;
a starting time of the DL signal;
a period of the DL signal;
an offset of the DL signal;
a transmission occasion of the DL signal;
a transmission pattern of the DL signal;
one or more secondary cells (SCells) which transmit the DL signal; or
a difference configuration between the configuration for determining the DL signal and a previous configuration for determining the DL signal.

5. The first network device of claim 3, wherein the information associated with the DL signal for stopping the DL signal comprises one or more of the following:

- a stopping point of the DL signal;
- a stopping time of the DL signal; or
- one or more SCells which stop the DL signal.

6. The first network device of claim 3, wherein:

the information associated with the DL signal for transmitting the DL signal further comprises a set of SSB configurations, and the second network device selects a configuration from the set of SSB configurations; and

the information associated with the DL signal for stopping the DL signal further comprises a set of SSB configurations, and the second network device selects one or more configurations from the set of SSB configurations.

7. The first network device of claim 1, wherein a first node of the first network device is configured to:

determine a configuration for determining the DL signal; and

transmit, via the transceiver and to a second node of the first network device, a configuration for determining the DL signal.

8. The first network device of claim 1, wherein a first node of the first network device is configured to:

transmit, via the transceiver and to a second node of the second network device, a configuration for determining the DL signal.

9. The first network device of claim 1, wherein a first node of the first network device is configured to:

receive, via the transceiver and from the second network device, information of the request for the DL signal.

10. The first network device of claim 1, wherein a first node of the first network device is further configured to:

transmit, via the transceiver and to a second node of the first network device, a signaling for transmitting the DL signal; or

transmit, via the transceiver and to the second node of the first network device, a signaling for stopping the DL signal.

11. The first network device of claim 1, wherein a second node of the first network device processor is configured to:

receive, via the transceiver and from a first node of the first network device, a configuration for determining the DL signal.

12. The first network device of claim 1, wherein a second node of the first network device is configured to:

transmit, via the transceiver and to a second node of the second network device, a configuration for determining the DL signal.

13. The first network device of claim 1, wherein a second node of the first network device is configured to:

receive, via the transceiver and from a second node of the second network device, information of a request for the DL signal.

14. The first network device of claim 1, wherein a second node of the first network device is configured to:

transmit, via the transceiver and to a first node of the first network device, a signaling for transmitting the DL signal; or

transmit, via the transceiver and to the first node of the first network device, a signaling for stopping the DL signal.

15. A second network device comprising:

a processor; and

a transceiver coupled to the processor,

wherein the processor is configured to:

determine a downlink (DL) signal of a cell; and

transmit, via the transceiver and to a first network device, information associated with the DL signal.

16. The second network device of claim 15, wherein the processor is further configured to:

determine one of the following actions:

transmitting the DL signal

stopping the DL signal; or

updating the DL signal;

transmit, via the transceiver and to the first network device, information for the determined action.

17. The second network device of claim 15, wherein a first network node of the second network device is configured to:

transmit, via the transceiver and to a first node of the first network device, a configuration for determining the DL signal.

18. The second network device of claim 15, wherein a second node of the second network device is configured to determine one of the following actions:

transmitting the DL signal,

stopping the DL signal; or

updating the DL signal; and

the second node of the second network device further transmits, via the transceiver, information for the determined action to a second node of the first network device.

19. A processor for wireless communication, comprising:

at least one memory; and

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

determine a downlink (DL) signal of a cell; and

transmit, to a second network device, information associated with the DL signal.

20. A processor for wireless communication, comprising:

at least one memory; and

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

determine a downlink (DL) signal of a cell; and

transmit, to a first network device, information associated with the DL signal.