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(54) **Title**: DOWNLINK ASSIGNMENT INDICATOR DESIGN FOR MULTI-CARRIER WIRELESS COMMUNICATION

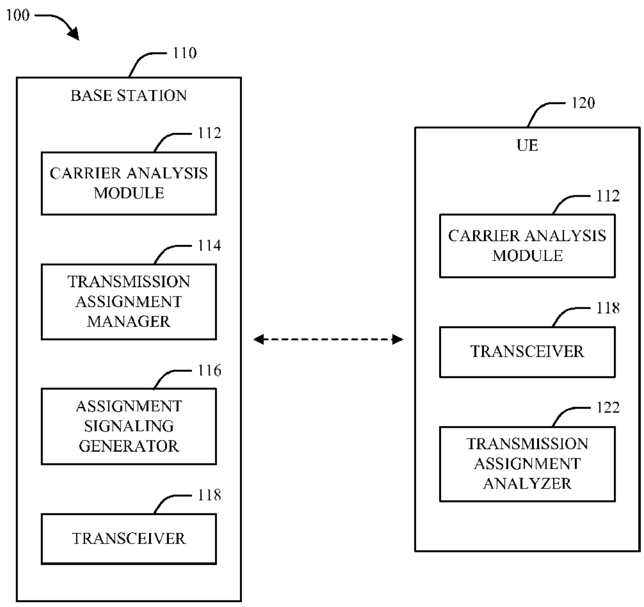

FIG. 1

(57) **Abstract**: Systems and methodologies are described herein that facilitate various techniques for enhanced downlink assignment index (DAI) signaling in a multi-carrier wireless communication system. As described herein, DAI and/or other indicator signaling transmitted on a first carrier can be configured to carry information relating to a number of downlink transmission assignments applied to at least a second carrier, which in some cases can be disparate from the first carrier. To these ends, described herein are techniques for cross-carrier DAI signaling, multiple DAI signaling, aggregate DAI signaling, and other similar techniques. As additionally described herein, DAI signaling can be related to downlink control transmissions and/or downlink data transmissions in connection with respective techniques that can be applied to the DAI signaling.

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DOWNLINK ASSIGNMENT INDICATOR DESIGN FOR MULTI-CARRIER WIRELESS COMMUNICATION

CROSS-REFERENCE

[0001] This application claims the benefit of U.S. Provisional Application Serial No. 61/183,496, filed June 2, 2009, and entitled "SYSTEMS AND METHODS OF DAI DESIGN FOR LTE-A TDD SYSTEMS," the entirety of which is incorporated herein by reference.

BACKGROUND

I. Field

[0002] The present disclosure relates generally to wireless communications, and more specifically to techniques for managing resource assignments in a multi-carrier wireless communication environment.

II. Background

[0003] Wireless communication systems are widely deployed to provide various communication services; for instance, voice, video, packet data, broadcast, and messaging services can be provided *via* such wireless communication systems. These systems can be multiple-access systems that are capable of supporting communication for multiple terminals by sharing available system resources. Examples of such multiple-access systems include Code Division Multiple Access (CDMA) systems, Time Division Multiple Access (TDMA) systems, Frequency Division Multiple Access (FDMA) systems, and Orthogonal Frequency Division Multiple Access (OFDMA) systems.

[0004] Generally, a wireless multiple-access communication system can simultaneously support communication for multiple wireless terminals. In such a system, each terminal can communicate with one or more base stations *via* transmissions on the forward and reverse links. The forward link (or downlink) refers to the communication link from the base stations to the terminals, and the reverse link (or uplink) refers to the communication link from the terminals to the base stations.

This communication link can be established *via* a single-in-single-out (SISO), multiple-in-signal-out (MISO), or a multiple-in-multiple-out (MIMO) system.

[0005] A MIMO system can support time division duplex (TDD) and frequency division duplex (FDD) systems. In a TDD system, forward and reverse link transmissions can be made on a shared frequency region so that the reciprocity principle can be used to enable estimation of a forward link channel separate from a reverse link channel. In turn, this can enable an access point to implement transmit beamforming gain on the forward link when multiple antennas are available at the access point.

[0006] Further, for various TDD systems utilizing orthogonal frequency division multiplexing (OFDM), a plurality of downlink subframes can generally be associated with one or more uplink subframes for feedback communication. A group of downlink subframes assigned to fewer uplink subframes for feedback communication is conventionally referred to as a bundling window. Thus, a device receiving transmissions on resources within a bundling window can perform feedback operations on the designated uplink subframe(s) for the bundling window. One type of feedback mode for TDD systems is acknowledgment (ACK) / negative acknowledgment (NACK) messaging, in which case a grouping of downlink subframes can be referred to as an ACK/NACK bundling window. Downlink transmissions received by the UE within this ACK/NACK bundling window are acknowledged on the uplink subframe(s). This bundling window design for wireless signals can result in more efficient utilization of downlink and uplink signal resources, providing an overall improvement for wireless communication systems.

[0007] In view of at least the above, it would be desirable to implement techniques by which bundling windows can be assigned, managed, and/or utilized in a multi-carrier wireless communication environment in a substantially efficient manner.

SUMMARY

[0008] The following presents a simplified summary of various aspects of the claimed subject matter in order to provide a basic understanding of such aspects. This summary is not an extensive overview of all contemplated aspects, and is intended to neither identify key or critical elements nor delineate the scope of such aspects. Its sole purpose is to present some concepts of the disclosed aspects in a simplified form as a prelude to the more detailed description that is presented later.

[0009] According to an aspect, a method is described herein. The method can comprise identifying a plurality of carriers configured for communication in a wireless communication system; determining a number of downlink transmission assignments associated with one or more first carriers in the plurality of carriers; and configuring, for communication over at least one or more second carriers in the plurality of carriers, at least one indication that specifies the number of downlink transmission assignments associated with at least the one or more first carriers.

[0010] A second aspect described herein relates to a wireless communications apparatus, which can comprise a memory that stores data relating to a plurality of carriers configured for communication in a wireless communication system. The wireless communications apparatus can further comprise a processor configured to determine a number of downlink transmission assignments associated with one or more first carriers in the plurality of carriers and to configure, for communication over one or more second carriers in the plurality of carriers, at least one indication that specifies the number of downlink transmission assignments associated with at least the one or more first carriers.

[0011] A third aspect relates to an apparatus, which can comprise means for identifying a plurality of carriers associated with a wireless communication system, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; means for obtaining information relating to a number of downlink transmission assignments applied to the at least one first carrier; and means for generating a downlink assignment index (DAI) for transmission on the at least one second carrier that specifies the number of downlink transmission assignments applied to the at least one first carrier.

[0012] A fourth aspect described herein relates to a computer program product, which can include a computer-readable medium that comprises code for causing a computer to identify a plurality of carriers associated with a wireless communication system, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; code for causing a computer to obtain information relating to a number of downlink transmission assignments applied to the at least one first carrier; and code for causing a computer to generate a DAI for transmission on the at least one second carrier that specifies the number of downlink transmission assignments applied to the at least one first carrier.

[0013] According to a fifth aspect, a method is described herein, which can comprise identifying a plurality of carriers configured for communication with a wireless communication network; obtaining transmission assignment signaling from the wireless communication network over at least one or more first carriers in the plurality of carriers; and determining, based on the transmission assignment signaling, a number of downlink transmission assignments associated with at least one or more second carriers in the plurality of carriers.

[0014] A sixth aspect described herein relates to a wireless communications apparatus, which can comprise a memory that stores data relating to a plurality of carriers configured for communication with a wireless communication network. The wireless communications apparatus can further comprise a processor configured to obtain transmission assignment signaling from the wireless communication network over at least one or more first carriers in the plurality of carriers and to determine, based on the transmission assignment signaling, a number of downlink transmission assignments associated with at least one or more second carriers in the plurality of carriers.

[0015] A seventh aspect relates to an apparatus, which can comprise means for identifying a plurality of carriers designated for communication with a wireless communication network, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; means for obtaining one or more DAIs from the wireless communication network on the at least one first carrier; and means for determining a number of downlink transmission assignments applied to the at least one second carrier based on the one or more DAIs.

[0016] An eighth aspect described herein relates to a computer program product, which can include a computer-readable medium that comprises code for causing a computer to identify a plurality of carriers designated for communication with a wireless communication network, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; code for causing a computer to obtain one or more DAIs from the wireless communication network on the at least one first carrier; and code for causing a computer to determine a number of downlink transmission assignments applied to the at least one second carrier based on the one or more DAIs.

[0017] To the accomplishment of the foregoing and related ends, one or more aspects of the claimed subject matter comprise the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth in detail certain illustrative aspects of the claimed subject matter. These aspects are indicative, however, of but a few of the various ways in which the principles of the claimed subject matter can be employed. Further, the disclosed aspects are intended to include all such aspects and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] FIG. 1 is a block diagram of a system that facilitates generation and processing of downlink assignment indication messaging in a multi-carrier wireless communication environment in accordance with various aspects.

[0019] FIG. 2 illustrates an example wireless communication system that facilitates multi-carrier communication in accordance with various aspects.

[0020] FIG. 3 illustrates an example wireless communication environment that supports feedback for multi-carrier communication in accordance with various aspects.

[0021] FIG. 4 is a block diagram of a system that facilitates cross-carrier and/or other signaling to support uplink feedback for multi-carrier communication in accordance with various aspects.

[0022] FIG. 5 illustrates an example downlink assignment index (DAI) design that can be employed in a wireless communication system.

[0023] FIGS. 6-8 illustrate respective techniques for enhanced DAI design for a multi-carrier wireless environment in accordance with various aspects described herein.

[0024] FIGS. 9-12 are flow diagrams of respective methods for generating signaling indicative of downlink transmission assignments made within a multi-carrier wireless communication environment.

[0025] FIG. 13 is a flow diagram of a method for processing transmission assignment signaling that includes multi-carrier assignment information.

[0026] FIGS. 14-15 are block diagrams of respective apparatuses that facilitate generation and processing of downlink assignment indicator signaling in a multi-carrier wireless communication system.

[0027] FIG. 16 illustrates a wireless multiple-access communication system in accordance with various aspects set forth herein.

[0028] FIG. 17 is a block diagram illustrating an example wireless communication system in which various aspects described herein can function.

DETAILED DESCRIPTION

[0029] Various aspects of the claimed subject matter are now described with reference to the drawings, wherein like reference numerals are used to refer to like elements throughout. In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of one or more aspects. It may be evident, however, that such aspect(s) may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form in order to facilitate describing one or more aspects.

[0030] As used in this application, the terms “component,” “module,” “system,” and the like are intended to refer to a computer-related entity, either hardware, firmware, a combination of hardware and software, software, or software in execution. For example, a component can be, but is not limited to being, a process running on a processor, an integrated circuit, an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a computing device and the computing device can be a component. One or more components can reside within a process and/or thread of execution and a component can be localized on one computer and/or distributed between two or more computers. In addition, these components can execute from various computer readable media having various data structures stored thereon. The components can communicate by way of local and/or remote processes such as in accordance with a signal having one or more data packets (*e.g.*, data from one component interacting with another component in a local system, distributed system, and/or across a network such as the Internet with other systems by way of the signal).

[0031] Furthermore, various aspects are described herein in connection with a wireless terminal and/or a base station. A wireless terminal can refer to a device providing voice and/or data connectivity to a user. A wireless terminal can be connected to a computing device such as a laptop computer or desktop computer, or it can be a self contained device such as a personal digital assistant (PDA). A wireless terminal can also be called a system, a subscriber unit, a subscriber station, mobile station, mobile, remote station, access point, remote terminal, access terminal, user terminal, user agent, user device, or user equipment (UE). A wireless terminal can be a subscriber station, wireless device, cellular telephone, PCS telephone, cordless telephone, a Session Initiation Protocol (SIP) phone, a wireless local loop (WLL) station, a personal digital assistant (PDA), a handheld device having wireless connection capability, or other processing device connected to a wireless modem. A base station (*e.g.,* access point or Node B) can refer to a device in an access network that communicates over the air-interface, through one or more sectors, with wireless terminals. The base station can act as a router between the wireless terminal and the rest of the access network, which can include an Internet Protocol (IP) network, by converting received air-interface frames to IP packets. The base station also coordinates management of attributes for the air interface.

[0032] Moreover, various functions described herein can be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions can be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media can be any available media that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store desired program code in the form of instructions or data structures and that can be accessed by a computer. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and blu-ray disc (BD), where disks usually reproduce data magnetically and discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0033] Various techniques described herein can be used for various wireless communication systems, such as Code Division Multiple Access (CDMA) systems, Time Division Multiple Access (TDMA) systems, Frequency Division Multiple Access (FDMA) systems, Orthogonal Frequency Division Multiple Access (OFDMA) systems, Single Carrier FDMA (SC-FDMA) systems, and other such systems. The terms "system" and "network" are often used herein interchangeably. A CDMA system can implement a radio technology such as Universal Terrestrial Radio Access (UTRA), CDMA2000, *etc.* UTRA includes Wideband-CDMA (W-CDMA) and other variants of CDMA. Additionally, CDMA2000 covers the IS-2000, IS-95 and IS-856 standards. A TDMA system can implement a radio technology such as Global System for Mobile Communications (GSM). An OFDMA system can implement a radio technology such as Evolved UTRA (E-UTRA), Ultra Mobile Broadband (UMB), IEEE 802.11 (Wi-Fi), IEEE 802.16 (WiMAX), IEEE 802.20, Flash-OFDM®, etc. UTRA and E-UTRA are part of Universal Mobile Telecommunication System (UMTS). 3GPP Long Term Evolution (LTE) is an upcoming release that uses E-UTRA, which employs OFDMA on the downlink and SC-FDMA on the uplink. UTRA, E-UTRA, UMTS, LTE and GSM are described in documents from an organization named "3rd Generation Partnership Project" (3GPP). Further, CDMA2000 and UMB are described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2).

[0034] Various aspects will be presented in terms of systems that can include a number of devices, components, modules, and the like. It is to be understood and appreciated that the various systems can include additional devices, components, modules, *etc.* and/or omit some or all of the devices, components, modules *etc.* discussed in connection with the figures. A combination of these approaches can also be used.

[0035] Referring now to the drawings, **Fig. 1** illustrates a system 100 that facilitates generation and processing of downlink assignment indication messaging in a multi-carrier wireless communication environment in accordance with various aspects described herein. As **Fig. 1** illustrates, system 100 can include one or more base stations 110 (also referred to herein as Node Bs or eNBs, cells or network cells, nodes or network nodes, access points (APs), *etc.*), which can communicate with one or more user equipment units (UEs, also referred to herein as access terminals (ATs), mobile or user stations, mobile devices, mobile terminals, *etc.*) 120 via respective transceivers

118. In accordance with one aspect, base station 110 can engage in one or more downlink (DL, also referred to herein as forward link (FL)) communications to UE 120, and UE 120 can engage in one or more uplink (UL, also referred to herein as reverse link (RL)) communications with base station 110. Additionally or alternatively, base station 110 and/or UE 120 can engage in any suitable communication(s) with each other, with other devices or entities in system 100, and/or any other suitable entities.

[0036] In accordance with one aspect, in various wireless communication systems (*e.g.*, TDD systems, *etc.*), one UL subframe can be associated with multiple DL subframes. Multiple DL subframes associated with an UL subframe in this manner is referred to herein and generally in the art as a DL subframe bundling window. For DL transmissions within the same bundling window, UL feedback, such as acknowledgement/negative acknowledgement (ACK/NAK) signaling, can be configured to be fed back in the corresponding UL subframe. In one example, ACK/NAK signaling can be made in response to and pertain to an expected or received signal(s), or one or more wireless resources demodulated at UE 120. Examples of suitable received/expected signals can include a predetermined number of data packets, a predetermined number of wireless resources (*e.g.*, time-frequency resources, OFDM symbols, code resources, time frames or subframes, *etc.*), or the like. Thus, as an example, a network protocol can configure UE 120 to send an ACK/NAK for a number, N, of received data packets, or for N DL resource blocks, or after expiration of X amount of time, or some combination thereof (where X and N are non-negative integers). If all expected signals or packets are received, UE 120 can send an ACK feedback signal, and otherwise sends a NAK feedback signal. Alternatively, other types of feedback can be employed, such as automatic repeat request (ARQ) signaling, hybrid ARQ (HARQ) signaling, or the like.

[0037] One type of ACK/NAK feedback mode that can be utilized by UE 120 in an example as provided above is called ACK/NAK bundling, where multiple ACK/NAKs within a bundling window are logically bundled into one ACK/NAK (*e.g.*, by performing a logical AND operation). Additionally or alternatively, another type of ACK/NAK feedback that can be utilized by UE 120 is called ACK/NAK multiplexing, where up to 4 bits of ACK/NAK can be fed back.

[0038] In some cases, it can be appreciated that UE 120 can miss signaling from base station 110 (*e.g.*, on a Physical Downlink Control Channel (PDCCH) and/or other suitable channel or combination of channels) that provides resource grants and/or other transmission assignment information. Consequently, in cases where UE 120 misses such signaling, base station 110 and UE 120 can have different interpretations on how many data transmissions (*e.g.*, Physical Downlink Shared Channel (PDSCH) transmissions, *etc.*) are to be performed within the bundling window.

[0039] Accordingly, to resolve and/or alleviate such misalignment, a 2-bit downlink assignment index (DAI) field can be utilized can be utilized in connection with various UL downlink control information (DCI) formats and/or DL DCI formats utilized for transmission of control signaling within system 100. For example, base station 110 can utilize a DAI field within one or more DL DCI formats to indicate an accumulative number of DL assignments within a bundling window. Thus, by way of example, a DAI field corresponding to a first assigned downlink transmission in a bundling window can indicate one assignment, a DAI field corresponding to a second downlink transmission in the bundling window can indicate two assignments, and so on. Additionally or alternatively, base station 110 can utilize a DAI field within one or more UL DCI formats to indicate a total number of DL assignments within a bundling window. Thus, by way of example, in the event that *n* downlink transmissions are assigned for a bundling window, DAI fields corresponding to each of the *n* assigned downlink transmissions can indicate *n* assignments.

[0040] In accordance with another aspect, it can be appreciated that as a need exists in a TDD system and/or other suitable wireless communication systems for UE 120 to feed back information on a single UL subframe that corresponds to multiple DL subframes, UE 120 can in some cases be required to have knowledge of how many DL transmissions have been scheduled in a given bundling window. Further, it can be appreciated that there may in some cases not be a guarantee to have any UL control signaling within a given bundling window. If such signaling is given and UE 120 successfully decodes the signaling, it can be appreciated that base station 110 and UE 120 can be substantially perfectly aligned in terms of the total number of DL transmissions within the corresponding bundling window. Thus, with the aid of DAIs provided with DL control signaling, UE 120 can efficiently feedback the corresponding ACK/NAK information. Alternatively, if UL control PDCCH and/or other control signaling does not exist, UE 120 can in some cases be required to rely on the DAI field given within DL control signaling. However, due to the accumulative nature of DAI information in DL signaling, the loss of the last DL control signal(s) in a given bundling window can cause misalignment between base station 110 and UE 120 regarding the total number of DL data transmissions, making it difficult for efficient ACK/NAK feedback. It can further be appreciated that with regard to DAI information transmitted on PDCCH and/or other suitable control channels between base station 110 and UE 120, transmissions on such control channels can in some cases have a relatively high tolerable loss rate (*e.g.*, approximately 1%, *etc.*) as compared to ACK/NAK signaling and/or other forms of signaling. In view of the above, it would be desirable to implement improved techniques for improving ACK/NAK performance within a given bundling window. Further, as further described herein, it would be desirable to implement techniques by which multiple carriers utilized by a wireless communication system can be leveraged to enhance DAI transmission and/or processing.

[0041] In view of at least the above, base station 110 and/or UE 120 can operate in accordance with various aspects as described herein to facilitate enhanced signaling and processing of DAIs and/or other indicators of the number of transmission assignments applied to various carriers in a multi-carrier system. For example, base station 110 can include a carrier analysis module 112 and/or other suitable mechanisms to identify a plurality of carriers configured for communication in a wireless communication system. Further, base station 110 can include a transmission assignment manager 114 and/or other suitable mechanisms to determine a number of DL transmission assignments associated with one or more first carriers in the plurality of carriers. In addition, base station 110 can include an assignment signaling generator 116 that can configure, for communication (*e.g.*, via transceiver 118) over at least one or more second carriers in the plurality of carriers, at least one indication that specifies the number of DL transmission assignments associated with at least the one or more first carriers. In one example, the one or more second carriers can be disparate from the one or more first carriers.

[0042] Correspondingly, UE 120 in system 100 can include a carrier analysis module 112 that can identify a plurality of carriers configured for communication with base station 110 and/or any suitable entity associated with a wireless communication network. UE 120 can further include a transceiver 118 and/or other mechanisms to obtain transmission assignment signaling from base station 110 over at least one or more first carriers in the plurality of carriers, based on which a transmission assignment analyzer 122 or the like can determine a number of DL transmission assignments associated with at least one or more second carriers in the plurality of carriers. In one example, the one or more second carriers can be disparate from the one or more first carriers. In another example, transmission assignment signaling communicated from base station 110 to UE 120 can include DL transmission assignments and/or UL transmission assignments.

[0043] In accordance with one aspect, a number of DL transmission assignments identified by transmission assignment manager 114 at base station 110 can be a number of DL transmission assignments associated with one or more first carriers over a predefined duration in time (*e.g.*, corresponding to a number of subframes and/or any other suitable time increments). Similarly, transmission assignment analyzer 122 at UE 120 can be utilized to determine, based on signaling from base station 110, a number of DL transmission assignments associated with one or more second carriers (that are disparate from one or more first carriers on which the signaling is received) over a predefined duration in time.

[0044] In accordance with various aspects, base station 110 can signal various types of DAI signaling and/or other indicator signaling to UE 120 to indicate a number of transmission assignments associated with a carrier other than that on which the signaling is provided. For example, base station 110 can utilize cross-carrier DAI signaling, multiple DAI signaling, aggregate DAI signaling, and/or any other suitable signaling type(s). Various examples of such signaling types are provided in further detail herein. It is to be appreciated that, unless explicitly stated otherwise, the description and claims provided herein are not intended to be limited to any specific type(s) of signaling that can be conducted by base station 110 and/or processed by UE 120.

[0045] Referring now to **Fig. 2**, a block diagram of an example system 200 that facilitates multi-carrier wireless communication in accordance with various aspects is illustrated. In one example, system 200 can facilitate improved reliability for feedback signaling pertaining to multi-carrier wireless communication. As a result, system 200 can achieve reduced re-transmission of control or traffic (whether voice or data traffic), thereby increasing overall wireless communication efficiency.

[0046] As shown in **Fig. 2**, system 200 can include a base station 110, which can be communicatively coupled with a UE 120 via a multi-carrier wireless link 210.

Multi-carrier wireless link 210 can, in turn, include two or more distinct carrier frequencies. While **Fig. 2** depicts four distinct carriers, it should be appreciated that such illustration is provided merely as an example and is not intended to be construed as limiting the number of carriers that can be employed in the context of multi-carrier wireless link 210. In accordance with one aspect, DL and/or UL communication between base station 110 and UE 120 can be conducted over one or more of the distinct carriers of multi-carrier wireless link 210. DL signals can be transmitted from base station 110 to UE 120 and can include, for example, control signals (*e.g.*, PDCCH), traffic signals (*e.g.*, PDSCH), or the like. Likewise, UL signals transmitted from UE 120 to base station 110 can include control signals (*e.g.*, ACK/NAK, channel feedback, scheduling requests, sounding reference signals (SRS), *etc.*), traffic signals (*e.g.*, Physical Uplink Shared Channel (PUSCH) signaling), *etc.*

[0047] In accordance with another aspect, various UL and DL signals can be assigned by base station 110 for transmission on any one of the distinct carriers of multi-carrier wireless link 210, or a group of such distinct carriers. Further, carrier assignments can be changed over time. As an illustrative example, a set of DL control signals can be transmitted on a first subset of carriers in one signal time frame (*e.g.*, a frame, subframe, time slot, subslot, *etc.*), on a second subset of the carriers in a subsequent signal time frame, and so on. Feedback signals assigned to the set of DL control signals can likewise be assigned to a subset of the carriers, which can be the same subset of carriers employed for the DL control signals or a different subset of the carriers.

[0048] Because a DL transmission (of control signals or traffic signals) can be transmitted over multiple carriers by base station 110, it can be appreciated that UE 120 can be configured to monitor multiple carriers in order to determine whether individual signals corresponding to the DL transmission are received at UE 120. Subsequently, UL feedback signals can be transmitted by UE 120 in response to the DL transmission. To assist UE 120 in monitoring and receiving the individual signals of the DL transmission, base station 110 can transmit a DAI 212 on a first subset of carriers that provides an indication of a total number of signals of the DL transmission that are transmitted on at least one additional subset of the carriers. Such a DAI 212 can be a cross-carrier DAI, a set of multiple DAIs, an aggregate DAI, and/or any other form of signaling suitable to indicate DL transmission assignments on carrier(s) other than those on which the DAI is transmitted. Additionally or alternatively, DAI 212 can identify a total number of signals of a DL transmission that are transmitted on the first subset of carriers as well, or this information can be transmitted in a separate DAI (not shown). Accordingly, UE 120 can determine whether DL signals received within a DL bundling window comprise a complete transmission (*e.g.*, all of the individual signals of the DL transmission) or an incomplete transmission.

[0049] In addition to the foregoing, DAI 212 can be employed by UE 120 to coordinate signaling of UL feedback 214 corresponding to DL transmissions within a given DL bundling window. The manner in which signaling of UL feedback 214 is performed can be according to a default arrangement (*e.g.*, as specified in a network standard, *etc.*), configured by base station 110 on a per-UE or per-cell basis, or the like.

[0050] In accordance with one aspect, DAI 212 can comprise DL signaling information pertaining to a single carrier, other than a carrier employed by base station 110 to transmit DAI 212 (herein referred to as a DL DAI carrier). In this case, UE 120 can perform ACK/NAK signaling for the single carrier. In one example, such ACK/NAK signaling can be accomplished with as few as one data bit, *e.g.*, to indicate that either all transmissions corresponding to DAI 212 on the single carrier have been received, or have not been received. Alternatively, multiple data bits can be utilized, *e.g.*, to specify particular received transmissions and/or to specify particular transmission that were not received.

[0051] In accordance with another aspect, DAI 212 can include DL signaling information for a plurality of carriers, including the DL DAI carrier, but which also includes at least one additional carrier. In this case, DAI 212 can specify information for the plurality of carriers, including one or more signal time slots per carrier (where a signal time slot can be, *e.g.*, a signal subframe, signal subslot, signal frame or slot, or other suitable time-based division of a DL signal). Alternatively, a plurality of DAIs 212 can be sent by base station 110 that provide DL signaling information for one or more of the plurality of carriers, or one or more signal time slots per carrier, or any other suitable combination of carriers and signal time slots.

[0052] Turning next to **Fig. 3**, an example system 300 that facilitates multi-carrier wireless communication in accordance with various aspects is illustrated. System 300 can comprise a base station 110, which can be coupled with one or more UEs 120. In addition, base station 110 can include or can be communicatively coupled with a node assignment apparatus 302. Node assignment apparatus 302 can be configured to support multi-carrier wireless communication by, *e.g.*, providing UE(s) 120 with information that indicates respective carriers on which individual DL transmissions (*e.g.*, associated with one or more UL feedback resources) are assigned within a DL bundling window. This information can be explicitly signaled by node assignment apparatus 206, or can be implicitly specified in a network specification (*e.g.*, with minimal or no higher layer signaling) and/or in any other suitable manner.

[0053] In one example, node assignment apparatus 302 can comprise a communication (comm.) interface 304 for communicating with UE(s) 120. Communication interface 304 can correspond to a transmit-receive chain of base station 110, or can include a separate electronic communication entity configured to utilize or communicate with this transmit-receive chain. In addition, node assignment apparatus 302 can comprise a memory 312 for storing instructions configured to facilitate multi-carrier wireless service for UE(s) 120 operating within a wireless network associated with base station 110, and a data processor 310 for executing modules to implement the instructions. For example, such modules can include a reference module 314 that forms a wireless message 316 for associating a set of DL transmissions on a first wireless carrier to an UL feedback resource. This association can be established with one or more DAIs, as described herein. Furthermore, node assignment apparatus 302 can comprise a transmission module 318 that encodes the wireless message onto a control channel resource of a wireless signal (*e.g.*, control message 320) and transmits the wireless message on a second wireless carrier to one or more UE(s) 120.

[0054] In accordance with one aspect, wireless message 316 can specify a total number of wireless carriers over which the set of DL transmissions are sent to UE(s) 120. In one example, wireless message 316 can further specify a total number of DL transmissions (*e.g.*, independent DL signals) in the set of DL transmissions on respective carriers of the total number of wireless carriers. Accordingly, UE(s) 120 can readily track a number of DL transmissions per carrier that are received, thereby improving coordination between base station 110 and UE(s) 120 and increasing reliability of feedback signaling transmitted by UE(s) 120.

[0055] In accordance with another aspect, various options can be utilized by control message 320 to convey information about DL transmissions on carriers other than (and optionally in addition to) the second wireless carrier (*e.g.*, the carrier employed to transmit control message 320). In one example, wireless message 316 can include a first data field that identifies the first wireless carrier and a second data field that specifies a total number of DL transmissions that are assigned to an UL feedback resource and that are transmitted on the first wireless carrier. In another example, wireless message 316 can be one of a set of wireless messages generated by reference module 314 and transmitted to UE(s) 120, each of which can specify a total number of DL transmissions assigned to the UL feedback resource that are transmitted on one respective subset of the set of wireless carriers. In this case, reference module 314 can generate different numbers of wireless messages and assign them to different subsets of the set of wireless carriers. As one example, the set of wireless messages comprises one wireless message 316 for each wireless carrier of the set of wireless carriers.

[0056] In one example, respective wireless messages 316 can include a cross-carrier DAI that identifies a total number of DL transmissions for one of the respective wireless carriers. Alternatively, one or more wireless messages 316 can comprise multiple DAIs, each specifying a total number of DL transmissions for a different carrier. As an example of this case, a set of wireless messages can include a number N of wireless messages (where N is a positive integer and is less than or equal to a number of the set of wireless carriers M), one for each anchor carrier of the set of wireless carriers (where the number of anchor carriers is less than or equal to M). At least one of the set of wireless messages can optionally include multiple DAIs, in effect bundling DL transmissions of a non-anchor carrier with DL transmissions of a corresponding anchor carrier. As another alternative, wireless message 316 can include one or more DAIs that logically bundle DL transmission information for a plurality of wireless carriers (*e.g.*, with a logical AND operation). In this alternative, reference module 314 can identify within wireless message 316 a total number of DL transmissions on at least one other wireless carrier in addition to a total number of the set of DL transmissions on the first wireless carrier. In identifying DL transmissions, wireless message 316 can employ alternative formats for explicitly or implicitly conveying DL transmission information. In one instance, a DAI can specify total transmissions within a DL bundling window. In another instance, a DAI can specify accumulative DL transmissions over the DL bundling window.

[0057] Depending on an amount of information to be conveyed by wireless message 316 (*e.g.*, how many DAIs are included, how many carriers are specified, *etc.*), different amounts of data may need to be reserved for this message. This can be accommodated in a network-wide standard, on a per-cell or per-UE basis, *etc.* Accordingly, reference module 314 can generate a number of data bits for wireless message 316 based on a controlling standard or configuration governing base station 110 and/or any other suitable factors.

[0058] In another example, DL transmissions corresponding to wireless message 316 can include either multi-carrier control or multi-carrier traffic transmissions, or both. Thus, for instance, a set of DL transmissions as referred to above can comprise data or voice traffic transmissions involving UE(s) 120 and transmitted at least in part on the first wireless carrier. In this case, wireless message 316 can be utilized to signal a total number of DL transmissions in the set of DL transmissions on the first wireless carrier. As another example, the set of DL transmissions can include control traffic transmissions involving UE(s) 120 and transmitted on the first wireless carrier. These control traffic transmissions can optionally pertain to data or voice traffic signals transmitted on an additional carrier (*e.g.*, the second wireless carrier or a third wireless carrier). In this case, wireless message 316 can optionally specify only the total number of DL control transmissions, only the total number of DL voice or data traffic transmissions on the additional carrier, or both the DL control transmissions and the DL voice/data traffic transmissions. Whether wireless message 316 pertains to data or voice traffic transmissions, control traffic transmissions, or both can be specified in a standard for the wireless network, a cell-specific or UE-specific configuration stored in memory 312, or the like. In one example, reference module 314 can access memory 312 to retrieve this standard when generating wireless message 316.

[0059] **Fig. 4** illustrates a further system 400 that can be deployed in accordance with various aspects described herein. System 400 can include a UE 120, which can be wirelessly coupled with a base station 110 via a multi-carrier wireless link. In addition, UE 120 can include a multi-carrier signal apparatus 402, which can provide improved feedback signaling based on DAI signals provided by base station 110.

[0060] In one example, multi-carrier signal apparatus 402 can comprise a communication interface 304 for exchanging wireless signals with base station 110. Additionally, multi-carrier signal apparatus 306 can comprise a memory 312 for storing instructions that facilitate multi-carrier wireless communication as well as a data processor 310 that executes and/or otherwise implements modules to implement these instructions. In operation, base station 110 can transmit a wireless message 422 to UE 120. This wireless message 422 can be transmitted on one carrier of the multi-carrier wireless link and can provide DL bundling window information pertaining to at least a second carrier of the multi-carrier wireless link. The DL bundling window information can be specified in one or more DAIs having various formats as described herein.

[0061] In another example, multi-carrier signal apparatus 402 can employ a filtering module 412 that extracts wireless message 422 from a signal that is received by communication interface 304 over a first wireless carrier. In addition, a mediation module 414 can be employed that analyzes wireless message 422 and identifies a number of transmissions that are assigned to an UL feedback resource and that are to be received on a second wireless carrier. In this manner, multi-carrier signal apparatus 402 can monitor the second wireless carrier for the specified number of transmissions and determine whether the number of transmissions has or has not been successfully received at UE 120.

[0062] In accordance with one aspect, multi-carrier signal apparatus 402 can comprise a counting module 416 that monitors traffic received by communication interface 304 on the multi-carrier wireless link, and particularly at least on the second wireless carrier identified in wireless message 422. Further, counting module 416 can track and determine a number of received transmissions assigned to the UL feedback resource that are received at least on the second wireless carrier. This number of received transmissions can be compared with a number of expected transmissions on the second wireless carrier as provided by mediation module 414. Multi-carrier signal apparatus 402 can additionally comprise a timing module 418 that sets a NAK period for receiving the number of transmissions on the second wireless carrier. As one illustrative example, the NAK period can be based on a response time for ACK/NAK signaling 424 included in a network specification, or specified by base station 304. By way of specific, non-limiting example, the response time can be four subframes such that a transmission in subframe N must be responded to by UE 302 in subframe N+4. Alternatively, the NAK period can be any other suitable number of signal time slots.

[0063] In accordance with another aspect, multi-carrier signal apparatus 402 and/or other mechanisms associated with UE 120 can compare a DAI value obtained from base station 110 (*e.g.*, via wireless message 422) with a detected number of DL transmissions received from base station 110. Based on this comparison, a layer 3 (L3) configured transmission scheme and/or any other suitable transmission scheme utilized by UE 120 (*e.g.*, bundling, multiplexing, *etc.*), and the physical layer means of transmission utilized by UE 120 (*e.g.*, on a Physical Uplink Control Channel (PUCCH), piggybacking on PUSCH, *etc.*), UE 120 can provide ACK/NAK signaling 424 to base station 110 accordingly.

[0064] As further described herein, wireless message 422 can comprise one or more DAIs respectively providing DL signal information pertaining to one or more carriers. The size of data fields within respective DAIs can be set by base station 110 and can vary per-UE, per-cell, or per DAI, or can be a standard size established by network protocols. Thus, in one instance, wireless message 422 can include a number of data bits suitable to identify each carrier employed for the multi-carrier wireless communication, each carrier available to base station 110, or each carrier assigned to UE 120. Alternatively, wireless message 422 can include a number of data bits suitable to identify a number of carriers employed for the multi-carrier wireless communication, a number of carriers available to base station 110, or a number of carriers assigned to UE 120. In yet another case, wireless message 422 can include a number of data bits suitable to minimize control channel blind decoding based on size matching between an UL DCI format and a DL DCI format.

[0065] The number of wireless carriers signaled by wireless message 422 (or a set of such wireless messages) can also vary, and can be configured by base station 110. In one instance, the number of wireless carriers can be equal to a number of anchor carriers employed by base station 110. In an alternative instance, the number of wireless carriers can be equal to or less than a total number of carriers available to base station 110, or assigned to UE 120 for the multi-carrier wireless communication. Where multiple carriers are signaled by wireless message 422, a plurality of DAIs can be employed, one for each carrier, or at least a subset of the DAIs can signal a number of transmissions on two or more carriers within a DL bundling window. Thus, wireless message 422 can contain, as one example, separate data fields specifying per-carrier number of transmissions for each of the number of wireless carriers. Alternatively, wireless message 422 can contain one or more aggregated data fields specifying a set of per-carrier numbers of transmissions for a plurality of the number of wireless carriers.

[0066] In accordance with one aspect, multi-carrier signal apparatus 402 can employ a network configuration or standard to interpret wireless message 314 and a

DAI(s) included therein. Further, filtering module 412 can obtain a network configuration identifying a number of wireless carriers, including at least the second wireless carrier, that are specified in wireless message 422. Additionally, mediation module 414 can employ the network configuration to identify a per-carrier number of transmissions assigned to the UL feedback resource for each of the number of wireless carriers. This aspect can be implemented, for instance, where wireless message 422 comprises a plurality of DAIs specifying numbers of DL transmissions for respective carriers, or a single DAI that is configured with a logical AND operation to do likewise.

[0067] With reference again to **Fig. 1**, it can be appreciated that in some wireless communication implementations, control and data can be configured to always be delivered on the same carrier. For multi-carrier operation, however, it can be appreciated that it can be possible for control and data to be transmitted from different carriers. Signaling performed in this manner, where control (*e.g.*, PDCCH) signaling is used to direct data (*e.g.*, PDSCH/PUSCH) signaling on at least a different carrier, is referred to herein and generally in the art as cross-carrier signaling. In one example, multi-carrier control signaling can be generated using separate coding of DL assignments and UL grants for each component carrier based on DCI format(s) for single carrier with an additional carrier indicator field of 0-3 bits. In the case of 0 bits, a carrier indicator can be omitted. Consequently, it can be appreciated that the carrier association of UL ACK/NAK in response to a data transmission can have two options: (1) an UL carrier for UL ACK/NAK and a DL carrier for DL data are always associated, or (2) an UL carrier for UL ACK/NAK and a DL carrier for DL control are always associated.

[0068] Based on at least the above discussion, it can be appreciated that the existence of the DAI in UL assignments can facilitate efficient ACK/NAK feedback for TDD systems and/or other suitable systems. However, as further noted above, UE 120 can in some cases be configured with multiple component carriers. Thus, in some cases, the concept of DAI for single-carrier systems can be extended to multi-carrier scenarios, where instead of indicating the number of DL assignments over the bundling window, the DAI can indicate the number of DL assignments over multiple carriers (*e.g.*, over frequency). Accordingly, for TDD systems, two DAIs can be utilized: a time-based DAI (DAI_time), which indicates the total (or accumulative) DL assignments in a given bundling window, and a frequency-based DAI (DAI_freq) that indicates the total number of DL carriers that have at least one DL assignment in the given DL subframe bundling window. This DAI configuration is illustrated in further detail by diagram 500 in **Fig. 5**.

[0069] In accordance with various aspects described herein, DAI signaling can be generated and/or processed within system 100 such that DAI signaling provided on a given carrier can provide a specific number of DL transmission assignments applied to a different carrier, thereby further improving DAI design over the techniques illustrated in diagram 500. It should be appreciated that the various examples provided herein can be utilized in place of, or complementary to, the {DAI_time, DAI_freq} structure illustrated in diagram 500.

[0070] In accordance with one aspect, base station 110 and UE 120 in system 100 can utilize cross-carrier DAI signaling for indicating and processing DL assignment information corresponding to various carriers. Thus, for example, base station 100 can configure at least one indication of a number of DL transmission assignments for one or more carriers to include index information (*e.g.*, a carrier index field (CIF) or the like) that associates the one or more carriers with the number of DL transmission assignments with which they are associated. Correspondingly, UE 120 can utilize transmission assignment analyzer 122 and/or other suitable means to identify one or more carriers corresponding to transmission assignment signaling via index information, such as a CIF or the like, provided in the transmission assignment signaling.

[0071] By way of example, cross-carrier DAI signaling can be implemented by base station 110 and/or UE 120 in the following manner. While the following example assumes a two-carrier allocation, it should be appreciated that the concepts described and illustrated herein can be applied for any suitable number of carriers. In one example, UE 120 can be configured with two component carriers denoted by C1 and C2, for the following two scenarios: (1) DL data transmission(s) on C1 and one UL data transmission on C2; and (2) two DL data transmissions in the bundling window on C1, one DL data transmission in the bundling window on C2, and one UL data transmission on C2. In scenario (1), it can be appreciated that the DAI field in the DL control signaling that assigns UL data transmission on C2 is meaningless, as there is no corresponding DL data transmission on C2. Further, in scenario (2), it can be appreciated that the DAI field in the DL control signaling that assigns UL transmission on C2 would be more useful if it was configured to indicate the total number of DL data transmissions on C1, instead of that of C2, as there are 2 DL data transmissions on C1 but only one on C2.

[0072] In both of the above scenarios, it can be appreciated that it would be desirable if the DAI field in the DL signaling that assigns UL data transmission on C2 could also indicate the total number of DL data transmissions in the bundling window for a different carrier (*e.g.*, such that the DAIs provide cross-carrier indication). Alternatively, it can be appreciated that other cases of cross-carrier DAI signaling would similarly be desirable. Accordingly, cross-carrier DAI signaling can be implemented as follows. In the event that M component carriers are configured for UE 120 (or a corresponding cell), for each UL or DL component, a CIF can be introduced for DAI (*e.g.*, CIF_DAI) that has a range of 0 to N bits, where $N = \text{ceil}(\log_2(M))$. An example of cross-carrier DAI signaling that can be generated and utilized in this manner is illustrated by diagram 600 in **Fig. 6**. It should be appreciated, however that the number of bits utilized for the CIF_DAI is not required to be $\text{ceil}(\log_2(M))$ such that the entire space of M component carriers can be addressed; instead, CIF values can be configured to apply only to a subset of carriers (*e.g.*, anchor carriers and/or any other suitable selected group(s) of carriers), respective groups of more than one carrier, and/or any other suitable CIF-to-carrier mapping.

[0073] By way of a specific illustrative example, a CIF can be a fixed 3-bit field that facilitates a UE-specific mapping of possible CIF values to respective carriers. Accordingly, for example, a value of 000 could be utilized to indicate a first carrier, a value of 001 could be utilized to indicate a second carrier, a value of 010 could be utilized to indicate the first carrier and the second carrier, and so on. Alternatively, it should be appreciated that any suitable mapping of CIF configurations to carriers could be utilized.

[0074] In another example, the number of bits utilized for CIF_DAI can be chosen by considering the possible size-matching between DL DCI formats and UL DCI formats such that, *e.g.*, PDCCH blind decoding and/or other suitable decoding operations can be minimized (*e.g.*, by having the same DL/UL DCI format sizes). For example, if a DL DCI has L bits and a corresponding UL DCI has L-1 bits before size-matching, a 1-bit CIF_DAI can be chosen such that no extra zero-padding bits are necessary. By doing so, it can be appreciated that a tradeoff can be achieved between control overhead and flexibility in cross-carrier DAI signaling. In a further example, for a given number of bits utilized for CIF_DAI, UE 120 can be configured via a radio resource control (RRC) entity and/or other suitable mechanisms to identify the carrier(s) addressed by the CIF_DAI. In an additional example, the number of bits utilized for CIF_DAI can be UE-specific, cell-specific, and/or determined in any suitable uniform or non-uniform manner throughout system 100.

[0075] In accordance with another aspect, base station 110 can facilitate signaling indications of DL transmission assignments on multiple carriers by transmitting multiple DAIs for the multiple carriers in a corresponding UL or DL assignment. An example of multiple DAI signaling that can be conducted in this manner is illustrated by diagram 700 in **Fig. 7**. With regard to base station 110 in system 100, assignment signaling generator 116 and/or other suitable associated modules can facilitate multiple DAI signaling by configuring a plurality of indications to specify numbers of DL transmission assignments associated with respective carriers in an associated plurality of carriers. Upon generation of such indications, the plurality of indications can be transmitted by transceiver 118 on one control signal or multiple (*e.g.*, two or more) control signals. The control signals can be communicated via, *e.g.*, PDCCH and/or any other suitable channel(s). In the event that two or more control signals are utilized, the control signals can be transmitted on one carrier or multiple (*e.g.*, two or more) carriers.

[0076] Correspondingly, at UE 120, transceiver 118 can be utilized to obtain transmission assignment signaling provided by base station 110 via one control signal or multiple control signals (on one or more carriers) as described above. Based on the transmission assignment signaling, transmission assignment analyzer 122 and/or other mechanisms associated with UE 120 can determine a plurality of numbers of DL transmission assignments associated with respective carriers in an associated plurality of carriers.

[0077] In one example, multiple DAIs can be transmitted by base station 110 for multiple carriers in a UL or DL assignment in the following manner. For example, instead of utilizing the {DAI value, CIF_DAI} structure as discussed above for cross-carrier DAI signaling, base station 110 can transmit $N \leq M$ DAIs in each UL or DL assignment, where M is the number of component carriers, in the form {DAI_1, DAI_2, …, DAI_N} or the like. In accordance with one aspect, the set

{DAI_1, DAI_2, …, DAI_N} can be individually coded (*e.g.*, coded on a per-indication basis) or jointly coded.

[0078] In another example, as implied by N ≤ M it can be appreciated that DAIs need not in all cases be provided for all M component carriers. Instead, in some cases N carriers can be selected that are associated with, *e.g.*, anchor carriers and/or any other selection of carriers, which can be equal to or less than M. In a further example, in the event that DAIs are provided for less than all component carriers assigned to a given UE 120, UE 120 can be operable to map respective DAIs to carriers in various manners. For example, CIF information can be provided with one or more DAIs. Alternatively, UE 120 can leverage a set of mappings between a number of DAIs provided in transmission assignment signaling and the carriers to which the DAIs refer. Such mappings can be static mappings (*e.g.*, L3-configured static mappings) and/or constructed in any other suitable manner. In a further example, multiple mappings can be provided for different numbers of DAIs, such that transmission assignment signaling with differing numbers of DAIs (*e.g.*, 2 DAIs, 3 DAIs, *etc.*) can correspond to different sets of carriers utilized within system 100.

[0079] In accordance with still another aspect, one or more DAI values can be provided by base station 110 within transmission assignment signaling that cover multiple carriers in a corresponding UL assignment, such that the DAI signaling is aggregated over frequency (*e.g.*, multiple carriers) and time (*e.g.*, over a DL subframe bundling window). An example of aggregated DAI signaling that can be constructed in this manner is illustrated by diagram 800 in **Fig. 8**. With regard to base station 110 in system 100, transmission assignment manager 114 and/or other suitable modules can be utilized to configure at least one indication (*e.g.*, a DAI) to specify a combined number of DL transmission assignments associated with one or more first carriers and one or more second carriers. Correspondingly, at UE 120, transmission assignment analyzer 122 can be utilized to determine a combined number of DL transmission assignments associated with one or more first carriers and one or more second carriers based on received transmission assignment signaling. In one non-limiting example case, transmission assignment signaling provided by base station 110 to UE 120 can include an indication and/or other information that specifies a number of DL transmission assignments associated with substantially all carriers in a set of carriers associated with one or more entities in system 100.

[0080] In one example, in the event that M component carriers are utilized, base station 110 can construct $K \geq 1$ DAIs, where each DAI covers M_k carriers such that $M_1 + M_2 + \ldots + M_K = M$. In one example, the respective K DAIs can be statically or semi-statically partitioned over the M component carriers in any suitable uniform or non-uniform manner. Thus, by way of illustration, in a 5-carrier system, a first DAI can correspond to carriers 1 and 2, a second DAI can correspond to carriers 3 and 4, and a third DAI can correspond to carrier 5. It should be appreciated, however, that any suitable mapping can be utilized. In another example, for the special case of $K = 1$ as noted above, a DAI in an UL assignment or DL assignment can indicate the total number of DL assignments in the DL subframe bundling window over all carriers. In a further example, aggregated DAI signaling as described above can utilize CIF information in a similar manner to the cross-carrier DAI signaling illustrated by **Fig. 6**, multiple DAIs in a similar manner to that shown by **Fig. 7**, and/or any other suitable properties to facilitate the DAI signaling.

[0081] In accordance with a further aspect, as discussed above, a carrier utilized by UE 120 for UL ACK/NAK feedback can be associated with corresponding DL data transmission or DL control transmissions (*e.g.*, PDSCH or PDCCH, *etc.*). As a result, it can be appreciated that base station 110 and/or UE 120 can leverage at least two options with respect to DAI signaling association. In a first example, DAI can be configured to always count the number of DL data transmissions over a given carrier. Alternatively, in a second example, DAI can be configured to always count the number of DL control transmissions over the given carrier, although some DL control may signal DL data transmissions over different carriers. Thus, in accordance with one aspect, base station 110 can determine at least one of a number of DL control signal transmission assignments or a number of DL data transmission assignments associated with one or more carriers such that UE 120 can retrieve such information from transmission assignment signaling received from base station 110. In one example, an option utilized for DAI association can be selected by base station 110 and/or UE 120 from the above options and/or other suitable options via an overarching network specification or other similar means, cell-specific or UE-specific configuration, and/or in any other suitable manner.

[0082] In accordance with an additional aspect, the number of bits utilized for a DAI can be leveraged to imply the carrier(s) to which the DAI refers. Accordingly, it can be appreciated that in addition to the payload of the DAI, the number of bits utilized for the DAI can additionally be utilized by base station 110 and/or UE 120 to facilitate one or more of the operations described above. In one example, an L3-configured mapping and/or other suitable means can be utilized to map respective DAI bit sizes to corresponding carriers, in a similar manner to that described for leveraging of a number of DAIs with respect to **Fig. 7** above.

[0083] Referring now to **Figs. 9-13**, various methodologies that can be performed in accordance with various aspects set forth herein are illustrated. While, for purposes of simplicity of explanation, the methodologies are shown and described as a series of acts, it is to be understood and appreciated that the methodologies are not limited by the order of acts, as some acts can, in accordance with one or more aspects, occur in different orders and/or concurrently with other acts from that shown and described herein. For example, those skilled in the art will understand and appreciate that a methodology could alternatively be represented as a series of interrelated states or events, such as in a state diagram. Moreover, not all illustrated acts may be required to implement a methodology in accordance with one or more aspects.

[0084] With reference to **Fig. 9**, illustrated is a first methodology 900 for generating signaling indicative of downlink transmission assignments made within a multi-carrier wireless communication environment. It is to be appreciated that methodology 900 can be performed by, for example, a base station (*e.g.*, base station 110) and/or any other appropriate network entity. Methodology 900 begins at block 902, wherein a plurality of carriers configured for communication in a wireless communication system is identified (*e.g.*, by a carrier analysis module 112). At block 904, a number of DL transmission assignments associated with one or more first carriers in the plurality of carriers is determined (*e.g.*, by a transmission assignment manager 114). At block 906, at least one indication is configured (*e.g.*, by an assignment signaling generator 116) for communication over at least one second carriers in the plurality of carriers that specifies the number of DL transmission assignments associated with at least the one or more first carriers.

[0085] **Fig. 10** illustrates a second methodology 1000 for generating signaling indicative of downlink transmission assignments made within a multi-carrier wireless communication environment. It is to be appreciated that methodology 1000 can be performed by, for example, an eNB and/or any other appropriate network entity. Methodology 1000 begins at block 1002, wherein a plurality of carriers configured for communication in a wireless communication system is identified. At block 1004, a number of DL transmission assignments associated with one or more first carriers in the plurality of carriers is determined. At block 1006, at least one indication is configured that specifies the number of DL transmission assignments associated with at least the one or more first carriers and index information that associates the one or more first carriers with the number of DL transmission assignments associated with the one or more first carriers.

[0086] Turning now to **Fig. 11**, a third methodology 1100 for generating signaling indicative of downlink transmission assignments made within a multi-carrier wireless communication environment. Methodology 1100 can be performed by, for example, a network cell and/or any other appropriate network entity. Methodology 1100 begins at block 1102, wherein a plurality of carriers configured for communication in a wireless communication system is identified. At block 1104, numbers of DL transmission assignments are determined that are associated with respective carriers in the plurality of carriers that include one or more first carriers. At block 1106, a plurality of indications is configured that specify the numbers of DL transmission assignments associated with the respective carriers in the plurality of carriers.

[0087] **Fig. 12** illustrates a fourth methodology 1200 for generating signaling indicative of downlink transmission assignments made within a multi-carrier wireless communication environment. Methodology 1200 can be performed by, for example, a base station and/or any other appropriate network entity. Methodology 1200 begins at block 1202, wherein a plurality of carriers configured for communication in a wireless communication system is identified. At block 1204, an indication is configured that specifies a number of DL transmission assignments associated with substantially all carriers in the plurality of carriers.

[0088] Turning to **Fig. 13**, a methodology 1300 for processing transmission assignment signaling that includes multi-carrier assignment information is illustrated. Methodology 1300 can be performed by, for example, a UE (*e.g.*, UE 120) and/or any other suitable network entity. Methodology 1300 begins at block 1302, wherein a plurality of carriers configured for communication with a wireless communication network is identified (*e.g.*, via a carrier analysis module 112). At block 1304, transmission assignment signaling is obtained from the wireless communication network (*e.g.*, via a transceiver 118) over at least one or more first carriers in the plurality of carriers. At block 1306, a number of DL transmission assignments associated with at least one or more second carriers in the plurality of carriers is determined (*e.g.*, by a transmission assignment analyzer 122) based on the transmission assignment signaling.

[0089] Referring next to **Figs. 14-15**, respective apparatuses 1400-1500 that can be implemented in accordance with various aspects herein are illustrated. It is to be appreciated that apparatuses 1400-1500 are represented as including functional blocks, which can be functional blocks that represent functions implemented by a processor, software, or combination thereof (*e.g.*, firmware).

[0090] With reference first to **Fig. 14**, a first apparatus 1400 that facilitates generation and processing of downlink assignment indicator signaling in a multi-carrier wireless communication system is illustrated. Apparatus 1400 can be implemented by a base station (*e.g.*, base station 110) and/or any other suitable network entity and can include a module 1402 for identifying a plurality of carriers associated with a wireless communication system, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; a module 1404 for obtaining information relating to a number of DL transmission assignments applied to the at least one first carrier; and a module 1406 for generating a DAI for transmission on the at least one second carrier that specifies the number of DL transmission assignments applied to the at least one first carrier.

[0091] **Fig. 15** illustrates a second apparatus 1500 that facilitates generation and processing of downlink assignment indicator signaling in a multi-carrier wireless communication system. Apparatus 1500 can be implemented by a mobile terminal (*e.g.*, UE 120) and/or any other suitable network entity and can include a module 1502 for identifying a plurality of carriers designated for communication with a wireless communication network, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers; a module 1504 for obtaining one or more DAIs from the wireless communication network on the at least one first carrier; and a module 1506 for determining a number of DL transmission assignments applied to the at least one second carrier based on the one or more DAIs.

[0092] Referring now to **Fig. 16**, an illustration of a wireless multiple-access communication system is provided in accordance with various aspects. In one example, an access point 1600 (AP) includes multiple antenna groups. As illustrated in **Fig. 16**, one antenna group can include antennas 1604 and 1606, another can include antennas 1608 and 1610, and another can include antennas 1612 and 1614. While only two antennas are shown in **Fig. 16** for each antenna group, it should be appreciated that more or fewer antennas may be utilized for each antenna group. In another example, an access terminal 1616 can be in communication with antennas 1612 and 1614, where antennas 1612 and 1614 transmit information to access terminal 1616 over forward link 1620 and receive information from access terminal 1616 over reverse link 1618. Additionally and/or alternatively, access terminal 1622 can be in communication with antennas 1606 and 1608, where antennas 1606 and 1608 transmit information to access terminal 1622 over forward link 1626 and receive information from access terminal 1622 over reverse link 1624. In a frequency division duplex system, communication links 1618, 1620, 1624 and 1626 can use different frequency for communication. For example, forward link 1620 may use a different frequency then that used by reverse link 1618.

[0093] Each group of antennas and/or the area in which they are designed to communicate can be referred to as a sector of the access point. In accordance with one aspect, antenna groups can be designed to communicate to access terminals in a sector of areas covered by access point 1600. In communication over forward links 1620 and 1626, the transmitting antennas of access point 1600 can utilize beamforming in order to improve the signal-to-noise ratio of forward links for the different access terminals 1616 and 1622. Also, an access point using beamforming to transmit to access terminals scattered randomly through its coverage causes less interference to access terminals in neighboring cells than an access point transmitting through a single antenna to all its access terminals.

[0094] An access point, *e.g.*, access point 1600, can be a fixed station used for communicating with terminals and can also be referred to as a base station, an eNB, an access network, and/or other suitable terminology. In addition, an access terminal, *e.g.*, an access terminal 1616 or 1622, can also be referred to as a mobile terminal, user equipment, a wireless communication device, a terminal, a wireless terminal, and/or other appropriate terminology.

[0095] Referring now to **Fig. 17**, a block diagram illustrating an example wireless communication system 1700 in which various aspects described herein can function is provided. In one example, system 1700 is a multiple-input multiple-output (MIMO) system that includes a transmitter system 1710 and a receiver system 1750. It should be appreciated, however, that transmitter system 1710 and/or receiver system 1750 could also be applied to a multi-input single-output system wherein, for example, multiple transmit antennas (*e.g.*, on a base station), can transmit one or more symbol streams to a single antenna device (*e.g.*, a mobile station). Additionally, it should be appreciated that aspects of transmitter system 1710 and/or receiver system 1750 described herein could be utilized in connection with a single output to single input antenna system.

[0096] In accordance with one aspect, traffic data for a number of data streams are provided at transmitter system 1710 from a data source 1712 to a transmit (TX) data processor 1717. In one example, each data stream can then be transmitted *via* a respective transmit antenna 1724. Additionally, TX data processor 1714 can format, encode, and interleave traffic data for each data stream based on a particular coding scheme selected for each respective data stream in order to provide coded data. In one example, the coded data for each data stream can then be multiplexed with pilot data using OFDM techniques. The pilot data can be, for example, a known data pattern that is processed in a known manner. Further, the pilot data can be used at receiver system 1750 to estimate channel response. Back at transmitter system 1710, the multiplexed pilot and coded data for each data stream can be modulated (*e.g.*, symbol mapped) based on a particular modulation scheme (*e.g.*, BPSK, QSPK, M-PSK, or M-QAM) selected for each respective data stream in order to provide modulation symbols. In one example, data rate, coding, and modulation for each data stream can be determined by instructions performed on and/or provided by processor 1730.

[0097] Next, modulation symbols for all data streams can be provided to a TX MIMO processor 1720, which can further process the modulation symbols (*e.g.*, for OFDM). TX MIMO processor 1720 can then provides N_T modulation symbol streams to N_T transceivers 1722a through 1722t. In one example, each transceiver 1722 can receive and process a respective symbol stream to provide one or more analog signals. Each transceiver 1722 can then further condition (*e.g.*, amplify, filter, and upconvert) the analog signals to provide a modulated signal suitable for transmission over a MIMO channel. Accordingly, N_T modulated signals from transceivers 1722a through 1722t can then be transmitted from N_T antennas 1724a through 1724t, respectively.

[0098] In accordance with another aspect, the transmitted modulated signals can be received at receiver system 1750 by N_R antennas 1752a through 1752r. The received signal from each antenna 1752 can then be provided to respective transceivers 1754. In one example, each transceiver 1754 can condition (*e.g.*, filter, amplify, and downconvert) a respective received signal, digitize the conditioned signal to provide samples, and then processes the samples to provide a corresponding "received" symbol stream. An RX MIMO/data processor 1760 can then receive and process the N_R received symbol streams from N_R transceivers 1754 based on a particular receiver processing technique to provide N_T "detected" symbol streams. In one example, each detected symbol stream can include symbols that are estimates of the modulation symbols transmitted for the corresponding data stream. RX processor 1760 can then process each symbol stream at least in part by demodulating, deinterleaving, and decoding each detected symbol stream to recover traffic data for a corresponding data stream. Thus, the processing by RX processor 1760 can be complementary to that performed by TX MIMO processor 1720 and TX data processor 1714 at transmitter system 1710. RX processor 1760 can additionally provide processed symbol streams to a data sink 1764.

[0099] In accordance with one aspect, the channel response estimate generated by RX processor 1760 can be used to perform space/time processing at the receiver, adjust power levels, change modulation rates or schemes, and/or other appropriate actions. Additionally, RX processor 1760 can further estimate channel characteristics such as, for example, signal-to-noise-and-interference ratios (SNRs) of the detected symbol streams. RX processor 1760 can then provide estimated channel characteristics to a processor 1770. In one example, RX processor 1760 and/or processor 1770 can further derive an estimate of the "operating" SNR for the system. Processor 1770 can then provide channel state information (CSI), which can comprise information regarding the communication link and/or the received data stream. This information can include, for example, the operating SNR. The CSI can then be processed by a TX data processor 1718, modulated by a modulator 1780, conditioned by transceivers 1754a through 1754r, and transmitted back to transmitter system 1710. In addition, a data source 1716 at receiver system 1750 can provide additional data to be processed by TX data processor 1718.

[00100] Back at transmitter system 1710, the modulated signals from receiver system 1750 can then be received by antennas 1724, conditioned by transceivers 1722, demodulated by a demodulator 1740, and processed by a RX data processor 1742 to recover the CSI reported by receiver system 1750. In one example, the reported CSI can then be provided to processor 1730 and used to determine data rates as well as coding and modulation schemes to be used for one or more data streams. The determined coding and modulation schemes can then be provided to transceivers 1722 for quantization and/or use in later transmissions to receiver system 1750. Additionally and/or alternatively, the reported CSI can be used by processor 1730 to generate various controls for TX data processor 1714 and TX MIMO processor 1720. In another example, CSI and/or other information processed by RX data processor 1742 can be provided to a data sink 1744.

[00101] In one example, processor 1730 at transmitter system 1710 and processor 1770 at receiver system 1750 direct operation at their respective systems. Additionally, memory 1732 at transmitter system 1710 and memory 1772 at receiver system 1750 can provide storage for program codes and data used by processors 1730 and 1770, respectively. Further, at receiver system 1750, various processing techniques can be used to process the N_R received signals to detect the N_T transmitted symbol streams. These receiver processing techniques can include spatial and space-time receiver processing techniques, which can also be referred to as equalization techniques, and/or "successive nulling/equalization and interference cancellation" receiver processing techniques, which can also be referred to as "successive interference cancellation" or "successive cancellation" receiver processing techniques.

[00102] It is to be understood that the aspects described herein can be implemented by hardware, software, firmware, middleware, microcode, or any combination thereof. When the systems and/or methods are implemented in software, firmware, middleware or microcode, program code or code segments, they can be stored in a machine-readable medium, such as a storage component. A code segment can represent a procedure, a function, a subprogram, a program, a routine, a subroutine, a module, a software package, a class, or any combination of instructions, data structures, or program statements. A code segment can be coupled to another code segment or a hardware circuit by passing and/or receiving information, data, arguments, parameters, or memory contents. Information, arguments, parameters, data, *etc.* can be passed, forwarded, or transmitted using any suitable means including memory sharing, message passing, token passing, network transmission, *etc.*

[00103] For a software implementation, the techniques described herein can be implemented with modules (*e.g.*, procedures, functions, and so on) that perform the functions described herein. The software codes can be stored in memory units and executed by processors. The memory unit can be implemented within the processor or external to the processor, in which case it can be communicatively coupled to the processor *via* various means as is known in the art.

[00104] What has been described above includes examples of one or more aspects. It is, of course, not possible to describe every conceivable combination of components or methodologies for purposes of describing the aforementioned aspects, but one of ordinary skill in the art can recognize that many further combinations and permutations of various aspects are possible. Accordingly, the described aspects are intended to embrace all such alterations, modifications and variations that fall within the spirit and scope of the appended claims. Furthermore, to the extent that the term “includes” is used in either the detailed description or the claims, such term is intended to be inclusive in a manner similar to the term “comprising” as “comprising” is interpreted when employed as a transitional word in a claim. Furthermore, the term “or” as used in either the detailed description or the claims is meant to be a “non-exclusive or.”

[00105] What is claimed is:

CLAIMS

1. A method, comprising:

identifying a plurality of carriers configured for communication in a wireless communication system;

determining a number of downlink transmission assignments associated with one or more first carriers in the plurality of carriers; and

configuring, for communication over at least one or more second carriers in the plurality of carriers, at least one indication that specifies the number of downlink transmission assignments associated with at least the one or more first carriers.

2. The method of claim 1, wherein the one or more second carriers are disparate from the one or more first carriers.

3. The method of claim 1, wherein the at least one indication comprises downlink assignment index (DAI) signaling.

4. The method of claim 1, wherein the configuring comprises configuring the at least one indication to include index information that associates the one or more first carriers with the number of downlink transmission assignments associated with the one or more first carriers.

5. The method of claim 4, wherein the index information comprises a carrier index field (CIF).

6. The method of claim 1, wherein the configuring comprises configuring the at least one indication to specify one or more of a total number of downlink transmission assignments associated with at least the one or more first carriers or an accumulative number of downlink transmission assignments associated with at least the one or more first carriers.

7. The method of claim 1, wherein the configuring comprises configuring the at least one indication to specify a combined number of downlink transmission

assignments associated with the one or more first carriers and the one or more second carriers.

8. The method of claim 1, further comprising transmitting the at least one indication via at least one of a downlink transmission assignment or an uplink transmission assignment.

9. The method of claim 1, wherein the configuring comprises configuring a plurality of indications to specify numbers of downlink transmission assignments associated with respective carriers in the plurality of carriers, and wherein the respective carriers include the one or more first carriers.

10. The method of claim 9, further comprising transmitting the plurality of indications via at least one control signal.

11. The method of claim 10, wherein the configuring further comprises coding the plurality of indications for transmission on the at least one control signal using at least one of per-indication coding or joint coding.

12. The method of claim 1, wherein the configuring comprises configuring the at least one indication to specify a number of downlink transmission assignments associated with substantially all carriers in the plurality of carriers.

13. The method of claim 1, wherein the determining comprises determining at least one of a number of downlink control signal transmission assignments associated with the one or more first carriers or a number of downlink data transmission assignments associated with the one or more first carriers.

14. A wireless communications apparatus, comprising:

a memory that stores data relating to a plurality of carriers configured for communication in a wireless communication system; and

a processor configured to determine a number of downlink transmission assignments associated with one or more first carriers in the plurality of carriers and to configure, for communication over one or more second carriers in the plurality of carriers, at least one indication that specifies the number of downlink transmission assignments associated with at least the one or more first carriers.

15. The wireless communications apparatus of claim 14, wherein the one or more second carriers are disparate from the one or more first carriers.

16. The wireless communications apparatus of claim 14, wherein the processor is further configured to configure the at least one indication to include index information that associates the one or more first carriers with the number of downlink transmission assignments associated with the one or more first carriers.

17. The wireless communications apparatus of claim 14, wherein the processor is further configured to configure the at least one indication to specify a combined number of downlink transmission assignments associated with the one or more first carriers and the one or more second carriers.

18. The wireless communications apparatus of claim 14, wherein the processor is further configured to configure a plurality of indications to specify numbers of downlink transmission assignments associated with respective carriers in the plurality of carriers, and wherein the respective carriers include the one or more first carriers.

19. An apparatus, comprising:

means for identifying a plurality of carriers associated with a wireless communication system, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers;

means for obtaining information relating to a number of downlink transmission assignments applied to the at least one first carrier; and

means for generating a downlink assignment index (DAI) for transmission on the at least one second carrier that specifies the number of downlink transmission assignments applied to the at least one first carrier.

20. The apparatus of claim 19, wherein the at least one first carrier is disparate from the at least one second carrier.

21. The apparatus of claim 19, wherein the means for generating comprises means for associating a carrier index field (CIF) that identifies the at least one first carrier with the DAI.

22. The apparatus of claim 19, wherein the means for generating comprises means for generating a DAI that specifies a combined number of downlink transmission assignments applied to the at least one first carrier and the at least one second carrier.

23. The apparatus of claim 19, wherein the means for generating comprises means for generating a plurality of DAIs that specify respective numbers of downlink transmission assignments applied to respectively corresponding sets of one or more carriers in the plurality of carriers.

24. A computer program product, comprising:

a computer-readable medium, comprising:

code for causing a computer to identify a plurality of carriers associated with a wireless communication system, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers;

code for causing a computer to obtain information relating to a number of downlink transmission assignments applied to the at least one first carrier; and

code for causing a computer to generate a downlink assignment index (DAI) for transmission on the at least one second carrier that specifies the number of downlink transmission assignments applied to the at least one first carrier.

25. The computer program product of claim 24, wherein the at least one first carrier is disparate from the at least one second carrier.

26. A method, comprising:

identifying a plurality of carriers configured for communication with a wireless communication network;

obtaining transmission assignment signaling from the wireless communication network over at least one or more first carriers in the plurality of carriers; and

determining, based on the transmission assignment signaling, a number of downlink transmission assignments associated with at least one or more second carriers in the plurality of carriers.

27. The method of claim 26, wherein the one or more second carriers are disparate from the one or more first carriers.

28. The method of claim 26, wherein the determining comprises determining the number of downlink transmission assignments associated with at least the one or more second carriers based on downlink assignment index (DAI) signaling provided in the transmission assignment signaling.

29. The method of claim 26, wherein the determining comprises identifying the one or more second carriers via index information provided in the transmission assignment signaling.

30. The method of claim 29, wherein the index information comprises a carrier index field (CIF).

31. The method of claim 26, wherein the determining comprises determining one or more of a total number of downlink transmission assignments associated with at least the one or more second carriers or an accumulative number of downlink transmission assignments associated with at least the one or more second carriers.

32. The method of claim 26, wherein the determining comprises determining a combined number of downlink transmission assignments associated with the one or more first carriers and the one or more second carriers based on the transmission assignment signaling.

33. The method of claim 26, wherein the transmission assignment signaling comprises at least one of a downlink transmission assignment or an uplink transmission assignment.

34. The method of claim 26, wherein determining comprises determining, based on the transmission assignment signaling, a plurality of numbers of downlink transmission assignments associated with respective carriers in the plurality of carriers, and wherein the respective carriers include the one or more second carriers.

35. The method of claim 34, wherein the obtaining comprises obtaining at least one control signal that includes the transmission assignment signaling.

36. The method of claim 35, wherein the plurality of numbers of downlink transmission assignments are encoded on the at least one control signal via at least one of individual coding or joint coding.

37. The method of claim 26, wherein the determining comprises determining a number of downlink transmission assignments associated with substantially all carriers in the plurality of carriers based on the transmission assignment signaling.

38. The method of claim 26, wherein the determining comprises determining at least one of a number of downlink control signal transmission assignments or a number of downlink data transmission assignments associated with the one or more second carriers based on the transmission assignment signaling.

39. A wireless communications apparatus, comprising:

a memory that stores data relating to a plurality of carriers configured for communication with a wireless communication network; and

a processor configured to obtain transmission assignment signaling from the wireless communication network over at least one or more first carriers in the plurality of carriers and to determine, based on the transmission assignment signaling, a number of downlink transmission assignments associated with at least one or more second carriers in the plurality of carriers.

40. The wireless communications apparatus of claim 39, wherein the one or more second carriers are disparate from the one or more first carriers.

41. The wireless communications apparatus of claim 39, wherein the processor is further configured to identify the one or more second carriers via index information provided in the transmission assignment signaling.

42. The wireless communications apparatus of claim 39, wherein the processor is further configured to determine a combined number of downlink transmission assignments associated with the one or more first carriers and the one or more second carriers based on the transmission assignment signaling.

43. The wireless communications apparatus of claim 39, wherein the processor is further configured to determine, based on the transmission assignment signaling, a plurality of numbers of downlink transmission assignments associated with respective carriers in the plurality of carriers, and wherein the respective carriers include the one or more second carriers.

44. An apparatus, comprising:

means for identifying a plurality of carriers designated for communication with a wireless communication network, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers;

means for obtaining one or more downlink assignment indexes (DAIs) from the wireless communication network on the at least one first carrier; and

means for determining a number of downlink transmission assignments applied to the at least one second carrier based on the one or more DAIs.

45. The apparatus of claim 44, wherein the at least one first carrier is disparate from the at least one second carrier.

46. The apparatus of claim 44, wherein the means for determining comprises:

means for identifying a carrier index field (CIF) in the one or more DAIs; and
means for identifying the at least one second carrier based on the CIF.

47. The apparatus of claim 44, wherein the means for determining comprises means for determining a combined number of downlink transmission assignments applied to the at least one first carrier and the at least one second carrier based on the one or more DAIs.

48. The apparatus of claim 44, wherein:
the means for obtaining comprises means for obtaining a plurality of DAIs; and
the means for determining comprises means for identifying respective numbers of downlink transmission assignments from respective DAIs in the plurality of DAIs that are applied to respective carriers in the plurality of carriers that include the at least one second carrier.

49. A computer program product, comprising:
a computer-readable medium, comprising:
code for causing a computer to identify a plurality of carriers designated for communication with a wireless communication network, at least one first carrier in the plurality of carriers, and at least one second carrier in the plurality of carriers that is disparate from the at least one first carrier;
code for causing a computer to obtain one or more downlink assignment indexes (DAIs) from the wireless communication network on the at least one first carrier; and
code for causing a computer to determine a number of downlink transmission assignments applied to the at least one second carrier based on the one or more DAIs.

50. The computer program product of claim 49, wherein the at least one first carrier is disparate from the at least one second carrier.

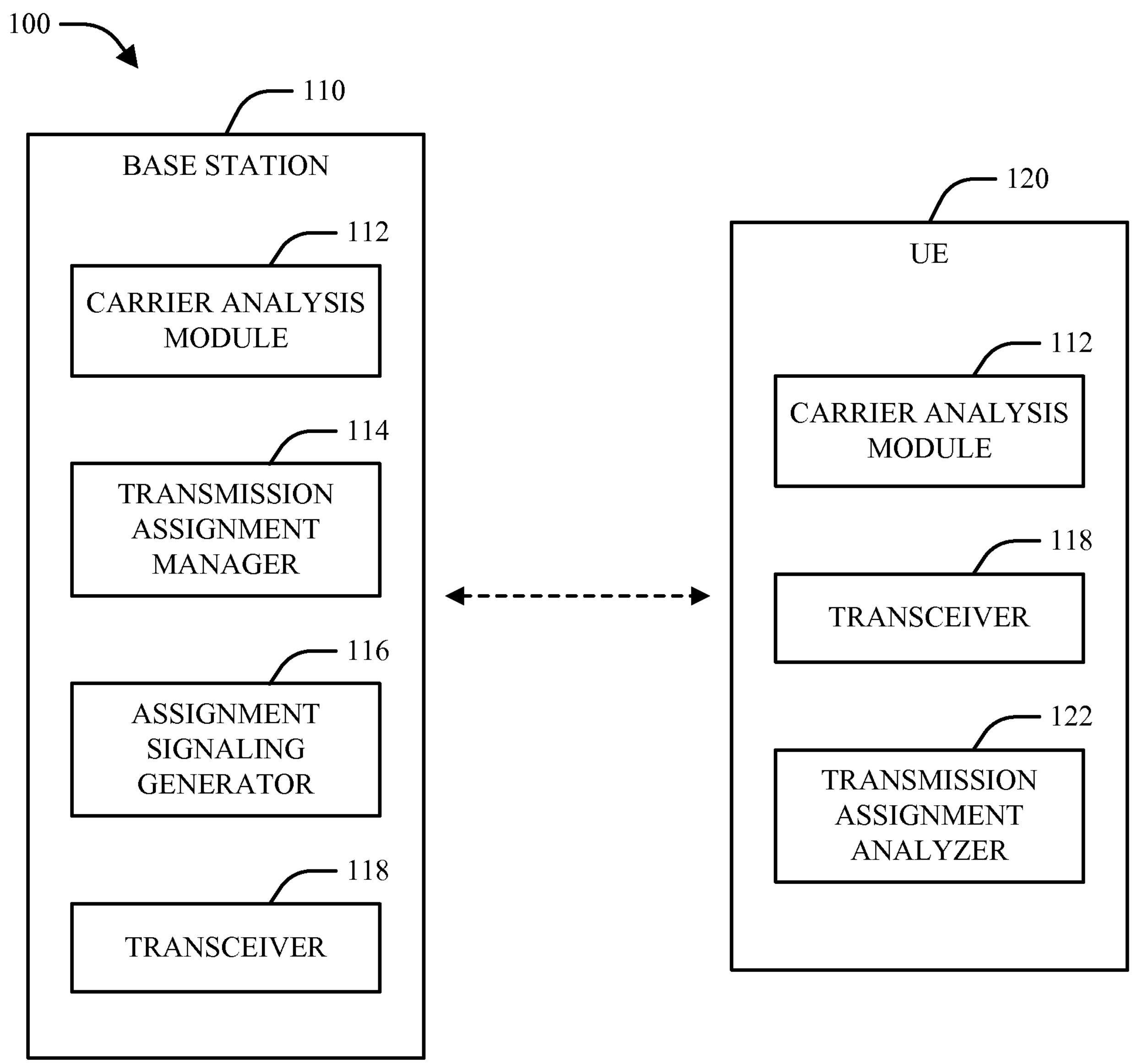
100
110
BASE STATION
112
CARRIER ANALYSIS MODULE
114
TRANSMISSION ASSIGNMENT MANAGER
116
ASSIGNMENT SIGNALING GENERATOR
118
TRANSCEIVER
120
UE
112
CARRIER ANALYSIS MODULE
118
TRANSCEIVER
122
TRANSMISSION ASSIGNMENT ANALYZER

FIG. 1

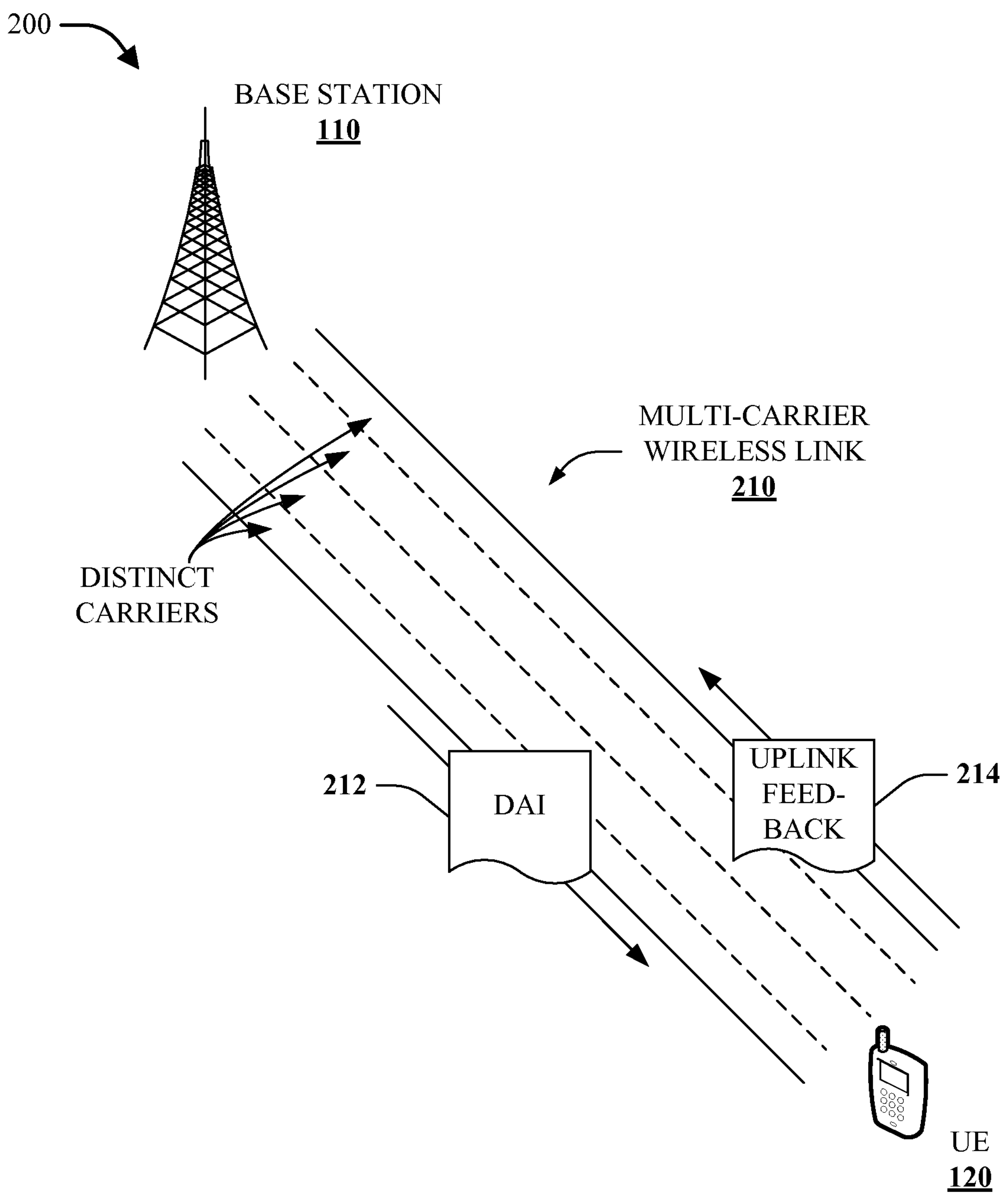
200
BASE STATION
110
MULTI-CARRIER
WIRELESS LINK
210
DISTINCT
CARRIERS
212
DAI
UPLINK
FEED-
BACK
214
UE
120

FIG. 2

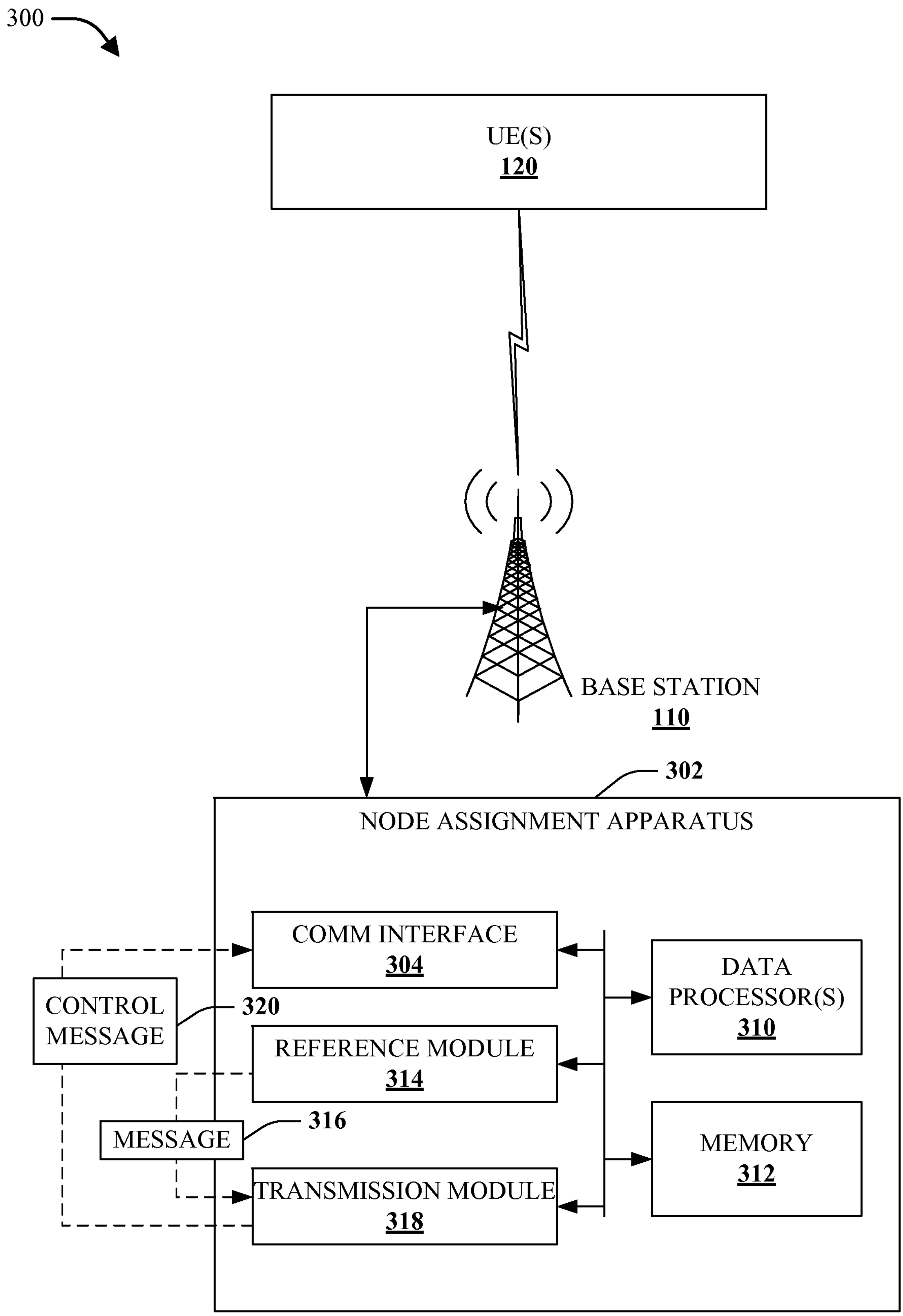
300
UE(S)
120
BASE STATION
110
302
NODE ASSIGNMENT APPARATUS
COMM INTERFACE
304
DATA
PROCESSOR(S)
310
CONTROL
MESSAGE
320
REFERENCE MODULE
314
MESSAGE
316
MEMORY
312
TRANSMISSION MODULE
318

FIG. 3

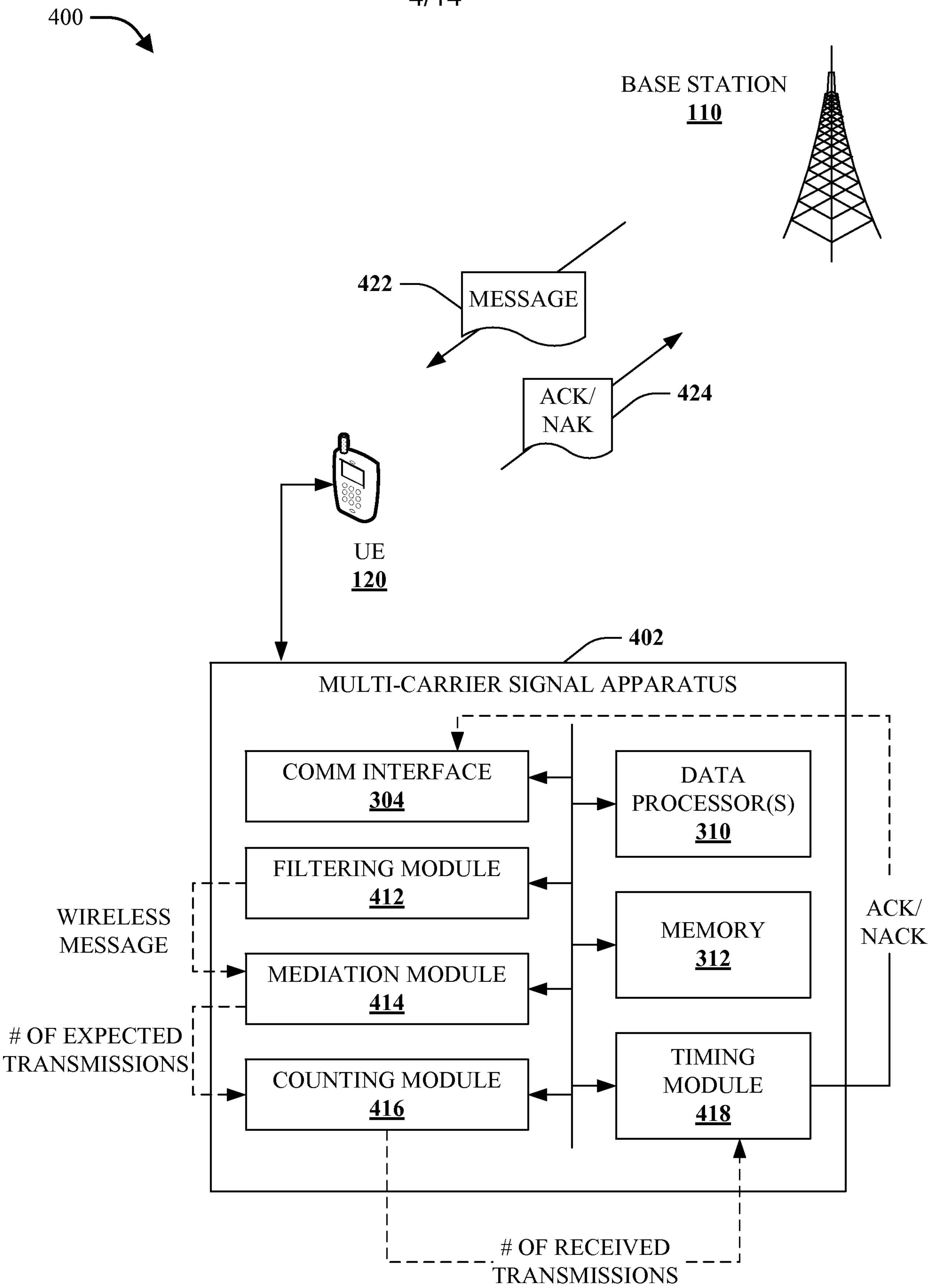
400
BASE STATION
110
422
MESSAGE
ACK/
NAK
424
UE
120
402
MULTI-CARRIER SIGNAL APPARATUS
COMM INTERFACE
304
DATA
PROCESSOR(S)
310
FILTERING MODULE
412
WIRELESS
MESSAGE
MEMORY
312
ACK/
NACK
MEDIATION MODULE
414
OF EXPECTED
TRANSMISSIONS
COUNTING MODULE
416
TIMING
MODULE
418
OF RECEIVED
TRANSMISSIONS

FIG. 4

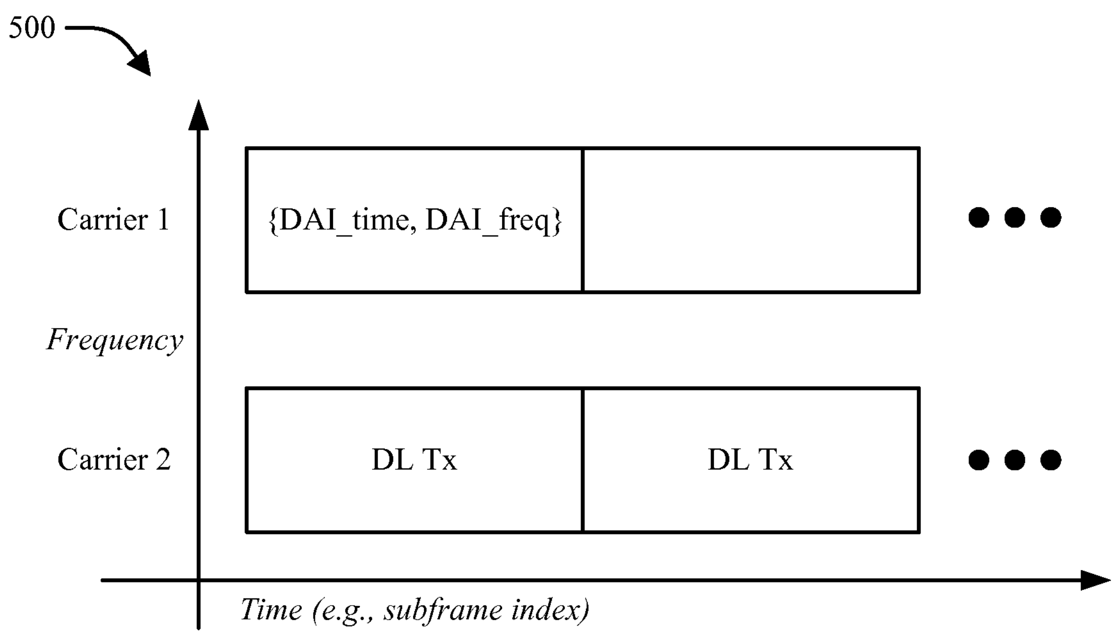
500
Carrier 1
{DAI_time, DAI_freq}
Frequency
Carrier 2
DL Tx
DL Tx
Time (e.g., subframe index)

FIG. 5

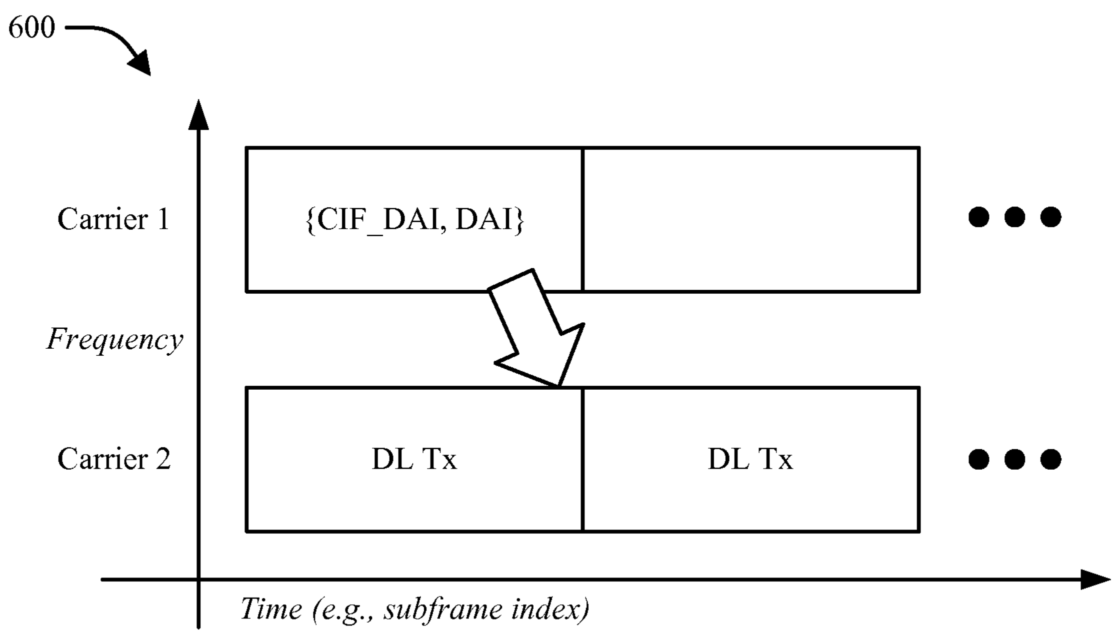
600
Carrier 1
{CIF_DAI, DAI}
Frequency
Carrier 2
DL Tx
DL Tx
Time (e.g., subframe index)

FIG. 6

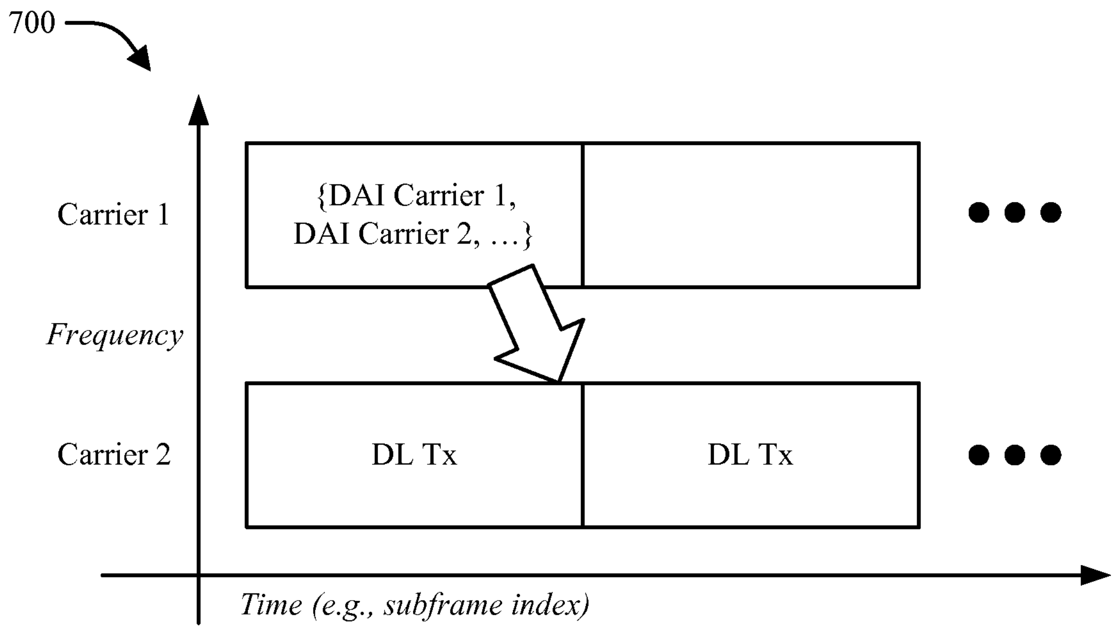
700
Carrier 1
{DAI Carrier 1,
DAI Carrier 2, …}
Frequency
Carrier 2
DL Tx
DL Tx
Time (e.g., subframe index)

FIG. 7

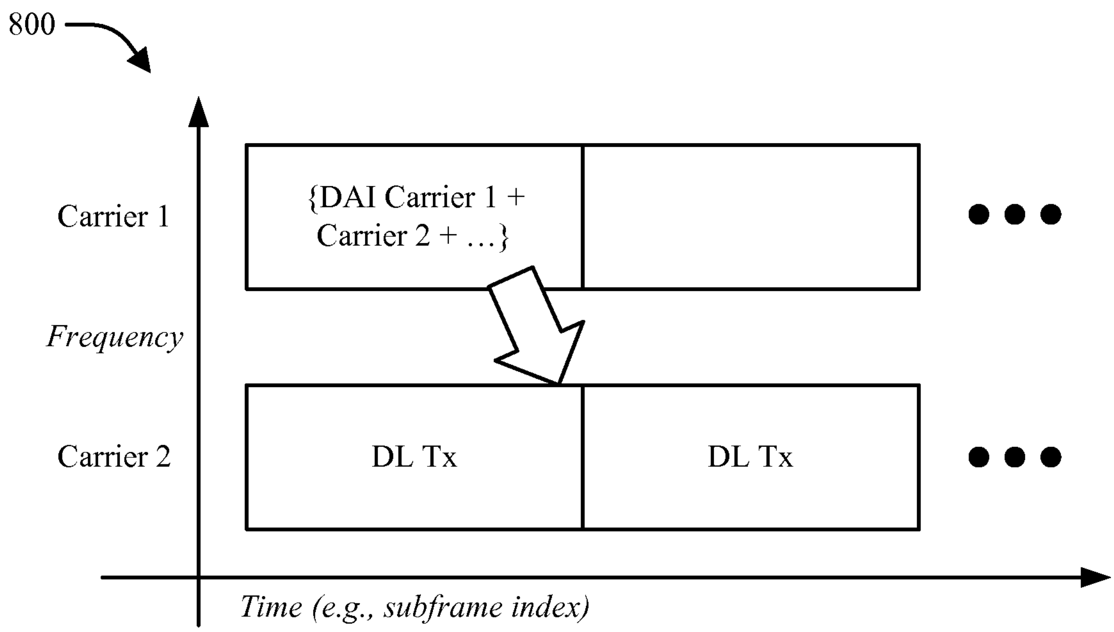
800
Carrier 1
{DAI Carrier 1 +
Carrier 2 + …}
Frequency
Carrier 2
DL Tx
DL Tx
Time (e.g., subframe index)

FIG. 8

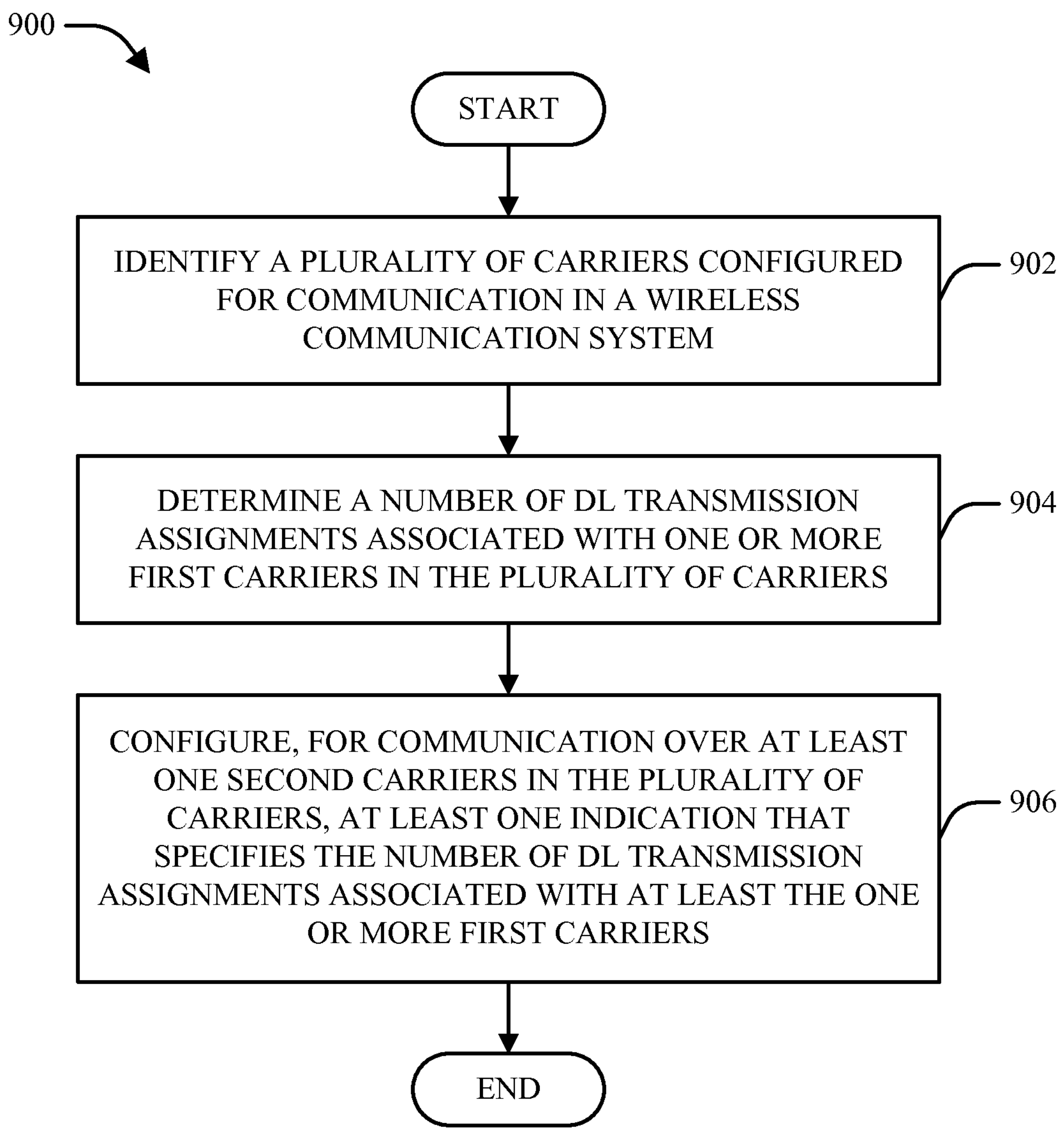
900
START
IDENTIFY A PLURALITY OF CARRIERS CONFIGURED FOR COMMUNICATION IN A WIRELESS COMMUNICATION SYSTEM
902
DETERMINE A NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH ONE OR MORE FIRST CARRIERS IN THE PLURALITY OF CARRIERS
904
CONFIGURE, FOR COMMUNICATION OVER AT LEAST ONE SECOND CARRIERS IN THE PLURALITY OF CARRIERS, AT LEAST ONE INDICATION THAT SPECIFIES THE NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH AT LEAST THE ONE OR MORE FIRST CARRIERS
906
END

FIG. 9

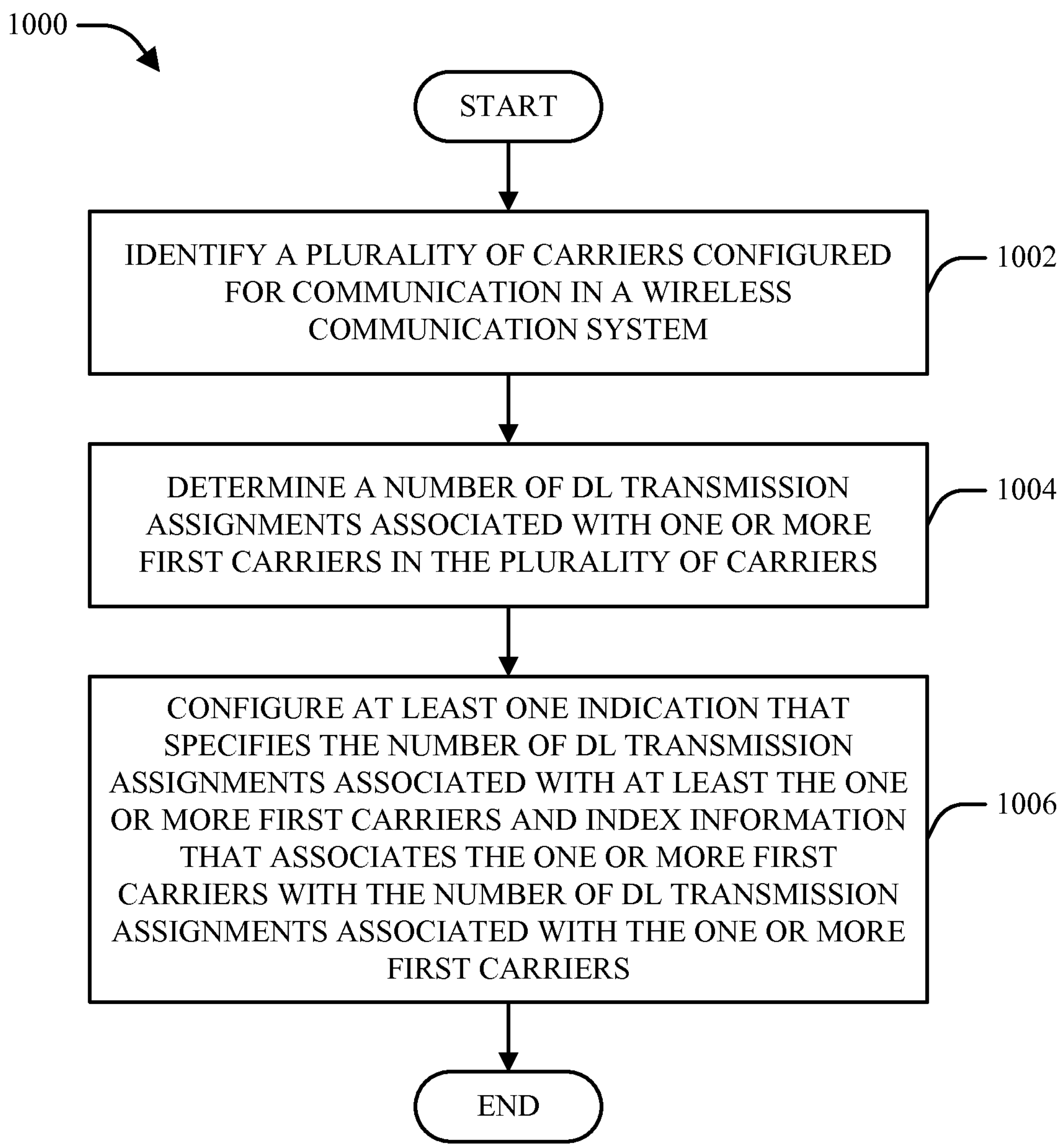
1000
START
IDENTIFY A PLURALITY OF CARRIERS CONFIGURED FOR COMMUNICATION IN A WIRELESS COMMUNICATION SYSTEM
1002
DETERMINE A NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH ONE OR MORE FIRST CARRIERS IN THE PLURALITY OF CARRIERS
1004
CONFIGURE AT LEAST ONE INDICATION THAT SPECIFIES THE NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH AT LEAST THE ONE OR MORE FIRST CARRIERS AND INDEX INFORMATION THAT ASSOCIATES THE ONE OR MORE FIRST CARRIERS WITH THE NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH THE ONE OR MORE FIRST CARRIERS
1006
END

FIG. 10

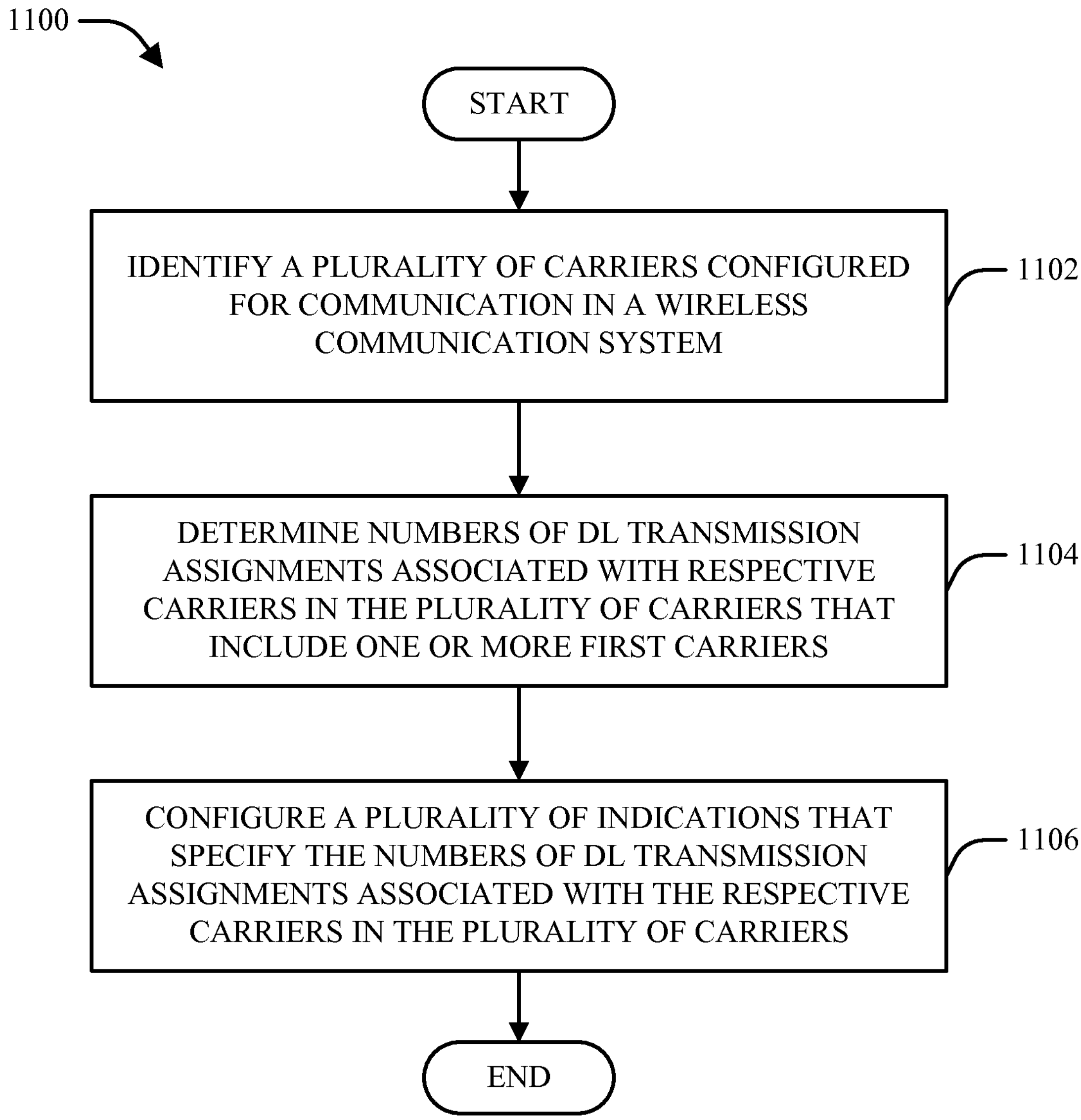
1100
START
IDENTIFY A PLURALITY OF CARRIERS CONFIGURED FOR COMMUNICATION IN A WIRELESS COMMUNICATION SYSTEM
1102
DETERMINE NUMBERS OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH RESPECTIVE CARRIERS IN THE PLURALITY OF CARRIERS THAT INCLUDE ONE OR MORE FIRST CARRIERS
1104
CONFIGURE A PLURALITY OF INDICATIONS THAT SPECIFY THE NUMBERS OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH THE RESPECTIVE CARRIERS IN THE PLURALITY OF CARRIERS
1106
END

FIG. 11

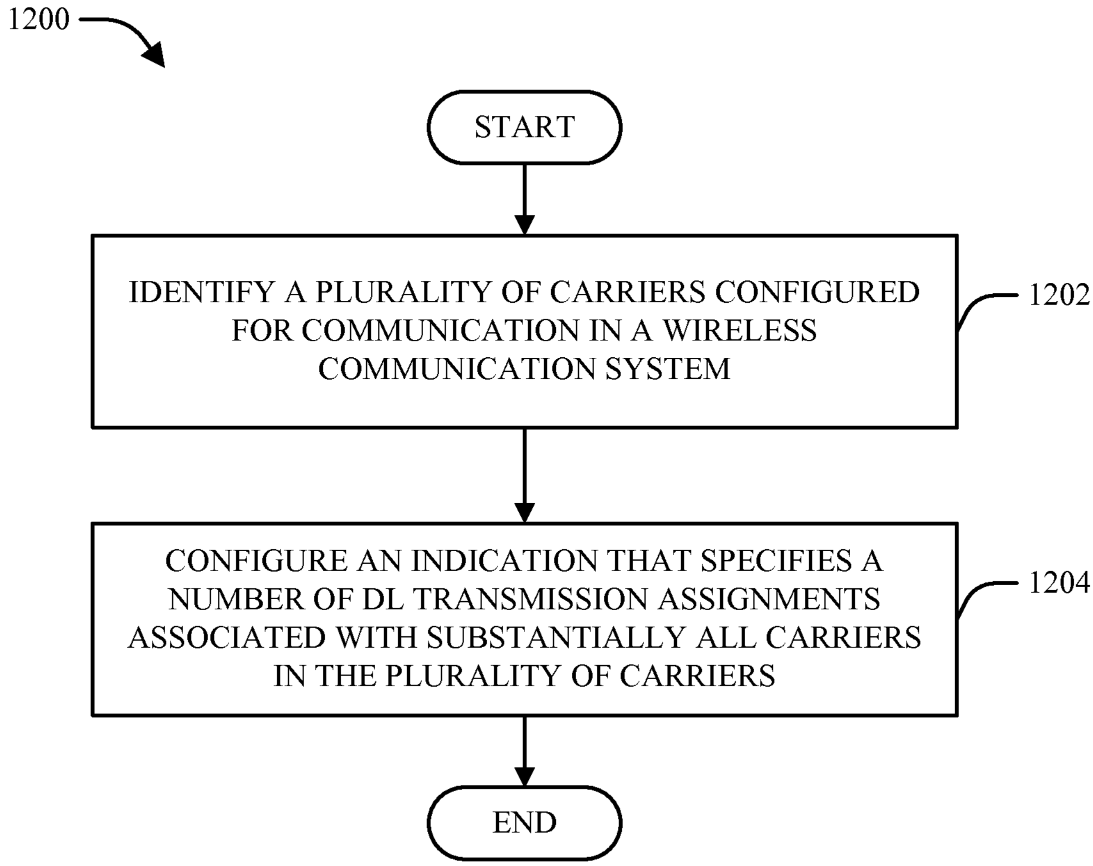
1200
START
IDENTIFY A PLURALITY OF CARRIERS CONFIGURED FOR COMMUNICATION IN A WIRELESS COMMUNICATION SYSTEM
1202
CONFIGURE AN INDICATION THAT SPECIFIES A NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH SUBSTANTIALLY ALL CARRIERS IN THE PLURALITY OF CARRIERS
1204
END

FIG. 12

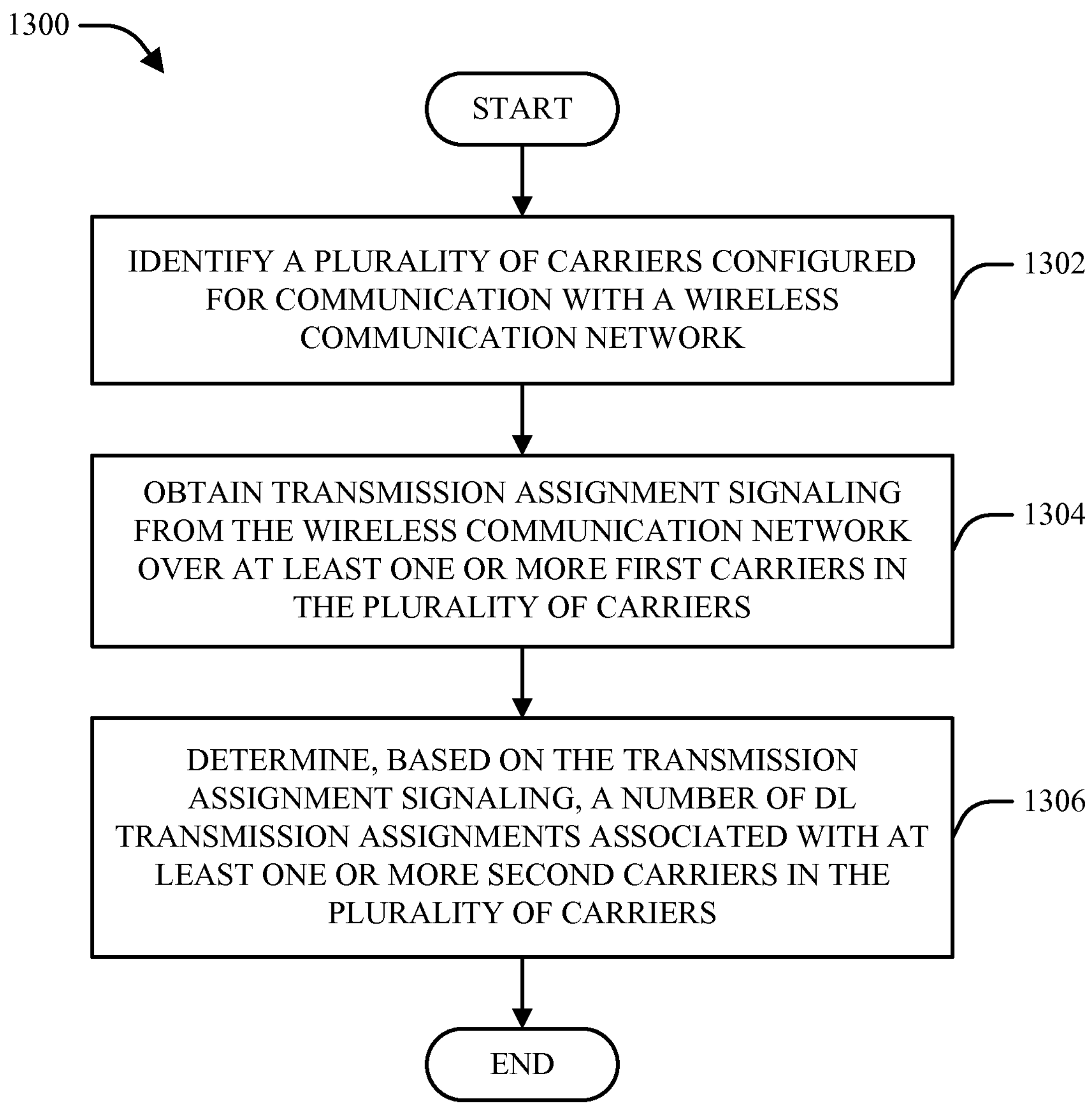
1300
START
IDENTIFY A PLURALITY OF CARRIERS CONFIGURED FOR COMMUNICATION WITH A WIRELESS COMMUNICATION NETWORK
1302
OBTAIN TRANSMISSION ASSIGNMENT SIGNALING FROM THE WIRELESS COMMUNICATION NETWORK OVER AT LEAST ONE OR MORE FIRST CARRIERS IN THE PLURALITY OF CARRIERS
1304
DETERMINE, BASED ON THE TRANSMISSION ASSIGNMENT SIGNALING, A NUMBER OF DL TRANSMISSION ASSIGNMENTS ASSOCIATED WITH AT LEAST ONE OR MORE SECOND CARRIERS IN THE PLURALITY OF CARRIERS
1306
END

FIG. 13

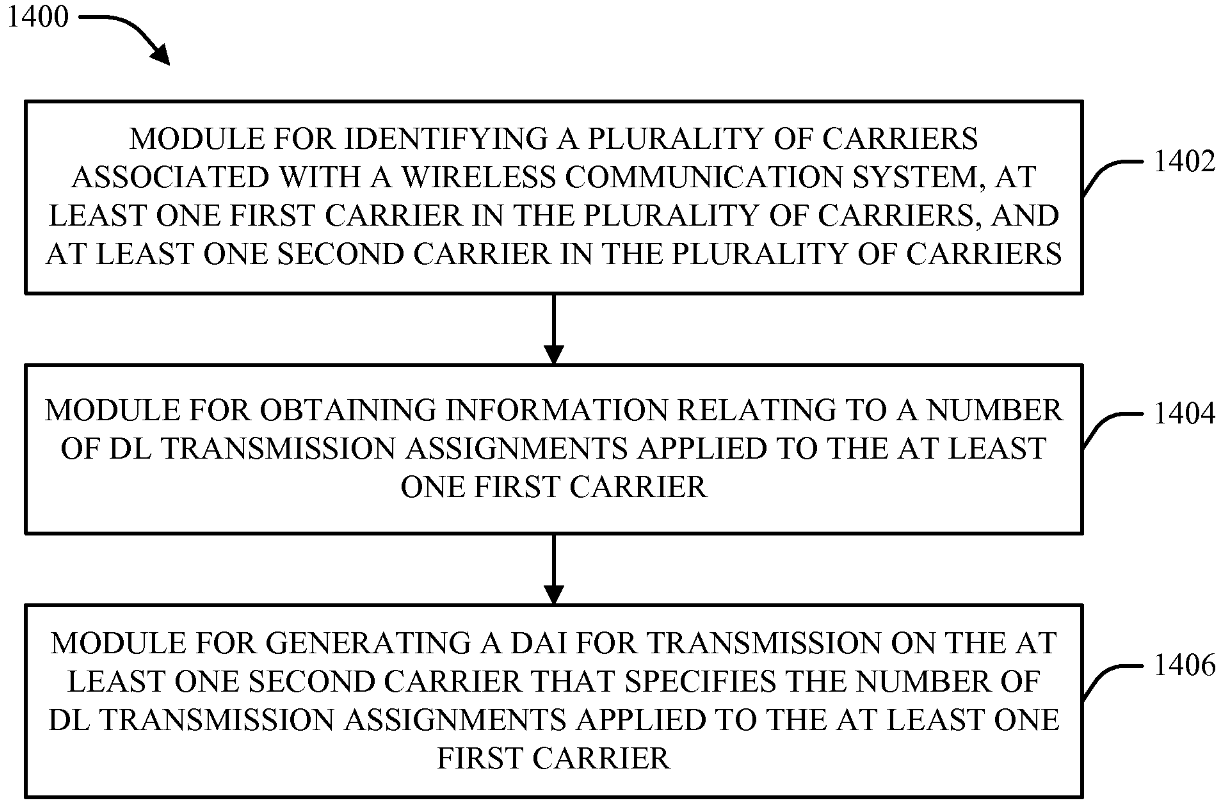
1400
MODULE FOR IDENTIFYING A PLURALITY OF CARRIERS ASSOCIATED WITH A WIRELESS COMMUNICATION SYSTEM, AT LEAST ONE FIRST CARRIER IN THE PLURALITY OF CARRIERS, AND AT LEAST ONE SECOND CARRIER IN THE PLURALITY OF CARRIERS
1402
MODULE FOR OBTAINING INFORMATION RELATING TO A NUMBER OF DL TRANSMISSION ASSIGNMENTS APPLIED TO THE AT LEAST ONE FIRST CARRIER
1404
MODULE FOR GENERATING A DAI FOR TRANSMISSION ON THE AT LEAST ONE SECOND CARRIER THAT SPECIFIES THE NUMBER OF DL TRANSMISSION ASSIGNMENTS APPLIED TO THE AT LEAST ONE FIRST CARRIER
1406

FIG. 14

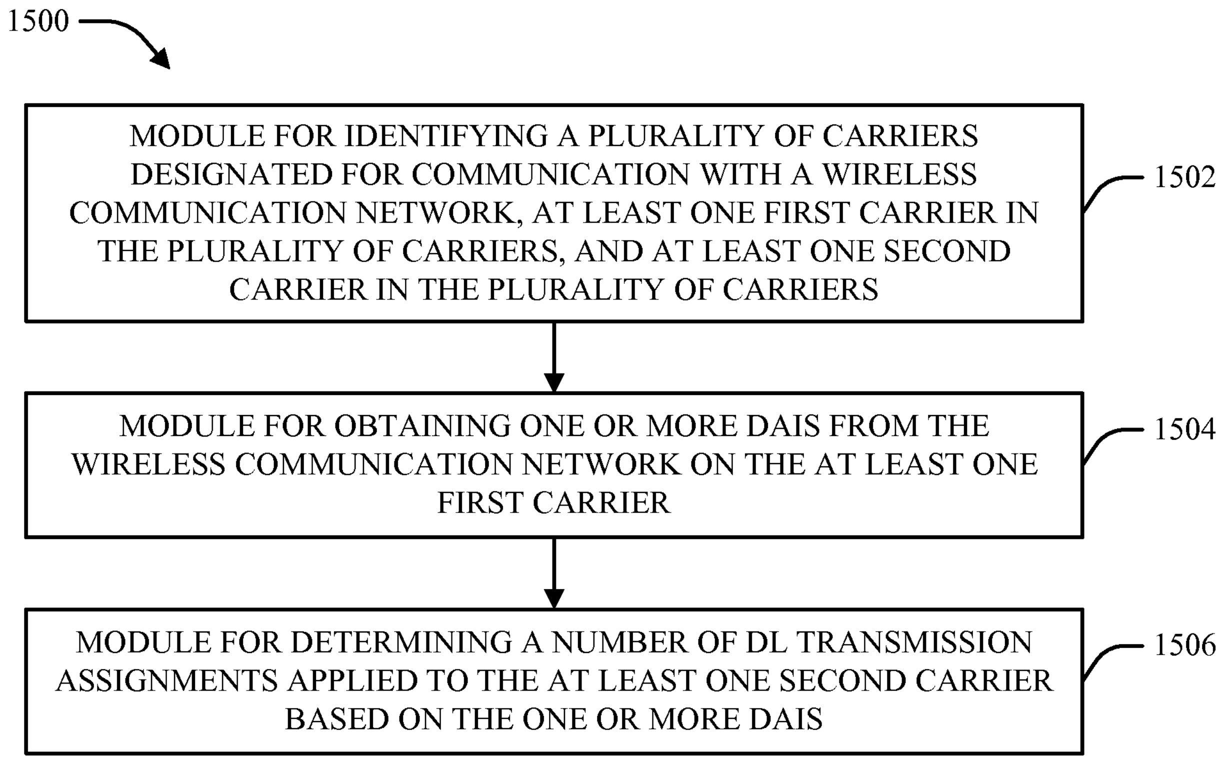
1500
MODULE FOR IDENTIFYING A PLURALITY OF CARRIERS DESIGNATED FOR COMMUNICATION WITH A WIRELESS COMMUNICATION NETWORK, AT LEAST ONE FIRST CARRIER IN THE PLURALITY OF CARRIERS, AND AT LEAST ONE SECOND CARRIER IN THE PLURALITY OF CARRIERS
1502
MODULE FOR OBTAINING ONE OR MORE DAIS FROM THE WIRELESS COMMUNICATION NETWORK ON THE AT LEAST ONE FIRST CARRIER
1504
MODULE FOR DETERMINING A NUMBER OF DL TRANSMISSION ASSIGNMENTS APPLIED TO THE AT LEAST ONE SECOND CARRIER BASED ON THE ONE OR MORE DAIS
1506

FIG. 15

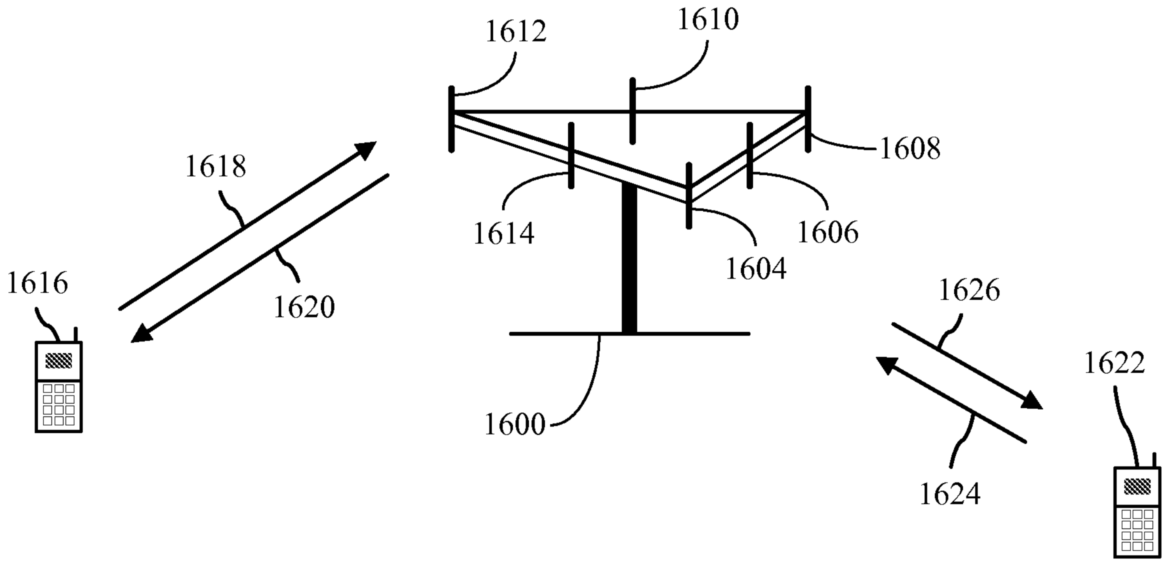
1612
1610
1608
1618
1614
1606
1604
1616
1620
1626
1622
1600
1624

FIG. 16

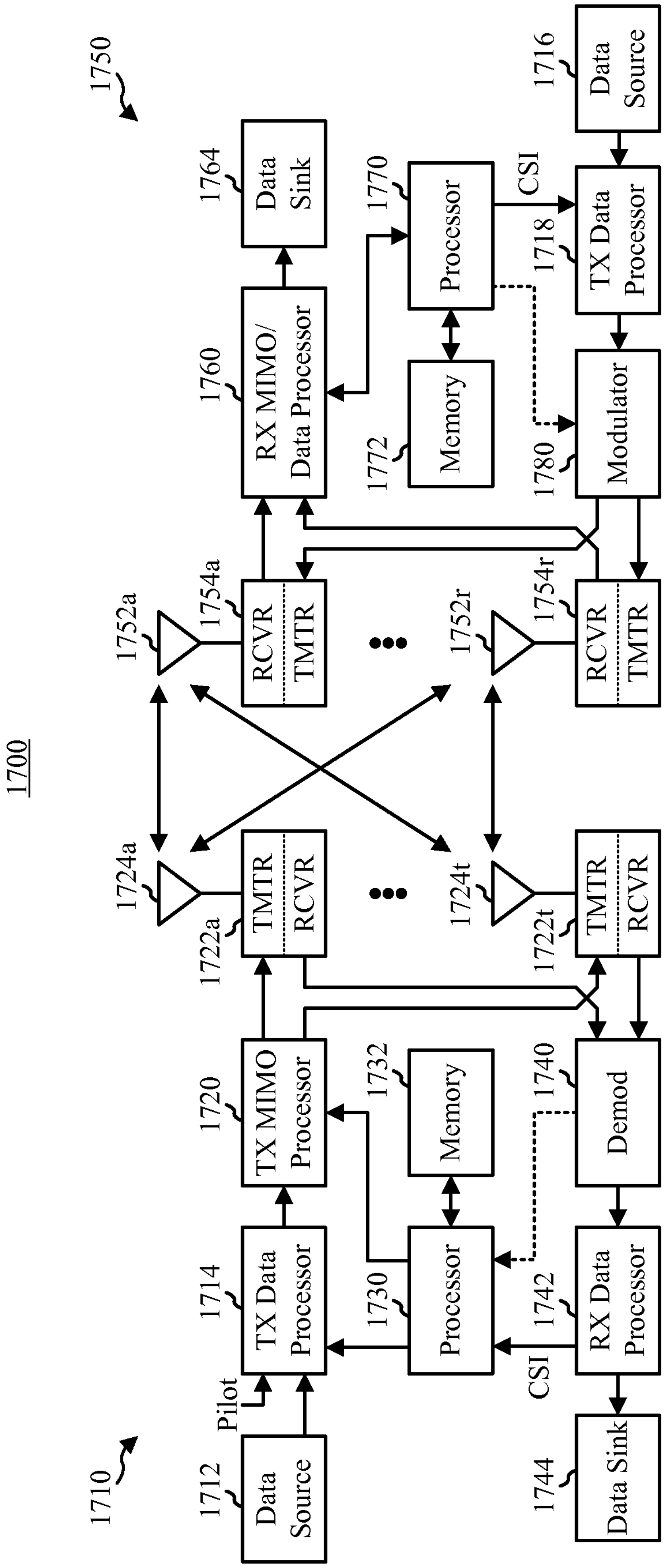
1700
1710
1750
1712
Data Source
Pilot
1714
TX Data Processor
1720
TX MIMO Processor
1722a
TMTR
RCVR
1722t
TMTR
RCVR
1724a
1724t
1730
Processor
1732
Memory
1740
Demod
1742
RX Data Processor
CSI
1744
Data Sink
1752a
1752r
1754a
RCVR
TMTR
1754r
RCVR
TMTR
1760
RX MIMO/ Data Processor
1764
Data Sink
1770
Processor
1772
Memory
CSI
1716
Data Source
1718
TX Data Processor
1780
Modulator

FIG. 17

(19)中华人民共和国国家知识产权局

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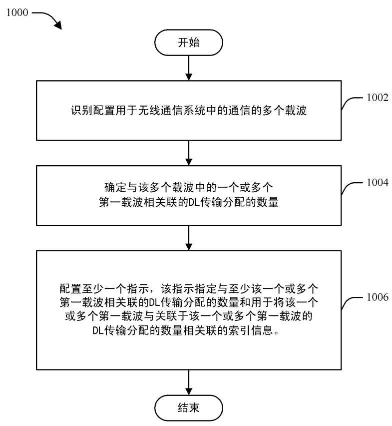
(54)发明名称

用于多载波无线通信的下行链路分配指示符设计

(57)摘要

本文描述了有助于多载波无线通信系统中的增强型下行链路分配索引(DAI)信令的各种技术的系统和方法。如本文所述的,DAI和/或在第一载波上传输的其它指示符信令可被配置为携带与应用于至少一个第二载波的下行链路传输分配的数量有关的信息,其中在一些情况中第二载波可以与第一载波不同。为了这些目的,本文描述了用于跨载波DAI信令、多个DAI信令、聚合DAI信令的技术以及其它类似的技术。如本文另外所述的,结合可应用于DAI信令的各种技术,DAI信令可以与下行链路控制传输和/或下行链路数据传输有关。



CN 102449971 A

1. 一种方法，包括：

识别配置用于无线通信系统中的通信的多个载波；

确定与所述多个载波中的一个或多个第一载波相关联的下行链路传输分配的数量；并且

针对所述多个载波中的至少一个或多个第二载波上的通信配置至少一个指示，所述指示指定与至少所述一个或多个第一载波相关联的下行链路传输分配的数量。

2. 如权利要求 1 所述的方法，其中，所述一个或多个第二载波与所述一个或多个第一载波不同。

3. 如权利要求 1 所述的方法，其中，所述至少一个指示包括下行链路分配索引 (DAI) 信令。

4. 如权利要求 1 所述的方法，其中，所述配置至少一个指示包括：

配置所述至少一个指示以包括索引信息，该索引信息将所述一个或多个第一载波与关联于所述一个或多个第一载波的所述下行链路传输分配的数量相关联。

5. 如权利要求 4 所述的方法，其中，所述索引信息包括载波索引字段 (CIF)。

6. 如权利要求 1 所述的方法，其中，所述配置至少一个指示包括：

配置所述至少一个指示以指定以下各项中的一个或多个：与至少所述一个或多个第一载波相关联的下行链路传输分配的总数，或者与至少所述一个或多个第一载波相关联的下行链路传输分配的累积数量。

7. 如权利要求 1 所述的方法，其中，所述配置至少一个指示包括：

配置所述至少一个指示以指定与所述一个或多个第一载波和所述一个或多个第二载波相关联的下行链路传输分配的组合数量。

8. 如权利要求 1 所述的方法，还包括：经由下行链路传输分配或上行链路传输分配中的至少一个来传输所述至少一个指示。

9. 如权利要求 1 所述的方法，其中，所述配置至少一个指示包括：

配置多个指示以指定与所述多个载波中的各个载波相关联的下行链路传输分配的数量，并且其中，所述各个载波包括所述一个或多个第一载波。

10. 如权利要求 9 所述的方法，还包括：经由至少一个控制信号传输所述多个指示。

11. 如权利要求 10 所述的方法，其中，所述配置至少一个指示还包括：

使用每指示编码或联合编码中的至少一种来对所述多个指示进行编码以便在所述至少一个控制信号上传输。

12. 如权利要求 1 所述的方法，其中，所述配置至少一个指示包括：

配置所述至少一个指示以指定与所述多个载波中的基本上所有载波相关联的下行链路传输分配的数量。

13. 如权利要求 1 所述的方法，其中，所述确定与所述多个载波中的一个或多个第一载波相关联的下行链路传输分配的数量包括：

确定与所述一个或多个第一载波相关联的下行链路控制信号传输分配的数量或与所述一个或多个第一载波相关联的下行链路数据传输分配的数量中的至少一个。

14. 一种无线通信装置，包括：

用于存储数据的存储器，所述数据与配置用于无线通信系统中的通信的多个载波有

关 ;以及

处理器,其被配置为 :确定与所述多个载波中的一个或多个第一载波相关联的下行链路传输分配的数量 ;并且针对所述多个载波中的至少一个或多个第二载波上的通信来配置至少一个指示,所述指示指定与至少所述一个或多个第一载波相关联的下行链路传输分配的数量。

15. 如权利要求 14 所述的无线通信装置,其中,所述一个或多个第二载波与所述一个或多个第一载波不同。

16. 如权利要求 14 所述的无线通信装置,其中,所述处理器还被配置为 :

配置所述至少一个指示以包括索引信息,该索引信息将所述一个或多个第一载波与关联于所述一个或多个第一载波的所述下行链路传输分配的数量相关联。

17. 如权利要求 14 所述的无线通信装置,其中,所述处理器还被配置为 :

配置所述至少一个指示以指定与所述一个或多个第一载波和所述一个或多个第二载波相关联的下行链路传输分配的组合数量。

18. 如权利要求 14 所述的无线通信装置,其中,所述处理器还被配置为 :

配置多个指示以指定与所述多个载波中的各个载波相关联的下行链路传输分配的数量,并且其中,所述各个载波包括所述一个或多个第一载波。

19. 一种装置,包括 :

识别模块,用于识别与无线通信系统相关联的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波 ;

获得模块,用于获得与应用于所述至少一个第一载波的下行链路传输分配的数量有关的信息 ;以及

生成模块,用于生成下行链路分配索引 (DAI) 以在所述至少一个第二载波上进行传输,所述 DAI 指定应用于所述至少一个第一载波的下行链路传输分配的数量。

20. 如权利要求 19 所述的装置,其中,所述至少一个第一载波与所述至少一个第二载波不同。

21. 如权利要求 19 所述的装置,其中,所述生成模块包括 :

用于将识别所述至少一个第一载波的载波索引字段 (CIF) 与所述 DAI 相关联的模块。

22. 如权利要求 19 所述的装置,其中,所述生成模块包括 :

用于生成用于指定应用于所述至少一个第一载波和所述至少一个第二载波的下行链路传输分配的组合数量的 DAI 的模块。

23. 如权利要求 19 所述的装置,其中,所述生成模块包括 :

用于生成用于指定应用于所述多个载波中的一个或多个载波的各个对应集合的下行链路传输分配的各个数量的多个 DAI 的模块。

24. 一种计算机程序产品,包括 :

计算机可读介质,所述计算机可读介质包括 :

识别代码,用于使计算机识别与无线通信系统相关联的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波 ;

获得代码,用于使计算机获得与应用于所述至少一个第一载波的下行链路传输分配的数量有关的信息 ;以及

生成代码，用于使计算机生成下行链路分配索引(DAI)以在所述至少一个第二载波上传输，所述 DAI 指定应用于所述至少一个第一载波的下行链路传输分配的数量。

25. 如权利要求 24 所述的计算机程序产品，其中，所述至少一个第一载波与所述至少一个第二载波不同。

26. 一种方法，包括：

识别配置用于与无线通信网络的通信的多个载波；

在所述多个载波中的至少一个或多个第一载波上从所述无线通信网络获得传输分配信令；并且

基于所述传输分配信令，确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量。

27. 如权利要求 26 所述的方法，其中，所述一个或多个第二载波与所述一个或多个第一载波不同。

28. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

基于所述传输分配信令中提供的下行链路分配索引(DAI)信令，确定与至少所述一个或多个第二载波相关联的下行链路传输分配的数量。

29. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

经由所述传输分配信令中提供的索引信息，识别所述一个或多个第二载波。

30. 如权利要求 29 所述的方法，其中，所述索引信息包括载波索引字段(CIF)。

31. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

确定以下各项中的一个或多个：与至少所述一个或多个第二载波相关联的下行链路传输分配的总数，或者与至少所述一个或多个第二载波相关联的下行链路传输分配的累积数量。

32. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

基于所述传输分配信令，确定与所述一个或多个第一载波和所述一个或多个第二载波相关联的下行链路传输分配的组合数量。

33. 如权利要求 26 所述的方法，其中，所述传输分配信令包括下行链路传输分配或上行链路传输分配中的至少一个。

34. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

基于所述传输分配信令，确定与所述多个载波中的各个载波相关联的下行链路传输分配的多个数量，并且其中，所述各个载波包括所述一个或多个第二载波。

35. 如权利要求 34 所述的方法，其中，所述获得传输分配信令包括：

获得包括所述传输分配信令的至少一个控制信号。

36. 如权利要求 35 所述的方法，其中，经由单独编码或联合编码中的至少一种，将所述下行链路传输分配的多个数量编码到所述至少一个控制信号上。

37. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

基于所述传输分配信令，确定与所述多个载波中的基本上所有载波相关联的下行链路传输分配的数量。

38. 如权利要求 26 所述的方法，其中，所述确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量包括：

基于所述传输分配信令，确定与所述一个或多个第二载波相关联的下行链路控制信号传输分配的数量或下行链路数据传输分配的数量中的至少一个。

39. 一种无线通信装置，包括：

用于存储数据的存储器，所述数据与配置用于与无线通信网络的通信的多个载波有关；以及

处理器，其被配置为：在所述多个载波中的至少一个或多个第一载波上从所述无线通信网络获得传输分配信令；并且基于所述传输分配信令，确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量。

40. 如权利要求 39 所述的无线通信装置，其中，所述一个或多个第二载波与所述一个或多个第一载波不同。

41. 如权利要求 39 所述的无线通信装置，其中，所述处理器还被配置为：

经由所述传输分配信令中提供的索引信息，识别所述一个或多个第二载波。

42. 如权利要求 39 所述的无线通信装置，其中，所述处理器还被配置为：

基于所述传输分配信令，确定与所述一个或多个第一载波和所述一个或多个第二载波相关联的下行链路传输分配的组合数量。

43. 如权利要求 39 所述的无线通信装置，其中，所述处理器还被配置为：

基于所述传输分配信令，确定与所述多个载波中的各个载波相关联的下行链路传输分配的多个数量，并且其中，所述各个载波包括所述一个或多个第二载波。

44. 一种装置，包括：

识别模块，用于识别指定用于与无线通信网络的通信的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波；

获得模块，用于在所述至少一个第一载波上从所述无线通信网络获得一个或多个下行链路分配索引 (DAI)；以及

确定模块，用于基于所述一个或多个 DAI，确定应用于所述至少一个第二载波的下行链路传输分配的数量。

45. 如权利要求 44 所述的装置，其中，所述至少一个第一载波与所述至少一个第二载波不同。

46. 如权利要求 44 所述的装置，其中，所述确定模块包括：

用于识别所述一个或多个 DAI 中的载波索引字段 (CIF) 的模块；以及

用于基于所述 CIF 来识别所述至少一个第二载波的模块。

47. 如权利要求 44 所述的装置，其中，所述确定模块包括：

用于基于所述一个或多个 DAI 来确定应用于所述至少一个第一载波和所述至少一个第二载波的下行链路传输分配的组合数量的模块。

48. 如权利要求 44 所述的装置，其中：

所述获得模块包括用于获得多个 DAI 的模块；并且

所述确定模块包括：用于从所述多个 DAI 中应用于所述多个载波中的各个载波的各个 DAI 中识别下行链路传输分配的各个数量的模块，其中所述各个载波包括所述至少一个第二载波。

49. 一种计算机程序产品，包括：

计算机可读介质，所述计算机可读介质包括：

识别代码，用于使计算机识别指定用于与无线通信网络的通信的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中与所述至少一个第一载波不同的至少一个第二载波；

获得代码，用于使计算机在所述至少一个第一载波上从所述无线通信网络获得一个或多个下行链路分配索引 (DAI)；以及

确定代码，用于使计算机基于所述一个或多个 DAI，确定应用于所述至少一个第二载波的下行链路传输分配的数量。

50. 如权利要求 49 所述的计算机程序产品，其中，所述至少一个第一载波与所述至少一个第二载波不同。

用于多载波无线通信的下行链路分配指示符设计

[0001] 交叉引用

[0002] 本申请要求2009年6月2日递交的、标题为“SYSTEMS AND METHODS OF DAI DESIGN FOR LTE-A TDD SYSTEMS”的美国临时申请No.61/183,496的优先权，通过引用的方式将其整体并入本文。

技术领域

[0003] 本公开一般而言涉及无线通信，更具体而言涉及用于管理多载波无线通信环境中的资源分配的技术。

背景技术

[0004] 已广泛地布置了无线通信系统以提供各种通信服务；例如，经由这种无线通信系统可以提供语音、视频、分组数据、广播和消息服务。这些系统可以是多址系统，其通过共享可用的系统资源来支持多个终端的通信。这种多址系统的例子包括：码分多址(CDMA)系统、时分多址(TDMA)系统、频分多址(FDMA)系统和正交频分多址(OFDMA)系统。

[0005] 通常，无线多址通信系统能够同时地支持多个无线终端的通信。在这种系统中，每个终端都能够经由前向和反向链路上的传输与一个或多个基站进行通信。前向链路(或下行链路)是指从基站到终端的通信链路，而反向链路(或上行链路)是指从终端到基站的通信链路。可以经由单输入单输出(SISO)、多输入单输出(MISO)、多输入多输出(MIMO)系统来建立这种通信链路。

[0006] MIMO系统能够支持时分双工(TDD)和频分双工(FDD)系统。在TDD系统中，可以在共享的频率区域上进行前向链路和反向链路传输，从而可以使用互易原则来根据反向链路信道估计前向链路信道。而这又使得当在接入点有多个天线可用时，接入点能够在前向链路上实现发射波束成形增益。

[0007] 此外，对于利用正交频分复用(OFDM)的各种TDD系统，多个下行链路子帧通常可以与一个或多个用于反馈通信的上行链路子帧相关联。分配给较少量的用于反馈通信的上行链路子帧的一组下行链路子帧通常被称为绑定窗。因此，在绑定窗内的资源上接收传输的设备可以在针对该绑定窗的指定上行链路子帧上执行反馈操作。用于TDD系统的一种类型的反馈模式是确认(ACK)/否定确认(NACK)消息，在这种情况下，一组下行链路子帧可以被称为ACK/NACK绑定窗。在上行链路子帧上对UE在该ACK/NACK绑定窗内所接收到的下行链路传输进行确认。用于无线信号的这种绑定窗设计可以更有效地利用下行链路和上行链路信号资源，为无线通信系统提供全面的改进。

[0008] 至少鉴于以上各点，可能希望实现用于在多载波无线通信环境中非常有效地分配、管理和/或利用绑定窗的技术。

发明内容

[0009] 以下给出了所要求的主题的各个方案的简化的摘要以提供对这些方案的基本理

解。该摘要不是对所有能想到的方案的详尽概述，并且既不是意图标识所有方案的关键的或至关重要的元素也不是意图界定这些方案的范围。其唯一目的是为了以简化的形式给出所公开方案的一些概念，以作为稍后给出的更详细的描述的序言。

[0010] 根据一个方案，本文描述了一种方法。该方法可以包括：识别配置用于无线通信系统中的通信的多个载波；确定与所述多个载波中的一个或多个第一载波相关联的下行链路传输分配的数量；并且针对所述多个载波中的至少一个或多个第二载波上的通信配置至少一个指示，所述指示指定与至少所述一个或多个第一载波相关联的下行链路传输分配的数量。

[0011] 本文所述的第二个方案涉及一种无线通信装置，其可以包括用于存储数据的存储器，所述数据与配置用于无线通信系统中的通信的多个载波有关。所述无线通信装置还可以包括处理器，其被配置为：确定与所述多个载波中的一个或多个第一载波相关联的下行链路传输分配的数量；并且针对所述多个载波中的至少一个或多个第二载波上的通信来配置至少一个指示，所述指示指定与至少所述一个或多个第一载波相关联的下行链路传输分配的数量。

[0012] 第三个方案涉及一种装置，其可以包括：识别模块，用于识别与无线通信系统相关联的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波；获得模块，用于获得与应用于所述至少一个第一载波的下行链路传输分配的数量有关的信息；以及生成模块，用于生成下行链路分配索引(DAI)以在所述至少一个第二载波上进行传输，所述DAI指定应用于所述至少一个第一载波的下行链路传输分配的数量。

[0013] 本文所述的第四个方案涉及一种计算机程序产品，其可以包括计算机可读介质，该计算机可读介质包括：识别代码，用于使计算机识别与无线通信系统相关联的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波；获得代码，用于使计算机获得与应用于所述至少一个第一载波的下行链路传输分配的数量有关的信息；以及生成代码，用于使计算机生成DAI以在所述至少一个第二载波上传输，所述DAI指定应用于所述至少一个第一载波的下行链路传输分配的数量。

[0014] 根据第五个方案，本文描述了一种方法，其可以包括：识别配置用于与无线通信网络的通信的多个载波；在所述多个载波中的至少一个或多个第一载波上从所述无线通信网络获得传输分配信令；并且基于所述传输分配信令，确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量。

[0015] 本文所述的第六个方案涉及一种无线通信装置，其可以包括用于存储数据的存储器，所述数据与配置用于与无线通信网络的通信的多个载波有关。所述无线通信装置还可以包括处理器，其被配置：在所述多个载波中的至少一个或多个第一载波上从所述无线通信网络获得传输分配信令；并且基于所述传输分配信令，确定与所述多个载波中的至少一个或多个第二载波相关联的下行链路传输分配的数量。

[0016] 第七个方案涉及一种装置，其可以包括：识别模块，用于识别指定用于与无线通信网络的通信的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波；获得模块，用于在所述至少一个第一载波上从所述无线通信网络获得一个或多个DAI；以及确定模块，用于基于所述一个或多个DAI，确定应用于所述至少一个第二载波的下行链路传输分配的数量。

[0017] 本文所述的第八个方案涉及一种计算机程序产品，其可以包括计算机可读介质，该计算机可读介质包括：识别代码，用于使计算机识别指定用于与无线通信网络的通信的多个载波、所述多个载波中的至少一个第一载波以及所述多个载波中的至少一个第二载波；获得代码，用于使计算机在所述至少一个第一载波上从所述无线通信网络获得一个或多个 DAI；以及确定代码，用于使计算机基于所述一个或多个 DAI，确定应用于所述至少一个第二载波的下行链路传输分配的数量。

[0018] 为了实现前述以及有关目的，所要求的主题的一个或多个方案包括下文中所完整描述的并且在权利要求中特别指出的特征。以下的描述和附图详细地阐述了所要求的主题的某些示例性方案。但是这些方案仅仅指示了可以应用所要求的主题的原理的各种方式中的一小部分。此外，所公开的方案意图包括所有这些方案和它们的等效形式。

附图说明

[0019] 图 1 是根据各个方案的在多载波无线通信环境中有助于产生和处理下行链路分配指示消息的系统的方框图。

[0020] 图 2 示出了根据各个方案的有助于多载波通信的示例性无线通信系统。

[0021] 图 3 示出了根据各个方案的支持多载波通信的反馈的示例性无线通信环境。

[0022] 图 4 是根据各个方案的有助于跨载波和 / 或其它信令以支持多载波通信的上行链路反馈的系统的方框图。

[0023] 图 5 示出了可以在无线通信系统中使用的示例性下行链路分配索引（DAI）设计。

[0024] 图 6-8 分别示出了根据本文所述各个方案的用于多载波无线环境的增强型 DAI 设计的技术。

[0025] 图 9-12 是示出了用于生成指示多载波无线通信环境中所做出的下行链路传输分配的信令的各个方法的流程图。

[0026] 图 13 是用于处理包括多载波分配信息的传输分配信令的方法的流程图。

[0027] 图 14-15 是有助于在多载波无线通信系统中产生和处理下行链路分配指示符信令的各个装置的方框图。

[0028] 图 16 示出了根据本文所述各个方案的无线多址通信系统。

[0029] 图 17 是可以在其中运行本文所述的各个方案的示例性无线通信系统的方框图。

具体实施方式

[0030] 现在参考附图来描述所要求的主题的各个方案，在附图中相同的附图标记始终表示相同的元素。在以下描述中，为了说明的目的，描述了大量具体的细节以提供对一个或多个方案的透彻的理解。然而，显然没有这些具体细节也可以实施这些方案。在其它实例中，将公知的结构和设备显示为框图形式，以便描述一个或多个方案。

[0031] 如在本申请中使用的，术语“部件”、“模块”、“系统”等意在指示计算机相关的实体，其既可以是硬件、固件、软硬件组合、软件，也可以是执行中的软件。例如，部件可以是，但并不仅限于：处理器上运行的进程、集成电路、对象、可执行程序、执行的线程、程序和 / 或计算机。举例来说，计算设备上运行的应用程序和此计算设备都可以是部件。一个或多个部件可以位于执行中的一个进程和 / 或线程内，并且部件可以位于一台计算机上和 / 或

分布于两台或更多台计算机之间。另外，可以从存储了多种数据结构的多种计算机可读介质中执行这些部件。这些部件可以如根据具有一个或多个数据分组（例如，来自与本地系统中、分布式系统中的另一个组件进行交互的组件的数据，和/或来自在诸如因特网的网络上通过信号与其他系统进行交互的组件的数据）的信号通过本地和/或远程进程进行通信。

[0032] 此外，本申请结合无线终端和/或基站描述各个方案。无线终端可以是指用于向用户提供语音和/或数据连接的设备。无线终端可以连接到诸如膝上计算机或台式计算机的计算设备，或者其可以是诸如个人数字助理(PDA)的自包含的设备。无线终端还可以称作为系统、用户单元、用户站、移动站、移动终端、远程站、接入点、远程终端、接入终端、用户终端、用户代理、用户装置或用户设备(UE)。无线终端可以是用户站、无线设备、蜂窝电话、PCS电话、无绳电话、会话初始协议(SIP)电话、无线本地环路(WLL)站、个人数字助理(PDA)、具有无线连接能力的手持设备或者连接到无线调制解调器的其它处理设备。基站（例如，接入点或节点B)可以是指在接入网中在空中接口上通过一个或多个扇区来与无线终端进行通信的设备。基站可以通过将接收到的空中接口帧转换为因特网协议(IP)分组，来作为无线终端和其它接入网之间的路由器，其中其它接入网可以包括IP网络。基站还可以协同管理空中接口的属性。

[0033] 此外，可以用硬件、软件、固件或它们的任意组合来实现本申请所述的各种功能。如果用软件来实现，则可以将所述功能作为一个或多个指令或代码存储在计算机可读介质上，或者作为计算机可读介质上的一个或多个指令或代码来传输。计算机可读介质包括计算机存储介质和通信介质，其中通信介质包括有助于计算机程序从一个地方传递到另一个地方的任意介质。存储介质可以是计算机可访问的任意可用介质。这种计算机可读介质可以包括，例如但不限于，RAM、ROM、EEPROM、CD-ROM或其它光盘存储设备、磁盘存储设备或其它磁存储设备，或者可用于以计算机可访问的指令或数据结构的形式来携带或存储希望的程序代码的任意其它介质。并且，任意连接也可以被称为是计算机可读介质。例如，如果软件是使用同轴电缆、光纤光缆、双绞线、数字用户线(DSL)或诸如红外线、无线电和微波之类的无线技术来从网站、服务器或其它远程源传输的，那么同轴电缆、光纤光缆、双绞线、DSL或诸如红外线、无线电和微波之类的无线技术也包括在介质的定义中。本申请所使用的盘片或盘包括压缩盘(CD)、激光盘、光盘、数字多用途盘(DVD)、软盘和蓝光(BD)盘，其中磁盘(disk)通常磁性地再现数据，而光盘(disc)用激光光学地再现数据。以上的组合也可以包括在计算机可读介质的范围中。

[0034] 本文所述的各种技术可用于各种无线通信系统，如码分多址(CDMA)系统、时分多址(TDMA)系统、频分多址(FDMA)系统、正交频分多址(OFDMA)系统、单载波FDMA(SC-FDMA)系统以及其它这样的系统。术语“网络”和“系统”一般可以互换使用。CDMA系统可以实现诸如通用地面无线接入(UTRA)、CDMA2000等的无线技术。UTRA包括宽带CDMA(W-CDMA)和CDMA的其它变形。此外，CDMA2000涵盖IS-2000、IS-95和IS-856标准。TDMA系统可以实现诸如全球移动通信系统(GSM)的无线技术。OFDMA系统可以实现诸如演进的UTRA(E-UTRA)、超移动宽带(UMB)、IEEE 802.11(Wi-Fi)、IEEE 802.16(WiMAX)、IEEE 802.20、Flash-OFDM®等的无线技术。UTRA和E-UTRA是通用移动通信系统(UMTS)的一部分。3GPP长期演进(LTE)是即将发布的使用E-UTRA的版本，其在下行链路上采用OFDMA，

在上行链路上采用 SC-FDMA。在名为"第三代合作伙伴计划"(3GPP) 的组织的文献中描述了 UTRA、E-UTRA、UMTS、LTE 和 GSM。此外,在名为"第三代合作伙伴计划 2"(3GPP 2) 的组织的文献中描述了 CDMA2000 和 UWB。

[0035] 本申请将针对可以包括多个设备、组件、模块等的系统来给出各个方案。应当明白和理解的是,各个系统还可以包括其它的设备、组件、模块等和/或可以省略结合附图讨论的所有设备、组件、模块等的部分或全部。此外,还可以使用这些方法的组合。

[0036] 现在参考附图,图 1 示出了根据本文所述的各个方案在多载波无线通信环境中有助于产生和处理下行链路分配指示消息的系统 100。如图 1 中所示,系统 100 可以包括一个或多个基站 110(在本文中又被称为节点 B 或 eNB、小区或网络小区、节点或网络节点、接入点 (AP) 等),其可以经由各自的收发机 118 与一个或多个用户设备单元 (UE,在本文中又被称为接入终端 (AT)、移动站或用户站、移动设备、移动终端等)120 进行通信。根据一个方案,基站 110 可以参与和 UE 120 的一个或多个下行链路 (DL,在本文中又被称为前向链路 (FL)) 通信,并且 UE 120 可以参与与基站 110 的一个或多个上行链路 (UL,在本文中又被称为反向链路 (RL)) 通信。另外或可替换地,基站 110 和/或 UE 120 可以参与彼此的、与系统 100 中的其它设备或实体的和/或与任意其它适当的实体的任意适当的通信。

[0037] 根据一个方案,在各种无线通信系统中(例如,TDD 系统等),一个 UL 子帧可以与多个 DL 子帧相关联。按照这种方式与一个 UL 子帧相关联的多个 DL 子帧在本文中并且在本领域中通常被称为 DL 子帧绑定窗 (bundling window)。对于同一绑定窗中的 DL 传输,可以将诸如确认/否定确认 (ACK/NAK) 信令的 UL 反馈配置为在对应的 UL 子帧中进行反馈。在一个实例中,可以响应于并且针对期望的或接收的信号或者在 UE 120 处解调的一个或多个无线资源来产生 ACK/NAK 信令。适当的接收/期望的信号的实例可以包括预定数量的数据分组、预定数量的无线资源(例如,时频资源、OFDM 符号、代码资源、时间帧或子帧等)等。因此,作为一个实例,网络协议可以对 UE 120 进行配置以针对 N 个接收数据分组或者针对 N 个 DL 资源块或者在时间量 X 到期之后或者针对它们的一些组合(其中,X 和 N 是非负整数)来发送 ACK/NAK。如果接收到所有期望信号或分组,那么 UE 120 可以发送 ACK 反馈信号,否则发送 NAK 反馈信号。或者,可以使用其它类型的反馈,如自动重传请求 (ARQ) 信令、混合 ARQ(HARQ) 信令等。

[0038] 在以上提供的一个实例中可以由 UE 120 利用的一种类型的 ACK/NAK 反馈模式被称为 ACK/NAK 绑定,其中绑定窗中的多个 ACK/NAK 被逻辑地绑定成一个 ACK/NAK(例如,通过执行逻辑 AND 运算)。另外或可替换地,UE 120 可以利用的另一种类型的 ACK/NAK 反馈被称为 ACK/NAK 复用,其中可以反馈多达 4 比特的 ACK/NAK。

[0039] 可以理解,在一些情况中,UE 120 可能错过来自基站 110 的用于提供资源许可和/或其它传输分配信息的信令(例如,在物理下行链路控制信道 (PDCCH) 和/或其它适当的信道或信道组合上)。因此,在 UE 120 错过这样的信令的情况下,基站 110 和 UE 120 对于要在绑定窗中执行多少数据传输(例如,物理下行链路共享信道 (PDSCH) 传输等)可能具有不同的理解。

[0040] 因此,为了解决和/或减轻该失准,可以结合用于系统 100 中的控制信令传输的各种 UL 下行链路控制信息 (DCI) 格式和/或 DL DCI 格式,利用 2 比特的下行链路分配索引 (DAI) 字段。例如,基站 110 可以利用一个或多个 DL DCI 格式中的 DAI 字段来指示绑定窗

中的 DL 分配的累积数量。因此，举例而言，与绑定窗中的第一分配下行链路传输相对应的 DAI 字段可以指示一个分配，与绑定窗中的第二分配下行链路传输相对应的 DAI 字段可以指示两个分配，诸如此类。另外或可替换地，基站 110 可以利用一个或多个 DL DCI 格式中的 DAI 字段来指示绑定窗中的 DL 分配的总数。因此，举例而言，在为绑定窗分配了 n 个下行链路传输的情况中，与所分配的 n 个下行链路传输中的每一个相对应的 DAI 字段可以指示 n 个分配。

[0041] 根据另一个方案，可以理解，由于在 TDD 系统和／或用于 UE 120 的其它适当的无线通信系统中需要在与多个 DL 子帧相对应的单个 UL 子帧上反馈信息，所以在一些情况中可能要求 UE 120 知道已调度了给定绑定窗中的多少 DL 传输。此外，可以理解，在一些情况中可能不能保证在给定绑定窗中具有 UL 控制信令。如果给出了这种信令并且 UE 120 成功地解码了该信令，则可以理解基站 110 和 UE 120 对于对应的绑定窗中的 DL 传输的总数而言可以基本上很好地对准。因此，在具有 DL 控制信令的 DAI 的辅助之下，UE 120 可以有效地反馈对应的 ACK/NAK 信息，或者，如果 UL 控制 PDCCH 和／或其它控制信令不存在，那么在一些情况中 UE 120 可能需要依赖于 DL 控制信令中给定的 DAI 字段。但是，由于 DL 信令中的 DAI 信息的累积特性，给定绑定窗中的最后一个或几个 DL 控制信号的丢失可能导致基站 110 与 UE 120 之间对于 DL 数据传输总数的失准，使得难以进行有效的 ACK/NAK 反馈。还可以理解，对于在 PDCCH 上和／或在基站 110 和 UE120 之间的其它适当的控制信道上传输的 DAI 信息，在一些情况中，与 ACK/NAK 信令和／或其它形式的信令相比，在该控制信道上的传输可能具有相对高的可容忍损失率（例如，大约 1％等等）。鉴于以上描述，将希望实现改进的技术来改进给定绑定窗中的 ACK/NAK 性能。此外，如本文进一步所述的，可能希望实现这样一种技术，可以通过该技术来调节无线通信系统所利用的多个载波以增强 DAI 传输和／或处理。

[0042] 至少鉴于以上描述，基站 110 和／或 UE 120 可以根据本文所述各种方案来进行操作以有助于增强 DAI 和／或其它指示符的信号发送和处理，其中所述 DAI 和／或其它指示符指示应用于多载波系统中的各个载波的传输分配的数量。例如，基站 110 可以包括载波分析模块 112 和／或其它适当的机制来识别配置用于无线通信系统中的通信的多个载波。此外，基站 110 可以包括传输分配管理器 114 和／或其它适当的机制来确定与该多个载波中的一个或多个第一载波相关联的 DL 传输分配的数量。另外，基站 110 可以包括分配信令生成器 116，其可以为所述多个载波中的至少一个或多个第二载波上的传输（例如，经由收发机 118）配置至少一个指示，所述指示指定至少与所述一个或多个第一载波相关联的 DL 传输分配的数量。在一个实例中，所述一个或多个第二载波可能与所述一个或多个第一载波不同。

[0043] 相应地，系统 100 中的 UE 120 可以包括载波分析模块 112，其可以识别配置用于与基站 110 和／或关联于无线通信网络的任意适当的实体进行通信的多个载波。UE 120 还可以包括收发机 118 和／或其它机制来通过所述多个载波中的至少一个或多个第一载波从基站 110 获得传输分配信令，传输分配分析器 122 等可以基于该信令来确定与所述多个载波中的至少一个或多个第二载波相关联的 DL 传输分配的数量。在一个实例中，所述一个或多个第二载波可能与所述一个或多个第一载波不同。在另一个实例中，从基站 110 传输到 UE 120 的传输分配信令可以包括 DL 传输分配和／或 UL 传输分配。

[0044] 根据一个方案，由基站 110 处的传输分配管理器 114 识别的 DL 传输分配的数量可以是在预定的持续时间（例如，对应于若干子帧和／或任意其它适当的时间增量）上与一个或多个第一载波相关联的 DL 传输分配的数量。类似地，可以利用 UE 120 处的传输分配分析器 122，基于来自基站 110 的信令，确定在预定的持续时间上与一个或多个第二载波（其与用于接收所述信令的一个或多个第一载波不同）相关联的 DL 传输分配的数量。

[0045] 根据各种方案，基站 110 可以以信号形式向 UE 120 发送各种类型的 DAI 信令和／或其它指示符，以指示与除了用于提供信令的载波之外的载波相关联的传输分配的数量。例如，基站 110 可以利用跨载波 DAI 信令、多个 DAI 信令、聚合 DAI 信令和／或任意其它适当的信令类型。本文进一步详细提供了这些信令类型的各种实例。可以理解，除非另外说明，否则本文提供的说明书和权利要求并不意在限于可以由基站 110 执行的和／或由 UE120 处理的任意特定类型的信令。

[0046] 现在参考图 2，示出了根据各种方案的有助于多载波无线通信的示例性系统 200 的方框图。在一个实例中，系统 200 可以有助于提高与多载波无线通信有关的反馈信令的可靠性。结果，系统 200 可以减少控制或业务（语音或者数据业务）的重传，从而提高总的无线通信效率。

[0047] 如图 2 中所示，系统 200 可以包括基站 110，其可以经由多载波无线链路 210 可通信地耦合到 UE 120。多载波无线链路 210 可以包括两个或更多个不同的载波频率。虽然图 2 描述了 4 个不同的载波，但是应该理解，仅仅作为实例来提供该说明而不是意图将其理解为限制多载波无线链路 210 的环境中可以使用的载波的数量。根据一个方案，可以通过多载波无线链路 210 的一个或多个不同的载波来执行基站 110 和 UE 120 之间的 DL 和／或 UL 通信。DL 信号可以从基站 110 发送到 UE 120，并且可以包括例如控制信号（例如，PDCCH）、业务信号（例如，PDSCH）等等。类似地，从 UE 120 发送到基站 110 的 UL 信号可以包括控制信号（例如，ACK/NAK、信道反馈、调度请求、探测参考信号（SRS）等）、业务信号（例如，物理上行链路共享信道（PUSCH）信令）等等。

[0048] 根据另一个方案，基站 110 可以分配各种 UL 和 DL 信号以在多载波无线链路 210 的任意一个不同的载波或一组这种不同的载波上传输。此外，载波分配可以随时间而改变。作为示例性的实例，可以在一个信号时间帧（例如，帧、子帧、时隙、子时隙等）中在第一载波子集上、在后续的信号时间帧中在第二载波子集上等，传输一组 DL 控制信号。分配给该组 DL 控制信号的反馈信号可以类似地被分配给一个载波子集，该载波子集可以是与用于 DL 控制信号的载波子集相同的载波子集或是不同的载波子集。

[0049] 因为（控制信号或业务信号的）DL 传输可以由基站 110 在多个载波上发送，所以可以理解，UE 120 可被配置为监视多个载波以确定在 UE 120 处是否接收到与该 DL 传输相对应的个体信号。然后，UE 120 可以响应于该 DL 传输而发送 UL 反馈信号。为了辅助 UE 120 监视并且接收 DL 传输的个体信号，基站 110 可以在第一载波子集上发送 DAI 212，其提供在至少一个其它载波子集上传输的 DL 传输信号的总数的指示。该 DAI 212 可以是跨载波的 DAI、多个 DAI 的集合、聚合的 DAI 和／或适用于指示在除了用于发送该 DAI 的载波之外的其它载波上的 DL 传输分配的任意其它形式的信令。另外或可替换地，DAI 212 还可以识别在第一载波子集上传输的 DL 传输的信号总数，或者可以在独立的 DAI（未显示）中传输该信息。因此，UE 120 可以确定在 DL 绑定窗中接收到的 DL 信号包括完整的传输（例如，

DL 传输的所有个体信号）还是不完整的传输。

[0050] 除了前述之外，UE 120 可以使用 DAI 212 来协调与给定 DL 绑定窗中的 DL 传输相对应的 UL 反馈 214 的信号发送。执行 UL 反馈 214 的信号发送的形式可以依据默认配置（例如，如网络标准中所指定的，等）、由基站 110 基于每个 UE 或每个小区配置，等等。

[0051] 根据一个方案，DAI 212 可以包括与除了由基站 110 用于发送 DAI 212 的载波（在本文中被称为 DL DAI 载波）之外的单个载波有关的 DL 信令信息。在这种情况下，UE 120 可以针对该单个载波执行 ACK/NAK 信号发送。在一个实例中，可以通过少到 1 个数据比特来完成该 ACK/NAK 信号发送，例如以指示在该单个载波上已接收到或者尚未接收到与 DAI 212 相对应的所有传输。或者，可以利用多个数据比特，以例如指出接收到的特定传输和 / 或指出未接收到的特定传输。

[0052] 根据另一个方案，DAI 212 可以包括针对多个载波（包括 DL DAI 载波，但是其至少还包括一个其它载波）的 DL 信令信息。在这种情况下，DAI 212 可以指定用于该多个载波的信息，包括每个载波的一个或多个信号时隙（其中信号时隙可以是例如信号子帧、信号子时隙、信号帧或时隙或者 DL 信号的其它适当的基于时间的分割）。或者，基站 110 可以发送多个 DAI 212，其提供针对所述多个载波中的一个或多个载波或者每个载波的一个或多个信号时隙或者载波和信号时隙的任意其它适当的组合的 DL 信令信息。

[0053] 接下来转到图 3，其示出了根据各种方案的有助于多载波无线通信的示例性系统 300。系统 300 可以包括基站 110，其可以与一个或多个 UE 120 耦合。另外，基站 110 可以包括或者可以可通信地耦合到节点分配装置 302。节点分配装置 302 可以被配置为通过，例如，向 UE 120 提供用于指示向 DL 绑定窗中的（例如，与一个或多个 UL 反馈资源相关联的）个体 DL 传输所分配的各个载波的信息，来支持多载波无线通信。可以由节点分配装置 302 显式地表示该信息，或者可以在网络规范中（例如，用最低层或非更高层信令）和 / 或以任意其它适当的方式隐式地指定该信息。

[0054] 在一个实例中，节点分配装置 302 可以包括用于与 UE 120 进行通信的通信 (comm.) 接口 304。通信接口 304 可以对应于基站 110 的发射 - 接收链，或者可以包括被配置来利用该发射 - 接收链或者与该发射 - 接收链通信的独立的电子通信实体。另外，节点分配装置 302 可以包括用于存储指令的存储器 312 以及数据处理器 310，其中所述指令被配置为有助于 UE 120 在与基站 110 相关联的无线网络中的多载波无线服务，数据处理器 310 用于运行实施所述指令的模块。例如，这些模块可以包括参考模块 314，其形成用于将第一无线载波上的一组 DL 传输与 UL 反馈资源相关联的无线消息 316。可以用如本文所述的一个或多个 DAI 来建立该关联。此外，节点分配装置 302 可以包括传输模块 318，其将无线消息编码到无线信号的控制信道资源（例如，控制消息 320) 上并且在第二无线载波上将该无线消息发送到一个或多个 UE 120。

[0055] 根据一个方案，无线消息 316 可以指定用于将该组 DL 传输发送给 UE120 的无线载波的总数。在一个实例中，无线消息 316 还可以指定该组 DL 传输中在该总数个无线载波的各个载波上的 DL 传输（例如，独立的 DL 信号）的总数。因此，UE 120 可以容易地追踪接收的每个载波的 DL 传输的数量，从而改进基站 110 与 UE 120 之间的协调并且提高 UE 120 所发送的反馈信令的可靠性。

[0056] 根据另一个方案，控制消息 320 可以利用各种选项来传送关于除了（并且可选地，

另外在)第二无线载波(例如,用于传输控制信息 320 的载波)之外的载波上的 DL 传输的信息。在一个实例中,无线消息 316 可以包括用于识别第一无线载波的第一数据字段和用于指定分配给 UL 反馈资源并且在第一无线载波上传输的 DL 传输的总数的第二数据字段。在另一个实例中,无线消息 316 可以是由参考模块 314 生成并且发送给 UE 120 的一组无线消息中的一个,每个所述无线消息可以指定分配给 UL 反馈资源的、在该组无线载波的各个子集上传输的 DL 传输的总数。在这种情况下,参考模块 314 可以生成不同数量的无线消息并且将它们分配给该组无线载波的不同子集。作为一个实例,该组无线消息包括针对该组无线载波中的每个无线载波的一个无线消息 316。

[0057] 在一个实例中,各个无线消息 316 可以包括跨载波 DAI,该跨载波 DAI 用于识别针对各个无线载波中的一个无线载波的 DL 传输的总数。或者,一个或多个无线消息 316 可以包括多个 DAI,每个 DAI 指定针对不同载波的 DL 传输的总数。作为该情况的实例,一组无线消息可以包括 N 个无线消息(其中,N 是正整数并且小于或等于该组无线载波的数量 M),其中每个无线消息针对该组无线载波中的每个锚载波(其中,锚载波的数量小于或等于 M)。该组无线消息中的至少一个无线消息可以可选地包括多个 DAI,实际上将非锚载波的 DL 传输与对应的锚载波的 DL 传输绑定。可替换地,无线消息 316 可以包括一个或多个 DAI,其(例如,使用逻辑 AND 运算)将多个无线载波的 DL 传输信息逻辑地绑定。在该可替换的实例中,参考模块 314 可以在无线消息 316 中除了识别第一无线载波上的该组 DL 传输的总数之外还识别至少一个其它无线载波上的 DL 传输的总数。在识别 DL 传输时,无线消息 316 可以使用可替换的格式来显式或隐式地传送 DL 传输信息。在一个实例中,DAI 可以指定 DL 绑定窗中的总传输。在另一个实例中,DAI 可以指定该 DL 绑定窗上累积的 DL 传输。

[0058] 取决于要由无线消息 316 传送的信息的量(例如,包括多少 DAI、指定多少载波等),需要为该消息预留不同的数据量。这可以在网络范围内的标准中提供,例如,基于每个小区或每个 UE。从而,参考模块 314 可以基于用于管理基站 110 和/或任意其它适当的因素的控制标准或配置,生成无线消息 316 的多个数据比特。

[0059] 在另一个实例中,对应于无线消息 316 的 DL 传输可以包括多载波控制或多载波业务传输中的任一种或两者都包括。因此,例如,以上提及的一组 DL 传输可以包括涉及 UE 120 并且至少部分地在第一无线载波上传输的数据或语音业务传输。在这种情况下,可以利用无线消息 316 来发送第一无线载波上的该组 DL 传输中的 DL 传输的总数。作为另一个实例,该组 DL 传输可以包括涉及 UE 120 并且在第一无线载波上传输的控制业务传输。这些控制业务传输可选地关于在其它载波(例如,第二无线载波或第三无线载波)上传输的数据或语音业务信号。在这种情况下,无线消息 316 可以可选地仅指定 DL 控制传输的总数、其它载波上的 DL 语音或数据业务传输的总数,或者 DL 控制传输和 DL 语音/数据业务传输这两者。可以在无线网络的标准、存储器 312 等中存储的小区专用的或 UE 专用的配置中指定无线消息 316 是涉及数据或语音业务传输、涉及控制业务传输还是涉及这两者。在一个实例中,当生成无线消息 316 时,参考模块 314 可以访问存储器 312 以获取该标准。

[0060] 图 4 示出了可根据本文所述的各个方案部署的进一步的系统 400。系统 400 可以包括 UE 120,其可以经由多载波无线链路无线地耦合到基站 110。另外,UE 120 可以包括多载波信号装置 402,其可以基于基站 110 所提供的 DAI 信号,提供改进的反馈信令。

[0061] 在一个实例中,多载波信号装置 402 可以包括用于与基站 110 交换无线信号的通

信接口 304。另外，多载波信号装置 306 可以包括用于存储有助于多载波无线通信的指令的存储器 312 以及用于运行和／或以其它方式实现用于实现所述指令的模块的数据处理器 310。在操作中，基站 110 可以向 UE 120 发送无线消息 422。该无线消息 422 可以在多载波无线链路的其中一个载波上传输，并且可以提供至少涉及该多载波无线链路的第二载波的 DL 绑定窗信息。可以在具有如本文所述的各种格式的一个或多个 DAI 中指定该 DL 绑定窗信息。

[0062]　在另一个实例中，多载波信号装置 402 可以使用过滤模块 412，其从通信接口 304 在第一无线载波上接收到的信号中提取无线消息 422。另外，可以使用中间模块 414，其分析无线消息 422 并且识别分配给 UL 反馈资源并且将要在第二无线载波上接收的传输的数量。这样，多载波信号装置 402 可以监视第二无线载波以寻找指定数量的传输，并且确定在 UE 120 是否已经成功地接收了该数量的传输。

[0063]　根据一个方案，多载波信号装置 402 可以包括计数模块 416，其监视通信接口 304 在多载波无线链路上，并且特别是至少在无线消息 422 中所识别的第二无线载波上，接收到的业务。此外，计数模块 416 可以追踪并且确定分配给 UL 反馈资源的、至少在第二无线载波上接收到的接收传输的数量。可以将所述接收传输的数量与由中间模块 414 所提供的第二无线载波上的期望传输的数量进行比较。多载波信号装置 402 还可以包括定时模块 418，其设置用于在第二无线载波上接收该数量的传输的 NAK 时间段。作为一个示例性的实例，NAK 时间段可以基于网络规范中所包括的 ACK/NAK 信令 424 的响应时间，或者由基站 304 指定。通过具体的非限制性的实例，该响应时间可以是 4 个子帧，从而必须由 UE 302 在子帧 N+4 中对子帧 N 中的传输进行响应。可替换地，NAK 时间段可以是任意其它适当数量的信号时隙。

[0064]　根据另一个方案，多载波信号装置 402 和／或与 UE 120 相关联的其它机制可以将（例如，经由无线消息 422）从基站 110 获得的 DAI 值与所检测到的从基站 110 接收到的 DL 传输的数量进行比较。基于该比较、第三层 (L3) 配置的传输方案和／或 UE 120 所利用的任意其它适当的传输方案（例如，绑定、复用等）以及 UE 120 所利用的物理层传输模块（例如，在物理上行链路控制信道 (PUCCH) 上、在 PUSCH 上捎带等），UE 120 可以相应地向基站 110 提供 ACK/NAK 信令 424。

[0065]　如本文进一步所述的，无线消息 422 可以包括分别提供涉及一个或多个载波的 DL 信号信息的一个或多个 DAI。各个 DAI 中的数据字段的大小可以由基站 110 设置，并且可以随每个 UE、每个小区或每个 DAI 而不同，或者可以是网络协议所建立的标准大小。因此，在一个实例中，无线消息 422 可以包括适合识别用于多载波无线通信的每个载波、基站 110 可用的每个载波或者被分配给 UE 120 的每个载波的多个数据比特。或者，无线消息 422 可以包括适合识别用于多载波无线通信的多个载波、基站 110 可用的多个载波或者被分配给 UE 120 的多个载波的多个数据比特。在另一种情况中，无线消息 422 可以包括适合基于 UL DCI 格式与 DL DCI 格式之间的大小匹配来最小化控制信道盲解码的多个数据比特。

[0066]　无线消息 422（或者一组这种无线消息）发送的无线载波的数量还可以变化并且可以由基站 110 进行配置。在一个实例中，无线载波的数量可以等于基站 110 所使用的锚载波的数量。在可替换的实例中，无线载波的数量可以等于或小于基站 110 可用的或分配给 UE 120 进行多载波无线通信的载波的总数。在无线消息 422 发送多个载波的情况中，可

以使用多个 DAI，一个载波一个 DAI，或者至少一个 DAI 子集可以发送一个 DL 绑定窗中的两个或更多个载波上的传输的数量。因此，作为一个实例，无线消息 422 可以包含独立的数据字段，用于为该多个无线载波中的每个无线载波指定每载波传输数量。或者，无线消息 422 可以包含一个或多个聚合数据字段，用于为该多个无线载波中的多个无线载波指定一组每载波传输数量。

[0067] 根据一个方案，多载波信号装置 402 可以使用网络配置或标准来解释无线消息 422 和其中包括的 DAI。此外，过滤模块 412 可以获得用于识别无线消息 422 中所指定的多个无线载波（至少包括第二无线载波）的网络配置。另外，中间模块 414 可以使用该网络配置来识别分配给该多个无线载波中的每个无线载波的 UL 反馈资源的每载波传输数量。例如，在无线消息 422 包括用于指定各个载波的 DL 传输的数量的多个 DAI 或者用逻辑 AND 运算来配置的单个 DAI 的情况下，可以实现该方案。

[0068] 再次参考图 1，可以理解，在一些无线通信实现中，控制和数据可以被配置为总是在同一载波上进行传递。但是，对于多载波操作，可以理解，能够从不同的载波传输控制和数据。以该方式执行的信号发送在本文中并且通常在本领域中被称为跨载波信号发送，其中在该方式中使用控制（例如，PDCCH）信令来指导在至少一个不同载波上的数据（例如，PDSCH/PUSCH）信号发送。在一个实例中，可以基于单个载波的具有 0-3 比特的附加载波指示符字段的 DCI 格式，使用针对每个分量载波的 DL 分配和 UL 许可的独立编码，生成多载波控制信令。在 0 比特的情况下，可以省略载波指示符。因此，可以理解，响应于数据传输的 UL ACK/NAK 的载波关联可以具有两种选项：(1) 用于 UL ACK/NAK 的 UL 载波和用于 DL 数据的 DL 载波总是相关联，或者 (2) 用于 UL ACK/NAK 的 UL 载波和用于 DL 控制的 DL 载波总是相关联。

[0069] 至少基于以上讨论，可以理解，在 UL 分配中存在 DAI 可以有助于 TDD 系统和/或其它适当的系统的有效的 ACK/NAK 反馈。但是，如以上进一步所示的，在一些情况中，UE 120 可能配置有多个分量载波。因此，在一些情况中，用于单载波系统的 DAI 的概念可以扩展到多载波情形，在多载波情形中，DAI 可以指示多个载波上（例如，频率上）的 DL 分配的数量，而不是指示绑定窗上的 DL 分配的数量。因此，对于 TDD 系统，可以利用 2 个 DAI：基于时间的 DAI(DAI_time)，其指示给定绑定窗中的总的（或累积的）DL 分配；以及基于频率的 DAI(DAI_freq)，其指示在给定的 DL 子帧绑定窗中具有至少一个 DL 分配的 DL 载波的总数。图 5 中的图 500 进一步详细示出了这种 DAI 配置。

[0070] 根据本文所述的各个方案，可以在系统 100 中生成和/或处理 DAI 信令，使得在给定载波上提供的 DAI 信令可以提供应用于不同载波的特定数量的 DL 传输分配，从而进一步改进了图 500 中所示的技术的 DAI 设计。应该理解，可以使用本文所提供的各个实例来代替或补充图 500 中所示的 {DAI_time，DAI_freq} 结构。

[0071] 根据一个方案，系统 100 中的基站 110 和 UE 120 可以利用跨载波 DAI 信令来指示并且处理对应于各个载波的 DL 分配信息。因此，例如，基站 110 可以将针对一个或多个载波的多个 DL 传输分配的至少一个指示配置为包括用于将该一个或多个载波与它们所关联的该多个 DL 传输分配相关联的索引信息（例如，载波索引字段 (CIF) 等等）。对应地，UE 120 可以利用传输分配分析器 122 和/或其它适当的机制来经由传输分配信令中所提供的索引信息，例如 CIF 等，识别与传输分配信令相对应的一个或多个载波。

[0072] 举例而言，可以由基站 110 和／或 UE 120 按照以下方式生成跨载波 DAI 信令。虽然以下实例假设二载波分配，但是应该理解，本文所述以及所示的概念可以应用于任意适当数量的载波。在一个实例中，对于以下两种情形，UE 可以配置有表示为 C1 和 C2 的两个分量载波：(1)DL 数据传输在 C1 上并且一个 UL 数据传输在 C2 上；和 (2) 绑定窗中的两个 DL 数据传输在 C1 上，绑定窗中的一个 DL 数据传输在 C2 上，并且一个 UL 数据传输在 C2 上。在情形 (1) 中，可以理解，用于在 C2 上分配 UL 数据传输的 DL 控制信令中的 DAI 字段是没有意义的，因为在 C2 上没有对应的 DL 数据传输。此外，在情形 (2) 中，可以理解，用于在 C2 上分配 UL 传输的 DL 控制信令中的 DAI 字段如果被配置为指示 C1 而不是 C2 上的 DL 数据传输的总数则会更加有用，因为在 C1 上有 2 个而在 C2 上只有一个 DL 数据传输。

[0073] 在以上两种情形中，可以理解，希望用于分配 C2 上的 UL 数据传输的 DL 信令中的 DAI 字段还可以指示对于另一载波在绑定窗中的 DL 数据传输的总数（例如，从而 DAI 提供跨载波指示）。或者，可以理解，类似地其它情况的跨载波 DAI 信令也是希望的。因此，可以如下实现跨载波 DAI 信令。在针对每个 UL 或 DL 分量为 UE 120（或对应的小区）配置 M 个分量载波的情况下，可以对 DAI 引入范围为 0 到 N 比特的 CIF（例如，CIF_DAI)，其中 N ＝ $ceil(log_2(M))$。图 6 中的图 600 示出了可以以该方式生成并且利用的跨载波 DAI 信令的实例。但是，应该理解，并不要求用于 CIF_DAI 的比特的数量是 $ceil(log_2(M))$ 来寻址 M 个分量载波的整个空间；而是，CIF 值可以被配置为仅应用于载波子集（例如，锚载波和／或任意其它适当的所选载波组）、多个载波的各个组和／或任意其它适当的 CIF 到载波映射。

[0074] 通过具体的非限制性的实例，CIF 可以是固定的 3 比特字段，其有助于可能的 CIF 值到各个载波的特定于 UE 的映射。因此，例如，可以利用值 000 来指示第一载波，可以利用值 001 来指示第二载波，可以利用值 010 来指示第一载波和第二载波，诸如此类。或者，应该理解，可以利用 CIF 配置到载波的任意适当的映射。

[0075] 在另一个实例中，可以通过考虑 DL DCI 格式与 UL DCI 格式之间的可能的大小匹配来选择用于 CIF_DAI 的比特的数量，使得，例如，PDCCH 盲解码和／或其它适当的解码操作能够最小化（例如，通过具有相同的 DL/ULDCI 格式大小）。例如，如果在大小匹配之前 DL DCI 具有 L 个比特并且对应的 UL DCI 具有 L-1 个比特，那么可以选择 1 比特的 CIF_DAI 以使得不需要额外的零填充比特。通过这么做，可以理解，可以在控制开销和跨载波 DAI 信令的灵活性之间实现折中。在进一步的实例中，对于用于 CIF_DAI 的给定数量的比特，可以经由无线资源控制 (RRC) 实体和／或其它适当的机制来配置 UE 120 以识别 CIF_DAI 所寻址的载波。在另一实例中，用于 CIF_DAI 的比特数量可以是特定于 UE 的、特定于小区的和／或通过系统 100 以任意适当的统一或不统一的形式确定的。

[0076] 根据另一个方案，基站 110 可以通过在对应的 UL 或 DL 分配中传输用于多个载波的多个 DAI 来有助于多个载波上的 DL 传输分配的信令指示。图 7 中的图 700 示出了可以按照该方式执行的多个 DAI 信号发送的实例。关于系统 100 中的基站 110，分配信令生成器 116 和／或其它适当的关联模块可以通过配置多个指示以指定与关联的多个载波中的各个载波相关联的 DL 传输分配的数量来有助于多个 DAI 信号发送。在产生这种指示之后，可以由收发机 118 在一个控制信号或多个（例如，两个或更多个）控制信号上传输多个指示。可以经由，例如，PDCCH 和／或任意其它适当的信道来传送控制信号。在利用两个或更多个控制信号的情况下，可以在一个载波或多个（例如，两个或更多个）载波上传输控制信号。

[0077] 相应地，在 UE 120，可以利用收发机 118 来获得由基站 110 经由如上所述的一个控制信号或多个控制信号（在一个或多个载波上）提供的传输分配信令。基于该传输分配信令，传输分配分析器 122 和／或与 UE 120 相关联的其它机制可以确定与关联的多个载波中的各个载波相关联的 DL 传输分配的多个数量。

[0078] 在一个实例中，可以按照以下方式由基站 110 针对 UL 或 DL 分配中的多个载波来传输多个 DAI。例如，基站 110 可以在每个 UL 或 DL 分配中传输 N ≤ M 个 DAI（其中 M 是分量载波的数量，形式为 {DAI_1，DAI_2，...，DAI_N}），而不是利用上述针对跨载波 DAI 信令的 {DAI 值，CIF_DAI} 结构。根据一个方案，集合 {DAI_1，DAI_2，...，DAI_N} 可以进行单独编码（例如，基于每个指示进行编码）或联合编码。

[0079] 在另一个实例中，如 N ≤ M 所暗示的，可以理解，并非在所有情况中都需要对所有 M 个分量载波提供 DAI。而是，在一些情况中，可以选择与例如锚载波和／或任意其它载波选择相关联的 N 个载波，N 可以等于或小于 M。在进一步的实例中，在针对少于分配给给定 UE 120 的所有分量载波的载波提供 DAI 的情况下，UE 120 可操作地以各种方式将各个 DAI 映射到载波。例如，CIF 信息可以具有一个或多个 DAI。或者，UE 120 可以对传输分配信令中提供的多个 DAI 与 DAI 所涉及的载波之间的一组映射进行调节。该映射可以是静态映射（例如，L3 配置的静态映射）和／或由任意其它适当的方式构造的。在进一步的实例中，可以对不同数量的 DAI 提供多个映射，使得具有不同数量的 DAI（例如，2 个 DAI、3 个 DAI 等）的传输分配信令可以对应于系统 100 中所利用的不同载波集合。

[0080] 根据另一个方案，可以由基站 110 在传输分配信令中提供一个或多个 DAI 值，其覆盖对应的 UL 分配中的多个载波，使得 DAI 信令在频率（例如，多个载波）和时间（例如，在 DL 子帧绑定窗上）聚合。图 8 中的图 800 示出了可以按照该方式构造的聚合 DAI 信令的实例。关于系统 100 中的基站 110，可以利用传输分配管理器 114 和／或其它适当的模块来配置至少一个指示（例如，DAI）以指定与一个或多个第一载波和一个或多个第二载波相关联的 DL 传输分配的组合数量。相应地，在 UE 120，可以利用传输分配分析器 122，基于接收的传输分配信令，确定与一个或多个第一载波和一个或多个第二载波相关联的 DL 传输分配的组合数量。在一个非限制性的示例性情况中，由基站 110 向 UE 120 提供的传输分配信令可以包括用于指定与关联于系统 100 中的一个或多个实体的载波集合中的基本上所有载波相关联的 DL 传输分配的数量的指示和／或其它信息。

[0081] 在一个实例中，在利用了 M 个分量载波的情况中，基站 110 可以构造 K ≥ 1 个 DAI，其中每个 DAI 覆盖 M_k 个载波，使得 $M_1+M_2+...+M_K = M$。在一个实例中，各自的 K 个 DAI 可以按照任意统一的或非统一的形式，在 M 个分量载波上静态的或者半静态的划分。因此，举例而言，在一个 5 载波系统中，第一个 DAI 可以对应于载波 1 和 2，第二个 DAI 可以对应于载波 3 和 4 并且第三个 DAI 可以对应于载波 5。但是，应该理解，可以利用任意适当的映射。在另一个实例中，对于上述 K = 1 的特殊情况，UL 分配或 DL 分配中的 DAI 可以指示在所有载波上的 DL 子帧绑定窗中的 DL 分配的总数。在进一步的实例中，如上所述的聚合 DAI 信令可以按照与图 6 所示的跨载波 DAI 信令相类似的方式利用 CIF 信息，按照与图 7 所示类似的方式利用多个 DAI 并且／或者利用任意其它适当的特性来有助于 DAI 信令。

[0082] 根据进一步的方案，如上所述，由 UE 120 用于 UL ACK/NAK 反馈的载波可以与对应的 DL 数据传输或 DL 控制传输（例如，PDSCH 或 PDCCH 等）相关联。结果，可以理解，基站

110 和 / 或 UE 120 可以调节关于 DAI 信令关联的至少两个选项。在第一实例中，DAI 可被配置为总是对给定载波上的 DL 数据传输的数量进行计数。可替换地，在第二实例中，DAI 可被配置为总是对给定载波上的 DL 控制传输的数量进行计数，尽管一些 DL 控制可以在不同载波上发送 DL 数据传输。因此，根据一个方案，基站 110 可以确定与一个或多个载波相关联的多个 DL 控制信号传输分配或多个 DL 数据传输分配中的至少一个，使得 UE 120 可以从接收自基站 110 的传输分配信令中获取该信息。在一个实例中，可以由基站 110 和 / 或 UE 120 经由预制网络规范或其它类似的手段、特定于小区或特定于 UE 的配置和 / 或按照任意其它适当的方式，从上述选项和 / 或其它适当的选项中选择用于 DAI 关联的选项。

[0083] 根据另一方案，可以调节用于 DAI 的比特数量，以暗示 DAI 所涉及的载波。因此，可以理解，除了 DAI 的有效载荷之外，用于 DAI 的比特数量可以另外由 UE 120 和 / 或基站 110 用来有助于一个或多个上述操作。在一个实例中，按照与上述针对图 7 所述的用于调节 DAI 数量的方式类似的方式，可以利用 L3 配置的映射和 / 或其它适当的手段来将各个 DAI 比特大小映射到对应的载波。

[0084] 现在参考图 9-13，示出了可以根据本文所述的各个方案执行的各种方法。虽然，为了简化说明的目的将该方法显示并且描述为一系列的动作，但是要理解并且明白，该方法不受动作次序的限制，因为根据一个或多个方案，一些动作可以以不同的次序发生并且 / 或者可以与本文所示和描述的其它动作同时发生。例如，本领域熟练技术人员应该理解并且明白，可以将方法可替换地表示为一系列互相关联的状态或事件，如以状态图形式。此外，实现根据一个或多个方案的方法不一定需要所示的所有动作。

[0085] 参考图 9，示出了用于生成指示多载波无线通信环境中所做出的下行链路传输分配的信令的第一方法 900。要理解，可以通过例如，基站（例如，基站 110）和 / 或任意其它适当的网络实体来执行方法 900。方法 900 在方框 902 开始，在方框 902 中（例如，通过载波分析模块 112）识别配置用于无线通信系统中的通信的多个载波。在方框 904，（例如，通过传输分配管理器 114）确定与该多个载波中的一个或多个第一载波相关联的 DL 传输分配的数量。在方框 906，针对该多个载波中的至少一个第二载波上的通信（例如，通过分配信令生成器 116）配置至少一个指示，该指示指定至少与该一个或多个第一载波相关联的 DL 传输分配的数量。

[0086] 图 10 示出了用于生成指示多载波无线通信环境中所做出的下行链路传输分配的信令的第二方法 1000。要理解，可以通过例如 eNB 和 / 或任意其它适当的网络实体来执行方法 1000。方法 1000 在方框 1002 开始，在方框 1002 中，识别配置用于无线通信系统中的通信的多个载波。在方框 1004，确定与该多个载波中的一个或多个第一载波相关联的 DL 传输分配的数量。在方框 1006，配置至少一个指示，该指示指定至少与该一个或多个第一载波相关联的 DL 传输分配的数量以及用于将该一个或多个第一载波与关联于该一个或多个第一载波的 DL 传输分配的数量相关联的索引信息。

[0087] 参考图 11，其示出了用于生成指示多载波无线通信环境中所做出的下行链路传输分配的信令的第三方法 1100。要理解，可以通过例如网络小区和 / 或任意其它适当的网络实体来执行方法 1100。方法 1100 在方框 1102 开始，在方框 1102 中，识别配置用于无线通信系统中的通信的多个载波。在方框 1104，确定与多个载波中的各个载波相关联的 DL 传输分配的数量，所述各个载波包括一个或多个第一载波。在方框 1106，配置多个指示，该指示

指定与所述多个载波中的所述各个载波相关联的DL传输分配的数量。

[0088] 图12示出了用于生成指示多载波无线通信环境中所做出的下行链路传输分配的信令的第四方法1200。可以通过例如基站和/或任意其它适当的网络实体来执行方法1200。方法1200在方框1202开始，在方框1202中，识别配置用于无线通信系统中的通信的多个载波。在方框1204，配置指示，该指示与该多个载波中的基本上所有载波都相关联的DL传输分配的数量。

[0089] 转到图13，示出了用于处理包括多载波分配信息的传输分配信令的方法1300。可以通过例如UE(例如，UE 120)和/或任意其它适当的网络实体来执行方法1300。方法1300在方框1302开始，在方框1302中，(例如，通过载波分析模块112)识别配置用于与无线通信网络的通信的多个载波。在方框1304，(例如，经由收发机118)在该多个载波中的至少一个或多个第一载波上从该无线通信网络获得传输分配信令。在方框1306，基于该传输分配信令，(例如，通过传输分配分析器122)确定与该多个载波中的至少一个或多个第二载波相关联的DL传输分配的数量。

[0090] 接下来参考图14-15，示出了可以根据本文所述各个方案来实现的各个装置1400-1500。要理解，装置1400-1500被表示为包括功能块，其可以是用于表示由处理器、软件或其组合(例如，固件)所实现的功能的功能块。

[0091] 参考图14，示出了有助于在多载波无线通信系统中产生和处理下行链路分配指示符信令的第一装置1400。可以通过基站(例如基站110)和/或任意其它适当的网络实体来实现装置1400，并且装置1400可以包括：模块1402，用于识别与无线通信系统相关联的多个载波、该多个载波中的至少一个第一载波以及该多个载波中的至少一个第二载波；模块1404，用于获得与应用于该至少一个第一载波的DL传输分配的数量有关的信息；以及模块1406，用于生成DAI以在该至少一个第二载波上进行传输，所述DAI指定应用于该至少一个第一载波的DL传输分配的数量。

[0092] 图15示出了有助于在多载波无线通信系统中产生和处理下行链路分配指示符信令的第二装置1500。可以通过移动终端(例如UE 120)和/或任意其它适当的网络实体来实现装置1500，并且装置1500可以包括：模块1502，用于识别指定用于与无线通信网络的通信的多个载波、该多个载波中的至少一个第一载波以及该多个载波中的至少一个第二载波；模块1504，用于在该至少一个第一载波上从该无线通信网络获得一个或多个DAI；以及模块1506，用于基于该一个或多个DAI，确定应用于该至少一个第二载波的DL传输分配的数量。

[0093] 现在转到图16，提供了根据各个方案的无线多址通信系统的图。在一个实例中，接入点1600(AP)包括多个天线组。如图16所示，一个天线组可以包括天线1604和1606，另一个天线组可以包括天线1608和1610，并且又一个天线组可以包括天线1612和1614。虽然在图16中为每个天线组仅示出了2个天线，但是可以理解，每个天线组可以利用更多或更少的天线。在另一个实例中，接入终端1616可以与天线1612和1614通信，其中天线1612和1614通过前向链路1620向接入终端1616发送信息并且通过反向链路1618从接入终端1616接收信息。另外和/或可替换地，接入终端1622可以与天线1606和1608通信，其中天线1606和1608通过前向链路1626向接入终端1622发送信息并且通过反向链路1624从接入终端1622接收信息。在频分双工系统中，通信链路1618、1620、1624和1626

可以使用不同的频率进行通信。例如，前向链路 1620 可以利用与反向链路 1618 所使用的频率不同的频率。

[0094] 每组天线和／或被它们被指定进行通信的区域可以被称为接入点的扇区。根据一个方案，天线组可以被设计为与接入点 1600 所覆盖的区域的扇区中的接入终端进行通信。在前向链路 1620 和 1626 上的通信中，接入点 1600 的发射天线可以利用波束成形来改善不同接入终端 1616 和 1622 的前向链路的信噪比。并且，与接入点通过单个天线向其所有接入终端进行发射相比，接入点利用波束成形来向随机散布在其覆盖区域中的接入终端进行发射对相邻小区中的接入终端产生的干扰更小。

[0095] 接入点，例如，接入点 1600，可以是用于与终端通信的固定的站，并且还可以被称为基站、eNB、接入网和／或其它适当的术语。另外，接入终端，例如，接入终端 1616 或 1622，还可以被称为移动终端、用户设备、无线通信设备、终端、无线终端和／或其它适当的术语。

[0096] 现在参考图 17，其提供了一个方框图，该方框图示出了可以在其中运行本文所述各个方案的示例性无线通信系统 1700。在一个实例中，系统 1700 是多输入多输出 (MIMO) 系统，其包括发射机系统 1710 和接收机系统 1750。但是应该理解，发射机系统 1710 和／或接收机系统 1750 还可以应用于多输入单输出系统，其中例如多个发射天线（例如，在基站上）可以向单个天线设备（例如，移动站）发送一个或多个符号流。另外，应该理解，可以结合单输出到单输入天线系统来利用本文所述的发射机系统 1710 和／或接收机系统 1750 的方案。

[0097] 根据一个方案，在发射机系统 1710，从数据源 1712 向发射 (TX) 数据处理器 1717 提供多个数据流的业务数据。在一个实例中，然后可以经由各个发射天线来发送每个数据流。另外，TX 数据处理器 1714 可以基于为每个数据流所选择的特定编码方案，对该数据流的业务数据进行格式化、编码和交织，以提供编码数据。在一个实例中，然后可以使用 OFDM 技术将每个数据流的编码数据与导频数据复用在一起。导频数据例如可以是以已知方式处理的已知数据模式。并且，可以在接收机系统 1750 处使用导频数据来估计信道响应。回到发射机系统 1710，可以基于为每个数据流所选择的特定调制方案（例如，BPSK、QPSK、M-PSK 或 M-QAM)，对该数据流的复用的导频和编码数据进行调制（例如，符号映射）以提供调制符号。在一个实例中，通过处理器 1730 上执行的和／或处理器 1730 提供的指令来确定每个数据流的数据速率、编码和调制。

[0098] 然后，向 TX MIMO 处理器 1720 提供所有数据流的调制符号，TX MIMO 处理器 1720 可以进一步处理这些调制符号（例如，用于 OFDM)。然后，TX MIMO 处理器 1720 向 N_T 个收发机 1722a 到 1722t 提供 N_T 个调制符号流。在一个实例中，每个收发机 1722 可以接收和处理各自的符号流，以便提供一个或多个模拟信号。每个收发机 1722 然后进一步调节（例如，放大、滤波和上变频）这些模拟信号以便提供适合于在 MIMO 信道上传输的已调信号。从而，然后分别从 N_T 个天线 1724a 到 1724t 发射来自收发机 1722a 到 1722t 的 N_T 个已调信号。

[0099] 根据另一个方案，在接收机系统 1750，可以通过 N_R 个天线 1752a 到 1752r 接收所发送的已调信号。然后将从每个天线 1752 接收的信号提供给各自的收发机 1754r。在一个实例中，每个收发机 1754 可以调节（例如，滤波、放大和下变频）各自的接收信号，对调节后的信号进行数字化以提供采样，并进一步处理这些采样以提供相应的“接收”符号流。然后，RX MIMO/ 数据处理器 1760 可以基于特定的接收机处理技术，从 N_R 个收发机 1754 接

收 N_R 个接收符号流并对其进行处理，以便提供 N_T 个“检测”符号流。在一个实例中，每个检测符号流可以包括作为为对应的数据流所传输的调制符号的估计的符号。然后 RX 处理器 1760 可以至少部分地通过解调、解交织和解码每个检测符号流来处理每个符号流，以恢复对应的数据流的业务数据。因此，RX 处理器 1760 所执行的处理与发射机系统 1710 处的 TX MIMO 处理器 1720 和 TX 数据处理器 1714 所执行的处理相反。RX 处理器 1760 还可以将处理后的符号流提供给数据宿 1764。

[0100] 根据一个方案，可以使用 RX 处理器 1760 所生成的信道响应估计来在接收机执行空／时处理、调整功率水平、改变调制速率或方案和／或其它适当的动作。另外，RX 处理器 1760 还可以估计信道特性，例如，检测符号流的信号与噪声干扰比 (SNR)。RX 处理器 1760 然后可以向处理器 1770 提供估计的信道特性。在一个实例中，RX 处理器 1760 和／或处理器 1770 还可以得出用于该系统的“操作”SNR 的估计。处理器 1770 然后可以提供信道状态信息 (CSI)，CSI 可以包括关于通信链路和／或接收数据流的信息。该信息可以包括，例如，操作 SNR。CSI 然后可以由 TX 数据处理器 1718 进行处理、由调制器 1780 进行调制、由收发机 1754a 到 1754r 进行调节并且传输回到发射机系统 1710。另外，接收机系统 1750 处的数据源 1716 可以提供将要由 TX 数据处理器 1718 处理的附加数据。

[0101] 回到发射机系统 1710，然后，来自接收机系统 1750 的已调信号由天线 1724 进行接收、由收发机 1722 进行调节、由解调器 1740 进行解调并且由 RX 数据处理器 1742 进行处理，以恢复接收机系统 1750 所报告的 CSI。在一个实例中，然后可以向处理器 1730 提供所报告的 CSI，并且将其用于确定将要用于一个或多个数据流的数据速率以及编码和调制方案。所确定的编码和调制方案然后可以提供给收发机 1722 以进行均衡和／或用于到接收机系统 1750 的稍后传输。另外和／或可替换地，处理器 1730 可以使用所报告的 CSI 来生成对于 TX 数据处理器 1714 和 TX MIMO 处理器 1718 的各种控制。在另一个实例中，CSI 和／或由 RX 数据处理器 1742 处理的其它信息可以提供给数据宿 1744。

[0102] 在一个实例中，发射机系统 1710 处的处理器 1730 和接收机系统 1750 处的处理器 1770 指导它们各自的系统上的操作。此外，发射机系统 1710 处的存储器 1732 和接收机系统 1750 处的存储器 1772 可以分别存储用于由处理器 1730 和 1770 使用的程序代码和数据。此外，在接收机系统 1750，可以使用各种处理技术来处理 N_R 个接收信号，以检测 N_T 个发射符号流。这些接收机处理技术可以包括空间和空时接收机处理技术，其还可以被称为均衡技术和／或“连续迫零／均衡和干扰消除”接收机处理技术，其还可以被称为“连续干扰消除”或“连续消除”接收机处理技术。

[0103] 应当理解，可以用硬件、软件、固件、中间件、微代码或其任意组合来实现本申请描述的方案。当使用软件、固件、中间件或微代码、程序代码或代码段来实现这些系统和／或方法时，可以将它们存储于诸如存储组件的机器可读介质中。代码段可以表示过程、函数、子程序、程序、例程、子例程、模块、软件包、类、或者指令、数据结构或程序语句的任意组合。可以通过传递和／或接收信息、数据、自变量、参数或存储器内容，将代码段连接到另一代码段或硬件电路。可以通过任何适当的方式，包括存储器共享、消息传递、令牌传递和网络传输等，对信息、自变量、参数、数据等进行传递、转发或发射。

[0104] 对于软件实现，本申请中描述的技术可用执行本申请所述功能的模块（例如，过程、函数等）来实现。软件代码可以存储在存储器单元中，并由处理器执行。存储器单元可

以实现在处理器内，也可以实现在处理器外部，在后一种情况下，它经由各种本领域已知的手段可通信地耦合到处理器。

[0105] 上文的描述包括一个或多个方案的举例。当然，我们不可能为了描述上述方案而描述部件或方法的所有可能的结合，但是本领域普通技术人员应该认识到，各个实施例可以做进一步的结合和变换。因此，所描述的方案旨在涵盖落入所附权利要求书的精神和保护范围内的所有改变、修改和变形。此外，就说明书或权利要求书中使用的“包含”一词而言，该词的涵盖方式类似于“包括”一词，就如同“包括”一词在权利要求中用作衔接词所解释的那样。此外，无论在说明书还是在权利要求书中所使用的“或”一词意味“非排他性的或”。

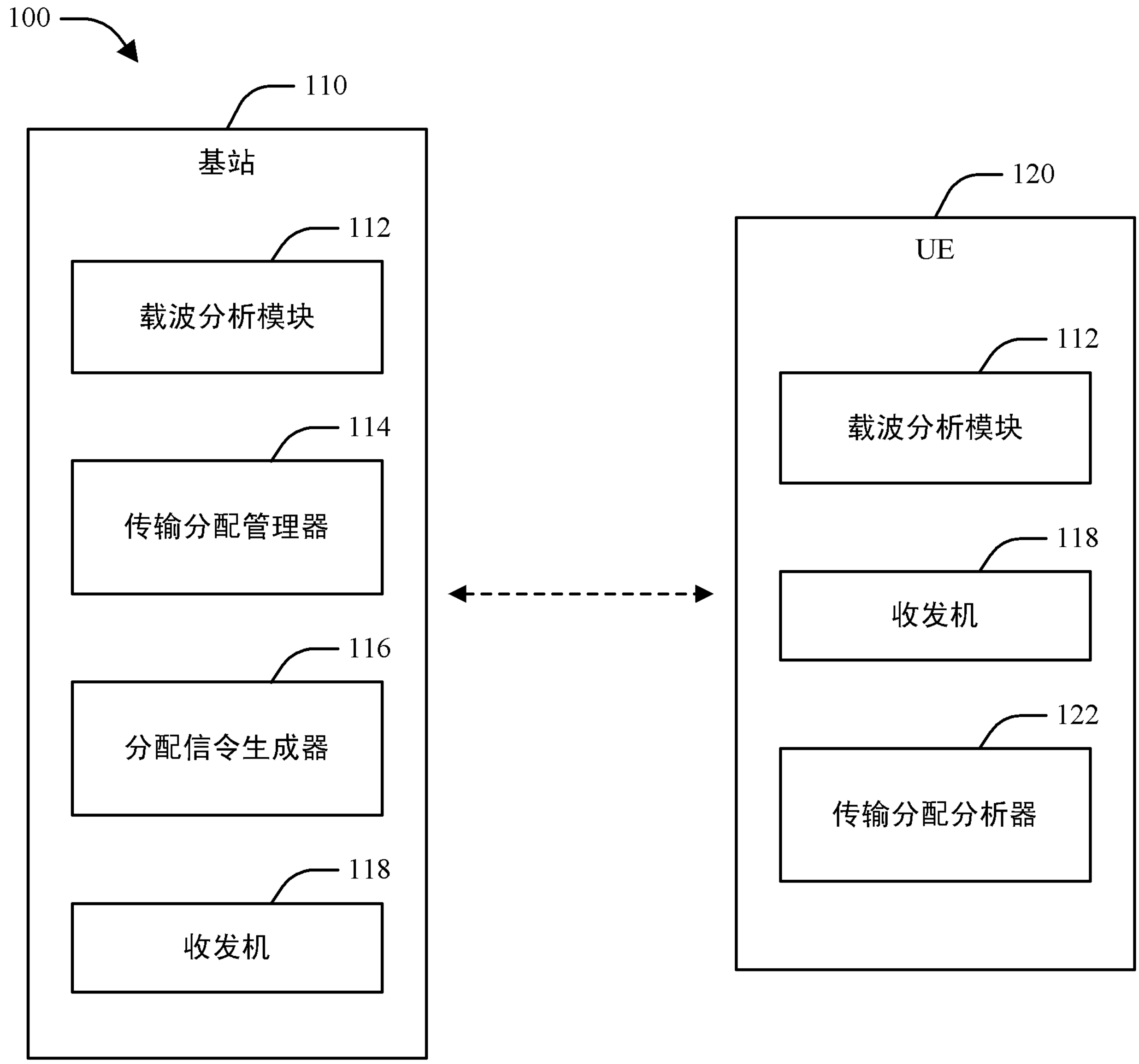

100
110
基站
112
载波分析模块
114
传输分配管理器
116
分配信令生成器
118
收发机
120
UE
112
载波分析模块
118
收发机
122
传输分配分析器

图 1

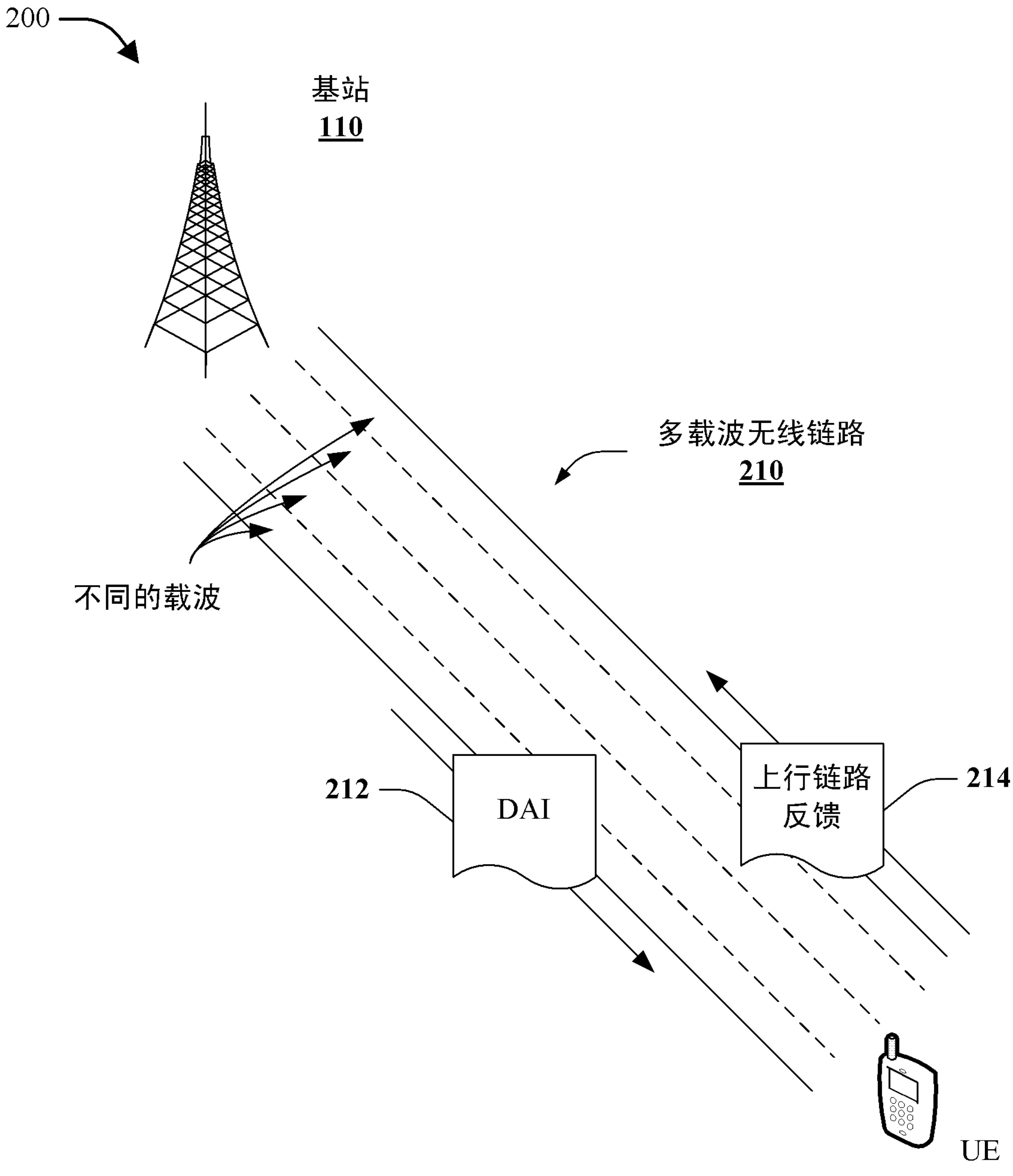


图 2

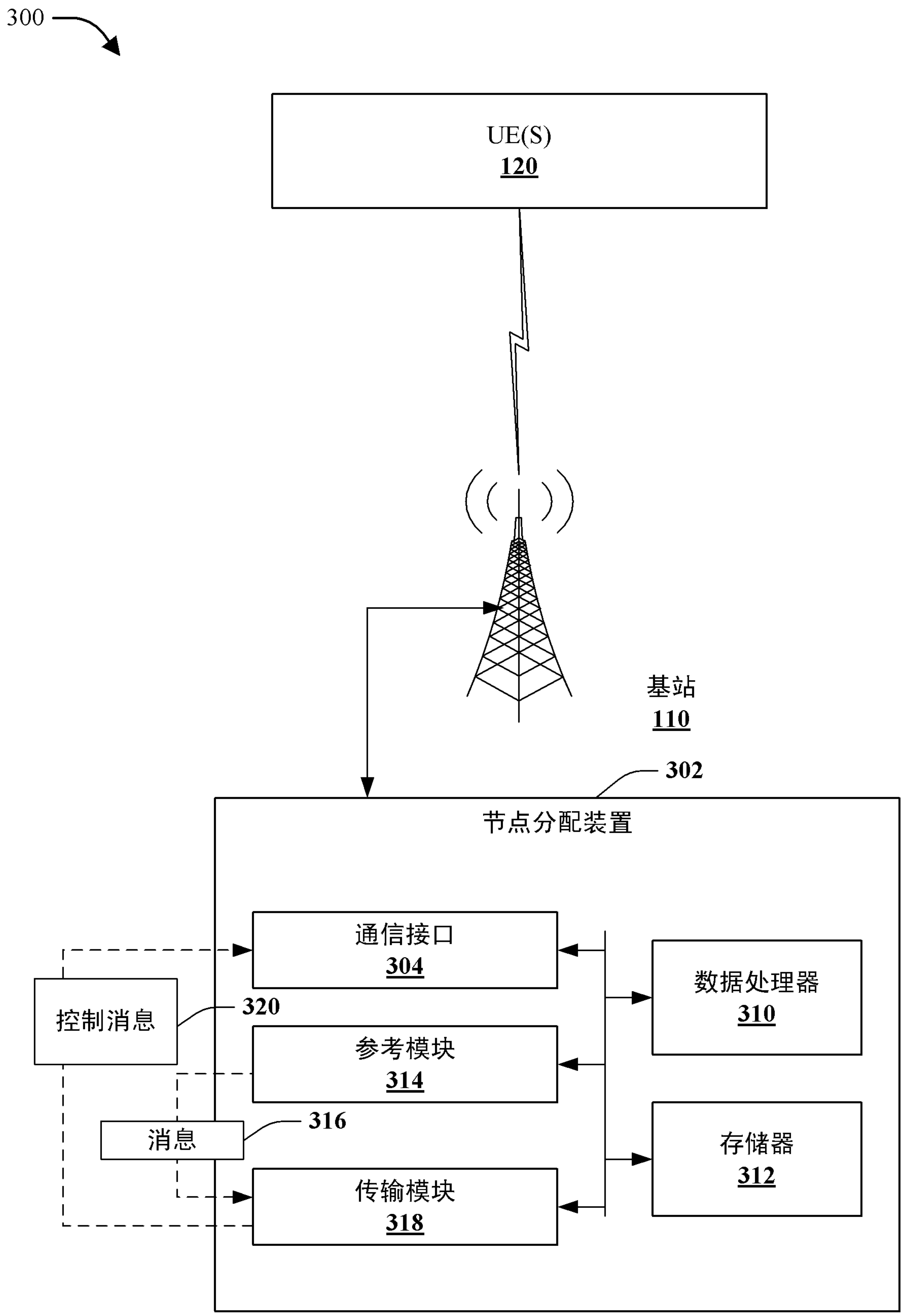

300
UE(S)
120
基站
110
302
节点分配装置
通信接口
304
参考模块
314
传输模块
318
数据处理器
310
存储器
312
控制消息
320
消息
316

图 3

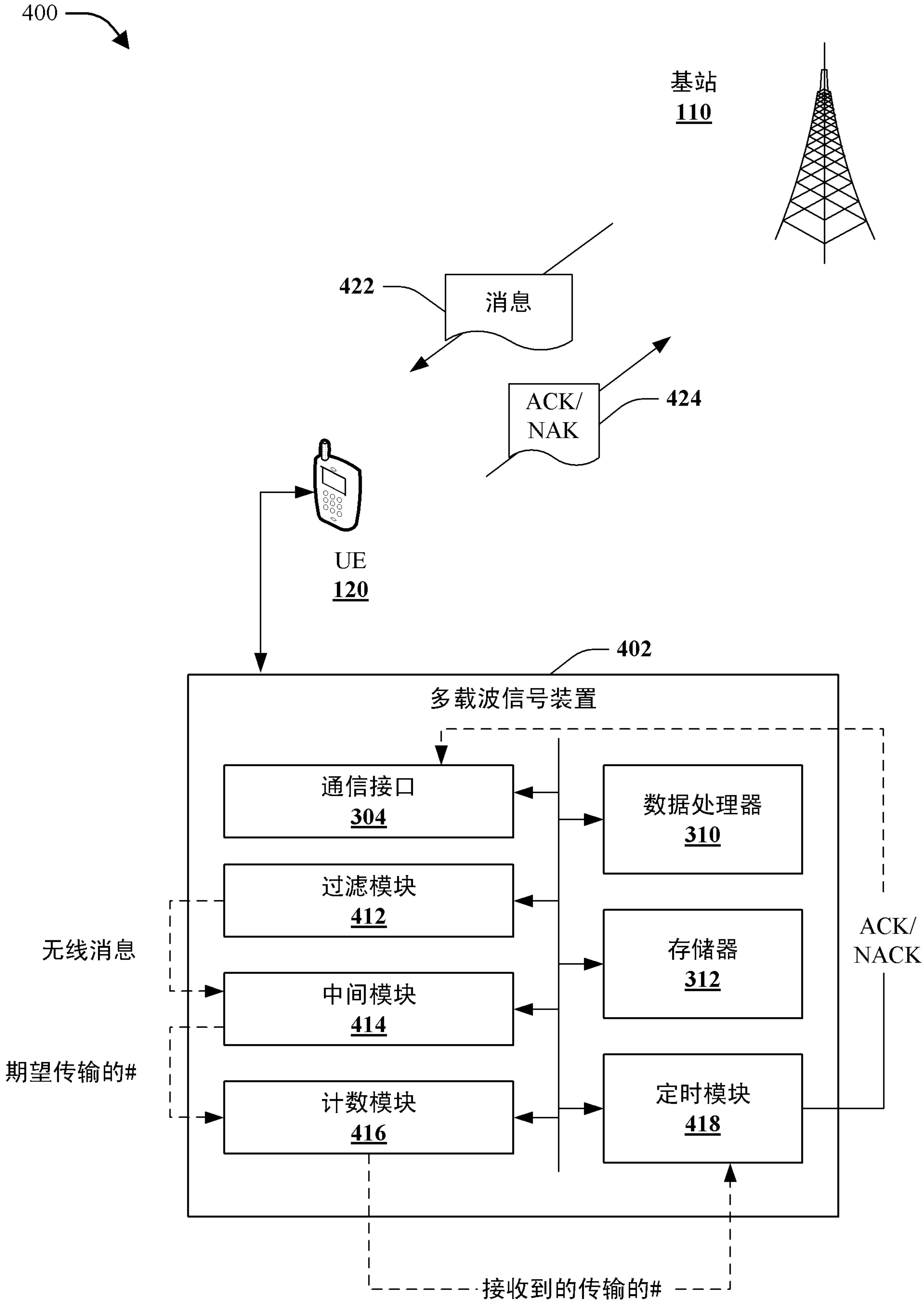

400
基站
110
422
消息
ACK/
NAK
424
UE
120
402
多载波信号装置
通信接口
304
数据处理器
310
过滤模块
412
存储器
312
中间模块
414
计数模块
416
定时模块
418
无线消息
期望传输的#
ACK/
NACK
接收到的传输的#

图 4

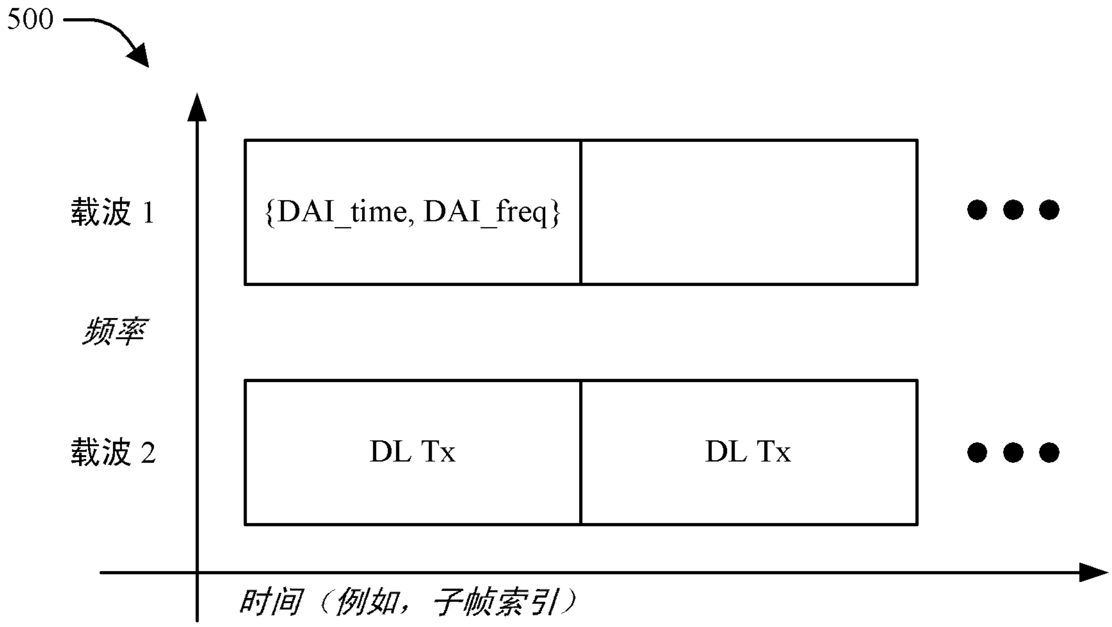

500
载波 1
{DAI_time, DAI_freq}
频率
载波 2
DL Tx
DL Tx
时间（例如，子帧索引）

图 5

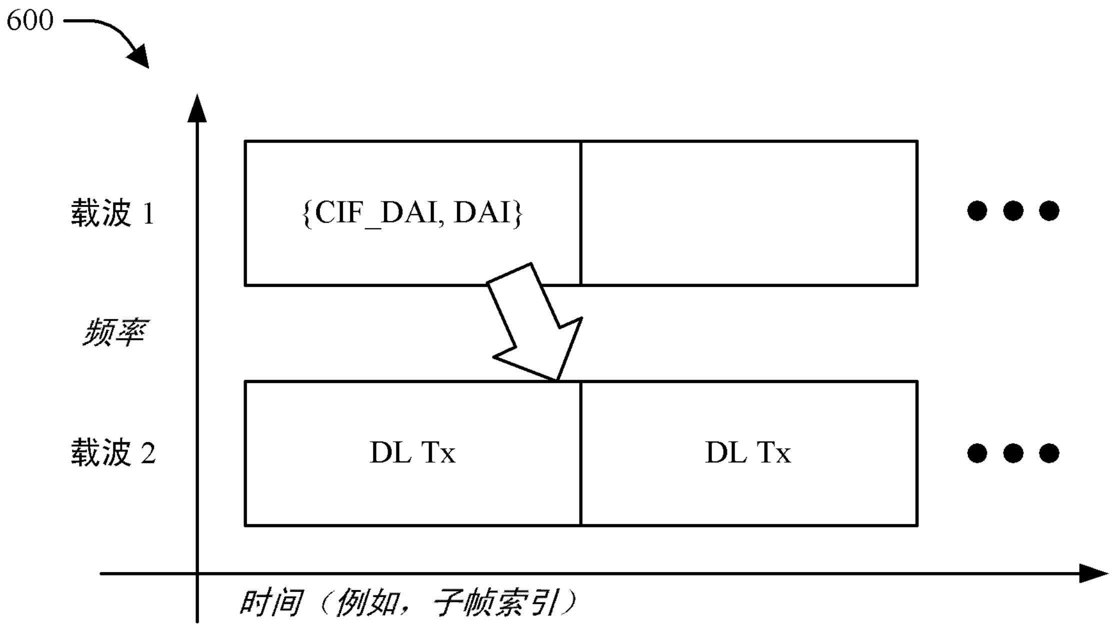

600
载波 1
{CIF_DAI, DAI}
频率
载波 2
DL Tx
DL Tx
时间（例如，子帧索引）

图 6

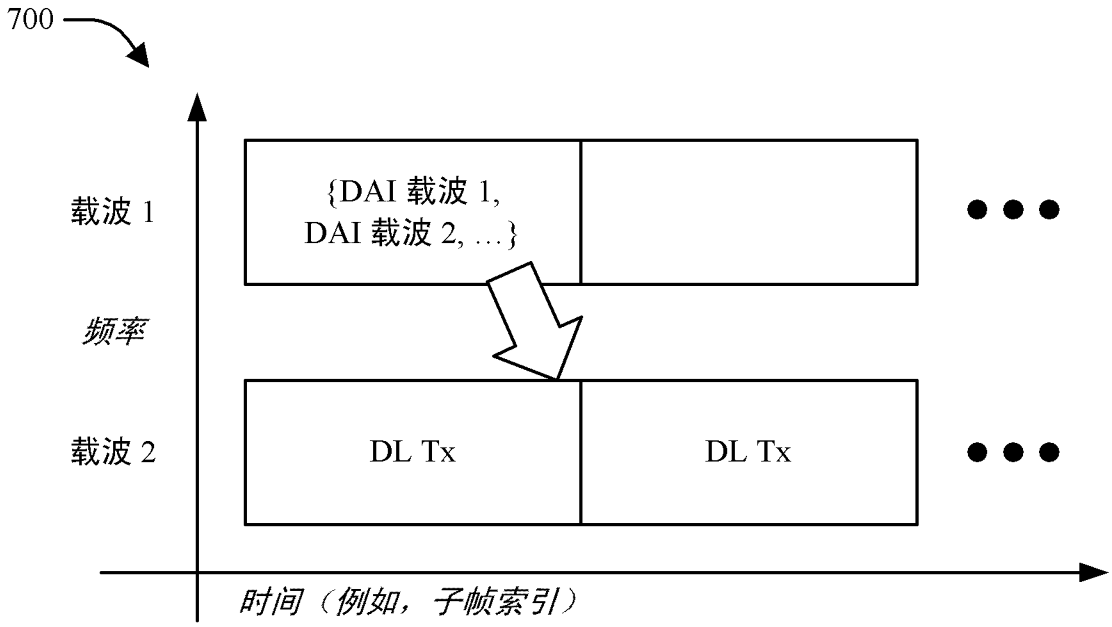

700
载波 1
{DAI 载波 1,
DAI 载波 2, …}
频率
载波 2
DL Tx
DL Tx
时间（例如，子帧索引）

图 7

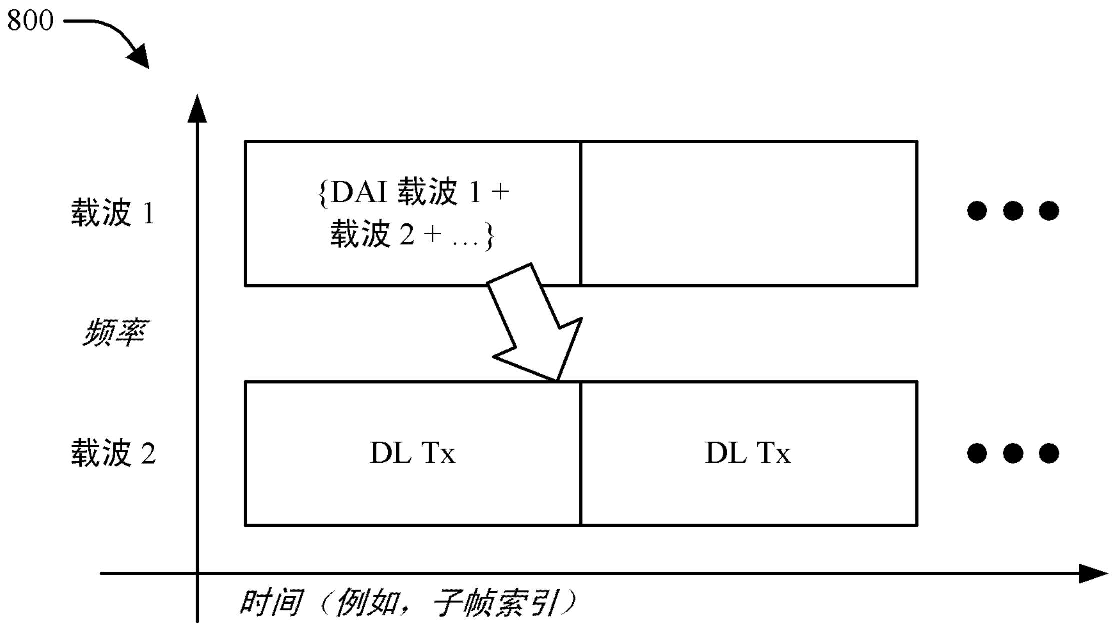

800
载波 1
{DAI 载波 1 +
载波 2 + …}
频率
载波 2
DL Tx
DL Tx
时间（例如，子帧索引）

图 8

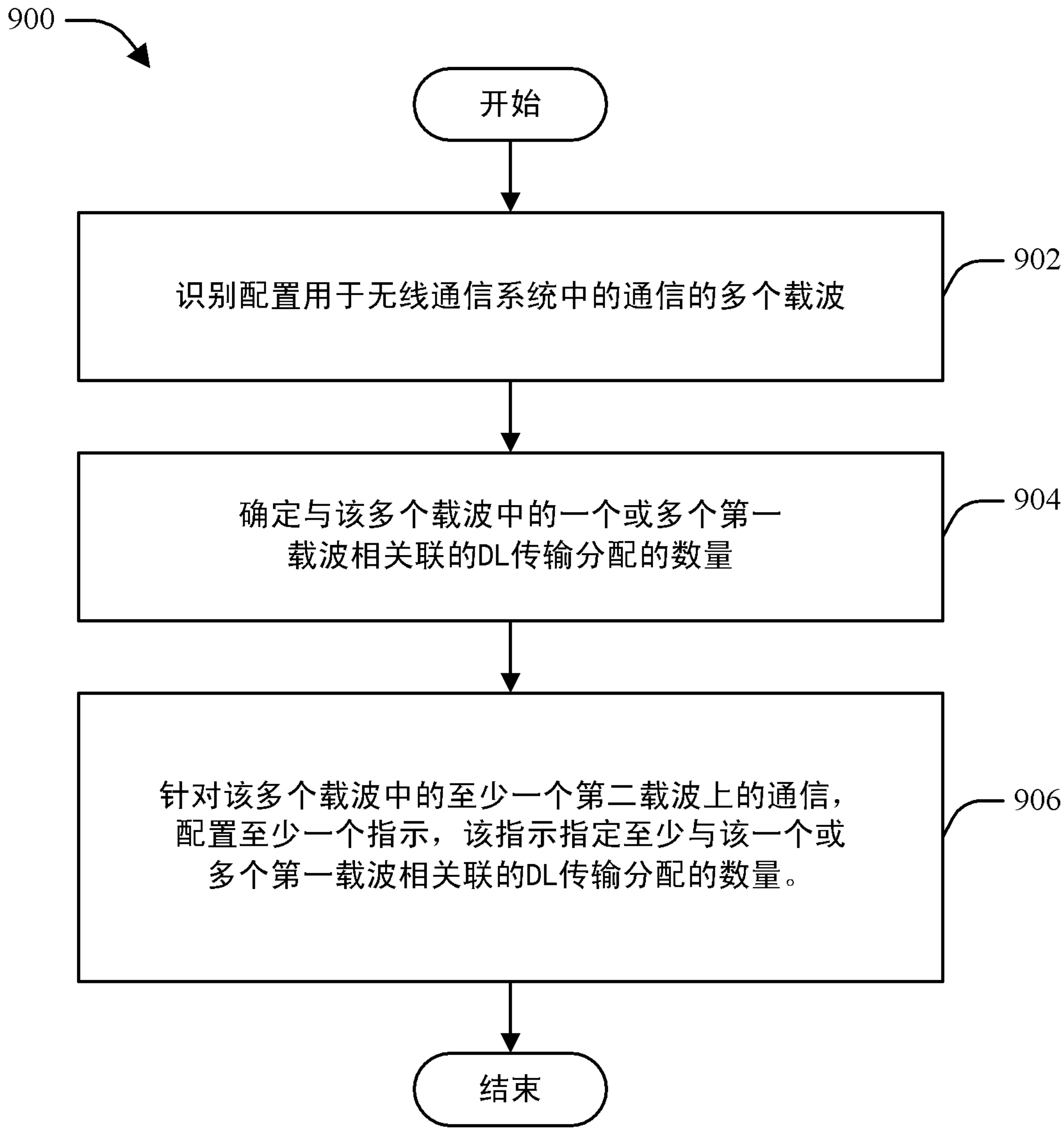

900
开始
识别配置用于无线通信系统中的通信的多个载波
902
确定与该多个载波中的一个或多个第一载波相关联的DL传输分配的数量
904
针对该多个载波中的至少一个第二载波上的通信，配置至少一个指示，该指示指定至少与该一个或多个第一载波相关联的DL传输分配的数量。
906
结束

图 9

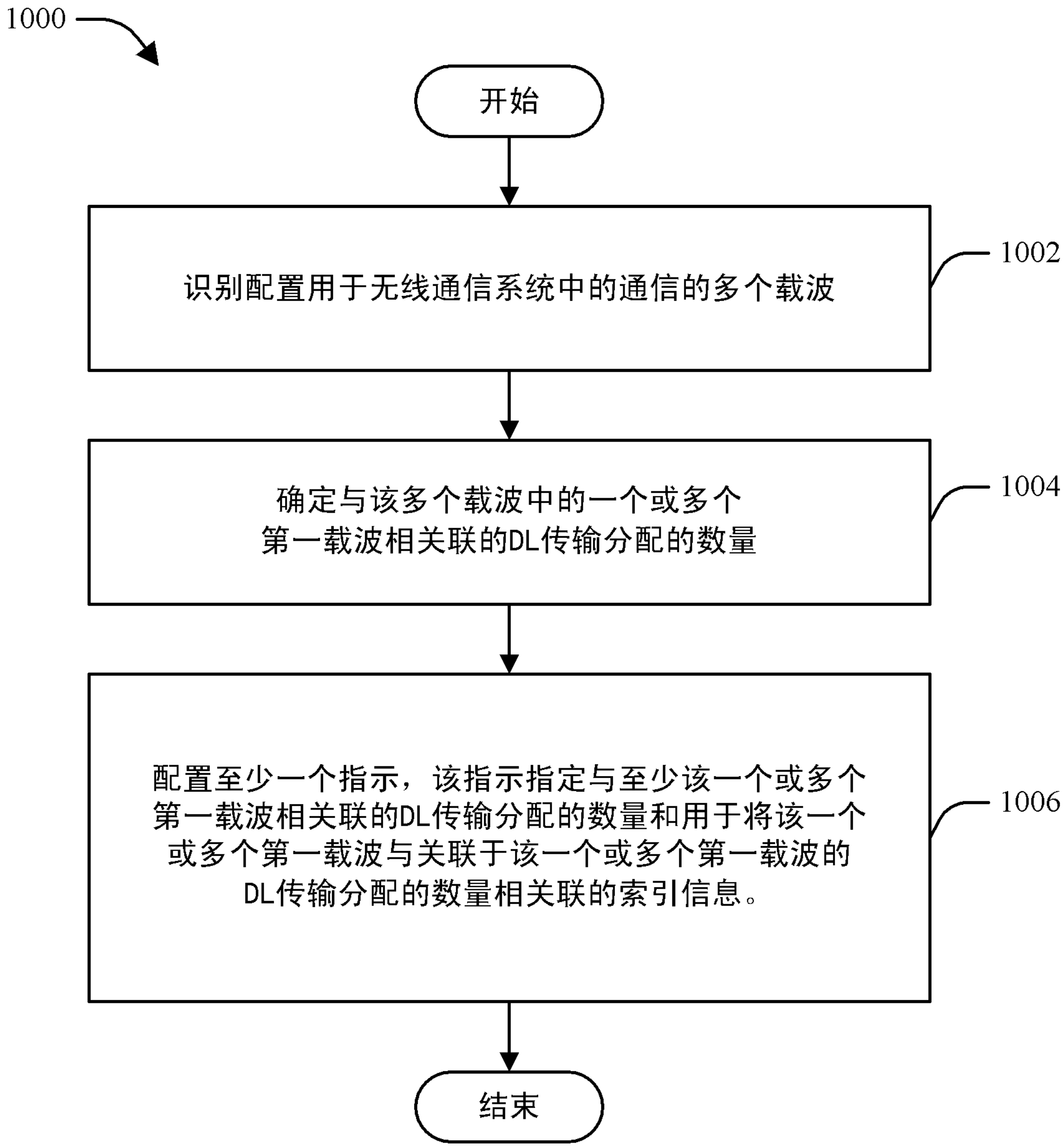

1000
开始
识别配置用于无线通信系统中的通信的多个载波
1002
确定与该多个载波中的一个或多个
第一载波相关联的DL传输分配的数量
1004
配置至少一个指示，该指示指定与至少该一个或多个
第一载波相关联的DL传输分配的数量和用于将该一个
或多个第一载波与关联于该一个或多个第一载波的
DL传输分配的数量相关联的索引信息。
1006
结束

图 10

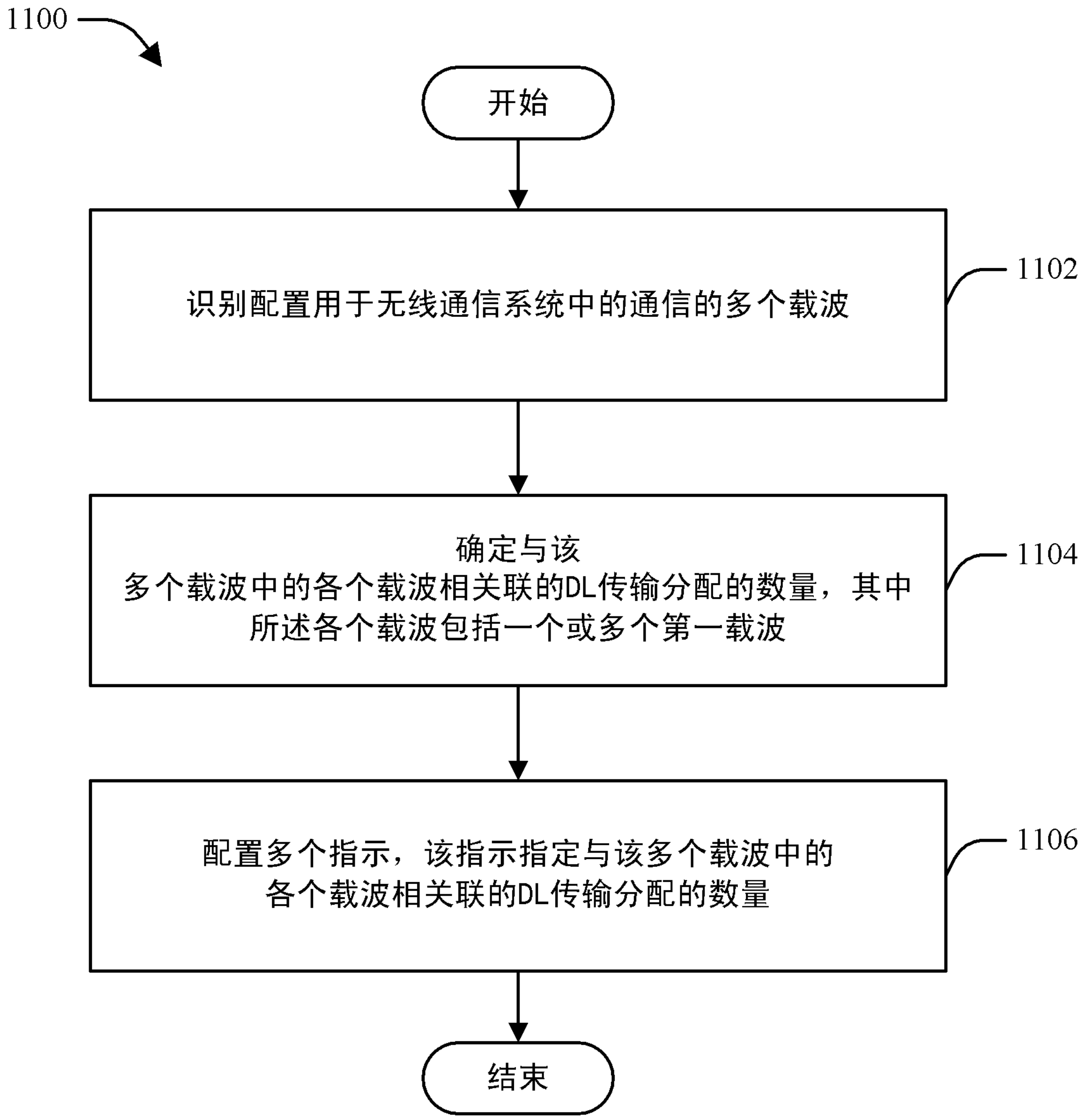

1100
开始
识别配置用于无线通信系统中的通信的多个载波
1102
确定与该
多个载波中的各个载波相关联的DL传输分配的数量，其中
所述各个载波包括一个或多个第一载波
1104
配置多个指示，该指示指定与该多个载波中的
各个载波相关联的DL传输分配的数量
1106
结束

图 11

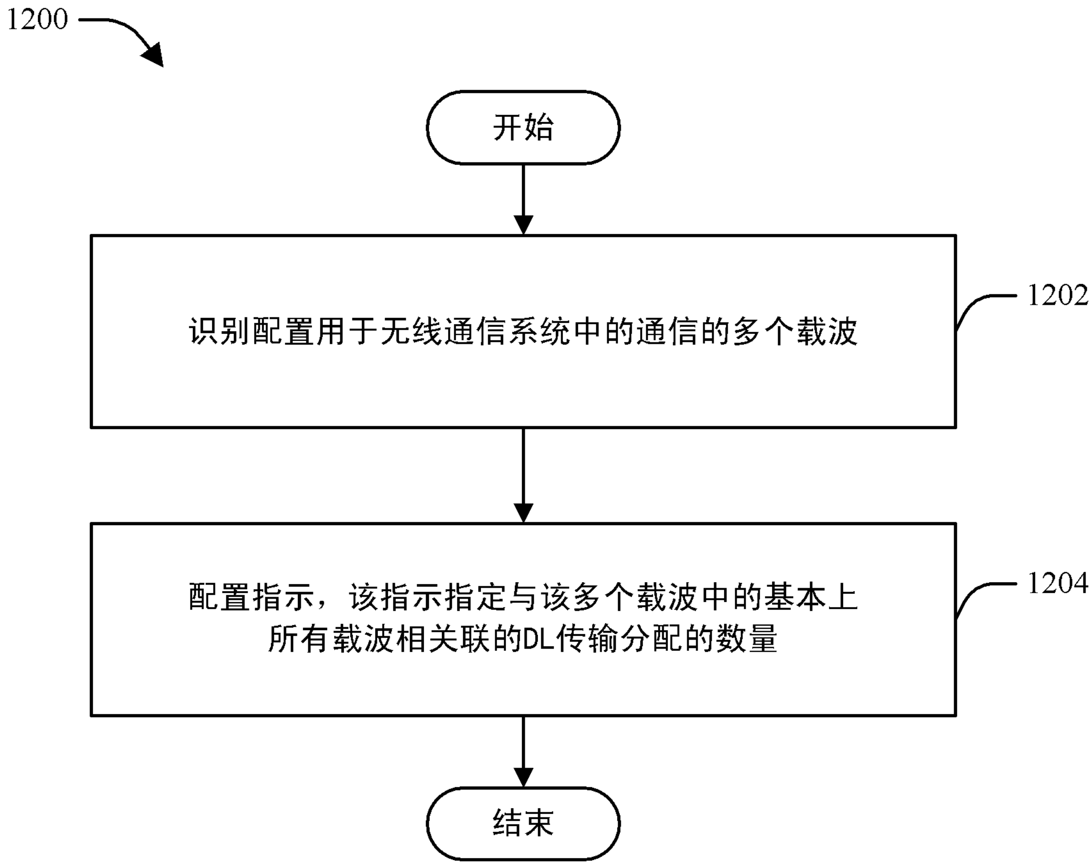

1200
开始
识别配置用于无线通信系统中的通信的多个载波
1202
配置指示，该指示指定与该多个载波中的基本上所有载波相关联的DL传输分配的数量
1204
结束

图 12

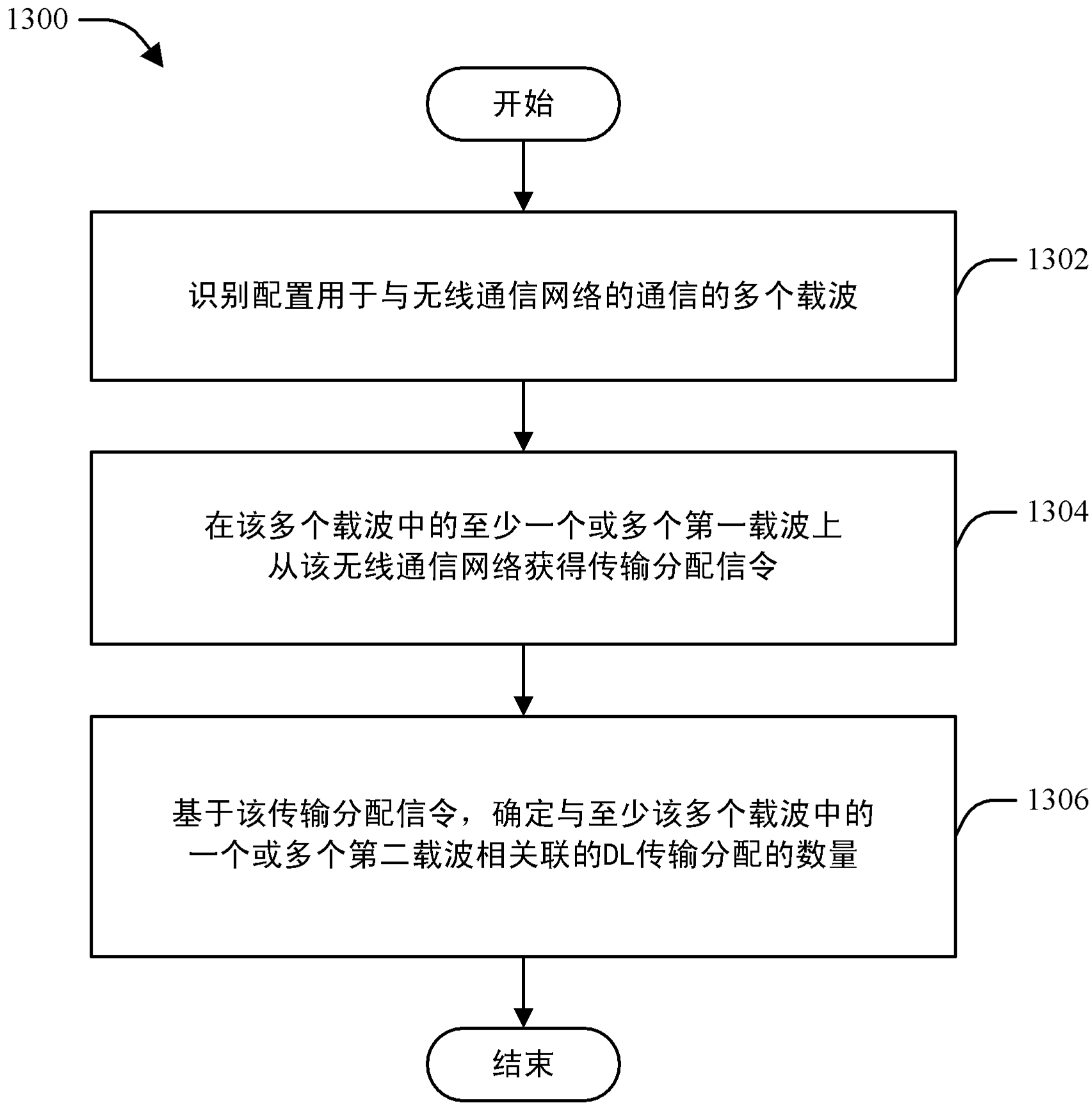

1300
开始
识别配置用于与无线通信网络的通信的多个载波
1302
在该多个载波中的至少一个或多个第一载波上
从该无线通信网络获得传输分配信令
1304
基于该传输分配信令，确定与至少该多个载波中的
一个或多个第二载波相关联的DL传输分配的数量
1306
结束

图 13

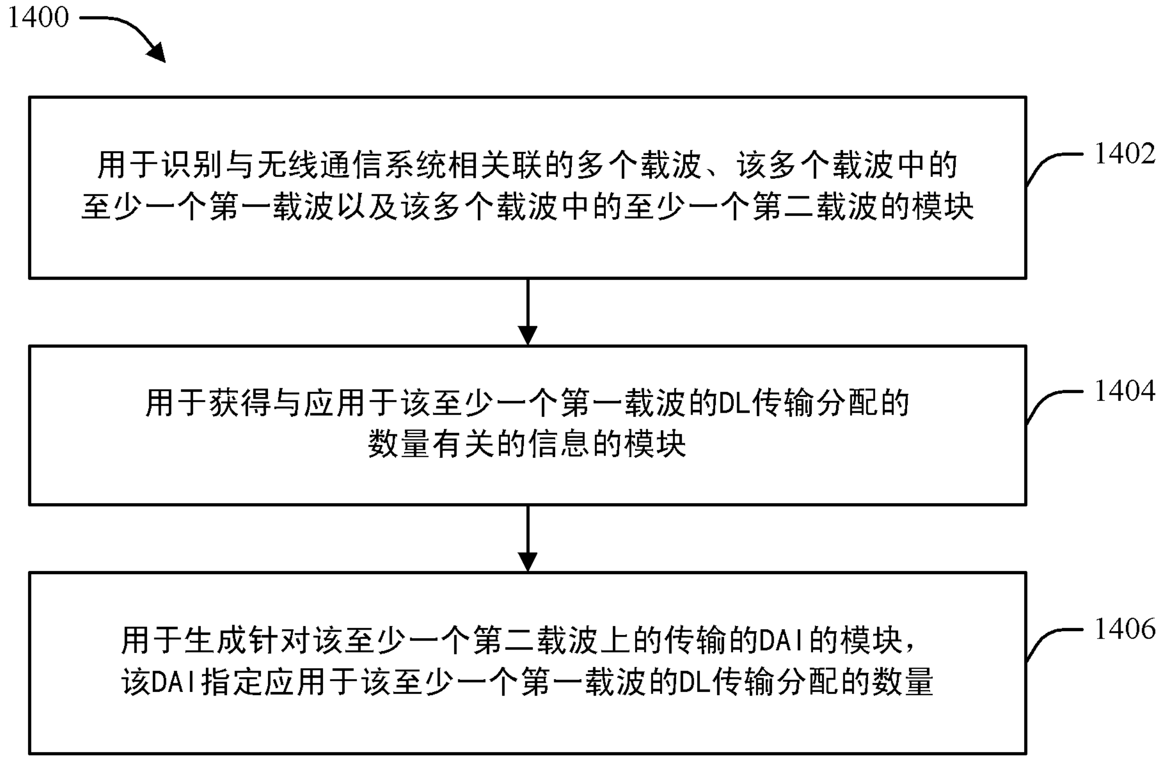

1400
用于识别与无线通信系统相关联的多个载波、该多个载波中的至少一个第一载波以及该多个载波中的至少一个第二载波的模块
1402
用于获得与应用于该至少一个第一载波的DL传输分配的数量有关的信息的模块
1404
用于生成针对该至少一个第二载波上的传输的DAI的模块，该DAI指定应用于该至少一个第一载波的DL传输分配的数量
1406

图 14

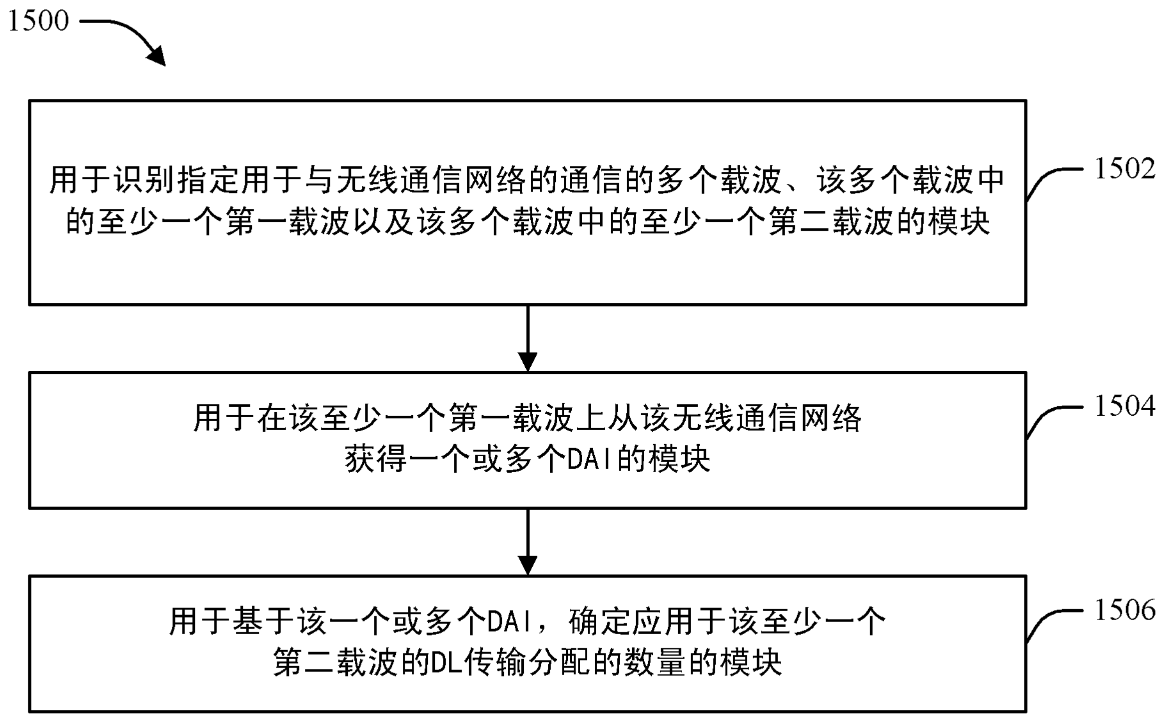

1500
用于识别指定用于与无线通信网络的通信的多个载波、该多个载波中的至少一个第一载波以及该多个载波中的至少一个第二载波的模块
1502
用于在该至少一个第一载波上从该无线通信网络获得一个或多个DAI的模块
1504
用于基于该一个或多个DAI，确定应用于该至少一个第二载波的DL传输分配的数量的模块
1506

图 15

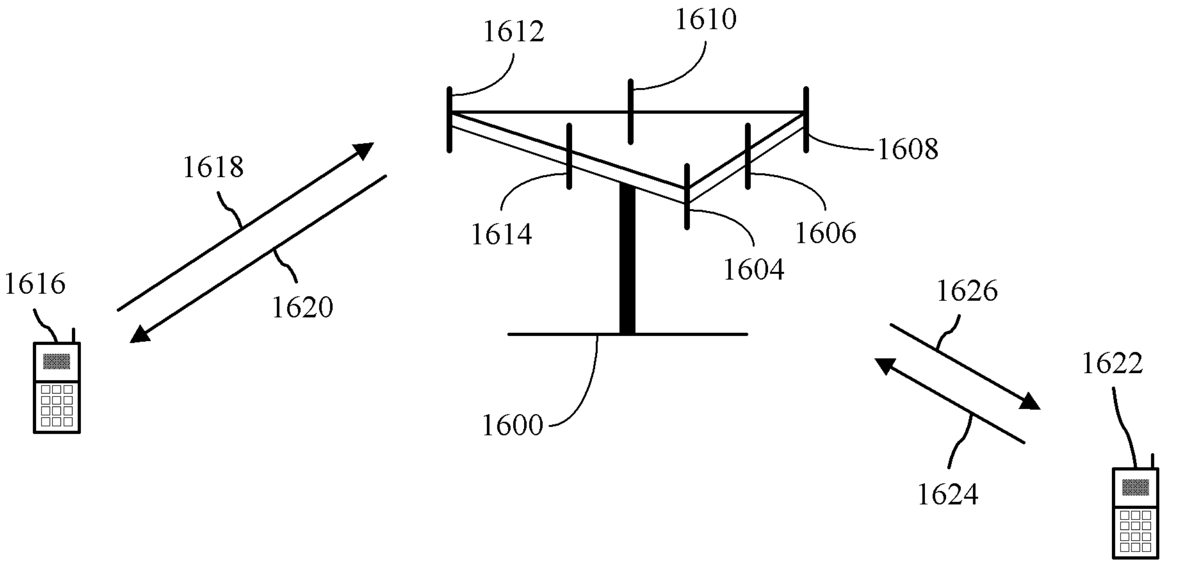

1612
1610
1608
1618
1614
1606
1604
1616
1620
1626
1622
1600
1624

图 16

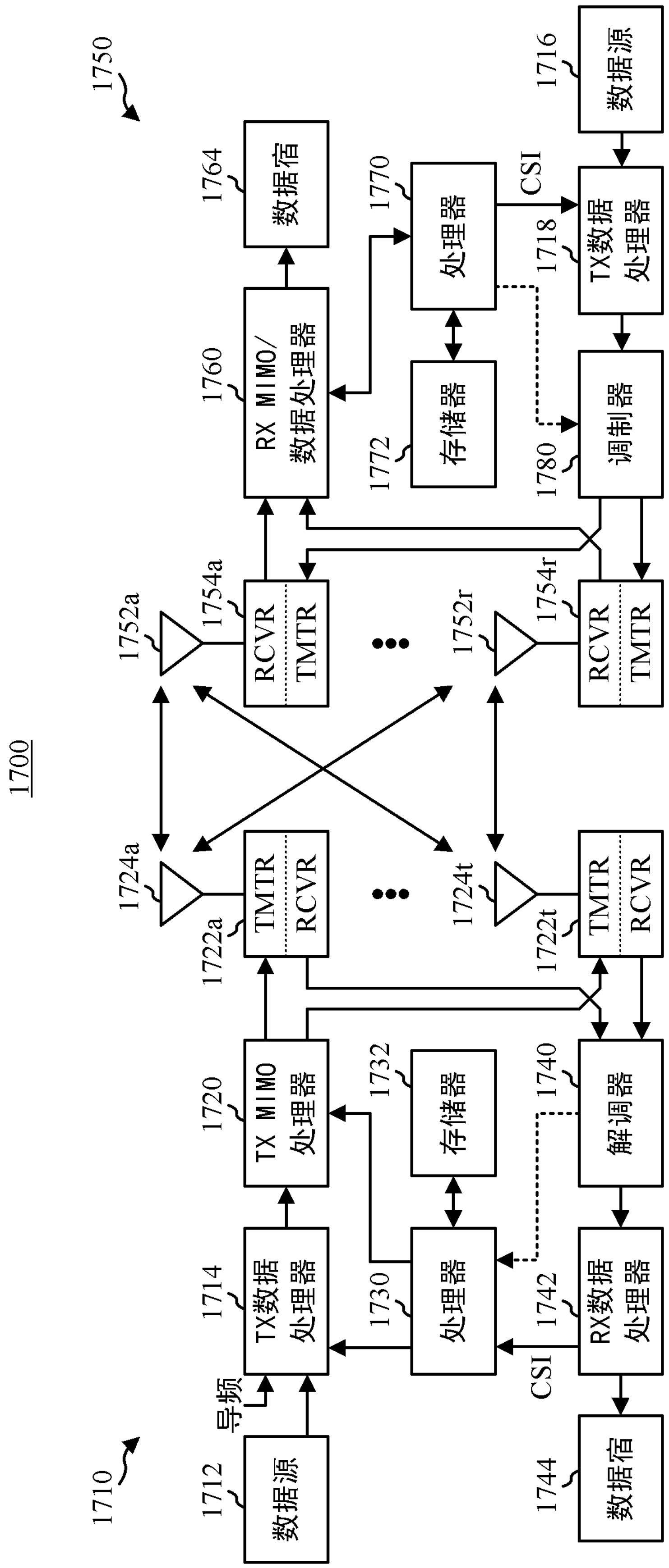

1700
1750
1710
1712 数据源
导频
1714 TX数据处理器
1720 TX MIMO 处理器
1730 处理器
1732 存储器
1722a TMTR RCVR
1722t TMTR RCVR
1724a
1724t
1740 解调器
1742 RX数据处理器
CSI
1744 数据宿
1752a
1752r
1754a RCVR TMTR
1754r RCVR TMTR
1760 RX MIMO/数据处理器
1764 数据宿
1770 处理器
1772 存储器
1780 调制器
1718 TX数据处理器
CSI
1716 数据源

图 17

ABSTRACT

Systems and methodologies are described herein that facilitate various techniques for enhanced downlink assignment index (DAI) signaling in a multi-carrier wireless communication system. As described herein, DAI and/or other indicator signaling transmitted on a first carrier can be configured to carry information relating to a number of downlink transmission assignments applied to at least a second carrier, which in some cases can be disparate from the first carrier. To these ends, described herein are techniques for cross-carrier DAI signaling, multiple DAI signaling, aggregate DAI signaling, and other similar techniques. As additionally described herein, DAI signaling can be related to downlink control transmissions and/or downlink data transmissions in connection with respective techniques that can be applied to the DAI signaling.