# US Patent & Trademark Office
# Patent Public Search | Text View

# TIME DIVISION DUPLEX (TDD) SLOT FORMAT CONFIGURATION INDICATION FOR SIDELINK COMMUNICATIONS

## Abstract

Wireless communications systems and methods related to sidelink communications in a TDD system are provided. A first user equipment (UE) may receive from a base station (BS), a time-division-duplexing (TDD) configuration. The first UE may select a first TDD configuration from a set of configured TDD configurations based on the TDD configuration. Additionally, the first UE may transmit to a second UE, an indication of the first TDD configuration. The first and the second UEs may communicate a sidelink communication based on the first TDD configuration. Other features are also claimed and described.

**Inventors:** **WU; Shuanshuan (San Diego, CA), BAGHEL; Sudhir Kumar (Hillsborough, NJ), GULATI; Kapil (Belle Mead, NJ), SARKIS; Gabi (San Diego, CA), NGUYEN; Tien Viet (Bridgewater, NJ)**

**Applicant:** **QUALCOMM Incorporated** (San Diego, CA)

**Family ID:** **75162643**

**Appl. No.:** **19/047172**

**Filed:** **February 06, 2025**

## Related U.S. Application Data

## Publication Classification

---

## Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS & PRIORITY CLAIM [0001] The present application is a continuation of U.S. Non-Provisional patent application Ser. No. 18/137,316, filed Apr. 20, 2023, which is a continuation of U.S. Non-Provisional patent application Ser. No. 16/948,557, filed Sep. 23, 2020, and issued as U.S. Pat. No. 11,659,552 on May 23, 2023, which claims priority to and the benefit of U.S. Provisional Patent Application No. 62/907,497 filed Sep. 27, 2019. The disclosures of which are hereby incorporated by reference in their entireties as if fully set forth below and for all applicable purposes.

TECHNICAL FIELD
[0002] This application relates to wireless communication systems, and more particularly to communicating an indication of a time division duplex (TDD) for sidelink communications. Aspects may provide solutions and techniques for reducing signaling overhead and improving resource utilization efficiency.
INTRODUCTION
[0003] Wireless communications systems are widely deployed to provide various types of communication content such as voice, video, packet data, messaging, broadcast, and so on. These systems may be capable of supporting communication with multiple users by sharing the available system resources (e.g., time, frequency, and power). A wireless multiple-access communications system may include a number of base stations (BSs), each simultaneously supporting communications for multiple communication devices, which may be otherwise known as user equipment (UE).
[0004] To meet the growing demands for expanded mobile broadband connectivity, wireless communication technologies are advancing from the long-term evolution (LTE) technology to a next generation new radio (NR) technology, which may be referred to as 5.sup.th Generation (5G). For example, NR is designed to provide a lower latency, a higher bandwidth or a higher throughput, and a higher reliability than LTE. NR is designed to operate over a wide array of spectrum bands, for example, from low-frequency bands below about 1 gigahertz (GHz) and mid-frequency bands from about 1 GHz to about 6 GHz, to high-frequency bands such as millimeter wave (mmWave) bands. NR is also designed to operate across different spectrum types, from licensed spectrum to unlicensed and shared spectrum. Spectrum sharing enables operators to opportunistically aggregate spectrums to dynamically support high-bandwidth services. Spectrum sharing can extend the benefit of NR technologies to operating entities that may not have access to a licensed spectrum.
BRIEF SUMMARY OF SOME EXAMPLES
[0005] The following summarizes some aspects of the present disclosure to provide a basic understanding of the discussed technology. This summary is not an extensive overview of all

contemplated features of the disclosure and is intended neither to identify key or critical elements of all aspects of the disclosure nor to delineate the scope of any or all aspects of the disclosure. Its sole purpose is to present some concepts of one or more aspects of the disclosure in summary form as a prelude to the more detailed description that is presented later.

[0006] In a wireless communication network, a BS may communicate with a UE in an uplink direction and a downlink direction. Earlier forms of sidelink were introduced in LTE to allow a UE to send data to another UE without tunneling through the BS and/or an associated core network. The LTE sidelink technology has been extended to provision for device-to-device (D2D) communications, vehicle-to-everything (V2X) communications, and/or cellular vehicle-to-everything (C-V2X) communications. Similarly, NR may be extended to support sidelink communications, D2D communications, V2X communications, and/or C-V2X over licensed bands and/or unlicensed bands.

[0007] Aspects of the present disclosure provide mechanisms for identifying a sidelink time-division-duplexing (TDD) configuration for use in sidelink communications. Sidelink communications allow a user equipment (UE) to communicate with another UE without tunneling through a base station (BS) and/or the core network. An in-coverage UE may be within a coverage area of a BS and thus may be in communication with the BS. The in-coverage sidelink UE may be preconfigured with a set of sidelink TDD configurations, may receive a BS TDD configuration from a serving BS, and may select a sidelink TDD configuration from the set of sidelink TDD configurations to match the BS TDD configuration. Additionally, the in-coverage sidelink UE may transmit an indication of the selected sidelink TDD configuration to a second UE. Accordingly, rather than transmit the selected sidelink TDD configuration in its entirety to the second UE, the first UE transmits an indication of the selected sidelink TDD configuration. In some aspects, a first UE may broadcast a sidelink TDD configuration indication. A second UE may receive the sidelink TDD configuration indication and identify, based on the sidelink TDD configuration indication, a sidelink TDD configuration from a preconfigured set of sidelink TDD configurations. The first UE and the second UE may communicate a sidelink communication based on the sidelink TDD configuration. The phrases "TDD configuration" and "sidelink TDD configuration" may be used interchangeably in the present disclosure. Additionally, the phrases "set of sidelink TDD configurations" and "set of configured TDD configurations" may be used interchangeably in the present disclosure.

[0008] In an aspect of the disclosure, a method of wireless communication includes receiving, by a first UE from a BS, a TDD configuration; selecting, by the first UE, a first TDD configuration from a set of configured TDD configurations based on the TDD configuration; transmitting, by the first UE to a second UE, an indication of the first TDD configuration; and communicating, by the first UE, a sidelink communication based on the first TDD configuration.

[0009] In an aspect of the disclosure, a method of wireless communication includes receiving, by a first UE from a second UE, a TDD configuration indication; identifying, by the first UE, a first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication; and communicating, by the first UE, a sidelink communication based on the first TDD configuration.

[0010] In an aspect of the disclosure, an apparatus of wireless communication includes a transceiver configured to: receive, by a first UE from a BS, a TDD configuration; transmit, by the first UE to a second UE, an indication of a first TDD configuration; and communicate, by the first UE, a sidelink communication based on the first TDD configuration. The apparatus also includes a processor configured to select, by the first UE, the first TDD configuration from a set of configured TDD configurations based on the TDD configuration.

[0011] In an aspect of the disclosure, an apparatus of wireless communication includes a transceiver configured to: receive, by a first UE from a second UE, a TDD configuration indication; and communicate, by the first UE, a sidelink communication based on a first TDD

configuration. The apparatus also includes a processor configured to identify, by the first UE, the first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication.

[0012] In an additional aspect of the disclosure, a computer-readable medium having program code recorded thereon, the program code includes code for causing a first UE to receive from a BS, a TDD configuration; code for causing the first UE to select a first TDD configuration from a set of configured TDD configurations based on the TDD configuration; code for causing the first UE to transmit to a second UE, an indication of the first TDD configuration; and code for causing the first UE to communicate a sidelink communication based on the first TDD configuration.

[0013] In an additional aspect of the disclosure, a computer-readable medium having program code recorded thereon, the program code includes code for causing a first UE to receive from a second UE, a TDD configuration indication; code for causing the first UE to identify a first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication; and code for causing the first UE to communicate with the second UE, a sidelink communication based on the first TDD configuration.

[0014] In an additional aspect of the disclosure, an apparatus includes means for receiving from a BS, a TDD configuration; means for selecting a first TDD configuration from a set of configured TDD configurations based on the TDD configuration; means for transmitting to a second UE, an indication of the first TDD configuration; and means for communicating with the second UE, a sidelink communication based on the first TDD configuration.

[0015] In an additional aspect of the disclosure, an apparatus includes means for receiving from a second UE, a TDD configuration indication; means for identifying a first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication; and means for communicating with the second UE, a sidelink communication based on the first TDD configuration.

[0016] Other aspects, features, and embodiments of the present invention will become apparent to those of ordinary skill in the art, upon reviewing the following description of specific, exemplary embodiments of the present invention in conjunction with the accompanying figures. While features of the present invention may be discussed relative to certain embodiments and figures below, all embodiments of the present invention can include one or more of the advantageous features discussed herein. In other words, while one or more embodiments may be discussed as having certain advantageous features, one or more of such features may also be used in accordance with the various embodiments of the invention discussed herein. In similar fashion, while exemplary embodiments may be discussed below as device, system, or method embodiments it should be understood that such exemplary embodiments can be implemented in various devices, systems, and methods.

## Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIG. **1** illustrates a wireless communication network according to some aspects of the present disclosure.

[0018] FIG. **2** illustrates a wireless communication network that provisions for sidelink communications according to some aspects of the present disclosure.

[0019] FIG. **3** illustrates a time-division-duplexing (TDD) configuration according to some aspects of the present disclosure.

[0020] FIG. **4** is a block diagram of a user equipment (UE) according to some aspects of the present disclosure.

[0021] FIG. **5** is a block diagram of a base station (BS) according to some aspects of the present

disclosure.

[0022] FIG. **6** is a signaling diagram of a sidelink communication method according to some aspects of the present disclosure.

[0023] FIG. **7** is an index table according to some aspects of the present disclosure.

[0024] FIG. **8** is a signaling diagram of a sidelink communication method 8 according to some aspects of the present disclosure.

[0025] FIG. **9** is a flow diagram of a communication method according to some aspects of the present disclosure.

[0026] FIG. **10** is a flow diagram of a communication method according to some aspects of the present disclosure.

DETAILED DESCRIPTION

[0027] The detailed description set forth below, in connection with the appended drawings, is intended as a description of various configurations and is not intended to represent the only configurations in which the concepts described herein may be practiced. The detailed description includes specific details for the purpose of providing a thorough understanding of the various concepts. However, it will be apparent to those skilled in the art that these concepts may be practiced without these specific details. In some instances, well-known structures and components are shown in block diagram form in order to avoid obscuring such concepts.

[0028] This disclosure relates generally to wireless communications systems, also referred to as wireless communications networks. In various embodiments, the techniques and apparatus may be used for wireless communication networks such as code division multiple access (CDMA) networks, time division multiple access (TDMA) networks, frequency division multiple access (FDMA) networks, orthogonal FDMA (OFDMA) networks, single-carrier FDMA (SC-FDMA) networks, LTE networks, Global System for Mobile Communications (GSM) networks, 5.sup.th Generation (5G) or new radio (NR) networks, as well as other communications networks. As described herein, the terms "networks" and "systems" may be used interchangeably.

[0029] An OFDMA network may implement a radio technology such as evolved UTRA (E-UTRA), Institute of Electrical and Electronics Engineers (IEEE) 802.11, IEEE 802.16, IEEE 802.20, flash-OFDM and the like. UTRA, E-UTRA, and GSM are part of universal mobile telecommunication system (UMTS). In particular, long term evolution (LTE) is a release of UMTS that uses E-UTRA. UTRA, E-UTRA, GSM, UMTS and LTE are described in documents provided from an organization named "3rd Generation Partnership Project" (3GPP), and cdma2000 is described in documents from an organization named "3rd Generation Partnership Project 2" (3GPP2). These various radio technologies and standards are known or are being developed. For example, the 3rd Generation Partnership Project (3GPP) is a collaboration between groups of telecommunications associations that aims to define a globally applicable third generation (3G) mobile phone specification. 3GPP long term evolution (LTE) is a 3GPP project which was aimed at improving the UMTS mobile phone standard. The 3GPP may define specifications for the next generation of mobile networks, mobile systems, and mobile devices. The present disclosure is concerned with the evolution of wireless technologies from LTE, 4G, 5G, NR, and beyond with shared access to wireless spectrum between networks using a collection of new and different radio access technologies or radio air interfaces.

[0030] In particular, 5G networks contemplate diverse deployments, diverse spectrum, and diverse services and devices that may be implemented using an OFDM-based unified, air interface. In order to achieve these goals, further enhancements to LTE and LTE-A are considered in addition to development of the new radio technology for 5G NR networks. The 5G NR will be capable of scaling to provide coverage (1) to a massive Internet of things (IoTs) with a ULtra-high density (e.g., ˜1M nodes/km.sup.2), ultra-low complexity (e.g., ˜10 s of bits/sec), ultra-low energy (e.g., ˜10+ years of battery life), and deep coverage with the capability to reach challenging locations; (2) including mission-critical control with strong security to safeguard sensitive personal, financial, or

classified information, ultra-high reliability (e.g., ˜99.9999% reliability), ultra-low latency (e.g., ˜1 ms), and users with wide ranges of mobility or lack thereof; and (3) with enhanced mobile broadband including extreme high capacity (e.g., ˜10 Tbps/km.sup.2), extreme data rates (e.g., multi-Gbps rate, 100+ Mbps user experienced rates), and deep awareness with advanced discovery and optimizations.

[0031] The 5G NR may be implemented to use optimized OFDM-based waveforms with scalable numerology and transmission time interval (TTI); having a common, flexible framework to efficiently multiplex services and features with a dynamic, low-latency time division duplex (TDD)/frequency division duplex (FDD) design; and with advanced wireless technologies, such as massive multiple input, multiple output (MIMO), robust millimeter wave (mmWave) transmissions, advanced channel coding, and device-centric mobility. Scalability of the numerology in 5G NR, with scaling of subcarrier spacing (SCS), may efficiently address operating diverse services across diverse spectrum and diverse deployments. For example, in various outdoor and macro coverage deployments of less than 3GHz FDD/TDD implementations, SCS may occur with 15 kHz, for example over 5, 10, 20 MHz, and the like bandwidth (BW). For other various outdoor and small cell coverage deployments of TDD greater than 3 GHZ, SCS may occur with 30 kHz over 80/100 MHz BW. For other various indoor wideband implementations, using a TDD over the unlicensed portion of the 5 GHz band, the SCS may occur with 60 kHz over a 160 MHz BW. Finally, for various deployments transmitting with mmWave components at a TDD of 28 GHz, the SCS may occur with 120 kHz over a 500 MHz BW.

[0032] The scalable numerology of the 5G NR facilitates scalable TTI for diverse latency and quality of service (QoS) requirements. For example, shorter TTI may be used for low latency and high reliability, while longer TTI may be used for higher spectral efficiency. The efficient multiplexing of long and short TTIs to allow transmissions to start on symbol boundaries. 5G NR also contemplates a self-contained integrated subframe design with UL/downlink scheduling information, data, and acknowledgement in the same subframe. The self-contained integrated subframe supports communications in unlicensed or contention-based shared spectrum, adaptive UL/downlink that may be flexibly configured on a per-cell basis to dynamically switch between UL and downlink to meet the current traffic needs.

[0033] Various other aspects and features of the disclosure are further described below. It should be apparent that the teachings herein may be embodied in a wide variety of forms and that any specific structure, function, or both being disclosed herein is merely representative and not limiting. Based on the teachings herein one of an ordinary level of skill in the art should appreciate that an aspect disclosed herein may be implemented independently of any other aspects and that two or more of these aspects may be combined in various ways. For example, an apparatus may be implemented or a method may be practiced using any number of the aspects set forth herein. In addition, such an apparatus may be implemented or such a method may be practiced using other structure, functionality, or structure and functionality in addition to or other than one or more of the aspects set forth herein. For example, a method may be implemented as part of a system, device, apparatus, and/or as instructions stored on a computer readable medium for execution on a processor or computer. Furthermore, an aspect may comprise at least one element of a claim.

[0034] The present application describes mechanisms for identifying a sidelink time-division-duplexing (TDD) configuration for use in sidelink communications. Sidelink communications allow a user equipment (UE) to communicate with another UE without tunneling through a base station (BS) and/or the core network. An in-coverage UE may be within a coverage area of a BS and thus may be in communication with the BS. The in-coverage sidelink UE may be preconfigured with a set of sidelink TDD configurations, may receive a BS TDD configuration from a serving BS, and may select a sidelink TDD configuration from the set of sidelink TDD configurations to match the BS TDD configuration. Additionally, the in-coverage sidelink UE may transmit an indication of the selected sidelink TDD configuration to a second UE. Accordingly,

rather than transmit the selected sidelink TDD configuration in its entirety to the second UE, the first UE transmits an indication of the selected sidelink TDD configuration. In some aspects, a first UE may broadcast a TDD configuration indication. A second UE may receive the TDD configuration indication and identify, based on the TDD configuration indication, a TDD configuration from a preconfigured set of TDD configurations. The first UE and the second UE may communicate a sidelink communication based on the TDD configuration. In some aspects, the first UE may communicate a sidelink communication by transmitting a sidelink communication to the second UE. In some aspects, the first UE may communicate a sidelink communication by receiving a sidelink communication from the second UE.

[0035] Aspects of the present disclosure can provide several benefits. For example, if a BS transmits communications in accordance with a TDD configuration, it may be desirable for a first UE to use the UL slots and/or the flexible slots specified in the TDD configuration for sidelink communications in order to avoid interference with the BS. The first UE may communicate a sidelink communication with a second UE. To avoid interference with the BS, it may be desirable for the second UE to know the first UE's TDD configuration and to transmit sidelink communications using the UL slots and/or the flexible slots specified in the first UE's TDD configuration. Additionally, rather than transmit an entire TDD configuration to a UE, the present disclosure may provide solutions and techniques for reducing signaling overhead and improving resource utilization efficiency by transmitting an indication of the TDD configuration.

[0036] FIG. **1** illustrates a wireless communication network **100** according to some aspects of the present disclosure. The network **100** may be a 5G network. The network **100** includes a number of base stations (BSs) **105** (individually labeled as **105***a*, **105***b*, **105***c*, **105***d*, **105***c*, and **105***f*) and other network entities. A BS **105** may be a station that communicates with UEs **115** and may also be referred to as an evolved node B (eNB), a next generation eNB (gNB), an access point, and the like. Each BS **105** may provide communication coverage for a particular geographic area. In 3GPP, the term "cell" can refer to this particular geographic coverage area of a BS **105** and/or a BS subsystem serving the coverage area, depending on the context in which the term is used.

[0037] A BS **105** may provide communication coverage for a macro cell or a small cell, such as a pico cell or a femto cell, and/or other types of cell. A macro cell generally covers a relatively large geographic area (e.g., several kilometers in radius) and may allow unrestricted access by UEs with service subscriptions with the network provider. A small cell, such as a pico cell, would generally cover a relatively smaller geographic area and may allow unrestricted access by UEs with service subscriptions with the network provider. A small cell, such as a femto cell, would also generally cover a relatively small geographic area (e.g., a home) and, in addition to unrestricted access, may also provide restricted access by UEs having an association with the femto cell (e.g., UEs in a closed subscriber group (CSG), UEs for users in the home, and the like). A BS for a macro cell may be referred to as a macro BS. A BS for a small cell may be referred to as a small cell BS, a pico BS, a femto BS or a home BS. In the example shown in FIG. **1**, the BSs **105***d* and **105***e* may be regular macro BSs, while the BSs **105***a*-**105***c* may be macro BSs enabled with one of three dimension (3D), full dimension (FD), or massive MIMO. The BSs **105***a*-**105***c* may take advantage of their higher dimension MIMO capabilities to exploit 3D beamforming in both elevation and azimuth beamforming to increase coverage and capacity. The BS **105***f* may be a small cell BS which may be a home node or portable access point. A BS **105** may support one or multiple (e.g., two, three, four, and the like) cells.

[0038] The network **100** may support synchronous or asynchronous operation. For synchronous operation, the BSs may have similar frame timing, and transmissions from different BSs may be approximately aligned in time. For asynchronous operation, the BSs may have different frame timing, and transmissions from different BSs may not be aligned in time.

[0039] The UEs **115** are dispersed throughout the wireless network **100**, and each UE **115** may be stationary or mobile. A UE **115** may also be referred to as a terminal, a mobile station, a subscriber

unit, a station, or the like. A UE **115** may be a cellular phone, a personal digital assistant (PDA), a wireless modem, a wireless communication device, a handheld device, a tablet computer, a laptop computer, a cordless phone, a wireless local loop (WLL) station, or the like. In one aspect, a UE **115** may be a device that includes a Universal Integrated Circuit Card (UICC). In another aspect, a UE may be a device that does not include a UICC. In some aspects, the UEs **115** that do not include UICCs may also be referred to as IoT devices or internet of everything (IoE) devices. The UEs **115a-115d** are examples of mobile smart phone-type devices accessing network **100**. A UE **115** may also be a machine specifically configured for connected communication, including machine type communication (MTC), enhanced MTC (eMTC), narrowband IoT (NB-IoT) and the like. The UEs **115e-115h** are examples of various machines configured for communication that access the network **100**. The UEs **115i-115k** are examples of vehicles equipped with wireless communication devices configured for communication that access the network **100**. A UE **115** may be able to communicate with any type of the BSs, whether macro BS, small cell, or the like. In FIG. **1**, a lightning bolt (e.g., communication links) indicates wireless transmissions between a UE **115** and a serving BS **105**, which is a BS designated to serve the UE **115** on the downlink (DL) and/or uplink (UL), desired transmission between BSs **105**, backhaul transmissions between BSs, or sidelink transmissions between UEs **115**.

[0040] In operation, the BSs **105a-105c** may serve the UEs **115a** and **115b** using 3D beamforming and coordinated spatial techniques, such as coordinated multipoint (COMP) or multi-connectivity. The macro BS **105d** may perform backhaul communications with the BSs **105a-105c**, as well as small cell, the BS **105f**. The macro BS **105d** may also transmits multicast services which are subscribed to and received by the UEs **115c** and **115d**. Such multicast services may include mobile television or stream video, or may include other services for providing community information, such as weather emergencies or alerts, such as Amber alerts or gray alerts.

[0041] The BSs **105** may also communicate with a core network. The core network may provide user authentication, access authorization, tracking, Internet Protocol (IP) connectivity, and other access, routing, or mobility functions. At least some of the BSs **105** (e.g., which may be an example of a gNB or an access node controller (ANC)) may interface with the core network through backhaul links (e.g., NG-C, NG-U, etc.) and may perform radio configuration and scheduling for communication with the UEs **115**. In various examples, the BSs **105** may communicate, either directly or indirectly (e.g., through core network), with each other over backhaul links (e.g., X1, X2, etc.), which may be wired or wireless communication links.

[0042] The network **100** may also support mission critical communications with ultra-reliable and redundant links for mission critical devices, such as the UE **115e**, which may be a drone. Redundant communication links with the UE **115e** may include links from the macro BSs **105d** and **105e**, as well as links from the small cell BS **105f**. Other machine type devices, such as the UE **115f** (e.g., a thermometer), the UE **115g** (e.g., smart meter), and UE **115h** (e.g., wearable device) may communicate through the network **100** either directly with BSs, such as the small cell BS **105f**, and the macro BS **105e**, or in multi-step-size configurations by communicating with another user device which relays its information to the network, such as the UE **115f** communicating temperature measurement information to the smart meter, the UE **115g**, which is then reported to the network through the small cell BS **105f**. The network **100** may also provide additional network efficiency through dynamic, low-latency TDD/FDD communications, such as vehicle-to-vehicle (V2V) communications among the UEs **115i-115k**, vehicle-to-everything (V2X) communications between a UE **115i**, **115j**, or **115k** and other UEs **115**, and/or vehicle-to-infrastructure (V2I) communications between a UE **115i**, **115j**, or **115k** and a BS **105**.

[0043] In some implementations, the network **100** utilizes OFDM-based waveforms for communications. An OFDM-based system may partition the system BW into multiple (K) orthogonal subcarriers, which are also commonly referred to as subcarriers, tones, bins, or the like. Each subcarrier may be modulated with data. In some instances, the SCS between adjacent

subcarriers may be fixed, and the total number of subcarriers (K) may be dependent on the system BW. The system BW may also be partitioned into subbands. In other instances, the SCS and/or the duration of TTIs may be scalable.

[0044] In some aspects, the BSs **105** can assign or schedule transmission resources (e.g., in the form of time-frequency resource blocks (RB)) for downlink (DL) and uplink (UL) transmissions in the network **100**. DL refers to the transmission direction from a BS **105** to a UE **115**, whereas UL refers to the transmission direction from a UE **115** to a BS **105**. The communication can be in the form of radio frames. A radio frame may be divided into a plurality of subframes or slots, for example, about **10**. Each slot may be further divided into mini-slots. In a FDD mode, simultaneous UL and DL transmissions may occur in different frequency bands. For example, each subframe includes a UL subframe in a UL frequency band and a DL subframe in a DL frequency band. A subframe may also be referred to as a slot. In a TDD mode, UL and DL transmissions occur at different time periods using the same frequency band. For example, a subset of the subframes (e.g., DL subframes) in a radio frame may be used for DL transmissions and another subset of the subframes (e.g., UL subframes) in the radio frame may be used for UL transmissions.

[0045] The DL subframes and the UL subframes can be further divided into several regions. For example, each DL or UL subframe may have pre-defined regions for transmissions of reference signals, control information, and data. Reference signals are predetermined signals that facilitate the communications between the BSs **105** and the UEs **115**. For example, a reference signal can have a particular pilot pattern or structure, where pilot tones may span across an operational BW or frequency band, each positioned at a pre-defined time and a pre-defined frequency. For example, a BS **105** may transmit cell specific reference signals (CRSs) and/or channel state information-reference signals (CSI-RSs) to enable a UE **115** to estimate a DL channel. Similarly, a UE **115** may transmit sounding reference signals (SRSs) to enable a BS **105** to estimate a UL channel. Control information may include resource assignments and protocol controls. Data may include protocol data and/or operational data. In some aspects, the BSs **105** and the UEs **115** may communicate using self-contained subframes. A self-contained subframe may include a portion for DL communication and a portion for UL communication. A self-contained subframe can be DL-centric or UL-centric. A DL-centric subframe may include a longer duration for DL communication than for UL communication. A UL-centric subframe may include a longer duration for UL communication than for DL communication.

[0046] In some aspects, the network **100** may be an NR network deployed over a licensed spectrum. The BSs **105** can transmit synchronization signals (e.g., including a primary synchronization signal (PSS) and a secondary synchronization signal (SSS)) in the network **100** to facilitate synchronization. The BSs **105** can broadcast system information associated with the network **100** (e.g., including a master information block (MIB), remaining system information (RMSI), and other system information (OSI)) to facilitate initial network access. In some instances, the BSs **105** may broadcast the PSS, the SSS, and/or the MIB in the form of synchronization signal block (SSBs) over a physical broadcast channel (PBCH) and may broadcast the RMSI and/or the OSI over a physical downlink shared channel (PDSCH).

[0047] In some aspects, a UE **115** attempting to access the network **100** may perform an initial cell search by detecting a PSS from a BS **105**. The PSS may enable synchronization of period timing and may indicate a physical layer identity value. The UE **115** may then receive a SSS. The SSS may enable radio frame synchronization, and may provide a cell identity value, which may be combined with the physical layer identity value to identify the cell. The PSS and the SSS may be located in a central portion of a carrier or any suitable frequencies within the carrier.

[0048] After receiving the PSS and SSS, the UE **115** may receive a MIB, which may be transmitted in the physical broadcast channel (PBCH). The MIB may include system information for initial network access and scheduling information for RMSI and/or OSI. After decoding the MIB, the UE **115** may receive RMSI, OSI, and/or one or more system information blocks (SIBs). The RMSI

and/or OSI may include radio resource control (RRC) information related to random access channel (RACH) procedures, paging, control resource set (CORESET) for physical downlink control channel (PDCCH) monitoring, physical UL control channel (PUCCH), physical UL shared channel (PUSCH), power control, and SRS. In some aspects, SIB1 may contain cell access parameters and scheduling information for other SIBs.

[0049] After obtaining the MIB, the RMSI and/or the OSI, the UE **115** can perform a random access procedure to establish a connection with the BS **105**. In some examples, the random access procedure may be a four-step random access procedure. For example, the UE **115** may transmit a random access preamble and the BS **105** may respond with a random access response. The random access response (RAR) may include a detected random access preamble identifier (ID) corresponding to the random access preamble, timing advance (TA) information, a UL grant, a temporary cell-radio network temporary identifier (C-RNTI), and/or a backoff indicator. Upon receiving the random access response, the UE **115** may transmit a connection request to the BS **105** and the BS **105** may respond with a connection response. The connection response may indicate a contention resolution. In some examples, the random access preamble, the RAR, the connection request, and the connection response can be referred to as message 1 (MSG1), message 2 (MSG2), message 3 (MSG3), and message 4 (MSG4), respectively. In some examples, the random access procedure may be a two-step random access procedure, where the UE **115** may transmit a random access preamble and a connection request in a single transmission and the BS **105** may respond by transmitting a random access response and a connection response in a single transmission.

[0050] After establishing a connection, the UE **115** and the BS **105** can enter a normal operation stage, where operational data may be exchanged. For example, the BS **105** may schedule the UE **115** for UL and/or DL communications. The BS **105** may transmit UL and/or DL scheduling grants to the UE **115** via a PDCCH. The scheduling grants may be transmitted in the form of DL control information (DCI). The BS **105** may transmit a DL communication signal (e.g., carrying data) to the UE **115** via a PDSCH according to a DL scheduling grant. The UE **115** may transmit a UL communication signal to the BS **105** via a PUSCH and/or PUCCH according to a UL scheduling grant.

[0051] In some aspects, the BS **105** may communicate with a UE **115** using HARQ techniques to improve communication reliability, for example, to provide a URLLC service. The BS **105** may schedule a UE **115** for a PDSCH communication by transmitting a DL grant in a PDCCH. The BS **105** may transmit a DL data packet to the UE **115** according to the schedule in the PDSCH. The DL data packet may be transmitted in the form of a transport block (TB). If the UE **115** receives the DL data packet successfully, the UE **115** may transmit a HARQ ACK to the BS **105**. Conversely, if the UE **115** fails to receive the DL transmission successfully, the UE **115** may transmit a HARQ NACK to the BS **105**. Upon receiving a HARQ NACK from the UE **115**, the BS **105** may retransmit the DL data packet to the UE **115**. The retransmission may include the same coded version of DL data as the initial transmission. Alternatively, the retransmission may include a different coded version of the DL data than the initial transmission. The UE **115** may apply soft-combining to combine the encoded data received from the initial transmission and the retransmission for decoding. The BS **105** and the UE **115** may also apply HARQ for UL communications using substantially similar mechanisms as the DL HARQ.

[0052] In some aspects, the network **100** may operate over a system BW or a component carrier (CC) BW. The network **100** may partition the system BW into multiple BWPs (e.g., portions). A BS **105** may dynamically assign a UE **115** to operate over a certain BWP (e.g., a certain portion of the system BW). The assigned BWP may be referred to as the active BWP. The UE **115** may monitor the active BWP for signaling information from the BS **105**. The BS **105** may schedule the UE **115** for UL or DL communications in the active BWP. In some aspects, a BS **105** may assign a pair of BWPs within the CC to a UE **115** for UL and DL communications. For example, the BWP pair may include one BWP for UL communications and one BWP for DL communications.

[0053] In some aspects, the network **100** may operate over a shared channel, which may include shared frequency bands or unlicensed frequency bands. For example, the network **100** may be an NR-unlicensed (NR-U) network operating over an unlicensed frequency band. In such an aspect, the BSs **105** and the UEs **115** may be operated by multiple network operating entities. To avoid collisions, the BSs **105** and the UEs **115** may employ a listen-before-talk (LBT) procedure to monitor for transmission opportunities (TXOPs) in the shared channel. For example, a transmitting node (e.g., a BS **105** or a UE **115**) may perform an LBT prior to transmitting in the channel. When the LBT passes, the transmitting node may proceed with the transmission. When the LBT fails, the transmitting node may refrain from transmitting in the channel. In an example, the LBT may be based on energy detection. For example, the LBT results in a pass when signal energy measured from the channel is below a threshold. Conversely, the LBT results in a failure when signal energy measured from the channel exceeds the threshold. In another example, the LBT may be based on signal detection. For example, the LBT results in a pass when a channel reservation signal (e.g., a predetermined preamble signal) is not detected in the channel.

[0054] In some aspects, the network **100** may provision for sidelink communications to allow a UE **115** to communicate with another UE **115** without tunneling through a BS **105** and/or the core network. For instance, the network **100** may operate over a TDD spectrum, where UL transmissions and DL transmissions may occur at different time periods. A sidelink may use the spectrum during at least some of the UL periods (e.g., a portion of the UL resources) for sidelink communications. A resource that can be used for sidelink communications may also be referred to as a sidelink resource. The BS **105** may configure certain resources in a licensed band and/or an unlicensed band for communications, and the UE **115** and another UE **115** may communicate sidelink communications using the sidelink resources.

[0055] FIG. **2** illustrates an example of a wireless communication network **200** that provisions for sidelink communications according to embodiments of the present disclosure. The network **200** may be similar to the network **100**. FIG. **2** illustrates one BS **205** and four UEs **215** for purposes of simplicity of discussion, though it will be recognized that embodiments of the present disclosure may scale to any suitable number of UEs **215** and/or BSs **205** (e.g., about 2, 3, 6, 7, 8, or more). The BS **205** and the UEs **215** may be similar to the BSs **105** and the UEs **115**, respectively. The BSs **205** and the UEs **215** may communicate over the same spectrum.

[0056] In the network **200**, some of the UEs **215** may communicate with each other in peer-to-peer communications. For example, the UE **215***a* may communicate with the UE **215***b* over a sidelink **251**, and the UE **215***c* may communicate with the UE **215***d* over another sidelink **252**. The sidelinks **251** and **252** are unicast bidirectional links. In some other instances, the sidelinks **251** and **252** can be multicast links supporting multicast sidelink services. For instance, the UE **215***c* may transmit multicast data to the UE **215***d* and the UE **215***b* over sidelinks. Some of the UEs **215** may also communicate with the BS **205** in an UL direction and/or a DL direction via communication links **253**. For instance, the UEs **215***a,* **215***b,* and **215***c* are within a coverage area **210** of the BS **205**, and thus may be in communication with the BS **205**. A UE that is within the coverage area of a BS may receive signals from the BS and may also be referred to as an in-coverage UE. The UE **215***d* is outside the coverage area **210**, and thus may not be in direct communication with the BS **205**. A UE that is outside the coverage area of a BS may not be able to receive signals from the BS and may also be referred to as an out-of-coverage UE. In some instances, the UE **215***c* may operate as a relay for the UE **215***d* to reach the BS **205**. In some aspects, some of the UEs **215** are associated with vehicles (e.g., similar to the UEs **115***i-k*) and the communications over the sidelinks **251** and/or **252** may be C-V2X communications. C-V2X communications may refer to communications between vehicles and any other wireless communication devices in a cellular network. In some aspects, the network **200** may be a LTE network or an NR network.

[0057] The BS **205** and the UEs **215***a,* **215***b,* **215***c,* and **215***d* may receive or transmit communications in accordance with a TDD configuration. In some aspects, sidelink

communications (e.g., V2X, D2D, or C-V2X) are deployed in a TDD system, and the sidelink may share the TDD spectrum and use the same frequency band as the DL and/or the UL in different timeslots. TDD refers to providing duplex communications links whereby DL communications signals are separated from UL communications signals by the allocation of different time slots in the same frequency band. A TDD configuration may specify one or more of the following parameters: a SCS, a periodicity (e.g., 0.5 ms, 0.625 ms, 1 ms, 1.25 ms, 2 ms, 2.5 ms, 5 ms, 10 ms), and/or a number of TDD patterns (e.g., 1 or 2). The periodicity of a TDD configuration indicates the duration of the TDD configuration, and the configuration may repeat periodically in accordance with the period. Additionally, each pattern may specify one or more of the following parameters: a number of UL slots, a number of UL symbols, a number of DL slots, a number of DL symbols, and/or a number of flexible slots. If a TDD configuration specifies two TDD patterns, each pattern may specify its own parameters (e.g., the number of UL slots and the number of DL slots). Each TDD configuration may specify an UL/DL slot format. In the present disclosure, a pattern that specifies a given parameter (e.g., number of UL slots) may also refer to the TDD configuration that specifies the pattern also specifying the given parameter. In some aspects, a first pattern may have a periodicity of 10 ms followed by a second pattern with a periodicity of 5 ms, resulting in a composite 15 ms periodicity.

[0058] FIG. **3** illustrates a TDD configuration **300** according to some aspects of the present disclosure. The TDD configuration **300** may be employed by BSs such as the BSs **105** and **205** and UEs such as the UEs **115** and **215** in a network such as the network **100** or network **200**. In some instances, the network may be an NR network. In FIG. **3**, the x-axis represents time in some arbitrary units, and the y-axis represents frequency in some arbitrary units.

[0059] A BS (e.g., the BSs **105** and/or **205**) may configure a UE (e.g., the UEs **115** and/or **215**) with resources **306**, **308**, and **310** in the frequency band **302** during a time period **304**. The time period **304** may refer to the periodicity of a pattern specified in a TDD configuration. The resources **306** may be DL resources (e.g., DL slots), the resources **308** may be flexible slots, and the resources **310** may be UL resources (e.g., UL slots). A flexible slot may be used for UL or DL communications. The TDD configuration **300** may indicate a pool of resources (e.g., UL slots, DL slots, flexible slots) in a frequency band (e.g., the frequency band **302**). In FIG. **3**, the TDD configuration **300** may specify a periodicity of 10 ms and one TDD UL/DL pattern. The TDD configuration **300** may include 20 slots, which corresponds to a periodicity of 10 ms if the SCS is 30 KHz. Additionally, the TDD configuration **300** may specify a number of DL slots, a number of UL slots, and a number of flexible slots within the time period **304**. The UEs may use the UL slots as resources for sidelink communications.

[0060] A TDD configuration may be a common TDD configuration or a flexible TDD configuration. In some aspects, a common TDD configuration may indicate a SCS and a first TDD UL/DL pattern. The common TDD configuration may also indicate a second pattern. The BS **205** may transmit a signal indicating the common TDD configuration in a SIB (e.g., SIB1), and the signal may indicate the periodicity of the TDD configuration, the number of DL slots, the number of DL symbols, the number of UL slots, and/or the number of UL symbols of the TDD configuration. The remaining symbols in the TDD frame may be flexible symbols.

[0061] In some aspects, the BS **205** may use UE-specific RRC signaling and may transmit a dedicated TDD configuration via a RRC configuration message. A dedicated TDD configuration may override flexible slots/symbols indicated by a common TDD configuration. In some instances, a common TDD configuration may specify a given slot as a flexible slot, and the dedicated TDD configuration may override the flexible slot designation and specify the given slot as an UL slot. In some instances, the dedicated TDD configuration may override a flexible slot designation and specify the flexible slot as a DL slot.

[0062] The BS and/or the UE may communicate in accordance with the TDD configuration **300**. To reduce interference between the sidelink and the UL/DL communications, it may be desirable for

the UEs to know the TDD configuration of a BS and to determine those resources (e.g., UL slots) that can be used for sidelink communications. In the TDD system, the UL resources may be referred to as UL slots. A UE may identify UL resources based on the UL/DL resources specified in the TDD configuration **300** and may accordingly use those UL resources to communicate (e.g., transmit and/or receive) sidelink communications. If the BS **205** transmits communications in accordance with the TDD configuration **300**, it may be desirable for the in-coverage UEs **215***a,* **215***bc,* and **215***c* to use the UL slots and/or the flexible slots specified in the TDD configuration **300** for sidelink communications to avoid interference with the BS **205**. Additionally, to avoid interference with the BS **205**, it may be desirable for the out-of-coverage UE **215***d* to know the TDD configuration **300** of the BS **205** for sidelink communications with the UE **215***a*, **215***bc*, or **215***c*.

[0063] A BS may transmit communications in accordance with a TDD configuration of the BS. A UE may transmit communications in accordance with a TDD configuration of the UE. The BS's TDD configuration and the UE's TDD configuration may be different or the same. A TDD configuration of a TDD frame may be flexible and specify different parameters from other TDD configurations (e.g., different UL/DL sequences for different slots). A first TDD configuration may have a different SCS, a different number of patterns, a different periodicity, a different number of UL slots, a different number of UL symbols, a different number of DL slots, a different number of DL symbols, and/or a different number of flexible slots than a second TDD configuration. A different TDD configuration may be defined for each SCS of a plurality of SCS. Some examples of SCSs may include 15 kHz, 30 kHz, 60 kHz, and/or 120 kHz.

[0064] The TDD configuration overhead is large because of the large number of possibilities for defining parameters of the TDD configuration (e.g., the sequence of DL/flexible slots/UL). Accordingly, the signaling overhead for conveying the TDD configuration in radio interface (Uu interface) is typically large. A TDD configuration that may be assumed for communicating sidelink communications may also be referred to as a sidelink TDD configuration. When UEs that communicate with each other on sidelink operate with the same TDD configuration (e.g., these UEs are in the coverage of same BS, or, all BSs may have same TDD configuration), the TDD configuration indicated by BS may be assumed for sidelink, i.e., the sidelink TDD configuration is the same as BS TDD configuration. The UEs may have access to a preconfigured set of UE sidelink TDD configurations. The preconfigured set of UE sidelink TDD configurations may include one or multiple TDD configurations, but may include fewer TDD configurations than can be specified by the Uu interface between UEs and various infrastructure nodes (e.g., BS **205**). A TDD configuration may be preconfigured if the TDD configuration is specified in the 3GPP specifications, the TDD configuration is configured at the UE as part of a set of parameters for the UE to perform sidelink communications, and/or the BS configures the TDD configuration for a UE when the UE was within coverage of the BS. Additionally, a set of configured TDD configurations may refer to a preconfigured set of TDD configurations.

[0065] The present disclosure provides techniques for enabling a UE to determine the TDD configuration for use in sidelink communications, whether the UE is within coverage of a BS or outside the coverage of the BS. Additionally, the present application provides techniques for reducing the signaling overhead for determining and/or indicating a sidelink TDD configuration for sidelink communications. Additionally, the reduced overhead may allow for the UE to transmit an indication of the TDD configuration in sidelink broadcast channel, e.g., physical sidelink broadcast channel (PSBCH).

[0066] In some aspects, an in-coverage sidelink UE is preconfigured with a set of TDD configurations, receives a BS TDD configuration from a serving BS, selects a UE sidelink TDD configuration from the set of TDD configurations to match the BS **205**'s TDD configuration. The UE **215***a* that is within coverage of the BS **205** may communicate with the BS **205** and receive the BS **205**'S TDD configuration. The BS **205** may transmit the TDD configuration **300** to the in-

coverage UE **215a**, **215b**, or **215c**. The BS **205** may transmit the TDD configuration **300** when the sidelink communication is over a licensed band or an unlicensed band. The UE **215a** may compare the BS's TDD configuration and a set of UE sidelink TDD configurations. The set of UE sidelink TDD configurations may be predetermined or preconfigured. The UE **215a** selects, based on the comparison, a UE sidelink TDD configuration from the set of UE sidelink TDD configurations. In some aspects, the selected UE sidelink TDD configuration may be the same as the BS's TDD configuration. In some aspects, a UE sidelink TDD configuration may be the same as the BS's TDD configuration if one or more of the following parameters specified in the TDD configurations is the same: SCS, TDD configuration periodicity, number of UL slots in the TDD configuration, number of UL symbols in the TDD configuration, number of flexible slots in the TDD configuration, number of flexible symbols in the TDD configuration, number of DL slots in the TDD configuration, or number of DL symbols in the TDD configuration.

[0067] In some aspects, the selected UE sidelink TDD configuration is the closest match to the BS's TDD configuration compared to the other UE sidelink TDD configurations included in the set. Although the UE sidelink TDD configuration selected and used by the UE for sidelink communications may not be the same as the BS's TDD configuration, the UE sidelink TDD configuration may be very close to the BS's TDD configuration and accordingly reduce interference with transmissions from the BS. The UE **215a**'s selection of the UE sidelink TDD configuration may be in accordance with a set of rules and is discussed further below. The UE **215a** may transmit an indication of the selected UE sidelink TDD configuration to another UE **215b**, **215c**, or **215d** for sidelink communications. The UE **215a** and the other UE (e.g., UE **215b**, **215c**, or **215d**) may communicate a sidelink communication based on the indicated UE sidelink TDD configuration.

[0068] In some aspects, the BS TDD configuration may be the common TDD configuration. The UE may select a TDD configuration from the set based only on the common TDD configuration. In some aspects, the BS TDD configuration is determined based on the common TDD configuration and dedicated TDD configuration. In some aspects, the BS TDD configuration is determined based on the common TDD configuration, dedicated TDD configuration, and physical layer TDD slot format indication.

[0069] In some aspects, a sidelink UE broadcasts a TDD configuration indication (e.g., index) via a sidelink broadcast channel (e.g., PSBCH) to another sidelink UE. The UE that receives the TDD configuration indication may be out-of-coverage or in-coverage of the same serving BS **205** or different serving BS. The UE **215d** that is outside the coverage of the BS **205** may be unable to receive a TDD configuration directly from the BS **205**. In some aspects, the UE **215d** receives an indication of a sidelink TDD configuration from the UE **215a**, where the indicated sidelink TDD configuration is used by the in-coverage UE **215a** to communicate with another sidelink UE (e.g., UE **215d**). The sidelink TDD configuration indication provides the UE **215d** with information regarding the resource configuration used by the in-coverage UE **215a** to avoid or mitigate any potential interference to sidelink communications from the UL or DL communications, and/or, avoid or mitigate any potential interference to UL or DL communications from sidelink communications. In some aspects, the indicated sidelink TDD configuration may be the UE sidelink TDD configuration that is selected by the UE **215a**, as discussed above. The UE **215a** and the UE **215d** may each have access to a set of UE sidelink TDD configurations, which may be predetermined or preconfigured. Additionally, the set of UE sidelink TDD configurations may include the indicated sidelink TDD configuration. Based on the indication, the UE **215d** may identify a sidelink TDD configuration from the set of UE sidelink TDD configurations, where the identified sidelink TDD configuration is the same as the indicated sidelink TDD configuration. The UE **215a** and the UE **215d** may communicate a sidelink communication based on the sidelink TDD configuration identified by the UE **215d**. Accordingly, the UE **215a** and the UE **215d** have the same understanding of the sidelink TDD configuration for use in sidelink communications.

[0070] If the UE **215***d* is within coverage of the BS **205**, the BS **205** may transmit the BS's TDD configuration to the UE **215***d*. Based on the BS's TDD configuration, the UE **215***d* may select a sidelink TDD configuration from the set of sidelink TDD configurations (as discussed above). Accordingly, the sidelink TDD configuration that is indicated by the UE **215***a* and is received by the UE **215***d* may be the same sidelink TDD configuration that would be selected by the UE **215***d* if the UE **215***d* were within coverage of the BS **205**.

[0071] FIG. **4** is a block diagram of a UE **400** according to some aspects of the present disclosure. The UE **400** may be a UE **115** discussed above in FIG. **1** or a UE **215** discussed above in FIG. **2**. As shown, the UE **400** may include a processor **402**, a memory **404**, a TDD indication module **408**, a sidelink communication module **409**, a transceiver **410** including a modem subsystem **412** and a radio frequency (RF) unit **414**, and one or more antennas **416**. These elements may be in direct or indirect communication with each other, for example via one or more buses.

[0072] The processor **402** may include a central processing unit (CPU), a digital signal processor (DSP), an application specific integrated circuit (ASIC), a controller, a field programmable gate array (FPGA) device, another hardware device, a firmware device, or any combination thereof configured to perform the operations described herein. The processor **402** may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0073] The memory **404** may include a cache memory (e.g., a cache memory of the processor **402**), random access memory (RAM), magnetoresistive RAM (MRAM), read-only memory (ROM), programmable read-only memory (PROM), erasable programmable read only memory (EPROM), electrically erasable programmable read only memory (EEPROM), flash memory, solid state memory device, hard disk drives, other forms of volatile and non-volatile memory, or a combination of different types of memory. In an aspect, the memory **404** includes a non-transitory computer-readable medium. The memory **404** may store, or have recorded thereon, instructions **406**. The instructions **406** may include instructions that, when executed by the processor **402**, cause the processor **402** to perform the operations described herein with reference to the UEs **115** in connection with aspects of the present disclosure, for example, aspects of FIGS. **6-10**. Instructions **406** may also be referred to as program code. The program code may be for causing a wireless communication device to perform these operations, for example by causing one or more processors (such as processor **402**) to control or command the wireless communication device to do so. The terms "instructions" and "code" should be interpreted broadly to include any type of computer-readable statement(s). For example, the terms "instructions" and "code" may refer to one or more programs, routines, sub-routines, functions, procedures, etc. "Instructions" and "code" may include a single computer-readable statement or many computer-readable statements.

[0074] The TDD indication module **408** and/or the sidelink communication module **409** may be implemented via hardware, software, or combinations thereof. The TDD indication module **408** and/or the sidelink communication module **409** may be implemented as a processor, circuit, and/or instructions **406** stored in the memory **404** and executed by the processor **402**. In some instances, the TDD indication module **408** and/or the sidelink communication module **409** can be integrated within the modem subsystem **412**. The TDD indication module **408** and/or the sidelink communication module **409** can be implemented by a combination of software components (e.g., executed by a DSP or a general processor) and hardware components (e.g., logic gates and circuitry) within the modem subsystem **412**. The TDD indication module **408** and/or the sidelink communication module **409** may be used for various aspects of the present disclosure, for example, aspects of FIGS. **1-3** and **6-10**.

[0075] FIG. **4** will be discussed in relation to FIG. **2** to better understand some of the concepts disclosed in the present disclosure. In some aspects, the UE **400** corresponds to the UE **215***a* in FIG. **2** and is within coverage of the BS **205** in FIG. **2**. Accordingly, the UE **400** may receive TDD

configuration signaling from the BS **205**. The TDD indication module **408** may be configured to receive from the BS, a TDD configuration of the BS (e.g., TDD configuration **300** in FIG. **3**). The TDD indication module **408** may be configured to select a TDD configuration from a set of configured TDD configurations based on the BS's TDD configuration. A TDD configuration indication may also be referred to as a sidelink TDD configuration indication in the present disclosure. Additionally, a set of sidelink TDD configurations may also be referred to as a set of configured TDD configurations in the present disclosure. The selected TDD configuration may be the same as the BS's TDD configuration or may be the closest match to the BS's TDD configuration compared to the other TDD configurations in the set of configured TDD configurations. Mechanisms for selecting a TDD configuration from a set of configured TDD configurations are described in greater detail herein. The TDD indication module **408** may be configured to transmit to a second UE, an indication of the selected TDD configuration. The second UE may be within coverage of the BS or may be outside the coverage of the BS. Mechanisms for transmitting the indication of the selected TDD configuration are described in greater detail herein. The sidelink communication module **409** may be configured to communicate a sidelink communication based on the selected TDD configuration.

[0076] In some aspects, the UE **400** corresponds to the UE **215***d* in FIG. **2** and is outside the coverage of the BS **205** in FIG. **2**. Accordingly, the UE **400** may be unable to receive TDD configuration signaling from the BS **205**. The TDD indication module **408** may be configured to receive from a second UE, a TDD configuration indication. The second UE may be within coverage of the BS or may be outside the coverage of the BS. Rather than receive the BS **205**'s TDD configuration, the UE **400** may receive an indication of the TDD configuration that is used by the second UE for sidelink communications. The TDD indication module **408** may be configured to identify a TDD configuration from a set of configured TDD configurations based on the sidelink TDD configuration indication. The sidelink communication module **409** may be configured to communicate a sidelink communication based on the identified TDD configuration. Mechanisms for identifying a TDD configuration from a set of configured configurations based on an indication of a TDD configuration are described in greater detail herein.

[0077] As shown, the transceiver **410** may include the modem subsystem **412** and the RF unit **414**. The transceiver **410** can be configured to communicate bi-directionally with other devices, such as the BSs **105**. The modem subsystem **412** may be configured to modulate and/or encode the data from the memory **404** and/or the sidelink communication module **409** according to a modulation and coding scheme (MCS), e.g., a low-density parity check (LDPC) coding scheme, a turbo coding scheme, a convolutional coding scheme, a digital beamforming scheme, etc. The RF unit **414** may be configured to process (e.g., perform analog to digital conversion or digital to analog conversion, etc.) modulated/encoded data (e.g., PSSCH data and/or PSCCH control information) from the modem subsystem **412** (on outbound transmissions) or of transmissions originating from another source such as a UE **115** or a BS **105**. The RF unit **414** may be further configured to perform analog beamforming in conjunction with the digital beamforming. Although shown as integrated together in transceiver **410**, the modem subsystem **412** and the RF unit **414** may be separate devices that are coupled together at the UE **115** to enable the UE **115** to communicate with other devices.

[0078] The RF unit **414** may provide the modulated and/or processed data, e.g. data packets (or, more generally, data messages that may contain one or more data packets and other information), to the antennas **416** for transmission to one or more other devices. The antennas **416** may further receive data messages transmitted from other devices. The antennas **416** may provide the received data messages for processing and/or demodulation at the transceiver **410**. The transceiver **410** may provide the demodulated and decoded data (e.g., the frequency interlace configuration, PSSCH data, and/or PSCCH control information) to the sidelink communication module **409** for processing. The antennas **416** may include multiple antennas of similar or different designs in order

to sustain multiple transmission links. The RF unit **414** may configure the antennas **416**.

[0079] In some aspects, the transceiver **410** is configured to receive a TDD configuration from a BS (e.g., the BSs **105** and **205**), receive a TDD configuration from another UE, receive and/or transmit an indication of a sidelink TDD configuration, receive sidelink communications from another UE, transmit sidelink communications to another UE, by coordinating with the TDD indication module **408** and/or sidelink communication module **409**.

[0080] In some aspects, the UE **400** can include multiple transceivers **410** implementing different RATs (e.g., NR and LTE). In an aspect, the UE **400** can include a single transceiver **410** implementing multiple RATs (e.g., NR and LTE). In an aspect, the transceiver **410** can include various components, where different combinations of components can implement different RATs.

[0081] FIG. **5** is a block diagram of a BS **500** according to some aspects of the present disclosure. The BS **500** may be a BS **105** as discussed above in FIG. **1** or a BS **205** as discussed above in FIG. **2**. As shown, the BS **500** may include a processor **502**, a memory **504**, a TDD module **508**, a transceiver **510** including a modem subsystem **512** and a RF unit **514**, and one or more antennas **516**. These elements may be in direct or indirect communication with each other, for example via one or more buses.

[0082] The processor **502** may have various features as a specific-type processor. For example, these may include a CPU, a DSP, an ASIC, a controller, a FPGA device, another hardware device, a firmware device, or any combination thereof configured to perform the operations described herein. The processor **502** may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, a plurality of microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0083] The memory **504** may include a cache memory (e.g., a cache memory of the processor **502**), RAM, MRAM, ROM, PROM, EPROM, EEPROM, flash memory, a solid state memory device, one or more hard disk drives, memristor-based arrays, other forms of volatile and non-volatile memory, or a combination of different types of memory. In some aspects, the memory **504** may include a non-transitory computer-readable medium. The memory **504** may store instructions **506**. The instructions **506** may include instructions that, when executed by the processor **502**, cause the processor **502** to perform operations described herein, for example, aspects of FIGS. **6**-**10**. Instructions **506** may also be referred to as code, which may be interpreted broadly to include any type of computer-readable statement(s) as discussed above with respect to FIG. **4**.

[0084] The TDD module **508** may be implemented via hardware, software, or combinations thereof. The TDD module **508** may be implemented as a processor, circuit, and/or instructions **506** stored in the memory **504** and executed by the processor **502**. In some instances, the TDD module **508** can be integrated within the modem subsystem **512**. The TDD module **508** can be implemented by a combination of software components (e.g., executed by a DSP or a general processor) and hardware components (e.g., logic gates and circuitry) within the modem subsystem **512**.

[0085] The TDD module **508** may be used for various aspects of the present disclosure, for example, aspects of FIGS. **1**-**3** and **6**-**8**. The TDD module **508** may be configured to transmit a TDD configuration of the BS **500** to one or more UEs. The TDD module **508** may also be configured to transmit an indication (e.g., index) of a TDD configuration of the BS **500** to one or more UEs.

[0086] As shown, the transceiver **510** may include the modem subsystem **512** and the RF unit **514**. The transceiver **510** can be configured to communicate bi-directionally with other devices, such as the UEs **115** and/or **400** and/or another core network element. The modem subsystem **512** may be configured to modulate and/or encode data according to a MCS, e.g., a LDPC coding scheme, a turbo coding scheme, a convolutional coding scheme, a digital beamforming scheme, etc. The RF unit **514** may be configured to process (e.g., perform analog to digital conversion or digital to analog conversion, etc.) modulated/encoded data (e.g., grants, resource allocations) from the modem subsystem **512** (on outbound transmissions) or of transmissions originating from another

source such as a UE **115** and/or UE **400**. The RF unit **514** may be further configured to perform analog beamforming in conjunction with the digital beamforming. Although shown as integrated together in transceiver **510**, the modem subsystem **512** and/or the RF unit **514** may be separate devices that are coupled together at the BS **105** to enable the BS **105** to communicate with other devices.

[0087] The RF unit **514** may provide the modulated and/or processed data, e.g. data packets (or, more generally, data messages that may contain one or more data packets and other information), to the antennas **516** for transmission to one or more other devices. This may include, for example, transmission of information to complete attachment to a network and communication with a camped UE **115** or **400** according to some aspects of the present disclosure. The antennas **516** may further receive data messages transmitted from other devices and provide the received data messages for processing and/or demodulation at the transceiver **510**. The transceiver **510** may provide the demodulated and decoded data (e.g., UCI, DMRS) to the sidelink communication module **508** for processing. The antennas **516** may include multiple antennas of similar or different designs in order to sustain multiple transmission links.

[0088] In an example, the transceiver **510** is configured to transmit a TDD configuration by coordinating with the TDD module **508**. In an aspect, the BS **500** can include multiple transceivers **510** implementing different RATs (e.g., NR and LTE). In an aspect, the BS **500** can include a single transceiver **510** implementing multiple RATs (e.g., NR and LTE). In an aspect, the transceiver **510** can include various components, where different combinations of components can implement different RATs.

[0089] FIG. **6** is a signaling diagram of a sidelink communication method **600** according to some aspects of the present disclosure. The method **600** may be implemented between a BS (e.g., BSs **105**, **205**, and/or **500**) and two UEs (e.g., UEs **115**, **215**, and/or **400**) shown as a UE **615***a* and a UE **615***b*. The method **600** may employ similar mechanisms as in the methods **900** and/or **1000**, described above with respect to FIGS. **9** and **10**, respectively. As illustrated, the method **600** includes a number of enumerated steps, but embodiments of the method **600** may include additional steps before, after, and in between the enumerated steps. In some aspects, one or more of the enumerated steps may be omitted or performed in a different order.

[0090] In some aspects, each TDD configuration in a set of preconfigured or predetermined TDD configurations is indexed into an index table. FIG. **7** is an index table **700** according to some aspects of the present disclosure. FIGS. **6** and **7** will be discussed in relation to each other to better understand some concepts of the present disclosure.

[0091] The UE **615***a* may be within a coverage area of the BS **605** and thus may receive communications from the BS **605**. The BS **605** may transmit TDD communication signals in accordance with a BS TDD configuration **608**. The BS TDD configuration **608** is a TDD configuration of the BS **605** and may include one or more TDD configurations. In an aspect, the BS TDD configuration **608** may be the TDD configuration **300** in FIG. **3**. The BS TDD configuration **608** may include one or more patterns (e.g., 1 or 2).

[0092] The UE **615***a* and the UE **615***b* may have access to a set of UE sidelink TDD configurations **606**. The set of UE sidelink TDD configurations **606** may include one or more TDD configurations. The UE **615***a* may identify the set of UE sidelink TDD configurations **606**. The set of UE sidelink TDD configurations **606** may be preconfigured or predetermined. A preconfigured or predetermined TDD configuration may refer to a TDD configuration that is specified in the 3GPP specifications, that is configured at the UE as part of a set of parameters for the UE to perform sidelink communications, and/or that is configured by the BS for the UE **615***a*. The UE **615***a* may transmit TDD communication signals in accordance with one or more TDD configuration included in the set of UE sidelink TDD configurations **606**. The set of UE sidelink TDD configurations **606** may include or may be devoid of the BS TDD configuration **608**.

[0093] At step **610**, the BS **605** transmits the BS TDD configuration **608** to the in-coverage UE

**615***a*. In some aspects, the BS **605** may transmit a signal indicating the BS TDD configuration **608** to the UE **615***a*. The UE **615***a* receives the BS TDD configuration **608** from the BS **605**

[0094] At step **620**, the UE **615***a* selects, based on the BS TDD configuration **608**, a sidelink TDD configuration from the set of UE sidelink TDD configurations **606**. Each TDD configuration in the set of UE sidelink TDD configurations **606** may be stored as shown in the index table **700**. The UEs **615***a* and **615***b* may transmit communications in accordance with the parameters provided in the index table **700**. An example set of UE sidelink TDD configurations (e.g., set of UE sidelink TDD configurations **606**) is shown in the index table **700**. Each TDD configuration has a periodicity and an indication of the number of UL slots and can be identified by a table index.

[0095] As shown in FIG. **7**, in the first entry of the index table **700**, a TDD configuration associated with an index "0" may specify a periodicity of 2 ms and indicate 2 UL slots. In the second entry of the index table **700**, a TDD configuration associated with an index "1" may specify a periodicity of 2 ms and indicate 4 UL slots. In the third entry of the index table **700**, a TDD configuration associated with an index "2" may specify a periodicity of 5 ms and indicate 2 UL slots. In the fourth entry of the index table **700**, a TDD configuration associated with an index "3" may specify a periodicity of 5 ms and indicate 4 UL slots. In the fifth entry of the index table **700**, a TDD configuration associated with an index "4" may specify a periodicity of 5 ms and indicate 8 UL slots. In the sixth entry of the index table **700**, a TDD configuration associated with an index "5" may specify a periodicity of 10 ms and indicate 2 UL slots. In the seventh entry of the index table **700**, a TDD configuration associated with an index "6" may specify a periodicity of 10 ms and indicate 4 UL slots. In the eighth entry of the index table **700**, a TDD configuration associated with an index "7" may specify a periodicity of 10 ms and indicate 8 UL slots. In the ninth entry of the index table **700**, a TDD configuration associated with an index "8" may specify a periodicity of 10 ms and indicate 16 UL slots.

[0096] The UE **615***a* selects one TDD configuration from the set of UE sidelink TDD configurations shown in the index table **700** for sidelink communications, where the selected TDD configuration is based on the BS TDD configuration **608**. The UE **615***a* may select, based on the comparison between the BS TDD configuration **608** and the set of UE sidelink TDD configurations **606**, a sidelink TDD configuration in accordance with one or more rules. The UE **615***a* may compare the BS TDD configuration **608** and the set of UE sidelink TDD configurations **606** to identify the closest TDD configuration from the set of UE sidelink TDD configurations **606** that matches the BS TDD configuration **608**.

[0097] A rule may specify that the UE **615***a* selects a sidelink TDD configuration from the set of UE sidelink TDD configurations **606** that has the greatest number of parameter matches or has the closest parameter matches to the BS TDD configuration **608**. A parameter may be a periodicity, a SCS, a number of UL slots, a number of DL slots, a number of flexible slots, and/or a number of patterns specified by the TDD configuration. The UE **615***a*'s use of the selected sidelink TDD configuration for sidelink communications may result in minimum interference to the BS **605**. A BS TDD configuration **608** that specifies a periodicity of 10 ms and a 30 kHz SCS has 20 slots in a TDD configuration period. Additionally, a number of UL slots in the period of the TDD configuration is 9. The UE **615***a* may receive this BS TDD configuration **608** and select the TDD configuration associated with the index "7," which specifies a periodicity of 10 ms and 8 UL slots. The UE **615***a* may select the TDD configuration associated with the index "7" by determining that the TDD configurations associated with indexes "5," "6," "7," and "8" have a periodicity of 10 ms and accordingly filter out the other TDD configurations (e.g., the TDD configurations associated with indexes "0" and "1" having a periodicity of 2 ms and the TDD configurations associated with indexes "2," "3," and "4" having a periodicity of 5 ms) from consideration. From the TDD configurations associated with indexes "5," "6," "7," and "8" in the index table **700**, the UE **615***a* may determine that the TDD configuration associated with the index "7" has 8 UL slots, the closest number of UL slots to the 9 UL slots.

[0098] In some aspects, the UE **615***a* may select the TDD configuration specifying a number of UL slots closest to and smaller than the number of UL slots specified in the BS TDD configuration. Accordingly, the number of UL slots in the sidelink TDD configuration selected from the set of UE sidelink TDD configurations **606** does not exceed the number of UL slots configured by the BS. In some aspects, the number of UL slots in the sidelink TDD configuration selected from the set of UE sidelink TDD configurations **606** matches a sum of the number of UL slots and the number of flexible slots specified in the BS TDD configuration.

[0099] Additionally, a set of rules may specify a priority for parameter matches (e.g., based on a weighting function). In some aspects, a rule may prioritize the parameters that match in the following order: the SCS, the number of patterns, the periodicity, the number of UL slots, the number flexible slots, and the number of DL slots. The first parameter (e.g., the SCS) listed has the highest priority, the last parameter (e.g., the number of DL slots) has the lowest priority, with each parameter have a lower priority than the preceding parameter. The UE may generate a score for each TDD configuration of the set of UE sidelink TDD configurations **606**. In some aspects, the UE may apply a weighting function in which the parameters having a higher parameter are given a greater weight than parameters having a lower parameter and may select the TDD configuration associated with the highest score.

[0100] It should be understood that in other aspects, the set of rules may provide for a different order of priorities and/or the set of rules may use different parameters than that provided in the disclosure. In some aspects, the SCS may not be part of the sidelink TDD configuration. Accordingly, the parameters used in the rule may be in an order from highest priority to lowest priority as follows: the number of patterns, the periodicity, the number of UL slots, the number flexible slots, and the number of DL slots.

[0101] At step **630**, the UE **615***a* transmits an indication of the selected sidelink TDD configuration to the UE **615***b*. The UE **615***a* may transmit an indication using a variety of mechanisms. In some aspects, the indication is an index of the TDD configuration, and the UE **615***a* transmits an index associated with the selected sidelink TDD configuration. In some aspects, each TDD configuration in the set of UE sidelink TDD configurations **606** has an index "3", and the UE **615***a* indicates the TDD configuration specifying a periodicity of 5 ms and 4 UL slots by conveying the index "3" via the sidelink broadcast channel (e.g., PSBCH).

[0102] If the BS TDD configuration **608** specifies a first BS pattern and a second BS pattern, the UE **615***a* may select a first sidelink TDD configuration from the set of UE sidelink TDD configurations **606** based on the first BS pattern. The first sidelink TDD configuration may specify the same parameters as those specified in the first BS pattern or may be the closest TDD configuration to the first BS pattern compared to the other sidelink TDD configurations included in the set of UE sidelink TDD configurations **608**. Additionally, the UE **615***a* may select a second sidelink TDD configuration from the set of UE sidelink TDD configurations **606** based on the second BS pattern. The second sidelink TDD configuration may specify the same parameters as those specified in the second BS pattern or may be the closest TDD configuration to the second BS pattern compared to the other sidelink TDD configurations included in the set of UE sidelink TDD configurations **608**.

[0103] Additionally, the UE **615***a* may transmit an indication for each pattern specified in a given TDD configuration. If the UE selects a sidelink TDD configuration having a first pattern specified by index "4" and a second pattern specified by index "6" in the index table **700**, the UE **615***a* may transmit both "4" and "7" via the PSBCH. In some aspects, the UE may also transmit a parameter indicating number of TDD patterns via the PSBCH. In some aspects, if each TDD configuration in the set of UE sidelink TDD configurations **606** specifies a number of UL slots in a period for a TDD pattern, the UE **615***a* may convey the index of the selected sidelink TDD configuration periodicity via the PSBCH.

[0104] It may be unnecessary for the UE to receive a signal indicating a DL/UL TDD pattern. In

some aspects, if a single TDD UL/DL configuration is preconfigured and a UE is unable to receive a BS TDD configuration from a BS (e.g., UE is out-of-coverage), the UE may assume usage of the preconfigured TDD UL/DL configuration and transmit communications in accordance with the preconfigured TDD UL/DL configuration. The preconfigured TDD UL/DL configuration may have an associated periodicity, number of UL slots, etc. In some aspects, a single UL/DL slot format is preconfigured for each TDD configuration periodicity and/or SCS. The priority may be conveyed on sidelink (e.g., in broadcast channel). Additionally, if the BS configures two TDD configuration patterns, the periodicity for both patterns may be indicated on sidelink. The number of patterns configured may also be indicated. If the UE is unable to obtain the BS's TDD configuration, the UE may detect the periodicity in broadcast channel and may assume usage of the preconfigured UL/DL slot format associated with the periodicity.

[0105] The UE **615***b* may receive the sidelink TDD configuration indication from the UE **615***a*. In some aspects, the UE **615***b* may detect the indication in the PSBCH and accordingly determine the sidelink resources for sidelink communications with the UE **615***a*. It should also be understood that the UE **615***a* may use other mechanisms for transmitting the indication of the selected sidelink TDD configuration to the UE **615***b*.

[0106] The UE **615***a* and the UE **615***b* may both have access to the index table **700**. In some aspects, a UE stores the index table **700** in memory (e.g., memory **404**). The UE **615***a* may select a TDD configuration from the plurality of TDD configurations specified in the index table **700** and may transmit the index associated with the selected TDD configuration to indicate the selection to the UE **615***b*. The UE **615***a* may select the TDD configuration associated with the index "0," and indicates the index "0" in a PSBCH. The UE **615***b* receives the indication from the UE **615***a* to determines, based on the indication, the correct sidelink TDD configuration to use for sidelink communications with the UE **615***a*. The UE **615***b* may detect the sidelink signal in the PSBCH indicating the index 0, obtain the TDD configuration based on the index 0, and use the TDD configuration corresponding to the index 0 for sidelink communications with the UE **615***a*.

[0107] At step **640**, the UE **615***a* and the UE **615***b* may communicate a sidelink communication based on the selected sidelink TDD configuration. The UEs **615***a* and **615***b* may apply the TDD configuration signaled in the PSBCH for sidelink communications.

[0108] FIG. **8** is a signaling diagram of a sidelink communication method **800** according to some aspects of the present disclosure. The method **800** may be implemented between a BS (e.g., BSs **105**, **205**, and/or **500**) and two UEs (e.g., UEs **115**, **215**, and/or **400**) shown as a UE **815***a* and a UE **815***b*. The method **800** may employ similar mechanisms as in the methods **900** and/or **1000**, described above with respect to FIGS. **9** and **10**, respectively. As illustrated, the method **800** includes a number of enumerated steps, but embodiments of the method **800** may include additional steps before, after, and in between the enumerated steps. In some aspects, one or more of the enumerated steps may be omitted or performed in a different order.

[0109] FIGS. **7** and **8** will be discussed in relation to each other to better understand some concepts of the present disclosure. In FIG. **8**, the UE **815***a* may be within a coverage area of the BS **805***a*, and the UE **815***b* may be within a coverage area of the BS **805***b*. Additionally, the UE **815***a* may be inside or outside the coverage area of the BS **805***b*, and the UE **815***b* may be inside or outside the coverage area of the BS **805***a*. If the UE **815***b* is outside the coverage area of the BS **805***a* and unable to obtain the BS **805***a*'s TDD configuration directly from the BS **805***a*, the UE **815***b* may still be able to communicate using the sidelink with UEs that are within coverage of the **805***a*, as will be discussed herein. Additionally, in some aspects, if the UE **815***b* knows the BS **805***b*'s TDD configuration, the UE **815***b* may receive data from the UE **815***a*, even if the BSs **805***a* and BS **805***b* have different TDD configurations.

[0110] The UEs **815***a* and **815***b* may have access to a set of UE sidelink TDD configurations **806**. Each of the UE **815***a* and the UE **815***b* may transmit TDD communication signals in accordance with one or more TDD configurations included in the set of UE sidelink TDD configurations **806**.

The set of UE sidelink TDD configurations **806** may be preconfigured or predetermined and may include a UE TDD configuration **807**. The UE **815***a* may transmit sidelink communications in accordance with the UE TDD configuration **807**. The UE **815***a* may use the UE TDD configuration **807** to communicate with one or more sidelink UEs. To reduce interference, it may be desirable for the UEs **815***a* and **815***b* to communicate sidelink communications based the same sidelink TDD configuration.

[0111] At step **810**, the UE **815***a* transmits to the UE **815***b*, an indication of a UE TDD configuration **807** used by the UE **815***a* for sidelink communications. The UE TDD configuration **807** may correspond to the sidelink TDD configuration that is selected by the UE **615***a* in FIG. **6** (step **620**). The UE **815***b* receives from the UE **815***a*, the indication of the UE TDD configuration **807**. In some aspects, the UE **815***b* detects sidelink signaling (e.g., PSBCH) and receives the indication of the UE TDD configuration **807** via the PSBCH.

[0112] At step **820**, the UE **815***b* identifies, based on the indication, a sidelink TDD configuration from the set of UE sidelink TDD configurations **806**. The set of UE sidelink TDD configurations **806** may include multiple TDD configurations, which may include the UE TDD configuration **807**.

[0113] At step **830**, the UE **815***b* communicates with the UE **815***a*, a sidelink communication based on the UE TDD configuration **807**. The UE **815***b* applies the TDD configuration signaled in the PSBCH for sidelink communications if the UE **815***b* detects the indication (e.g., index into the index table **700**) from the PSBCH. In some aspects, the step **830** includes receiving from the UE **815***a*, a sidelink communication based on the UE TDD configuration **807**. In some aspects, the step **830** includes transmitting to the UE **815***a*, a sidelink communication based on the UE TDD configuration **807**.

[0114] The index table **700** provided in FIG. **7** may provide different information than that shown in FIG. **7**. In some aspects, for a TDD configuration, the third column may be labeled n.sub.indicate and store an index, and the number of UL slots in the TDD configuration is determined based on this index n.sub.indicate and SCS (numerology). The number of UL slots implied by a configuration may be 2{circumflex over ( )}$(\mu-1)$ n.sub.indicate, where $\mu$ is numerology (i.e., SCS) index (e.g., for 15 kHz SCS, $\mu=1$, for 30 kHz SCS, $\mu=2$, etc.).

[0115] In some aspects, it may be unnecessary for the UE **215** to receive a signal indicating the BS's TDD configuration for determining the TDD configuration to use for sidelink communications. In some aspects, the preconfigured set of UE sidelink TDD configurations includes a single TDD configuration. If the UE **215** is unable to obtain a TDD configuration of the BS from the BS **205**, the UE **215** may determine to use the single TDD configuration (which has associated periodicity, number of UL slots, etc.) for sidelink communications. In some aspects, one UL/DL slot format is preconfigured for each TDD configuration periodicity and/or SCS. Accordingly, the UE may convey the periodicity and/or SCS on sidelink, e.g., in broadcast channel. If the BS **205** configures two TDD configuration patterns, the periodicity for both patterns may be indicated on sidelink (e.g., the number of patterns configured may also be indicated). If the UE **215** is unable to obtain the TDD configuration from the BS **205**, the UE **215** may detect the periodicity in the broadcast channel and determine to use the preconfigured UL/DL slot format associated with the periodicity for sidelink communications.

[0116] For each periodicity of a plurality of periodicities (e.g., 0.5 ms, 0.625 ms, 1 ms, 1.25 ms, 2 ms, 2.5 ms, 5 ms, 10 ms), a pre-configured TDD configuration indicates the number of UL slots and number of DL slots for the respective periodicity. In some aspects, the BS **205** may transmit to an in-coverage UE **215***a*, an indication of the BS's TDD configuration, where the indication indicates the periodicity of the TDD configuration. In some aspects, the UE **215***a* transmits an indication of the UE **215***a*'s TDD configuration for sidelink communications, and the indication indicates the periodicity of the UE **215***a*'s TDD configuration. In this way, signaling overhead may be reduced by transmitting the periodicity associated with a TDD configuration rather than the entire TDD configuration.

[0117] In some aspects, only parameter is explicitly specified by a TDD configuration is the number of UL slots. In some aspects, the periodicity of a TDD configuration is conveyed on sidelink, e.g., in broadcast channel. If the BS **205** configures two TDD configuration patterns, the periodicity for both patterns may be indicated on sidelink (e.g., number of TDD patterns configured may also be indicated). In some aspects, the number of UL slots in a TDD period of a pattern is also conveyed on sidelink, e.g., in broadcast channel. In some instances, the number of UL slots in a TDD configuration period is carried by PSBCH. In some instances, an index is carried by PSBCH, and this index is mapped to the number of UL slots in a TDD configuration period (e.g., an index "0" may indicate 2 UL slots, an index "1" may indicate 4 UL slots, an index "2" may indicate 8 UL slots, and an index "3" may indicate 16 UL slots in a TDD configuration. Two bits may be used to indicate the four different numbers of UL slots (e.g., the bit value "00" may indicate 2 UL slots, the bit value "01" may indicate 4 UL slots, the bit value "10" may indicate 8 UL slots, and the bit value "11" may indicate 16 UL slots). Similarly mechanisms may have used for indicating a particular number of UL slots. For example, four bits may be used to indicate sixteen different numbers of UL slots. In this way, signaling overhead for indicating a TDD configuration may be reduced by transmitting indexes associated with TDD configurations rather than the entire TDD configurations.

[0118] FIG. **9** is a flow diagram of a communication method **900** according to some aspects of the present disclosure. Steps of the method **900** can be executed by a computing device (e.g., a processor, processing circuit, and/or other suitable component) of a wireless communication device or other suitable means for performing the steps. For example, a wireless communication device, such as the UE **115**, **215**, or the UE **400**, may utilize one or more components, such as the processor **402**, the memory **404**, the TDD indication module **408**, the sidelink communication module **409**, the transceiver **410**, the modem **412**, and the one or more antennas **416**, to execute the steps of method **900**. The method **900** may employ similar mechanisms as in the methods **600** and/or **800** described above with respect to FIGS. **6** and **8**, respectively. As illustrated, the method **900** includes a number of enumerated steps, but aspects of the method **900** may include additional steps before, after, and in between the enumerated steps. In some aspects, one or more of the enumerated steps may be omitted or performed in a different order.

[0119] At step **910**, the method **900** includes receiving, by a first UE, a TDD configuration. The first UE may receive the TDD configuration from a BS, another UE, a scheduling entity, and/or other wireless communication device. The TDD configuration may specify at least one of a SCS, a periodicity, or a number of TDD patterns. Additionally, a TDD pattern specified in the TDD configuration may specify at least one of a number of UL slots, a number of UL symbols, a number of DL slots, a number of DL symbols, or a number of flexible slots. The first UE may receive one or more communications from the BS in accordance with the TDD configuration.

[0120] At step **920**, the method **900** includes selecting, by the first UE, a first TDD configuration from a set of configured TDD configurations based on the TDD configuration. In some aspects, the first UE determines whether the TDD configuration is included in the set of configured TDD configurations. If so, the selected first TDD configuration may be the same as the TDD configuration. In some aspects, in response to a determination that the TDD configuration is not included in the set of configured TDD configurations, the first UE may compare the TDD configuration and the set of configured TDD configurations. The first UE may select, based on the comparing, the first TDD configuration. In some aspects, the TDD configuration specifies a first set of parameters, the first TDD configuration specifies a second set of parameters, a second TDD configuration of the set of configured TDD configurations specifies a third set of parameters, and the first and second sets of parameters have a greater number of matches than the first and third sets of parameters.

[0121] At step **930**, the method **900** includes transmitting, by the first UE to a second UE, an indication of the first TDD configuration. The first UE may transmit the indication by transmitting

an index associated with the first TDD configuration. The first UE may transmit the indication by transmitting the indication in a sidelink broadcast channel (e.g., PSBCH). In some aspects, the first TDD configuration specifies a number of UL slots in a TDD period of a TDD pattern, and the first UE transmits the indication by transmitting the number of UL slots in PSBCH. In some aspects, the first UE identifies an index that maps to a number of UL slots, and the first TDD configuration specifies the number of UL slots in a TDD period of a TDD pattern. The first UE may transmit the indication by transmitting the index in PSBCH.

[0122] At step **940**, the method **900** includes communicating, by the first UE and/or the second UE, a sidelink communication based on the first TDD configuration. The first UE and/or the second UE may transmit communication signals to and/or receive communication signals in accordance with the first TDD configuration. In some instances, at step **940**, the first UE and the second UE communicate with each other. In some instances, the first UE and/or the second UE communicate with a third UE (different than the first and second UEs) in accordance with the first TDD configuration.

[0123] FIG. **10** is a flow diagram of a communication method **1000** according to some aspects of the present disclosure. Steps of the method **1000** can be executed by a computing device (e.g., a processor, processing circuit, and/or other suitable component) of a wireless communication device or other suitable means for performing the steps. For example, a wireless communication device, such as the UE **115**, **215**, or the UE **400**, may utilize one or more components, such as the processor **402**, the memory **404**, the TDD indication module **408**, the sidelink communication module **409**, the transceiver **410**, the modem **412**, and the one or more antennas **416**, to execute the steps of method **1000**. The method **1000** may employ similar mechanisms as in the methods **600** and/or **800** described above with respect to FIGS. **6** and **8**, respectively. As illustrated, the method **1000** includes a number of enumerated steps, but aspects of the method **1000** may include additional steps before, after, and in between the enumerated steps. In some aspects, one or more of the enumerated steps may be omitted or performed in a different order.

[0124] At step **1010**, the method **1000** includes receiving, by a first UE, a TDD configuration indication. The first UE may receive the TDD configuration indication from a second UE, a BS, a scheduling entity, and/or other wireless communication device. The TDD configuration indication may indicate a TDD configuration that is used by the second UE for sidelink communications. In some aspects, each of the first UE and the second UE is within a coverage area of a common BS. In some aspects, the first UE is outside a coverage area of a BS, and the second UE is within the coverage area of the BS. Accordingly, in some instances the first UE may receive the TDD configuration from the second UE when the first UE is outside a coverage area of a BS. In some aspects, the first UE is within a first coverage area of a first BS, and the second UE is within a second coverage area of a second BS, and the first and second BSs communicate in accordance with different TDD configurations. Accordingly, in some instances the first UE may receive the TDD configuration from the second UE when the first UE is within a first coverage area of a first BS and the second UE is within a second coverage area of a second BS.

[0125] At step **1020**, the method **1000** includes identifying, by the first UE, a first TDD configuration from a set of sidelink TDD configurations based on the sidelink TDD configuration indication. The first UE may receive the TDD configuration indication by detecting the TDD configuration indication in a sidelink broadcast channel. The first UE may receive the TDD configuration indication by detecting an index in a sidelink broadcast channel. The index may map to the first TDD configuration of the set of configured TDD configurations. In some aspects, one UL/DL slot format is preconfigured for each TDD configuration periodicity, and the first UE receives the TDD configuration indication by detecting a periodicity of the first TDD configuration. In some aspects, one UL/DL slot format is preconfigured for each TDD configuration SCS, and the first UE receives the TDD configuration indication by detecting a SCS of the first TDD configuration in PSBCH. In some aspects, the first TDD configuration specifies a

number of UL slots in a TDD period of a TDD pattern, and the first UE receives the TDD configuration indication by detecting the number of UL slots in PSBCH.

[0126] At step **1030**, the method **1000** includes communicating, by the first UE, a sidelink communication based on the first TDD configuration. The first UE may transmit communication signals to and/or receive communication signals from the second UE, or a third UE (different than the second UE), in accordance with the first TDD configuration.

[0127] In some instances, a computer-readable medium having program code recorded thereon is provided. The program code can include: code for causing a first user equipment (UE) to receive from a base station (BS), a time-division-duplexing (TDD) configuration; code for causing the first UE to transmit to a second UE, an indication of a first TDD configuration; and code for causing the first UE to communicate a sidelink communication based on the first TDD configuration. In some instances, the code for causing the first UE to communicate the sidelink communication includes code for causing the first UE to communicate the sidelink communication with the second UE or code for causing the first UE to communicate the sidelink communication with a third UE, different than the second UE. In some aspects, the program code can include code for causing the first UE to select the first TDD configuration from a set of configured TDD configurations based on the TDD configuration; ![]text missing or illegible when filed

[0128] In some instances, the program code can include: code for causing a first user equipment (UE) to receive from a second UE, a time-division-duplexing (TDD) configuration indication; code for causing the first UE to identify a first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication; and code for causing the first UE to communicate a sidelink communication based on the first TDD configuration. In some instances, the code for causing the first UE to communicate the sidelink communication includes code for causing the first UE to communicate the sidelink communication with the second UE or code for causing the first UE to communicate the sidelink communication with a third UE, different than the second UE.

[0129] In some instances, an apparatus includes: means for receiving from a base station (BS), a time-division-duplexing (TDD) configuration; means for transmitting to a second user equipment (UE), an indication of the first TDD configuration; and means for communicating a sidelink communication based on the first TDD configuration. In some instances, the means for communicating the sidelink communication include means for communicating the sidelink communication with the second UE or means for communicating the sidelink communication with a third UE, different than the second UE. In some aspects, the apparatus includes means for selecting the first TDD configuration from a set of configured TDD configurations based on the TDD configuration.

[0130] In some instances, an apparatus includes means for receiving from a second user equipment (UE), a time-division-duplexing (TDD) configuration indication; means for identifying a first TDD configuration from a set of configured TDD configurations based on the TDD configuration indication; and means for communicating a sidelink communication based on the first TDD configuration. In some instances, the means for communicating the sidelink communication include means for communicating the sidelink communication with the second UE or means for communicating the sidelink communication with a third UE, different than the second UE.

[0131] Information and signals may be represented using any of a variety of different technologies and techniques. For example, data, instructions, commands, information, signals, bits, symbols, and chips that may be referenced throughout the above description may be represented by voltages, currents, electromagnetic waves, magnetic fields or particles, optical fields or particles, or any combination thereof.

[0132] The various illustrative blocks and modules described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a DSP, an ASIC, an FPGA or other programmable logic device, discrete gate or transistor logic, discrete hardware

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

[0133] The functions described herein may be implemented in hardware, software executed by a processor, firmware, or any combination thereof. If implemented in software executed by a processor, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Other examples and implementations are within the scope of the disclosure and appended claims. For example, due to the nature of software, functions described above can be implemented using software executed by a processor, hardware, firmware, hardwiring, or combinations of any of these. Features implementing functions may also be physically located at various positions, including being distributed such that portions of functions are implemented at different physical locations. Also, as used herein, including in the claims, "or" as used in a list of items (for example, a list of items prefaced by a phrase such as "at least one of" or "one or more of") indicates an inclusive list such that, for example, a list of [at least one of A, B, or C] means A or B or C or AB or AC or BC or ABC (i.e., A and B and C).

[0134] As those of some skill in this art will by now appreciate and depending on the particular application at hand, many modifications, substitutions and variations can be made in and to the materials, apparatus, configurations and methods of use of the devices of the present disclosure without departing from the spirit and scope thereof. In light of this, the scope of the present disclosure should not be limited to that of the particular embodiments illustrated and described herein, as they are merely by way of some examples thereof, but rather, should be fully commensurate with that of the claims appended hereafter and their functional equivalents.

## Claims

**1**. (canceled)

**2**. A first user equipment (UE), comprising: one or more memory devices; and one or more processors in communication with the one or more memory devices, wherein the first UE is configured to: receive a first time-division-duplexing (TDD) configuration, wherein the first TDD configuration specifies a first TDD pattern; transmit, to a second UE, a TDD configuration index value for a second TDD configuration, wherein the second TDD configuration is different from the first TDD configuration, and wherein the TDD configuration index value is associated with the first TDD pattern; and communicate a sidelink communication based on the second TDD configuration.

**3**. The first UE of claim 2, wherein the first TDD configuration further specifies a first SCS configuration, and wherein the TDD configuration index value is further associated with the first SCS configuration.

**4**. The first UE of claim 2, wherein the first TDD pattern is associated with at least one of a first periodicity, a number of uplink (UL) slots, a number of UL symbols, a number of downlink (DL) slots, a number of DL symbols, or a number of flexible slots.

**5**. The first UE of claim 4, wherein the TDD configuration index value is further based on the at least one of the first periodicity, the number of UL slots, the number of UL symbols, the number of DL slots, the number of DL symbols, or the number of flexible slots.

**6**. The first UE of claim 5, wherein the TDD configuration index comprises a plurality of bits, and wherein a portion of the plurality of bits is based on the number of UL slots.

**7**. The first UE of claim 4, wherein the TDD configuration index value indicates the first periodicity.

**8**. The first UE of claim 4, wherein the TDD configuration index value is determined based on a

TDD configuration index table, wherein the TDD configuration index table associates the TDD configuration index value with the first periodicity.

9. The first UE of claim 2, wherein the second TDD configuration further indicates a second TDD pattern, and wherein the TDD configuration index value is further based on the second TDD pattern.

10. The first UE of claim 2, wherein the first UE configured to transmit the TDD configuration index value comprises the first UE configured to transmit the TDD configuration index value in a physical sidelink broadcast channel (PSBCH).

11. A first user equipment (UE), comprising: one or more memory devices; and one or more processors in communication with the one or more memory devices, wherein the first UE is configured to: receive a first time-division-duplexing (TDD) configuration; determine a second, different TDD configuration associated with the first TDD configuration; and transmit, to a second UE in a physical sidelink broadcast channel (PSBCH), an indication of the second TDD configuration, the indication of the second TDD configuration comprising a TDD Configuration Index value, the value associated with the second TDD configuration.

12. The first UE of claim 11, wherein the first TDD configuration specifies a first SCS configuration, and wherein the TDD configuration index value is further associated with the first SCS configuration.

13. The first UE of claim 11, wherein the first TDD configuration specifies a first TDD pattern, wherein the first TDD pattern is associated with at least one of a first periodicity, a number of uplink (UL) slots, a number of UL symbols, a number of downlink (DL) slots, a number of DL symbols, or a number of flexible slots.

14. The first UE of claim 13, wherein the TDD configuration index value is further based on the at least one of the first periodicity, the number of UL slots, the number of UL symbols, the number of DL slots, the number of DL symbols, or the number of flexible slots.

15. The first UE of claim 14, wherein the TDD configuration index comprises a plurality of bits, and wherein a portion of the plurality of bits is based on the number of UL slots.

16. The first UE of claim 13, wherein the TDD configuration index value indicates the first periodicity.

17. The first UE of claim 13, wherein the TDD configuration index value is determined based on a TDD configuration index table, wherein the TDD configuration index table associates the TDD configuration index value with the first periodicity.

18. The first UE of claim 11, wherein the second TDD configuration further indicates a second TDD pattern, and wherein the TDD configuration index value is further based on the second TDD pattern.

19. A second user equipment (UE), comprising: one or more memory devices; and one or more processors in communication with the one or more memory devices, wherein the second is configured to: receive, from a first UE in a physical sidelink broadcast channel (PSBCH), an indication of a first time-division-duplexing (TDD) configuration, the indication of the first TDD configuration comprising a TDD Configuration Index value, the value associated with the first TDD configuration; and identify, based on the value, a second, different TDD configuration from a set of configured TDD configurations.

20. The second UE of claim 19, wherein the first TDD configuration specifies a first SCS configuration, and wherein the TDD configuration index value is further associated with the first SCS configuration.

21. The second UE of claim 19, wherein the first TDD configuration specifies a first TDD pattern, wherein the first TDD pattern is associated with at least one of a first periodicity, a number of uplink (UL) slots, a number of UL symbols, a number of downlink (DL) slots, a number of DL symbols, or a number of flexible slots.